2011 National Emissions Inventory, version 2 Technical Support Document

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Office of Air Quality Planning and Standards
Air Quality Assessment Division
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Research Triangle Park, North Carolina

Contents

List of Tables

List of Figures

Acronyms and Chemical Notations

AERR	Air Emissions Reporting Rule
APU	Auxiliary power unit
BEIS	Biogenics Emissions Inventory System
C1	Category 1 (commercial marine vessels)
C2	Category 2 (commercial marine vessels)
C3	Category 3 (commercial marine vessels)
CAMD	Clean Air Markets Division (of EPA Office of Air and Radiation)
CAP	Criteria Air Pollutant
CBM	Coal bed methane
CDL	Cropland Data Layer
CEC	North American Commission for Environmental Cooperation
CEM	Continuous Emissions Monitoring
CENRAP	Central Regional Air Planning Association
CERR	Consolidated Emissions Reporting Rule
CFR	Code of Federal Regulations
CH_4	Methane
CHIEF	Clearinghouse for Inventories and Emissions Factors
CMU	Carnegie Mellon University
CMV	Commercial marine vessels
CNG	Compressed natural gas
CO	Carbon monoxide
CO_2	Carbon dioxide
CSV	Comma Separated Variable
dNBR	Differenced normalized burned ratio
E10	10% ethanol gasoline
EDMS	Emissions and Dispersion Modeling System
EF	emission factor
EGU	Electric Generating Utility
EIS	Emission Inventory System
EAF	Electric arc furnace
EF	Emission factor
EI	Emissions Inventory
EIA	Energy Information Administration
EMFAC	Emission FACtor (model) – for California
EPA	Environmental Protection Agency
ERG	Eastern Research Group
ERTAC	Eastern Regional Technical Advisory Committee
FAA	Federal Aviation Administration
FACTS	Forest Service Activity Tracking System
FCCS	Fuel Characteristic Classification System
FETS	Fire Emissions Tracking System
FWS	United States Fish and Wildlife Service
FRS	Facility Registry System

GHG	Greenhouse gas
GIS	Geographic information systems
GPA	Geographic phase-in area
GSE	Ground support equipment
HAP	Hazardous Air Pollutant
HCl	Hydrogen chloride (hydrochloric acid)
Hg	Mercury
HMS	Hazard Mapping System
ICR	Information collection request
I/M	Inspection and maintenance
IPM	Integrated Planning Model
KMZ	Keyhole Markup Language, zipped (used for displaying data in Google Earth
LRTAP	Long-range Transboundary Air Pollution
LTO	Landing and takeoff
LPG	Liquified Petroleum Gas
MARAMA	Mid-Atlantic Regional Air Management Association
MATS	Mercury and Air Toxics Standards
MCIP	Meteorology-Chemistry Interface Processor
MMT	Manure management train
MOBILE6	Mobile Source Emission Factor Model, version 6
MODIS	Moderate Resolution Imaging Spectroradiometer
MOVES	Motor Vehicle Emissions Simulator
MW	Megawatts
MWC	Municipal waste combustors
NAA	Nonattainment area
NAAQS	National Ambient Air Quality Standards
NAICS	North American Industry Classification System
NARAP	North American Regional Action Plan
NASF	National Association of State Foresters
NASS	USDA National Agriculture Statistical Service
NATA	National Air Toxics Assessment
NCD	National County Database
NEEDS	National Electric Energy Data System (database)
NEI	National Emissions Inventory
NESCAUM	Northeast States for Coordinated Air Use Management
NFEI	National Fire Emissions Inventory
NG	Natural gas
NH_3	Ammonia
NMIM	National Mobile Inventory Model
NO	Nitrous oxide
NO_2	Nitrogen dioxide
NOAA	National Oceanic and Atmospheric Administration
NO_X	Nitrogen oxides
O_3	Ozone
OAQPS	Office of Air Quality Standards and Planning (of EPA)
OEI	Office of Environmental Information (of EPA)

ORIS	Office of Regulatory Information Systems
OTAQ	Office of Transportation and Air Quality (of EPA)
PADD	Petroleum Administration for Defense Districts
PAH	Polycyclic aromatic hydrocarbons
Pb	Lead
PCB	Polychlorinated biphenyl
PM	Particulate matter
PM25-CON	Condensable $PM_{2.5}$
PM25-FIL	Filterable $PM_{2.5}$
PM25-PRI	Primary $PM_{2.5}$ (condensable plus filterable)
$PM_{2.5}$	Particulate matter 2.5 microns or less in diameter
PM_{10}	Particular matter 10 microns or less in diameter
PM10-FIL	Filterable PM_{10}
PM10-PRI	Primary PM_{10}
POM	Polycyclic organic matter
POTW	Publicly Owned Treatment Works
PSC	Program system code (in EIS)
RFG	Reformulated gasoline
RPD	Rate per distance
RPP	Rate per profile
RPV	Rate per vehicle
RVP	Reid Vapor Pressure
Rx	Prescribed (fire)
SCC	Source classification code
SEDS	State Energy Data System
SFv1	SMARTFIRE version 1
SFv2	SMARTFIRE version 2
S/L/T	State, local, and tribal (agencies)
SMARTFIRE	Satellite Mapping Automated Reanalysis Tool for Fire Incident Reconciliation
SMOKE	Sparse Matrix Operator Kernel Emissions
SO_2	Sulfur dioxide
SO_4	Sulfate
TAF	Terminal Area Forecasts
TEISS	Tribal Emissions Inventory Software Solution
TRI	Toxics Release Inventory
UNEP	United Nations Environment Programme
USDA	United States Department of Agriculture
VMT	Vehicle miles traveled
VOC	Volatile organic compounds
USFS	United States Forest Service
WebFIRE	Factor Information Retrieval System
WFU	Wildland fire use
WLF	Wildland fire
WRAP	Western Regional Air Partnership
WRF	Weather Research and Forecasting Model

1 Introduction

1.1 What data are included in the 2011 NEI, Version 2?

The 2011 National Emissions Inventory (NEI), version 2, hereafter referred to as the “2011 v2” (not synonymous with “2011 NEI” which is a general reference to the 2011 NEI that denotes methods that do not differ between 2011 v2 and version 1 of the 2011 NEI “2011 v1”), is a national compilation of emissions sources collected from state, local, and tribal air agencies as well as emissions information from the Environmental Protection Agency (EPA) emissions programs including the Toxics Release Inventory (TRI), emissions trading programs such as the Acid Rain Program, and data collected as part of EPA regulatory development for reducing emissions of air toxics. The NEI program develops datasets, blends data from these multiple sources, and performs quality assurance steps that further enhance and augment the compiled data. The emissions data in the NEI are compiled for detailed emissions processes within a facility for large “point” sources or as a county total for smaller “nonpoint” sources and spatially dispersed sources such as on-road and nonroad mobile sources. For wildfires and prescribed burning, the data are compiled as day-specific events in the “event” portion of the inventory.

The pollutants included in the NEI are the pollutants associated with the National Ambient Air Quality Standards (NAAQS), known as criteria air pollutants (CAPs), as well as hazardous air pollutants (HAPs) associated with EPA’s Air Toxics Program. The CAPs have ambient concentration limits or are precursors for pollutants with such limits from the NAAQS program. These pollutants include lead (Pb), carbon monoxide (CO), nitrogen oxides (NO_X), volatile organic compounds (VOC), sulfur dioxide (SO_2), particulate matter 10 microns or less (PM_{10}), particulate matter 2.5 microns or less ($PM_{2.5}$) and ammonia (NH_3), technically not a CAP, but an important PM precursor. The HAP pollutants include the 187 remaining HAP pollutants (hydrogen sulfide was removed) from the original 188 listed in Section 112(b) of the 1990 Clean Air Act Amendments[1]. Key HAP emissions sources include mercury (Hg), hydrochloric acid (HCl) and other acid gases, heavy metals such as nickel and cadmium, and hazardous organic compounds such as benzene, formaldehyde, and acetaldehyde.

1.2 What is included in this documentation?

This document provides a central reference for the 2011 v2 NEI. The primary purpose of this document is to explain the sources of information included in the inventory. This includes showing which sources of data are used for each sector, and then providing more information about the EPA-created components of the data. For each emissions sector, we provide a synopsis of the types of sources that are included in that sector.

After the introductory material included in this section, Section 2 explains the sectors that we use for summarizing the 2011 v2 and organizing this document, and it provides an overview of the contents of the inventory and a summary of mercury emissions. Section 3 provides an overview of stationary sources in the point and nonpoint data categories, as well as sector-by-sector documentation of the stationary sources. Sections 4, 5 and 6 provide the sector-by-sector documentation for the mobile, fire and biogenics emissions respectively. Section 7 provides instructions for accessing supporting materials. A separate document contains the appendix.

[1] The current list of HAPs

1.3 Where can I obtain the 2011 v2 NEI data?

1.3.1 EPA continues to review and streamline the approach for accessing the NEI data. The 2011 NEI data are available in several different ways. Emission Inventory System Gateway

Clearinghouse for Inventories and Emissions Factors (CHIEF)

The Emission Inventory System (EIS) Gateway is available to all EPA staff, EIS data partners responsible for submitting data to EPA (i.e., the state, local, and tribal air agency staff), Regional Planning Organization staff that support state, local and tribal agencies, and contractors working for EPA on emissions related work. The Gateway can be used to obtain raw input datasets and create summary files from these datasets as well as the 2011 NEI general public releases. Use the link provided above for more information about how to obtain an account and to access the gateway itself. The 2011 v2 NEI in the EIS is called "2011 NEI V2". Note that if you run facility, unit or process level reports in the EIS, you will get the 2011 v2 emissions, but the facility inventory, which is dynamic in the EIS, will reflect more current information. For example, if an Agency ID has been changed since the time we ran the reports for the public website (March 2015), then that new Agency ID will be in the Facility Inventory or a Facility Configuration report in the EIS but not in the report on the public website nor the Facility Emissions Summary reports run on the"2011 NEI V2" in the EIS.

1.3.2 2011 NEI main webpage

2011 National Emissions Inventory (NEI) Data

The 2011 NEI webpage is available from the Clearinghouse for Inventories and Emissions factors (CHIEF) website. It includes a query tool that allows for summaries by EIS Sector (see Section 2.1) or the more traditional Tier 1 summary level used in the EPA Trends Report. Summaries from this site include national, state-, and county-level of CAP and HAP emissions. You can choose which states, EIS Sectors, Tiers, and pollutants to include in custom-generated reports to download Comma Separated Value (CSV) files to import into Microsoft® Excel ® or other spreadsheet tools. Biogenic emissions and tribal data (but not tribal onroad, nonroad or prescribed burning/wildfire emissions) are also available from this tool. Onroad and nonroad tribal summaries are posted under the "Additional Summary Data" section of this page.

The SCC data files section of the webpage provide detailed data files for point, nonpoint, onroad and nonroad data categories via a pull-down menu. These detailed CSV files (provided in zip files) contain emissions at the process level. Due to their size, all but nonpoint are broken out into EPA regions. These CSV files must be "linked" (as opposed to imported) in order to open them with Microsoft® ACCESS®.

The 2011 NEI webpage also contains Google® fusion tables and maps with facility-level emissions for CAPs and specific HAPs.

1.3.3 Air Emissions and "Where you live"

Air Emissions Sources

Where You Live

NOTE: Please review table legends which provide the NEI year and version when using the data from these sites.

The Air Emissions website provides emissions of CAP pollutants except for ammonia using point-and-click maps and bar charts to provide access to summary and detailed emissions data. The maps, charts, and underlying data (in CSV format) can be saved from the website and used in documents or spreadsheets.

In addition, the "Where you live" feature of the Air Emissions website allows users to select states and EIS sectors (see Section 2.1) to create KMZ files used by Google Earth. You must have Google Earth installed on your computer to open the files. You can customize the maps to select the facility types of interest (e.g., airport, steel mill, petroleum refinery, pulp and paper plant), and all other facility types will go into an "Other" category on the maps. The resulting maps allow you to click on the icons for each facility to get a chart of emissions associated with each facility for all criteria pollutants.

1.3.4 Modeling files

The modeling files are provided in formats that can be read by the Sparse Matrix Operator Kernel Emissions (SMOKE). These files are also CSV formats that can be read by other systems, such as databases. The modeling files provide the process-level emissions apportioned to release points, and the release parameters for the release points. Release parameters include stack height, stack exit diameter, exit temperature, and exit velocity. EPA makes changes to the NEI prior to use in modeling, so both the 2011 NEI data as well as the latest available modeling files can be found at this website. The 2011 modeling platform was based on the 2011 v2 NEI. Any changes between the NEI and modeling platform data are described in the technical support document for the 2011 Emissions Modeling Platform, which is posted at the above website.

1.4 Why is the NEI created?

The NEI is created to provide EPA, federal and state decision makers, the public, and other countries the best and most complete estimates of CAP and HAP emissions. While EPA is not directly obligated to create the NEI under the Clean Air Act, the Act authorizes the EPA Administrator to implement data collection efforts needed to properly administer the NAAQS program. Therefore, the Office of Air Quality Planning and Standards (OAQPS) maintains the NEI program in support of the NAAQS. Furthermore, the Clean Air Act requires states to submit emissions to EPA as part of their State Implementation Plans (SIPs) that describe how they will attain the NAAQS. The NEI is used as a starting point for many SIP inventory development efforts and for states to obtain emissions from other states needed for their modeled attainment demonstrations.

While the NAAQS program is the basis on which EPA collects CAP emissions from the state, local, and tribal (S/L/T) air agencies, it does not require collection of HAP emissions. For this reason, the HAP reporting requirements are voluntary. Nevertheless, the HAP emissions are an essential part of the NEI program. These emissions estimates allow EPA to assess progress in meeting HAP reduction goals described in the Clean Air Act amendments of 1990. These reductions seek to reduce the negative impacts to people of HAP emissions in the environment, and the NEI allows EPA to assess how much emissions have been reduced since 1990.

1.5 How is the NEI created?

The NEI is created based on both regulatory and technical components. The Air Emissions Reporting Rule (AERR) is the rule that requires states to submit emissions of CAP emissions and provides the framework for voluntary submission of HAP emissions. The 2008 NEI was the first inventory compiled using the AERR, rather than its predecessor the Consolidated Emissions Reporting Rule (CERR). The 2011 NEI is the second AERR-based inventory, and improvements in the 2011 NEI process reflect lessons learned by the states and EPA from the 2008 NEI process. The AERR requires agencies to report all sources of emissions, except fires and biogenic sources. Open fire sources such as wildfires are encouraged but not required. Sources are divided into large groups called "data categories": stationary sources are "point" or "nonpoint" (county totals) and mobile sources are either on-road (cars and trucks driven on roads) or non-road (locomotives, aircraft, marine, off-road vehicles and nonroad equipment such as lawn and garden equipment).

The AERR has emissions thresholds above which states must report stationary emissions as “point” sources with the remainder of the stationary emissions reported as “nonpoint” sources.

The AERR changed the way these reporting thresholds work as compared to the CERR to make these thresholds “potential to emit” thresholds rather than actual emissions thresholds. In both the CERR and the AERR, the emissions that are reported are actual emissions, despite that the criterion for which sources to report is now based on potential emissions. The AERR requires emissions reporting every year, with additional requirements every third year in the form of lower point source emissions thresholds, and 2011 is one of these third-year inventories.

Table 1-1 provides the potential-to-emit reporting thresholds that applied for the 2011 NEI cycle. “Type B” is the terminology in the rule that represents the lower emissions thresholds required for point sources in the triennial years. The reporting thresholds are sources with potential to emit 100 tons/year or more for most criteria pollutants with the exceptions of CO (1000 tons/year) and Pb (5 tons/year). As shown in the table, special requirements apply to nonattainment area (NAA) sources, where even lower thresholds apply. The relevant ozone (O3), CO, and PM10 nonattainment areas that applied during the year that the S/L/T agencies submitted their data for the 2011 NEI

Table 1-1: Point source reporting thresholds (potential to emit) for CAPs in the AERR

Pollutant	2011 NEI thresholds: potential to emit (tons/yr)	
	Everywhere (Type B sources)	NAA sources[1]
1 SO_2	≥ 100	≥ 100
2 VOC	≥ 100	O_3 (moderate) ≥ 100
3 VOC		O_3 (serious) ≥ 50
4 VOC		O_3 (severe) ≥ 25
5 VOC		O_3 (extreme) ≥ 10
6 NO_X	≥ 100	≥ 100
7 CO	≥ 1000	O_3 (all areas) ≥ 100
8 CO		CO (all areas) ≥ 100
9 Pb	≥ 5	≥ 5
10 PM_{10}	≥ 100	PM_{10} (moderate) ≥ 100
11 PM_{10}		PM_{10} (serious) ≥ 70
12 $PM_{2.5}$	≥ 100	≥ 100
13 NH_3	≥ 100	≥ 100

[1] NAA = Nonattainment Area. Special point source reporting thresholds apply for certain pollutants by type of nonattainment area. The pollutants by nonattainment area are: Ozone: VOC, NO_X, CO; CO: CO; PM_{10}: PM_{10}

Based on the AERR requirements, S/L/T agencies submit emissions or model inputs of point, nonpoint, on-road mobile, nonroad mobile, and fires emissions sources. For on-road and nonroad mobile, states were encouraged to submit model inputs instead of emissions. For the 2011 NEI, all these emissions and inputs were due to EPA per the AERR by December 31, 2012 (with an extension given through January 8, 2013). Once the initial reporting NEI period closed, EPA provided feedback on data quality such as suspected outliers and missing data by comparing to previously established emissions ranges and past inventories. In addition, EPA augmented the S/L/T data using various sources of data and augmentation procedures. This documentation provides a detailed account of EPA’s quality assurance and augmentation methods.

1.5.1 NEI 2011 v2 point source updates

The NEI 2011 v1 point source file was produced on July 23, 2013. The 2011 v2 was produced on November 23, 2014. The overall process and procedures for producing the point source emissions and modeling parameters for 2011 v2 are very similar to those used for 2011 v1, and the resulting overall emissions magnitudes are very similar for the two versions, although individual emission sources may differ. The processes and procedures used to produce 2011 v1 were described in the original version of this document and remain largely unedited in this second version of this documentation. For point sources, 2011 v2 is essentially the 2011 v1 inventory with individual edits and updates from various sources and commenters who reviewed or updated the previous 2011 v1 point source inventory. Edits and comments on 2011 v1 were received from the following sources:

A. S/L/T air agencies
B. Public comments on the emissions modeling platform built from 2011 v1
C. NATA 2011 reviewers
D. EPA/OAQPS initiated reviews and updates

The various comments resulted in changes to emissions values, release point locations, and release point modeling parameters. These edits are not believed to impact large-scale regional modeling or emissions trends in any significant way; and significant impacts on individual facilities are limited in number. In addition, a few ancillary pieces of data were also updated for v2 by EPA/OAQPS. These include a set of revisions to the Emission Unit types and the identifiers used to match NEI units to the IPM future year electric generating units and the base year Continuous Emissions Monitor values reported by facilities to EPA's Clean Air Markets Division. More details on the v2 edits made for each of the four main reviewer mechanisms are provided below.

A. S/L/T air agencies

The 2011 v1 NEI point sources file was based in large part on the emissions data submitted by 82 State, local, and Tribal air agencies to the EIS data system. All emissions data and facility inventory data (facility names, locations, release point characteristics, etc) are submitted directly from these 82 air agencies to the EIS data system, either in bulk xml files sent to EPA's Central Data Exchange or via individual on-line edits made in the EIS Gateway. After the 2011 v1 was released, the same S/L/T agencies had the opportunity to submit updates and additions to their 2011 data for use in 2011 v2. For the 2011 v2 updates, this process was handled a little differently than the 2011 v1 and 2008 submittal processes. In order to avoid wholesale and possibly unintended overwriting of 2011 v1 data that had been through a draft quality-assurance review and had been available for further use and review as part of the final 2011 v1, S/L/T agencies were asked to either edit values on-line using the EIS Gateway or to submit by bulk xml only the changes that they wished to make to 2011 v1 data. In addition, rather than having the EIS Production window open at any time for S/L/T agency edits or xml submittals, the Production window was opened only upon request and only after a clean and EPA-reviewed submittal had been made by the S/L/T agencies to the EIS QA Environment. 25 agencies submitted some point emissions updates and 20 submitted some facility inventory updates by xml batch files during the v1 to v2 update cycle. An unknown but probably smaller number of agencies also made smaller volume edits to both facility inventory and emissions data by individual on-line edits via the EIS Gateway. Most of the edits occurred during the January to mid-April 2014 review and update period.

The two most significant sets of edits from S/L/T agencies came from Minnesota and North Carolina. Minnesota re-submitted their entire HAP emissions inventory after the January thru mid-April 2014 review and update period, just before the 2011 v2 selection was run. As a result, a limited amount of QA review was done on these values. North Carolina coordinated with EPA/OAQPS to submit a file which included emissions for a large set of smaller facilities which had not been included in their 2011 v1 data. For these facilities NC submitted their emissions estimates for 2008, 2009, or 2010, because they did not have 2011 emissions for these facilities, but preferred that EPA use the earlier year State emissions values rather than the TRI 2011 values that would otherwise be used for gap-filling. These facilities are below the NEI triennial year reporting thresholds, and they report only every fifth year to North Carolina.

B. Public comments on the emissions modeling platform built from v1

A set of emissions modeling platform files based on the 2011 v1 was made available for public review and comment in early 2014. Twenty-seven comment letters were received as a result that resulted in edits being made to either the EIS facility inventory or the v1 emissions values. Many of these comments were from companies or facilities that operated electric generating units, although a few were from the State air agencies who also had access to the EIS data system and its submittal and edit processes. The most significant comment was to add PM-Condensible emissions values (and therefore to increase PM2.5-Primary and PM10-Primary emissions values) at eight coal-fired electric power plants located in Pennsylvania. Other comments were to some of the HAP emissions values for 3 power plants located in New Jersey, to add or revise the unit IDs used by the IPM model for electric generating units, to revise generating unit design capacities, and edits to release point parameters. A detailed Response to Comments document on these and other modeling platform comments is available.

One comment was received from a regional modeling center suggesting that stack parameters from their 2007-based modeling platform should be used in the EPA 2011 platform. The 2007-based files were accessed and compared and evaluated against the 2011 facility inventory coordinates and release point parameters, for the instances where this could be done based on common State identifiers between the two. Where significant differences in release point coordinates or parameters were identified and where the EIS facility inventory data (reported by the same State air agencies as the 2007 platform, but at a later date) were also found to be highly suspect, edits were made to the EIS facility inventory. As part of this review it was noted that one State had significantly modified the EIS facility inventory for their sources by re-routing many combustion emission processes to fugitive emission release points, despite the fact that stack release points were already available in EIS and had been used previously for these same emission processes. A subset of these anomalies that could be individually reviewed were therefore reset such that the largest combustion processes were routed to the earlier-used stack release points.

The v1 modeling platform had included 17 ethanol production facilities with EPA estimated emissions in support of a rule-making effort that were not in the 2011 v1. After States had provided their updates to the 2011 for v2, it was found that 3 of these 17 facilities had been added by States. The remaining 14 facilities were added to the 2011 v2 facility inventory, although with sometimes different coordinates than were used in the v1 modeling platform following a review. However, the EPA-estimated 2011 emissions for these 14 facilities were not added to EIS until after the 2011 v2 was created.

C. NATA 2011 reviewers

The 2011 v1 was used to run preliminary risks assessment modeling in late 2013 as part of the 2011 National Air Toxics Assessment. The risk results from these preliminary runs were distributed in November 2013 to State, local, and Tribal air agencies for review and comment, including comments on the emissions values, locations, and release point modeling parameters. The reviewers of the risk results included additional S/L/T agency personnel beyond those responsible for compiling and submitting the S/L/T agency data to the NEI for use in v1 and v2. While some reviewers likely had their comments addressed as part of the S/L/T agency v2 review and update cycle as described in section A above without EPA involvement, a number of reviewers provided written comments to EPA thru the NATA process. All such comments were addressed by EPA and incorporated into the 2011 v2, either by EPA editing the EIS facility inventory or EPA emissions values, or in some cases by having the S/L/T agency inventory personnel edit the emissions values in their emissions datasets as stored in EIS.

In addition to the available risk results derived from the 2011 v1 data, the November 2013 call for comments also included a list of approximately 500 facility-pollutant combinations that had not been included in v1, but that EPA was proposing to add to the v2 NEI for final NATA risk modeling. These facility-pollutant combinations were those that did not appear in the 2011 S/L/T agency emissions submittals to the NEI, but which had emissions estimates available from facility submittals to the 2011 Toxics Release Inventory via the use of an emissions range check box. TRI allows facilities with low but difficult to quantify emissions to check one of several pre-set range boxes to indicate their emissions level range rather than attempting to provide a discreet emissions value. The lowest such range choices available are 0 to 10 pounds and 10 to 500 pounds. The TRI emissions summaries use 5 pounds and 250 pounds to represent these range choices in summary tables. In April and May 2014, EPA attempted to find discrete values for as many of these TRI range values as possible, including by contacting S/L/T agencies directly and by reviewing other TRI year reports for these facilities. Many of the discrete values so obtained tended to fall at the very low end of the selected range, or even below the range in the case of several "10-500" choices. Where no discrete values could be determined, the mid-point of the ranges were added to the 2011 v2.

D. EPA/OAQPS initiated reviews and updates

Several other updates and edits of various pieces of the 2011 NEI inventory were done between v1 and v2, either as a result of the changed values entered as parts of sections A, B, and C above, or to take advantage of newer improved datasets.

1. Off-shore oil and gas platform emissions for 2011 were added. 2011 v1 included the 2008 emissions for off-shore Federal waters platforms in the Gulf of Mexico as a gap fill estimate, because the 2011 emissions inventory prepared by the Bureau of Ocean Energy Management was not available in time for v1. The BOEM's data for 2011 was added to the EIS and included as part of the 2011 v2.

2. TRI emissions were updated for the 2011 v2 to use TRI data as published on the TRI website as of late April 2014. This dataset included many updates that facilities submitted to TRI as a result of the preliminary NATA risk reviews that S/L/T agencies performed, as well as other needed changes that facilities became aware of by other means.

3. As a result of edits, additions, and deletions made to S/L/T agency emissions values, the EPA datasets for PM-Augmentation and HAP Augmentation had to be reviewed and adjusted. Due to the size of the v1 datasets involved, as well as the relatively limited number and magnitude of edits made to the S/L/T agency PM and VOC values, for v2 EPA looked at only instances where the responsible agency PM or VOC emissions had been changed by more than 5 tons. For these instances the PM-Augmentation and HAP Augmentation values derived by EPA were re-calculated and used to replace the values in the EPA datasets for PM Augmentation and HAP Augmentation.

4. Also, as a result of edits, additions, and deletions made to S/L/T agency emissions values as well as the use of an updated TRI emissions dataset, the tags on the individual HAP Augmentation and TRI dataset emissions values were updated to ensure that emission values from these datasets would not add double-counted emissions.

5. The emissions values and unit identifiers used for the EPA EGU emissions dataset were re-reviewed against the unit identifiers and emissions used by S/L/T agencies as seen after all S/L/T agency emissions edits had been accepted. A small number of instances were found where S/L/T agency emissions had changed unit identifiers between versions. The EPA EGU datasets were revised accordingly to ensure that double-counting of S/L/T and EPA emissions values would not occur.

6. A revised table of factors for splitting total chromium emissions values into chromium VI and chromium III values by SCC was received and applied to the 2011 data in May 2014 for use in v2. This work was done outside of the EIS data system and did not use the EIS function for chromium speciation, because the EIS factor table has not been updated. The impacts due to the revised factors were negligible, but one large chromium emitting process in Ohio was noticed as a consequence of re-running these splits. The chromium values for this one process were confirmed to be erroneous and were tagged out so as not to be used in v2.

7. An internal EPA review of facilities appearing on the preliminary NATA list of highest risk sources in November 2013 was done to identify anomalies. Part of this review focused on landfills where EPA was the source of the emissions values, because the location data for many of these landfills was potentially using a county centroid value. Locational data and some stack parameter edits were made to a small number of these preliminary high-risk facilities as a result of this review.

8. Similar to checks done on 2011 v1 and earlier year inventories, the facility site coordinates of all v2 emitting facilities were compared against county boundary files. Any facilities with site coordinates more than 0.5 miles outside of the county boundaries and with either criteria pollutant totals greater than 5 tons or hazardous pollutant totals greater than 20 pounds (in either the S/L/T reports or in the draft v2 selection incorporating all emissions datasets) and not verified by earlier reviews were checked via Google Earth and revised and locked as needed. 17 facilities were revised as a result. Individual release point coordinates that were not consistent with the newly verified site coordinates were set to equal the revised site coordinates. California, Alaska, and airport facilities were excluded from these tighter tolerances of this review due to the number of smaller and difficult to locate facilities.

9. Facility site coordinates for 30 facilities in California that all had the same incorrect latitude-longitude pair were revised to use the coordinates found in the Federal Registry System for those facilities. Individual release point coordinates that were not consistent with the newly verified site coordinates were set to equal the revised site coordinates. Additional California facilities using the same pair of default coordinates still remain in the EIS and in the 2011 v2, because the emissions for these facilities were small and because no alternative set of coordinates was available via FRS.

10. A set of approximately 7000 release point latitude-longitude coordinates that had been edited in previous NEIs because they were too distant from the verified site coordinates for their corresponding facilities, and which had been revised by S/L/T agencies, were reset to the values that agree with the verified site coordinates.

11. Approximately 1200 IPM unique IDs from the NEEDs v5.13 draft file was added to the EIS emission units. July 2014. Approximately 200 of the IPM ids previously existing in the EIS were revised so that they match exactly to those seen in NEEDs. These revisions will facilitate future checks and updating to

revisions to the NEEDs file, although the previous non-matching IPM ID in the EIS were still being separated out to the PTIPM modeling file as intended. Approximately 300 CAMD CEM IDs were also added to EIS units. These units allow the hourly CEM emissions values to be used in modeling applications. The 300 additions were for very small annual emitters however, as earlier work had focused on having all CEM IDs for the larger SO2 and NOx sources matched.

12. For all EIS facilities that were matched to a TRI facility ID and which had an EIS zip code of "00000", the EIS zip codes were revised to equal the TRI zip codes.

13. Emission unit types which had been revised by S/L/T agencies back to "unclassified" were reset to the various types which had been previously set.

14. The NAICs codes for 105 facilities were revised from 33991 (Jewelry and Silverware Manufacturing) to the NAICs of the TRI facility that they were matched to (usually 332812, Metal Coating and Engraving). It appears that the conversion done from the old SIC codes to the NAICs codes done in earlier NEI years not specific enough. Of the 105 facilities, 91 did not have any state facility ID, and were likely TRI-only facilities. An additional 252 facilities remain in the EIS with the jewelry NAICs but could not be matched to a TRI facility with an alternative NAICs. However, 211 of these remaining facilities do have State Facility IDs.

1.5.2 NEI 2011 v2 nonpoint source updates

There were many changes in the nonpoint data category between 2011 v1 and 2011 v2 of the NEI; highlights are given here. As oil and gas was a large focus for the 2011 NEI, EPA continued to make improvements to the EPA Nonpoint Oil and Gas Emissions Estimation Tool for 2011 v2. Some of the more significant efforts included 1) better aligning the inputs and emission factors between the EPA's Office of Atmospheric Program (OAP) work on the Greenhouse Gas (GHG) Emissions Inventory (EI) / GHG Reporting Program and the NEI on condensate tanks, liquids unloading, pneumatic devices and well completions, 2) additional information from the Western Regional Air Partnership (WRAP) based on new survey data and studies, 3) improved resolution of data (to county level rather than basin), and 4) new SCCs, including the distinction between Coal Bed Methane (CBM) wells from other natural gas (NG) wells. Furthermore, some states, including CO, WV, OK, TX, and WY made improvements to their oil and gas submissions in this time period, and these emissions were included in 2011 v2.

Many states resubmitted data based on EPA or their own review, including CA, CT, DC, DE, IA, ME, MI, NC, NE, NY, OK, UT, VA, WA. Some tribes also submitted their data for the first time for the 2011 NEI, and this data was included in 2011 v2. MN resubmitted many solvents and residential wood combustion emissions, due to errors found between versions. ID data was tagged for Ag livestock because it was the only state that submitted pollutants other than ammonia. EPA also made adjustments to publicly owned treatment works (POTW) emissions, because it was noted in the review of 2011 v1 that several point sources with POTW SCCs were not POTWs based on their facility name. Thus, the tagging that EPA had performed for 2011 v1 was not necessary, and many of these were thus untagged for 2011 v2.

1.5.3 NEI 2011 v2 mobile source updates

The most significant change for mobile sources in this version (2011 v2) is the use of EPA's most current onroad model MOVES2014. In addition to new modeled emissions results, the SCCs used in the NEI/EIS were changed. MOVES2014 uses new and additional SCCs. However, for the NEI, SCCs were aggregated at the vehicle and fuel level and no longer include road class or emissions type.

Commercial marine inventories were revised for diesel-powered Class I and II vessels with a new geographic allocation (from top-down national emissions estimates) to better distribute emissions along river ways and ports and thereby improve model results. Class III, residual-fueled vessel emissions were revised to correct an error in the implementation date and resultant controls of Emission Control Areas.

The remaining mobile sectors (nonroad, rail, and aircraft) had minor changes in specific geographic areas, but no universal corrections or modifications.

1.5.4 NEI 2011 v2 fires updates

In going from 2011 v1 to 2011 v2 of the NEI, wild land and prescribed fire emissions were altered for two states: North Carolina and Delaware. NC submitted their own emissions in going from v1 to v2, and EPA accepted those emissions. This resulted in an over 95% reduction in NC wildfire emissions for v2 compared to v1. Nationally, this caused emissions to be about 30% lower in 2011 v2 vs 2011 v1. The state of DE also asked for a misclassified wildfire to be moved to the prescribed fire SCC as well as to omit several anomalous 100-acre fires in Sussex County, which DE said did not occur. Making these changes resulted in total wildfire emissions being much lower for DE in v2 (about 96%), but the 2011 v1 wildland fires (WLF) emission totals for DE were very low so no effects were seen on nationwide totals.

For agricultural fires, in going from 2011 v1 to 2011 v2 of the NEI, the following changes were made. EPA decreased emissions for all LADCO and neighboring states (WI, IL, MI, IA, MO, and OH) based on comments received from LADCO that questioned the quality of a satellite's ability to detect very small agricultural fires in the mid-western region of the US and to avoid false detects. When the states involved confirmed this information, EPA reduced all emissions by a factor of 0.000189 for these states, resulting in near-zero emissions. Based on comments from MN, we applied an 87% reduction in emissions rate that they supplied after their analysis of these data. Overall, this technique resulted in a reduction of between 95-99% of emissions for WI, MI, OH, MO, and IL. Cumulatively, these changes reduced emissions about 34% nationwide.

1.6 Who are the target audiences for the 2011 NEI?

The comprehensive nature of the NEI allows for many uses and therefore its target audiences include EPA staff and policy makers, the U.S. public, other federal and state decision makers, and other countries. Table 1-2 below lists the major current uses of the NEI and the plans for use of the 2011 NEI in those efforts. These uses include those by EPA in support of the NAAQS, Air Toxics, and other programs as well as uses by other federal and regional agencies and international support. In addition to this list, the NEI is used to respond to Congressional inquiries, provide data that supports university research, and allow environmental groups to understand sources of air pollution.

Table 1-2: Examples of major current uses of the NEI

Audience	Purposes	Last NEI data used
U.S. Public	Learn about sources of air emissions	2011 v2
EPA – NAAQS	Regulatory Impact Analysis – benefits estimates using air quality modeling	Modified 2005 v2, for PM NAAQS Proposal, Modified 2008 v2, for PM NAAQS Final 2011 v1 for Ozone NAAQS Proposal
	PM and SO_2 NAAQS Implementation	2011 v1

Audience	Purposes	Last NEI data used
	SO_2 NAAQS Monitoring Implementation - Population Weighted Emissions Index	2008 v3 with some 2009 data
	Pb Monitoring Rule	2005 v2
	Pb NAAQS final designations	2008 v3
	Pb NAAQS Policy Assessment	Modified 2008 v3
	Transport Rule air quality modeling (e.g., Clean Air Interstate Rule, Cross-State Air Pollution Rule)	2011 v2
	State Implementation Plans – source of emissions data for regions outside of the state jurisdiction	2011 v2
EPA – Air toxics	National Air Toxics Assessment (NATA)	2011 v2
	Mercury and Air Toxics Standard – mercury risk assessment and Regulatory Impact Assessment	Modified 2005 v2
	Residual Risk and Technology Review – starting point for inventory development	2011 v1
EPA - other	Inspector General – review of oil and gas industry	2008 v1.5
	NEI Report – analysis of emissions inventory data	2011 v1
	Report on the Environment	2011 v1
	Air Emissions website for providing graphical access to CAP emissions for state maps and Google Earth views of facility total emissions	2011 v2
	Department of Transportation, national transportation sector summaries of CAPs	2008 v1.5
	Black Carbon Report to Congress	Modified 2005 v2
Other federal or regional agencies	Western Regional Air Partnership – modeling in support of Regional Haze SIPs and other air quality issues	Modified 2008 v2 (including different oil & gas, fire and biogenic emissions)
International	United Nations Economic Commission for Europe's Convention on Long-range Transboundary Air Pollution (LRTAP)	2011 v2
	United Nations Environment Programme (UNEP) – global mercury program	2008 v2
	North American Commission for Environmental Cooperation (CEC) – North American Regional Action Plan (NARAP) on Mercury	Modified 2005 v2
Other outside parties	Researchers and graduate students	2011 v2

1.7 What are appropriate uses of the NEI 2011 v2 and what are the caveats about the data?

As shown in the preceding section, the NEI provides a readily-available comprehensive inventory of both CAP and HAP emissions to meet a variety of user needs. Although the accuracy of individual emissions estimates will vary from facility-to-facility or county-to-county, the NEI largely meets the needs of these users in the aggregate. Some NEI users may wish to evaluate and revise the emission estimates for specific pollutants from specific source types for either the entire US or for smaller geographical areas as their particular needs may dictate. Regulatory uses of the NEI by the EPA such as for interstate transport always include a public review and comment period. Large-scale assessment uses such as the NATA study also provide review periods. The NATA provides an effective screening tool for identifying potential risks, the results of which should be reviewed in more detail, including an assessment of the key emissions and other modeling inputs.

One of the primary goals of the NEI is to provide the best assessment of current emissions levels using the data, tools and methods currently available. For significant emissions sectors of key pollutants, the available data, tools and methods typically evolve over time in response to identified deficiencies and the need to understand the costs and benefits of proposed emissions reductions. As these method improvements have been made, there have not been consistent efforts to revise previous NEI year estimates to use the same methods as the current year. Therefore, care must be taken when reviewing different NEI year publications as a time series with the goal of determining the trend or difference in emissions from year to year. An example of such a method change in the 2008 NEI v3 and 2011 NEI is the use of the Motor Vehicle Emissions Simulator (MOVES) model[2] for the on-road data category. Previous NEI years had used the Mobile Source Emission Factor Model, version 6 (MOBILE6)[3] and earlier versions of the MOBILE model for this data category. The previous version of the 2011 NEI (2011v1) used an older version of MOVES (2010b) that has been substantially updated in the current 2011 v2 (MOVES2014). The change of model has been demonstrated to make significant changes in some pollutants.

Other significant emissions sectors which have seen improvements and therefore inconsistent trend data through the years include paved and unpaved road PM emissions, animal waste ammonia emissions, oil and gas production, and residential wood combustion emissions. In addition, the 2011 NEI uses updated emissions factors (EFs) for several metal HAPs and acid gases from coal-fired utility boilers as well as EFs for PM based on site specific measurements for some units. These EFs were not incorporated in previous year inventories (however, all 2011 updated EFs except for $PM_{2.5}$ and HCN were used in the 2008 NEI) so trends may for these pollutants are influenced by method changes as well as actual reductions or increases in emissions.

<u>Outstanding Issues</u>

Users should take caution in using the emissions data for filterable and condensable components of particulate matter (PM10-FIL, PM2.5-FIL and PM-CON) which is not complete and should not be used at any aggregated level. These data are provided for users who wish to better understand the components of the primary PM species, where they are available, in the disaggregated, process-specific emissions reports. Where not reported by S/L/T agencies, EPA augments these components (see Section 3.1.2). However, not all sources are covered by this routine, and in mobile source models, only the primary particulate species are estimated. Thus, users interested in PM emissions should use the primary species of particulate matter (PM10-PRI and PM25-PRI), described in this document simply as PM_{10} and $PM_{2.5}$.

There is likely to be some double-counting of cyanide and hydrogen cyanide emissions, where we think emission factors or stack test results are available for both pollutant codes, but it's likely that cyanide emission factors or tests would include any hydrogen cyanide and possibly other cyanide compounds. There are 31 emission processes in the point source category of 2011 v2 which have both cyanide and hydrogen cyanide emissions. The total of both CN and HCN for these 31 processes is 502,000 lbs, although 399,000 lbs is for hydrogen cyanide at one refinery process. The estimated double-counting would therefore be no more than 50,000 lbs, and the bulk of the double-counting is for four EGUs in Mississippi, where hydrogen cyanide emissions based upon a recalled MATs emission factor were not tagged out.

Additional issues were identified as the result of the 2011 NATA comment period. Because this comment period is still ongoing, we will not list each individual issue but give a brief overview of the types of issues identified.

- There were several corrections provided for data augmented using the TRI. Comments mostly addressed chromium and other metals, and, in most cases, the emissions were found to be overestimated. Updated data were provided due to miscalculations by the reporting facility, or the use of a mid-point value which overestimated the actual emissions. In addition, for chromium, comments were received on the speciation into hexavalent and trivalent forms. In most cases, the speciation was

[2] See MOVES and Other Mobile Source Emissions Models
[3] See Transportation, Air Pollution, and Climate Change

changed to a higher percent (in some cases to 100%) of trivalent chromium based on product formulation or testing. Many SLT agencies revised their emissions due to corrections to emission factors, errors or because they had received updated data from their facilities for 2011. In most cases the revisions were emissions decreases, but in some cases, emissions increased. In a few cases emissions were zeroed out (e.g., ethylene oxide from certain hospital sterilizers) because data that the state had carried forward from previous years was found to be no longer valid.

- Revised emissions based on facility and process-specific information were provided by SLT agencies to replace some HAPs augmented data SCC-specific emission factor ratios.
- Some HAPs were found to be inappropriately augmented via the emission factor ratio approach
  - Nickel from SCC 20300201 – emission factor units for PM and nickel were based on different throughput units (input versus output) hence nickel should not be augmented for this SCC
  - Ethylene dichloride from the following SCCs since this pollutant is associated with leaded gasoline which is no longer used other than in aviation fuel.: '40600136','40600144','40600301','40600302','40600306','40600402'
- Some HAPs augmented for oil and gas used default emission factor ratios applied to state-supplied VOC emission estimates; Uinta basin specific speciation data showed significantly lower HAP fractions than the default ratios used for the NEI.

2 2011 inventory contents overview

2.1 What are EIS sectors and what list was used for this document?

First used for the 2008 NEI, EIS Sectors continue to be used for the 2011 NEI. The sectors were developed to better group emissions for both CAP and HAP summary purposes. The sectors are based simply on grouping the emissions by the emissions process based on the source classification code (SCC) to the EIS sector. In building this list, we gave consideration not only to the types of emissions sources our data users most frequently ask for, but also to the need to have a relatively concise list in which all sectors have a significant amount of emissions of at least one pollutant. The SCC-EIS Sector cross-walk used for the summaries provided in this document can be found in the Microsoft® Excel ® spreadsheet "scc_eissector_xwalk_2011neiv1.xlsx". No changes were made to the SCC-mapping or sectors used for the 2008 NEI except where SCCs were retired, or new SCCs were added. Users of the NEI are free to obtain the SCC-level data and modify the EIS Sector cross-walk to make custom groupings of their own or to request assistance from EPA to do so.

Some of the sectors include the nomenclature "NEC", which stands for "not elsewhere classified." This simply means that those emissions processes were not appropriate to include in another EIS sector and their emissions were too small individually to include as its own EIS sector.

Since the 2008 NEI, the inventory has been compiled using five major categories, which are also data categories in the EIS: point, nonpoint, on-road, nonroad and event. The event category is used to compile day-specific data from prescribed burning and wildfires. While events could be other intermittent releases such as chemical spills and structure fires, prescribed burning and wildfires have been a focus of the NEI creation effort and are the only emission sources contained in the event data category.

Table 2-1 shows the EIS sectors in the left most column and identifies the EIS data category associated with that sector. It also identifies in the rightmost column the section number of this document that provides more information about that EIS sector. As the column illustrates, many EIS sectors include emissions from more than one EIS data category because the EIS sectors are compiled based on the type of emissions sources rather than the data category. Note that the EIS sector "Mobile – Aircraft" is part of the point and nonpoint data categories and "Mobile – Commercial Marine Vessels", and "Mobile – Locomotives" is part of the nonpoint data category. We include biogenics emissions, "Biogenics - Vegetation and Soil", in the nonpoint data category in the EIS. NEI users who sum emissions by EIS data category rather than EIS sector should be aware that these changes will give differences from historical summaries of "nonpoint" and "nonroad" data unless care is taken to assign those emissions to the historical grouping.

Table 2-1: EIS sectors and associated emissions categories and document sections

Sector name	Point	Nonpoint	On-road	Nonroad	Event	Document Section
Agriculture - Crops & Livestock Dust		☑				3.2
Agriculture - Fertilizer Application		☑				3.3
Agriculture - Livestock Waste	☑	☑				3.4
Biogenics - Vegetation and Soil		☑				6
Bulk Gasoline Terminals	☑	☑				3.5
Commercial Cooking		☑				3.6

Sector name	Point	Nonpoint	On-road	Nonroad	Event	Document Section
Dust - Construction Dust	☑	☑				3.7
Dust - Paved Road Dust		☑				3.8
Dust - Unpaved Road Dust		☑				3.9
Fires - Agricultural Field Burning		☑				5.2
Fires - Prescribed Burning					☑	5.1
Fires - Wildfires					☑	5.1
Fuel Comb - Comm/Institutional - Biomass	☑	☑				3.12
Fuel Comb - Comm/Institutional - Coal	☑	☑				3.12
Fuel Comb - Comm/Institutional - Natural Gas	☑	☑				3.12
Fuel Comb - Comm/Institutional - Oil	☑	☑				3.12
Fuel Comb - Comm/Institutional - Other	☑	☑				3.12
Fuel Comb - Electric Generation - Biomass	☑					3.10
Fuel Comb - Electric Generation - Coal	☑					3.10
Fuel Comb - Electric Generation - Natural Gas	☑					3.10
Fuel Comb - Electric Generation - Oil	☑					3.10
Fuel Comb - Electric Generation - Other	☑					3.10
Fuel Comb - Industrial Boilers, ICEs - Biomass	☑	☑				3.11
Fuel Comb - Industrial Boilers, ICEs - Coal	☑	☑				3.11
Fuel Comb - Industrial Boilers, ICEs - Natural Gas	☑	☑				3.11
Fuel Comb - Industrial Boilers, ICEs - Oil	☑	☑				3.11
Fuel Comb - Industrial Boilers, ICEs - Other	☑	☑				3.11
Fuel Comb - Residential - Natural Gas		☑				3.13
Fuel Comb - Residential - Oil		☑				3.13
Fuel Comb - Residential - Other		☑				3.13
Fuel Comb - Residential - Wood		☑				3.14
Gas Stations	☑	☑				3.5
Industrial Processes - Cement Manufacturing	☑					3.15
Industrial Processes - Chemical Manufacturing	☑	☑				3.16
Industrial Processes - Ferrous Metals	☑					3.17
Industrial Processes - Mining	☑	☑				3.18
Industrial Processes - NEC	☑	☑				3.24
Industrial Processes - Non-ferrous Metals	☑	☑				3.19
Industrial Processes - Oil & Gas Production	☑	☑				3.20
Industrial Processes - Petroleum Refineries	☑	☑				3.21
Industrial Processes - Pulp & Paper	☑					3.22
Industrial Processes - Storage and Transfer	☑	☑				3.23
Miscellaneous Non-Industrial NEC	☑	☑				3.25
Mobile - Aircraft	☑	☑				4.2
Mobile - Commercial Marine Vessels		☑				4.3

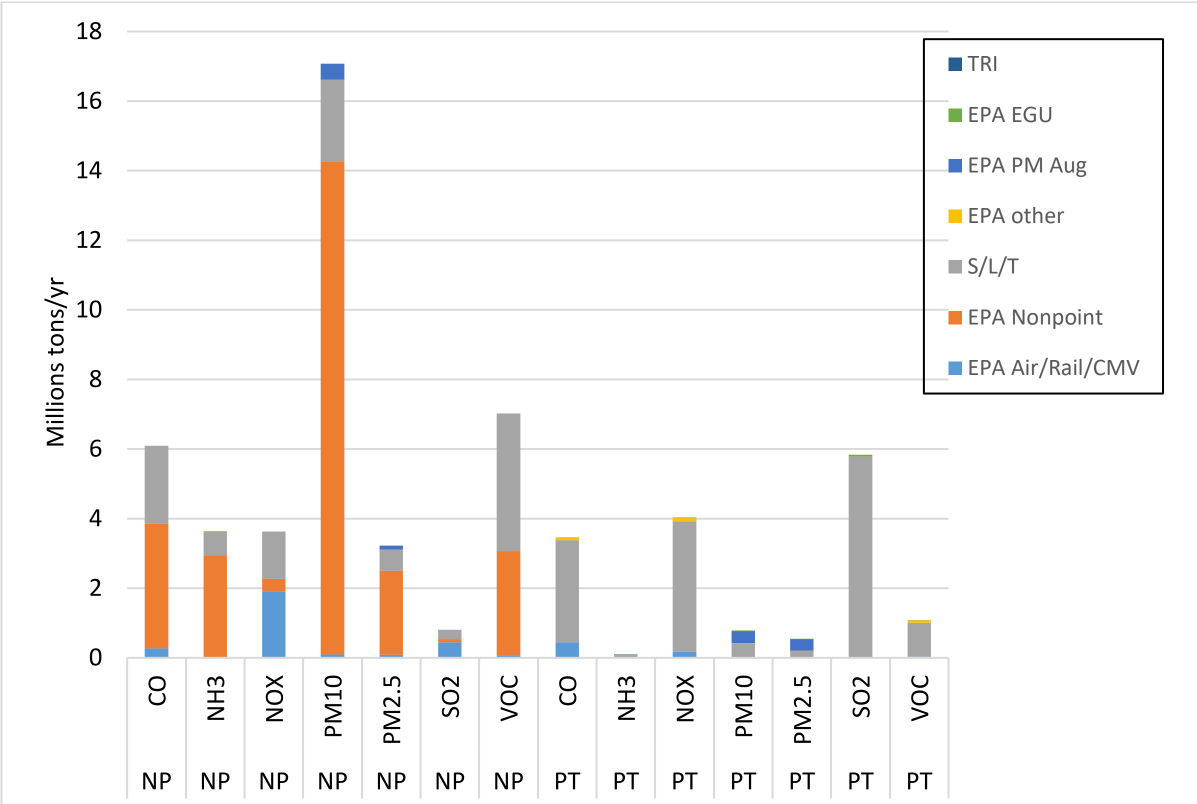
Sector name	Point	Nonpoint	On-road	Nonroad	Event	Document Section
Mobile - Locomotives	☑	☑				4.4
Mobile - Non-Road Equipment - Diesel	☑			☑		4.5
Mobile - Non-Road Equipment - Gasoline	☑			☑		4.5
Mobile - Non-Road Equipment - Other	☑			☑		4.5
Mobile - On-road – Diesel Heavy Duty Vehicles			☑			4.6
Mobile - On-road – Diesel Light Duty Vehicles			☑			4.6
Mobile - On-road – Gasoline Heavy Duty Vehicles			☑			4.6
Mobile - On-road – Gasoline Light Duty Vehicles			☑			4.6
Solvent - Consumer & Commercial Solvent Use		☑				3.26
Solvent - Degreasing	☑	☑				3.28
Solvent - Dry Cleaning	☑	☑				3.29
Solvent - Graphic Arts	☑	☑				3.30
Solvent - Industrial Surface Coating & Solvent Use	☑	☑				3.31
Solvent - Non-Industrial Surface Coating		☑				3.27
Waste Disposal	☑	☑				3.32

2.2 What do the data show about the sources of data in the 2011 NEI?

Data in the NEI come from a variety of sources. The emissions are predominantly from S/L/T agencies for both CAP and HAP emissions. In addition, EPA quality assures and augments the data provided by states to assist with data completeness, particularly with the HAP emissions since the S/L/T HAP reporting is voluntary. Additional details on EPA's augmentation datasets are available in the remainder of this document.

Figure 2-1 shows the proportion of criteria pollutant emissions from various data sources in the NEI for point and nonpoint sources. For the nonpoint data in the figure (left 7 bars), most of the emissions come from EPA sources of data, with S/L/T agency data the majority for VOC and SO_2. The large "EPA Nonpoint" bar for PM_{10} is predominantly dust sources from unpaved roads (7.7 million tons), agricultural dust from crop cultivation (3.5 million tons), and construction dust (1.1 million tons). For point data in the figure (right 7 bars), most of the emissions come from S/L/T agency data, with EPA data making up a large proportion only for the $PM_{2.5}$ with the EPA PM Augmentation dataset ("EPA PM Aug" in the figure, see Section 3.1.2. The data sources shown in the figure are described in more detail in Section 3.

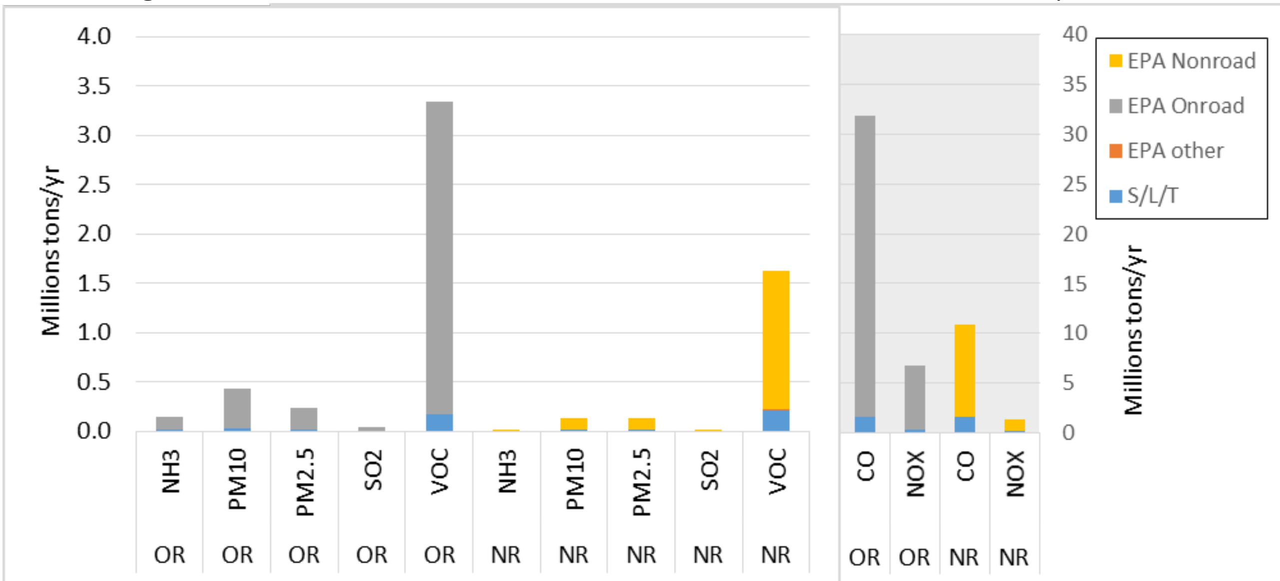
Figure 2-1: Data sources for point and nonpoint emissions for criteria pollutants



[1] Nonpoint emission shown here exclude biogenic sources, which are all EPA data

The data sources for the emissions from nonroad and on-road data categories are shown in Figure 2-2. These show that emissions are comprised primarily using data from EPA. That is because each of these data categories has its own emissions model and EPA primarily collected model inputs from S/L agencies for these categories and ran the models using these inputs to generate the emissions. The S/L agencies that provided inputs are presented in the sections covering nonroad, on-road and fires emission sectors (4.5, 4.6 and 5.1). Note that the scale for NO_X and CO in Figure 2-2 is on the right vertical axis in the chart.

Figure 2-2: Data sources for onroad and nonroad mobile emissions for criteria pollutants



In Figure 2-3, the nonpoint acid gases are very small, with 4,400 tons from both S/L/T agencies and the EPA nonpoint dataset. For point sources, the bulk of the acid gases emissions (primarily HCl) comes from two EPA EGU datasets (73,000 tons) in addition to 45,000 tons from S/L/T agencies, while most of the HAP VOC emissions come from the S/L/T/ agency data (165,000 tons) and just 30,000 tons from TRI.

Figure 2-3: Data sources of emissions for acid gases and HAP VOCs, by data category

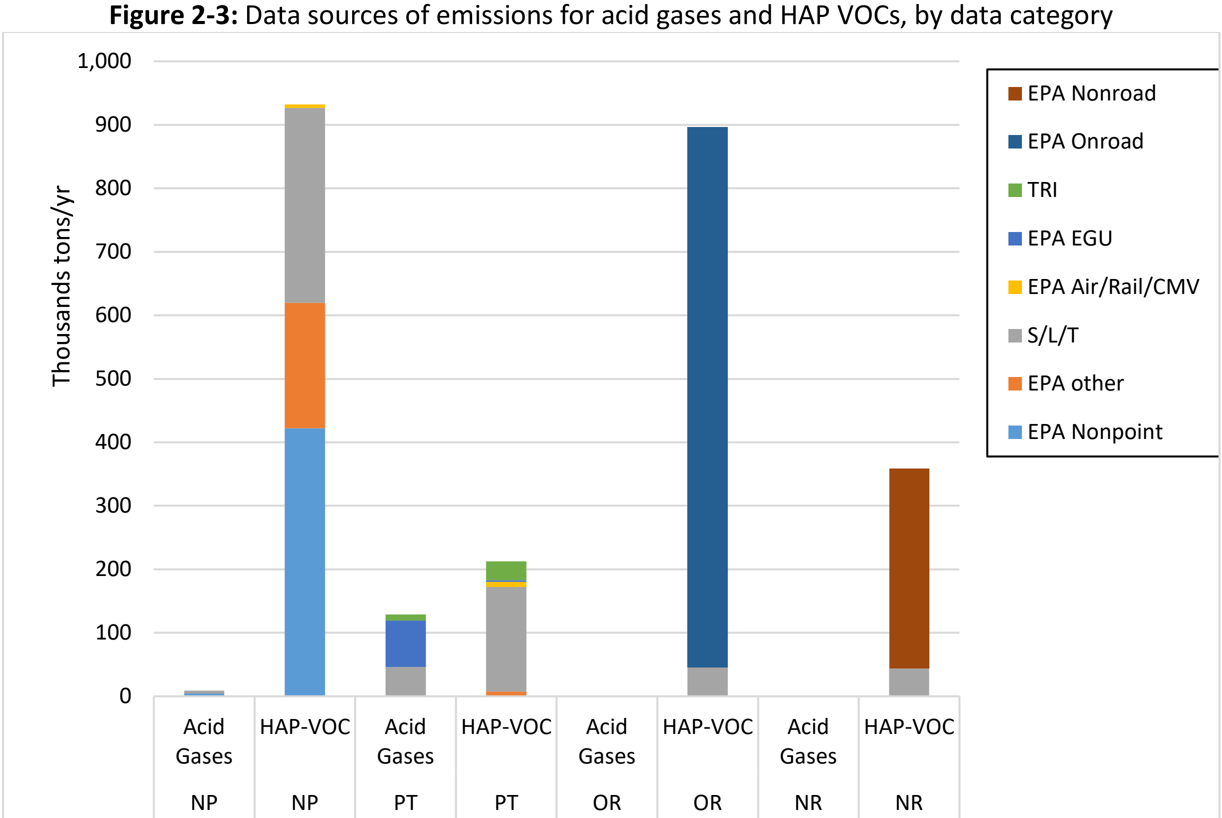
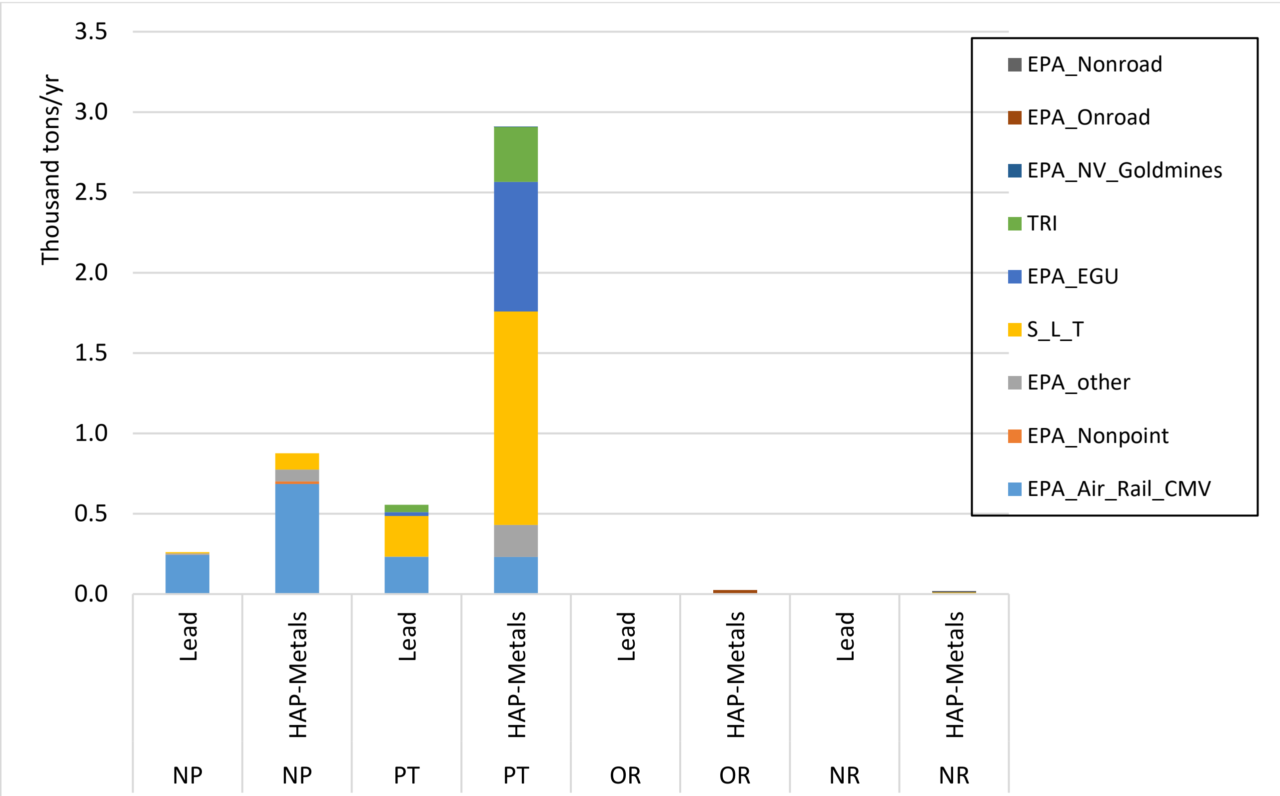


Figure 2-4 shows emissions sources for Pb and HAP metal emissions. For nonpoint sources, almost all the emissions are from the EPA nonroad dataset, which includes emissions from airports, locomotives, and commercial marine vessels. For point sources, about half of the Pb comes from S/L/T agency data (250 tons), while the EPA nonroad dataset airport emissions make up a substantial part of the rest (230 tons). For metals, the point sources data has a significant portion from S/L/T agencies (1,300 tons), with the rest from the EPA EGU dataset (800 tons), TRI (300 tons), and other EPA datasets (400 tons).

Figure 2-4: Data sources of emissions for Pb and HAP metals, by data category



The figures below provide more detail about which states submitted data to the NEI for the stationary and mobile categories. In Sections 3 through 5, we explain more about what data were used by EPA in creating the NEI for each sector. Usually, but not always, EPA uses the data provided by the states. These figures present the states for which data were used by EPA in compiling the 2011 NEI.

Figure 2-5 shows that all states submitted point source CAP emissions. All states except Utah, South Dakota and Alaska submitted point source HAP emissions (at least one HAP pollutant). Though not shown in the figure, Georgia submitted point HAPs only for airports and only a local agency in Nevada (not the state agency[4]) submitted HAPs. Generally, when states submitted CAP emissions they submitted all the CAPs, but for HAP emissions there is more variability in the data provided. S/L/T generally report what they collect, and collection varies depending on state, local, and tribal reporting regulations. Puerto Rico and the Virgin Islands are not shown in Figure 2-5. Puerto Rico submitted point source CAP emissions for 2011. Virgin Islands did not emissions for any data category.

[4] Though the Nevada Division of Environmental Protection does not submit HAPs to EIS, they do provide mercury emissions data to EPA for gold mines from their annual emissions reporting program (EPA NV Gold Mines dataset listed in Table 3-1)

Figure 2-5: Point inventory - submission types - includes local agencies

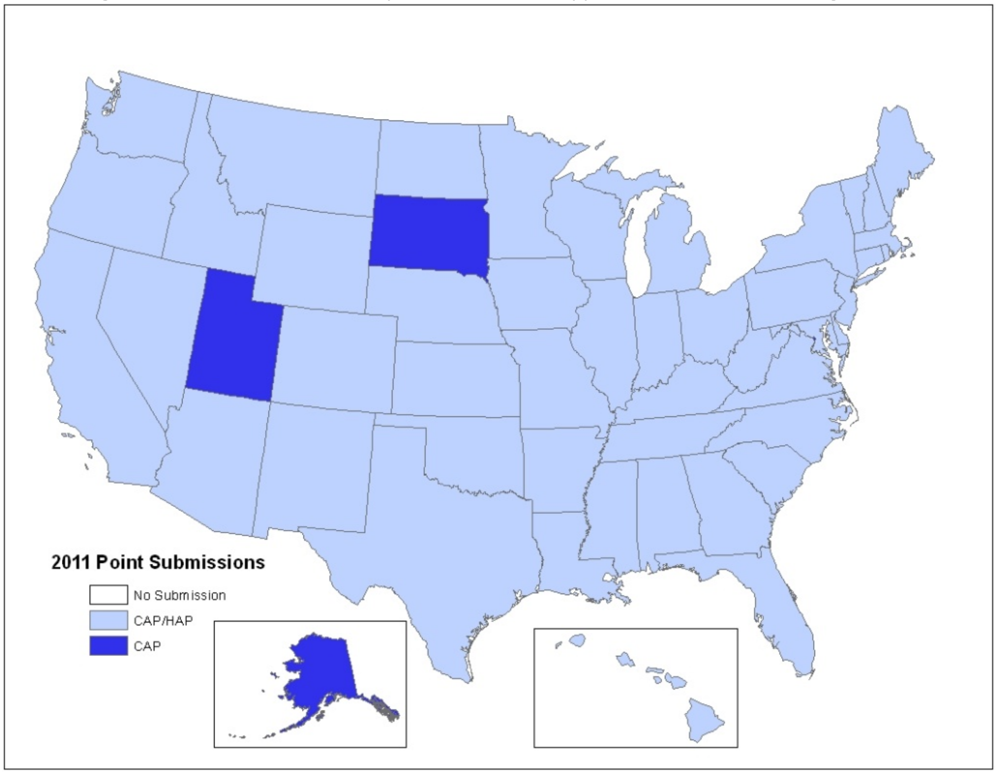


Figure 2-6 shows the states and/or local agencies that submitted nonpoint emissions. Forty-two states submitted CAPs and thirty-four also submitted HAPs. Only eight states did not submit any nonpoint emissions, and at least some of these notified EPA that EPA's estimates were acceptable for the source types that EPA estimated. Puerto Rico and Virgin Islands did not submit any nonpoint emissions. The state of Nevada did not submit nonpoint CAPs or HAPs, but the state is colored light blue because of local agency submittals in that state.

For on-road mobile sources, emissions in all states except California are based on the EPA's run of the MOVES2014 model. California emissions are estimated by the EMFAC (short for Emission FACtor) model[5] and California has provided CAP and HAP emissions which are used in the 2011 NEI. Figure 2-7 shows the states and local agencies that submitted at least one table of onroad model inputs. Section 4.6 has more detail and identifies the local agencies that submitted inputs.

[5] See "EMFAC Overview" link available at on CARB Mobile Emissions Inventory website

Figure 2-6: Nonpoint inventory – submission types – includes local agencies

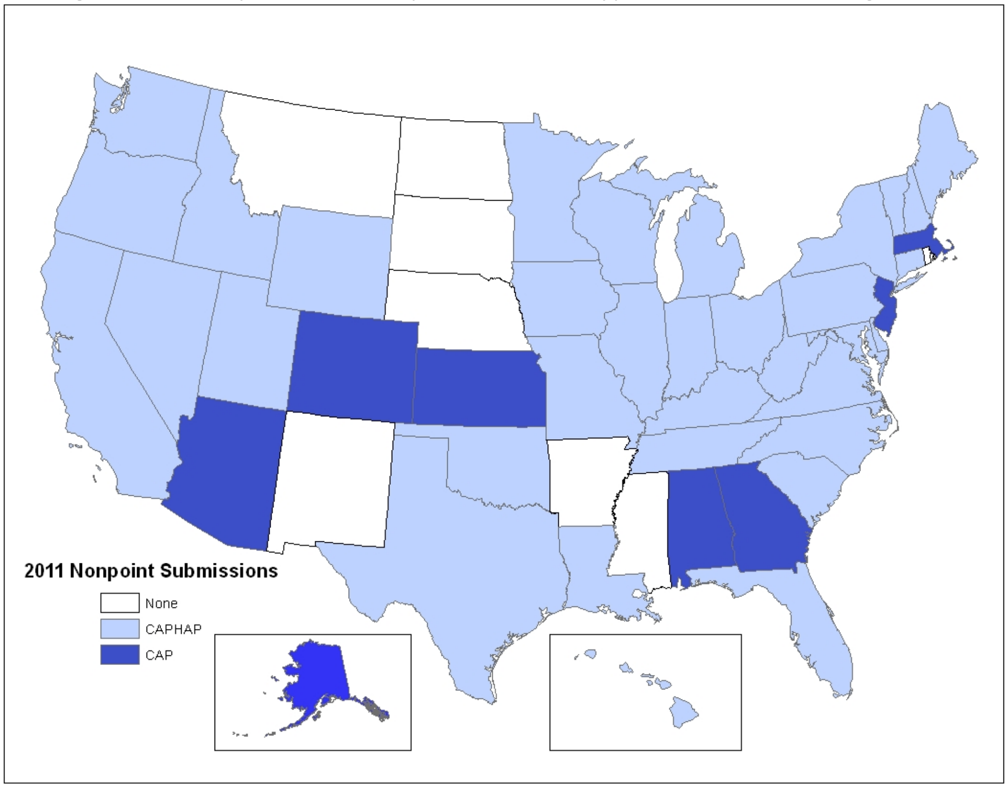
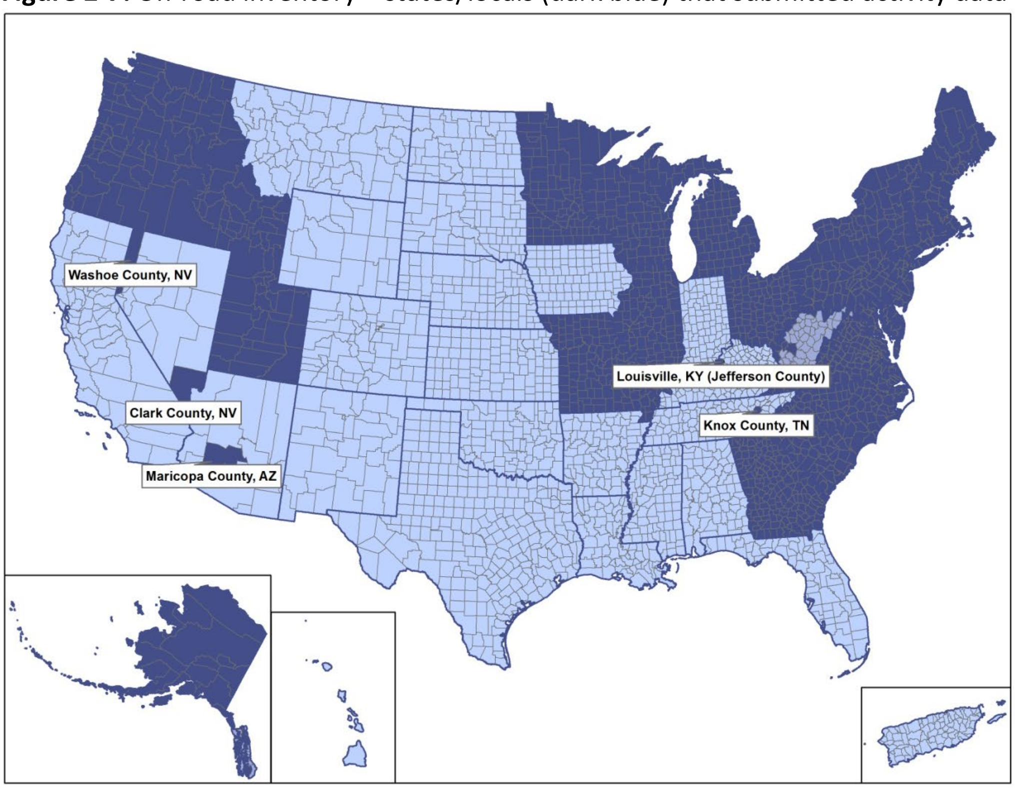
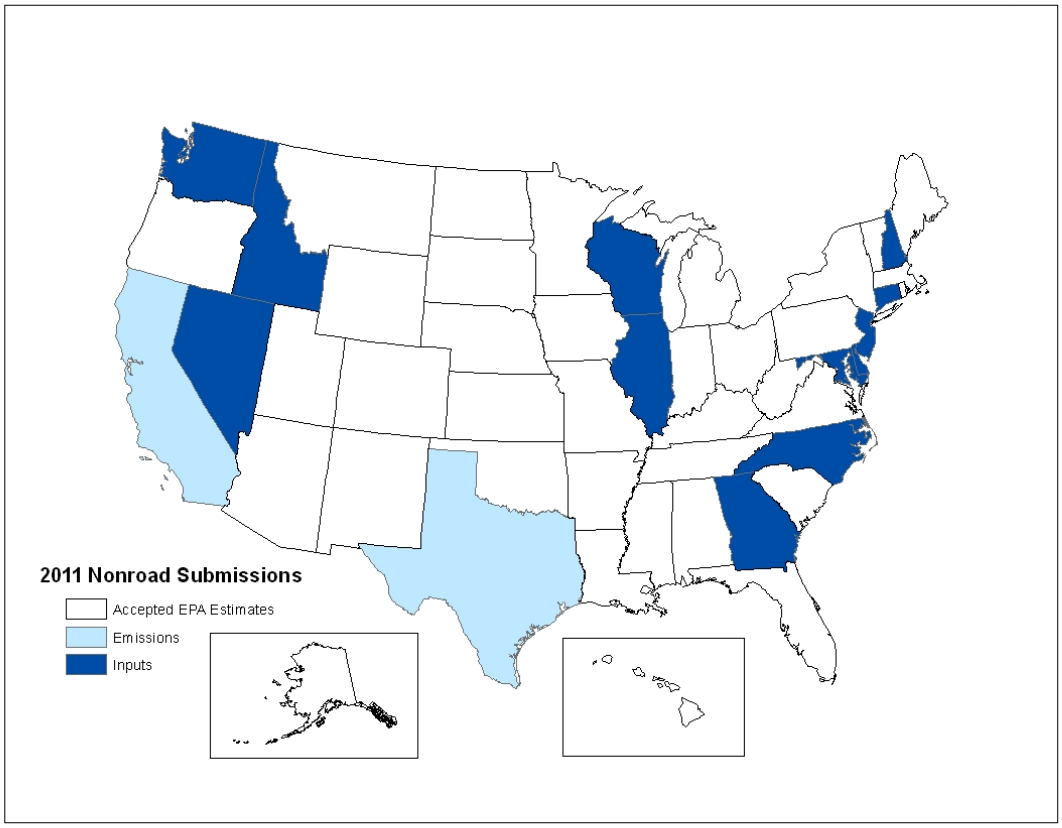


Figure 2-7: On-road inventory – states/locals (dark blue) that submitted activity data



As seen in Figure 2-8, Texas and California are the only states for which state-submitted emissions are used in the NEI for the nonroad data category (i.e., nonroad equipment). Again, California has provided EPA CAP and HAP emissions based on a different model than the other states – the OFFROAD model[6]. Texas provided CAP and HAP emissions using the NONROAD model with finer granularity than the National Mobile Inventory Model (NMIM) that EPA used. Twelve states submitted NONROAD model inputs that EPA used to generate emissions, and the remaining states accepted EPA estimates. More detail on the states and local agencies that submitted inputs is provided in Section 4.5.

Figure 2-8: Nonroad equipment inventory – submission types – does not include local agencies



In addition to the maps above, each sector-specific section below has maps that show the distribution of state and EPA data for CAPs and HAPs. Finally, Appendix A provides a table that shows for each EIS sector whether the data comes from S/L/T agencies or a selection of EPA created datasets including TRI.

2.3 What are the top sources of some key pollutants?

This section simply provides a summary of criteria pollutants and total HAP emissions for all the EIS sectors, including the biogenic emissions from vegetation and soil. Emissions in federal waters and from vegetation and soils have been split out and totals both with and without these emissions are included. Emissions in federal waters include offshore drilling platforms and commercial marine vessel emissions outside the typical 3-10 nautical mile boundary defining state waters. These emissions values are subject to change and are bounded by the caveats and methods described by this documentation.

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[6] The OFFROAD model and documentation are available at the CARB Mobile Source Emissions Inventory website.

Table 2-2: EIS sectors and associated CAP emissions and total HAP (1000 short tons/year)

	1000 short tons / year								
Sector	CO	NH_3	NO_X	$PM_{2.5}$	PM_{10}	SO_2	VOC	Lead	Total HAPs[1]
Agriculture - Crops & Livestock Dust				897	4,506				
Agriculture - Fertilizer Application		1,183							
Agriculture - Livestock Waste	0.13	2,344	0.13	0.19	0.34	8.32E-03	0.19		0.04
Bulk Gasoline Terminals	0.75	0.02	0.33	0.02	0.02	4.11E-03	157	8.33E-04	7.94
Commercial Cooking	31		5.38E-04	85	89	8.28E-05	13		5.37
Dust - Construction Dust	0.08	2.93E-03	0.08	163	1,510	0.02	0.04		0.05
Dust - Paved Road Dust				270	1,131				
Dust - Unpaved Road Dust				833	8,339				
Fires - Agricultural Field Burning	966	3.47	43	96	143	16	76	4.5E-04	55
Fires - Prescribed Fires	10,092	162	168	903	1,063	83	2,320		255
Fires - Wildfires	12,831	205	187	1,137	1,340	97	2,922		296
Fuel Comb - Comm/Institutional - Biomass	19	0.14	8.39	11	13	1.08	0.64	3.27E-04	0.26
Fuel Comb - Comm/Institutional - Coal	6.57	0.06	17	1.34	3.29	59	0.22	2.46E-03	1.75
Fuel Comb - Comm/Institutional - Natural Gas	113	1.54	154	6.21	7.09	1.64	11	2.48E-03	1.48
Fuel Comb - Comm/Institutional - Oil	15	0.74	60	5.72	7.88	56	1.99	8.42E-04	0.12
Fuel Comb - Comm/Institutional - Other	9.09	0.03	7.95	0.63	0.66	1.24	0.95	2.81E-04	0.13
Fuel Comb - Electric Generation - Biomass	21	0.97	11	1.88	2.17	2.35	0.75	8.9E-04	1.66
Fuel Comb - Electric Generation - Coal	616	9.04	1,791	170	242	4,521	25	0.03	91
Fuel Comb - Electric Generation - Natural Gas	101	11	172	25	25	5.71	9.85	7.86E-04	3.52
Fuel Comb - Electric Generation - Oil	13	1.09	89	5.92	8.04	76	2.13	1.44E-03	0.52
Fuel Comb - Electric Generation - Other	34	2.94	26	2.51	2.86	20	3.25	1.59E-03	1.15
Fuel Comb - Industrial Boilers, ICEs - Biomass	281	2.78	102	128	154	24	9.51	8.33E-03	5.72
Fuel Comb - Industrial Boilers, ICEs - Coal	40	0.61	148	14	33	405	1.24	0.01	15
Fuel Comb - Industrial Boilers, ICEs - Natural Gas	350	6.40	690	26	27	16	68	3.71E-03	22
Fuel Comb - Industrial Boilers, ICEs - Oil	29	0.56	100	8.51	11	91	3.13	3.32E-03	0.58
Fuel Comb - Industrial Boilers, ICEs - Other	122	1.09	56	24	26	53	7.87	3.91E-03	2.04
Fuel Comb - Residential - Natural Gas	94	41	219	4.79	6.10	1.45	13	1.1E-04	0.98
Fuel Comb - Residential - Oil	11	2.08	41	4.59	5.74	90	1.42	2.99E-03	0.10
Fuel Comb - Residential - Other	58	0.46	40	0.98	1.47	8.93	2.98	8.15E-06	0.26
Fuel Comb - Residential - Wood	2,525	20	35	382	383	8.97	444		68
Gas Stations	0.04	2.13E-04	0.03	1.79E-03	1.9E-03	1.51E-03	712	3.73E-04	86
Industrial Processes - Cement Manuf	77	0.91	119	6.54	12	60	4.37	3.79E-03	2.36
Industrial Processes - Chemical Manuf	185	24	75	20	25	133	96	4.64E-03	29
Industrial Processes - Ferrous Metals	417	0.22	56	29	35	29	17	0.05	2.32
Industrial Processes - Mining	33	0.09	33	74	486	2.04	1.63	6.21E-03	0.77
Industrial Processes - NEC	208	28	180	89	150	139	195	0.06	45
Industrial Processes - Non-ferrous Metals	330	0.53	15	16	20	103	15	0.08	9.44
Industrial Processes - Oil & Gas Production	654	0.11	673	17	19	74	2,730	1.2E-04	101
Industrial Processes - Petroleum Refineries	50	2.57	76	21	24	86	55	2.95E-03	6.20
Industrial Processes - Pulp & Paper	106	5.78	71	33	42	32	117	3.74E-03	51
Industrial Processes - Storage and Transfer	19	5.99	15	19	51	8.97	236	6.92E-03	14
Miscellaneous Non-Industrial NEC	11	2.74	2.73	2.12	2.26	0.24	201	7.1E-04	23
Mobile - Aircraft	423		111	7.33	8.63	14	30	0.49	8.04
Mobile - Commercial Marine Vessels	76	0.25	448	20	22	100	14	1.65E-03	1.64
Mobile - Locomotives	132	0.37	865	26	28	8.53	46	2.23E-03	5.00
Mobile - Non-Road Equipment - Diesel	624	0.99	1,098	86	89	2.42	111	1.05E-05	25
Mobile - Non-Road Equipment - Gasoline	9,764	0.66	198	42	46	0.89	1,496		334
Mobile - Non-Road Equipment - Other	546	0.61	87	1.68	1.68	0.62	20		0.09
Mobile - On-Road Diesel Heavy Duty Vehicles	899	6.71	2,951	140	184	3.67	248		46
Mobile - On-Road Diesel Light Duty Vehicles	451	0.93	149	7.74	11	0.32	51		8.61
Mobile - On-Road non-Diesel Heavy Duty Vehicles	1,040	1.11	111	1.87	4.11	0.58	50		14
Mobile - On-Road non-Diesel Light Duty Vehicles	29,472	138	3,588	81	237	31	2,741		767
Solvent - Consumer & Commercial Solvent Use	0.03		0.01	0.01	0.02	7.7E-03	1,677		314

	1000 short tons / year								
Sector	**CO**	**NH_3**	**NO_X**	**$PM_{2.5}$**	**PM_{10}**	**SO_2**	**VOC**	**Lead**	**Total HAPs[1]**
Solvent - Degreasing	0.41	0.03	0.01	0.05	0.06	0.03	148	7.48E-05	24
Solvent - Dry Cleaning	1.88E-04	4.15E-05		5.73E-04	5.73E-04		8.81		9.47
Solvent - Graphic Arts	0.14	0.08	0.15	0.17	0.19	0.01	72	2.21E-05	7.42
Solvent - Industrial Surface Coating & Solvent Use	3.48	0.63	2.38	3.82	4.29	0.43	571	3.22E-03	196
Solvent - Non-Industrial Surface Coating		0.02					334		142
Waste Disposal	1,113	34	83	165	192	17	125	0.01	29
Sub Total (no federal waters)	**75,014**	**4,257**	**15,175**	**6,117**	**20,772**	**6,485**	**18,218**	**0.81**	**3,137**
Fuel Comb - Industrial Boilers, ICEs - Natural Gas	65		54	0.33	0.33	0.03	1.40		
Fuel Comb - Industrial Boilers, ICEs - Oil	4.06		28	0.47	0.48	3.13	0.46		
Fuel Comb - Industrial Boilers, ICEs - Other	1.03E-03		1.24E-03	2.89E-05	2.89E-05	1.02E-05	1.75E-04		
Industrial Processes - Oil & Gas Production	1.65		1.92	0.03	0.03	0.03	52		
Industrial Processes - Storage and Transfer							0.93		
Mobile - Commercial Marine Vessels	117	0.46	930	57	62	369	29	2.96E-03	1.96
Sub Total (federal waters)	**188**	**0.46**	**1,014**	**58**	**63**	**372**	**84**	**2.96E-03**	**1.96**
Sub Total (all but vegetation and soil)	**75,202**	**4,257**	**16,189**	**6,175**	**20,835**	**6,857**	**18,301**	**0.82**	**3,139**
Biogenics - Vegetation and Soil[2]	6,842		1,021				40,728		5,969
Total	**82,044**	**4,257**	**17,210**	**6,175**	**20,835**	**6,857**	**59,029**	**0.82**	**9,108**

[1] Total HAP does not include diesel PM, which is not a HAP listed by the Clean Air Act

[2] Biogenic vegetation and soil emissions excludes emissions from Alaska, Hawaii, and territories

2.4 How does this NEI compare to past inventories?

Many similarities between the 2011 NEI approaches and past NEI approaches exists, notably that the data are largely compiled from data submitted by S/L/T agencies for CAPs, and that the HAP emissions have greater augmentation by EPA because they are a voluntary contribution from the partner agencies. 2011 S/L/T participation was somewhat more comprehensive than in 2008, though both were good. The NEI program continues with the 2011 NEI to work towards a complete compilation of the nation's CAPs and HAPs. EPA provided feedback to states during the compilation of the data on critical issues (such as potential outliers, missing SCCs, missing mercury [Hg] data and coke oven data) as has been done in the past, and EPA improved the inventory for the release. In addition to these similarities, there are some important differences in how the 2011 NEI has been created and the resulting emissions, which are described in the following two subsections.

2.4.1 Differences in approaches

With any new inventory cycle, changes to approaches are made to improve the data and process. The key changes for the 2011 cycle are highlighted here.

The 2011 NEI is the second triennial inventory compiled with the EIS. We made a number of changes to improve issues we came across in the 2008 NEI including preventing double counting, improving data quality, and completeness. We made changes to pollutant and SCC codes, added QA checks and added features that were used to assist in the QA and added flexibility to the data selection process. We retired benzene soluble organics and methylene chlorine soluble organics and brought back the general "coke oven emissions" to replace these.

We also added a few automated QA checks to the hundreds of existing automated EIS checks. One check applicable to HAPs was added to prevent double counting of a specific pollutant with the pollutant representing the aggregated group. For example, submitters may not report both "o-Xylene" and" Xylenes (Mixed Isomers)" at the same process. This check applied to the following groups: xylenes, cresols, chromium compounds, polycylic organic matter, glycol ethers and polychlorinated biphenyls. We also required PM_{10} to be greater than or equal to $PM_{2.5}$, and we required PM_{10} to be reported if $PM_{2.5}$ was reported for the same process. If either of these criteria were not met (HAP group, or PM_{10} vs $PM_{2.5}$ magnitude) then none of the pollutants submitted for the process were allowed into the EIS for that process. Another new check was to allow only certain pollutant-emission type combinations to be reported for on-road and nonroad data categories.

We also implemented a data tagging process in the EIS. This allowed EPA to tag suspect data and communicate it using the EIS during the QA process to the data submitters, and to enable us to better control the hierarchy of the data selected for the NEI. Tagged data were not selected for the NEI. Much of the suspect data we tagged were corrected (and untagged) prior to the 2011 NEI. We also tagged to prevent pollutant/SCC combinations that were reported by states from being used due to inconsistency. For example, we tagged metal HAPs from dust-related sources that were submitted by only 1 or 2 states and not estimated by the EPA methods for these categories. We also tagged data to fine tune the hierarchy of data to use in the 2011 NEI, which is shown for point and nonpoint data categories in Table 3-1 and Table 3-2 in Section 3 of this document. Within any of the datasets in those tables, tagged data (from either EPA or S/L/T datasets) were not used.

Chromium speciation and HAP augmentation were added to the EIS. These features allowed us to develop the chromium speciation and HAP augmentation datasets in a more automated way and for S/L/T to view the underlying data (tables in the EIS) used to create the augmented values. In addition, we augmented HAPs in the nonpoint inventory using S/L/T-reported CAPS; we expected this to result in the HAP data to be more consistent with the S/L/T CAP data.

We also developed new communications/processes to foster more complete inventory submittals from S/L/T agencies and more complete gap filling of EPA nonpoint data. We used the EIS feature that provides completeness reports (expected facilities) and informed S/L/T of their completeness status based on the number of expected facilities for which emissions were submitted and based on the submittal of certain nonpoint categories. Also geared toward fostering completeness and communications, we surveyed S/L/T regarding their nonpoint submittals and/or acceptance of EPA nonpoint data. This additional information helped us determine how to combine the EPA and S/L/T nonpoint data more correctly, preventing double counting and missing data. To improve on completeness, we added EPA data to industrial, commercial and institutional combustion categories where S/L/T data were found to be missing. Previously, we did not add EPA data for these categories.

We changed methods for several sectors. We updated methods for residential wood combustion, fires (agricultural, wild and prescribed), and on-road emissions. We also estimated emissions for industrial, commercial and institutional biomass burning and used these emissions where not provided by S/L/T. For prescribed and wild fires and on-road emissions, we collected inputs to models EPA used to estimate emissions. Using the EIS, S/L agencies submitted on-road inputs in the form of MOVES county database files. Prescribed and wildfire inputs were collected outside of the EIS. For nonroad mobile sources, we encouraged S/L agencies to provide inputs to NMIM via the EIS, and we used S/L agency submitted emissions for only California and Texas.

For EGUs, we used the emission factors developed from the Mercury and Air Toxics Standards (MATS) test program for PM2.5-FIL and PM-CON, for tested units only. These PM test data were not used for the 2008 NEI (test data and average emission factors for HAPs were used in both 2008 and 2011). We computed PM_{10} through PM Augmentation of the MATS $PM_{2.5}$ data and used the resultant EFs along with 2011 heat input to estimate PM_{10} emissions for the tested units. The EPA data were used ahead of the S/L/T $PM_{2.5}$ and PM_{10} except where the S/L/T PM data were indicated by the S/L/T agency to have been from measurement data.

The point source augmentation approach for using TRI changed in the 2011 NEI. In the 2008 NEI, we summed the TRI “stack” and “fugitive” emission estimates and apportioned the total based on the corresponding CAP emissions (PM was used for metal HAPs; VOC for VOC HAPs). In 2011, we kept the TRI breakout of stack and fugitive for the NEI and assigned to generic placeholder stack and fugitive processes in the EIS. We assigned an SCC code based on the SCC codes used for CAPS (see Section 3.1.4 for further details). The primary difference in this approach is that in 2008 NEI, the TRI-based HAP emissions were apportioned and present at processes with CAPs (with the exception of high-risk facilities and mercury-emitting facilities[7]), whereas in the 2011 NEI, the TRI-based HAP emissions are grouped at a one or two processes with TRI HAP emissions only. In addition, we added ammonia, a CAP, using the TRI in 2011, but not for 2008. In both years, if a S/L/T agency reported a pollutant matching TRI at *any* process at the facility, then the TRI data for that pollutant was not used in the NEI.

2.4.2 Differences in emissions between 2011 and 2008 NEI

This section presents a comparison from the 2008 v3 to the 2011 v2. Figure 2-9 through Figure 2-12 compare emissions for the CAPs and for select HAPs using seven highly aggregated emission sectors. Emissions from the biogenic (natural) sources are excluded, and the wildfire sector is shown separately for CAPs and HAPs in Figure 2-10 and in Figure 2-12. While lead is a CAP for the purposes of the NAAQS, due to toxic attributes and inclusion in the previous national air toxics assessment (NATA 2005), it is reviewed here with the HAPs. The HAPs selected for comparison are based on their national scope of interest as defined by NATA 2005.

In Figure 2-9 through Figure 2-12, the y-axis shows the emissions difference as estimated by subtracting the 2008 emissions from the 2011 emissions. Values greater than zero indicate that 2011 emissions are larger than 2008 values. Note in Figure 2-9 that the emission units for CO, SO_2, NO_X and VOC are in units of millions of tons (x10^6), while $PM_{2.5}$ and PM_{10} are in units of hundred thousands of tons (x10^5) and NH_3 is in units of tens of thousands of tons (x10^4). Similarly, y-axis scales vary in Figure 2-11 from thousands of tons (x10^3) for HAPs like formaldehyde, to actual tons for arsenic. Table 2-3 and Table 2-4 show the emission changes for CAPs and HAPs respectively, for each pollutant/sector combination; these tables contain the underlying numbers used in Figure 2-9 through Figure 2-12.

CAP emissions are overall lower in 2011 than in 2008, though some specific sector/pollutants increased in 2011 from 2008. Except for wildfires, the increases in NO_X, $PM_{2.5}$, VOC and CO are off-set by more substantial decreases to result in an overall emissions decrease. Mobile source sector emissions are lower in 2011 than 2008. Wildfire CAP emissions are higher in 2011 than in 2008, with the most substantial increase for CO. CAP emission increases in 2011 occur for the following sectors:

- Miscellaneous – agricultural field burning ($PM_{2.5}$, SO_2, CO, NO_X, VOC); waste disposal (CO); prescribed fires (CO, VOC)
- Fuel Combustion – biomass (CO, VOC)
- Industrial Processes – oil and gas production (VOC, CO, NO_X).

For the select HAPs reviewed, Table 2-4 and Figure 2-11 indicate that emissions are higher overall for sectors except for slight decreases for the metals (chromium, arsenic, and lead) and a more substantial decrease for ethylbenzene. With the exception of the metals shown and ethylbenzene, sector decreases for the other HAPs are off-set by more substantial increases to result in an overall emissions increase. While mobile source sector emissions for these HAPs are lower in 2011 than 2008, those decreases are off-set by increases in other sectors. Wildfire HAP emissions are higher in 2011 than in 2008, with the most substantial increase for formaldehyde. HAP emission increases in sectors, include the following:

[7] For the 2008 NEI, we added TRI pollutants that were determined to be risk drivers at high risk facilities based on the 2005 NATA, and we added TRI Hg for several key Hg categories regardless of whether CAPs were reported.

- Miscellaneous - agricultural field burning (formaldehyde, acetaldehyde, 1,3-butadiene); prescribed fires (formaldehyde, acetaldehyde, 1,3-butadiene, acrolein); gas stations (ethyl benzene)
- Industrial Processes –industrial surface coating and solvent use (ethyl benzene)
- Fuel Combustion – biomass and natural gas (formaldehyde, acrolein).

Table 2-3: Emission differences (tons) for CAPs, 2011 minus 2008

Sector	CO	NH_3	NO_X	PM_{10}	$PM_{2.5}$	SO_2	VOC
Miscellaneous	1,879,866	-99,646	29,757	-670,863	115,923	26,118	94,222
Fuel Combustion	214,977	487	-1,191,884	-4,383	10,213	-3,594,384	76,412
Industrial Processes	238,316	-19,056	179,548	-331,910	-85,591	-213,929	972,700
Nonroad Mobile	-2,946,001	-317	-559,336	-48,203	-36,844	-182,345	-393,257
Highway Vehicle	-5,801,073	-13,990	-1,071,088	38,926	-55,075	-9,958	-409,578
Total Difference, excluding wildfires	-6,413,915	-132,521	-2,613,003	-1,016,433	-51,373	-3,974,497	340,498
Total % Difference, excluding wildfires	-9%	-3%	-15%	-5%	-1%	-37%	2%
Fires - Wildfires	501,308	5,140	88,432	148,057	126,571	25,844	44,637

Table 2-4: Emission differences (tons) for select HAPs, 2011 minus 2008

Sector	1,3-Butadiene	1,4-Dichlorobenzene	Acetaldehyde	Acrolein	Arsenic	Chromium Compounds	Ethyl Benzene	Formaldehyde	Lead	Tetrachloroethylene
Miscellaneous	5,972	653	13,308	40	0	-46	4,462	48,266	-2	6,458
Fuel Combustion	-147	0	195	149	-20	-72	25	2,569	-31	-13
Industrial Processes	200	-2	618	877	0	7	1,915	7,622	-36	-31
Nonroad Mobile	-2,392		-2,981	-46	-3	0	-8,511	-7,150	-67	
Highway Vehicle	-1,503		1,335	228	0	-15	-8,877	-2,958		
Total Difference, excluding wildfires	2,130	651	12,474	1,247	-23	-125	-10,986	48,348	-136	6,414
Total % Difference, excluding wildfires	6%	56%	15%	4%	-16%	-21%	-12%	22%	-14%	109%
Fires - Wildfires	5,380		5,423	5,633				34,208		

Figure 2-9: Comparison of CAP emissions, 2011 minus 2008, excluding wildfires and biogenics

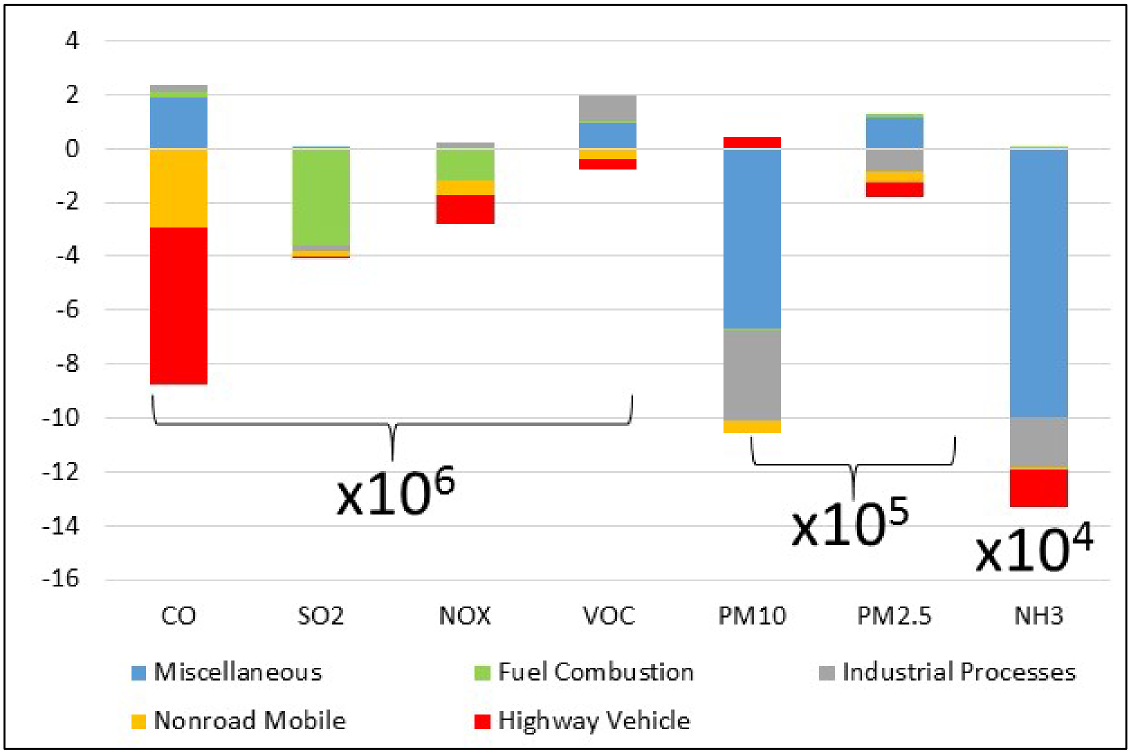
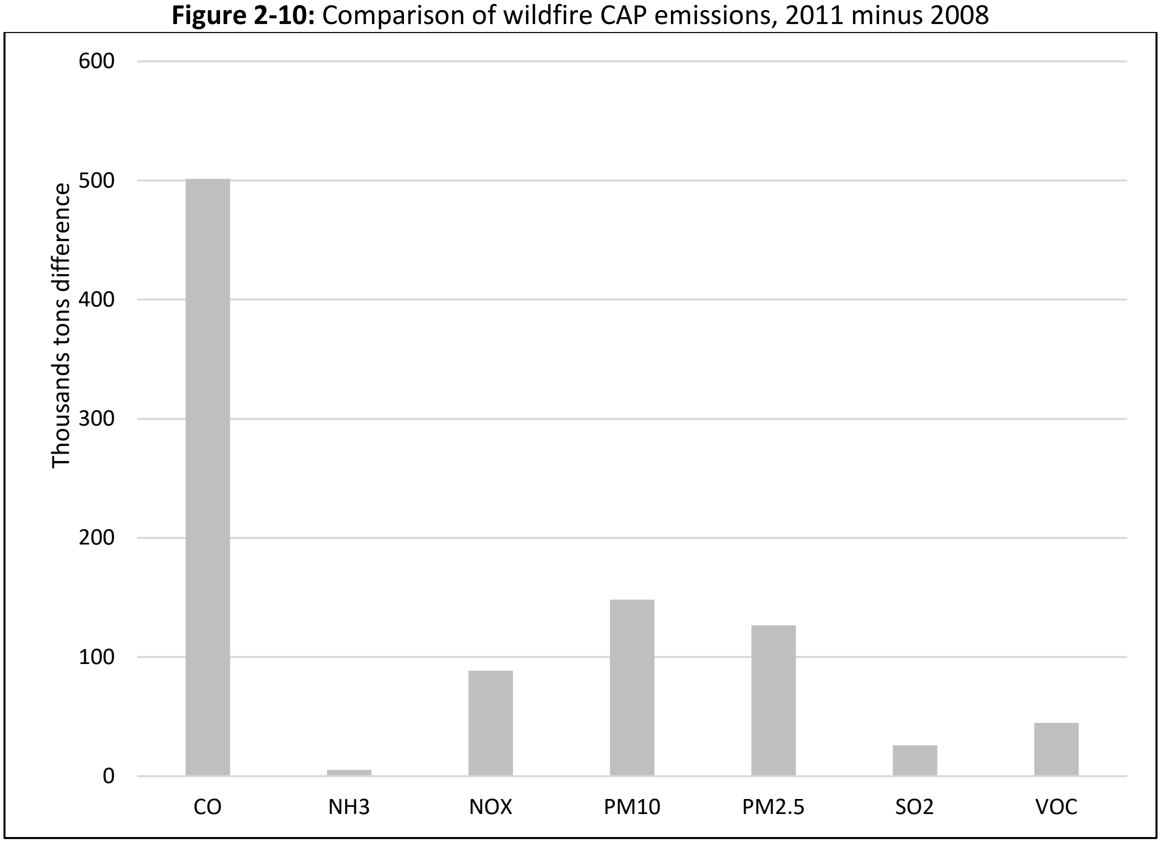


Figure 2-10: Comparison of wildfire CAP emissions, 2011 minus 2008



Additional information about sources within each sector that drive the decrease or increase observed by pollutant / sector combination, including where some differences are also due to method changes – are described in this technical support document, or are included in the EPA's "2011 NEI Report"; however, the 2011 NEI report was developed for the v1 of the 2011 NEI and updating this report to the current 2011 v2 is not planned.

Figure 2-11: Comparison of HAP emissions, 2011 minus 2008, excluding wildfires and biogenics

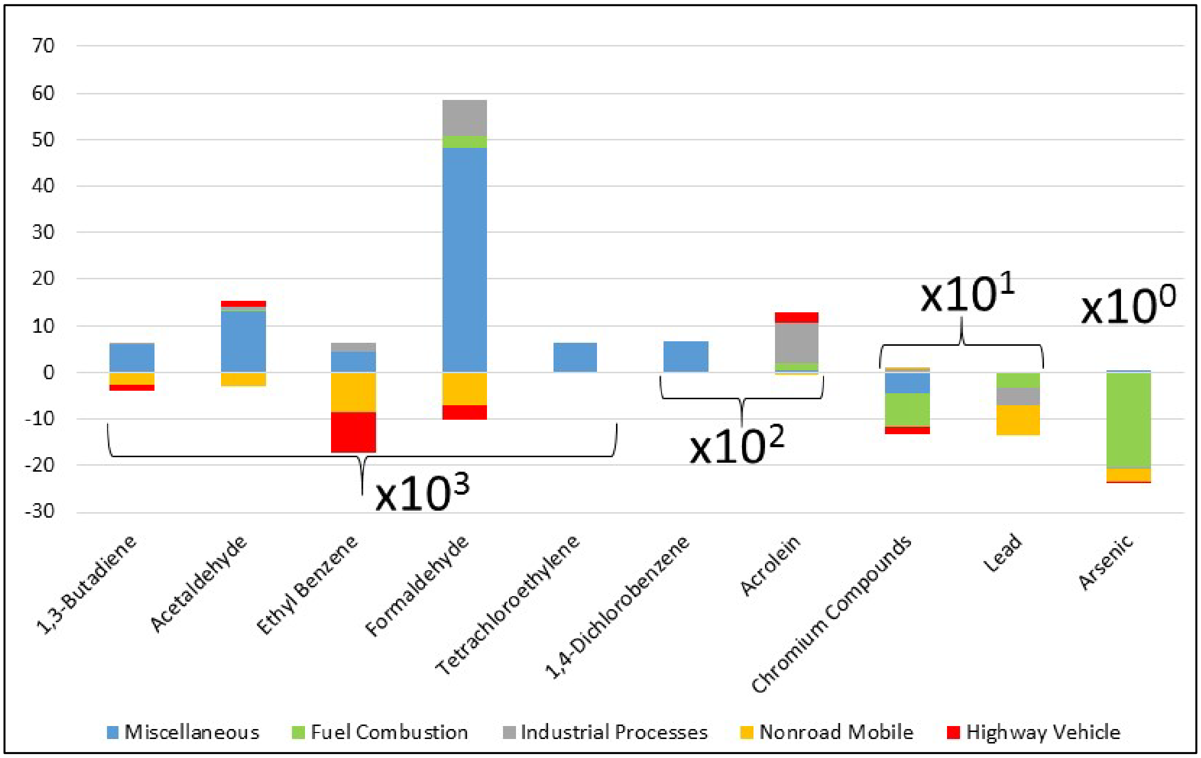
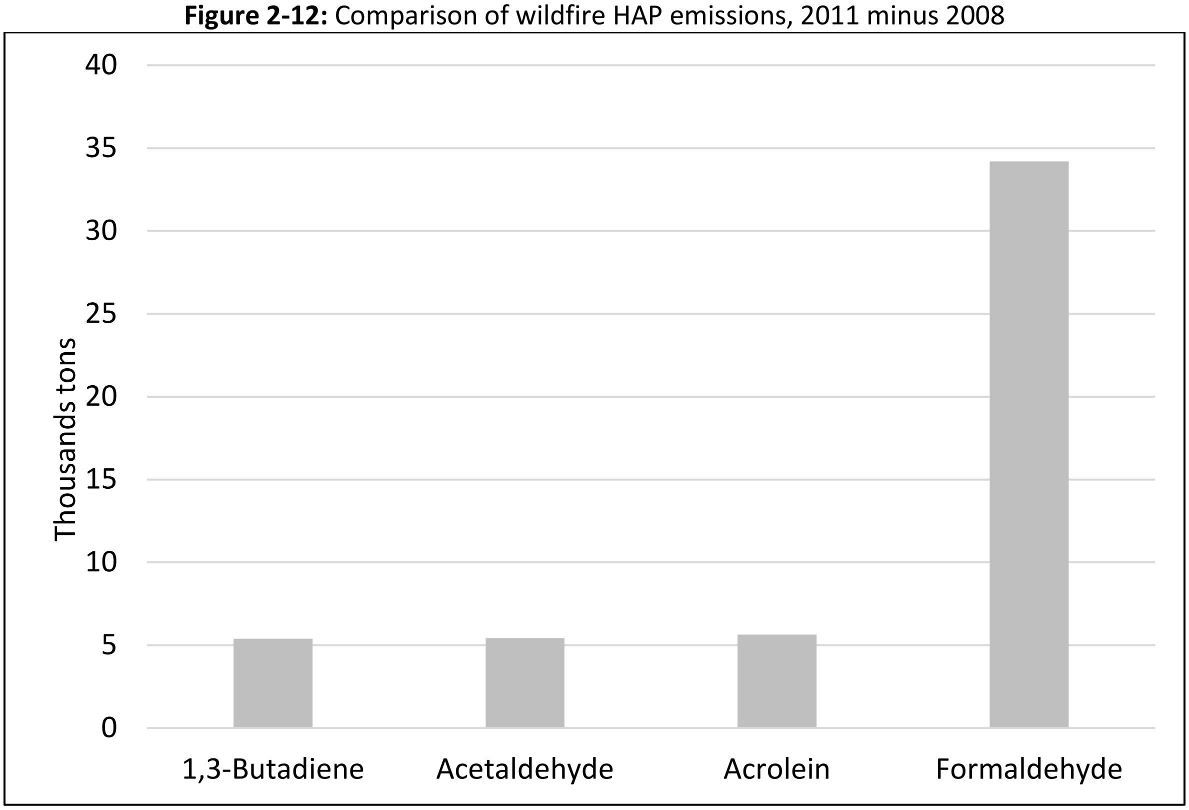


Figure 2-12: Comparison of wildfire HAP emissions, 2011 minus 2008



2.5 How well are tribal data and regions represented in the 2011 NEI?

Sixteen tribes submitted data to the EIS for 2011 as shown in Table 2-5. In this table, a “CAP, HAP” designation indicates that both criteria and hazardous air pollutants were submitted by the tribe. CAP indicates that only criteria pollutants were submitted. Facilities on Tribal land were augmented using TRI, HAPs and PM in the same manner as facilities under the state and local jurisdictions, as explained in Section 3.1; therefore, Tribal Nations in Table 2-5 with just a CAP flag will also have some HAP emissions in most cases.

Six additional tribes, shown in Table 2-6, which did not submit any data, are represented in the point data category of the 2011 NEI due to the emissions added by EPA. The emissions for these facilities are from the EPA gap fill datasets for airports, electric generating units and the TRI data. Furthermore, many nonpoint datasets included are presumed to include tribal activity. Most notably, the oil & gas nonpoint emissions have been confirmed to include activity on tribal lands because the underlying database contained data reported by tribes. See Section 3.21 for more information.

Table 2-5: Tribal participation in the 2011 v2 NEI

Tribe	Point	Nonpoint	Onroad*	Nonroad*
Bishop Paiute Tribe		CAP, HAP		
Coeur d'Alene Tribe	CAP	CAP, HAP	CAP, HAP	CAP, HAP
Confederated Tribes of the Colville Reservation, Washington	CAP			
Eastern Band of Cherokee Indians		CAP, HAP	CAP, HAP	CAP, HAP
Kickapoo Tribe of Indians of the Kickapoo Reservation in Kansas	CAP	CAP		
Kootenai Tribe of Idaho		CAP, HAP	CAP, HAP	CAP, HAP
Navajo Nation	CAP			
Nez Perce Tribe	CAP, HAP	CAP, HAP	CAP, HAP	CAP, HAP
Northern Cheyenne Tribe		CAP		
Prairie Band of Potawatomi Indians		CAP, HAP		
Sac and Fox Nation of Missouri in Kansas and Nebraska Reservation		CAP, HAP		CAP
Santee Sioux Nation, Nebraska		CAP, HAP		
Shoshone-Bannock Tribes of the Fort Hall Reservation of Idaho	CAP, HAP	CAP, HAP	CAP, HAP	CAP, HAP
Southern Ute Indian Tribe	CAP, HAP			
Tohono O'Odham Nation Reservation		CAP, HAP		
Washoe Tribe of California and Nevada		CAP, HAP		

*onroad and nonroad tribal emissions are not part of the 2011 NEI sector/tier data. They are available from the Onroad and Nonroad Mobile Tribal Lands Emissions Summaries posted with the 2011 NEI Data or from summaries of the Tribal datasets in the EIS.

Table 2-6: Facilities on Tribal lands with 2011 NEI emissions from EPA only

Tribe	EPA data used
Assiniboine and Sioux Tribes of the Fort Peck Indian Reservation, Montana	Airport Emissions
Confederated Tribes and Bands of the Yakama Nation, Washington	TRI data
Fond du Lac Band of the Minnesota Chippewa Tribe	Airport Emissions
Omaha Tribe of Nebraska	Airport Emissions
Tohono O'Odham Nation of Arizona	TRI data
Ute Mountain Tribe of the Ute Mountain Reservation, Colorado, New Mexico & Utah	Airport Emissions, TRI data and EGU Emissions

2.6 What does this NEI tell us about mercury?

This documentation includes this Hg section because of the importance of this pollutant and because the sectors used to categorize Hg are different than the sectors presented for the other pollutants. The Hg sectors primarily focus on regulatory categories and categories of interest to the international community; emissions are summarized by these categories at the end of this section, in Table 2-8.

Hg emission estimates in the 2011 v2 sum to 56.4 tons, with 55.1 tons from stationary sources (not including commercial marine vessels and locomotives) and 1.3 tons from mobile sources (including commercial marine vessels and locomotives). Of the stationary source emissions, the inventory shows that 26.9 tons come from coal, petroleum coke or oil-fired EGUs with units larger than 25 megawatts (MW), with coal-fired units making up the vast majority (26.8 tons) of that total.

For the 2011 v2, EPA revised and added new estimates from several nonpoint categories. Categories that had not been previously estimated are:

- switches and relays – emissions from the shredding and crushing of cars containing Hg components at auto crushing yards, SCC = 2650000002: Waste Disposal, Treatment, and Recovery; Scrap and Waste Materials; Scrap and Waste Materials; Shredding (2.1 tons)
- landfill “working face” emissions associated with the release of mercury via churning/crushing of new material added to the landfill, SCC= 2620030001: Waste Disposal, Treatment, and Recovery; Landfills; Municipal; Dumping/Crushing/Spreading of New Materials (working face) (0.4 tons)
- thermometers and thermostats – the portion that emit mercury prior to disposal at landfills or incinerators, SCC=2650000000: Waste Disposal, Treatment, and Recovery; Scrap and Waste Materials; Scrap and Waste Materials; Total: All Processes (0.1 tons)

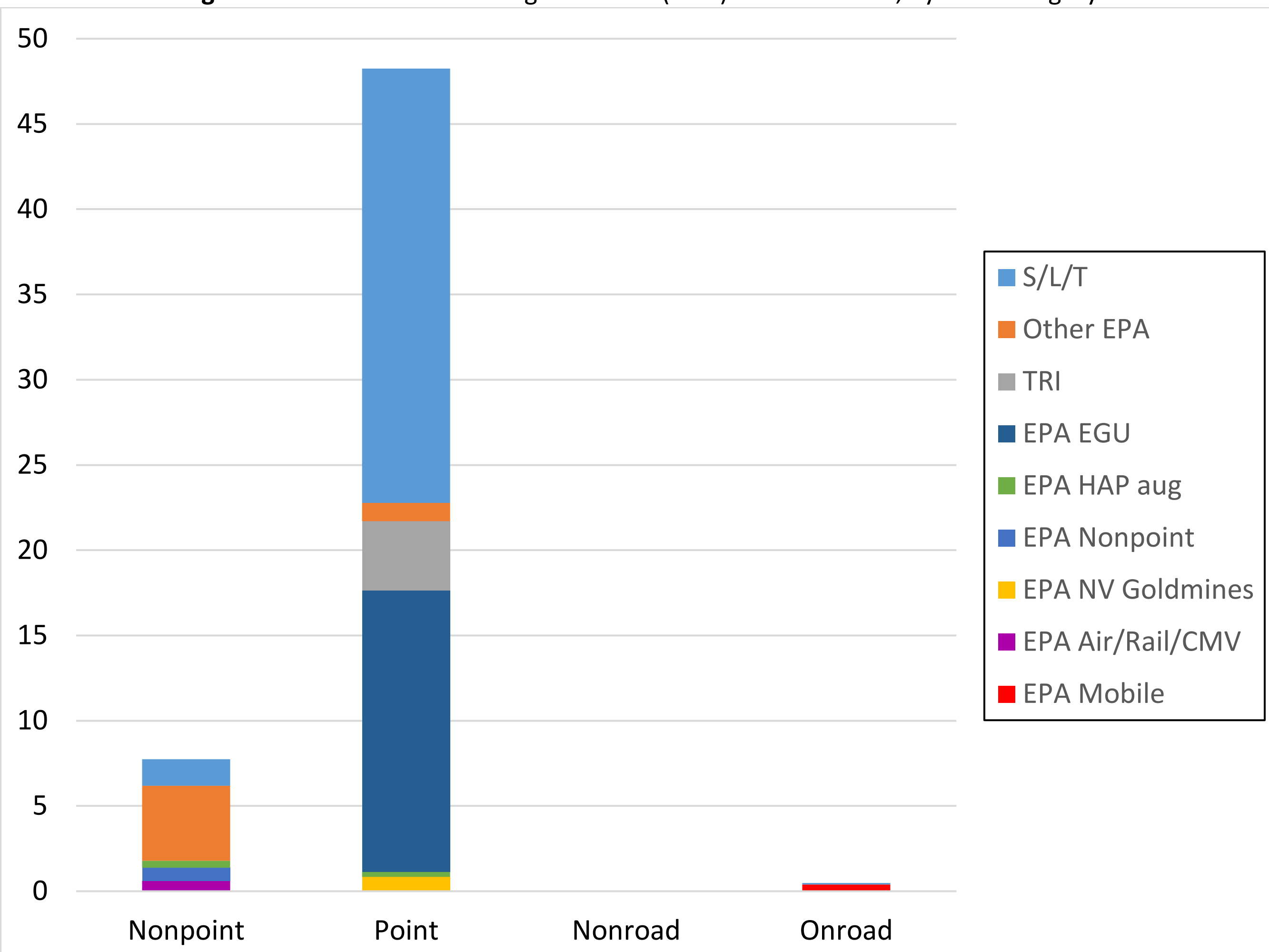
Categories with method changes are: human cremation (1.4 tons in 2011 which is the sum of the updated EPA nonpoint with S/L/T agency reported nonpoint and point); animal cremation (less than 0.1 tons which is the sum of the updated EPA nonpoint with S/L/T agency reported nonpoint and point); fluorescent lamp breakage (less than 1 lb.; sum of EPA and S/L/T agency nonpoint); fluorescent lamp recycling (0.4 tons; sum of EPA and S/L/T agency nonpoint); and dental amalgam (0.4 tons sum of EPA and S/L/T agency nonpoint).

None of these categories are distinct regulatory sectors and are therefore put into the “Other” category in Table 2-8. Previous-year emissions were not revised to include these new emissions or method changes. Detailed documentation on the methods is provided in a memorandum “Nonpoint Sources of Mercury - documentation 6-26-2014.docx” provided in the supplemental documentation.

The data sources used to create the 2011 v2 Hg inventory are shown in Figure 2-13. The datasets are described in more detail starting in Section 3.1.1, and we highlight some key datasets here.

For EGUs, we used unit specific and "bin"-average emission factors collected from a test program conducted primarily in 2010 to support the MATS rule[8], and used 2011-specific activity from the Clean Air Markets Division Data and the Department of Energy. The MATS-based Hg data are labeled "EPA EGU" in the figure; all the mercury emissions from the EPA EGU dataset use MATS-based data. Also, for EGUs, 33% of the Hg data are from S/L/T agency data instead of the MATS-based data. These data were used for units where S/L/T agency reported the calculation method to be based either on continuous emissions monitors (CEMs) or test data. In addition, S/L/T agency data were used for 65% of the other stationary source emissions and is represented by "S/L/T" in the figure. We used several other datasets developed by EPA including TRI (see Section 3.1.4), EPA HAP Augmentation or "HAP Aug" in the figure (see Section 3.1.5), and other EPA data developed for gap filling (see Section 3.1.1).

Figure 2-13: Data sources of Hg emissions (tons) in the 2011 v2, by data category



[8] See "Memorandum: Emissions Overview: Hazardous Air Pollutants in Support of the Final Mercury and Air Toxics Standard" EPA-454/R-11-014, 12/1/2011, or at Docket number EPA-HQ-OAR-2009-0234

In addition to Figure 2-13, Table 2-7 breaks out the emissions data sources further into the amounts of Hg from each individual dataset used in the selection. More information on these datasets is available in Sections 3.1.1 for stationary sources, and Section 4 for mobile sources.

Since mercury is a HAP, it is reported voluntarily by S/L/T agencies. For the 2011 v2, 42 states reported point source Hg emissions; Figure 2-14 identifies the states that included state or local data. No tribal agencies reported point source Hg. Six tribal agencies reported Hg to the nonpoint data category: Coeur d'Alene Tribe of the Coeur d'Alene Reservation, Idaho; Eastern Band of Cherokee Indians; Kootenai Tribe of Idaho; Shoshone-Bannock Tribes of the Fort Hall Reservation of Idaho; Nez Perce Tribe of Idaho, and Sac & Fox Nation of Missouri in Kansas and Nebraska.

Table 2-7 shows that a large portion of mercury in the point data category is from the 2011EPA_EGU dataset. This is due to the selection hierarchy. EPA chose to use HAP emissions computed using from EFs developed from Mercury and Air Toxics Standards (MATS) test program used ahead of S/L/T agency data except where the S/L/T agency data were from a source test or a continuous emissions monitor (CEMS). EPA used the emissions calculation method code (a required field) to determine where S/L/T agency data were from a source test or CEMS.

Table 2-7: 2011 v2 Hg emissions for each dataset type and group

Data Category	Dataset short name	Mercury Emissions (tons/yr)	Grouped Data Source for Chart
Nonpoint	2011EPA_NP_Mercury	4.40	EPA other
	S/L/T	1.54	S/L/T
	2011EPA_NP_NoOvrlp	0.71	EPA Nonpoint
	2011EPA_Rail	0.58	EPA Air/Rail/CMV
	2011EPA_HAP-Aug	0.41	EPA other
	2011EPA_NP_Ovrlp	0.06	EPA Nonpoint
	2011EPA_CMV	0.04	EPA Air/Rail/CMV
	2011EPA_CMVLADCO	0.00	EPA Air/Rail/CMV
Point	S/L/T	25.5	S/L/T
	2011 EPA EGUs	16.5	EPA EGU
	2011EPA_TRI	4.07	TRI
	2011_NVGLD	0.80	EPA NV Goldmines
	2011EPA_CarryForward	0.72	EPA other
	2011EPA_Other	0.35	EPA other
	2011EPA_HAP-Aug	0.30	EPA other
	2011EPA_Rail	0.05	EPA Air/Rail/CMV
	2011 EPA Landfills	0.005	EPA other
Nonroad	S/L/T	0.03	S/L/T
	2011EPAMOBILE	0.01	EPA Nonroad
Onroad	2011EPAMOVES2014	0.40	EPA Onroad
	S/L/T	0.08	S/L/T

Figure 2-14: States with state- or local-provided Hg emissions in the point data category of the 2011 v2

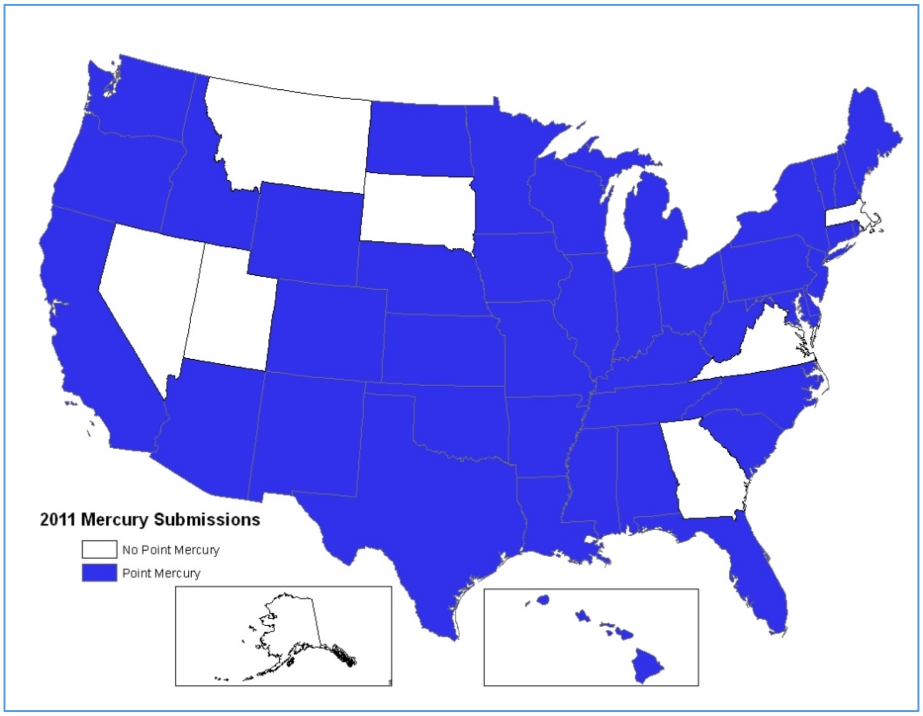


Table 2-8 shows the 2011 v2 mercury emissions for the key categories of interest in comparison to 1990. Also shown are the most recent 2005 emissions, which were used in support of the MATS rule. The Microsoft ® 2013 ACCESS ® database included in the zip file 2011nei_supdata_mercury.zip provides the category assignments at the facility-process level for point sources, and the county-SCC level for nonpoint, onroad and nonroad data categories.

Table 2-8: Trends in NEI mercury emissions – 1990, 2005, 2008 v3 and 2011 v2

Source Category	1990 (tpy) Baseline for HAPs, 11/14/2005	2005(tpy) MATS proposal 3/15/2011	2008 (tpy) 2008 v3	2011 (tpy) 2011 v2	Categorization Approach
Utility Coal Boilers (Electricity Generation Units – EGUs, combusting coal)	58.8	52.2	29.4	26.8	Regulatory code, NESHAP: MATS rule and unit specific info on boiler config (from MATS rule) to assign fuel, SCC for units not in MATS database
Hospital/Medical/ Infectious Waste Incineration	51	0.2	0.1	0.1	Regulatory code: Hospital, Medical, Infectious Waste Incineration (HMIWI)
Municipal Waste Combustors	57.2	2.3	1.3	1.0	Regulatory codes: Section 129 rules for Small Municipal Waste Combustors (MWC) and Large MWC
Industrial, Commercial Institutional Boilers and Process Heaters	14.4	6.4	4.2	3.6	SCC list- chose only processes with these SCCs that were not already tagged with rule or via manual approach
Mercury Cell Chlor-Alkali Plants	10	3.1	1.3	0.5	Regulatory code: NESHAP, Mercury Cell Chlor-Alkali Plants.

Source Category	1990 (tpy) Baseline for HAPs, 11/14/2005	2005(tpy) MATS proposal 3/15/2011	2008 (tpy) 2008 v3	2011 (tpy) 2011 v2	Categorization Approach
Electric Arc Furnaces	7.5	7.0	4.8	5.4	Regulatory code: Area Source rule for "Stainless & Non-Stainless-Steel Manufacturing: Electric Arc Furnaces" plus 2 major sources that have EAFs
Commercial/Industrial Sold Waste Incineration	Not available	1.1	0.02	0.01	Source Classification Code (50200101) and Manually assigned based on how it was categorized in previous inventories
Hazardous Waste Incineration	6.6	3.2	1.3	0.7	Combination of regulatory code, NESHAP: Hazardous Waste Incineration, and manual examination based on examination of unit/process description and how it was categorized in 2008.
Portland Cement Non-Hazardous Waste	5.0	7.5	4.2	2.9	Regulatory code: NESHAP, Portland Cement Manufacturing
Gold Mining	4.4	2.5	1.7	0.8	Regulatory code: NESHAP, Gold Mine Ore Processing and Production
Sewage Sludge Incineration	2	0.3	0.3	0.3	Source Classification Code: 50100506, 50100515, 50100516, 50382501, 50100701, 50100793
Mobile Sources	Not available	1.2	1.8	1.3	Sum of all onroad, nonroad, locomotives and commercial marine vessels (locomotives and marine used SCC code)
Other Categories	29.5	18	10.7	13	
Total (all categories)	**246**	**105**	**61**	**56**	

The top emitting 2011 Mercury categories are: EGUs (rank 1), electric arc furnaces (rank 2), industrial, commercial and institutional boilers and process heaters (rank 3) and Portland cement excluding hazardous waste kilns (rank 4).

As shown in Table 2-8, 2011 mercury emissions are 5 tons lower than in the 2008. Almost three tons of this difference is due to lower mercury emissions from EGUs covered by MATS; three other categories with large decreases are Portland Cement Manufacturing, Gold Mining and Chlor-Alkali plants. The lower emissions in 2011 are due to a combination of voluntary agreements, state rules, consent decrees, activity levels (e.g., lower cement production in 2011) and reductions that occurred from facilities prior to MACT compliance dates. For EGUs, the decrease is due primarily to the installation of Hg controls to comply with state rules and voluntary reductions, and the co-benefits of Hg reductions from control devices installed for the reduction of SO_2 and PM as a result of state and federal actions, such as New Source Review enforcement actions. There has also been an increased use of natural gas resulting in lower coal usage. The lower Hg is consistent with a 33% decrease in SO_2.

The cement decrease is due primarily to reductions at existing cement plants, including a voluntary agreement to install controls by the highest emitting cement plant in 2008, and several plant closures that occurred between 2008 and 2011. For gold mines, reductions occurred initially due to a voluntary program developed by EPA Region 9 and Nevada, and then further reductions were achieved through a Nevada state regulatory program. In the mercury chlor-alkali industry, facilities have been switching technologies to eliminate Hg emissions from chlorine production. Many switched prior to 2008 and several switched after. In 2011, there were four facilities using the Hg chlor-alkali process: Olin Corporation in Tennessee and Georgia and PPG in Louisiana and West Virginia.

For electric arc furnaces (EAFs), emissions increased from 2008 by about a half a ton. The largest increase for this category occurs in Alabama which relied heavily on EPA estimates for 2008 and solely on estimates from the state and local agency (Jefferson County Health Department) in 2011. Increases occur at existing facilities in this state. Ohio also shows large increases in emissions, again from existing facilities. However, the data from Ohio (for both 2008 and 2011) is predominantly from the TRI. For situations where neither the state nor TRI provided Hg, EPA estimated Hg using 2011 activity data provided by the state with emission factors from a test program conducted in support of rule development for the EAF industry. These were included in the "2011EPA_Other" dataset in the EIS. The EFs are provided in the file electric_arc_furnace_testabased_efs.zip; they are the same EFs as were used for gap filling for the 2008 NEI.

For other categories, the difference in emissions from 2008 to 2011 is similarly due to a combination of methodological differences in the approaches used to develop the two inventories, in addition to changes in activity between, and reductions implemented by states ahead of Federal regulations and other factors. For the non-EGU categories, the 2011 NEI primarily uses data submitted by S/L/T agencies. Where S/L/T agency data are missing EPA supplemented the information using the TRI for the year 2011 and, as discussed in Section 3.1, other datasets developed by EPA, particularly those for "working face" landfill emissions as well as switches and relays.

The municipal waste combustor and boiler MACT data gathered by EPA for rule development and used for the 2008 NEI were used in 2011 without adjustment for situations in which S/L/T agency or TRI data were not available. These data were put into the EIS dataset "2011EPA_CarryForward".

3 Stationary sources

This section begins with an overview of the stationary sources comprising most of the point and nonpoint data categories in Section 3.1. All subsequent sub-sections detail specific stationary EIS sectors, from agricultural, industrial, commercial, residential fuel combustion and solvents to dust, industrial processes, miscellaneous sources, and waste disposal.

Note that while some “nonroad” sources such as aircraft, commercial marine vessels and trains reside in the NEI point and nonpoint data categories, discussion of these sources is provided in the mobile source Section (4) of this document.

3.1 Stationary source approaches

Stationary source emissions data are inventoried as point sources or nonpoint sources. These data are provided by S/L/T agencies, and for certain sectors and/or pollutants, they are supplemented with data from EPA. This section describes the various sources of data and the priority for each of the datasets for choosing the data value to use for the NEI when multiple data sources are available for the same emissions source.

3.1.1 Sources of data overview and selection hierarchies

Table 3-1 and Table 3-2 describe the datasets comprising the point and nonpoint inventories, respectively, and the hierarchy for combining these datasets in construction of the NEI. While the bulk of these datasets are for stationary sources of emissions, some of these datasets contain mobile sources so that emissions from airports and rail yards could be included as point sources.

EPA developed all datasets other than those containing S/L/T agency data and the dataset containing emissions from offshore platforms in Federal waters -2011 Bureau of Ocean Energy Management (BOEM) data. We used various methods and databases to compile the EPA generated datasets, which the tables and subsequent subsections fully describe. The primary purpose of the EPA datasets is to add or “gap fill” pollutants or sources not provided by S/L/T agencies, to resolve inconsistencies in S/L/T agency-reported pollutant submissions for PM (Section 3.1.2) and to speciate S/L/T agency reported total chromium into hexavalent and trivalent forms (Section 3.1.3).

The hierarchy or “order” provided in the tables below defines which data are to be used for situations where multiple datasets provide emissions for the same pollutant and emissions process. The dataset with the lowest order on the list is preferentially used over other datasets. In addition to the order of the datasets, the hierarchy was also influenced by the new EIS feature of data tagging. Any data that were tagged by EPA in any of the datasets were not used. S/L/T agency data were tagged for two reasons: 1) if they were deemed to be likely outliers and were not addressed during the S/L/T agency data reviews, 2) to set the hierarchy to use the Mercury and Air Toxics Standard (MATS) data ahead of the S/L/T agency data where the S/L/T agency data were not from either source test or continuous emission monitoring sources. The MATS data covered acid gases (except HCN which was deemed unreliable and tagged from the EPA dataset), metal HAPs (including lead), and PM. MATS PM data were used only for units in which both PM2.5-FIL and PM-CON were tested during the MATS test program. The tables include the rationale for why each dataset was assigned its position in the hierarchy.

We excluded pollutants from stationary sources in the 2011 NEI as shown in the last row of both tables: we excluded greenhouse gases and pollutants in the pollutant groups “dioxins/furans” and “radionuclides”[9].

Table 3-1: Data sources and selection hierarchy used for point sources

Dataset name (Short name$^{\lambda}$ provided if different)	Description and Rationale for the Order of the Selected Datasets	Order
2011EPA_PM-Augmentation (2011EPA_PM-AUG)	PM species added to gap fill missing S/L/T agency data or make corrections where S/L/T agency have inconsistent PM species’ emissions. Uses speciation factors from the PM Calculator for covered SCCs. For others, checks/corrects discrepancies or missing PM species using basic relationships such as ensuring that primary PM is greater than or equal filterable PM (See Section 3.1.2). This dataset is ahead of the S/L/T agency data because in addition to filling in missing data, it also corrects S/L/T agency values based on feedback from the agencies.	1
2011 Responsible Agency Selection	S/L/T agency submitted data; multiple datasets – one for each reporting agency. These data are selected ahead of other datasets except the 2011EPA_PM-Augmentation (above). The only other situation where S/L/T agency emissions are not used is where tagged in the EIS (at the specific source/pollutant level). This occurs: 1) for hierarchy purposes to allow the Mercury and Air Toxics Standard (MATS) to be used ahead of S/L/T agency data except where S/L/T agency data were from source test or continuous emission monitors and 2) where S/L/T agency data were suspected outliers that were not addressed.	2
2011EPA_EGU	HAP and CAP emissions from 3 sources: 1. MATS EFs and 2011 throughput—for lead, mercury, other HAP metals, acid gas HAP and PM emissions from the MATS rule information collection request, including unit-specific test data and emissions data derived from EFs from a 2010 testing program and 2011 throughput. PM used only where PM25-FIL and PM-CON were tested. Throughput primarily from CAMD but also used EIA and data provided by Puerto Rico for EGUs 2. CAMD CEMs data for SO_2 and NO_X 3. EFs used in previous year inventories from AP-42 and other sources along with CAMD heat input data.	3
2011EPA_ chrom_split	Hexavalent and trivalent chromium speciated from S/L/T agency reported chromium. New EIS augmentation function creates the dataset by applying multiplication factors by SCC, facility, process or North American Industry Classification System (NAICS) code to S/L/T agency chromium. See Section 3.1.3.	4
EPA NV Gold Mines (2011_NVGLD)	2011 Mercury emissions from the Nevada Mercury Control Program - Annual Emissions Reporting – early copy of the data emailed by Adele Malone, Nevada Division of Environmental Protection, 11/05/2012	5

[9] Dioxins/furans include all pollutants with pollutant category name of: Dioxins/Furans as 2,3,7,8-TCDD TEQs, or Dioxins/Furans as 2,3,7,8-TCDD TEQs – WHO2005, both of which were valid pollutant groups for reporting 2011 emissions. Radionuclides have the pollutant category name of “radionuclides” The specific compounds and codes are in the pollutant code tables in EIS.

Dataset name (Short name[λ] provided if different)	Description and Rationale for the Order of the Selected Datasets	Order
2011EPA_Other	Variety of EPA gap fill data including: coke oven emissions using state – provided information for facilities in Kentucky, Michigan and Pennsylvania; electric arc furnace mercury emissions using activity reported to the EIS by states and EFs from the ICR test program or S/L/T agency provided information, emissions for several New Mexico facilities that were provided by NM after the submission deadline (EPA used the CAP data only), mercury emissions for Iowa sources that were below Iowa thresholds and were reported by Iowa as zero, mercury emissions for a boiler in Missouri using state-provided data.	6
2011EPA_TRI	Toxics Release Inventory data for the year 2011 (see Section 3.1.4). These data are selected for a facility only when alternative emissions are not included in the S/L/T agency data.	7
2011EPA_Airports	Emissions of CAP and HAP for aircraft operations including commercial, general aviation, air taxis and military aircraft, auxiliary power units and ground support equipment computed by EPA for approximately 20,000 airports. Methods include the use of the Federal Aviation Administration's Emissions and Dispersion Modeling System. See Section 4.2. EPA airport data are selected for a county only if S/L/T agency data are not contained in the first dataset, with the exception of possible airport-related PM data.	8
2011EPA_Rail	Emissions of CAP and HAP for diesel rail yard locomotives at 753 rail yards. CAP emissions computed using yard-specific emission factors using yard-specific fleet information and on national fuel values allocated to rail yards using an approximation of line haul activity within the yard. HAP emissions computed using HAP-to-CAP emission ratios. See Section 4.4. EPA Rail data are selected for a county only if S/L/T agency data are not. This dataset also contains county-level emissions used in the nonpoint selection (Table 3-2).	9
2011EPA_LF (2011 EPA Landfills)	Landfill emissions developed by EPA using methane data from the EPA's Greenhouse Gas reporting rule program. Dataset contains landfills only for which no pollutants were reported by S/L/T agency in the 2011 reporting year.	10
2011EPA_ Carry Forward- Previous Year Data (2011EPA_ Carry Forward)	Variety of estimates used to gap fill important sources/pollutants: 1) coke oven missing from S/L/T agency data and not in the EPA Other dataset. 2) Mercury from MWCs and boilers (in 2008 it was in the dataset called "2008 EPA Rule Data from OAQPS/SPPD" 3) Numerous HAPs from an MWC in California.	11
2011EPA_HAP-Augmentation (2011EPA_HAP-Aug)	HAP data computed from S/L/T agency criteria pollutant data using HAP/CAP emission factor ratios based on the EPA Factor Information Retrieval System (WebFIRE) database as described in Section 3.1.5. These data are selected below the TRI data and 2011EPA_CarryForward-PreviousYearData because the TRI data are expected to be better. These data are selected for a facility only when not included in the S/L/T agency data.	12
2011EPA_BOEM	CAP Emissions from Offshore oil platforms located in Federal Waters in the Gulf of Mexico developed by the U.S. Department of the Interior, Bureau of Ocean and Energy Management, Regulation, and Enforcement in the National Inventory Input Format and converted to the CERS format by EPA. The state code for data from this data set is "DM" (Federal Waters).	13

Dataset name (Short name[λ] provided if different)	Description and Rationale for the Order of the Selected Datasets	Order
Exceptions to the hierarchy 1. Excluded dioxin/furan individual pollutants and groups, greenhouse gas pollutants, and radionuclides. USEPA has not evaluated the completeness or accuracy of the S/L/T agency dioxin and furan values nor radionuclides and does not have plans to supplement these reported emissions with other data sources in order to compile a complete estimate for dioxin and furans nor radionuclides as part of the NEI.		

[λ] The dataset short name is the name that the EIS will list in its process-level reports

Table 3-2: Data sources and selection hierarchy used for nonpoint sources

Dataset name (Short Name[λ] provided if different)	Description and Rationale for the Order of the Selected Datasets	Order
2011EPA_PM-Augmentation (2011EPA_PM-AUG)	Adds PM species to fill in missing S/L/T agency data or make corrections where S/L/T agency data have inconsistent emissions across PM species. Uses the PM calculator for processes covered by that database. For other processes, checks/corrects discrepancies or missing PM species using basic relationships such as ensuring that PMXX FIL is less than or equal PMXX PRI (See Section 3.1.2).	1
2011EPA_ AgBurningSF2	Agricultural fire emission estimates developed by EPA. See Section 5.2.	2
2011 Responsible Agency Selection	S/L/T agency submitted data; multiple datasets – one for each reporting agency. These data are selected ahead of other datasets. The only other situation where S/L/T agency emissions are not used is where tagged in the EIS (at the specific source/pollutant level). This occurs: 1) for hierarchy purposes to allow EPA nonpoint emissions to be used ahead of S/L/T agency data where states asked for EPA data to be used in place of their data and 2) where S/L/T agency data were suspected outliers.	3
2011EPA_chrom_ split	Hexavalent and trivalent chromium speciated from S/L/T agency reported chromium. New EIS augmentation function creates the dataset by applying multiplication factors by SCC, facility, process or NAICS code to S/L/T agency chromium. See Section 3.1.3.	4
2011EPA_HAP-Augmentation (2011EPA_HAP-Aug)	HAP data computed from S/L/T agency criteria pollutant data using HAP/CAP emission factor ratios based on ratios of HAP to CAP emission factors used in the EPA estimates. This dataset is below the S/L/T agency data so that the S/L/T agency HAP data are used first.	5
2011EPA_CMVLADCO	Submitted by the Lake Michigan Air Directors Consortium (LADCO) for state's that approved. See Section 4.3	6
2011EPA_CMV	EPA commercial marine vessel emissions estimates. See Section 4.3.	7
2011EPA_Rail	EPA locomotive (referred to as "rail" in this document) emissions estimates. See Section 4.4.	8
2011EPA_NP_ NoOverlap_w_Pt (2011EPA_NP_ NoOvrlp)	Contains data for categories primarily for which there was no or limited possibility of point source contribution (or overlap). Examples include: residential fuel combustion, consumer solvent utilization, open burning, agricultural burning, dust, petroleum product transport. The data does include some where there may be some overlap, such as some solvent utilization categories. Also includes Hg data used in the 2002 NEI for the following categories: fluorescent light breakage, fluorescent light recycling,	9

Dataset name (Short Name[λ] provided if different)	Description and Rationale for the Order of the Selected Datasets	Order
	laboratory activities, and dental amalgam. These 2002 NEI data were not estimated for 2008 or 2011 but are categories that were largely unavailable from the S/L/T agency data (though some states did report cremation and where this occurred it was excluded from this dataset).	
2011EPA_NP_ Overlap_w_Pt (2011EPA_NP_Ovrlp)	Contains data for categories for which there was the possibility of point source contribution (or overlap). These categories include industrial, commercial and institutional emissions that are often accounted for in the point source inventory and oil and gas emissions. EPA added these emissions to the NEI only after analyses to determine if the S/L/T agency had accounted for them in the point data category. EPA did not adjust nonpoint data with the point data. See Section 3.1.7.	10
2011EPA_biogenics	Natural emissions from vegetation and soil, computed using 2011 meteorology and the BEIS3.14 model. See Section 6. The order does not matter because it does not overlap with any other data used in this selection.	11
2011EPA_NP_Mercury	Mercury only data for select source categories within the waste disposal (see Section 3.32) and Miscellaneous Non-Industrial NEC (see Section 3.26) sectors.	12
Exceptions to the hierarchy 1. Excluded dioxin/furan individual pollutants and groups, greenhouse gas pollutants, and radionuclides. The EPA has not evaluated the completeness or accuracy of the S/L/T agency dioxin and furan values nor radionuclides and does not have plans to supplement these reported emissions with other data sources in order to compile a complete estimate for dioxin and furans nor radionuclides as part of the NEI.		

3.1.2 Particulate matter augmentation

Particulate matter (PM) emissions species in the NEI are: primary PM_{10} (called PM10-PRI in the EIS and NEI) and primary $PM_{2.5}$ (PM25-PRI), filterable PM (PM10-FIL and PM25-FIL) and condensable PM (PM-CON). EPA needed to augment the S/L/T agency PM components to ensure completeness of the PM components in the final NEI and to ensure that S/L/T agency data did not contain inconsistencies. An example of an inconsistency is if the S/L/T agency submitted a primary $PM_{2.5}$ value that was greater than a primary PM_{10} value for the same process. Commonly, the augmentation added condensable PM or PM filterable (PM10-FIL and/or PM25-FIL) where none was provided, or primary $PM_{2.5}$ where only primary PM_{10} was provided. Additional information on the procedure is provided in the 2008 NEI PM augmentation documentation [ref 1].

In general, emissions for PM species missing from S/L/T agency inventories were calculated by applying factors to the PM emissions data supplied by the S/L/T agencies. These conversion factors were first used in the 1999 NEI's "PM Calculator" as described in an NEI conference paper [ref 2]. The resulting methodology allows EPA to derive missing PM10-FIL or PM25-FIL emissions from incomplete S/L/T agency submissions based on the SCC and PM controls that describe the emissions process. In cases where condensable emissions are not reported, conversion factors developed are applied to S/L/T agency reported PM species or species derived from the PM Calculator databases. The PM Calculator is a Microsoft ® Access ® database, available under the "Emission Inventory Tools" heading.

3.1.3 Chromium augmentation

The 2011 reporting cycle has 5 valid pollutant codes for chromium, as shown in Table 3-3.

Table 3-3: Valid chromium pollutant codes

Pollutant Code	Description	Pollutant Category Name	Speciated?
1333820	Chromium Trioxide	Chromium Compounds	yes
16065831	Chromium III	Chromium Compounds	yes
18540299	Chromium (VI)	Chromium Compounds	yes
7440473	Chromium	Chromium Compounds	no
7738945	Chromic Acid (VI)	Chromium Compounds	yes

In the above table, all pollutants but "chromium" are considered speciated; and so, for clarity, chromium is referred to as "total chromium" in the remainder of this section. Total chromium could contain a mixture of chromium with different valence states. Since one key inventory use is for risk assessment, and since the valence states of chromium have very different risks, speciated chromium pollutants are the most useful pollutants for the NEI and why we have performed this augmentation. Hexavalent chromium (Chromium (VI)) is considered high risk and other valence states are not. Most of the non-hexavalent chromium is trivalent chromium ((Chromium III)); therefore, EPA speciated total chromium into hexavalent and trivalent chromium. The 2011 NEI does not contain any total chromium; only the speciated pollutants shown in Table 3-3.

This section describes the procedure we used for speciating chromium emissions from total chromium that was reported by S/L/T agencies. This procedure generated trivalent chromium (Chromium III) and hexavalent chromium (Chromium (VI)), and it had no impact on S/L/T agency data that were provided as one of the speciated forms of chromium. The sum of the EPA-computed species (hexavalent and trivalent chromium) equals the mass of the total chromium (i.e., pollutant 7440473) submitted by the S/L/T agencies.

We used the new EIS augmentation feature to speciate S/L/T agency reported chromium. The EIS uses the following priority order for applying the factors: 1) by specific process using the EIS process id, 2) by specific facility using the EIS facility id, 3) by regulatory code, 4) by NAICS code, and 5) by SCC. The EIS generates and stores an EPA dataset containing the resultant hexavalent and trivalent chromium species. EPA then used this dataset in the 2011 NEI selection by adding it to the selection hierarchies shown in Table 3-1 and Table 3-2 and excludes the S/L/T agency unspeciated chromium from the selection through a pollutant exception to the hierarchy. This EIS feature does not speciate chromium from any of the EPA datasets because the EPA data contains only speciated chromium.

For the 2011 NEI, EPA named this dataset "2011EPA_chrom_split". Most of the speciation factors used in the 2011 NEI are SCC-based and are the same as were used in 2008, based on data that have long been used by EPA for NATA and other risk projects. However, some of the values were updated based on data used or developed by OAQPS during rule development. The speciation factors are accessed in the EIS through the reference data link "Augmentation Priority Order". The "Priority Data" table provides the factors used for point sources, and the "Priority Data Area" provides the factors used for data in the nonpoint/onroad/nonroad categories. For access by non-EIS users, the factors are included in the zip file 2011nei_supdata_chromspeciation.zip. If a particular emission source of total chromium is not covered by the speciation factors specified by any of these attributes, a default value of 34% hexavalent chromium, 66% trivalent chromium is applied.

3.1.4 Use of the 2011 Toxics Release Inventory

EPA used air emissions data from the 2011 Toxic Release Inventory (TRI) to supplement point source HAP and NH_3 emissions provided to EPA by S/L/T agencies. The resulting augmentation dataset is labeled as "2011EPA_TRI" in the Table 3-1 selection hierarchy shown above. For 2011, all TRI emissions values that could reasonably be matched to an EIS facility were loaded into the EIS for viewing and comparison if desired, but only those pollutants that were not reported anywhere at the EIS facility by the S/L/T agency were considered for inclusion in the 2011 NEI.

The basis of the 2011EPA_TRI dataset is the US EPA's 2011 Toxic Release Inventory. TRI is an EPA database containing data on disposal or other releases including air emissions of over 650 toxic chemicals from approximately 21,000 facilities. One of TRI's primary purposes is to inform communities about toxic chemical releases to the environment. Data are submitted annually by U.S. facilities that meet TRI reporting criteria. The TRI database used for this project was named TRI_2011_US.csv and was downloaded on December 1, 2012.

The approach used for the 2011 NEI differed from that used for the 2008 NEI in that the TRI emissions were not apportioned to the same EIS processes that S/L/T agencies used to report their PM and VOC emissions. Instead, the TRI emissions were included in the EIS (and the NEI) as facility-total stack and facility-total fugitive emissions processes, which reflected the aggregation detail of the TRI database. Double-counting of TRI and other data sources was prevented by tagging (and not using) any TRI pollutant emissions for a facility where the S/L/T agency or a higher priority (as per Table 3-1) EPA dataset also had a pollutant emissions value for any unit and process within that facility.

This new approach has several benefits. It does not rely on the need for any PM or VOC surrogate emissions to have been reported by the S/L/T agency in order to apportion the TRI values among multiple processes. It also allows most of the TRI emissions to be viewable, comparable, and downloadable from the EIS with the same detail as was reported to TRI by the facility. In addition to allowing the use of more of the TRI data, especially for smaller emitting facilities that may not have PM or VOC emissions reported by S/L/T agencies, this approach allows the TRI data to be loaded into the EIS earlier in the reporting cycle, and there are no process allocations that need to be re-done when S/L/T agency emissions updates are made.

A key potential disadvantage to this approach was having to choose a useful SCC for the emissions process, which in the past NEI cycles prior to 2008 led to a "miscellaneous" SCC for all TRI data. The 2008 approach of apportioning the emissions based on S/L/T agency data allowed for TRI emissions to be associated with more appropriate SCCs (though limitations applied there as well). To minimize this disadvantage, we implemented an approach to assign more appropriate SCCs that allow the emissions to at least be lumped into the proper EIS Sector.

The following steps describe in more detail the development of the 2011EPA_TRI dataset.

1. **Develop a TRI_ID to EIS_ID facility-level crosswalk**
   The TRI emissions database contains the data element TRI Facility ID (TRI_ID) which is used to uniquely identify a facility site. The NEI uses the field "EIS Facility Identifier" (EIS_ID) to uniquely identify facilities. The USEPA's Office of Environmental Information (OEI) maintains the Facility Registry System (FRS) data system as a way to crosswalk such unique identifiers between various EPA programs and data systems. This FRS linkage had been used as a starting point to develop the needed TRI_ID to EIS_ID crosswalk for the 2008 NEI. The 2008 effort supplemented the FRS linkage by performing various QA reviews and comparisons.

For 2011, the facility crosswalk used for the 2008 NEI was combined with all TRI IDs that had been migrated from the 2002 and 2005 NEIs into the EIS as legacy data. This combined file was reviewed to resolve all occurrences of multiple TRI_IDs being matched to a single EIS_ID and multiple EIS_IDs being matched to a single TRI_ID. The resolved set of EIS_IDs was then attached to the complete set of 20,927 TRI_IDs in the 2011 TRI dataset. A comparison of the TRI to EIS facility information (latitude, longitude, street address, facility name, city, county, and state) was made and all significant differences were resolved. This resulted in many previous matches being removed and in the correction of some latitudes and longitudes in the EIS. Many TRI latitudes and longitudes were also found to be in error compared to the indicated addresses. TRI facilities with no corresponding EIS_ID and with over 10,000 pounds total TRI air emissions of all pollutants, or over 200 pounds of lead, chromium, manganese, mercury, or cadmium had a search performed for an EIS facility. Several dozen additional matches were found in this last step.

The complete list of the TRI_ID to EIS_ID facility crosswalk, along with facility name and location information and emissions levels from both TRI and the EIS, was distributed to all S/L/T agencies for review and comment, with about a dozen corrections and additions being made to the list as a result. The final set of crosswalk IDs is stored in the EIS[10]. For any EIS facility with a valid TRI_ID crosswalk, the TRI_ID appears as an Alternate Facility ID for that EIS Facility and that Alternative Facility ID is locked and "active" (the End date field is null). Note that there are additional legacy TRI IDs still in the EIS as Alternative Facility IDs which have not been locked, or which may have the End Date field filled. Such TRI Alternative Facility IDs were not used for writing 2011 TRI emissions values into the EIS. A total of 11,637 TRI_IDs are currently in the EIS-stored crosswalk as valid and current as of November 25, 2013. Not all of these TRI facilities reported 2011 emissions. A total of 14,900 TRI facilities reported non-zero air emissions for 2011.

2. **Map TRI pollutant codes to valid EIS pollutant codes and sum where necessary**
   Table 3-4 provides the pollutant mapping from TRI pollutants to EIS pollutants. Many of the 650 TRI pollutants do not have any EIS counterpart, and so are not shown in Table 3-4. In addition, several EIS pollutants may be reported to TRI as either of two TRI pollutants. For example, both lead and lead compounds may be reported to TRI, and similarly for several other metal and metal compound TRI pollutants. Table 3-4 shows where such pairs of TRI pollutants both correspond to the same EIS pollutant. In such cases we summed the two TRI pollutants together as part of the step of assigning the TRI emissions to valid EIS pollutant codes. For the 2011 NEI, a total of 184 TRI pollutant codes were mapped to 172 unique EIS pollutant codes. For 2011 we did use TRI ammonia emissions and 11 additional HAP pollutants beyond what had been included from TRI in the 2008 NEI. The TRI pollutants added for the 2011 NEI are indicated by the right-most column in Table 3-4. Similar to the 2008 NEI, we did not use TRI emissions reported for TRI pollutants "Certain Glycol Ethers", "Dioxin and Dioxin-like Compounds", Dichlorobenzene (mixed isomers)", and "Toluene di-isocyanate (mixed isomers)" because they do not represent the same scope as the EIS pollutants "Glycol ethers", "Dioxins/Furans as 2,3,7,8-TCDD TEQs", "1,4-Dichlorobenzene" and "2,4-Di-isocyanate", respectively. We maintained TRI stack and fugitive emissions separately during the summation step and maintained that separation through the storage of the TRI emissions in the EIS.

[10] A file of the crosswalked IDs can be obtained from EIS by running a Facility Configuration Report, for Alternate Facility IDs, specifying a Program System Code of "EPATRI". From the resulting EIS report, remove all records which have a non-null End Date, and, also remove all records for which the Alternative Identifier Protected field indicates "no".

3. **Split TRI total chromium emissions into hexavalent and trivalent emissions**
The TRI allows facilities to report either "Chromium" or "Chromium compounds", but not the hexavalent or trivalent chromium species that are needed for the NEI (see section 3.1.3). Because the only characterization available for the TRI facilities or their emissions is the facilities' NAICS codes, we created a NAICS-based set of fractions to split the TRI-reported total chromium emissions into the hexavalent and trivalent chromium species. A table of Standard Industrial Classification (SIC)-based chromium split fractions was available from earlier year NEI usage of TRI databases, which had been compiled by SIC rather than NAICS. The earlier SIC-based fractions were used wherever they could be re-assigned to a closely matching NAICS description.

Unfortunately, not all SIC-based fractions could be assigned this way, so we computed NAICS-based split fractions for any NAICS codes in the 2011 TRI data that did not already have a SIC-to-NAICS assigned split fraction. These factors were used for the remaining TRI-reported chromium. To calculate the NAICS-based factors, we summed by NAICS the total amounts of chromium III and chromium VI for the entire US in the 2011 draft NEI data. These 2011 NEI S/L/T emissions were either reported directly by the S/L/T agencies as chromium III and chromium VI, or they had been split from S/L/T agency-reported total chromium by USEPA using the procedures described in section 3.1.3. Those procedures largely rely on either SCC-based or Regulatory code-based split factors. The derived NAICS split factors therefore represent a weighted average of the SCC and Regulatory code-based split factors, weighted according to the mass of each chromium valence in the 2011 draft NEI for that NAICS.

After all TRI facilities with chromium had been assigned a NAICS-based split factor, the factors were applied separately to both the TRI stack and fugitive total chromium emissions. This resulted in speciated chromium emissions for each facility's stack and fugitive emissions that were included in the EIS as part of the 2011EPA_TRI dataset.

4. **Review high TRI emissions values for and exclude any data suspected to be outliers**
A review and comparison of the largest TRI emissions values was done for several key high-risk pollutants. The following pollutants were specifically reviewed, although a few extremely large values for some of the other TRI pollutants were also noticed and treated in the same manner: mercury, lead, chromium, manganese, nickel, arsenic, 1,3 butadiene, benzene, toluene, ethyl benzene, p-xylene, methanol, acrolein, carbon tetrachloride, tetrachloroethylene, methylene chloride, acrylonitrile, 1,4-dichlorobenzene, ethylene oxide, hydrochloric acid, hydrogen fluoride, chlorine, 2,4-toluene diisocyanate, hexamethylene diisocyanate, and naphthalene. The review included looking at the largest 10 emitting facilities for each of the pollutants in the 2011 TRI dataset itself to identify large differences between facilities and unexpected industry types. Comparisons were then made to the 2008 TRI and the 2011 draft NEI emissions values from S/L/T agencies for any suspect facilities identified by that review. Lastly, as part of the S/L/T agency review of the TRI-to-EIS facility matching described in step 1 above, we also provided to the S/L/T agencies for review and comment the emissions comparisons and differences of the 2011 TRI, 2008 TRI, and their 2011 submittals for all facilities. The result was a small set of 2011 TRI emissions values which were too large to be considered reliable enough to be added to the 2011 NEI. These values were excluded from the 2011EPA_TRI dataset.

In addition to the high outlier values, two other classes of TRI emissions values were included in the 2011EPA_TRI dataset but were originally tagged to be unavailable for selection in the March 2013 draft NEI. The two classes were TRI emissions values that were less than 10 pounds, and TRI emissions values that appeared to be the result of the facility checking a “range box”, indicating that emissions were somewhere between 0 and 500 pounds or between 0 and 10 pounds, for example. The TRI dataset reports the “range box” reports as the mid-point of the range, i.e. “0-500” pounds would be recorded as 250 pounds in the dataset. It is thus possible that sources emitting 15 or 20 pounds of some pollutant may appear as a 250-pound source. Tagging the values of less than 10 pounds kept many 0-10 “range box” reports as well as many discretely reported small values (e.g. “2.9 pounds”) out of the March 2013 draft NEI. For the final 2011 v1 NEI selection, the EIS tags on these two classes of TRI emissions values were removed, allowing those TRI values to be used in the 2011 v1 wherever the S/L/T agency had not reported that pollutant for that facility. The 2011 v2 also retained these range box values as part of the NEI, although many of them were removed from the 2011 NATA modeling per State comments.

5. **Write the 2011 TRI emissions to EIS Process IDs with stack and fugitive release points**
   The total facility stack and total facility fugitive emissions values from the above steps were written to a set of EIS process IDs created to reflect those facility total type emissions. In most cases the EIS process IDs for a given facility already existed in EIS as a result of the 2002 and 2005 NEI inventories which were used to populate the original EIS data system. Those NEI years contained the TRI stack and fugitive totals as single processes. Where such legacy NEI process IDs did not exist in the EIS, they were created.

6. **Revise SCCs on the EIS Processes used for the TRI emissions**
   The 2002 and 2005 NEIs had assigned all the TRI emissions to a default process code SCC of 39999999, which caused a large amount of HAP emissions to be summed to a misleading “miscellaneous” sector. The 2008 NEI approach reduced this problem somewhat because it apportioned all TRI emissions to the multiple processes and SCCs that were used by the S/L/T agencies to report their emissions, but this apportioning created other distortions. The 2011 NEI reverts back to loading the TRI emissions as the single process stack and fugitive values as reported by facilities to the TRI, but we have revised the SCCs on those single processes to something other than the default 39999999 wherever possible. The purpose of this is to allow the TRI emissions to map to a more appropriate EIS sector.

   To assign an SCC, we first determined for each facility and release type (stack or fugitive) which EIS Sector had the largest amount of S/L/T agency-reported emissions in the 2011 draft NEI. Within the largest EIS sector for the facility and release type, we then determined which single SCC had the largest emissions. The emissions values used were sums of emissions across all pollutants except CO, CO_2, and NO_X, with all units converted to tons[11]. Excluding CO and CO_2 was done because their high mass would overwhelm the contribution of the other criteria pollutants, and NO_X was excluded because the HAPs that we are trying to assign to an appropriate summation sector are more closely associated with SO_2 or PM emissions. The usage of the default 39999999 SCC has not been completely eliminated as a result of this approach, because there remain a number of S/L/T agency-reported criteria emissions for some facilities in EIS for which that is the most viable SCC choice. In the rare cases that the S/L/T agency used 39999999 for the majority of their emissions, this approach did not work.

7. **Tag TRI pollutant emissions in EIS to avoid double counting with other datasets**
   Because the 2011 NEI does not attempt to place the TRI emissions at the same processes used by the S/L/T agency datasets or other EPA datasets that are higher in the EIS selection hierarchy, it is necessary to tag any TRI emissions values stored in the EIS wherever the same pollutant is already reported by a

[11] In fact, a “SMOKE” modeling file was used as the easiest way to get the file in the right format for this step.

S/L/T agency or one of the more preferred EPA datasets for a given EIS facility. In addition to a direct comparison of individually matching pollutants between these datasets, it is also necessary to compare to any of the related EIS pollutant codes that are in the same pollutant group.

Table 3-5 shows the EIS pollutant groups that had to be accounted for in this comparison. For example, if the S/L/T agency data or the 2011EPA_EGU dataset included “Xylenes (Mixed Isomers)” for a facility, any of the related individual xylene isomers would be tagged in the 2011EPA_TRI dataset in the EIS as well as any “Xylenes (Mixed Isomers)”. Tagging an emissions value in the EIS in any dataset makes that emissions value not available for selection to the NEI.

Table 3-4: Mapping of TRI pollutant codes to EIS pollutant codes

TRI CAS	TRI Pollutant Name	EIS Pollutant Code	EIS Pollutant Name	New in 2011
79345	1,1,2,2-TETRACHLOROETHANE	79345	1,1,2,2-TETRACHLOROETHANE	
79005	1,1,2-TRICHLOROETHANE	79005	1,1,2-TRICHLOROETHANE	
57147	1,1-DIMETHYL HYDRAZINE	57147	1,1-DIMETHYL HYDRAZINE	
120821	1,2,4-TRICHLOROBENZENE	120821	1,2,4-TRICHLOROBENZENE	
96128	1,2-DIBROMO-3-CHLOROPROPANE	96128	1,2-DIBROMO-3-CHLOROPROPANE	
57147	1,1-DIMETHYL HYDRAZINE	57147	1,1-Dimethyl Hydrazine	Yes
106887	1,2-BUTYLENE OXIDE	106887	1,2-EPOXYBUTANE	
75558	PROPYLENEIMINE	75558	1,2-PROPYLENIMINE	
106990	1,3-BUTADIENE	106990	1,3-BUTADIENE	
542756	1,3-DICHLOROPROPYLENE	542756	1,3-DICHLOROPROPENE	
1120714	PROPANE SULTONE	1120714	1,3-PROPANESULTONE	
106467	1,4-DICHLOROBENZENE	106467	1,4-DICHLOROBENZENE	
25321226	DICHLOROBENZENE (MIXED ISOMERS)		NA- pollutant not used	
95954	2,4,5-TRICHLOROPHENOL	95954	2,4,5-TRICHLOROPHENOL	
88062	2,4,6-TRICHLOROPHENOL	88062	2,4,6-TRICHLOROPHENOL	
94757	2,4-DICHLOROPHENOXY ACETIC ACID	94757	2,4-DICHLOROPHENOXY ACETIC ACID	
51285	2,4-DINITROPHENOL	51285	2,4-DINITROPHENOL	
121142	2,4-DINITROTOLUENE	121142	2,4-DINITROTOLUENE	
53963	2-ACETYLAMINOFLUORENE	53963	2-ACETYLAMINOFLUORENE	
79469	2-NITROPROPANE	79469	2-NITROPROPANE	
91941	3,3'-DICHLOROBENZIDINE	91941	3,3'-Dichlorobenzidine	Yes
119904	3,3'-DIMETHOXYBENZIDINE	119904	3,3'-Dimethoxybenzidine	Yes
119937	3,3’-DIMETHYLBENZIDINE	119937	3,3’-DIMETHYLBENZIDINE	
101144	4,4’-METHYLENEBIS(2-CHLOROANILINE)	101144	4,4’-METHYLENEBIS(2-CHLORANILINE)	
101779	4,4’-METHYLENEDIANILINE	101779	4,4’-METHYLENEDIANILINE	
534521	4,6-DINITRO-O-CRESOL	534521	4,6-DINITRO-O-CRESOL	
92671	4-AMINOBIPHENYL	92671	4-AMINOBIPHENYL	
60117	4-DIMETHYLAMINOAZOBENZENE	60117	4-DIMETHYLAMINOAZOBENZENE	
100027	4-NITROPHENOL	100027	4-NITROPHENOL	
75070	ACETALDEHYDE	75070	ACETALDEHYDE	
60355	ACETAMIDE	60355	ACETAMIDE	
75058	ACETONITRILE	75058	ACETONITRILE	
98862	ACETOPHENONE	98862	ACETOPHENONE	
107028	ACROLEIN	107028	ACROLEIN	
79061	ACRYLAMIDE	79061	ACRYLAMIDE	
79107	ACRYLIC ACID	79107	ACRYLIC ACID	
107131	ACRYLONITRILE	107131	ACRYLONITRILE	
107051	ALLYL CHLORIDE	107051	ALLYL CHLORIDE	
7664417	AMMONIA	NH3	Ammonia	Yes
62533	ANILINE	62533	ANILINE	
7440360	ANTIMONY	7440360	ANTIMONY	
N010	ANTIMONY COMPOUNDS	7440360	ANTIMONY	
7440382	ARSENIC	7440382	ARSENIC	
N020	ARSENIC COMPOUNDS	7440382	ARSENIC	
1332214	ASBESTOS (FRIABLE)	1332214	ASBESTOS	
71432	BENZENE	71432	BENZENE	

TRI CAS	TRI Pollutant Name	EIS Pollutant Code	EIS Pollutant Name	New in 2011
92875	BENZIDINE	92875	BENZIDINE	
98077	BENZOIC TRICHLORIDE	98077	BENZOTRICHLORIDE	
100447	BENZYL CHLORIDE	100447	BENZYL CHLORIDE	
7440417	BERYLLIUM	7440417	BERYLLIUM	
N050	BERYLLIUM COMPOUNDS	7440417	BERYLLIUM	
92524	BIPHENYL	92524	BIPHENYL	
117817	DI(2-ETHYLHEXYL) PHTHALATE	117817	BIS(2-ETHYLHEXYL)PHTHALATE	
542881	BIS(CHLOROMETHYL) ETHER	542881	Bis(Chloromethyl)Ether	Yes
75252	BROMOFORM	75252	BROMOFORM	
7440439	CADMIUM	7440439	CADMIUM	
N078	CADMIUM COMPOUNDS	7440439	CADMIUM	
156627	CALCIUM CYANAMIDE	156627	CALCIUM CYANAMIDE	
133062	CAPTAN	133062	CAPTAN	
63252	CARBARYL	63252	CARBARYL	
75150	CARBON DISULFIDE	75150	CARBON DISULFIDE	
56235	CARBON TETRACHLORIDE	56235	CARBON TETRACHLORIDE	
463581	CARBONYL SULFIDE	463581	CARBONYL SULFIDE	
120809	CATECHOL	120809	CATECHOL	
57749	CHLORDANE	57749	CHLORDANE	
7782505	CHLORINE	7782505	CHLORINE	
79118	CHLOROACETIC ACID	79118	CHLOROACETIC ACID	
108907	CHLOROBENZENE	108907	CHLOROBENZENE	
510156	CHLOROBENZILATE	510156	Chlorobenzilate	Yes
67663	CHLOROFORM	67663	CHLOROFORM	
107302	CHLOROMETHYL METHYL ETHER	107302	CHLOROMETHYL METHYL ETHER	
126998	CHLOROPRENE	126998	CHLOROPRENE	
7440473	CHROMIUM	7440473	CHROMIUM	
N090	CHROMIUM COMPOUNDS(EXCEPT CHROMITE ORE MINED IN THE TRANSVAAL REGION)	7440473	CHROMIUM	
7440484	COBALT	7440484	COBALT	
N096	COBALT COMPOUNDS	7440484	COBALT	
1319773	CRESOL (MIXED ISOMERS)	1319773	CRESOL/CRESYLIC ACID (MIXED ISOMERS)	
108394	M-CRESOL	108394	M-CRESOL	
95487	O-CRESOL	95487	O-CRESOL	
106445	P-CRESOL	106445	P-CRESOL	
98828	CUMENE	98828	CUMENE	
N106	CYANIDE COMPOUNDS	57125	CYANIDE	
74908	HYDROGEN CYANIDE	57125	Cyanide	Yes
132649	DIBENZOFURAN	132649	DIBENZOFURAN	
84742	DIBUTYL PHTHALATE	84742	DIBUTYL PHTHALATE	
111444	BIS(2-CHLOROETHYL) ETHER	111444	DICHLOROETHYL ETHER	
62737	DICHLORVOS	62737	DICHLORVOS	
111422	DIETHANOLAMINE	111422	DIETHANOLAMINE	
64675	DIETHYL SULFATE	64675	DIETHYL SULFATE	
131113	DIMETHYL PHTHALATE	131113	DIMETHYL PHTHALATE	
77781	DIMETHYL SULFATE	77781	DIMETHYL SULFATE	
79447	DIMETHYLCARBAMYL CHLORIDE	79447	DIMETHYLCARBAMOYL CHLORIDE	
N120	DIISOCYANATES		NA- pollutant not used	
26471625	TOLUENE DIISOCYANATE (MIXED ISOMERS)		NA- pollutant not used	
584849	TOLUENE-2,4-DIISOCYANATE	584849	2,4-Toluene Diisocyanate	Yes
N150	DIOXIN AND DIOXIN-LIKE COMPOUNDS		NA- pollutant not used	
106898	EPICHLOROHYDRIN	106898	EPICHLOROHYDRIN	
140885	ETHYL ACRYLATE	140885	ETHYL ACRYLATE	
51796	URETHANE	51796	ETHYL CARBAMATE	
75003	CHLOROETHANE	75003	ETHYL CHLORIDE	
100414	ETHYLBENZENE	100414	ETHYL BENZENE	
106934	1,2-DIBROMOETHANE	106934	ETHYLENE DIBROMIDE	
107062	1,2-DICHLOROETHANE	107062	ETHYLENE DICHLORIDE	
107211	ETHYLENE GLYCOL	107211	ETHYLENE GLYCOL	
151564	ETHYLENEIMINE	151564	Ethyleneimine	Yes
75218	ETHYLENE OXIDE	75218	ETHYLENE OXIDE	
96457	ETHYLENE THIOUREA	96457	ETHYLENE THIOUREA	

TRI CAS	TRI Pollutant Name	EIS Pollutant Code	EIS Pollutant Name	New in 2011
75343	ETHYLIDENE DICHLORIDE	75343	ETHYLIDENE DICHLORIDE	
50000	FORMALDEHYDE	50000	FORMALDEHYDE	
N230	CERTAIN GLYCOL ETHERS	171	N/A Pollutant not used	
76448	HEPTACHLOR	76448	HEPTACHLOR	
118741	HEXACHLOROBENZENE	118741	HEXACHLOROBENZENE	
87683	HEXACHLORO-1,3-BUTADIENE	87683	HEXACHLOROBUTADIENE	
77474	HEXACHLOROCYCLOPENTADIENE	77474	HEXACHLOROCYCLOPENTADIENE	
67721	HEXACHLOROETHANE	67721	HEXACHLOROETHANE	
110543	N-HEXANE	110543	HEXANE	
302012	HYDRAZINE	302012	HYDRAZINE	
7647010	HYDROCHLORIC ACID (1995 AND AFTER “ACID AEROSOLS” ONLY)	7647010	HYDROCHLORIC ACID	
7664393	HYDROGEN FLUORIDE	7664393	HYDROGEN FLUORIDE	
123319	HYDROQUINONE	123319	HYDROQUINONE	
7439921	LEAD	7439921	LEAD	
N420	LEAD COMPOUNDS	7439921	LEAD	
58899	LINDANE	58899	1,2,3,4,5,6-HEXACHLOROCYCLOHEXANE	
108316	MALEIC ANHYDRIDE	108316	MALEIC ANHYDRIDE	
7439965	MANGANESE	7439965	MANGANESE	
N450	MANGANESE COMPOUNDS	7439965	MANGANESE	
7439976	MERCURY	7439976	MERCURY	
N458	MERCURY COMPOUNDS	7439976	MERCURY	
67561	METHANOL	67561	METHANOL	
72435	METHOXYCHLOR	72435	METHOXYCHLOR	
74839	BROMOMETHANE	74839	METHYL BROMIDE	
74873	CHLOROMETHANE	74873	METHYL CHLORIDE	
71556	1,1,1-TRICHLOROETHANE	71556	METHYL CHLOROFORM	
74884	METHYL IODIDE	74884	METHYL IODIDE	
108101	METHYL ISOBUTYL KETONE	108101	METHYL ISOBUTYL KETONE	
624839	METHYL ISOCYANATE	624839	METHYL ISOCYANATE	
80626	METHYL METHACRYLATE	80626	METHYL METHACRYLATE	
1634044	METHYL TERT-BUTYL ETHER	1634044	METHYL TERT-BUTYL ETHER	
75092	DICHLOROMETHANE	75092	METHYLENE CHLORIDE	
60344	METHYL HYDRAZINE	60344	METHYLHYDRAZINE	
121697	N,N-DIMETHYLANILINE	121697	N,N-DIMETHYLANILINE	
68122	N,N-DIMETHYLFORMAMIDE	68122	N,N-DIMETHYLFORMAMIDE	
91203	NAPHTHALENE	91203	NAPHTHALENE	
7440020	NICKEL	7440020	NICKEL	
N495	NICKEL COMPOUNDS	7440020	NICKEL	
98953	NITROBENZENE	98953	NITROBENZENE	
684935	N-NITROSO-N-METHYLUREA	684935	N-Nitroso-N-Methylurea	Yes
90040	O-ANISIDINE	90040	O-ANISIDINE	
95534	O-TOLUIDINE	95534	O-TOLUIDINE	
123911	1,4-DIOXANE	123911	P-DIOXANE	
56382	PARATHION	56382	Parathion	Yes
82688	QUINTOZENE	82688	PENTACHLORONITROBENZENE	
87865	PENTACHLOROPHENOL	87865	PENTACHLOROPHENOL	
108952	PHENOL	108952	PHENOL	
75445	PHOSGENE	75445	PHOSGENE	
7803512	PHOSPHINE	7803512	PHOSPHINE	
7723140	PHOSPHORUS (YELLOW OR WHITE)	7723140	PHOSPHORUS	
85449	PHTHALIC ANHYDRIDE	85449	PHTHALIC ANHYDRIDE	
1336363	POLYCHLORINATED BIPHENYLS	1336363	POLYCHLORINATED BIPHENYLS	
120127	ANTHRACENE	120127	Anthracene	Yes
191242	BENZO(G,H,I)PERYLENE	191242	BENZO[G,H,I,]PERYLENE	
85018	PHENANTHRENE	85018	PHENANTHRENE	
N590	POLYCYCLIC AROMATIC COMPOUNDS	130498292	PAH, total	
106503	P-PHENYLENEDIAMINE	106503	P-PHENYLENEDIAMINE	
123386	PROPIONALDEHYDE	123386	PROPIONALDEHYDE	
114261	PROPOXUR	114261	PROPOXUR	
78875	1,2-DICHLOROPROPANE	78875	PROPYLENE DICHLORIDE	
75569	PROPYLENE OXIDE	75569	PROPYLENE OXIDE	

TRI CAS	TRI Pollutant Name	EIS Pollutant Code	EIS Pollutant Name	New in 2011
91225	QUINOLINE	91225	QUINOLINE	
106514	QUINONE	106514	QUINONE	
7782492	SELENIUM	7782492	SELENIUM	
N725	SELENIUM COMPOUNDS	7782492	SELENIUM	
100425	STYRENE	100425	STYRENE	
96093	STYRENE OXIDE	96093	STYRENE OXIDE	
127184	TETRACHLOROETHYLENE	127184	TETRACHLOROETHYLENE	
7550450	TITANIUM TETRACHLORIDE	7550450	TITANIUM TETRACHLORIDE	
108883	TOLUENE	108883	TOLUENE	
95807	2,4-DIAMINOTOLUENE	95807	TOLUENE-2,4-DIAMINE	
8001352	TOXAPHENE	8001352	TOXAPHENE	
79016	TRICHLOROETHYLENE	79016	TRICHLOROETHYLENE	
121448	TRIETHYLAMINE	121448	TRIETHYLAMINE	
1582098	TRIFLURALIN	1582098	TRIFLURALIN	
108054	VINYL ACETATE	108054	VINYL ACETATE	
75014	VINYL CHLORIDE	75014	VINYL CHLORIDE	
75354	VINYLIDENE CHLORIDE	75354	VINYLIDENE CHLORIDE	
108383	M-XYLENE	108383	M-XYLENE	
95476	O-XYLENE	95476	O-XYLENE	
106423	P-XYLENE	106423	P-XYLENE	
1330207	XYLENE (MIXED ISOMERS)	1330207	XYLENES (MIXED ISOMERS)	

Table 3-5: Pollutant groups

Group Name	Pollutant Code	Pollutant
Chromium	7440473	Chromium
	1333820	Chromium Trioxide
	7738945	Chromic Acid (VI)
	18540299	Chromium (VI)
	16065831	Chromium III
Xylenes (Mixed Isomers)	1330207	Xylenes (Mixed Isomers)
	95476	o-Xylene
	106423	p-Xylene
	108383	m-Xylene
Cresol/Cresylic Acid (Mixed Isomers)	1319773	Cresol/Cresylic Acid (Mixed Isomers)
	95487	o-Cresol
	108394	m-Cresol
	106445	p-Cresol
Polychlorinated Biphenyls	1336363	Polychlorinated Biphenyls (PCBs)
	2050682	4,4’-Dichlorobiphenyl (PCB-15)
	2051243	Decachlorobiphenyl (PCB-209)
	2051607	2-Chlorobiphenyl (PCB-1)
	25429292	Pentachlorobiphenyl
	26601649	Hexachlorobiphenyl
	26914330	Tetrachlorobiphenyl
	28655712	Heptachlorobiphenyl
	53742077	Nonachlorobiphenyl
	55722264	Octachlorobiphenyl
	7012375	2,4,4’-Trichlorobiphenyl (PCB-28)
Polycyclic Organic Matter (POM)	130498292	PAH, total
	120127	Anthracene
	129000	Pyrene

Group Name	Pollutant Code	Pollutant
	189559	Dibenzo[a,i]Pyrene
	189640	Dibenzo[a,h]Pyrene
	191242	Benzo[g,h,I,]Perylene
	191300	Dibenzo[a,l]Pyrene
	192654	Dibenzo[a,e]Pyrene
	192972	Benzo[e]Pyrene
	193395	Indeno[1,2,3-c,d]Pyrene
	194592	7H-Dibenzo[c,g]carbazole
	195197	BenzoIphenanthrene
	198550	Perylene
	203123	Benzo(g,h,i)Fluoranthene
	203338	Benzo(a)Fluoranthene
	205823	Benzo[j]fluoranthene
	205992	Benzo[b]Fluoranthene
	206440	Fluoranthene
	207089	Benzo[k]Fluoranthene
	208968	Acenaphthylene
	218019	Chrysene
	224420	Dibenzo[a,j]Acridine
	226368	Dibenz[a,h]acridine
	2381217	1-Methylpyrene
	2422799	12-Methylbenz(a)Anthracene
	250	PAH/POM – Unspecified
	26914181	Methylanthracene
	3697243	5-Methylchrysene
	41637905	Methylchrysene
	42397648	1,6-Dinitropyrene
	42397659	1,8-Dinitropyrene
	50328	Benzo[a]Pyrene
	53703	Dibenzo[a,h]Anthracene
	5522430	1-Nitropyrene
	56495	3-Methylcholanthrene
	56553	Benz[a]Anthracene
	56832736	Benzofluoranthenes
	57835924	4-Nitropyrene
	57976	7,12-Dimethylbenz[a]Anthracene
	602879	5-Nitroacenaphthene
	607578	2-Nitrofluorene
	65357699	Methylbenzopyrene
	7496028	6-Nitrochrysene
	779022	9-Methyl Anthracene
	8007452	Coal Tar
	832699	1-Methylphenanthrene
	83329	Acenaphthene
	85018	Phenanthrene
	86737	Fluorene
	86748	Carbazole

Group Name	Pollutant Code	Pollutant
	90120	1-Methylnaphthalene
	91576	2-Methylnaphthalene
	91587	2-Chloronaphthalene
Cyanide & Compounds	57125	Cyanide
	74908	Hydrogen Cyanide
Nickel & Compounds	7440020	Nickel
	12035722	Nickel Subsulfide
	1313991	Nickel Oxide
	604	Nickel Refinery Dust

3.1.5 HAP augmentation based on emission factor ratios

The 2011EPA_HAP-augmentation dataset was used for gap filling (supplementing) missing HAPs in the S/L/T agency-reported data. We calculated HAP emissions by multiplying the appropriate surrogate CAP emissions (provided by S/L/T agencies) by an emissions ratio of HAP to CAP emission factors. This was also done for the 2008 NEI, but only for the point data category. For the 2011 NEI, we augmented HAP via the use of HAP to CAP ratios for both point (other than airport-related SCCs) and nonpoint data categories. For point sources, these emission factor (EF) ratios were largely the same as were used in the 2008 NEI v3, though additional quality assurance resulted in some changes. The ratios were computed using the EFs from WebFIRE) and are based solely on the SCC code. The computation of these point HAP to CAP ratios is described in detail in the 2008 NEI documentation, Section 3.1.5.

In summary, for pollutants other than Hg, we computed ratios for only the SCCs in WebFIRE that met specific criteria: 1) the CAP and HAP WebFIRE EFs were both based on uncontrolled emissions and, 2) the units of the EF had to be the same or be able to be converted to the same units. For Hg we added ratios for point SCCs that were not in WebFIRE for both PM10-FIL (the CAP surrogate for Hg) and Hg by using Hg or PM10-FIL factors for similar SCCs and computing the resulting ratio. That process is described (and supporting data files provided) in the 2008 NEI documentation (Section 3.1.5.2), since these additional Hg augmentation factors were used in the 2008 NEI v3 as well.

For nonpoint sources, augmentation ratios were derived from the EFs used to develop the EPA nonpoint source estimates. This allowed the ratios of augmented HAP to S/L/T agency-submitted CAP to be the same as the HAP to CAP ratios, and the HAP emissions to be consistent with the S/L/T agency-reported CAP data.

A HAP augmentation feature was built into the EIS for the 2011 cycle, and the HAP EF ratios are available to the EIS users through the reference data link “Augmentation Priority Order”. The same tables (“Priority Data” and “Priority Data Area”) provide both the HAP augmentation factors and chromium speciation factors. The “Priority Data” table provides chromium speciation and HAP augmentation factors for point sources; the “Priority Data Area” table provides them for nonpoint sources. These tables provide the SCC, CAP surrogate, HAP and multiplication factor (HAP to CAP ratio).

For access by non-EIS users, the zip file called “2011nei_supdata_hapaug.zip” provides the emission ratios used for point and nonpoint data categories.

A key facet of our approach is that the resulting HAP augmentation dataset does duplicate HAPs from the S/L/T agency data or other EPA datasets. The extra step of data tagging of the HAP augmentation dataset was taken to ensure the NEI would not use the data from the HAP augmentation dataset for facilities where the HAP was reported by an S/L/T agency at any process at the facility or where the HAP was included in the EPA TRI dataset.

For example, if a facility reported formaldehyde at process A only, and the WebFIRE emission factor database yields formaldehyde emissions for processes A, B, and C, then we would not use any records from the HAP augmentation dataset containing formaldehyde from any processes at the facility. If that facility had no formaldehyde, but the TRI dataset had formaldehyde for any processes at that facility, then the NEI would still not use formaldehyde from the HAP augmentation dataset for any of the processes (it would use the TRI data). If the EPA EGU dataset contained formaldehyde for that facility we would use the HAP augmentation set but not for any process at the same unit as EPA EGU dataset. If the EPA EGU dataset contained formaldehyde at process A or any other process within the same unit as process A, then the HAP augmentation dataset would be used for processes B and C, but not process A.

This approach was taken to be conservative in our attempt to prevent double counted emissions, which is necessary because we know that some states aggregate their HAP emissions and assign to fewer or different processes than their CAP emissions. These types of differences are expected since CAPs are required to be submitted at the process level, but HAPs are entirely voluntary for the NEI's reporting rule. We used the EIS tagging to tag records from the 2011EPA_HAP-augmentation dataset that prevented the possibility of double counting. Because some HAPs are in pollutant groups, if any one HAP in that group was reported by the state anywhere at the facility, then we tagged all HAPs in that group. We used the same groups as provided in Table 3-5, except we neglected to include the nickel pollutants in our tagging. This caused the inadvertent addition of nickel emissions from HAP augmentation as listed in Table 3-6.

Table 3-6: HAP-augmentation dataset nickel species which should not have been used in the NEI

State	EIS Facility ID	EIS Process ID	Nickel species in HAP Augmentation Dataset	Emissions (lbs)	Data Set	Potential Double Count With:
Minnesota	7146811	27576114	Nickel Oxide	16.5	2011EPA_HAP-Aug	State
Illinois	7337911	43356414	Nickel Oxide	1.3	2011EPA_HAP-Aug	State
Ohio	13429911	100593714	Nickel Oxide	0.034	2011EPA_HAP-Aug	State
Louisiana	7355411	105681714	Nickel	2.3	2011EPA_HAP-Aug	State
Louisiana	7355411	105679214	Nickel	4.1	2011EPA_HAP-Aug	State
Louisiana	7355411	105683114	Nickel	6.3	2011EPA_HAP-Aug	State
Iowa	12807811	94016214	Nickel Oxide	0.5	2011EPA_HAP-Aug	TRI
Iowa	12807811	94016314	Nickel Oxide	0.	2011EPA_HAP-Aug	TRI

We also tagged all point source HAP augmentation values that met one or more of the following criteria: a) the HAP augmentation value exceeded the maximum emissions reported by any S/L/T agency for the same SCC/pollutant combination, or if no S/L/T agency reported any values for the same SCC/pollutant, b) SCCs for coke ovens (potential double count with the "Coke oven emissions" pollutant) and c) waste oil (due to insufficient information about the waste which would likely impact the ratio), d) if greater than 0.05 tons lead would have been added from coal combustion. This last criterion impacted 3 sources, as shown in Table 3-7. We tagged these due to the uncertainty in the WebFIRE emission factor. The value 0.05 tons lead was selected because it was at the top end of the HAP augmentation values for coal combustion.

Table 3-7: Lead from HAP-augmentation from coal combustion that was not used.

EIS Facility ID	EIS Unit ID	EIS Process ID	SCC	State	County	St/Co FIPS	Facility Name	Unused Lead (tons)
4944011	30874213	67784214	10200203	WI	Brown	55009	Georgia-Pacific Consumer Products LP	0.1800
6478511	87095313	117793514	10200222	WY	Sweet	56037	Green River Trona Plant	0.1500

					water			
6478511	87095513	117793714	10200222	WY	Sweet water	56037	Green River Trona Plant	0.0600

For nonpoint we did not tag the HAP augmentation dataset where the HAP was reported by the S/L/T agency, nor where it was present in the EPA nonpoint dataset. This is because the NEI selection hierarchy in the EIS ensured that the S/L/T agency data would be selected first, HAP-augmentation next, and EPA data third. However, we did need to tag HAP augmentation values where the pollutant was different from what was reported by the S/L/T agency but belonged to the same pollutant group. For example, if the HAP-augmentation dataset had o-xylene, and the S/L/T agency reported total xylenes, then we tagged the o-xylene in the HAP-augmentation dataset. The resultant tagging was done for the xylenes, PAHs and cresols groups in Table 3-5.

Similarly, to point, quality assurance of the nonpoint HAP augmentation resulted in tagging of specific lead and mercury values.

One issue with nonpoint HAP augmentation we found after the release of 2011 v1 was an error in the augmentation of drycleaning tetrachloroethylene. We used a tetrachloroethylene to VOC ratio, but these pollutants are not related (tetrachloroethylene is not a VOC HAP and the use of tetrachloroethylene at a dry cleaner is not dependent on the VOC use. These emissions were tagged out for v2, and HAP augmentation of these SCCs will not occur next (NEI 2014) inventory cycle due to SCC retirements.

3.1.6 Priority Facility List

For the 2011 NEI, EPA developed a Priority Facility List and posted it for reference in order to provide S/L/T agencies an indication of important facilities on which to focus. EPA constructed the priority facility list based on select HAPs and CAPS and facilities that contributed to the top 80% nationally of those pollutants in the 2008 NEI v2. However, EPA's QA reviews for emissions outlier values, incorrect locational coordinates, S/L/T agency reporting completeness and preliminary risk modeling was not restricted or focused on solely the priority facility list for 2011.

3.1.7 EPA nonpoint data

For the 2011 NEI, the EPA developed emission estimates for many nonpoint sectors in collaboration with a consortium of state and regional planning organizations called the Eastern Regional Technical Advisory Committee (ERTAC). This task is referred to by ERTAC as the "Area Source Comparability" project on the ERTAC website, and a subgroup was developed to work on this project. The purpose of the subgroup and project was to agree on methodologies, emission factors, and SCCs for a number of important nonpoint sectors, allowing EPA to prepare the emissions estimates for all states using the group's final approaches. During the 2011 NEI inventory development cycle, S/L/T agencies could accept the ERTAC/EPA estimates to fulfill their nonpoint emissions reporting requirements. EPA encouraged S/L/T agencies that did not use EPA's estimates or tools to improve upon these "default" methodologies and submit further improved data. The ERTAC process is described in an NEI conference paper [ref 3].

One dataset was created for 2011 v2 that represented mercury emissions from nonpoint categories that span different sectors. This dataset is called 2011EPA_NP_Mercury and comes at the end of the hierarchy in the selection. It represents emissions from various mercury sources, described in Table 3-8. Methodologies for these specific source categories are included in the Sector sections for Waste Disposal (3.32) and Miscellaneous Non-Industrial NEC (3.25).

Table 3-8: New nonpoint Hg sources of emissions in the 2011 v2 NEI

Sector	Source Category Description	SCC	Emissions (lbs.)
Waste Disposal	Switches and Relays	2650000002	4,292.8
Miscellaneous Non-Industrial NEC	Human Cremation	2810060100	2,291.5
Waste Disposal	Landfills	2620030001	828.0
Miscellaneous Non-Industrial NEC	Fluorescent Lamp Breakage	2861000000	802.7
Miscellaneous Non-Industrial NEC	Dental Amalgam	2850001000	803.8
Miscellaneous Non-Industrial NEC	General Laboratory Activities*	2851001000	600.0
Waste Disposal	Thermostats	2650000000	228.2
Miscellaneous Non-Industrial NEC	Animal Cremation	2810060200	80.2
Waste Disposal	Thermometers	2650000000	14.4
Miscellaneous Non-Industrial NEC	Fluorescent Lamp Recycling	2861000010	0.2
		TOTAL	**9,941.8**

***** A new estimate for General Laboratory Activities was not developed, but was pulled forward from the 2008 NEI

Table 3-9 and Table 3-10 describe the sectors for which EPA developed emission estimates. They separately list emissions sectors entirely comprised of data in the nonpoint (and not point source) data category (Table 3-9), such as residential heating, from sectors that may overlap with the point sources (Table 3-10). For sectors that overlap, some emissions will be submitted as point sources and other emissions in the same state or county are submitted as nonpoint, for example, fuel combustion at commercial or institutional facilities. Unlike in 2008, EPA attempted to include all the EPA-estimated nonpoint emissions that overlap if it was determined that the category was missing from the S/L/T agency data.

All methodologies are provided in zip files, which is the directory containing all supporting data files listed in Table 3-9 and Table 3-10. Emission emissions sources using data from former EPA inventories are identified in the column "Carried Forward" in these tables. The SCCs associated with the EPA nonpoint data categories are in the excel file list_of_sources_2011v1_nonpoint_20131127.xlsx. The file "2011nei_np_matrix_submittals.xlsx" has a list of submitting S/L/T agencies and for what nonpoint sectors they submitted data.

Table 3-9: EPA-estimated emissions sources expected to be exclusively nonpoint

EPA-estimated emissions source description	Carried Forward?	EIS Sector Name	Name of supporting data file or other reference
Residential Heating; bituminous and anthracite coal		Fuel Comb – Residential – Other	residential_consumption__coal.zip
Residential Heating; distillate oil		Fuel Comb – Residential – Oil	residential_consumption_oil_revised_06272012.zip
Residential Heating; Kerosene		Fuel Comb – Residential – Oil	residential_consumption_kerosene.zip
Residential Heating; natural gas		Fuel Comb – Residential – Natural Gas	residential_consumption_ng_revised_06222012.zip
Residential Heating; liquefied petroleum gas		Fuel Comb – Residential – Other	residential_consumption_lpg.zip
Residential Heating; Fireplaces, woodstoves, fireplace inserts, pellet		Fuel Comb – Residential – Wood	rwc_estimation_tool_2011v1_120612.zip

EPA-estimated emissions source description	Carried Forward?	EIS Sector Name	Name of supporting data file or other reference
stoves, indoor furnaces, outdoor hydronic heaters, and firelogs.			
Paved Roads		Dust – Paved Road Dust	roads_paved_2011.zip
Unpaved Roads		Dust – Unpaved Road Dust	roads_unpaved_2011.zip
Dust from Residential Construction		Dust – Construction Dust	construction_residential_2011.zip
Dust from Commercial Institutional		Dust – Construction Dust	construction_nonresidential_2011.zip
Dust from Road Construction		Dust – Construction Dust	construction_road_2011.zip
Commercial Cooking		Commercial Cooking	commercial_cooking_2302002nnn_2011.zip
Mining and Quarrying		Industrial Processes – Mining	mining_and_quarrying.zip
Architectural Coatings		Solvent – Non-Industrial Surface Coating	surface_coatings_arch_coatings_whaps_2011.zip
Traffic Markings		Solvent – Industrial Surface Coating & Solvent Use	traffic_markings_whaps_2011.zip
Railroad surface coating		Solvent - Industrial Surface Coating & Solvent Use	surface_coating_railroad_whaps_2011.zip
Consumer & Commercial – All personal care products		Solvent – Consumer & Commercial Solvent Use	cons_comm_personal_care_products_whaps_2011.zip
Consumer & Commercial – All household products		Solvent – Consumer & Commercial Solvent Use	cons_comm_misc_products_whaps_2011.zip cons_comm_cleaning_products_whaps_2011.zip cons_comm_auto_aftermarket_whaps_2011.zip
Consumer & Commercial – All coatings and related products		Solvent – Consumer & Commercial Solvent Use	cons_comm_coatings_and_related_products_whaps_2011.zip
Consumer & Commercial – All adhesives and sealants		Solvent – Consumer & Commercial Solvent Use	cons_comm_adhesives_sealants_whaps_2011.zip
Consumer & Commercial – All FIFRA related products		Solvent – Consumer & Commercial Solvent Use	cons_comm_fifra_whaps_2011.zip
Cutback Asphalt Paving	x	Solvent – Consumer & Commercial Solvent Use	asphalt_paving_cutback_2011.zip
Emulsified Asphalt Paving	x	Solvent – Consumer & Commercial Solvent Use	asphalt_paving_emulsified_2011.zip
Consumer Pesticide Application		Solvent – Consumer & Commercial Solvent Use	cons_comm_fifra_whaps_2011.zip
Commercial Pesticide Application	x	Solvent – Consumer & Commercial Solvent Use	agricultural_pesticides_2011_eis_format.zip
Residential Portable Gas Cans		Miscellaneous Non-Industrial NEC	portable_fuel_containers_2011.zip
Commercial Portable Gas Cans		Miscellaneous Non-Industrial NEC	portable_fuel_containers_2011.zip
Aviation Gasoline Stage 1	x	Gas Stations	av_gasoline_distribution_stage1.zip
Aviation Gasoline Stage 2	x	Gas Stations	av_gasoline_distribution_stage2.zip
Open Burning – Leaves		Waste Disposal	open_burning_yard_waste_2011.zip
Open Burning – Brush		Waste Disposal	open_burning_yard_waste_2011.zip

EPA-estimated emissions source description	Carried Forward?	EIS Sector Name	Name of supporting data file or other reference
Open Burning – Residential Household Waste		Waste Disposal	open_burning_msw_2011.zip
Open Burning – Land Clearing Debris		Waste Disposal	open_burning_land_clearing_debris_2011.zip
Publicly Owned Treatment Works		Waste Disposal	potw_2011_rev.zip
Agricultural Tilling		Agriculture – Crops & Livestock Dust	agricultural_tilling_2801000003_2011.zip
Fertilizer Application		Agriculture – Fertilizer Application	ag_fertilizer_application_2011.zip
Animal Husbandry	x	Agriculture – Livestock Waste	animal_livestock_emissions_2011.zip
Dental Preparation and Use		Miscellaneous Non-Industrial NEC	2011 NEI FTP Directory
General Laboratory Activities		Miscellaneous Non-Industrial NEC	Documentation for the Final 2002 Nonpoint Sector (Feb 06 version) National Emission Inventory for Criteria and HAPs, page A-106
Lamp Breakage (Landfill emissions)		Miscellaneous Non-Industrial NEC	2011 NEI FTP Directory
Lamp (Fluorescent) Recycling		Miscellaneous Non-Industrial NEC	2011 NEI FTP Directory
"Carried Forward" indicates whether EPA data were carried forward from the 2008 or other previous year inventory.			

Table 3-10: Emissions sources with potential nonpoint and point contribution

EPA-estimated emissions source description	Carried Forward?	EIS Sector Name	Link to supporting data file
Industrial, Commercial/Institutional Fuel Combustion		Fuel Comb – Industrial Boilers, ICEs – All Fuels Fuel Comb – Comm/ Institutional – All Fuels	ici_fuel_combustion_by_state/
Oil and Gas Production		Industrial Processes - Oil & Gas Production	Oil_and_gas_tool_v2_20140331.zip
Industrial Surface Coating – Auto Refinishing		Solvent – Industrial Surface Coating & Solvent Use	surface_coating_automobile_refinishing_2011whaps.zip
Industrial Surface Coating – Factory Finished Wood		Solvent – Industrial Surface Coating & Solvent Use	surface_coating_factory_finished_wood_2011whaps.zip
Industrial Surface Coating – Wood Furniture		Solvent – Industrial Surface Coating & Solvent Use	surface_coating_wood_furniture_2011whaps_rev_4.zip
Industrial Surface Coating – Metal Furniture		Solvent – Industrial Surface Coating & Solvent Use	surface_coating_metal_furn_2011whaps.zip
Industrial Surface Coating – Paper Foil and Film		Solvent – Industrial Surface Coating & Solvent Use	surface_coating_paper_film_foil_2011_whaps.zip
Industrial Surface Coating – Metal Can Coating		Solvent – Industrial Surface Coating & Solvent Use	surface_coatings_metal_can_whaps_2011.zip
Industrial Surface Coating – Machinery and Equipment		Solvent – Industrial Surface Coating & Solvent Use	surface_coating_machinery_and_equip_whaps2011.zip
Industrial Surface Coating – Large Appliances		Solvent – Industrial Surface Coating & Solvent Use	surface_coating_appliances_2011whaps.zip

EPA-estimated emissions source description	Carried Forward?	EIS Sector Name	Link to supporting data file
Industrial Surface Coating – Electronic and other Electric Coatings		Solvent – Industrial Surface Coating & Solvent Use	surface_coating_electronic_and_other_electrical_coatings_whaps_2011.zip
Industrial Surface Coating – Motor Vehicles		Solvent – Industrial Surface Coating & Solvent Use	surface_coating_motor%20vehicles_whaps_2011.zip
Industrial Surface Coating – Aircraft		Solvent – Industrial Surface Coating & Solvent Use	surface_coating_aircraft_mfg__2011whaps.zip
Industrial Surface Coating – Marine		Solvent – Industrial Surface Coating & Solvent Use	surface_coating_marine_mfgwhaps2011.zip
Industrial Surface Coating – Railroad		Solvent – Industrial Surface Coating & Solvent Use	surface_coating_railroad_whaps_2011.zip
Industrial Surface Coating – Miscellaneous Manufacturing		Solvent – Industrial Surface Coating & Solvent Use	surface_coating_misc_mfg_2011whaps.zip
Industrial Maintenance Coatings		Solvent – Industrial Surface Coating & Solvent Use	surface_coating_ind_maint_coating_2011whaps.zip
Other Special Purpose Coatings		Solvent – Industrial Surface Coating & Solvent Use	surface_coating_other_special_purpose_whaps_2011.zip
Degreasing		Solvent – Degreasing	degreasing_whaps_2011_eisformat.zip
Graphic Arts		Solvent – Graphic Arts	graphic_arts_w_haps_2011.zip
Dry Cleaning		Solvent – Dry Cleaning	dry_cleaning_emissions_2011_rev.zip
Gasoline Distribution – Stage 1 Bulk Plants	x	Bulk Gasoline Terminals	gasoline_distribution_stage_1_bulk_plants_2011.zip
Gasoline Distribution – Stage 1 Bulk Terminals	x	Bulk Gasoline Terminals	gasoline_distribution_stage%201%20bulk_terminals_2011.zip
Gasoline Distribution – Stage 1 Pipelines		Industrial Processes – Storage and Transfer	gasoline_distribution_stage_1_pipelines_2011.zip
Gasoline Distribution – Stage 1 Service Station Unloading		Gas Stations	gas_distribution_service_station_unloading_eis_format.zip
Gasoline Distribution – Stage 1 Underground Storage Tanks		Gas Stations	gasoline_distribution_stage1_ust_2011.zip
Gasoline Distribution – Stage 1 Trucks In Transit	x	Industrial Processes – Storage and Transfer	gasoline_distribution_stage_1_tank_trucks_2011.zip
Gasoline Distribution – Stage 2 Refueling at Pump		Gas Stations	gasoline_distribution_stage_2.zip
Human Cremation		Miscellaneous Non-Industrial NEC	2011 NEI FTP Directory
"Carried Forward" indicates whether EPA data were carried forward from the 2008 or other previous year inventory.			

To determine whether EPA nonpoint data should be added for the categories with possible point/nonpoint overlap, EPA used information provided by S/L/T agencies regarding their submitted nonpoint data. Specifically, EPA used a survey of state and local agencies to get details about whether they had performed point/nonpoint reconciliation, whether they did nonpoint estimates for each SCC, what SCCs they used, whether the state had any nonpoint sources in a sector, and whether a state preferred to use EPA estimates. This information was used, in conjunction with a few assumptions, to determine whether EPA should augment the data submitted by the S/L/T agency with EPA-generated data. Using the Industrial Fuel Combustion sector as an example, because the EPA-generated data were based on activity data that would cover all industrial combustion sources (both point and nonpoint), it was necessary to use this methodology so that double counting of emissions would not occur. This comparison was done on a state level basis, except where county agencies are responsible for their own submissions. The algorithm for determining whether to augment data in the 2011 NEI is given in Table 3-11 and Table 3-12.

Table 3-11: Algorithm for using survey data to determine source categories that should be augmented with EPA nonpoint data for Industrial Combustion and Commercial/Institutional Combustion for Oil, Coal, and Other fuels

Survey Data	State Submitted to Point?	State Submitted to Nonpoint?	EPA Action	Rationale
State indicates that category is fully covered by their point inventory for an SCC	Yes	Yes or No	Do not augment nonpoint data. Tag EPA data so that it does not get put into NEI.	The nonpoint inventory is based on Energy Information Administration (EIA) numbers, which takes all fuel combustion into account. The EIA makes no distinction between point and nonpoint. Augmenting would double count point emissions.
	No	No	Augment with EPA estimates for nonpoint category.	The EIA data tracks fuel usage by state. There will be a gap in the data if this category is not covered by the state at all.
	No	Yes	Do not augment	Assume that they filled out the survey incorrectly, and that they meant that the category is fully covered by nonpoint.
State indicates that category is fully covered by their nonpoint inventory for an SCC	No	Yes	Do not augment	Augmenting would double count nonpoint emissions.
	No	No	Augment	The EIA data tracks fuel usage by state. There will be a gap in the data if this category is not covered by the state at all.
	Yes	Yes or No	Do not augment	Assume that they filled out the survey incorrectly.
State indicates that they do point/ nonpoint reconciliation	Yes	No	Augment	We believe that they intended to submit nonpoint. Though there will be some double counting, we believe that their submitted emissions for point would be lower than if they claimed that their category was covered fully in point.
	Yes or No	Yes	Do not augment	No augmentation is necessary, since either both point and nonpoint were submitted, or nonpoint would be double counted.
	No	No	Augment	The EIA data tracks fuel usage by state. There will be a gap in the data if this category is not covered by the state at all.

Table 3-12: Algorithm for using survey data to determine source categories that should be augmented with EPA nonpoint data for Commercial/Institutional Combustion for Natural Gas and Biomass, and Gas Stations

Survey Data	State Submitted to Point?	State Submitted to Nonpoint?	EPA Action	Rationale
State indicates that category is fully covered by their point inventory for an SCC	Yes	No	Sum up their submissions for point, and if this number is not very large (the sum of the point submissions is <20% of the EPA estimate for nonpoint), augment their data.	We believe that the state filled out the survey incorrectly. There must be small commercial/institutional sources or gas stations that were not covered by the point source inventory.
State indicates that category is fully covered by their point inventory for an SCC	No	No	Augment	The EIA data tracks fuel usage by state. There will be a gap in the data if this category is not covered by the state at all.
State indicates that category is fully covered by their point inventory for an SCC	Yes or No	Yes	Do not augment	Assume that either they filled out the survey incorrectly, or they submitted for both point and nonpoint, and we do not need to augment.
State indicates that category is fully covered by their nonpoint inventory for an SCC	No	Yes	Do not augment	Augmenting would double count nonpoint emissions.
State indicates that category is fully covered by their nonpoint inventory for an SCC	No	No	Augment	The EIA data tracks fuel usage by state. There will be a gap in the data if this category is not covered by the state at all.
State indicates that category is fully covered by their nonpoint inventory for an SCC	Yes	Yes	Do not augment	Assume that they filled out the survey incorrectly, but since they have an inventory that covers both point and nonpoint, we assume it is complete.
State indicates that category is fully covered by their nonpoint inventory for an SCC	Yes	No	Augment	While there would be some double counting of point emissions, it would be, and we believe that there would still be nonpoint emissions for this category.
State claims that they do point/ nonpoint reconciliation	Yes	No	Augment	Assume that they intended to submit nonpoint. Though there will be some double counting, we believe that their submitted emissions for point would be lower than if they claimed that their category was covered fully in point.
State claims that they do point/ nonpoint reconciliation	Yes or No	Yes	Do not augment	No augmentation is necessary, since either both point and nonpoint were submitted, or nonpoint would be double counted.
State claims that they do point/ nonpoint reconciliation	No	No	Augment	The EIA data tracks fuel usage by state. There will be a gap in the data if this category is not covered by the state at all.

Finally, there are some emissions sources for which EPA did not compute 2011 emissions nor use old inventories to fill in where states did not provide estimates. These sources are listed in Table 3-13 below. If a state within the NEI data does not include emissions for these emissions sources, then either that state does not have such sources, or the state did not send EPA these emissions.

Table 3-13: SCCs used in past inventories that were not included in the EPA's 2011 nonpoint estimates

SCC	Description	EIS Sector Name
2309100010	Chromium Electroplating, Hard	Industrial Processes - NEC
2309100030	Chromium Electroplating, Decorative	Industrial Processes - NEC
2309100050	Chromic Acid Anodizing	Industrial Processes - NEC
2461160000	Drum and Barrel Reclamation	Miscellaneous Non-Industrial NEC
2801000000	Cotton Ginning	Agriculture – Crops & Livestock Dust
2805001000	Beef Cattle Feedlots Dust (PM emissions)	Agricultural – Livestock Waste
2830000000	Open Burning - Scrap Tires	Waste Disposal
2850000010	Hospital Sterilization	Miscellaneous Non-Industrial NEC
2862000000	Swimming Pools	Miscellaneous Non-Industrial NEC
2401045000	Surface Coating: Sheet, Strip and Coil Coatings	Solvent – Industrial Surface Coating & Solvent Use
2810030000	Structure Fires	Miscellaneous Non-Industrial NEC
2801000007	Grain Elevators: Terminal	Agriculture – Crops & Livestock Dust

3.1.8 References for Stationary sources

1. Dorn, J, 2012. *Memorandum: 2011 NEI Version 2 – PM Augmentation approach.* Memorandum to Roy Huntley, US EPA. (PM augmt 2011 NEIv2 feb2012.pdf, accessible in the reference documents of the 2008 NEI documentation
2. Strait et al. (2003). Strait, R.; MacKenzie, D.; and Huntley, R., 2003. *PM Augmentation Procedures for the 1999 Point and Area Source NEI*, 12th International Emission Inventory Conference – "Emission Inventories – Applying New Technologies", San Diego, April 29 – May 1, 2003**.**
3. Dorn, J., Divita, F., Huntley, R., Janssen, M., 2010. *Implementing a Collaborative Process to Improve the Consistency, Transparency, and Accessibility of the Nonpoint Source Emission Estimates in the 2011 National Emissions Inventory*, 19th International Emission Inventory Conference – "Emissions Inventories – Informing Emerging Issues", San Antonio, TX, September 27 – 30, 2010.)

3.2 Agriculture – Crops & Livestock Dust

3.2.1 Sector description

The SCCs that belong to this sector are provided in Table 3-14. EPA estimates emissions for fugitive dust emissions from agricultural tilling (SCC 2801000003), highlighted in the table; the methodology is described in Section 3.2.4.

Table 3-14: SCCs used in the 2011 NEI for the Agriculture – Crops & Livestock Dust sector

SCC	SCC Level 2	SCC Level 3	SCC Level 4
2801000000	Agriculture Production - Crops	Agriculture - Crops	Total
2801000002	Agriculture Production - Crops	Agriculture - Crops	Planting
2801000003	Agriculture Production - Crops	Agriculture - Crops	Tilling
2801000005	Agriculture Production - Crops	Agriculture - Crops	Harvesting
2801000008	Agriculture Production - Crops	Agriculture - Crops	Transport
2801600000	Agriculture Production - Crops	Country Grain Elevators	Total
2805001000	Agriculture Production - Livestock	Beef cattle - finishing operations on feedlots (drylots)	Dust Kicked-up by Hooves (use 28-05-020, -001, -002, or -003 for Waste)
*SCC Level 1 for all is "Miscellaneous Area Sources"			

3.2.2 Sources of data overview and selection hierarchy

The agricultural crops and livestock dust sector includes data from S/L/T agency submitted data and the default EPA generated emissions. The agencies listed in Table 3-15 submitted emissions for this sector. Table 3-16 shows the selection hierarchy for datasets included in the agricultural crops and livestock dust sector.

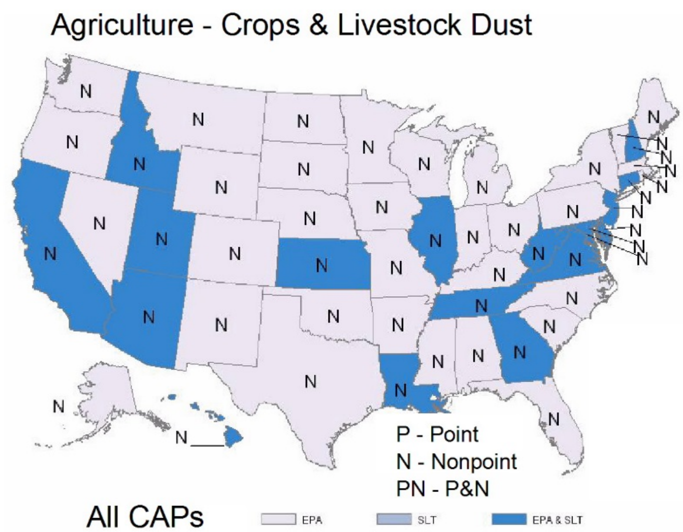
Table 3-15: Agencies that submitted Agricultural Crops and Livestock Dust data

Agency	Type	2801000000	2801000002	2801000003	2801000005	2801000008	2801600000	2805001000
EPA- PM augmentation	EPA	x	x	x	x	0	x	x
EPA – estimated (section 3.2.4)	EPA			x				
California Air Resources Board	S			x				
Coeur d'Alene Tribe	T			x	x		x	
Connecticut Department of Environmental Protection	S			x				
Delaware Department of Natural Resources and Environmental Control	S			x	x			
Georgia Department of Natural Resources	S	x						x
Hawaii Department of Health Clean Air Branch	S			x				
Idaho Department of Environmental Quality	S			x	x		x	
Illinois Environmental Protection Agency	S			x				
Kansas Department of Health and Environment	S			x			x	
Kootenai Tribe of Idaho	T			x	x		x	
Louisiana Department of Environmental Quality	S	x						
Maricopa County Air Quality Department	L	x		x	x	x		
Maryland Department of the Environment	S			x				
Metro Public Health of Nashville/Davidson County	L			x				
New Hampshire Department of Environmental Services	S			x				
New Jersey Department of Environment Protection	S			x				
Nez Perce Tribe	T			x	x		x	
Sac and Fox Nation of Missouri in Kansas and Nebraska Reservation	T			x	x			
Shoshone-Bannock Tribes of the Fort Hall Reservation of Idaho	T			x	x		x	
Utah Division of Air Quality	S		x		x			
Virginia Department of Environmental Quality	S			x				
West Virginia Division of Air Quality	S			x				

Table 3-16: 2011 NEI agricultural crops and livestock dust data selection hierarchy

Priority	Dataset Name	Dataset Content
1	Responsible Agency Data Set	State and Local Agency submitted emissions
2	2011EPA_PM-Augmentation	Augments PM emissions
3	2011EPA_NP_NoOverlap_w_Pt	EPA-generated data

3.2.3 Spatial coverage and data sources for the sector



3.2.4 EPA-developed agricultural crops and livestock dust emissions data

EPA estimates emissions for fugitive dust emissions from agricultural tilling (SCC 2801000003); this includes the airborne soil particulate emissions produced during the preparation of agricultural lands for planting. EPA's fugitive dust emissions from agricultural tilling were estimated for PM10-PRI, PM10-FIL, PM25-PRI, and PM25-FIL. Since there are no PM-CON emissions for this category, PM10-PRI emissions are equal to PM10-FIL emissions and PM25-PRI emissions are equal to PM25-FIL.

Particulate emissions from agricultural tilling were computed by multiplying a crop specific emissions factor by an activity factor.

The county-level emissions factors for agricultural tilling (in lbs. per acre) are specific to the crop and tilling type and were calculated using the following equation [ref 1, ref 2]:

$$EF = 4.8 \times k \times s^{0.6} \times p_{crop,tilling\ type}$$

where:

k = dimensionless particle size multiplier (PM_{10} = 0.21; $PM_{2.5}$ = 0.042),
s = silt content of surface soil (%),
p = number of passes or tillings in a year for a given crop and tillage type.

The silt content of surface soil is defined as the percentage of particles (mass basis) of diameter smaller than 75 micrometers (µm) found in the soil to a depth of 10 centimeters (cm). Silt contents were assigned by comparing the United States Department of Agriculture (USDA) surface soil survey map to a USDA county map and assigning a soil type to each county. Table 3-17 shows silt content assumed for each soil type.

Table 3-17: Silt content for soil types in USDA surface soil map

Soil Type	Silt Content (%)
Silt Loam	52
Sandy Loam	33
Sand	12
Loamy Sand	12
Clay	29
Clay Loam	29
Organic Material	10-82
Loam	40

Table 3-18 shows the number of passes or tillings in a year for each crop for conservation use and conventional use [ref 3]. No till, mulch till, and ridge till tillage systems are classified as conservation use, while 0 to 15 percent residue and 15 to 30 percent residue tillage systems are classified as conventional use.

Table 3-18: Number of passes or tillings per year

Crop	Conservation Use	Conventional Use
Barley	3	5
Beans and Peas	3	3
Canola	3	3
Corn	2	6
Cotton	5	8
Cover	1	1
Fallow	1	1
Fall-seeded Wheat	3	5
Forage	3	3
Hay	3	3
Oats	3	5
Peanuts	3	3
Permanent Pasture	1	1
Potatoes	3	3
Rice	5	5

Crop	Conservation Use	Conventional Use
Rye	3	5
Sorghum	1	6
Soybeans	1	6
Spring Wheat	1	4
Sugar beets	3	3
Sugarcane	3	3
Sunflowers	3	3
Tobacco	3	3

Activity Data

Since the CTIC has not prepared an updated National Crop Residue Management (CRM) Survey for 2011, activity data for this category were updated from the 2008 inventory using growth factors derived from state-level USDA statistics on various crop types [ref 5]. These growth factors were then matched by state and crop type and applied to the 2008 activity data at the county level. See Table 3-19 for how USDA and CRM categories were matched.

Table 3-19: Crosswalk between Crop Residue Management category and USDA data

CRM Category	USDA Data Items
Barley	BARLEY - ACRES HARVESTED
Beans and Peas	SUM OF BEANS AND PEAS HARVESTED
Canola	CANOLA - ACRES HARVESTED
Corn	CORN, GRAIN - ACRES HARVESTED
Cotton	COTTON - ACRES HARVESTED
Cover	TOTAL ACRES HARVESTED
Fallow	TOTAL ACRES HARVESTED
Forage	FORAGE, ALFALFA, HAY - ACRES HARVESTED
Hay	FORAGE (EXCL ALFALFA), HAY - ACRES HARVESTED
Oats	OATS - ACRES HARVESTED
Peanuts	PEANUTS - ACRES HARVESTED
Permanent Pasture	TOTAL ACRES HARVESTED
Potatoes	POTATOES - ACRES HARVESTED
Rice	RICE - ACRES HARVESTED
Rye	RYE - ACRES HARVESTED
Sorghum	SORGHUM, GRAIN - ACRES HARVESTED
Soybeans	SOYBEANS - ACRES HARVESTED
Sugar beets	SUGAR BEETS - ACRES HARVESTED
Sugarcane	SUGARCANE, SUGAR & SEED - ACRES HARVESTED
Sunflower	SUNFLOWER - ACRES HARVESTED
Tobacco	TOBACCO - ACRES HARVESTED
Wheat	WHEAT - ACRES HARVESTED
Winter Wheat	WHEAT, WINTER - ACRES HARVESTED

In addition, for those categories where a specific state/crop combination match was not made, the number of acres tilled were grown using a growth factor based on the total number of farm acres in those states.

The basis of agricultural tilling emission estimates was the number of acres of crops tilled in each county by crop type and tillage type. These data were obtained from the *2008 National Crop Residue Management Survey*, developed by the Conservation Technology Information Center (CTIC) [ref 5]. Data summaries are available on the CTIC web site. The five types of tilling for which emission estimates were calculated are:

Conservation Till	Conventional Till
No till/strip till	0 to 15 percent residue till (Intensive till)
Mulch till	15 to 30 percent residue till (Reduced till)
Ridge till	

Note that the 2008 activity data for highly erodible land (HEL) overlap the other crop-type-specific data. Therefore, the HEL and Treated HEL data are not included in the calculation of emissions estimates. A summary of national-level acres planted in 2008 for each tilling type, and total conservation and conventional acres planted in 2011, are presented in Table 3-20. Due to data nondisclosure agreements with CTIC, the EPA cannot release the county-level tillage data by crop type.

Table 3-20: Acres planted by tillage type, Fallow and pasture in 2008 and 2011

Tillage System	Actual National Number of Acres Planted in 2008 (million acres)	Actual National Number of Acres Planted in 2011 (million acres)
Conservation		
No-Till/Strip Till	74.86	n/a
Ridge-Till	2.32	n/a
Mulch-Till	49.43	n/a
Total Conservation Acres	126.61	124.02
Conventional		
Reduced-Till (15-30% cover)	63.31	n/a
Intensive-Till (<15% cover)	105.13	n/a
Total Conventional Acres	168.44	159.13
Total Conservation + Conventional	295.05	283.15

The following equation was used to determine the emissions from agricultural tilling [ref 1], [ref 2]. The county-level activity data are the acres of land tilled for a given crop and tilling type. The equation is adjusted to estimate PM_{10} and $PM_{2.5}$ emissions using the following parameters: a particle size multiplier, the silt content of the surface soil, the number of tillings per year for a given crop and tilling type, and the acres of land tilled for a given crop and tilling type.

$$E = \Sigma c \times k \times s^{0.6} \times p_{crop,tilling\ type} \times a_{crop,tilling\ type}$$

where:
- E = PM10-FIL or PM25-FIL emissions
- c = constant 4.8 lbs/acre-pass
- k = dimensionless particle size multiplier (PM_{10}=0.21; $PM_{2.5}$=0.042)
- s = percent silt content of surface soil, defined as the mass fraction of particles smaller than 75 µmdiameter found in soil to a depth of 10 cm
- p = number of passes or tillings in a year
- a = acres of land tilled (activity data)

Controls

No controls were accounted for in the EPA emission estimations.

3.2.5 Summary of quality assurance methods

A comparison was performed between emissions from 2011 and 2008. There were no large discrepancies in emissions from this sector between the two years. However, there were 12 HAPs submitted by California, which we do not consider to be expected pollutants from this process. These values were tagged. In addition, Louisiana requested that their submitted values be tagged and not used, because they believed that EPA's estimates were more up to date (they submitted data identical to 2008 submissions). Table 3-21 summarizes the number of tagged process-level emissions values from each agency affected by this QA. The EPA tagged the EPA data to avoid double counting in UT, since UT submitted agricultural dust using other SCCs.

Table 3-21: Agencies tagged values for Agriculture – Crop and Livestock Dust

Agency	Number of Values Tagged	Tag Reason
California Air Resources Board	672	Unexpected pollutants from this process
Louisiana Department of Environmental Quality	256	Louisiana asked us to replace their data (identical to 2008) with EPA estimates.

3.2.6 References for Agriculture – Crop & Livestock Dust

1. *The Role of Agricultural Practices in Fugitive Dust Emissions*, T.A. Cuscino, Jr., et al., California Air Resources Board, Sacramento, CA, June 1981.
2. Memorandum from Chatten Cowherd of Midwest Research Institute, to Bill Kuykendal of the U.S. Environmental Protection Agency, Emission Factor and Inventory Group, and W.R. Barnard of E.H. Pechan & Associates, Inc., September 1996.
3. *Agricultural Activities Influencing Fine Particulate Matter Emissions*, Woodard, Kenneth R., Midwest Research Institute, March 1996.
4. *National Crop Residue Management Survey*, Conservation Technology Information Center, 2008.
5. USDA Quickstats 2.0, Accessed April 2012.

3.3 Agriculture – Fertilizer Application

3.3.1 Sector description

Fertilizer in this category refers to any nitrogen-based compound, or mixture containing such a compound, that is applied to land to improve plant fitness. The SCCs that belong to this sector are provided in Table 3-22. EPA-estimated emissions are highlighted and discussed in Section 3.3.4.

Table 3-22: Source categories for Agricultural Fertilizer Application

SCC	Descriptor 2	Descriptor 4	Descriptor 5	Descriptor 10
2801700001	Miscellaneous Area Sources	Agriculture Production - Crops	Fertilizer Application	Anhydrous Ammonia
2801700002	Miscellaneous Area Sources	Agriculture Production - Crops	Fertilizer Application	Aqueous Ammonia
2801700003	Miscellaneous Area Sources	Agriculture Production - Crops	Fertilizer Application	Nitrogen Solutions
2801700004	Miscellaneous Area Sources	Agriculture Production - Crops	Fertilizer Application	Urea
2801700005	Miscellaneous Area Sources	Agriculture Production - Crops	Fertilizer Application	Ammonium Nitrate
2801700006	Miscellaneous Area Sources	Agriculture Production - Crops	Fertilizer Application	Ammonium Sulfate
2801700007	Miscellaneous Area Sources	Agriculture Production - Crops	Fertilizer Application	Ammonium Thiosulfate
2801700008	Miscellaneous Area Sources	Agriculture Production - Crops	Fertilizer Application	Other Straight Nitrogen
2801700009	Miscellaneous Area Sources	Agriculture Production - Crops	Fertilizer Application	Ammonium Phosphates (see also subsets (-13, -14, -15)
2801700010	Miscellaneous Area Sources	Agriculture Production - Crops	Fertilizer Application	N-P-K (multi-grade nutrient fertilizers)
2801700011	Miscellaneous Area Sources	Agriculture Production - Crops	Fertilizer Application	Calcium Ammonium Nitrate
2801700012	Miscellaneous Area Sources	Agriculture Production - Crops	Fertilizer Application	Potassium Nitrate
2801700013	Miscellaneous Area Sources	Agriculture Production - Crops	Fertilizer Application	Diammonium Phosphate
2801700014	Miscellaneous Area Sources	Agriculture Production - Crops	Fertilizer Application	Monoammonium Phosphate
2801700015	Miscellaneous Area Sources	Agriculture Production - Crops	Fertilizer Application	Liquid Ammonium Polyphosphate
2801700099	Miscellaneous Area Sources	Agriculture Production - Crops	Fertilizer Application	Miscellaneous Fertilizers

3.3.2 Sources of data overview and selection hierarchy

The agricultural fertilizer application sector includes data from the S/L/T agency submitted data and the default EPA generated agricultural fertilizer emissions. The agencies listed in

Table 3-23 submitted emissions for this sector. Note that not all agencies submitted all the different fertilizer types. Where only zero emissions were submitted (sum across all pollutants submitted), these are shown as zeroes ("0") in the table. Table 3-24 shows the selection hierarchy for the agricultural fertilizer application sector.

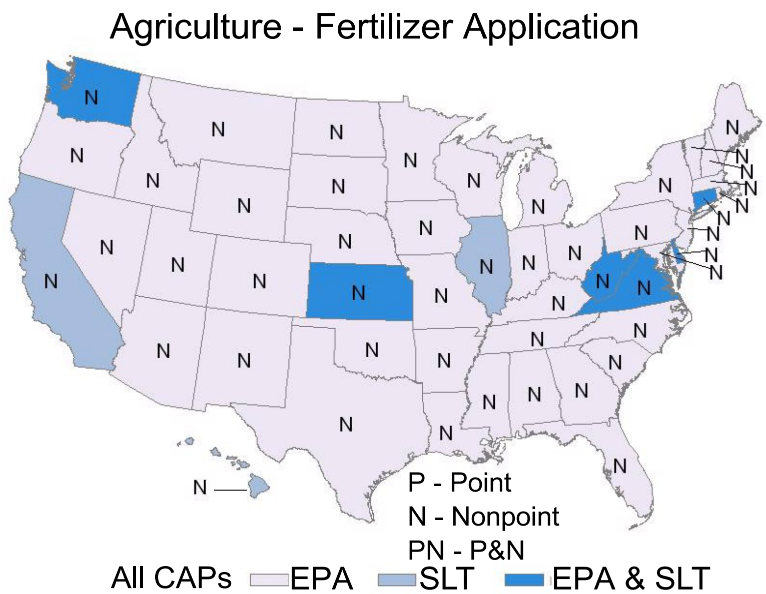
Table 3-23: Agencies that submitted Agricultural Fertilizer Application data

AGENCY	Type	Ammonium Nitrate	Ammonium	Ammonium Sulfate	Ammonium	Anhydrous Ammonia	Aqueous Ammonia	Calcium Ammonium Nitrate	Diammonium Phosphate	Liquid Ammonium Polyphosphate	Miscellaneous	Mono-Ammonium Phosphate	Nitrogen Solutions	N-P-K (multi-grade nutrient fertilizers)	Other Straight	Potassium Nitrate	Urea
EPA estimates (section 3.3.4)	EPA	X		X	X	X	X	X	X	X	X	X	X	X		X	X
California Air Resources Board	S					X											
Connecticut Department of Environmental Protection	S	X		X	X						X	X	X	X			X
Delaware Department of Natural Resources and Environmental Control	S										X						
Hawaii Department of Health Clean Air Branch	S	0	0	X	0	0	0	0					X	X	0	X	X
Illinois Environmental Protection Agency	S	X		X	X	X	0	0	X	X	X	X	X	X		0	X
Kansas Department of Health and Environment	S	X		X	X	X		X	X	X	X	X	X	X		X	X
Kickapoo Tribe of Indians of the Kickapoo Reservation in Kansas	T	X		X		X						X					
Sac and Fox Nation of Missouri in Kansas and Nebraska Reservation	T					X											
Virginia Department of Environmental Quality	S	X		X	X	X	X	X	X	X	X	X	X	X		X	X
Washington State Department of Ecology	S	X	X	X	X	X	X	X	X	X	X	X	X		X		X
West Virginia Division of Air Quality	S	X		X	0	0	0	0	X	0	X	0	X	X	0		X

Table 3-24: 2011 NEI Agricultural Fertilizer Application data selection hierarchy

Priority	Dataset Name	Dataset Content
1	Responsible Agency Data Set	State and Local Agency submitted emissions
2	2011EPA_NP_NoOverlap_w_Pt	EPA-generated data

3.3.3 Spatial coverage and data sources for the sector



3.3.4 EPA-developed agricultural fertilizer application emissions data

The approach to calculating emissions from this sector consisted of three general steps, as follows:

- Calculating the percent change in county-level fertilizer quantities applied between 2002 and 2007.
- Using the percent change in applied fertilizer quantity to grow the fertilizer activity files provided with the CMU Ammonia Model v.3.6. [ref 1]
- Running the CMU Ammonia Model to calculate ammonia emissions based on the updated county-level fertilizer quantities.

<u>Activity Data</u>

County-level fertilizer consumption data for 2002 and 2007 were obtained from the Fertilizer Institute's Commercial Fertilizers 2002 and 2007 reports [ref 2]. The consumption data includes total fertilizer sales or shipments for farm and non-farm use and is reported semi-annually for the fiscal year. To make the fertilizer types listed in the Commercial Fertilizers reports match the activity input files from the CMU Ammonia Model, the fertilizer types were grouped according to

Table 3-25. For any state in 2002 reporting fertilizer quantities from unknown counties, the quantities were apportioned to every county in the state based on cropland area obtained from the U.S. Department of Agriculture's 2002 Census of Agriculture [ref 3]. Similarly, for 2007, fertilizer quantities from unknown counties were apportioned based on cropland area reported in the 2007 Census of Agriculture [ref 4]. For each fertilizer group, the percent difference in fertilizer consumption between 2002 and 2007 was calculated for each county. These percentages were used to grow the 2002 county-level nitrogen quantities from the fertilizer activity files provided with the CMU Ammonia Model v.3.6.

Table 3-25: Fertilizers assigned to fertilizer groups

CMU Ammonia Model Fertilizer Group	Commercial Fertilizers Report - Fertilizer Code	Description 1	Description 2
Ammonium Nitrate	10	Ammonium Nitrate	Ammoniumnitrate
Ammonium Sulfate	24	Ammonium Sulfate	Ammoniumsulfate
Ammonium Thiosulfate	31	Ammonium Thiosulfate	Ammoniumthiosul
Anhydrous Ammonia	2	Anhydrous Ammonia	Anhy Ammonia
Aqueous Ammonia	6	Aqua Ammonia	Aqua Ammonia
Calcium Ammonium Nitrate	35	Calcium Ammonium Nit	Calcium Amm Nit
Diammonium Phosphate	203	Diammonium Phosphate	DAP
Liquid Ammonium Polyphosphate	249	Liquid Ammonium Poly	Liq Amm Poly
Miscellaneous	12	Ammonium Nitrate Sol	Amm Nit Solution
	13	Ammonium Nitrate-Lim	Amm Nit Lime Mix
	16	Ammonium Nitrate-Sul	Ammoniumnit-Sul
	20	Ammonium Polysulfide	Ammoniumpolysulf
	25	Ammonium Sulfate Sol	Amm Sul Solution
	27	Ammonium Sulfate-Nit	Ammoniumsul-Nit
	29	Ammonium Sulfate-Ure	Ammoniumsul-Urea
	46	Calcium Nitrate-Urea	Calcium Nit-Urea
	52	Magnesium Nitrate	Magnesium Nit
	54	Nitric Acid	Nitric Acid
	62	Sodium Nitrate	Sodium Nitrate
	64	Sulfur Coated Urea	Sul Ctd Urea
	67	Urea Solution	Urea Solution
	68	Urea-Formaldehyde	Urea-Form
	97	Nitrogen Product - C	Nitrogen No Code
	98	Nitrogen Product - C	Nitrogen No Id
	201	Ammonium Metaphospha	Ammoniummetaphos
	202	Ammonium Phosphate	Ammoniumphos
	204	Ammonium Polyphospha	Ammoniumpoly
	206	Ammonium Phosphate N	Amm Phosnitrate
	207	Ammonium Phosphate S	Amm Phossulfate
	241	Nitric Phosphate	Nitric Phos
	413	Manure Salts	Manure Salts
	458	Potassium-Sodium Nit	Pot-Sod Nitrate
	617	Fish Scrap	Fish Scrap
	629	Guano	Guano
	649	Manure	Manure
	652	Peat	Peat
	661	Sewage Sludge, Activ	Act Sew Sludge
	663	Sewage Sludge, Diges	Dig Sew Sludge
	665	Sewage Sludge, Heat	Ht Driedsew Slge
	667	Sewage Sludge, Other	Oth Sew Sludge
	671	Soybean Meal	Soybean Meal
	673	Tankage, Animal	Animal Tankage
	675	Tankage, Process	Process Tankage

CMU Ammonia Model Fertilizer Group	Commercial Fertilizers Report - Fertilizer Code	Description 1	Description 2
Miscellaneous (cont.)	697	Natural Organic Prod	Nat Org No Code
	698	Nat Organic Product	Nat Org No Id
	764	Soil Amendment	Soil Amendmnt
	766	Soil Conditioner	Soil Cond
	767	Potting Soil	Potting Soil
	797	Sec./Micronut. - Cod	Sec/Mic No Code
	798	Sec./Micronut. - Cod	Sec/Mic No Id
	978	Fertilizer Product -	Fert No Id
	988	Single Nutrient - Co	Sgle-Nu No Id
Mix	0	Identified By Grade	Ident. By Grade
	998	Multiple Nutrient -	Mult-Nut No Grade
Monoammonium Phosphate	209	Monoammonium Phosphate	Monoamm Phos
Nitrogen Solutions	56	Nitrogen Solution <28%	Nitrogensol <28%
	58	Nitrogen Solution 28%	Nitrogensol 28%
	59	Nitrogen Solution 30%	Nitrogensol 30%
	60	Nitrogen Solution 32%	Nitrogensol 32%
	61	Nitrogen Solution >32%	Nitrogensol >32%
Potassium Nitrate	453	Potassium Nitrate	Pot Nitrate
Urea	66	Urea	Urea

The average nitrogen content for each fertilizer group, reported in Table 3-26, was calculated by summing the county-level fertilizer quantities for all counties from the CMU Ammonia Model activity files to generate total nitrogen applied. For each fertilizer group, the total nitrogen applied was then divided by the 2002 fertilizer consumption data from the 2002 Commercial Fertilizers report to obtain the percent nitrogen content for each fertilizer group. For any county with fertilizer consumption in 2007, but not in 2002, the fertilizer quantity obtained from the 2007 Commercial Fertilizer's report was multiplied by the percent nitrogen content of each fertilizer group to determine tons of nitrogen. The tons of nitrogen were then converted to kilograms and allocated temporally by month according to the state-level percentage of total fertilizer in that group applied each month. The state-level percentage was calculated using data in the CMU Ammonia Model input files.

Table 3-26: Fertilizer Nitrogen content

Fertilizer	Nitrogen Content (percent)
Ammonium Nitrate	36
Ammonium Sulfate	22
Ammonium Thiosulfate	12
Anhydrous Ammonia	82
Aqueous Ammonia	21
Calcium Ammonium Nitrate	17
Diammonium Phosphate	18
Liquid Ammonium Polyphosphate	10
Miscellaneous	8
Mix	12

Fertilizer	Nitrogen Content (percent)
Monoammonium Phosphate	11
Nitrogen Solutions	29
Potassium Nitrate	14
Urea	46

Emission Factors

NH_3 emission factors for each fertilizer group were provided with the CMU Ammonia Model [ref 1] and are reported in Table 3-27.

Table 3-27: Fertilizer NH_3 emission factors

Fertilizer Description	Emission Factor (varies by county for some fertilizers)			Emission Factor Unit	Emission Factor Reference
	Min	Max	Average		
Ammonium Nitrate	1.0	3.0	1.91	% N volatilized as NH_3	1
Ammonium Sulfate	5.0	15.0	9.53	% N volatilized as NH_3	1
Ammonium Thiosulfate	2.5	2.5	2.5	% N volatilized as NH_3	1
Anhydrous Ammonia	4.0	4.0	4.0	% N volatilized as NH_3	1
Aqueous Ammonia	4.0	4.0	4.0	% N volatilized as NH_3	1
Calcium Ammonium Nitrate	1.0	3.0	1.91	% N volatilized as NH_3	1
Diammonium Phosphate	5.0	5.0	5.0	% N volatilized as NH_3	1
Liquid Ammonium Polyphosphate	5.0	5.0	5.0	% N volatilized as NH_3	1
Miscellaneous Fertilizers	6.0	8.0	6.59	% N volatilized as NH_3	1
Monoammonium Phosphate	5.0	5.0	5.0	% N volatilized as NH_3	1
Nitrogen Solutions	8.0	8.0	8.0	% N volatilized as NH_3	1
N-P-K (multi-grade nutrient fertilizers)	1.0	3.0	1.91	% N volatilized as NH_3	1
Potassium Nitrate	2.0	2.0	2.0	% N volatilized as NH_3	1
Urea	15.0	20.0	15.8	% N volatilized as NH_3	1

Emissions

The fertilizer activity files provided with the CMU Ammonia Model v.3.6 were replaced with the updated county-level fertilizer files. County-level ammonia emissions were then calculated by running the model. The model corrects for the difference in mass between nitrogen and ammonia.

N applied x % N volatilized as NH_3 x 17 g /14 g = NH_3 emissions

Sample Calculations

Allocation of Fertilizer Quantities from Unknown Counties

From the 2007 Commercial Fertilizers report, Colorado reported 4,774,000 kg of ammonium nitrate from unknown counties for January through June of 2007. This quantity was distributed to counties based on the percent of cropland in the state located in each county. For example, Colorado has 11,484,000 acres of cropland. Adams County, Colorado has 547,000 acres of cropland.

Percent of cropland in CO located in Adams County = (547,000 / 11,484,000) x 100 = 4.76
Ammonium nitrate allocated to Adams County = 4,774,000 kg x .0476 = 227,240 kg

Growing the CMU Ammonia Model Input Files

After allocating fertilizer data from unknown counties for 2002 and 2007, the county-level percent difference between fertilizer quantity applied in 2002 and 2007 was used to grow the data in the activity files provided with the CMU Ammonia Model. For example, Autauga County, Alabama applied 473,180 kg of ammonium nitrate from July 2001 through December 2001 and 516,240 kg from July 2006 through December 2006.

Percent change in ammonium nitrate applied = (516,240 kg / 473,180 kg) x 100 = 109

The quantity of nitrogen, in the form of ammonium nitrate, applied per month from July through December 2002 in Autauga County was extracted from the CMU Ammonia Model activity files and multiplied by the percent change.

July:	3,250 kg x 1.09 = 3,543 kg N
August:	3,210 kg x 1.09 = 3,499 kg N
September:	9,640 kg x 1.09 = 10,508 kg N
October:	6,320 kg x 1.09 = 6,889 kg N
November:	2,600 kg x 1.09 = 2,834 kg N
December:	1,380 kg x 1.09 = 1,504 kg N

Calculation of Nitrogen Content in a Fertilizer Group

The sum of all nitrogen applied in the form of ammonium nitrate from the CMU Ammonia Model ammonium nitrate activity file was 508,000,000 kg. From the 2002 Commercial Fertilizers report, the total quantity of ammonium nitrate applied in 2002 was 1,420,000,000 kg.

N content of ammonium nitrate = (508,000,000 kg / 1,420,000,000 kg) x 100 = 36 %

County Where Fertilizer was Applied in 2007, but not in 2002

In Meade County, Kentucky, there was no ammonium nitrate applied from January to June of 2002, but there were 356,705 kg applied from January to June of 2007. To convert to kg of nitrogen, the quantity of ammonium nitrate applied in 2007 was multiplied by the nitrogen content of ammonium nitrate.

N applied = 356,705 kg x 0.36 = 128,414 kg

The quantity of nitrogen was then allocated temporally by month from January to June based on the state-level distribution of nitrogen applied in the form of ammonium nitrate from the CMU Ammonia Model ammonium nitrate activity file. Total nitrogen in the form of ammonium nitrate applied in Kentucky from January through June of 2002 was 17,000,000 kg. The total for January was 289,000 kg. The total for February was 745,000 kg.

January: (289,000 kg / 17,000,000 kg) x 128,414 kg = 2,183 kg N applied in Meade County
February: (745,000 kg / 17,000,000 kg) x 128,414 kg = 5,600 kg N applied in Meade County
March – June: calculated same as above.

3.3.5 Summary of quality assurance methods

A comparison was performed between emissions from 2011 and 2008. There were no large discrepancies in emissions from this sector between the two years. In fact, two states, Georgia and Louisiana, had data that were remarkably similar to their 2008 submissions, so these states were called for clarification on their submissions. Contact with these states revealed that Georgia and Louisiana had pulled 2008 data forward for this sector, and both states requested that we use EPA data for 2011 for these emissions instead. Therefore, these state values were tagged. In addition, one value from West Virginia was determined to be an outlier (greater than 2008 by a factor of 10). Table 3-28 summarizes the number of tagged process-level emissions values from each agency affected by this QA.

Table 3-28: Agencies tagged values for Agriculture – Fertilizer

Agency	Number of Values Tagged	Tag Reason
Georgia Department of Natural Resources	2,226	State requested that we replace their submitted data with EPA's estimates.
Louisiana Department of Environmental Quality	256	State requested that we replace their data with EPA estimates.
West Virginia Division of Air Quality	1	Outlier

3.3.6 References for Agriculture – Fertilizer Application

1. Cliff Davidson, Peter Adams, Ross Strader, Rob Pinder, Natalie Anderson, Marian Goebes, and Josh Ayers. The Environmental Institute, Carnegie Mellon University, *CMU Ammonia Model v.3.6.*, 2004, accessed 25 April 2009.
2. Association of American Plant Food Control Officials in partnership with The Fertilizer Institute, *Commercial Fertilizers 2002* and *Commercial Fertilizers 2007*, accessed 2 May 2009.
3. U.S. Department of Agriculture, *2002 Census of Agriculture*, accessed 30 April 2009.
4. U.S. Department of Agriculture, *2007 Census of Agriculture*, accessed 30 April 2009.

3.4 Agriculture – Livestock Waste

3.4.1 Sector description

The emissions from this category are primarily from domesticated animals intentionally reared for the production of food, fiber, or other goods or for the use of their labor. The livestock included in the EPA–estimated emissions include beef cattle, dairy cattle, ducks, geese, goats, horses, poultry, sheep, and swine. As discussed in Section 3.4.2, a few S/L/T agencies reported data from a few other categories in this sector such as domestic and wild animal waste, though these emissions are small compared to the livestock defined above.

3.4.2 Sources of data overview and selection hierarchy

The agricultural livestock waste sector includes data from three datasets from the nonpoint data category: the S/L/T agency submitted data, the PM Augmentation dataset, and the default EPA generated livestock emissions. It also includes data from the point data category the S/L/T agency submitted data, the PM Augmentation dataset, TRI, chromium speciation and EPA EGU. The TRI, chromium speciation and EPA EGU datasets in this sector result from the use of an erroneous SCC code (30202001) submitted by California for approximately 40 facilities that are unrelated to this category[12].

Table 3-29 shows the nonpoint SCCs covered by the EPA estimates (discussed in Section 3.4.4) and by the State/Local and Tribal agencies that submitted data. Table 3-30 presents the two "Industrial Processes" point SCCs reported by 3 states: California, Wisconsin and Colorado. Point emissions from this sector are negligible compared to the nonpoint emissions (3 orders of magnitude lower).

Table 3-29: Nonpoint SCCs with 2011 NEI emissions in the Livestock Waste sector

SCC	SCC Level Two	SCC Level Three	SCC Level Four	EPA	Local	State	Tribe
2805001100	Agriculture Production - Livestock	Beef cattle - finishing operations on feedlots (drylots)	Confinement	X	X	X	X
2805001200	Agriculture Production - Livestock	Beef cattle - finishing operations on feedlots (drylots)	Manure handling and storage	X		X	X
2805001300	Agriculture Production - Livestock	Beef cattle - finishing operations on feedlots (drylots)	Land application of manure	X		X	X
2805002000	Agriculture Production - Livestock	Beef cattle production composite	Not Elsewhere Classified	X		X	X
2805003100	Agriculture Production - Livestock	Beef cattle - finishing operations on pasture/range	Confinement	X		X	X
2805007100	Agriculture Production - Livestock	Poultry production - layers with dry manure management systems	Confinement	X	X	X	X
2805007300	Agriculture Production - Livestock	Poultry production - layers with dry manure management systems	Land application of manure	X		X	X
2805008100	Agriculture Production - Livestock	Poultry production - layers with wet manure management systems	Confinement	X		X	X
2805008200	Agriculture Production - Livestock	Poultry production - layers with wet manure management systems	Manure handling and storage	X		X	X
2805008300	Agriculture Production - Livestock	Poultry production - layers with wet manure management systems	Land application of manure	X		X	X
2805009100	Agriculture Production - Livestock	Poultry production - broilers	Confinement	X		X	X
2805009200	Agriculture Production - Livestock	Poultry production - broilers	Manure handling and storage	X		X	X
2805009300	Agriculture Production - Livestock	Poultry production - broilers	Land application of manure	X		X	X
2805010100	Agriculture Production - Livestock	Poultry production - turkeys	Confinement	X		X	X
2805010200	Agriculture Production - Livestock	Poultry production - turkeys	Manure handling and storage	X		X	X
2805010300	Agriculture Production - Livestock	Poultry production - turkeys	Land application of manure	X		X	X

[12] California does have some point sources appropriately assigned to 30202001

SCC	SCC Level Two	SCC Level Three	SCC Level Four	EPA	Local	State	Tribe
2805018000	Agriculture Production - Livestock	Dairy cattle composite	Not Elsewhere Classified	X		X	X
2805019100	Agriculture Production - Livestock	Dairy cattle - flush dairy	Confinement	X	X	X	X
2805019200	Agriculture Production - Livestock	Dairy cattle - flush dairy	Manure handling and storage	X		X	X
2805019300	Agriculture Production - Livestock	Dairy cattle - flush dairy	Land application of manure	X		X	X
2805020000	Agriculture Production - Livestock	Cattle and Calves Waste Emissions	Total (see also 28-05-001, -002, -003)				X
2805021100	Agriculture Production - Livestock	Dairy cattle - scrape dairy	Confinement	X		X	X
2805021200	Agriculture Production - Livestock	Dairy cattle - scrape dairy	Manure handling and storage	X		X	X
2805021300	Agriculture Production - Livestock	Dairy cattle - scrape dairy	Land application of manure	X		X	X
2805022100	Agriculture Production - Livestock	Dairy cattle - deep pit dairy	Confinement	X		X	X
2805022200	Agriculture Production - Livestock	Dairy cattle - deep pit dairy	Manure handling and storage	X		X	X
2805022300	Agriculture Production - Livestock	Dairy cattle - deep pit dairy	Land application of manure	X		X	X
2805023100	Agriculture Production - Livestock	Dairy cattle - drylot/pasture dairy	Confinement	X		X	X
2805023200	Agriculture Production - Livestock	Dairy cattle - drylot/pasture dairy	Manure handling and storage	X		X	X
2805023300	Agriculture Production - Livestock	Dairy cattle - drylot/pasture dairy	Land application of manure	X		X	X
2805025000	Agriculture Production - Livestock	Swine production composite	Not Elsewhere Classified (see also 28-05-039, -047, -053)	0		X	0
2805030000	Agriculture Production - Livestock	Poultry Waste Emissions	Not Elsewhere Classified (see also 28-05-007, -008, -009)	X		X	X
2805030001	Agriculture Production - Livestock	Poultry Waste Emissions	Pullet Chicks and Pullets less than 13 weeks old			0	
2805030002	Agriculture Production - Livestock	Poultry Waste Emissions	Pullets 13 weeks old and older but less than 20 weeks old			0	
2805030003	Agriculture Production - Livestock	Poultry Waste Emissions	Layers			0	
2805030004	Agriculture Production - Livestock	Poultry Waste Emissions	Broilers			0	
2805030007	Agriculture Production - Livestock	Poultry Waste Emissions	Ducks	X		X	X
2805030008	Agriculture Production - Livestock	Poultry Waste Emissions	Geese	X		X	X
2805030009	Agriculture Production - Livestock	Poultry Waste Emissions	Turkeys			0	

SCC	SCC Level Two	SCC Level Three	SCC Level Four	EPA	Local	State	Tribe
2805035000	Agriculture Production - Livestock	Horses and Ponies Waste Emissions	Not Elsewhere Classified	X	X	X	X
2805039100	Agriculture Production - Livestock	Swine production - operations with lagoons (unspecified animal age)	Confinement	X	X	X	X
2805039200	Agriculture Production - Livestock	Swine production - operations with lagoons (unspecified animal age)	Manure handling and storage	X		X	X
2805039300	Agriculture Production - Livestock	Swine production - operations with lagoons (unspecified animal age)	Land application of manure	X		X	X
2805040000	Agriculture Production - Livestock	Sheep and Lambs Waste Emissions	Total	X	X	X	X
2805045000	Agriculture Production - Livestock	Goats Waste Emissions	Not Elsewhere Classified	X	X	X	X
2805045002	Agriculture Production - Livestock	Goats Waste Emissions	Angora Goats			0	
2805045003	Agriculture Production - Livestock	Goats Waste Emissions	Milk Goats			0	
2805047100	Agriculture Production - Livestock	Swine production - deep-pit house operations (unspecified animal age)	Confinement	X		X	X
2805047300	Agriculture Production - Livestock	Swine production - deep-pit house operations (unspecified animal age)	Land application of manure	X		X	X
2805053100	Agriculture Production - Livestock	Swine production - outdoor operations (unspecified animal age)	Confinement	X		X	X
2806010000	Domestic Animals Waste Emissions	Cats	Total		X	X	
2806015000	Domestic Animals Waste Emissions	Dogs	Total		X	X	
2807025000	Wild Animals Waste Emissions	Elk	Total			X	
2807030000	Wild Animals Waste Emissions	Deer	Total			X	

Table 3-30: Point SCCs with 2011 NEI emissions in the Livestock Waste sector – reported only by States

SCC	SCC Level Two	SCC Level Three	SCC Level Four	CA	CO	WI
30202001	Food and Agriculture	Beef Cattle Feedlots	Feedlots: General	X	X	X
30202101	Food and Agriculture	Eggs and Poultry Production	Manure Handling: Dry		X	

The agencies listed in Table 3-31 submitted emissions for this sector.

Table 3-31: Agencies that submitted Livestock Waste data

Agency	Type
California Air Resources Board	State
Clark County Department of Air Quality and Environmental Management	Local
Connecticut Department of Environmental Protection	State
Delaware Department of Natural Resources and Environmental Control	State

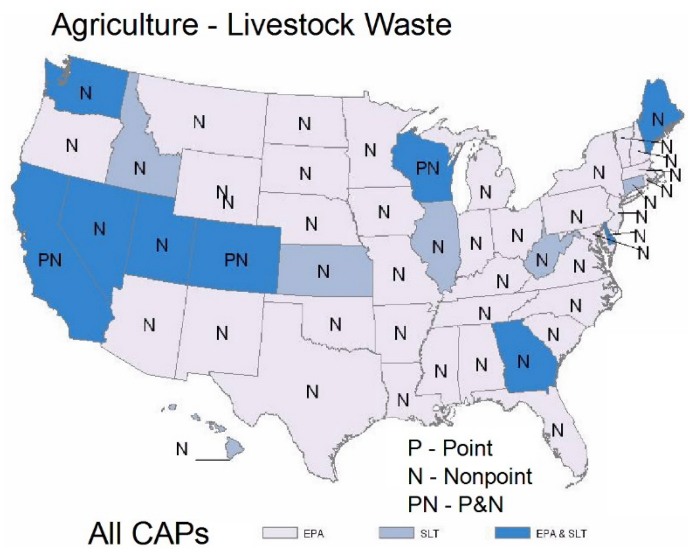
Agency	Type
Georgia Department of Natural Resources	State
Hawaii Department of Health Clean Air Branch	State
Idaho Department of Environmental Quality	State
Illinois Environmental Protection Agency	State
Kansas Department of Health and Environment	State
Maine Department of Environmental Protection	State
Shoshone-Bannock Tribes of the Fort Hall Reservation of Idaho	Tribal
Coeur d'Alene Tribe	Tribal
Nez Perce Tribe	Tribal
Kootenai Tribe of Idaho	Tribal
Sac and Fox Nation of Missouri in Kansas and Nebraska Reservation	Tribal
Utah Division of Air Quality	State
West Virginia Division of Air Quality	State
Kickapoo Tribe of Indians of the Kickapoo Reservation in Kansas	Tribal

Table 3-32 shows the selection hierarchy that applies to the *nonpoint* datasets included in this sector. The point source datasets are not included in the table. The point hierarchy includes the EPA PM-Augmentation dataset first, the Responsible Agency Data Set second, and the other EPA datasets behind the Responsible Agency Data Set.

Table 3-32: 2011 NEI Agricultural Livestock Waste data selection hierarchy

Priority	Dataset Name	Dataset Content
1	Responsible Agency Data Set	State and Local Agency submitted emissions
2	2011EPA_PM-Augmentation	Augments PM emissions
3	2011EPA_NP_NoOverlap_w_Pt	EPA-generated data

3.4.3 Spatial coverage and data sources for the sector



3.4.4 EPA-developed livestock waste emissions data

Due to resource constraints at EPA, 2011 emissions are assumed to be the same as 2008 emissions.

EPA's approach to calculating 2008 emissions for this sector consisted of four general steps, as follows:

- Determine county-level activity data, i.e., the population of animals for 2007.
- For beef, dairy, poultry, and swine, apportion animal populations to a manure management train (MMT) for each county. Animal populations for ducks, geese, goats, horses, and sheep were not apportioned to MMTs.
- Modify the emission factor files provided with the Carnegie Mellon University (CMU) Ammonia Model v. 3.6 [ref 1] to ensure that every county had an assigned emission factor.
- Use the CMU Ammonia Model v. 3.6 to calculate ammonia emissions based on the updated county-level animal populations and emission factor.

<u>Activity Data</u>

County-level animal population numbers for 2007 were obtained from the U.S. Department of Agriculture's 2007 Census of Agriculture report [ref 2]). 2007 data were used because they were the most recent available at the time these estimates were prepared (in 2008). For Virginia, the county-level census data includes animal populations from Virginia's 39 independent cities. For some counties and states, census data were withheld to avoid disclosing data for individual farms. However, the total national-level animal numbers and most state-level animal numbers for each livestock type reported in the Census include those animal numbers not disclosed at the county-level. When available, state-level animal numbers from the United States Department of Agriculture (USDA) National Agriculture Statistical Service (NASS) online database [ref 3], were used for states with undisclosed animal numbers in the 2007 Census of Agriculture. To determine the total number of undisclosed animals, we summed and subtracted disclosed county-level animal numbers for each livestock type from the total state animal numbers. The total undisclosed animal population for a specific livestock type was then allocated to those counties reporting undisclosed data proportionally based on the number of farms raising that livestock in each county. If the state-level data were undisclosed and not available in the NASS database, then national animal numbers were used to determine undisclosed state numbers in a manner similar to the case where counties had undisclosed data. We then summed and subtracted the disclosed county-level data from the state-level data to determine animal numbers not disclosed at the county-level. We then allocated the difference to those counties with undisclosed data proportionally based on the number of farms raising that livestock in each county. States that had undisclosed data at the state level are as follows: for broilers, Massachusetts and Rhode Island; for layers, Arizona, Connecticut, Delaware, Idaho, Kansas, Maine and New Mexico; for turkeys, Colorado and Oklahoma; for pullets, Arizona, Connecticut, Delaware, Hawaii, Idaho, Kansas, Massachusetts, New Mexico, North Dakota, and South Dakota; and for ducks, New Jersey and Utah.

Apportion activity data to manure management trains

To run the model using 2007 animal population, it was necessary to match the 2007 animal information to the CMU model's (v3.6) input files, which were based on 2002 animal population and MMTs. We apportioned the 2007 county-level animal population data to MMTs based on data available in the model. A MMT consists of an animal confinement area (e.g., drylot, pasture, flush, scrape); components used to store, process, or stabilize the manure (e.g., anaerobic lagoons, deep pits); and a land application site where manure is used as a fertilizer source [ref 4]. It is important to apportion the animal populations to MMTs because it has a large impact on the emissions estimates in the CMU model for the animals using that approach. Not all animal types were apportioned to MMTs. MMTs for ducks, geese, goats, horses, and sheep are not a part of the model. Also, some animal category names did not match the category names currently in the model. See the example of "Other Cattle" described below.

The apportionment was based on county-level MMT percentages derived from the CMU Ammonia Model v3.6, which was originally developed for a 2002 inventory year. For each livestock type, we divided the CMU Model's 2002 county-level number of animals in each MMT by the total county-level animal population for that livestock type to calculate the percentage of total animals managed by each MMT. In cases where the county-level numbers were zero in the CMU Ammonia Model and the county animal population in 2007 for that MMT was not zero, we assigned the county state-level MMT percentages. We then multiplied the county-level animal population for each livestock type by the MMT percentages to apportion the 2007 animal populations to each MMT. The result of this approach is that the proportion of animals in each MMT is unchanged from the CMU model's 2002-based approach to the 2011 NEI.

Cattle reported as "Other Cattle" in the 2007 Census of Agriculture were divided between dairy cattle and beef cattle at the county-level using percent allocations derived from county-level dairy and beef cattle reported in the 2007 Census of Agriculture and corrected for undisclosed data. The animal numbers from "Other Cattle" apportioned to dairy and beef cattle were used to grow the "Dairy Cattle – Composite and Beef Cattle – Composite" activity input files from 2002 to 2007 for input to the CMU Ammonia Model.

County-level pullet numbers reported in the 2007 Census of Agriculture were used to grow the "Poultry – Composite" activity input file from 2002 to 2007 for input to the CMU Ammonia Model.

Emission Factors

Table 3-33 provides information on emission factors used in the EPA emissions estimate. The table lists "county" for county-specific emission factors, and "state" for state-specific emission factors. The emission factor for the poultry composite categories was obtained from an EPA report [ref 4]. The county-level emission factors for the beef composite and dairy composite categories were developed using beef and dairy cattle emission factors provided with the CMU Model. Specifically, weighted average emission factors were calculated based on the number of beef or dairy cattle in each MMT from the CMU Model's 2002 activity files and the emission factor assigned to each MMT. The calculations made for the beef composite are available in the file "County-Level Emission Factors for Beef Composite.xls", and the calculations for the dairy composite are available in the file "County-level Emission factors for Diary Component.xls". All other emission factors are consistent with those included in the CMU Ammonia Model v.3.6.

The emission factors for some counties in the CMU Ammonia Model files were zero. To ensure that all counties with animal populations were assigned emissions factors, the emission factor input files provided with the CMU Ammonia Model were modified. For all counties with an emission factor of zero, the emission factor was replaced with the state average emission factor. If all counties in the state had emission factors of zero, then the county emission factor was replaced with the national average emission factor.

The state average emission factor was calculated by summing the counties with non-zero emission factors in the state and dividing the total by the number of counties in that state with non-zero emission factors. The national average emission factors listed in the table were calculated by summing the counties with non-zero emission factors in the nation and dividing the total by the number of counties in the nation with non-zero emission factors. The final county-specific and state-specific emission factors are available in the file "Emission Factors for Ag animal husbandry 2008v2.xlsx".

Table 3-33: Emission factors for NH_3 emissions used for EPA's Agricultural Livestock Waste data

Description	Emission Factor	Emission Factor Unit	Emission Factor Reference
Beef Cattle – Composite	county	kg NH_3/cow/month	ref 5
Beef Cattle – Drylot Operation – Confinement	9.45E-01	kg NH_3/cow/month	ref 1
Beef Cattle – Drylot Operation – Land Application	state	kg NH_3/cow/month	ref 1
Beef Cattle – Drylot Operation – Manure Storage	3.78E-04	kg NH_3/cow/month	ref 1
Beef Cattle – Pasture Operation – Confinement	county	kg NH_3/cow/month	ref 1
Dairy Cattle – Composite	county	kg NH_3/cow/month	ref 5
Dairy Cattle – Deep Pit Dairy Confinement	2.42E+00	kg NH_3/cow/month	ref 1
Dairy Cattle – Deep Pit Dairy Land Application	state	kg NH_3/cow/month	ref 1
Dairy Cattle – Deep Pit Dairy Manure Storage	1.13E-01	kg NH_3/cow/month	ref 1
Dairy Cattle – Drylot Dairy Confinement	state	kg NH_3/cow/month	ref 1
Dairy Cattle – Drylot Dairy Land Application	state	kg NH_3/cow/month	ref 1
Dairy Cattle – Drylot Dairy Manure Storage	state	kg NH_3/cow/month	ref 1
Dairy Cattle – Flush Dairy Confinement	2.00E+00	kg NH_3/cow/month	ref 1
Dairy Cattle – Flush Dairy Land Application	state	kg NH_3/cow/month	ref 1
Dairy Cattle – Flush Dairy Manure Storage	state	kg NH_3/cow/month	ref 1
Dairy Cattle – Scrape Dairy Confinement	state	kg NH_3/cow/month	ref 1
Dairy Cattle – Scrape Dairy Land Application	state	kg NH_3/cow/month	ref 1
Dairy Cattle – Scrape Dairy Manure Storage	state	kg NH_3/cow/month	ref 1
Ducks	7.67E-02	kg NH_3/duck/month	ref 1
Geese	7.67E-02	kg NH_3/goose/month	ref 1
Goats	5.29E-01	kg NH_3/goat/month	ref 1
Horses	1.02E+00	kg NH_3/horse/month	ref 1
Poultry – Broiler Operation – Confinement	8.32E-03	kg NH_3/bird/month	ref 1
Poultry – Broiler Operation – Land Application	6.80E-03	kg NH_3/bird/month	ref 1
Poultry – Broiler Operation – Manure Storage	1.51E-03	kg NH_3/bird/month	ref 1
Poultry – Composite	2.00E-02	kg NH_3/bird/month	ref 4
Poultry – Layers – Dry Manure Operation – Confinement	3.36E-02	kg NH_3/bird/month	ref 1
Poultry – Layers – Dry Manure Operation – Land Application	county	kg NH_3/bird/month	ref 1
Poultry – Layers – Wet Manure Operation – Confinement	9.45E-03	kg NH_3/bird/month	ref 1
Poultry – Layers – Wet Manure Operation – Land Application	county	kg NH_3/bird/month	ref 1

Description	Emission Factor	Emission Factor Unit	Emission Factor Reference
Poultry – Layers – Wet Manure Operation – Manure Storage	county	kg NH_3/bird/month	ref 1
Poultry – Turkey Operation – Confinement	3.78E-02	kg NH_3/bird/month	ref 1
Poultry – Turkey Operation – Land Application	3.40E-02	kg NH_3/bird/month	ref 1
Poultry – Turkey Operation – Storage	6.80E-03	kg NH_3/bird/month	ref 1
Sheep	2.65E-01	kg NH_3/sheep/month	ref 1
Swine – Composite	county	kg NH_3/pig/month	ref 1
Swine – Deep Pit Operation – Confinement	2.65E-01	kg NH_3/pig/month	ref 1
Swine – Deep Pit Operation – Land Application	county	kg NH_3/pig/month	ref 1
Swine – Lagoon Operation – Confinement	2.27E-01	kg NH_3/pig/month	ref 1
Swine – Lagoon Operation – Land Application	county	kg NH_3/pig/month	ref 1
Swine – Lagoon Operation – Manure Storage	county	kg NH_3/pig/month	ref 1
Swine – Outdoor Operation – Confinement	county	kg NH_3/pig/month	ref 1

Emissions

The livestock activity files provided with the CMU Ammonia Model v.3.6 were replaced with the updated county-level animal population files and modified emission factors files. We then ran the CMU Ammonia Model v.3.6 to create county/SCC ammonia emissions. EPA's county-level emissions can be found in the supporting materials in the file "animal_livestock_emissions_2011.zip" as listed in Table 3-9, Section 3.1.7.

Sample Calculations

Allocation of Undisclosed Data

From the 2007 Census of Agriculture, the total national number of beef cattle in Alabama is 678,949. The total number of beef cattle disclosed at the county-level is 388,827.

Total number of beef cattle undisclosed at the county-level = 678,949 – 338,827 = 340,122

From the 2007 Census of Agriculture, the total number of farms in Alabama not disclosing beef cattle numbers is 10,518.

Average beef cattle per farm not disclosing data = 340,122 / 10,518 = 32.3

For 2007, Baldwin County, Alabama beef cattle data were not disclosed. The total number of farms with beef cattle in Baldwin County is 343.

Estimated number of beef cattle in Baldwin County = 32.3 x 343 = 11,092

Manure Management Train

From the 2002 CMU Ammonia Model input files, Chilton County, Alabama had 79 beef cattle under drylot management and 18,900 beef cattle under pasture management in 2002.

Total beef cattle = 79 + 18,900 = 18,979
% of beef cattle under drylot management = 79 / 18,979 = 0.42
% of beef cattle under pasture management = 18,900 / 18,979 = 99.58

The total number of beef cattle for Chilton County reported in the 2007 Census of Agriculture is 7,939.

Number of beef cattle under drylot management in 2007 = 7,939 x 0.0042 = 33

Number of beef cattle under pasture management in 2007 = 7,939 x 0.9958 = 7,906

Other Cattle

For Clay County, Alabama, the 2007 Census of Agriculture reports the number of "Other Cattle" as 5,471, the number of dairy cattle as 216, and the number of beef cattle as 9,096.

Total beef and dairy cattle reported = 216 + 9,096 = 9,312
% of other cattle assigned to beef cattle = (9,096/9,312)*100 = 97.68
% of other cattle assigned to dairy cattle = (216/9,312)*100 = 2.32
Other cattle allocated to beef cattle = 5,471 x .9768 = 5,344
Other cattle allocated to dairy cattle = 5,471 x 0.0232 = 127

3.4.5 Summary of quality assurance methods

Data analyses involving comparison of emissions between 2011 and 2008 showed some large discrepancies in emissions from this sector between the two years. Values submitted by S/L/T agencies that were larger than 10 times the 2008 submitted values were tagged as outliers and were not used in the 2011 NEI (unless the agency corrected the values prior to the final 2011 selection). Furthermore, California and Idaho submitted some pollutants for this sector that EPA did not estimate nor did any other states, so for consistency, these values were tagged and not used in the 2011 NEI. In addition, Louisiana requested that some values be tagged and not used, because Louisiana had pulled 2008 data forward for this sector and requested that we use EPA data for 2011 for these emissions instead. Table 3-34 summarizes the number of tagged process-level emissions values from each agency affected by this QA.

Table 3-34: Agencies tagged values for Agriculture Livestock Waste

Agency	Number of Values Tagged	Tag Reason
California Air Resources Board	1,653	Extraneous pollutants (no other states submitted)
California Air Resources Board	9	Outlier
Idaho Department of Environmental Quality	11,088	Extraneous pollutants (no other states submitted)
Louisiana Department of Environmental Quality	2,944	State requested that we replace their data with EPA estimates.

3.4.6 References for Agriculture – Livestock Waste

1. Cliff Davidson, Peter Adams, Ross Strader, Rob Pinder, Natalie Anderson, Marian Goebes, and Josh Ayers. The Environmental Institute, Carnegie Mellon University, *CMU Ammonia Model v.3.6.*, 2004, accessed 25 April 2009.
2. U.S. Department of Agriculture, *2007 Census of Agriculture*, accessed 30 April 2009.
3. U.S. Department of Agriculture, National Agricultural Statistics Service, accessed 28 January 2010.
4. U.S. Environmental Protection Agency, *National Emission Inventory – Ammonia Emissions from Animal Agricultural Operations*, Revised Draft Report, 22 April 2005, p. 4-6, accessed 5 May 2009.
5. Jonathan Dorn, E.H. Pechan & Associates. 2009. A weighted average emission factor calculated using data from the 2002 CMU Ammonia Model v.3.6.

3.5 Bulk Gasoline Terminals and Gas Stations

3.5.1 Sector description

This section covers the creation of the EIS sectors “Bulk Gasoline Terminals” and “Gas Stations”. In composite, we refer to these sources as “Stage I gasoline distribution”.

Stage I gasoline distribution includes the following gasoline emission points: 1) bulk terminals; 2) pipeline facilities; 3) bulk plants; 4) tank trucks; and 5) service stations. Emissions from Stage I gasoline distribution occur as gasoline vapors are released into the atmosphere. These Stage I processes are subject to EPA’s maximum available control technology (MACT) standards for gasoline distribution [ref 1].

Emissions from gasoline distribution at bulk terminals and bulk plants take place when gasoline is loaded into a storage tank or tank truck, from working losses (for fixed roof tanks), and from working losses and roof seals (for floating roof tanks). Working losses consist of both breathing and emptying losses. Breathing losses are the expulsion of vapor from a tank vapor space that has expanded or contracted because of daily changes in temperature and barometric pressure; these emissions occur in the absence of any liquid level change in the tank. Emptying losses occur when the air that is drawn into the tank during liquid removal saturates with hydrocarbon vapor and expands, thus exceeding the fixed capacity of the vapor space and overflowing through the pressure vacuum valve [ref 2].

Emissions from tank trucks in transit occur when gasoline vapor evaporates from (1) loaded tank trucks during transportation of gasoline from bulk terminals/plants to service stations, and (2) empty tank trucks returning from service stations to bulk terminals/plants [ref 3]. Pipeline emissions result from the valves and pumps found at pipeline pumping stations and from the valves, pumps, and storage tanks at pipeline breakout stations. Stage I gasoline distribution emissions also occur when gasoline vapors are displaced from storage tanks during unloading of gasoline from tank trucks at service stations (Gasoline Service Station Unloading) and from gasoline vapors evaporating from service station storage tanks and from the lines going to the pumps (Underground Storage Tank Breathing and Emptying).

3.5.2 Source of data overview and selection hierarchy

The Stage I gasoline distribution sources -bulk gasoline terminals and gasoline stations EIS sectors- include emissions from both S/L/T agencies and from the EPA overlap nonpoint dataset. Table 3-35 lists the various datasets used in the 2011 NEI for this sector. Table 3-36 shows the agencies that submitted data used by the 2011 NEI. In some cases, the EPA PM and HAP augmentation datasets were used to fill in PM species and HAP pollutants based on S/L/T agency data. The figures shown in Section 3.5.3 illustrate where S/L/T agency data are used for this sector. EPA data is used where S/L/T agency data were not provided.

Table 3-35: 2011 NEI selection hierarchy for datasets used in Bulk Terminals sector

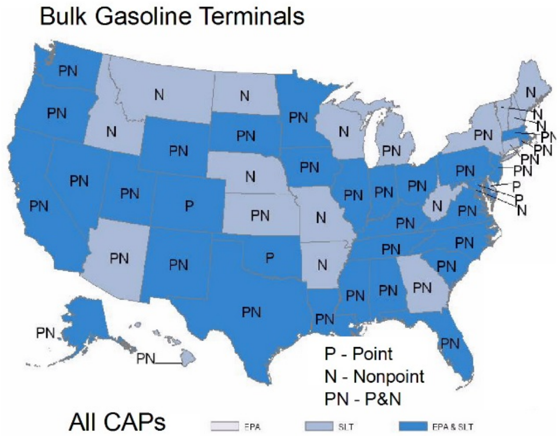
Priority	Dataset Name	Dataset Content
1	2011EPA_PM-Augmentation	Augments PM data in 47 states and some tribes
2	Responsible Agency Data Set	State and Local Agency submitted emissions
4	2011EPA_HAP-Augmentation	Adds Pb and other HAP emissions in 46 states
5	2011EPA_NP_Overlap_w_Pt	EPA-generated data

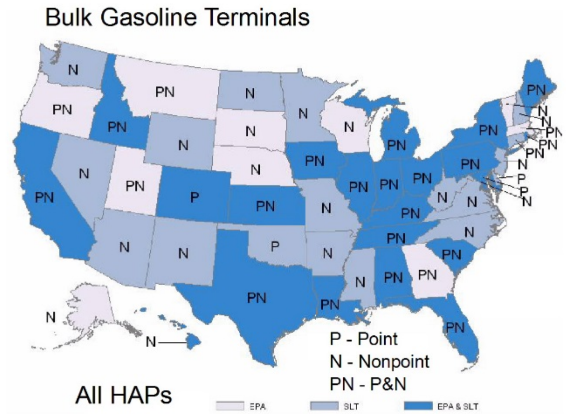
Table 3-36: Agencies that submitted data for the sector Bulk Gasoline Terminals and Gasoline Stations

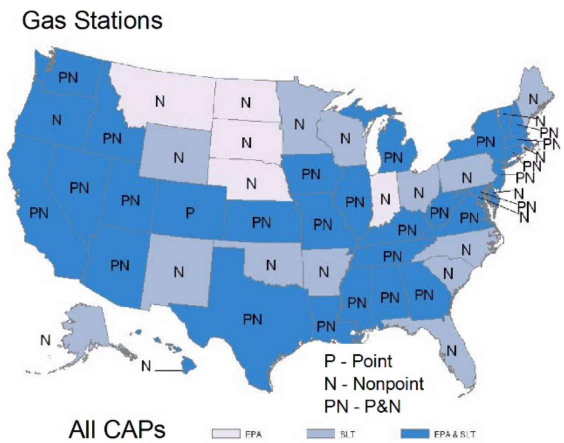
	Bulk Gasoline Terminals	Gasoline Stations	
Agency Name	**Point**	**Point**	**Nonpoint**
Alabama Department of Environmental Management		X	
Alaska Department of Environmental Conservation	X	X	
City of Albuquerque		X	
Allegheny County Health Department		X	
Arkansas Department of Environmental Quality		X	
California Air Resources Board	X	X	X
Chattanooga Air Pollution Control Bureau (CHCAPCB)	X		X
Clark County Department of Air Quality and Environmental Management			X
Colorado Department of Public Health and Environment		X	
Connecticut Department of Environmental Protection		X	
DC-District Department of the Environment	X		X
Delaware Department of Natural Resources and Environmental Control			X
HAP Augmentation EPA		X	X
No Overlap EPA			X
Overlap EPA			X
PM Augmentation EPA		X	X
TRI EPA		X	
Florida Department of Environmental Protection		X	
Georgia Department of Natural Resources	X	X	X
Hawaii Department of Health Clean Air Branch	X		X
Iowa Department of Natural Resources	X	X	
Idaho Department of Environmental Quality		X	X
Illinois Environmental Protection Agency	X	X	X
Indiana Department of Environmental Management	X		
Jefferson County (AL) Department of Health		X	
Knox County Department of Air Quality Management			X
Kansas Department of Health and Environment	X	X	X
Kentucky Division for Air Quality		X	
Louisiana Department of Environmental Quality		X	
Louisville Metro Air Pollution Control District		X	
Massachusetts Department of Environmental Protection		X	X
Maricopa County Air Quality Department	X	X	X
Maryland Department of the Environment		X	X
Mecklenburg County Air Quality		X	
Maine Department of Environmental Protection		X	
Memphis and Shelby County Health Department - Pollution Control		X	
Michigan Department of Environmental Quality	X	X	X
Minnesota Pollution Control Agency		X	

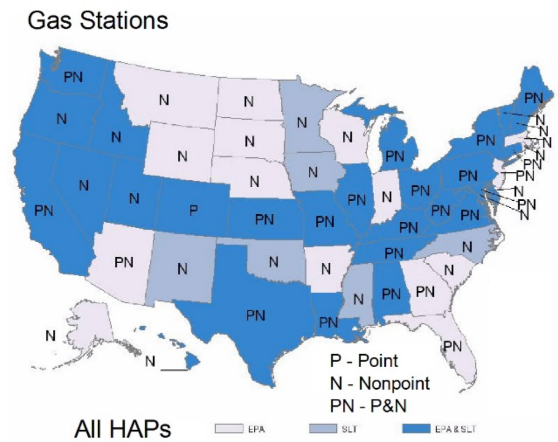
Agency Name	Bulk Gasoline Terminals	Gasoline Stations	
	Point	Point	Nonpoint
Missouri Department of Natural Resources		X	
Mississippi Dept of Environmental Quality		X	
Metro Public Health of Nashville/Davidson County			X
North Carolina Department of Environment and Natural Resources		X	
New Hampshire Department of Environmental Services		X	X
New Jersey Department of Environment Protection	X	X	X
New Mexico Environment Department Air Quality Bureau		X	
Nevada Division of Environmental Protection		X	
New York State Department of Environmental Conservation	X	X	X
Ohio Environmental Protection Agency	X	X	
Oklahoma Department of Environmental Quality		X	
Oregon Department of Environmental Quality			X
Pennsylvania Department of Environmental Protection		X	
Philadelphia Air Management Services		X	
Pinal County		X	
Rhode Island Department of Environmental Management		X	
South Carolina Department of Health and Environmental Control	X	X	
Southwest Clean Air Agency		X	
Tennessee Department of Environmental Conservation		X	
Shoshone-Bannock Tribes of the Fort Hall Reservation of Idaho			X
Coeur d’Alene Tribe			X
Nez Perce Tribe			X
Kootenai Tribe of Idaho			X
Bishop Paiute Tribe			X
Washoe Tribe of California and Nevada			X
Texas Commission on Environmental Quality	X	X	X
Utah Division of Air Quality	X	X	X
Virginia Department of Environmental Quality	X	X	X
Vermont Department of Environmental Conservation	X		X
Washington State Department of Ecology			X
Washoe County Health District			X
Wisconsin Department of Natural Resources		X	
West Virginia Division of Air Quality		X	X
Wyoming Department of Environmental Quality		X	
Kickapoo Tribe of Indians of the Kickapoo Reservation in Kansas		X	

3.5.3 Spatial coverage and data sources for the sector









3.5.4 EPA-developed emission estimates

The nonpoint SCCs that comprise the Stage I Gasoline Distribution source category are provided in Table 3-37; SCC level 1 and 2 descriptions for all SCCs are “Storage and Transport; Petroleum and Petroleum Product Storage”.

Table 3-37: Nonpoint Stage I Gasoline Distribution SCCs

SCC	SCC Level 3	SCC Level 4
2501050120	Bulk Terminals: All Evaporative Losses	Gasoline
2501055120	Bulk Plants: All Evaporative Losses	Gasoline
2501060051	Gasoline Service Stations	Stage 1: Submerged Filling
2501060052	Gasoline Service Stations	Stage 1: Splash Filling
2501060053	Gasoline Service Stations	Stage 1: Balanced Submerged Filling
2501060201	Gasoline Service Stations	Underground Tank: Breathing and Emptying
2505030120	Truck	Gasoline
2505040120	Pipeline	Gasoline

Bulk Terminals and Pipelines

For 2011, EPA used 2008 emission estimates due to resource constraints. This section describes the method used in 2008. There is no generally accepted activity-based VOC emission factors for the pipelines and bulk terminals sectors because they are generally treated as point sources whose emissions are estimated using site-specific information. For example, emission estimates for bulk terminal storage tanks are typically derived from tank specific parameters that are input into the TANKS program [ref 4] Therefore, for bulk terminals and pipelines, EPA estimated 2008 national VOC emissions by multiplying 1998 national estimates developed in support of the Gasoline Distribution MACT standard [ref 5] by the 2008 to 1998 ratio of the national volume of wholesale gasoline supplied (see Table 3-38). The gasoline supply information was obtained from Table 2 in Volume I of Petroleum Supply Annual 2008 [ref 6].

Table 3-38: Estimation of national 2008 VOC emissions for Pipelines and Bulk Terminals

Category	1998 Post-MACT Control Emissions (Mg)	Mg to Ton Conversion Factor	1998 Emissions (tons)	Ratio of 2008 to 1998 Gasoline Supplied	2008 Emissions (tons)
Pipelines	79,830	1.1023	87,997	1.089 = (8,989,000 barrels per day / 8,253,000 barrels per day)	95,844
Bulk Terminals	137,555	1.1023	151,627		165,149

To estimate HAP emissions, EPA applied national average speciation profiles to the VOC emission estimates [ref 7]. Table 3-39 presents these speciation profiles and the national bulk terminal and pipeline HAP emission estimates (note that unless otherwise noted, all emission values reported in this section exclude estimates for Puerto Rico and the U.S. Virgin Islands). EPA used total VOC emission estimates, so emissions represent total emissions. Where necessary, States should perform point source subtractions to obtain nonpoint emissions. The following describes how total national VOC estimates were allocated to counties.

Table 3-39: HAP speciation profiles and 2008 Bulk Terminal and Pipeline emissions

HAP	Pollutant Code	Percentage of VOC Emissions	Reference	2008 National Emissions (tons)	
				Bulk Terminals	Pipelines
Benzene	71432	0.27	7	4.46E+02	2.59E+02
2,2,4-Trimethylpentane	540841	0.75	7	1.24E+03	7.19E+02
Cumene	98828	0.012	7	1.98E+01	1.15E+01
Ethyl Benzene	100414	0.053	7	8.75E+01	5.08E+01
n-Hexane	110543	1.8	7	2.97E+03	1.73E+03
Naphthalene	91203	0.00027	7	4.46E-01	2.59E-01
Toluene	108883	1.4	7	2.31E+03	1.34E+03
Xylenes	1330207	0.56	7	9.25E+02	5.37E+02

For both categories, EPA allocated national VOC and HAP emissions for these categories in a two-step manner. First, EPA allocated emissions based on 2008 gasoline supply data reported by the U.S. Department of Energy (DOE). Next, EPA allocated emissions based on employment data reported in the 2007 County Business Patterns [ref 8].

For pipelines, EPA allocated emissions to Petroleum Administration for Defense (PAD) Districts based on the total amount of finished motor gasoline moved by pipeline in each PAD in year 2008. There are five PAD Districts across the United States: PAD District 1 comprises seventeen states plus the District of Columbia along the Atlantic Coast; PAD District 2 comprises fifteen states in the Midwest; PAD District 3 comprises six states in South Central U.S.; PAD District 4 comprises five states in the Rocky Mountains; and PAD District 5 comprises seven states along the West Coast. These data, which are displayed below in Table 3-40, are reported in Table 35 of Volume 1 of Petroleum Supply Annual 2008 [ref 9]. Next, EPA allocated pipeline emissions in each PAD District to counties based on County Business Patterns employment data. Because employment data for NAICS code 48691 (Pipeline Transportation of Refined Petroleum Products) are often withheld due to confidentiality reasons, EPA used the number of employees in NAICS code 42471 (Petroleum Bulk Stations and Terminals) for this allocation. To better account for the location of refined petroleum pipelines, however, EPA did not allocate any activity to States which had employees in this NAICS code, but, did not have employees in NAICS code 48691 (i.e., District of Columbia, Idaho, Maine, New Hampshire, Vermont, and West Virginia).

Table 3-40: Movement of finished motor gasoline by pipeline between PAD Districts, 2008

	From I	From II	From III	From IV	From V
To I	n/a	393	333,462	0	0
To II	70,895	n/a	99,167	7,442	0
To III	0	9,193	n/a	0	0
To IV	0	8,680	5,778	n/a	0
To V	0	0	25,453	9,287	n/a

For bulk terminals, EPA first allocated national emissions to States based on the 2008 refinery, bulk terminal, and natural gas plant stocks of motor gasoline reported for each State in Table 33 of Volume 1 of DOE's Petroleum Supply Annual 2008 (see Table 3-41) [ref 9]. Next, EPA allocated emissions in each State to counties based on the number of NAICS code 42471 (Petroleum Bulk Stations and Terminals) employees reported in the 2007 County Business Patterns [ref 8].

Table 3-41: Refinery, Bulk Terminal, and Natural Gas Plant Stocks of Motor Gasoline, 2008

State	Motor Gasoline (Thousand Barrels)	State	Motor Gasoline (Thousand Barrels)
Alabama	1,090	Montana	872
Alaska	616	Nebraska	658
Arizona	470	Nevada	102
Arkansas	819	New Hampshire	0
California	460	New Jersey	2,956
Colorado	748	New Mexico	350
Connecticut	0	New York	1,469
Delaware	105	North Carolina	1,724
District of Columbia	0	North Dakota	291
Florida	1,877	Ohio	2,724
Georgia	1,724	Oklahoma	1,245
Hawaii	12	Oregon	525
Idaho	181	Pennsylvania	3,595
Illinois	1,940	Rhode Island	0
Indiana	2,464	South Carolina	720
Iowa	1,090	South Dakota	283

State	Motor Gasoline (Thousand Barrels)	State	Motor Gasoline (Thousand Barrels)
Kansas	2,347	Tennessee	923
Kentucky	1,045	Texas	9,530
Louisiana	5,209	Utah	793
Maine	374	Vermont	31
Maryland	31	Virginia	1,285
Massachusetts	0	Washington	1,902
Michigan	1,772	West Virginia	183
Minnesota	1,305	Wisconsin	704
Mississippi	1,580	Wyoming	910
Missouri	491		

It is important to reiterate that the above discussion addresses the calculation of total VOC emissions. The 2008 point source NEI reports VOC emissions related to bulk terminal and pipeline processes. To obtain nonpoint emissions, States should subtract the 2008 point source VOC emission estimates from the total VOC emission estimates reported here. The relevant point source SCCs are listed in Table 3-42 and Table 3-43; the SCC level 1 description for all SCCs in both tables is “Petroleum and Solvent Evaporation”.

Table 3-42: Pipeline Point Source SCCs

SCC	SCC Level 2	SCC Level 3	SCC Level 4
40600501	Transportation and Marketing of Petroleum Products	Pipeline Petroleum Transport - General - All Products	Pipeline Leaks
40600502	Transportation and Marketing of Petroleum Products	Pipeline Petroleum Transport - General - All Products	Pipeline Venting
40600503	Transportation and Marketing of Petroleum Products	Pipeline Petroleum Transport - General - All Products	Pump Station
40600504	Transportation and Marketing of Petroleum Products	Pipeline Petroleum Transport - General - All Products	Pump Station Leaks

Table 3-43: Bulk Terminal Point Source SCCs

SCC	SCC Level 2	SCC Level 3	SCC Level 4
40400101	Petroleum Liquids Storage (non-Refinery)	Bulk Terminals	Gasoline RVP 13: Breathing Loss (67000 Bbl Capacity) - Fixed Roof Tank
40400102	Petroleum Liquids Storage (non-Refinery)	Bulk Terminals	Gasoline RVP 10: Breathing Loss (67000 Bbl Capacity) - Fixed Roof Tank
40400103	Petroleum Liquids Storage (non-Refinery)	Bulk Terminals	Gasoline RVP 7: Breathing Loss (67000 Bbl. Capacity) - Fixed Roof Tank
40400104	Petroleum Liquids Storage (non-Refinery)	Bulk Terminals	Gasoline RVP 13: Breathing Loss (250000 Bbl Capacity)-Fixed Roof Tank
40400105	Petroleum Liquids Storage (non-Refinery)	Bulk Terminals	Gasoline RVP 10: Breathing Loss (250000 Bbl Capacity)-Fixed Roof Tank
40400106	Petroleum Liquids Storage (non-Refinery)	Bulk Terminals	Gasoline RVP 7: Breathing Loss (250000 Bbl Capacity) - Fixed Roof Tank
40400107	Petroleum Liquids Storage (non-Refinery)	Bulk Terminals	Gasoline RVP 13: Working Loss (Diam. Independent) - Fixed Roof Tank
40400108	Petroleum Liquids Storage (non-Refinery)	Bulk Terminals	Gasoline RVP 10: Working Loss (Diameter Independent) - Fixed Roof Tank

SCC	SCC Level 2	SCC Level 3	SCC Level 4
40400109	Petroleum Liquids Storage (non-Refinery)	Bulk Terminals	Gasoline RVP 7: Working Loss (Diameter Independent) - Fixed Roof Tank
40400110	Petroleum Liquids Storage (non-Refinery)	Bulk Terminals	Gasoline RVP 13: Standing Loss (67000 Bbl Capacity)-Floating Roof Tank
40400111	Petroleum Liquids Storage (non-Refinery)	Bulk Terminals	Gasoline RVP 10: Standing Loss (67000 Bbl Capacity)-Floating Roof Tank
40400112	Petroleum Liquids Storage (non-Refinery)	Bulk Terminals	Gasoline RVP 7: Standing Loss (67000 Bbl Capacity)- Floating Roof Tank
40400113	Petroleum Liquids Storage (non-Refinery)	Bulk Terminals	Gasoline RVP 13: Standing Loss (250000 Bbl Cap.) - Floating Roof Tank
40400114	Petroleum Liquids Storage (non-Refinery)	Bulk Terminals	Gasoline RVP 10: Standing Loss (250000 Bbl Cap.) - Floating Roof Tank
40400115	Petroleum Liquids Storage (non-Refinery)	Bulk Terminals	Gasoline RVP 7: Standing Loss (250000 Bbl Cap.) - Floating Roof Tank
40400116	Petroleum Liquids Storage (non-Refinery)	Bulk Terminals	Gasoline RVP 13/10/7: Withdrawal Loss (67000 Bbl Cap.) - Float Rf Tnk
40400117	Petroleum Liquids Storage (non-Refinery)	Bulk Terminals	Gasoline RVP 13/10/7: Withdrawal Loss (250000 Bbl Cap.) - Float Rf Tnk
40400118	Petroleum Liquids Storage (non-Refinery)	Bulk Terminals	Gasoline RVP 13: Filling Loss (10500 Bbl Cap.) - Variable Vapor Space
40400119	Petroleum Liquids Storage (non-Refinery)	Bulk Terminals	Gasoline RVP 10: Filling Loss (10500 Bbl Cap.) - Variable Vapor Space
40400120	Petroleum Liquids Storage (non-Refinery)	Bulk Terminals	Gasoline RVP 7: Filling Loss (10500 Bbl Cap.) - Variable Vapor Space
40400131	Petroleum Liquids Storage (non-Refinery)	Bulk Terminals	Gasoline RVP 13: Standing Loss - Ext. Floating Roof w/ Primary Seal
40400132	Petroleum Liquids Storage (non-Refinery)	Bulk Terminals	Gasoline RVP 10: Standing Loss - Ext. Floating Roof w/ Primary Seal
40400133	Petroleum Liquids Storage (non-Refinery)	Bulk Terminals	Gasoline RVP 7: Standing Loss - External Floating Roof w/ Primary Seal
40400141	Petroleum Liquids Storage (non-Refinery)	Bulk Terminals	Gasoline RVP 13: Standing Loss - Ext. Floating Roof w/ Secondary Seal
40400142	Petroleum Liquids Storage (non-Refinery)	Bulk Terminals	Gasoline RVP 10: Standing Loss - Ext. Floating Roof w/ Secondary Seal
40400143	Petroleum Liquids Storage (non-Refinery)	Bulk Terminals	Gasoline RVP 7: Standing Loss - Ext. Floating Roof w/ Secondary Seal
40400148	Petroleum Liquids Storage (non-Refinery)	Bulk Terminals	Gasoline RVP 13/10/7: Withdrawal Loss - Ext. Float Roof (Pri/Sec Seal)
40400150	Petroleum Liquids Storage (non-Refinery)	Bulk Terminals	Miscellaneous Losses/Leaks: Loading Racks
40400151	Petroleum Liquids Storage (non-Refinery)	Bulk Terminals	Valves, Flanges, and Pumps
40400152	Petroleum Liquids Storage (non-Refinery)	Bulk Terminals	Vapor Collection Losses
40400153	Petroleum Liquids Storage (non-Refinery)	Bulk Terminals	Vapor Control Unit Losses
40400161	Petroleum Liquids Storage (non-Refinery)	Bulk Terminals	Gasoline RVP 13: Standing Loss - Int. Floating Roof w/ Primary Seal

SCC	SCC Level 2	SCC Level 3	SCC Level 4
40400162	Petroleum Liquids Storage (non-Refinery)	Bulk Terminals	Gasoline RVP 10: Standing Loss - Int. Floating Roof w/ Primary Seal
40400163	Petroleum Liquids Storage (non-Refinery)	Bulk Terminals	Gasoline RVP 7: Standing Loss - Internal Floating Roof w/ Primary Seal
40400171	Petroleum Liquids Storage (non-Refinery)	Bulk Terminals	Gasoline RVP 13: Standing Loss - Int. Floating Roof w/ Secondary Seal
40400172	Petroleum Liquids Storage (non-Refinery)	Bulk Terminals	Gasoline RVP 10: Standing Loss - Int. Floating Roof w/ Secondary Seal
40400173	Petroleum Liquids Storage (non-Refinery)	Bulk Terminals	Gasoline RVP 7: Standing Loss - Int. Floating Roof w/ Secondary Seal
40400178	Petroleum Liquids Storage (non-Refinery)	Bulk Terminals	Gasoline RVP 13/10/7: Withdrawal Loss - Int. Float Roof (Pri/Sec Seal)

Bulk Plants

EPA calculated VOC emissions from bulk plants by developing an average emission factor from the bulk plant motor gasoline VOC emissions and throughput data developed in support of the Gasoline Distribution MACT standards [ref 2, ref 5]. To estimate 2008 national VOC emissions, the VOC emission factor (8.62 pounds of VOC per 1,000 gallons) was applied to the estimated national volume of gasoline passing through bulk plants in 2008. The volume of bulk plant gasoline throughput was assumed to be 9 percent of total gasoline consumption [ref 10]. Total gasoline consumption for 2008 was assumed to be the same as the volume of finished motor gasoline supplied as reported on the U.S. Energy Information Administration's Petroleum Navigator website [ref 11]. The resulting national VOC emission estimate was then allocated to counties based on employment data for NAICS code 42471 (Petroleum Bulk Stations and Terminals). To estimate benzene emissions from bulk plants, EPA multiplied VOC emission estimates by county-level speciation profiles calculated from the annual onroad refueling (Stage 2) emissions from the 2008 NEI NMIM results [ref 12]. All other HAPs were estimated by multiplying VOC emissions by the national average speciation profiles displayed in Table 3-44.

Table 3-44: Bulk Plant HAP Speciation Profiles and Total Emission Estimates

Pollutant	Pollutant Code	Emission Factor	Reference	National Emissions (tpy)
VOC	VOC	8.62 lb./1,000 gallons	2 and 5	5.35E+04
2,2,4-Trimethylpentane	540841	0.75% of VOC	7	4.01E+02
Cumene	98828	0.012% of VOC	7	6.41E+00
Ethyl Benzene	100414	0.053% of VOC	7	2.83E+01
n-Hexane	110543	1.8% of VOC	7	9.62E+02
Naphthalene	91203	0.00027% of VOC	7	1.44E-01
Toluene	108883	1.4% of VOC	7	7.48E+02
Xylenes	1330207	0.56% of VOC	7	2.99E+02
Benzene	71432	county-specific % of VOC	12	3.94E+02

It is important to reiterate that the above discussion addresses the calculation of total VOC emissions. The 2008 point source NEI reports VOC emissions related to bulk plants. To obtain nonpoint emissions, States should subtract the 2008 point source VOC emission estimates from the total VOC emission estimates reported here.

The relevant point source SCCs are listed in Table 3-45; SCC level 1 descriptions are “Petroleum and Solvent Evaporation” for all SCCs.

Table 3-45: Bulk Plant Point Source SCCs

SCC	SCC Level 2	SCC Level 3	SCC Level 4
40400201	Petroleum Liquids Storage (non-Refinery)	Bulk Plants	Gasoline RVP 13: Breathing Loss (67000 Bbl Capacity) - Fixed Roof Tank
40400202	Petroleum Liquids Storage (non-Refinery)	Bulk Plants	Gasoline RVP 10: Breathing Loss (67000 Bbl Capacity) - Fixed Roof Tank
40400203	Petroleum Liquids Storage (non-Refinery)	Bulk Plants	Gasoline RVP 7: Breathing Loss (67000 Bbl. Capacity) - Fixed Roof Tank
40400204	Petroleum Liquids Storage (non-Refinery)	Bulk Plants	Gasoline RVP 13: Working Loss (67000 Bbl. Capacity) - Fixed Roof Tank
40400205	Petroleum Liquids Storage (non-Refinery)	Bulk Plants	Gasoline RVP 10: Working Loss (67000 Bbl. Capacity) - Fixed Roof Tank
40400206	Petroleum Liquids Storage (non-Refinery)	Bulk Plants	Gasoline RVP 7: Working Loss (67000 Bbl. Capacity) - Fixed Roof Tank
40400207	Petroleum Liquids Storage (non-Refinery)	Bulk Plants	Gasoline RVP 13: Standing Loss (67000 Bbl Cap.) - Floating Roof Tank
40400208	Petroleum Liquids Storage (non-Refinery)	Bulk Plants	Gasoline RVP 10: Standing Loss (67000 Bbl Cap.) - Floating Roof Tank
40400209	Petroleum Liquids Storage (non-Refinery)	Bulk Plants	Gasoline RVP 7: Standing Loss (67000 Bbl Cap.) - Floating Roof Tank
40400210	Petroleum Liquids Storage (non-Refinery)	Bulk Plants	Gasoline RVP 13/10/7: Withdrawal Loss (67000 Bbl Cap.) - Float Rf Tnk
40400211	Petroleum Liquids Storage (non-Refinery)	Bulk Plants	Gasoline RVP 13: Filling Loss (10500 Bbl Cap.) - Variable Vapor Space
40400212	Petroleum Liquids Storage (non-Refinery)	Bulk Plants	Gasoline RVP 10: Filling Loss (10500 Bbl Cap.) - Variable Vapor Space
40400213	Petroleum Liquids Storage (non-Refinery)	Bulk Plants	Gasoline RVP 7: Filling Loss (10500 Bbl Cap.) - Variable Vapor Space
40400231	Petroleum Liquids Storage (non-Refinery)	Bulk Plants	Gasoline RVP 13: Standing Loss - Ext. Floating Roof w/ Primary Seal
40400232	Petroleum Liquids Storage (non-Refinery)	Bulk Plants	Gasoline RVP 10: Standing Loss - Ext. Floating Roof w/ Primary Seal
40400233	Petroleum Liquids Storage (non-Refinery)	Bulk Plants	Gasoline RVP 7: Standing Loss - External Floating Roof w/ Primary Seal
40400241	Petroleum Liquids Storage (non-Refinery)	Bulk Plants	Gasoline RVP 13: Standing Loss - Ext. Floating Roof w/ Secondary Seal
40400242	Petroleum Liquids Storage (non-Refinery)	Bulk Plants	Gasoline RVP 10: Standing Loss - Ext. Floating Roof w/ Secondary Seal
40400243	Petroleum Liquids Storage (non-Refinery)	Bulk Plants	Gasoline RVP 7: Standing Loss - Ext. Floating Roof w/ Secondary Seal

SCC	SCC Level 2	SCC Level 3	SCC Level 4
40400248	Petroleum Liquids Storage (non-Refinery)	Bulk Plants	Gasoline RVP 10/13/7: Withdrawal Loss - Ext. Float Roof (Pri/Sec Seal)
40400250	Petroleum Liquids Storage (non-Refinery)	Bulk Plants	Loading Racks
40400251	Petroleum Liquids Storage (non-Refinery)	Bulk Plants	Valves, Flanges, and Pumps
40400252	Petroleum Liquids Storage (non-Refinery)	Bulk Plants	Miscellaneous Losses/Leaks: Vapor Collection Losses
40400253	Petroleum Liquids Storage (non-Refinery)	Bulk Plants	Miscellaneous Losses/Leaks: Vapor Control Unit Losses
40400261	Petroleum Liquids Storage (non-Refinery)	Bulk Plants	Gasoline RVP 13: Standing Loss - Int. Floating Roof w/ Primary Seal
40400262	Petroleum Liquids Storage (non-Refinery)	Bulk Plants	Gasoline RVP 10: Standing Loss - Int. Floating Roof w/ Primary Seal
40400263	Petroleum Liquids Storage (non-Refinery)	Bulk Plants	Gasoline RVP 7: Standing Loss - Internal Floating Roof w/ Primary Seal
40400271	Petroleum Liquids Storage (non-Refinery)	Bulk Plants	Gasoline RVP 13: Standing Loss - Int. Floating Roof w/ Secondary Seal
40400272	Petroleum Liquids Storage (non-Refinery)	Bulk Plants	Gasoline RVP 10: Standing Loss - Int. Floating Roof w/ Secondary Seal
40400273	Petroleum Liquids Storage (non-Refinery)	Bulk Plants	Gasoline RVP 7: Standing Loss - Int. Floating Roof w/ Secondary Seal
40400278	Petroleum Liquids Storage (non-Refinery)	Bulk Plants	Gasoline RVP 10/13/7: Withdrawal Loss - Int. Float Roof (Pri/Sec Seal)
40400401	Petroleum Liquids Storage (non-Refinery)	Petroleum Products - Underground Tanks	Gasoline RVP 13: Breathing Loss
40400402	Petroleum Liquids Storage (non-Refinery)	Petroleum Products - Underground Tanks	Gasoline RVP 13: Working Loss
40400403	Petroleum Liquids Storage (non-Refinery)	Petroleum Products - Underground Tanks	Gasoline RVP 10: Breathing Loss
40400404	Petroleum Liquids Storage (non-Refinery)	Petroleum Products - Underground Tanks	Gasoline RVP 10: Working Loss
40400405	Petroleum Liquids Storage (non-Refinery)	Petroleum Products - Underground Tanks	Gasoline RVP 7: Breathing Loss
40400406	Petroleum Liquids Storage (non-Refinery)	Petroleum Products - Underground Tanks	Gasoline RVP 7: Working Loss
40600101	Transportation and Marketing of Petroleum Products	Tank Cars and Trucks	Gasoline: Splash Loading **
40600126	Transportation and Marketing of Petroleum Products	Tank Cars and Trucks	Gasoline: Submerged Loading **
40600131	Transportation and Marketing of Petroleum Products	Tank Cars and Trucks	Gasoline: Submerged Loading (Normal Service)

SCC	SCC Level 2	SCC Level 3	SCC Level 4
40600136	Transportation and Marketing of Petroleum Products	Tank Cars and Trucks	Gasoline: Splash Loading (Normal Service)
40600141	Transportation and Marketing of Petroleum Products	Tank Cars and Trucks	Gasoline: Submerged Loading (Balanced Service)
40600144	Transportation and Marketing of Petroleum Products	Tank Cars and Trucks	Gasoline: Splash Loading (Balanced Service)
40600147	Transportation and Marketing of Petroleum Products	Tank Cars and Trucks	Gasoline: Submerged Loading (Clean Tanks)

Tank Trucks in Transit

The EPA calculated VOC emissions from Tank Trucks in Transit by multiplying county-level tank truck gasoline throughput by a 0.06 lb of VOC per 1,000 gallon emission factor. As noted in Table 3-46, this emission factor is the sum of the individual emission factors reported in the Gasoline Distribution EIIP guidance document for gasoline-filled trucks (traveling to service station/bulk plant for delivery) and vapor-filled trucks (traveling to bulk terminal/plant for reloading) [ref 3]. County-level gasoline consumption was estimated by summing county-level onroad and nonroad estimates. County-level onroad consumption was estimated by subtracting the NMIM-derived national nonroad consumption from the EIA's estimate of finished motor gasoline supplied and then allocating to counties using NMIM-derived onroad county-level CO_2 emissions [ref 11, ref 13]. County-level nonroad consumption was estimated by allocating NMIM-derived state/SCC-level nonroad gasoline consumption to the county-level based on nonroad county/SCC-level CO_2 emissions [ref 13]. Gasoline throughput for tank trucks was computed by multiplying the county-level gasoline consumption estimates by a factor of 1.09 to account for gasoline that is transported more than once in a given area (i.e., transported from bulk terminal to bulk plant and then from bulk plant to service station) [ref 10]. Benzene emission estimates were calculated by multiplying county-level NMIM speciation profiles by the VOC emission estimates [ref 12]. Emissions for the remaining HAPs were calculated by multiplying VOC emissions by the national speciation profiles presented in Table 3-47.

Table 3-46: Tank Trucks in Transit VOC Emission Factors

	VOC Emission Factor
Vapor-Filled Trucks	0.055 lb/1,000 gallons
Gasoline Filled Trucks	0.005 lb/1,000 gallons
Total	**0.06 lb/1,000 gallons**

Table 3-47: Tank Trucks in Transit HAP Speciation Profiles and Total Emission Estimates

Pollutant	Pollutant Code	Emission Factor	Reference	National Emissions (tpy)
VOC	VOC	0.06 lb./1,000 gallons	3	4.51E+03
2,2,4-Trimethylpentane	540841	0.75% of VOC	7	3.38E+01
Cumene	98828	0.012% of VOC	7	5.41E-01
Ethyl Benzene	100414	0.053% of VOC	7	2.39E+00

Pollutant	Pollutant Code	Emission Factor	Reference	National Emissions (tpy)
n-Hexane	110543	1.8% of VOC	7	8.11E+01
Naphthalene	91203	0.00027% of VOC	7	1.22E-02
Toluene	108883	1.4% of VOC	7	6.31E+01
Xylenes	1330207	0.56% of VOC	7	2.52E+01
Benzene	71432	county-specific % of VOC	12	3.13E+01

It is important to reiterate that the above discussion addresses the calculation of total VOC emissions. The 2008 point source NEI reports VOC emissions related to tank trucks in transit. To obtain nonpoint emissions, States should subtract the 2008 point source VOC emission estimates from the total VOC emission estimates reported here. The relevant point source SCCs are listed in Table 3-48; the SCC level 1 description is "Petroleum and Solvent Evaporation" for all SCCs.

Table 3-48: Tank Trucks in Transit Point Source SCCs

SCC	SCC Level 2	SCC Level 3	SCC Level 4
40400154	Petroleum Liquids Storage (non-Refinery)	Bulk Terminals	Tank Truck Vapor Leaks
40400254	Petroleum Liquids Storage (non-Refinery)	Bulk Plants	Tank Truck Vapor Losses
40600162	Transportation and Marketing of Petroleum Products	Tank Cars and Trucks	Gasoline: Loaded with Fuel (Transit Losses)
40600163	Transportation and Marketing of Petroleum Products	Tank Cars and Trucks	Gasoline: Return with Vapor (Transit Losses)

Underground Storage Tank (UST) Breathing and Emptying

The EPA calculated VOC emissions from UST breathing and emptying by multiplying county-level total gasoline consumption, calculated as described above in the Tank Trucks in Transit section, by the 1 lb/1,000 gallons emission factor recommended by the Gasoline Distribution EIIP guidance document [ref 3]. With the exception of benzene, HAP emissions were estimated by multiplying VOC emissions by the national HAP speciation profiles listed in Table 3-49. To estimate benzene emissions, EPA multiplied VOC emissions by county-level speciation profiles from NMIM [ref 12].

Table 3-49: Underground Storage Tank (UST) Breathing and Emptying Emissions

Pollutant	Pollutant Code	Emission Factor	Reference	National Emissions (tpy)
VOC	VOC	1 lb./1,000 gallons	3	6.89E+04
2,2,4-Trimethylpentane	540841	0.75% of VOC	7	5.17E+02
Cumene	98828	0.012% of VOC	7	8.27E+00
Ethyl Benzene	100414	0.053% of VOC	7	3.65E+01
n-Hexane	110543	1.8% of VOC	7	1.24E+03
Naphthalene	91203	0.00027% of VOC	7	1.86E-01
Toluene	108883	1.4% of VOC	7	9.65E+02
Xylenes	1330207	0.56% of VOC	7	3.86E+02
Benzene	71432	county-specific % of VOC	12	4.78E+02

It is important to reiterate that the above discussion addresses the calculation of total VOC emissions. The 2008 point source NEI reports VOC emissions related to UST breathing and emptying. To obtain nonpoint emissions, States should subtract the 2008 point source VOC emission estimates from the total VOC emission estimates reported here. The relevant point source SCCs are listed in Table 3-50; SCC level 1 and 2 descriptions are "Petroleum and Solvent Evaporation; Transportation and Marketing of Petroleum Products" for both SCCs.

Table 3-50: UST Breathing and Emptying Point Source SCCs

SCC	SCC Level 3	SCC Level 4
40600307	Gasoline Retail Operations - Stage I	Underground Tank Breathing and Emptying
40600707	Consumer (Corporate) Fleet Refueling - Stage I	Underground Tank Breathing and Emptying

Gasoline Service Station Unloading

Stage I gasoline distribution emissions also occur when gasoline vapors are displaced from storage tanks during unloading of gasoline from tank trucks at service stations (Gasoline Service Station Unloading). States vary in whether these emissions are reported to point or nonpoint. The gasoline service station unloading sector includes data from the S/L/T agency submitted data and the default EPA generated emissions. The agencies listed in Table 3-36 submitted emissions for this sector.

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

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

where:

L = uncontrolled loading loss of liquid loaded (in lb/1,000 gallons)
S = saturation factor;
P = true vapor pressure of liquid loaded (pounds per square inch absolute);
M = molecular weight of vapors (lbs per lb/mole); and
T = temperature of liquid loaded (Rankine) [ref 14].

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

Gasoline RVP values were obtained from the NMIM 2008 database. Because NMIM is a county-level database that reports RVP values by month, EPA developed county-level monthly gasoline consumption estimates by multiplying annual county gasoline consumption by monthly allocation factors. State-level monthly allocation factors were developed from monthly gasoline sales data reported in the Federal Highway Administration's Highway Statistics 2008 [ref 15]. Geographic-specific information on the temperature of gasoline and the method of loading were obtained from a Stage I and II gasoline emission inventory study prepared for the EIIP [ref 16].

The true vapor pressure of gasoline was estimated for each county/month using the following equation:

$$P = \exp\left\{\begin{aligned}&\left[0.7553 - \left(\frac{413.0}{T+459.6}\right)\right]S^{0.5}\log_{10}(RVP) - \left[1.854 - \left(\frac{1{,}042}{T+459.6}\right)\right]S^{0.5} \\ &+ \left[\left(\frac{2{,}416}{T+459.6}\right) - 2.013\right]\log_{10}(RVP) - \left(\frac{8{,}742}{T+459.6}\right) + 15.64\end{aligned}\right\}$$

where:

P	=	Stock true vapor pressure, in pounds per square inch absolute.
T	=	Stock temperature, in degrees Fahrenheit.
RVP	=	Reid vapor pressure, in pounds per square inch.
S	=	Slope of the ASTM distillation curve at 10 percent evaporated, in degrees Fahrenheit per percent (assumed that S = 3.0 for gasoline per Figure 7.1-14a of AP-42) [ref 17].

This equation was used to calculate monthly county-level true vapor pressure estimates. In cases where more than one filling method was assumed to apply in a county (e.g., due to vapor balancing requirement applying to a portion of a county's total gasoline throughput due to a throughput exemption), EPA developed two sets of calculations for each month, one for each filling method.

The EIIP study regional stock temperature information was used to estimate the temperature of gasoline in each county in each month (see Table 3-51) [ref 16].

Table 3-51: Temperature Data Used in Estimating True Vapor Pressure (ºF)

Region	Jan	Feb	Mar	Apr	May	June	July	Aug	Sep	Oct	Nov	Dec
1 (Northeast)	46	44	44	48	57	64	70	73	70	64	60	51
2 (Southeast)	66	67	69	74	78	81	80	81	80	77	69	60
3 (Southwest)	60	61	62	66	73	78	81	84	82	78	71	62
4 (Midwest)	33	35	40	47	55	62	71	73	68	65	64	63
5 (West)	50	52	62	66	73	76	80	83	86	84	73	60
6 (Northwest)	49	50	50	52	57	62	67	72	68	60	49	42

Region 1: Alaska, Connecticut, Delaware, DC, Illinois, Indiana, Kentucky, Maine, Maryland, Massachusetts, Michigan, New Hampshire, New Jersey, New York, Ohio, Pennsylvania, Rhode Island, Vermont, Virginia, West Virginia, Wisconsin
Region 2: Alabama, Arkansas, Florida, Georgia, Hawaii, Louisiana, Mississippi, N. Carolina, S. Carolina, Tennessee
Region 3: Arizona, New Mexico, Oklahoma, Texas
Region 4: Colorado, Iowa, Kansas, Minnesota, Missouri, Montana, Nebraska, N. Dakota, S. Dakota, Wyoming
Region 5: California, Nevada, Utah
Region 6: Idaho, Oregon, Washington

The EPA incorporated the effect of Stage I Gasoline Service Station vapor balancing controls based on the county-level control efficiency values (either 90 or 95 percent) that were compiled for the EIIP study [ref 16]. Table 3-52 presents the HAP speciation profiles and total VOC and HAP emission estimates calculated using these procedures.

Emissions are reported by SCC based on the filling methods used in each county as determined from the EIIP study: SCC 2501060051 (Submerged Filling); SCC 2501060052 (Splash Filling); and SCC 2501060053 (Balanced Submerged Filling).

Table 3-52: Stage I Service Station Unloading HAP Speciation Profiles and Total Emission Estimates

Pollutant	Pollutant Code	Emission Factor	Reference	National Emissions (tpy)
VOC	VOC	Equation 1	14	3.82E+05
2,2,4-Trimethylpentane	540841	0.75% of VOC	7	2.86E+03
Cumene	98828	0.012% of VOC	7	4.58E+01
Ethyl Benzene	100414	0.053% of VOC	7	2.02E+02
n-Hexane	110543	1.8% of VOC	7	6.87E+03
Naphthalene	91203	0.00027% of VOC	7	1.03E+00
Toluene	108883	1.4% of VOC	7	5.35E+03
Xylenes	1330207	0.56% of VOC	7	2.14E+03
Benzene	71432	county-specific % of VOC	12	2.97E+03

It is important to reiterate that the above discussion addresses the calculation of total VOC emissions. The 2008 point source NEI reports VOC emissions related to service station unloading. To obtain nonpoint emissions, States should subtract the 2008 point source VOC emission estimates from the total VOC emission estimates reported here. The relevant point source SCCs are listed in Table 3-53, Table 3-54 and Table 3-55; the SCC level 1 and 2 description for all SCCs in these tables is "Petroleum and Solvent Evaporation; Transportation and Marketing of Petroleum Products".

Table 3-53: Service Station Unloading: Submerged Fill Point Source SCCs

SCC	SCC Level 3	SCC Level 4
40600302	Gasoline Retail Operations - Stage I	Submerged Filling w/o Controls
40600702	Consumer (Corporate) Fleet Refueling - Stage I	Submerged Filling w/o Controls

Table 3-54: Service Station Unloading: Splash Fill Point Source SCCs

SCC	SCC Level 3	SCC Level 4
40600301	Gasoline Retail Operations - Stage I	Splash Filling
40600701	Consumer (Corporate) Fleet Refueling - Stage I	Splash Filling

Table 3-55: Service Station Unloading: Balanced Submerged Fill Point Source SCCs

SCC	SCC Level 3	SCC Level 4
40600305	Gasoline Retail Operations - Stage I	Unloading **
40600306	Gasoline Retail Operations - Stage I	Balanced Submerged Filling
40600706	Consumer (Corporate) Fleet Refueling - Stage I	Balanced Submerged Filling

**Unloading emissions might also be reported in the point source inventory under SCC 40600399 (Gasoline Retail Operations – Stage I, Not Classified).

Example Emission Calculations

Bulk Terminals

2008 national benzene emissions = VOC emissions x HAP speciation factor

1.65E+05 tons x 0.0027

4.46E+02 tons

Pipelines

2008 national cumene emissions = VOC emissions x HAP speciation factor

9.58E+04 tons x 0.00012
1.15E+01 tons

Bulk Plants

2008 national VOC emissions

= national gasoline consumption x proportion passing through bulk plants x VOC emission factor
= 137,801,370 thousand gallons x 0.09 x 8.62 lbs. VOC/thousand gallons
= 1.07E+08 lbs. / 2000 lbs.
= 5.35E+04 tons

Tank Trucks in Transit

2008 Alamance County, North Carolina VOC emissions

= total county gasoline consumption x (1+proportion of gasoline transported twice) x VOC emission factor
= 61,446 thousand gallons x (1+0.09) x 0.06 lbs. VOC/thousand gallons
= 4.02E+03 lbs. / 2000 lbs.
= 2.01E+00 tons

UST Breathing and Emptying

2008 Alamance County, North Carolina VOC emissions

= total county gasoline consumption x VOC emission factor
= 61,466 thousand gallons x 1 lb. VOC/thousand gallons
= 6.15E+04 lbs. / 2000 lbs.
= 30.73E+00 tons

Stage I Gasoline Service Station Unloading - uncontrolled VOC emissions in July for balanced submerged fill unloading in Alamance County, NC

= annual county consumption x proportion of annual gasoline sold in July x VOC emission factor
= 61,466 thousand gallons x 0.1087 x VOC emission factor
= 6,681 thousand gallons x ((12.46 x saturation factor x true vapor pressure x vapor molecular weight) / temperature))
= 6,681 thousand gallons x ((12.46 x 1.0 x 6.309 x 67.811) / 540)
= 65,950 lbs

Incorporate effect of control (vapor balancing requirement)

= Uncontrolled emissions x ((100-CE)/100)
= 65,950 lbs x ((100-90)/100)
= 6,595 lbs / 2,000 lbs
= 3.30E+00 tons

3.5.5 References for Bulk Gasoline Terminals and Gas Stations

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16. Pacific Environmental Services, Inc., "Draft Summary of the Analysis of the Emissions Reported in the 1999 NEI for Stage I and Stage II Operations at Gasoline Service Stations," prepared for the U.S. Environmental Protection Agency and the Emission Inventory Improvement Program, September 2002.
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3.6 Commercial Cooking

3.6.1 Sector description

Commercial cooking refers to the cooking of meat, including steak, hamburger, poultry, pork, and seafood, and french fries on five different cooking devices: chain-driven (conveyorized) charbroilers, underfired charbroilers, deep-fat fryers, flat griddles and clamshell griddles. The 2011 NEI has emissions for the SCCs in Table 3-56; EPA computes emissions for all except the first one (2302002000), since it's a grouping of the two more detailed SCCs for charbroiling.

Table 3-56: SCCs used in the Commercial Cooking sector

SCC	EI Sector	SCC Level One	SCC Level Two	SCC Level Three	SCC Level Four
2302002000	Commercial Cooking	Industrial Processes	Food and Kindred Products: SIC 20	Commercial Cooking - Charbroiling	Charbroiling Total
2302002100	Commercial Cooking	Industrial Processes	Food and Kindred Products: SIC 20	Commercial Cooking - Charbroiling	Conveyorized Charbroiling
2302002200	Commercial Cooking	Industrial Processes	Food and Kindred Products: SIC 20	Commercial Cooking - Charbroiling	Under-fired Charbroiling
2302003100	Commercial Cooking	Industrial Processes	Food and Kindred Products: SIC 20	Commercial Cooking - Frying	Flat Griddle Frying
2302003000	Commercial Cooking	Industrial Processes	Food and Kindred Products: SIC 20	Commercial Cooking - Frying	Deep Fat Frying
2302003200	Commercial Cooking	Industrial Processes	Food and Kindred Products: SIC 20	Commercial Cooking - Frying	Clamshell Griddle Frying

3.6.2 Sources of data overview and selection hierarchy

The commercial cooking sector includes data from the S/L/T agency submitted data, the EPA PM Augmentation data, the EPA Chromium Split data, the EPA HAP Augmentation data, and the default EPA generated commercial cooking emissions. This sector is only present in the nonpoint data category. The agencies listed in Table 3-57 submitted emissions for this sector. EPA datasets are individually listed. Where only zero emissions were submitted (sum across all pollutants submitted), these are shown as zeroes ("0") in the table.

Table 3-57: Agencies that submitted Commercial Cooking data

Agency	Type	Char-broiling Total	Convey--orized Char-broiling	Under-fired Char-broiling	Deep Fat Frying	Flat Griddle Frying	Clamshell Griddle Frying
EPA Chromium Speciation	EPA	X					
EPA HAP Augmentation	EPA	X	X	X		X	
EPA Commercial Cooking data (Section 3.6.4)	EPA		X	X	X	X	X
EPA PM Augmentation	EPA	X	X	X	0	X	X
California Air Resources Board	S	X					
Clark County Department of Air Quality and Environmental Management	L		X	X	X	X	X
Coeur d'Alene Tribe	T		X	X	X	X	X
DC-District Department of the Environment	S		X	X	X	X	X
Delaware Department of Natural Resources and Environmental Control	S		X	X	X	X	X

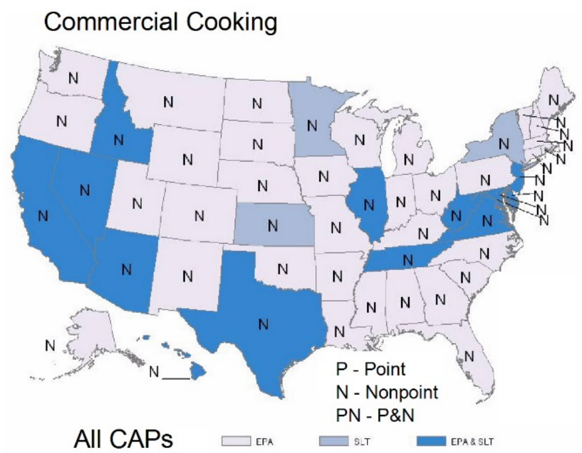
Agency	Type	Char-broiling Total	Convey--orized Char-broiling	Under-fired Char-broiling	Deep Fat Frying	Flat Griddle Frying	Clamshell Griddle Frying
Hawaii Department of Health Clean Air Branch	S		X	X	X	X	X
Idaho Department of Environmental Quality	S		X	X	X	X	X
Illinois Environmental Protection Agency	S		X	X	X	X	X
Kansas Department of Health and Environment	S		X	X	X	X	X
Kootenai Tribe of Idaho	T		X	X	X	X	X
Maricopa County Air Quality Department	L		X	X	X	X	X
Maryland Department of the Environment	S		X	X	X	X	X
Memphis and Shelby County Health Department - Pollution Control	L				X		X
Minnesota Pollution Control Agency	S		X	X	X	X	X
New Jersey Department of Environment Protection	S		X	X	X	X	X
New York State Department of Environmental Conservation	S		X	X	X	X	X
Nez Perce Tribe	T		X	X	X	X	X
Shoshone-Bannock Tribes of the Fort Hall Reservation of Idaho	T		X	X	X	X	X
Texas Commission on Environmental Quality	S		X	X	X	X	X
Virginia Department of Environmental Quality	S		X	X	X	X	X
West Virginia Division of Air Quality	S		X	X	X	X	X

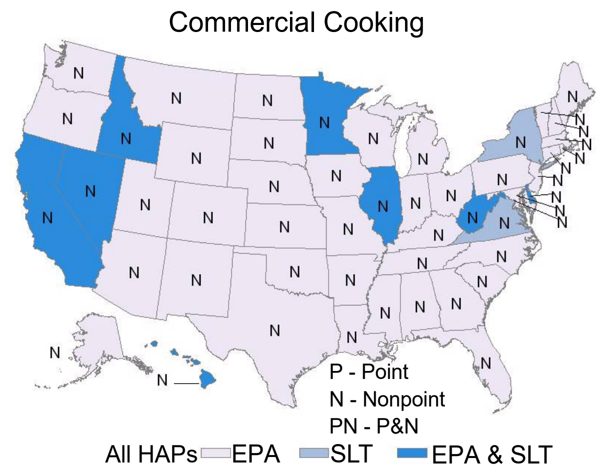
Table 3-58 shows the selection hierarchy for the datasets included in the commercial cooking sector.

Table 3-58: 2011 NEI Commercial Cooking data selection hierarchy

Priority	Dataset Name	Dataset Content
1	Responsible Agency Data Set	State and Local Agency submitted emissions
2	2011EPA_PM-Augmentation	Augments PM data in 47 states and some tribes
3	2011EPA_chrom_split	Splits total chromium into speciated chromium in 37 states
4	2011EPA_HAP-Augmentation	Adds Pb and other HAP emissions in 46 states
5	2011EPA_NP_NoOverlap_w_Pt	EPA-generated data

3.6.3 Spatial coverage and data sources for the sector





3.6.4 EPA-developed commercial cooking emissions data

The approach to estimating emissions from commercial cooking in 2011 consists of three general steps, as follows:

- Determine county-level activity, i.e., the number of restaurants in each county in 2011;
- Determine the fraction of restaurants with commercial cooking equipment, the average number of units of each type of equipment per restaurant, and the average amount of food cooked on each type of equipment; and
- Apply emission factors to each type of food for each type of commercial cooking equipment.

<u>Activity Data</u>

Data on the number of restaurants in each county are available from the U.S. Census Bureau County Business Patterns database [ref 1], which reports the number of full-service restaurants (NAICS 722110) and limited-service restaurants (722211) in each county. The 2002 NEI, which is the most recent inventory in which the emissions from commercial cooking were estimated using restaurant-level data, rather than population data, used the Dun and Bradstreet industry database, which contains more specific information on the type of restaurant in each county. The documentation from the 2002 NEI [ref 2] identifies five specific categories of restaurants that are likely to have the equipment that matches the source categories for commercial cooking emissions, including: Ethnic food restaurants, Fast food restaurants, Family restaurants, Seafood restaurants, and Steak & Barbecue restaurants. Because Dun and Bradstreet data for 2011 were not readily available, the number of restaurants in each county was estimated using a two-step process. First the number of restaurants in 2002 was estimated using equation 1:

$$REST_{i,2002} = \frac{E_{ijm,2002}}{FRAC_j \times UNITS_j \times AVG\_EMISSIONS_{jm}} \quad (1)$$

where:

$REST_{i,2002}$	=	the total number of restaurants in county *i* in 2002
$E_{ijm,2002}$	=	the emissions of pollutant *m* from source category *j* in county *i* in 2002, as calculated for the 2002 National Emissions Inventory
$FRAC_j$	=	the fraction of restaurants in those categories that have equipment in source *j*

$UNITS_j$	=	the average number of units of source category *j* in each restaurant
$AVG\_EMISSIONS_{jm}$	=	the average emissions of pollutant *m* from food cooked on source category *j*, based on summing the average amount of food cooked on source category *j* multiplied by the emission factor for pollutant *m* from source category *j*

The values of $FRAC_i$, and $UNITS_i$, as well as the average amount of food cooked on each type of source category equipment used to calculate $AVG\_EMISSIONS_{jm}$, came from Potepan [ref 3]. The emission factors used to calculate $AVG\_EMISSIONS_{jm}$ are from the 2002 NEI documentation [ref 2].

Next the change in the number of restaurants in each county between 2002 and 2011 was determined using data from the U.S. Census Bureau County Business Patterns database [ref 1] to create a growth factor. For example, if the number of restaurants in a particular county increased from 100 to 125 between 2002 and 2011, the growth factor would be 1.25; in some cases, the number of restaurants decreased, and the growth factor was less than 1. This growth factor was multiplied by the number of restaurants in each county in 2002, as shown in equation 2, to estimate the number of restaurants in 2011:

$$REST_{i,2011} = REST_{i,2002} \text{ X } GF_i \quad (2)$$

where GF_i is the growth factor for county *i*.

Emission Factors

Emission factors for each pollutant for each type of commercial cooking equipment (EF_{jmn}) came from the 2002 NEI documentation [ref 1]. This information remains the most complete catalog of emission factors for commercial cooking; a recent review of the literature on emissions from cooking [ref 4] revealed no new studies with a similar breadth of pollutants analyzed. The particulate matter (PM) emission factors from the 2002 documentation only contain primary PM. The emission factors for filterable PM were derived by applying ratios to primary PM (Table 3-59). The condensable particulate matter (PM-CON) emission factors were derived by subtracting PM10-FIL from PM10-PRI.

Table 3-59: Ratio of filterable PM to primary PM for $PM_{2.5}$ and PM_{10} by SCC.

Cooking Device	SCC	PM25-FIL / PM25-PRI	PM10-FIL / PM10-PRI
Conveyorized Charbroiling	2302002100	0.00321	0.00331
Underfired Charbroiling	2302002200	0.00287	0.00297
Flat Griddle Frying	2302003100	0.00201	0.00264
Clamshell Griddle Frying	2302003200	0.00241	0.00283

Emissions

After determining the number of establishments in 2011 using Equation 2, Equation 3 provides the amount of emissions in 2011 by rearranging Equation 1:

$$E_{ijm,2011} = REST_{i,2011} \times FRAC_j \times UNITS_j \times AVG\_Emissions_{jm} \quad (3)$$

where $E_{ijm,2011}$ is the emissions of pollutant *m* from commercial equipment *j* in county *i* in 2011.

The fraction of restaurants with commercial cooking equipment ($FRAC_j$) and the average units of equipment per restaurant ($UNITS_j$) were obtained from Potepan [ref 3]. Because Potepan reports the fraction of restaurants with commercial cooking equipment broken down by subcategories of restaurant types (Ethnic food restaurants, Fast food restaurants, Family restaurants, Seafood restaurants, and Steak & Barbecue restaurants), a weighted average of these fractions was calculated to determine an overall fraction of the number of all restaurants across all five subcategories that utilize commercial cooking equipment. Furthermore, because Potepan reports that 31% of all restaurants fall into one of those five subcategories, the weighted averages were multiplied by 0.31 to determine the fraction of all restaurants in each county with commercial cooking equipment. These numbers are reported in Table 3-60. The percentage of restaurants with under-fired charbroilers (12.5%) is similar to a more recent survey [ref 5] in North Carolina, which found that 13% of surveyed restaurants employed charbroilers. The North Carolina survey did not include the other types of commercial cooking equipment reported here.

Table 3-60: Fraction of restaurants with source category equipment and average number of units per restaurant.

Source Category	SCC	Percent of Restaurants with Equipment ($FRAC_j$)	Average Number of Units Per Restaurant ($UNITS_j$)
Conveyorized Charbroiling	2302002100	3.6%	1.3
Under-fired Charbroiling	2302002200	12.5%	1.5
Deep Fat Frying	2302003000	28.0%	2.5
Flat Griddle Frying	2302003100	18.4%	1.6
Clamshell Griddle Frying	2302003200	2.8%	1.7

The number of restaurants in 2011 estimated using Equation 2 was then used in Equation 3 to determine the quantity of emissions in 2011.

Sample Calculations

Determining the Number of Restaurants in Autauga County, AL in 2002

$$REST_{i,2002} = \frac{E_{ijm,2002}}{FRAC_j \times UNITS_j \times AVG\_EMISSIONS_{jm}}$$

$$100 \text{ restaurants } = \frac{8.76_{PM25,Underfired-Charbroilers}}{0.125 \times 1.54 \times \ 0.454}$$

Emissions of $PM_{2.5}$ from underfired charbroilers in county Autauga County, AL in 2002 were 8.76 tons. To determine the number of restaurants that generated these emissions in 2002, the emissions are divided by the fraction of restaurants that use underfired charbroilers (0.125), the average number of underfired charbroilers used at each restaurant (1.54), and the average emissions from each establishment from underfired charbroilers (0.454 tons $PM_{2.5}$). The result shows that there were approximately 100 restaurants in Autauga County, AL in 2002. This process is repeated for each SCC across all counties.

Determining the Number of Restaurants in Each County in 2011

Using the estimated number of restaurants in 2002, the number of restaurants in 2011 was determined by employing a growth factor based on the change in the number of restaurants between 2002 and 2011 as determined by the U.S. Census Bureau County Business Statistics Database.

$$REST_{i,2011} = REST_{i,2002} \text{ X } GF_i$$

$$138 \text{ restaurants} = \ 100 \text{ restaurants} \times 1.38$$

There were 100 restaurants estimated to be in Autauga County, AL in 2002. Data from the U.S. Census Bureau show that there was a 38% increase in the number of restaurants in Autauga between 2002 and 2011. The growth factor (1.38) was multiplied by 100 to estimate that there were 138 restaurants in Autauga in 2011. Note that the actual number of restaurants in 2011 as determined from the U.S. Census Bureau County Business Statistics database is not equal to $REST_{i,2011}$ as determined by the equation above because the emissions from the 2002 NEI were calculated using activity data from the Dun and Bradstreet database, rather than the U.S. Census Bureau County Business Statistics database.

Determining the Emissions in 2011

The emissions in 2011 were determined using the following equation:

$$E\_(ijm, 2011) = 〚REST〛\_(i, 2011) \times 〚FRAC〛\_j \times 〚UNITS〛\_j \times 〚AVG\_EMISSIONS〛\_jm$$

$$12.06\ tons\ PM2.5 = 138 \times 0.125 \times 1.54 \times 0.454$$

There were 138 restaurants in Autauga County, AL in 2011. This was multiplied by the fraction of restaurants that use underfired charbroilers (0.125), the average number of underfired charbroilers used at each restaurant (1.54), and the average emissions from each establishment from underfired charbroilers (0.454 tons $PM_{2.5}$). The result shows that the emissions of $PM_{2.5}$ in Autauga County, AL were 12.06 tons in 2011.

3.6.5 Summary of quality assurance methods

Data analyses involving comparison of emissions between 2011 and 2008 showed no large discrepancies in emissions from this sector between the two years. However, California submitted some pollutants for this sector that EPA did not estimate nor did any other states; so, for consistency, these values were tagged and not used in the 2011 NEI. In addition, Louisiana requested that some values be tagged and not used, because Louisiana had pulled 2008 data forward for this sector and requested that we use EPA data for 2011 for these emissions instead. Table 3-61 summarizes the number of tagged process-level emissions values from each agency affected by this QA. EPA data for CA were tagged to avoid double counting with state data because CA used different SCCs than EPA did. We noticed a problem with the HAP augmentation applied to commercial cooking in the VA dataset. In several counties, the selection used some erroneous PM augmentation data instead of the state submitted data. The errors are small, and these emissions were also not tagged out of 2011 v2; the PM augmentation methodology should be revised for these SCCs for the next (2014 NEI) inventory cycle.

Table 3-61: Agencies tagged values for Commercial Cooking

Agency	Number of Values Tagged	Tag Reason
California Air Resources Board	57	Extraneous pollutants (no other states submitted)
Louisiana Department of Environmental Quality	988	State requested that we replace their data with EPA estimates.

3.6.6 References for Commercial Cooking

1. County Business Patterns
2. Environmental Protection Agency (EPA). 2002. Commercial Cooking. From: Documentation for the Final 2002 Nonpoint Sector (FEB 06 version) National Emission Inventory for Criteria and Hazardous Air Pollutants.
3. Potepan, M. 2001. Charbroiling Activity Estimation. Public Research Institute, report for the California Air Resources Board and the California Environmental Protection Agency.

4. Abdullahi, K.L, J.M. Delgado-Saborit, and R.M. Harrison. 2013. Emissions and indoor concentrations of particulate matter and its specific chemical components from cooking: a review. Atmospheric Environment, 71: 260–294.
5. North Carolina Division of Air Quality. 2013. Supplement Section 110(a)(1) Maintenance Plan - February 2013, Appendix B, Section 4.4.4.

3.7 Dust – Construction Dust

3.7.1 Sector description

Construction dust refers to residential and non-residential construction activity, which are functions of acreage disturbed for construction. This sector will be divided below when describing the calculation of EPA's emissions. Table 3-62 lists the SCCs associated with this sector in the 2011 NEI. EPA estimates emissions for the SCCs covered by the shaded rows in the table.

Table 3-62: SCCs in the 2011 NEI in the Dust - Construction Dust sector

SCC	SCC Level One	SCC Level Two	SCC Level Three	SCC Level Four
NONPOINT				
2311010000	Industrial Processes	Construction: SIC 15 - 17	Residential	Total
2311020000	Industrial Processes	Construction: SIC 15 - 17	Industrial/Commercial/Institutional	Total
2311030000	Industrial Processes	Construction: SIC 15 - 17	Road Construction	Total
2311040000	Industrial Processes	Construction: SIC 15 - 17	Special Trade Construction	Total
POINT				
31100101	Industrial Processes	Building Construction	Construction: Building Contractors	Site Preparation: Topsoil Removal
31100102	Industrial Processes	Building Construction	Construction: Building Contractors	Site Preparation: Earth Moving (Cut and Fill)
31100103	Industrial Processes	Building Construction	Construction: Building Contractors	Site Preparation: Aggregate Hauling (On Dirt)
31100199	Industrial Processes	Building Construction	Construction: Building Contractors	Other Not Classified
31100202	Industrial Processes	Building Construction	Demolitions/Special Trade Contracts	Mechanical or Explosive Dismemberment
31100206	Industrial Processes	Building Construction	Demolitions/Special Trade Contracts	On-site Truck Traffic
31100299	Industrial Processes	Building Construction	Demolitions/Special Trade Contracts	Other Not Classified: Construction/Demolition

3.7.2 Sources of data overview and selection hierarchy

The construction dust sector includes data from the S/L/T agency submitted data and the default EPA generated construction dust emissions. The agencies listed in Table 3-63 submitted emissions for this sector.

Table 3-63: Agencies that submitted Construction Dust data

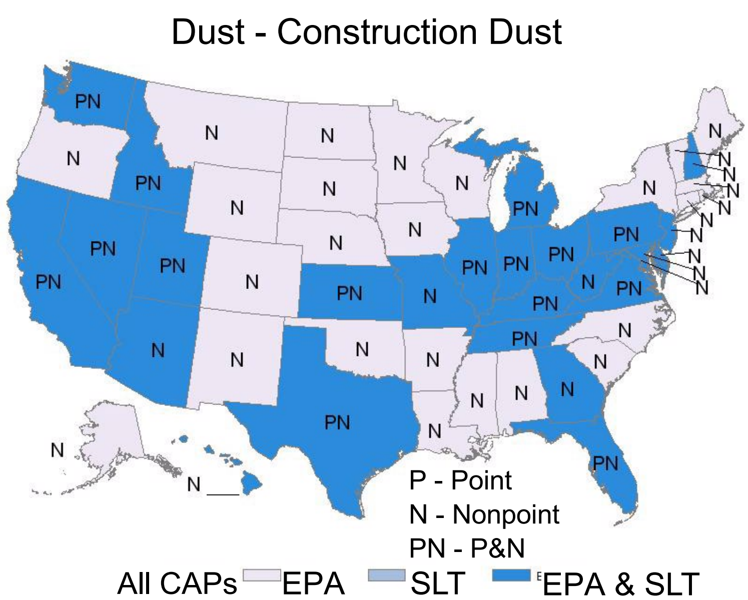
		Nonpoint SCCs				Point SCCs						
Agency	**Type**	**2311010000**	**2311020000**	**2311030000**	**2311040000**	**31100101**	**31100102**	**31100103**	**31100199**	**31100202**	**31100206**	**31100299**
Allegheny County Health Department	L								X			X
California Air Resources Board	S	X		X		X			X	X	X	
Chattanooga Air Pollution Control Bureau (CHCAPCB)	L								X			
Clark County Department of Air Quality and Environmental Management	L	X	X	X								
Coeur d'Alene Tribe	T	X	X	X								
Delaware Department of Natural Resources and Environmental Control	S	X	X	X								
Florida Department of Environmental Protection	S										X	
Georgia Department of Natural Resources	S	X	X									
Hawaii Department of Health Clean Air Branch	S	X	X	X								
Idaho Department of Environmental Quality	S	X	X	X			0				X	X
Illinois Environmental Protection Agency	S	X	X	X						X		X
Indiana Department of Environmental Management	S						X				X	
Kansas Department of Health and Environment	S	X	X	X				X				
Kentucky Division for Air Quality	S							X				
Kootenai Tribe of Idaho	T	X	0	X								
Maricopa County Air Quality Department	L	X	X	X	X							
Maryland Department of the Environment	S	X	X	X								
Metro Public Health of Nashville/Davidson County	L	X	X	X							X	
Michigan Department of Environmental Quality	S										X	
Missouri Department of Natural Resources	S		X									
Nevada Division of Environmental Protection	S								X			
New Hampshire Department of Environmental Services	S	X										
New Jersey Department of Environment Protection	S	X	X	X								
Nez Perce Tribe	T	X	X	X								
Ohio Environmental Protection Agency	S								X			
Pennsylvania Department of Environmental Protection	S							X				
Philadelphia Air Management Services	L							X				
Puget Sound Clean Air Agency	L								X			
Shoshone-Bannock Tribes of the Fort Hall Reservation of Idaho	T	X	X	X								
Texas Commission on Environmental Quality	S								X			
Utah Division of Air Quality	S					X						
Virginia Department of Environmental Quality	S	X	X	X							X	
West Virginia Division of Air Quality	S	X	X	X								

Table 3-64 shows the selection hierarchy for datasets included in the construction dust sector.

Table 3-64: 2011 NEI Construction Dust data selection hierarchy

Priority	Dataset Name	Dataset Content
Nonpoint Data Category		
1	Responsible Agency Data Set	State and Local Agency submitted emissions
2	2011EPA_PM-Augmentation	Augments PM data
5	2011EPA_NP_NoOverlap_w_Pt	EPA-generated data
Point Data Category		
1	2011EPA_PM-Augmentation	Augments PM data
2	Responsible Agency Data Set	State and Local agency submitted emissions
3	2011EPA_chrom_split	Speciates S/L/T agency submitted chromium
4	EPA NV Gold Mines	Mercury emissions at Nevada gold mine facilities (likely incorrect SCC used)
5	2011EPA_TRI	EPA TRI data (likely incorrect SCC used)

3.7.3 Spatial coverage and data sources for the sector



3.7.4 Construction - Non-Residential – EPA estimates

3.7.4.1 *Source category description*

Emissions from non-residential construction activity are a function of the acreage disturbed for non-residential construction. The SCC that belongs to this sector is provided in Table 3-65.

Table 3-65: SCC for Non-Residential Construction

SCC	SCC Level One	SCC Level Two	SCC Level Three	SCC Level Four
2311020000	Industrial Processes	Construction: SIC 15 - 17	Heavy Construction	Total

Activity Data

Annual Value of Construction Put in Place in the U.S. [ref 1] has the 2011 National Value of Non-residential construction. The national value of non-residential construction put in place (in millions of dollars) was allocated to counties using county-level non-residential construction (NAICS Code 2362) employment data obtained from *County Business Patterns (CBP)* [ref 2]. Because some counties employment data were withheld due to privacy concerns, the following procedure was adopted:

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

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

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

In 1999 a figure of 2 acres/$\$10^6$ was developed. The Bureau of Labor Statistics *Producer Price Index* [ref 3] lists costs of the construction industry from 1999-2011.

2011 acres per $\$10^6$ = 1999 acres per $\$10^6$ x (1999 PPI / 2011 PPI)
=2 acres/$\$10^6$ * (132.9 / 229.3)
= 1.159 acres per $\$10^6$

Emission Factors

Initial PM_{10} emissions from construction of non-residential buildings are calculated using an emission factor of 0.19 tons/acre-month [ref 4]. The duration of construction activity for non-residential construction is assumed to be 11 months. Since there are no condensable emissions, primary PM emissions are equal to filterable emissions. Once PM10-xx emissions are developed, PM25-xx emissions are estimated by applying a particle size multiplier of 0.10 to PM10-xx emissions.

Regional variances in construction emissions are corrected using soil moisture level and silt content. These correction parameters are applied to initial PM_{10} emissions from non-residential construction to develop the final emissions inventory.

To account for the soil moisture level, the PM_{10} emissions are weighted using the 30-year average precipitation-evaporation (PE) values from Thornthwaite's PE Index. Average precipitation evaporation values for each State were estimated based on PE values for specific climatic divisions within a State [ref 4].

To account for the silt content, the PM_{10} emissions are weighted using average silt content for each county. A data base containing county-level dry silt values was complied. These values were derived by applying a correction factor developed by the California Air Resources Board to convert wet silt values to dry silt values [ref 5].

The equation for PM_{10} emissions corrected for soil moisture and silt content is:

$$Corrected\ E_{PM10} = Initial\ \mathrm{E}_{PM10} \times \frac{24}{PE} \times \frac{S}{9\%}$$

where:

Corrected E_{PM10}	=	PM_{10} emissions corrected for soil moisture and silt content,
PE	=	precipitation-evaporation value for each State,
S	=	% dry silt content in soil for area being inventoried.

Once PM_{10} adjustments have been made, $PM_{2.5}$ emissions are set to 10% of PM_{10}.

<u>Example Calculation</u>

$Emissions_{PM10} = N_{Spending} \times (Emp_{county} / Emp_{National}) \times Apd \times EF_{Adj} \times M$

where:

$N_{Spending}$	=	National spending on nonresidential construction (million dollars)
Emp_{county}	=	County level employment in nonresidential construction
$Emp_{National}$	=	National level employment in nonresidential construction
Apd	=	Acres per million dollars (national data)
EF_{Adj}	=	Adjusted PM_{10} emission factor (ton/acre-month)
M	=	duration of construction activity (months)

As an example, in Grand Traverse County, Michigan, 2011 acres disturbed and PM_{10} emissions from non-residential construction are calculated as follows:

$Emissions_{PM10}$ = 269,045 x 10^6 \$ x (130/651,996) x 1.159 acres/10^6\$ x EF_{Adj} x M
= 62.2 acres x 0.059 ton/acre-month x 11 months
= 40.4 tons PM_{10}

where EF_{Adj} is calculated as follows:

EF_{Adj} = 0.19 ton/acre-month * (24/103.6 * 12/9)
= 0.059 ton/acre-month

3.7.4.2 *References for Construction – Non-Residential*

1. US Census Bureau, 2011. Annual Value of Construction Put in Place
2. County Business Patterns
3. Bureau of Labor Statistics: Table BMNR
4. Midwest Research Institute. Improvement of Specific Emission Factors Emission Factors (BACM Project No. 1). Prepared for South Coast Air Quality Management District. March 29, 1996.
5. Campbell, 1996: Campbell, S.G., D.R. Shimp, and S.R. Francis. *Spatial Distribution of PM-10 Emissions from Agricultural Tilling in the San Joaquin Valley*, pp. 119-127 in Geographic Information Systems in Environmental Resources Management, Air and Waste Management Association, Reno, NV. 1996.

3.7.5 Construction – Residential –EPA estimates

3.7.5.1 *Source category description*

Emissions from residential construction activity are a function of the acreage disturbed and volume of soil excavated for residential construction. Residential construction activity is developed from data obtained from the U.S. Department of Commerce (DOC)'s Bureau of the Census. The SCC that belongs to this sector is provided in Table 3-66.

Table 3-66: SCC for Residential Construction

SCC	SCC Level One	SCC Level Two	SCC Level Three	SCC Level Four
2311010000	Industrial Processes	Construction: SIC 15 - 17	General Building Construction	Total

<u>Activity Data</u>

There are two activity calculations performed for this SCC, acres of surface soil disturbed, and volume of soil removed for basements.

Surface soil disturbed

The US Census Bureau has 2010 data for *Housing Starts - New Privately Owned Housing Units Started* [ref 6] which provides regional level housing starts based on the groupings of 1 unit, 2-4 units, 5 or more units. A consultation with the Census Bureau in 2002 gave a breakdown of approximately 1/3 of the housing starts being for 2 unit structures, and 2/3 being for 3 and 4 unit structures. The 2-4 unit category was then divided into 2-units, and 3-4 units based on this ratio. To get the number of structures for each grouping, the 1 unit category was divided by 1, the 2 unit category was divided by 2, and the 3-4 unit category was divided by 3.5. The 5 or more unit category listed may be made up of more than one structure. *New Privately Owned Housing Units Authorized Unadjusted Units* [ref 7] gives a conversion factor to determine the ratio of structures to units in the 5 or more unit category. For example, if a county has one 40 unit apartment building, the ratio would be 40/1. If there are 5 different 8 unit buildings in the same project, the ratio would be 40/5. Structures started by category are then calculated at a regional level. The table *Annual Housing Units Authorized by Building Permit* [ref 8] has 2010 data at the county level to allocate regional housing starts to the county level. This results in county level housing starts by number of units. Table 3-67 provides surface areas that were assumed disturbed for each unit type.

Table 3-67: Surface soil removed per unit type

Unit Type	Surface Acres Disturbed
1-Unit	1/4 acre/structure
2-Unit	1/3 acre/structure
Apartment	1/2 acre/structure

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

Basement soil removal

To calculate basement soil removal, 2010 *Characteristics of New Houses* [ref 9] is used to estimate the percentage of 1 unit structures that have a basement (on the regional level). The county level estimate of number of 1 unit starts is multiplied by the percent of 1 unit houses in the region that have a basement to get the number of basements in a county. Basement volume is calculated by assuming a 2000 square foot house has a basement dug to a depth of 8 feet (making 16,000 ft^3 per basement). An additional 10% is added for peripheral dirt bringing the total to 17,600 ft^3 per basement.

Emission Factors

Initial PM_{10} emissions from construction of single family, two family, and apartments structures are calculated using the emission factors given in Table 3-68 [ref 10]. The duration of construction activity for houses is assumed to be 6 months and the duration of construction for apartments is assumed to be 12 months.

Table 3-68: Emission factors for Residential Construction

Type of Structure	Emission Factor	Duration of Construction
Apartments	0.11 tons PM_{10}/acre-month	12 months
2-Unit Structures	0.032 tons PM_{10}/acre-month	6 months
1-Unit Structures w/o Basements	0.032 tons PM_{10}/acre-month	6 months
1-unit Structures with Basements	0.011 tons PM_{10}/acre-month	6 months
	0.059 tons PM_{10}/1000 cubic yards	

Regional variances in construction emissions are corrected using soil moisture level and silt content. These correction parameters are applied to initial PM_{10} emissions from residential construction to develop the final emissions inventory.

To account for the soil moisture level, the PM_{10} emissions are weighted using the 30-year average precipitation-evaporation (PE) values from Thornthwaite's PE Index [ref 11]. Average precipitation evaporation values for each State were estimated based on PE values for specific climatic divisions within a State.

To account for the silt content, the PM_{10} emissions are weighted using average silt content for each county. A data base containing county-level dry silt values was compiled. These values were derived by applying a correction factor developed by the California Air Resources Board to convert wet silt values to dry silt values [ref 12].

The equation for PM_{10} emissions corrected for soil moisture and silt content is:

$$Corrected\ E_{PM10} = Initial\ E_{PM10} \times \frac{24}{PE} \times \frac{S}{9\%}$$

where: Corrected E_{PM10} = PM_{10} emissions corrected for soil moisture and silt content,
PE = precipitation-evaporation value for each State,
S = % dry silt content in soil for area being inventoried.

Once PM_{10} adjustments have been made, PM2.5-FIL emissions are estimated by applying a particle size multiplier of 0.10 to PM10-FIL emissions [ref 7]. Primary PM emissions are equal to filterable emissions since there are no condensable emissions from residential construction.

Example Calculation

PM_{10} Emissions = $\sum(A_{unit} \times T_{construction} \times EF_{unit}) \times Adj_{PM}$

where A_{unit} = $HS_{Unit} \times SM_{Unit}$
HS_{Unit} = Regional Housing Starts x (county building permits/Regional building permits)

SM_{Unit}	=	Area or volume of soil moved for the given unit type
$T_{Construction}$	=	Construction time (in months) for given unit type
EF_{Unit}	=	Unadjusted emission factor for PM_{10} for the given unit type
Adj_{PM}	=	PM Adjustment factor

As an example, in Beaufort County, North Carolina, 2010 acres disturbed and PM_{10} emissions from 1-unit housing starts without a basement are calculated as follows:

A_{unit} = 247,000 x (211/232,280) x $0.907_{(\text{Fraction without basement})}$ * 0.25 acres/unit
= 203 units * 0.25 acres/unit = 50.9 acres
Adj_{PM} = (24/110.1) * (10/9) = 0.242

PM_{10} Emissions = (50.9 acres x 6 months x 0.032 tons PM_{10}/acre-month) x 0.242 = 2.37 tons PM_{10}

Summary of Quality Assurance Methods

Data analyses involving comparison of emissions between 2011 and 2008 showed no large discrepancies in emissions from this sector between the two years.

3.7.5.2 *References for Construction - Residential*

6. New Privately Owned Housing Units Started for 2010 (Not seasonally adjusted).
7. Table 2au. New Privately Owned Housing Units Authorized - Unadjusted Units for Regions, Divisions, and States, Annual 2010.
8. Annual Housing Units Authorized by Building Permits CO2010A, purchased from US Department of Census
9. Type of Foundation in New One-Family Houses Completed.
10. Midwest Research Institute. Improvement of Specific Emission Factors (BACM Project No. 1). Prepared for South Coast Air Quality Management District. March 29, 1996.
11. Campbell, 1996: Campbell, S.G., D.R. Shimp, and S.R. Francis. *Spatial Distribution of PM-10 Emissions from Agricultural Tilling in the San Joaquin Valley*, pp. 119-127 in Geographic Information Systems in Environmental Resources Management, Air and Waste Management Association, Reno, NV. 1996.
12. "Proposed Revisions to Fine Fraction Ratios Used for AP-42 Fugitive Dust Emission Factors," C. Cowherd, J. Donaldson and R. Hegarty, Midwest Research Institute; D. Ono, Great Basin UAPCD.

3.7.6 Construction – Road- EPA estimates

Activity data for 2011 were not yet available when developing the 2011 NEI. Therefore, emissions from road construction were not recalculated for the 2011 NEI. Instead, emissions in 2011 are assumed to be the same as emissions in 2008. The methodology for estimating road construction emissions in 2008 is presented below.

3.7.6.1 *Source category description*

Emissions from road construction activity are a function of the acreage disturbed for road construction. Road construction activity is developed from data obtained from the Federal Highway Administration (FHWA). The SCC that belongs to this sector is provided in Table 3-69.

Table 3-69: SCC for Road Construction

SCC	SCC Level One	SCC Level Two	SCC Level Three	SCC Level Four
2311030000	Industrial Processes	Construction: SIC 15 - 17	Road Construction	Total

Activity Data

The Federal Highway Administration has *Highway Statistics, Section IV - Highway Finance, Table SF-12A, State Highway Agency Capital Outlay* [ref 13] for 2008 which outlines spending by state in several different categories. For this SCC, the following columns are used: New Construction, Relocation, Added Capacity, Major Widening, and Minor Widening. These columns are also differentiated according to the following six classifications:

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

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

The new miles of road constructed are used to estimate the acreage disturbed due to road construction. The total area disturbed in each state is calculated by converting the new miles of road constructed to acres using an acres disturbed/mile conversion factor for each road type as given in Table 3-70.

Table 3-70: Spending per mile and acres disturbed per mile by highway type

Road Type	Thousand Dollars per mile	Total Affected Roadway Width (ft)*[ref 3]	Acres Disturbed per mile [ref 3]
Urban Areas, Interstate	4,000	125	15.2
Rural Areas, Interstate	4,000	125	15.2
Urban Areas, Other Arterials	1,900	125	15.2
Rural Areas, Other Arterials	1,900	105	12.7
Urban Areas, Collectors	1,900	81	9.8
Rural Areas, Collectors	1,900	65	7.9

**Total Affected Roadway Width = (lane width (12 ft) * number of lanes) + (shoulder width * number of shoulders) + area affected beyond road width (25 ft)*

The acres disturbed per mile data shown in Table 3-70 are calculated by multiplying the total affected roadway width (including all lanes, shoulders, and areas affected beyond the road width) by one mile and converting the resulting land area to acres. Building permits [ref 14] are used to allocate the state-level acres disturbed by road construction to the county. A ratio of the number of building starts in each county to the total number of building starts in each state is applied to the state-level acres disturbed to estimate the total number of acres disturbed by road construction in each county.

Emission Factors

Initial PM_{10} emissions from construction of roads are calculated using an emission factor of 0.42 tons/acre-month [ref 15]. This emission factor represents the large amount of dirt moved during the construction of roadways, reflecting the high level of cut and fill activity that occurs at road construction sites. The duration of construction activity for road construction is assumed to be 12 months.

Regional variances in construction emissions are corrected using soil moisture level and silt content. These correction parameters are applied to initial PM_{10} emissions from road construction to develop the final emissions inventory.

To account for the soil moisture level, the PM_{10} emissions are weighted using the 30-year average precipitation-evaporation (PE) values from Thornthwaite's PE Index. Average precipitation evaporation values for each State were estimated based on PE values for specific climatic divisions within a State [ref 16].

To account for the silt content, the PM_{10} emissions are weighted using average silt content for each county. A data base containing county-level dry silt values was complied. These values were derived by applying a correction factor developed by the California Air Resources Board to convert wet silt values to dry silt values [ref 15].

The equation for PM_{10} emissions corrected for soil moisture and silt content is:

$$Corrected\ E_{PM10} = Initial\ \mathrm{E}_{PM10} \times \frac{24}{PE} \times \frac{S}{9\%}$$

where: Corrected E_{PM10} = PM_{10} emissions corrected for soil moisture and silt content,
PE = precipitation-evaporation value for each State,
S = % dry silt content in soil for area being inventoried.

Once PM_{10} adjustments have been made, $PM_{2.5}$ emissions are set to 10% of PM_{10}. Primary PM emissions are equal to filterable emissions since there are no condensable emissions from road construction.

Example Calculation

$Emissions_{PM10} = \sum(HD_{rt} \times MC_{rt} \times AC_{rt}) \times (HS_{County} / HS_{State}) \times EF_{Adj} \times M$

where:

HD_{rt}	=	Highway Spending for a specific road type
MC_{rt}	=	Mileage conversion for a specific road type
AC_{rt}	=	Acreage conversion for a specific road type
HS_{County}	=	Housing Starts in a given county
HS_{State}	=	Housing Starts in a given State
EF_{Adj}	=	Adjusted PM_{10} Emission Factor
M	=	duration of construction activity

As an example in 2010, in Newport County, Rhode Island, acres disturbed and PM_{10} emissions from urban interstate and urban other arterial road construction are calculated as follows:

$Emissions_{PM10}$ = $\sum(HD_{rt} \times MC_{rt} \times AC_{rt}) \times (HS_{County} / HS_{State}) \times EF_{Adj} \times M$
= ($35,474/$4,000/mi x 15.2 acres/mi) * (187/1058) + ($21,332/$1,600/mi x 15.2 acres/mi) * (187/1058)
= 54 acres x 0.28ton/acre-month x 12 months
= 181.4 tons PM_{10}

where EF_{Adj} is calculated as follows:

EF_{Adj} = 0.42 ton/acre-month * (24/110.1 * 33/9)
= 0.28 ton/acre-month

3.7.6.2 *References for Construction - Road*

13. 2008 Highway Spending.
14. 2008 Building Permits data from US Census "BPS01",
15. Midwest Research Institute. Improvement of Specific Emission Factors (BACM Project No. 1). Prepared for South Coast Air Quality Management District. March 29, 1996.
16. Campbell, 1996: Campbell, S.G., D.R. Shimp, and S.R. Francis. *Spatial Distribution of PM-10 Emissions from Agricultural Tilling in the San Joaquin Valley*, pp. 119-127 in Geographic Information Systems in Environmental Resources Management, Air and Waste Management Association, Reno, NV. 1996.

3.8 Dust – Paved Road Dust

3.8.1 Sector description

The SCCs that belong to this sector are provided in Table 3-71. EPA estimates emissions for particulate matter for the first SCC in this table.

Table 3-71: SCCs used for Paved Road Dust – 2011 NEI

SCC	SCC Level 1	SCC Level 2	SCC Level 3	SCC Level 4
2294000000	Mobile Sources	Paved Roads	All Paved Roads	Total: Fugitives
2294005000	Mobile Sources	Paved Roads	Interstate/Arterial	Total: Fugitives
2294010000	Mobile Sources	Paved Roads	All Other Public Paved Roads	Total: Fugitives

3.8.2 Sources of data overview and selection hierarchy

The paved road dust sector includes data from the S/L/T agency submitted data and the default EPA generated paved road dust emissions. The agencies listed in Table 3-72 submitted emissions for this sector. Table 3-73 shows the selection hierarchy for the datasets included in the paved road dust sector.

Table 3-72: Agencies that submitted Paved Road Dust data

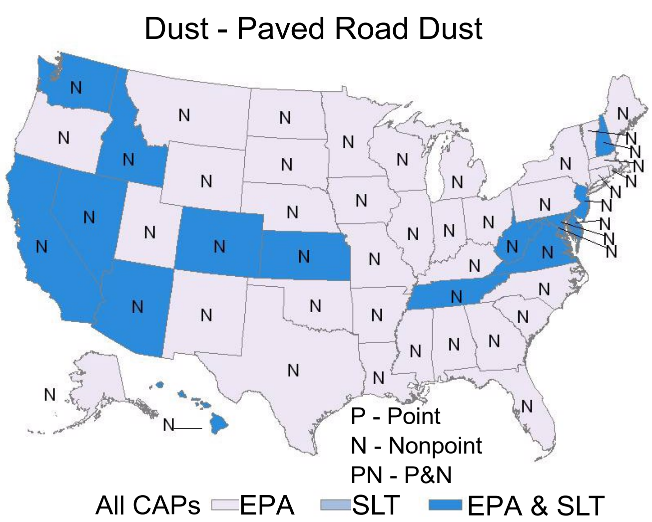
AGENCY	Type	All Other Public Paved Roads	All Paved Roads	Interstate/ Arterial
EPA- paved road estimates	EPA		X	
EPA- PM-augmentation	EPA	X	X	X
Bishop Paiute Tribe	T		X	
California Air Resources Board	S		X	
Clark County Department of Air Quality and Environmental Management	L		X	
Coeur d'Alene Tribe	T		X	
Colorado Department of Public Health and Environment	S		X	
Delaware Department of Natural Resources and Environmental Control	S		X	
Hawaii Department of Health Clean Air Branch	S		X	
Idaho Department of Environmental Quality	S		X	
Kansas Department of Health and Environment	S		X	
Kickapoo Tribe of Indians of the Kickapoo Reservation in Kansas	T	X		X

AGENCY	Type	All Other Public Paved Roads	All Paved Roads	Interstate/ Arterial
Kootenai Tribe of Idaho	T		X	
Maricopa County Air Quality Department	L		X	
Maryland Department of the Environment	S		X	
Metro Public Health of Nashville/Davidson County	L		X	
New Hampshire Department of Environmental Services	S		X	
New Jersey Department of Environment Protection	S		X	
Nez Perce Tribe	T		X	
Northern Cheyenne Tribe	T		X	
Sac and Fox Nation of Missouri in Kansas and Nebraska Reservation	T	X		
Shoshone-Bannock Tribes of the Fort Hall Reservation of Idaho	T		X	
Virginia Department of Environmental Quality	S		X	
Washington State Department of Ecology	S		X	
West Virginia Division of Air Quality	S		X	

Table 3-73: 2011 NEI Paved Road Dust data selection hierarchy

Priority	Dataset Name	Dataset Content
1	Responsible Agency Data Set	State and Local Agency submitted emissions
2	2011EPA_PM-Augmentation	Augments PM data in 47 states and some tribes
3	2011EPA_NP_NoOverlap_w_Pt	EPA-generated data

3.8.3 Spatial coverage and data sources for the sector



3.8.4 EPA methodology for paved road dust

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

Uncontrolled paved road emissions were calculated by EPA at the county level by roadway type and year. This was done by multiplying the county/roadway class paved road VMT by the appropriate paved road emission factor. Next, control factors were applied to the paved road emissions in PM_{10} nonattainment area counties. Emissions and VMT by roadway class were then totaled to the county level for reporting in the NEI. The following provides further details on the emission factor equation, determination of paved road VMT, and controls.

Emission Factor Equation

Re-entrained road dust emissions for paved roads were estimated using paved road VMT and the emission factor equation from AP-42 [ref 1]:

$$E = [k \times (sL)^{0.91} \times (W)^{1.02}] \times [1-P/(4 \times N)]$$

where:

- E = paved road dust emission factor (gram [g]/VMT)
- k = particle size multiplier (1 g/VMT for PM10-PRI/-FIL and .25 g/VMT for PM25-PRI/-FIL)
- sL = road surface silt loading (g/square meter [m^2]) (dimensionless in eq.)
- W = average weight (tons) of all vehicles traveling the road (dimensionless in eq.)
- P = number of days in the year with at least 0.01 inches of precipitation
- N = number of days in the year

The uncontrolled PM10-PRI/-FIL and PM25-PRI/-FIL emission factors by county, roadway class, and year are provided in the tab "Emission Factors" in the calculation workbook "2011_paved_roads_2294000000_cap_emissions.xlsx", available at. They are provided both utilizing the precipitation correction and without it, as needed for emissions modeling.

Paved road silt loadings were assigned to each of the twelve functional roadway classes (six urban and six rural) based on the average annual traffic volume of each functional system by State [ref 2]. The silt loading values per average daily traffic volume come from the ubiquitous baseline values from Section 13.2.1 of AP-42. Average daily traffic volume was calculated by dividing an estimate of VMT by functional road length. The resulting paved road silt loadings calculated from the average annual traffic volume data are shown in Table 3-74.

Table 3-74: 2011 Silt loadings by state and roadway class used in paved road emission factor calculations (g/m^2)

	Rural						Urban					
State	**Interstate**	**Other Principal Arterial**	**Minor Arterial**	**Major Collector**	**Minor Collector**	**Local**	**Interstate**	**Other Freeways and**	**Other Principal Arterial**	**Minor Arterial**	**Collectors**	**Local**
Alabama	0.015	0.06	0.2	0.2	0.2	0.6	0.015	0.015	0.03	0.06	0.2	0.2
Alaska	0.015	0.2	0.2	0.2	0.6	0.6	0.015	0.015	0.03	0.03	0.2	0.6
Arizona	0.015	0.06	0.2	0.2	0.2	0.6	0.015	0.015	0.03	0.03	0.06	0.2
Arkansas	0.015	0.06	0.2	0.2	0.6	0.6	0.015	0.015	0.03	0.06	0.2	0.6
California	0.015	0.03	0.2	0.2	0.2	0.6	0.015	0.015	0.03	0.03	0.2	0.2

	Rural						Urban					
State	**Interstate**	**Other Principal Arterial**	**Minor Arterial**	**Major Collector**	**Minor Collector**	**Local**	**Interstate**	**Other Freeways and**	**Other Principal Arterial**	**Minor Arterial**	**Collectors**	**Local**
Colorado	0.015	0.2	0.2	0.2	0.6	0.6	0.015	0.015	0.03	0.06	0.2	0.2
Connecticut	0.015	0.06	0.06	0.2	0.2	0.6	0.015	0.015	0.03	0.06	0.2	0.2
Delaware	0.015	0.03	0.06	0.2	0.2	0.6	0.015	0.015	0.03	0.03	0.06	0.2
Dist. of Columbia	0.015	0.6	0.6	0.6	0.6	0.6	0.015	0.015	0.03	0.03	0.06	0.2
Florida	0.015	0.06	0.2	0.2	0.2	0.2	0.015	0.015	0.03	0.03	0.06	0.2
Georgia	0.015	0.06	0.2	0.2	0.2	0.6	0.015	0.015	0.03	0.06	0.2	0.2
Hawaii	0.015	0.03	0.06	0.2	0.2	0.2	0.015	0.015	0.03	0.03	0.06	0.2
Idaho	0.015	0.2	0.2	0.2	0.6	0.6	0.015	0.015	0.03	0.06	0.2	0.2
Illinois	0.015	0.2	0.2	0.2	0.6	0.6	0.015	0.015	0.03	0.06	0.2	0.2
Indiana	0.015	0.06	0.2	0.2	0.2	0.6	0.015	0.015	0.03	0.06	0.06	0.2
Iowa	0.015	0.2	0.2	0.2	0.6	0.6	0.015	0.015	0.03	0.06	0.2	0.2
Kansas	0.015	0.2	0.2	0.6	0.6	0.6	0.015	0.015	0.03	0.06	0.2	0.2
Kentucky	0.015	0.06	0.2	0.2	0.2	0.6	0.015	0.015	0.03	0.06	0.2	0.2
Louisiana	0.015	0.06	0.2	0.2	0.2	0.6	0.015	0.015	0.03	0.06	0.2	0.6
Maine	0.015	0.06	0.2	0.2	0.2	0.6	0.015	0.015	0.03	0.03	0.2	0.2
Maryland	0.015	0.03	0.06	0.2	0.2	0.6	0.015	0.015	0.03	0.03	0.06	0.2
Massachusetts	0.015	0.06	0.2	0.2	0.2	0.6	0.015	0.015	0.03	0.06	0.2	0.2
Michigan	0.015	0.2	0.2	0.2	0.2	0.6	0.015	0.015	0.03	0.06	0.2	0.2
Minnesota	0.015	0.06	0.2	0.2	0.6	0.6	0.015	0.015	0.03	0.06	0.2	0.2
Mississippi	0.015	0.06	0.2	0.2	0.2	0.6	0.015	0.015	0.03	0.06	0.2	0.2
Missouri	0.015	0.2	0.2	0.2	0.6	0.6	0.015	0.015	0.03	0.06	0.2	0.2
Montana	0.015	0.2	0.2	0.6	0.6	0.6	0.015	0.015	0.03	0.06	0.2	0.2
Nebraska	0.015	0.2	0.2	0.6	0.6	0.6	0.015	0.015	0.03	0.06	0.2	0.2
Nevada	0.015	0.2	0.2	0.2	0.6	0.6	0.015	0.015	0.03	0.03	0.06	0.2
New Hampshire	0.015	0.06	0.06	0.2	0.2	0.6	0.015	0.015	0.03	0.03	0.2	0.2
New Jersey	0.015	0.03	0.06	0.2	0.2	0.6	0.015	0.015	0.03	0.06	0.2	0.2
New Mexico	0.015	0.2	0.2	0.2	0.6	0.6	0.015	0.015	0.03	0.06	0.2	0.2
New York	0.015	0.2	0.2	0.2	0.2	0.6	0.015	0.015	0.03	0.06	0.2	0.2
North Carolina	0.015	0.03	0.06	0.2	0.2	0.6	0.015	0.015	0.03	0.03	0.06	0.2
North Dakota	0.015	0.2	0.2	0.6	0.6	0.6	0.015	0.015	0.03	0.06	0.2	0.2
Ohio	0.015	0.06	0.2	0.2	0.2	0.6	0.015	0.015	0.03	0.06	0.2	0.2
Oklahoma	0.015	0.06	0.2	0.2	0.6	0.6	0.015	0.015	0.03	0.06	0.2	0.2
Oregon	0.015	0.2	0.2	0.2	0.6	0.6	0.015	0.015	0.03	0.06	0.2	0.2
Pennsylvania	0.015	0.06	0.2	0.2	0.2	0.6	0.015	0.015	0.03	0.06	0.2	0.2
Rhode Island	0.015	0.06	0.06	0.2	0.2	0.6	0.015	0.015	0.03	0.06	0.2	0.6
South Carolina	0.015	0.06	0.2	0.2	0.6	0.6	0.015	0.015	0.03	0.03	0.2	0.2
South Dakota	0.015	0.2	0.2	0.6	0.6	0.6	0.015	0.015	0.03	0.06	0.2	0.6
Tennessee	0.015	0.06	0.2	0.2	0.2	0.6	0.015	0.015	0.03	0.06	0.2	0.2
Texas	0.015	0.06	0.2	0.2	0.6	0.6	0.015	0.015	0.03	0.06	0.2	0.6
Utah	0.015	0.2	0.2	0.2	0.6	0.6	0.015	0.015	0.03	0.03	0.2	0.2
Vermont	0.015	0.06	0.2	0.2	0.2	0.6	0.015	0.015	0.03	0.06	0.2	0.2
Virginia	0.015	0.03	0.2	0.2	0.2	0.6	0.015	0.015	0.03	0.03	0.2	0.2
Washington	0.015	0.2	0.2	0.2	0.2	0.6	0.015	0.015	0.03	0.06	0.2	0.2
West Virginia	0.015	0.06	0.2	0.2	0.6	0.6	0.015	0.015	0.03	0.06	0.2	0.6
Wisconsin	0.015	0.06	0.2	0.2	0.6	0.6	0.015	0.015	0.03	0.06	0.2	0.6
Wyoming	0.015	0.2	0.2	0.2	0.6	0.6	0.015	0.015	0.06	0.06	0.2	0.2

To better estimate paved road fugitive dust emissions, the average vehicle weight was estimated by road type for each county in the U.S. (plus Puerto Rico and the U.S. Virgin Islands) based on the mix of VMT by vehicle type from the 2008 onroad NEI. For state and local agencies that provided VMT data to EPA for use in the 2008 NEI, those data are included in this data set. Additionally, if a state/local agency did not provide VMT data for the 2008 NEI, but, had provided information for either the 2005 or 2002 NEI, the state/local-supplied data were grown to 2008 based on 2008 VMT data from the Federal Highway Administration (FHWA). The VMT data for the remaining counties were based on 2008 Federal Highway Administration data. (See the NEI onroad documentation for more details on how the default VMT data were calculated from the FHWA data set.)

The 2008 VMT data set from the NEI included in EPA's National Mobile Inventory Model (NMIM) BaseYearVMT table includes 2008 VMT for each county by road type and 28 MOBILE6 vehicle types. An average vehicle weight was estimated for each of these 28 vehicle types, as shown in Table 3-75. For the heavy-duty Class 2B through Class 7 vehicle classes, the average of the gross vehicle weight rating (GVWR) range was selected as the average weight of the vehicle class. More detailed information for the heavy-duty Class 8A and 8B vehicle classes were available from the U.S. Bureau of the Census Vehicle Inventory and Use Survey (VIUS). The Class 8A and 8B subcategories by weight from VIUS were weighted by annual mileage to estimate the average 8A and 8B average vehicle class weights. For the light-duty vehicle and truck classes, data from the U.S. Department of Energy Annual Energy Outlook 2010 were used to represent the average vehicle weights. The average weight of motorcycles and the three bus categories were estimated using professional judgment based on information about existing model weights for these vehicle classes. Once the average vehicle weight was assigned to each of the 28 MOBILE6 vehicle classes, these averages were then assigned to each VMT record in the NMIM BaseYearVMT table, corresponding to the vehicle class that the VMT represented. A VMT-weighted average vehicle weight was then calculated by county and road type for each county/road type combination in the database.

Table 3-75: Average vehicle weights by MOBILE6 vehicle class

Vehicle Class Abbreviation	Vehicle Class Description	Vehicle Weight Estimate (lbs)
LDGV	Light-Duty Gasoline Vehicles (Passenger Cars)	3,369
LDGT1	Light-Duty Gasoline Trucks 1 (0-6,000 lbs. GVWR, 0-3750 lbs. LVW)	4,150
LDGT2	Light-Duty Gasoline Trucks 2 (0-6,000 lbs. GVWR, 3751-5750 lbs. LVW)	4,150
LDGT3	Light-Duty Gasoline Trucks 3 (6,001-8,500 lbs. GVWR, 0-5750 lbs. ALVW)	5,327
LDGT4	Light-Duty Gasoline Trucks 4 (6,001-8,500 lbs. GVWR, 5751 lbs. and greater ALVW)	5,327
HDGV2B	Class 2b Heavy-Duty Gasoline Vehicles (8501-10,000 lbs. GVWR)	9,250
HDGV3	Class 3 Heavy-Duty Gasoline Vehicles (10,001-14,000 lbs. GVWR)	12,000
HDGV4	Class 4 Heavy-Duty Gasoline Vehicles (14,001-16,000 lbs. GVWR)	15,000
HDGV5	Class 5 Heavy-Duty Gasoline Vehicles (16,001-19,500 lbs. GVWR)	17,750
HDGV6	Class 6 Heavy-Duty Gasoline Vehicles (19,501-26,000 lbs. GVWR)	22,750
HDGV7	Class 7 Heavy-Duty Gasoline Vehicles (26,001-33,000 lbs. GVWR)	29,500
HDGV8A	Class 8a Heavy-Duty Gasoline Vehicles (33,001-60,000 lbs. GVWR)	48,000
HDGV8B	Class 8b Heavy-Duty Gasoline Vehicles (>60,000 lbs. GVWR)	71,900
LDDV	Light-Duty Diesel Vehicles (Passenger Cars)	3,369
LDDT12	Light-Duty Diesel Trucks 1 and 2 (0-6,000 lbs. GVWR)	4,150
HDDV2B	Class 2b Heavy-Duty Diesel Vehicles (8501-10,000 lbs. GVWR)	9,250
HDDV3	Class 3 Heavy-Duty Diesel Vehicles (10,001-14,000 lbs. GVWR)	12,000
HDDV4	Class 4 Heavy-Duty Diesel Vehicles (14,001-16,000 lbs. GVWR)	15,000
HDDV5	Class 5 Heavy-Duty Diesel Vehicles (16,001-19,500 lbs. GVWR)	17,750

Vehicle Class Abbreviation	Vehicle Class Description	Vehicle Weight Estimate (lbs)
HDDV6	Class 6 Heavy-Duty Diesel Vehicles (19,501-26,000 lbs. GVWR)	22,750
HDDV7	Class 7 Heavy-Duty Diesel Vehicles (26,001-33,000 lbs. GVWR)	29,500
HDDV8A	Class 8a Heavy-Duty Diesel Vehicles (33,001-60,000 lbs. GVWR)	48,000
HDDV8B	Class 8b Heavy-Duty Diesel Vehicles (>60,000 lbs. GVWR)	71,900
MC	Motorcycles (Gasoline)	500
HDGB	Gasoline Buses (School, Transit and Urban)	32,500
HDDBT	Diesel Transit and Urban Buses	32,500
HDDBS	Diesel School Buses	25,000
LDDT34	Light-Duty Diesel Trucks 3 and 4 (6,001-8,500 lbs. GVWR)	5,327

The AP-42 equation listed above includes a correction factor to adjust for the number of days with measurable precipitation in the year. The factor of "4" in the precipitation adjustment accounts for the fact that paved roads dry more quickly than unpaved roads and that precipitation may not occur over the entire 24-hour day period. The number of days with at least 0.01 inches of precipitation in each month by State was obtained from the National Climatic Data Center by state [ref 3]. Data were collected from a meteorological station selected to be representative of urban areas within each State.

Activity

Total annual VMT estimates by county and roadway class were derived from the 2008 NMIM run described above, totaling all vehicle types and speeds for each county and road type. Paved road VMT was estimated using a ratio of state-level paved road VMT to total VMT. State level paved road VMT was calculated by subtracting the State/roadway class unpaved road VMT from total State/roadway class VMT. Federal Highway Administration's (FHWA) annual Highway Statistics report was used to determine the unpaved VMT in each state [ref 2]. Once the paved road VMT were calculated for 2008, these numbers were grown to 2010 using the ratio of the 2010 to 2008 VMT estimates by state and road type from the highway statistics series table VM2 Annual Vehicle-Miles.

Controls

Paved road dust controls were applied by county to urban and rural roads in serious PM_{10} nonattainment areas and to urban roads in moderate PM_{10} nonattainment areas. The assumed control measure is vacuum sweeping of paved roads twice per month. A control efficiency of 79 percent was assumed for this control measure [ref 4]. The assumed rule penetration varies by roadway class and PM_{10} nonattainment area classification (serious or moderate). The rule penetration rates are shown in Table 3-76. Rule effectiveness was assumed to be 100% for all counties where this control was applied.

Table 3-76: Penetration rates of paved road vacuum sweeping

PM_{10} Nonattainment Status	Roadway Class	Vacuum Sweeping Penetration Rate (%)
Moderate	Urban Freeway & Expressway	67
Moderate	Urban Minor Arterial	67
Moderate	Urban Collector	64
Moderate	Urban Local	88
Serious	Rural Minor Arterial	71
Serious	Rural Major Collector	83
Serious	Rural Minor Collector	59

PM_{10} Nonattainment Status	Roadway Class	Vacuum Sweeping Penetration Rate (%)
Serious	Rural Local	35
Serious	Urban Freeway & Expressway	67
Serious	Urban Minor Arterial	67
Serious	Urban Collector	64
Serious	Urban Local	88

Note that the controls were applied at the county/roadway class level, and the controls differ by roadway class. No controls were applied to interstate or principal arterial roadways because these road surfaces typically do not have vacuum sweeping. In the CERS submission, the emissions for all roadway classes were summed to the county level. Therefore, the emissions at the county level can represent several different control efficiency, rule effectiveness, and rule penetration levels. As a result, the control efficiency values were reported in the ControlPollutant table as a composite, overall control efficiency for each county; the rule effectiveness and rule penetration values were not reported separately in the ControlApproach table.

3.8.5 Summary of quality assurance methods

The EPA compared 2008 to the estimates for 2011 and found one issue with the state of Colorado and paved road emissions. Colorado submitted a reasonable dataset that contained both species of filterable and primary PM, but the EPA PM-Aug methodology did not work as expected and produced some erroneous PM10-FIL and PM25-FIL data. This data is currently in the 2011 v2 and should be disregarded. The PM10-PRI and the PM25-PRI data appear to be reasonable estimates.

3.8.6 References for Dust – Paved Road Dust

1. United States Environmental Protection Agency, Office of Air Quality Planning and Standards. “Compilation of Air Pollutant Emission Factors, AP-42, Fifth Edition, Volume I: Stationary Point and Area Sources, Section 13.2.1, Paved Roads.” Research Triangle Park, NC. January 2011.
2. U.S. Department of Transportation, Federal Highway Administration. *Highway Statistics 2010.* Office of Highway Policy Information. Washington, DC. 2011.
3. U.S. Department of Commerce, National Oceanic and Atmospheric Administration. “2011 Local Climatological Data Annual Summaries with Comparative Data”, retrieved April 2012.
4. E.H. Pechan & Associates, Inc. “Phase II Regional Particulate Strategies; Task 4: Particulate Control Technology Characterization,” draft report prepared for U.S. Environmental Protection Agency, Office of Policy, Planning and Evaluation. Washington, DC. June 1995.

3.9 Dust – Unpaved Road Dust

3.9.1 Sector description

The 2011 NEI has emissions for the SCCs shown in Table 3-77 for this sector. EPA estimates emissions for particulate matter for the first SCC (2296000000) in Table 3-77.

Table 3-77: SCCs used for Unpaved Road Dust – 2011 NEI

SCC	SCC Level 1	SCC Level 2	SCC Level 3	SCC Level 4
2296000000	Mobile Sources	Unpaved Roads	All Unpaved Roads	Total: Fugitives
2296005000	Mobile Sources	Unpaved Roads	Public Unpaved Roads	Total: Fugitives
2296010000	Mobile Sources	Unpaved Roads	Industrial Unpaved Roads	Total: Fugitives

3.9.2 Sources of data overview and selection hierarchy

The unpaved road emissions sector includes data from the S/L/T agency submitted data and the default EPA generated unpaved road emissions. The agencies listed in Table 3-78 submitted emissions for this sector.

Table 3-78: Agencies that submitted Unpaved Road Dust emissions data

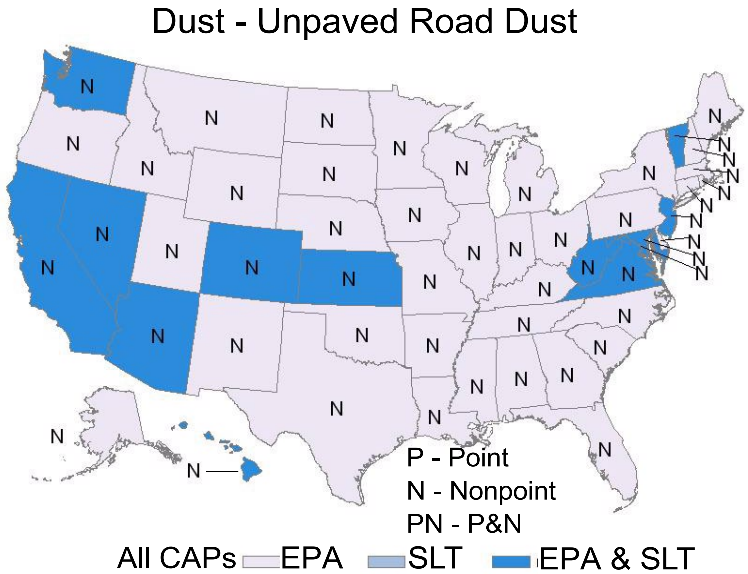
Agency	Type	All Unpaved Roads	Industrial Unpaved Roads	Public Unpaved Roads
2011EPA Unpaved Road estimates	EPA	X		
EPA PM Augmentation	EPA	X	0	X
Bishop Paiute Tribe	T	X		
California Air Resources Board	S	X		
Clark County Department of Air Quality and Environmental Management	L	X		
Colorado Department of Public Health and Environment	S	X		
Eastern Band of Cherokee Indians	T	X		
Hawaii Department of Health Clean Air Branch	S	X		
Kansas Department of Health and Environment	S	X		
Kickapoo Tribe of Indians of the Kickapoo Reservation in Kansas	T	X		
Maricopa County Air Quality Department	L	X	X	
Maryland Department of the Environment	S	X		
New Jersey Department of Environment Protection	S	X		
Northern Cheyenne Tribe	T			X
Sac and Fox Nation of Missouri in Kansas and Nebraska Reservation	T			X
Santee Sioux Nation	T			X
Vermont Department of Environmental Conservation	S	X		
Virginia Department of Environmental Quality	S	X		
Washington State Department of Ecology	S	X		
West Virginia Division of Air Quality	S	X		

Table 3-79 shows the selection hierarchy for the datasets used in the unpaved roads sector.

Table 3-79: 2011 NEI Unpaved Road Dust data selection hierarchy

Priority	Dataset Name	Dataset Content
1	Responsible Agency Data Set	State and Local Agency submitted emissions
2	2011EPA_PM-Augmentation	Augments PM data in 47 states and some tribes
3	2011EPA_chrom_split	Splits total chromium into speciated chromium in 37 states
4	2011EPA_HAP-Augmentation	Adds Pb and other HAP emissions in 46 states
5	2011EPA_NP_NoOverlap_w_Pt	EPA-generated data, including agricultural crops and livestock dust emissions

3.9.3 Spatial coverage and data sources for the sector



3.9.4 EPA methodology for unpaved road dust

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

Uncontrolled unpaved road emissions were calculated at the State level by roadway class and month. This was done by multiplying the State/roadway class unpaved roadway VMT by the appropriate monthly temporal allocation factor and by the monthly unpaved road emission factor. After the unpaved road dust emissions were calculated at the State/roadway class/monthly level of detail, the uncontrolled emissions were then allocated to the county level using 2010 rural population data as a surrogate. Next, control factors were applied to the unpaved road emissions in PM_{10} nonattainment area counties. Emissions and VMT by roadway class were then totaled to the county level for reporting in the NEI. The following provides further details on the emission factor equation, temporal and spatial allocation procedures, and controls.

<u>Emission Factor Equation</u>

Re-entrained road dust emissions for unpaved roads were estimated using unpaved road VMT and the emission factor equation for public roads from AP-42 [ref 1]:

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

where k and C are empirical constants given in Table 3-80, with

k	=	particle size multiplier (lb/VMT)
E	=	size specific emission factor (lb/VMT)
S	=	surface material silt content (%)
SPD	=	mean vehicle speed (mph)
M	=	surface material moisture content (%)
C	=	emission factor for 1980's vehicle fleet exhaust, brake wear, and tire wear (lb/VMT)

The uncontrolled emission factors without precipitation corrections are in the worksheet "Emission Factors" by State and roadway class.

Values used for the particle size multiplier and the 1980's vehicle fleet exhaust, brake wear, and tire wear are provided in Table 3-80 [ref 1] and come from AP-42 defaults.

Average State-level unpaved road silt content values, developed as part of the 1985 NAPAP Inventory, were obtained from the Illinois State Water Survey [ref 2]. Silt contents of over 200 unpaved roads from over 30 States were obtained. Average silt contents of unpaved roads were calculated for each sate that had three or more samples for that State. For States that did not have three or more samples, the average for all samples from all States was used as a default value. The silt content values by State, and, identifies if the values were based on a sample average or default value.

Table 3-80: Constants for Unpaved Roads re-entrained dust emission factor Equation [ref 1]

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

Table 3-81 lists the speeds modeled on the unpaved roads by roadway class. These speeds were determined based on the average speeds modeled for onroad emission calculations and weighted to determine a single average speed for each of the roadway classes.

Table 3-81: Speeds modeled by roadway type on Unpaved Roads

Unpaved Roadway Type	Speed (mph)
Rural Minor Arterial	39
Rural Major Collector	34
Rural Minor Collector	30
Rural Local	30
Urban Other Principal Arterial	20
Urban Minor Arterial	20
Urban Collector	20
Urban Local	20

The value of 0.5 percent for M was chosen as the national default as sufficient resources were not available at the time the emissions were calculated to determine more locally-specific values for this variable.

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

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

where:

E_{corr} = unpaved road dust emission factor corrected for precipitation effects
E = uncorrected emission factor
D = number of days in the month
p = number of days in the month with at least 0.01 inches of precipitation

The number of days with at least 0.01 inches of precipitation in each month was obtained from the National Climatic Data Center [ref 3]. Data were collected from a meteorological station selected to be representative of rural areas within the State.

Activity

Unpaved roadway mileage estimates were obtained from the FHWA's annual *Highway Statistics* report Table HM-51 [ref 4]. Unpaved mileage data for 2008 were used, as data for 2009-2011 were not available.

Separate calculations of VMT were performed for locally and non-locally- (State or federally) maintained roadways. State-level, locally-maintained roadway mileage was organized by surface type (rural and urban) and the average daily traffic volume (ADTV) groups shown in Table 3-82.

From these data, State-level unpaved roadway mileage estimates were made. The following equation was then used to calculate State-level unpaved road VMT estimates:

$$VMT_{UP} = ADTV * FSRM * 365 \text{ days/year}$$

where:

VMT_{UP} = VMT on unpaved roads (miles/year)
ADTV = average daily traffic volume (vehicles/day/mile)
FSRM = functional system roadway mileage (miles)

State and federally maintained roadway mileage was categorized by arterial classification, not roadway traffic volume; therefore, the VMT was calculated differently than for county-maintained roadways. The ADTV was assumed to not vary by roadway maintenance responsibility, so the ADTV calculated from county-maintained VMT and mileage (ADTV = VMT/Mileage) was used with non-locally-maintained roadway mileage to calculate VMT in the above equation. The following roadway types do not have unpaved road segments and therefore had zero VMT calculated: rural and urban interstates and other principal arterial roadways, rural minor arterial roadways, and urban other freeways and expressways.

Table 3-82: Assumed values for average daily traffic volume (ADTV) by volume group

Rural Roads				
Volume Category (vehicles per day per mile)	< 50	50-199	200-499	> 500
Assumed ADTV	5*	125**	350**	550***
Urban Roads				
Volume Category (vehicles per day per mile)	< 200	200-499	500-1999	> 2000
Assumed ADTV	20*	350**	1250**	2200***

Notes: *10% of volume group's maximum range endpoint.
** Average of volume group's range endpoints.
*** 110% of volume group's minimum range endpoint.

Allocation

The unpaved road VMT estimates by State/roadway class were first temporally allocated by season using the NAPAP inventory seasonal temporal allocations factors for VMT [ref 5]. These factors are provided in the worksheet "NAPAP Temporal VMT Adjustment". The seasonal VMT values were then multiplied by the ratio of the number of days in a month to the number of days in a season to adjust to monthly VMT. The emission factors were then applied to estimate emissions by month.

The State/roadway class unpaved road emissions were then spatially allocated to each county using estimates of the ratio of 2010 county rural population to the State rural population from the U.S. Census Bureau as shown by the following equation:

$$EMIS_{x,y} = (CL_x / SL) * EMIS_y$$

where:

$EMIS_{x,y}$	=	unpaved road emissions (tons) for county x and roadway class y
CL_x	=	rural population in county x SL = rural population in the State
$EMIS_{,y}$	=	unpaved road emissions in entire State for roadway class y

The county-level allocation factors are provided in the worksheet "State to County Emis Allocation." The factors are derived from the 2010 census rural population [ref 6]. An exception was made for the District of Columbia, where 100% of households were considered urban, but it there is only one "county" in the district, so no allocation was necessary.

Controls

The controls assumed for unpaved roads varied by PM_{10} nonattainment area classification and by urban and rural areas. On urban unpaved roads in moderate PM_{10} nonattainment areas, paving of the unpaved road was assumed, and a control efficiency of 96 percent and a rule penetration of 50 percent were applied. Chemical stabilization, with a control efficiency or 75 percent and a rule penetration of 50 percent, was assumed for rural areas in serious PM_{10} nonattainment areas. A combination of paving and chemical stabilization, with a control efficiency of 90 percent and a rule penetration of 75 percent, was assumed for urban unpaved roads in serious PM_{10} nonattainment areas [ref 7].

Note that the controls were applied at the county/roadway class level, and the controls differ by roadway class. In the NIF 3.0 emissions table, the emissions for all roadway classes were summed to the county level. Therefore, the emissions at the county level can represent several different control, rule effectiveness, and rule penetration levels. As a result, the control efficiency, rule effectiveness, and rule penetration values were reported in the control equipment table as a composite, overall control level for each county; the rule effectiveness and rule penetration values were not reported separately in the emissions table.

3.9.5 Summary of quality assurance methods

The EPA compared emissions from unpaved roads to previous inventories and found no significant issues. The EPA also compared state submitted data to EPA data and found no significant issues

3.9.6 References for Dust – Unpaved Road Dust

1. United States Environmental Protection Agency, Office of Air Quality Planning and Standards. "Compilation of Air Pollutant Emission Factors, AP-42, Fifth Edition, Volume I: Stationary Point and Area Sources, Section 13.2.2, Unpaved Roads." Research Triangle Park, NC. 2003.
2. W. Barnard, G. Stensland, and D. Gatz, Illinois State Water Survey, "Evaluation of Potential Improvements in the Estimation of Unpaved Road Fugitive Emission Inventories," paper 87-58.1, presented at the 80th Annual Meeting of the APCA. New York, New York. June 21-26, 1987.
3. U.S. Department of Commerce, National Oceanic and Atmospheric Administration. Summary of the Day Element TD-3200, 2008 data provided via FTP. National Climatic Data Center, 2009.
4. U.S. Department of Transportation, Federal Highway Administration. *Highway Statistics 2007.* Office of

Highway Policy Information. Washington, DC. 2009.
5. U.S. Environmental Protection Agency. “The 1985 NAPAP Emissions Inventory: Development of Temporal Allocation Factors,” EPA-600/7-89-010d. Air & Energy Engineering Research Laboratory. Research Triangle Park, NC. April 1990.
6. U.S. Census Bureau. “2010 Census Urban and Rural Classification,” Bureau of the Census. Washington, DC., August 2012.
7. E.H. Pechan & Associates, Inc. “Phase II Regional Particulate Strategies; Task 4: Particulate Control Technology Characterization,” draft report prepared for U.S. Environmental Protection Agency, Office of Policy, Planning and Evaluation. Washington, DC. June 1995.

3.10 Fuel Combustion – Electric Generation

This section includes the description of five EIS sectors:

- Fuel Comb – Electric Generation – Coal
- Fuel Comb – Electric Generation – Oil
- Fuel Comb – Electric Generation – Natural Gas
- Fuel Comb – Electric Generation – Biomass
- Fuel Comb – Electric Generation – Other

They are treated here in a single section because the methods used are the same across all sectors.

3.10.1 Sector description

These five sectors are defined by the point source SCCs beginning with 101 (primarily boilers) and 201 (primarily turbines and engines). There are no nonpoint contributions to this sector. These SCCs include boilers, combustion gas turbines, combined cycle units, and reciprocating engines firing any type of fuel for the purpose of turning a generator connected to the electrical grid. The primary fuels used by the boilers are coal and natural gas. A much smaller number of oil and wood-fired boilers are also included in the oil and natural gas sectors. Various waste or by-products such as municipal waste, bagasse, petroleum coke, and tires are also used in some boilers. The primary fuel used by the combustion gas turbines and combined cycle units is natural gas, although some distillate oil is also used. The reciprocating engines are generally much smaller in terms of generating capacity and also much less efficient than either the boilers and steam turbines or the combustion gas turbines. The engines are primarily fired by natural gas or diesel oil, but there are some which use various available waste gases, such as landfill gas.

The SCC-based EIS sector definitions will cause a different universe of units to be included in these sectors than would other definitions of EGUs. For example, the EIS sector definitions do not include a heat input or generator output size threshold. In contrast, some EPA regulatory applications define EGUs to include only units with capacity greater than 25 MW. Many of the engines and some of the combustion gas turbines in the EIS sectors for EGUs are well below 25 MW generating capacity. The boilers and steam turbine-generators, and particularly those fired on coal, are almost always greater than 25 MW capacity, except for some older units.

The use of SCCs in the NEI by S/L/T agencies impacts the units included in these EIS sectors. There are some boilers and gas turbines in industrial facilities which cogenerate both electricity for distribution to the public power grid and process steam for their internal use. Some S/L/T agencies reporting to the NEI use an SCC (1-01 or 2-01) that would include these units in one of the EGU sectors, while others use an Industrial (1-02 or 2-02) or a Commercial/Institutional (1-03 or 2-03) SCC. This can result in boilers or gas turbines not connected to the public power grid being included in these EGU sectors, with the SCC assigned based upon either strictly their large size (some EPA references to utility boilers have cited them as greater than 100 mmBTU/hr heat input) or because they may generate electrical power for internal consumption.

3.10.2 Sources of data overview and selection hierarchy

The primary sources of data for the EGU sectors were the S/L/T agency-submitted data and EPA's EGU dataset. The EPA EGU dataset emissions for a suite of 15 HAP pollutants that were tested as part of the Mercury and Air Toxics Standard (MATS) rule development were used ahead of S/L/T agency-submitted data except where the S/L/T agency submittal indicated that it was based on either a CEM or recent stack testing. Additional emissions data in the EPA EGU dataset from either CAMD's SO_2 and NO_X CEM data or from AP-42 emissions factors were only used where the responsible S/L/T agency did not report a pollutant for a given unit. In addition to these two primary sources of data, the EGU sectors also have contributions from the EPA PM Augmentation, EPA Chromium Split, EPA TRI, and EPA HAP Augmentation datasets. A smaller amount of contributions was also from the EPA Carry Forward, EPA other, and EPA's Nevada Gold datasets.

The agencies listed in Table 3-83 submitted emissions for these sectors. A box with an "X" means that the agency submitted data for EGU units included in that EGU fuel group for the individual EIS Sectors.

Table 3-83: Agencies that submitted 2011 EGU data by EGU fuel groups

Agency	Type	Coal	Oil	Natural Gas	Biomass	Other
Alabama Department of Environmental Management	State	X	X	X	X	X
Alaska Department of Environmental Conservation	State	X	X	X		
Allegheny County Health Department	Local	X	X	X	X	
Arizona Department of Environmental Quality	State	X	X	X	X	X
Arkansas Department of Environmental Quality	State	X	X	X	X	X
California Air Resources Board	State	X	X	X	X	X
City of Albuquerque	Local		X	X		X
Clark County Dept of Air Quality and Environmental Management	Local		X	X		X
Colorado Department of Public Health and Environment	State	X	X	X		X
Connecticut Department Of Environmental Protection	State	X	X	X		X
DC Department of Health Air Quality Division	State		X			
Delaware Dept of Natural Resources and Environmental Control	State	X	X	X		X
Florida Department of Environmental Protection	State	X	X	X	X	X
Forsyth County Environmental Affairs Department	Local					X
Georgia Department of Natural Resources	State	X	X	X	X	X
Hawaii Department of Health Clean Air Branch	State	X	X		X	X
Idaho Department OF Environmental Quality	State		X	X	X	X
Illinois Environmental Protection Agency	State	X	X	X	X	X
Indiana Department of Environmental Management	State	X	X	X		X
Iowa Department of Natural Resources	State	X	X	X	X	X
Jefferson County (AL) Department of Health	Local	X	X	X		
Kansas Department of Health and Environment	State	X	X	X		X

Agency	Type	Coal	Oil	Natural Gas	Biomass	Other
Kentucky Division for Air Quality	State	X	X	X	X	X
Lane Regional Air Pollution Authority	Local				X	
Lincoln/Lancaster County Health Department	Local	X				
Louisiana Department of Environmental Quality	State	X	X	X		X
Louisville Metro Air Pollution Control District	Local	X	X	X		
Maine Department of Environmental Protection	State		X	X	X	X
Maricopa County Air Quality Department	Local		X	X		
Maryland Department of the Environment	State	X	X	X		X
Massachusetts Department of Environmental Protection	State	X	X	X	X	X
Mecklenburg County Air Quality	Local		X			
Memphis and Shelby County Health Dept - Pollution Control	Local	X	X	X	X	X
Metro Public Health of Nashville/Davidson County	Local		X	X		X
Michigan Department of Environmental Quality	State	X	X	X	X	X
Minnesota Pollution Control Agency	State	X	X	X	X	X
Mississippi Department of Environmental Quality	State	X	X	X		X
Missouri Department of Natural Resources	State	X	X	X	X	X
Montana Department of Environmental Quality	State	X	X	X		X
Navajo Nation	Tribal	X				
Nebraska Environmental Quality	State	X	X	X	X	X
Nevada Division of Environmental Protection	State	X	X	X		X
New Hampshire Department of Environmental Services	State	X	X	X	X	X
New Jersey Department of Environment Protection	State	X	X	X		X
New Mexico Environment Department Air Quality Bureau	State	X	X	X		
New York State Department of Environmental Conservation	State	X	X	X	X	X
North Carolina Dept of Environment and Natural Resources	State	X	X	X	X	X
North Dakota Department of Health	State	X	X	X		
Ohio Environmental Protection Agency	State	X	X	X	X	X
Oklahoma Department of Environmental Quality	State	X	X	X		X
Olympic Region Clean Air Agency	Local		X	X		
Omaha Air Quality Control Division	Local					X
Oregon Department of Environmental Quality	State	X	X	X		X
Pennsylvania Department of Environmental Protection	State	X	X	X	X	X
Philadelphia Air Management Services	Local		X	X		
Pinal County	Local	X	X	X		
Puerto Rico	State	X	X	X		X
Puget Sound Clean Air Agency	Local		X	X	X	X
Rhode Island Department of Environmental Management	State		X	X		X
South Carolina Dept of Health and Environmental Control	State	X	X	X	X	X
South Dakota Dept of Environment and Natural Resources	State	X	X	X	X	
Southern Ute Indian Tribe	Tribal		X	X		X
Southwest Clean Air Agency	Local	X	X	X		X

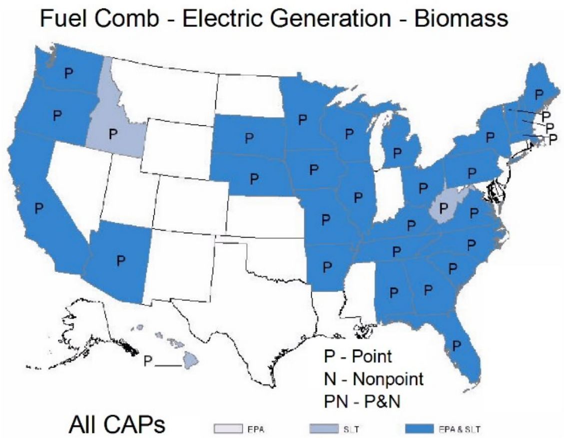
Agency	Type	Coal	Oil	Natural Gas	Biomass	Other
Tennessee Department of Environmental Conservation	State	X	X	X	X	X
Texas Commission on Environmental Quality	State	X	X	X		X
Utah Division of Air Quality	State	X	X	X		X
Vermont Department of Environmental Conservation	State		X	X	X	X
Virginia Department of Environmental Quality	State	X	X	X	X	X
Washington State Department of Ecology	State		X	X	X	X
Washoe County Health District	Local		X			X
West Virginia Division of Air Quality	State	X	X	X	X	X
Western North Carolina Regional Air Quality Agency	Local	X	X	X		X
Wisconsin Department of Natural Resources	State	X	X	X	X	X
Wyoming Department of Environmental Quality	State	X	X	X		X

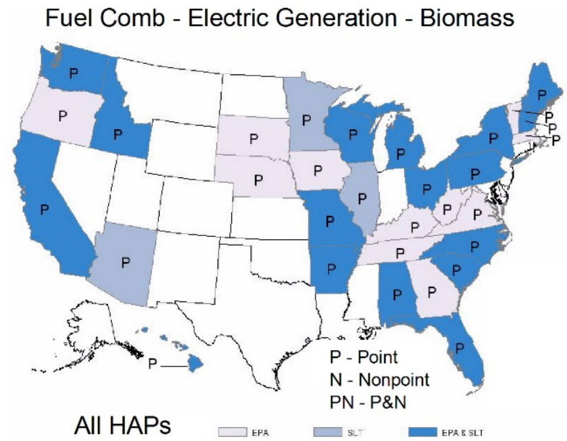
Table 3-84 shows the selection hierarchy for the EGU sectors. A box with an "X" means that the dataset contributed to the EGU sector for that fuel group.

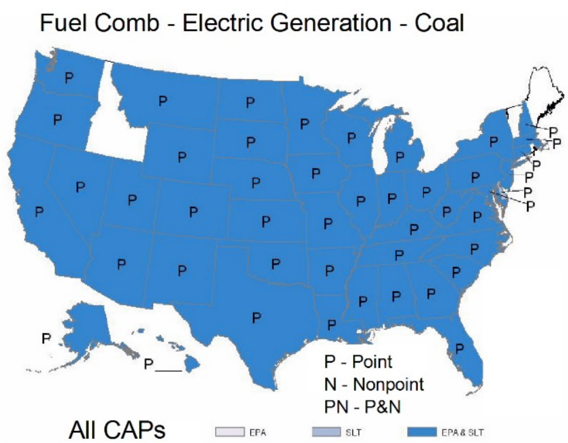
Table 3-84: 2011 NEI EGU data selection hierarchy by EGU fuel groups

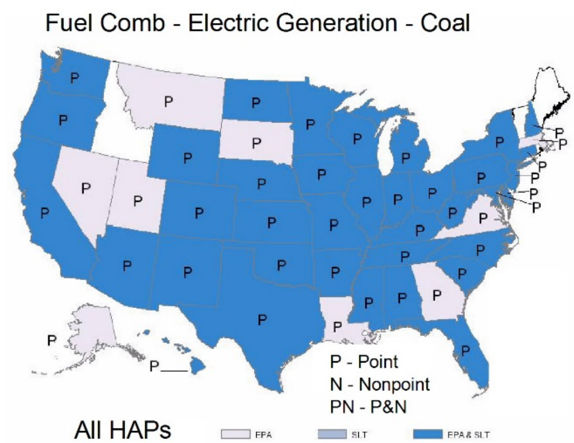
Priority	Data Set Name	Data Set Contents and Impact	Coal	Oil	Natural	Biomass	Other
1	2011EPA_PM-Augmentation	Augments PM data in 47 states and some tribes (see Section 3.1.2)	X	X	X	X	X
2	2011 Responsible Agency Selection	S/L/T agency submitted emissions	X	X	X	X	X
3	2011EPA_EGU	Overwrites Hg, other metals, and acid gases to use data from the MATS rule in 49 states and some tribes (see Section 3.10.5)	X	X	X	X	X
4	2011EPA_chrom_split	Splits total chromium into speciated chromium in 37 states (see Section 3.1.3)	X	X	X	X	X
5	EPA NV Gold Mines	EPA-generated data		X			
6	2011EPA_Other	EPA-generated data	X				
7	2011EPA_TRI	Adds Pb and HAP emissions in 53 states and 4 tribes (see Section 3.1.4)	X	X	X		X
8	2011EPA_CarryForward-PreviousYearData	EPA-generated data					X
9	2011EPA_HAP -Augmentation	Adds Pb and HAP emissions in 26 states (see Section 3.1.5)	X	X	X	X	X

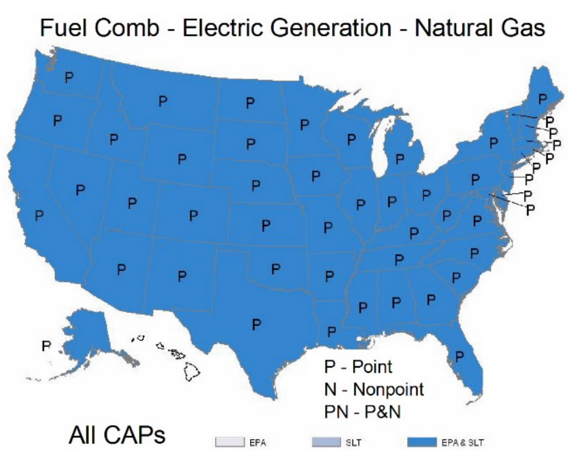
3.10.3 Spatial coverage and data sources for the sector

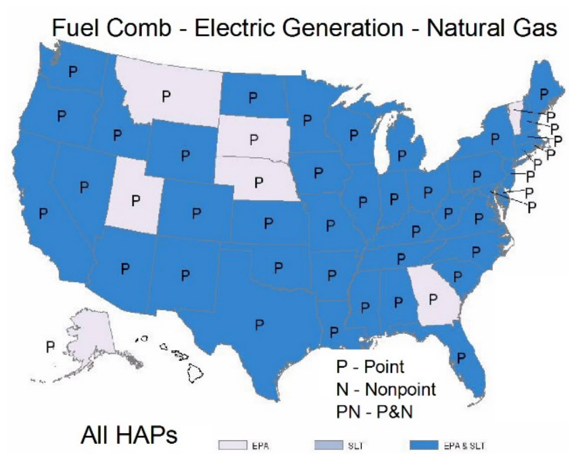


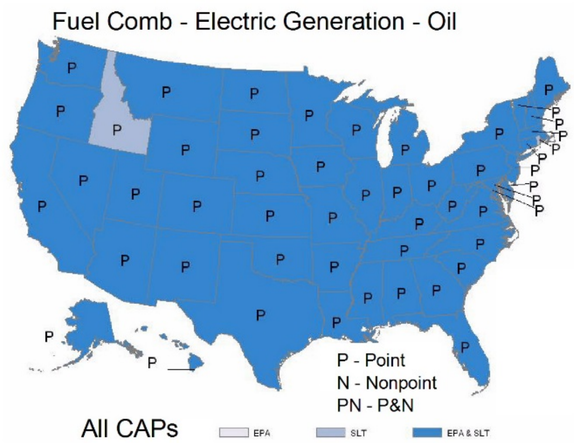


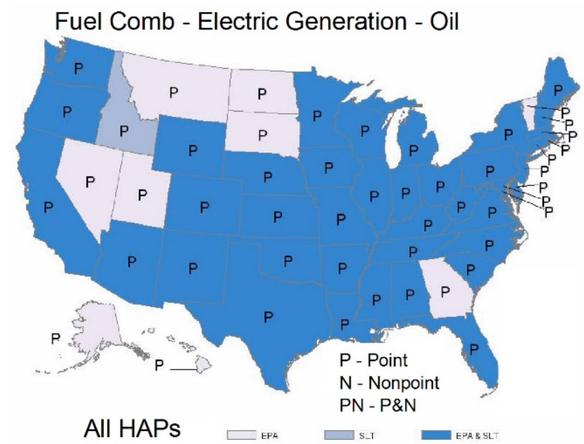


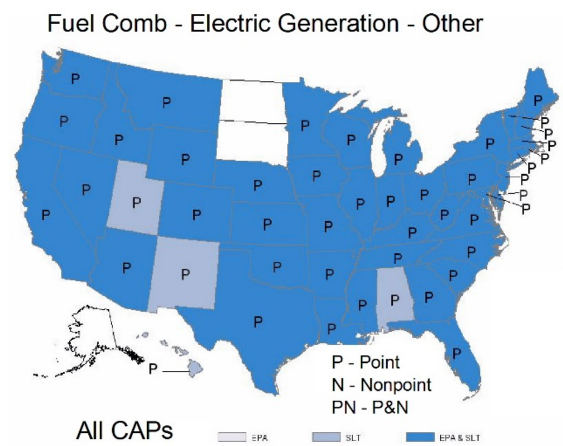


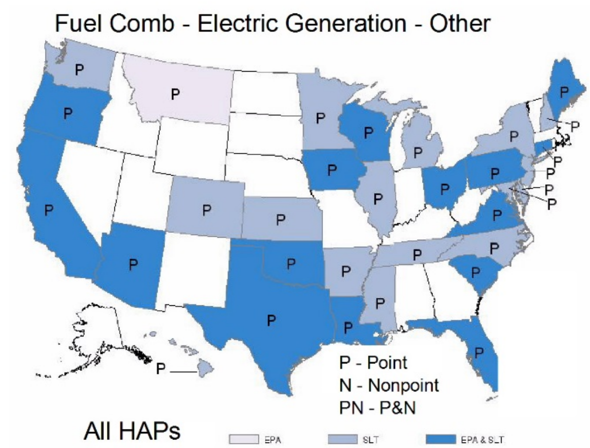












3.10.4 PM Augmentation for EGUs

As described above in section 3.1.2, EPA performs various steps starting from the S/L/T agency submitted emissions for the various pieces of PM emissions in order to complete a consistent representation for both PM10-Primary and PM2.5-Primary emissions from all sectors. These steps may be a simple as adding S/L/T agency submitted filterable and condensable pieces together to create the PM_{10} and $PM_{2.5}$ Primary species, or they may also include EPA estimates for the condensable piece if not submitted by the S/L/T agency. For the five EGU sectors as a whole, the 2011EPA_PM-Augmentation dataset contributed 44% of the total PM10-Primary mass and 51% of the total PM2.5-Primary mass. Table 3-85 provides the emissions contribution from all S/L/T agencies and from the EPA PM Augmentation data for each of the EIS sectors associated with EGUs.

Table 3-85: Agency-submitted, PM Augmentation, and total PM_{10} and $PM_{2.5}$ emissions for EGU sectors

EIS Sector	PM_{10} Agency (tons)	PM_{10} Aug (tons)	PM_{10} Total (tons)	$PM_{2.5}$ Agency (tons)	$PM_{2.5}$ Aug (tons)	$PM_{2.5}$ Total (tons)
Fuel Comb - Electric Generation - Biomass	1,440	735	2,174	1,010	866	1,877
Fuel Comb - Electric Generation - Coal	131,218	110,472	241,690	80,808	89,556	170,364
Fuel Comb - Electric Generation - Natural Gas	12,374	13,027	25,401	10,641	13,945	24,586
Fuel Comb - Electric Generation - Oil	6,985	1,053	8,038	4,508	1,415	5,922
Fuel Comb - Electric Generation - Other	1,680	1,178	2,858	1,086	1,427	2,513
	153,696	**126,464**	**280,161**	**98,054**	**107,209**	**205,263**

3.10.5 EPA-developed EGU emissions data

In addition to the S/L/T-reported data, EPA developed a single combined dataset of emission estimates for EGUs to be used to fill gaps for pollutants and emission units not reported by S/L/T agencies and in some cases to be used instead of S/L/T agency submitted data. The 2011EPA_EGU dataset was developed from three separate estimation sources. The three sources were: the 2010 MATS testing program emission factors for 15 HAPs with annual throughputs primarily from EPA's Clean Air Market Division (CAMD) but also from the Department of Energy's Energy Information Administration (EIA) and data provided by Puerto Rico; SO_2 and NO_X emissions from CAMD's CEM database; and emission factors used in the 2008 NEI that were built from AP-42 emission factors and 2008 fuel heat and sulfur contents with 2011 annual throughputs from CAMD. A small number of the AP-42 based estimates were not included in the 2011EPA-EGU dataset because the primary fuel burned, or the control devices used by the units in 2011 were found to be different than in 2008, which would render the 2008 emission factors non-representative of 2011 operations for these emission units.

As shown above in Table 3-84, the selection hierarchy was set such that S/L/T agency-submitted data would be used ahead of the values in the 2011EPA_EGU dataset. However, the emissions values in the 2011EPA_EGU dataset that were derived from the MATS testing program were believed to be based on more up-to-date and more reliable emissions factors than what EPA had previously made available for S/L/T agency use via AP-42. Therefore, wherever a MATS-based emissions estimate was available in the 2011EPA_EGU dataset, it was used for the 2011 NEI rather than the S/L/T agency value, except where the S/L/T agency submittal indicated that the S/L/T agency value was from either a CEM or a recent stack test. The selection of the MATS-based emissions over the S/L/T agency emissions was accomplished by setting a "tag" on those S/L/T agency emissions values to exclude them from being available for selection even though they remain in the EIS data system. The purpose of this approach was to use the best available data, with either the unit-specific MATS-tested data or the more recent MATS-based bin emission factors assumed to be more representative of current operations than the published AP-42 emissions factors.

For the 2011EPA_EGU dataset, the emissions were estimated at the unit level, because that is the level at which the CAMD heat input activity data and the MATS-based emissions factors and the CAMD CEM data are available. In making the estimates, EPA assumed that all heat input came from the primary fuel, and the emission factors used reflected only that primary fuel. The resultant unit-level estimates had to be loaded into the EIS at the process-level to meet the EIS requirement that emissions can only be associated with that most detailed level. For the EGU sectors, the unit-level represents the boiler or gas turbine unit as a whole, while the process level represents the individual fuels burned within the units. EPA therefore assigned all of the calculated unit-level emissions to a single process representing the primary fuel, which EPA determined to be the process used by the S/L/T agency for reporting the largest portion of the S/L/T agency NO_X emissions. Wherever S/L/T agency emissions values were to be excluded from the 2011 NEI because there was an available EPA MATS-based emissions value, it was therefore necessary that all processes at that emission unit that had S/L/T agency emissions for that pollutant be tagged.

In summary, the 2011 NEI for EGUs is comprised of largely S/L/T agency-reported data for the CAPs and any HAPs that the S/L/T agencies reported other than the fifteen MATS-estimated pollutants. For those fifteen MATS-estimated pollutants, the 2011 NEI is comprised largely of the EPA estimates, except S/L/T agency data were used where it was believed to be based upon use of a CEM or unit-specific test. Other HAPs for the MATS-regulated units, and all HAPs for units not part of MATS, include S/L/T agency emissions values where they were reported (with PM and Chromium augmentation, if needed), or include the 2011EPA_EGU emissions where no S/L/T agency emissions were reported.

The matching of the 2011EPA_EGU dataset to the responsible agency facility; unit and process IDs was done largely by using the ORIS plant and CAMD boiler IDs, as found in the CAMD heat input activity dataset, and linking these to the same two IDs as had been stored in EIS. We also compared the facility names and counties for agreement, and revisions were made wherever discrepancies were noted. As a final confirmation that the correct emissions unit and a reasonable process ID in the EIS had been matched to the EPA data, the magnitudes of the SO_2 and NO_X emissions for all preliminary matches were compared between the S/L/T agency-reported datasets and the EPA dataset. Several discrepancies were identified and resolved from this emissions comparison.

3.10.6 Alternative facility and unit IDs needed for matching with other databases

The 2011 NEI data contains two sets of alternate unit identifiers related to the ORIS plant ID and CAMD unit IDs. The first set is stored in the EIS with a Program System Code (PSC) of “EPACAMD”. The alternate unit IDs are stored as a concatenation of the ORIS Plant ID and CAMD unit ID with “CAMDUNIT” between the two IDs. These IDs are exported to the SMOKE file in the fields named ORIS_FACILITY_CODE and ORIS_BOILER_ID. These two fields are used by the SMOKE processing software to replace the annual NEI emissions values with the appropriate hourly CEM values at model run time.

The second set of alternate unit IDs are stored in the EIS with a PSC of “EPAIPM” and are exported to the SMOKE file as a field named “IPM_YN”. The SMOKE processing software uses this field to determine if the unit is one that will have future year projections provided by the IPM model. The storage format of these alternate unit IDs, in both the EIS and in the exported SMOKE file, replicates the IDs as found in the NEEDS database used as input to the IPM model. The NEEDS IDs are a concatenation of the ORIS plant ID and a unit ID, with either a “_B_” or a “_G_” between the two IDs, indicating “Boiler” or “Generator”. Note that the ORIS plant IDs and the unit IDs as stored in the CAMD dataset and in the NEEDS database are almost always the same, but that there are occasional differences for the same unit. The EPACAMD alternate unit IDs available in the 2011 NEI are believed to be a complete set of all those that can safely be used for the purpose of substituting hourly CEM values during SMOKE processing. The EPAIPM alternate unit IDs in the 2011 NEI are not a complete listing of all the NEEDS/IPM units, although almost all of the larger emitters, including all of the EPACAMD CEM units, do have an EPAIPM alternate unit ID. The NEEDS database includes a much larger set of smaller, non-CEM units.

3.10.7 Summary of quality assurance methods

The S/L/T agency-reported data were subject to the same overall emissions outlier analysis that was performed on the S/L/T agency point source emissions datasets as a whole. That outlier analysis included a comparison of the facility-level sums for each of the key pollutants to the corresponding values seen in the 2008 NEI v3 and to the facility’s Toxics Release Inventory reports for 2011. New facility-pollutant values, missing facility-pollutant values, and significant increases or decreases in facility-pollutant values compared to the 2008 NEI v3 values were identified in a comparison file provided to S/L/T agencies for review. Significance levels were established separately for each key pollutant. The identified S/L/T agency values were either revised or confirmed as accurate by the responsible S/L/T agency or if no action was taken by the S/L/T agency and the value was exceptionally suspect, the value was tagged to be excluded from selection for the NEI.

3.11 Fuel Combustion – Industrial Boilers, ICEs

This section includes the description of five EIS sectors:

- Fuel Comb - Industrial Boilers, ICEs - Coal
- Fuel Comb - Industrial Boilers, ICEs – Oil

- Fuel Comb - Industrial Boilers, ICEs - Natural Gas
- Fuel Comb - Industrial Boilers, ICEs – Biomass
- Fuel Comb - Industrial Boilers, ICEs – Other

They are treated here in a single section because the methods used are the same across all sectors.

3.11.1 Sector description

These five sectors are defined by the point source SCCs beginning with 102105, 202, 2040 (engine testing including aircraft engines) and SCC 28888801 (engine fugitive emissions). It also includes the nonpoint SCCs starting with 2102 (boilers, engines or total across boilers and engines) and 280152 (orchard heaters). These SCCs include boilers, internal combustion engines (ICE), including reciprocating and turbines, industrial space heaters and orchard heaters (nonpoint) firing any type of fuel. The primary fuels used by the boilers are coal, oil and natural gas. Other fuels used by industrial boilers include biomass, waste products and process gases. The primary fuels used by the ICE are natural gas and oil, but there are some which use various available process gases and liquefied petroleum gas (LPG).

The SCC-based EIS sector definitions will cause a different universe of units to be included in these sectors than would other definitions of boilers, turbines or reciprocating internal combustion engines. For example, the Industrial/Commercial/Institutional Boilers and Process Heaters MACT include 25 MW and smaller boilers used to generate electricity; these boilers are not included in the sectors described here because they have SCCs beginning with 1-01. Thus, the EIS sector definition would put these units, which are considered industrial boilers for the purpose of the MACT, in the Fuel Combustion – Electric Generation sector described in section 3.10. In addition, while CO Boilers are in this sector, they are not included in the Industrial/Commercial/Institutional Boilers and Process Heaters MACT category.

Also, as described in section 3.10 the use of SCCs in the NEI by S/L/T agencies impacts the units included in these EIS sectors. There are some boilers and gas turbines in industrial facilities which cogenerate electricity for distribution to the public power grid and process steam for their internal use. Some S/L/T agencies reporting to the NEI use an SCC starting with 101 or 201 that would include these units in one of the EGU sectors, while others use an Industrial (102 or 202) or a Commercial/Institutional (103 or 203) SCC. This can result in boilers or gas turbines not connected to the public power grid being included in these EGU sectors and not the Industrial sectors.

In addition to the potential of ambiguity in assigning SCCs to industrial boiler units that may be used to generate electricity, there is also miss-assignment, where the wrong SCC is applied to clearly defined units, based on description fields such as the unit description in the EIS. For this reason, when looking at individual units, these other description fields may be useful in accurately categorizing the unit.

3.11.2 Sources of data overview and selection hierarchy

The industrial fuel combustion sectors include data from S/L/T agencies and 9 EPA datasets that cover both point and nonpoint data categories. Table 3-86 shows the agencies that submitted data in each of the data categories for each of the fuel combustion – industrial boilers and ICE sectors. Where only emission values of zero were submitted (sum across all pollutants submitted), these are shown as zeroes in the table. No “X” or “0” indicates that nothing was submitted by the agency for that data category and fuel combination for the industrial boilers sector.

Table 3-86: Agencies that submitted data for the Fuel Combustion - Industrial Boilers, ICEs sectors

		Nonpoint					Point				
Agency	**TYPE**	**Bio-mass**	**Coal**	**Natural Gas**	**Oil**	**Other**	**Bio-mass**	**Coal**	**Natural Gas**	**Oil**	**Other**
US Environmental Protection Agency	EPA	X	X	X	X	X	X	X	X	X	X
Alabama Department of Environmental Management	S	X	X	X	X	X	X	X	X	X	X
Alaska Department of Environmental Conservation	S			X	X			X	X	X	X
Allegheny County Health Department	L							X	X	X	X
Arizona Department of Environmental Quality	S							X	X	X	X
Arkansas Department of Environmental Quality	S						X	X	X	X	X
California Air Resources Board	S			X	X	X	X	X	X	X	X
Chattanooga Air Pollution Control Bureau (CHCAPCB)	L	0	X	0	X	0		X	X	X	
City of Albuquerque	L								X	X	X
Clark County Department of Air Quality and Environmental Management	L		X	X	X	X			X	X	X
Coeur d'Alene Tribe	T	0	X	X	X	X	X			X	X
Colorado Department of Public Health and Environment	S						X	X	X	X	X
Connecticut Department of Environmental Protection	S	X	0	X	X	X			X	X	X
DC-District Department of the Environment	S		0	0	X	X			X	X	
Delaware Department of Natural Resources and Environmental Control	S		0	X	X	X		X	X	X	X
Eastern Band of Cherokee Indians	T				X						
Florida Department of Environmental Protection	S	X	X	X	X	X	X	X	X	X	X
Forsyth County Office of Environmental Assistance and Protection	L						X	X	X	X	X
Georgia Department of Natural Resources	S	0	0	X	X	X	X	X	X	X	X
Hawaii Department of Health Clean Air Branch	S		0	X	X	X				X	X
Idaho Department of Environmental Quality	S	X	X	X	X	X	X	X	X	X	X
Illinois Environmental Protection Agency	S	0	0	X	X	0	X	X	X	X	X
Indiana Department of Environmental Management	S	X	0	X	X	X	X	X	X	X	X
Iowa Department of Natural Resources	S	X	0	X	X	X	X	X	X	X	X
Jefferson County (AL) Department of Health	L							X	X	X	X
Kansas Department of Health and Environment	S	X	0	X	X	X	X		X	X	X
Kentucky Division for Air Quality	S						X	X	X	X	X
Kickapoo Tribe of Indians of the Kickapoo Reservation in Kansas	T									X	X
Knox County Department of Air Quality Management	L	0	0	X	X	X				X	
Kootenai Tribe of Idaho	T	X	X	X	X	X					
Lane Regional Air Pollution Authority	L						X		X	0	0
Lincoln/Lancaster County Health Department	L							X	X		
Louisiana Department of Environmental Quality	S	X	X	0	X	X	X		X	X	X
Louisville Metro Air Pollution Control District	L	X	0	X	X	X	X	X	X	X	X
Maine Department of Environmental Protection	S		0	0	X	0	X	X	X	X	X
Maricopa County Air Quality Department	L		0	X	X				X	X	
Maryland Department of the Environment	S							X	X	X	X
Massachusetts Department of Environmental Protection	S	X	0	X	X	X	X	X	X	X	X
Mecklenburg County Air Quality	L							X	X	X	
Memphis and Shelby County Health Department - Pollution Control	L								X	X	X
Metro Public Health of Nashville/Davidson County	L							X	X	X	X
Michigan Department of Environmental Quality	S		X	X	X	X	X	X	X	X	X
Minnesota Pollution Control Agency	S	X	X	X	X	X	X	X	X	X	X
Mississippi Dept of Environmental Quality	S						X	X	X	X	X
Missouri Department of Natural Resources	S	X	0	X	X	X	X	X	X	X	X
Montana Department of Environmental Quality	S						X	X	X	X	X
Navajo Nation	T								X		

		Nonpoint					Point				
Agency	TYPE	Bio-mass	Coal	Natural Gas	Oil	Other	Bio-mass	Coal	Natural Gas	Oil	Other
Nebraska Environmental Quality	S						X	X	X	X	X
Nevada Division of Environmental Protection	S								X	X	X
New Hampshire Department of Environmental Services	S	X		X	X	X	X		X	X	X
New Jersey Department of Environment Protection	S		0	0	X	X		X	X	X	X
New Mexico Environment Department Air Quality Bureau	S								X	X	X
New York State Department of Environmental Conservation	S		X		X	X	X	X	X	X	X
Nez Perce Tribe	T	X	X	X	X	X	X			X	
North Carolina Department of Environment and Natural Resources	S	X		X	X	0	X	X	X	X	X
North Dakota Department of Health	S							X	X	X	X
Ohio Environmental Protection Agency	S	X	0	X	X	X	X	X	X	X	X
Oklahoma Department of Environmental Quality	S	X	X	X	X	0	X	X	X	X	X
Olympic Region Clean Air Agency	L						X		X	X	X
Omaha Air Quality Control Division	L								X	X	
Oregon Department of Environmental Quality	S	X	X	X	X	X	X	0	X	X	X
Pennsylvania Department of Environmental Protection	S	X	X	0	X	X	X	X	X	X	X
Philadelphia Air Management Services	L								X	X	X
Pinal County	L						X		X	X	
Puerto Rico	S								0	X	X
Puget Sound Clean Air Agency	L						X		X	X	X
Rhode Island Depart. of Environmental Management	S						X		X	X	X
Shoshone-Bannock Tribes of the Fort Hall Reservation of Idaho	T	X	X	X	X	X					
South Carolina Department of Health and Environmental Control	S	X	X	X	X	0	X	X	X	X	X
South Dakota Department of Environment and Natural Resources	S						X		X	X	
Southern Ute Indian Tribe	T								X		
Southwest Clean Air Agency	L						X		X	X	X
Tennessee Department of Environmental Conservation	S	X	X	X	X	X	X	X	X	X	X
Texas Commission on Environmental Quality	S	0		X	X		X	X	X	X	X
Utah Division of Air Quality	S							X	X	X	X
Vermont Department of Environmental Conservation	S	X	0	X	X	X	X		X	X	X
Virginia Department of Environmental Quality	S	X	0	X	X	0	X	X	X	X	X
Washington State Department of Ecology	S						X	X	X	X	X
Washoe County Health District	L								X		
West Virginia Division of Air Quality	S		X	X	X		X	X	X	X	X
Western North Carolina Regional Air Quality Agency (Buncombe Co.)	L								X	X	X
Wisconsin Department of Natural Resources	S	0	0	X	X	X	X	X	X	X	X
Wyoming Department of Environmental Quality	S						X	X	X	X	X

Table 3-87 shows the selection hierarchy for all datasets contributing emissions to the Fuel Comb - Industrial Boilers, ICEs Sectors. This selection hierarchy combines the S/L/T agency data with the EPA datasets. As can be seen, most of the datasets used for this selection have data for the point source data category only.

Table 3-87: 2011 NEI selection hierarchy for datasets used by Fuel Comb - Industrial Boilers, ICEs sectors

Data Set Name	Description	Point	Non-point
2011EPA_PM-Augmentation	PM species added to gap fill missing S/L/T agency data or make corrections where S/L/T agency have inconsistent PM species' emissions.	1	2
Responsible Agency Data Set	S/L/T agency submitted data	2	1
2011EPA_EGU	EPA MATS EGU data developed from CAMD heat input and EFs.	3	
2011EPA_chrom_split	Contains corrected and speciated hexavalent and trivalent chromium emissions derived from the S/L/T agency data for sources in which S/L/T agency reports the total (unspeciated) chromium pollutant.	4	3
2011EPA_Other	Data added to boiler and ICE SCCs resulting mercury emissions for a boiler in Missouri using state-provided data	5	
2011EPA_TRI	Toxics Release Inventory data for the year 2011.	6	
2011EPA_CarryForward-PreviousYear Data	Variety of estimates used to gap fill important sources/pollutants.	7	
2011EPA_HAP-Augmentation	HAP data computed from S/L/T agency criteria pollutant data using HAP/CAP emission factor ratios.	8	4
2011EPA_BOEM	CAP Emissions from Offshore oil platforms located in Federal Waters in the Gulf of Mexico developed by the U.S. Department of the Interior, Bureau of Ocean and Energy Management, Regulation, and Enforcement.	9	
2011EPA_NP_Overlap_w_Pt	EPA generated emissions for nonpoint sources		5

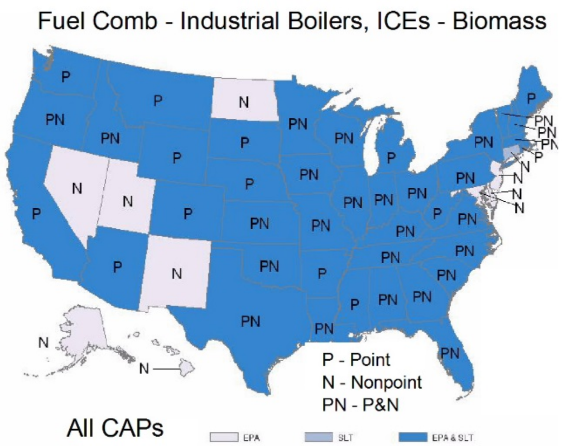
EPA requested feedback from states and local agencies on the extent of their inventories, including details on whether they had performed point/nonpoint reconciliation, whether they did nonpoint estimates for each SCC, whether the state had any nonpoint sources in a category or whether a state preferred to use EPA estimates. This survey was used, in conjunction with a few assumptions, to determine whether EPA should potentially augment the data submitted by the S/L/T agency with EPA generated data. Because the EPA generated data were based on activity data that would cover all industrial combustion sources (both point and nonpoint), it was necessary to use this methodology so that double counting of emissions would not occur. For this sector, the algorithm for determining whether to augment data in the 2011 NEI is given in Table 3-88.

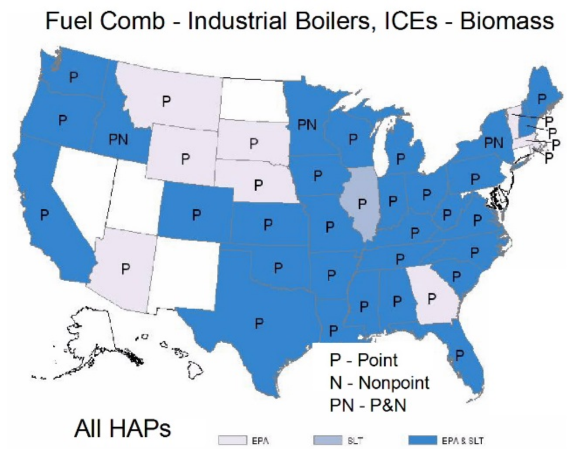
Table 3-88: Algorithm to determine whether to augment state data with EPA data for Industrial Boilers

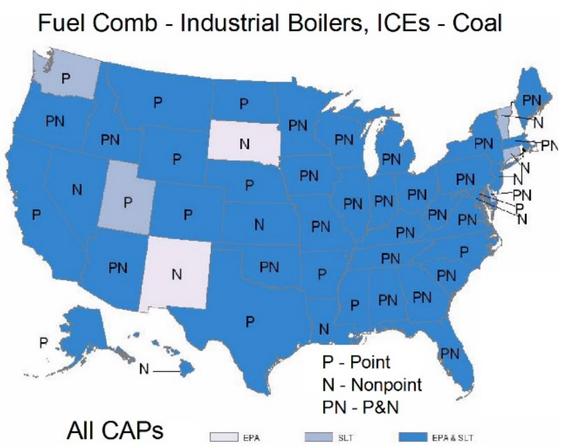
Survey Data	State Submitted to Point?	State Submitted to Nonpoint?	EPA Action	Rationale
State claims that category is fully covered by their point inventory for an SCC	Yes	Yes or No	Don't augment their nonpoint data. Tag EPA data so that it doesn't get put into the EIS	The nonpoint inventory is based on EIA numbers, which takes all fuel combustion into account. The EIA makes no distinction between point and nonpoint. Augmenting would double-count point emissions.

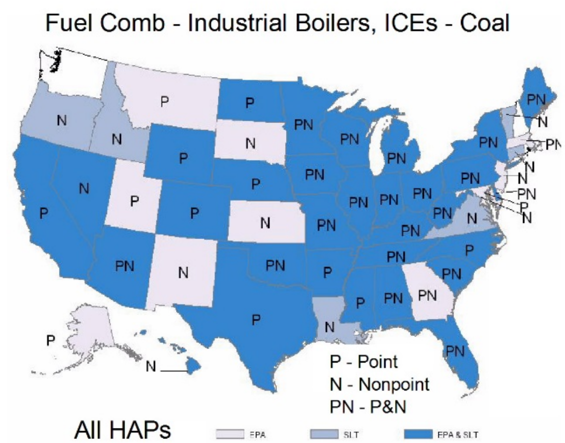
Survey Data	State Submitted to Point?	State Submitted to Nonpoint?	EPA Action	Rationale
	No	No	Augment with EPA estimates for nonpoint category	The EIA data tracks fuel usage by state. There will be a gap in the data if this category is not covered by the state at all.
	No	Yes	Don’t augment	Assume that they filled out the survey incorrectly, and that they meant that the category is fully covered by nonpoint.
State claims that category is fully covered by their nonpoint inventory for an SCC	No	Yes	Don’t augment	Augmenting would double-count nonpoint emissions.
	No	No	Augment	The EIA data tracks fuel usage by state. There will be a gap in the data if this category is not covered by the state at all.
	Yes	Yes or No	Don’t augment	Assume that they filled out the survey incorrectly.
State claims that they do point/nonpoint reconciliation	Yes	No	Augment	We believe that they intended to submit nonpoint. Though there will be some double-counting, we believe that their submitted emissions for point would be lower than if they claimed that their category was covered fully in point.
	Yes or No	Yes	Don’t augment	No augmentation is necessary, since either both point and nonpoint were submitted, or nonpoint would be double-counted.
	No	No	Augment	The EIA data tracks fuel usage by state. There will be a gap in the data if this category is not covered by the state at all.
	Yes	No	Augment	While there would be some double-counting of point emissions, it would be small, and we believe that there would still be nonpoint emissions for this category.
State claims that they do point/nonpoint reconciliation	Yes	No	Augment	Assume that they intended to submit nonpoint. Though there will be some double-counting, we believe that their submitted emissions for point would be lower than if they claimed that their category was covered fully in point.
	Yes or No	Yes	Don’t augment	No augmentation is necessary, since either both point and nonpoint were submitted, or nonpoint would be double-counted.
	No	No	Augment	The EIA data tracks fuel usage by state. There will be a gap in the data if this category is not covered by the state at all.

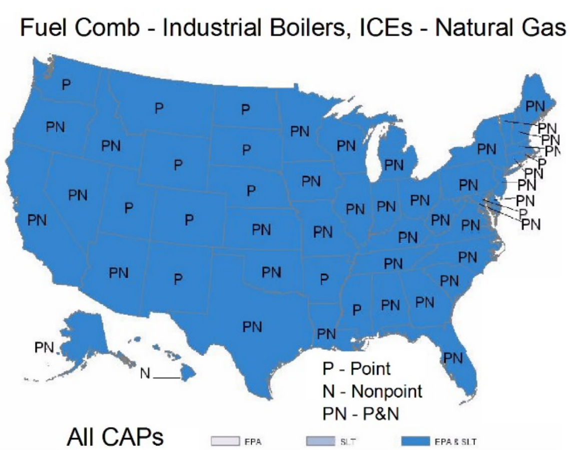
3.11.3 Spatial coverage and data sources for the sector

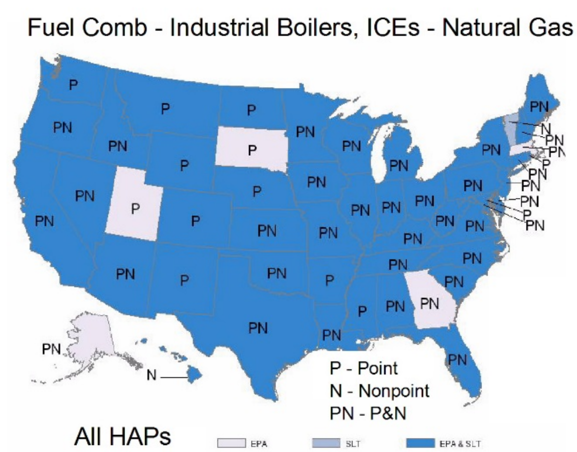


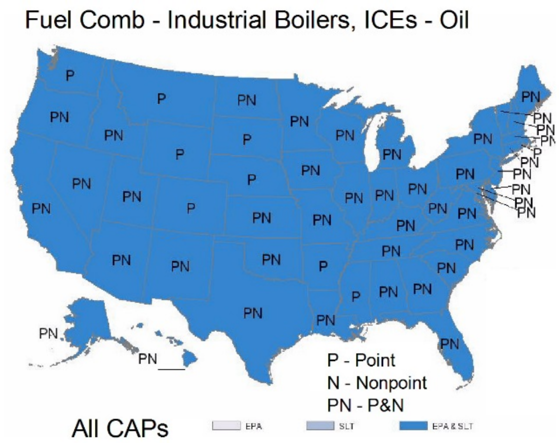


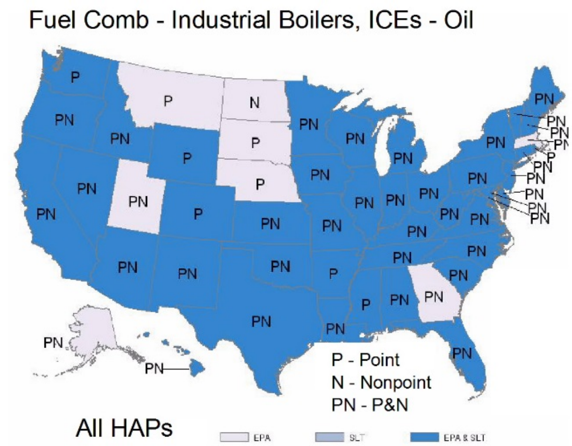


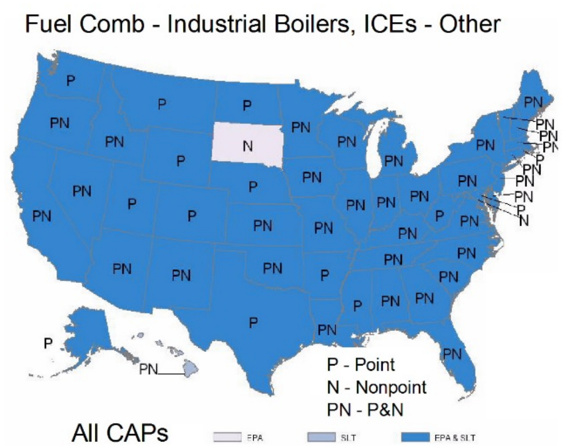


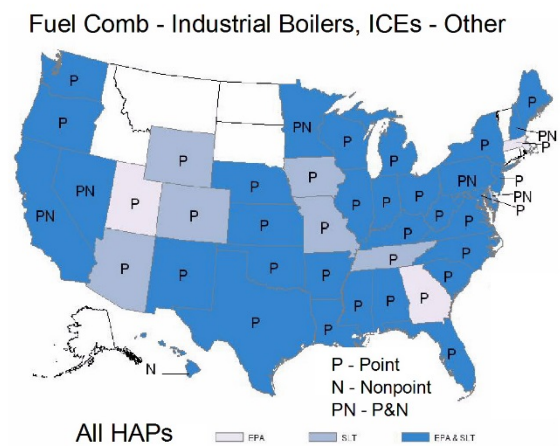












3.11.4 EPA-developed fuel combustion –Industrial Boilers, ICEs emissions data

Nonpoint industrial fuel combustion emissions were computed for the following fuel types: coal, distillate oil, residual oil, natural gas, liquefied petroleum gas (LPG), kerosene, and wood.

There are additional types of energy that are consumed in the industrial sector: asphalt and road oil; feedstocks, naphtha (less than 401°F); feedstocks, 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 feedstocks, 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 nonpoint source industrial fuel combustion activity/emissions. Motor gasoline is not inventoried as a nonpoint source because it is expected that gasoline combustion in this sector is included in the nonroad inventory.

The EPA approach 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.

Total state-level industrial sector energy consumption data are available from the Energy Information Administration (EIA)'s State Energy Data System (SEDS) [ref 1] and were used for most source categories. In calculating the emission activity for industrial fuel combustion, EPA excluded all SEDS fuel types for which EIA assumes 100 percent of consumption is non-fuel use. For fuel types for which non-fuel use occurs, but is less than 100 percent, EPA reviewed two information sources to identify the non-fuel use percentage to apply in the NEI: EIA's 2002 *Manufacturing Energy Consumption Survey* (MECS) [ref 2] and EIA's GHG emissions inventory for 2005 [ref 3]. Further adjustments were made to the SEDS data for the coal and LPG sectors, and a separate EIA data source, Fuel Oil and Kerosene Sales [ref 4], was used for distillate oil. These adjustments were necessary in order to avoid double counting between the point, nonroad, and nonpoint inventories. For example, coal consumed by coke plants is accounted for in the point source inventory, so when estimating nonpoint emissions, this consumption should be removed. Similarly, for distillate oil and LPG, the SEDS data includes consumption estimates for equipment that EPA includes in the nonroad sector inventory. Therefore, the SEDS data should be adjusted so that these emissions are not double counted. More details on these adjustments. Year 2009 SEDS data were used to estimate 2011 emissions because these were the most recent consumption data available at the time this work was performed in 2012.

County-level activity estimates were developed by allocating the state-level adjusted EIA data. To do this, the EPA compiled 2009 estimates of manufacturing sector employment from the Bureau of Census' *County Business Patterns 2009* [ref 5] for use in this procedure. We allocated state-level industrial fuel combustion by fuel type 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 [ref 6].

The EPA has compiled and used criteria and hazardous air pollutant emission factors for nonpoint source industrial fuel combustion categories [ref 7]. These emission factors, which are too numerous to list here, are included in a spreadsheet within the ICI fuel combustion workbook. In most cases, these are the same emission factors that were used in preparing the 2002 nonpoint source NEI [ref 8]. Industrial LPG and wood combustion emission factors were obtained from an ICI fuel combustion study being performed for the Central Regional Air Planning Association (CENRAP) [ref 9].

3.11.5 Summary of quality assurance methods

Data analyses involving comparison of emissions between 2011 and 2008 showed some large discrepancies in emissions from this sector between the two years. Values submitted by S/L/T agencies that were larger than 10 times the 2008 submitted values were tagged as outliers and were not used in the 2011 NEI (unless the agency corrected the values prior to the final 2011 selection). Furthermore, some lead values from California were more than 2 times the highest value of the EPA dataset for this sector, and these values were tagged as outliers and not used in the 2011 NEI. In addition, some states requested that some values be tagged and not used, because they realized errors after submission.

The QA process included the release of a draft to data submitters that showed where tagged data values needed to be reexamined and possibly revised. State submitters were given the chance to resubmit tagged data during this period of time. Some states, like Minnesota, resubmitted some data, but it still did not pass the second QA check, and therefore remains tagged in the 2011 v2 NEI. Other states agreed that the tagged values seemed incorrect, and that EPA should use the EPA generated estimates in its place. Table 3-89 summarizes the number of tagged process-level emissions values from each agency affected by this QA in 2011 v1. This analysis was not repeated for the 2011 v2 but any differences in number of tags are suspected to be minor.

Table 3-89: Agencies tagged values for Industrial Fuel Combustion in 2011 NEI v1

Agency	Number of Values Tagged	Tag Reason
California Air Resources Board	6	Duplicated facility
California Air Resources Board	6	Outlier
Minnesota Pollution Control Agency	311	Outlier
Nebraska Environmental Quality	1	Outlier
New York State Department of Environmental Conservation	61	Outlier
Ohio Environmental Protection Agency	33	State requested that these be tagged because values were off by a factor of 1000
Pennsylvania Department of Environmental Protection	2	State requested that these records be tagged because state submitted incorrect values
Pennsylvania Department of Environmental Protection	1	Outlier
Wisconsin Department of Natural Resources	1	State planned to resubmit for 2011 v2
Wisconsin Department of Natural Resources	2	State did not report hex, so EPA data should be used

3.11.6 References for Fuel Combustion – Industrial Boilers, ICEs

1. EIA, 2012a: Energy Information Administration, U.S. Department of Energy, *State Energy Data System – Consumption, Physical Units, 1960-2009,* available from http://205.254.135.7/state/seds/, accessed March 2012.
2. EIA, 2007a: Energy Information Administration, U.S. Department of Energy, *2002 Manufacturing Energy Consumption Survey*, U.S. Department of Energy, Energy Information Administration, issued January 2007.
3. 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.
4. EIA, 2012b: Energy Information Administration, U.S. Department of Energy, *Fuel Oil and Kerosene Sales*, accessed March 2012.
5. Census, 2012: Bureau of the Census, U.S. Department of Commerce, *County Business Patterns 2009*, Washington, DC, accessed March 2012.
6. 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.
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]," May 1, 2009.
8. Pechan, 2006: E.H. Pechan & Associates, Inc. "Documentation for the Final 2002 Nonpoint Sector (Feb 06 Version) National Emission Inventory for Criteria and Hazardous Air Pollutants," prepared for U.S. Environmental Protection Agency, July 2006.
9. Pechan, 2009a: E.H. Pechan & Associates, Inc., "Area Combustion Source Emissions Inventory Improvement Methodology, Technical Memorandum," E.H. Pechan & Associates, Inc., prepared for Central Regional Air Planning Association, March 20, 2009.

3.12 Fuel Combustion – Commercial/Institutional

This section includes the description of five EIS sectors:

- Fuel Comb – Commercial/Institutional Boilers, ICEs - Coal
- Fuel Comb - Commercial/Institutional Boilers, ICEs – Oil
- Fuel Comb - Commercial/Institutional Boilers, ICEs - Natural Gas
- Fuel Comb - Commercial/Institutional Boilers, ICEs – Biomass
- Fuel Comb - Commercial/Institutional Boilers, ICEs – Other

They are treated here in a single section because the methods used are the same across all sectors.

3.12.1 Sector description

These five sectors are defined by the point source SCCs beginning with 103, 105 and 2030 and the nonpoint SCCs starting with 2103. These SCCs include boilers, internal combustion engines (ICE), including reciprocating and turbines, and space heaters. The primary fuels used by the boilers are coal, oil and natural gas. Other fuels used by commercial/institutional boilers include biomass, waste products and process gases. The primary fuels used by the ICE are natural gas and oil, but there are some which use various available process gases and LPG.

The SCC-based EIS sector definitions will cause a different universe of units to be included in these sectors than would other definitions of boilers, turbines or reciprocating internal combustion engines. For example, the Industrial/Commercial/Institutional Boilers and Process Heaters MACT include 25 MW and smaller boilers used to generate electricity; these boilers are not included in the sectors described here because they may have SCCs beginning with 101. Thus, the EIS sector definition would put these units in the Fuel Combustion – Electric Generation sector described in Section 3.10.

The use of SCCs in the NEI by S/L/T agencies impacts the units included in these EIS sectors. There are some boilers and gas turbines in commercial/institutional facilities which cogenerate electricity for distribution to the public power grid and process steam for their internal use. Some S/L/T agencies reporting to the NEI use an SCC (e.g., starting with 101 or 201) that would include these units in one of the EGU sectors, while others use an Industrial (starting with 102 or 202) SCC. This can result in boilers or gas turbines not connected to the public power grid being included in these EGU sectors and not the commercial/institutional boiler sectors.

3.12.2 Sources of data overview and selection hierarchy

The commercial/institutional fuel combustion sector includes data from the S/L/T agency submitted data and the default EPA generated emissions. The agencies listed in Table 3-90 submitted emissions for this sector. Where only emission values of zero were submitted (sum across all pollutants submitted), these are shown as zeroes in the table. No “X” or “0” indicates that nothing was submitted by the agency for that data category and fuel combination for this sector.

Table 3-90: Agencies that submitted Commercial/Institutional Fuel Combustion data

		Nonpoint					Point				
Agency	**Type**	**Bio-mass**	**Coal**	**Natural Gas**	**Oil**	**Other**	**Bio-mass**	**Coal**	**Natural Gas**	**Oil**	**Other**
US Environmental Protection Agency	EPA	X	X	X	X	X	X	X	X	X	X
Alabama Department of Environmental Management	S	X	0	X	X	X	X		X	X	0
Alaska Department of Environmental Conservation	S							X	X	X	X
Allegheny County Health Department	L								X	X	X
Arizona Department of Environmental Quality	S							X	X	X	X
Arkansas Department of Environmental Quality	S						X		X	X	
California Air Resources Board	S			X	X	X	X	X	X	X	X
Chattanooga Air Pollution Control Bureau (CHCAPCB)	L		0	X	0				X	X	
City of Albuquerque	L								X	X	X
City of Huntsville Division of Natural Resources and Environmental Mgmt	L									X	
Clark County Department of Air Quality and Environmental Management	L		0	X	X	X			X	X	
Coeur d'Alene Tribe	T	X	X	X	X	X					
Colorado Department of Public Health and Environment	S						X	X	X	X	X
Connecticut Department Of Environmental Protection	S	X	0	X	X	X			X	X	X
DC-District Department of the Environment	S		0	X	X	X		X	X	X	
Delaware Department of Natural Resources and Environmental Control	S		0	X	X	X		X	X	X	X
Eastern Band of Cherokee Indians	T			X	X	X					
Florida Department of Environmental Protection	S	X	0	X	X	X	X		X	X	X
Forsyth County Office of Environmental Assistance and Protection	L						X		X	X	X
Georgia Department of Natural Resources	S	0	0	X	X	X	X	X	X	X	X
Hawaii Department of Health Clean Air Branch	S		0	X	X	X			X	X	
Idaho Department of Environmental Quality	S	X	X	X	X	X	X		X	X	X
Illinois Environmental Protection Agency	S	0	0	X	X	X		X	X	X	X
Indiana Department of Environmental Management	S	X	0	X	X	X	X	X	X	X	X
Iowa Department of Natural Resources	S	X	0	X	X	X	X	X	X	X	X
Jefferson County (AL) Department of Health	L						X	X	X	X	X
Kansas Department of Health and Environment	S	X	0	X	X	X	X		X	X	X
Kentucky Division for Air Quality	S						X	X	X	X	X
Kickapoo Tribe of Indians of the Kickapoo Reservation in Kansas	T					X					
Knox County Department of Air Quality Management	L	X	X	X	X	X		X	X		
Kootenai Tribe of Idaho	T	X	X	X	X	X					
Lane Regional Air Pollution Authority	L						X		X		
Louisiana Department of Environmental Quality	S	X	0	X	X	X	X		X	X	X
Louisville Metro Air Pollution Control District	L	X	0	X	X	X		X	X		X
Maine Department of Environmental Protection	S	X		0	X	X	X		X	X	X
Maricopa County Air Quality Department	L			X	X				X	X	X
Maryland Department of the Environment	S		X	X	X	X	X	0	X	X	X
Massachusetts Department of Environmental Protection	S		0	X	X	X	X		X	X	X
Mecklenburg County Air Quality	L									X	
Memphis and Shelby County Health Department - Pollution Control	L	0	0	X	X	X		X	X	X	X
Metro Public Health of Nashville/Davidson County	L			X				X	X	X	X
Michigan Department of Environmental Quality	S		X	X	X	X	X	X	X	X	X
Minnesota Pollution Control Agency	S	X		X	X	X	X	X	X	X	X
Mississippi Dept of Environmental Quality	S								X	X	0
Missouri Department of Natural Resources	S	X	0	X	X	X	X	X	X	X	X
Montana Department of Environmental Quality	S								X	X	X
Nebraska Environmental Quality	S						X		X	X	X

		Nonpoint					Point				
Agency	Type	Bio-mass	Coal	Natural Gas	Oil	Other	Bio-mass	Coal	Natural Gas	Oil	Other
Nevada Division of Environmental Protection	S						X		X	X	X
New Hampshire Department of Environmental Services	S	X		X	X	X			X	X	X
New Jersey Department of Environment Protection	S		0	X	X	X		X	X	X	X
New Mexico Environment Department Air Quality Bureau	S								X		
New York State Department of Environmental Conservation	S	X		X	X	X	X	X	X	X	X
Nez Perce Tribe	T	X	X	X	X	X					
North Carolina Department of Environment and Natural Resources	S	X	X	X	X	X	X	X	X	X	X
North Dakota Department of Health	S								X		X
Northern Cheyenne Tribe	T	X	X		X	X					
Ohio Environmental Protection Agency	S	X	X	X	X	X	X	X	X	X	X
Oklahoma Department of Environmental Quality	S	X	0	X	X	X			X	X	X
Olympic Region Clean Air Agency	L						X				
Omaha Air Quality Control Division	L								X	X	
Oregon Department of Environmental Quality	S	X	0	X	X	X	X		X	X	X
Pennsylvania Department of Environmental Protection	S	X	0	X	X	X	X	X	X	X	X
Philadelphia Air Management Services	L								X	X	X
Pinal County	L						X		X	X	
Puerto Rico	S									X	X
Puget Sound Clean Air Agency	L								X	X	X
Rhode Island Department of Environmental Management	S								X	X	X
Shoshone-Bannock Tribes of the Fort Hall Reservation of Idaho	T	X	X	X	X	X					
South Carolina Department of Health and Environmental Control	S	X	X	X	X	X	X	0	X	X	X
South Dakota Department of Environment and Natural Resources	S						X	X	X	X	X
Southern Ute Indian Tribe	T								X		
Southwest Clean Air Agency	L								X	0	
Tennessee Department of Environmental Conservation	S	X	X	X	X	X	X		X	X	0
Texas Commission on Environmental Quality	S	0		X	X	X	X		X	X	X
Utah Division of Air Quality	S		X	X	X	X			X	X	X
Vermont Department of Environmental Conservation	S	X	0	X	X	X			X	X	X
Virginia Department of Environmental Quality	S	X	X	X	X	X	X	X	X	X	X
Washington State Department of Ecology	S								X	X	X
Washoe County Health District	L								X	X	
West Virginia Division of Air Quality	S			X	X			0	X	X	X
Wisconsin Department of Natural Resources	S	X	X	X	X	X	X	X	X	X	X
Wyoming Department of Environmental Quality	S						X	X	X	X	X

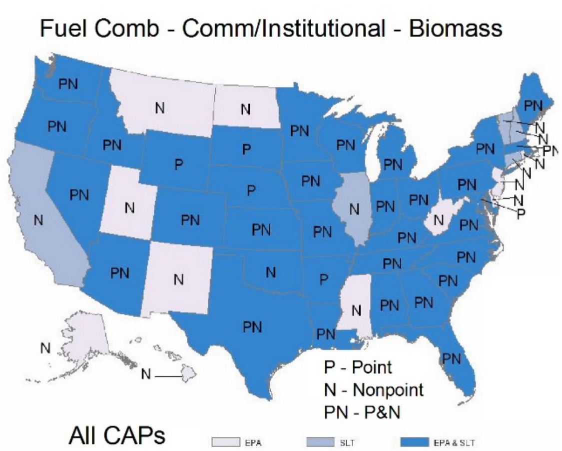
Table 3-91 shows the selection hierarchy for the commercial/institutional fuel combustion sector.

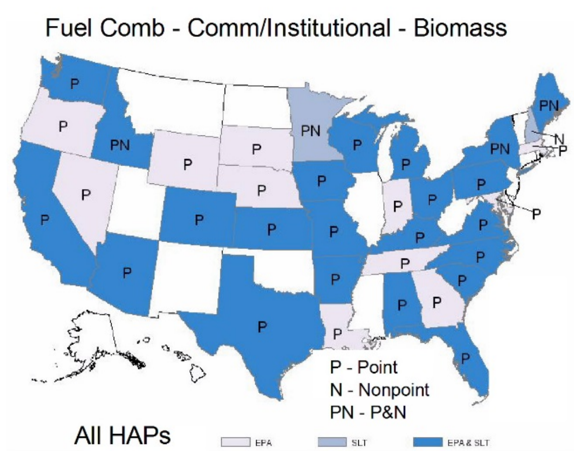
Table 3-91: 2011 NEI Commercial/Institutional Fuel Combustion data selection hierarchy

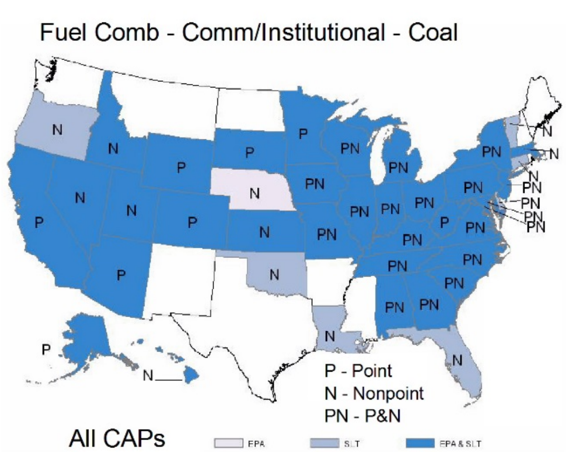
Data Set Name	Description	Point	Non-point
2011EPA_PM-Augmentation	PM species added to gap fill missing S/L/T agency data or make corrections where S/L/T agency have inconsistent PM species' emissions.	1	2
Responsible Agency Data Set	S/L/T agency submitted data	2	1

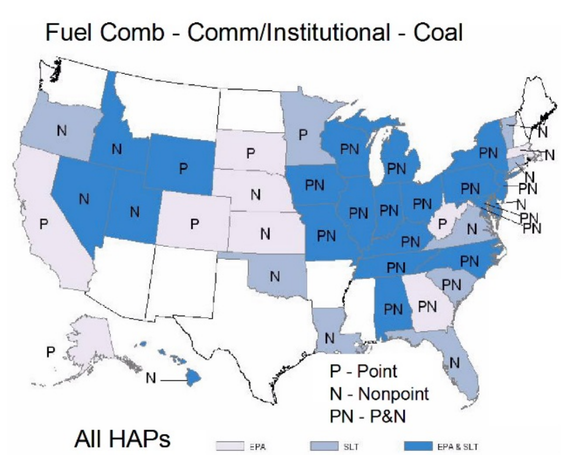
Data Set Name	Description	Point	Non-point
2011EPA_EGU	EPA MATS EGU data developed from CAMD heat input and EFs.	3	
2011EPA_chrom_split	Contains corrected and speciated hexavalent and trivalent chromium emissions derived from the S/L/T agency data for sources in which S/L/T agency reports the total (unspeciated) chromium pollutant.	4	3
2011EPA_TRI	Toxics Release Inventory data for the year 2011.	5	
2011EPA_CarryForward-PreviousYear Data	Variety of estimates used to gap fill important sources/pollutants.	6	
2011EPA_HAP-Augmentation	HAP data computed from S/L/T agency criteria pollutant data using HAP/CAP emission factor ratios.	7	4
2011EPA_BOEMS	CAP Emissions from Offshore oil platforms located in Federal Waters in the Gulf of Mexico developed by the U.S. Department of the Interior, Bureau of Ocean and Energy Management, Regulation, and Enforcement.	8	
2011EPA_NP_Overlap_w_Pt	EPA generated emissions for nonpoint sources		5

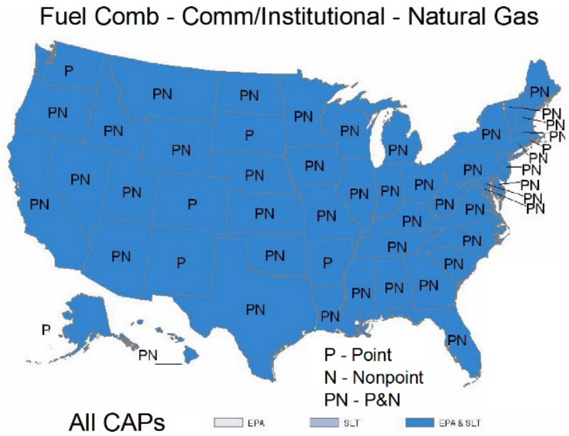
3.12.3 Spatial coverage and data sources for the sector

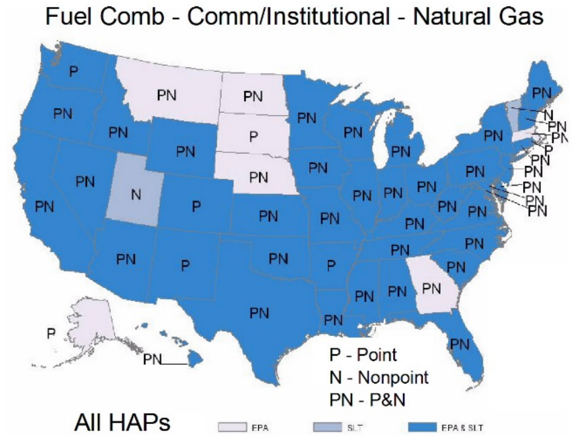


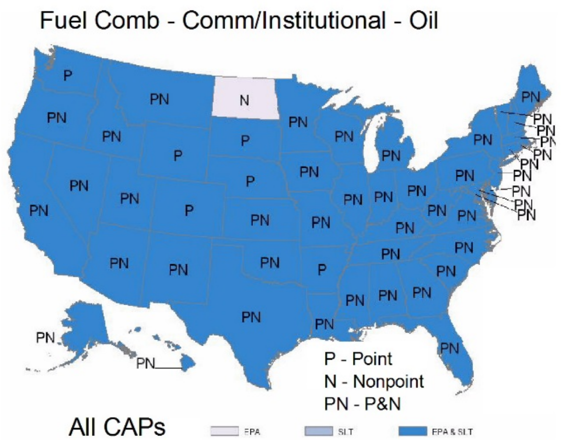


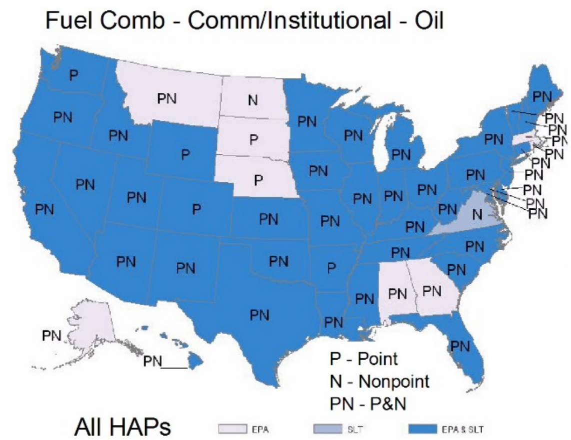


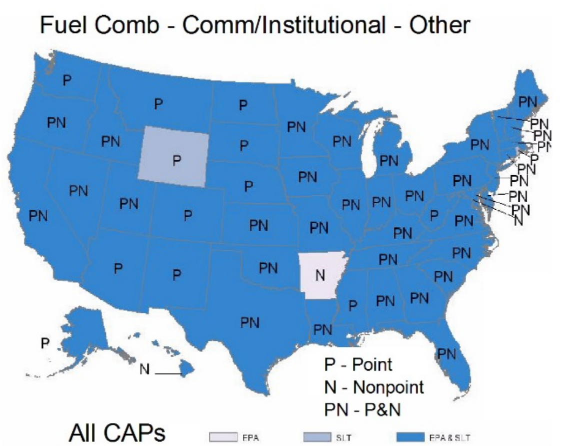


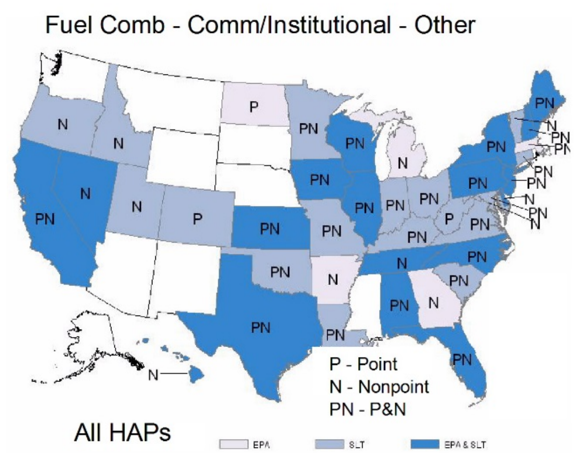












3.12.4 EPA-developed commercial/institutional fuel combustion data

The approach in calculating nonpoint 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.

Total state-level commercial sector energy consumption data are available from the Energy Information Administration (EIA)'s State Energy Data System (SEDS) [ref 1] and were used for most source categories. Several adjustments were made to the SEDS data. These adjustments were necessary in order to avoid double counting between the nonroad and nonpoint inventories. Furthermore, for the coal sector, SEDS data do not provide coal consumption estimates by type of coal (i.e., anthracite versus bituminous/subbituminous), and this level of data is needed because of differing emission factors for these coal types.

For LPG and distillate oil, the SEDS data includes consumption estimates for equipment that EPA includes in the nonroad sector inventory. Therefore, the SEDS data should be adjusted so that these emissions are not double counted.

To estimate the volume of commercial/institutional sector LPG consumption that should not be included in the nonpoint source inventory, EPA subtracted 18 percent from each state's commercial sector LPG consumption estimate reported in SEDS. EPA ran the National Mobile Inventory Model (NMIM) for 2006 and calculated the national volume of nonroad LPG consumption from commercial sector source categories. This estimate was then divided into the SEDS total commercial sector LPG consumption estimate to yield the proportion of total commercial/institutional sector LPG consumption attributable to the nonroad sector in that year (approximately 18 percent).

To avoid double-counting of distillate oil consumption between the nonpoint and nonroad sector emission inventories, EPA relied on a source other than SEDS to estimate consumption. The approach uses more detailed distillate oil consumption estimates reported in EIA's *Fuel Oil and Kerosene Sales* [ref 2], and assumptions from the regulatory impact analysis (RIA) for EPA's nonroad diesel emissions rulemaking [ref 3]. Table 3-92 displays the assumptions that were applied to the state-level distillate oil consumption estimates reported in *Fuel Oil and Kerosene Sales* to estimate total stationary source commercial/institutional sector consumption. The percentages shown in Table 3-92 come from p 7-8 of EPA's RIA for the nonroad diesel emissions rulemaking [ref 3]. Note, a very small portion of total commercial/institutional diesel is consumed by point sources (SCC 203001xx).

More details on these adjustments. Year 2009 SEDS 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 3-92: Assumptions used to estimate Commercial/Institutional stationary source distillate fuel consumption

Sector	**Distillate Fuel Type**	**% of Total Consumption from Stationary Sources**
Commercial	No. 1 Distillate Fuel Oil	80
	No. 2 Distillate Fuel Oil	100
	No. 2 Distillate/Ultra-Low, Low, and High Sulfur Diesel	0[a]
	No. 4 Distillate Fuel Oil	100

Year 2009 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 2006 estimates of commercial sector (NAICS codes 42 through 81) employment from the Bureau of Census' *County Business Patterns 2009* [ref 4] for use in this procedure. A separate document [ref 5] describes how withheld *County Business Patterns* employment data were estimated. The EPA also developed 2006 county-level estimates of institutional sector (NAICS code 92) employment from 2007 local government employment data in the 2007 *Census of Governments* [ref 6] and adjustments reflecting each state's 2006/2007 local government employment ratio. 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.

The EPA has compiled criteria and hazardous air pollutant emission factors for nonpoint source commercial/institutional fuel combustion categories [ref 7]. These emission factors, which are too numerous to list here, are included in a spreadsheet within the ICI fuel combustion workbook. In most cases, these are the same emission factors that were used in preparing the 2002 nonpoint source NEI [ref 8]. Commercial/institutional wood combustion emission factors were obtained from an ICI fuel combustion study being performed for the Central Regional Air Planning Association (CENRAP) [ref 9].

3.12.5 Summary of quality assurance methods

Data analyses involving comparison of emissions between 2011 and 2008 showed some large discrepancies in emissions from this sector between the two years. Emissions values submitted by S/L/T agencies that were larger than 10 times the 2008-submitted values were tagged as outliers and were not used in the 2011 NEI, unless the agency corrected or confirmed the value. Furthermore, some lead values from Clark County, Nevada were more than 2 times the highest value of the EPA dataset for this SCC, and these values were tagged as outliers and not used in the 2011 NEI.

The QA process included the release of a draft to data submitters that showed where tagged data values needed to be reexamined and possibly revised. State submitters were given the chance to resubmit tagged data during this period of time. Some states, like Minnesota, resubmitted some data, but it still did not pass the second QA check, and therefore remains tagged in the 2011 NEI. Other states agreed that the tagged values seemed incorrect, and that EPA should use the EPA generated estimates in its place. Table 3-93 summarizes the number of tagged process-level emissions values from each agency affected by this QA in v1 of the 2011 NEI. This analysis was not repeated for the v2 NEI but any differences in number of tags are suspected to be minor.

Table 3-93: Agencies tagged values for Commercial/Institutional Fuel Combustion in v1 of the 2011 NEI.

Agency	Number of Values Tagged	Tag Reason
Clark County Department of Air Quality and Environmental Management	1	Outlier
Minnesota Pollution Control Agency	67	Outlier
Nebraska Environmental Quality	1	Outlier

3.12.6 References for Fuel Combustion – Commercial/Institutional

1. EIA, 2012a: Energy Information Administration, U.S. Department of Energy, *State Energy Data System – Consumption, Physical Units, 1960-2009,* available from http://205.254.135.7/state/seds/, accessed March 2012.
2. EIA, 2012b: Energy Information Administration, U.S. Department of Energy, *Fuel Oil and Kerosene Sales*, accessed March 2012.
3. EPA, 2003: U.S. Environmental Protection Agency, "Draft Regulatory Impact Analysis: Control of Emissions from Nonroad Diesel Engines," EPA420-R-03-008, Office of Transportation and Air Quality, April 2003.
4. Census, 2012a: Bureau of the Census, U.S. Department of Commerce, *County Business Patterns 2009*, Washington, DC, accessed March 2012.
5. 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.
6. Census, 2009b: Bureau of the Census, U.S. Department of Commerce, "Local Government Employment and Payroll, March 2006," *2007 Census of Governments*, accessed March 2009.
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]," May 1, 2009.

8. Pechan, 2006: E.H. Pechan & Associates, Inc. "Documentation for the Final 2002 Nonpoint Sector (Feb 06 Version) National Emission Inventory for Criteria and Hazardous Air Pollutants," prepared for U.S. Environmental Protection Agency, July 2006.
9. Pechan, 2009a: E.H. Pechan & Associates, Inc., "Area Combustion Source Emissions Inventory Improvement Methodology, Technical Memorandum," E.H. Pechan & Associates, Inc., prepared for Central Regional Air Planning Association, March 20, 2009.

3.13 Fuel Combustion – Residential – Natural Gas, Oil, and Other

The EIS sectors to be documented here are:

- "Fuel Comb - Residential – Other" which includes the fuels: (1) coal, (2) liquid petroleum gas and (3) "Biomass; all except Wood". Note that "Biomass; all except Wood" is not an EPA-estimated category, and no S/L/T agency submitted data for it for the 2011 NEI.
- "Fuel Comb - Residential – Oil" which includes the fuels: (1) distillate oil, (2) kerosene and (3) residual oil. Residual oil is not an EPA-estimated category, and the only S/L that submitted data for this category in 2011 submitted emissions of 0 (zero).
- "Fuel Comb - Residential - Natural Gas" which includes the fuel natural gas only.

3.13.1 Source category description

Table 3-94 shows the SCCs used in the 2011 NEI from the sectors: "Fuel Comb - Residential – Other", "Fuel Comb - Residential – Oil" and "Fuel Comb - Residential - Natural Gas". EPA estimates emission for all SCCs other than SCC=2104005000 and SCC=2104006010.

Table 3-94: SCCs in the Residential Fuel Combustion sectors (except Wood) in the 2011 NEI

SCC	SCC Level Three	SCC Level Four	EI Sector
2104001000	Anthracite Coal	Total: All Combustor Types	Fuel Comb - Residential - Other
2104002000	Bituminous/Subbituminous Coal	Total: All Combustor Types	Fuel Comb - Residential - Other
2104004000	Distillate Oil	Total: All Combustor Types	Fuel Comb - Residential - Oil
2104005000	Residual Oil	Total: All Combustor Types	Fuel Comb - Residential - Oil
2104006000	Natural Gas	Total: All Combustor Types	Fuel Comb - Residential - Natural Gas
2104006010	Natural Gas	Residential Furnaces	Fuel Comb - Residential - Natural Gas
2104007000	Liquified Petroleum Gas (LPG)	Total: All Combustor Types	Fuel Comb - Residential - Other
2104011000	Kerosene	Total: All Heater Types	Fuel Comb - Residential - Oil

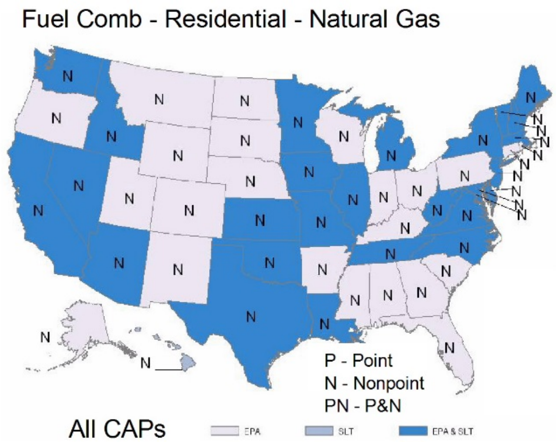
3.13.2 Sources of data overview and selection hierarchy

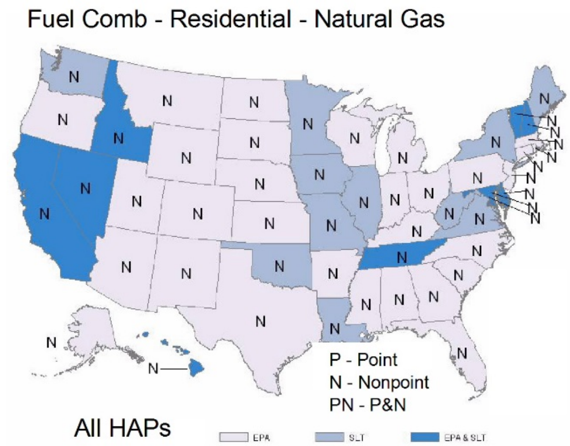
The residential fuel combustion sectors include data from the S/L/T agency submitted data and the default EPA generated emissions. This sector is contained solely in the nonpoint data category. The agencies listed in Table 3-95 submitted emissions for this sector. Where only emission values of zero were submitted (sum across all pollutants submitted), these are shown as zeroes in the table. No "X" or "0" indicates that nothing was submitted by the agency for that data category and fuel combination for this sector.

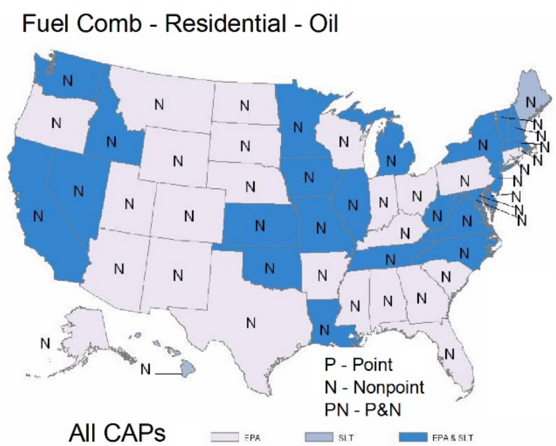
Table 3-95: Agencies that submitted data for Fuel Combustion – Residential Heating – Natural Gas, Oil and Other

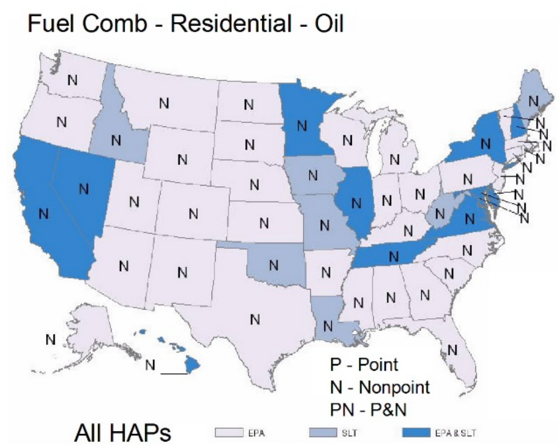
		Natural Gas	Oil			Other		
Agency	**Type**	**Natural Gas**	**Distillate Oil**	**Kero-sene**	**Residual Oil**	**Anthracite Coal**	**Bituminous/ Subbitumi-nous Coal**	**Liquified Petroleum Gas (LPG)**
US Environmental Protection Agency (2011EPA_NP_NoOvrlp dataset, to be described in 3.13.4)	EPA	X	X	X		X	X	X
California Air Resources Board	S	X	X					X
Chattanooga Air Pollution Control Bureau (CHCAPCB)	L					0	0	
Clark County Department of Air Quality and Environmental Management	L	X	X	X	0		0	X
Coeur d'Alene Tribe	T	X	X	X		0	X	X
DC-District Department of the Environment	S	X	X				0	X
Delaware Department of Natural Resources and Environmental Control	S	X	X	X			0	X
Eastern Band of Cherokee Indians	T	X	X	X				X
Hawaii Department of Health Clean Air Branch	S	X	X	X			0	X
Idaho Department of Environmental Quality	S	X	X	X		0	X	X
Illinois Environmental Protection Agency	S	X	X	X		0	X	X
Iowa Department of Natural Resources	S	X	X	X		X	X	X
Kansas Department of Health and Environment	S	X	X	X	0	0	0	X
Kickapoo Tribe of Indians of the Kickapoo Reservation in Kansas	T							X
Kootenai Tribe of Idaho	T	X	X	X		0	0	X
Louisiana Department of Environmental Quality	S	X	X	X		0	0	X
Maine Department of Environmental Protection	S	X	X	X				X
Maricopa County Air Quality Department	L	X						X
Maryland Department of the Environment	S	X	X	X			X	X
Massachusetts Department of Environmental Protection	S	X	X	X			0	X
Memphis and Shelby County Health Department - Pollution Control	L	X	X	X		0	0	X
Metro Public Health of Nashville/Davidson County	L	X	X				0	X
Michigan Department of Environmental Quality	S	X	X	X		X	X	X
Minnesota Pollution Control Agency	S	X	X	X		X	X	X
Missouri Department of Natural Resources	S	X	X	X	0	0	0	X
New Hampshire Department of Environmental Services	S	X	X					X
New Jersey Department of Environment Protection	S	X	X	X		0	0	X
New York State Department of Environmental Conservation	S	X	X	X				X
Nez Perce Tribe	T	X	X	X		0	X	X
Northern Cheyenne Tribe	T	X	X				X	X
Oklahoma Department of Environmental Quality	S	X	X	X	0	0	0	X
Sac and Fox Nation of Missouri in Kansas and Nebraska Reservation	T							X
Santee Sioux Nation	T							X
Shoshone-Bannock Tribes of the Fort Hall Reservation of Idaho	T	X	X	X		0	X	X
Texas Commission on Environmental Quality	S	X						X
Utah Division of Air Quality	S						X	
Vermont Department of Environmental Conservation	S	X	X	X				
Virginia Department of Environmental Quality	S	X	X	X		0	X	X
Washington State Department of Ecology	S	X	X					X
West Virginia Division of Air Quality	S	X	X	X		X	X	X

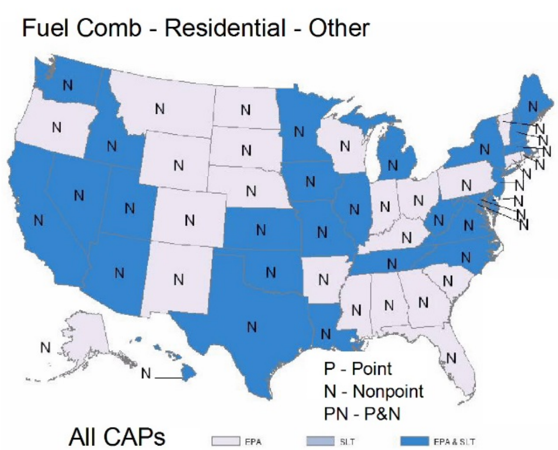
3.13.3 Spatial coverage and data sources for the sector

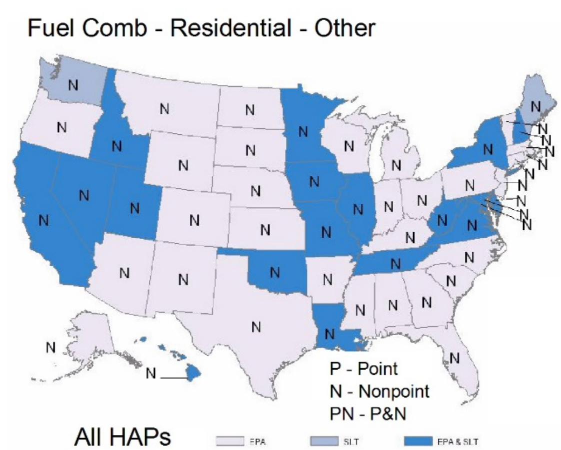












3.13.4 EPA Residential Heating estimates for oil, natural gas and other fuels

Documentation on residential heating emissions estimates are provided for coal, natural gas, distillate oil, kerosene and liquefied petroleum gas (LPG) are provided on the main 2011 NEI website under "2011 NEI

Documentation" and then under the "Data and documentation" FTP link under "Nonpoint Emissions Tools and Methods". Specific links to each fuel type for this category are provided below:

Residential Consumption Natural Gas

Residential Consumption Oil

Residential Consumption Coal

Residential Consumption Kerosene

Residential Consumption LPG

3.13.5 Summary of quality assurance methods

Comparisons of the EPA estimates for 2011 to previous inventories, and comparison of EPA estimates to state submitted data indicated no issues.

3.14 Fuel Combustion – Residential – Wood

3.14.1 Sector description

This source category includes residential wood burning devices such as fireplaces, fireplaces with inserts (inserts), free standing woodstoves, pellet stoves, outdoor hydronic heaters (also known as outdoor wood boilers), indoor furnaces, and outdoor burning in firepits and chimeneas. We further differentiate free standing woodstoves and inserts into three categories: conventional (not EPA certified); EPA certified, catalytic; and EPA certified, noncatalytic. Generally speaking, the conventional units were constructed prior to 1988. Units constructed after 1988 had to meet EPA emission standards and they are either catalytic or non-catalytic.

Table 3-96 shows the SCCs used in the 2011 NEI from in this sector. EPA estimates emission for all SCCs in Table 3-96 other than SCC=2104008300, which is a general woodstove SCC that provides no details on the category. Only the Tohono O'Odham Nation of Arizona, the Washoe Tribe of California and Nevada, the Prairie Band Potawatomi Nation and Sac and Fox Nation of Missouri in Kansas and Nebraska Reservation submitted emissions for this general woodstove SCC.

Table 3-96: SCCs in the Residential Wood Combustion sector in the 2011 NEI

SCC	SCC Level Three*	SCC Level Four
2104008100	Wood	Fireplace: general
2104008210	Wood	Woodstove: fireplace inserts; non-EPA certified
2104008220	Wood	Woodstove: fireplace inserts; EPA certified; non-catalytic
2104008230	Wood	Woodstove: fireplace inserts; EPA certified; catalytic
2104008300	Wood	Woodstove: freestanding, general
2104008310	Wood	Woodstove: freestanding, non-EPA certified
2104008320	Wood	Woodstove: freestanding, EPA certified, non-catalytic
2104008330	Wood	Woodstove: freestanding, EPA certified, catalytic
2104008400	Wood	Woodstove: pellet-fired, general (freestanding or FP insert)
2104008510	Wood	Furnace: Indoor, cordwood-fired, non-EPA certified
2104008610	Wood	Hydronic heater: outdoor
2104008700	Wood	Outdoor wood burning device, NEC (fire-pits, chimeneas, etc)
2104009000	Firelog	Total: All Combustor Types
*SCC Level One is "Stationary Source Fuel Combustion" and SCC Level Two is "Residential"		

3.14.2 Sources of data overview and selection hierarchy

The residential wood sector includes emissions from both S/L/T agencies and from the EPA no-overlap nonpoint dataset. Table 3-97 shows the selection hierarchy for all datasets contributing to the residential wood heating sector. Table 3-98 shows the agencies that submitted data used by the 2011 NEI. In some cases, the EPA PM and HAP augmentation as well as chromium split datasets were used to fill in PM species and HAP pollutants based on S/L/T agency data. Table 3-99 lists the various datasets used in the 2011 NEI for this sector. The figures shown in Section 3.14.3 illustrate where EPA, S/L/T agency or both types of data are used for this sector. In cases where an agency is listed in Table 3-98 and "both" is shown in the figure, this means that one of the EPA augmentation datasets was used in that state.

Table 3-97: 2011 NEI selection hierarchy for datasets used by the residential wood heating sector

Priority	Dataset Name	Dataset Content
1	2011EPA_PM-Augmentation	Augments PM data in 47 states and some tribes
2	Responsible Agency Data Set	State and Local Agency submitted emissions
3	2011EPA_chrom_split	Splits total chromium into speciated chromium in 37 states
4	2011EPA_HAP-Augmentation	Adds Pb and other HAP emissions in 46 states
5	2011EPA_NP_NoOverlap_w_Pt	EPA-generated data, including agricultural crops and livestock dust emissions

Table 3-98: Agencies that submitted data for the sector Fuel Combustion – Residential Heating – Wood

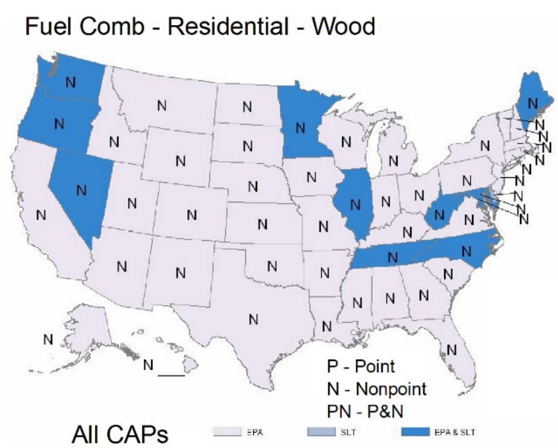
Agency Name	Agency Type
Bishop Paiute Tribe	Tribal
California Air Resources Board	State
Clark County Department of Air Quality and Environmental Management	Local Agency
Eastern Band of Cherokee Indians	Tribal
Illinois Environmental Protection Agency	State
Kootenai Tribe of Idaho	Tribal
Maine Department of Environmental Protection	State

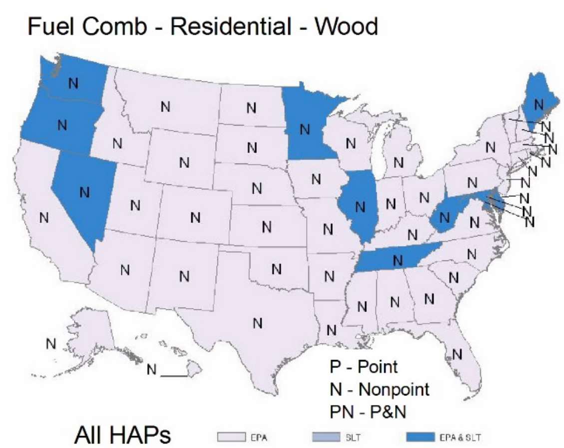
Agency Name	Agency Type
Maryland Department of the Environment	State
Metro Public Health of Nashville/Davidson County	Local Agency
Minnesota Pollution Control Agency	State
Nez Perce Tribe	Tribal
Northern Cheyenne Tribe	Tribal
Oregon Department of Environmental Quality	State
Sac and Fox Nation of Missouri in Kansas and Nebraska Reservation	Tribal
Shoshone-Bannock Tribes of the Fort Hall Reservation of Idaho	Tribal
Washington State Department of Ecology	State
West Virginia Division of Air Quality	State

Table 3-99: Datasets Included in the Fuel Comb – Residential – Wood sector

Dataset Short Name	Order
2011 Responsible Agency Selection	1
2011EPA_PM-AUG	2
2011EPA_chrom_split	3
2011EPA_HAP-Aug	4
2011EPA_NP_NoOvrlp	6

3.14.3 Spatial coverage and data sources for the sector





3.14.4 EPA-developed residential wood combustion estimates

Emission estimates were developed using a tool in Microsoft® Access®, developed by EPA. This tool computes county- and SCC-level emissions of criteria and HAPs for the entire country. EPA updated the inputs to the tool for the 2011 NEI in partnership with ERTAC. Details about the development of the tool can be found in a conference paper [ref 1], and details on the updates made for 2011 are provided here.

<u>Updated AHS appliance profile data</u>

The tool developed to estimate emissions from residential wood combustion relies on "appliance profiles," which include estimates of the fraction of homes in each county that have and use each type of wood-burning appliance listed in Table 3-96. The appliance profiles used for most counties (approximately 83%) are constructed using data from the American Housing Survey (AHS), while other state- and local-level surveys are used for the other counties, as described below. Appliance profiles are constructed by dividing the number of survey respondents that use a particular appliance into the total number of respondents. The appliance profiles are used with Census data on the number of occupied homes in each county to estimate the number of appliances in use in each county.

The AHS conducts national and metropolitan area surveys on the Nation's housing, including household characteristics and heating equipment and fuels. Both the national and metropolitan statistical area (MSA) surveys are conducted during a 3- to 7- month period. The national survey, which gathers information on housing throughout the country, conducts interviews at about 55,000 housing units every 2 years, in odd-numbered years. The metropolitan area survey consists of 47 metropolitan areas, where householders are interviewed every 6 years. Data is gathered for about 14 metropolitan areas on an even numbered year until all 47 metropolitan areas are surveyed. Data are also gathered for non-MSA counties in 4 bins: West, South, Northeast, and Midwest. We used the non-MSA information as defaults where we did not have any other information. We used the data in Table 2-4: "Selected Equipment and Plumbing," which provides information on the number of respondents that use fireplaces (with or without inserts) or woodstoves. The methodology for constructing the appliance profiles for the other appliances is discussed below. Because the AHS do not differentiate between fireplaces that burn wood with those that burn gas, we applied an adjustment factor to the AHS data that assumes that 30% of fireplaces burn gas, based on Houck [ref 2]. Table 3-100 lists the MSAs using updated AHS survey data for the 2011 NEI.

Table 3-100: MSA's using updated AHS data for residential wood combustion

MSA	**Year of American Housing Survey Data**
Seattle	2009
Philadelphia	2009
New Orleans	2009
New York City	2009
Detroit	2009
Chicago	2009
Northeast	2009
Midwest	2009
West	2009
South	2009

The area contained in a MSA will usually contain an urban core and surrounding areas that are more sub-urban than urban. One of the problems noted in previous versions of the tool is that applying the MSA information to all the counties in the MSA usually results in the overestimation of residential wood combustion emissions in the urban core and underestimation in the suburban counties. For future versions of the NEI (2014), we plan to address this by separating the urban core county from the sub-urban counties and allocating a higher proportion of the emissions to the suburban counties.

In addition to the appliance profiles used to estimate the number of appliances in each county, the tool uses "burn rates," which are the estimated amount of wood burned in each appliance. The burn rates are constructed using a mixture of local surveys, fuel sales data, and expert judgment. For the non-MSA counties, the tool uses a mix of resources to establish burn rates and appliance profiles. Information on burn rates can be found in the conference paper referenced earlier [ref 1]. For appliance counts, for many of the New England States, the tool uses a MARAMA (Mid-Atlantic Regional Air Management Association) survey that was later adjusted by ERTAC. In addition, we used a 2008 Vermont (VT) survey [ref 3]. We used the VT data as a reality check on the other New England states (the survey was released in 2011 so it was not available for the 2008 NEI). The VT survey showed strong wood use (32% of household's burn wood for space heating) and a general increase from the last survey which was in 1998. There were also news reports of higher wood use. Surveys from other states (MN and OR) also showed strong wood use. According to the OR survey, 36% of household use wood to heat as backup heat and 34.7% of all households burned wood in at least one wood burning device. In MN, 45% use wood as primary source of heat, based on a 2008 survey. In order to get the tool to calculate the expected increase in emissions from 2008, the appliance percentage for fireplaces, woodstoves, and inserts was adjusted.

EPA added additional state- and regional-level survey data, which are deemed more accurate and specific than the survey data used in most counties in the tool. The main sources of data are the American Housing Survey (AHS),[13] various state-level surveys (Minnesota,[14] Oregon,[15] and Vermont[16]) and regional-level surveys (Mid-Atlantic Regional Air Management Association [MARAMA][17] and the tri-state area of Washington, Oregon, and Idaho), and expert judgment. These survey data are used to estimate the number of each type of wood-burning appliance and the amount of wood burned in each appliance in each county. The source of the data and the specific location within the data source where these data can be found are now listed in the Burn Rates, Appliance Profiles, and Other Appliance Populations tables in the accompanying Excel workbook.

The counties for which EPA added data include the following:

- All counties in California;
- All counties in Washington;
- Ada, Canyon, and Elmore Counties, Idaho;
- Silver Bow County and Lincoln Counties, Montana;
- Klamath and Lane Counties, Oregon; and
- Washoe County, Nevada.

In all, this represents 163 counties. EPA attempted to collect recent survey data from Alaska but, were unable to make contact with the state agency staff. EPA also received data from Minnesota from their 2011-2012 wood combustion survey, but the data arrived too late to incorporate into the tool. However, these data are available to analyze and include in the tool for the 2014 National Emissions Inventory.

Using the survey data obtained, EPA updated the appliance fractions and burn rates for all appliances for which these surveys collected data. For any appliances for which the surveys did not specifically ask questions, which

[13] U.S. Census Bureau. American Housing Survey.(accessed July 2014).
[14] Minnesota Department of Natural Resources. Residential Fuelwood Assessment: 2002–2003 Heating Season, (accessed July 2014) (Note: Minnesota conducted another residential wood combustion survey in 2012, but these data were not available for analysis in time to include in the tool.)
[15] Johnson, A.B., T. Conklin, and D. Elliot. 2009. Department of Environmental Quality Residential Wood Combustion Survey: Results Report. Prepared by Portland State University Survey Research Lab for the Oregon Department of Environmental Quality. (accessed July 2014).
[16] Data provided by Vermont Division of Forestry (accessed July 2014).
[17] Houck, J.E. and B.N. Eagle. 2006. Control Analysis and Documentation for Residential Wood Combustion in the MANE-VU Region. Technical Memorandum prepared by OMNI Environmental Services Inc. for the Mid-Atlantic Regional Air Management Association, (accessed July 2014).

typically included outdoor wood boilers (OWBs), indoor furnaces, and outdoor appliances not elsewhere classified (NEC), EPA kept the existing appliance and burn rate data.

Decreases of emissions from RWC from 2008 occur in the southeast; we believe the 2008 version of the tool overestimated emissions in those states.

<u>Other appliance profile - outdoor wood boilers (OWBs) and indoor furnaces</u>

Because the AHS and, in some cases, other local survey data do not include information on OWBs or indoor furnaces, the populations for these appliances had to be estimated using a separate methodology. Projecting growth for OWBs and indoor furnaces was a challenge due to conflicting data. For OWBs, the last good year of sales is 2005 in which 67,564 of these units were sold. In 2004, 24,560 were sold. In 2003, 15,342 units were sold. These data indicate a significant increasing trend. In EPA's earlier estimates for 2008, it was assumed that sales did not increase in 2006 or 2007; we held sales constant at 67,564 units sold per year, which we thought was a conservative estimate at the time. Since then, we have decreased the assumed sales, based partly on the Frost and Sullivan report dated 2010 which reported declining growth since 2008 due to the weak economy, decline in residential new construction, and the lack of credit. However, Ellen Burkhard with the New York State Energy Research and Development Authority has higher estimates for NY than the EPA tool. She estimates that there are 49,000 units in 2010 in NY, versus tool's 2011 estimates of 28,626. Also, we have 2033 OWB units in the state of Vermont in 2005 and 4014 units in 2008, an almost 100% increase in 3 years from 2005 to 2008 (Note: the source for the 2008 number is the Vermont Residential Fuel survey for the 2007-2008 heating season, released in August 2011 by the VT Department of Forestry, Parks and Recreation; the source for the 2005 number is the cumulative sales data from NESCAUM). In MN, a 9% increase in OWB population from 2002 to 2008 is reported, which is about a 1.6% increase per year. EPA based its growth projection on this and the Frost and Sullivan report. Consequently, for the 2011 NEI, we grew the OWB county population from 2008 to 2011 by a factor of 1.1 for the following states; IL, IN, ME, MA, MN, MI, NH, NY, OH, VT, and WI. We assumed no growth for WA, OR, and HI. All other states were grown from 2008 to 2011 by a factor of 1.067. The factor 1.067 was chosen because it was 50% of the growth rate we used to grow 2005 to 2008. The 1.1 factor was chosen because it was conservative, which was in line with comments provided by MI. For the 2011 v2, we expect to change the growth rate using sales data reported to EPA by vendors. This sales data shows that sales were stronger than expected, so this will result in higher emissions from OWBs.

We did not have sales data for Indoor furnaces. Based on a conversation with an industry representative who indicated that that sales were not good, we assumed no growth from 2008.

<u>Allocating OWBs and Indoor Furnaces to the county level</u>

ERTAC devised two approaches. One was to allocate by an inverse population density, and the other was to allocate by rural population and to zero out the counties where housing density was above a certain threshold. Inverse density takes into account the area of the county. So, this normalizes the procedure for the physical size of the county. The threshold we choose was 300 households/square mile. The ERTAC states that participated in this exercise also had the opportunity to zero out any additional counties they wanted. The idea was to minimize the number of these units in the urban counties where we thought they should not be as numerous. OWB and indoor furnaces are typically used in rural settings, although they do exist in some suburban settings. The units that were zeroed out were reallocated to other counties, not deleted. This was done on the NEI 2008 v3, and then this was the baseline data for the 2011 updates.

The other appliance types (fireplaces, woodstoves, and inserts) did not need to be allocated to the county level, because the data from the AHS and other surveys allowed the populations of these appliances to be estimated at the county level.

Outdoor wood boiler emission factors

For 2011, we updated emission factors for OWB. The factors for all other SCCs which were not updated were a mix of factors used by MARAMA and for non-certified conventional wood stoves. The emission factor for mercury was from the EPA's Report to Congress on Mercury. The emission factors are documented in the tool. The full report title is listed in the references [ref 4]. The testing was done by EPA. In general, the emissions for PM increased. Prior to the 2011 NEI, in lieu of specific data, EPA used the emissions factors for the conventional woodstoves. For the 2011 NEI, EPA used the emission factors developed in reference 4. Essentially, the emission factor for outdoor wood boilers for primary $PM_{2.5}$ doubled from 30.6 to 64 lbs primary $PM_{2.5}$/ton wood burned.

Tool Interface

EPA created a user-friendly interface that simplifies the process of running the RWC Tool. This interface allows users to select the states for which they would like to estimate emissions. This feature reduces the run time if the user is only interested in the emissions from one or a few states. Once the desired states are selected, the user needs only to click a single button to calculate the inventory.

The interface includes easy options for displaying the following:

- County-level input data and Primary $PM_{2.5}$ emissions by SCC and burn type;
- County-level number of appliances by appliance type;
- State-level number of appliances by appliance type;
- Emission factors by SCC; and
- A flow diagram of the calculation methodology.

The ease-of-use provided by this interface could allow for a public release of the tool so that state, local, and tribal agencies could use it to estimate residential wood combustion emissions in their own locales.

Hazardous Air Pollutant Emission Factors

There are several emission factors for hazardous air pollutants that were not listed uniformly across wood stove types. For example, some of the emission factors were listed for EPA-certified wood stoves, but not for conventional (uncertified) wood stoves. Following discussion with EPA, EPA updated the emissions factors listed in Table 3-101 from all freestanding wood stove and fireplace insert categories with emission factors derived from Hays et al.[18] These emission factors included factors for seven pollutants that were not previously included in the tool. They are marked as "n/a" in Table 3-101. EPA did not change the emission factors, or add new emission factors, for any of these pollutants for any of the other SCCs.

[18] Hays, M.D., N.D. Smith, J. Kinsey, Y. Dong, P. Kariher. 2003. Polycyclic aromatic hydrocarbon size distributions in aerosols from appliances of residential wood combustion as determined by direct thermal desorption—GC/MS. Aerosol Science, 34: 1061-1084.

Table 3-101: Emission factors for selected hazardous air pollutants in the RWC tool. The emission factors updated or added for woodstoves (freestanding and inserts) but were left unchanged for all other SCCs.

Pollutant	Code	Original Emission Factor	Updated Emission Factor
Benzo[a]anthracene	56553	n/a	0.000577
Benzo[a]fluoranthene	203338	n/a	0.000321
Benzo[a]Pyrene	50328	0.00248	0.000979
Benzo[b]fluoranthene	205992	n/a	0.000592
Benzo[e]Pyrene	192972	0.00745	0.000589
Benzo[g,h,i,]Perylene	191242	0.00248	0.000201
Benzo[k]Fluoranthene	207089	0.00124	0.000509
Chrysene	218019	0.00745	0.000472
Dibenzo[ah]anthracene	53703	n/a	0.000039
Fluoranthene	206440	0.0124	0.000249
Indeno[1; 2; 3 . cd]pyrene	193395	n/a	0.000408
Methylchrysene	41637905	n/a	0.000058
Perylene	198550	n/a	0.000155
Pyrene	129000	0.0149	0.000217

<u>Changes to Appliance Fractions and Burn Rates for Densely Populated Counties</u>

Following discussion with EPA on the estimation of emissions in densely populated urban areas, EPA made adjustments to the appliance fractions and burn rates of certain counties based on their population density to ensure that the tool does not overestimate emissions in those areas.

Specifically, EPA zeroed the burn rates and appliance fractions for all appliances in New York County (FIPS 36061). For counties with more than 1,500 but less than 4,000 homes per square mile, EPA zeroed the burn rate and appliance fractions for OWBs, indoor furnaces, and outdoor burning (NEC). The burn rates and appliance fractions for all other appliances were left unchanged for these counties.

For counties with more than 4,000 homes per square mile (except New York County), EPA made several changes, summarized in the Table 3-102. All counties affected by these changes are shown in Table 3-103.

Table 3-102: Updates to burn rates and appliance fractions in counties with more than 4,000 homes per square mile (except New York County).

Appliance	Burn Type	Updated Burn Rate	Updated Appliance Fraction
Fireplaces	Main	0	0
	Secondary	0.5 [(a)]	kept as is
	Pleasure	0.069 [(b)]	kept as is
Noncertified Woodstoves/ Inserts	Main	0	0
	Secondary	1.5 [(c)]	kept as is
	Pleasure	0	kept as is
Certified Woodstoves/ Inserts	Main	0	0
	Secondary	1.2 [(d)]	kept as is
	Pleasure	0	kept as is
Pellet Stoves	Main	0	0
	Secondary	1.5 [(c)]	kept as is
	Pleasure	0	kept as is

Appliance	Burn Type	Updated Burn Rate	Updated Appliance Fraction
Firelogs	Main	0	0
	Secondary	0	kept as is
	Pleasure	kept as is	kept as is

(a) Assumes approximately one fire per week for 7 months
(b) Assumes approximately four fires per year
(c) Based on engineering judgment
(d) Scaled using the difference in efficiency from AP-42

Emissions for New York County were zeroed out entirely. All other counties with more than 4,000 housing units per square mile were updated with the appliance fractions and burn rates shown in Table 3-102, and the burn rates and appliance populations of OWBs, indoor furnaces, and other outdoor burning were zeroed. For counties with between 1,500 and 4,000 housing units per square mile, the burn rates and appliance populations of OWBs, indoor furnaces, and other outdoor burning were zeroed, and the burn rates and appliance fractions for all other appliances were left untouched.

Table 3-103: Densely populated counties subject to updated appliance fractions and burn rates.

County	State	Occupied Housing Units	Area (mi^2)	Density (Housing Units/mi^2)
New York	NY	763,846	25	30,554
Kings	NY	916,856	62	14,788
Bronx	NY	483,449	39	12,396
Queens	NY	780,117	111	7,028
San Francisco	CA	345,811	52	6,650
Hudson	NJ	246,437	54	4,564
Suffolk	MA	292,767	65	4,504
Philadelphia	PA	599,736	148	4,052
Washington	DC	266,707	66	4,041
Alexandria	VA	68,082	18	3,782
Arlington	VA	98,050	26	3,771
Richmond	NY	165,516	53	3,123
Baltimore	MD	249,903	81	3,085
Denver	CO	263,107	104	2,530
Manassas Park	VA	4,507	2	2,254
Essex	NJ	283,712	130	2,182
Cook	IL	1,966,356	961	2,046
St. Louis	MO	142,057	73	1,946
Union	NJ	188,118	106	1,775
Nassau	NY	448,528	278	1,613
Bristol	VA	7,879	5	1,576
Milwaukee	WI	383,591	244	1,572
Norfolk	VA	86,485	56	1,544

<u>Outdoor Wood Boiler Distribution</u>

The OWB populations in the RWC tool were originally based on a combination of data from the Northeast States for Coordinated Air Use Management (NESCAUM) report Assessment of Outdoor Wood-fired Boilers,[19] the 2008 Minnesota Residential Fuelwood Assessment,[20] and the 2008 Vermont Residential Fuel Assessment.[21]

In November, EPA supplied EPA with sales data from 80% of the manufacturers of OWBs showing that 28,075 boilers were sold over a three-year period ending in July 2012 (Table 3-104).[22] Scaling these numbers to estimate 100% of OWB sales (by dividing the total number of OWBs sold by 0.8) suggests that there have been approximately 35,000 OWBs added to the national population since the 2008 National Emissions Inventory. Because the data were rolled up to the national level, EPA distributed the OWBs to counties using the methodology described below, which was developed and approved by the Eastern Regional Technical Advisory Committee (ERTAC).

Table 3-104: Outdoor wood boilers sold from 80% of manufacturers between August 2009 and July 2012.

Time Period	Number of OWBs Sold
8/2009 – 7/2010	7,163
8/2010 – 7/2011	10,469
8/2011 – 7/2012	10,754
Total	28,386

First, EPA distributed the 35,000 boilers to all states except Connecticut, Hawaii, Oregon, and Washington,[23] based on their existing proportion of OWBs. For example, if a state had 3% of all OWBs in 2008, then it received 3% of the new OWBs, or 1,050 boilers.

Once the boilers were distributed to the states, EPA then distributed the state-level OWBs to counties based on a county's proportion of rural households in the state. Note that this is slightly different from the method used to distribute OWBs to counties for the 2008 NEI, in which they were distributed based on rural *population*, rather than households.

The U.S. Census Bureau collects information at the county level on the urban and rural population, and the total households, but it does not break the household data down into urban and rural data. Therefore, EPA estimated the number of rural households by multiplying the total number of households in each county by the percentage of the rural population in each county. For example, if 60% of the county's total population is listed as rural, then the number of households would be multiplied by 0.6 to estimate the number of rural households.

Then EPA distributed each state's population of OWBs to each county based on that county's proportion of rural households. OWBs were only distributed to counties with an average population density of less than 300 people per square mile.

EPA used a different methodology to distribute OWBs in the states of Michigan and Ohio, which was also developed and approved by ERTAC. In keeping with the previous methodology used for the 2008 NEI, state-level OWBs in Michigan and Ohio were distributed to counties based on inverse population density. Therefore, in

[19] NESCAUM. 2006. Assessment of Outdoor Wood-fired Boilers, (accessed July 2014).
[20] Barzen, M., R. Piva, C.Y. Wu, R. Dahlman. 2008. Residential Fuelwood Assessment, State of Minnesota: 2007-2008 Heating Season, (accessed July 2014).
[21] See Vermont Division of Forestry, (accessed July 2014).
[22] EPA's Burnwise Program has established partnerships with approximately 80% of OWB manufacturers in which the manufacturers voluntarily report sales data to EPA, (accessed July 2014).
[23] These states were excluded based on conversations with the states suggesting no growth in OWBs.

these states, the counties with the lowest population density received the highest number of OWBs, but in keeping with the previous methodology, a cap was employed to ensure that no county would be allocated more OWBs than 10% of its population. In other words, if a county has a population of 1,000 people and if the inverse population density method would distribute more than 100 boilers to that county, then the number of boilers in that county would be set to 100. To ensure that all OWBs estimated for Michigan and Ohio were distributed to the counties, the boilers in the counties with numbers below the cap were adjusted using the inverse population density method.

Gas Log Adjustments

After reviewing the AHS questionnaire, EPA determined that the AHS do not distinguish between gas and wood-burning fireplaces in the data it collects. For this reason, the appliance fractions constructed from AHS data are likely overestimating the number of wood-burning fireplaces in use. Based on data from Houck (2003), Abt estimated that approximately 30% of fireplaces use gas. Queries were constructed in the RWC Tool to adjust the AHS appliance fractions to reflect the number of gas-burning fireplaces. These queries can be adjusted so that the fraction of gas-burning fireplaces can be changed in the future, and the appliance fractions will be updated accordingly.

Urban Core Pleasure Burning Adjustments

Many of the appliance profiles in the RWC tool are based on AHS data from Metropolitan Statistical Area (MSA) surveys. These appliance profiles are typically applied equally across all counties within the relevant MSA. For example, the appliance profile for Denver was applied equally to all counties in the MSA, even though Denver County itself is much more densely populated than many of the outlying counties in the MSA.

To address this issue, EPA identified the “urban core” of the MSA based on the county in the MSA with the highest proportion of multi-family homes (defined here as buildings with three or more living units). EPA then adjusted the pleasure burning profiles in those counties to account for the proportion of multi-family homes. For example, if the urban core of the county had 30% of its occupied units in multi-family homes, then EPA multiplied the appliance fraction by 0.7. EPA also zeroed out the populations of OWBs and indoor furnaces in the urban core counties.

St. Louis, MO, Adjustments

Following discussions over the high level of RWC emissions in St. Louis, Missouri, EPA revisited the assumptions about that county. The appliance fractions in the tool were exactly double what they should be using AHS data. EPA corrected this issue by returning the appliance profile value to the values that agree with AHS data.

3.14.5 Summary of quality assurance methods

EPA expected to see an increase in RWC emissions due to the slow economy and an increase in the price of alternative heating fuels, like fuel oil and natural gas. Additionally, there were numerous articles in the newspapers about the increased use of home heating with wood. The RWC tool generates a spreadsheet that shows the burn rates (cords/year) and the appliance counts for every SCC in every county. That spreadsheet was sent to ERTAC and other EPA offices for review. The 2011 v2 RWC inventory was compared to 2008 values. One comment that we received was that emissions were too high in the urban centers in some cities. Additionally, we were told that CA had some detailed county-level RWC emission data. Adjustments were made to address the urban core issue (described earlier in this document), and we were able to obtain the CA and put it in our tool. The EPA also looked for double counting caused by the inconsistent use of SCCs. If a state submitted data using an SCC that was different than the one EPA used, then the EIS could select both estimates, causing a double count of emissions. This was the situation for CA. CA submitted RWC data to two SCCs; 2104008100 for fireplaces and 2104008300 for woodstoves and neither SCC is used by the EPA. The EPA used 12 SCCs. The CA data do not have the detail that the EPA has, so EPA tagged the CA data and used the EPA tool data. The state level emission totals were similar, plus the underlying EPA RWC tool data had been revised with data from CA, so EPA believes the use of the RWC tool data is reasonable. The EPA also tagged the RWC data from UT (per a request from UT) and used the RWC data generated from the EPA RWC tool for UT. UT preferred the EPA estimates to their own. The EPA also tagged RWC data submitted by CT, ID, MO, and KS because the data was actually EPA Tool data that the state submitted back to EPA. We believe it better to use EPA data so that the data source is correctly seen to be generated by EPA. The EPA also tagged numerous PMxx-FIL and PM-CON data that were erroneously generated by the EPA's PM augmentation tool. The EPA does not have the information to determine filterable or condensable emissions from primary PM.

3.14.6 References for Fuel Combustion – Residential - Wood

1. Huntley, Roy; Van Bruggen, J., Coldner, S., Divita, F.; "New Methodology for Estimating Emissions from Residential Wood Combustion", presented at the 17th International Emission Inventory Conference, Portland, Oregon, June 2008.
   Vermont Residential Fuel Assessment for the 2007-2008 Heating Season, Paul Frederick, Wood Vermont Residential Fuel Assessment for the 2007-2008 Heating Season, Paul Frederick, Wood Utilization Forester, August 2011
2. Houck, J. and P. Tiegs, *Wood or Gas Fireplaces?*, Hearth & Home, October, 2003.
3. Vermont Residential Fuel Assessment for the 2007-2008 Heating Season, Paul Frederick, Wood Utilization Forester, August 2011.
4. Environmental, Energy Market and Health Characterization of Wood-Fired Hydronic Heater Technologies, Final Report, Prepared for The New York State Energy Research and Development Authority, Albany, NY, Ellen Burkhard, Ph.D., Senior Project Manager.

3.15 Industrial Processes – Cement Manufacturing

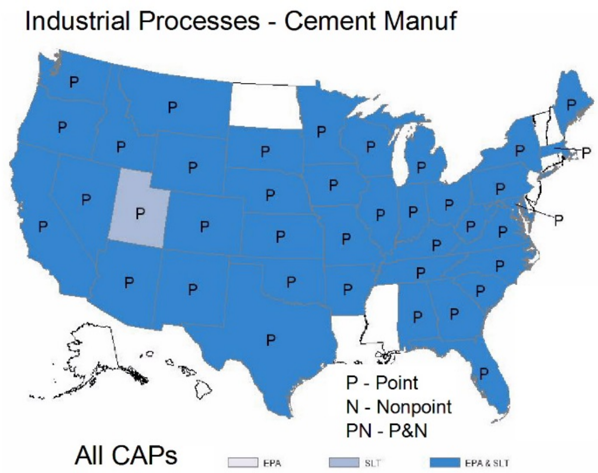
3.15.1 Sector description

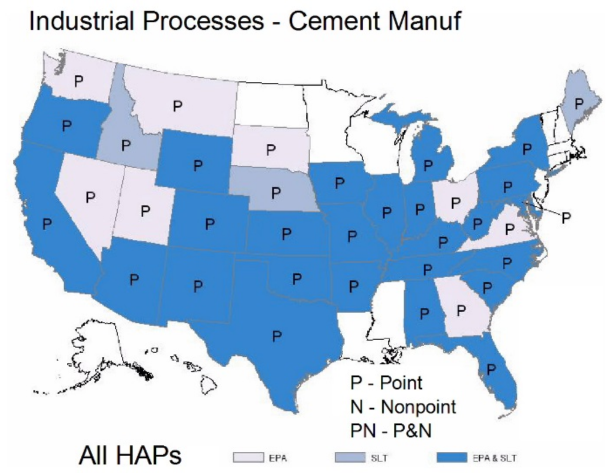
This sector is defined by some, but not all SCCs beginning with 305006, 305007 plus 39000201 (In-Process Fuel Use /Bituminous Coal /Cement Kiln/Dryer), 39000402 (In-Process Fuel Use /Residual Oil /Cement Kiln/Dryer), 39000502 (In-Process Fuel Use /Distillate Oil /Cement Kiln/Dryer) and 39000602 (In-Process Fuel Use /Natural Gas /Cement Kiln/Dryer). The processes associated with this sector from 305006 (dry process) and 305007 (wet process) include the kilns including preheater and pre-calciner kilns, coal kiln feed units, crushing, screening, raw material grinding and drying, clinker cooler, clinker grinding, cement loadout, pre-dryer, and raw mill processes.

3.15.2 Sources of data overview and selection hierarchy

Cement Manufacturing is covered fully in point. EPA did not provide estimates for nonpoint for this sector. The selection hierarchy for all datasets contributing to this sector are provided in Table 3-1: **Data sources and selection hierarchy used for point sources**.

3.15.3 Spatial coverage and data sources for the sector





3.16 Industrial Processes – Chemical Manufacturing

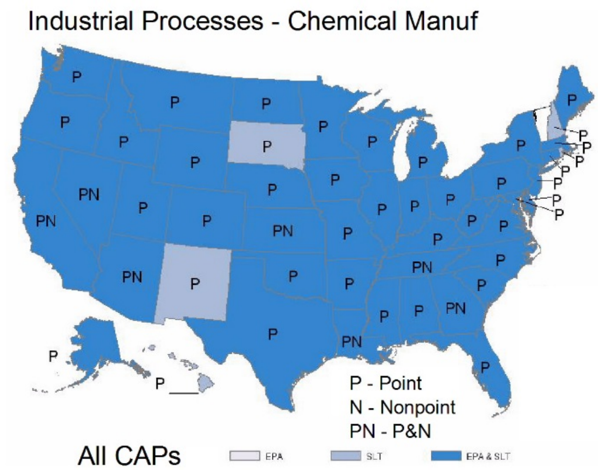
3.16.1 Sector description

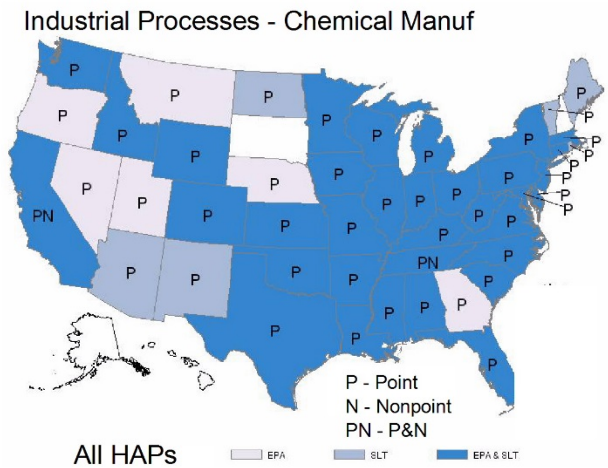
This sector involves creating products by transforming organic and inorganic raw materials with chemical processes. More information on chemical manufacturing can be found on the US EPA Chemical Manufacturing Sector Information web site. This sector is defined by most point SCCs beginning with 301 and 302, and most "MACT Source Category" SCCs (beginning with 631, 641, 646, 645, 646, 648, 649, 651, 684 and 685). Most non-chemical manufacturing SCCs in these ranges deal with "Storage and Transfer" processes (see Section 3.23). This sector also includes a handful of nonpoint SCCs (beginning with 230100, 230101, 230102, 230103 and 231004).

3.16.2 Sources of data overview and selection hierarchy

Chemical Manufacturing is covered almost completely in point. EPA did not provide estimates for nonpoint for this sector. The selection hierarchy for all point inventory datasets contributing to this sector are provided in Table 3-1: **Data sources and selection hierarchy used for point sources**. The selection hierarchy for all nonpoint inventory datasets contributing to this sector are provided in Table 3-2: Data sources and selection hierarchy used for nonpoint sources.

3.16.3 Spatial coverage and data sources for the sector





3.17 Industrial Processes – Ferrous Metals

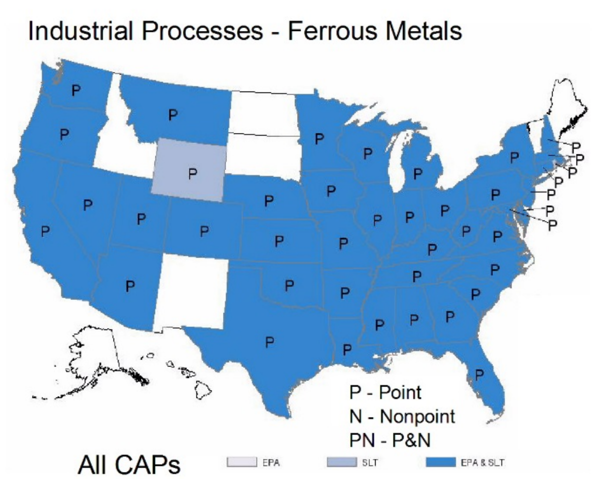
3.17.1 Sector description

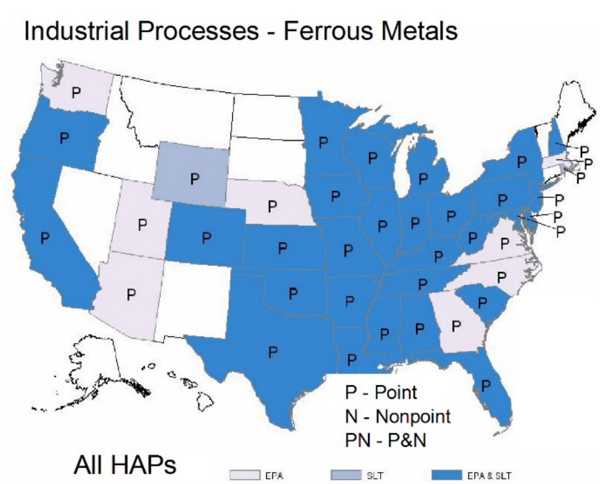
This sector is defined by the processing of iron ores to metals. This sector includes primary and secondary metal production processes such as taconite iron ore processing (SCCs beginning with 303023), grey iron foundries (SCCs beginning with 304003), steel foundries (SCCs beginning with 304007) and malleable iron (SCCs beginning with 304009). Most non-ferrous metals SCCs in these SCC ranges deal with “Storage and Transfer” processes (see Section 3.23).

3.17.2 Sources of data overview and selection hierarchy

Ferrous Metals is covered fully in the point data category. EPA did not provide estimates for nonpoint data category for this sector. The selection hierarchy for all point inventory datasets contributing to this sector are provided in Table 3-1: **Data sources and selection hierarchy used for point sources**.

3.17.3 Spatial coverage and data sources for the sector





3.18 Industrial Processes – Mining

3.18.1 Sector description

Mining and quarrying activities produce particulate emissions due to the variety of processes used to extract the ore and associated overburden, including drilling and blasting, loading and unloading, and overburden replacement. Fugitive dust emissions for mining and quarrying operations are the sum of emissions from the mining of metallic and nonmetallic ores and coal. Each of these mining operations has specific emission factors accounting for the different means by which the resources are extracted.

The 2011 NEI has emissions for the SCCs shown in Table 3-105 for this sector. The first 4 SCCs are in the nonpoint data category and the remaining are point. The EPA-estimated emissions cover only SCC 2325000000 (first row of the table). Emissions for all other SCCs were submitted by S/L/T agency.

Table 3-105: SCCs for Industrial Processes- Mining

SCC	SCC Level Two	SCC Level Three	SCC Level Four
2325000000	Mining and Quarrying: SIC 14	All Processes	Total
2325020000	Mining and Quarrying: SIC 14	Crushed and Broken Stone	Total
2325030000	Mining and Quarrying: SIC 14	Sand and Gravel	Total
2325060000	Mining and Quarrying: SIC 14	Lead Ore Mining and Milling	Total
30302401	Primary Metal Production	Metal Mining (General Processes)	Primary Crushing: Low Moisture Ore
30302402	Primary Metal Production	Metal Mining (General Processes)	Secondary Crushing: Low Moisture Ore
30302403	Primary Metal Production	Metal Mining (General Processes)	Tertiary Crushing: Low Moisture Ore
30302404	Primary Metal Production	Metal Mining (General Processes)	Material Handling: Low Moisture Ore
30302405	Primary Metal Production	Metal Mining (General Processes)	Primary Crushing: High Moisture Ore
30302406	Primary Metal Production	Metal Mining (General Processes)	Secondary Crushing: High Moisture Ore
30302407	Primary Metal Production	Metal Mining (General Processes)	Tertiary Crushing: High Moisture Ore
30302408	Primary Metal Production	Metal Mining (General Processes)	Material Handling: High Moisture Ore
30302409	Primary Metal Production	Metal Mining (General Processes)	Dry Grinding with Air Conveying
30302410	Primary Metal Production	Metal Mining (General Processes)	Dry Grinding without Air Conveying
30302411	Primary Metal Production	Metal Mining (General Processes)	Ore Drying
30303102	Primary Metal Production	Leadbearing Ore Crushing and Grinding	Zinc Ore w/ 0.2% Lead Content
30303107	Primary Metal Production	Leadbearing Ore Crushing and Grinding	Copper-Lead-Zinc w/ 2% Lead Content
30501001	Mineral Products	Coal Mining, Cleaning, and Material Handling	Fluidized Bed Reactor
30501002	Mineral Products	Coal Mining, Cleaning, and Material Handling	Flash or Suspension Dryer
30501003	Mineral Products	Coal Mining, Cleaning, and Material Handling	Multilouvered Dryer
30501004	Mineral Products	Coal Mining, Cleaning, and Material Handling	Rotary Dryer
30501005	Mineral Products	Coal Mining, Cleaning, and Material Handling	Cascade Dryer
30501006	Mineral Products	Coal Mining, Cleaning, and Material Handling	Continuous Carrier/Conveyor
30501008	Mineral Products	Coal Mining, Cleaning, and Material Handling	Unloading
30501009	Mineral Products	Coal Mining, Cleaning, and Material Handling	Raw Coal Storage
30501010	Mineral Products	Coal Mining, Cleaning, and Material Handling	Crushing
30501011	Mineral Products	Coal Mining, Cleaning, and Material Handling	Coal Transfer
30501012	Mineral Products	Coal Mining, Cleaning, and Material Handling	Screening
30501013	Mineral Products	Coal Mining, Cleaning, and Material Handling	Coal Cleaning: Air Table
30501014	Mineral Products	Coal Mining, Cleaning, and Material Handling	Cleaned Coal Storage
30501015	Mineral Products	Coal Mining, Cleaning, and Material Handling	Coal Loading (For Clean Coal Loading USE 30501016)
30501016	Mineral Products	Coal Mining, Cleaning, and Material Handling	Clean Coal Loading
30501017	Mineral Products	Coal Mining, Cleaning, and Material Handling	Secondary Crushing
30501022	Mineral Products	Coal Mining, Cleaning, and Material Handling	Drilling/Blasting
30501024	Mineral Products	Coal Mining, Cleaning, and Material Handling	Hauling
30501030	Mineral Products	Coal Mining, Cleaning, and Material Handling	Topsoil Removal (See also 305010 -33, -35, -36, -37, -42, -45, -48)
30501031	Mineral Products	Coal Mining, Cleaning, and Material Handling	Scrapers: Travel Mode
30501032	Mineral Products	Coal Mining, Cleaning, and Material Handling	Topsoil Unloading
30501033	Mineral Products	Coal Mining, Cleaning, and Material Handling	Overburden (See also 305010 -30, -35, -36, -37, -42, -45, -48)
30501034	Mineral Products	Coal Mining, Cleaning, and Material Handling	Coal Seam: Drilling
30501035	Mineral Products	Coal Mining, Cleaning, and Material Handling	Blasting: Coal Overburden
30501036	Mineral Products	Coal Mining, Cleaning, and Material Handling	Dragline: Overburden Removal

SCC	SCC Level Two	SCC Level Three	SCC Level Four
30501037	Mineral Products	Coal Mining, Cleaning, and Material Handling	Truck Loading: Overburden
30501038	Mineral Products	Coal Mining, Cleaning, and Material Handling	Truck Loading: Coal
30501039	Mineral Products	Coal Mining, Cleaning, and Material Handling	Hauling: Haul Trucks
30501040	Mineral Products	Coal Mining, Cleaning, and Material Handling	Truck Unloading: End Dump - Coal
30501041	Mineral Products	Coal Mining, Cleaning, and Material Handling	Truck Unloading: Bottom Dump - Coal
30501043	Mineral Products	Coal Mining, Cleaning, and Material Handling	Open Storage Pile: Coal
30501044	Mineral Products	Coal Mining, Cleaning, and Material Handling	Train Loading: Coal
30501045	Mineral Products	Coal Mining, Cleaning, and Material Handling	Bulldozing: Overburden
30501046	Mineral Products	Coal Mining, Cleaning, and Material Handling	Bulldozing: Coal
30501047	Mineral Products	Coal Mining, Cleaning, and Material Handling	Grading
30501048	Mineral Products	Coal Mining, Cleaning, and Material Handling	Overburden Replacement
30501049	Mineral Products	Coal Mining, Cleaning, and Material Handling	Wind Erosion: Exposed Areas
30501050	Mineral Products	Coal Mining, Cleaning, and Material Handling	Vehicle Traffic: Light/Medium Vehicles
30501051	Mineral Products	Coal Mining, Cleaning, and Material Handling	Surface Mining Operations: Open Storage Pile: Spoils
30501060	Mineral Products	Coal Mining, Cleaning, and Material Handling	Surface Mining Operations: Primary Crusher
30501061	Mineral Products	Coal Mining, Cleaning, and Material Handling	Surface Mining Operations: Secondary Crusher
30501062	Mineral Products	Coal Mining, Cleaning, and Material Handling	Surface Mining Operations: Screens
30501090	Mineral Products	Coal Mining, Cleaning, and Material Handling	Haul Roads: General
30501099	Mineral Products	Coal Mining, Cleaning, and Material Handling	Other Not Classified
30501640	Mineral Products	Lime Manufacture	Vehicle Traffic
30501650	Mineral Products	Lime Manufacture	Quarrying Raw Limestone
30502009	Mineral Products	Stone Quarrying - Processing (See also 305320)	Blasting: General
30502010	Mineral Products	Stone Quarrying - Processing (See also 305320)	Drilling
30502513	Mineral Products	Construction Sand and Gravel	Excavating
30502514	Mineral Products	Construction Sand and Gravel	Drilling and Blasting
30504001	Mineral Products	Mining and Quarrying of Nonmetallic Minerals	Open Pit Blasting
30504002	Mineral Products	Mining and Quarrying of Nonmetallic Minerals	Open Pit Drilling
30504003	Mineral Products	Mining and Quarrying of Nonmetallic Minerals	Open Pit Cobbing
30504010	Mineral Products	Mining and Quarrying of Nonmetallic Minerals	Underground Ventilation
30504024	Mineral Products	Mining and Quarrying of Nonmetallic Minerals	Overburden Stripping
30504401	Mineral Products	Clay processing: Bentonite	Mining
30504601	Mineral Products	Clay processing: Common clay and shale, NEC	Mining
SCC Level 1 is "Industrial Processes" for all SCCS			

3.18.2 Sources of data overview and selection hierarchy

The industrial processes-mining sector includes data from S/L/T agency and EPA datasets that cover both point and nonpoint data categories. Table 3-106 shows the agencies that submitted data in each of the data categories for the Industrial Processes - Mining sector. Where only zero emissions were submitted (sum across all pollutants submitted), these are shown as zeroes ("0") in the table.

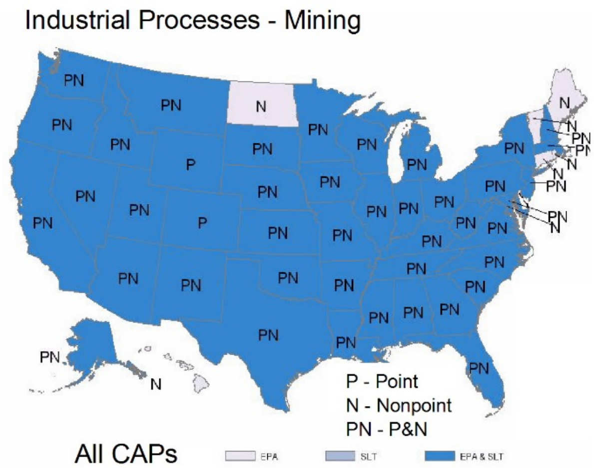
Table 3-106: Agencies that submitted data for the Industrial Processes – Mining sector

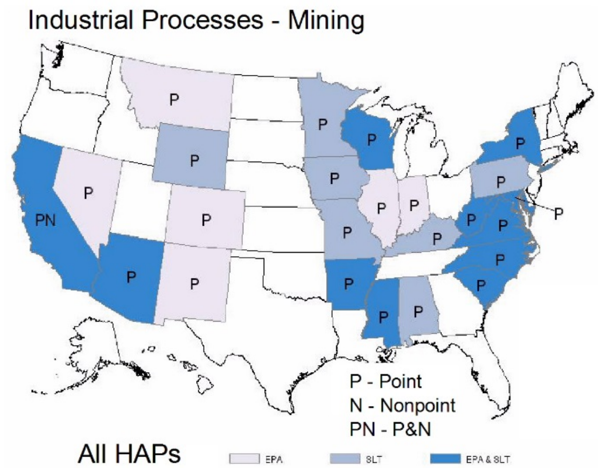
	NONPOINT					POINT								
	Nonpoint: Mining and quarrying SIC 24					Mineral products							Primary metal production	
AGENCY_DESCRIPTION		Lead Ore Mining and Milling	All Processes	Crushed and Broken Stone	Sand and Gravel	Clay processing: Bentonite	Clay processing: Common clay and shale, NEC	Coal Mining, Cleaning, and Material Handling	Construction Sand and Gravel	Lime Manufacture	Mining and Quarrying of Nonmetallic Minerals	Stone Quarrying - Processing	Leadbearing Ore Crushing and Grinding	Metal Mining (General Processes)
US Environmental Protection Agency *	EPA		X	X	X	X	X	X	X	X	X	X	X	X
Alabama Department of Environmental Management	S							X		X	X			

	NONPOINT					POINT								
	Nonpoint: Mining and quarrying SIC 24					Mineral products							Primary metal production	
AGENCY_DESCRIPTION		**Lead Ore Mining and Milling**	**All Processes**	**Crushed and Broken Stone**	**Sand and Gravel**	**Clay processing: Bentonite**	**Clay processing: Common clay and shale, NEC**	**Coal Mining, Cleaning, and Material Handling**	**Construction Sand and Gravel**	**Lime Manufacture**	**Mining and Quarrying of Nonmetallic Minerals**	**Stone Quarrying - Processing**	**Leadbearing Ore Crushing and Grinding**	**Metal Mining (General Processes)**
Alaska Department of Environmental Conservation	S							X					X	X
Allegheny County Health Department	L							X						X
Arizona Department of Environmental Quality	S							X			X	X		X
Arkansas Department of Environmental Quality	S							X		X				
California Air Resources Board	S				X			X	X	X	X	X		X
Chattanooga Air Pollution Control Bureau (CHCAPCB)	L		0											
Clark County Department of Air Quality and Environmental Management	L				X				X					
Colorado Department of Public Health and Environment	S						X	X	X	X	X	X		X
Florida Department of Environmental Protection	S							X						X
Georgia Department of Natural Resources	S		X					X						
Idaho Department of Environmental Quality	S							X				0		
Illinois Environmental Protection Agency	S		0					X	X	X				X
Indiana Department of Environmental Management	S							X			X	X		X
Iowa Department of Natural Resources	S		X					X		X	0	X		
Jefferson County (AL) Department of Health	L							X						X
Kansas Department of Health and Environment	S		X					X				X		
Kentucky Division for Air Quality	S							X		X		0		
Lincoln/Lancaster County Health Department	L							X						
Louisiana Department of Environmental Quality	S		X					X						
Louisville Metro Air Pollution Control District	L							X						
Maricopa County Air Quality Department	L		X											
Maryland Department of the Environment	S		X					X				0		
Massachusetts Department of Environmental Protection	S											X		
Memphis and Shelby County Health Department - Pollution Control	L							X						
Metro Public Health of Nashville/Davidson County	L											0		
Michigan Department of Environmental Quality	S						X	X		X		X		X
Minnesota Pollution Control Agency	S							X				X		X
Mississippi Dept of Environmental Quality	S							X						
Missouri Department of Natural Resources	S	X	X					X				X		
Montana Department of Environmental Quality	S							X			X	X		X
Navajo Nation	T							X						
Nebraska Environmental Quality	S							X				X		

	NONPOINT					POINT								
	Nonpoint: Mining and quarrying SIC 24					Mineral products							Primary metal production	
AGENCY_DESCRIPTION		**Lead Ore Mining and Milling**	**All Processes**	**Crushed and Broken Stone**	**Sand and Gravel**	**Clay processing: Bentonite**	**Clay processing: Common clay and shale, NEC**	**Coal Mining, Cleaning, and Material Handling**	**Construction Sand and Gravel**	**Lime Manufacture**	**Mining and Quarrying of Nonmetallic Minerals**	**Stone Quarrying - Processing**	**Leadbearing Ore Crushing and Grinding**	**Metal Mining (General Processes)**
Nevada Division of Environmental Protection	S							X						X
New Hampshire Department of Environmental Services	S							0						
New Jersey Department of Environment Protection	S		0	X	X			X						
New Mexico Environment Department Air Quality Bureau	S							X						X
New York State Department of Environmental Conservation	S							X				X		
North Carolina Department of Environment and Natural Resources	S							X						
Ohio Environmental Protection Agency	S							X		X	X	X		
Oklahoma Department of Environmental Quality	S							X		X				
Oregon Department of Environmental Quality	S							X						
Pennsylvania Department of Environmental Protection	S							X		X		X		
Pinal County	L							X		X				X
Puerto Rico	S											X		
Santee Sioux Nation	T				X									
South Carolina Department of Health and Environmental Control	S		X					X		X	X			
South Dakota Department of Environment and Natural Resources	S							X						
Southwest Clean Air Agency	L							X						
Tennessee Department of Environmental Conservation	S							X						
Texas Commission on Environmental Quality	S							X		X	X	X		X
Utah Division of Air Quality	S				X			X	X			X		X
Virginia Department of Environmental Quality	S		X					X				X		X
West Virginia Division of Air Quality	S		X					X		X		X		
Wisconsin Department of Natural Resources	S							X			X	X	X	
Wyoming Department of Environmental Quality	S					X		X	X	X		X		
EPA data for most categories is due to PM augmentation of S/L/T agency data (see Section 3.1.2). EPA estimates for SCC 2325000000 is described in Section 3.18.4.														

3.18.3 Spatial coverage and data sources for the sector





3.18.4 EPA-developed emissions

The below sections explain how the PM_{10} and $PM_{2.5}$ emissions for the EPA data (SCC 2325000000; Industrial Processes; Mining and Quarrying: SIC 14; All Processes; Total) were developed.

3.18.4.1 *Metallic Ore Mining- emission factors and equations*

The emissions factor for metallic ore mining includes overburden removal, drilling and blasting, and loading and unloading activities. The TSP emission factors developed for copper ore mining are applied to all three activities with PM_{10}/TSP ratios of 0.35 for overburden removal, 0.81 for drilling and blasting, and 0.43 for loading and unloading operations [ref 1]. The emissions factor equation for metallic ore mining is:

$$EF_{mo} = EF_o + (B \times EF_b) + EF_l + EF_d$$

where,

EF_{mo} = metallic ore mining emissions factor (lbs/ton)
EF_o = PM_{10} open pit overburden removal emission factor for copper ore (lbs/ton)
B = fraction of total ore production that is obtained by blasting at metallic ore mines
EF_b = PM_{10} drilling/blasting emission factor for copper ore (lbs/ton)
EF_l = PM_{10} loading emission factor for copper ore (lbs/ton)
EF_d = PM_{10} truck dumping emission factor for copper ore (lbs/ton)

Applying the copper ore mining TSP emissions factors [ref 2] and PM_{10}/TSP ratios yields the following metallic ore mining emissions factor:

$$EF_{mo} = 0.0003 + (0.57625 \times 0.0008) + 0.022 + 0.032 = 0.0548 \text{ lbs/ton}$$

3.18.4.2 *Non-Metallic Ore Mining- emission factors and equations*

The emissions factor for non-metallic ore mining includes overburden removal, drilling and blasting, and loading and unloading activities. The emissions factor is based on western surface coal mining operations.

$$EF_{nmo} = EFv + (D \times EF_r) + EF_a + 0.5\,(EF_e + EF_t)$$

where,

EF_{nmo}	=	non-metallic ore mining emissions factor (lbs/ton)
EF_v	=	PM_{10} open pit overburden removal emission factor at western surface coal mining operations (lbs/ton)
D	=	fraction of total ore production that is obtained by blasting at non-metallic ore mines
EF_r	=	PM_{10} drilling/blasting emission factor at western surface coal mining operations (lbs/ton)
EFa	=	PM_{10} loading emission factor at western surface coal mining operations (lbs/ton)
EFe	=	PM_{10} truck unloading: end dump-coal emission factor at western surface coal mining operations (lbs/ton)
EFt	=	PM_{10} truck unloading: bottom dump-coal emission factor at western surface coal mining operations (lbs/ton)

Applying the TSP emissions factors developed for western surface coal mining operations from AP-42 [ref 3] and a PM_{10}/TSP ratio of 0.4 [ref 4] yields the following non-metallic ore mining emissions factor:

$$EF_{nmo} = 0.225 + (0.61542 \times 0.00005) + 0.05 + 0.5\ (0.0035 + 0.033) = 0.293 \text{ lbs/ton}$$

3.18.4.3 *Coal Mining- emission factors and equations*

The emissions factor for coal mining includes overburden removal, drilling and blasting, loading and unloading and overburden replacement activities. The amount of overburden material handled is assumed to equal ten times the quantity of coal mined, and coal unloading is assumed to split evenly between end-dump and bottom-dump operations. The emissions factor equation for coal mining is:

$$EF_c = (10 \times (EF_{to} + EF_{or} + EF_{dt})) + EF_v + EF_r + EF_a + (0.5 \times (EF_e + EF_t))$$

where,

EF_c	=	coal mining emissions factor (lbs/ton)
EF_{to}	=	PM_{10} emission factor for truck loading overburden at western surface coal mining operations (lbs/ton of overburden)
EF_{or}	=	PM_{10} emission factor for overburden replacement at western surface coal mining operations (lbs/ton of overburden)
EF_{dt}	=	PM_{10} emission factors for truck unloading: bottom dump-overburden at western surface coal mining operations (lbs/ton of overburden)
EF_v	=	PM_{10} open pit overburden removal emission factor at western surface coal mining operations (lbs/ton)
EF_r	=	PM_{10} drilling/blasting emission factor at western surface coal mining operations (lbs/ton)
EF_a	=	PM_{10} loading emission factor at western surface coal mining operations (lbs/ton)
EF_e	=	PM_{10} truck unloading: end dump-coal emission factor at western surface coal mining operations (lbs/ton)
EF_t	=	PM_{10} truck unloading: bottom dump-coal emission factor at western surface coal mining operations (lbs/ton)

Applying the PM_{10} emissions factors developed for western surface coal mining operations [ref 3] yields the following coal mining emissions factor:

$$EF_c = (10 \times (0.015 + 0.001 + 0.006)) + 0.225 + 0.00005 + 0.05 + (0.5 \times (0.0035 + 0.033)) = 0.513 \text{ lbs/ton}$$

PM-FIL emissions factors are assumed to be the same as PM-PRI emissions factors; however, in reality, there is a small amount of PM-CON emissions included in the PM-PRI emissions, but insufficient data exists to tease out the PM-CON portion. In 2006, the EPA adopted new $PM_{2.5}/PM_{10}$ ratios for several fugitive dust categories and concluded that the $PM_{2.5}/PM_{10}$ ratios for fugitive dust categories should be in the range of 0.1 to 0.15 [ref 5]. Consequently, a ratio of 0.125 was applied to the PM_{10} emissions factors to estimate $PM_{2.5}$ emissions factors for mining and quarrying. A summary of emissions factors is presented in Table 3-107.

Table 3-107: Summary of emission factors

Mining Type	Pollutant Code	Factor Numeric Value	Factor Unit Numerator	Factor Unit Denominator
Coal	PM10-PRI	0.513	LB	TON
Coal	PM10-FIL	0.513	LB	TON
Coal	PM25-PRI	0.064	LB	TON
Coal	PM25-FIL	0.064	LB	TON
Metallic	PM10-PRI	0.0548	LB	TON
Metallic	PM10-FIL	0.0548	LB	TON
Metallic	PM25-PRI	0.0068	LB	TON
Metallic	PM25-FIL	0.0068	LB	TON
Non-Metallic	PM10-PRI	0.293	LB	TON
Non-Metallic	PM10-FIL	0.293	LB	TON
Non-Metallic	PM25-PRI	0.037	LB	TON
Non-Metallic	PM25-FIL	0.037	LB	TON

3.18.4.4 *EPA activity data*

Emissions were estimated by obtaining state-level metallic and non-metallic crude ore handled at surface mines from the U.S. Geologic Survey (USGS) [ref 6] and mine specific coal production data for surface mines from the Energy Information Administration (EIA) [ref 7]. Since some of the USGS metallic and non-metallic minerals waste data associated with ore production are withheld to avoid disclosing company proprietary data, an allocation procedure was developed to estimate the withheld data. For states with withheld waste data, the state fraction of national ore production was multiplied by the national undisclosed waste value to estimate the state withheld data. In addition, the USGS only reports metallic and non-metallic minerals production data separately at the national-level (e.g., the production data is combined at the state-level). To estimate metallic versus non-metallic ore production and associated waste at the state-level, the state-level total production and waste data were multiplied by the national metallic or non-metallic percentage of total production.

3.18.4.5 *Activity allocation procedure*

State-level metallic and non-metallic crude ore and associated waste handled was allocated to the county-level using employment. Specifically, state-level activity data was multiplied by the ratio of county- to state-level number of employees in the metallic and non-metallic mining industries (see Table 3-108 for a list of NAICS codes).

Table 3-108: NAICS codes for Metallic and Non-Metallic Mining

NAICS Code	Description
2122	Metal Ore Mining
212210	Iron Ore Mining

NAICS Code	Description
21222	Gold Ore and Silver Ore Mining
212221	Gold Ore Mining
212222	Silver Ore Mining
21223	Copper, Nickel, Lead, and Zinc Mining
212231	Lead Ore and Zinc Ore Mining
212234	Copper Ore and Nickel Ore Mining
21229	Other Metal Ore Mining
212291	Uranium-Radium-Vanadium Ore Mining
212299	All Other Metal Ore Mining
2123	Nonmetallic Mineral Mining and Quarrying
21231	Stone Mining and Quarrying
212311	Dimension Stone Mining and Quarrying
212312	Crushed and Broken Limestone Mining and Quarrying
212313	Crushed and Broken Granite Mining and Quarrying
212319	Other Crushed and Broken Stone Mining and Quarrying
21232	Sand, Gravel, Clay, and Ceramic and Refractory Minerals Mining and Quarrying
212321	Construction Sand and Gravel Mining
212322	Industrial Sand Mining
212324	Kaolin and Ball Clay Mining
212325	Clay and Ceramic and Refractory Minerals Mining
21239	Other Nonmetallic Mineral Mining and Quarrying
212391	Potash, Soda, and Borate Mineral Mining
212392	Phosphate Rock Mining
212393	Other Chemical and Fertilizer Mineral Mining
212399	All Other Nonmetallic Mineral Mining

Employment data was obtained from the U.S. Census Bureau's 2009 County Business Patterns (*CBP*) [ref 8]. Due to concerns with releasing confidential business information, the *CBP* does not release exact numbers for a given NAICS code if there are enough data that individual businesses could be identified. Instead a series of range codes is used. To estimate withheld counties the following procedure was used for each NAICS code being computed.

1. County level data for counties with known employment were totaled by state.
2. #1 subtracted from the state total reported in state-level *CBP*.
3. Each of the withheld counties is assigned the midpoint of the range code (e.g., A: 1-19 employees would be assigned 10).
4. These midpoints are then summed to the state level.
5. #2 is divided by #4 as an adjustment factor to the midpoints.
6. #5 is multiplied by #3 to get the adjusted county-level employment.

For example, take the 2006 *CBP* data for NAICS 31-33 (Manufacturing) in Maine provided in Table 3-109.

Table 3-109: 2006 County Business Pattern for NAICS 31-33 in Maine

State FIPS	County FIPS	NAICS	Mid-point flag	Total Employees
23	001	31----		6,774
23	003	31----		3,124
23	005	31----		10,333
23	007	31----		1,786
23	009	31----		1,954
23	011	31----		2,535
23	013	31----		1,418
23	015	31----	F	0
23	017	31----		2,888
23	019	31----		4,522
23	021	31----		948
23	023	31----	I	0
23	025	31----		4,322
23	027	31----		1,434
23	029	31----		1,014
23	031	31----		9,749

1. The total of employees not including counties 015 and 023 is 52801.
2. The state-level *CBP* reports 59322 employees for NAICS 31----. The difference is 6521.
3. County 015 is given a midpoint of 1750 (since range code F is 1000-2499) and County 023 is given a midpoint of 17500.
4. State total for these two counties is 19250.
5. 6521/19250 = 0.33875.
6. The adjusted employment for county 015 is 1750*0.33875 = 592.82. County 023 has an adjusted employment of 17500*0.33875 = 5928.18.

In the event that data at the state level is withheld, a similar procedure is first performed going from the U.S. level to the state level. For example, known state-level employees are subtracted from the U.S. total yielding the total withheld employees. Next the estimated midpoints of the withheld states are added together and compared (by developing a ratio) to the U.S. total withheld employees. The midpoints are then adjusted by the ratio to give an improved estimate of the state total.

3.18.4.6 *Controls*

No controls were accounted for in the emissions estimation.

3.18.4.7 *EPA approach - emissions equation and sample calculation*

Fugitive dust emissions for mining and quarrying operations are the sum of emissions from the mining of metallic and nonmetallic ores and coal:

$$E = E_m + E_n + E_c$$

where,

E = PM_{10} emissions from mining and quarrying operations
E_m = PM_{10} emissions from metallic ore mining operations

E_n = PM_{10} emissions from non-metallic ore mining
E_c = PM_{10} emissions from coal mining operations

Four specific activities are included in the emissions estimate for mining and quarrying operations: overburden removal, drilling and blasting, loading and unloading, and overburden replacement. Not included are the transfer and conveyance operations, crushing and screening operations, and storage since the dust emissions from these activities are assumed to be well controlled. Emissions for each activity are calculated using the following equation:

$$E = EF \times A$$

where,

E = PM_{10} emissions from operation (e.g., metallic ore, non-metallic ore, or coal mining; lbs)
EF = emissions factor associated with operation (lbs/ton)
A = ore handled in mining operation (tons)

As an example, in 2009 Autauga County, Alabama handled 456,346 tons of metallic ore and associated waste, 714,718 tons of non-metallic ore and associated waste, and 0 tons of coal. Mining and quarrying PM10-PRI emissions for Autauga County are:

$$E_{PM10\text{-}PRI,\ Autauga\ County} = [(456{,}346 \times 0.0548) + (714{,}718 \times 0.293) + (0 \times 0.513)]/2000 = 117 \text{ tons}$$

The division by 2000 is to convert from pounds to tons.

3.18.5 References for Industrial Processes - Mining

1. United States Environmental Protection Agency. *Generalized Particle Size Distributions for Use in Preparing Size-Specific Particulate Emissions Inventories*, EPA-450/4-86-013, July 1986.
2. United States Environmental Protection Agency, *National Air Pollutant Emission Trends Procedure Document for 1900-1996*, EPA-454/R-98-008, May 1998.
3. United States Environmental Protection Agency, AP-42, Fifth Edition, Volume 1, Chapter 11: Mineral Products Industry, Section 11.9: Western Surface Coal Mining, (accessed November 2011).
4. United States Environmental Protection Agency, *AIRS Facility Subsystem Source Classification Codes and Emission Factor Listing for Criteria Air Pollutants*, EPA-450/4-90-003, March 1990.
5. Midwest Research Institute, *Background Document for Revisions to Fine Fraction Ratios Used for AP-42 Fugitive Dust Emission Factors*, MRI Project No. 110397, November 2006, (accessed December 2011).
6. United States Geologic Survey, "Minerals Yearbook 2009", (accessed April 2012).
7. Energy Information Administration, "Production by Company and Mine - 2009", (accessed April 2012).
8. U.S. Census Bureau, 2009 County Business Patterns, (accessed April 2012)

3.19 Industrial Processes – Non-ferrous Metals

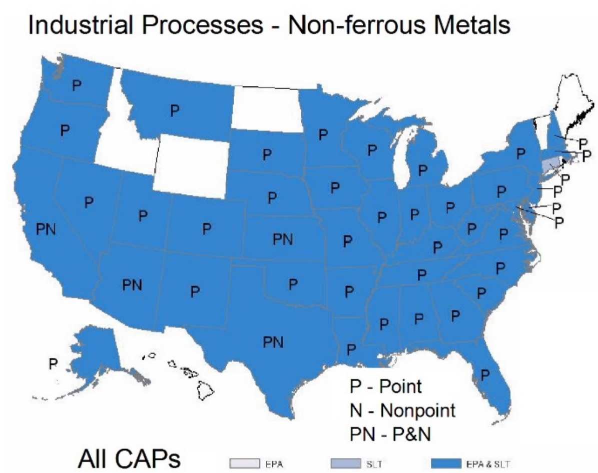
3.19.1 Sector description

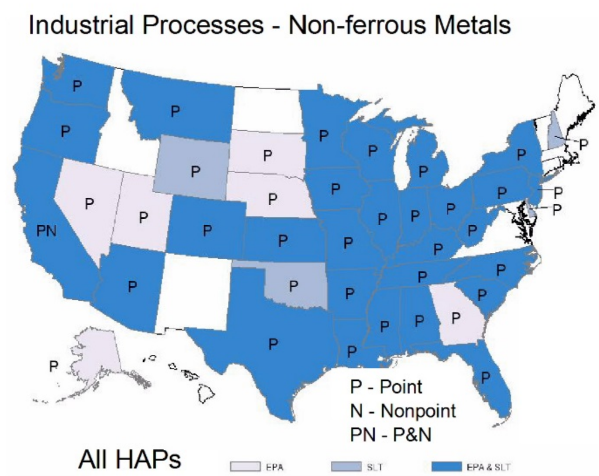
This sector is defined by the processing of non-iron various types of metals. This sector includes, but is not limited to: primary and secondary metal production processes such as alumina electrolytic reduction (SCCs beginning with 303001 and 303040), primary copper smelting (303005x), lead production (303010x), gold processing (303013x), barium ore processing (303014x), zinc production (303030x), aluminum (304001) copper (304002x), lead (304004x), lead battery manufacture (304005x), magnesium (304006x), zinc (304008x) and nickel (304010x) and numerous other primary and secondary metal production processes with SCCs beginning with 303 and 304. Most other SCCs in these ranges not related to non-ferrous metals deal with "Storage and Transfer" processes (see Section 3.23).

3.19.2 Sources of data overview and selection hierarchy

Non-ferrous metals are covered mostly in the point data category. EPA did not provide estimates for nonpoint for this sector. The selection hierarchy for all point inventory datasets contributing to this sector are provided in Table 3-1: **Data sources and selection hierarchy used for point sources**. The selection hierarchy for all nonpoint inventory datasets contributing to this sector are provided in Table 3-2: Data sources and selection hierarchy used for nonpoint sources.

3.19.3 Spatial coverage and data sources for the sector





3.20 Industrial Processes – Oil & Gas Production

3.20.1 Sector description

This sector includes processes associated with the exploration and drilling at oil and gas wells and the equipment used at the well sites to extract the product from the well and deliver it to a central collection point or processing facility. Table 3-110 lists the processes below with their corresponding SCCs; the SCCs used by EPA to estimate nonpoint emissions marked in second column. Note also that the SCCs in this list are only the SCCs that either the EPA used or the submitting State agencies used in the 2011 NEI. All of the SCCs that the EPA oil and gas tool uses are nonpoint SCCs.

Table 3-110: SCCs used for the Oil and Gas Production sector

Data Category	EPA uses	SCC	SCC Description (Abbreviated)
Nonpoint		2310000000	Total: All Processes (doesn't distinguish oil or gas)
Nonpoint	Y	2310000220	Drill Rigs
Nonpoint		2310000230	Workover Rigs
Nonpoint	Y	2310000330	Artificial Lift
Nonpoint	Y	2310000550	Produced Water
Nonpoint	Y	2310000660	Hydraulic Fracturing Engines
Nonpoint		2310002000 through 2310002421	Off-Shore Oil & Gas Production; Total: All Processes, Flares: Continuous Pilot Light, Flares: Flaring Operations, Pneumatic Pumps: Gas and Oil Wells, Pressure/Level Controllers, Cold Vents
Nonpoint		2310010000	Crude Petroleum; Total: All Processes
Nonpoint	Y	2310010100	Crude Petroleum; Oil Well Heaters
Nonpoint	Y	2310010200	Crude Petroleum; Oil Well Tanks - Flashing & Standing/Working/Breathing
Nonpoint	Y	2310010300	Crude Petroleum; Oil Well Pneumatic Devices
Nonpoint		2310010700	Crude Petroleum; Oil Well Fugitives
Nonpoint		2310010800	Crude Petroleum; Oil Well Truck Loading
Nonpoint	Y	2310011000	On-shore oil production; Total: All Processes
Nonpoint		2310011020	On-shore oil production; Storage Tanks: Crude Oil
Nonpoint		2310011100	On-shore oil production; Heater Treater
Nonpoint	Y	2310011201	On-shore oil production; Tank Truck/Railcar Loading: Crude Oil
Nonpoint		2310011450	On-shore oil production; Wellhead
Nonpoint		2310011500	On-shore oil production; Fugitives: All Processes
Nonpoint	Y	2310011501	On-shore oil production; Fugitives: Connectors
Nonpoint	Y	2310011502	On-shore oil production; Fugitives: Flanges
Nonpoint	Y	2310011503	On-shore oil production; Fugitives: Open Ended Lines
Nonpoint		2310011504	On-shore oil production; Fugitives: Pumps
Nonpoint	Y	2310011505	On-shore oil production; Fugitives: Valves
Nonpoint		2310011506	On-shore oil production; Fugitives: Other
Nonpoint		2310012000 through 2310012526	Off-Shore Oil Production; Total: All Processes, Storage Tanks: Crude Oil, Fugitives, Connectors: Oil Streams, Fugitives, Flanges: Oil, Fugitives, Valves: Oil, Fugitives, Other: Oil, Fugitives, Connectors: Oil/Water Streams, Fugitives, Flanges: Oil/Water, Fugitives, Other: Oil/Water
Nonpoint		2310020000 through 2310020800	Natural Gas; Total: All Processes, Compressor Engines, Gas Well Truck Loading
Nonpoint	Y	2310021010	On-Shore Gas Production; Storage Tanks: Condensate
Nonpoint		2310021011	On-Shore Gas Production; Condensate Tank Flaring
Nonpoint	Y	2310021030	On-Shore Gas Production; Tank Truck/Railcar Loading: Condensate
Nonpoint	Y	2310021100	On-Shore Gas Production; Gas Well Heaters
Nonpoint		2310021101	Natural Gas Fired 2Cycle Lean Burn Compressor Engines < 50 HP
Nonpoint		2310021102	Natural Gas Fired 2Cycle Lean Burn Compressor Engines 50 To 499 HP
Nonpoint		2310021103	Natural Gas Fired 2Cycle Lean Burn Compressor Engines 500+ HP

Data Category	EPA uses	SCC	SCC Description (Abbreviated)
Nonpoint		2310021201	Natural Gas Fired 4Cycle Lean Burn Compressor Engines <50 HP
Nonpoint	Y	2310021202	Natural Gas Fired 4Cycle Lean Burn Compressor Engines 50 To 499 HP
Nonpoint		2310021203	Natural Gas Fired 4Cycle Lean Burn Compressor Engines 500+ HP
Nonpoint		2310021209	Total: All Natural Gas Fired 4Cycle Lean Burn Compressor Engines
Nonpoint	Y	2310021251	On-Shore Gas Production; Lateral Compressors 4 Cycle Lean Burn
Nonpoint	Y	2310021300	On-Shore Gas Production; Gas Well Pneumatic Devices
Nonpoint		2310021301	Natural Gas Fired 4Cycle Rich Burn Compressor Engines <50 HP
Nonpoint	Y	2310021302	Natural Gas Fired 4Cycle Rich Burn Compressor Engines 50 To 499 HP
Nonpoint		2310021303	Natural Gas Fired 4Cycle Rich Burn Compressor Engines 500+ HP
Nonpoint		2310021309	Total: All Natural Gas Fired 4Cycle Rich Burn Compressor Engines
Nonpoint		2310021310	On-Shore Gas Production; Gas Well Pneumatic Pumps
Nonpoint	Y	2310021351	On-Shore Gas Production; Lateral Compressors 4 Cycle Rich Burn
Nonpoint	Y	2310021400	On-Shore Gas Production; Gas Well Dehydrators
Nonpoint		2310021401	Nat Gas Fired 4Cycle Rich Burn Compressor Engines <50 HP w/NSCR
Nonpoint		2310021402	Nat Gas Fired 4Cycle Rich Burn Compressor Engines 50 To 499 HP w/NSCR
Nonpoint		2310021403	Nat Gas Fired 4Cycle Rich Burn Compressor Engines 500+ HP w/NSCR
Nonpoint		2310021411	On-Shore Gas Production; Gas Well Dehydrators - Flaring
Nonpoint		2310021500	On-Shore Gas Production; Gas Well Completion - Flaring
Nonpoint	Y	2310021501	On-Shore Gas Production; Fugitives: Connectors
Nonpoint	Y	2310021502	On-Shore Gas Production; Fugitives: Flanges
Nonpoint	Y	2310021503	On-Shore Gas Production; Fugitives: Open Ended Lines
Nonpoint		2310021504	On-Shore Gas Production; Fugitives: Pumps
Nonpoint	Y	2310021505	On-Shore Gas Production; Fugitives: Valves
Nonpoint	Y	2310021506	On-Shore Gas Production; Fugitives: Other
Nonpoint		2310021509	On-Shore Gas Production; Fugitives: All Processes
Nonpoint		2310021600	On-Shore Gas Production; Gas Well Venting
Nonpoint		2310021601	On-Shore Gas Production; Gas Well Venting - Initial Completions
Nonpoint		2310021602	On-Shore Gas Production; Gas Well Venting - Recompletions
Nonpoint	Y	2310021603	On-Shore Gas Production; Gas Well Venting - Blowdowns
Nonpoint		2310021604	On-Shore Gas Production; Gas Well Venting - Compressor Startups
Nonpoint		2310021605	On-Shore Gas Production; Gas Well Venting - Compressor Shutdowns
Nonpoint		2310021700	On-Shore Gas Production; Miscellaneous Engines
Nonpoint		2310022000 through 2310022506	Off-Shore Gas Production; Total: All Processes, Storage Tanks: Condensate, Turbines: Natural Gas Boilers/Heaters: Natural Gas, Diesel Engines, Amine Unit Dehydrator, Fugitives, Connectors: Gas Streams, Fugitives, Flanges: Gas Streams, Fugitives, Valves: Gas, Fugitives, Other: Gas
Nonpoint		2310030000 through 2310030401	Natural Gas Liquids; Total: All Processes, Gas Well Tanks - Flashing & Standing/Working/ Breathing, Uncontrolled, Gas Well Water Tank Losses, Gas Plant Truck Loading
Nonpoint	Y	2310111100	On-shore Oil Exploration; Mud Degassing
Nonpoint	Y	2310111401	On-shore Oil Exploration; Oil Well Pneumatic Pumps

Data Category	EPA uses	SCC	SCC Description (Abbreviated)
Nonpoint	Y	2310111700	On-shore Oil Exploration; Oil Well Completion: All Processes
Nonpoint		2310112401	On-shore Oil Exploration; Oil Well Pneumatic Pumps
Nonpoint	Y	2310121100	Off-shore Oil Exploration; Mud Degassing
Nonpoint	Y	2310121401	Off-shore Oil Exploration; Gas Well Pneumatic Pumps
Nonpoint	Y	2310121700	Off-shore Oil Exploration; Gas Well Completion: All Processes
Nonpoint		2310122100	Off-shore Gas Exploration; Mud Degassing
Point		31000101 through 31000506,	Various descriptions; Excludes 31000104 through 31000108 and 31000140 through 31000145, which are in the sector "Industrial Processes – Storage and Transfer"
Point		31088801 through 31088811	Fugitive Emissions; Specify in Comments Field
Point		31700101	Natural Gas Transmission and Storage Facilities; Pneumatic Controllers Low Bleed

3.20.2 Sources of data overview and selection hierarchy

The S/L/T agencies that submitted data to the EPA are listed in Table 3-111 below, as well as in the charts. A number of states submitted both point and nonpoint emissions. In all cases, the majority of emissions are in the nonpoint data category.

Table 3-111: Agencies that submitted data for the Industrial Processes – Oil and Gas Production sector

Data Set Name	State	Dataset Short Name	Data Category
Shoshone-Bannock Tribes of the Fort Hall Reservation of Idaho		2011TR180	Point
Navajo Nation, Arizona, New Mexico & Utah		2011TR780	Point
Southern Ute Indian Tribe		2011TR750	Point
Alaska Department of Environmental Conservation	AK	2011AKDEC	Point
Alabama Department of Environmental Management	AL	2011ADEM	Point
Jefferson County (AL) Department of Health	AL	2011JeffCty	Point
Arkansas Department of Environmental Quality	AR	2011ARDEQ	Point
Pinal County	AZ	2011Pinal	Point
Arizona Department of Environmental Quality	AZ	2011AZDEQ	Point
California Air Resources Board	CA	2011CARB	Nonpoint
California Air Resources Board	CA	2011CARB	Point
Colorado Department of Public Health and Environment	CO	2011CODPHE	Nonpoint
Colorado Department of Public Health and Environment	CO	2011CODPHE	Point
Connecticut Department Of Environmental Protection	CT	2011CTBAM	Point
Florida Department of Environmental Protection	FL	2011FLDEP	Point
Georgia Department of Natural Resources	GA	2011GADNR	Nonpoint
Georgia Department of Natural Resources	GA	2011GADNR	Point
Iowa Department of Natural Resources	IA	2011IADNR	Point
Illinois Environmental Protection Agency	IL	2011ILEPA	Point
Indiana Department of Environmental Management	IN	2011INDEM	Point

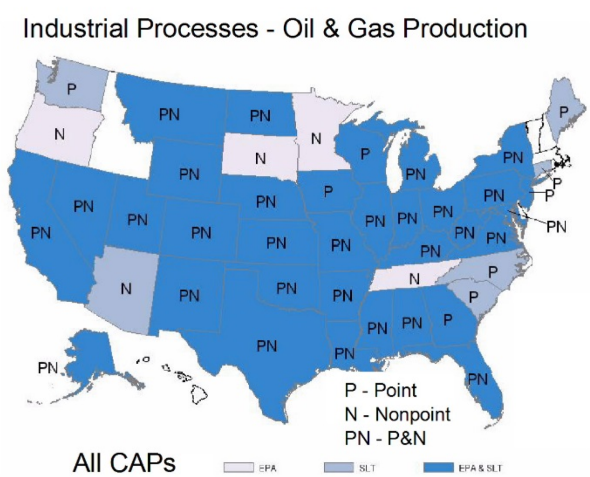
Data Set Name	State	Dataset Short Name	Data Category
Kansas Department of Health and Environment	KS	2011KSDOHE	Nonpoint
Kansas Department of Health and Environment	KS	2011KSDOHE	Point
Kentucky Division for Air Quality	KY	2011KYDAQ	Point
Louisiana Department of Environmental Quality	LA	2011LADEQ	Nonpoint
Louisiana Department of Environmental Quality	LA	2011LADEQ	Point
Maryland Department of the Environment	MD	2011MDDOE	Point
Maine Department of Environmental Protection	ME	2011MEDEP	Point
Michigan Department of Environmental Quality	MI	2011MIDEQ	Point
Michigan Department of Environmental Quality	MI	2011MIDEQ	Nonpoint
Missouri Department of Natural Resources	MO	2011MODNR	Nonpoint
Missouri Department of Natural Resources	MO	2011MODNR	Point
Mississippi Dept of Environmental Quality	MS	2011MSDEQ	Point
Montana Department of Environmental Quality	MT	2011MTDEQ	Point
North Dakota Department of Health	ND	2011NDDOH	Point
Omaha Air Quality Control Division	NE	2011Omaha	Point
Nebraska Environmental Quality	NE	2011NEDEQ	Point
New Jersey Department of Environment Protection	NJ	2011NJDEP	Point
New Mexico Environment Department Air Quality Bureau	NM	2011NMED	Point
Nevada Division of Environmental Protection	NV	2011NVBAQ	Point
New York State Department of Environmental Conservation	NY	2011NYDEC	Nonpoint
New York State Department of Environmental Conservation	NY	2011NYDEC	Point
Ohio Environmental Protection Agency	OH	2011OHEPA	Nonpoint
Ohio Environmental Protection Agency	OH	2011OHEPA	Point
Oklahoma Department of Environmental Quality	OK	2011OKDEQ	Nonpoint
Oklahoma Department of Environmental Quality	OK	2011OKDEQ	Point
Pennsylvania Department of Environmental Protection	PA	2011PADEP	Nonpoint
Pennsylvania Department of Environmental Protection	PA	2011PADEP	Point
Allegheny County Health Department	PA	2011Alleg	Point
South Carolina Department of Health and Environmental Control	SC	2011SCDHEC	Point
Texas Commission on Environmental Quality	TX	2011TXCEQ	Nonpoint
Texas Commission on Environmental Quality	TX	2011TXCEQ	Point
Utah Division of Air Quality	UT	2011UTDAQ	Nonpoint
Utah Division of Air Quality	UT	2011UTDAQ	Point
Virginia Department of Environmental Quality	VA	2011VADEQ	Point
Southwest Clean Air Agency	WA	2011SWCAA	Point
Wisconsin Department of Natural Resources	WI	2011WIDNR	Point
West Virginia Division of Air Quality	WV	2011WVDAQ	Nonpoint
West Virginia Division of Air Quality	WV	2011WVDAQ	Point
Wyoming Department of Environmental Quality	WY	2011WYDEQ	Nonpoint
Wyoming Department of Environmental Quality	WY	2011WYDEQ	Point

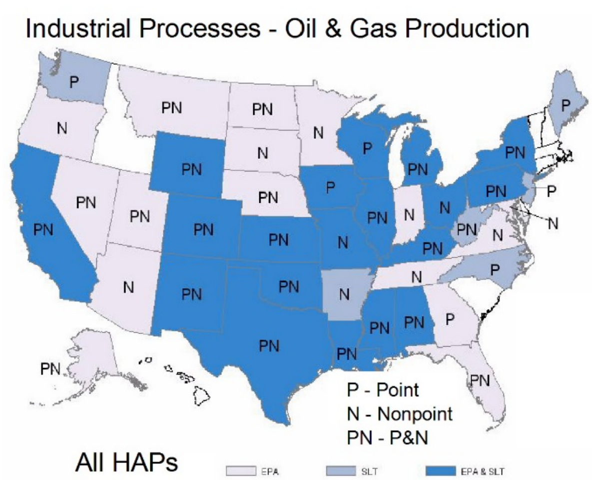
Table 3-112 shows the selection hierarchy for datasets included in the Industrial Processes – Oil & Gas Production sector.

Table 3-112: 2011 NEI Industrial Processes – Oil & Gas Production data selection hierarchy

Priority	Dataset Name	Dataset Content
Point Hierarchy		
1	2011EPA_PM-Augmentation	Augments PM emissions
2	Responsible Agency Data Set	State and Local Agency submitted emissions
3	2011EPA_chrom_split	Speciates chromium
4	2011EPA_Other	New Mexico emissions that state was unable to submit to the EIS due to submittal issues
5	2011EPA_TRI	Toxics Release Inventory data for the year 2011.
6	2011EPA_HAP-Augmentation	Augments HAP emissions
7	2008 MMS Data	Off shore Platforms from the Bureau of Ocean and Energy Management, carried forward from 2008
Nonpoint Hierarchy		
1	Responsible Agency Data Set	State and Local Agency submitted emissions
2	2011EPA_PM-Augmentation	Augments PM emissions
3	2011EPA_NP_Overlap_w_Pt	EPA-generated data

3.20.3 Spatial coverage and data sources for the sector





3.20.4 EPA emissions calculation approach

The EPA developed a methodology to estimate nonpoint emissions for the oil and gas production sector. This development started in April 2012 and was done in collaboration with a national workgroup, which includes state and regional emissions developers. The tool can produce county-level emissions for calendar year 2011 for criteria pollutants and their precursors including volatile organic compounds and ammonia, as well as for hazardous air pollutants (HAPs). This methodology was used by EPA to estimate emissions for use in the NEI for field exploration, production, and gathering activities. The tool allows the S/L/T agency inventory developers to subtract out point source emissions from the nonpoint estimates to avoid double counted emissions.

For the 2011 NEI, the tool was used by both states and EPA to estimate emissions. As was the case in previous NEI cycles, states can use their own methodologies to estimate oil & gas emissions. States can also use the tool by either using the default tool inputs, or by providing their own basin- and/or county-specific inputs. Custom inputs to the tool allows for customized emissions from the tool. The tool is pre-populated with basin- and state-specific inputs where those are available, and it uses default EPA inputs when nothing else is available. The EPA default inputs are based on data developed during the recent rulemaking for this industry.

In the maps provided in Section 3.20.3, EPA data are considered as "EPA" even when they are based on state-specific inputs from the tool. The EPA tool contains within its database descriptions of the sources for all data used. So, the tool is the best place to better understand the underlying origin of the emissions data (see below for tool access information).

The EPA oil and gas tool considers all significant sources of oil and gas industry emissions, such as:

- Drill rigs
- Workover rigs
- Well completions (flaring/venting for both conventional and green completions)
- Well hydraulic fracturing and completion engines
- Heaters (separator, line, tank, reboilers)
- Storage tanks (condensate, black oil, produced water)
- Mud degassing
- Dehydration units
- Pneumatics (pumps, all other devices)
- Well venting/blow downs (liquid unloading)
- Fugitives
- Truck loading
- Wellhead engines
- Pipeline compressor engines
- Flaring
- Artificial lifts
- Gas actuated pumps

The file contains the tool, directions on how to use the tool, documentation regarding the calculations with sample calculations and national county level tool-generated emissions from this sector.

3.20.5 Summary of data quality assurance methods

We reviewed data comparisons between the 2008 and 2011 NEIs and between state-submitted data and EPA generated data. Table 3-113 below lists some comments and the resolution. Many more comments were received through the national workgroup while building the oil & gas tool. Generally speaking, emissions comparisons between 2008 and 2011 were not very informative because not many states submitted to EPA in 2008, and the industry is changing so fast that 3 years can make a big difference.

Table 3-113: List of comments and resolution for building the 2011 NEI for the Oil and Gas Production sector

State	EIS Sector	Pollutant	Comment
UT	Oil and gas	all	We added emissions from 7 counties that Utah did not submit for. Utah only submitted data for 2 counties to EPA, the counties done by WRAP. This was done per in coordination with Utah staff.
TX	Oil and gas	all	We added emissions from 5 SCCs from EPA tool to the NEI, at Texas staff request, since they did not cover that process. The SCCs are 2310000660 (hydro-fracturing engines), 2310111100 (oil well mud degassing), 2310111401 (Oil well pneumatic pumps), 2310121100 (mud degassing), and 2310121401 (gas well pneumatic pumps). Since Texas had submitted emissions values of zero for this process, they asked EPA to tag the state data, so the EPA data would be selected ahead of the Texas-provided zero values.
CA	Oil and gas	all	We noted that California estimates look very different compared to EPA's estimates. Emissions are lower (about one tenth of EPA estimates) and SCC coverage is different than EPA's. We have discussed this with California and they have reviewed their data, and we are using the California-submitted data in the 2011 v1 NEI.

We also tagged EPA's oil well completions data, which blocked them from merging to the NEI. These data were not ready for use in the NEI because the available emission factors are not known to be applicable to oil well completions. There are no emission factors that are specific to oil-well completions available from EPA at this time.

We also noticed that in the raw data used by EPA's tool, there was one well that had a wrong latitude/longitude and was actually supposed to be located in Kansas, not Minnesota, when allocating to counties. To resolve this, we tagged the data, so it would not appear in Minnesota. Emissions were small enough that we believed it was not worth the effort to add the well emissions back into the Kansas data (3.3 tons of VOC and 1.7 tons of NO_X).

We noted several states where there were large differences between EPA's estimates and the state submittals. We selected 2 states that had good emission inventory programs and therefore, the staff at each state (WY and CO) have a lot of confidence in their own estimates. We believed it would be a good calculation check on the tool if we compared emissions submitted by these states to emissions from the tool.

We compared county level EPA tool data to state submitted data for Sublette County in WY. We picked Sublette County because of the high activity in that county plus some large differences in emission estimates between the EPA tool and the state. In the tool for Sublette County, we populated some of the basin factors with data from the WRAP III study, which the committee considered good data and certainly better than default data from the CenSARA (Central States Air Resources Agencies) states. In several instances, this turned out not to be true. For condensate tanks, according to the WRAP III data, none of the emissions from condensate tanks were controlled by flares, and VOC emissions were calculated at 67,985 tons for condensate tanks for just Sublette County. That is much higher than the emissions reported by WY (453 tons VOC). WY informed us that all condensate tanks in Sublette County were controlled by flares. When we changed the basin factor in the tool to match this new information, the tool calculated 1,622 tons VOC, which is still higher than what was reported by the state but much more in line with the states estimates. For well completions, again for Sublette County, the

WRAP III data had no green completions in Sublette County and the tool calculated emissions of 4240 tons of VOC. The state submitted emissions of 54 tons of VOC. WY informed us that all well completions in Sublette County were green, so with this new information, the tool now calculates zero VOC emissions from green completions. This change brought the tool pretty much in line with the state estimates.

One of the problems with comparing the tool data to WY data is that WY submits a significant portion of their oil and gas production emissions to the point source sector and it is not trivial to query and analyze. Currently the tool still estimates about 12,000 more tons of VOC in Sublette County than the state submitted in the nonpoint, and the discrepancy may be the emission submitted by WY in the point source sector. Another case in point, for wellhead compressor engines, we noticed that the tool estimates 4,561 tons of NO_X for Sublette County and WY submitted zero emissions to the nonpoint sector. WY told us that all of their emissions from wellhead compressors were submitted to the point source inventory.

In Natrona County, WY, the tool has little condensate production, so emissions are low, but WY reports high condensate tank emissions in Natrona County. The discrepancy was traced to the fact that the HPDI database called the liquid produced in Natrona County “oil” and WY called the liquid produced “condensate”. The difference is that the emission factor for condensate is about 10 times higher than the emission factor for oil, so emissions for condensate are going to be a lot higher for condensate. We made the appropriate adjustments in the tool and then the tool calculation more closely matched WY data, the emissions from the tool matched the state submitted emissions for condensate tanks a lot better.

3.21 Industrial Processes – Petroleum Refineries

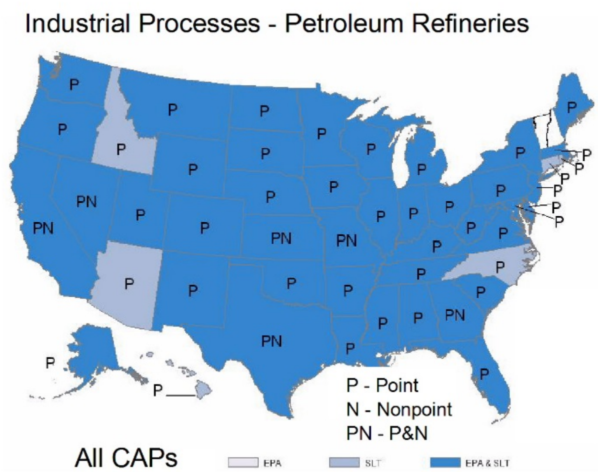
3.21.1 Sector description

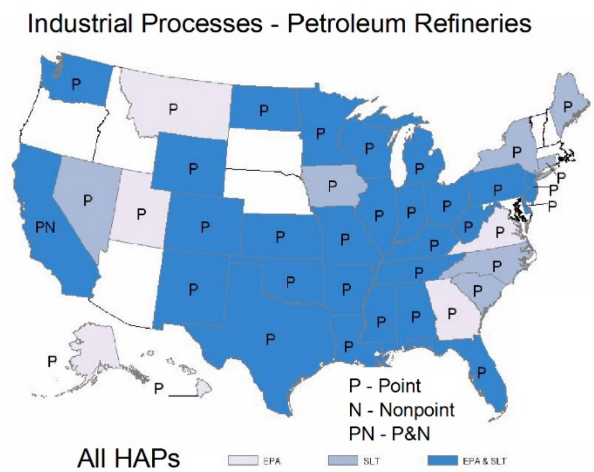
This sector includes petroleum industry processes except non-storage and handling processes (see Section 3.23) with SCCs beginning with 3060x. A couple of nonpoint SCCs for “Petroleum Refining: SIC 29” (2306000000 and 2306010000) are also assigned to this sector. Petroleum refinery processes include but are not limited to: process heaters, catalytic cracking units, wastewater treatment, cooling towers, flares, distillation, blending and treating units, incineration, and various fugitive sources at locations such as pipelines, drains and compressors.

3.21.2 Sources of data overview and selection hierarchy

This sector is covered almost completely in the point data category. EPA does not provide estimates for this sector in nonpoint. The selection hierarchy for all point inventory datasets contributing to this sector are provided in Table 3-1: **Data sources and selection hierarchy used for point sources**. The selection hierarchy for all nonpoint inventory datasets contributing to this sector are provided in Table 3-2: Data sources and selection hierarchy used for nonpoint sources.

3.21.3 Spatial coverage and data sources for the sector





3.22 Industrial Processes – Pulp & Paper

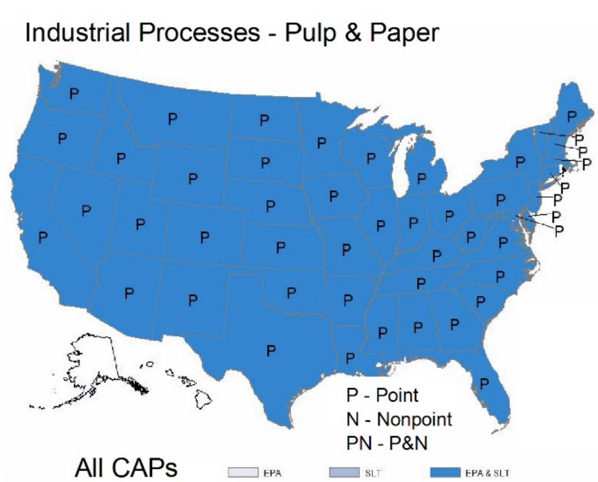
3.22.1 Sector description

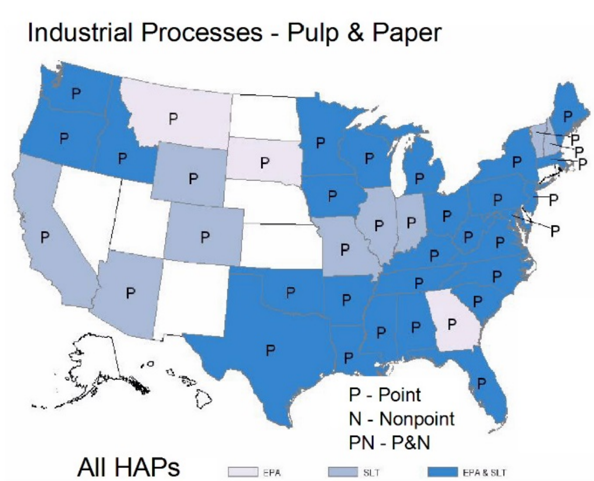
This sector includes pulp and paper wood products processes except non-storage and handling processes (see Section 3.23) with SCCs beginning with 307x. Pulp and paper processes include but are not limited to: sulfate (Kraft) pulping, sulfite pulping, neutral sulfite semi-chemical pulping, semi-chemical (non-sulfur), soda, wood pressure treating, particleboard manufacture, plywood and sawmill operations, medium density fiberboard (MDF), oriented strand board (OSB), laminated strand lumber, fiberboard and hardboard (HB) manufacture, and miscellaneous wood working operations.

3.22.2 Sources of data overview and selection hierarchy

This sector covered completely in point. The selection hierarchy for all point inventory datasets contributing to this sector are provided in Table 3-1: **Data sources and selection hierarchy used for point sources**.

3.22.3 Spatial coverage and data sources for the sector





3.23 Industrial Processes – Storage and Transfer

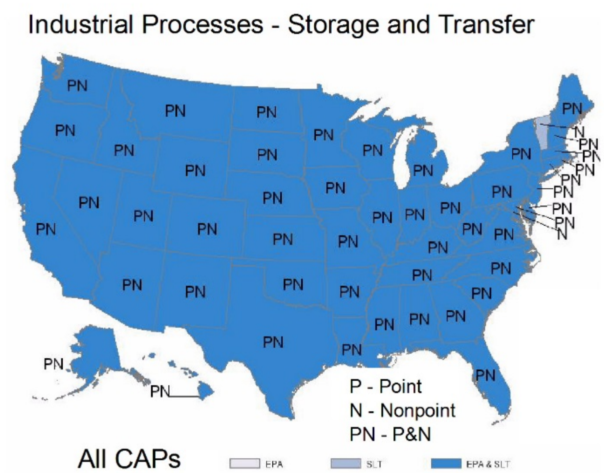
3.23.1 Sector description

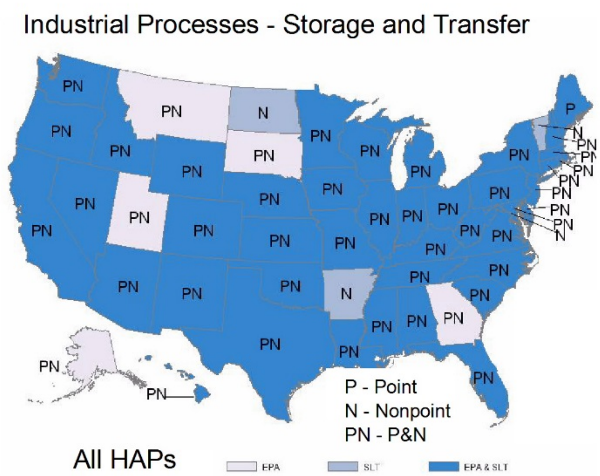
This sector includes storage and transport activities at industrial sources and includes emissions categorized as nonpoint and point. Much of the emissions in this sector are related to working/breathing loss of various fuels and inorganic and organic chemicals –both liquid and solid. Processes in this sector include those at chemical manufacturing, primary and secondary metal production and cement mineral processing (e.g., cement manufacturing) facilities. There is considerable overlap in emissions calculations and methodology with the processes in the Bulk Gasoline Terminals and Gas Stations sector, particularly for bulk terminals and pipelines discussed in Section 3.5.4.

3.23.2 Sources of data overview and selection hierarchy

The wide range of processes that define this sector impact most types of industrial facilities and therefore, most states report both (at least some) point and nonpoint emissions for both CAPs and HAPs. The selection hierarchy for all point inventory datasets contributing to this sector are provided in Table 3-1: **Data sources and selection hierarchy used for point sources**. The selection hierarchy for all nonpoint inventory datasets contributing to this sector are provided in Table 3-2: Data sources and selection hierarchy used for nonpoint sources.

3.23.3 Spatial coverage and data sources for the sector





3.24 Industrial Processes – NEC (Other)

3.24.1 Sector description

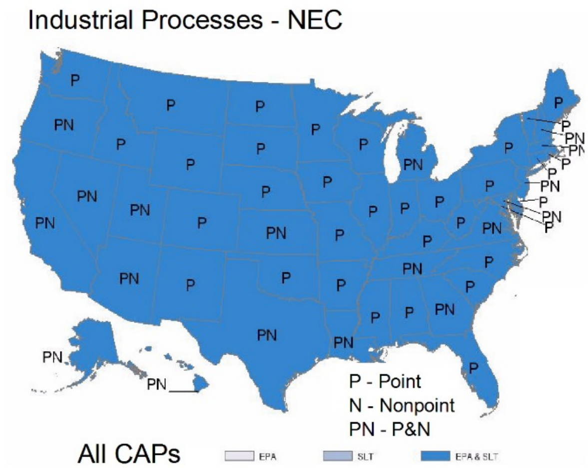
This Industrial Processes NEC (not elsewhere classified) sector includes all industrial processes not covered in other NEI/EIS sectors (i.e., sectors discussed in Section 3.15 through Section 3.23. These processes are ubiquitous in the point and nonpoint data categories. Some point inventory processes (SCCs) include: internal combustion engines wastewater and equipment leaks (2018x, 2028x, 2038x, 2048x), food and agriculture coffee roasting, cotton ginning, feed and grain terminal elevators, grain millings, beer production, meat smokehouses, sugar cane refining, and vegetable oil processing (3020x), by-product coke manufacturing (303003x), asphalt roofing manufacture (305001x), brick manufacture (305003x), fiberglass manufacture (30501x), glass manufacture (305014x), lime manufacture (305016x), mineral wood manufacturing (305017x), phosphate rock

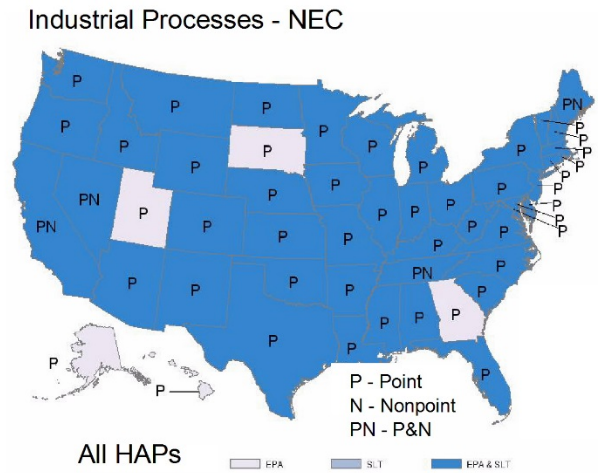
(305019x), industrial sand and gravel (305027x), tire manufacture (308001x), plastic products manufacturing (308010x), vinyl floor tile manufacturing (308050x) and hundreds of other industrial processes. Some nonpoint inventory processes (SCCs) include: food and kindred products (23020x), wood products (23070x) and fabricated metals (2309x).

3.24.2 Sources of data overview and selection hierarchy

Most of the data in this sector is point sources. EPA does not generate nonpoint emissions for this sector. The selection hierarchy for all point inventory datasets contributing to this sector are provided in Table 3-1: **Data sources and selection hierarchy used for point sources**. The selection hierarchy for all nonpoint inventory datasets contributing to this sector are provided in Table 3-2: Data sources and selection hierarchy used for nonpoint sources.

3.24.3 Spatial coverage and data sources for the sector





3.25 Miscellaneous Non-industrial NEC (Other)

3.25.1 Sector description

This sector includes primarily nonpoint processes and 4 point processes (waste disposal…firefighting, SCCs=5010060x). The nonpoint sources include portable fuel containers (SCCs like 250101101x and 250101201x), structure and motor vehicle fires, catastrophic/accidental releases, and human and animal cremation (280100x), automotive repair shops (28400x), miscellaneous repair shops (28410x), health services (285000x), fluorescent lamp breakage (28610000x) and swimming pools (286200x).

3.25.2 Sources of data overview and selection hierarchy

The miscellaneous non-industrial not elsewhere classified (NEC) sector includes data from S/L/T agency and EPA datasets that cover both point and nonpoint data categories. Table 3-114 shows the data categories and SCCs submitted by each agency in this sector. Note that there are a wide range of sources in this sector, including new (to 2011 v2) nonpoint mercury emissions provided by the EPA. Much of the EPA nonpoint data in this table are discussed in section 3.1.7. The only EPA data in the point inventory in this sector is limited to PM and chromium augmentation (see Section 3.1.2 and Section 3.1.3). The selection hierarchy for all point inventory datasets contributing to this sector are provided in Table 3-1: **Data sources and selection hierarchy used for point**

sources. The selection hierarchy for all nonpoint inventory datasets contributing to this sector are provided in Table 3-2: Data sources and selection hierarchy used for nonpoint sources.

Table 3-114: Agencies and the SCCs submitted for the Miscellaneous Non-Industrial - NEC sector

Data Set Name	Data Category	SCC	SCC Level One	SCC Level Two	SCC Level Three	SCC Level Four
EPA Nonpoint Mercury	Nonpoint	2810060100	Miscellaneous Area Sources	Other Combustion	Cremation	Humans
EPA Nonpoint Mercury	Nonpoint	2810060200	Miscellaneous Area Sources	Other Combustion	Cremation	Animals
EPA Nonpoint Mercury	Nonpoint	2850001000	Miscellaneous Area Sources	Health Services	Dental Alloy Production	Overall Process
EPA Nonpoint Mercury	Nonpoint	2861000000	Miscellaneous Area Sources	Fluorescent Lamp Breakage	Non-recycling Related Emissions	Total
EPA Nonpoint Mercury	Nonpoint	2861000010	Miscellaneous Area Sources	Fluorescent Lamp Breakage	Recycling Related Emissions	Total
2011EPA_chrom_split	Nonpoint	2810050000	Miscellaneous Area Sources	Other Combustion	Motor Vehicle Fires	Unspecified
2011EPA_chrom_split	Nonpoint	2810060100	Miscellaneous Area Sources	Other Combustion	Cremation	Humans
2011EPA_chrom_split	Nonpoint	2810060200	Miscellaneous Area Sources	Other Combustion	Cremation	Animals
2011EPA_chrom_split	Point	50100601	Waste Disposal	Solid Waste Disposal - Government	Fire Fighting	Structure: Jet Fuel
2011EPA_HAP-Augmentation	Nonpoint	2810060100	Miscellaneous Area Sources	Other Combustion	Cremation	Humans
2011EPA_NP_NoOverlap_w_Pt	Nonpoint	2810060100	Miscellaneous Area Sources	Other Combustion	Cremation	Humans
2011EPA_NP_NoOverlap_w_Pt	Nonpoint	2851001000	Miscellaneous Area Sources	Laboratories	Bench Scale Reagents	Total
2011EPA_NP_Overlap_w_Pt	Nonpoint	2810030000	Miscellaneous Area Sources	Other Combustion	Structure Fires	Unspecified
2011EPA_NP_Overlap_w_Pt	Nonpoint	2810060200	Miscellaneous Area Sources	Other Combustion	Cremation	Animals
2011EPA_NP_Overlap_w_Pt	Nonpoint	2850000010	Miscellaneous Area Sources	Health Services	Hospitals	Sterilization Operations
2011EPA_PM-Augmentation	Nonpoint	2810003000	Miscellaneous Area Sources	Other Combustion	Cigarette Smoke	Total
2011EPA_PM-Augmentation	Nonpoint	2810025000	Miscellaneous Area Sources	Other Combustion	Charcoal Grilling - Residential (see 23-02-002-xxx for Commercial)	Total
2011EPA_PM-Augmentation	Nonpoint	2810030000	Miscellaneous Area Sources	Other Combustion	Structure Fires	Unspecified
2011EPA_PM-Augmentation	Nonpoint	2810035000	Miscellaneous Area Sources	Other Combustion	Firefighting Training	Total
2011EPA_PM-Augmentation	Nonpoint	2810040000	Miscellaneous Area Sources	Other Combustion	Aircraft/Rocket Engine Firing and Testing	Total
2011EPA_PM-Augmentation	Nonpoint	2810050000	Miscellaneous Area Sources	Other Combustion	Motor Vehicle Fires	Unspecified

Data Set Name	Data Category	SCC	SCC Level One	SCC Level Two	SCC Level Three	SCC Level Four
2011EPA_PM-Augmentation	Nonpoint	2810060100	Miscellaneous Area Sources	Other Combustion	Cremation	Humans
2011EPA_PM-Augmentation	Nonpoint	2810060200	Miscellaneous Area Sources	Other Combustion	Cremation	Animals
2011EPA_PM-Augmentation	Nonpoint	2830001000	Miscellaneous Area Sources	Catastrophic/Accidental Releases	Industrial Accidents	Total
2011EPA_PM-Augmentation	Nonpoint	2850000000	Miscellaneous Area Sources	Health Services	Hospitals	Total: All Operations
2011EPA_PM-Augmentation	Point	50100601	Waste Disposal	Solid Waste Disposal - Government	Fire Fighting	Structure: Jet Fuel
2011EPA_PM-Augmentation	Point	50100602	Waste Disposal	Solid Waste Disposal - Government	Fire Fighting	Structure: Distillate Oil
2011EPA_PM-Augmentation	Point	50100603	Waste Disposal	Solid Waste Disposal - Government	Fire Fighting	Structure: Kerosene
2011EPA_PM-Augmentation	Point	50100604	Waste Disposal	Solid Waste Disposal - Government	Fire Fighting	Structure: Wood Pallets
California Air Resources Board	Nonpoint	2810030000	Miscellaneous Area Sources	Other Combustion	Structure Fires	Unspecified
California Air Resources Board	Nonpoint	2810050000	Miscellaneous Area Sources	Other Combustion	Motor Vehicle Fires	Unspecified
California Air Resources Board	Point	50100601	Waste Disposal	Solid Waste Disposal - Government	Fire Fighting	Structure: Jet Fuel
California Air Resources Board	Point	50100602	Waste Disposal	Solid Waste Disposal - Government	Fire Fighting	Structure: Distillate Oil
Chattanooga Air Pollution Control Bureau (CHCAPCB)	Nonpoint	2810060100	Miscellaneous Area Sources	Other Combustion	Cremation	Humans
Clark County Department of Air Quality and Environmental Management	Nonpoint	2810030000	Miscellaneous Area Sources	Other Combustion	Structure Fires	Unspecified
Clark County Department of Air Quality and Environmental Management	Nonpoint	2810050000	Miscellaneous Area Sources	Other Combustion	Motor Vehicle Fires	Unspecified
Coeur d'Alene Tribe	Nonpoint	2810025000	Miscellaneous Area Sources	Other Combustion	Charcoal Grilling - Residential (see 23-02-002-xxx for Commercial)	Total
Coeur d'Alene Tribe	Nonpoint	2810030000	Miscellaneous Area Sources	Other Combustion	Structure Fires	Unspecified
Coeur d'Alene Tribe	Nonpoint	2810050000	Miscellaneous Area Sources	Other Combustion	Motor Vehicle Fires	Unspecified
Coeur d'Alene Tribe	Nonpoint	2810060100	Miscellaneous Area Sources	Other Combustion	Cremation	Humans
Coeur d'Alene Tribe	Nonpoint	2810060200	Miscellaneous Area Sources	Other Combustion	Cremation	Animals
Connecticut Department Of Environmental Protection	Nonpoint	2810060100	Miscellaneous Area Sources	Other Combustion	Cremation	Humans
DC Department of Health Air Quality Division	Nonpoint	2810030000	Miscellaneous Area Sources	Other Combustion	Structure Fires	Unspecified

Data Set Name	Data Category	SCC	SCC Level One	SCC Level Two	SCC Level Three	SCC Level Four
DC Department of Health Air Quality Division	Nonpoint	2810035000	Miscellaneous Area Sources	Other Combustion	Firefighting Training	Total
DC Department of Health Air Quality Division	Nonpoint	2810050000	Miscellaneous Area Sources	Other Combustion	Motor Vehicle Fires	Unspecified
DC Department of Health Air Quality Division	Nonpoint	2810060200	Miscellaneous Area Sources	Other Combustion	Cremation	Animals
Delaware Department of Natural Resources and Environmental Control	Nonpoint	2810030000	Miscellaneous Area Sources	Other Combustion	Structure Fires	Unspecified
Delaware Department of Natural Resources and Environmental Control	Nonpoint	2810035000	Miscellaneous Area Sources	Other Combustion	Firefighting Training	Total
Delaware Department of Natural Resources and Environmental Control	Nonpoint	2810050000	Miscellaneous Area Sources	Other Combustion	Motor Vehicle Fires	Unspecified
Eastern Band of Cherokee Indians	Nonpoint	2810025000	Miscellaneous Area Sources	Other Combustion	Charcoal Grilling - Residential (see 23-02-002-xxx for Commercial)	Total
Georgia Department of Natural Resources	Nonpoint	2810030000	Miscellaneous Area Sources	Other Combustion	Structure Fires	Unspecified
Georgia Department of Natural Resources	Nonpoint	2810050000	Miscellaneous Area Sources	Other Combustion	Motor Vehicle Fires	Unspecified
Hawaii Department of Health Clean Air Branch	Nonpoint	2810010000	Miscellaneous Area Sources	Other Combustion	Human Perspiration and Respiration	Total
Hawaii Department of Health Clean Air Branch	Nonpoint	2810030000	Miscellaneous Area Sources	Other Combustion	Structure Fires	Unspecified
Hawaii Department of Health Clean Air Branch	Nonpoint	2810050000	Miscellaneous Area Sources	Other Combustion	Motor Vehicle Fires	Unspecified
Idaho Department of Environmental Quality	Nonpoint	2810025000	Miscellaneous Area Sources	Other Combustion	Charcoal Grilling - Residential (see 23-02-002-xxx for Commercial)	Total
Idaho Department of Environmental Quality	Nonpoint	2810030000	Miscellaneous Area Sources	Other Combustion	Structure Fires	Unspecified
Idaho Department of Environmental Quality	Nonpoint	2810050000	Miscellaneous Area Sources	Other Combustion	Motor Vehicle Fires	Unspecified
Idaho Department of Environmental Quality	Nonpoint	2810060100	Miscellaneous Area Sources	Other Combustion	Cremation	Humans
Idaho Department of Environmental Quality	Nonpoint	2810060200	Miscellaneous Area Sources	Other Combustion	Cremation	Animals
Illinois Environmental Protection Agency	Nonpoint	2810030000	Miscellaneous Area Sources	Other Combustion	Structure Fires	Unspecified
Illinois Environmental Protection Agency	Nonpoint	2810060100	Miscellaneous Area Sources	Other Combustion	Cremation	Humans
Illinois Environmental Protection Agency	Nonpoint	2810060200	Miscellaneous Area Sources	Other Combustion	Cremation	Animals
Illinois Environmental Protection Agency	Nonpoint	2850001000	Miscellaneous Area Sources	Health Services	Dental Alloy Production	Overall Process

Data Set Name	Data Category	SCC	SCC Level One	SCC Level Two	SCC Level Three	SCC Level Four
Illinois Environmental Protection Agency	Nonpoint	2851001000	Miscellaneous Area Sources	Laboratories	Bench Scale Reagents	Total
Illinois Environmental Protection Agency	Nonpoint	2861000000	Miscellaneous Area Sources	Fluorescent Lamp Breakage	Non-recycling Related Emissions	Total
Illinois Environmental Protection Agency	Nonpoint	2861000010	Miscellaneous Area Sources	Fluorescent Lamp Breakage	Recycling Related Emissions	Total
Iowa Department of Natural Resources	Point	50100601	Waste Disposal	Solid Waste Disposal - Government	Fire Fighting	Structure: Jet Fuel
Kootenai Tribe of Idaho	Nonpoint	2810025000	Miscellaneous Area Sources	Other Combustion	Charcoal Grilling - Residential (see 23-02-002-xxx for Commercial)	Total
Kootenai Tribe of Idaho	Nonpoint	2810030000	Miscellaneous Area Sources	Other Combustion	Structure Fires	Unspecified
Kootenai Tribe of Idaho	Nonpoint	2810050000	Miscellaneous Area Sources	Other Combustion	Motor Vehicle Fires	Unspecified
Kootenai Tribe of Idaho	Nonpoint	2810060100	Miscellaneous Area Sources	Other Combustion	Cremation	Humans
Kootenai Tribe of Idaho	Nonpoint	2810060200	Miscellaneous Area Sources	Other Combustion	Cremation	Animals
Louisiana Department of Environmental Quality	Nonpoint	2810030000	Miscellaneous Area Sources	Other Combustion	Structure Fires	Unspecified
Maine Department of Environmental Protection	Nonpoint	2810010000	Miscellaneous Area Sources	Other Combustion	Human Perspiration and Respiration	Total
Maine Department of Environmental Protection	Nonpoint	2810030000	Miscellaneous Area Sources	Other Combustion	Structure Fires	Unspecified
Maine Department of Environmental Protection	Nonpoint	2810050000	Miscellaneous Area Sources	Other Combustion	Motor Vehicle Fires	Unspecified
Maine Department of Environmental Protection	Nonpoint	2810060100	Miscellaneous Area Sources	Other Combustion	Cremation	Humans
Maine Department of Environmental Protection	Nonpoint	2810060200	Miscellaneous Area Sources	Other Combustion	Cremation	Animals
Maine Department of Environmental Protection	Nonpoint	2850000010	Miscellaneous Area Sources	Health Services	Hospitals	Sterilization Operations
Maine Department of Environmental Protection	Nonpoint	2861000000	Miscellaneous Area Sources	Fluorescent Lamp Breakage	Non-recycling Related Emissions	Total
Maricopa County Air Quality Department	Nonpoint	2810010000	Miscellaneous Area Sources	Other Combustion	Human Perspiration and Respiration	Total
Maricopa County Air Quality Department	Nonpoint	2810030000	Miscellaneous Area Sources	Other Combustion	Structure Fires	Unspecified
Maricopa County Air Quality Department	Nonpoint	2810040000	Miscellaneous Area Sources	Other Combustion	Aircraft/Rocket Engine Firing and Testing	Total
Maricopa County Air Quality Department	Nonpoint	2810050000	Miscellaneous Area Sources	Other Combustion	Motor Vehicle Fires	Unspecified
Maricopa County Air Quality Department	Nonpoint	2810060100	Miscellaneous Area Sources	Other Combustion	Cremation	Humans
Maricopa County Air Quality Department	Nonpoint	2830001000	Miscellaneous Area Sources	Catastrophic/Accidental Releases	Industrial Accidents	Total

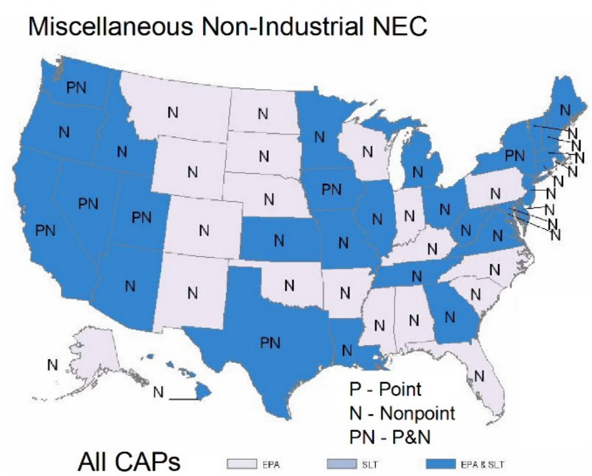
Data Set Name	Data Category	SCC	SCC Level One	SCC Level Two	SCC Level Three	SCC Level Four
Maricopa County Air Quality Department	Nonpoint	2850000000	Miscellaneous Area Sources	Health Services	Hospitals	Total: All Operations
Maryland Department of the Environment	Nonpoint	2810030000	Miscellaneous Area Sources	Other Combustion	Structure Fires	Unspecified
Maryland Department of the Environment	Nonpoint	2810050000	Miscellaneous Area Sources	Other Combustion	Motor Vehicle Fires	Unspecified
Maryland Department of the Environment	Nonpoint	2810060100	Miscellaneous Area Sources	Other Combustion	Cremation	Humans
Maryland Department of the Environment	Nonpoint	2810060200	Miscellaneous Area Sources	Other Combustion	Cremation	Animals
Maryland Department of the Environment	Nonpoint	2830000000	Miscellaneous Area Sources	Catastrophic/Accidental Releases	All Catastrophic/Accidental Releases	Total
Maryland Department of the Environment	Nonpoint	2850000010	Miscellaneous Area Sources	Health Services	Hospitals	Sterilization Operations
Maryland Department of the Environment	Nonpoint	2851001000	Miscellaneous Area Sources	Laboratories	Bench Scale Reagents	Total
Maryland Department of the Environment	Nonpoint	2861000000	Miscellaneous Area Sources	Fluorescent Lamp Breakage	Non-recycling Related Emissions	Total
Maryland Department of the Environment	Nonpoint	2861000010	Miscellaneous Area Sources	Fluorescent Lamp Breakage	Recycling Related Emissions	Total
Massachusetts Department of Environmental Protection	Nonpoint	2810025000	Miscellaneous Area Sources	Other Combustion	Charcoal Grilling - Residential (see 23-02-002-xxx for Commercial)	Total
Massachusetts Department of Environmental Protection	Nonpoint	2810030000	Miscellaneous Area Sources	Other Combustion	Structure Fires	Unspecified
Massachusetts Department of Environmental Protection	Nonpoint	2810040000	Miscellaneous Area Sources	Other Combustion	Aircraft/Rocket Engine Firing and Testing	Total
Massachusetts Department of Environmental Protection	Nonpoint	2810050000	Miscellaneous Area Sources	Other Combustion	Motor Vehicle Fires	Unspecified
Massachusetts Department of Environmental Protection	Nonpoint	2830000000	Miscellaneous Area Sources	Catastrophic/Accidental Releases	All Catastrophic/Accidental Releases	Total
Metro Public Health of Nashville/Davidson County	Nonpoint	2810030000	Miscellaneous Area Sources	Other Combustion	Structure Fires	Unspecified
Metro Public Health of Nashville/Davidson County	Nonpoint	2810050000	Miscellaneous Area Sources	Other Combustion	Motor Vehicle Fires	Unspecified
Metro Public Health of Nashville/Davidson County	Nonpoint	2840010000	Miscellaneous Area Sources	Automotive Repair Shops	Auto Top and Body Repair	Total
Minnesota Pollution Control Agency	Nonpoint	2810030000	Miscellaneous Area Sources	Other Combustion	Structure Fires	Unspecified
Minnesota Pollution Control Agency	Nonpoint	2850001000	Miscellaneous Area Sources	Health Services	Dental Alloy Production	Overall Process
Minnesota Pollution Control Agency	Nonpoint	2851001000	Miscellaneous Area Sources	Laboratories	Bench Scale Reagents	Total
Minnesota Pollution Control Agency	Nonpoint	2862000000	Miscellaneous Area Sources	Swimming Pools	Total (Commercial, Residential, Public)	Total

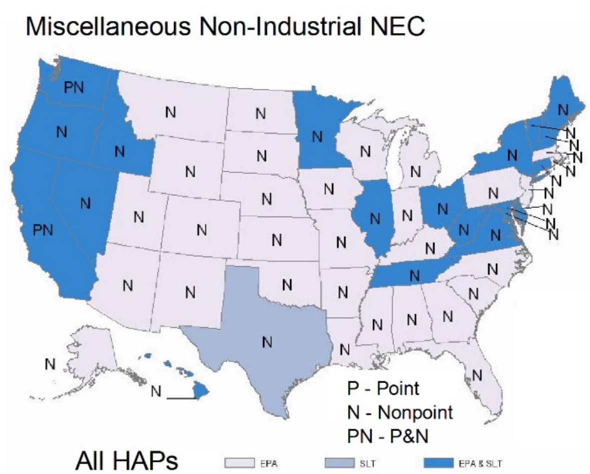
Data Set Name	Data Category	SCC	SCC Level One	SCC Level Two	SCC Level Three	SCC Level Four
Missouri Department of Natural Resources	Nonpoint	2810060100	Miscellaneous Area Sources	Other Combustion	Cremation	Humans
Missouri Department of Natural Resources	Nonpoint	2810060200	Miscellaneous Area Sources	Other Combustion	Cremation	Animals
Nevada Division of Environmental Protection	Point	50100603	Waste Disposal	Solid Waste Disposal - Government	Fire Fighting	Structure: Kerosene
Nevada Division of Environmental Protection	Point	50100604	Waste Disposal	Solid Waste Disposal - Government	Fire Fighting	Structure: Wood Pallets
New Hampshire Department of Environmental Services	Nonpoint	2810030000	Miscellaneous Area Sources	Other Combustion	Structure Fires	Unspecified
New Hampshire Department of Environmental Services	Nonpoint	2810050000	Miscellaneous Area Sources	Other Combustion	Motor Vehicle Fires	Unspecified
New Jersey Department of Environment Protection	Nonpoint	2810003000	Miscellaneous Area Sources	Other Combustion	Cigarette Smoke	Total
New Jersey Department of Environment Protection	Nonpoint	2810030000	Miscellaneous Area Sources	Other Combustion	Structure Fires	Unspecified
New Jersey Department of Environment Protection	Nonpoint	2810050000	Miscellaneous Area Sources	Other Combustion	Motor Vehicle Fires	Unspecified
New York State Department of Environmental Conservation	Nonpoint	2810060200	Miscellaneous Area Sources	Other Combustion	Cremation	Animals
New York State Department of Environmental Conservation	Point	50100602	Waste Disposal	Solid Waste Disposal - Government	Fire Fighting	Structure: Distillate Oil
Nez Perce Tribe	Nonpoint	2810025000	Miscellaneous Area Sources	Other Combustion	Charcoal Grilling - Residential (see 23-02-002-xxx for Commercial)	Total
Nez Perce Tribe	Nonpoint	2810030000	Miscellaneous Area Sources	Other Combustion	Structure Fires	Unspecified
Nez Perce Tribe	Nonpoint	2810050000	Miscellaneous Area Sources	Other Combustion	Motor Vehicle Fires	Unspecified
Nez Perce Tribe	Nonpoint	2810060100	Miscellaneous Area Sources	Other Combustion	Cremation	Humans
Nez Perce Tribe	Nonpoint	2810060200	Miscellaneous Area Sources	Other Combustion	Cremation	Animals
Ohio Environmental Protection Agency	Nonpoint	2810030000	Miscellaneous Area Sources	Other Combustion	Structure Fires	Unspecified
Ohio Environmental Protection Agency	Nonpoint	2810060100	Miscellaneous Area Sources	Other Combustion	Cremation	Humans
Oregon Department of Environmental Quality	Nonpoint	2810030000	Miscellaneous Area Sources	Other Combustion	Structure Fires	Unspecified
Oregon Department of Environmental Quality	Nonpoint	2850000010	Miscellaneous Area Sources	Health Services	Hospitals	Sterilization Operations
Shoshone-Bannock Tribes of the Fort Hall Reservation of Idaho	Nonpoint	2810025000	Miscellaneous Area Sources	Other Combustion	Charcoal Grilling - Residential (see 23-02-002-xxx for Commercial)	Total

Data Set Name	Data Category	SCC	SCC Level One	SCC Level Two	SCC Level Three	SCC Level Four
Shoshone-Bannock Tribes of the Fort Hall Reservation of Idaho	Nonpoint	2810030000	Miscellaneous Area Sources	Other Combustion	Structure Fires	Unspecified
Shoshone-Bannock Tribes of the Fort Hall Reservation of Idaho	Nonpoint	2810050000	Miscellaneous Area Sources	Other Combustion	Motor Vehicle Fires	Unspecified
Shoshone-Bannock Tribes of the Fort Hall Reservation of Idaho	Nonpoint	2810060100	Miscellaneous Area Sources	Other Combustion	Cremation	Humans
Shoshone-Bannock Tribes of the Fort Hall Reservation of Idaho	Nonpoint	2810060200	Miscellaneous Area Sources	Other Combustion	Cremation	Animals
Texas Commission on Environmental Quality	Nonpoint	2810030000	Miscellaneous Area Sources	Other Combustion	Structure Fires	Unspecified
Texas Commission on Environmental Quality	Nonpoint	2810050000	Miscellaneous Area Sources	Other Combustion	Motor Vehicle Fires	Unspecified
Texas Commission on Environmental Quality	Point	50100601	Waste Disposal	Solid Waste Disposal - Government	Fire Fighting	Structure: Jet Fuel
Utah Division of Air Quality	Nonpoint	2810010000	Miscellaneous Area Sources	Other Combustion	Human Perspiration and Respiration	Total
Utah Division of Air Quality	Nonpoint	2810040000	Miscellaneous Area Sources	Other Combustion	Aircraft/Rocket Engine Firing and Testing	Total
Utah Division of Air Quality	Point	50100604	Waste Disposal	Solid Waste Disposal - Government	Fire Fighting	Structure: Wood Pallets
Vermont Department of Environmental Conservation	Nonpoint	2810030000	Miscellaneous Area Sources	Other Combustion	Structure Fires	Unspecified
Vermont Department of Environmental Conservation	Nonpoint	2810050000	Miscellaneous Area Sources	Other Combustion	Motor Vehicle Fires	Unspecified
Vermont Department of Environmental Conservation	Nonpoint	2810060100	Miscellaneous Area Sources	Other Combustion	Cremation	Humans
Virginia Department of Environmental Quality	Nonpoint	2810030000	Miscellaneous Area Sources	Other Combustion	Structure Fires	Unspecified
Virginia Department of Environmental Quality	Nonpoint	2810060100	Miscellaneous Area Sources	Other Combustion	Cremation	Humans
Washington State Department of Ecology	Nonpoint	2810030000	Miscellaneous Area Sources	Other Combustion	Structure Fires	Unspecified
Washington State Department of Ecology	Nonpoint	2810050000	Miscellaneous Area Sources	Other Combustion	Motor Vehicle Fires	Unspecified
Washington State Department of Ecology	Point	50100601	Waste Disposal	Solid Waste Disposal - Government	Fire Fighting	Structure: Jet Fuel
Washoe County Health District	Nonpoint	2810030000	Miscellaneous Area Sources	Other Combustion	Structure Fires	Unspecified
Washoe County Health District	Nonpoint	2810035000	Miscellaneous Area Sources	Other Combustion	Firefighting Training	Total
Washoe County Health District	Nonpoint	2810050000	Miscellaneous Area Sources	Other Combustion	Motor Vehicle Fires	Unspecified

Data Set Name	Data Category	SCC	SCC Level One	SCC Level Two	SCC Level Three	SCC Level Four
Washoe County Health District	Nonpoint	2810060100	Miscellaneous Area Sources	Other Combustion	Cremation	Humans
Washoe County Health District	Nonpoint	2810060200	Miscellaneous Area Sources	Other Combustion	Cremation	Animals
Washoe County Health District	Nonpoint	2840000000	Miscellaneous Area Sources	Automotive Repair Shops	Automotive Repair Shops	Total
Washoe County Health District	Nonpoint	2850000000	Miscellaneous Area Sources	Health Services	Hospitals	Total: All Operations
Washoe County Health District	Nonpoint	2851001000	Miscellaneous Area Sources	Laboratories	Bench Scale Reagents	Total
West Virginia Division of Air Quality	Nonpoint	2810060100	Miscellaneous Area Sources	Other Combustion	Cremation	Humans
West Virginia Division of Air Quality	Nonpoint	2850001000	Miscellaneous Area Sources	Health Services	Dental Alloy Production	Overall Process
West Virginia Division of Air Quality	Nonpoint	2851001000	Miscellaneous Area Sources	Laboratories	Bench Scale Reagents	Total
West Virginia Division of Air Quality	Nonpoint	2861000000	Miscellaneous Area Sources	Fluorescent Lamp Breakage	Non-recycling Related Emissions	Total
West Virginia Division of Air Quality	Nonpoint	2861000010	Miscellaneous Area Sources	Fluorescent Lamp Breakage	Recycling Related Emissions	Total

3.25.3 Spatial coverage and data sources for the sector





3.26 Solvent – Consumer & Commercial Solvent Use

3.26.1 Sector description

Consumer products are those products used around the home, office, institution, or similar settings. The commercial and institutional use of these products is included under "consumer products." The solvent-containing products in this category include personal care products, household products, automotive aftermarket products, adhesives and sealants, pesticides, some coatings, and other commercial and consumer products that may emit VOCs. Products not included in this category are products used as non-aerosol traffic markings, architectural and industrial maintenance coatings, autobody refinishing coatings, and products used in industrial processes.

Volatile organic compounds (VOC) are ingredients of consumer and commercial products that serve as propellants, aid in product drying (through evaporation), act as co-solvents and cleaning agents, and are emitted during product use. Typically, these VOC sources are large in number, highly dispersed, and individually emit relatively small amounts of VOC. It is important to note here that not all organic compounds contained in consumer and commercial products are considered reactive VOCs by the EPA due to their negligible photochemical reactivity. For more information on Consumer Solvents, see the EIIP document, Consumer and Commercial Solvent Use, Final Report, 1996.

SCCs that are used by state, local and tribal agencies are provided in Table 3-115. The SCCs that EPA estimates emissions for are marked in column 2. Because of the different nature of the activity inputs, the methodology description for estimating emissions for this sector will be divided into three parts: 1) Personal Care, Household, Automotive Aftermarket, Coatings, Adhesives and Sealants Products, NEC and FIFRA Related Products (Household Pesticide); 2) Asphalt Paving, and 3) Agricultural Pesticides. SCC level 1 descriptions for all SCCs in this table are "Solvent Utilization". SCC level 2 descriptions are "Miscellaneous Non-industrial: ", and one the following: "Commercial", "Consumer" or "Consumer and Commercial".

Table 3-115: SCCs used by S/L/T agencies for Solvent – Consumer & Commercial Solvent Use sector

SCC	EPA uses	SCC short description
2460000000		All Processes
2460100000	Y	All Personal Care Products
2460110000		Personal Care Products: Hair Care Products
2460120000		Personal Care Products: Deodorants and Antiperspirants
2460130000		Personal Care Products: Fragrance Products
2460150000		Personal Care Products: Nail Care Products
2460160000		Personal Care Products: Facial and Body Treatments
2460170000		Personal Care Products: Oral Care Products
2460180000		Personal Care Products: Health Use Products (External Only)
2460190000		Personal Care Products: Miscellaneous Personal Care Products
2460200000	Y	All Household Products
2460210000		Household Products: Hard Surface Cleaners
2460220000		Household Products: Laundry Products
2460230000		Household Products: Fabric and Carpet Care Products
2460250000		Household Products: Waxes and Polishes
2460270000		Household Products: Shoe and Leather Care Products
2460290000		Household Products: Miscellaneous Household Products
2460400000	Y	All Automotive Aftermarket Products
2460410000		Automotive Aftermarket Products: Detailing Products
2460420000		Automotive Aftermarket Products: Maintenance and Repair Products
2460500000	Y	All Coatings and Related Products
2460510000		Coatings and Related Products: Aerosol Spray Paints
2460520000		Coatings and Related Products: Coating Related Products
2460600000	Y	All Adhesives and Sealants
2460610000		Adhesives and Sealants: Adhesives

SCC	EPA uses	SCC short description
2460800000	Y	All FIFRA Related Products
2460810000		FIFRA Related Products: Insecticides
2460820000		FIFRA Related Products: Fungicides and Nematicides
2460900000	Y	Miscellaneous Products (Not Otherwise Covered)
2461000000		All Processes
2461020000		Asphalt Application: All Processes
2461021000	Y	Cutback Asphalt
2461022000	Y	Emulsified Asphalt
2461023000		Asphalt Roofing
2461100000		Solvent Reclamation: All Processes
2461160000		Tank/Drum Cleaning: All Processes
2461800000		Pesticide Application: All Processes
2461800001		Pesticide Application: All Processes, surface application
2461800002		Pesticide Application: All Processes, soil incorporation
2461850000	Y	Pesticide Application: Agricultural
2461850001		Pesticide Application: Agricultural, herbicides, corn
2461850002		Pesticide Application: Agricultural, herbicides, apples
2461850003		Pesticide Application: Agricultural, herbicides, grapes
2461850004		Pesticide Application: Agricultural, herbicides, potatoes
2461850005		Pesticide Application: Agricultural, herbicides, soy beans
2461850006		Pesticide Application: Agricultural, herbicides, hay & grains
2461850009		Pesticide Application: Agricultural, herbicides, NEC
2461850051		Pesticide Application: Agricultural, other pesticides, corn
2461850052		Pesticide Application: Agricultural, other pesticides, apples
2461850053		Pesticide Application: Agricultural, other pesticides, grapes
2461850054		Pesticide Application: Agricultural, other pesticides, potatoes
2461850055		Pesticide Application: Agricultural, other pesticides, soy beans
2461850056		Pesticide Application: Agricultural, other pesticides, hay & grains
2461850099		Pesticide Application: Agricultural, other pesticides, NEC
2461870999		Pesticide Application: Non-Agricultural, NEC
2465000000		All Products/Processes
2465100000		Personal Care Products
2465200000		Household Products
2465400000		Automotive Aftermarket Products
2465800000		Pesticide Application

3.26.2 Sources of data overview and selection hierarchy

The S/L/T agencies that submitted data to the EPA are listed in Table 3-116**.** A number of states submitted nonpoint emissions for this sector. Table 3-117 shows the selection hierarchy included in the Solvent – Commercial and Consumer sector.

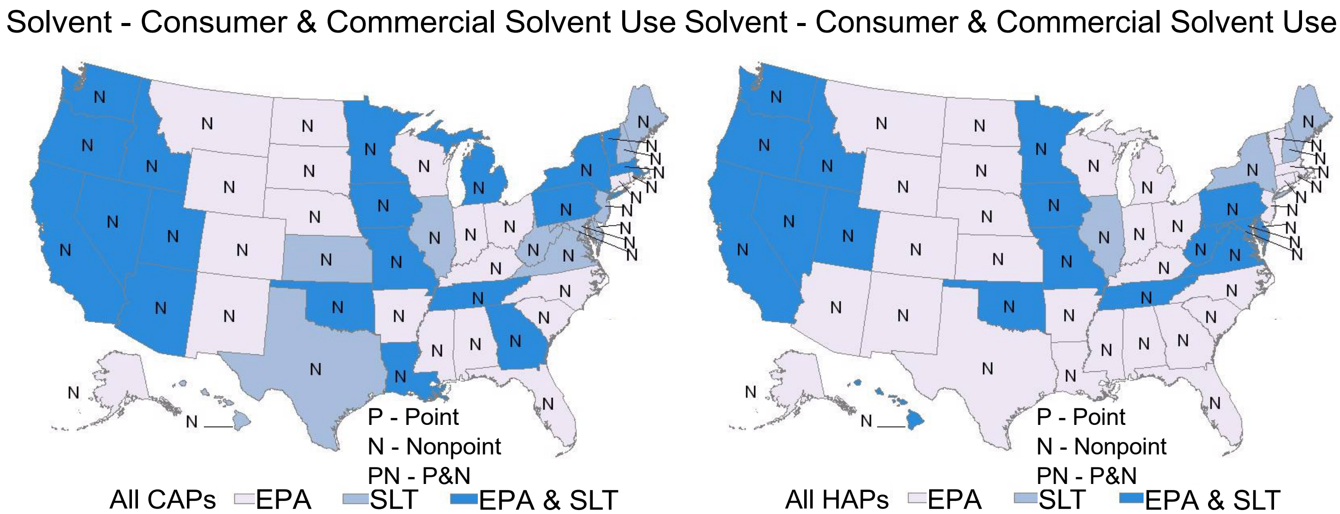
Table 3-116: Agencies that submitted data for Consumer & Commercial Solvents

Data Set Short Name	State	Data Set Name	Data Category
2011CARB	CA	California Air Resources Board	Nonpoint
2011ClarkCty		Clark County Department of Air Quality and Environmental Management	Nonpoint
2011DDOE	DC	DC Department of Health Air Quality Division	Nonpoint
2011DEDNR	DE	Delaware Deparment of Natural Resources and Environmental Control	Nonpoint
2011GADNR	GA	Georgia Department of Natural Resources	Nonpoint
2011HIDOH	HI	Hawaii Department of Health Clean Air Branch	Nonpoint
2011IADNR	IA	Iowa Department of Natural Resources	Nonpoint
2011IDDEQ	ID	Idaho Department of Environmental Quality	Nonpoint
2011ILEPA	IL	Illinois Environmental Protection Agency	Nonpoint
2011KSDOHE	KS	Kansas Department of Health and Environment	Nonpoint
2011LADEQ	LA	Louisiana Department of Environmental Quality	Nonpoint
2011MADEP	MA	Massachusetts Department of Environmental Protection	Nonpoint
2011Maricopa		Maricopa County Air Quality Department	Nonpoint
2011MDDOE	MD	Maryland Department of the Environment	Nonpoint
2011MEDEP	ME	Maine Department of Environmental Protection	Nonpoint
2011MIDEQ	MI	Michigan Department of Environmental Quality	Nonpoint
2011MNPCA	MN	Minnesota Pollution Control Agency	Nonpoint
2011MODNR	MO	Missouri Department of Natural Resources	Nonpoint
2011Nashville		Metro Public Health of Nashville/Davidson County	Nonpoint
2011NHDES	NH	New Hampshire Department of Environmental Services	Nonpoint
2011NJDEP	NJ	New Jersey Department of Environment Protection	Nonpoint
2011NYDEC	NY	New York State Department of Environmental Conservation	Nonpoint
2011OKDEQ	OK	Oklahoma Department of Environmental Quality	Nonpoint
2011ORDEQ	OR	Oregon Department of Environmental Quality	Nonpoint
2011PADEP	PA	Pennsylvania Department of Environmental Protection	Nonpoint
2011TR001		Eastern Band of Cherokee Indians	Nonpoint
2011TR180		Shoshone-Bannock Tribes of the Fort Hall Reservation of Idaho	Nonpoint
2011TR181		Coeur d'Alene Tribe	Nonpoint
2011TR182		Nez Perce Tribe	Nonpoint
2011TR183		Kootenai Tribe of Idaho	Nonpoint
2011TR207		Northern Cheyenne Tribe	Nonpoint
2011TR863		Sac and Fox Nation of Missouri in Kansas and Nebraska Reservation	Nonpoint
2011TXCEQ	TX	Texas Commission on Environmental Quality	Nonpoint
2011UTDAQ	UT	Utah Division of Air Quality	Nonpoint
2011VADEQ	VA	Virginia Department of Environmental Quality	Nonpoint
2011VTDEC	VT	Vermont Department of Environmental Conservation	Nonpoint
2011WADOE	WA	Washington State Department of Ecology	Nonpoint
2011WashoeCty		Washoe County Health District	Nonpoint
2011WVDAQ	WV	West Virginia Division of Air Quality	Nonpoint
TR382		Santee Sioux Nation, Nebraska	Nonpoint
TR861		Kickapoo Tribe of Indians of the Kickapoo Reservation in Kansas	Nonpoint

Table 3-117: Data selection hierarchy for the Solvent –Commercial and Consumer Solvent Use sector

Priority	Dataset Name	Dataset Content
1	Responsible Agency Data Set	State and Local Agency submitted emissions
2	2011EPA_HAP-Augmentation	Adds Pb and other HAP emissions in 46 states
3	2011EPA_NP_NoOverlap_w_Pt	EPA-generated data, including agricultural crops and livestock dust emissions

3.26.3 Spatial coverage and data sources for the sector



3.26.4 Development of EPA Emissions for Consumer and Commercial Solvents

EPA developed emission estimates for the 10 SCCs given in Table 3-118. SCC level 1 descriptions for these SCCs are "Solvent Utilization". SCC level 2 descriptions are "Miscellaneous Non-industrial: ", and one the following: "Commercial" or "Consumer and Commercial".

Table 3-118: Nonpoint SCC estimates developed by EPA for Consumer & Commercial Solvents sector

SCC	SCC Description
2460100000	All Personal Care Products
2460200000	All Household Products
2460400000	All Automotive Aftermarket Products
2460500000	All Coatings and Related Products
2460600000	All Adhesives and Sealants
2460900000	Miscellaneous Products (Not Otherwise Covered)
2460800000	All FIFRA Related Products
2461021000	Cutback Asphalt
2461022000	Emulsified Asphalt
2461850000	Pesticide Application: Agricultural

Because of the different nature of the activity factors that go into the methodology, this sector's methodology description for estimating emissions will be divided into three parts: 1) Personal Care, Household, Automotive Aftermarket, Coatings, Adhesives and Sealants Products, NEC and FIFRA Related Products (Household Pesticide); 2) Asphalt Paving, and 3) Agricultural Pesticides.

3.26.4.1 *Personal Care, Household, Automotive Aftermarket, Coatings, Adhesives and Sealants Products, NEC and FIFRA Related Products (Household Pesticide)*

Emissions were calculated in accordance with the alternative method in EIIP Volume 3, Chapter 5 [ref 2]. Emissions are calculated for each county using emission factors and activity as:

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

$E_{x,p}$ = annual emissions for category x and pollutant p

A_x = population data associated with category x

$EF_{x,p}$ = emission factor for category x and pollutant p

Example:

According to the U.S. Census Bureau, Ada County had a total population of 392,365 people. The emission factor for personal care products VOC is 1.9 lb/ person:

E_{VOC} = 392,365 people × 1.9 lb VOC/ person

= 372.7 tons VOC

Activity Data

This category uses population and emissions factors to calculate emissions. National population data were collected from the 2010 Census Bureau Interactive Population Search [ref 1] for each county.

Emission Factors

EPA, through the ERTAC committee process, chose emission factors for consumer and commercial solvent use from the Emission Inventory Improvement Program (EIIP) [ref 2] and a Freedonia 2007 report. The emission factors are based on national population (lb/person). Two of the VOC factors were updated with information from the EPA ERTAC 2008 calculations for this category [ref 3]. Information about the EIIP can be found on the CHIEF website. Emission factors EPA used in the 2011 NEI are provided in Table 3-119. The emission factors from Fredonia were taken from the Freedonia report for 2007. For all SCCs, the leading SCC description is "Solvent Utilization; Miscellaneous Non-Industrial: Consumer and Commercial" and the level 4 description is "Total: All Solvent Types".

Table 3-119: Consumer and Commercial Solvent Use emission factors

SCC	Description	Pollutant Code	Pollutant Description	Emission Factor	EF units	source
2460100000	All Personal Care Products	108883	Toluene	0.5092	LB/person	HAP speciation profile
2460100000	All Personal Care Products	67561	Methanol	0.2546	LB/person	HAP speciation profile
2460100000	All Personal Care Products	VOC	VOC	1.9	LB/person	Freedonia, 2007
2460200000	All Household Products	108883	Toluene	0.4824	LB/person	HAP speciation profile
2460200000	All Household Products	67561	Methanol	0.2412	LB/person	HAP speciation profile
2460200000	All Household Products	VOC	VOC	1.8	LB/person	Freedonia, 2007
2460400000	All Automotive Aftermarket Products	107211	Ethylene Glycol	0.39712	LB/person	HAP speciation profile
2460400000	All Automotive Aftermarket Products	108883	Toluene	0.36448	LB/person	HAP speciation profile

SCC	Description	Pollutant Code	Pollutant Description	Emission Factor	EF units	source
2460400000	All Automotive Aftermarket Products	67561	Methanol	0.18224	LB/person	HAP speciation profile
2460400000	All Automotive Aftermarket Products	VOC	VOC	1.36	LB/person	EIIP [ref 2]
2460500000	All Coatings and Related Products	108883	Toluene	0.2546	LB/person	HAP speciation profile
2460500000	All Coatings and Related Products	67561	Methanol	0.1273	LB/person	HAP speciation profile
2460500000	All Coatings and Related Products	VOC	VOC	0.95	LB/person	EIIP [ref 2]
2460600000	All Adhesives and Sealants	108883	Toluene	0.15276	LB/person	HAP speciation profile
2460600000	All Adhesives and Sealants	67561	Methanol	0.07638	LB/person	HAP speciation profile
2460600000	All Adhesives and Sealants	VOC	VOC	0.57	LB/person	EIIP [ref 2]
2460900000	Miscellaneous Products NEC	108883	Toluene	0.1876	LB/person	HAP speciation profile
2460900000	Miscellaneous Products NEC	67561	Methanol	0.00938	LB/person	HAP speciation profile
2460900000	Miscellaneous Products NEC	VOC	VOC	0.07	LB/person	EIIP [ref 2]

3.26.4.2 *Asphalt Paving- Cutback and Emulsified*

While Asphalt Paving is part of Consumer and Commercial Solvents sector, the nature of its methodology is significantly different from most of the other sources in this sector.

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

Asphalt cements thinned with petroleum distillates are known as cutback asphalts (SCC=246102100). The primary uses of cutback asphalt include tack and seal operations, priming roadbeds, and paving operations for pavements up to several inches thick. Cut-back asphalt is produced by thinning the binder in a diluent containing 25 to 45 percent petroleum distillates by volume prior to mixing with the aggregate. This reduces the viscosity of the asphalt making it easier to work with the mixture. Emissions from cutback asphalt result from the evaporation of VOCs and HAPS after the mixture is laid down. Of all asphalt types, cutback asphalt has the highest diluent content and, as a result, emits the highest levels of VOCs per ton used. The timeframe and quantity of VOC and HAP emissions depend on the type and the quantity of organic solvent used as a diluent.

Asphalt cements thinned with water and an emulsifying agent are known as emulsified asphalts (SCC=2461022000). This thinning reduces the viscosity of the asphalt making it easier to work with the mixture. The primary uses of emulsified asphalt include tack and seal operations, priming roadbeds, and paving operations for pavements up to several inches thick. Emulsified asphalt may contain up to 12 percent organic solvents by volume. Emissions from emulsified asphalt result from the evaporation of VOCs after the mixture is laid down. Compared to cutback asphalt, emulsified asphalt has lower VOCs emissions per ton used.

Emissions were calculated by multiplying the county-level asphalt usage (barrels) by the emission factors listed in Table 3-120 [ref 4] and then dividing by 2000 to convert pounds to tons.

$$Emissions_{x,y} = (Asphalt\ Usage_x * EF_y) / 2000$$

where:

$Emissions_{x,y}$ = emissions (tons) of pollutant y in county x
$Asphalt\ Usage_x$ = emulsified asphalt (barrels) used in county x
EF_y = emission factor for pollutant y

To convert tons of asphalt reported in the 2008 Asphalt Usage Survey to barrels, it was assumed that the density of asphalt is similar to that of water, 8.34 lbs/gal, and that one barrel equals 42 gallons.

Barrels of Asphalt = (tons of asphalt * 2000 lbs / 8.34 lbs per gal) / 42 gal per barrel

Note that one barrel of asphalt weights approximately 350 pounds.

Example:
Nez Perce County was allocated 3,413.16 barrels of emulsified asphalt for 2011. The emission factor for VOC is 9.2 lb/Barrel of emulsified asphalt.

E_{VOC} = 3,413.16 barrels of emulsified asphalt × 9.2 lb VOC/Barrel.
= 15.7 Tons VOC for Nez Perce County.

Activity Data

The activity data required to calculate the emissions from asphalt paving are the number of barrels of cutback asphalt and emulsified asphalt used in each county. To determine the amount of each kind of asphalt used in each county, the total number of barrels of asphalt used in each state was required. The amount of cutback and emulsified asphalt used was obtained from the 2008 Asphalt Usage Survey, from the Asphalt Institute [ref 5]. The 2008 data was used for 2011 due to the Asphalt Institute no longer publishing a state by state report, and no other data was found for a more recent year due to time constraints. The barrels of asphalt used per state were then allocated to county-level according to the fraction of paved road vehicle miles traveled (VMT) in each county.

Total annual VMT estimates by State and roadway class were obtained from the Federal Highway Administration's (FHWA) annual Highway Statistics report [ref 6]. Paved road VMT was calculated by subtracting the State/roadway class unpaved road VMT from total State/roadway class VMT. State-level paved road VMT was spatially allocated to counties according to the fraction of total VMT in each county for the specific roadway class as shown by the following equation:

$$VMT_{x,total} = \sum VMTST_y * VMT_{x,y} / VMTST_y$$

where:

$VMT_{x,total}$ = VMT (million miles) in county x on all paved roadways
$VMTST_y$ = paved road VMT for the entire State for roadway class y

$VMT_{x,y}$ = total VMT (million miles) in county x and roadway class y
$VMTST_y$ = total VMT (million miles) in entire State for roadway class y

The county-level total VMT by roadway class used in this calculation was previously developed by E.H. Pechan and Associates, Inc. to support the onroad national emissions inventory [ref 7]. To convert tons of asphalt reported in the 2008 Asphalt Usage Survey to barrels, it was assumed that the density of asphalt is similar to that of water, 8.34 lbs/gal, and that one barrel equals 42 gallons.

Emission Factors

Emission factors for cutback and emulsified asphalt usage, provided in Table 3-120, were obtained from the EIIP Technical Report Series produced by the U.S. EPA's Emission Inventory Improvement Program and are reported in [ref 4].

Table 3-120: Criteria and HAP emission factors for Asphalt Paving

Source Category	**Pollutant**	**Emission Factor (lb/bbl)**
Emulsified Asphalt	VOC	9.2
Cutback Asphalt	VOC	88.00
	Ethylbenzene	2.02
	Toluene	5.63
	Xylenes (mix of o, m, p isomers)	10.74

3.26.4.3 *Agricultural Pesticide Application*

While Agricultural Pesticide Application (SCC=246185000, "Solvent Utilization; Miscellaneous Non-industrial: Commercial; Pesticide Application: Agricultural; All Processes") is part of Consumer and Commercial Solvents sector, the nature of its methodology is significantly different from most of the other sources in this sector. Pesticides are substances used to control nuisance species and can be classified by targeted pest group: weeds (herbicides), insects (insecticides), fungi (fungicides), and rodents (rodenticides). They can be further described by their chemical characteristics: synthetics, non-synthetics (petroleum products), and inorganics. Different pesticides are made through various combinations of the pest-killing material, also called the active ingredient (AI), and various solvents (which serve as carriers for the AI). Both types of ingredients contain volatile organic compounds (VOC) that may be emitted to the air during application or after application as a result of evaporation.

Approximately 68 to 75 percent of pesticides used in the United States are applied to agricultural lands, both cropland and pasture. Agricultural pesticides continue to be a cost-effective means of controlling weeds, insects, and other threats to the quality and yield of food production. Since application rates for a particular pesticide may vary from crop to crop and from region to region, the crop-specific, regional application rates should be considered when estimating potential VOC emissions.

Emissions Factors

The default emissions factor for pesticide application (0.751) is expressed as the pounds of VOC that evaporate per pound of pesticide active ingredient (AI) applied and was calculated using the following equation:

$$EF = ER \times VOC$$

where:

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

The evaporation rate was assumed to be 0.9 (or 90 percent) and is based on EPA recommendations provided in the Emissions Inventory Improvement Program guidance [ref 8]. As discussed below in the section on activity data, The Crop Life Foundation (CLF) has compiled a state-level dataset of fungicide, herbicide, and insecticide use based on survey data from 1999 to 2004 [ref 9]. A default VOC content was calculated as the weighted average VOC content for all pesticides reported in the Crop Life Foundation database for which there were pesticide matches to the California Department of Pesticide Regulation's (DPR) Pesticide Product Emission Potential database [ref 10]. Each record in the DPR database is for a specific pesticide product, and provides product name, primary active ingredient, emission potential (EP), registration number, and method used to estimate the EP. The pesticide specific VOC EP of reactive organic gases (i.e., the weight percentage of product that contributes to VOC emissions) and the weight percent of active ingredient from the DPR database were used to calculate the weighted average VOC content.

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

where:

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

The active ingredient applied (AI) was calculated from the active ingredient application rates reported in the CLF database and the harvested acres reported in the 2007 Census of Agriculture [ref11]. The national pesticide usage (T), reported as pounds of pesticides applied, was calculated using the following equation:

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

Activity

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

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

where:

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

The application rate, R x I, is simply the pounds of active ingredient per harvested acre per year. This rate data, as well as the percent of crop acres in a state treated with the active ingredient, are available in the CLF database [ref 9]. The county-level harvested acres per crop in 2007 are available in the Department of Agriculture's 2007 Census of Agriculture [ref 11]. In cases where there was not a direct match between the crop type provided in the CLF and the Census of Agriculture databases, the crop type from the CLF database was matched to a general crop category from the Census of Agriculture using the crosswalk provided in Table 3-121. This crosswalk enabled the assignment of pesticides to certain crops or crop types and allowed estimation of the quantity of pesticide applied by crop at the county level by linking the rate and AT data from the CLF database with the harvested acreage data from the Census of Agriculture.

<u>Activity Allocation Procedure</u>

To prevent disclosing proprietary data, some crop-specific harvested acre information in the Census of Agriculture is withheld. Estimates for these withheld data were developed in a three-step process, starting with estimating values for data withheld at the national-level, then at the state-level and finally at the county-level. Where data are withheld at the national-level for a given crop, the average harvested acres per farm from all disclosed farms at the national-level was multiplied by the total national-level number of undisclosed farms harvesting that crop and added to the national disclosed number of acres to estimate the national total. If a value is withheld at the state-level, the difference between the national total and the sum of disclosed state totals was evenly distributed among withheld states. Similarly, if a value is withheld at the county level, the difference between the state total and the sum of disclosed county totals was evenly distributed among withheld counties.

For example, as shown in Table 2, the data on total harvested acres of bentgrass seed are withheld at the national level. Taking the disclosed harvested acres of bentgrass seed at the national-level (6,374) and dividing by the total number of disclosed harvested farms at the national-level (58) yields an average of ~110 harvested acres per farm. This value was then applied to the total number of undisclosed farms harvesting bentgrass seed at the national level (6) and the result added to the national-level disclosed acres (6,374) to estimate the total number of acres of bentgrass at the national level (7,033). Subtracting the total number of bentgrass acres associated with disclosed state totals (6,809) from the estimated national total (7,033) yields 224 acres which were then distributed evenly across the undisclosed states.

Table 3-121: Estimation of national-level total harvested acres of bentgrass seed

Estimated Harvested Acres (Total)	Harvested Acres (Disclosed)	Farms (Total)	Farms (Disclosed)	Farms (Undisclosed)	Average Harvested Acres per Disclosed Farm
7,033	6,374	64	58	6	110

Bentgrass seed is only grown in two states (Oregon and Illinois). The allocation procedure for Oregon is discussed and presented in Table 3-122. The state-level data from the Census of Agriculture indicate that there are 6,809 harvested acres in Oregon associated with 63 total harvested farms. At the county-level there are 6,374 harvested acres associated with 58 disclosed farms. To fill in values for the undisclosed farms, the sum of the disclosed county values (6,374) was subtracted from the total state value (6,809) yielding a difference of 435 harvested acres. Dividing these remaining 435 acres by the 5 undisclosed farms gives an average value of 87 harvested acres per farm.

Table 3-122: Estimation of county-level harvested acres of bentgrass seed

State-level Harvested Acres (Total)	County-level Harvested Acres (Disclosed)	State-level Farms (Total)	County-level Farms (Disclosed)	Farms (Undisclosed)	Difference
6,809	6,374	63	58	5	435
Note: The difference is then allocated evenly to the undisclosed farms, in this case 87 acres per farm.					

<u>Controls</u>

No controls were accounted for in the emissions estimation.

<u>Emissions Equation and Sample Calculation</u>

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

$$\text{Total VOC Emissions}_{county} = \Sigma\ (A_{pesticide,crop} \times EF)$$

Taking Autauga County, Alabama as an example, the first step was to determine the amount of active ingredient per pesticide being applied in the county by multiplying each crop type by pesticide specific application rates and the percent of acres treated. For Trifluralin application to green lima beans in Autauga County, there were 5 acres harvested and 50 percent of those acres had pesticide applied. Taking the number of acres to which Trifluralin was applied (2.5) and multiplying by the Trifluralin application rate of 0.5 lbs of AI applied per acre yields 1.25 lbs of AI due to Trifluralin application to green lima beans in Autauga County.

5 acres harvested x 50% (acres treated) x 0.5 (lbs of AI per acre) = 1.25 lbs of AI

This process was then repeated for every crop and pesticide combination present in the county (~600 for Autauga County) and the values were summed to determine the amount of AI applied across the county. For Autauga County this aggregate value was determined to be 60,125 lbs of AI. This value was then multiplied by the emissions factor of 0.751 lb VOC per lb AI to estimate VOC emissions.

60,125 (lbs of AI applied in Autauga County) x 0.751 (lb VOC per lb AI) = 45,179 lb of VOC

This is equivalent to approximately 23 tons of VOC emitted due to agricultural pesticide application in Autauga County.

3.26.5 Summary of data quality assurance methods

The EPA compared EPA generated emissions from this category to previous inventories and found an error that was noted and corrected in 2011 v2. Emissions for toluene for consumer/commercial solvent emissions were mistakenly calculated too high in the EPA dataset. This error was caused by a bad emission factor that other states used. VA noted some errors and EPA assisted VA in resubmitting and the toluene error was corrected at that time. This problem could still be an issue for other states in the cases where they used the bad emission factor for toluene.

The EPA also compared state submitted data to EPA data and found some overlap and instances where possible double counting could occur. To eliminate the double counting in Clarke County, NV, EPA tagged emissions in the EPA dataset for a number of SCCs: 2460100000, 2460200000, 2460400000, 2460500000, 2460600000, and

2460800000. Similar tagging was done for CA (SCCs 2460100000 and 2460600000), and NH and NJ (SCCs 2460100000, 2460200000, 2460400000, 2460500000, 2460600000, 2460800000, and 2460900000).

Ethylene Glycol (pollutant code = 107211) emissions were erroneously applied to all consumer& commercial solvents (this pollutant should only be applied to automotive aftermarket), and these EPA emissions were tagged and removed for 2011 v2.

3.26.6 References for Solvent –Consumer & Commerical Solvent Use

1. U.S. Census Bureau. 2010 Interactive Population Search, Census 2010, accessed November 2011.
2. U.S. EPA Technology Transfer Network, Clearinghouse for Inventories & Emissions Factors, Technical Report Series, Volume 3: Area Sources and Area Source Method Abstracts, Chapter 5 "Consumer and Commercial Solvent Use.", accessed February 2011.
3. ERTAC 2008. Consumer_solvents_epa_data.zip, accessed November 2011.
4. U.S. Environmental Protection Agency, Emissions Inventory Improvement Program, Technical Report Series, Volume III – Area Sources, Chapter 17, "Asphalt Paving," prepared by Eastern Research Group, Inc. for EPA, Research Triangle Park, NC, 2001.
5. Asphalt Institute, 2008 Asphalt Usage Survey for the United States and Canada,
6. U.S. Department of Transportation, Federal Highway Administration, Highway Statistics 2007, Office of Highway Policy Information, Washington, DC, 2008.
7. E.H. Pechan & Associates, Inc. "Documentation for the Onroad National Emission Inventory (NEI) for Base Years 1970 - 2002," report prepared for U.S. Environmental Protection Agency, Office of Air Quality Planning and Standards, Research Triangle Park, NC. January 2004.
8. United States Environmental Protection Agency, "*Pesticides - Agricultural and Nonagricultural*", Vol. 3, Ch. 9, Section 5.1, p. 9.5-4, Emissions Inventory Improvement Program, June 2001.
9. Crop Life Foundation, "*National Pesticide Use Database*", (accessed July 2011).
10. California Department of Pesticide Regulation, "*Pesticide Emission Potential Database*", (accessed August 5, 2011).
11. United States Department of Agriculture, "*Census of Agriculture 2007*", (accessed July 2011).

3.27 Solvent – Non-Industrial Surface Coating

3.27.1 Sector description

Architectural coating (AC) operations consist of applying a thin layer of coating such as paint, paint primer, varnish, or lacquer to architectural surfaces, and the use of solvents as thinners and for cleanup. Architectural surface coatings protect the substrates to which they are applied from corrosion, abrasion, decay, ultraviolet light damage, and/or the penetration of water. Some architectural coatings also increase the aesthetic value of a structure by changing the color or texture of its surface. Architectural coatings are also important in construction of structures. Examples of the latter are concrete form release compounds, which prevent concrete from sticking to forms, and concrete curing compounds, which allow concrete to cure properly. It should be noted that this category does not include auto refinishing, traffic marking, surface coating during manufacturing, industrial maintenance coatings, special purpose coatings, or paints used in graphic arts applications.

Volatile organic compounds (VOCs) that are used as solvents in the coatings are emitted during application of the coating and as the coating dries. The amount of coating used, and the VOC content of the coating are the factors that primarily determine emissions from architectural surface coating operations. Secondary sources of VOC emissions are from the solvents used to clean the architectural coating application equipment and VOC released as reaction byproducts while the coating dries and hardens. VOC emitted from this chemical reaction is determined by the resins used in a particular coating. The VOC emitted from any of these sources could include HAPs. The 2011 NEI does not include any byproduct emissions.

Table 3-123 lists the SCCs that are included in the 2011 NEI v2. EPA estimates use the highlighted SCC below.

Table 3-123: Non-Industrial Architectural Coatings SCCs in the 2011 NEI

SCC	SCC Level One	SCC Level Two	SCC Level Three	SCC Level Four
2401001000	Solvent Utilization	Surface Coating	Architectural Coatings	Total: All Solvent Types
2401002000	Solvent Utilization	Surface Coating	Architectural Coatings - Solvent-based	Total: All Solvent Types
2401003000	Solvent Utilization	Surface Coating	Architectural Coatings - Water-based	Total: All Solvent Types

3.27.2 Sources of data overview and selection hierarchy

Table 3-124 shows the selection hierarchy for all datasets contributing to the architectural coatings sector. Table 3-125 shows the agencies that submitted data used by the 2011 NEI. In some cases, the EPA PM and HAP augmentation were used to fill in PM species and HAP pollutants based on S/L/T agency data. There was no point data submitted to this category.

Table 3-124: 2011 NEI Architectural Coatings sector data selection hierarchy

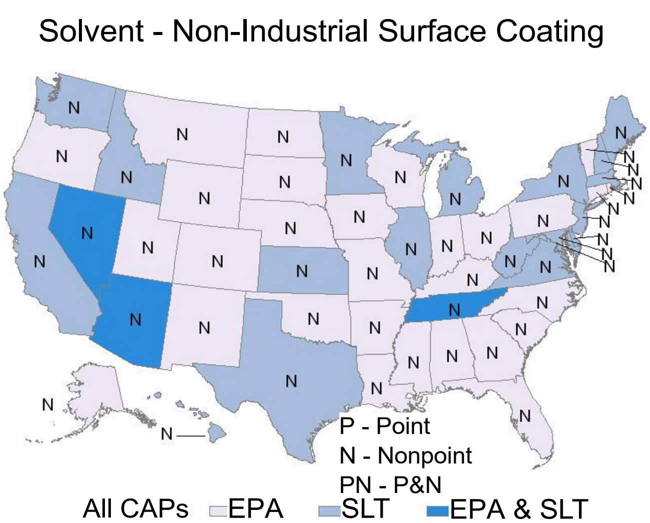
Priority	Dataset Name	Dataset Content
1	2011EPA_PM-Augmentation	Augments PM data in 47 states and some tribes
2	Responsible Agency Data Set	State and Local Agency submitted emissions
3	2011EPA_HAP-Augmentation	Adds Pb and other HAP emissions in 46 states
4	2011EPA_NP_NoOverlap_w_Pt	EPA-generated data

Table 3-125: Agencies that submitted data for the Architectural Coatings sector

Data Set Name	SCC
2011EPA_HAP-Augmentation	2401001000
2011EPA_HAP-Augmentation	2401002000
2011EPA_HAP-Augmentation	2401003000
2011EPA_NP_NoOverlap_w_Pt	2401001000
2011EPA_PM-Augmentation	2401002000
2011EPA_PM-Augmentation	2401003000
California Air Resources Board	2401001000
California Air Resources Board	2401002000
California Air Resources Board	2401003000
Clark County Department of Air Quality and Environmental Management	2401002000
Clark County Department of Air Quality and Environmental Management	2401003000
Coeur d'Alene Tribe	2401001000
DC Department of Health Air Quality Division	2401001000
Delaware Department of Natural Resources and Environmental Control	2401002000
Delaware Department of Natural Resources and Environmental Control	2401003000
Hawaii Department of Health Clean Air Branch	2401002000
Hawaii Department of Health Clean Air Branch	2401003000

Data Set Name	SCC
Idaho Department of Environmental Quality	2401001000
Illinois Environmental Protection Agency	2401001000
Kansas Department of Health and Environment	2401001000
Kootenai Tribe of Idaho	2401001000
Maine Department of Environmental Protection	2401001000
Maricopa County Air Quality Department	2401001000
Maryland Department of the Environment	2401002000
Maryland Department of the Environment	2401003000
Massachusetts Department of Environmental Protection	2401001000
Metro Public Health of Nashville/Davidson County	2401001000
Michigan Department of Environmental Quality	2401001000
Minnesota Pollution Control Agency	2401001000
New Hampshire Department of Environmental Services	2401002000
New Hampshire Department of Environmental Services	2401003000
New Jersey Department of Environment Protection	2401001000
New York State Department of Environmental Conservation	2401001000
Nez Perce Tribe	2401001000
Northern Cheyenne Tribe	2401002000
Northern Cheyenne Tribe	2401003000
Shoshone-Bannock Tribes of the Fort Hall Reservation of Idaho	2401001000
Texas Commission on Environmental Quality	2401001000
Virginia Department of Environmental Quality	2401001000
Washington State Department of Ecology	2401001000
Washoe County Health District	2401001000
West Virginia Division of Air Quality	2401001000

3.27.3 Spatial coverage and data sources for the sector



3.27.4 EPA-developed emissions

EPA uses the SCC code 2401001000 for its emissions estimation development. EPA calculated emissions in accordance with the alternative method in EIIP Volume 3, Chapter 3 [ref 1]. Emissions are calculated for each county using emission factors and activity as:

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

where:

$E_{x,p}$ = annual emissions for category x and pollutant p
A_x = population data associated with category x
$EF_{x,p}$ = emission factor for category x and pollutant p

Example:

According to the U.S. Census Bureau, Ada County had a total population of 392,365 people. The emission factor for VOC is 2.3 lb/ person:

E_{VOC} = 392,365 × 2.3 lb VOC/ person
= 461.03 tons VOC

Activity Data

Since this category is so pervasive, this category uses population and emissions factors to calculate emissions. US population data were collected from the 2010 Census Bureau Interactive Population Search [ref 2] on each county.

Emission Factors

The emission factors for 2011, shown in Table 3-126, were derived by adjusting the 2008 emission factor by the change in the amount of solvent sold from 2007 to 2010 according to the US Census (see the "AC" tab in the spreadsheet "2011_NEI_EFs_Revision_v2_JCS_062612.xlsx"). The 2008 emission factor was derived by using the amount of solvents sold for architectural coating in the US in 2007 (Freedonia). That amount was scaled upwards by 19% to account for solvents used in cleanup, thinning, and additives (CARB, 2005). ERTAC used a value of 2.41 lb VOC/person to calculate the solvents used (aka emissions) in the 16 states (see Table 3-127) that have rules that limit the VOC in coatings. That number was subtracted from the total used in the US, and then the remainder population of the 34 states that do not have VOC limits on architectural coatings (AC) was used to derive an emission factor for the states with no rules.

Table 3-126: Emission Factors for Architectural Coatings used in the 2011 NEI

	2008 NEI	**2011 NEI**
States with architectural coatings rules	2.41 lb VOC/person	1.88 lb VOC/person
States without architectural coatings rules	3.09 lb VOC/person	2.35 lb VOC/person

Table 3-127: States with Architectural Coatings rules

Region	States
1	CT, MA, ME, NH, RI, VT
2	NJ, NY
3	DC, DE, MD, PA, VA
6	TX
9	AZ, CA

3.27.5 Summary of quality assurance methods

For a number of states, plus Clark County, NV, it was necessary to tag EPA data to avoid a double count for AC. This is a case of the states using different SCCs. The SCCs that were used by these states are 2401002000 (solvent based) and 2401003000 (water based). EPA uses the more general SCC of 2401001000. The agencies that submitted using these more detailed SCCs are CA, DE, HI, MD, NH, and Clark County, NV.

3.27.6 References for Solvent – Non-Industrial Surface Coating

1. U.S. Environmental Protection Agency, Emissions Inventory Improvement Program, Technical Report Series, Volume III – Area Sources, Chapter 3, "Architectural Surface Coating" prepared by Eastern Research Group, Inc. for EPA, Research Triangle Park, NC, 1995.
2. U.S. Census Bureau. 2010 Interactive Population Search, Census 2010.

3.28 Solvent – Degreasing

3.28.1 Sector description

Solvent cleaning (degreasing) operations are an integral part of many industries and involve the use of solvents or solvent vapor to remove water-insoluble contaminants such as grease, oils, waxes, carbon deposits, fluxes, and tars from metal, plastic, glass, and other surfaces. Solvent cleaning is usually performed prior to painting, plating, inspection, repair, assembly, heat treating, and machining. For this sector, the EPA developed estimates for the nonpoint general SCC, 2415000000, highlighted in Table 3-128. The nonpoint SCC descriptions begin with "Solvent Utilization; Degreasing;" and the point SCC descriptions begin with "Petroleum and Solvent Evaporation; Organic Solvent Evaporation".

Table 3-128: SCCs for Solvent Cleaning and Degreasing

Data Category	SCC	SCC level 3 & 4 Description
nonpoint	2415000000	All Solvents/All Industries; All Processes
nonpoint	2415005000	Furniture and Fixtures; All Processes
nonpoint	2415010000	Primary Metal Industries; All Processes
nonpoint	2415020000	Fabricated Metal Products; All Processes
nonpoint	2415025000	Industrial Machinery and Equipment; All Processes
nonpoint	2415030000	Electronic and Other Elec.; All Processes
nonpoint	2415035000	Transportation Equipment; All Processes
nonpoint	2415040000	Instruments and Related Products; All Processes
nonpoint	2415045000	Miscellaneous Manufacturing; All Processes
nonpoint	2415050000	Transportation Maintenance Facilities; All Processes
nonpoint	2415055000	Automotive Dealers; All Processes
nonpoint	2415060000	Miscellaneous Repair Services; All Processes
nonpoint	2415065000	Auto Repair Services; All Processes

Data Category	SCC	SCC level 3 & 4 Description
point	40100201	Degreasing; Stoddard (Petroleum Solvent): Open-top Vapor Degreasing
point	40100202	Degreasing; 1,1,1-Trichloroethane (Methyl Chloroform): Open-top Vapor Degreasing
point	40100203	Degreasing; Perchloroethylene: Open-top Vapor Degreasing
point	40100204	Degreasing; Methylene Chloride: Open-top Vapor Degreasing
point	40100205	Degreasing; Trichloroethylene: Open-top Vapor Degreasing
point	40100206	Degreasing; Toluene: Open-top Vapor Degreasing
point	40100207	Degreasing; Trichlorotrifluoroethane (Freon): Open-top Vapor Degreasing
point	40100209	Degreasing; Butyl Acetate: Open-top Vapor Degreasing
point	40100215	Degreasing; Entire Unit: Open-top Vapor Degreasing
point	40100221	Degreasing; Stoddard (Petroleum Solvent): Conveyorized Vapor Degreasing
point	40100222	Degreasing; 1,1,1-Trichloroethane (Methyl Chloroform):Conveyorized Vapor Degreaser
point	40100223	Degreasing; Perchloroethylene: Conveyorized Vapor Degreasing
point	40100224	Degreasing; Methylene Chloride: Conveyorized Vapor Degreasing
point	40100225	Degreasing; Trichloroethylene: Conveyorized Vapor Degreasing
point	40100235	Degreasing; Entire Unit: with Vaporized Solvent: Conveyorized Vapor Degreasing
point	40100236	Degreasing; Entire Unit: with Non-boiling Solvent: Conveyorized Vapor Degreasing
point	40100251	Degreasing; Stoddard (Petroleum Solvent): General Degreasing Units
point	40100252	Degreasing; 1,1,1-Trichloroethane (Methyl Chloroform): General Degreasing Units
point	40100253	Degreasing; Perchloroethylene: General Degreasing Units
point	40100254	Degreasing; Methylene Chloride: General Degreasing Units
point	40100255	Degreasing; Trichloroethylene: General Degreasing Units
point	40100256	Degreasing; Toluene: General Degreasing Units
point	40100257	Degreasing; Trichlorotrifluoroethane (Freon): General Degreasing Units
point	40100296	Degreasing; Other Not Classified: General Degreasing Units
point	40100298	Degreasing; Other Not Classified: Conveyorized Vapor Degreasing
point	40100299	Degreasing; Other Not Classified: Open-top Vapor Degreasing
point	40100301	Cold Solvent Cleaning/Stripping; Methanol
point	40100302	Cold Solvent Cleaning/Stripping; Methylene Chloride
point	40100303	Cold Solvent Cleaning/Stripping; Stoddard (Petroleum Solvent)
point	40100304	Cold Solvent Cleaning/Stripping; Perchloroethylene
point	40100305	Cold Solvent Cleaning/Stripping; 1,1,1-Trichloroethane (Methyl Chloroform)
point	40100306	Cold Solvent Cleaning/Stripping; Trichloroethylene
point	40100307	Cold Solvent Cleaning/Stripping; Isopropyl Alcohol
point	40100308	Cold Solvent Cleaning/Stripping; Methyl Ethyl Ketone
point	40100309	Cold Solvent Cleaning/Stripping; Freon
point	40100310	Cold Solvent Cleaning/Stripping; Acetone
point	40100311	Cold Solvent Cleaning/Stripping; Glycol Ethers
point	40100335	Cold Solvent Cleaning/Stripping; Entire Unit
point	40100336	Cold Solvent Cleaning/Stripping; Degreaser: Entire Unit
point	40100399	Cold Solvent Cleaning/Stripping; Other Not Classified
point	40188898	Fugitive Emissions; Specify in Comments Field

3.28.2 Sources of data overview and selection hierarchy

The degreasing sector includes emissions from both S/L/T agencies and from the EPA overlap nonpoint dataset. The hierarchy of datasets used in the 2011 NEI for this sector is provided in Table 3-129. In some cases, the EPA PM and HAP augmentation as well as chromium split datasets were used to fill in PM species and HAP pollutants based on S/L/T agency data. The S/L/T agencies that submitted data to the EPA are listed in **Table 3-116**Table 3-130**.** Several agencies submitted nonpoint emissions for this sector.

Table 3-129: Data selection hierarchy for the Solvent –Degreasing sector

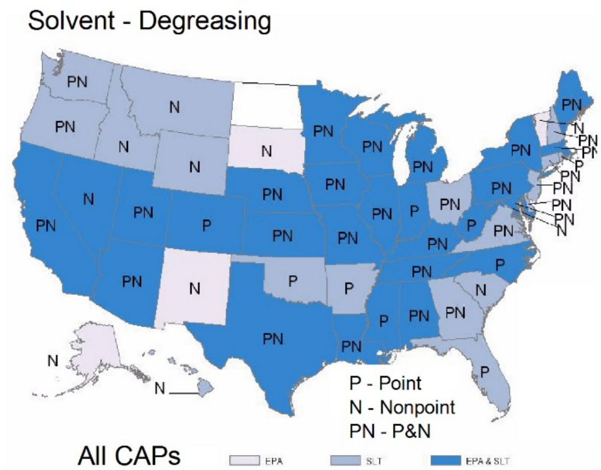
Priority	Dataset Name	Dataset Content
1	2011EPA_PM-Augmentation	Augments PM data in 47 states and some tribes
2	Responsible Agency Data Set	State and Local Agency submitted emissions
3	2011EPA_chrom_split	Splits total chromium into speciated chromium in 37 states
4	2011EPA_HAP-Augmentation	Adds Pb and other HAP emissions in 46 states
5	2011EPA_NP_Overlap_w_Pt	EPA-generated data

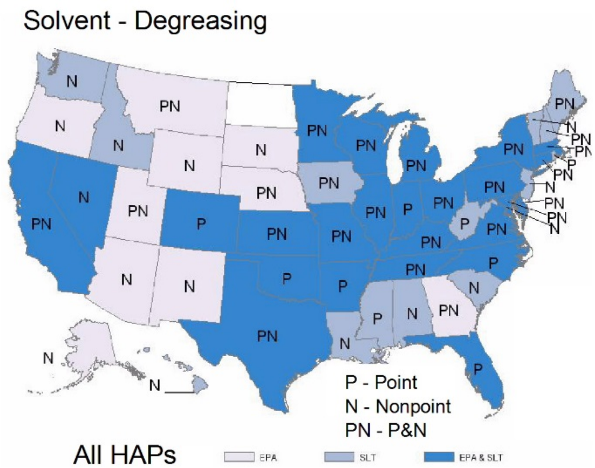
Table 3-130: Agencies that submitted data for Solvent –Degreasing sector

Data Set Name	Point	Nonpoint
2011EPA_chrom_split	X	
2011EPA_HAP-Augmentation	X	X
2011EPA_NP_Overlap_w_Pt		X
2011EPA_PM-Augmentation	X	X
2011EPA_TRI	X	
Alabama Department of Environmental Management	X	
Allegheny County Health Department	X	
Arizona Department of Environmental Quality	X	
Arkansas Department of Environmental Quality	X	
California Air Resources Board	X	X
Chattanooga Air Pollution Control Bureau (CHCAPCB)	X	X
Clark County Department of Air Quality and Environmental Management		X
Coeur d'Alene Tribe		X
Colorado Department of Public Health and Environment	X	
Connecticut Department of Environmental Protection	X	X
Delaware Department of Natural Resources and Environmental Control	X	X
Florida Department of Environmental Protection	X	
Forsyth County Environmental Affairs Department	X	
Georgia Department of Natural Resources	X	X
Hawaii Department of Health Clean Air Branch		X
Idaho Department of Environmental Quality		X
Illinois Environmental Protection Agency	X	X
Indiana Department of Environmental Management	X	
Iowa Department of Natural Resources	X	X
Jefferson County (AL) Department of Health	X	
Kansas Department of Health and Environment	X	X
Kentucky Division for Air Quality	X	
Knox County Department of Air Quality Management	X	X
Kootenai Tribe of Idaho		X
Louisiana Department of Environmental Quality	X	
Louisville Metro Air Pollution Control District	X	
Maine Department of Environmental Protection	X	X

Data Set Name	Point	Nonpoint
Maricopa County Air Quality Department	X	X
Maryland Department of the Environment	X	X
Massachusetts Department of Environmental Protection	X	X
Memphis and Shelby County Health Department - Pollution Control	X	
Metro Public Health of Nashville/Davidson County	X	X
Michigan Department of Environmental Quality	X	X
Minnesota Pollution Control Agency	X	X
Mississippi Dept of Environmental Quality	X	
Missouri Department of Natural Resources	X	X
Montana Department of Environmental Quality	X	
Nebraska Environmental Quality	X	
New Hampshire Department of Environmental Services	X	X
New Jersey Department of Environment Protection	X	X
New York State Department of Environmental Conservation	X	X
Nez Perce Tribe		X
North Carolina Department of Environment and Natural Resources	X	
Ohio Environmental Protection Agency	X	X
Oklahoma Department of Environmental Quality	X	
Olympic Region Clean Air Agency	X	
Omaha Air Quality Control Division	X	
Oregon Department of Environmental Quality	X	X
Pennsylvania Department of Environmental Protection	X	X
Philadelphia Air Management Services	X	
Puerto Rico	X	
Puget Sound Clean Air Agency	X	
Rhode Island Department of Environmental Management	X	
Shoshone-Bannock Tribes of the Fort Hall Reservation of Idaho		X
South Carolina Department of Health and Environmental Control	X	
Southwest Clean Air Agency	X	
Tennessee Department of Environmental Conservation	X	X
Texas Commission on Environmental Quality	X	X
Utah Division of Air Quality	X	
Vermont Department of Environmental Conservation	X	
Virginia Department of Environmental Quality	X	X
Washington State Department of Ecology		X
Washoe County Health District		X
West Virginia Division of Air Quality	X	
Western North Carolina Regional Air Quality Agency (Buncombe Co.)	X	
Wisconsin Department of Natural Resources	X	X
Wyoming Department of Environmental Quality	X	

3.28.3 Spatial coverage and data sources for the sector





3.28.4 EPA-developed emissions

<u>Activity Data</u>

The activity data needed for this category is the number of employees from several categories of industry listed by the North American Industrial Classification Standard (NAICS) code(s) to determine county-level employment for the category. County data were gathered from NAICS categories: 331, 332, 333, 334, 335, 336, 337, 339, 441, 483, 484, 485, 488, 8111, and 8112. NAICS data was gathered from the 2010 Census County Business Patterns (CBP) [ref 1].

Due to concerns with releasing confidential business information, the Census CBP does not release exact numbers for a given NAICS code if there is enough data that individual businesses could be identified. Instead a series of range codes are used. Because employment data is a key factor in determining emissions, it is important to estimate the number of employees for each county.

To estimate the number of employees in counties where data was withheld, EPA used the following procedure for each NAICS code being computed:

1. County level data for each NAICS were obtained and any numerical values were summed.
2. The sum generated in step 1 was subtracted from the state total number of employees in that NAICS reported in the state-level CBP.
3. The county level CBP report includes the number of establishments in the county within a specific employee range. For each of the counties with withheld data, EPA multiplied the number of establishments in a particular employee range (1 – 4, 5 – 9, etc.) by the midpoint of the range code (5 - 9 employees would be assigned 7) and summed the results.
4. An adjustment factor (to ensure the total number of estimated employees matches the state reported total) is calculated by dividing the sum of all the county level generated in step 2 by the sum of the county calculations in step 3. If there are no numerical values at the county level the adjustment factor is calculated by dividing the state total number of employees by the sum of the calculations in step 3.
5. The estimated number of employees, in counties where data was withheld, is calculated by multiplying the sum from step 3 by the adjustment factor calculated in step 4.

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

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

where:

$E_{x,p}$ = annual emissions for category x and pollutant p
A_x = employment data associated with category x
$EF_{x,p}$ = emission factor for category x and pollutant p

Example:
According to the U.S. Census Bureau, Kootenai County had a total of 557 employees in NAICS 335 – Electrical Equipment/Appliance/Component industry.

The emission factor for VOC is 36.97 lb /employee.

$$E_{VOC} = 557 \text{ employees} \times 36.97 \text{ lb VOC/employee}$$
$$= 10.296 \text{ tons VOC}$$

3.28.5 References for Solvent - Degreasing

1. U.S. Census Bureau, 2010 County Business Patterns, accessed September 2012.

3.29 Solvent – Dry Cleaning

3.29.1 Sector description

The dry cleaning industry is a service industry for the cleaning of garments, draperies, leather goods, and other fabric items. Dry cleaning operations do not use water that can swell textile fibers, but typically use either synthetic halogenated or petroleum distillate organic solvents for cleaning purposes. Use of solvents rather than water prevents wrinkles and shrinkage of fabrics. The dry cleaning industry is the most significant emission source of perchloroethylene (PERC) in the United States.

The two major types of dry cleaning operations are coin-operated (coin-op) and commercial. Industrial launderers are usually associated with soap and detergent cleaning, but also use large capacity dry cleaning units. Coin-operated dry cleaning units are self-service machines that are usually found in laundromats. Commercial dry cleaners are independent small businesses that offer dry cleaning services to the public. Some commercial dry cleaning businesses provide numerous drop-off/pick-up outlet stores that are serviced by a single dry cleaning plant, and thus some sites identified as dry cleaners may not be emissions sources. Industrial launderers who use dry cleaning solvents are usually part of a business operation that generates soiled fabrics, where it is convenient or cost-effective to perform dry cleaning on site. Industrial launderers can also be large businesses that provide uniform and other rental services to business, industrial, and institutional customers.

For this sector, the EPA developed estimates for the nonpoint general SCC, 2420000000, highlighted in Table 3-131. The nonpoint SCC descriptions begin with "Solvent Utilization;" and the point SCC descriptions begin with "Petroleum and Solvent Evaporation".

Table 3-131: SCCs for Solvent Utilization – Dry Cleaners

Data Category	SCC	SCC Level 2, 3 & 4 Description
Nonpoint	2420000000	Dry Cleaning; All Processes; Total: All Solvent Types
Nonpoint	2420000055	Dry Cleaning; All Processes; Perchloroethylene
Nonpoint	2420000370	Dry Cleaning; All Processes; Special Naphthas

Nonpoint	2420010000	Dry Cleaning; Commercial/Industrial Cleaners; Total: All Solvent Types
Nonpoint	2420010055	Dry Cleaning; Commercial/Industrial Cleaners; Perchloroethylene
Nonpoint	2420010370	Dry Cleaning; Commercial/Industrial Cleaners; Special Naphthas
Nonpoint	2420020000	Dry Cleaning; Coin-operated Cleaners; Total: All Solvent Types
Point	40100101	Organic Solvent Evaporation; Dry Cleaning; Perchloroethylene
Point	40100102	Organic Solvent Evaporation; Dry Cleaning; Stoddard (Petroleum Solvent) ** (Use 4-10-001-01 or 4-10-002-01)
Point	40100104	Organic Solvent Evaporation; Dry Cleaning; Stoddard (Petroleum Solvent) ** (Use 4-10-001-02 or 4-10-002-02)
Point	40100146	Organic Solvent Evaporation; Dry Cleaning; Stoddard:Filtr Disp/Cooked Muck(Drained)**(Use 4-10-001-61 or 002-61)
Point	40100198	Organic Solvent Evaporation; Dry Cleaning; Other Not Classified
Point	40100199	Organic Solvent Evaporation; Dry Cleaning; See Comment **
Point	41000101	Dry Cleaning; Petroleum Solvent - Industrial; Stoddard
Point	41000130	Dry Cleaning; Petroleum Solvent - Industrial; Dryer
Point	41000143	Dry Cleaning; Petroleum Solvent - Industrial; Filtration, Diatomite: Regenerative
Point	41000202	Dry Cleaning; Petroleum Solvent - Commercial; Stoddard
Point	41000230	Dry Cleaning; Petroleum Solvent - Commercial; Dryer
Point	41000231	Dry Cleaning; Petroleum Solvent - Commercial; Dryer: Loading/Unloading
Point	41000244	Dry Cleaning; Petroleum Solvent - Commercial; Filtration, Cartridge, Carbon Core, Batch Operation
Point	41082001	Dry Cleaning; Petroleum Solvent - Wastewater, Aggregate; Process Area Drains

3.29.2 Sources of data overview and selection hierarchy

The dry cleaning sector includes emissions from both S/L/T agencies and from the EPA overlap nonpoint dataset. The hierarchy of datasets used in the 2011 NEI for this sector is provided in Table 3-132. In some cases, the EPA PM and HAP augmentation datasets were used to fill in PM species and HAP pollutants based on S/L/T agency data. The S/L/T agencies that submitted data to the EPA are listed in **Table 3-116**Table 3-133**.** Several agencies submitted nonpoint emissions for this sector.

Table 3-132: Data selection hierarchy for the Solvent –Dry Cleaning sector

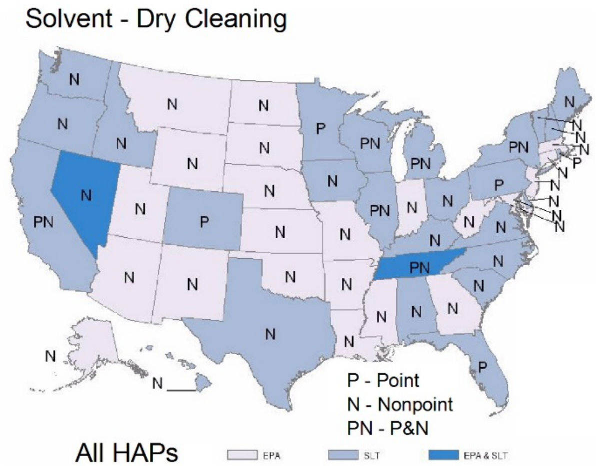
Priority	Dataset Name	Dataset Content
1	2011EPA_PM-Augmentation	Augments PM data in 47 states and some tribes
2	Responsible Agency Data Set	State and Local Agency submitted emissions
3	2011EPA_HAP-Augmentation	Adds Pb and other HAP emissions in 46 states
4	2011EPA_NP_Overlap_w_Pt	EPA-generated data

Table 3-133: Agencies that submitted data for Solvent –Dry Cleaning sector

Data Set Name	Point	Nonpoint
Delaware Department of Natural Resources and Environmental Control		X
Florida Department of Environmental Protection	X	
Georgia Department of Natural Resources		X
Hawaii Department of Health Clean Air Branch		X
Idaho Department of Environmental Quality		X
Illinois Environmental Protection Agency	X	X
Indiana Department of Environmental Management	X	
Iowa Department of Natural Resources	X	

Data Set Name	Point	Nonpoint
Kansas Department of Health and Environment		X
Kentucky Division for Air Quality	X	
Kootenai Tribe of Idaho		X
Louisville Metro Air Pollution Control District	X	
Maine Department of Environmental Protection		X
Maricopa County Air Quality Department		X
Maryland Department of the Environment		X
Massachusetts Department of Environmental Protection	X	X
Metro Public Health of Nashville/Davidson County	X	X
Michigan Department of Environmental Quality	X	X
Minnesota Pollution Control Agency	X	X
New Hampshire Department of Environmental Services	X	
New Jersey Department of Environment Protection		X
New York State Department of Environmental Conservation	X	X
Nez Perce Tribe		X
North Carolina Department of Environment and Natural Resources	X	X
Ohio Environmental Protection Agency	X	X
Oregon Department of Environmental Quality		X
Pennsylvania Department of Environmental Protection	X	
Rhode Island Department of Environmental Management	X	
Shoshone-Bannock Tribes of the Fort Hall Reservation of Idaho		X
South Carolina Department of Health and Environmental Control	X	
Texas Commission on Environmental Quality	X	X
Vermont Department of Environmental Conservation		X
Virginia Department of Environmental Quality	X	X
Washington State Department of Ecology		X
Washoe County Health District		X
West Virginia Division of Air Quality		X
Wisconsin Department of Natural Resources	X	X

3.29.3 Spatial coverage and data sources for the sector



3.29.4 EPA-developed emissions

<u>Activity Data</u>

This category uses dry cleaning employees per county from NAICS 81232 and emissions factors to calculate emissions. National dry cleaning employee data were collected from the 2010 Census Bureau County Business Patterns [ref 1] for each county.

Due to concerns with releasing confidential business information, the Census CBP does not release exact numbers for a given NAICS code if there is enough data that individual businesses could be identified. Instead, a series of range codes are used. Because employment data is a key factor in determining emissions, it is important to estimate the number of employees for each county.

To estimate the number of employees in counties where data was withheld, EPA used the following procedure for each NAICS code being computed:

- County level data for each NAICS were obtained and any numerical values were summed.
- The sum generated in step 1 was subtracted from the state total number of employees in that NAICS reported in the state-level CBP.
- The county level CBP report includes the number of establishments in the county within a specific employee range. For each of the counties with withheld data, Idaho multiplied the number of establishments in a particular employee range (1 – 4, 5 – 9, etc.) by the midpoint of the range code (5 - 9 employees would be assigned 7) and summed the results.
- An adjustment factor (to ensure the total number of estimated employees matches the state reported total) is calculated by dividing the sum of all the county level generated in step 2 by the sum of the county calculations in step 3. If there are no numerical values at the county level the adjustment factor is calculated by dividing the state total number of employees by the sum of the calculations in step 3.
- The estimated number of employees, in counties where data was withheld, is calculated by multiplying the sum from step 3 by the adjustment factor calculated in step 4.

Emission Factors

The VOC and tetrachloroethylene emissions factors are from EPA ERTAC 2011 calculations [ref 2]. A VOC factor is computed based on national population (lb/person).

Calculations

EPA calculated emissions in accordance with the alternative method in EIIP Volume 3, Chapter 4, alternative method two [ref 3]. Emissions are calculated for each county using emission factors and activity as:

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

where:

$E_{x,p}$ = annual emissions for category x and pollutant p
A_x = employee data associated with category x
$EF_{x,p}$ = emission factor for category x and pollutant p

Example:

According to the U.S. Census Bureau County Business Patterns, Ada County had a total of 239 dry cleaning employees. The emission factor for VOC is 10 lb/employee:

E_{VOC} = 239 dry cleaning employees × 10 lb VOC/employee
= 1.195 tons VOC in Ada County

3.29.5 References for Solvent – Dry Cleaning

1. U.S. Census Bureau. 2010 County Business Patterns, accessed September 2012.
2. ERTAC 2011. Dry Cleaning, accessed December 2012.
3. U.S. EPA Technology Transfer Network, Clearinghouse for Inventories & Emissions Factors, Technical Report Series, Volume 3: Area Sources and Area Source Method Abstracts, accessed February 2011.

3.30 Solvent – Graphic Arts

3.30.1 Sector description

Graphic arts operations are performed on printing presses that are made up of one or more "units." Each unit can print only one color. The substrate in graphic arts operations is either individual pieces of substrate called "sheets", or continuous and called a "web" [ref 1; ref 2]. The pattern that is printed on the substrate is called the "image". For this source category, the following SCCs were used in the 2011 NEI, with the highlighted SCC used for EPA's estimates:

For this source category, the EPA developed estimates for the nonpoint general SCC, 2425000000, highlighted in Table 3-134. The nonpoint SCC descriptions begin with "Solvent Utilization;" and the point SCC descriptions begin with "Petroleum and Solvent Evaporation".

Table 3-134: Graphic Arts SCCs used in the 2011 NEI

SCC	SCC Level 2, 3 & 4 Description
2425000000	Graphic Arts; All Processes; Total: All Solvent Types
2425010000	Graphic Arts; Lithography; Total: All Solvent Types
2425020000	Graphic Arts; Letterpress; Total: All Solvent Types

SCC	SCC Level 2, 3 & 4 Description
2425030000	Graphic Arts; Rotogravure; Total: All Solvent Types
2425040000	Graphic Arts; Flexography; Total: All Solvent Types
40500101	Printing/Publishing; Drying; Dryer
40500201	Printing/Publishing; Letter Press; Printing
40500203	Printing/Publishing; Letter Press; Ink Thinning Solvents, Mineral Solvents
40500215	Printing/Publishing; Letter Press; Cleaning Solution
40500301	Printing/Publishing; Flexographic; Printing
40500302	Printing/Publishing; Flexographic; Ink Thinning Solvent, Carbitol
40500303	Printing/Publishing; Flexographic; Ink Thinning Solvent, Cellosolve
40500304	Printing/Publishing; Flexographic; Ink Thinning Solvent, Ethyl Alcohol
40500305	Printing/Publishing; Flexographic; Ink Thinning Solvent, Isopropyl Alcohol
40500306	Printing/Publishing; Flexographic; Ink Thinning Solvent, n-Propyl Alcohol
40500307	Printing/Publishing; Flexographic; Ink Thinning Solvent, Naphtha
40500314	Printing/Publishing; Flexographic; Propyl Alcohol Cleanup
40500315	Printing/Publishing; Flexographic; Steam: Water-based
40500318	Printing/Publishing; Flexographic; Steam: Water-based in Ink
40500401	Printing/Publishing; Lithographic; Printing
40500413	Printing/Publishing; Lithographic; Isopropyl Alcohol Cleanup
40500415	Printing/Publishing; Offset Lithography; Dampening Solution with Alcohol Substitute
40500416	Printing/Publishing; Offset Lithography; Dampening Solution with High Solvent Content
40500417	Printing/Publishing; Offset Lithography; Cleaning Solution: Water-based
40500418	Printing/Publishing; Offset Lithography; Dampening Solution with Isopropyl Alcohol
40500421	Printing/Publishing; Offset Lithography; Heatset Ink Mixing
40500422	Printing/Publishing; Offset Lithography; Heatset Solvent Storage
40500431	Printing/Publishing; Offset Lithography; Nonheated Lithographic Inks
40500502	Printing/Publishing; Gravure; Ink Thinning Solvent, Dimethylformamide
40500503	Printing/Publishing; Gravure; Ink Thinning Solvent, Ethyl Acetate
40500506	Printing/Publishing; Gravure; Ink Thinning Solvent, Methyl Ethyl Ketone
40500510	Printing/Publishing; Gravure; Ink Thinning Solvent, Toluene
40500511	Printing/Publishing; Gravure; Printing
40500514	Printing/Publishing; Gravure; Cleanup Solvent
40500597	Printing/Publishing; General; Other Not Classified
40500599	Printing/Publishing; Printing; Ink Thinning Solvent
40500601	Printing/Publishing; Printing; Ink Mixing
40500801	Printing/Publishing; Screen Printing; Screen Printing
40500802	Printing/Publishing; Screen Printing; Fugitive Emissions: Cleaning Rags
40588801	Printing/Publishing; Fugitive Emissions; SCC Needs to be Assigned

3.30.2 Sources of data overview and selection hierarchy

The graphic arts sector includes emissions from both S/L/T agencies and from the EPA overlap nonpoint dataset. The hierarchy of datasets used in the 2011 NEI for this sector is provided in Table 3-135. In some cases, the EPA

PM and HAP augmentation as well as TRI and chromium split datasets were used to fill in PM species and HAP pollutants based on S/L/T agency data. The S/L/T agencies that submitted data to the EPA are listed in **Table 3-116**Table 3-136**.** Several agencies submitted nonpoint emissions for this sector.

Table 3-135: Data selection hierarchy for the Solvent –Graphic Arts sector

Priority	Dataset Name	Dataset Content
1	2011EPA_PM-Augmentation	Augments PM data in 47 states and some tribes
2	Responsible Agency Data Set	State and Local Agency submitted emissions
3	2011EPA_chrom_split	Splits total chromium into speciated chromium in 37 states
4	2011EPA_TRI	Toxics Release Inventory data for the year 2011. These data are selected for a facility only when alternative emissions are not included in the S/L/T agency data.
5	2011EPA_HAP-Augmentation	Adds Pb and other HAP emissions in 46 states
6	2011EPA_NP_Overlap_w_Pt	EPA-generated data

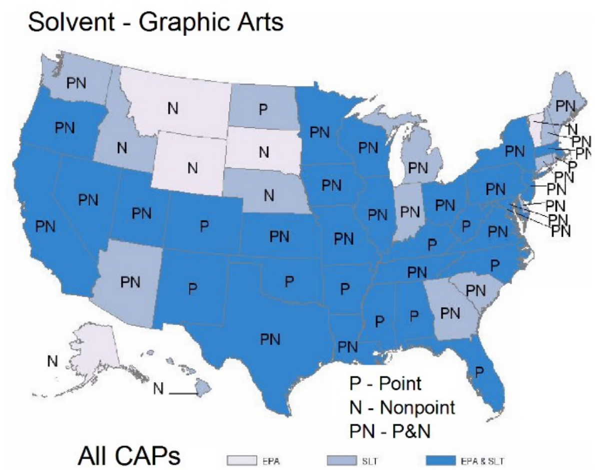
Table 3-136: Agencies that submitted data for Solvent –Graphic Arts sector

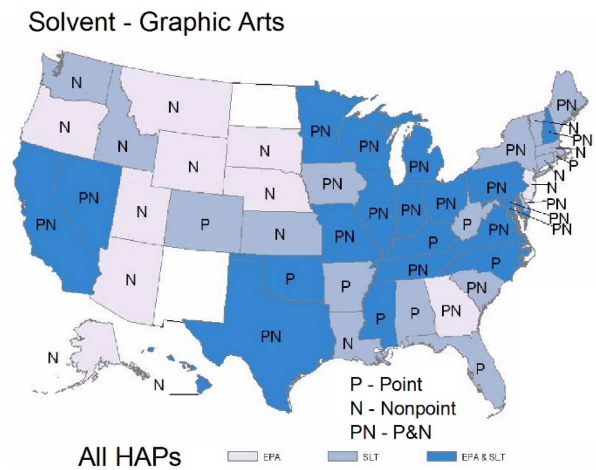
Data Set Name	Point	Nonpoint
2011EPA_chrom_split	X	
2011EPA_HAP-Augmentation		X
2011EPA_NP_Overlap_w_Pt		X
2011EPA_PM-Augmentation	X	X
2011EPA_TRI	X	
Alabama Department of Environmental Management	X	
Allegheny County Health Department	X	
Arkansas Department of Environmental Quality	X	
California Air Resources Board	X	X
Chattanooga Air Pollution Control Bureau (CHCAPCB)	X	X
City of Albuquerque	X	
Clark County Department of Air Quality and Environmental Management		X
Coeur d'Alene Tribe		X
Colorado Department of Public Health and Environment	X	
Connecticut Department of Environmental Protection	X	X
DC Department of Health Air Quality Division	X	X
Delaware Department of Natural Resources and Environmental Control	X	X
Florida Department of Environmental Protection	X	
Forsyth County Environmental Affairs Department	X	
Georgia Department of Natural Resources	X	X
Hawaii Department of Health Clean Air Branch		X
Idaho Department of Environmental Quality		X
Illinois Environmental Protection Agency	X	X
Indiana Department of Environmental Management	X	X
Iowa Department of Natural Resources	X	X
Jefferson County (AL) Department of Health	X	
Kansas Department of Health and Environment	X	X

Data Set Name	Point	Nonpoint
Kentucky Division for Air Quality	X	
Kootenai Tribe of Idaho		X
Louisiana Department of Environmental Quality	X	
Louisville Metro Air Pollution Control District	X	
Maine Department of Environmental Protection	X	X
Maricopa County Air Quality Department		X
Maryland Department of the Environment	X	X
Massachusetts Department of Environmental Protection	X	X
Mecklenburg County Air Quality	X	
Memphis and Shelby County Health Department - Pollution Control	X	
Metro Public Health of Nashville/Davidson County	X	
Michigan Department of Environmental Quality	X	X
Minnesota Pollution Control Agency	X	X
Mississippi Dept of Environmental Quality	X	
Missouri Department of Natural Resources	X	X
Nevada Division of Environmental Protection	X	
New Hampshire Department of Environmental Services	X	X
New Jersey Department of Environment Protection	X	X
New York State Department of Environmental Conservation	X	X
Nez Perce Tribe		X
North Carolina Department of Environment and Natural Resources	X	
North Dakota Department of Health	X	
Ohio Environmental Protection Agency	X	X
Oklahoma Department of Environmental Quality	X	
Omaha Air Quality Control Division	X	
Oregon Department of Environmental Quality	X	X
Pennsylvania Department of Environmental Protection	X	X
Philadelphia Air Management Services	X	
Pinal County	X	
Puget Sound Clean Air Agency	X	
Rhode Island Department of Environmental Management	X	
Shoshone-Bannock Tribes of the Fort Hall Reservation of Idaho		X
South Carolina Department of Health and Environmental Control	X	X
Tennessee Department of Environmental Conservation	X	X
Texas Commission on Environmental Quality	X	X
Utah Division of Air Quality	X	
Vermont Department of Environmental Conservation	X	
Virginia Department of Environmental Quality	X	X
Washington State Department of Ecology		X
Washoe County Health District		X
West Virginia Division of Air Quality	X	

Data Set Name	Point	Nonpoint
Western North Carolina Regional Air Quality Agency (Buncombe Co.)	X	
Wisconsin Department of Natural Resources	X	X

3.30.3 Spatial coverage and data sources for the sector





3.30.4 EPA-developed emissions

EPA calculated emissions using EPA's EIIP Volume 3, Chapter 7 Alternate Method 1 [ref 3]. Emissions are calculated for each county using emission factors and activity as:

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

where:

$E_{x,p}$ = annual emissions for category x and pollutant p
A_x = employment data associated with category x
$EF_{x,p}$ = emission factor for category x and pollutant p

Activity Data

Graphic arts employment data is listed by the North American Industrial Classification Standard (NAICS) code(s) that were used to determine county-level employment for the category. County data were gathered from NAICS categories: 32311, and 3222. NAICS data was gathered from the 2010 Census County Business Patterns (CBP) [ref 4].

Due to concerns with releasing confidential business information, the Census CBP does not release exact numbers for a given NAICS code if there is enough data that individual businesses could be identified. Instead, a series of range codes are used. Because employment data is a key factor in determining emissions, it is important to estimate the number of employees for each county.

To estimate the number of employees in counties where data was withheld, EPA used the following procedure for each NAICS code being computed:

1. County level data for each NAICS were obtained and any numerical values were summed.

2. The sum generated in step 1 was subtracted from the state total number of employees in that NAICS reported in the state-level CBP.
3. The county level CBP report includes the number of establishments in the county within a specific employee range. For each of the counties with withheld data, EPA multiplied the number of establishments in a particular employee range (1 – 4, 5 – 9, etc.) by the midpoint of the range code (5 - 9 employees would be assigned 7) and summed the results.
4. An adjustment factor (to ensure the total number of estimated employees matches the state reported total) is calculated by dividing the sum of all the county level generated in step 2 by the sum of the county calculations in step 3. If there are no numerical values at the county level the adjustment factor is calculated by dividing the state total number of employees by the sum of the calculations in step 3.
5. The estimated number of employees, in counties where data was withheld, is calculated by multiplying the sum from step 3 by the adjustment factor calculated in step 4.

Emission Factors

The VOC emission factor is from EPA's ERTAC Penna Graphic Arts study for 2011 [ref 5]. Additional emission factors were developed by ERTAC in 2011 [ref 6].

Sample Calculation

According to the U.S. Census Bureau, Kootenai County had a total of 80 employees in the graphic arts industry. The emission factor for VOC is 200.82 lb/employee

$$E_{VOC} = 80 \times 200.82 \text{ lb VOC/ employee}$$
$$= 8.033 \text{ tons VOC}$$

3.30.5 References for Solvent – Graphic Arts

1. Graphic Arts & Printing Inks. An example of specific gravity differences in ink, accessed April 2013.
2. Offset Printing Inks, Fillers for printing inks. Accessed April 2013.
3. U.S. Environmental Protection Agency, Emissions Inventory Improvement Program, *Technical Report Series*, Volume III – Area Sources, Chapter 7, "Graphic Arts," prepared by Eastern Research Group, Inc. for EPA, Research Triangle Park, NC, 2001.
4. U.S. Census Bureau, 2010 County Business Patterns for Idaho Counties, accessed September 2012.
5. ERTAC 2011 Final Penna Graphic Arts EI Study, Final Penna Graphic Arts EF Study.xlsx, from an email from Roy Huntley on 2/29/12.
6. ERTAC 2011 graphic arts calculations for Idaho, graphic_arts_2425000000_ employment_2011_.xls, accessed September, 2012.

3.31 Solvent – Industrial Surface Coating

3.31.1 Sector description

Surface coating operations involve applying a thin layer of coating (e.g., paint, lacquer, enamel, varnish, etc.) to an object for decorative or protective purposes. The surface coating products include either a water-based or solvent-based liquid carrier that generally evaporates in the drying or curing process.

Emissions result from the evaporation of the paint solvent and any additional solvent used to thin the coating. Emissions also result from the use of solvents in cleaning the surface prior to coating and in cleaning coating equipment after use.

Ideally, all industrial surface coating facilities would be inventoried as point sources. Preferred and alternative methods for estimating point source emissions from industrial surface coating operations are given in EIIP Volume II, Chapter 7 [ref 1]. That chapter also includes more detailed discussion of surface coatings technology and controls, as well as process descriptions for industries having significant point source emissions. As a practical matter, it is not usually possible to account for all industrial surface coating facilities as point sources. Although the majority of industrial surface coating emissions may be inventoried as point sources, remaining emissions of volatile organic compounds (VOCs) and hazardous air pollutants (HAPs) from industrial surface coating operations must be accounted for as nonpoint sources. Since the use of surface coatings by manufacturing industries is so widespread, it is extremely difficult to identify all of the industries in which coating materials are consumed.

The SCCs in this sector are listed in Table 3-137; SCC descriptions do not include level 4 descriptions for many point SCCs. The "x" in several point source SCCs indicates that all SCCs are included; this was done to avoid listing 300+ point source SCCs in this sector.

Table 3-137: Industrial Solvent Use SCCs in the 2011 NEI

SCC	SCC Description
2401075000	Solvent Utilization; Surface Coating; All Solvent Types; Aircraft
2401060000	Solvent Utilization; Surface Coating; All Solvent Types; Appliances
2401065000	Solvent Utilization; Surface Coating; All Solvent Types; Electronic and Other Electrical
2401015000	Solvent Utilization; Surface Coating; All Solvent Types; Factory Finished Wood
2401100000	Solvent Utilization; Surface Coating; All Solvent Types; Industrial Maintenance Coatings
2401055000	Solvent Utilization; Surface Coating; All Solvent Types; Machinery and Equipment
2401080000	Solvent Utilization; Surface Coating; All Solvent Types; Marine
2401040000	Solvent Utilization; Surface Coating; All Solvent Types; Metal Cans
2401025000	Solvent Utilization; Surface Coating; All Solvent Types; Metal Furniture
2401045000	Solvent Utilization; Surface Coating; All Solvent Types; Metal Sheet/Strip/Coil
2401050000	Solvent Utilization; Surface Coating; All Solvent Types; Miscellaneous Finished Metals:
2401090000	Solvent Utilization; Surface Coating; All Solvent Types; Miscellaneous Manufacturing
2401070000	Solvent Utilization; Surface Coating; All Solvent Types; Motor Vehicles
2401200000	Solvent Utilization; Surface Coating; All Solvent Types; Other Special Purpose Coatings
2401030000	Solvent Utilization; Surface Coating; All Solvent Types; Paper, Film, and Foil
2401085000	Solvent Utilization; Surface Coating; All Solvent Types; Railroad
2401020000	Solvent Utilization; Surface Coating; All Solvent Types; Wood Furniture
40100499	Petroleum and Solvent Evaporation; Organic Solvent Evaporation; Knit Fabric Scouring with Chlorinated Solvent; Other Not Classified
40200x01	Petroleum and Solvent Evaporation; Surface Coating Operations; Surface Coating Application - General
402007xx	Petroleum and Solvent Evaporation; Surface Coating Operations; Surface Coating Application - General
402008xx	Petroleum and Solvent Evaporation; Surface Coating Operations; Coating Oven - General
402009xx	Petroleum and Solvent Evaporation; Surface Coating Operations; Thinning Solvents - General
40201004	Petroleum and Solvent Evaporation; Surface Coating Operations; Coating Oven Heater
402011xx	Petroleum and Solvent Evaporation; Surface Coating Operations; Fabric Coating/Printing
40201201	Petroleum and Solvent Evaporation; Surface Coating Operations; Fabric Dyeing
402013xx	Petroleum and Solvent Evaporation; Surface Coating Operations; Paper Coating
402014xx	Petroleum and Solvent Evaporation; Surface Coating Operations; Large Appliances
402015xx	Petroleum and Solvent Evaporation; Surface Coating Operations; Magnet Wire Surface Coating
402016xx	Petroleum and Solvent Evaporation; Surface Coating Operations; Automobiles and Light Trucks
402017xx	Petroleum and Solvent Evaporation; Surface Coating Operations; Metal Can Coating
402018xx	Petroleum and Solvent Evaporation; Surface Coating Operations; Metal Coil Coating

SCC	SCC Description
402019xx	Petroleum and Solvent Evaporation; Surface Coating Operations; Wood Furniture Surface Coating
402020xx	Petroleum and Solvent Evaporation; Surface Coating Operations; Metal Furniture Operations
402021xx	Petroleum and Solvent Evaporation; Surface Coating Operations; Flatwood Products
402022xx	Petroleum and Solvent Evaporation; Surface Coating Operations; Plastic Parts
402023xx	Petroleum and Solvent Evaporation; Surface Coating Operations; Large Ships
402024xx	Petroleum and Solvent Evaporation; Surface Coating Operations; Large Aircraft
402025xx	Petroleum and Solvent Evaporation; Surface Coating Operations; Miscellaneous Metal Parts
402026xx	Petroleum and Solvent Evaporation; Surface Coating Operations; Steel Drums
40202701	Petroleum and Solvent Evaporation; Surface Coating Operations; Glass Mirrors
402028xx	Petroleum and Solvent Evaporation; Surface Coating Operations; Glass Optical Fibers
40203001	Petroleum and Solvent Evaporation; Surface Coating Operations; Semiconductors
402040xx	Petroleum and Solvent Evaporation; Surface Coating Operations; Fabric Printing
402041xx	Petroleum and Solvent Evaporation; Surface Coating Operations; Fabric Coating, Knife Coating
402042xx	Petroleum and Solvent Evaporation; Surface Coating Operations; Fabric Coating, Roller Coating
402043xx	Petroleum and Solvent Evaporation; Surface Coating Operations; Fabric Coating, Dip Coating
402044xx	Petroleum and Solvent Evaporation; Surface Coating Operations; Fabric Coating, Transfer Coating
402045xx	Petroleum and Solvent Evaporation; Surface Coating Operations; Fabric Coating, Extrusion Coating
40204630	Petroleum and Solvent Evaporation; Surface Coating Operations; Fabric Coating, Melt Roll Coating
402047xx	Petroleum and Solvent Evaporation; Surface Coating Operations; Fabric Coating, Coagulation Coating
402060xx	Petroleum and Solvent Evaporation; Surface Coating Operations; Fabric Dyeing
40280001	Petroleum and Solvent Evaporation; Surface Coating Operations; Equipment Leaks
40282001	Petroleum and Solvent Evaporation; Surface Coating Operations; Wastewater, Aggregate
40282599	Petroleum and Solvent Evaporation; Surface Coating Operations; Wastewater, Points of Generation
402888xx	Petroleum and Solvent Evaporation; Surface Coating Operations; Fugitive Emissions
402900x3	Petroleum and Solvent Evaporation; Surface Coating Operations; Fuel Fired Equipment
40299998	Petroleum and Solvent Evaporation; Surface Coating Operations; Miscellaneous
490001xx	Petroleum and Solvent Evaporation; Organic Solvent Evaporation; Solvent Extraction Process
490002xx	Petroleum and Solvent Evaporation; Organic Solvent Evaporation; Waste Solvent Recovery Operations
49000399	Petroleum and Solvent Evaporation; Organic Solvent Evaporation; Rail Car Cleaning
490004xx	Petroleum and Solvent Evaporation; Organic Solvent Evaporation; Tank Truck Cleaning
490005xx	Petroleum and Solvent Evaporation; Organic Solvent Evaporation; Air Stripping Tower
49000601	Petroleum and Solvent Evaporation; Organic Solvent Evaporation; Freon Recovery/Recycling Operations
490900xx	Petroleum and Solvent Evaporation; Organic Solvent Evaporation; Fuel Fired Equipment
49099998	Petroleum and Solvent Evaporation; Organic Solvent Evaporation; Miscellaneous Volatile Organic Compound Evaporation

3.31.2 Sources of data overview and selection hierarchy

The industrial surface coating sector includes emissions from both S/L/T agencies and from the EPA overlap nonpoint dataset. This sector is present in the point and nonpoint data category. The hierarchy of datasets used in the 2011 NEI for this sector is provided in Table 3-138. In some cases, the EPA PM and HAP augmentation datasets were used to fill in PM species and HAP pollutants based on S/L/T agency data. All S/L/T agencies that submitted data to the EPA are listed in Table 3-139**Table 3-116.** Several agencies submitted nonpoint emissions for this sector; these nonpoint sources are broken out by different types of categories in this table. EPA datasets are individually listed.

Table 3-138: Data selection hierarchy for the Solvent –Industrial Surface Coating sector

Priority	Dataset Name	Dataset Content
1	2011EPA_PM-Augmentation	Augments PM data in 47 states and some tribes
2	Responsible Agency Data Set	State and Local Agency submitted emissions
3	2011EPA_HAP-Augmentation	Adds Pb and other HAP emissions in 46 states
4	2011EPA_NP_Overlap_w_Pt	EPA-generated data

Table 3-139: EPA and S/L/T agency-submitted point and nonpoint data for Industrial Surface Coating sector

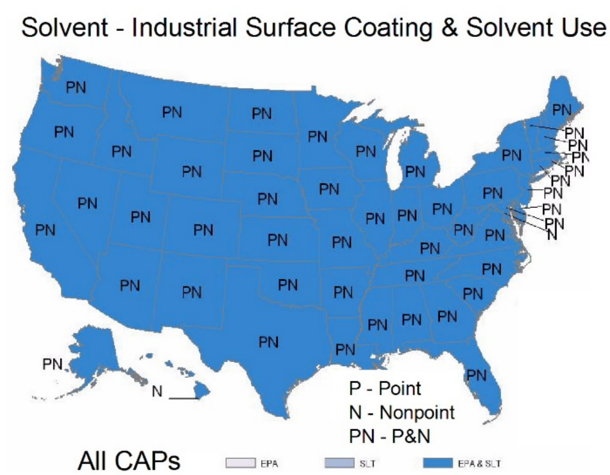
Data Set Name	Point	Aircraft	Auto Refinishing	Electronic & Other Electrical	Factory Finished Wood	Ind. Maintenance Coatings	Large Appliances	Machinery & Equipment	Marine	Metal Cans	Metal Coils	Metal Furniture	Misc. Finished Metals	Misc. Manufacturing	Motor Vehicles	Other Special Purpose	Paper	Plastic Products	Railroad	Textile Products	Traffic Markings	Wood Furniture
2011EPA_chrom_split	X																					
2011EPA_PM-Augmentation	X		X	X	X	X	X	X	X			X	X	X	X	X			X		X	X
2011EPA_HAP-Augmentation		X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X
2011EPA_NP_NoOverlap_w_Pt			X																		X	
2011EPA_NP_Overlap_w_Pt			X	X	X	X	X	X	X	X		X		X	X	X	X		X			X
2011EPA_TRI	X																					
Alabama Department of Environmental Management	X																					
Alaska Department of Environmental Conservation	X																					
Allegheny County Health Department	X																					
Arizona Department of Environmental Quality	X																					
Arkansas Department of Environmental Quality	X																					
California Air Resources Board	X		X						X	X		X	X			X	X			X		X
Chattanooga Air Pollution Control Bureau (CHCAPCB)	X			X	X			X	X	X		X		X	X							X
City of Albuquerque	X																					
Clark County Department of Air Quality and Environmental Management	X		X	X	X	X	X	X	X	X			X	X	X	X			X		X	X
Coeur d'Alene Tribe		X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X
Colorado Department of Public Health and Environment	X																					
Connecticut Department Of Environmental Protection	X	X		X			X	X									X					X
DC Department of Health						X										X					X	
Delaware Department of Natural Resources and Environmental Control	X	X	X	X	X	X	X	X	X	X	X	X		X	X		X		X		X	X
Florida Department of Environmental Protection	X																					

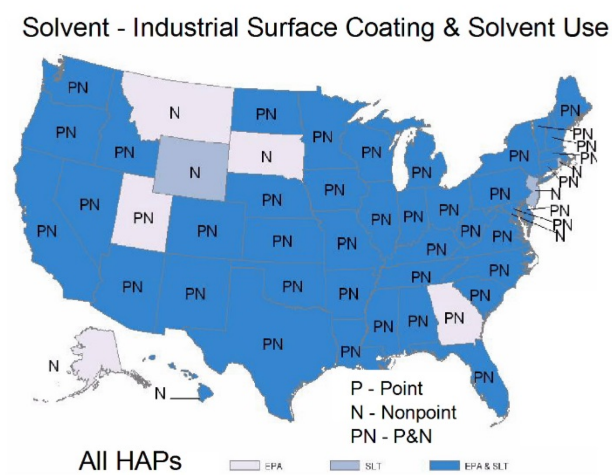
Data Set Name	Point	Aircraft	Auto Refinishing	Electronic & Other Electrical	Factory Finished Wood	Ind. Maintenance Coatings	Large Appliances	Machinery & Equipment	Marine	Metal Cans	Metal Coils	Metal Furniture	Misc. Finished Metals	Misc. Manufacturing	Motor Vehicles	Other Special Purpose	Paper	Plastic Products	Railroad	Textile Products	Traffic Markings	Wood Furniture
Forsyth County Environmental Affairs Department	X																					
Georgia Department of Natural Resources	X	X	X	X	X		X	X	X	X	X	X		X	X		X					X
Hawaii Department of Health Clean Air Branch			X	X	X	X	X	X	X	X			X	X	X	X			X		X	X
Idaho Department of Environmental Quality	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X
Illinois Environmental Protection Agency	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X		X		X	X
Indiana Department of Environmental Management	X	X		X	X		X	X	X	X		X		X	X		X					X
Iowa Department of Natural Resources	X		X		X			X				X		X	X		X					X
Jefferson County (AL) Department of Health	X																					
Kansas Department of Health and Environment	X	X	X	X	X	X	X	X	X	X		X		X	X	X	X		X		X	X
Kentucky Division for Air Quality	X																					
Knox County Department of Air Quality Management	X	X												X								
Kootenai Tribe of Idaho		X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X
Lane Regional Air Pollution Authority	X																					
Lincoln/Lancaster County Health Department	X																					
Louisiana Department of Environmental Quality	X																					
Louisville Metro Air Pollution Control District	X																					
Maine Department of Environmental Protection	X	X				X			X					X	X	X			X		X	X
Maricopa County Air Quality Department	X	X	X		X									X							X	X
Maryland Department of the Environment	X	X	X	X	X	X	X		X	X		X		X	X	X	X		X		X	X
Massachusetts Department of Environmental Protection	X		X	X	X	X		X	X	X	X	X		X	X	X	X				X	X
Mecklenburg County Air Quality	X																					
Memphis and Shelby County Health Department - Pollution Control	X																					
Metro Public Health of Nashville/Davidson County	X																				X	
Michigan Department of Environmental Quality	X	X	X	X	X	X	X	X	X	X		X		X	X	X	X		X		X	X
Minnesota Pollution Control Agency	X	X	X	X		X	X					X		X	X	X			X		X	X
Mississippi Dept of Environmental Quality	X																					
Missouri Department of Natural Resources	X	X		X	X		X	X	X	X		X		X	X		X		X			X

Data Set Name	Point	Aircraft	Auto Refinishing	Electronic & Other Electrical	Factory Finished Wood	Ind. Maintenance Coatings	Large Appliances	Machinery & Equipment	Marine	Metal Cans	Metal Coils	Metal Furniture	Misc. Finished Metals	Misc. Manufacturing	Motor Vehicles	Other Special Purpose	Paper	Plastic Products	Railroad	Textile Products	Traffic Markings	Wood Furniture
Montana Department of Environmental Quality	X																					
Navajo Nation	X																					
Nebraska Environmental Quality	X																					
Nevada Division of Environmental Protection	X																					
New Hampshire Department of Environmental Services	X	X	X	X	X			X	X			X	X		X						X	X
New Jersey Department of Environment Protection	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X		X		X	X
New Mexico Environment Department Air Quality Bureau	X																					
New York State Department of Environmental Conservation	X		X	X		X	X	X	X	X		X		X	X	X	X		X		X	X
Nez Perce Tribe		X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X
North Carolina Department of Environment and Natural Resources	X																					
North Dakota Department of Health	X																					
Ohio Environmental Protection Agency	X	X			X		X	X	X	X	X	X		X	X		X					X
Oklahoma Department of Environmental Quality	X																					
Olympic Region Clean Air Agency	X																					
Omaha Air Quality Control Division	X																					
Oregon Department of Environmental Quality	X	X	X	X	X	X	X	X	X	X		X		X	X	X	X	X	X			X
Pennsylvania Department of Environmental Protection	X				X					X		X		X	X		X					X
Philadelphia Air Management Services	X																					
Pinal County	X																					
Puerto Rico	X																					
Puget Sound Clean Air Agency	X																					
Rhode Island Department of Environmental Management	X																					
Shoshone-Bannock Tribes		X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X
South Carolina Department of Health and Environmental Control	X	X			X				X	X				X	X		X					
South Dakota Department of Environment and Natural Resources	X																					
Southwest Clean Air Agency	X																					
Tennessee Department of Environmental Conservation	X				X		X	X		X		X		X	X		X					X

Data Set Name	Point	Aircraft	Auto Refinishing	Electronic & Other Electrical	Factory Finished Wood	Ind. Maintenance Coatings	Large Appliances	Machinery & Equipment	Marine	Metal Cans	Metal Coils	Metal Furniture	Misc. Finished Metals	Misc. Manufacturing	Motor Vehicles	Other Special Purpose	Paper	Plastic Products	Railroad	Textile Products	Traffic Markings	Wood Furniture
Texas Commission on Environmental Quality	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X		X
Utah Division of Air Quality	X																					
Vermont Department of Environmental Conservation	X																					
Virginia Department of Environmental Quality	X	X	X	X	X	X	X	X	X	X		X	X	X	X	X	X		X		X	X
Washington State Department of Ecology	X	X	X	X	X	X	X	X	X	X		X		X	X	X	X				X	X
Washoe Tribe of California and Nevada			X																			
Washoe County Health District	X		X	X				X						X			X	X				X
West Virginia Division of Air Quality	X																				X	
Western North Carolina Regional Air Quality Agency (Buncombe Co.)	X																					
Wisconsin Department of Natural Resources	X		X																X			
Wyoming Department of Environmental Quality	X																					

3.31.3 Spatial coverage and data sources for the sector





3.31.4 EPA-developed emissions

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

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

where:

$E_{x,p}$ = annual emissions for category x and pollutant p
A_x = employment or population data associated with category x
$EF_{x,p}$ = emission factor for category x and pollutant p

Activity Data

There are two types of activity data that are used in this category. The first is employment data listed by the North American Industrial Classification Standard (NAICS) codes used to determine county-level employment for the various categories. NAICS data was gathered from the 2010 Census County Business Patterns (CBP) for the US [ref 2].

Due to concerns with releasing confidential business information, the Census CBP does not release exact numbers for a given NAICS code if individual businesses could be identified. Instead a series of range codes are used. Because employment data is a key factor in determining emissions it is important to estimate the number of employees for each county.

To estimate the number of employees in counties where data was withheld, EPA used the following procedure for each NAICS code being computed:

1. County level data for each NAICS were obtained and any numerical values were summed.
2. The sum generated in step 1 was subtracted from the state total number of employees in that NAICS reported in the state-level CBP.
3. The county level CBP report includes the number of establishments in the county within a specific employee range. For each of the counties with withheld data, EPA multiplied the number of establishments in a particular employee range (1 – 4, 5 – 9, etc.) by the midpoint of the range code (5 - 9 employees would be assigned 7) and summed the results.
4. An adjustment factor (to ensure the total number of estimated employees matches the state reported total) is calculated by dividing the sum of all the county level generated in step 2 by the sum of the county calculations in step 3. If there are no numerical values at the county level the adjustment factor is calculated by dividing the state total number of employees by the sum of the calculations in step 3.
5. The estimated number of employees, in counties where data was withheld, is calculated by multiplying the sum from step 3 by the adjustment factor calculated in step 4.

The second category of activity data used to estimate emissions from industrial solvent use was 2010 county-level population data, which was obtained from the US Census Bureau's interactive population search for the 2010 Census [ref 3]. The per capita emission factors were then multiplied by the 2010 county-level population estimates. This method was used when there was no applicable NAICS category or enough employees in a NAICS category (Industrial Maintenance Coatings, Miscellaneous Finished Metals, Metal Sheet/Strip/Coil, and Other Special Purpose Coatings).

Emission Factors

EPA emission factors for Industrial Surface Coatings, available in the SPECIATE v4.3 database [ref 4], are provided in Table 3-140.

Table 3-140: EPA emission factors for Industrial Surface Coating used in 2011 NEI

SCC	Description	Pollutant Code	Pollutant Description	Emission Factor	Units	EF source
2401075000	Aircraft	108383	m-Xylene	0.1626394	LB/employee	HAP Speciation
2401075000	Aircraft	100414	Ethyl Benzene	0.0780098	LB/employee	HAP Speciation
2401075000	Aircraft	106423	p-Xylene	0.0724284	LB/employee	HAP Speciation

SCC	Description	Pollutant Code	Pollutant Description	Emission Factor	Units	EF source
2401075000	Aircraft	95476	o-Xylene	0.07139	LB/employee	HAP Speciation
2401075000	Aircraft	108101	Methyl Isobutyl Ketone	0.3117796	LB/employee	HAP Speciation
2401075000	Aircraft	110543	Hexane	3.0676932	LB/employee	HAP Speciation
2401075000	Aircraft	121448	Triethylamine	0.0063602	LB/employee	HAP Speciation
2401075000	Aircraft	540885	Tert-butyl Acetate	0.329043	LB/employee	HAP Speciation
2401075000	Aircraft	108883	Toluene	1.682857	LB/employee	HAP Speciation
2401075000	Aircraft	VOC	VOC	12.98	LB/employee	2010 Fredonia
2401060000	Appliances	540885	Tert-butyl Acetate	5.22082	LB/employee	HAP Speciation
2401060000	Appliances	121448	Triethylamine	0.09823	LB/employee	HAP Speciation
2401060000	Appliances	110543	Hexane	49.39506	LB/employee	HAP Speciation
2401060000	Appliances	108383	m-Xylene	3.01796	LB/employee	HAP Speciation
2401060000	Appliances	108101	Methyl Isobutyl Ketone	14.41473	LB/employee	HAP Speciation
2401060000	Appliances	106423	p-Xylene	1.34596	LB/employee	HAP Speciation
2401060000	Appliances	100414	Ethyl Benzene	1.39821	LB/employee	HAP Speciation
2401060000	Appliances	108883	Toluene	26.36953	LB/employee	HAP Speciation
2401060000	Appliances	95476	o-Xylene	1.32506	LB/employee	HAP Speciation
2401060000	Appliances	VOC	VOC	209	LB/employee	2010 Freedonia
2401005000	Auto Refinishing	108883	Toluene	12.6269115	LB/employee	HAP Speciation
2401005000	Auto Refinishing	106423	p-Xylene	0.6495734	LB/employee	HAP Speciation
2401005000	Auto Refinishing	540885	Tert-butyl Acetate	4.9106234	LB/employee	HAP Speciation
2401005000	Auto Refinishing	67561	Methanol	0.2727072	LB/employee	HAP Speciation
2401005000	Auto Refinishing	100414	Ethyl Benzene	0.6637769	LB/employee	HAP Speciation
2401005000	Auto Refinishing	110543	Hexane	24.5673205	LB/employee	HAP Speciation
2401005000	Auto Refinishing	2807309	Propyl Cellosolve	0.6306354	LB/employee	HAP Speciation
2401005000	Auto Refinishing	112072	2-Butoxyethyl Acetate	0.8569445	LB/employee	HAP Speciation
2401005000	Auto Refinishing	108101	Methyl Isobutyl Ketone	5.0857999	LB/employee	HAP Speciation
2401005000	Auto Refinishing	108383	m-Xylene	1.5396594	LB/employee	HAP Speciation
2401005000	Auto Refinishing	95476	o-Xylene	0.7613076	LB/employee	HAP Speciation
2401005000	Auto Refinishing	121448	Triethylamine	0.0463981	LB/employee	HAP Speciation
2401005000	Auto Refinishing	80626	Methyl Methacrylate	0.09469	LB/employee	HAP Speciation
2401005000	Auto Refinishing	VOC	VOC	94.69	LB/employee	2010 Freedonia
2401015000	Factory Finished Wood	1330207	Xylenes (Mixed Isomers)	2.3847527	LB/employee	HAP Speciation
2401015000	Factory Finished Wood	VOC	VOC	48.07	LB/employee	2010 Freedonia
2401055000	Machinery and Equipment	108383	m-Xylene	0.6754512	LB/EACH	HAP Speciation
2401055000	Machinery and Equipment	110543	Hexane	12.2045976	LB/EACH	HAP Speciation
2401055000	Machinery and Equipment	106423	p-Xylene	0.3010612	LB/EACH	HAP Speciation
2401055000	Machinery and Equipment	100414	Ethyl Benzene	0.3258484	LB/EACH	HAP Speciation
2401055000	Machinery and Equipment	540885	Tert-butyl Acetate	1.2899672	LB/EACH	HAP Speciation
2401055000	Machinery and Equipment	108883	Toluene	6.4560328	LB/EACH	HAP Speciation
2401055000	Machinery and Equipment	95476	o-Xylene	0.29693	LB/EACH	HAP Speciation

SCC	Description	Pollutant Code	Pollutant Description	Emission Factor	Units	EF source
2401055000	Machinery and Equipment	121448	Triethylamine	0.0242708	LB/EACH	HAP Speciation
2401055000	Machinery and Equipment	108101	Methyl Isobutyl Ketone	2.0459768	LB/EACH	HAP Speciation
2401055000	Machinery and Equipment	VOC	VOC	51.64	LB/EACH	2010 Freedonia
2401080000	Marine	111900	Diethylene Glycol Monoethyl Ether	0	LB/employee	HAP Speciation
2401080000	Marine	2807309	Propyl Cellosolve	2.61	LB/employee	HAP Speciation
2401080000	Marine	1330207	Xylenes (Mixed Isomers)	0	LB/employee	HAP Speciation
2401080000	Marine	VOC	VOC	225	LB/employee	2010 Freedonia
2401025000	Metal Furniture	106423	p-Xylene	5.17704	LB/employee	HAP Speciation
2401025000	Metal Furniture	110543	Hexane	209.86992	LB/employee	HAP Speciation
2401025000	Metal Furniture	108883	Toluene	111.01776	LB/employee	HAP Speciation
2401025000	Metal Furniture	540885	Tert-butyl Acetate	22.18224	LB/employee	HAP Speciation
2401025000	Metal Furniture	100414	Ethyl Benzene	5.60328	LB/employee	HAP Speciation
2401025000	Metal Furniture	121448	Triethylamine	0.41736	LB/employee	HAP Speciation
2401025000	Metal Furniture	95476	o-Xylene	5.106	LB/employee	HAP Speciation
2401025000	Metal Furniture	108383	m-Xylene	11.61504	LB/employee	HAP Speciation
2401025000	Metal Furniture	108101	Methyl Isobutyl Ketone	35.18256	LB/employee	HAP Speciation
2401025000	Metal Furniture	VOC	VOC	888	LB/employee	2010 Freedonia
2401090000	Miscellaneous Manufacturing	95476	o-Xylene	0.5313	LB/employee	HAP Speciation
2401090000	Miscellaneous Manufacturing	100414	Ethyl Benzene	0.583044	LB/employee	HAP Speciation
2401090000	Miscellaneous Manufacturing	108383	m-Xylene	1.208592	LB/employee	HAP Speciation
2401090000	Miscellaneous Manufacturing	108101	Methyl Isobutyl Ketone	3.660888	LB/employee	HAP Speciation
2401090000	Miscellaneous Manufacturing	106423	p-Xylene	0.538692	LB/employee	HAP Speciation
2401090000	Miscellaneous Manufacturing	540885	Tert-butyl Acetate	2.308152	LB/employee	HAP Speciation
2401090000	Miscellaneous Manufacturing	108883	Toluene	11.551848	LB/employee	HAP Speciation
2401090000	Miscellaneous Manufacturing	110543	Hexane	21.837816	LB/employee	HAP Speciation
2401090000	Miscellaneous Manufacturing	121448	Triethylamine	0.043428	LB/employee	HAP Speciation
2401090000	Miscellaneous Manufacturing	VOC	VOC	92.4	LB/employee	2010 Freedonia
2401070000	Motor Vehicles	121448	Triethylamine	0.09555	LB/employee	HAP Speciation
2401070000	Motor Vehicles	80626	Methyl Methacrylate	0.195	LB/employee	HAP Speciation
2401070000	Motor Vehicles	108101	Methyl Isobutyl Ketone	10.47345	LB/employee	HAP Speciation
2401070000	Motor Vehicles	95476	o-Xylene	1.5678	LB/employee	HAP Speciation
2401070000	Motor Vehicles	110543	Hexane	50.59275	LB/employee	HAP Speciation
2401070000	Motor Vehicles	112072	2-Butoxyethyl Acetate	1.76475	LB/employee	HAP Speciation
2401070000	Motor Vehicles	540885	Tert-butyl Acetate	10.1127	LB/employee	HAP Speciation
2401070000	Motor Vehicles	106423	p-Xylene	1.3377	LB/employee	HAP Speciation

SCC	Description	Pollutant Code	Pollutant Description	Emission Factor	Units	EF source
2401070000	Motor Vehicles	2807309	Propyl Cellosolve	1.2987	LB/employee	HAP Speciation
2401070000	Motor Vehicles	67561	Methanol	0.5616	LB/employee	HAP Speciation
2401070000	Motor Vehicles	100414	Ethyl Benzene	1.36695	LB/employee	HAP Speciation
2401070000	Motor Vehicles	108883	Toluene	26.00325	LB/employee	HAP Speciation
2401070000	Motor Vehicles	108383	m-Xylene	3.1707	LB/employee	HAP Speciation
2401070000	Motor Vehicles	VOC	VOC	195	LB/employee	2010 Freedonia
2401030000	Paper Film and Foil	110543	Hexane	143.93106	LB/employee	HAP Speciation
2401030000	Paper Film and Foil	540885	Tert-butyl Acetate	15.21282	LB/employee	HAP Speciation
2401030000	Paper Film and Foil	106423	p-Xylene	3.55047	LB/employee	HAP Speciation
2401030000	Paper Film and Foil	108883	Toluene	76.13718	LB/employee	HAP Speciation
2401030000	Paper Film and Foil	100414	Ethyl Benzene	3.84279	LB/employee	HAP Speciation
2401030000	Paper Film and Foil	95476	o-Xylene	3.50175	LB/employee	HAP Speciation
2401030000	Paper Film and Foil	108383	m-Xylene	7.96572	LB/employee	HAP Speciation
2401030000	Paper Film and Foil	108101	Methyl Isobutyl Ketone	24.12858	LB/employee	HAP Speciation
2401030000	Paper Film and Foil	121448	Triethylamine	0.28623	LB/employee	HAP Speciation
2401030000	Paper Film and Foil	VOC	VOC	609	LB/employee	2010 Freedonia
2401085000	Railroad	100414	Ethyl Benzene	3.12832	LB/employee	HAP Speciation
2401085000	Railroad	108883	Toluene	41.44816	LB/employee	HAP Speciation
2401085000	Railroad	110543	Hexane	73.8608	LB/employee	HAP Speciation
2401085000	Railroad	1330207	Xylenes (Mixed Isomers)	12.03488	LB/employee	HAP Speciation
2401085000	Railroad	VOC	VOC	208	LB/employee	2010 Freedonia
2401200000	Special Purpose	112072	2-Butoxyethyl Acetate	0.0009216	LB/Person	HAP Speciation
2401200000	Special Purpose	108907	Chlorobenzene	0.000288	LB/Person	HAP Speciation
2401200000	Special Purpose	540885	Tert-butyl Acetate	0.00186112	LB/Person	HAP Speciation
2401200000	Special Purpose	108883	Toluene	0.0097856	LB/Person	HAP Speciation
2401200000	Special Purpose	106423	p-Xylene	0.00013952	LB/Person	HAP Speciation
2401200000	Special Purpose	111900	Diethylene Glycol Monoethyl Ether	0.00043904	LB/Person	HAP Speciation
2401200000	Special Purpose	108101	Methyl Isobutyl Ketone	0.00013824	LB/Person	HAP Speciation
2401200000	Special Purpose	98828	Cumene	0.000128	LB/Person	HAP Speciation
2401200000	Special Purpose	108383	m-Xylene	0.00033088	LB/Person	HAP Speciation
2401200000	Special Purpose	95476	o-Xylene	0.00017152	LB/Person	HAP Speciation
2401200000	Special Purpose	100414	Ethyl Benzene	0.00027392	LB/Person	HAP Speciation
2401200000	Special Purpose	67561	Methanol	0.00037184	LB/Person	HAP Speciation
2401200000	Special Purpose	VOC	VOC	0.064	LB/Person	2010 Freedonia
2401008000	Traffic Markings	540885	Tert-butyl Acetate	0.000899	LB/Person	HAP Speciation
2401008000	Traffic Markings	106990	1,3-Butadiene	0.00029	LB/Person	HAP Speciation
2401008000	Traffic Markings	1330207	Xylenes (Mixed Isomers)	0.0015022	LB/Person	HAP Speciation
2401008000	Traffic Markings	91203	Naphthalene	0.000145	LB/Person	HAP Speciation
2401008000	Traffic Markings	108883	Toluene	0.0246674	LB/Person	HAP Speciation
2401008000	Traffic Markings	100414	Ethyl Benzene	0.0008033	LB/Person	HAP Speciation
2401008000	Traffic Markings	VOC	VOC	0.29	LB/Person	2010 Freedonia
2401020000	Wood Furniture	1330207	Xylenes (Mixed Isomers)	25.99564	LB/Employee	HAP Speciation
2401020000	Wood Furniture	VOC	VOC	524	LB/Employee	2010 Freedonia

The total volume of coatings sold was obtained from the Census Bureau, Paint and Allied Products, 2010 [ref 5]. The volume of architectural and powder coatings was subtracted from the total to obtain the total non-architectural coating volume. The volume of coatings sold for a particular category, like Automotive, Other

Transportation and Machinery Refinish Paints and Enamels Including Primers, was obtained from the same source and used to determine a percentage of category coatings to total non-architectural coating. This percentage was applied to the amount of solvents in tons used for non-architectural Paint and Coatings, obtained from the Freedonia Group (Report #2357, Solvents to 2012, June 2008) [ref 6]. The result is the tons of solvents sold for the particular category. An assumption is made that all the solvent is eventually emitted, so the result is considered VOC emissions in tons. The emission factor units need to be lb of VOC per employee, so employment data is obtained from the National American Industry Classification System (NAICS) for the appropriate NAICS employment codes and a value per employee is determined. The HAP emission factors were determined using HAP speciation profiles obtained from EPA's SPPD. EIAG received a database from SPPD, which originated from the Aerosol Coatings Rule that EPA promulgated on March 24, 2008. Manufacturers, importers, and distributors of aerosol coatings were required to submit initial notifications of product formulations by July 1, 2009 to their EPA Regional Offices. From this database, EIAG developed speciated HAPs [ref 4] for industrial surface coating categories.

Example Calculation

According to the U.S. Census Bureau, Kootenai County had a total of 492 employees in the factory finished wood industry. According to EPA's 2011 calculations, the solvent use emission factor for VOC is 48.07 lb/employee.

$$E_{VOC} = 492 \times 48.07 \text{ lb VOC/ employee}$$
$$= 11.83 \text{ tons VOC}$$

3.31.5 Summary of data quality assurance methods

The EPA compared the 2011 dataset to previous year EPA dataset and found no significant issues. Since this source category overlaps with the point source inventory, the submitting agency has the responsibility for reconciling the emissions and submitting nonpoint data to EPA that has the point sources emissions accounted for. Some effort was made by EPA to determine if point sources were properly accounted for. The EPA used state responses to EPA surveys and personal communication, if necessary, to determine the status of point source reconciliation for these categories.

Colorado asked EPA to tag the EPA nonpoint emissions for industrial surface coating, because they determined that they had these sources covered in the point data category.

3.31.6 References for Solvent – Industrial Surface Coating

1. U.S. EPA Technology Transfer Network, Clearinghouse for Inventories & Emissions Factors, Technical Report Series, Volume 3, Chapter 8: Industrial Surface Coatings., accessed February 2011.
2. U.S. Census Bureau, 2010 County Business Patterns, accessed September 2012.
3. U.S. Census Bureau. 2010 Interactive Population Search, Census 2010.
4. U.S. EPA Technology Transfer Network, Clearinghouse for Inventories and Emissions Factors, Software and Tools, Speciate 4.3 September 2011. , accessed September 2012.
5. U.S. Census Bureau. Paints and Allied Products, 2010.
6. Freedonia Group. Study #2357, $4600. Solvents to 2012, June 2008.

3.32 Waste Disposal

3.32.1 Sector description

Waste disposal covers a wide range of source categories, from incineration, open burning, landfills, wastewater treatment, soil and groundwater remediation, scrap and waste materials, hazardous waste treatment storage and disposal facilities (TSDFs) and leaking underground storage tanks. SCCs that are included in the 2011 NEI v2 in the Waste Disposal sector are provided in Table 3-141. The leading SCC description is "Waste Disposal, Treatment, and Recovery" for nonpoint SCCs and "Waste Disposal" for point source SCCs. EPA estimates emissions from the highlighted SCCs below, which include in the nonpoint category: open burning of municipal solid waste, land clearing debris, and yard waste; publicly owned treatment works (POTW); and a few specific mercury sources in landfills. The column "Hg only?" denotes categories where only mercury was estimated by EPA. EPA also estimated landfill emissions in point, where S/L/T agencies did not include landfill emissions in their point source submissions. The methodologies for the select source categories in the Waste Disposal sector that EPA estimates are provided in separate subsections (reflected in the table) within this chapter. SCCs with an "x" denote that all SCC level 4 descriptions have been removed and that the "Remaining SCC Description" covers all SCCs under the Level 3 SCC description.

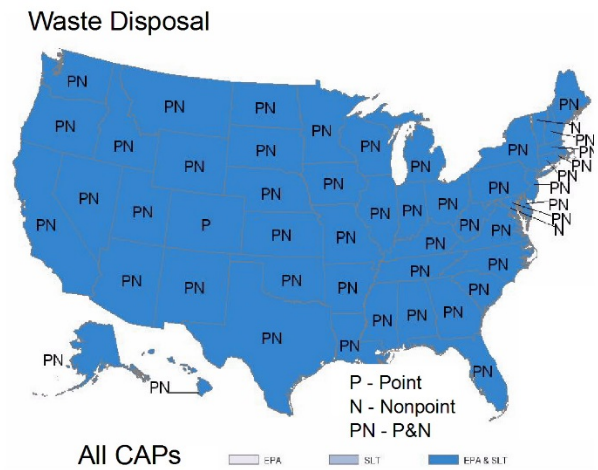
Table 3-141: Waste Disposal sector SCCs with locations of section discussion where available

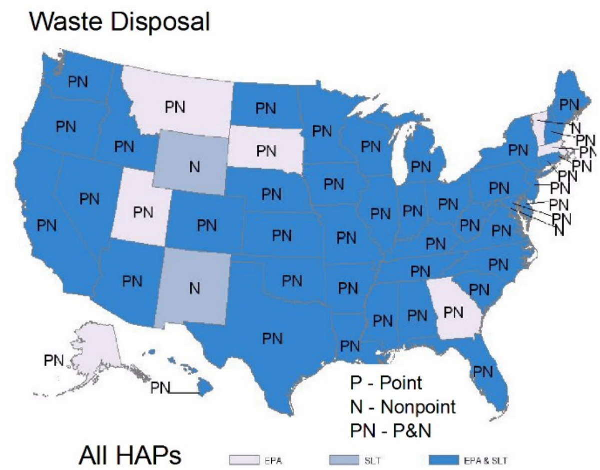
SCC Level One	Section	Hg only?	SCC	Remaining SCC Description
Waste Disposal, Treatment, and Recovery			2601000000	On-site Incineration; All Categories; Total
Waste Disposal, Treatment, and Recovery			2601010000	On-site Incineration; Industrial; Total
Waste Disposal, Treatment, and Recovery			2601020000	On-site Incineration; Commercial/Institutional; Total
Waste Disposal, Treatment, and Recovery	3.32.4		2610000100	Open Burning; All Categories; Yard Waste - Leaf Species Unspecified
Waste Disposal, Treatment, and Recovery			2610000300	Open Burning; All Categories; Yard Waste - Weed Species Unspecified (incl Grass)
Waste Disposal, Treatment, and Recovery	3.32.4		2610000400	Open Burning; All Categories; Yard Waste - Brush Species Unspecified
Waste Disposal, Treatment, and Recovery	3.32.6		2610000500	Open Burning; All Categories; Land Clearing Debris (use 28-10-005-000 for Logging Debris Burning)
Waste Disposal, Treatment, and Recovery	3.32.5		2610030000	Open Burning; Residential; Household Waste (use 26-10-000-xxx for Yard Wastes)
Waste Disposal, Treatment, and Recovery			2610040400	Open Burning; Municipal (collected from residences, parks, other for central burn); Yard Waste - Total (includes Leaves, Weeds, and Brush)
Waste Disposal, Treatment, and Recovery			2620000000	Landfills; All Categories; Total
Waste Disposal, Treatment, and Recovery			2620030000	Landfills; Municipal; Total
Waste Disposal, Treatment, and Recovery	3.32.8	Y	2620030001	Landfills; Municipal; Dumping/Crushing/Spreading of New Materials (working face)
Waste Disposal, Treatment, and Recovery			2630000000	Wastewater Treatment; All Categories; Total Processed
Waste Disposal, Treatment, and Recovery			2630010000	Wastewater Treatment; Industrial; Total Processed
Waste Disposal, Treatment, and Recovery	3.32.7		2630020000	Wastewater Treatment; Public Owned; Total Processed

SCC Level One	Section	Hg only?	SCC	Remaining SCC Description
Waste Disposal, Treatment, and Recovery			2630020020	Wastewater Treatment; Public Owned; Biosolids Processes Total
Waste Disposal, Treatment, and Recovery			2630040000	Wastewater Treatment; Public Owned; Ammonia pH Control
Waste Disposal, Treatment, and Recovery			2635000000	Soil and Groundwater Remediation; All Categories; Total
Waste Disposal, Treatment, and Recovery			2640000000	TSDFs; All TSDF Types; Total: All Processes
Waste Disposal, Treatment, and Recovery	3.32.8	Y	2650000000	Scrap and Waste Materials; Scrap and Waste Materials; Total: All Processes
Waste Disposal, Treatment, and Recovery	3.32.8	Y	2650000002	Scrap and Waste Materials; Scrap and Waste Materials; Shredding
Waste Disposal, Treatment, and Recovery			2660000000	Leaking Underground Storage Tanks; Leaking Underground Storage Tanks; Total: All Storage Types
Waste Disposal, Treatment, and Recovery			2680001000	Composting; 100% Biosolids (e.g., sewage sludge, manure, mixtures of these matls); All Processes
Waste Disposal, Treatment, and Recovery			2680002000	Composting; Mixed Waste (e.g., a 50:50 mixture of biosolids and green wastes); All Processes
Waste Disposal, Treatment, and Recovery			2680003000	Composting; 100% Green Waste (e.g., residential or municipal yard wastes); All Processes
Miscellaneous Area Sources			2810005001	Other Combustion; Managed Burning, Slash (Logging Debris); Pile Burning
Miscellaneous Area Sources			2810005002	Other Combustion; Managed Burning, Slash (Logging Debris); Broadcast Burning
Waste Disposal			501001xx	Solid Waste Disposal - Government; Municipal Incineration
Waste Disposal			501002xx	Solid Waste Disposal - Government; Open Burning Dump
Waste Disposal			50100402	Solid Waste Disposal - Government; Landfill Dump; Fugitive Emissions
Waste Disposal			501004xx	Solid Waste Disposal - Government; Landfill Dump; <All other processes>
Waste Disposal			501005xx	Solid Waste Disposal - Government; Other Incineration;
Waste Disposal			501007xx	Solid Waste Disposal - Government; Sewage Treatment
Waste Disposal			50180001	Solid Waste Disposal - Government; Equipment Leaks; Equipment Leaks
Waste Disposal			5018200x	Solid Waste Disposal - Government; Wastewater, Aggregate
Waste Disposal			50182599	Solid Waste Disposal - Government; Wastewater, Points of Generation; Specify Point of Generation
Waste Disposal			501900xx	Solid Waste Disposal - Government; Auxiliary Fuel/No Emissions
Waste Disposal			5020010x	Solid Waste Disposal - Commercial/Institutional; Incineration
Waste Disposal			5020020x	Solid Waste Disposal - Commercial/Institutional; Open Burning
Waste Disposal			502005xx	Solid Waste Disposal - Commercial/Institutional; Incineration: Special Purpose
Waste Disposal			50200601	Solid Waste Disposal - Commercial/Institutional; Landfill Dump; Waste Gas Flares ** (Use 5-01-004-10)
Waste Disposal			50200602	Solid Waste Disposal - Commercial/Institutional; Landfill Dump; Municipal: Fugitive Emissions ** (Use 5-01-004-02)
Waste Disposal			50280001	Solid Waste Disposal - Commercial/Institutional; Equipment Leaks; Equipment Leaks
Waste Disposal			5028200x	Solid Waste Disposal - Commercial/Institutional; Wastewater, Aggregate

SCC Level One	Section	Hg only?	SCC	Remaining SCC Description
Waste Disposal			50282599	Solid Waste Disposal - Commercial/Institutional; Wastewater, Points of Generation; Specify Point of Generation
Waste Disposal			502900xx	Solid Waste Disposal - Commercial/Institutional; Auxiliary Fuel/No Emissions
Waste Disposal			503001xx	Solid Waste Disposal - Industrial; Incineration
Waste Disposal			503002xx	Solid Waste Disposal - Industrial; Open Burning;
Waste Disposal			503005xx	Solid Waste Disposal - Industrial; Incineration; Hazardous Waste Incinerators
Waste Disposal			503005xx	Solid Waste Disposal - Industrial; Incineration
Waste Disposal			50300601	Solid Waste Disposal - Industrial; Landfill Dump; Waste Gas Flares
Waste Disposal			50300602	Solid Waste Disposal - Industrial; Landfill Dump; Liquid Waste Disposal
Waste Disposal			50300603	Solid Waste Disposal - Industrial; Landfill Dump; Hazardous: Fugitive Emissions
Waste Disposal			503007xx	Solid Waste Disposal - Industrial; Liquid Waste
Waste Disposal			503008xx	Solid Waste Disposal - Industrial; Treatment, Storage, Disposal/TSDF
Waste Disposal			50300901	Solid Waste Disposal - Industrial; Asbestos Removal; General
Waste Disposal			50380001	Solid Waste Disposal - Industrial; Equipment Leaks; Equipment Leaks
Waste Disposal			5038200x	Solid Waste Disposal - Industrial; Wastewater, Aggregate; Process Area Drains
Waste Disposal			503825xx	Solid Waste Disposal - Industrial; Wastewater, Points of Generation; Liquid Injection Incinerator
Waste Disposal			503900xx	Solid Waste Disposal - Industrial; Auxiliary Fuel/No Emissions
Waste Disposal			504001xx	Site Remediation; General Processes
Waste Disposal			50400201	Site Remediation; General Processes; Miscellaneous
Waste Disposal			504003xx	Site Remediation; General Processes
Waste Disposal			504100xx	Site Remediation; Excavation/Soils Handling
Waste Disposal			504101xx	Site Remediation; Stabilization/Solidification
Waste Disposal			5041021	Site Remediation; Capping
Waste Disposal			504103xx	Site Remediation; In Situ Venting/Venting of Soils
Waste Disposal			504104xx	Site Remediation; Air Stripping of Groundwater
Waste Disposal			504105xx	Site Remediation; Thermal Destruction
Waste Disposal			50410621	Site Remediation; Thermal Desorption; Thermal Desorber: Indirect Heat Transfer
Waste Disposal			504107xx	Site Remediation; Biological Treatment
Waste Disposal			5048200x	Site Remediation; Wastewater, Aggregate
Waste Disposal			50482599	Site Remediation; Wastewater, Points of Generation; Specify Point of Generation
Waste Disposal			50490004	Site Remediation; General Processes; Incinerators: Process Gas

3.32.2 Spatial coverage and data sources for the sector





3.32.3 Selection hierarchy

The waste disposal sector includes data from the S/L/T agency submitted data and the default EPA generated emissions. The agencies listed in Table 3-142 submitted emissions for this sector.

Table 3-142: Agencies that submitted Waste Disposal data

Agency	Data Category	Composting	Landfills	Leaking Storage Tanks	Onsite Incineration	Open Burning	Other Combustion	Scrap & Waste Materials	Site Remediation	Soil & Groundwater Remediation	Solid Waste Commercial/Instit.	Solid Waste Government	Solid Waste Industrial	TSDFs	Wastewater Treatment
2011EPA_CarryForward-PreviousYearData	P														
2011EPA_HAP-Augmentation	NP					X									X
2011EPA_HAP-Augmentation	P								X	X					
2011EPA_LF	P								X	X					
2011EPA_NP_NoOverlap_w_Pt	NP					X									X
2011EPA_Other	P									X					
2011EPA_PM-Augmentation	NP	X	X		X	X	X	X						X	X
2011EPA_PM-Augmentation	P								X	X					
2011EPA_TRI	P								X	X					
2011EPA_chrom_split	NP	X	X			X								X	
2011EPA_chrom_split	P									X					
Alabama Department of Environmental Management	P								X	X					
Alaska Department of Environmental Conservation	NP				X										X
Alaska Department of Environmental Conservation	P								X	X					
Allegheny County Health Department	P									X					
Arizona Department of Environmental Quality	P									X					
Arkansas Department of Environmental Quality	P								X	X					

Agency	Data Category	Composting	Landfills	Leaking Storage Tanks	Onsite Incineration	Open Burning	Other Combustion	Scrap & Waste Materials	Site Remediation	Soil & Groundwater Remediation	Solid Waste Commercial/Instit.	Solid Waste Government	Solid Waste Industrial	TSDFs	Wastewater Treatment
Bishop Paiute Tribe	NP					X									
California Air Resources Board	NP	X	X			X								X	X
California Air Resources Board	P								X	X					
Chattanooga Air Pollution Control Bureau (CHCAPCB)	NP														X
Chattanooga Air Pollution Control Bureau (CHCAPCB)	P									X					
City of Albuquerque	P								X	X					
City of Huntsville Division of Natural Resources and Environmental Mgmt	P									X					
Clark County Department of Air Quality and Environmental Management	NP					X									X
Clark County Department of Air Quality and Environmental Management	P									X					
Coeur d'Alene Tribe	NP		X												X
Colorado Department of Public Health and Environment	P								X	X					
Connecticut Department Of Environmental Protection	NP					X									X
Connecticut Department Of Environmental Protection	P									X					
DC Department of Health Air Quality Division	NP														X
Delaware Department of Natural Resources and Environmental Control	NP					X									
Delaware Department of Natural Resources and Environmental Control	P									X					
Delaware Department of Natural Resources and Environmental Control	P									X					
Eastern Band of Cherokee Indians	NP		X												X
Florida Department of Environmental Protection	P								X	X					
Forsyth County Environmental Affairs Department	P								X	X					
Georgia Department of Natural Resources	NP		X	X	X	X								X	X
Georgia Department of Natural Resources	P								X	X					
Hawaii Department of Health Clean Air Branch	NP		X												X
Hawaii Department of Health Clean Air Branch	P									X					
Idaho Department of Environmental Quality	NP		X			X									X
Idaho Department of Environmental Quality	P								X	X					
Illinois Environmental Protection Agency	NP				X	X									X
Illinois Environmental Protection Agency	P								X	X					
Indiana Department of Environmental Management	P								X	X					
Iowa Department of Natural Resources	NP														X
Iowa Department of Natural Resources	P								X	X					
Jefferson County (AL) Department of Health	P									X					
Kansas Department of Health and Environment	NP					X									X
Kansas Department of Health and Environment	P								X	X					

Agency	Data Category	Composting	Landfills	Leaking Storage Tanks	Onsite Incineration	Open Burning	Other Combustion	Scrap & Waste Materials	Site Remediation	Soil & Groundwater Remediation	Solid Waste Commercial/Instit.	Solid Waste Government	Solid Waste Industrial	TSDFs	Wastewater Treatment
Kentucky Division for Air Quality	P								X	X					
Knox County Department of Air Quality Management	NP									X					
Kootenai Tribe of Idaho	NP		X												X
Lane Regional Air Pollution Authority	P									X					
Louisiana Department of Environmental Quality	NP				X									X	
Louisiana Department of Environmental Quality	P								X	X					
Louisville Metro Air Pollution Control District	P									X					
Maine Department of Environmental Protection	NP	X				X									X
Maine Department of Environmental Protection	P									X					
Maricopa County Air Quality Department	NP		X	X	X	X		X							
Maricopa County Air Quality Department	P									X					
Maryland Department of the Environment	NP		X	X	X	X									X
Maryland Department of the Environment	P								X	X					
Massachusetts Department of Environmental Protection	NP		X	X											
Massachusetts Department of Environmental Protection	P								X	X					
Mecklenburg County Air Quality	P									X					
Memphis and Shelby County Health Department - Pollution Control	P								X	X					
Metro Public Health of Nashville/Davidson County	NP					X									X
Metro Public Health of Nashville/Davidson County	P								X	X					
Michigan Department of Environmental Quality	NP		X	X											X
Michigan Department of Environmental Quality	P								X	X					
Minnesota Pollution Control Agency	NP					X									
Minnesota Pollution Control Agency	P								X	X					
Mississippi Dept of Environmental Quality	P								X	X					
Missouri Department of Natural Resources	NP					X									
Missouri Department of Natural Resources	P								X	X					
Montana Department of Environmental Quality	P									X					
Nebraska Environmental Quality	P								X	X					
Nevada Division of Environmental Protection	P								X	X					
New Hampshire Department of Environmental Services	NP		X	X											
New Hampshire Department of Environmental Services	P									X					
New Jersey Department of Environment Protection	NP		X	X	X	X									X
New Jersey Department of Environment Protection	P								X	X					
New Mexico Environment Department Air Quality Bureau	P								X	X					
New York State Department of Environmental Conservation	NP					X									X
New York State Department of Environmental Conservation	P								X	X					
Nez Perce Tribe	NP		X												X

Agency	Data Category	Composting	Landfills	Leaking Storage Tanks	Onsite Incineration	Open Burning	Other Combustion	Scrap & Waste Materials	Site Remediation	Soil & Groundwater Remediation	Solid Waste Commercial/Instit.	Solid Waste Government	Solid Waste Industrial	TSDFs	Wastewater Treatment
North Carolina Department of Environment and Natural Resources	P								X	X					
North Dakota Department of Health	P								X	X					
Northern Cheyenne Tribe	NP					X									
Ohio Environmental Protection Agency	NP														X
Ohio Environmental Protection Agency	P								X	X					
Oklahoma Department of Environmental Quality	P								X	X					
Olympic Region Clean Air Agency	P									X					
Omaha Air Quality Control Division	P									X					
Oregon Department of Environmental Quality	NP	X	X			X									
Oregon Department of Environmental Quality	P								X	X					
Pennsylvania Department of Environmental Protection	P									X					
Philadelphia Air Management Services	P									X					
Pinal County	P									X					
Puerto Rico	P									X					
Puget Sound Clean Air Agency	P									X					
Rhode Island Department of Environmental Management	P									X					
Sac and Fox Nation of Missouri in Kansas and Nebraska Reservation	NP					X									
Shoshone-Bannock Tribes of the Fort Hall Reservation of Idaho	NP		X												X
South Carolina Department of Health and Environmental Control	P								X	X					
South Dakota Department of Environment and Natural Resources	P									X					
Southern Ute Indian Tribe	P									X					
Tennessee Department of Environmental Conservation	P								X	X					
Texas Commission on Environmental Quality	NP														X
Texas Commission on Environmental Quality	P								X	X					
Utah Division of Air Quality	NP		X	X											
Utah Division of Air Quality	P								X	X					
Vermont Department of Environmental Conservation	NP					X									X
Virginia Department of Environmental Quality	NP			X	X	X								X	X
Virginia Department of Environmental Quality	P								X	X					
Washington State Department of Ecology	NP					X	X								X
Washington State Department of Ecology	P									X					
Washoe County Health District	NP				X	X				X					
Washoe County Health District	P									X					
West Virginia Division of Air Quality	NP					X									X
West Virginia Division of Air Quality	P									X					

Agency	Data Category	Composting	Landfills	Leaking Storage Tanks	Onsite Incineration	Open Burning	Other Combustion	Scrap & Waste Materials	Site Remediation	Soil & Groundwater Remediation	Solid Waste Commercial/Instit.	Solid Waste Government	Solid Waste Industrial	TSDFs	Wastewater Treatment
Western North Carolina Regional Air Quality Agency (Buncombe Co.)	P									X					
Wisconsin Department of Natural Resources	P									X					
Wyoming Department of Environmental Quality	P									X					
Wyoming Department of Environmental Quality	P									X					

Table 3-143 shows the selection hierarchy for datasets included in the waste disposal sector. The waste disposal sector includes emissions from both S/L/T agencies and from the EPA no overlap nonpoint dataset. The table below lists the hierarchy of datasets used in the 2011 NEI for this sector. In some cases, the EPA PM and HAP augmentation as well as TRI and chromium split datasets were used to fill in PM species and HAP pollutants based on S/L/T agency data. In addition, if states did not report landfill emissions to their point source inventories, EPA estimated these emissions and gap-filled the NEI to account for these in the dataset called 2011EPA_LF. Finally, EPA also estimated mercury emissions that end up in landfills and in shredding and crushing operations, and if states did not include emissions of this nature, EPA gap-filled these data as well.

Table 3-143: 2011 NEI Waste Disposal data selection hierarchy

Priority	Dataset Name	Dataset Content
1	2011EPA_PM-Augmentation	Augments PM data in 47 states and some tribes
2	Responsible Agency Data Set	State and Local Agency submitted emissions
3	2011EPA_chrom_split	Splits total chromium into speciated chromium in 37 states
4	2011EPA_TRI	Toxics Release Inventory data for the year 2011. These data are selected for a facility only when alternative emissions are not included in the S/L/T agency data.
5	2011EPA_LF	Landfills generated from GHG data
6	2011EPA_HAP-Augmentation	Adds Pb and other HAP emissions in 46 states
7	2011EPA_NP_NoOverlap_w_Pt	EPA-generated data
8	2011EPA_Mercury	Mercury only data for certain nonpoint categories

The following sections explain the EPA methodologies for those source categories for which EPA estimated emissions.

3.32.4 EPA-developed emissions of Open Burning of Leaf and Brush Species

County-level criteria pollutant and HAP emissions were calculated by multiplying the total amount of yard waste (either leaf or brush) burned per year by an emission factor. Emissions for leaves and residential brush were calculated separately, since emission factors vary by yard waste type.

<u>Source Category Description</u>

Open burning of yard waste is the purposeful burning of leaf and brush species in outdoor areas. Criteria air pollutant (CAP) and hazardous air pollutant (HAP) emission estimates for leaf and brush waste burning are a function of the amount of waste burned per year. For this source category, the SCCs provided in Table 3-144 were assigned and estimated by EPA for the 2011 NEI.

Table 3-144: Open Burning, Leaf and Brush Species SCCs estimated by EPA in the 2011 NEI

SCC	SCC Level 1	SCC Level 2	SCC Level 3	SCC Level 4
2610000100	Waste Disposal, Treatment, and Recovery	Open Burning	All Categories	Yard Waste – Leaf Species Unspecified
2610000400	Waste Disposal, Treatment, and Recovery	Open Burning	All Categories	Yard Waste – Brush Species Unspecified

Activity Data

The amount of leaf and brush waste burned was estimated using data from EPA's report *Municipal Solid Waste Generation, Recycling, and Disposal in the United States: Facts and Figures for 2010* [ref 1]. The report presents the total mass of waste generated from the residential and commercial sectors, including yard waste, in the United States by type of waste for the calendar year 2010. According to the EPA report, residential waste generation accounts for 55-65 percent of the total waste from the residential and commercial sectors [ref 2]. For the calculation of per capita yard waste subject to burning, the median value of 60 percent was assumed. This information was used to calculate a daily estimate of the per capita yard waste of 0.36 lbs./person/day. Of the total amount of yard waste generated, the yard waste composition was assumed to be 25 percent leaves, 25 percent brush, and 50 percent grass by weight [ref 3].

Open burning of grass clippings is not typically practiced by homeowners, and as such only estimates for leaf burning and brush burning were developed. Approximately 25 to 32 percent of all waste that is subject to open burning is actually burned [ref 3]. A median value of 28 percent is assumed to be burned in all counties in the United States.

The per capita estimate was then multiplied by the 2010 population in each county that is expected to burn waste. Since open burning is generally not practiced in urban areas, only the rural population of each county was assumed to practice open burning. The ratio of urban to rural population was obtained from 2010 U.S. Census data [ref 4]. This ratio was then multiplied by the 2010 U.S. Census Bureau estimate of the population in each county to obtain the county-level rural population for 2010 [ref 5].

The percentage of forested acres from Version 2 of BELD2 within BEIS was used to adjust for variations in vegetation. The percentage of forested acres per county (including rural forest and urban forest) was then determined. To better account for the native vegetation that would likely be occurring in the residential yards of farming States, agricultural land acreage was subtracted before calculating the percentage of forested acres. Table 3-145 presents the ranges that were used to make adjustments to the amount of yard waste that is assumed to be generated per county. All municipalities in Puerto Rico and counties in the U.S. Virgin Islands, Hawaii, and Alaska were assumed to have greater than 50 percent forested acres.

Table 3-145: Adjustment for percentage of forested acres

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

Controls

Controls for yard waste burning are generally in the form of a ban on open burning of waste in a given municipality or county. Counties that were more than 80% urban were assumed not to practice any open burning. Therefore, criteria pollutant and HAP emissions from residential yard waste burning are zero in these counties. In addition, the State of Colorado implemented a state-wide ban on open burning. Emissions from open burning of residential yard waste in all Colorado counties were assumed to be zero.

Emission Factors

Emission factors for CAPs were developed by the U.S. Environmental Protection Agency (EPA) in consultation with the Eastern Regional Technical Advisory Committee [ref 6]. For leaf burning, emission factors for $PM_{2.5}$ were calculated by multiplying the PM_{10} leaf burning emission factors by the $PM_{2.5}$ to PM_{10} emission factor ratio for brush burning (0.7709). Emission factors for HAPs are from an EPA Control Technology Center report [ref 7]. Forest fire simulation emission factors were used to estimate emissions for 17 dioxin congeners [ref 8].

Example Calculations

VOC emissions in Autauga County, Alabama from open burning of leaf waste:

Population of Autauga County in 2010	= 54,571
Rural fraction of Autauga County population	= 0.42
Per capita waste yard waste generated (lb/person/day)	= 0.3557
Leaf fraction of waste	= 0.25
Fraction of rural population that burns yard waste	= 0.28
Adjustment factor based on % forested acres	= 1
Number of days in a year	= 365
Factor to convert from lbs to tons	= 1/2000

2010 leaf burning activity in Autauga County = 54,571 * 0.42 * 0.3557 * 0.25 * 0.28 * 1 * 365 /2000
2010 leaf burning activity in Autauga County = 104.15 tons

VOC emissions = tons of leaves burned * VOC emission factor
VOC emission factor = 28 lb/ton

VOC emissions in Autauga County in 2010 = 104.15 tons * 28 lbs/ton * 1 ton/2000 lbs
VOC emissions in Autauga County in 2010 = 1.46 tons

3.32.5 EPA-developed emissions of Open Burning of Municipal Solid Waste (MSW)

County-level criteria pollutant and HAP emissions were calculated by multiplying the total amount of residential municipal solid waste burned per year by an emission factor.

Source Category Description

Open burning of residential municipal solid waste (MSW) is the purposeful burning of MSW in outdoor areas. Criteria air pollutant (CAP) and hazardous air pollutant (HAP) emission estimates for MSW burning are a function of the amount of waste burned per year.

For this source category, the following SCC was assigned, and emissions were estimated for the 2011 NEI: SCC=2610030000, SCC description=" Waste Disposal, Treatment, and Recovery; Open Burning; Residential; Household Waste (use 26-10-000-xxx for Yard Wastes)".

Activity Data

The amount of household MSW burned was estimated using data from EPA's report *Municipal Solid Waste Generation, Recycling, and Disposal in the United States: Facts and Figures for 2010 [ref 1]*. The report presents the total mass of waste generated from the residential and commercial sectors in the United States by type of waste for the calendar year 2010. According to the EPA report, residential waste generation accounts for 55-65 percent of the total waste from the residential and commercial sectors [ref 2]. For the calculation of per capita household waste subject to burning, the median value of 60 percent was assumed. This information was used to calculate a daily estimate of the per capita household waste subject to burning of 1.94 lbs./person/day. Non-combustible waste, such as glass and metals, was not considered to be waste subject to burning. Burning of yard waste is included in SCC 2610000100 and SCC 2610000400; therefore, it is not part of residential MSW. Approximately 25 to 32 percent of all waste that is subject to open burning is actually burned [ref 4, ref 9]. A median value of 28 percent is assumed to be burned in all counties in the United States.

Since open burning is generally not practiced in urban areas, only the rural population of each county was assumed to practice open burning. The ratio of urban to rural population was obtained from 2010 U.S. Census data [ref 4]. This ratio was then multiplied by the 2010 U.S. Census Bureau estimate of the population in each county to obtain the county-level rural population for 2010 [ref 5]. The county-level rural population was then multiplied by the per capita household waste subject to burning to determine the amount of rural household MSW generated in each county in 2010.

Controls

Controls for residential MSW burning are generally in the form of a ban on open burning of waste in a given municipality or county. Counties that were more than 80% urban were assumed not to practice any open burning. Therefore, criteria pollutant and HAP emissions from residential municipal solid waste burning are zero in these counties. In addition, the State of Colorado implemented a state-wide ban on open burning. Emissions from open burning of residential waste in all Colorado counties were assumed to be zero.

Emission Factors

Emission factors for CAPs were developed by the U.S. Environmental Protection Agency (EPA) in consultation with the Eastern Regional Technical Advisory Committee and based primarily on the AP-42 report [ref 10]. Emission factors for HAPs are from an EPA Control Technology Center report and emission factors for 17 dioxin congeners were obtained from an EPA dioxin report [ref 11]. These emission factors are provided in Table 3-146.

Table 3-146: Emission factors for Open Burning of Residential MSW (2610030000)

Pollutant	Pollutant Code	Emission Factor (lb/ton)	Emission Factor Reference
CO	CO	8.50E+01	Reference 9
NOX	NOX	6.00E+00	Reference 9
PM10-FIL	PM10-FIL	3.80E+01	Reference 8
PM10-PRI	PM10-PRI	3.80E+01	Reference 8
PM25-FIL	PM25-FIL	3.48E+01	Reference 8
PM25-PRI	PM25-PRI	3.48E+01	Reference 8
SO2	SO2	1.00E+00	Reference 9

Pollutant	Pollutant Code	Emission Factor (lb/ton)	Emission Factor Reference
VOC	VOC	8.56E+00	Reference 8
1,2,3,4,6,7,8-heptachlorodibenzofuran	67562394	2.48E-07	Reference 11
1,2,3,4,6,7,8-heptachlorodibenzo-p-dioxin	35822469	7.96E-08	Reference 11
1,2,3,4,7,8,9-heptachlorodibenzofuran	55673897	3.00E-08	Reference 11
1,2,3,4,7,8-hexachlorodibenzofuran	70648269	2.28E-07	Reference 11
1,2,3,4,7,8-hexachlorodibenzo-p-dioxin	39227286	1.28E-08	Reference 11
1,2,3,6,7,8-hexachlorodibenzofuran	57117449	7.70E-08	Reference 11
1,2,3,6,7,8-hexachlorodibenzo-p-dioxin	57653857	1.94E-08	Reference 11
1,2,3,7,8,9-hexachlorodibenzofuran	72918219	5.00E-09	Reference 11
1,2,3,7,8,9-hexachlorodibenzo-p-dioxin	19408743	3.80E-08	Reference 11
1,2,3,7,8-pentachlorodibenzofuran	57117416	7.44E-08	Reference 11
1,2,3,7,8-pentachlorodibenzo-p-dioxin	40321764	1.62E-08	Reference 11
1,2,4-trichlorobenzene	120821	1.95E-04	Reference 10
1,4-dichlorobenzene	106467	6.65E-05	Reference 10
2,3,4,6,7,8-hexachlorodibenzofuran	60851345	1.24E-07	Reference 11
2,3,4,7,8-pentachlorodibenzofuran	57117314	1.30E-07	Reference 11
2,3,7,8-tetrachlorodibenzofuran	51207319	9.12E-08	Reference 11
2,3,7,8-tetrachlorodibenzo-p-dioxin	1746016	5.40E-09	Reference 11
Acenaphthene	83329	1.54E-03	Reference 10
Acenaphthylene	208968	2.26E-02	Reference 10
Acetaldehyde	75070	8.57E-01	Reference 10
Acrolein	107028	6.19E-02	Reference 10
Anthracene	120127	3.66E-03	Reference 10
Benz[a]anthracene	56553	4.48E-03	Reference 10
Benzene	71432	2.48E+00	Reference 10
Benzo[a]pyrene	50328	4.24E-03	Reference 10
Benzo[b]fluoranthene	205992	5.26E-03	Reference 10
Benzo[g,h,i,]Perylene	191242	3.95E-03	Reference 10
Benzo[k]fluoranthene	207089	2.05E-03	Reference 10
Chlorobenzene	108907	8.48E-04	Reference 10
Chrysene	218019	5.07E-03	Reference 10
Dibenzo[a,h]anthracene	53703	6.46E-04	Reference 10
Fluoranthene	206440	8.14E-03	Reference 10
Fluorene	86737	7.31E-03	Reference 10
Hexachlorobenzene	118741	4.40E-05	Reference 10
Hydrochloric Acid	7647010	5.68E-01	Reference 10
Hydrogen Cyanide	74908	9.36E-01	Reference 10
Indeno[1,2,3-c,d]pyrene	193395	3.75E-03	Reference 10
Naphthalene	91203	3.51E-02	Reference 10
Octachlorodibenzofuran	39001020	7.28E-08	Reference 11
Octachlorodibenzo-p-dioxin	3268879	9.94E-08	Reference 11
Pentachlorophenol	87865	1.06E-04	Reference 10
Phenanthrene	85018	1.46E-02	Reference 10
Phenol	108952	2.80E-01	Reference 10
Polychlorinated Biphenyls	1336363	5.72E-03	Reference 10

Pollutant	Pollutant Code	Emission Factor (lb/ton)	Emission Factor Reference
Pyrene	129000	9.66E-03	Reference 10
Styrene	100425	1.48E+00	Reference 10

Example Calculations

VOC emissions in Autauga County, Alabama from open burning of residential MSW:

Population of Autauga County in 2010	= 54,571
Rural fraction of Autauga County population	= 0.42
Per capita MSW generated (lb/person/day)	= 1.9435
Fraction of rural population that burns MSW	= 0.28
Number of days in a year	= 365
Factor to convert from lbs to tons	= 1/2000
2010 MSW burning activity in Autauga County	= 54,571 * 0.42 * 1.9435 * 0.28 * 365 /2000
2010 MSW activity in Autauga County	= 2,276 tons
VOC emissions	= MSW burned * VOC emission factor
VOC emission factor	= 8.56 lb/ton
VOC emissions in Autauga County	= 2,276 tons * 8.56 lbs/ton * 1 ton/2000 lbs
VOC emissions in Autauga County in 2010	= 9.74 tons

3.32.6 EPA-developed emissions of Open Burning of Land Clearing Debris

County-level criteria pollutant and HAP emissions were calculated by multiplying the total mass of land clearing debris burned per year by an emission factor.

Source Category Description

Open burning of land clearing debris is the purposeful burning of debris, such as trees, shrubs, and brush, from the clearing of land for the construction of new buildings and highways. Criteria air pollutant (CAP) and hazardous air pollutant (HAP) emission estimates from open burning of land clearing debris are a function of the amount of material or fuel subject to burning per year.

For this source category, the following SCC was assigned and estimated by EPA for the 2011 NEI: SCC=2610000500, SCC description=” Waste Disposal, Treatment, and Recovery; Open Burning; All Categories; Land Clearing Debris (use 28-10-005-000 for Logging Debris Burning)”.

Activity Data

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

Acres Disturbed from Residential Construction

The US Census Bureau has 2010 data for Housing Starts - New Privately Owned Housing Units Started [ref 12] which provides regional level housing starts based on the groupings of 1 unit, 2-4 units, 5 or more units. A consultation with the Census Bureau in 2002 gave a breakdown of approximately 1/3 of the housing starts being for 2 unit structures, and 2/3 being for 3 and 4 unit structures. The 2-4 unit category was divided into 2-units, and 3-4 units based on this ratio. To determine the number of structures for each grouping, the 1 unit category was divided by 1, the 2 unit category was divided by 2, and the 3-4 unit category was divided by 3.5. The 5 or more unit category may be made up of more than one structure. New Privately Owned Housing Units Authorized Unadjusted Units [ref 13] gives a conversion factor to determine the ratio of structures to units in the 5 or more unit category. For example if a county has one 40 unit apartment building, the ratio would be 40/1. If there are 5 different 8 unit buildings in the same project, the ratio would be 40/5. Structures started by category are then calculated at a regional level. The table Annual Housing Units Authorized by Building Permit [ref 14] has 2010 data at the county level to allocate regional housing starts to the county level. This results in county level housing starts by number of units. The surface areas were assumed disturbed for each unit type shown in Table 3-147.

Table 3-147: Surface acres disturbed per unit type

Unit Type	Surface Acres Disturbed
1-Unit	1/4 acre/structure
2-Unit	1/3 acre/structure
Apartment	1/2 acre/structure

The 3-4 unit and 5 or more unit categories were considered to be apartments. Multiplication of housing starts to surface acres disturbed results in total number of acres disturbed for each unit category.

Acres Disturbed from Non-Residential Construction

Annual Value of Construction Put in Place in the U.S [ref 15] has the 2011 National Value of Non-residential construction. The national value of non-residential construction put in place (in millions of dollars) was allocated to counties using county-level non-residential construction (NAICS Code 2362) employment data obtained from *County Business Patterns (CBP)* [ref 16]. Because some county employment data was withheld due to privacy concerns, the following procedure was adopted:

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

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

A ratio of estimated employees (Step 2) to withheld employees (Step 1) was then used to adjust the county level estimates up or down so the state total of adjusted guesses should match state total of withheld employees (Step 1)

In 1999 a figure of 2 acres/\$1 million (\$$10^6$) was developed. The Bureau of Labor Statistics *Producer Price Index* [ref 17] lists costs of the construction industry from 1999-2011.

$$\text{2011 acres per } \$10^6 = \text{1999 acres per } \$10^6 \times (\text{1999 PPI / 2011 PPI})$$

$$= 2 \text{ acres}/\$10^6\ (132.9 / 229.3)$$

$$= 1.159 \text{ acres per } \$10^6$$

Acres Disturbed by Road Construction

The Federal Highway Administration provides data on spending by state in several different categories of road construction and maintenance in *Highway Statistics, Section IV - Highway Finance, Table SF-12A, State Highway Agency Capital Outlay* [ref 18] for 2008. (Note that this table has not been available in subsequent versions of *Highway Statistics*. Thus, 2008 is the latest data currently available.) For this SCC, the following sets of data (or columns) are used: New Construction, Relocation, Added Capacity, Major Widening, and Minor Widening. Each of these data sets are also differentiated according to the following six roadway classifications:

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

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

The new miles of road constructed are used to estimate the acreage disturbed due to road construction. The total area disturbed in each state was calculated by converting the new miles of road constructed to acres using an acres disturbed/mile conversion factor for each road type as given in Table 3-148.

Table 3-148: Spending per mile and acres disturbed per mile by highway type

Road Type	Dollars per mile	Acres Disturbed per mile
Urban Areas, Interstate	$4,000,000	15.2
Rural Areas, Interstate	$4,000,000	15.2
Urban Areas, Other Arterials	$1,900,000	15.2
Rural Areas, Other Arterials	$1,900,000	12.7
Urban Areas, Collectors	$1,900,000	9.8
Rural Areas, Collectors	$1,900,000	7.9

County-level building permits data are used to allocate the state-level acres disturbed by road construction to the county [ref 19]. A ratio of the number of building starts in each county to the total number of building starts in each state was applied to the state-level acres disturbed to estimate the total number of acres disturbed by road construction in each county.

<u>Converting Acres Disturbed to Tons of Land Clearing Debris Burned</u>

Version 2 of the Biogenic Emissions Land Cover Database (BELD2) within EPA's Biogenic Emission Inventory System (BEIS) was used to identify the acres of hardwoods, softwoods, and grasses in each county. Table 3 presents the average fuel loading factors by vegetation type. The average loading factors for slash hardwood and slash softwood were adjusted by a factor of 1.5 to account for the mass of tree that is below the soil surface that would be subject to burning once the land is cleared [ref 20]. Weighted average county-level loading factors, provided in Table 3-149, were calculated by multiplying the average loading factors by the percent contribution of each type of vegetation class to the total land area for each county.

Table 3-149: Fuel loading factors by vegetation type

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

The total acres disturbed by all construction types was calculated by summing the acres disturbed from residential, non-residential, and road construction. The county-level total acres disturbed were then multiplied by the weighted average loading factor to derive tons of land clearing debris.

Controls

Controls for land clearing debris burning are generally in the form of a ban on open burning of waste in a given municipality or county. Counties that were more than 80% urban were assumed not to practice any open burning. Therefore, criteria pollutant and HAP emissions from open burning of land clearing debris are zero in these counties. In addition, the State of Colorado implemented a state-wide ban on open burning. Emissions from open burning of land clearing debris in all Colorado counties were assumed to be zero.

Emission Factors

Emission factors for CAPs were developed by the U.S. Environmental Protection Agency (EPA) in consultation with the Eastern Regional Technical Advisory Committee and based primarily on the AP-42 report [ref 6, ref 10]. The $PM_{2.5}$ to PM_{10} emission factor ratio for brush burning (0.7709) was multiplied by the PM_{10} emission factors for land clearing debris burning to develop $PM_{2.5}$ emission factors.

Emission factors for HAPs are from an EPA Control Technology Center report [ref 7] and emission factors for 17 dioxin congeners were obtained from an EPA dioxin report [ref 8]. The dioxin emission factors were multiplied by 0.002 to convert from mg/kg to lb/ton. Emission factors for open burning land clearing debris are provided in Table 3-150.

Table 3-150: Emission factors for Open Burning of Land Clearing Debris (SCC 2610000500)

Pollutant	Pollutant Code	Emission Factor (lb/ton)	Emission Factor Reference
VOC	VOC	11.6	Reference 10
NOX	NOX	5	Reference 10
CO	CO	169	Reference 10
PM10-FIL	PM10-FIL	17	Reference 10
PM25-FIL	PM25-FIL	13.1	PM10-FIL multiplied by 0.7709
PM10-PRI	PM10-PRI	17	Reference 10
PM25-PRI	PM25-PRI	13.1	PM10-PRI multiplied by 0.7709
1,2,3,4,6,7,8-HpCDD	35822469	3.33E-07	Reference 13
1,2,3,4,6,7,8-HpCDF	67562394	5.08E-08	Reference 13
1,2,3,4,7,8,9-HpCDF	55673897	6.12E-09	Reference 13
1,2,3,4,7,8-HxCDD	39227286	1.14E-08	Reference 13
1,2,3,4,7,8-HxCDF	70648269	3.34E-08	Reference 13
1,2,3,6,7,8-HxCDD	57653857	2.14E-08	Reference 13
1,2,3,6,7,8-HxCDF	57117449	1.43E-08	Reference 13

Pollutant	Pollutant Code	Emission Factor (lb/ton)	Emission Factor Reference
1,2,3,7,8,9-HxCDD	19408743	3.47E-08	Reference 13
1,2,3,7,8,9-HxCDF	72918219	2.23E-09	Reference 13
1,2,3,7,8-PeCDD	40321764	7.66E-09	Reference 13
1,2,3,7,8-PeCDF	57117416	1.27E-08	Reference 13
2,3,4,6,7,8-HxCDF	60851345	1.96E-08	Reference 13
2,3,4,7,8-PeCDF	57117314	2.02E-08	Reference 13
2,3,7,8-TCDD	1746016	2.30E-09	Reference 13
2,3,7,8-TCDF	51207319	1.40E-08	Reference 13
Cumene	98828	1.33E-02	Reference 12
Dibenzofuran	132649	6.75E-03	Reference 12
Ethyl Benzene	100414	4.80E-02	Reference 12
OCDD	3268879	1.33E-06	Reference 13
OCDF	39001020	2.05E-08	Reference 13
Phenol	108952	1.15E-01	Reference 12
Styrene	100425	1.02E-01	Reference 12

<u>Example Calculations</u>

VOC emissions in Autauga County, Alabama from open burning of land clearing debris:

Rural fraction of Autauga County population = 0.42, so no emission controls
Acres disturbed by residential, non-residential, and road construction in Autauga County = 84.83
Weighted average fuel loading factor for Autauga County = 65.48 tons/acre
Mass of land clearing debris burned = 84.83 acres * 65.48 tons/acre = 5,555 tons

VOC emission factor = 11.6 lbs/ton
Factor to convert from lbs to tons = 1/2000

VOC emissions = tons of land clearing debris burned * VOC emission factor
VOC emissions = 5,555 tons * 11.6 lbs/ton * 1 ton /2000 lbs
VOC emissions (from land clearing debris burning in Autauga County in 2010) = 32 tons

3.32.7 EPA-developed emissions of Publicly Owned Treatment Works (POTW)

<u>Source Category Description</u>

Due to resource constraints, POTW emissions were not estimated for the 2011 NEI. The emissions from 2008 NEI were assumed to be similar in nature and were used in lieu of recalculated emissions. The below describes the methods used in the 2008 NEI EPA estimates for POTWs.

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

The general approach to calculating emissions for POTWs is to estimate the POTW flow rate using methods described below and then multiply the estimated flow rate by the emission factors for VOCs, ammonia, and numerous HAPs. The emissions are allocated to the county level using methods described below. It is important to note that the emission estimates for this category represent total emissions. It may be necessary to determine whether there are point source emissions in SCCs 50100701 through 50100781 and 50100791 through 50182599 that need to be subtracted to yield the nonpoint source emission estimates for this category.

For this source category, the following SCC was assigned, and EPA estimated emissions for the NEI: SCC=2630020000, SCC description=" Waste Disposal, Treatment and Recovery - Wastewater Treatment - Public Owned - Total Processed".

Activity Data

A nationwide projected flow rate in 2010 of 39,780 million gallons per day (MMGD) was available from an EPA report [ref 21]. Of this, POTWs account for 98.5 percent of the flow rate or 39,180 MMGD, with privately owned treatment works accounting for the rest. The EPA Clean Watersheds Needs Survey reports the existing flow rate in 2004 for POTWs as 34,370 MMGD [ref 22]. The interpolated 2008 nationwide flow rate (using a linear regression) was calculated at 37,580 MMGD, or 13,754,280 million gallons annually. The nationwide flow rate includes Puerto Rico and the U.S. Virgin Islands.

Emissions were allocated to the county-level by the county proportion of the U.S. population [ref 23].

Emission Factors

The ammonia emission factor was obtained from a report to EPA [ref 24], while the VOC emission factor was based on a TriTAC (technical advisory committee representing three California associations) study [ref 25]. Emission factors for the 53 HAPs were derived using 1996 area source emissions estimates that were provided by the EPA Sector Policies and Programs Division [ref 26] and the 1996 nationwide flow rate [ref 27]. These HAP emission factors were then multiplied by the 2008 to 2002 VOC emission factor ratio (0.85/9.9) to obtain the final HAP emission factors applied in the 2008 inventory.

Example Calculations

The 1996 flow rate per day was 32,175 MMGD. (1996 was a leap year.) Annually, this computes to:

32,175 MMGD treated * 366 days = 11,776,050 million gallons treated

Benzene emissions in 1996 for area source POTWs were estimated to be 461.44 tons per year. The derived benzene emission factor is calculated as follows:

Benzene emission factor = ((461.44 tons * 2000 lb/ton) / (11,776,050 million gallons treated)) * (0.85/9.9)
Benzene emission factor = 0.0067287 lb/million gallons treated

National total benzene emissions for 2008 for area source POTWs are calculated as follows:

2008 benzene emissions = (37,580 MMGD * 366 days) * (0.0067287 lb/million gallons treated)
2008 benzene emissions = 92,548 pounds / 2,000 pounds = 46.27 tons/year

Total national 2008 benzene emissions from area source POTWs are allocated to county-level by the county proportion of the U.S. population. The total U.S. population in 2008 is 308,123,578. Benzene emissions for Autauga County, Alabama (2008 population of 50,364) are calculated as follows:

2008 benzene emissions = 46.27 tons/year * 50,364/308,123,578 = 0.0076 tons/year

3.32.8 EPA-developed emissions of Landfills

Source Category Description

Most landfill emissions are developed by EPA using methane data from the EPA's Greenhouse Gas reporting rule program. This dataset is called 2011 EPA Landfills, and was presumed to contain landfills only for which no pollutants were reported by S/L/T in the 2011 reporting year.

Mercury emissions for landfills are accounted for with an EPA estimated dataset called 2011EPA_NP_Mercury. This methodology was not developed until 2011 v2, so these emissions are not accounted for in 2011 v1. These Hg-only SCCs are provided in Table 3-151; the SCC Level 1 description is "Waste Disposal, Treatment, and Recovery".

Table 3-151. Hg-only EPA-generated SCCs for Landfills

Subcategory	**SCC**	**SCC Description**
Landfill working face	2620030001	Landfills; Municipal; Dumping/Crushing/Spreading of New Materials (working face)
Thermostats and thermometers	2650000000	Scrap and Waste Materials; Scrap and Waste Materials; Total: All Processes
Switches and Relays	2650000002	Scrap and Waste Materials; Scrap and Waste Materials; Shredding

Mercury from the Working Face of Landfills

While the amount of mercury in products placed in landfills has tended to decrease in recent years, there is still a significant amount of mercury in place at landfills across the country. There are three main pathways for mercury emissions at landfills: (1) emissions from landfill gas (LFG) systems, including flare and vented systems; (2) emissions from the working face of landfills where new waste is placed; and (3) emissions from the closed, covered portions of landfills [ref 28]. Emissions from LFG systems are considered point sources and are already included in the NEI as submissions from SLT agencies or from the point source dataset that gap fills these landfill emissions (2011EPA_LF). Lindberg et al. (2005) [ref 28] found that emissions from the closed, covered portions of landfills are negligible and are similar to background soil emission rates. Therefore, this methodology focuses on emissions from the working face of landfills.

Activity Data

The US EPA's Landfill Methane Outreach Program (LMOP) maintains a database of the landfills in the United States with information on the total amount of waste in place, as well as the opening and closing years of the landfill and the county where the landfill is located [ref 29]. The average number of tons of waste each landfill receives is estimated by dividing the total waste in place by the number of years the landfill has been operating. Only landfills that were open in 2011 are included in the analysis.

Allocation Approach

The EPA LMOP database provides data at the county level.

Emission Factor

Lindberg et al. (2005) [ref 29], measured mercury emissions from the working face of four landfills in Florida and determined emission factors per ton of waste placed in a landfill annually, ranging from 1-6 mg per ton of waste. The average of these emission factors is 2.5 mg/ton of waste, or 5.51×10^{-6} lbs. / ton of waste.

Example Calculation

The City of Durham landfill in Durham County, NC is estimated to receive approximately 144,000 tons of waste annually.

144,000 tons of waste × 5.51×10^{-6} lbs. Hg/ton of waste = 0.79 lbs. Hg emissions

3.32.8.1 *Quality Assurance*

EPA noted some issues with point and nonpoint overlap for landfills after the 2011 v1 was published. EPA estimates landfill emissions for the point source inventory, and, believed that nonpoint SCCs were not being used by the S/L/T agencies. However, approximately 15 states or tribes do use these nonpoint SCCs, and, when using the EIS report for QA, some potential overlap was noted. Some tribal agencies submitted nonpoint landfill emissions after the 2011 v1, after this EPA point landfills dataset was created, so this was not resolved until 2011 v2.

EPA has proposed to resolve this in future inventories by retiring the nonpoint SCCs, and, using EPA's point inventory landfill dataset to fill in where S/L/T agencies do not report these as point sources. This would remove the need for point-nonpoint reconciliation in the future. However, EPA created a new nonpoint SCC for working face of landfills (currently restricted to Hg), so EPA is struggling with this question: does it really make sense to retire the other nonpoint SCCs for landfills?

EPA's short-term solution has been to propose tagging out any point landfills where agencies report landfills to the nonpoint inventory. This solution means that EPA would not retire the nonpoint landfill SCCs, which would be consistent with the fact that we are adding a nonpoint landfill SCC.

3.32.8.2 *EPA-Developed Emissions of Thermostats*

Mercury has been used in thermostats to switch on or off a heater or air conditioner based on the temperature of a room. Most of the historic production of mercury thermostats came from three corporations: Honeywell, White-Rogers, and General Electric. In 1998 these corporations formed the Thermostat Recycling Corporation (TRC), a voluntary program that attempts to collect and recycle mercury thermostats as they come out of service.

Activity Data

The 2002 EPA report estimated that 2-3 million thermostats came out of service in 1994 [ref 30]. A 2013 report from a consortium of environmental groups assumes that the estimate from the 2002 report remains viable and it estimates that the TRC collects at most 8% of the retired thermostats each year [ref 31]. Therefore, using this estimate, there are approximately 2.3 million thermostats that are not recycled each year.

Allocation Approach

The national-level mercury emissions are apportioned to each county based on population.

Emission Factor

The 2002 EPA report estimates that there are 3 grams of mercury per thermostat [ref 30]. Cain et al. (2007) [ref 32] estimate that 1.5% of mercury in "control devices," including thermostats, is emitted to the air before it is disposed of at a landfill or incinerator. Therefore, the amount of mercury emitted is 0.045 grams per thermostat, or 9.9×10^{-5} lbs. per thermostat.

Example Calculation

2.3 million improperly disposed thermostats × 9.9 × 10^{-5} lbs. per thermostat = 228 lbs. mercury emissions

Shelby County, TN has 933,902 people, or 0.3% of the national population. The mercury emissions from thermostats in Shelby County, TN are estimated by the following:

228 lbs. national mercury emissions × 0.3% = 0.684 lbs. mercury emissions

3.32.8.3 *EPA-Developed Emissions of Thermometers*

Mercury thermometers have all but been phased out in the United States, with the USEPA and National Institute of Standards and Technology (NIST) working to phase out mercury thermometers in industrial and laboratory settings. NIST issued notice in 2011 that it would no longer calibrate mercury-in-glass thermometers for traceability purposes. EPA issued a rule in 2012 that provides flexibility to use alternatives to mercury thermometers when complying with certain regulations pertaining to petroleum refining, power generation, and PCB waste disposal [ref 33]. Furthermore, thirteen states have laws that limit the manufacture, sale, and/or distribution of mercury-containing fever thermometers [ref 33].

Nevertheless, given the historical prevalence of mercury thermometers, it is likely that a significant amount of mercury remains in thermometers in homes in the United States.

Activity Data

Data from the Northeast Waste Management Officials' Association (NEWMOA) Interstate Mercury Education & Reduction Clearinghouse (IMERC) database suggests that there were 713 lbs. of mercury used in thermometers in 2007 [ref 34]. We assume that this value is held constant each year through 2011.

The US EPA assumes that the average lifespan of a glass thermometer is 5 years, and that 5% of glass thermometers are broken each year [ref 30].[24] Therefore, if 713 lbs. of mercury are used in thermometers each year there would be an estimated 3,228 lbs. of mercury remaining in thermometers in 2011 (accounting for the breakage rate each year).

NEWMOA [ref 34] estimates that during the period 2000-2006 there were 350 lbs. of mercury from thermometers collected in recycling programs.

Therefore, there were 2,878 lbs. (1.44 tons) of mercury available for release in 2011.

Allocation Approach

The national-level mercury emissions from thermometers are allocated to the county level based on population.

Emission Factor

Cain et al. (2007) [ref 32] estimates that 10% of mercury from thermometers is emitted to the air before disposal in a landfill, and Leopold (2002) [ref 30] estimates that 5% of thermometers are broken each year. Therefore, the emission factor is estimated to be 10 lbs. of mercury emissions per ton of mercury in thermometers.

[24] The US EPA does not explain what happens to the remaining 75% of unbroken thermometers after the estimated 5-year lifespan, but it does suggest that recycling, such as through Fisher Scientific's thermometer trade-in program, may account for some of the remaining thermometers.

Example Calculation

1.44 tons of mercury in broken thermometers × 10 lbs. emissions per ton = 14.4 lbs. of emissions

Boise County, ID has 7,028 people, or 0.0023% of the national population. The mercury emissions from broken thermometers for Boise County are estimated by the following:

14.4 lbs. national emissions × 0.0023% = 0.00033 lbs. emissions

3.32.8.4 *EPA-Developed Emissions of Switches and Relays*

Switches and relays make up the largest potential source of mercury from products that intentionally contain mercury. Mercury is an excellent electrical conductor and is liquid at room temperature, making it useful in a variety of products, including switches used to indicate motion or tilt, as the mercury will flow when the switch is in a certain position, completing the circuit.

While mercury switches in cars were phased out as of the 2002 model year, there are still millions of cars on the road that contain them, which are potential emissions sources when the cars are recycled at the end of their useful lives, which involves crushing and shredding cars. The shredded material is then sent to an arc furnace to recycle the steel. To avoid double counting point source emissions from arc furnaces, this source category only includes an estimate of nonpoint emissions from crushing/shredding operations.

Activity Data

A 2011 report from the North Carolina Department of Environment and Natural Resources [35] provides information on the estimated number of switches available for recovery in each state and the amount of switches actually recovered in 2011. There were 3.4 million mercury-containing automobile switches available nationwide in 2011 and 664,690 switches collected for recycling, for a collection rate of 19.4%. These nationwide estimates are supported by similar data from the Quicksilver Caucus [36]. Therefore, there were approximately 2.7 million unrecycled automotive switches in 2011.

Allocation Approach

The number of unrecovered switches is apportioned to each county based on the number of car recycling facilities (NAICS 423930) from the 2011 US Census Bureau County Business Patterns.

Emission Factor

The response to comments for the 2007 EPA Significant New Use Rule on Mercury Switches (72 Fed. Reg. 56903), suggests that the weighted average amount of mercury in switches is 1.2 grams (0.0026 lbs.). A 201 report by Griffith et al. [ref 37] shows that 60% of mercury in switches is released at the shredding operation, while 40% is sent to arc furnaces for smelting. Therefore, the emission factor for switches is 0.00156 lbs. per switch.

Example Calculation

Alabama had 80,892 unrecovered vehicle switches in 2011. Baldwin County, AL has 3 car recycling facilities, which represents 1.53% of the facilities in the state. Therefore, that county is apportioned switches as follows:

80,892 switches in AL × 1.53% = 1,238 switches in Baldwin County, AL

Emissions are estimated as follows:

1,238 switches × 0.00156 lbs./switch = 1.93 lbs. Hg emissions

3.32.9 References for Waste Disposal

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4 Mobile sources

4.1 Mobile sources overview

Mobile sources are sources of pollution caused by vehicles transporting goods or people (e.g., highway vehicles, aircraft, rail, and marine vessels) and other nonroad engines and equipment, such as lawn and garden equipment, construction equipment, engines used in recreational activities, and portable industrial, commercial, and agricultural engines.

EPA created a comprehensive set of mobile source emissions data for criteria, hazardous air pollutants, and greenhouse gases for all states, Puerto Rico, and US Virgin Islands as a starting point for the NEI. EPA uses models to estimate emissions for most of the mobile sources' categories. During training for their 2011 NEI cycle, EPA encouraged S/L/T agencies to submit model inputs, where applicable, rather than emissions, so that EPA could use those inputs beyond the 2011 NEI for future year projections. Agencies had the option to accept EPA's estimates or submit new emissions or emission inputs to replace or enhance EPA's data.

For development and documentation purposes, the major groups of mobile sources are aircraft (Section 4.2), commercial marine vessels (Section 4.3), locomotives (Section 4.4), nonroad equipment (Section 4.5) and on-road vehicles (Section 4.6). In addition, EPA developed nationally consistent datasets for all those sectors, though without the benefit of local-specific model inputs in all cases. The sections below explain how we created the EPA estimates, which S/L/T agencies provided model inputs or emissions data for each sector, and how the EPA data and S/L/T agency data were blended to produce the NEI.

In general, EPA used the data submitted by S/L/T agencies unless EPA determined that the data caused double counting or invalid pollutant or pollutant/emission type combinations inclusion.

4.2 Aircraft

EPA estimated emissions related to aircraft activity for all known US airports, including seaplane ports and heliports, in the 50 states, Puerto Rico, and US Virgin Islands. All the approximately 20,000 individual airports are geographically located by latitude/longitude and stored in the NEI as point sources. As part of the development process, S/L/T agencies had the opportunity to provide both activity data as well emissions to the NEI. When activity data were provided, EPA used that data to calculate EPA's emissions estimates.

4.2.1 Revisions for the NEI 2011 v2

There were minimal aircraft sector changes between 2011 v1 and 2011 v2. Military aircraft emissions for one airport in Virginia were updated. One airport in Chicago was removed.

4.2.2 Sector description

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 (AT), (3) General Aviation (GA), and (4) Military. 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 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 carry passengers, freight, or both, but usually are smaller aircraft and operate on a more limited basis than the commercial aircraft. General Aviation includes most other aircraft used for recreational flying and personal transportation. Finally, military aircraft are associated with military purposes, and they sometimes have activity at non-military airports.

The national AT and GA fleet includes both jet- and piston-powered aircraft. Most of the Air Taxi and General Aviation 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 Non-road equipment (gasoline, diesel, and other), described in Section 4.5. This sector includes the SCCs listed in Table 4-1.

Table 4-1: 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	
2275087000	Nonpoint	Mobile Sources; Aircraft; In-flight (non-Landing-Takeoff cycle)	X

4.2.3 Sources of data overview and selection hierarchy

The aircraft sector includes data from two data components: S/L/T agency-provided emissions data, and an EPA dataset that is enhanced with state- and local-provided model inputs. The S/L/T agency emissions data were received from agencies listed in Table 4-2. States that provided activity data for use in the EPA method are listed in Section 4.2.5

Table 4-2: Agencies that submitted 2011 Aircraft emissions or emissions at facilities identified as "Airports"

Agency	Agency Type	Notes
California Air Resources Board	State	1 county, 20 airports included
Illinois Environmental Protection Agency	State	
Michigan Department of Environmental Quality	State	
Pinal County	Local	Non-aircraft SCCs: see Section 4.2.6
Tennessee Department of Environmental Conservation	State	
Texas Commission on Environmental Quality	State	

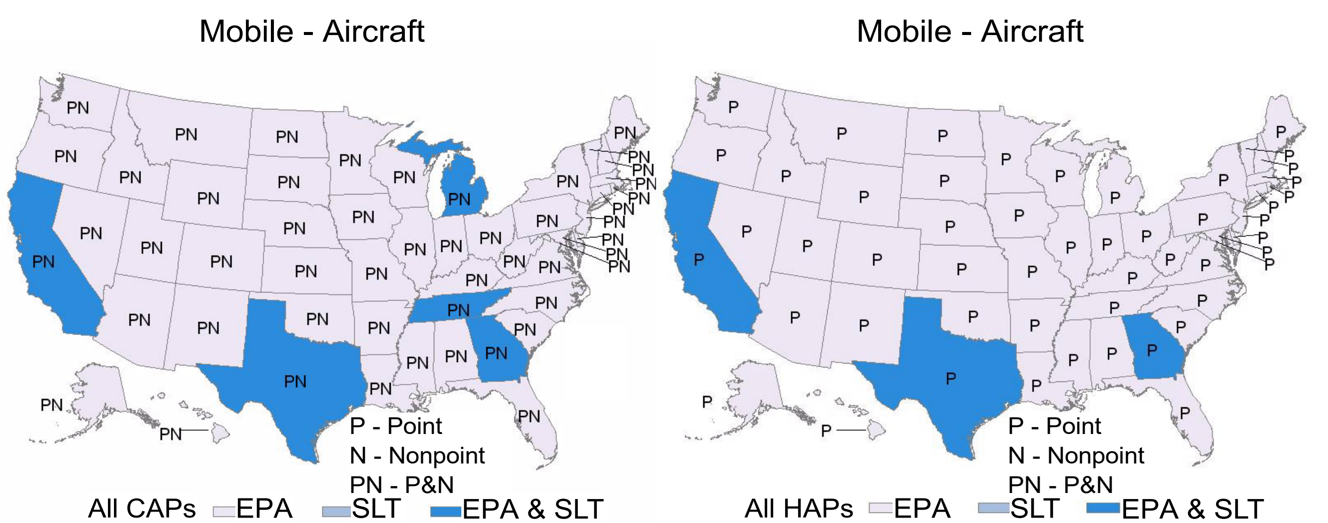
The selection hierarchy used for aircraft is shown below in Table 4-3. This hierarchy pulls the relevant datasets for this sector from the overall point sources hierarchy listed in Section 3. The aircraft emissions also have a nonpoint component (in-flight lead) which is discussed in 4.2.5.3 and uses only EPA data.

Table 4-3: 2011 NEI Aircraft data selection hierarchy

Priority	Dataset Name	Dataset Content
1	State/Local/Tribal Data	Submitted aircraft emissions
2	2011EPA_Airports	EPA data (Section 4.2.5)

4.2.4 Spatial coverage and data sources for the sector

The aircraft sector includes emissions in every state, Puerto Rico, and the US Virgin Islands as well as six tribes.



4.2.5 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 (climb out) 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 to:

- Airport names and locations for airports to be included in the EIS facility inventory;
- LTO information that will be used to estimate emissions for each airport;
- Aircraft/engine combinations to link to FAA LTO data including default assumptions and AircraftEngineCodeTypes for EIS submittals; and

Refer to *Development of 2011 Aircraft Component for National Emissions Inventory, June 17, 2013* [ref 1] 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 agency replacement/revisions. As shown in Table 4-4, the following S/L/T agencies submitted aircraft activity data that EPA incorporated as inputs to the final EPA dataset model run.

Table 4 4: Agencies that submitted Aircraft activity data for EPA's emissions calculation

State	Affiliation
CA	Planning & Evaluation Division, Ventura County APCD
CT	Technical Services Group, Bureau of Air Management, Connecticut Department of Energy and Environmental Protection
GA	Air Branch, Planning & Support GA Environmental Protection Division
KS	Air Inventory Modeling Unit, Kansas Department of Health & Environment
MD	Maryland Department of the Environment
NH	New Hampshire Department of Environmental Services
NJ	NJ Department of Environmental Protection
NV	Air Quality Management Division, Washoe County Health District
VA	Virginia Department of Environmental Quality
VT	Vermont Air Pollution Control Division
WA	Air Quality Program, Department of Ecology
WI	Regional Pollutant and Mobile Sources Section, Bureau of Air Management, Wisconsin Department of Natural Resources

4.2.5.1 *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 [ref 2]. This type of detail is available for most LTOs at approximately three thousand larger airports that have commercial air traffic. Smaller and most general-aviation-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 non-road equipment data category which would duplicate emissions. More on Non-road equipment is described in Section 4.5. Thus, the 2011 NEI uses only data for GSEs and APUs from EDMS.

4.2.5.2 *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. These sources provide LTO estimates for 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 [ref 3]. Then EPA estimated emissions based on the percent of each aircraft type, LTOs, and emission factors.

4.2.5.3 *Aviation lead emissions*

Lead (Pb) emission estimates were handled differently than the other pollutants. Lead emissions are associated with leaded aviation fuel used in piston driven aircraft associated with general aviation. EDMS has a limited number of piston engine aircraft in its aircraft data and is currently not set up to calculate metal emissions; therefore, we did not use it to estimate aircraft lead emissions. Lead emissions are instead based on per-LTO emissions factors, assumptions about lead content in the fuel, and lead retention rates in the piston engines and oil. The general equation is:

$$\text{LTO Pb (tons)} = \frac{\text{(piston – engine LTO)(avgas Pb g/LTO)(1-Pb retention)}}{\text{907,180 g/ton}}$$

The LTO estimate requires assumptions about the number of piston engines per plane, and number of LTOs necessary to account for US average fuel usage. The assumptions are detailed in a project report *Calculating Piston-Engine Aircraft Airport Inventories for Lead for the 2011 National Emissions Inventory, September 2013* [ref 4]. In addition, a summary of the EPA-only airport lead emissions "2011nei_subdata_airportPb.xlsx". This summary is not the same as any summaries of the 2011 NEI, which would include Pb emissions data from S/L/T agencies. The EPA-only estimate for total LTO-based Pb emissions is 245 short tons nationwide, but the merged EPA and S/L/T data total to 237 tons for the 2011NEv1. EPA's estimate for out-of-LTO or "in-flight" Pb is 238 tons. A summary of national EPA-only lead estimates is available [ref 5].

In-flight lead emissions were calculated based on national aviation gasoline consumption and similar assumptions noted above about lead fuel content and retention rates. These emissions are included in the nonpoint data category under SCC 227508700 (Mobile Sources; Aircraft; In-flight non-Landing-Takeoff cycle; Total). Lead emissions associated with airport LTO activities were subtracted from the national fuel-based lead emissions to approximate in-flight lead emissions which were allocated to individual states and noted with the county code 777. This county code is not used to identify any actual counties and; therefore, county code 777 provides a way of uniquely identifying all in-flight emissions from other sources in the nonpoint data category in the NEI.

4.2.6 Summary of quality assurance methods

The agency-submitted aircraft emission estimates were compared to EPA's estimates by pollutant and SCC at the unit (e.g., commercial, general aviation, military, air taxi) and process (SCC).

Findings and impacts:

1. Aircraft-related records were tagged (and excluded from the NEI selection) as follows:

    - California records with outlier high values:
        - 10 records for PM25-PRI and PM10-PRI in SCC 2265008005

    - 2 records for PM25-PRI and PM10-PRI in SCC 2275001000

- Illinois records that duplicated EPA estimates by using generic equipment emissions factors, rather than detailed ones that EPA calculated via EDMS. Also 53 Illinois airports that were not in the EPA data set, which are submitted with emissions totaling zero for all submitted pollutants.
    - includes all aircraft SCCs and criteria and HAP pollutants. 40948 records.

- Texas records zero emission records intended to overwrite EPA records, but actually lead to undercounts of piston general aviation and air taxi lead and other criteria and HAP values
    - 12992 records for SCC 2275050011
    - 64 records for SCC 2275060011

- Michigan records that duplicated EPA estimates by duplicating processes and 33 Airport Facilities that EPA does not, 31 of which are submitted with emissions totaling zero for all submitted pollutants.
    - 18017 criteria pollutant records for all aircraft (not GSE or APU) SCCs

2. Pinal County's single process submittal at one airport was for a fuel tank, not aircraft-related process (FIP 04021, EIS Facility ID 12342611, SCC 40600307). No change was made.

3. Pinal CA reports non-aircraft process SCC 20200102 (Internal combustion engines) at Airport EIS Facility ID 10026511. No change was made.

4. Pinal TN reports military aircraft SCC 2275001000 at EIS Facility ID 6670811 (ARNOLD ENGINEERING DEVELOPMENT CENTER (AEDC) in FIP 47031 (Coffee County). Other point source emissions processes are located there. If the aircraft processes are correct, the facility should be split into airport and nonairport and given facility type "Airport". Currently these emissions are not captured in a Facility Type = airport query. No change was made.

4.2.7 References for Aircraft

1. Eastern Research Group (ERG), 2013. Memorandum: *Development of 2011 Aircraft Component for National Emissions Inventory,* June 17, 2013.
2. Federal Aviation Administration (FAA), 2011. Emissions and Dispersion Modeling System, Version 5.1. September, 2011.
3. Federal Aviation Administration (FAA), 2012. General Aviation and Part 135 Activity Survey – Calendar Year 2010.
4. 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.
5. Spreadsheet of EPA lead estimates "2011nei_supdata_airportPb_20140306.xlsx".

4.3 Commercial Marine Vessels

The 2011 NEI includes emissions from commercial marine vessel (CMV) activity in the 50 states, Puerto Rico, and US Virgin Isles, out to 200 nautical miles from the US coastline.

4.3.1 Revisions for the NEI 2011 v2

Substantial revisions were made for 2011 v2:

- All EPA CMV C1 and C2 estimates were revised with geographic allocation updates (national totals remained the same)
- All EPA CMV C3 estimates within Emission Control Areas (ECA) were revised because v1 had been calculated as if the sulfur ECA was in effect, but it did not actually take effect until August 2012. This change in fuel type increased SO_2, PM, and NO_X emissions for C3 vessels in these areas.
- SLT emissions were resubmitted to prohibit double counting where EPA and SLT locations/shapes were in conflict and became additive when they were merged.
- California VOC-HAPs were found to be erroneously high and were tagged and replaced using "HAP-augmentation" that calculates VOC-HAPs from the California VOC submittals.
- Port of Angeles (Washington State) emissions were revised, including a port shape file addition.
- Alaska emissions in retired FIP counties were reallocated to existing counties.
- Oregon had their marine vessel submission deleted in favor of EPA-only estimates for that state.

4.3.2 Sector description

The 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 that are either fueled with distillate or residual fuel oil blends. For the purpose of this inventory, we assume that Category 3 (C3) vessels primarily use residual blends while Category 1 and 2 (C1 and C2) vessels typically used distillate fuels.

The C3 inventory includes vessels which use C3 engines for propulsion. C3 engines are defined as having displacement above 30 liters per cylinder. 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. shoreline, 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 (see Section 4.3.4).

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.

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. These emissions are included in those calculated by the NONROAD model; they reside in the nonroad data category and EIS "Mobile - Non-Road Equipment" sectors of the 2011 NEI.

Each of the commercial marine SCCs requires an appropriate emissions type (M=maneuvering, H=hotelling, C=cruise, Z=reduced speed zone) because emission factors vary by emission type. Each SCC and emissions type combination were allocated to a shape file identifier in the nonpoint inventory. The allowed combinations are shown in Table 4-5. 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 'hotelling', which only occurs at ports.

Table 4-4: Commercial Marine Vessel 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

Shown in Table 4-6, gasoline CMV emissions were submitted by Washington State and included in the NEI.

Table 4-5: Additional Commercial Marine Vessel SCC used by Washington

SCC	SCC Description	States
2280004000	Mobile Sources, Marine Vessels, Commercial, Gasoline, Total, All Vessel Types	WA

4.3.3 Sources of data overview and selection hierarchy

EPA received emissions data from the agencies identified in Table 4-7.

Table 4-6: Agencies that submitted Commercial Marine Vessels emissions data

Agency	Agency Type
California Air Resources Board	State
Delaware Department of Natural Resources and Environmental Control	State
Illinois Environmental Protection Agency	State
Maryland Department of the Environment	State
New Hampshire Department of Environmental Services	State
New Jersey Department of Environment Protection	State
Oregon Department of Environmental Quality*	State
South Carolina Department of Health and Environmental Control	State
Texas Commission on Environmental Quality	State
Washington State Department of Ecology	State

*Oregon estimate were removed for 2011 v2

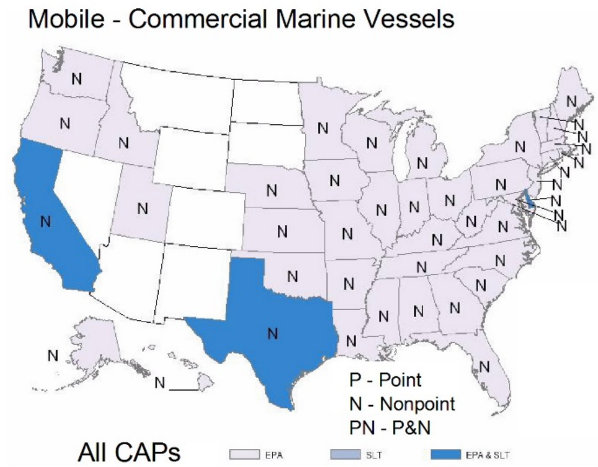
Table 4-8 shows the selection hierarchy for the CMV sector. This hierarchy pulls the relevant datasets for this sector from the overall nonpoint sources hierarchy listed in Section 3.

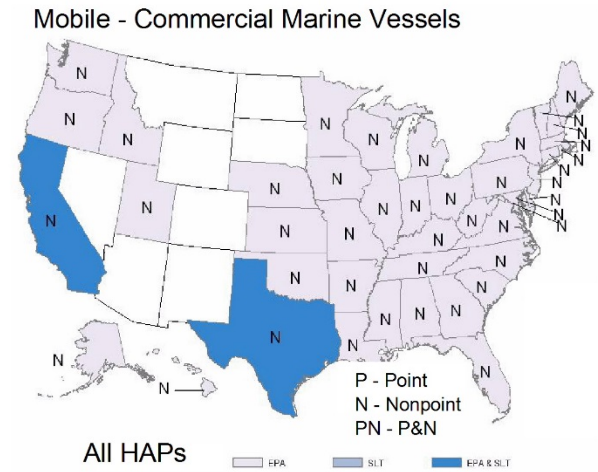
Table 4-7: 2011 NEIv2 commercial marine vehicle selection hierarchy

Priority	Dataset Name	Dataset Content
1	State/Local/Tribal Data	Submitted commercial marine vessel emissions
2	2011EPA_HAP-Augmentation	Uses emission factors to calculate HAP values based on S/L/T agency submitted criteria estimates (VOC or PM species)
3	2011EPA_CMVLADCO	Submitted by LADCO for state's that approved
4	2011EPA_CMV	EPA data (Section 4.3.5)

4.3.4 Spatial coverage and data sources for the sector

The commercial marine vessel sector includes emissions in every US state except Arizona, Colorado, Montana, Nevada, New Mexico, North Dakota, South Dakota, Utah, Vermont, and Wyoming. It also includes emissions for Puerto Rico and US Virgin Islands, as well as emissions in federal waters.





4.3.5 EPA-developed commercial marine vessel emissions data

EPA estimated CMV emission estimates as a collaborative effort between the Office of Transportation and Air Quality (OTAQ) and OAQPS. EPA developed the Category 3 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 [ref 1]. For Category 1 and 2 marine diesel engines, the emission estimates were consistent with the 2011 Locomotive and Marine federal rule making [ref 2]). EPA derived HAP estimates by applying toxic fractions to VOC or PM estimates.

EPA then allocated these emissions to individual GIS polygons (see Section 4.3.5.1) using methods that varied by operating mode (i.e., hotelling, maneuvering, reduced speed zone, and underway). For example, port emissions appear only in port polygons, federal water emissions in federal waters. HAP emissions were estimated by applying speciation profiles to each polygon's VOC and PM estimates; see also Appendix B of the 2008 NEI CMV documentation [ref 1].

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.

4.3.5.1 *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. We placed primary emphasis on mapping the 117 ports with Category 3 vessel activity using available shape files of the port area. The shape file used for 2011 incorporated the efforts made in 2008. During the 2008 NEI development, the Port of Huntington was developed independently, given its large extent and limited available map data. The state of West Virginia provided a revised shape file of US Army Corps of Engineers port terminals reported to be part of the Port of Huntington-Tristate area. The revised shape that includes a 200-meter buffer of the water features near these port terminals was created to identify the port area.

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 Category 1 and 2 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 Category 3 emissions were mapped to small circles. The final set of port and underway shapefile GIS data.

To develop emissions for the Category 1 and 2 part of the inventory, EPA started with criteria emissions and activity as a single national number. EPA allocated category 1 and 2 vessels based on activity for the underlying vessel types (deep water, ferries, fishing, government, Great Lake, offshore, research, and tugs). See ref 3, ref 4 and ref 5.

These updates changed the allocation fractions of emissions to underway and port county/shapeID combinations. Agencies were given an opportunity to resubmit their emissions allocated in proportion to EPA's.

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*. Emissions Modeling Platform Criteria pollutant estimates from combined C3 SCCs from model platform were allocated to shapes by ratio to 2008 county/shape/emistype. HAP speciation fractions based on VOC and PM were employed to calculate HAPs. Alaska and Hawaii are outside of the model domain and used OTAQ ECA estimates allocated based on previous NEI.

In cases where model files had emissions in counties for which we had no shape ids, the model file emissions were dropped. In all 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.

4.3.5.1 *LADCO emissions*

The regional organization Lake Michigan Air Directors Consortium (LADCO) provided an alternative data set, labeled in the NEI as 2011EPA_CMVLADCO. For state's that approved the use of these estimates, they were used as the highest priority. Those states are Indiana, Michigan, Minnesota, Ohio, and Wisconsin.

4.3.6 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

Findings:

The EIS generated a critical error and did not allow county-wide emission records for CMV, except when the S/L/T submitted to counties for which EPA had no shape ID available for that SCC. S/L/T agencies were encouraged to use the EPA-provided shape-to-county fractions if they were unsure how to distribute county emissions to shapes. For 2011 v2, all SLT emissions were updated to insure no duplication (additive results) when EPA and SLT data were merged in the selection.

1. California VOC HAPs were found to be out of agreement and erroneously high in comparison to their submitted VOCs. EPA used "HAP Augmentation" to create HAP species from CA's submitted VOC values.

2. California submitted CMV values also to counties for which EPA had no shape IDs or emissions. CA submitted several HAPs, and only some CAP (no VOC)

4.3.7 References for Commercial Marine Vessels

1. 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.
2. 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*, EPA420-R-03-004, January 2003.
3. Eastern Research Group (ERG), 2013. Project report*: Category 2 Vessel Census, Activity, and Spatial Allocation Assessment and Category 1 and Category 2 In-Port/At-Sea Splits,* February 16, 2007.
4. Eastern Research Group (ERG), 2012. Project report: *Category 1 / Category 2 Commercial Marine Activity Spatial Allocation, August 22, 2012*.
5. Eastern Research Group (ERG), 2013. Project report: *Disaggregation of Category 1 / Category 2 Commercial Marine Vessel Emissions for 2011*, "2011neiv2_CMV_Cat12_Reallocation.pdf", November 20, 2013

4.4 Locomotives

4.4.1 Revisions for the NEI 2011 v2

Changes to this sector were limited to new SLT submittal updates from Virginia, New Jersey, and Washoe County NV. Alaska emissions in retired FIP counties were reallocated to existing counties.

4.4.2 Sector description

The locomotive sector includes railroad locomotives powered by diesel-electric engines. A diesel-electric locomotive uses 2-stroke 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. Table 4-9 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 4-8: 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)	No	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

4.4.3 Sources of data overview and selection hierarchy

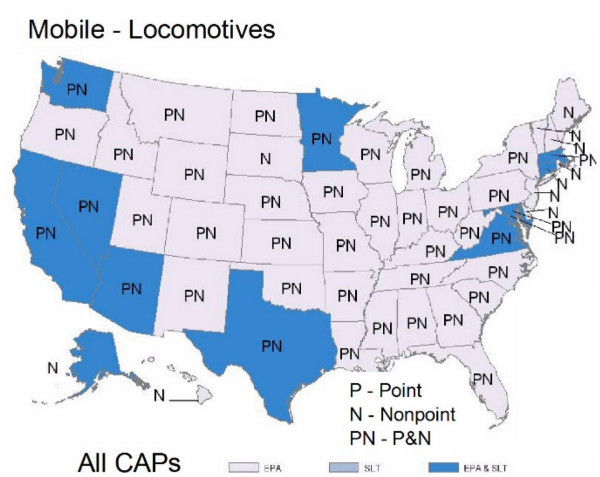
The locomotives sector includes data from S/L/T agency-provided emissions data, and an EPA dataset of locomotive emissions. EPA estimated emissions from select locomotive SCCs as indicated in Table 4-9. The agencies listed in Table 4-10 also submitted emissions to locomotive SCCs.

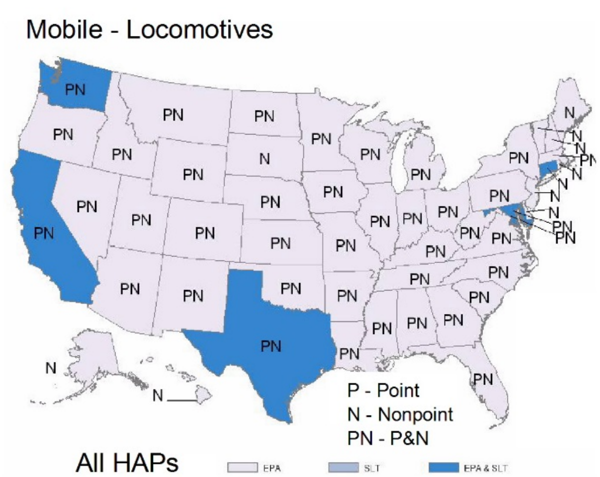
Table 4-9: Agencies that submitted Locomotives emissions to the 2011 NEI

Agency Name	Data Set Short Name	Agency FIP or Tribal Code	Rail	Point Yard	Nonpoint Yard
Alaska	2011AKDEC	02	X		
California	2011CARB	06	X		X
Connecticut	2011CTBAM	09	X		X
Illinois	2011ILEPA	17	X		
Maricopa Co Arizona	2011Maricopa	04013	X		
Maryland	2011MDDOE	24	X	X	X
Massachusetts	2011MADEP	25	X		
New Jersey	2011NJDEP	34	X		
North Carolina	2011NCDAQ	37	X		
Sac & Fox Nation of Missouri in Kansas and Nebraska	2011TR863	863	X		
Texas	2011TXCEQ	48	X	X	X
Utah	2011UTDAQ	49	X		
Virginia	2011VADEQ	51	X		
Washington	2011WADOE	53	X		
Washoe Co Nevada	2011WashoeCty	32031	X	X	

4.4.4 Spatial coverage and data sources for the sector

The locomotives sector includes emissions in all states, DC, Puerto Rice, and some tribes.





4.4.5 EPA-developed locomotive emissions data

EPA's 2011 national rail estimates were developed by applying growth factors to the 2008NEI 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* [ref 1] for details. For more information on the 2008 methodology, refer to the 2008 documentation [ref 2]. The emissions were allocated to line haul shape IDs and yard locations based on 2008 allocations.

4.4.5.1 *Hazardous Air Pollutant emissions estimates*

HAP emissions were estimated by applying speciation profiles to the VOC or PM estimates. Since California uses low sulfur diesel fuel and emission factors specific for California railroad fuels were available, calculations of California's emissions were done separately from the other states. HAP estimates were calculated at the yard and link level, after the criteria emissions had been allocated.

4.4.6 Summary of quality assurance methods

EPA and Agency submitted emissions were compared at shape, state, and county to EPA default values.

Findings:

- California rail emissions had suspiciously high HAP values. These HAP data were tagged and therefore are not included in the 2011 v2.
- California submitted rail records that duplicated identical CA submittal but with the addition of an emission type = C (which is intended only for cruising CMV records). These records were tagged.
- Though EPA's estimates are intended to include activity in all tribe and non-tribal areas, the EPA dataset does not break out the data into tribal areas. Therefore the 2011 NEI emissions in tribal areas are equal to the tribal submission only, and do not have consistent SCCs and pollutants as are present in counties.

EPA and Agency rail yard emissions were compared. All EPA's rail yard estimates are point sources. S/L/T agencies were allowed to submit nonpoint county-level estimates but were asked to verify they did not conflict with EPA's, or they could submit point estimates that would be chosen over EPA's. No obvious conflicts were noted.

As with CMV, where S/L/T agency and EPA estimates did not use identical county/shape/SCC combinations, the resultant selection may equal to neither EPA's nor the SLT agencies value. For example, see AZ and NJ SCC =2285002007, and MD SCC = 2285002007 in Table 4-11.

Table 4-10: Comparison of NO_X emissions (tons) among EPA, S/L/T agency, and 2011v1NEI selection for Rail

State	Tribal Code	SCC	EPA	SLT	2011v1 Selection	2011v2 Selection
	863	2285002006		3	3	3
AK		2285002007	417		417	417
AK		2285002009		703	703	703
AZ		2285002006	22,181	1,263	22,030	22,030
AZ		2285002007	529	0	485	485
AZ		2285002008		9	9	9
CA		2285002006	29,642	31,225	31,225	31,225
CA		2285002007	1,714	0	0	0
CA		2285002008		2,667	2,667	2,667
CA		2285002009		1,078	1,078	1,078
CA		2285002010		2,280	2,280	2,280
CT		2285002006	0		0	0

State	Tribal Code	SCC	EPA	SLT	2011v1 Selection	2011v2 Selection
CT		2285002007	639		639	639
CT		2285002008		241	241	241
CT		2285002009		358	358	358
CT		2285002010		85	85	85
IL		2285002006	36,886	39,841	39,841	39,841
IL		2285002007	1,869	2,388	2,388	2,388
MA		2285002006	882		882	882
MA		2285002007	686		686	686
MA		2285002009		2,589	2,589	2,589
MD		2285002006	3,419	2,154	2,154	2,154
MD		2285002007	251	12	145	145
MD		2285002008		20	20	20
MD		2285002009		460	460	460
MD		2285002010		134	134	134
NJ		2285002006	1,194		1,194	1,194
NJ		2285002007	652	738	652	815
NJ		2285002009		2,606		2,606
NY		2285002006	12,070		12,070	12,070
NY		2285002007	1,922		1,922	1,922
TX		2285002006	60,389	58,762	58,762	58,762
TX		2285002007	2,168	2,633	2,633	2,633
TX		2285002010		2,225	2,225	2,225
UT		2285002006	6,287	5,878	5,878	5,878
UT		2285002007	244		244	244
VA		2285002006	15,603		15,603	15,603
VA		2285002007	387		387	387
VA		2285002008		622		622
VA		2285002009		267		267
WA		2285002006	14,445	12,420	12,420	12,420
WA		2285002007	978		978	978
WA		2285002009		534	534	534

4.4.7 References for Locomotives

1. Eastern Research Group (ERG), 2012. Memorandum: Development of 2011 Railroad Component for National Emissions Inventory, September 5, 2012
2. Eastern Research Group (ERG), 2011. Project report: *Documentation for Locomotive Component of the National Emissions Inventory Methodology,* ERG No. 0245.03.402.001, May 3, 2011.

4.5 Nonroad Equipment – Diesel, Gasoline and other

Although "nonroad" is used to refer to all transportation sources that are not on-highway, these EIS sectors and this section address nonroad equipment other than locomotives, aircraft, or commercial marine vehicles.

4.5.1 Revisions for the NEI 2011 v2

Only Delaware was updated for 2011 v2, to reflect revised inputs provided by the state.

4.5.2 Sector description

This section deals specifically with emissions processes calculated by the EPA's NONROAD model and the OFFROAD model used by California. They include nonroad engines and equipment, such as: lawn and garden equipment, construction equipment, engines used in recreational activities, portable industrial, commercial, and agricultural engines.

The National Mobile Inventory Model (NMIM) is EPA's consolidated mobile emissions estimation system that allows EPA to produce nonroad mobile emissions in a consistent and automated way for the entire country. EPA encouraged agencies to submit NMIM inputs to the EIS for the 2011 NEI for inclusion in the National County Database (NCD). The NCD contains all the county-specific information needed to run NONROAD. It also contains the ratios that are applied to NONROAD outputs to estimate emissions of HAPs, dioxins/furans (not part of the NEI), and some metals. Although NMIM was designed to also estimate onroad emissions, it is no longer used, and we now use the MOVES model described in Section 4.6. Eventually MOVES will be revised to also estimate nonroad emissions and NMIM will be retired.

Nonroad mobile source emissions are generated by a diverse collection of equipment from lawn mowers to locomotive support. NMIM estimates emissions from nonroad mobile sources using a variety of fuel types as shown in Table 4-12.

Table 4-11: NMIM Nonroad Equipment and fuel types

Equipment Types	Fuel Types
Recreational	CNG Diesel Gasoline LPG
Construction	
Industrial	
Lawn and Garden	
Agriculture	
Commercial	
Logging	
Airport Support (GSE) (excludes aircraft)	
Underground Mining	
Oilfield	
Pleasure Craft (recreational marine) (excludes commercial marine vessels)	
Railroad (excludes locomotives)	

NMIM estimates monthly emissions for total hydrocarbons (THC), nitrogen oxides, carbon monoxide, particulate matter, and sulfur dioxide, as well as calculating monthly fuel consumption. NMIM uses ratios from some of these emissions to calculate emissions for an additional 33 hazardous air pollutants (HAPs) and 17 dioxin/furan congeners. All of the input and activity data required to run NMIM are contained within the NCD, which is distributed with the model. S/L/T agencies are able to update the data within the NCD to create emissions estimates that accurately reflect local conditions and equipment usage.

4.5.3 Sources of data overview and selection hierarchy

Table 4-13 shows the selection hierarchy for the nonroad data category. EPA's NMIM estimates using S/L inputs are used other than in California and Texas. California-submitted emissions were used along with an EPA correction dataset containing only VOC. For Texas, Texas-submitted data were used ahead of the EPA's NMIM estimates, which were used second to gap fill any missing data/pollutants from the Texas dataset.

EPA asked S/L/T agencies to provide model inputs (NCDs) instead of emissions for 2011. However, some agencies also submitted nonroad emissions. In addition to EPA's estimates, the agencies included in Table 4-14 submitted inputs and/or emissions to the 2011 NEI.

Table 4-12: Selection hierarchy for the Nonroad mobile Equipment data category

Priority	Dataset	Notes
Everywhere except California and Texas		
1	2011_EPA_Mobile	Contains emissions from EPA's NMIM run using S/L-provided inputs as shown in Table 4-14 and NMIM defaults where S/L accepted EPA default.
California		
1	California Air Resources Board	Uses CA-specific model, OFFROAD
2	2011EPA_CAmodelerdata	Correction dataset (see QA): EPA added VOC emissions for several SCCs which were missing in the California data due to an error. These data were obtained by the modeling group at CARB.
Texas		
1	Texas Commission on Environmental Quality	Emissions based on Texas NONROAD (TexN) model. TexN allows Texas to calculate emissions at a more granular level than what NMIM is able to accommodate.
2	2011_EPA_Mobile	EPA estimates (same dataset described above)

Table 4-14 shows the submission dates for the S/L/T agency-submitted nonroad emissions and/or NCD activity data for the 2011 NEI via the Emission Inventory System (EIS) Gateway.

Table 4-13: S/L/T agency-submitted data for Nonroad mobile Equipment

Agency Organization	Nonroad Emissions	Nonroad NCD	Notes
California Air Resources Board	4/23/13		Uses model specific to CA
Coeur d'Alene Tribe	12/7/12		
Connecticut Department Of Environmental Protection		1/8/13	
Delaware Department of Natural Resources and Environmental Control*		4/1/13	
Eastern Band of Cherokee Indians	10/23/12		
Georgia Department of Natural Resources		12/12/12	
Idaho Department of Environmental Quality		12/5/12	
Illinois Environmental Protection Agency	10/24/12	10/24/12	Submitted NCD was used rather than emissions
Kootenai Tribe of Idaho	12/14/12		
Maryland Department of the Environment	12/21/12	2/22/13	
Metro Public Health of Nashville/Davidson County	12/18/12		Accepted EPA Emission Estimates
Nevada Division of Environmental Protection		12/31/12	

Agency Organization	Nonroad Emissions	Nonroad NCD	Notes
New Hampshire Department of Environmental Services		10/17/12	
New Jersey Department of Environment Protection		5/14/13	
Nez Perce Tribe	12/10/12		
North Carolina Department of Environment and Natural Resources		12/19/12	
Sac and Fox Nation of Missouri in Kansas and Nebraska Reservation	10/5/12		
Shoshone-Bannock Tribes of the Fort Hall Reservation of Idaho	12/6/12		
Texas Commission on Environmental Quality	12/11/12		
Utah Division of Air Quality	1/7/13		Accepted EPA Emission Estimates
Washington State Department of Ecology		1/9/13	
Washoe County Health District	12/26/12		Accepted EPA Emission Estimates
Wisconsin Department of Natural Resources		1/9/13	

*Original Nonroad NCD submission was January 7, 2013. The updated NCD to reflect this update is named NCD20140620_nei2011v2.

4.5.4 Spatial coverage and data sources for the sector

Nonroad equipment emissions are included in every state, DC, Puerto Rice, and the Virgin Islands.

4.5.5 EPA-developed NMIM-based nonroad emissions data

EPA uses the activity data within NIMIM as a basis for air quality modeling, rule development, international reporting, air quality trends analysis, and other activities. To that end, a single NCD for the 2011 NEI was developed to represent, as accurately as possible, the activity data upon which the 2011 NEI emissions are based. This newly developed NCD, named **NCD20130531_nei2011v1**, was created using the approach discussed in the following sections. Like the emissions, the updates to the NCD were determined using a hierarchy decision model, where defaults were replaced with S/L-supplied data. The exception to hierarchy decision model is that EPA-supplied fuel and meteorological data were used for all 2011 NMIM modeling runs, as explained below. However, as a matter of record, a copy of NCD20130531_nei2011v1 which includes all the state-supplied updates, including fuel and meteorological data was provided to EPA and is named NCD20130531. Once 2011 v1 was posted, S/L/T agencies had the opportunity to submit updates. The state of Delaware submitted an update for the activity data used for developing the nonroad emissions. The final version of the NCD, reflecting all the updates for the 2011 NEI are reflected in the NCD named **NCD20140620_nei2011v2**. The development of the NCD for the 2011 NEI is explained in the following sections. See file "2011NEIv2_supdata_nr_RunNotesChangeLog" for a description of the update history of the NMIM NCD for the most recent updates made to NMIM. A comprehensive history of updates is recorded in the file Change Log.docx, which is included in the NCD Readme folder.

4.5.5.1 *Default NCD*

The default 2011 NCD, **NCD20130531_nei2011v1**, is based upon NCD20101201a.[25] EPA provided updated fuel and meteorological data for inclusion in the new 2011 NCD. Using the fuel data provided by EPA in the file named *RegionalFuels_2011_20130208fuelsNMIM.zip*, the countyyearmonth, gasoline, and diesel tables were replaced. However, the fuel updates provided by EPA did not contain fuel data for Alaska, Hawaii, Puerto Rico, or the U.S. Virgin. For these areas, fuel data from the original NCD20101201a was retained. The meteorological data provided by EPA in the file named *countymonthhour2011.zip* were used to replace the countymonthhour table.

The NCD for 2011 v2 is a copy of the 2011 v1 NCD, **NCD20130531_nei2011v1**, but includes the second round updated submitted by the state of Delaware. This new NCD is titled **NCD20140620_nei2011v2.** The following sections describe all the updates made to create the 2011 NEI v02.

4.5.5.2 *State-submitted NCDs*

NCD activity data submitted by state and local agencies via the EIS Gateway were used to replace default data, except for fuel and meteorological data. Even if an agency submitted fuel and meteorological data, per the instructions provided by EPA, the default values for these data parameters were retained. NCD tables updated using state and local NCD submissions are presented in Table 4-15. Again, more detailed information regarding specific updates can be found in the abbreviated NCD update history presented in "2011NEIv2_supdata_nr_RunNotesChangeLog", which also contains a table of external files updated using state-specific data.

Table 4-14: NCD tables updated based on State and Local NCD submissions

State Name	DataSource	CountyNRFile	County	CountyYearMonth*	Diesel*	Gasoline*	External Files	CountyYearMonthHour*
Maryland	✓	✓					✓	
New Jersey	✓	✓		✓	✓	✓	✓	
Connecticut	✓	✓		✓		✓	✓	
Delaware	✓	✓					✓	✓
Georgia	✓	✓					✓	
Idaho			✓					✓
Illinois								✓
Nevada	✓	✓		✓		✓	✓	
New Hampshire	✓	✓					✓	
North Carolina				✓	✓	✓		
Washington	✓	✓					✓	
Wisconsin				✓	✓	✓		

* Updates to these tables were not used to develop the 2011 NEI NCD. Instead EPA-supplied data was used.

25 NCD20101201a is the NCD that is included in the current download of NMIM.

4.5.5.3 *State-assisted NCD development*

Some State and Local agencies possessed activity data that could be incorporated into the 2011 NCD. However, the data were not formatted appropriately for inclusion into the NCD. In these instances, ERG worked with the state and local agencies to obtain the data and incorporate as much as possible into the 2011 NCD. A summary of the tables updated using this approach is presented in Table 4-16.

Table 4-15: State-assisted NCD table updates

State Name	DataSource	CountyNRFile	County	CountyYearMonth*	Diesel*	Gasoline*	External Files	CountyYearMonthHour*
Davidson County (Tennessee)	✓			✓	✓	✓		
New York	✓	✓		✓	✓	✓	✓	
Texas	✓	✓		✓	✓	✓	✓	

* Updates to these tables were not used to develop the 2011 NEI NCD. Instead EPA-supplied data were used.

4.5.5.4 *Nashville/Davidson County Tennessee*

Nashville Pollution Control Division provided all the NONROAD option files used to create their 2011 emissions inventory. The fuel data contained within the option files were extracted and used to update the RVP and sulfur values in the fuel data tables within NMIM. Using EPA fuel data instead of agency-supplied fuel inputs for the 2011 NEI NCD, these updates were provided as a matter of record to EPA in NCD20130531.

4.5.5.5 *New York*

The New York Department of Environmental Conservation provided a state-specific allocation file for new housing developments (36000hou.alo). These data represent single and double (duplex) family homes. This data was updated using the U.S. Census data.[26] These updates are reflected in the NMIM database **NCD20140620_nei2011v2**.

New York also provided copies of their NONROAD option files used to create their 2011 emissions inventory. The fuel data contained within the option files were extracted and used to update the RVP and sulfur values in the fuel data tables within NMIM. Using EPA fuel data instead of agency-supplied fuel inputs for the 2011 NEI NCD, these updates were provided as a matter of record to EPA in NCD20130531.

4.5.5.6 *Texas*

The Texas Commission on Environmental Quality (TCEQ) uses the Texas NONROAD (TexN) model to create their emissions estimates. TexN allows Texas to calculate emissions at a more granular level than what NMIM is able to accommodate. In addition to including state-specific climate and fuel profiles, TexN contains a separate activity profile for 25 different subsectors of diesel construction equipment (DCE). Diesel construction

[26] U.S. Census data file dc_acs_2009_5yr_g00__data1.txt, which is based on the 2005-2009 American Community Survey 5-Year Estimates (http://factfinder.census.gov/servlet/DTTable?_bm=y&-geo_id=01000US&-ds_name=ACS_2009_5YR_G00_&-mt_name=ACS_2009_5YR_G2000_B25024).

equipment is found in many different types of construction. However, their population and use profiles are unique within each of the sectors defined by the TexN model. TexN processes each of these subsectors separately and sums the emissions across all subsectors at the end of the processing. Furthermore, TexN applies post-processing adjustments to the calculated emissions based on several factors such as Texas Low Emission Diesel (TxLED) use, ground cover variation, altitude, and humidity corrections to name a few. Furthermore, Texas has done studies specific to certain areas within the state and have compiled activity data specific to specific areas (e.g., Houston-Galveston-Brazoria and Dallas-Fort Worth). These activity values are denoted using a county flag within TexN. In order to create the NCD activity tables for Texas, data from TexN was queried and used to create an NCD that approximates Texas emissions. The approach used to develop the NCD for Texas is presented below.

Population data were extracted for the year 2011 for all sectors contained within TexN. The population data were then summed by SCC and horsepower bin. Average horsepower values within the TexN population data, weighted by equipment population, were calculated by SCC and horsepower bin. These data were used to update the external population file and are included in **NCD20140620_nei2011v2.**

The external growth file for the 2011 NCD was updated using population profiles from TexN. Population data from TexN was summed by year and SCC and assigned the appropriate indicator code, according to the default indicator code mapping with the NONROAD model. These data were used to update the external growth file and are included in **NCD20140620_nei2011v2**.

The activity data from TexN was processed using a statistical analysis software program (SAS©). A weighted average activity value was calculated for each equipment SCC using horsepower-hours as the weighting factor. (HP-hours were selected as the weighting factor as this value should correlate reasonably closely with total exhaust emissions.) The first step in this process was to calculate the cumulative hp-hrs over the entire population. Next, the population and hp-hrs were summed over each unique SCC-DCE Subsector-County Flag-Load Factor combination. Then, the fraction of hp-hrs for each SCC within each DCE Subsector and County Flag was calculated and applied to the total activity value. The resulting SAS outputs were then formatted according to the external file format for activity used by NMIM. These updates are included in **NCD20140620_nei2011v2**.

The geographic allocation of equipment populations was also updated using county-specific population values from TexN. The population values were summed by county and SCC, then each SCC was assigned the correct allocation indicator (XRF) value. These values were then used to build new allocation files for inclusion into NMIM and are included in **NCD20140620_nei2011v2**.

The fuel data within TexN contains fuel properties specific to Texas obtained through multiple fuel sampling surveys conducted by the State. These fuel properties were used to update the fuel data within NMIM for:

- gasoline RVP,
- diesel sulfur,
- gasoline sulfur,
- marine diesel sulfur,
- CNG and LPG sulfur,
- MTBE volume, ETBE volume, TAME volume, EtOH volume, and
- MTBE, ETBE, TAME, and EtOH market share.

Once again, the final NEI used EPA fuel data instead of agency-supplied fuel inputs, though the state updates were provided as a matter of record to EPA in NCD20130531.

4.5.5.7 *Quality assurance*

After the NMIM completed its execution, the resulting output databases were checked to ensure that no error messages were created during the runs for each geographical area. Furthermore, the NMIM generates the same number of output records for each RunID-FIPSCountyID-FIPSStateID-Year-Month combination. Therefore, each of the output tables was checked to ensure the number of records for this combination of fields summed to the correct record count. As expected, zero error messages were recorded by NMIM and every county produced the same number of output records.

Once the NMIM outputs were exported from the NMIM database, ERG created SAS programs to read in the detailed NMIM outputs and produce emissions summaries, plots, and charts to help identify outliers in emissions. As a part of this process, ERG also created programs to compare the 2011 emissions generated under this effort against other emission datasets. Comparisons were made between the 2011 emissions generated under this effort, 2011 emission estimates generated using all default input, the 2011 emissions submitted by state and local agencies for the 2011 NEI, as well as the 2008 NEI emissions.

Upon completion of the review and approval by EPA, ERG generated MOVES SMOKE-formatted files using the emissions generated by NMIM using the **NCD20130531_nei2011v1**, which includes all the required updates (excluding state-submitted fuel and meteorological data) submitted for 2011 v1. Later, updated SMOKE files were generated to reflect Delaware's update for 2011 v2 using the **NCD20140620_nei2011v2**.

4.5.5.8 *Summary of quality assurance on S/L/T agency emissions*

Because EPA emphasized the submittal of inputs and helped agencies develop those inputs, there were only 2 states (TX and CA) and no tribes that submitted emissions data. Tribal emissions are accepted as is into the EIS but are not included in the 2011 NEI because they may duplicate emissions already accounted for at the county-level.

For Texas, we compared state and county EPA defaults, agency submittals and selection results by (1) included pollutants, SCCs, SCC-Emission Types (nonroad emission types are R=refueling, E=evap, X=exhaust), and (2) emissions summed to agency level.

<u>Findings</u>

Texas-submitted SCC/emission type/county/pollutant records account for all the NEI emissions in Texas, except for mercury and arsenic, which were not in Texas' submittal. For those two pollutants, EPA values are used.

For California, because a state-specific model was run, EPA NMIM/NONROAD emissions estimates are not merged with the state-supplied data. However, we found that VOC estimates were missing from the SCC/emission type combinations provided in Table 4-17.

Table 4-16: SCC and emissions type with missing VOC in CA submittal

SCC	Emissions Type
2260001020	Evaporation
2260001020	Exhaust
2265001010	Evaporation
2265001010	Exhaust
2265001030	Evaporation
2265001030	Exhaust
2265001060	Evaporation

SCC	Emissions Type
2265001060	Exhaust
2270001060	Evaporation
2270001060	Exhaust

Separately from the EIS submittal, the California Air Resources Board (CARB) modeling group provided nonroad emissions data to EPA's emissions modeling group in July 2012. This CARB "modelers" dataset was different than the data the CARB inventory group submitted to the EIS in that it contained total organic gases (TOG) instead of VOC, and TOG was present where the VOC was missing from the EIS CARB data. We chose to compute VOC for Table 4-17 SCC/emission types using the TOG from the "modelers" dataset. The original format of the "modelers" dataset was a text file with annual mobile emissions totals at the county level and for California source categories. The nonroad emissions were extracted from this file based on a California source category crosswalk to EPA's SCCs. TOG was converted to VOC using VOC/TOG factors based on the SCC and emission type. Prior to using the "modelers" -based VOC for the missing SCCs, we compared VOC between the "modelers" dataset (after the conversion from TOG to VOC) and the EIS CARB data for SCCs with non-missing VOC. Because they were not identical, we chose to adjust the "modelers" VOC before adding submitting it to the EIS. The "modelers" data were adjusted by multiplying by the ratio of EIS CARB VOC to "modelers" VOC from common non-missing SCCs in both datasets. Ratios were computed for each county using VOC from the non-missing SCCs at the "SCC7" level (first 7 digits of the SCC). We submitted this adjusted "modelers" VOC to the EIS in the dataset "2011EPA_CAmodelerdata".

4.5.6 References for Nonroad Equipment

1. My SQL file of NCD inputs for 2011 v2 "2011neiv2_supdata_nonroad".
2. Run specifications and Change log for 2011 v2 "2011NEIv2_supdata_nr_RunNotesChangeLog" On-road mobile –All Vehicles and Refueling

4.5.7 Sector description

The four sectors for on-road mobile sources include emissions from motorized vehicles that are normally operated on public roadways. This includes passenger cars, motorcycles, minivans, sport-utility vehicles, light-duty trucks, heavy-duty trucks, and buses. The sectors include emissions from parking areas as well as emissions while the vehicles are moving.

The 2008 NEI v1 and past NEIs included emissions from the MOBILE6 model. The 2011 NEI v1 included emissions from the MOVES2010b model. The 2011 NEI v2 used the latest available model, MOVES2014.

4.5.8 Sources of data overview, selection hierarchy, and changes to default data in NEI 2011 v2

EPA calculated the on-road emissions for the 2011 v2 for all states using MOVES. California emissions were later replaced with estimates based on California's emissions submittal, as described in Section 4.6.2.2. Many states submitted county level input data for MOVES. The following states or counties provided inputs for v2: NY, Clark County NV, GA, NC, NH, NJ, OR, UT, VA, and WI. Table 4-25 lists the agencies who submitted 2011 data and their submittal dates to the EIS. This agency submission list includes the previous v1 submittals as well as the new and revised data states provided for 2011 v2. For counties in the lower 48 states, EPA used the SMOKE-MOVES integration tools (SMOKE-MOVES) to generate emission inventories sources. Section 4.6.3.7 describes SMOKE-MOVES processing steps. EPA ran MOVES in "inventory mode" to directly estimate county level emissions for states and territories outside the lower 48 states (i.e., AK, HI, PR, and VI). California provided EPA with complete emissions based on the EMFAC2011 model.[27]

The selection hierarchy for v2 favored local input data over EPA default input data. For California, EPA used the California ARB-provided emissions. For other states, EPA preferentially selected submitted local data over default data for use in MOVES runs.

As part of v2 updates of default data, EPA introduced new nationwide datasets of recent county-specific data to replace the older NEI EPA-default inputs. The Coordinating Research Council (CRC) and ERG conducted CRC project A-88 to compile and develop improved on-road datasets to improve the defaults used the NEI.[28] The NEI default data updates focused on three specific areas: light-duty age distribution, light-duty population, and long-haul VMT fractions. Section 4.6.2.3 (EPA Default MOVES Inputs) describes these new data in detail.

EPA generated emissions using the latest available version of MOVES2014 (code version 20140925 and database version movesdb20140918).

4.5.8.1 *Updated Source Classification Codes (SCC)*

For 2011 NEIv2, EPA revised the source classification codes (SCCs) for the on-road sector. Previous inventories' SCCs were consistent with the MOBILE6 model, while this model-ready inventory utilizes detailed SCCs that are more consistent with the source types and fuels that are in MOVES. The new SCCs have the form:

220FSSRRPP

Where "F" is the fuel type, "SS" is the source type, "RR" is the road type, and "PP" is the process type. For example, gas passenger cars on urban unrestricted roads running exhaust has SCC 2201210501 and diesel combination long-haul trucks parked in extended idle has SCC 2202620190.

For the underlying modeling (described below), EPA used these more detailed SCCs[29]. For the NEI, the results were aggregated to more general SCCs which do not include road type and have more aggregated processes. For example, in the posted annual 2011 v2 emissions data, gas commercial trucks for all roads and parked emissions for all process (except refueling) has SCC 2201320080.

The previous SCCs from 2011 v1 do not map directly to the current set of SCCs. Therefore, it was necessary to create a third set of SCCs, comparison SCCs, which would allow for comparison across the inventories. The MOBILE6 era SCCs need to be aggregated to these comparison SCCs and the MOVES2014 based SCCs need to be aggregated to these comparison SCCs to create an equivalent set of aggregate source types. Detailed mappings between both set of SCCs and the comparison SCCs are provided in the supplementary material (see Table 4-26 for access information).

4.5.8.2 *California submitted on-road emissions*

California submitted on-road emissions data directly according to SCC-level formatting requirements. EPA instituted a quality assurance process to ensure the submitted data were complete and correctly formatted. California's submissions were generated by ARB using the EMFAC2011 model.

[27] The EMFAC2011 model the supporting documentation

[28] "MOVES Input Improvements for the 2011 NEI" Report for the Coordinating Research Council (CRC) by Eastern Research Group, Inc. under CRC Project A-88; October 2014.

[29] For the modeling, EPA used a set of aggregate processes: 62 (all refueling), 91 (Auxiliary Power Units), 53 (all extended idle), and 81 (all exhaust, evaporative, brake, and tire except refueling and hotelling).

California submissions were based on the older MOBILE6 SCCs. To maintain consistency with the rest of the county, EPA converted these emissions to the new SCCs through a two-step process. First, EPA estimated California emissions using MOVES2014 (same process as the rest of the lower 48 states). Second, EPA aggregated California's submissions to comparison SCC6 (aggregate fuel and source type) and then redistributed those emissions to the new SCCs based on EPA's distribution of emissions. This distribution from comparison SCC6 to new SCCs was done by county, SCC, and pollutant. All VOC HAPs used the VOC adjustment factor to convert from EPA estimates to CARB estimates for that county/SCC. This preserved the speciation in MOVES2014 (i.e. the relationship between each of the VOC HAPs and total VOC was consistent with EPA estimates). EPA estimated PAHs were summed and adjusted to match CARB submitted total PAH. The distribution between the individual PAHs was preserved to match EPA estimates.[30]

4.5.8.3 *Agency-submitted MOVES inputs*

State and local (S/L) agencies provided inputs for MOVES at the county level in the form of county databases (CDBs). This established format requirement in which states must submit data (as a CDB) enables EPA to more efficiently identify errors and manage the input datasets. EPA screened the submitted data using several quality assurance (QA) scripts that analyze the individual tables in each CDB to look for missing data or unrealistic values.

<u>Overview of MOVES Input Submissions</u>

S/L agencies prepared complete sets of MOVES input data in the form of one CDB per county using the MOVES county data manager (CDM). Table 4-18 lists each table in a MOVES CDB and describes its content.

Table 4-17: MOVES CDB tables

CDB Table	Description of Content
auditlog	Information about the creation of the database
avft	Fuel type sales fractions
avgspeeddistribution	Average speed distributions
county	Description of the county
dayvmtfraction	VMT distribution across the type of day
fuelformulation	Fuel properties
fuelsupply	Fuel differences by month of the year
fuelsupplyyear	Year for the fuel properties
hourvmtfraction	VMT distribution across the hours of the day
hpmsvtypeyear	Total annual VMT by HPMS vehicle type
imcoverage	Description of the Inspection and Maintenance program
monthvmtfraction	VMT distribution across the months of the year
roadtype	Description of the road types
roadtypedistribution	VMT distribution across the road types
sourcetypeagedistribution	Distribution of vehicle ages
sourcetypeyear	Vehicle populations
state	Description of the state
year	Year of the database
zone	Allocations of starts, extended idle and vehicle hours parked to the county

[30] Chromium in MOVES2014 is chromium trivalent only. CARB submitted chromium total. EPA calculated the faction of chromium trivalent as 0.18*chromium total. The emissions in the NEI therefore represent the portion of California's submission that is approximately chromium trivalent.

CDB Table	Description of Content
zonemonthhour	Temperature and relative humidity values
zoneroadtype	Allocation of road types to the county
countyyear	Description of the Stage 2 program
emissionratebyage	Implementation of California standards [not part of CDB but included for NEI since state-specific data is applicable]

Previously during v1, agencies submitted 1,363 CDBs. Adding in the new submittals for v2, the total number of submitted CDBs became 1,426. Agencies submitting data through the EIS provided complete CDBs with all database tables filled as well as documentation and a submission checklist indicating which of CDB tables contained local data.

Table 4-19 summarizes these submission checklists, showing the number of counties within each State/County submission for which the information was local data. Empty records in the table below indicate that the State/County did not provide local data for that particular CDB table. The grand totals of submittals across all states show that VMT and population ('hpmsvtypeyear' and 'sourcetypeyear' tables, respectively) were the most commonly provided local data.

Table 4-18: Number of counties with submitted data, by state and MOVES CDB input table

State/County	avft	avgspeeddistribution	dayvmtfraction	fuelformulation	fuelsupply	hourvmtfraction	hpmsvtypeyear	imcoverage	monthvmtfraction	roadtype	roadtypedistribution	sourcetypeagedistribution	sourcetypeyear	emissionratebyage
Alaska	29	29	29	29	29	29	29	2	29		29	29	29	
Arizona (Maricopa County)	1	1	1	1	1	1	1	1	1	1	1	1	1	
Colorado								11**						
Connecticut		8	8	8	8	8	8	8		8	8	8	8	8
Delaware*		3		3	3		3	3	3	3	3	3	3	
Dist. of Columbia	1	1	1	1	1	1	1	1	1	1	1	1	1	
Georgia		21	159			21	159	13	159	20	159	159	159	
Idaho	44	44	44		44	44	44	2	44	44	44	44	44	
Illinois		102	102	102	102	102	102	11	102	102	102	102	102	
Kentucky (Jefferson County)	1	1	1	1	1	1	1	1	1	1	1	1	1	1
Maine		16	16	16	16	16	16	1	16	16	16		16	
Maryland	24	24	24	24	24	24	24	24	24		24	24	24	24
Massachusetts*		14	14		14	14	14	14	14	14	14	14	14	14
Michigan		83	83	83	83	83	83		83	83	83	83	83	76
Minnesota				87	87		87				87	4**	87	
Missouri					110		115	5			115	115	115	
Nevada (Clark County)						1	1	1	1		1	1	1	
Nevada (Washoe County)				1	1		1							
New Hampshire				10	10		10	10				10	10	
New Jersey		21	21	21	21	21	21	21	21	21	21	21	21	
New York	62	62	62	62	62	62	62	62	62	62	62	62	62	62

State/County	avft	avgspeeddistribution	dayvmtfraction	fuelformulation	fuelsupply	hourvmtfraction	hpmsvtypeyear	imcoverage	monthvmtfraction	roadtype	roadtypedistribution	sourcetypeagedistribution	sourcetypeyear	emissionratebyage
North Carolina		19		100	100	100	100	100				100	100	
Ohio	88	88	88	1	1	88	88	14	88	23	88	88	88	
Oregon				36				6						
Pennsylvania		67	67	67	67	67	67	67	67		67	67	67	67
Rhode Island							5						5	
South Carolina			46			46	46		46				46	
Tennessee (Knox County)			1				1		1		1			
Utah	29	29	29	29	29	29	29	29	29	29	29	29	29	29
Vermont							14						14	
Virginia		134	40	34	34		134	10	40		134	134	134	
Washington	1		39	39	39	39	39	5	39		39	39	39	
West Virginia							13		13		13	13	13	
Wisconsin		7		6	72		72	7			72	72	72	
Total	**280**	**774**	**875**	**761**	**959**	**797**	**1390**	**429**	**884**	**428**	**1214**	**1224**	**1388**	**281**

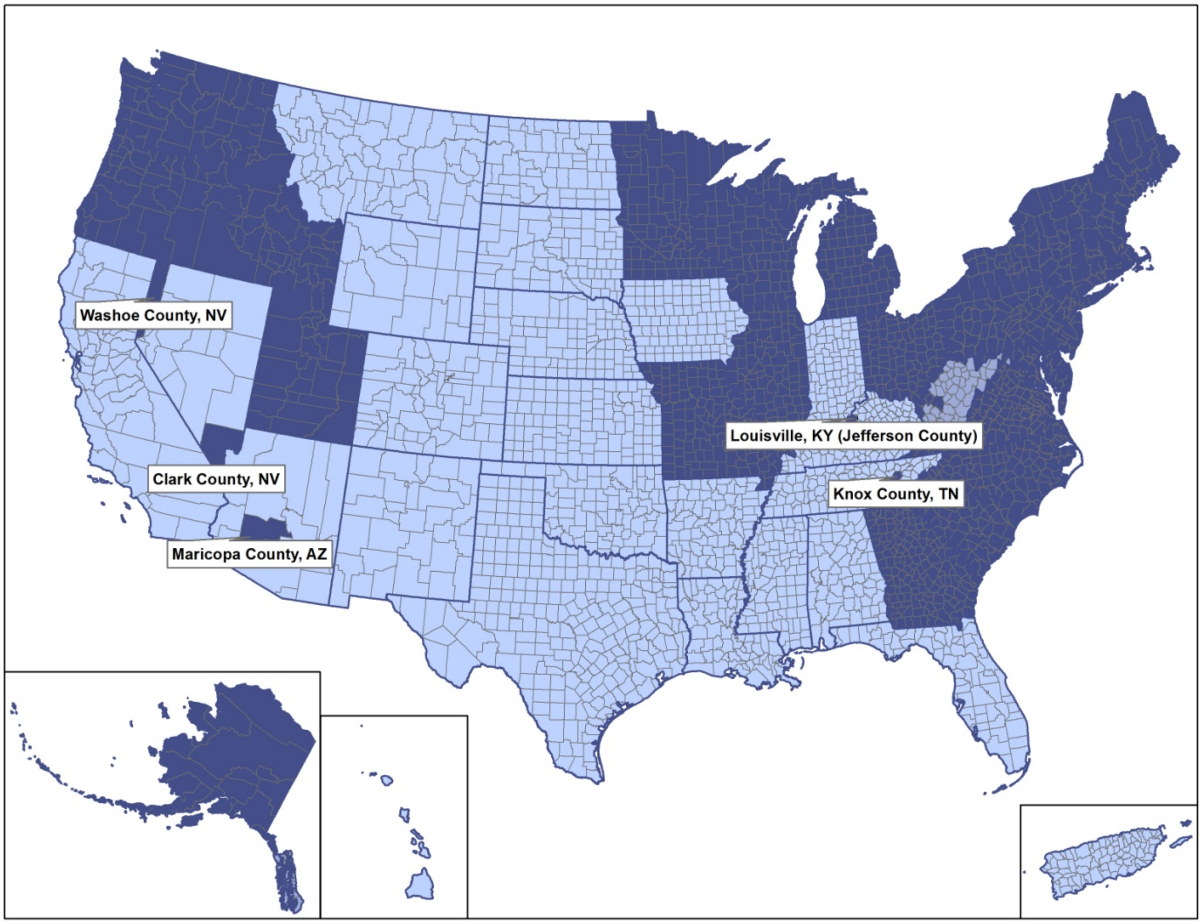
* EIS checklist submitted blank, determined from documentation

** Submitted directly to EPA staff, not through the EIS

As shown above, some states supplied local data for only a subset of CDB tables. The other tables contained old or default information.

Figure 4-1 shows geographic coverage of CDB submissions the S/L agencies submitting any local data at the county level in dark blue. The light blue areas indicate counties where the MOVES runs used EPA default data.

Figure 4-1: Dark blue indicates States/Counties that submitted at least 1 CDB input table



<u>QA checks on MOVES CDB tables</u>

EPA developed a QA process in the form of MySQL scripts which EPA's contractor ERG supplemented with additional scripted checks to evaluate the reasonableness of data values compared to expected ranges in user inputs. EPA's QA scripts read the database tables in each agency-submitted CDB and recorded warnings and errors indicating the table's completeness and reasonableness. The EIS submission process required agencies to run one of the QA scripts on each CDB and report results, but EPA performed the supplemental QA checks using a second QA script to evaluate on reasonableness of data after receiving the submitted CDBs. The second QA script that checked data reasonableness included the following:

1. Calculate average speeds by RoadType and SourceType using avgSpeedFraction values in the AvgSpeedDistribution table; compare to the national average values in the MOVES default database table. Flag differences > 10 miles per hour.
2. Flag RVP values in the FuelFormulation table if > 9 psi in the summer months (monthID=5 through 9); or > 10 psi for E10.
3. Flag hourVMTFraction in the HourVMTFraction table if the sum of HourID=6 through 18 (daytime hours) if < 0.5; or if values for individual hours = 0, or > 0.8.
4. Flag monthVMTFraction in the MonthVMTFraction table if the sum of summer months (4<MonthID<10) is < 0.5, or if values for individual months = 0, or > 0.8.

5. Flag rampFraction in the RoadType table for roadTypeID=2 and 4 if = 0, or > 0.2; or > 0 roadTypeID=1, 3 and 5.
6. Flag ageFractions in the SourceTypeAgeDistribution table for SourceTypes where the sum across ageID 0-15 is < 0.5; or for individual ageFraction = zero or > 0.8.
7. Flag DayVMT values where weekday VMT > weekend VMT
8. Flag gasoline sulfur in FuelFormulation for values > 80ppm
9. Flag EtOH Volume in FuelFormulation for values > 10
10. Flag sourceType Population in SourceTypeYear table where sum of population for SourceTypeIDs 21 and 31 is < 0.5
11. Flag HPMSBaseYearVMT in HPMSVTypeYear table where sum of VMT for SourceTypeIDs 21 and 31 is < 0.5
12. Calculate VMT/Population ratios by sourcetype and compare to national default ratios. Flag ratios that differ from default > 50% [note: this was increased from original flag of 10% after this threshold flagged most of the submitted data].

During v2 development, EPA refined a number of the v1 QA checks including the screening of the Inspection/Maintenance (I/M) coverage table. The I/M Coverage QA check flagged errors related to sequence, gaps, and overlaps in model year coverage of exhaust and evaporative I/M programs. For example, the I/M checking script flagged counties where two exhaust I/M programs were applied to the same set of model years for passenger cars. EPA's contractor identified these errors, recommended specific corrections, and EPA confirmed the proposed corrections with individual states when possible prior to implementation. As a result of these efforts, the I/M tables were corrected for many counties in several states, including Rhode Island, Oregon, Virginia, and Indiana.

Aside from I/M checks, the general QA scripts flagged errors in the new v2 data. For example, several counties had speeds that were unrealistically low for restricted access road types (for example, 15 mph for all hours of day). In these cases, EPA contacted the responsible agency for CDB submission and requested an additional review. The outcome of review resulted in either the S/L agency opting to use EPA default speeds in the NEI in place of submitted data or correcting their data.

Another common category of error was distributions that did not sum to 1. For example, age distributions for specific source types summed to 0.96 instead of 1. EPA corrected this type of data problem by renormalizing the distribution. The QA scripts also flagged distributions with atypical patterns, such as hourly VMT fractions with a higher fraction in nighttime hours than daytime. EPA evaluated and addressed these potential errors on a case-by-case basis.

4.5.8.4 *EPA default MOVES inputs*

EPA developed the CDBs for counties that did not submit any input data. Table 4-20 describes the source of default data used for 2011 v2 for each table in a CDB for which states have the option to supply alternate data. There are additional tables in a CDB, not listed below, that are informational only (i.e., state, county, year etc.) that EPA populated. The new EPA default data in v2 applies to light-duty source type data in the age distribution and vehicle population tables.

Table 4-19: Source of defaults for data tables in MOVES CDBs

CDB Table	Description of Content	Default CDB Table Content
avgspeeddistribution	Average speed distributions	MOVES2010b national default
dayvmtfraction	VMT distribution across the type of day	2011 NEI v1

CDB Table	Description of Content	Default CDB Table Content
fuelformulation	Fuel properties	Based on EPA estimates for each county from calendar year 2011 refinery data
fuelsupply	Fuel differences by month of the year	Based on EPA estimates for each county from calendar year 2011
hourvmtfraction	VMT distribution across the hours of the day	MOVES2010b national default
hpmsvtypeyear	Total annual VMT by HPMS vehicle type	2011 county-level data from FHWA
imcoverage	Description of the Inspection and Maintenance program	2011 NEI v1
monthvmtfraction	VMT distribution across the months of the year	MOVES2010b national default
roadtype	Ramp fractions by road type	0.08 fraction (8 percent) of vehicle operating hours on urban and rural restricted access roads
roadtypedistribution	VMT distribution across the road types	2011 NEI v1
sourcetypeagedistribution	Distribution of vehicle ages	For source types 21, 31, and 32: CRC A-88 estimates for each county; For all other source types: MOVES2010b national default for 2011
sourcetypeyear	Vehicle populations	For source types 21, 31, and 32: CRC A-88 estimates for each county; For all other source types: Calculated from county-level VMT based on ratios of population to VMT from state-level FHWA data
zonemonthhour	Temperature and relative humidity values	Temperature and humidity data are EPA provided data for each county from calendar year 2011
emissionratebyage	Implementation of California standards	The EmissionRateByAge tables for some counties have been populated using the appropriate data described in the guidance for states adopting California emission standards.

Default California Emission Standards

EPA populated an alternative MOVES database table 'EmissionRateByAge' for some counties in states that adopted emission standards California's Low Emission Vehicle (LEV) program. Table 4-21 shows which states adopted the California standards and the year it began.

Table 4-20: States adopting California LEV standards, start years

FIPS State ID	State Name	LEV Program Start Year
6	California	1994
9	Connecticut	2008
10	Delaware	2014
23	Maine	2001
24	Maryland	2011
25	Massachusetts	1995
34	New Jersey	2009
36	New York	1996

FIPS State ID	State Name	LEV Program Start Year
41	Oregon	2009
42	Pennsylvania	2008
44	Rhode Island	2008
50	Vermont	2000
53	Washington	2009

<u>Updated defaults from CRC A-88</u>

Light Duty Age Distribution and Population

EPA updated light-duty default data in 2011 v2 CDBs for two specific inputs— age distribution (the `sourceTypeAgeDistribution` table) and population (the `sourceTypeYear` table). The affected light-duty source types included passenger cars, passenger trucks, and light-duty commercial trucks (source types 21, 31, and 32). Historically, EPA's default data source for fleet age has been a nationwide average age distribution applied to all counties. For light-duty vehicles in 2011, the default data average age was 9 years old. The updated default age distributions from CRC A-88 show a range in average age of 4 to 16 years old by county. EPA previously determined default data population using a single national ratio of population to VMT for each source type; the ratio did not vary geographically. The CRC project A-88 population data replacing this default is based on state-reported vehicle registrations.

In order to improve the county resolution and to use more recent data, EPA incorporated county-level data from CRC project A-88. The CRC project team procured vehicle populations from IHS Automotive (formerly R.L. Polk). IHS compiled their data from state vehicle registrations provided to IHS by state departments of motor vehicles. The IHS database provided vehicle population for each county separately for cars and light trucks by model years 1981 through 2012. A limitation of the IHS data is that it did not include vehicles for model years 1980 or earlier as these models did not have a standardized Vehicle Identification Number (VIN) schema. To adjust for this, the CRC project team added population to the oldest age category (1981 representing the 30+ vehicles) by until the "tail" of the age distribution reached the median of data provided by states. CRC normalized the modified by-model-year populations to produce the light-duty age distributions for cars (applicable to source type 21) and light trucks (applicable to both source types 31 and 32). CRC summed the populations over the same set of modified population data to calculate the total population for passenger cars and light trucks. The light-duty truck population was split into source types 31 and 32 using the MOVES national average split of 75% and 25%, respectively.

Updated fraction of Long-Haul Truck VMT

CRC data improvements also addressed a third default data parameter in the on-road NEI—the fraction of long-haul truck VMT. EPA's approach for determining the default allocations of truck VMT to the long-haul categories has relied on national average rates of annual mileage accumulation and the relative vehicle population by source types within an HPMS vehicle group, listed in Table 4-22

Table 4-21: HPMS truck categories and their MOVES source types

HPMS Vehicle Type ID	HPMS Vehicle Name	Source Type ID	Source Type Name
50	Single Unit Trucks	51	Refuse Truck
		52	Single Unit Short-haul Truck
		53	Single Unit Long-haul Truck
		54	Motor Home
60	Combination Unit Trucks	61	Combination Unit Short-haul Truck
		62	Combination Unit Long-haul Truck

These default methods resulted in a static value of 59 percent of long-haul VMT from combination unit trucks and 12 percent long-haul VMT from single unit trucks nationwide with no geographic variability. The CRC A-88 analysis of the Freight Analysis Framework (FAF) data set suggested variability in the allocations of long-haul VMT by region of the U.S. and by road type. The updated allocations show a range of 30 to 90 percent long-haul VMT from combination unit trucks and a range of 2 to 50 percent long-haul VMT from single unit trucks, depending on region and road type[31].

Because a MOVES CDB input table does not exist for long-haul VMT, EPA implemented the updated VMT fractions by post-processing the SMOKE-ready activity files (see Section 4.6.3.4). EPA also estimated the hotelling hours from the combination unit long-haul trucks based on their updated VMT values resulting from the CRC A-88 data.

4.5.9 Calculation of EPA Emissions

4.5.9.1 *EPA-developed on-road emissions data for the continental U.S.*

For the 2011 NEI, EPA estimated emissions for every county as discussed below. California had additional processing (see Sections 4.6.2.2 for details). For the continental U.S., EPA used a modeling framework that took into account the strong temperature sensitivity of the on-road emissions. Specifically, EPA used county-specific inputs and tools that integrated the MOVES model with the SMOKE[32] emission inventory model to take advantage of the gridded hourly temperature information available from meteorology modeling used for air quality modeling. This integrated “SMOKE-MOVES” tool was developed by EPA in 2010 and is in use by states and regional planning organizations for regional air quality modeling. SMOKE-MOVES requires emission rate “lookup” tables generated by MOVES that differentiate emissions by process (running, start, vapor venting, etc.), vehicle type, road type, temperature, speed, hour of day, etc. To generate the MOVES emission rates that could be applied across the U.S., EPA used an automated process to run MOVES to produce emission factors by temperature and speed for 284 “representative counties,” to which every other county could be mapped, as detailed below. Using the MOVES emission rates, SMOKE selected appropriate emissions rates for each county, hourly temperature, SCC, and speed bin and multiplied the emission rate by activity (VMT (vehicle miles travelled), vehicle population, or hotelling hours) to produce emissions. These calculations were done for every county, grid cell, and hour in the continental U.S. and aggregated to produce continental U.S. emissions. The MOVES “RunSpec” files (that tells MOVES what to run for each representative county) are provided in the supplementary materials (see Table 4-26 for access information).

[31] The explicit regions and long-haul splits are the in the CRC A-88 report, specifically Figures 17, 18, and 19. See “MOVES Input Improvements for the 2011 NEI” Report for the Coordinating Research Council (CRC) by Eastern Research Group, Inc. under CRC Project A-88; October 2014.

[32] SMOKE v3.6 was used for the 2011 v2. The current version of SMOKE

EPA used a different approach for states and territories outside the lower 48 states. For Alaska, Hawaii, Puerto Rico and the Virgin Islands, EPA ran MOVES in “inventory mode” for each county and month, using county-specific inputs. More information is provided Section 4.6.4.

SMOKE-MOVES can be used with different versions of the MOVES model. For the 2011 v2, EPA used the latest publicly released version: MOVES2014. Using SMOKE-MOVES for creating the NEI requires numerous steps, as described in the sections below:

- Determine which counties will be used to represent other counties in the MOVES runs (see Section 4.6.3.2)
- Determine which months will be used to represent other month’s fuel characteristics (see Section 4.6.1.1)
- Create MOVES inputs needed only for the MOVES runs (see Section 4.6.2.4). MOVES requires county-specific information on vehicle populations, age distributions, and inspection-maintenance programs for each of the representative counties.
- Create inputs needed both by MOVES and by SMOKE, including a list of temperatures and activity data (see Sections 4.6.3.3 and 4.6.3.4).
- Run MOVES to create emission factor tables (see Section 4.6.3.6)
- Run SMOKE to apply the emission factors to activities to calculate emissions (see Section 4.6.3.7)
- Aggregate the results at the county-SCC level for the NEI, summaries, and quality assurance (see Section 4.6.3.8)

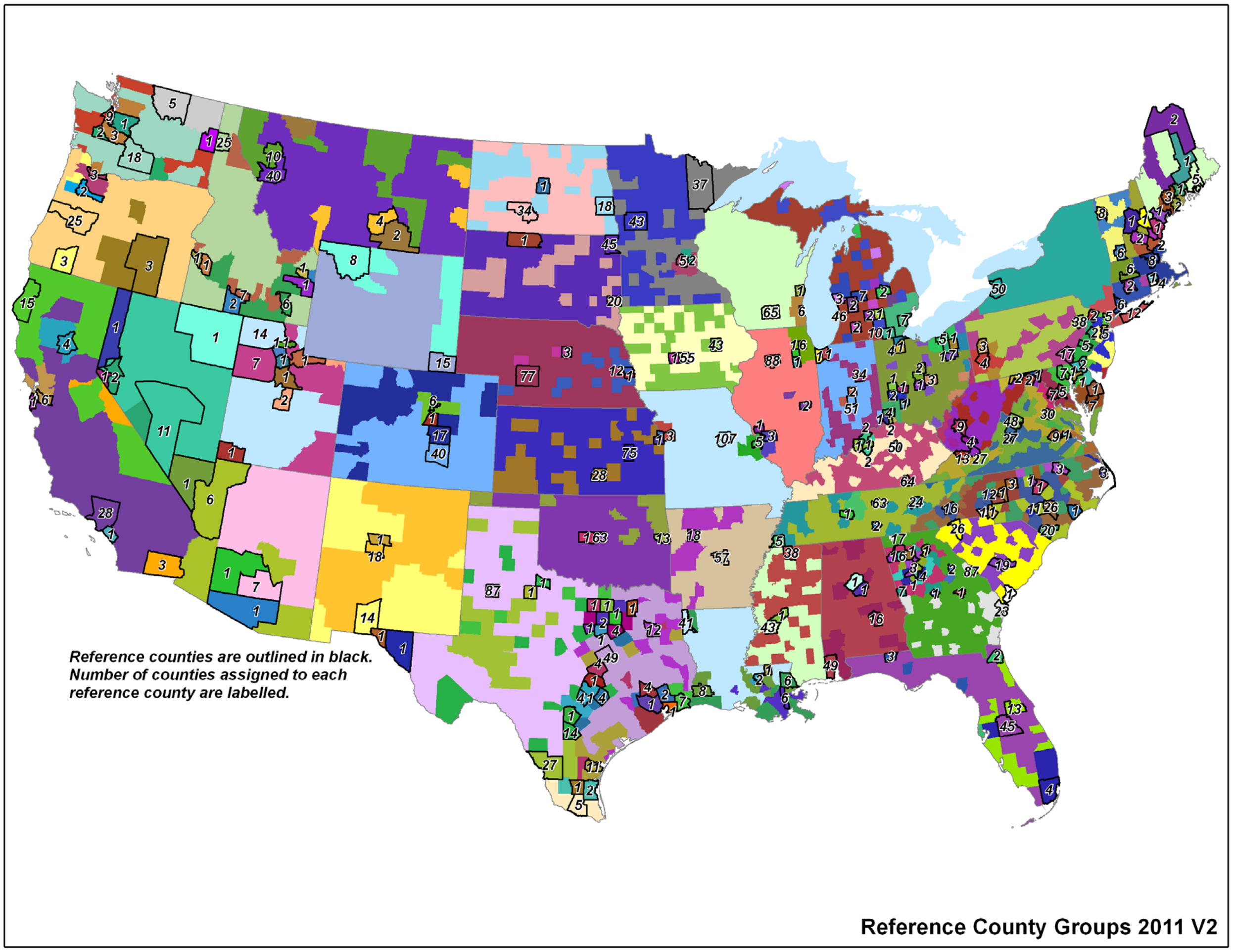
4.5.9.2 *Representative counties*

Although EPA compiles county-specific database for all counties in the nation, EPA runs MOVES for a subset of these because the important emissions-determining differences among counties can be accounted for by assigning counties to groups with similar properties (e.g., similar fleet age, shared I/M programs, shared specific fuel controls such as low RVP for summer gasoline, same state). This approach of running representative counties helps manage computation time by reducing the number of MOVES runs needed to generate a nationwide inventory.

Within the SMOKE-MOVES framework, lookup tables of representative county emission factors are multiplied with the county-level activity for all counties within the representative country group. The activity specific to each county in the inventory includes VMT, population, speed distributions, and hotelling hours.

EPA increased the number of representative counties for v2. The first update to the v1 representative county groups was to accommodate requests from five states, including CO, ME, MD, NC, and AK. EPA then undertook new analysis to further subdivide the approximately 164 county groups based on ramp fractions and updated default age distributions resulting from CRC A-88 data. After the conclusion of EPA’s v2 representative county analysis, other states requested changes including GA and AL, and EPA implemented these minor changes. The final number of representative counties for 2011 v2 increased to 284. Figure 4-2 is a map of the representative counties by state and their corresponding county groups.

Figure 4-2: Representative county groups for NEI 2011 v2



Ramp Fractions

During the 2011 on-road NEI development cycle, agencies had the option to provide the CDB table `roadType` which specifies the fraction of restricted access road operating time that occurs on ramps. The `roadType` table is optional in a CDB; if the CDB table is empty, MOVES will revert to its nationwide default value of a 0.08 fraction (8 percent) of vehicle operation time that occurs on ramps.

A ramp fraction value of 0 is possible for a county where a single highway passes through the edge of the county without having any exits. Conversely, a busy urban county with many flyovers and entrance/exit ramps could have a much higher ramp fraction than the average of 8 percent. Because emission factors are higher on ramps compared to highway driving and there exists a potential for wide variation in the county data, EPA added this parameter in the consideration for county groups in 2011 v2.

S/L agencies provided ramp fractions for 716 counties out of the approximately 1,400 submitted CDBs. The ramp fraction values ranged from 0 to 1 although most (97 percent) of the values were less than 0.13. After examining the distribution of the data, EPA grouped the ramp fractions values according to the 5-bin scheme shown below in Table 4-23.

Table 4-22: Binning scheme for submitted ramp fraction data

Bin	Description (Fractions from 0 to 1)	Number of Counties
1	0 ≤ ramp fraction < 0.05	244
2	0.05 ≤ ramp fraction < 0.09	336
3	0.09 ≤ ramp fraction < 0.13	120
4	0.13 ≤ ramp fraction < 0.17	7
5	0.17 ≤ ramp fraction	9

EPA assigned counties to one of the 5 bins according to the ramp fraction on either road type 2 (Rural Restricted Access) or road type 4 (Urban Restricted Access), selecting the road type that had the higher VMT. Next, EPA split the county groups on the basis of the new ramp fraction bin assignments. This process resulted in the addition of more than 30 new representative counties in v2.

<u>Mean Age of Light Duty Vehicles</u>

Age distribution was previously a factor in the selection of representative counties in the 2011 v1, but the binning at that time effectively only distinguished among submitted data because the default age distributions did not vary by county in the states that did not submit data. Given the introduction of new nationwide county specific age distributions from CRC A-88 to replace the default, the mean age parameter needed to be re-evaluated in 2011 v2.

Just as for the ramp fraction analysis, EPA evaluated mean age with the intent to further subdivide existing county groups where differences would likely affect emission factors within the group. The counties in v2 using the default age distributions from CRC A-88 are those that either did not submit a CDB (see light blue in Figure 4-1) or did submit but elected to use the CRC age distributions or a modified version thereof instead of submitted data. The latter category includes the following states and/or counties: GA, ME, MN, Washoe County NV, RI, SC, VT, and WV[33]. In total, EPA binned 2,082 counties based on light-duty mean age of the IHS-derived data from CRC A-88. Table 4-24 shows the definitions of the 6 bins. The mean age binning process added nearly 70 new representative counties to the NEI.

Table 4-23: Binning scheme for CRC A-88 age distribution data

Bin	Description (Mean age in number of years old in 2011)	Number of Counties
1	0.0 ≤ Mean Age < 7.0	1
2	7.0 ≤ Mean Age < 9.0	140
3	9.0 ≤ Mean Age < 11.0	994
4	11.0 ≤ Mean Age < 13.0	920
5	13.0 ≤ Mean Age < 15.0	25
6	15.0 ≤ Mean Age	2

Validation of the average-age approach to binning similar counties

Following the analysis of grouping counties based on mean light duty vehicle age, EPA examined the full age distribution of each representative county to determine how similar it was to the age distributions of its

[33] RI, SC, and VT used their own state supplied population data and used CRC data only for age distribution. WV did not use CRC data for the following 13 counties: Berkeley (54003), Brook (54009), Cabell (54011), Hancock (54029), Kanawha (54039), Marshall (54051), Mason (54053), Monongalia (54061), Ohio (54069), Pleasants (54073), Putnam (54079), Wayne (54099), and Wood (54107). For all other counties, WV elected to use CRC data.

member counties. Unlike the ramp fraction or mean age analysis, the purpose of examining the full age distributions was not to add any new county groups, but rather identify whether any atypical age distribution shapes that exist in the representative county set. The parameter used to analyze the age distribution, termed "vector angle," indicates how similar a particular age distribution (or vector) is to a reference vector by calculating their "angle," resulting in a value between 0° (very similar distribution) and 90° (maximum difference). In general, most county age distributions matched well with their representative county age distribution in overall shape, with approximately 95 percent of all vector angles below 7°, a value which upon visual inspection corresponded to reasonable agreement between the full distributions. The remaining 5 percent of county vector angles were mostly clustered around the range of 8 to 10°, with exception of one county vector angle of 19.6° (the maximum angle). These relatively high vector angles for particular counties occurred in a distributed fashion, among various county groups, in groups where other member counties showed good agreement with the representative county. Therefore, EPA made no changes to the representative county selection based on the vector angle validation check.

Fuel Months

The concept of a fuel month is used to indicate when a particular set of fuel properties should be used in a MOVES simulation. Similar to the reference county, the fuel month reduces the computational time of MOVES by using a single month to represent a set of months. Because there are winter fuels and summer fuels, EPA used January to represent October through April and July to represent May through September. For example, if the grams/mile exhaust emission rates in January are identical to February's rates for a given reference county, and temperature (as well as other factors), then we use a single fuel month to represent January and February. In other words, only one of the months needs to be modeled through MOVES. The hour-specific VMT, temperature and other factors for February are still used to calculate emissions in February, but the emission factors themselves do not need to be created since one month can represent the other month sufficiently. The fuel months used for each representative county are provided in the supplementary materials (see Table 4-26 for access information).

Fuels

Although state-submitted MOVES input data may have included information about fuel properties, the MOVES runs for the 2011 NEI v2 were run using a set of fuel properties for a set of fuel regions generated by EPA. EPA developed these data using a combination of purchased fuel survey data, proprietary fuel refinery information and known federal and local regulatory constraints.

The steps used to determine the fuel properties in each fuel region are as follows:

1) Fuel properties from proprietary refinery certification data were compiled on a regional basis (based on typical pipeline delivery areas).
2) Properties within a region for finished fuel batches (e.g. no CBOB, RBOB or OBO fuel batches) produced in 2010, excluding RFG, were averaged to generate non-ethanol conventional gasoline fuel properties within that region, for a given month.
3) RFG fuel properties were based on RFG fuel compliance survey data, and oxygenate levels were assumed to be 10% ethanol (E10, no MTBE).
4) Refinery modeling results generated for the RFS2 rulemaking were used to adjust the regional conventional gasoline fuel properties to account for ethanol blending up to E10, for a given month.

5) Additional adjustments to fuel properties were performed on individual counties within a region, based on refinery modeling, for known local regulatory constraints such as low-RVP or oxygenate level mandates.
6) Appropriate E10 and conventional gasoline fuel market shares were calculated on a regional basis for the level of ethanol produced in 2011, after ethanol required for RFG compliance was taken into account.
7) Gasoline fuel properties and ethanol market shares were applied to each county regionally and accounting for known local regulatory constraints.
8) Diesel properties were assumed to be 15 ppm nationally with no significant biodiesel penetration.

The regional fuel supply database is provided in the supplementary materials (see Table 4-26 for access information).

4.5.9.3 *Temperature and humidity*

Ambient temperature can have a large impact on emissions. Low temperatures are associated with high start emissions for many pollutants. High temperatures and high relative humidity are associated with greater running emissions due to the increase in the heat index and resulting higher engine load for air conditioning. High temperatures also are associated with higher evaporative emissions.

The 12-km gridded meteorological input data for the entire year of 2011 covering the continental United States were derived from simulations of version 3.4 of the Weather Research and Forecasting Model (WRF), Advanced Research WRF core [ref 1]. The WRF Model is a mesoscale numerical weather prediction system developed for both operational forecasting and atmospheric research applications. The Meteorology-Chemistry Interface Processor (MCIP) version 4.1.3

CMAS was used as the software for maintaining dynamic consistency between the meteorological model, the emissions model, and air quality chemistry model.

EPA applied the SMOKE-MOVES tool Met4moves to the gridded, hourly meteorological data (output from MCIP) to generate a list of the maximum temperature ranges, average relative humidity, and temperature profiles that are needed for MOVES to create the emission-factor lookup tables. “Temperature profiles” are arrays of 24 temperatures that describe how temperatures change over a day, and they are used by MOVES to estimate vapor venting emissions. The hourly gridded meteorological data (output from MCIP) was also used directly by SMOKE (4.6.3.6).

The temperature lists were organized based on the representative counties and fuel months as described in Sections 4.6.3.2 and 4.6.1.1, respectively. Temperatures were analyzed for all of the counties that are mapped to the representative counties, i.e., for the county groups, and for all the months that were mapped to the fuel months. EPA used Met4moves to determine the minimum and maximum temperatures in a county group for the January fuel month and for the July fuel month, and the minimum and maximum temperatures for each hour of the day. Met4moves also generated idealized temperature profiles using the minimum and maximum temperatures and 10 °F intervals. In addition to the meteorological data, the representative counties and the fuel months, Met4moves uses spatial surrogates to determine which grid cells from the meteorological data to collect temperature and relative humidity statistics. For example, if a county had a mountainous area with no roads, this would be excluded from the meteorological statistics.

To account for changes in relative humidity, there is a pairing of relative humidity to temperature bins. Met4moves calculated an average relative humidity for the county group for all grid cells that make up that temperature bin. In other words, for all grid cells and hours within a single temperature bin and county group, it extracts and averages the corresponding relative humidity. Met4moves repeats this calculation for each temperature bin and county group, and finally repeats the whole process for each fuel month. When the emission factors are applied by SMOKE (Section 4.6.3.6), the appropriate temperature bin and fuel month specific relative humidity was used for all runs of the county group. EPA used a 5 °F temperature bin size for RPD, RPV, and RPH.

Met4moves can be run in daily or monthly mode for producing SMOKE input. In monthly mode, the temperature range is determined by looking at the range of temperatures over the whole month for that specific grid cell. Therefore, there is one temperature range per grid cell per month. While in daily mode, the temperature range is determined by evaluating the range of temperatures in that grid cell for each day. The output for the daily mode is one temperature range per grid cell per day and is a more detailed approach for modeling the vapor venting (RPP) based emissions. EPA ran Met4moves in daily mode for 2011 NEI.

The resulting temperatures provided to the representative counties are provided in the supplementary materials (see Table 4-26 for access information). The gridded, hourly temperature data used are publicly available only upon request and with provision of a disk media to copy these very large datasets (contact info.chief@epa.gov).

4.5.9.4 *VMT, vehicle population, speed, and hotelling for SMOKE*

EPA prepared SMOKE-ready activity files in FF10 formats for all the activity types used by SMOKE-MOVES. The activity files include FF10 tables for VMT, population, average speed, and hotelling. The script also produced weekday and weekend hourly speed profiles, an optional input to SMOKE-MOVES.

EPA and its contractor ERG developed scripts that automated the creation of FF10 tables based on submitted CDBs and supplemental information in the MOVES database. For clarity, it should be noted that the speed profile input to SMOKE (spdpro) is not an FF10 file, but it was generated by the same script that produces the FF10s. Regardless of activity type, the objective of the script was to transform all user-supplied activity from CDB input table format into the level of detail required for SMOKE input. SMOKE inputs require activity by SCC which includes detail of MOVES source type, fuel type, and road type[34]. The script looped through the submitted CDBs and reported results to each FF10 table, collating results for all counties.

VMT FF10 file creation

EPA's script included several calculation steps to produce SCC-level VMT. First, the script calculated travel fractions by source type and model year that sum to one (1) for each HPMS vehicle type. The script generated these travel fractions using the CDB tables `sourceTypeAgeDistribution` and `sourceTypeYear` and the MOVES database table of annual mileage accumulation rates. Next, the script further divided the travel fractions by model year into fuel types of gasoline, diesel, ethanol (E85), and compressed natural gas (CNG) based on MOVES database table containing national sales of these engine types by model year and source type. Following that step, the script multiplied the travel fractions with the corresponding HPMS vehicle type's VMT in the CDB table `HPMSVtypeYear` resulting in VMT disaggregated into source type, fuel type and model year. The script then aggregated over model years and multiplied the resulting VMT at the source type level by road type fractions of

[34] The activity is by county and SCC8 (i.e. fuel, source type, and road type). The activity did not need to be by process as well (last 2 digits of the SCC). For example, the VMT for exhaust would be identical to the VMT for brake and tire wear. Because the EF tables are by full SCC (including process), SMOKE internally maps the activity by SCC8 to full SCCs using the SCCXREF file. Note, for hotelling the activity is by full SCC because the number of hours for extended idle is different than the number of hours for APU.

VMT using the CDB table `roadTypeDistribution`. The end result of these various calculations and table joins was the annual total VMT by SCC consistent with the CDB tables. The script also used the CDB table `monthVMTFraction` to divide annual totals into monthly VMT for January through December in the FF10 table.

Population FF10 file creation

The script's calculation of vehicle population (POP) was simpler than for VMT because the CDB table of population was much closer to the SCC format – it already contained source type detail and road types are not relevant for population activity SCCs. The only change needed was to incorporate fuel type detail into the source type population.

In order to augment the fuel type information into population data, the script first disaggregated the source type populations from the CDB table `sourceTypeYear` into model years using the CDB table `sourceTypeAgeDistribution`. Next, the script split the population into fuel types using the same MOVES national fuel type fractions of gasoline, diesel, E85, and CNG by model year previously described for the VMT FF10 file creation. In a third and final step, the script aggregated over model year for each source type and fuel type to arrive at the SCC level populations. Unlike the VMT FF10, population is only available at the annual level, without variation by month, because the registered populations are considered to be constant over the year.

Speed FF10 file creation

The script calculates average speed (SPEED) by SCC for each month and an annual average using primarily the CDB table `averageSpeedDistribution` which contains fractions of VMT by 16 speed bins for each source type by hour of weekday and weekend day types. The script first calculated the weighted average speed for each hour and then aggregated over hours up to the annual and month level using the various CDB tables for VMT distributions (i.e., `hourVMTFraction`, `dayVMTFraction`, and `monthVMTFraction`).

Hotelling FF10 file creation

"Hotelling" is the time spent by long-haul combination trucks during federally required rest periods during long-haul trips. The MOVES model assumes that only diesel combination unit trucks are used in long-haul operations that result in hotelling. EPA calculated the national rate of hotelling to be 0.033807 hours per mile on all restricted access roads (urban and rural together), and the script applied this rate to combination unit long-haul VMT in each county to estimate county-level hotelling.

The MOVES model database includes a "HotellingActivityDistribution" table that identifies whether the main engine or an auxiliary power unit (APU) was used during the hotelling activity. This engine description of the activity is a function of model year because not all trucks are equipped with APUs. MOVES2014 and the NEI assume that 100 percent of the hotelling hours from pre-2010 model year trucks use the main engine, but only 70 percent of hotelling hours are main engine beginning with model year 2010 into the future. The other 30 percent are assumed to operate on APUs with the main engine turned off. EPA's FF10 creation script calculated the main engine hours of extended idle (EXT) and APU hours for each county according to the equations below:

$$\text{Hotelling Hours} = 0.003807 * VMT_{restricted}$$
$$\text{EXT Hours} = \text{Hotelling Hours} * \text{EXT Fraction}$$
$$\text{APU Hours} = \text{Hotelling Hours} * \text{APU Fraction}$$

where:

Hotelling Hours = total extended idle hours (hours)
0.003807 = national rate of hotelling (hours/mile)

$VMT_{restricted}$	= vehicle-miles traveled by diesel combination unit long-haul trucks on both urban and rural restricted access road types (miles)
EXT Hours	= extended idle hours operating the main engine as the power source (hours)
APU Hours	= extended idle hours operating an APU as the power source (hours)
EXT Fraction	= weighted fraction of main engine hotelling hours, a value ranging from 0.7 to 1 depending on the age distribution (dimensionless)
APU Fraction	= weighted fraction of APU hotelling hours, a value ranging from 0 to 0.3 depending on the age distribution (dimensionless)

A few states provided their own estimates of total hotelling hours based on their own analysis. These states include: GA, NC, PA, and VA[35]. EPA used the state provided hotelling hours over EPA's estimates. Due to the possibility of mismatches at the county level, if a state provided hotelling hours, the state-submitted data was used for all counties in the state. States did not provide separate extended idle vs APU hours. EPA used the APU fraction based on EPA estimates for each county to calculate the APU hours in the state submitted data, while conserving the total number of hotelling hours (EXT + APU).[36]

Speed Profile file creation

The speed profile (SPDPRO) input to SMOKE is optional and allows the user to provide SMOKE with hour-specific speeds by SCC and weekday/weekend day types. Similar to the SPD FF10 file creation, EPA's script calculated a weighted average speed over the 16 speed bins for each hour by day type. For the 2011 NEI v2, the SPDPRO file contained speed profiles for every county, source type, and road type in the country and it takes precedence over the SPEED FF10 input.

VMT adjustments based on CRC A-88

As previously described for NEI v2 default data inputs, EPA updated the long-haul fractions of VMT based on data from CRC project A-88. The CRC A-88 data resulted from an analysis of the FAF dataset for single unit (source types 52 and 53) and combination unit (source types 61 and 62) trucks and found significant regional differences in the relative amount of long-haul activity. EPA implemented the long-haul VMT reallocation by updating the VMT activity files for SMOKE in a processing step prior to running SMOKE. Specifically, EPA's contractor processed the SMOKE-ready VMT files using a script that summed VMT over the affected source types (i.e., 52+53, and 61+62) and reapportioned the combined VMT totals to the constituent source types using a lookup table of relative VMT fractions that varied by region and summed to 1 for single unit (52+53) and combination unit (61+62) trucks. After calculating new long-haul VMT, EPA re-calculated the hotelling hours in order to be consistent with the revised long-haul VMT resulting from the CRC A-88 data incorporation.

Population adjustments based on CRC A-88

EPA incorporated the county level CRC A-88 light duty vehicle populations for source types 21, 31, and 32 in areas using "EPA default" data or where S/L/T agencies elected to use CRC data over their own previously submitted data. The CRC A-88 population and age distribution data impacts the distribution of light duty vehicle VMT between the three MOVES source types (21, 31, and 32). Total light duty is conserved and would match the

[35] CT and NJ also provided data. After consultation with the states, they accepted EPA's revised estimates for 2011 NEIv2 hotelling based on rural + urban restricted VMT.

[36] Additional modifications were made to the state data. For GA, NC, and VA, the states provided annual data. EPA used the EPA estimates to distribute the annual to monthly data by county. PA did provide monthly data, but the sum of the months was slightly different than the annual estimates. EPA renormalized their monthly estimates so that it equaled the annual value. After consulting with the state, NC accepted EPA's revised 2011 NEIv2 estimate for the statewide total hotelling hours. EPA distributed the statewide total to county using NC's distribution.

HPMS vehicle type (25) VMT, but the distribution between the MOVES light duty source types depends on both the age distribution and population tables.

Default data for SMOKE

The data for SMOKE obtained from state provided CDBs is the source for much of the data used for the 2011 NEI. However, CDBs were not provided for all counties in all states. The necessary information for the SMOKE FF10 files for these counties was derived from EPA default information used in the MOVES model tables and other EPA sources. All of the EPA default data was processed in a similar manner to the state supplied data and added to the state supplied data in the FF10 formatted files for use with SMOKE.

The average speeds, speed profiles, road type distribution and day type, hour and monthly distributions of VMT default values are all taken from the default MOVES database (movesdb20141021). VMT is obtained from the 2011 NEI Version 1 analysis and vehicle populations were derived from those VMT values. The source and handling of VMT and populations is described in the documentation for the 2011 NEI Version 1.

The age distributions and populations used for the default case were obtained from the CRC A-88 for source types 21, 31 and 32. The default MOVES database age distributions were used for all other source types. Similar to the submitted data, the incorporation of the CRC A-88 age distribution and population impacts the distribution of VMT between the three light duty source types.

The same VMT adjustments to account for long haul fractions that were applied to state supplied data were also applied to VMT in the default case. All hotelling hours and extended idle and APU usage fractions were derived in the same manner as for state supplied data from the VMT estimates.

The SMOKE-ready activity data used for the 2011 NEIv2 are provided in the supplementary materials (see Table 4-26 for access information).

4.5.9.5 *Public release of the NEI county databases*

Two sets of 2011 CDBs are available for download: (1) the representative county CDBs and (2) all county CDBs. See Table 4-26 for access details. EPA converted all submitted and default CDBs to MOVES2014 formats using the database conversion script available in the MOVES GUI, described in the MOVES model user guide[37].

Representative CDBs

The representative counties are the counties for which EPA ran the MOVES model to generate emission factor lookup tables for SMOKE-MOVES. EPA performed special processing on the CDBs for these counties to prepare them for MOVES modeling. This processing "seeded" the databases to produce emission factors for every SCC regardless of whether the representative county has all of the categories. The seeding step was necessary because counties mapping to this representative county may require the emission factor. The seeding script updated every 0 value to 1e-15, and also added missing categories to the various tables and set their data values to 1e-15.

The following describes how the seeding process might affect a representative CDB. For example, a particular submitted representative county may have only gasoline school buses (i.e., no diesel ones). A submitted CDB would reflect this local information through a fraction of value set to 0 for diesel fuel in the alternative vehicle and fuel technologies (AVFT) table. EPA's seeding script updated this 0 value to a small value of 1e-15 so that MOVES could calculate an emission rate for diesel school buses. The small value of 1e-15 ensures that all

[37] MOVES2014 User Guide

distributions still sum to very close to one (1). The fact that this particular county in reality has no diesel school buses would be incorporated in the NEI, but on the SMOKE side of processing. The SCC for diesel school buses for the county would have zero activity because EPA created the FF10 SMOKE activity files for each county based on the unseeded CDBs provided by S/L agencies or EPA default.

All county CDBs

The full set of CDBs includes both S/L-submitted CDBs as well as EPA default data CDBs. The submitted CDBs include minor changes in some counties resulting from the QA process described previously. All CDBs, submitted or default, were converted to MOVES2014 format, which altered the format of same tables and added some new ones including the 'hotellinghours' CDB table. EPA inserted the final FF10 hotelling activity into the new 'hotellinghours' table from the FF10 format so that users would have access to the same activity used in the NEI already incorporated into a MOVES input database format. EPA also inserted the default population and VMT into the EPA default CDBs, so these are consistent with the FF10 files used in the NEI with one exception – the long-haul vs. short-haul VMT. The long-haul fractions could not straightforwardly be put into a MOVES CDB. However, the long-haul VMT allocations are available from the CRC project A-88 report or alternatively could be derived from the VMT FF10 files provided with the NEI modeling platform.

4.5.9.6 *Run MOVES to create emission factors*

EPA ran MOVES for each representative county using January fuels and July fuels for the range of temperatures spanned by the represented county group and set of months associated with each fuel set (January and July). The runspec generator created a series of runspecs (MOVES jobs) based on the outputs from Met4moves. Specifically, the script used a 5-degree bin and the minimum and maximum temperature ranges from Met4moves and used the idealized diurnal profiles from Met4moves to generate a series of MOVES runs that captured the full range of temperatures for the county group for the months assigned to each fuel. The MOVES runs resulted in four emission factors (EF) tables for each representative county and fuel month: rate per distance (RPD), rate per vehicle (RPV), rate per hour (RPH), and rate per profile (RPP). After the MOVES runs were completed, the post-processor Moves2smk converted the MySQL tables into EF files that can be read by SMOKE. For more details, see the SMOKE documentation.

4.5.9.7 *Run SMOKE to create emissions*

Lastly, EPA generated air quality model ready emissions at a gridded and hourly resolution. The Movesmrg SMOKE-MOVES program performs this function by combining activity data, meteorological data, and emission factors to produce gridded, hourly emissions. EPA ran Movesmrg for each of the four sets of emission factor tables (RPD, RPV, RPH, and RPP). During the Movesmrg run, the program used the hourly, gridded temperature (for RPD, RPV, and RPH) or daily, gridded temperature profile (for RPP) to select the proper emissions rates and compute emissions. These calculations were done for all counties and SCCs in the SMOKE inputs, covering the continental U.S.

The emissions process RPD is for modeling the driving emissions. This includes the following modes: vehicle exhaust, evaporation, evaporative permeation, refueling, brake wear, and tire wear. For RPD, the activity data is monthly VMT, monthly speed (SPEED), and hourly speed profiles for weekday versus weekend (SPDPRO)[38]. The SMOKE program Temporal takes vehicle and roadtype specific temporal profiles and distributes the monthly VMT to day of the week and hour. Movesmrg reads the speed data for that county and SCC and the temperature

[38] If the SPDPRO file is available, the hourly speed takes precedence over the average monthly speed. For the NEI, the SPDPRO covered all county and SCC combinations.

from the gridded hourly (MCIP) data and uses these values to look-up the appropriate emission factors (EFs) from the representative county's EF table. It then multiplies this EF by temporalized and gridded VMT for that SCC to calculate the emissions for that grid cell and hour. This is repeated for each pollutant and SCC in that grid cell.

The emission process RPV is for modeling the parked emissions. This includes the following modes: vehicle exhaust, evaporative, evaporative permeation, and refueling. For RPV, the activity data is vehicle population (VPOP). Movesmrg reads the temperature from the gridded hourly data and uses the temperature plus SCC and the hour of the day to look up the appropriate EF from the representative county's EF table. It then multiplies this EF by the gridded VPOP for that SCC to calculate the emissions for that grid cell and hour. This repeats for each pollutant and SCC in that grid cell.

The emissions process RPH is for modeling the parked emissions for combination long-haul trucks (source type 62) that are hotelling[39]. This includes the following modes: extended idle and auxiliary power units (APU). For RPH, the activity data is monthly HOTELLING hours. The SMOKE program Temporal takes a temporal profile and distributes the monthly HOTELLING hours to day of the week and hour. Movesmrg reads the temperature from the gridded hourly (MCIP) data and uses these values to look-up the appropriate emission factors (EFs) from the representative county's EF table. It then multiplies this EF by temporalized and gridded HOTELLING hours for that SCC to calculate the emissions for that grid cell and hour. This is repeated for each pollutant and SCC in that grid cell.

The emission process RPP is for modeling the parked emissions for vehicles that are key-off. This includes the mode vehicle evaporative (fuel vapor venting). For RPP, the activity data is VPOP. Movesmrg reads the gridded diurnal temperature range (Met4moves' output for SMOKE). It uses this temperature range to determine a similar idealized diurnal profile from the EF table using the temperature min and max, SCC, and hour of the day. It then multiplies this EF by the gridded VPOP for that SCC to calculate the emissions for that grid cell and hour. This repeats for each pollutant and SCC in that grid cell.

The result of the Movesmrg processing is hourly, gridded data suitable for use in air quality modeling as well as daily reports for the four processing streams (RPD, RPV, RPH, and RPP). The results include emissions for every county in the continental U.S., rather than just for the representative counties.

4.5.9.8 *Post-processing to create annual inventory*

For the purposes of the NEI, EPA needed emissions data by county, SCC, pollutant[40]. EPA developed and used a set of scripts to combine the emissions from the four sets of reports and from all days to create the annual inventory.

The on-road emissions for Alaska, Hawaii, Puerto Rico and the Virgin Islands, which EPA generated via MOVES in inventory mode (see Section 4.6.4) were appended to the on-road inventory generated from SMOKE-MOVES to create the final emissions. This complete inventory was submitted to the EIS as the EPA estimates for the on-road sector. The resulting EIS dataset is named "2011_EPA_MOBILE"[41].

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[39] The hotelling emissions is differentiated from simple idling emissions. These are the emissions for trucks that are parked for an extended period of time while the driver rests.
[40] EPA ran SMOKE-MOVES at a more detailed level including road type and emission processes (e.g. extended idle) and summed over the road types and processes to create the more aggregate NEI SCCs.
[41] The corresponding EMF datasets are 2011eg_NEIv2_onroad_SMOKE-MOVES_MOVES2014_forNEI (v4) and 2011_NEIv2_onroad_AK_HI_PR_VI_MOVES2014_forNEI (v2).

4.5.10 On-road mobile emissions data for Alaska, Hawaii, Puerto Rico and the Virgin Islands

Since the meteorology domain used by EPA for running SMOKE-MOVES covers only the continental U.S., EPA used the MOVES "inventory mode" to create emissions for Alaska, Hawaii, Puerto Rico and the Virgin Islands. These runs used the average monthly hourly temperatures and humidity values derived from the National Climatic Data Center temperature and humidity data from calendar year 2011. These emissions characterized all pollutants including a full set of metals and dioxins.

These emission inventory estimates were not derived using the same SMOKE-MOVES process used for the other counties. Instead, each county was run independently using the inventory scale mode of the MOVES2014 model. This approach directly calculates the inventory in each county using the inputs provided in each of the county databases. For Hawaii, Puerto Rico, and the Virgin Islands, MOVES was run for January and July only due to the relatively modest temperature variation over the year for these islands. All other months were mapped to those months to create an annual estimate of the emissions. Due to the greater meteorological variation in Alaska, MOVES was run for every month of the year.

The MOVES inputs used for these emissions are the MOVES county database manager databases, the run specifications used to run MOVES, and the MySQL database containing the tables that describe the temperatures and relative humidity values used for these states and territories. These inputs are provided in the supplementary materials (Table 4-26 for access information).

4.5.11 Summary of quality assurance methods

EPA did a series of checks and comparisons against both the inputs and the resulting emissions to quality assure the on-road inventory. These checks are in addition to the ones described on the underlying CDBs (see Section 4.6.2). The following is a list of the more significant checks and resulting corrections:

- Checked the VMT data by comparing the 2011v2 with 2011v1 based activity data. Compared the VMT at various resolutions including: state, county, vehicle type (comparison SCC6), and road type. Also analyzed the ratio of VMT to vehicle population to look for extreme values.
- Checked the VMT data by comparing the 2011 NEIv2 (state supplied) with 2011 NEIv2 (default) for those states that submitted activity data. Compared the VMT at various resolutions including: state, county, and road type.
- Checked the VPOP data by comparing the 2011v2 with 2011v1 based activity data. Compared the VPOP at various resolutions including: state, county, and vehicle type (comparison SCC6).
- Checked the consistency of VMT with vehicle population to ensure that all counties with VMT for a vehicle type also had VPOP for that vehicle type.
- Compared the on-road emission results to similar results for 2011 NEIv1. As expected, found numerous differences between the two sets of results. Detailed comparisons by state, county and vehicle type (comparison SCC6) showed that most of the differences were due to updated input data from the states, updated age distributions for the EPA defaults, updated hotelling data, or due to differences between how the two models were run in terms of representative counties. Additionally, compared the results using difference maps both at the county level and gridded (after spatially allocating the emissions to grid cells using SMOKE).
- Identified that E-85 emission factors were missing from a significant number of representative counties. Decided to reclassify E-85 vehicles to gas vehicles for the purposes of the NEIv2. Added the E-85 VMT to gas VMT by county/source type (repeated for VPOP) and re-estimated the emissions for the new set of gas activity.

- Some Idaho representative counties were missing RPD emission factors for CNG, and so emission factors for CNG needed to be appended from other counties' emission factor tables. For the initial run, an error was made when adding these CNG emission factors. This was corrected, and then the affected counties were rerun through SMOKE.
- In the initial run, NH3 emissions were dropped from RPH due to an error in the SMOKE pollutant list (MEPROC). This was corrected in a SMOKE rerun.
- Diesel refueling included both evaporative headspace and spillage emissions. It should only have included spillage.
- Diesel refueling emission factors for benzene were all zero. To correct this, benzene for diesel refueling was calculated using a constant emission factor multiplied by VOC (benzene = VOC * 0.00410).
- The I/M programs were incorrectly characterized in the following counties: CO (for county FIPS 8001, 8005, 8013, 8014, 8031, 8035, 8041, 8059, 8069, 8097, and 8123), LA (for county FIPS 22005, 22047, and 22063), and PA (for county FIP 42073). This was identified too late to be corrected in v2.
- Worked with the states as part of the MOVES working group to evaluate these national runs in comparison to individual states' runs using MOVES in inventory mode.

4.5.12 Supporting data

Onroad 2011 v2 emissions came from EPA estimates exclusively, except in CA. Emissions and/or county database submittal history and notes are provided in Table 4-25. Onroad reference data files are listed in Table 4-26.

Table 4-24: Agency submittal history for onroad inputs and emissions

Agency Organization	Onroad Emissions Submission Date	Onroad CDB Submission Date	Notes
Alaska Department of Environmental Conservation	12/11/2012	12/18/2012	
Alabama Department of Environmental Management	N/A	N/A	AL supplied county level VMT directly to EPA staff.
California Air Resources Board	4/16/2013	N/A	CA uses a CA-specific model (EMFAC). CA emissions are included in NEI.
Clark County Department of Air Quality and Environmental Management	N/A	6/3/2014	
Coeur d'Alene Tribe	11/28/2012	N/A	EPA does not currently break out tribal areas in EPA estimates; however, tribal emissions submittals are included in the NEI.
Colorado Department of Public Health and Environment	N/A	?	CO supplied updated IM coverage data directly to EPA staff.
Connecticut Department Of Environmental Protection	N/A	5/10/2013	In addition to submitting CDBs, CT supplied updated CDBs directly to EPA staff.

Agency Organization	Onroad Emissions Submission Date	Onroad CDB Submission Date	Notes
DC-District Department of the Environment	N/A	1/8/2013	
Delaware Department of Natural Resources and Environmental Control	N/A	1/7/2013	
Eastern Band of Cherokee Indians	10/23/2012	N/A	EPA does not currently break out tribal areas in EPA estimates; however, tribal emissions submittals are included in the NEI.
Florida Department of Environmental Protection	N/A	N/A	FL requested directly from EPA staff to replace their default data for I/M coverage and Stage II refueling to effectively turn off all programs.
Georgia Department of Natural Resources	N/A	6/10/2014	In addition to submitting CDBs for v2, GA provided age distributions and populations for source types 21, 31, and 32 for each county in GA directly to EPA staff.
Idaho Department of Environmental Quality	12/18/2012	12/5/2012	ID submitted both input and emissions. ID emissions included only a subset of HAPs and had SCC-emtype combinations that do not occur in EPA estimates. ID CDB was used in NEI estimates instead of emission submittal.
Illinois Environmental Protection Agency	N/A	2/19/2013	
Knox County Department of Air Quality Management	N/A	1/7/2013	
Kootenai Tribe of Idaho	12/14/2012	N/A	EPA does not currently break out tribal areas in EPA estimates; however, tribal emissions submittals are included in the NEI.
Louisville Metro Air Pollution Control District	N/A	2/19/2013	
Maine Department of Environmental Protection	N/A	11/19/2012	
Maricopa County Air Quality Department	N/A	12/18/2012	
Maryland Department of the Environment	N/A	12/24/2012	
Massachusetts Department of Environmental Protection	N/A	6/5/2013	CDB was submitted late after deadline to the NEI but was available to EPA prior to submittal and used on EPA NEI estimates.
Metro Public Health of Nashville/Davidson County	12/18/2012	N/A	EPA assisted Metro in creating CDB from their inputs to EPA estimation. Submitted emissions were not used in NEI
Michigan Department of Environmental Quality	N/A	1/8/2013	

Agency Organization	Onroad Emissions Submission Date	Onroad CDB Submission Date	Notes
Minnesota Pollution Control Agency	N/A	12/13/2012; 5/20/2013	In addition to submitting CDBs, MN supplied updated age bin distribution data directly to EPA staff, and VMT for Kanabec county and VPOP for Otter Tail County.
Missouri Department of Natural Resources	N/A	12/21/2012	
New Hampshire Department of Environmental Services	N/A	3/26/2014	
New Jersey Department of Environment Protection	N/A	6/20/2014	
New York State Department of Environmental Conservation	N/A	4/9/2014	
Nez Perce Tribe	11/29/2012	N/A	EPA does not currently break out tribal areas in EPA estimates; however, tribal emissions submittals are included in the NEI.
North Carolina Department of Environment and Natural Resources	N/A	3/25/2014	
Northern Cheyenne Tribe	1/28/2013	N/A	EPA does not currently break out tribal areas in EPA estimates; however, tribal emissions submittals are included in the NEI.
Ohio Environmental Protection Agency	N/A	5/16/2013	
Oregon Department of Environmental Quality	1/7/2013	8/12/2014	
Pennsylvania Department of Environmental Protection	N/A	12/31/2012	
Rhode Island Department of Environmental Management	N/A	1/10/2013	
Shoshone-Bannock Tribes of the Fort Hall Reservation of Idaho	11/27/2012	N/A	EPA does not currently break out tribal areas in EPA estimates; however, tribal emissions submittals are included in the NEI.
South Carolina Department of Health and Environmental Control	N/A	12/13/2012	
Texas Commission on Environmental Quality	12/21/2012	N/A	Texas' v1 submissions used MOVES2010b. For v2, EPA estimated the emissions using MOVES2014 to provide consistency with the other states.

Agency Organization	Onroad Emissions Submission Date	Onroad CDB Submission Date	Notes
Utah Division of Air Quality	N/A	4/14/2014	
Vermont Department of Environmental Conservation	N/A	12/14/2012	
Virginia Department of Environmental Quality	N/A	4/18/2014	In addition to submitting CDBs, VA supplied activity data (by SMOKE SCCs) for all counties directly to EPA staff.
Washington State Department of Ecology	N/A	12/19/2012	
Washoe County Health District	12/26/2012	1/8/2013	
West Virginia Division of Air Quality	N/A	1/4/2013	
Wisconsin Department of Natural Resources	N/A	4/1/2014	

Table 4-25: Onroad data file references for 2011 v2 NEI

NEI 2011 v2 Supporting Data File Name	Description of Contents
2011neiv2_supdata_or_RepCounty_Runspecs.zip	The MOVES2014 run specifications (runspecs) for the representative counties. This is for running MOVES in emissions rate mode (for SMOKE-MOVES).
2011neiv2_supdata_or_FuelCR.zip	Fuels cross reference (MFMREF) is a table that maps representative fuel months to calendar months for each representative county. The MFMREF file is an input to SMOKE.
2011neiv2_supdata_or_RegFuel.zip	Regional fuels contain the fuel properties used for each county in each month and replace all fuel descriptions contained in the individual county databases. These fuel properties were developed by EPA.
2011neiv2_supdata_or_RepCounty_temperatures.zip	The temperature and relative humidity bins for running MOVES to create the full range of emissions factors necessary to run SMOKE-MOVES. Generated from running met4moves
2011neiv2_supdata_or_AKHIPRVI_Runspecs.zip	The MOVES2014 run specifications (runspecs) for all counties in Alaska, Hawaii, Puerto Rico and the Virgin Islands. This is for running MOVES in inventory mode.
2011neiv2_supdata_or_CountyCR.zip	County cross reference file (MCXREF) is a table that shows every US county along with the representing county used as its surrogate. The MCXREF is an input to SMOKE.
MOVES_CDBs_by_State Directory	MOVES2014 county database. Includes all agency submittals thru the EIS, and all subsequent revisions and EPA replacements (e.g., fuel and age distributions)
2011neiv2_supdata_or_CDB_RepCnty.zip	MOVES county databases (CDBs) for the representative counties. These CDBs include all agency submittals through the EIS in addition to subsequent revisions and EPA replacements to prepare counties to run in rates mode.
2011neiv2_supdata_or_VPOP.zip	Vehicle population (VPOP) by county and SCC covering every county in the US. Data is in FF10 format for SMOKE and is a combination of EPA estimates, agency submittals, and corrections.
2011neiv2_supdata_or_VMT.zip	Vehicle miles traveled (VMT) annual and monthly by county and SCC covering every county in the US. Data is in FF10 format for SMOKE and is a combination of EPA estimates, agency submittals, and corrections.
2011neiv2_supdata_or_Speed.zip	Average speed in miles per hour, annual and monthly values, by county and SCC covering every county in the US. Data is in FF10 format for SMOKE and is a combination of EPA estimates, agency submittals, and corrections.

NEI 2011 v2 Supporting Data File Name	Description of Contents
2011neiv2_supdata_or_SpdProf.zip	Weekend and weekday hourly speed profiles (SPDPRO) in miles per hour, by county and SCC covering every county in the US. Data is for SMOKE and is a combination of EPA estimates, agency submittals, and corrections.
2011neiv2_supdata_or_Hotelling.zip	Hotelling hours (HOTELLING) annual and monthly by county covering every county in the US. This includes hours of extended idle and hours of auxiliary power units for combination long-haul trucks only. Data is in FF10 format for SMOKE and is a combination of EPA estimates, agency submittals, and corrections.
2011neiv2_supdata_or_CALEV.zip	California LEV data contain the alternate base emission rates that reflect the adoption of California emission standards and replaces the emission rates based on federal standards. A separate file exists for each state which has adopted California standards to reflect the different years of adoption.
2011neiv2_supdata_or_MySQL.zip	MySQL scripts contain the commands that translate MOVES formatted inputs from the state supplied county databases to SMOKE input format. These include the vehicle populations, VMT, average speeds and allocation of heavy-duty truck extended idling. The translation includes a mapping of MOVES vehicle and road type classifications to the SCC classifications.
2011neiv2_supdata_or_SCC.zip	A set of tables that describe the new MOVES2014 based SCCs. Additional tables show the cross reference between MOBILE6 SCCs and a set of comparison SCCs as well as a cross reference between MOVES2014 SCCs and a set of comparison SCCs.

4.5.13 References for On-road Mobile

1. Skamarock, W.C., et al., National Center for Atmospheric Research, Mesoscale and Microscale Meteorology Division, Boulder CO, June 2008, NCAR/TN-475+STR, A Description of the Advanced Research WRF Version 3.

5 Fires

Fire sources in this section are sources of pollution caused by the inadvertent or intentional burning of biomass including forest, rangeland (e.g., grasses and shrubs), and agricultural vegetative residue. This section describes the 2011 NEI wildfires (Section 5.1), prescribed burning (also Section 5.1), and agricultural burning (Section 5.2). Other types of fires are included in other EIS sectors, such as "Fuel Combustion – Residential – Wood" (Section 3.13.4), the "Waste Disposal" (Section 3.32) sector, which includes fires from burning yard waste, land clearing, residential household waste, logging debris, and commercial, institutional, industrial, and "open dump" burning of biomass and other refuse; and "Miscellaneous Non-Industrial NEC" sector (Section 3.25), which includes structure fires, firefighting as part of waste disposal, firefighting training fires, motor vehicle fires, and other open fires.

Collectively, the fires data included in this section have come to be known by the fire emissions community as the National Fire Emissions Inventory (NFEI). This inventory is not a separate product, but rather the highest-emitting fires component of the NEI.

5.1 Wildfires and Prescribed Burning

This section describes the 2011 NEI approach for wildfires, prescribed burning, and wild land fire use, collectively called "wild land" fires (WLFs). Precise definitions of these types of fires are provided below in Section 5.1.1. These are included in the same section because the approach used is exactly the same.

Unlike in the 2008 NEI, when the EIS database contained wildfires and prescribed fires as both event-based (point source, day-specific) data and nonpoint data, the 2011 contains all of these data in day-specific events-based format. The 2011 NEI website (see Section 1.3.2) provides separately wildfire and prescribed fire data at the county-SCC resolution, it can also be obtained in the EIS through a summary of the "2011 NEI v1 with biogenics" EIS selection for the EVENT data category. A day-specific events summary is also available in the EIS; however, it should only be run for a small geographic area such as one or two counties due to the size of the data.

5.1.1 Sector description

WLFs are generally defined as any non-structural fire that occurs in wild lands. Included in WLFs are the following types of fires:

- Prescribed (Rx) fire: Any fire ignited by management actions to meet specific objectives, generally related to the reduction of the biomass potentially available for wildfires.
- Wildfire (WF): An unplanned, unwanted WLF including unauthorized human-caused fires, escaped prescribed fire projects, or other inadvertent fire situation where objective is to put the fire out.
- Wildland Fire Use (WFU): The application of appropriate management response to naturally-ignited WLFs to accomplish specific resource management objective in pre-designated areas outlined in fire management plans. In other words, an unplanned fire that is subsequently controlled and used as a Rx fire to meet specific objectives. This category existed in 2008, but no longer is used as a way to classify fires in 2011, and thus will not be discussed further in this section.

For 2011, EPA continues to use the SMARTFIRE2 (SF2) system (which includes the BlueSky modeling framework) to estimate wild land fire emission estimates. Significant improvements were made from 2005 to 2008 to SF2 as documented in the 2008 NEI TSD. From 2008 to 2011, smaller improvements and refinements were made to the SF2 system as outlined in Reid [ref 1]. In 2011, the most significant improvement made was in collecting local activity data (acres burned, types of fuels, fuel consumption values, etc.) to make emission estimates for both wild and prescribed fires more accurate in the 2011 NEI. This is documented further in section 5.1.4. Also, in 2011, EPA estimates included the states of AK and HI, unlike in previous NEI cycles.

Table 5-1 lists the SCCs that define the different types of WLFs in the 2011 NEI, both for EPA data and for S/L/T agency data. Note that EPA data have only one unique SCC for each of these types of fires. Data submitted by S/L/T agencies can have several different SCCs that define prescribed fires. As described below, EPA's approach to combine EPA data with S/L/T agency data for the 2011 NEI considers all SCCs that define any one type of fire and appropriately combines emissions from those SCCs.

Table 5-1: Source classification codes for wildland fires

Data Origin	Wildfires	Prescribed Burns
EPA	2810001000	2811015000
States/Locals/Tribes	2810001000	2810001000 ("wildland fire use") 2811015000 ("forested") 2811020000 ("rangeland")

5.1.2 Sources of data overview and selection hierarchy

The wildfire and Rx fire EIS sectors include data only from two components: S/L/T agency-provided emissions data (day specific data in Events format) for Georgia and North Carolina, and the EPA dataset created from SFv2 (see Section 5.1.4) which used available state inputs. Only the combination (rather than the individual datasets) of these data are available as summary information on the 2011 NEI website and in the EIS.

S/L/T agency data were received in event format from two agencies (GA and NC) as listed in Table 5-2.

Table 5-2: Agency that submitted wildfire and prescribed burning emissions data

Agency	Agency Type	Rx provided	Wildfire provided
Georgia	State	as event	as event
North Carolina	State	as event	as event

In 2011, no tribes submitted wild land fire emissions data, and EPA did not assign any fires based on the tribal land boundaries. These fires were assigned to the states within which the tribal lands fall. Table 5-3 shows the selection hierarchy for the wildfire and Rx burning sectors. There were no overlapping data in the above datasets. Georgia and North Carolina were excluded from the 2011EPA_Event dataset and the State/Local/Tribal Data contained only Georgia and North Carolina.

Table 5-3: 2011 NEI wildfire and prescribed fires selection hierarchy

Priority	Dataset Name	Dataset Content	Is Dataset in EIS?
1	State/Local/Tribal Data	Submitted data as listed above.	Yes
2	2011EPA_Event	Emissions from SF2	Yes

5.1.3 Spatial coverage and data sources for the sector

The 2011 NEI includes wildfire and Rx fire emissions for all continental US states, Alaska, and Hawaii. These emissions represent a combination of state-submitted information and EPA-estimated emissions from these fires. The EPA methods are described in Section 5.1.4 below. The simple way we blend these emissions is summarized in Table 5-3 above. As discussed above, only GA and NC reported wildfire and prescribed fire emissions to the NEI in 2011. GA and NC data were used as submitted, and no backfilling was done with EPA data for any counties that were missing or null.

5.1.4 EPA-developed fire emissions estimates

For the dataset developed by EPA for the 2011 NEI, we used the following general equation to estimate wildfires and prescribed fires. Accurate estimates of fire emissions rely on accurate estimates of the terms in the equation below.

*Emissions = Area burned * Fuel Load Available * Fuel Consumed (Burn Efficiency) * Emission Factors*

Daily CAP emission estimates were prepared using the software SF2 [ref 2]**,** which include fire estimation algorithms and is built within a database. Additional information on the approaches specific to the NEI are available in Raffuse [ref 3]. SF2 estimates the "Area burned" term in the above equation, in conjunction with the BlueSky framework model that estimates the last three terms in the above equation. The "fuel load available" term is estimated using the Fuel Characteristic Classification System (FCCS) maps in the BlueSky model. The "fuel consumed" term is estimated from BlueSky using the CONSUME3 model, which predicts the fraction of fuel that burns based on many parameters including fuel moisture. Finally, the "Emission Factors" term is estimated in BlueSky using the Fire Emissions Prediction Simulator which relies on EFs from the literature apportioned by flaming and smoldering combustion. Since SF2 was recently developed, direct references to its development in conjunction with updated BlueSky methods are not yet available; however, the following reference can be used in general for past applications of these process models in the SF/BlueSky process. Reid [ref 1] provides more exacting details on the specific procedures used in developing the 2011 prescribed and wildfires.

The EPA data include emissions estimates for 38 pollutants. These pollutants are listed in Table 5-4 below. CAPs were estimated via SF2 as just described. In addition, a set of 29 HAPs are estimated by applying the activity levels estimated from the methods above with the emission factors shown in the table [ref 4]. These same 29 HAPs have been estimated for fires over the past 10 years or so for the NEI by EPA. In 2011, only GA and NC submitted their own emissions data. Both agencies used the same FEPS system as EPA did to estimate all the CAP emissions. EPA sent to GA and NC the HAP EFs to use, so that the set of HAPs reported from WLFs is consistent throughout the US. Thus, there was no need to do any further HAP augmentation as had been done with previous NEIs. GA nor NC submitted CO_2 nor CH_4 (GHGs) so these pollutants are not available for these two states but in general are available for all the other states for which we used EPAs methods to estimate WLF emissions.

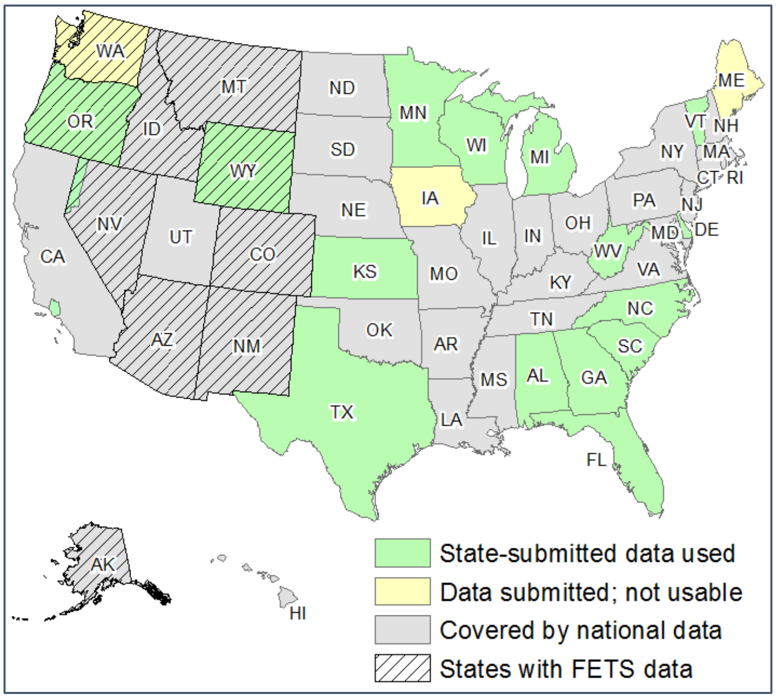
Table 5-4: Pollutants estimated by EPA* for wildland fires and HAP emission factors

Pollutant	HAP Emission factor (lb/ton fuel consumed)
$PM_{2.5}$	N/A
PM_{10}	
CO	
CO_2	
CH_4	
NO_X	
NH_3	
SO_2	
VOC	
1,3-butadiene	0.405
Acrolein	0.424
Toluene	0.56825
n-hexane	0.0164025
Anthracene	0.005
Pyrene	0.00929
o,m,p-xylene	0.242
benzo(ghi)perlyene	0.00508
benzo(e)pyrene	0.00266
indeno(1,2,3-cd)pyrene	0.00341
Benzo(c)phenanthrene	0.0039
Perylene	0.000856
benzo(a)fluoranthene	0.0026
Fluoranthene	0.00673
benzo(k)fluoranthene	0.0026
Chrysene	0.0062
methylpyrene,-fluoranthene	0.00905
Methylbenzopyrenes	0.00296
Methylchrysene	0.0079
Methylanthracene	0.00823
Carbonyl Sulfide	0.000534
Formaldehyde	2.575
benzo(a)pyrene	0.00148
benz(a)anthracene	0.0062
Benzofluoranthenes	0.00514
Benzene	1.125
Methylchloride	0.128325
Acetaldehyde	0.40825
Phenanthrene	0.005
*Other than CO_2 and CH_4, these pollutants were also submitted by GA , the only state that submitted its own data for wildfires and prescribed burning	

One of the big improvements made in the 2011 process was the collection and use of WLF activity data submitted by State and Local Agencies. Through funding supplied by the USDA Forest Service (USFS), states were invited to submit fire occurrence data in any format for use in developing the 2011 NEI for WLFs. The spatial and temporal qualities of each data set were assessed to determine the usability of the data. A written assessment of each data set was sent to each submitting state, regardless of whether the data set was ultimately included in the NFEI. Suitable data sets were processed through the SF2 fire information system along with other traditional or new fire data sets at national or regional scales[42] to reconcile the various fire information data sets. .

EPA assessed a total of 50 data sets from 20 individual states and one regional data set from the Fire Emissions Tracking System (FETS). The FETS data set was provided by Air Sciences Inc., and contains data for 10 of the states that make up the Western Regional Air Partnership (WRAP). Overall, additional fire activity data from 24 states were used in the development of the final NFEI. Figure 5-1 shows the states that submitted fire activity data and identifies states that provided usable data and states covered by the FETS data set.

Figure 5-1: The coverage of state-submitted fire activity data sets



In addition to submitting fire activity data, the following states provided comments on the on the draft version of the NFEI, all of these comments were addressed in the final version of the 2011 NFEI. Details of how these comments were addressed can be found in Reid [ref 1].

- The Lake States (Michigan, Minnesota, and Wisconsin) recommended using the boreal equation in Consume instead of the western equation for all fires in these states.
- Minnesota recommended the use of local values for duff depth for the state's two largest wildfires (7 inches for the Pagami Creek fire and 5 inches for the Juneberry 3 fire).
- The Hawaii Department of Health Clean Air Branch (HIDOHCAB) determined that certain prescribed burns in the draft NFEI are Hawaiian Commercial and Sugar (HC&S) agricultural burns. They

[42] Additional details on these other data sets are provided in the "Other Data Sources" section that follows.

recommended removing these prescribed burns from the final 2011 NFEI since HI submitted these emissions as part of their nonpoint agricultural fires.

- Colorado found a discrepancy in fire size for a prescribed burn between draft NFEI and their data, and recommended use of the latter.

Other Supporting Data Sources

In addition to the data provided by state, local, and tribal agencies, fire information from the following data sources was also used to develop the final 2011 NFEI:

- Inputs to SmartFire2
  - *Hazard Mapping System (HMS)* data were acquired daily from the National Oceanic and Atmospheric Administration's (NOAA) HMS via FTP as part of a routine process. Data were acquired in ASCII text format from. Before input to SF2, the HMS detects in the conterminous United States were intersected with the U.S. Geological Survey (USGS) 2006 30-m National Land Cover Dataset (NLCD), while those in Alaska, Hawaii, and Puerto Rico were intersected with the 2001 30-m NLCD. The NLCD classifies all land area in the United States into one of 19 land cover types, as outlined in Huang [ref 5]. The HMS detects that fell within land cover types 81 (Pasture/Hay) or 82 (Cultivated Crops) were treated as agricultural burns and removed from the final HMS data input to SF2. In addition, STI was advised by the USFS that Texas implemented a no-burn requirement in 2011 as a result of hazardous drought conditions. Based on this information, HMS detects that fell in the state of Texas were all assigned as wildfires.
  - *ICS-209 Reports* were acquired as a Microsoft® Access® database via the Fire and Aviation Management Web Applications website.
  - *U.S. Fish and Wildlife Service (FWS)* fire information data were provided by the U.S. FWS.
  - *National Association of State Foresters (NASF)* fire information data were downloaded from the National Fire and Aviation Management Web Applications.
  - *Forest Service Activity Tracking System (FACTS)* fire information data were supplied by the USFS.
  - *GeoMAC* fire perimeter data were downloaded via the USGS GeoMAC wildland fire support website.
  - *Moderate Resolution Imaging Spectroradiometer (MODIS)* satellite data were downloaded via the USFS Remote Sensing Applications Center website. Data were converted from a shapefile to an ASCII text file and used to fill in blank dates from HMS.
- Fuel moistures – Fire weather observation files (fdr_obs.dat) were acquired for each analysis day from the USFS archive. Files were acquired and used as inputs to the Fuel_Moisture_WIMS module implemented in the latest BlueSky Framework build [ref 6].
- Fuel loading – Fuel Characteristic Classification System (FCCS) 1-km fuels shapefile and lookup table for the conterminous United States were provided by the AirFire Team. The Alaskan FCCS 1-kilometer fuels shapefile and lookup table were acquired from the Fire and Environmental Research Applications Team's website.

For all other details on how the data process streams were coalesced, the emissions processing that was done, and the QA/QC used to develop final emission estimates, the reader is referred to Reid et al. [ref 1].

Adjustments made to and comments on final EPA Data

After EPA developed the final SF2 estimates, Florida staff requested that we rescale their emissions so that we exactly match the total acres burned for prescribed and wildfires as they reported in the data they sent to EPA for processing through SF2. Table 5-5 lists the acres burned the SF2 process arrived at for FL (which took into account the activity data FL sent as well as some ancillary data) and the amount of acres burned FL reported as activity data (FL did not want us to supplement that data in any way and wanted us to match it exactly for wild and prescribed fires). EPA scaled the information by computing the acres burned difference between what EPA estimated using SF2 and what the FL activity data indicated it should be. EPA apportioned the difference on a fire by fire basis, separately for prescribed and wildfires. Then, fire-by-fire, the resulting percentage difference in acres burned was applied to each fire to arrive at the correct total. More specifics are given below on the algorithm used, separately for prescribed and wildfires.

Table 5-5: SF2 and State-submitted acres burned for FL WLFs

	2011 Final SF2 estimates (EPA)	**2011 Activity acreage from Florida Database**
Prescribed Fires	897,833	1,314,868 (Silvicuture, authorized)
Wildfires	398,357	221,756
TOTAL	1,296,191	1,536,624

For <u>Prescribed fires</u> (an increase in total acres as requested by Florida staff):

- Add 65.182 acres to each fire (then fire-by-fire increase emissions by the amount that adding 65.182 acres increases acres by on a percentage basis)

For <u>Wildfires</u>, we applied the following factors as a function of area burned:

- For fires 2000 acres or bigger, adjust each fire's acres burned by the factor [(old acres * 0.4)-495.6]. Then, fire by fire adjust emissions accordingly down.
- For fires 1000 acres or bigger, adjust each fire's acres burned by [(old acres)*0.4)]. Then, use the same adjustment to revise emissions.
- For fires 500 acres or bigger, adjust each fire's acres burned by [(old acres) * 0.6)]. Then, use the same adjustment to revise emissions.
- For fires 100 acres or bigger, adjust each fire's acres burned by {(0ld acres)*0.75)]. Then, use the same adjustment to revise emissions.
- For fires 10 acres or bigger, adjust each fire's acres burned by [(old acres) * 0.9)]. Then, use the same adjustment to revise emissions.
- For all other remaining fires (many), adjust each fires acres burned by [(old acres) * 0.5)]. Adjust emissions accordingly fire by fire.

In sum, the adjustments to the Florida data caused acres burned to go up by about 19% and total emissions by about 12% (due to varying Rx and WF changes). We confirmed with Florida staff that they were satisfied with this scaling algorithm.

We have caveated the 2011 NEI data for Maryland. Well after the final estimates were developed and released to the public, Maryland staff commented that EPA's estimate of acres burned for prescribed fires in 2011 is too high. They are satisfied with EPA's estimates for wildfires. EPA estimates that in Maryland there was about 10,925 acres burned for prescribed fires; whereas, Maryland staff have data that show this should be closer to 700 acres. Because this information came to EPA late in the process, we could not include these Maryland-specific activity data into the final SF2 model runs. Instead we are reporting in the documentation that Maryland believes that acres burned in 2011 for prescribed fires should be reduced by 90% from what EPA estimates. It is expected that the emissions associated with prescribed fires using Maryland-reported acres burned in the fire emissions models, would also decrease by a significant amount. We could use a scaling approach (as done for Florida above) to estimate the decreased emissions; however, for 2011 v2, EPA was unable to make this revision prior to releasing the data.

Washington state staff accepted all of our wild and prescribed fire data to help maintain consistency nationally. However, they provided comments which indicated they are not in total agreement with how the county distribution of acres burned compares with their own data. They indicated that they expected a closer match since at the county level since FETS data for WA were used in EPA's processing. Note that statewide total acres burned match well between their estimates and EPS's estimates. In future inventories, Washington staff have indicated they will set aside extra time to understand why the differences in county allocation of acres burned.

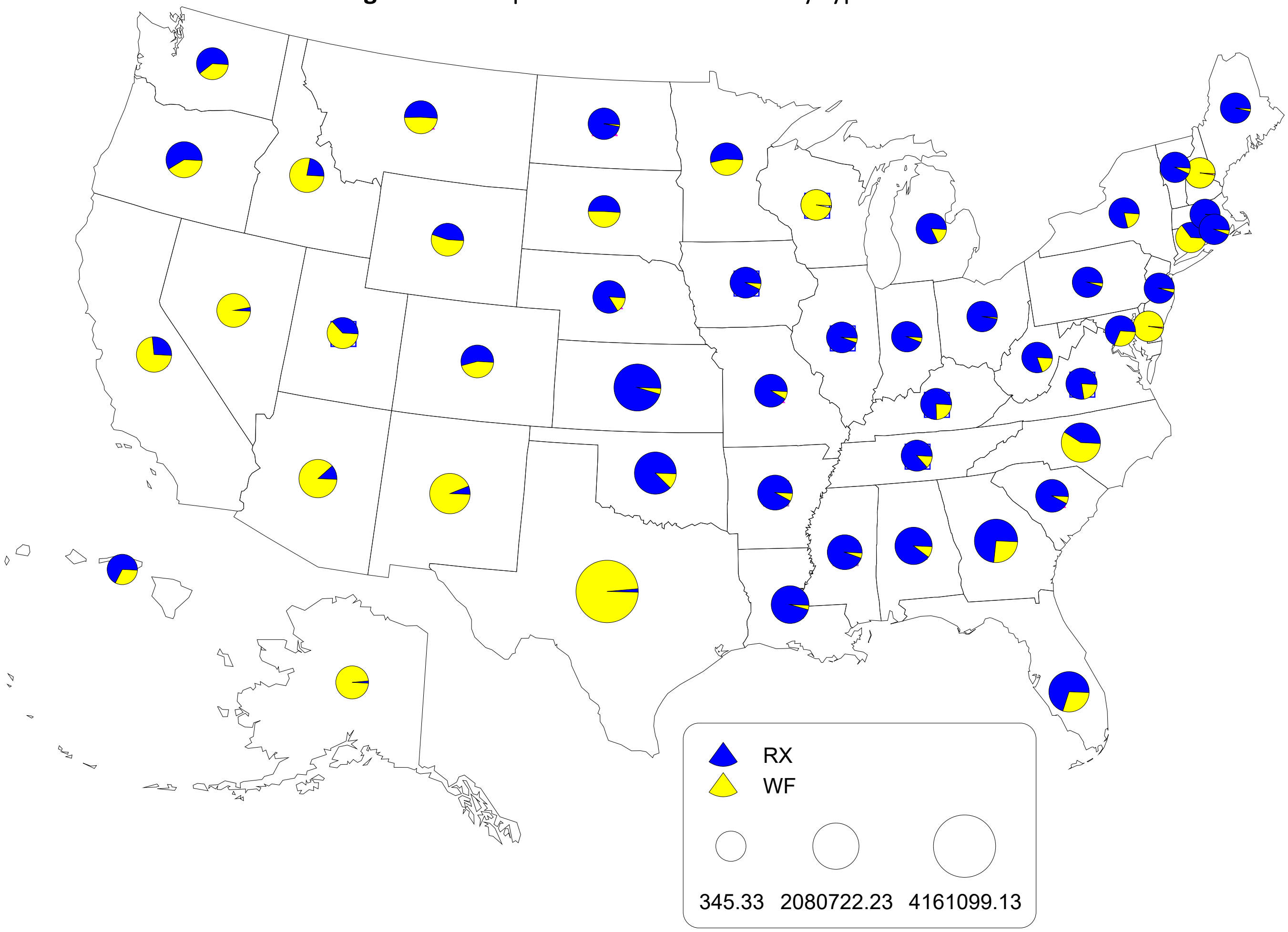
Kansas state staff provided a comment that all of their prescribed fires identified using EPA methodology should correctly be stored in the EIS/NEI using SCC 2811020000 (which is "prescribed rangeland burning"). We currently store all EPA-estimated prescribed fires under SCC 2811015000 (which is "prescribe forest burning"). We have indicated that we will fix this in future versions of the NEI (2014).

After v1 was complete, DE commented that we have misidentified one of the large fires as wildfire when in fact it should be a prescribed fire (with much lower emissions). The name of the fire in question in the SF2 dataset is "Phragmites fire" and per DE's comment that fire has been moved from wildfire to prescribed fire in v2, and since we did not rerun SF2 to compute emissions, we used emissions generated by DE for this fire (as a prescribed fire), which result in much lower emissions for DE in general for wild land fires in the 2011 v2. In the example of $PM_{2.5}$ emissions, when this fire was moved over to a prescribed fire in v2, the emission went from 502 tons as wildfire to 19.9 tons as a prescribed fire (and all other pollutants were decreased by a similar percentage amount in v2 for this fire). In addition, in accordance with DE comments, we removed all the 100-acre fires that were identified by EPA methods in Sussex county, since the comments indicated these fires did not occur at all (false detects by satellites due to small size of fires). These changes result in $PM_{2.5}$ emissions for prescribed fires going up from 92 to 96 tons for DE and Wild fire $PM_{2.5}$ emissions going down from 502 to 8.5 tons for DE in going from v1 to v2.

Using the SF2 approach, EPA's 2011 emissions data are shown in several summary maps below. In each of these maps, all of the data reflect output from SF2 other than for Georgia and North Carolina, which submitted their own data. These data also reflect the changes made to the Florida and Delaware data as detailed above. These data thus reflect what is in the NEI for wild and prescribed fires.

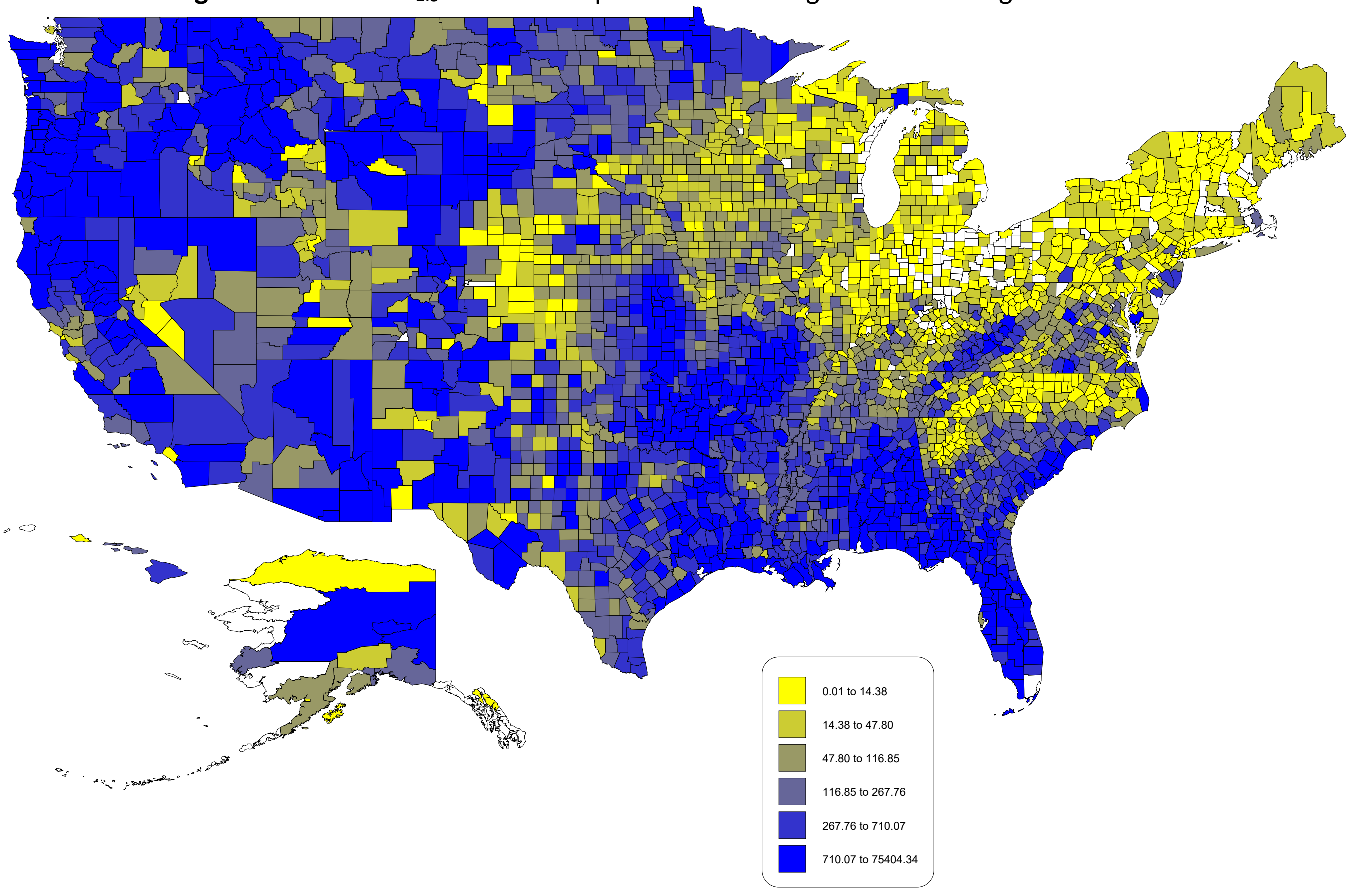
First, Figure 5-2 shows the proportion of acres burned for each type of fire by state. In the West, there are more wildfires than in the East (with AK showing almost entirely wild fire activity), where most of the burning is seen to be from prescribed burning. Kansas and Oklahoma also show a high level of acres burned for prescribed fires. Texas, Oklahoma, Georgia, and Kansas have among the highest total acres burned (width of circles). In the 2011 NEI, there are an estimated 24.6 million acres burned from prescribed and wildfires. Of these 24.6 million acres, about half is estimated to be prescribed fires and half wild fires. .

Figure 5-2: Proportion of acres burned by type of fire



In the 2011 NEI, there is an estimated total of 6.1 million tons of $PM_{2.5}$ emissions. Of this total, 1.13 million is estimated to be from wildfires and about 903,000 tons from prescribed fires. The total of ~2.1 million tons of $PM_{2.5}$ from these fires are mapped in Figure 5-3 on a county basis. For emissions, the pattern is based on not only on acres burned, but also on fuel consumption, fuel loading, and how emission factors vary by fire type and other dynamic processes that occur in a given type of fire. Wildfire $PM_{2.5}$ emissions account for 58% of the total emissions and prescribed burns account for 42%. Certain areas in the country (eastern NC, northern MN and northern CA) stand out for emissions but not necessarily for acres burned. This is likely due to the relationship between fire characteristics and emission factors: prescribed fires likely have lower amounts of emissions on a per-acre basis due to lower burn temperatures than wildfires; prescribed fires have less smoldering than wildfires, which causes wildfire emissions to accumulate over time; peat type wildfires burning extensive duff; and wildfires burning very hot and for a long duration causing higher emissions.

Figure 5-3: 2011 $PM_{2.5}$ wildfire and prescribed burning emissions using EPA methods

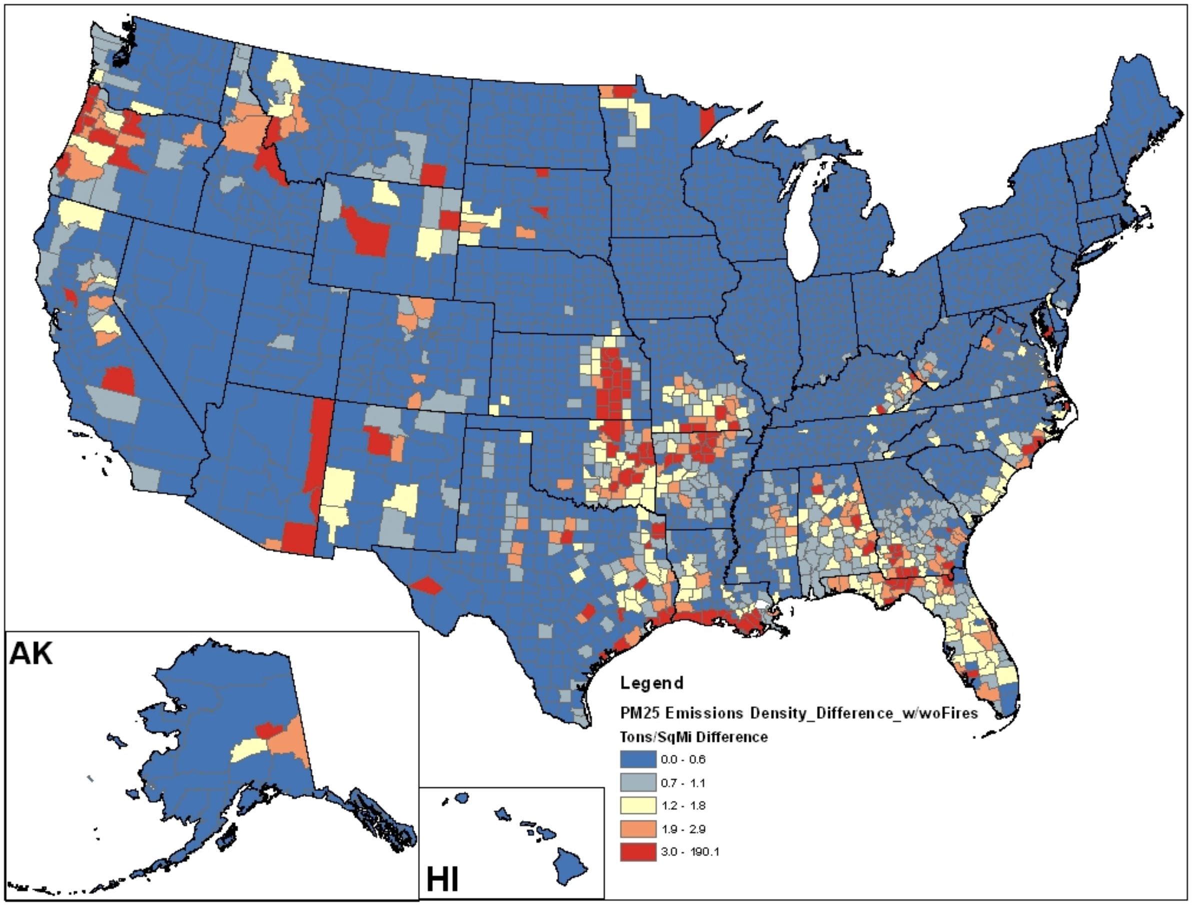


5.1.5 Summary of quality assurance methods

- WLF emissions developed using the methods above were compared to EPA's 2008 estimates, since the models used are very consistent. The spatial (and temporal) patterns seen in the data correspond to what was expected in 2011, and how the domains changed from 2008 –Alaska and Hawaii are new to the domain in 2011. 2011 was a "worse" fire year than 2008, as more acres were burned (about 30% more), so the emissions are expected to be higher in 2011 compared to 2008.
- Georgia and NC were the only state to submit emissions data. A comparison of the data between the GA submitted and SF2-generated emissions for GA showed a very good match for wildfires, but a marginal match for prescribed fires. Due to that concern and some concerns that GA had on the spatial extent of emissions estimate on a county basis for GA in SF2, they submitted their own emissions in 2011. In future NEI cycles, the methods used by SF2 to estimate emissions from prescribed fires deserve additional review and improvement. A comparison of the data between the NC submitted and SF2-generated emissions for NC shows that SF2 estimates are much higher (emissions an order of magnitude higher for both wild and prescribed fires). Although for the 2011 NEI v2, we decided to accept NC's estimates over EPA estimates, in the future a closer evaluation will be done between state-submitted data and EPA estimates to ensure that the State-submitted data is in accordance with known activity data for the state as well as to check whether the state-submitted data covers the entire domain of the state as well as all fires that occur over this area.

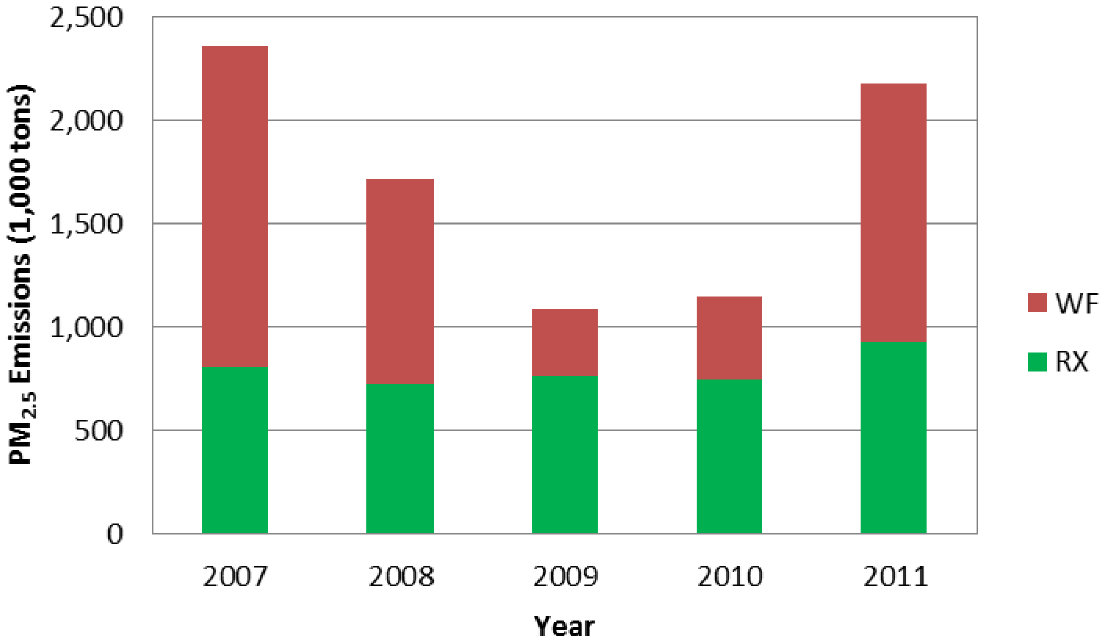
- In Figure 5-4, we show a county by county map of $PM_{2.5}$ emissions density (per square mile) that reflects the difference in total $PM_{2.5}$ emissions in 2011 NEI with and without wild and prescribed fire $PM_{2.5}$ emissions. The resulting density difference map highlights those counties in which these large fires dominate the $PM_{2.5}$ emissions load. The areas identified in this map align well with known areas of very high fire activity in 2011.

Figure 5-4: Difference map of 2011 NEI v2 $PM_{2.5}$ emissions, with and without large fires



- As shown in Figure 5-5, we compared total mass of PM2.5 emissions (the sum of all WLFs) to past EPA inventories which used SF2 to estimate emissions. This generally shows that all pollutants were in a reasonable range that would be expected from these types of fires, given the expected year to year variability. The figure shows SF2-based $PM_{2.5}$ emissions from 2007 to 2011. Though the SF2 model has undergone improvements over this time frame, the overall model is the same and, as such, the agreement across years for total emissions is still relevant. As shown in the figure, the total of 2.1 million tons of $PM_{2.5}$ estimated in 2011 is in line with past estimates. However, 2011 had more fires than did 2008, and 2011 has the second highest emissions in the time frame shown. As expected, wildfires are seen to drive most of the variation year-to-year.

Figure 5-5: 2011 $PM_{2.5}$ wild land fire emissions using EPA methods



- Changes between v1 and v2 for wild land fires: In accordance with the changes made between v1 and v2 identified above (North Carolina submitting their own emissions in v2 and Delaware data being altered based on comments), Table 5-6 highlights the $PM_{2.5}$ emission changes (other pollutants will behave the same way) in going from v1 to v2 of the 2011 wild land fire inventory

Table 5-6: $PM_{2.5}$ Emission differences (tons) for WLFs between 2011 v1 and 2011 v2

	Prescribed Fires		Wild Fires	
	2011 v1	**2011 v2**	**2011 v1**	**2011 v2**
Alabama	50,537	50,537	11,035	11,035
Alaska	2,647	2,643	181,161	181,161
Arizona	7,218	7,218	121,112	121,112
Arkansas	55,057	55,057	9,907	9,907
California	25,866	25,866	65,116	53,487
Colorado	24,233	24,233	8,029	8,029
Connecticut	13	13	37	37
Delaware	92	96	502	9
Florida	47,030	69,583	32,236	19,372
Georgia	73,485	48,686	58,201	84,174
Hawaii	674	674	127	127
Idaho	20,098	19,284	41,585	40,878
Illinois	4,817	4,817	744	744
Indiana	2,124	2,124	151	151
Iowa	6,435	6,435	399	399
Kansas	81,560	81,560	2,675	2,675
Kentucky	8,078	8,078	7,898	7,898

	Prescribed Fires		Wild Fires	
	2011 v1	**2011 v2**	**2011 v1**	**2011 v2**
Louisiana	83,493	83,493	21,672	21,672
Maine	346	346	21	21
Maryland	1,042	1,042	1,562	1,562
Massachusetts	413	413	0	0
Michigan	1,689	1,689	1,005	1,005
Minnesota	16,358	16,358	51,811	51,811
Mississippi	27,783	27,783	2,022	2,022
Missouri	45,055	45,055	8,556	8,556
Montana	22,472	22,472	62,265	62,265
Nebraska	9,792	9,792	979	979
Nevada	628	628	7,381	7,381
New Hampshire	47	47	0	0
New Jersey	1,215	1,215	200	200
New Mexico	3,796	3,796	81,100	81,100
New York	462	462	201	201
North Carolina	21,245	2,871	138,376	8,873
North Dakota	13,857	13,857	384	384
Ohio	830	830	46	46
Oklahoma	66,628	66,628	26,439	26,439
Oregon	83,490	83,490	38,142	38,142
Pennsylvania	1,753	1,753	114	114
Rhode Island	59	59	5	5
South Carolina	15,028	15,028	3,235	3,235
South Dakota	14,728	14,728	17,675	17,675
Tennessee	8,626	8,626	2,654	2,654
Texas	5,253	5,253	188,970	188,970
Utah	4,446	4,446	2,312	2,312
Vermont	50	50	5	5
Virginia	7,193	7,193	7,506	7,506
Washington	18,797	18,797	3,706	3,706
West Virginia	4,723	4,723	2,772	2,772
Wisconsin	3,135	3,135	43	43
Wyoming	30,086	30,086	42,296	42,319
Total	**924,482**	**903,048**	**1,254,370**	**1,125,170**

5.1.6 References for Wildfires and Prescribed Burning

1. Reid, S.B., Technical Memorandum, Sonoma Technology, Inc., Preparation of Version 2 of the Wildland Fire Emissions Inventory for 2011, April 26, 2013.

2. Pollard E.K., Du Y., Raffuse S.M., and Reid S.B. (2011) Preparation of wildland and agricultural fire emissions inventories for 2009. Technical memorandum prepared for the U.S. Environmental Protection Agency, Research Triangle Park, NC, by Sonoma Technology, Inc., Petaluma, CA, STI-910221-4231, October 6.
3. Raffuse, S., 2012. Sonoma Technical Inc. Technical Memorandum: *AirFire/STI National Wildland Fire Emission Inventory for 2011*, DRAFT, April 2012.
4. Pace, T., Attachment 1 in Work Assignment #3-18. Tom Pace to Sonoma Technologies, *Preparation of Wildland and Agricultural Fire Emission Inventories for 2003-2006*, April 2007
5. Huang S., Du Y., Raffuse S.M., and Reid S.B. (2012) Preparation of wildland fire emissions inventories for 2009. Technical memorandum prepared for the U.S. Environmental Protection Agency, Research Triangle Park, NC by Sonoma Technology, Inc., Petaluma, CA, STI-910321-5446, August 15.
6. Du Y., Raffuse S.M., and Reid S.B. (2013) Technical guidance for using SmartFire2 / BlueSky Framework to develop national wildland fire emissions inventories. Draft user's guide prepared for the U.S. Environmental Protection Agency, Research Triangle Park, NC by Sonoma

5.2 Fires – Agricultural field Burning

An EPA approach to estimate agricultural fire emissions was developed for the first time for the 2008 NEI. In the 2008 effort, only CAPs were estimated for this sector. In 2011, EPA changed its methods for this sector to those based on the peer-reviewed approach of Jessica McCarthy [ref 1]. In 2011, 17 HAPs were also included in the suite of pollutants estimated for this sector in the EPA data. In addition to the data submitted by S/L/T agencies, EPA developed a nationally consistent agricultural fires estimate based on the McCarthy methods, which relies on remote sensing, crop-usage maps and appropriate emission factors to estimate CAP (all CAPs except for ammonia) and 17 HAPs for this sector. Within the EIS, the EPA annual agricultural fire estimates are county-totals and are included in the dataset “2011EPA_NP_NoOverlap_w_Pt.” They are also available outside of the EIS as monthly totals upon request.

5.2.1 Sector description

Agricultural burning refers to fires that occur over lands used for cultivating crops and agriculture. The SCCs that pertain to this source in the NEI are listed in Table 5-7. EPA data are all put into one SCC, while state-submitted data are entered into one or more of 25 different SCCs shown in Table 5-7. These other SCCs have more specific details about the type of crop burned.

Table 5-7: SCCs in the NEI for Agricultural Burning

Data Origin	Agricultural Fires – SCCs used
EPA	2801500000
States/Locals/Tribes	2801500000, 2801500100, 2801500111,2801500130, 2801500150, 2801500170, 2801500181, 2801500191, 2801500220, 2801500250, 2801500261, 2801500262, 2801500300, 2801500320, 2801500330, 2801500350, 2801500350, 2801500390, 2801500410, 2801500420, 2801500430, 2801500500, 2801500600, 2801520000, 2801500141

5.2.2 Sources of data overview and selection hierarchy

The agricultural fire sector includes data from the following: S/L/T agency-provided emissions data, the 2011EPA_chrom_split dataset (see Section 3.1.3), 2011EPA_PM-Aug, and an EPA dataset created from the McCarthy methods (see Section 5.2.4) and stored in the dataset 2011EPA_NP_NoOverlap_w_Pt.

The chromium speciation data were used only to speciate California total chromium to hexavalent and trivalent chromium. The PM augmentation data had no impact on the primary PM emissions; it added filterable PM by setting it equal to primary PM and condensable PM by setting it equal to zero. The EPA dataset includes emissions from the pollutants VOC, NO_X, SO_2, CO, $PM_{2.5}$, CO_2 and methane because we had emission factors available for these. The CO_2 and methane emissions were not included in the final 2011 NEI but are available upon request. Table 5-8 lists the state and tribal agencies that submitted agricultural fire emissions.

Table 5-8: Agencies that submitted agricultural fire emissions to the 2011 NEI

Agency	Agency Type
Arizona Department of Environmental Quality	State
California Air Resources Board	State
Delaware Department of Natural Resources and Environmental Control	State
Georgia Department of Natural Resources	State
Hawaii Department of Health Clean Air Branch	State
Idaho Department of Environmental Quality	State
Indiana Department of Environmental Management	State
Kansas Department of Health and Environment	State
Louisiana Department of Environmental Quality	State
New Jersey Department of Environment Protection	State
North Carolina Department of Environmental Quality	State
Oregon Department of Environmental Quality	State
South Carolina Department of Health and Environmental Control	State
Washington State Department of Ecology	State
Coeur d'Alene Tribe of Idaho	Tribal
Kootenai Tribe of Idaho	Tribal
Nez Perce Tribe	Tribal
Shoshone-Bannock Tribes of the Fort Hall Reservation of Idaho	Tribal

When we created the 2011 NEI, the EPA data were combined with the other data in such a way that any counties or pollutants that were null in the S/L/T agency data were backfilled with EPA-based county estimates. Any "zero" submissions were left as zero in the 2011 NEI for those counties and pollutants. In addition, EPA augmented HAPs for those states that did not submit any of the HAPs (listed in the first paragraph of Section 5.2.3) using a simple ratio of state-based VOC to the HAP in question in the EPA emissions database. These ratios were applied to the state submitted VOC emission values (all counties in a given state used the same EPA-data based VOC:HAP ratio to estimate HAP emissions). The actual EPA-data based ratios provided along with all of the other HAP augmentation ratios described in Section 3.1.5 and can be accessed via the supplemental data file described in that section. For states that reported any of the HAPs that EPA estimates or any other HAPs, they were left as is in the final NEI (as long as they passed the QA checks). The hierarchy used to select data for this sector is outlined in Table 5-9.

Table 5-9: Data source and selection hierarchy used for agricultural fire emissions

Dataset name (Short Name provided if different)	Description and Rationale for the Order of the Selected Datasets	Order
2011 Responsible Agency Selection	S/L/T agency submitted data for agricultural burning; multiple datasets – one for each reporting agency. These data are selected ahead of other datasets.	1
2011EPA_PM-Augmentation (2011EPA_PM-AUG)	Adds PM species to fill in missing S/L/T agency data or make corrections where S/L/T agency data have inconsistent emissions across PM species. Uses the PM calculator for processes covered by that database. See Section 3.1.1 for additional details.	2
2011EPA_ chrom_split	Hexavalent and trivalent chromium speciated from S/L/T agency reported chromium. New EIS augmentation function creates the dataset by applying multiplication factors by SCC, facility, process or NAICS code to S/L/T agency chromium. See 3.1.3.	3
2011EPA_HAP-Augmentation (2011EPA_HAP-Aug)	HAP data computed from S/L/T agency criteria pollutant data using HAP/CAP emission factor ratios based on ratios of HAP to CAP emission factors used in the EPA estimates. This dataset is below the S/L/T agency data in order that the S/L/T agency HAP data are used first.	4
2011EPA_AgBurningSF2	Contains data for categories primarily for which there was no or unlikely possibility of point source contribution (or overlap). Agricultural burning is one such category.	5

5.2.3 Spatial coverage and data sources for the sector

Using the methods described below in section 5.2.4, EPA developed county-by-county agriculture burning estimates for the contiguous United States (no EPA estimates were developed for AK, HI, PR or VI). HI submitted CAPs only; thus, there are no data for AK, PR or VI in the 2011 NEI. All CAPs other than NH_3 were estimated with EPA methods. Table 5-10 summarizes these CAP estimates by state. For example, total $PM_{2.5}$ emissions for the 48 contiguous states in the US based on EPA methods is about 148,000 tons. EPA also estimated emissions for the following 17 HAPs: 1,3-butadiene, acetaldehyde, anthracene, benz(a)anthracene, benzo(a)pyrene, benzene, benzo(e)pyrene, benzo(ghi)perylene, benzo(k)fluoroanthene, chrysene, fluoroanthene, formaldehyde, indeno(1,2,3-cd)pyrene, perylene, phenanthrene, pyrene, and toluene.

Table 5-10: Emission estimates for Agricultural Burning (short tons/year) using EPA methods

State	CO	NOx	SO2	PM2.5	PM10	VOC
Alabama	4,065.5	152.3	60.3	420.4	644.5	284.6
Arizona	7,600.2	339.4	142.8	684.0	1,079.5	603.6
Arkansas	74,423.7	3,673.4	1,721.1	7,291.5	9,774.6	5,987.2
California	78,693.4	3,560.1	1,385.0	7,134.4	11,499.6	5,434.6
Colorado	33,958.2	1,427.8	615.0	3,165.8	5,940.6	2,337.6
Connecticut	50.4	1.9	0.8	5.3	9.6	3.1
Delaware	848.8	37.5	17.6	79.1	149.9	60.6
Florida	32,324.5	1,497.7	746.8	2,799.8	3,512.6	2,434.2
Georgia	15,343.7	656.6	294.0	1,431.8	2,353.8	1,130.1
Idaho	51,079.7	2,042.2	735.5	4,904.8	7,864.3	3,830.8
Illinois	16,139.2	741.1	373.9	1,532.7	2,817.3	1,218.3
Indiana	87,776.5	4,011.5	2,001.8	8,386.7	15,118.4	6,685.0
Iowa	132,324.8	6,071.7	3,074.3	12,588.6	23,175.6	9,969.6
Kansas	131,752.6	5,296.8	2,059.0	12,828.9	21,516.4	9,390.6
Kentucky	10,077.9	452.1	213.9	977.3	1,648.0	788.8
Louisiana	49,115.0	2,361.2	1,105.8	4,758.4	6,839.1	3,747.1
Maine	22.8	0.7	0.2	2.7	4.1	1.4
Maryland	1,605.0	67.5	30.6	156.4	280.6	113.3
Massachusetts	25,814.7	670.3	155.1	3,200.4	4,375.2	1,615.1
Michigan	1,305.2	56.7	26.0	125.0	221.3	96.4
Minnesota	180,964.6	8,259.1	3,776.6	16,838.7	28,923.8	14,297.5
Mississippi	47,915.5	2,276.7	1,083.0	4,567.7	6,975.8	3,926.2
Missouri	74,587.9	3,268.5	1,531.1	7,420.6	12,111.0	5,757.9
Montana	23,296.4	967.8	297.7	2,083.5	3,208.3	1,828.1
Nebraska	81,242.6	3,598.3	1,747.1	7,604.8	14,704.6	5,711.0
Nevada	6,625.1	174.6	39.4	811.2	1,120.1	411.3
New Hampshire	167.3	6.1	2.7	17.7	32.0	10.2
New Jersey	191.2	8.2	3.9	18.6	34.1	13.5
New Mexico	6,555.3	283.7	115.2	585.2	1,072.8	476.4
New York	3,949.6	149.0	65.5	411.3	728.0	255.4
North Carolina	18,678.2	841.9	399.2	1,724.2	3,130.3	1,375.3
North Dakota	110,207.0	4,902.2	1,902.0	10,001.7	16,048.0	8,810.1
Ohio	1,771.1	78.3	36.8	173.4	291.9	136.9
Oklahoma	15,520.1	661.1	229.8	1,373.1	2,326.2	1,123.1
Pennsylvania	3,050.6	119.2	53.8	314.4	553.2	204.8
Rhode Island	7.6	0.2	0.0	0.9	1.2	0.5
South Carolina	4,064.7	177.3	82.8	381.8	688.3	292.1
South Dakota	119,293.1	5,058.6	2,219.9	11,479.8	20,281.2	8,543.5
Tennessee	8,508.6	390.2	185.5	828.9	1,303.1	708.1
Texas	42,269.2	1,779.4	725.6	3,962.5	6,759.4	2,913.6
Utah	5,719.3	186.9	61.1	631.1	978.0	369.8
Vermont	331.2	10.4	3.8	38.0	60.5	20.2
Virginia	2,852.3	112.9	48.2	291.4	483.5	201.3
Washington	33,475.5	1,261.3	383.8	3,277.8	5,032.2	2,428.0
West Virginia	620.5	18.8	6.3	72.9	108.9	39.2
Wisconsin	4,246.8	181.4	87.4	411.9	772.3	295.0
Wyoming	6,564.0	216.3	70.0	718.9	1,114.5	426.4
Totals:	**1,556,997.1**	**68,107.1**	**29,917.6**	**148,515.8**	**247,668.0**	**116,307.5**

As an example of data contained in the 2011 NEI for this sector, the $PM_{2.5}$ emissions data in Table 5-10 are combined (using the hierarchy discussed earlier) with the S/L agency submissions (excluding tribal) shown in Table 5-8 and summarized in Figure 5-6 below. For this sector, Louisiana, Kansas, and the Dakotas, all show high levels of emissions compared to areas in the Northeast and Western US. The Midwest region shows very low agricultural burning emissions due to very limited activity.

Figure 5-6: 2011 NEI state-total $PM_{2.5}$ emissions from agricultural fires

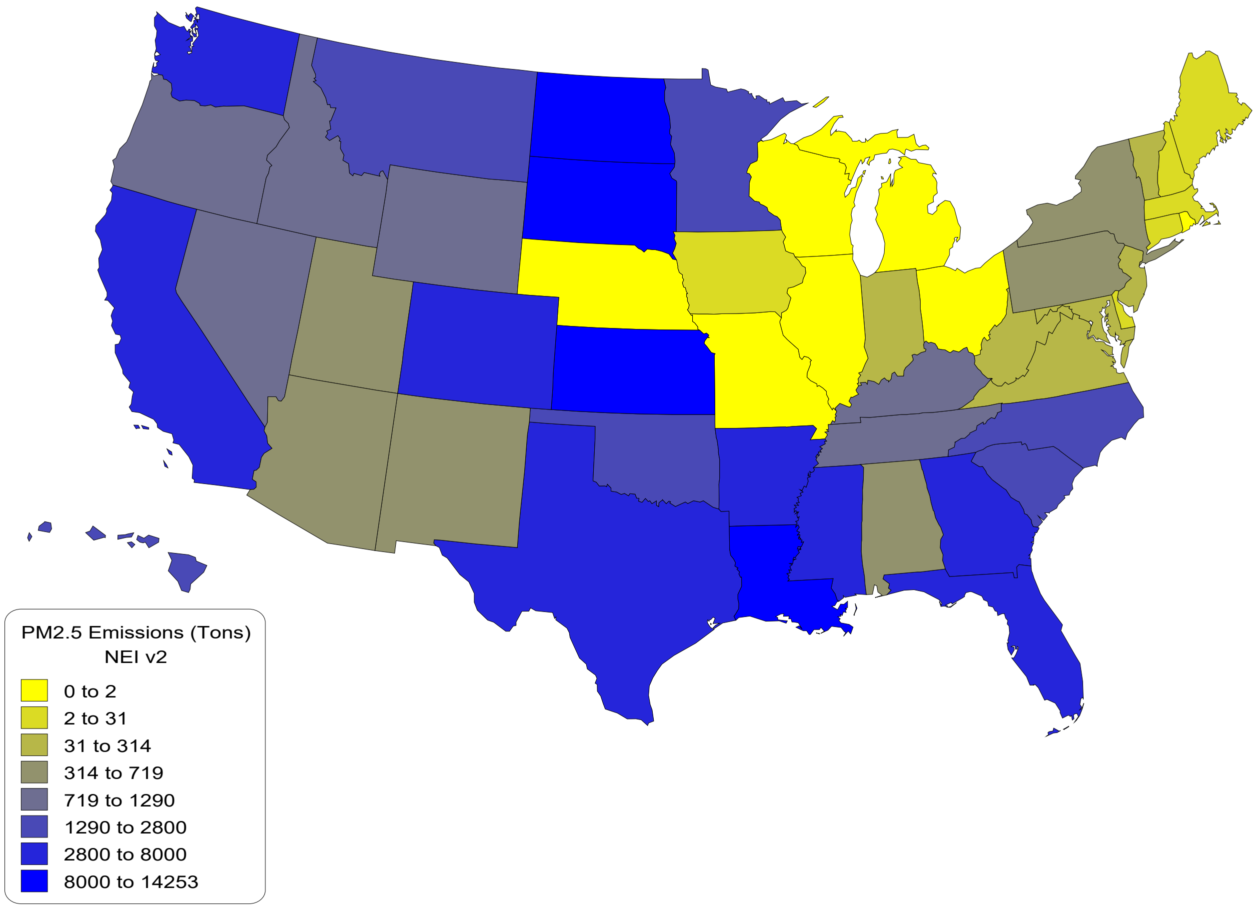
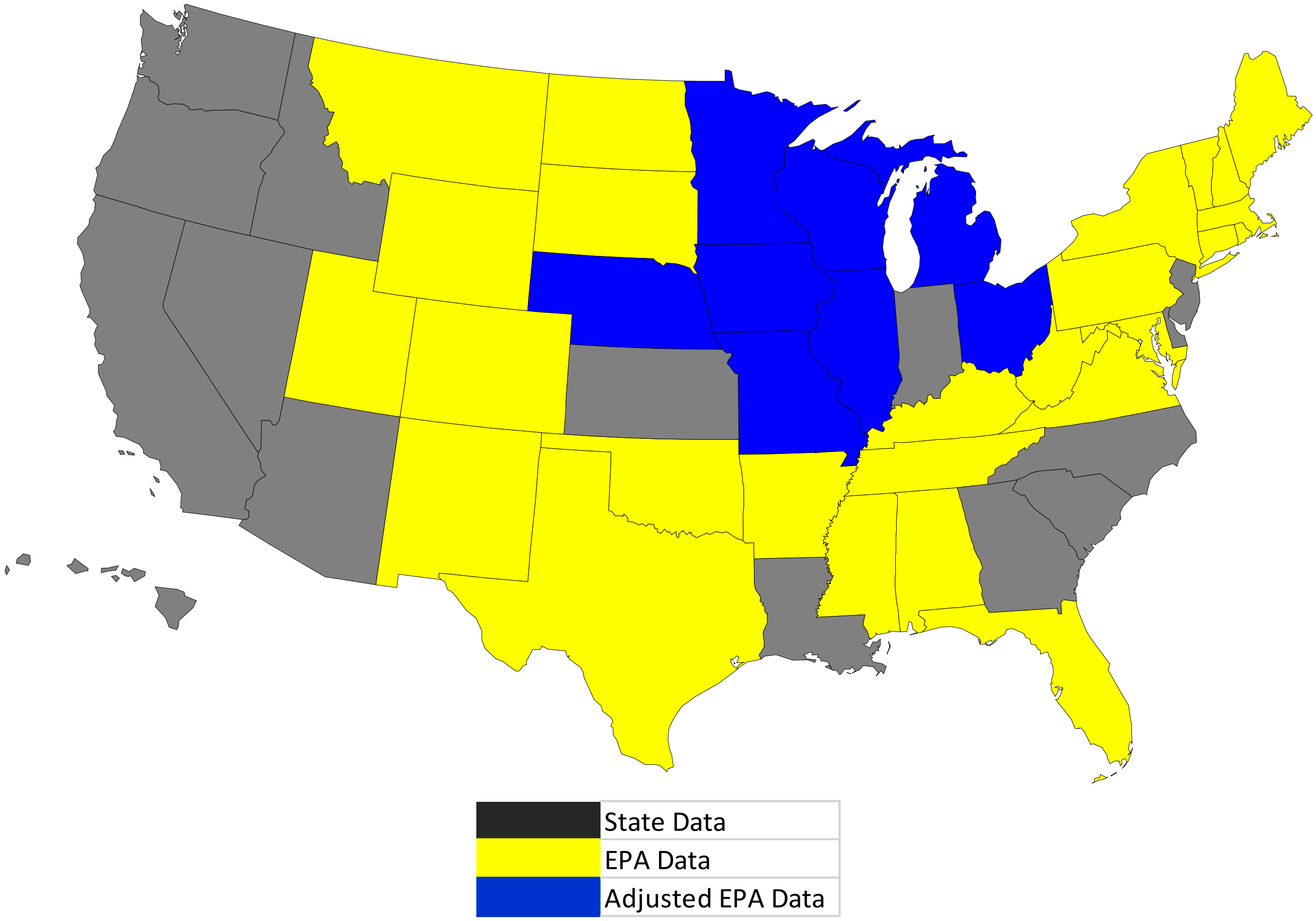


Figure 5-7 below shows states that submitted agricultural burning data to the NEI, corresponding to the list shown in Table 5-8. States in gray submitted some data to the NEI for this sector, while states in yellow submitted none and were reliant on emission estimates based on EPA methods. For the states in blue (all LADCO states plus MO, NE and IA), the EPA data were adjusted to be more compliant with local information we got on amounts of agricultural burning occurring in these states [ref 2]. This adjustment procedure is discussed in more detail in Section 5.2.4. AK is not shown, because AK does not have any agricultural burning activity. In addition, states that submitted other pollutants not in the list of EPA-based HAPs and CAPs discussed in Section 5.2.3, were left as is in the NEI (this mainly included other PAHs, phenol, ethyl benzene, some trace metals, ammonia, and lead emissions).

Figure 5-7: States that submitted agricultural burning emissions to the NEI



5.2.4 EPA-developed agricultural emissions data

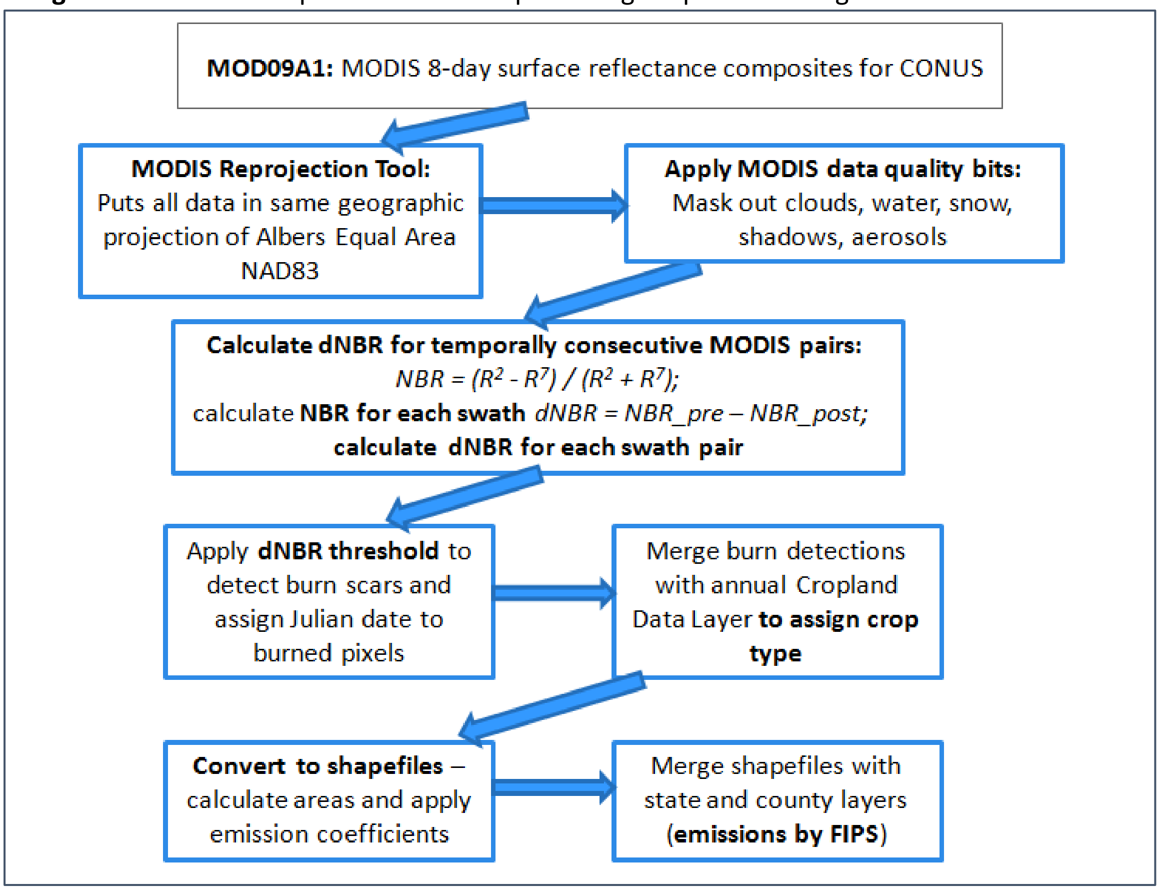
In the 2008 NEI for this sector, a method similar to that used for estimating wild land fires (relying on the "SMARTFIRE" model) was used to develop emission estimates. In the current 2011 NEI, a different method was used to estimate emissions for this sector. This caused the EPA-based emission estimates to be significantly higher in 2011 (a factor of 2-3 times higher) for many states. The 2011 approach is based on the peer-reviewed methods of Dr. Jessica McCarthy. This method relies mainly on satellite-based methods to develop the burned area and then uses an assigned crop type to estimate final emissions. Readers should consult the references provided at the end of this section for in-depth details on this method.

Burned Area: A differenced Normalized Burned Ratio (dNBR) was used to map potential cropland burned area using 500 m MOD09A1 8-day surface reflectance of the MODIS. This method was published in McCarty et al. [ref 1] with results published in McCarty et al. [ref 3] and McCarty [ref 4]. This product represents a weekly product, not a daily product. For the 2011 v2, a higher difference Normalized Burn Ratio ("dNBR;" Key and Benson, 2006) [ref 5] threshold of 425 was applied across the CONUS. This threshold was set based on burn scars in cropland areas derived from 2011 Landsat data. These burn scars were digitized in cropland areas of Florida, Minnesota, North Dakota, California, and Wyoming. Active fire data from the MODIS sensor were also used for visual comparison with the cropland dNBR. The visual comparison was an analysis of spatio-temporal similarity, which is the same approach used by Roy et al. [ref 6] when the MODIS Burned Area Product MCD45A1 was validated

Crop Type: The agricultural area map and specific crop type of each burned area polygon was derived from the U.S. Department of Agriculture (USDA) National Agricultural Statistics Service (NASS) Cropland Data Layer (CDL) product. This is a 30 meter product created for the CONUS annually. Users of these emission estimates should note that Conservation Reserve Program (CRP) lands are included in this estimate. CRP lands tend to be native grasses, reeds/wetlands, shrubs, and trees in areas prone to soil erosion or lacking in nutrients within or adjacent to actively farmed croplands.

Emissions: All emissions are crop-type specific and were calculated using the Seiler and Crutzen [ref 7] method of multiplying burned area, combustion completeness, fuel loadings, and atmospheric species-specific emission factors. For this analysis this equation included burn area as acres burned from the MODIS Cropland Burned Area product, crop-type specific combustion completeness taken from McCarty [ref 4], fuel loading in tons/acre representing the crop residue biomass per acre of cropland taken from McCarty [ref 4], and emission factors in lbs/ton taken from McCarty [ref 4] or retained from previous NEI development. With the aid of a flow diagram, Figure 5-8 shows the overall geospatial method for producing the remote sensing-based cropland emission estimates.

Figure 5-8: EPA's Geospatial method for producing Cropland Burning emissions for 2011 NEI



The initial version of the emissions database was shared by Dr. McCarthy with EPA for consideration and initial dissemination to the states in July 2012. From July 2012 to January 2013, based on state partner comments, we further analyzed Wyoming and Indiana results using other satellite sources of burned area at higher resolution (30-meter Landsat and very high-resolution commercial datasets) to determine if this dataset was appropriately quantifying burn conditions on the ground. For the corn belt portion of the U.S (Iowa, Indiana, Illinois), state-level feedback and the analysis of Indiana led to a reduction of 20% in all cropland burning emissions as there was an initial overestimation of the burn scars in which dark soils (i.e., plowed and/or irrigated black soils) were incorrectly classified as burned areas. The EPA emission estimates in the 2011 NEI reflects these changes: the emission estimates for the states of Indiana, Illinois, and Iowa were all lowered by 20% based on the "dark soil" issue. All satellite data processing was performed using ENVI IDL, the MODIS Reprojection Tool (MRT), and Arc Python within ESRI ArcGIS.

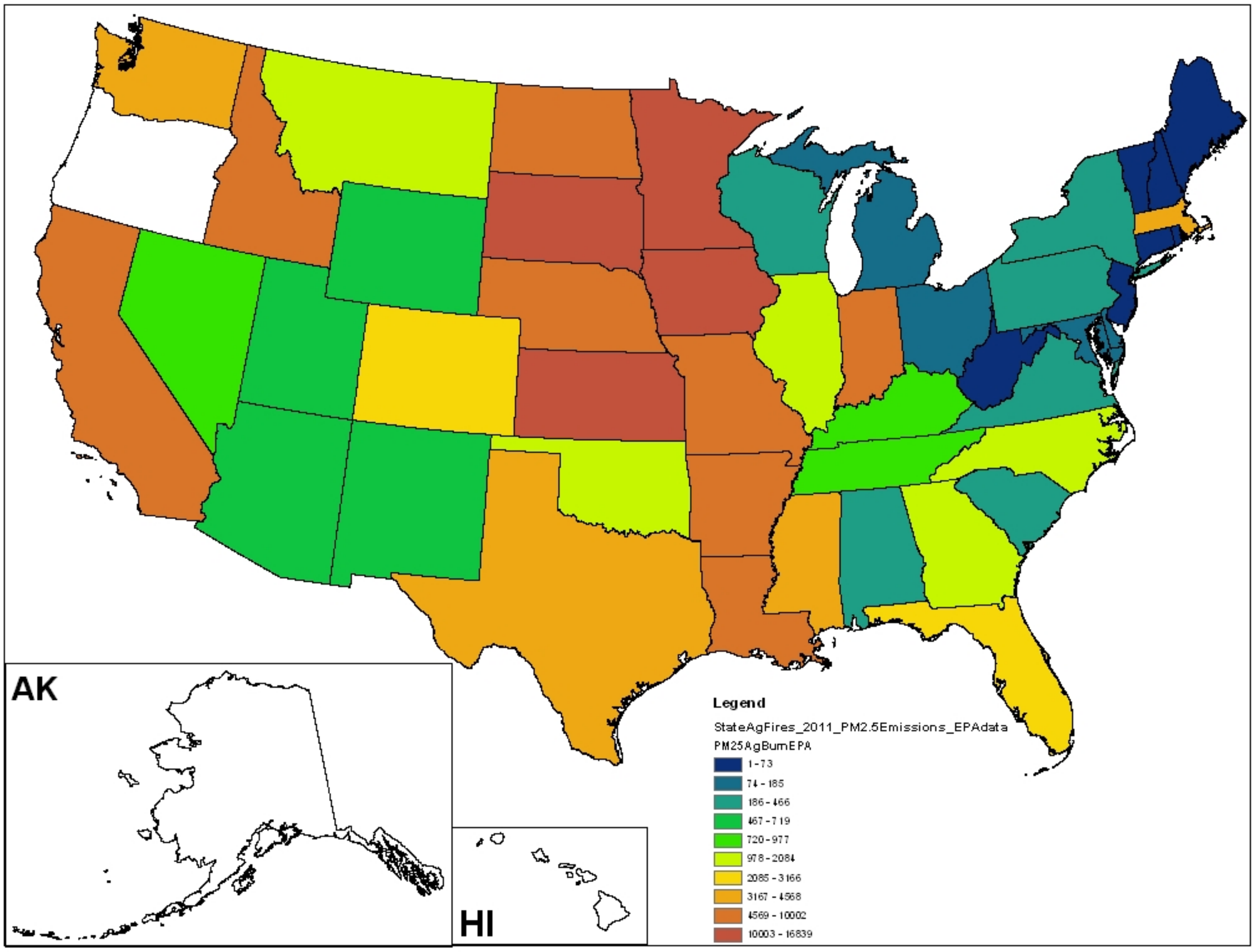
In addition to the application of a 20% emissions reduction for these midwestern states as stated above, EPA decreased the emissions for other nearby states (Wisconsin, Illinois, Michigan, Iowa, Missouri, and Ohio) based on comments received from LADCO that questioned the quality of satellite data's ability to detect small agricultural fires in the mid-western region of the US. When the states confirmed this information, EPA reduced all emissions by a factor of 0.000189 for all these states, resulting in near-nil emissions. For MN, we had different reduction rates they supplied based on their information: MN emissions were reduced by 87%. This ratio approach led to a reduction of between 95-99% of emissions for Wisconsin, Michigan, Ohio, Missouri, and Illinois. These changes are reflected in the results shown in Figure 5-6. Figure 5-9 below shows the resulting $PM_{2.5}$ emissions for the lower 48 states based on EPA methods (it can be compared to Figure 5-6 which is a combination of EPA results and state submitted data). Table 5-11 below outlines the changes in ag burning $PM_{2.5}$ emissions state-by-state in going from NEI v1 to NEI v2. Nationwide there is about a 34% reduction in $PM_{2.5}$ emissions (other pollutants will show similar reductions) with the states outlined about showing much larger reductions and many states staying unchanged.

Table 5-11: Agricultural Burning $PM_{2.5}$ emission differences between NEI 2011 v1 and 2011 v2

State	2011 v1	2011 v2	Difference (v2 - v1)
AL	466	466	0
AR	7,292	7,292	0
AZ	557	557	0
CA	3,933	3,933	0
CO	3,166	3,166	0
CT	5	5	0
DE	70	26	-44
FL	2,800	2,800	0
GA	3,583	3,583	0
HI	1,441	1,441	0
IA	13,065	2	-13,063
ID	876	876	0
IL	1,533	0	-1,533
IN	31	31	0
KS	14,253	14,253	0
KY	977	977	0
LA	8,278	8,278	0
MA	9	9	0
MD	156	156	0
ME	3	3	0
MI	125	0	-125
MN	16,839	2,189	-14,650
MO	7,421	1	-7,420

State	2011 v1	2011 v2	Difference (v2 - v1)
MS	4,568	4,568	0
MT	2,084	2,084	0
NC	1,724	1,290	-434
ND	10,002	10,002	0
NE	7,605	1	-7,604
NH	18	18	0
NJ	185	185	0
NM	585	585	0
NV	811	811	0
NY	411	411	0
OH	173	0	-173
OK	1,373	1,373	0
OR	869	869	0
PA	314	314	0
RI	1	1	0
SC	1,896	1,896	0
SD	11,480	11,480	0
TN	829	829	0
TX	3,963	3,963	0
UT	631	631	0
VA	291	291	0
VT	38	38	0
WA	2,923	2,923	0
WI	412	0	-412
WV	73	73	0
WY	719	719	0
Total	**140,857**	**95,399**	**-45,458**

Figure 5-9: $PM_{2.5}$ Emissions from Agricultural Burning, 2011 EPA data



The McCarthy methodology used by EPA only included emission estimates for the lower 48 contiguous States (no agricultural burning activity was detected in Oregon based on these methods). Alaska does not have any agricultural burning activity, and Hawaii submitted their own emissions as noted in Table 5-8.

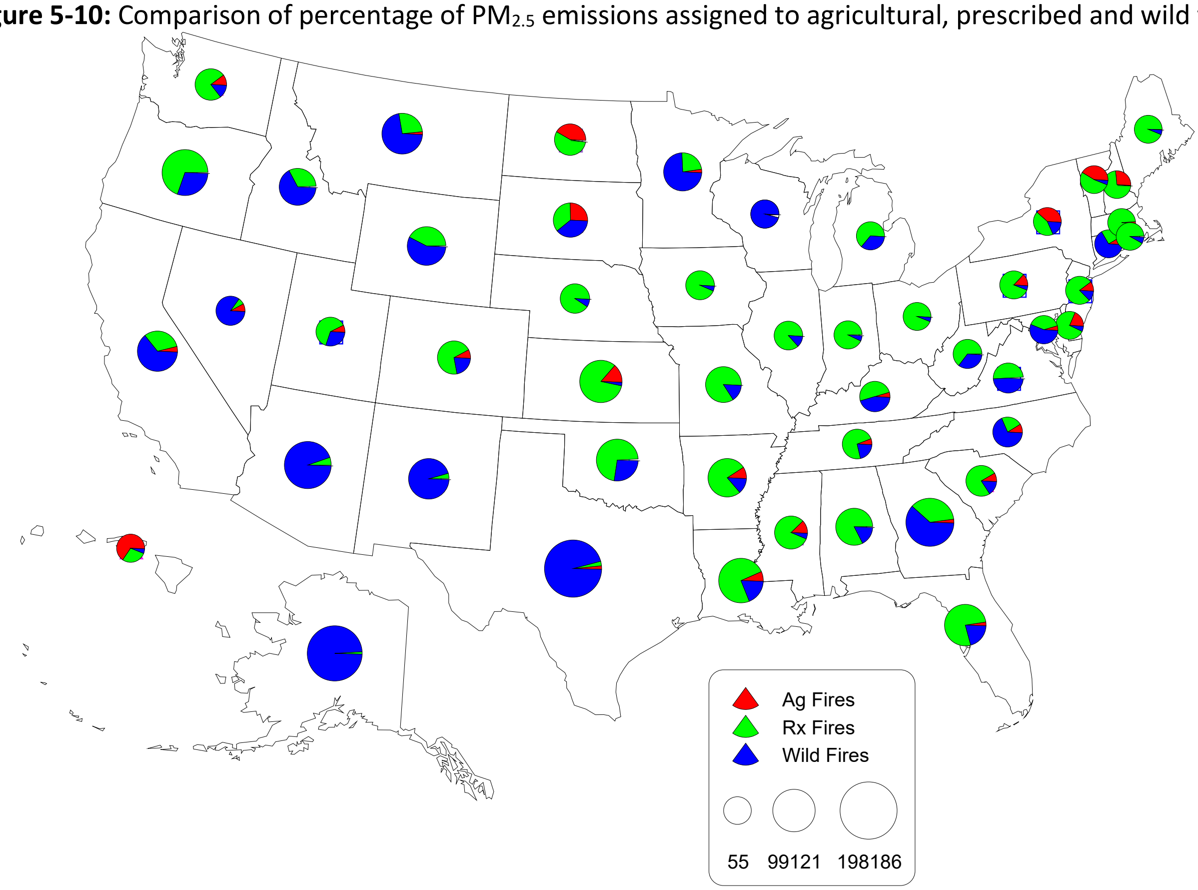
5.2.5 Summary of quality assurance methods

- We compared EPA estimates to State submitted estimates, and discovered discrepancies in the Midwestern States, where EPA emission estimates were too high. A report by LADCO [ref 2] provided additional corroboration that EPA estimates may be too high for some of these states. We corrected by applying a ratio based on state submitted information for Indiana after confirming that the state-based estimates are likely more accurate. Similarly, for the state of Idaho, EPA estimates were much higher than those submitted by the state; however, Idaho submitted a complete set of emissions which was used in the final 2011 NEI. Most of the states that had noted discrepancies between its estimates and EPA-based estimates have large areas of "dark soils" which can spectrally be confused with burned areas and thus produce overestimations of cropland burned area due to soil properties as well as tillage and irrigation practices. In the future, if the McCarthy methods are to be used further, this area of uncertainty has to be further investigated.
- 2011 EPA methods differed from the methods used by EPA in 2008, causing emissions in 2011 to be significantly higher overall and in some major crop burning areas. While there could have been some

increase in activity between 2008 and 2011, it is likely these new methods contributed most to the increased emissions noted.

- For other states that submitted agricultural burning data (see Table 5-8), we compared those data to EPA estimates in the same counties. The matches between state and EPA data varied, with Eastern states generally matching better. It is difficult to arrive at major conclusions because we have limited information on the methods used by states in estimating agricultural burning emissions. We tagged one emission value submitted by California in Santa Barbara County (2,040.47 tons of acrolein) because it was suspected to be incorrect. No other pollutants were reported for agricultural burning in this county, and this value is 6 times higher than all other county emissions for this pollutant reported by California. In addition, EPA data were tagged to avoid double counting with SLT-submitted data (this was needed because SLT agencies submitted too many different SCCs (see Table 5-7) and EPA reported to only one SCC as shown in the same table). EPA data in DE, KS, LA, NJ, OR, WA, and ID were all tagged to avoid double counting with SLT-submitted data for those states.
- Finally, as a very rough check, Figure 5-10 below shows the percentage of $PM_{2.5}$ emissions associated with agricultural fires vs. wild vs. prescribed fires. Even though EPA methods in 2011 caused agricultural fire acres burned (and emissions) to increase significantly, the agricultural fires still should be very small in emissions magnitude compared to the large wild and prescribed fires. Figure 5-10 confirms this. Further, the figure shows the highest emissions in states known to have significant cropland burning activity.

Figure 5-10: Comparison of percentage of $PM_{2.5}$ emissions assigned to agricultural, prescribed and wild fires



5.2.6 References for Agricultural Field Burning

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6 Biogenics – Vegetation and Soil

Biogenic emissions are emissions that come from natural sources. They need to be accounted for in photochemical grid models, as most types are widespread and ubiquitous contributors to background air chemistry. In the NEI, only the emissions from vegetation and soils are included, but other relevant sources include volcanic emissions, lightning, and sea salt.

Biogenic emissions from vegetation and soils are computed using a model which utilizes spatial information on vegetation and land use and environmental conditions of temperature and solar radiation. The model inputs are typically horizontally allocated (gridded) data, and the outputs are gridded biogenic emissions which can then be speciated and utilized as input to photochemical grid models.

6.1 Sector description

In the 2011 NEI, biogenic emissions are included in the nonpoint data category, in the EIS sector "Biogenics – Vegetation and Soil." Table 6-1 lists the two SCCs used in the 2011 NEI that comprise this sector. These 2 SCCs have distinct pollutants: SCC 2701220000 has only NO_X emissions, and SCC 2701200000 has emissions for CO, VOC and 3 VOC HAPs: formaldehyde, acetaldehyde and methanol.

Table 6-1: SCCs for Biogenics – Vegetation and Soil

Source Classification Code	SCC Level One	SCC Level Two	SCC Level Three	SCC Level Four	Tier 1 Description	Tier 2 Description	Tier 3 Description
2701200000	Natural Sources	Biogenic	Vegetation	Total	Natural Resources	Biogenic	Vegetation
2701220000	Natural Sources	Biogenic	Vegetation/ Agriculture	Total	Natural Resources	Biogenic	Vegetation

The biogenic emissions for the 2011 NEI were computed based on 2011 meteorology data from the Weather Research and Forecasting (WRF) Model using the Biogenic Emission Inventory System, version 3.6 (BEIS3.6) model within SMOKE. The BEIS3.6 model creates gridded, hourly, model-species emissions from vegetation and soils. The 12-kilometer gridded hourly data are summed to monthly and annual level and are mapped from 12-kilometer grid cells to counties using a standard mapping file. BEIS produces biogenic emissions for a modeling domain which includes the contiguous 48 states in the U.S., parts of Mexico, and Canada. The NEI uses the biogenic emissions from counties from the contiguous 48 states and DC.

The model-species are those associated with the carbon bond 2005 chemical mechanism (CB05). The NEI pollutants produced are: CO, VOC, NO_X, methanol, formaldehyde and acetaldehyde. VOC is the sum of all biogenic species except CO, NO, SESQ. Mapping of BEIS pollutants to NEI pollutants is as follows:

- NO maps to NO_X
- FORM maps to formaldehyde;
- ALD2 maps to acetaldehyde;
- MEOH maps to methanol;
- VOC is the sum of all biogenic species except CO, NO, SESQ.

An older version of the BEIS model. BEIS 3.6 will be described in more detail in Bash, J.O., Baker, K.R., Beaver, M.R., Park, J.-H., Goldstein, A.H., Evaluation of improved land use and canopy representation in BEIS with biogenic VOC measurements in California (in preparation, July 2015).

The inputs to BEIS include:

- Land-use data from the Biogenic Emissions Land use Database, version 4 (BELD4). BELD4 is derived from the 2006 National Land Cover Database (NLCD) and Moderate Resolution Imaging Spectoradiometer (MODIS) satellite data. Vegetation speciation information is based on data from 2002 to 2013 from the Forest Inventory and Analysis (FIA) version 5.1.6.

- The following meteorological variables that are also inputs to the air quality model are provided in Table 6-2.

Table 6-2: Meteorological variables used by BEIS and air quality modeling

BEIS Meteorological Inputs	
Met Variable	**Description**
LAI	leaf-area index
PRSFC	surface pressure
Q2	mixing ratio at 2 m
RC	convective pcpn per met TSTEP
RGRND	solar rad reaching sfc
RN	nonconvec. pcpn per met TSTEP
RSTOMI	inverse of bulk stomatal resistance
SLYTP	soil texture type by USDA category
SOIM1	volumetric soil moisture in top cm
SOIT1	soil temperature in top one cm
TEMPG	skin temperature at ground
USTAR	cell averaged friction velocity
RADYNI	inverse of aerodynamic resistance
TEMP2	temperature at 2 meters

6.2 Sources of data overview and selection hierarchy

The only source of data for this sector is the EPA-estimated emissions from BEIS3.6. States are neither required nor encouraged to report emissions, and no state has done this. The name of the EPA dataset in the EIS is: 2011EPA_biogenics.

6.3 Spatial coverage and data sources for the sector

The spatial coverage of the biogenics emissions is governed by the "2011 platform" modeling domain which covers all counties in the lower 48 states. More information on this modeling platform.

Table 6-3 shows state emissions summaries for the biogenic emissions sector and the contribution of biogenics to the total 2011v2 NEI in that state. Biogenic emissions are a very large fraction of the total NEI VOC, methanol, formaldehyde and acetaldehyde emissions but a very small fraction of the CO and NO_X.

More detailed summaries of the BEIS model species at county level and monthly are available as a supporting summary "2011_biogenic_reports.zip" on the 2011 web page.

Table 6-3: State summary of Biogenics – Vegetation and Soil emissions (short tons/year)

	formaldehyde		methanol		acetaldehyde		CO		NO_X		VOC	
state	**biogenics**	**% of total**	**biogenics**	**% of total**	**biogenics**	**% of total**	**biogenics**	**% of total**	**biogenics**	**% of total**	**biogenics**	**% of total**
AL	26,766	74%	114,495	85%	19,628	74%	187,956	9%	13,989	4%	2,041,217	84%
AR	23,930	71%	97,626	82%	17,548	71%	168,551	11%	25,331	10%	1,668,285	83%
AZ	54,769	79%	237,270	86%	40,163	79%	383,525	14%	13,924	5%	2,125,466	80%
CA	56,594	75%	221,121	89%	41,501	75%	396,812	10%	45,581	6%	2,412,727	74%
CO	22,570	76%	93,240	89%	16,551	76%	158,241	10%	32,910	10%	902,706	62%
CT	1,027	42%	3,308	59%	753	42%	7,328	2%	531	1%	66,784	45%
DC	18	12%	65	15%	13	12%	126	0%	15	0%	1,114	12%
DE	520	56%	2,004	85%	381	56%	3,826	3%	920	3%	25,080	52%
FL	31,438	62%	130,409	79%	23,054	62%	234,615	5%	22,534	4%	1,861,911	68%
GA	31,404	77%	137,126	90%	23,029	77%	221,820	7%	22,147	5%	2,197,186	84%
IA	10,492	74%	40,743	91%	7,694	74%	73,760	9%	34,354	13%	284,361	60%
ID	19,904	73%	65,397	79%	14,596	73%	139,504	11%	16,669	15%	787,965	75%
IL	12,423	67%	49,370	83%	9,110	67%	87,797	5%	36,678	7%	417,236	53%
IN	7,968	61%	30,689	86%	5,843	61%	56,148	3%	22,566	5%	270,734	49%
KS	23,741	65%	100,459	82%	17,410	65%	166,306	9%	57,224	14%	558,912	55%
KY	11,068	69%	43,006	84%	8,116	69%	78,021	7%	17,390	5%	611,525	69%
LA	23,769	59%	99,859	72%	17,430	59%	174,991	7%	16,831	3%	1,494,761	68%
MA	1,867	41%	5,687	70%	1,369	41%	13,501	2%	836	1%	108,787	42%
MD	2,789	55%	10,332	80%	2,045	55%	20,323	3%	3,451	2%	155,650	55%
ME	8,797	88%	20,432	95%	6,451	88%	62,334	18%	2,848	5%	355,085	84%
MI	11,813	59%	37,928	84%	8,663	59%	84,430	4%	16,767	4%	524,136	54%
MN	14,361	54%	46,247	68%	10,531	54%	103,663	5%	27,597	8%	617,109	56%
MO	19,504	68%	79,531	81%	14,303	68%	137,236	7%	35,050	9%	1,226,623	77%
MS	23,942	78%	101,648	90%	17,557	78%	168,706	14%	17,971	8%	1,752,773	86%
MT	28,990	75%	97,545	80%	21,259	75%	203,185	13%	47,324	28%	1,030,794	75%
NC	19,143	76%	77,308	90%	14,038	76%	135,569	7%	16,628	4%	1,228,396	78%
ND	9,803	69%	33,210	89%	7,189	69%	69,640	12%	32,261	16%	214,839	43%
NE	15,033	85%	61,881	94%	11,024	85%	105,754	17%	52,775	20%	352,591	74%
NH	2,209	71%	6,211	92%	1,620	71%	15,628	6%	717	2%	104,534	69%
NJ	1,924	41%	6,852	65%	1,411	41%	13,986	1%	1,482	1%	122,017	40%
NM	43,642	82%	203,642	90%	32,004	82%	305,612	17%	30,991	12%	1,647,455	79%
NV	30,022	94%	132,715	98%	22,016	94%	210,305	28%	7,588	7%	1,093,557	93%
NY	9,872	58%	30,884	70%	7,239	58%	69,826	3%	9,936	3%	415,115	50%
OH	8,321	50%	31,772	80%	6,102	50%	58,523	2%	19,143	3%	332,886	43%

	formaldehyde		methanol		acetaldehyde		CO		NO_X		VOC	
state	biogenics	% of total	biogenics	% of total	biogenics	% of total	biogenics	% of total	biogenics	% of total	biogenics	% of total
OK	29,022	71%	117,296	81%	21,282	71%	203,403	9%	42,428	9%	1,221,367	65%
OR	26,257	64%	76,670	67%	19,255	64%	184,245	7%	12,188	7%	963,526	66%
PA	8,892	57%	31,011	78%	6,521	57%	63,027	3%	11,107	2%	477,800	56%
RI	255	38%	793	55%	187	38%	1,867	1%	142	1%	17,896	43%
SC	15,025	74%	63,849	87%	11,018	74%	106,736	9%	9,872	4%	1,012,624	81%
SD	13,412	69%	52,126	84%	9,835	69%	94,424	12%	37,933	33%	335,805	68%
TN	13,722	71%	55,858	88%	10,062	71%	96,460	7%	16,506	5%	861,902	75%
TX	152,960	83%	670,246	91%	112,169	83%	1,074,822	16%	113,563	8%	6,052,447	73%
UT	19,865	90%	84,927	96%	14,567	90%	139,219	20%	8,148	4%	761,463	76%
VA	13,085	69%	51,092	84%	9,596	69%	92,614	7%	10,790	3%	893,208	75%
VT	2,048	75%	5,851	94%	1,502	75%	14,442	9%	1,408	7%	78,595	74%
WA	18,090	72%	43,492	80%	13,266	72%	127,103	7%	15,069	5%	594,115	66%
WI	9,781	63%	34,050	87%	7,172	63%	70,517	5%	16,841	6%	469,051	62%
WV	5,543	72%	19,926	86%	4,065	72%	39,192	8%	4,620	3%	414,018	75%
WY	17,717	68%	70,655	77%	12,992	68%	124,325	10%	16,880	7%	672,959	64%

7 Supporting data and summaries

The previous sections provide number references to both supporting data and key output summaries. All supporting input data and summaries referenced in the sections above can be obtained through the CHIEF ftp site or, on the 2011 webpage.