



# 2011 National Emissions Inventory, version 1 Technical Support Document

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2011 National Emissions Inventory, version 1  
Technical Support Document  
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U.S. Environmental Protection Agency  
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## Acronyms and Chemical Notations

AERR	<a href="#">Air Emissions Reporting Rule</a>
APU	Auxiliary power unit
BEIS	Biogenics Emissions Inventory System
BSO	Benzene Soluble Organics
C1	Category 1 (commercial marine vessels)
C2	Category 2 (commercial marine vessels)
C3	Category 3 (commercial marine vessels)
CAIR	Clean Air Interstate Rule
CAMD	Clean Air Markets Division (of EPA Office of Air and Radiation)
CAP	Criteria Air Pollutant
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 <sub>4</sub>	Methane
CHIEF	<a href="#">Clearinghouse for Inventories and Emissions Factors</a>
CMU	Carnegie Mellon University
CMV	Commercial marine vessels
CNG	Compressed Natural Gas
CO	Carbon Monoxide
CO <sub>2</sub>	Carbon Dioxide
CSV	Comma Separated Variable
dNBR	Differenced normalized burned ratio
E10	10% ethanol gasoline
EDMS	<a href="#">Emissions and Dispersion Modeling System</a>
EF	emission factor
EGU	Electric Generating Utility
EIS	<a href="#">Emission Inventory System</a>
EAF	Electric arc furnace
EF	Emission factor
EIA	Energy Information Administration
EMFAC	<a href="#">Emission FACTor</a> (model) – for California
EPA	<a href="#">Environmental Protection Agency</a>
ERG	Eastern Research Group
ERTAC	<a href="#">Eastern Regional Technical Advisory Committee</a>
FAA	<a href="#">Federal Aviation Administration</a>
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	<a href="#">Hazard Mapping System</a>
ICR	Information collection request
I/M	Inspection and maintenance
IPM	<a href="#">Integrated Planning Model</a>
KMZ	Keyhole Markup Language, zipped (used for displaying data in Google Earth)
LRTAP	<a href="#">Long-range Transboundary Air Pollution</a>
LTO	Landing and takeoff
LPG	Liquified Petroleum Gas
MARAMA	Mid-Atlantic Regional Air Management Association
MATS	<a href="#">Mercury and Air Toxics Standards</a>
MCIP	<a href="#">Meteorology-Chemistry Interface Processor</a>
MMT	Manure management train
MOBILE6	<a href="#">Mobile Source Emission Factor Model, version 6</a>
MODIS	Moderate Resolution Imaging Spectroradiometer
MOVES	<a href="#">Motor Vehicle Emissions Simulator</a>
MSO	Methylene Chloride Soluble Organics
MW	Megawatts
MWC	Municipal waste combustors
NAA	Nonattainment area
NAAQS	<a href="#">National Ambient Air Quality Standards</a>
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	<a href="#">National Air Toxics Assessment</a>
NCD	National County Database
NEEDS	National Electric Energy Data System (database)
NEI	<a href="#">National Emissions Inventory</a>
NESCAUM	Northeast States for Coordinated Air Use Management
NFEI	National Fire Emissions Inventory
NH <sub>3</sub>	Ammonia
NMIM	<a href="#">National Mobile Inventory Model</a>
NO	Nitrous oxide
NO <sub>2</sub>	Nitrogen dioxide

NOAA	<a href="#">National Oceanic and Atmospheric Administration</a>
NO <sub>x</sub>	Nitrogen oxides
O <sub>3</sub>	Ozone
OAQPS	<a href="#">Office of Air Quality Standards and Planning</a> (of EPA)
OEI	<a href="#">Office of Environmental Information</a> (of EPA)
ORIS	Office of Regulatory Information Systems
OTAQ	<a href="#">Office of Transportation and Air Quality</a> (of EPA)
PADD	Petroleum Administration for Defense Districts
PAH	Polycyclic Aromatic Hydrocarbons
Pb	Lead
PCB	Polychlorinated Biphenyl
PM	Particulate matter
PM25-CON	Condensable PM <sub>2.5</sub>
PM25-FIL	Filterable PM <sub>2.5</sub>
PM25-PRI	Primary PM <sub>2.5</sub> (condensable plus filterable)
PM <sub>2.5</sub>	Particulate matter 2.5 microns or less in diameter
PM <sub>10</sub>	Particulate matter 10 microns or less in diameter
PM10-FIL	Filterable PM <sub>10</sub>
PM10-PRI	Primary PM <sub>10</sub>
POM	Polycyclic Organic Matter
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	<a href="#">Satellite Mapping Automated Reanalysis Tool for Fire Incident Reconciliation</a>
SMOKE	<a href="#">Sparse Matrix Operator Kernel Emissions</a>
SO <sub>2</sub>	Sulfur dioxide
SO <sub>4</sub>	Sulfate
TAF	Terminal Area Forecasts
TEISS	<a href="#">Tribal Emissions Inventory Software Solution</a>
TRI	<a href="#">Toxics Release Inventory</a>
UNEP	<a href="#">United Nations Environment Programme</a>
USDA	<a href="#">United States Department of Agriculture</a>
VMT	Vehicle miles traveled
VOC	Volatile organic compounds



USFS	United States Forest Service
WebFIRE	<a href="#">Factor Information Retrieval System</a>
WFU	Wildland fire use
WLF	Wildland fire
WRAP	Western Regional Air Partnership
WRF	<a href="#">Weather Research and Forecasting Model</a>

# 1 Introduction

## 1.1 What data are included in the 2011 NEI?

The 2011 National Emissions Inventory (NEI), version 1 (hereafter referred to as the 2011 NEI) 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 related to implementation of 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<sub>x</sub>), volatile organic compounds (VOC), sulfur dioxide (SO<sub>2</sub>), ammonia (NH<sub>3</sub>), particulate matter 10 microns or less (PM<sub>10</sub>) and particulate matter 2.5 microns or less (PM<sub>2.5</sub>). The HAP pollutants include the 187 remaining HAP pollutants from the original 188 listed in Section 112(b) of the 1990 Clean Air Act Amendments<sup>1</sup>. 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 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 NEI 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 a quality assessment of the 2011 NEI. Finally, Section 8 provides instructions for accessing supporting materials. A separate document contains the appendices.

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<sup>1</sup> The current list of HAPs is available at <http://www.epa.gov/ttn/atw/188polls.html>.

### 1.3 Where can I obtain the 2011 NEI data?

The 2011 NEI data are available in several different ways, as follows. EPA continues to review and streamline the approach for accessing the NEI data.

#### 1.3.1 Emission Inventory System Gateway

<http://www.epa.gov/ttn/chief/eis/gateway/>

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 NEI v1 in EIS is called “2011 NEI v1 with biogenics”. Note that if you run facility, unit or process level reports in EIS, you will get the 2011 NEI v1 emissions, but the facility inventory, which is dynamic in 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 (Summer 2013), then that new Agency ID will be in the Facility Inventory or a Facility Configuration report in EIS but not in the report on the public website nor the Facility Emissions Summary reports run on the “2011 NEI v1 with biogenics” in EIS.

#### 1.3.2 2011 NEI main webpage

<http://www.epa.gov/ttn/chief/net/2011inventory.html>

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”

Main: <http://www.epa.gov/air/emissions/>  
Where you live: <http://www.epa.gov/air/emissions/where.htm>

NOTE: This site may not yet contain the 2011 NEI emissions, but will be updated by the end of calendar year 2013. 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

<http://www.epa.gov/ttn/chief/emch/index.html#2011>

The modeling files are provided in formats that can be read by the Sparse Matrix Operator Kernel Emissions (SMOKE, <http://www.smoke-model.org>). These formats 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 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 U.S. public, and other countries the U.S.’s 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 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.

**Table 1:** Point source reporting thresholds (potential to emit) for criteria pollutants in the Air Emissions Reporting Rule

Pollutant	2011 NEI thresholds: potential to emit (tons/yr)	
	Everywhere (Type B sources)	NAA sources <sup>1</sup>
1 SO <sub>x</sub> .....	≥ 100	≥ 100
2 VOC .....	≥ 100	O <sub>3</sub> (moderate) ≥ 100
3 VOC .....	.....	O <sub>3</sub> (serious) ≥ 50
4 VOC .....	.....	O <sub>3</sub> (severe) ≥ 25
5 VOC .....	.....	O <sub>3</sub> (extreme) ≥ 10
6 NO <sub>x</sub> .....	≥ 100	≥ 100
7 CO .....	≥ 1000	O <sub>3</sub> (all areas) ≥ 100
8 CO .....	.....	CO (all areas) ≥ 100
9 Pb .....	≥ 5	≥ 5
10 PM <sub>10</sub> .....	≥ 100	PM <sub>10</sub> (moderate) ≥ 100
11 PM <sub>10</sub> .....	.....	PM <sub>10</sub> (serious) ≥ 70
12 PM <sub>2.5</sub> .....	≥ 100	≥ 100
13 NH <sub>3</sub> .....	≥ 100	≥ 100

<sup>1</sup> 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<sub>x</sub>, CO; CO: CO; PM<sub>10</sub>: PM<sub>10</sub>

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.

### 1.6 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 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 2: Examples of major current uses of the NEI**

<b>Audience</b>	<b>Purposes</b>	<b>Last NEI data used</b>
U.S. Public	Learn about sources of air emissions	2011NEI v1
EPA – NAAQS	Regulatory Impact Analysis – benefits estimates using air quality modeling	Modified 2005 NEI v2, for PM NAAQS Proposal, Modified 2008 NEI v2, for PM NAAQS Final
	PM and SO <sub>2</sub> NAAQS Implementation	2011 NEI v1
	SO <sub>2</sub> NAAQS Monitoring Implementation - Population Weighted Emissions Index	2008 NEI v3 with some 2009 data
	Pb Monitoring Rule	2005 NEI v2
	Pb NAAQS final designations	2008 NEI v3
	Pb NAAQS Policy Assessment	Modified 2008 NEI v3
	Transport Rule air quality modeling (e.g., Clean Air Interstate Rule, Cross-State Air Pollution Rule)	2005 NEI v2
	State Implementation Plans – source of emissions data for regions outside of the state jurisdiction	2011 NEI v1
EPA – Air toxics	National Air Toxics Assessment (NATA)	Modified 2005 NEI, v2; will be updated with 2011 NEI
	Mercury and Air Toxics Standard – mercury risk assessment and Regulatory Impact Assessment	Modified 2005 NEI, v2
	Residual Risk and Technology Review – starting point for inventory development	2008 NEI v3
EPA - other	Inspector General – review of oil and gas industry	2008 NEI v1.5
	NEI booklet – analysis of emissions inventory data	2002 NEI v2
	Report on the Environment	2008 NEI v3
	Air Emissions website for providing graphical access to CAP emissions for state maps and Google Earth views of facility total emissions	2011 NEI v1
	Department of Transportation, national transportation sector summaries of CAPs	2008 NEI v1.5
	Black Carbon Report to Congress	Modified 2005 NEI, v2
Other federal or regional agencies	Western Regional Air Partnership – modeling in support of Regional Haze SIPs and other air quality issues	Modified 2008 NEI 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)	2005 NEI v2
	United Nations Environment Programme (UNEP) – global mercury program	2008 NEI, v2
	North American Commission for Environmental Cooperation (CEC) – North American Regional Action Plan (NARAP) on Mercury	Modified 2005 NEI, v2

### 1.7 What are appropriate uses of the 2011 NEI version 1 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 users 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 2010b (MOVES) model<sup>2</sup> for the on-road data category. Previous NEI years had used the Mobile Source Emission Factor Model, version 6 (MOBILE6)<sup>3</sup> and earlier versions of the MOBILE model for this data category. 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, 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<sub>2.5</sub> 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.

The spreadsheet "[2011neiv1\\_issues.xlsx](#)" provides a detailed listing of the issues that were identified during the course of the development of the 2011 NEI and the current status of those issues. This issues list is also available from the main 2011 NEI data page listed in Section 1.3.2.

In addition to the issues, users should take caution in using the emissions data for filterable and condensable components of particulate matter (PM<sub>10</sub>-FIL, PM<sub>2.5</sub>-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, 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 (PM<sub>10</sub>-PRI and PM<sub>25</sub>-PRI), described in this document simply as PM<sub>10</sub> and PM<sub>2.5</sub>.

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<sup>2</sup> See <http://www.epa.gov/otaq/models/moves/index.htm>

<sup>3</sup> See <http://www.epa.gov/otaq/m6.htm>



## 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 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 3 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 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 3:** EIS sectors and associated emissions categories and document sections

Sector name	Point	Nonpoint	On-road	Nonroad	Event	Document Section
Agriculture - Crops & Livestock Dust		<input checked="" type="checkbox"/>				0
Agriculture - Fertilizer Application		<input checked="" type="checkbox"/>				3.3
Agriculture - Livestock Waste	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>				3.4
Biogenics - Vegetation and Soil		<input checked="" type="checkbox"/>				6
Bulk Gasoline Terminals	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>				0

Sector name	Point	Nonpoint	On-road	Nonroad	Event	Document Section
Commercial Cooking		<input checked="" type="checkbox"/>				3.6
Dust - Construction Dust	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>				3.7
Dust - Paved Road Dust		<input checked="" type="checkbox"/>				3.8
Dust - Unpaved Road Dust		<input checked="" type="checkbox"/>				3.9
Fires - Agricultural Field Burning		<input checked="" type="checkbox"/>				5.2
Fires - Prescribed Burning					<input checked="" type="checkbox"/>	5.1
Fires - Wildfires					<input checked="" type="checkbox"/>	5.1
Fuel Comb - Comm/Institutional - Biomass	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>				3.12
Fuel Comb - Comm/Institutional - Coal	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>				3.12
Fuel Comb - Comm/Institutional - Natural Gas	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>				3.12
Fuel Comb - Comm/Institutional - Oil	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>				3.12
Fuel Comb - Comm/Institutional - Other	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>				3.12
Fuel Comb - Electric Generation - Biomass	<input checked="" type="checkbox"/>					3.10
Fuel Comb - Electric Generation - Coal	<input checked="" type="checkbox"/>					3.10
Fuel Comb - Electric Generation - Natural Gas	<input checked="" type="checkbox"/>					3.10
Fuel Comb - Electric Generation - Oil	<input checked="" type="checkbox"/>					3.10
Fuel Comb - Electric Generation - Other	<input checked="" type="checkbox"/>					3.10
Fuel Comb - Industrial Boilers, ICEs - Biomass	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>				3.11
Fuel Comb - Industrial Boilers, ICEs - Coal	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>				3.11
Fuel Comb - Industrial Boilers, ICEs - Natural Gas	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>				3.11
Fuel Comb - Industrial Boilers, ICEs - Oil	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>				3.11
Fuel Comb - Industrial Boilers, ICEs - Other	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>				3.11
Fuel Comb - Residential - Natural Gas		<input checked="" type="checkbox"/>				3.13
Fuel Comb - Residential - Oil		<input checked="" type="checkbox"/>				3.13
Fuel Comb - Residential - Other		<input checked="" type="checkbox"/>				3.13
Fuel Comb - Residential - Wood		<input checked="" type="checkbox"/>				3.13.4
Gas Stations	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>				3.15
Industrial Processes - Cement Manufacturing	<input checked="" type="checkbox"/>					3.16
Industrial Processes - Chemical Manufacturing	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>				3.17
Industrial Processes - Ferrous Metals	<input checked="" type="checkbox"/>					3.18
Industrial Processes - Mining	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>				3.19
Industrial Processes - NEC	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>				3.25
Industrial Processes - Non-ferrous Metals	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>				3.20
Industrial Processes - Oil & Gas Production	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>				3.21
Industrial Processes - Petroleum Refineries	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>				3.22
Industrial Processes - Pulp & Paper	<input checked="" type="checkbox"/>					3.23
Industrial Processes - Storage and Transfer	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>				3.24
Miscellaneous Non-Industrial NEC	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>				3.26
Mobile - Aircraft	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>				4.2

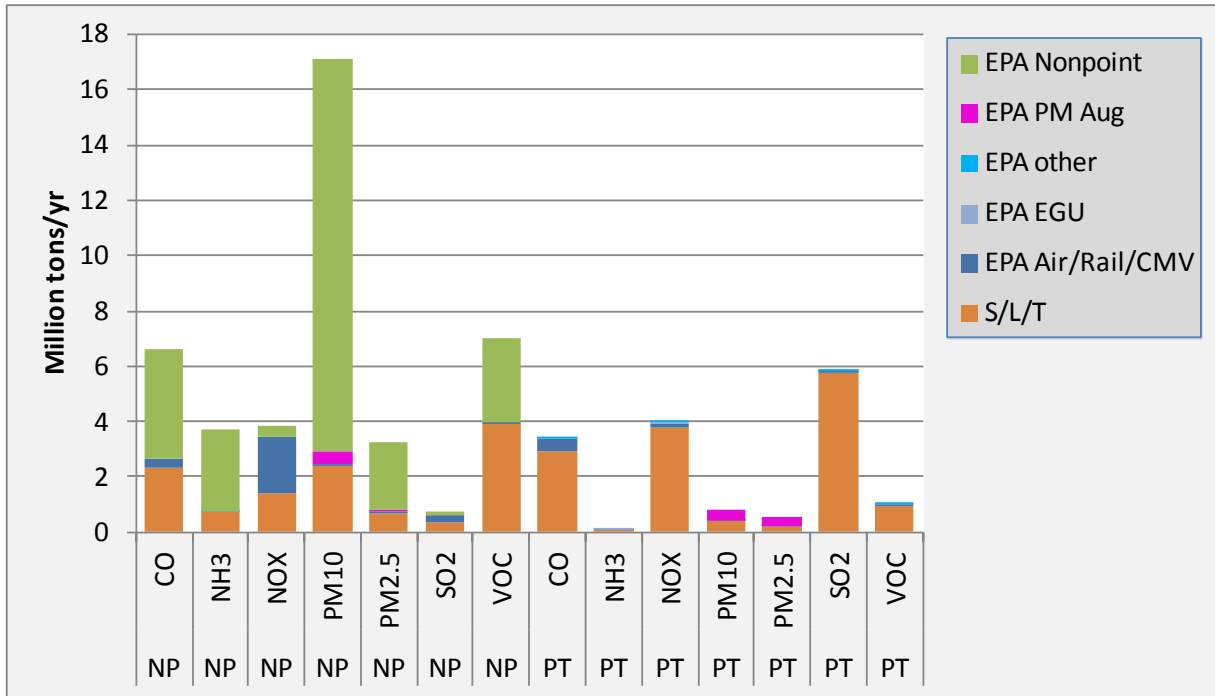
Sector name	Point	Nonpoint	On-road	Nonroad	Event	Document Section
Mobile - Commercial Marine Vessels		<input checked="" type="checkbox"/>				4.3
Mobile - Locomotives	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>				4.4
Mobile - Non-Road Equipment - Diesel	<input checked="" type="checkbox"/>			<input checked="" type="checkbox"/>		4.5
Mobile - Non-Road Equipment - Gasoline	<input checked="" type="checkbox"/>			<input checked="" type="checkbox"/>		4.5
Mobile - Non-Road Equipment - Other	<input checked="" type="checkbox"/>			<input checked="" type="checkbox"/>		4.5
Mobile - On-road – Diesel Heavy Duty Vehicles			<input checked="" type="checkbox"/>			4.6
Mobile - On-road – Diesel Light Duty Vehicles			<input checked="" type="checkbox"/>			4.6
Mobile - On-road – Gasoline Heavy Duty Vehicles			<input checked="" type="checkbox"/>			4.6
Mobile - On-road – Gasoline Light Duty Vehicles			<input checked="" type="checkbox"/>			4.6
Solvent - Consumer & Commercial Solvent Use		<input checked="" type="checkbox"/>				3.27
Solvent - Degreasing	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>				3.28
Solvent - Dry Cleaning	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>				3.28
Solvent - Graphic Arts	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>				3.28
Solvent - Industrial Surface Coating & Solvent Use	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>				3.29
Solvent - Non-Industrial Surface Coating		<input checked="" type="checkbox"/>				3.29
Waste Disposal	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>				3.30

## 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 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<sub>2</sub>. The large “EPA Nonpoint” bar for PM<sub>10</sub> 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<sub>2.5</sub> 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.

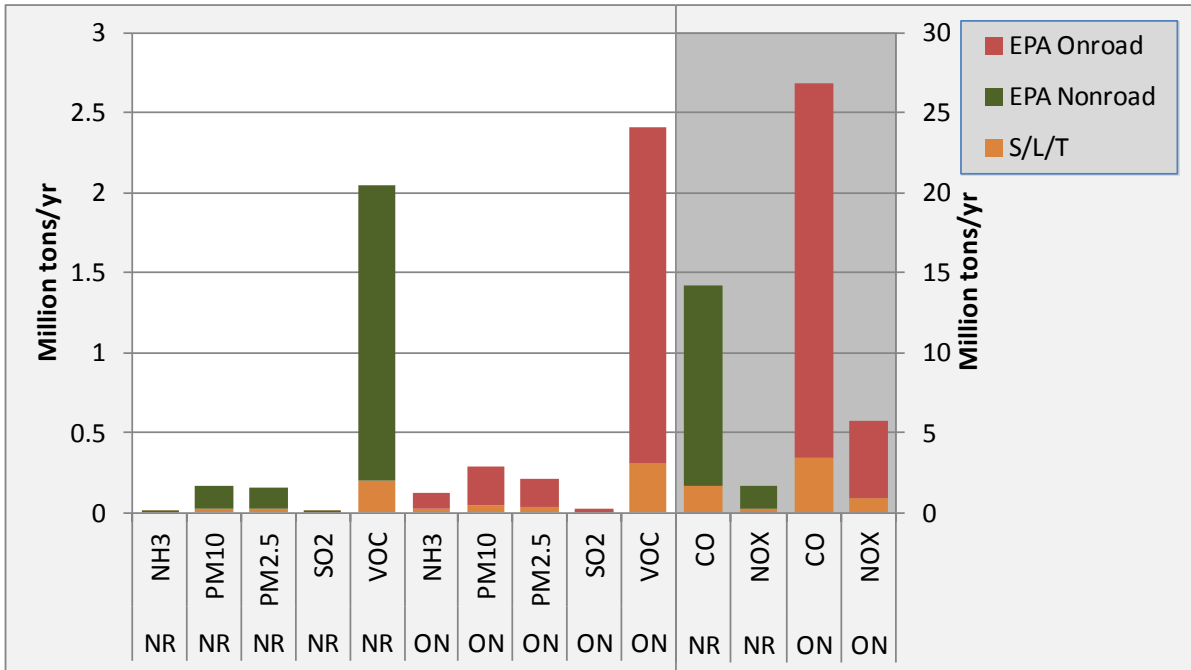
**Figure 1:** Data sources for point and nonpoint emissions for criteria pollutants



<sup>1</sup> Nonpoint emission shown here exclude biogenic sources, which are all EPA data

The data sources for the emissions from nonroad, on-road and event data categories are shown in Figure 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).

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



In Figure 3, the nonpoint acid gases are very small, with 6,700 tons from S/L/T agencies and 3,500 tons from the EPA nonpoint dataset. For point sources, the bulk of the acid gases emissions (primarily HCl) comes from two EPA EGU datasets (75,000 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 3:** Data sources of emissions for acid gases and HAP VOCs, by data category

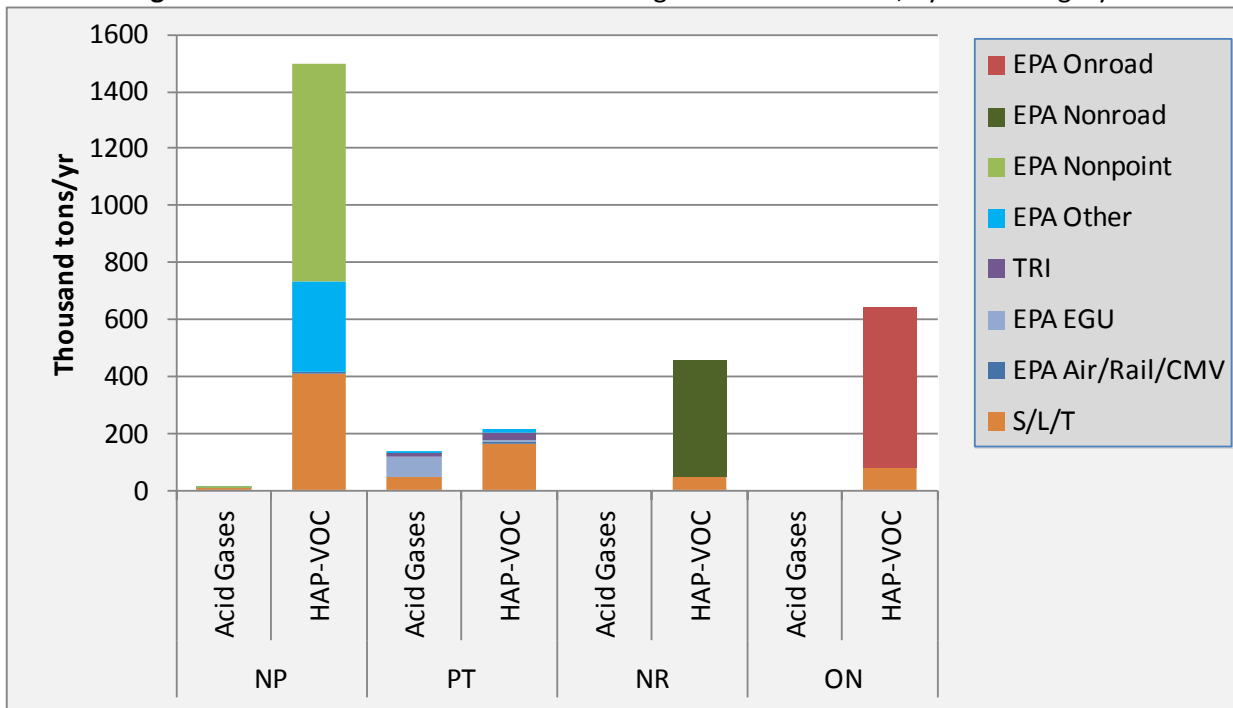
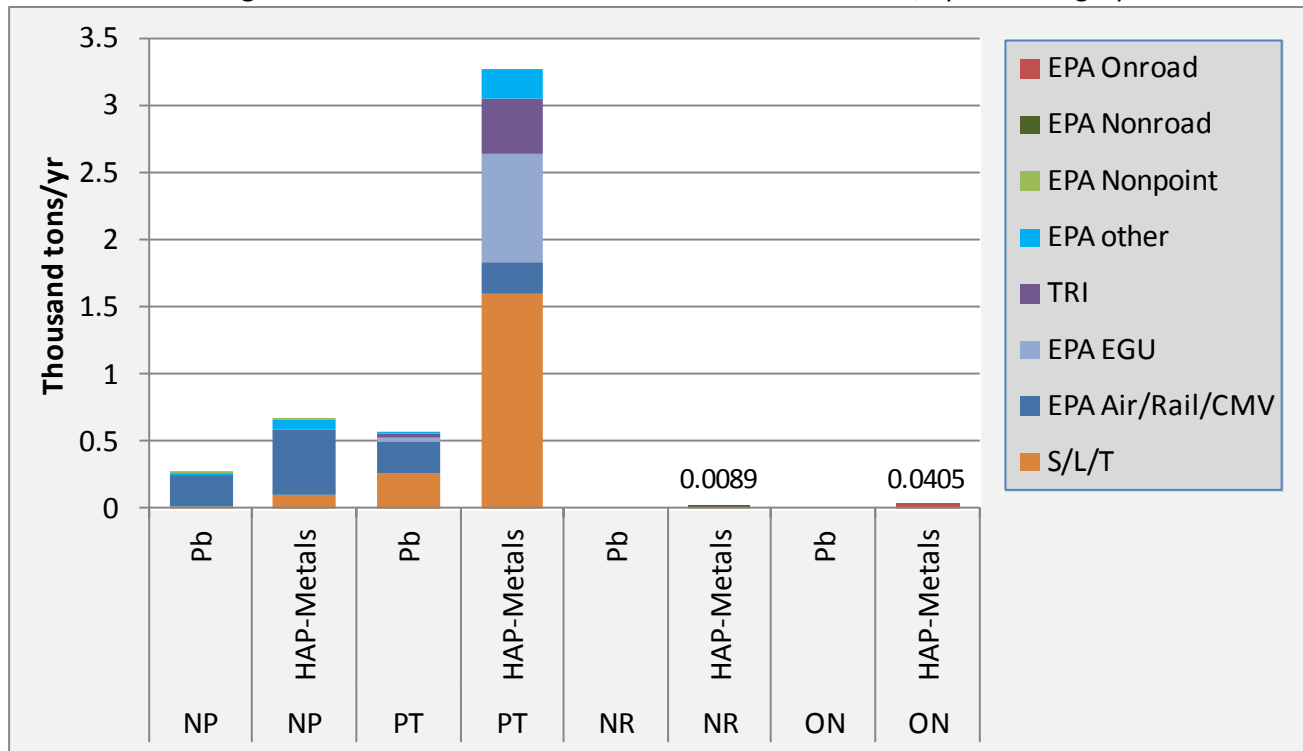


Figure 4 shows emissions sources for Pb and HAP metal emissions. For nonpoint sources, almost all of the emissions are from the EPA nonroad dataset, which includes emissions from airports, locomotives, and commercial marine vessels. For point sources, about half of the Pb comes from S/L/T agency data (260 tons), while the EPA nonroad dataset airport emissions makes up a substantial part of the rest (230 tons). For metals, the point sources data has a significant portion from S/L/T agencies (1,600 tons), with the rest from the EPA EGU dataset (800 tons), TRI (400 tons), and other EPA datasets (220 tons).

**Figure 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 actually 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 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<sup>4</sup>) submitted HAPs. Generally, when states submitted CAP emissions they submitted all of 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

<sup>4</sup> 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 1.1)

shown in Figure 5. Puerto Rico submitted point source CAP emissions for 2011. Virgin Islands did not emissions for any data category.

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

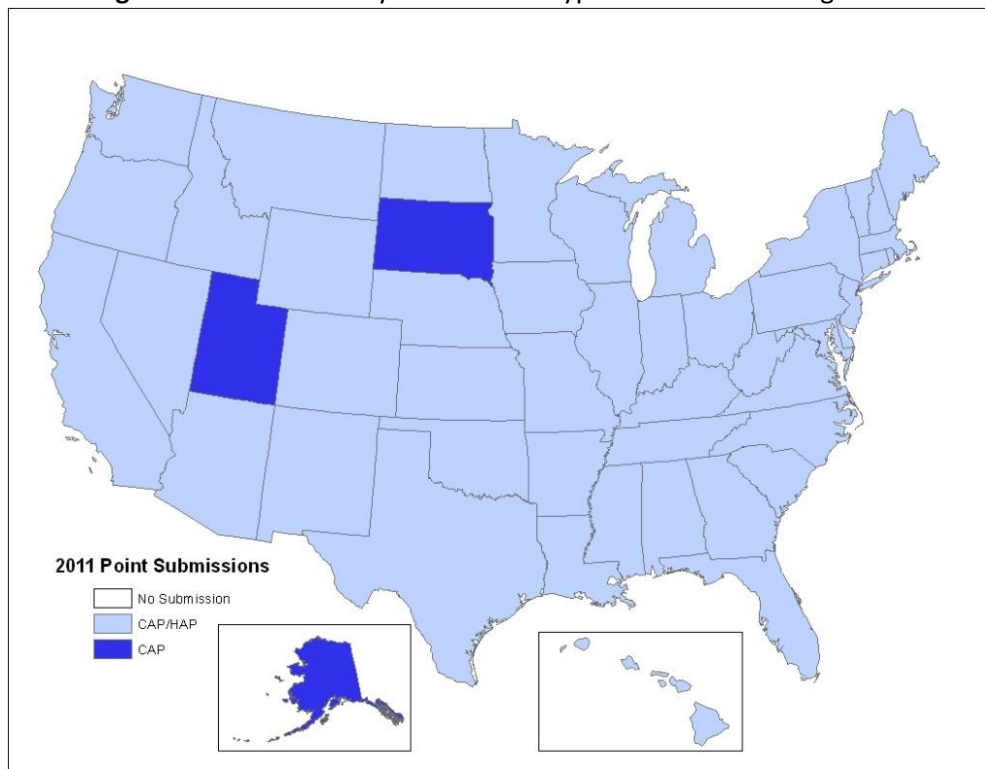
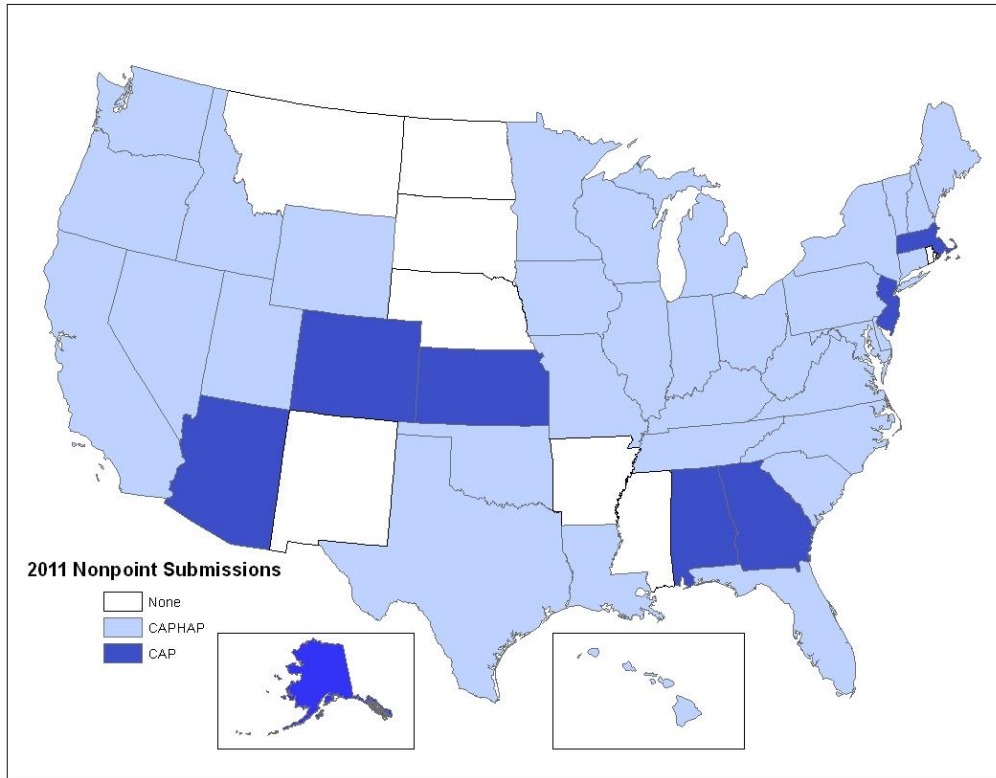


Figure 6 shows the states and/or local agencies that submitted nonpoint emissions. Forty-two states submitted CAPs and thirty-four also submitted HAPs. Only eight states did not submit any nonpoint emissions, and at least some of these notified EPA that EPA’s estimates were acceptable for the source 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.

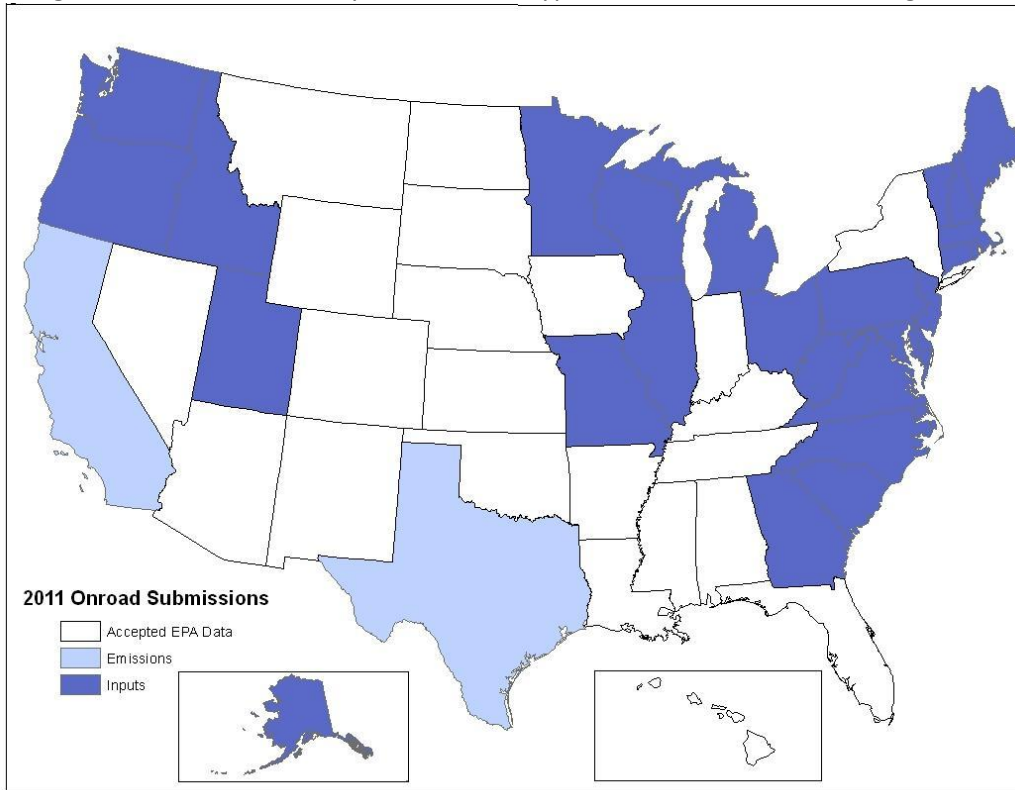
For on-road mobile sources, emissions in all states except California and Texas are based on the EPA’s run of the MOVES2010b model. California emissions are estimated by the EMFAC (short for Emission FACTor) model<sup>5</sup> and California has provided CAP and HAP emissions which are used in the 2011 NEI. Texas provided emissions using the MOVES2010b model. Figure 7 shows the states that submitted onroad model inputs, emissions or accepted EPA estimates. Several states provided consultation on representative counties (i.e., groups of counties that share emission factors), but those states were not counted in the map as having provided inputs in this figure. Section 4.6 has more detail and identifies the local agencies that submitted inputs.

<sup>5</sup> See “EMFAC Overview” link available at <http://www.arb.ca.gov/msei/onroad/background.htm>

**Figure 6: Nonpoint inventory – submission types – includes local agencies**



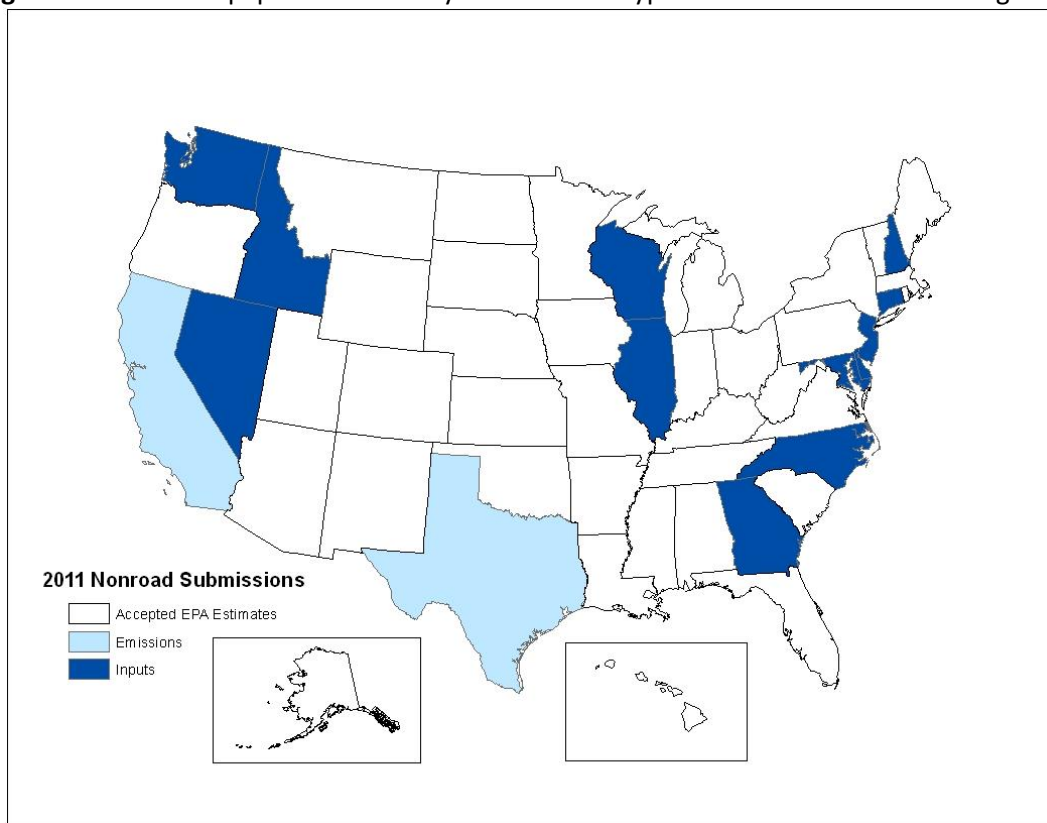
**Figure 7: On-road inventory – submission types – does not include local agencies**





As seen in Figure 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<sup>6</sup>. 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 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 of 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

<sup>6</sup> The OFFROAD model and documentation are available at <http://www.arb.ca.gov/msei/offroad/offroad.htm>.

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.

**Table 4: EIS sectors and associated CAP emissions and total HAP (1000 short tons/year)**

Sector	1000 short tons / year								Total HAP <sup>1</sup>
	CO	VOC	NO <sub>x</sub>	SO <sub>2</sub>	PM <sub>2.5</sub>	PM <sub>10</sub>	NH <sub>3</sub>	Lead	
Agriculture - Crops & Livestock Dust					897	4,506			
Agriculture - Fertilizer Application							1,185		
Agriculture - Livestock Waste	0.14	56	0.13	8.45E-03	0.22	0.50	2,344		0.04
Bulk Gasoline Terminals	0.70	153	0.31	4.04E-03	0.02	0.02	0.02	8.33E-04	7.39
Commercial Cooking	31	13			84	88			5.26
Dust - Construction Dust	0.02	0.02	0.02	7.14E-04	163	1,509			0.05
Dust - Paved Road Dust					270	1,134			
Dust - Unpaved Road Dust					832	8,329			
Fires - Agricultural Field Burning	1,443	112	65	27	141	225	3.47	4.50E-04	80
Fires - Prescribed Fires	10,308	2,375	171	85	921	1,085	166		261
Fires - Wildfires	14,494	3,320	195	105	1,267	1,493	233		322
Fuel Comb - Comm/Institutional - Biomass	23	0.64	8.51	1.08	11	13	0.13	3.49E-04	0.26
Fuel Comb - Comm/Institutional - Coal	6.63	0.22	17	60	1.40	3.69	0.06	2.42E-03	1.70
Fuel Comb - Comm/Institutional - Natural Gas	112	10	153	1.61	5.94	6.17	1.55	2.36E-03	1.47
Fuel Comb - Comm/Institutional - Oil	17	2.03	70	58	6.77	8.09	0.75	8.39E-04	0.15
Fuel Comb - Comm/Institutional - Other	8.58	0.91	7.51	1.23	0.63	0.66	0.02	2.91E-04	0.12
Fuel Comb - Electric Generation - Biomass	21	0.75	11	2.36	1.87	2.18	0.97	0.001	2.14
Fuel Comb - Electric Generation - Coal	615	25	1,793	4,526	167	237	9.05	0.04	93
Fuel Comb - Electric Generation - Natural Gas	101	9.82	172	5.87	25	26	11	8.18E-04	3.63
Fuel Comb - Electric Generation - Oil	13	2.30	95	76	5.87	7.99	1.09	1.44E-03	0.51
Fuel Comb - Electric Generation - Other	34	3.25	26	20	2.55	2.89	2.94	1.58E-03	1.15
Fuel Comb - Industrial Boilers, ICEs - Biomass	247	8.69	106	23	105	123	2.48	8.16E-03	5.70
Fuel Comb - Industrial Boilers, ICEs - Coal	46	1.37	174	483	21	60	0.87	0.01	16
Fuel Comb - Industrial Boilers, ICEs - Natural Gas	344	65	691	17	26	27	6.32	3.62E-03	22
Fuel Comb - Industrial Boilers, ICEs - Oil	29	3.17	105	100	8.80	11	0.61	3.23E-03	0.55
Fuel Comb - Industrial Boilers, ICEs - Other	122	7.77	57	53	24	26	1.09	3.84E-03	3.04
Fuel Comb - Residential - Natural Gas	94	13	219	1.44	4.24	4.41	41	1.06E-04	0.97
Fuel Comb - Residential - Oil	11	1.42	43	92	4.52	5.18	2.12	3.01E-03	0.10
Fuel Comb - Residential - Other	61	3.09	41	9.41	0.99	1.45	0.48	7.97E-06	0.27
Fuel Comb - Residential - Wood	2,588	449	36	9.01	390	390	20	2.10E-04	75
Gas Stations	0.03	644	0.02	1.51E-03	1.45E-03	1.54E-03	2.13E-04	3.75E-04	81
Industrial Processes - Cement Manuf	76	4.32	117	60	6.48	12	0.91	3.79E-03	2.31
Industrial Processes - Chemical Manuf	185	92	74	133	19	24	24	4.40E-03	29
Industrial Processes - Ferrous Metals	417	17	56	28	29	35	0.22	0.06	1.94
Industrial Processes - Mining	32	1.66	34	2.07	74	487	0.11	6.10E-03	0.75
Industrial Processes - NEC	207	195	177	137	89	148	47	0.06	46
Industrial Processes - Non-ferrous Metals	331	15	15	103	16	20	0.52	0.08	9.49
Industrial Processes - Oil & Gas Production	668	2,445	678	73	19	24	0.11	1.06E-04	54
Industrial Processes - Petroleum Refineries	50	56	74	85	22	25	2.82	2.94E-03	6.28
Industrial Processes - Pulp & Paper	107	117	71	32	33	41	5.83	3.63E-03	51
Industrial Processes - Storage and Transfer	19	231	15	8.79	18	50	5.72	0.01	14
Miscellaneous Non-Industrial NEC	11	202	2.71	0.23	2.05	2.19	2.74	5.32E-04	22
Mobile - Aircraft	424	30	111	14	7.34	8.63		0.49	8.24
Mobile - Commercial Marine Vessels	85	15	505	65	17	18	0.24	1.65E-03	1.95
Mobile - Locomotives	131	46	862	8.52	26	28	0.37	2.24E-03	5.01
Mobile - Non-Road Equipment - Diesel	726	130	1,291	2.88	101	104	1.19	1.05E-05	29
Mobile - Non-Road Equipment - Gasoline	12,886	1,912	253	1.10	54	59	0.86		429
Mobile - Non-Road Equipment - Other	708	27	112	0.70	2.08	2.08	0.61		0.09
Mobile - On-Road Diesel Heavy Duty Vehicles	887	213	2,774	4.26	130	149	6.00		42
Mobile - On-Road Diesel Light Duty Vehicles	44	8.98	64	0.12	3.92	4.46	0.35		1.57
Mobile - On-Road Gasoline Heavy Duty Vehicles	1,947	122	231	1.31	3.42	6.64	4.70		33
Mobile - On-Road Gasoline Light Duty Vehicles	23,929	2,069	2,717	23	71	130	109		564
Solvent - Consumer & Commercial Solvent Use	0.03	1,676	0.01	7.70E-03	0.01	0.02			809
Solvent - Degreasing	7.16E-03	144	4.94E-03	4.55E-04	0.06	0.06	0.03	7.48E-05	23
Solvent - Dry Cleaning	1.88E-04	11			5.73E-04	5.73E-04	4.15E-05		66
Solvent - Graphic Arts	0.14	75	0.15	0.01	0.17	0.18	0.08	7.21E-05	7.57

Sector	1000 short tons / year								Total HAP <sup>1</sup>
	CO	VOC	NO <sub>x</sub>	SO <sub>2</sub>	PM <sub>2.5</sub>	PM <sub>10</sub>	NH <sub>3</sub>	Lead	
Solvent - Industrial Surface Coating & Solvent Use	3.43	576	2.32	0.43	3.78	4.23	0.59	3.63E-03	199
Solvent - Non-Industrial Surface Coating		334					0.02		167
Waste Disposal	1,116	126	84	17	172	201	67	0.01	32
<b>Sub Total (no federal waters)</b>	<b>75,760</b>	<b>18,169</b>	<b>14,574</b>	<b>6,557</b>	<b>6,306</b>	<b>20,907</b>	<b>4,316</b>	<b>0.82</b>	<b>3,641</b>
Fuel Comb - Industrial Boilers, ICEs - Natural Gas	78	1.42	64	0.04	0.38	0.38			
Fuel Comb - Industrial Boilers, ICEs - Oil	1.83	0.35	7.55	0.72	0.33	0.34			
Fuel Comb - Industrial Boilers, ICEs - Other	5.02E-03	3.06E-04	4.47E-03	2.84E-05	9.69E-05	9.69E-05			
Industrial Processes - Oil & Gas Production	1.85	58	2.31	0.27	0.06	0.06			
Industrial Processes - Storage and Transfer		0.91							
Mobile - Commercial Marine Vessels	129	34	1,035	223	36	38	0.34	2.32E-03	1.66
<b>Sub Total (federal waters)</b>	<b>211</b>	<b>95</b>	<b>1,110</b>	<b>224</b>	<b>36</b>	<b>39</b>	<b>0.34</b>	<b>2.32E-03</b>	<b>1.66</b>
<b>Sub Total (all but vegetation and soil)</b>	<b>75,971</b>	<b>18,264</b>	<b>15,684</b>	<b>6,781</b>	<b>6,342</b>	<b>20,946</b>	<b>4,316</b>	<b>0.82</b>	<b>3,643</b>
Biogenics - Vegetation and Soil <sup>2</sup>	6,528	39,653	1,018						5,101
<b>Total</b>	<b>82,499</b>	<b>57,917</b>	<b>16,702</b>	<b>6,781</b>	<b>6,342</b>	<b>20,946</b>	<b>4,316</b>	<b>0.82</b>	<b>8,744</b>

<sup>1</sup> Total HAP does not include diesel PM, which is not a HAP listed by the Clean Air Act

<sup>2</sup> 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 exist, 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, and 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, polycyclic organic matter, glycol ethers and polychlorinated biphenyls. We also required PM<sub>10</sub> to be greater than or equal to PM<sub>2.5</sub>, and we required PM<sub>10</sub> to be reported if PM<sub>2.5</sub> was reported for the same process. If either of these criteria were not met (HAP group, or PM<sub>10</sub> vs PM<sub>2.5</sub> magnitude) then none of the pollutants submitted for

the process were allowed into 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 EIS. This allowed EPA to tag suspect data and communicate it using 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 11 and Table 12 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 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 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 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 EIS, S/L agencies submitted on-road inputs in the form of MOVES county database files. Prescribed and wildfire inputs were collected outside of EIS. For nonroad mobile sources, we encouraged S/L agencies to provide inputs to NMIM via 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 PM<sub>2.5</sub>-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<sub>10</sub> through PM Augmentation of the MATS PM<sub>2.5</sub> data and used the resultant EFs along with 2011 heat input to estimate PM<sub>10</sub> emissions for the tested units. The EPA data were used ahead of the S/L/T PM<sub>2.5</sub> and PM<sub>10</sub> 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 EIS. We assigned an SCC code based on the SCC codes used for CAPS (see 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<sup>7</sup>), 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**

This section presents a comparison from the 2008 NEI v3 to the 2011 NEI. Figure 9 through Figure 13 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 10 and in Figure 13. 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 9 and Figure 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. Table 5 and Table 6 show the emission changes for CAPs and HAPs respectively, for each pollutant/sector combination.

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<sup>7</sup> 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.

**Table 5:** Emission differences for CAPs as shown in Figures 9 and 10

Emissions Sum Difference (tons)						
<i>Total Sum Difference excludes wildfire</i>	(77,004)	(2,449,635)	(9,037)	(4,056,146)	(115,749)	(6,173,841)
<b>Sector</b>	<b>NH<sub>3</sub></b>	<b>NO<sub>x</sub></b>	<b>PM<sub>2.5</sub></b>	<b>SO<sub>2</sub></b>	<b>VOC</b>	<b>CO</b>
<b>Miscellaneous</b>	(60,341)	60,093	184,117	39,268	628,277	2,583,264
<b>Fuel Combustion</b>	1,325	(1,125,840)	(1,958)	(3,501,010)	78,299	265,022
<b>Industrial Processes</b>	507	172,529	(85,621)	(220,475)	201,381	246,710
<b>Nonroad Mobile</b>	(441)	(400,552)	(61,600)	(363,474)	(384,929)	(2,920,106)
<b>Highway Vehicle</b>	(18,054)	(1,155,865)	(43,974)	(10,454)	(638,778)	(6,348,731)
<b>Fires - Wildfires</b>	34,794	98,584	268,197	35,234	473,833	2,293,543
	<b>NH<sub>3</sub></b>	<b>NO<sub>x</sub></b>	<b>PM<sub>2.5</sub></b>	<b>SO<sub>2</sub></b>	<b>VOC</b>	<b>CO</b>
Pollutant Percent Difference 2011 to 2008						
<i>Total % Difference excludes wildfire</i>	-2	-14	-0.2	-38	-1	-9

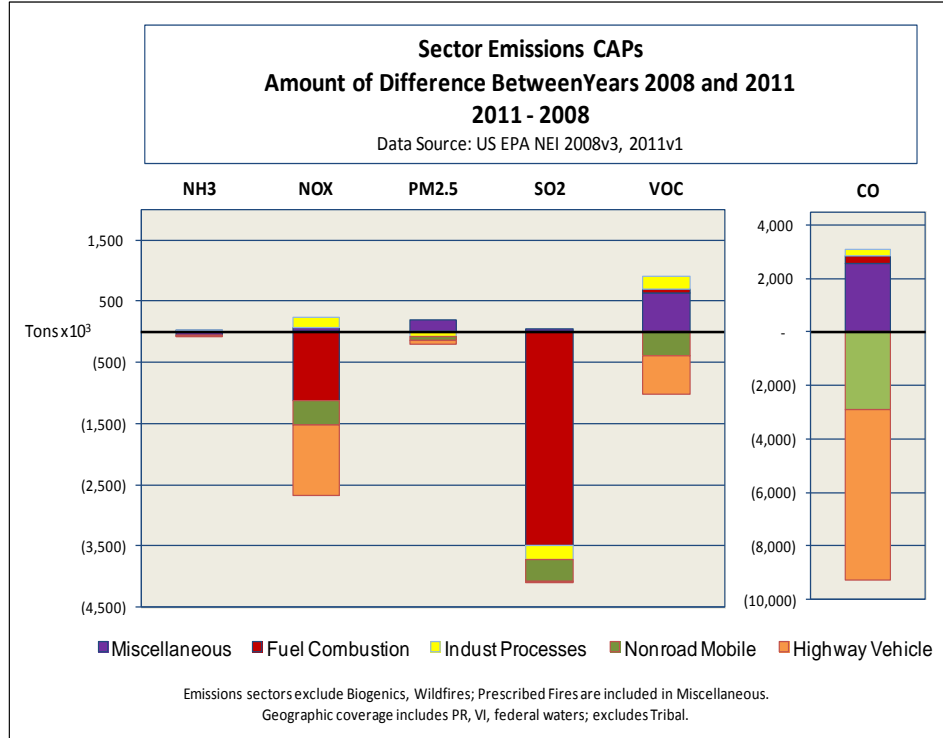
**Table 6:** Emission Sum Differences for HAP Emissions 2011-2008 as shown in Figure 11 through Figure 13

Emissions Sum Difference (tons)										
<i>Total Sum Difference excludes wildfire</i>	(17,460)	16,384	860	60,730	63,281	650	3,098	(98)	(28)	(130)
<b>Sector</b>	<b>Ethyl Benzene</b>	<b>Acetaldehyde</b>	<b>Acrolein</b>	<b>Formaldehyde</b>	<b>Tetrachloroethylene</b>	<b>1,4-Dichlorobenzene</b>	<b>1,3-Butadiene</b>	<b>Chromium Compounds</b>	<b>Arsenic</b>	<b>Lead</b>
<b>Miscellaneous</b>	2,404	20,513	391	64,279	19	(2)	7,773	(50)	0	0
<b>Fuel Combustion</b>	24	2,040	387	4,473	(11)	1	269	(54)	(20)	(30)
<b>Industrial Processes</b>	2,163	(1,025)	442	3,517	63,274	651	110	14	0	(32)
<b>Nonroad Mobile</b>	(8,502)	(2,847)	(31)	(6,851)	(1)	-	(2,380)	(8)	(8)	(68)
<b>Highway Vehicle</b>	(13,549)	(2,296)	(329)	(4,688)	-	-	(2,675)	(0)	0	-
<b>Fires - Wildfires</b>	-	7,388	7,673	46,599	-	-	7,329	-	-	-
Pollutant Percent Difference 2011 to 2008										
<i>Total % Difference excludes wildfires</i>	-19	19	3	28	1080	56	8	-17	-19	-14

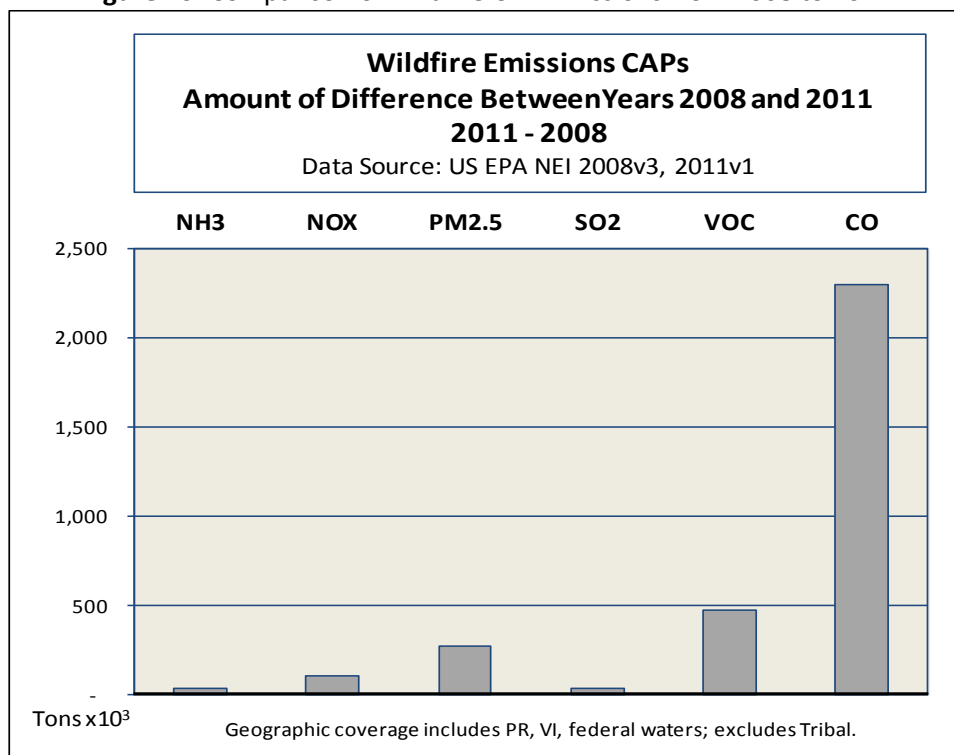
CAP emissions are overall lower in 2011 than in 2008, though some specific sector/pollutants increased in 2011 from 2008. Except for wildfires, the increases in NO<sub>x</sub>, PM<sub>2.5</sub>, VOC and CO are off-set by more substantial decreases to result in an overall emissions decrease. Mobile source 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<sub>2.5</sub>, SO<sub>2</sub>, CO, NO<sub>x</sub>, VOC); waste disposal (CO); prescribed fires (CO, VOC)
- Fuel Combustion – biomass (CO, VOC)
- Industrial Processes – oil and gas production (VOC, CO, NO<sub>x</sub>).

**Figure 9:** Comparison of CAP Emissions from 2008 to 2011, Excluding Wildfires and Biogenics



**Figure 10: Comparison of Wildfire CAP Emissions from 2008 to 2011**



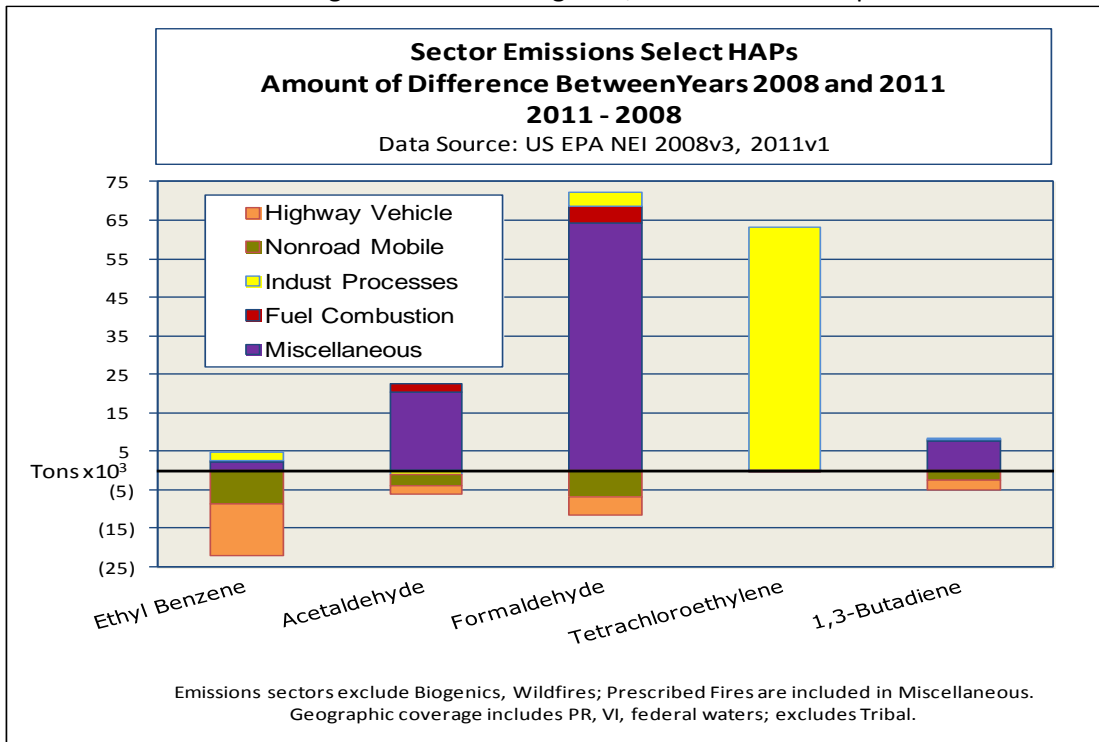
For the select HAPs reviewed, Table 6 and Figure 12 indicate that emissions are higher overall for sectors except for slight decreases for the metals (chromium, arsenic, and lead) and a more substantial decrease for ethylbenzene. With the exception of the metals shown and ethylbenzene, sector decreases 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. Note that Figure 11 and Figure 12 use different scales for emissions. Figure 11 is in thousands of tons and Figure 12 is in tons. Figure 13 is also in thousands of tons. HAP emission increases in sectors, include the following:

- Miscellaneous - agricultural field burning (formaldehyde, acetaldehyde, 1,3-butadiene); prescribed fires (formaldehyde, acetaldehyde, 1,3-butadiene, acrolein); gas stations (ethyl benzene)
- Industrial Processes – solvent dry cleaning (tetrachloroethylene—which was found to be an error due to EPA’s HAP augmentation and is on the version 1 issues list); industrial surface coating and solvent use (ethyl benzene); consumer and commercial solvent use (1,4-dichlorobenzene, tetrachloroethylene)
- Fuel Combustion – biomass and natural gas (formaldehyde, acrolein).

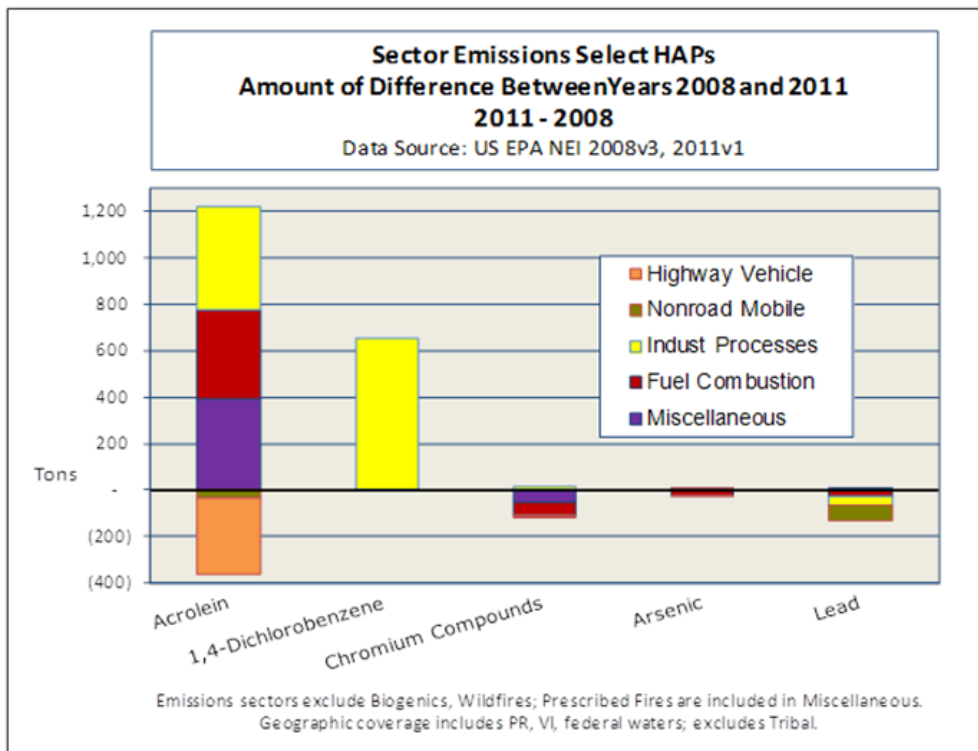
Additional information about sources within each sector that drive the decrease or increase observed by pollutant / sector combination, including where some differences are also due to method changes – are described in this draft technical support document, or will be included in the EPA’s “2011 NEI Report”.



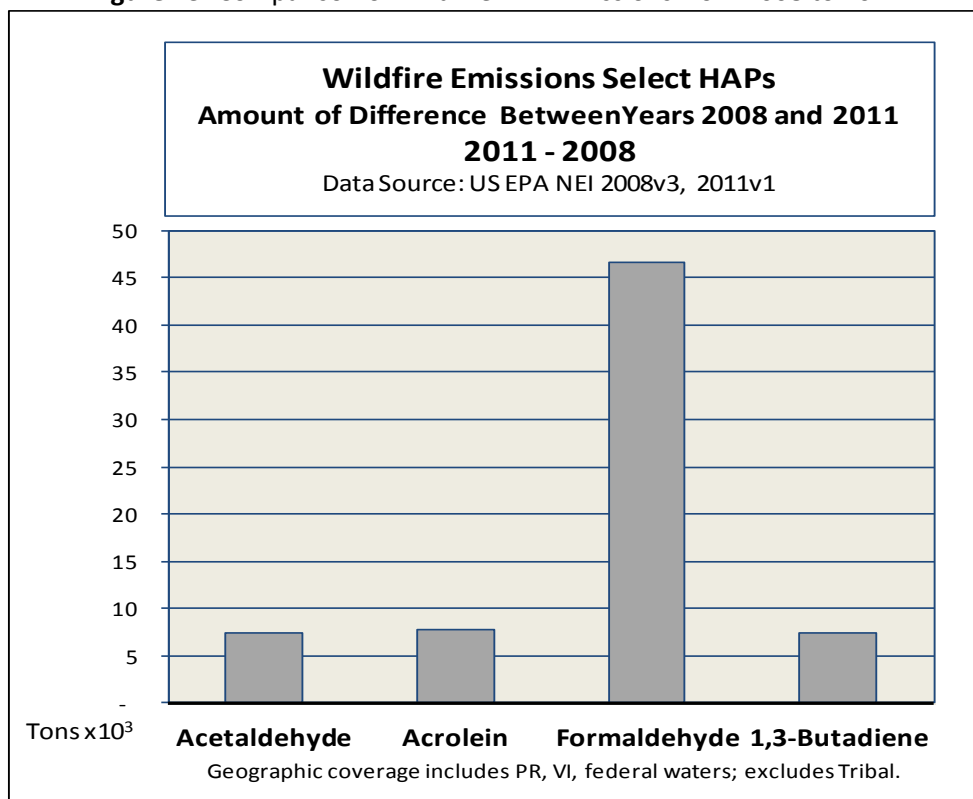
**Figure 11:** Comparison of Select HAP Emissions from 2008 to 2011, Excluding Wildfires and Biogenics, Select HAPs- Group 1



**Figure 12:** Comparison of Select HAP Emissions from 2008 to 2011, Excluding Wildfires and Biogenics, Select HAPs- Group 2



**Figure 13:** Comparison of Wildfire HAP Emissions from 2008 to 2011



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

Thirteen tribes submitted data to EIS for 2011 as shown in Table 7. 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 7 with just a CAP flag will also have some HAP emissions in most cases.

Six additional tribes, shown in Table 8, 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 include 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 7: Tribal Participation in the 2011 NEI**

Tribe	Point	Nonpoint	Onroad*	Nonroad*
Coeur d'Alene Tribe of the Coeur d'Alene Reservation, Idaho	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			
Kootenai Tribe of Idaho		CAP, HAP	CAP, HAP	CAP, HAP
Navajo Nation, Arizona, New Mexico & Utah	CAP			
Nez Perce Tribe of Idaho	CAP, HAP	CAP, HAP	CAP, HAP	CAP, HAP
Northern Cheyenne Tribe of the Northern Cheyenne Indian Reservation, Montana		CAP		
Paiute-Shoshone Indians of the Bishop Community of the Bishop Colony, California		CAP, HAP		
Sac & Fox Nation of Missouri in Kansas and Nebraska		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			

\* 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 EIS.

**Table 8: 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?

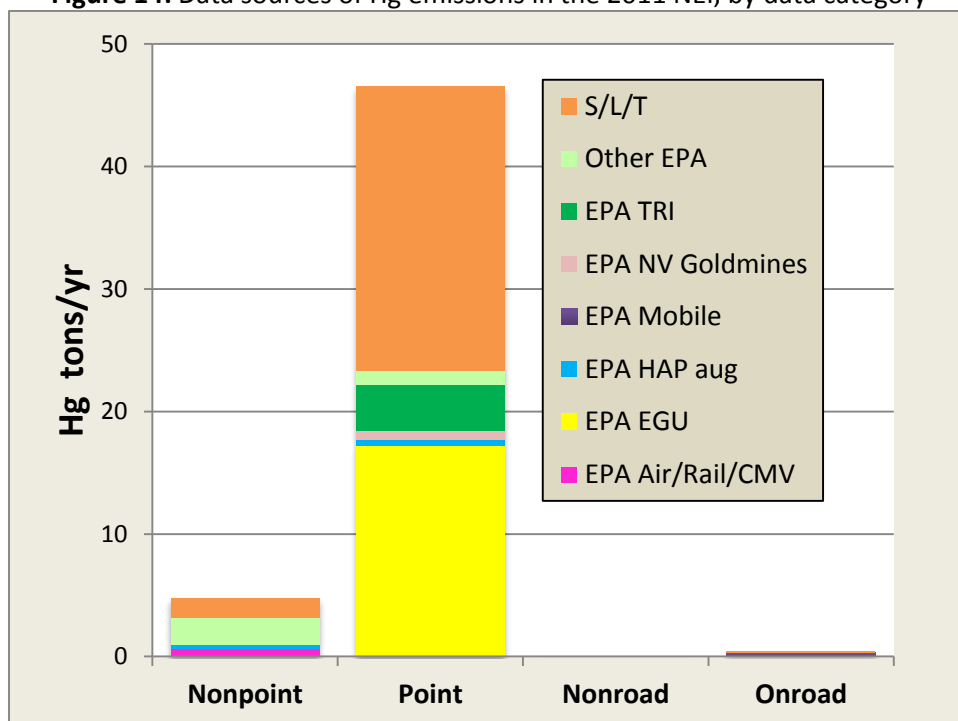
This documentation includes this Hg section because of the importance of this pollutant and because the sectors used to categorize Hg are different than the sectors presented for the other pollutants. The Hg sectors primarily focus on regulatory categories and categories of interest to the international community.

Hg emission estimates in the 2011 NEI sum to 52 tons with 50.5 tons from stationary sources and 1.2 tons from mobile sources. Of the stationary source emissions, the inventory shows that 25.5 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 (25.4 tons) of that total. The other sources of emissions are summarized below for the special Hg sectors.

We used a variety of data sources to create the 2011 NEI Hg inventory, as shown Figure 14 below. The datasets are described in more detail starting in Section 3.1.1, and we highlight some key datasets here. For EGUs, we used an approach developed for the Mercury and Air Toxics Standards (MATS) rule during 2011<sup>8</sup>, and used 2011-specific activity. The MATS-based data are labeled “EPA EGU” in the figure; all of 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 reported the calculation method to be based either on continuous emissions monitors (CEMs) or test data. In addition, S/L/T 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 0), and other EPA data developed for gap filling (see Section 3.1.1).

**Figure 14:** Data sources of Hg emissions in the 2011 NEI, by data category



In addition to Figure 14, Table 9 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.

<sup>8</sup> 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, available at [http://www.epa.gov/ttn/atw/utility/emis\\_overview\\_memo\\_matsfinal.pdf](http://www.epa.gov/ttn/atw/utility/emis_overview_memo_matsfinal.pdf), or at Docket number EPA-HQ-OAR-2009-0234

**Table 9:** Datasets, groups, and amount of Hg in 2011 NEI from each

<b>Data Category</b>	<b>Dataset Short name</b>	<b>Mercury Emissions (tons/yr)</b>	<b>Grouped Data Source for Chart</b>
Nonpoint	2011EPA_NP_NoOvrlp	2.3	Other EPA
	S/L/T	1.6	S/L/T
	2011EPA_Rail	0.59	EPA Air/Rail/CMV
	2011EPA_HAP-Aug	0.32	EPA HAP aug
	2011EPA_CMV	0.02	EPA Air/Rail/CMV
	2011EPA_NP_Ovrlp	0.01	Other EPA
Point	S/L/T	23.2	S/L/T
	2011EPA_EGU	17.2	EPA EGU
	2011EPA_TRI	3.7	EPA TRI
	2011_NVGLD	0.8	EPA NV Goldmines
	2011EPA_CarryForward	0.72	Other EPA
	2011EPA_HAP-Aug	0.4	EPA HAP aug
	2011EPA_Other	0.39	Other EPA
	2011EPA_Rail	0.05	EPA Air/Rail/CMV
	2011 EPA Landfills	0.01	Other EPA
Nonroad	S/L/T	0.03	S/L/T
	2011_EPA_Mobile	0.02	EPA Mobile
Onroad	2011_EPA_Mobile	0.29	EPA Mobile
	S/L/T	0.11	S/L/T

Since mercury is a HAP, it is reported voluntarily by S/L/T agencies. For the 2011 NEI, 42 states reported point source Hg emissions; Figure 15 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 9 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 data except where the S/L/T 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 data were from a source test or CEMS.

**Figure 15:** States with state- or local-provided Hg emissions in the point data category of the 2011 NEI

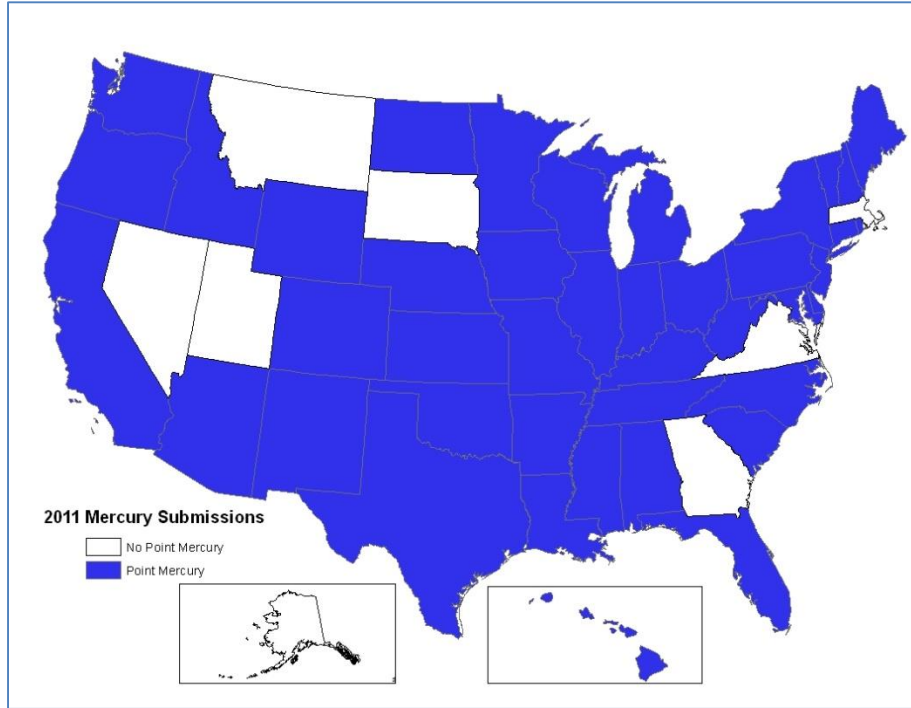


Table 10 shows the 2011 NEI mercury emissions for the key categories of interest in comparison to 1990. Also shown are the most recent 2005 emissions, which were used in support of the MATS rule. The Microsoft® 2007 ACCESS® database included in the zip file 2011nei\_supdata\_mercury.zip at <ftp://ftp.epa.gov/EmisInventory/2011/doc/> 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 10:** Trends in Mercury Emissions – 1990, 2005, 2008 and 2011

Source Category	1990 (tpy) Baseline NEI for HAPs, 11/14/2005	2005(tpy) MATS proposal 3/15/2011	2008 (tpy) 2008 NEIv3	2011 (tpy) 2011 NEIv1	Categorization Approach
Utility Coal Boilers (Electricity Generation Units – EGUs, combusting coal)	58.8	52.2	29.4	25.4	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	3.8	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 NEI for HAPs, 11/14/2005	2005(tpy) MATS proposal 3/15/2011	2008 (tpy) 2008 NEIv3	2011 (tpy) 2011 NEIv1	Categorization Approach
Electric Arc Furnaces	7.5	7.0	4.8	5.3	Regulatory code: Area Source rule for "Stainless & Non-stainless Steel Manufacturing: Electric Arc Furnaces" plus 2 major sources that have EAFs
Commercial/Industrial Solid 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	0.8	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	1.2	Sum of all of onroad, nonroad, locomotives and commercial marine vessels (locomotives and marine used SCC code)
Other Categories	29.5	18	10.7	9.5	
<b>Total (all categories)</b>	<b>246</b>	<b>105</b>	<b>61</b>	<b>52</b>	

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 10, 2011 mercury emissions are 9 tons lower than in the 2008. Four tons of this difference is due to lower mercury emissions from EGUs covered by MATS; two 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<sub>2</sub> 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<sub>2</sub>.

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 chloralkali 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 EIS. The EFs are provided in the file `electric_arc_furnace_testbased_efs.zip` at <ftp://ftp.epa.gov/EmisInventory/2011/doc/>; 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 nonEGU 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 other datasets developed by EPA.

The MWC 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 or TRI data were not available. These data were put into the EIS dataset "2011EPA\_CarryForward".



## 3 Stationary sources

### 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 11 and Table 12 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 (2008 MMS 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-reported pollutant submissions for PM (Section 3.1.2) and to speciate S/L/T 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 data were tagged for two reasons: 1) if they were deemed to be likely outliers and were not addressed during the S/L/T data reviews, 2) to set the hierarchy to use the Mercury and Air Toxics Standard (MATS) data ahead of the S/L/T data where the S/L/T 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”<sup>9</sup>.

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<sup>9</sup> 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 or at: [http://www.epa.gov/ttn/chief/net/neip/appendix\\_6.mdb](http://www.epa.gov/ttn/chief/net/neip/appendix_6.mdb).

**Table 11:** Data sources and selection hierarchy used for point sources

Dataset name (Short name <sup>λ</sup> 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 emissions are not used is where tagged in 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 data except where S/L/T data were from source test or continuous emission monitors and 2) where S/L/T 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 <sub>2</sub> and NO <sub>x</sub> 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 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 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 ( <a href="http://ndep.nv.gov/bapc/hg/aer.html">http://ndep.nv.gov/bapc/hg/aer.html</a> ) – early copy of the data emailed by Adele Malone, Nevada Division of Environmental Protection, 11/05/2012	5
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 EIS by states and EFs from the ICR test program or S/L/T 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

Dataset name (Short name <sup>λ</sup> provided if different)	Description and Rationale for the Order of the Selected Datasets	Order
2011EPA_TRI	Toxics Release Inventory data for the year 2011. (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 12).	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 in the 2011 reporting year.	10
2011EPA_CarryForward- PreviousYearData (2011EPA_CarryForward)	Variety of estimates used to gap fill important sources/pollutants: 1) coke oven missing from S/L/T 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 0. 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
2008 MMS Data	Same data as were used in 2008: 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 (Wilson et. al, 2010) in the National Inventory Input Format and converted to the CERS format by EPA. See also <a href="http://www.gomr.boemre.gov/homepg/regulate/environ/airquality/gulfwide_emission_inventory/2008GulfwideEmissionInventory.html">http://www.gomr.boemre.gov/homepg/regulate/environ/airquality/gulfwide_emission_inventory/2008GulfwideEmissionInventory.html</a> . The state code for data from this data set is "DM" (Federal Waters).	13
<p><b>Exceptions to the hierarchy</b></p> <p>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.</p>		

<sup>λ</sup> The dataset short name is the name that EIS will list in its process-level reports

**Table 12:** Data sources and selection hierarchy used for nonpoint sources

<b>Dataset name (Short Name<sup>λ</sup> provided if different)</b>	<b>Description and Rationale for the Order of the Selected Datasets</b>	<b>Order</b>
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 emissions are not used is where tagged in 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 data where states asked for EPA data to be used in place of their data and 2) where S/L/T data were suspected outliers.	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. 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).	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 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 data so that the S/L/T agency HAP data are used first.	4
2011EPA_CMV	EPA commercial marine vessel emissions estimates. See Section 4.3.	5
2011EPA_Rail	EPA locomotive (referred to as “rail” in this document) emissions estimates. See Section 4.4.	6
2011EPA_NP_NoOverlap_w_Pt (2011EPA_NP_NoOverlap)	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, 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).	7
2011EPA_NP_Overlap_w_Pt (2011EPA_NP_Overlap)	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.	8

<b>Dataset name (Short Name<sup>λ</sup> provided if different)</b>	<b>Description and Rationale for the Order of the Selected Datasets</b>	<b>Order</b>
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.	9
<u>Exceptions to the hierarchy</u> 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<sub>10</sub> (called PM10-PRI in EIS and NEI) and primary PM<sub>2.5</sub> (PM25-PRI), filterable PM (PM10-FIL and PM25-FIL) and condensable PM (PM-CON). EPA needed to augment the S/L/T 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<sub>2.5</sub> value that was greater than a primary PM<sub>10</sub> 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<sub>2.5</sub> where only primary PM<sub>10</sub> 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 at <http://www.epa.gov/ttn/chief/eiinformation.html>.

### 3.1.3 Chromium augmentation

The 2011 reporting cycle has 5 valid pollutant codes for chromium, as shown in Table 13.

**Table 13:** Valid chromium pollutant codes

<b>Pollutant Code</b>	<b>Description</b>	<b>Pollutant Category Name</b>	<b>Speciated?</b>
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 13.

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.

We used the new EIS augmentation feature to speciate S/L/T reported chromium. 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. 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 11 and Table 12 and excludes the S/L/T 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 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<sub>3</sub> emissions provided to EPA by S/L/T agencies. The resulting augmentation dataset is labeled as “2011EPA\_TRI” in the Table 11 selection hierarchy shown above. For 2011, all TRI emissions values that could reasonably be matched to an EIS facility were loaded into 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 were considered for inclusion in the 2011 NEI.

The basis of the 2011EPA\_TRI dataset is the US EPA’s 2011 Toxic Release Inventory ([www.epa.gov/tri](http://www.epa.gov/tri)). 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 from <http://www2.epa.gov/toxics-release-inventory-tri-program/tri-basic-data-files-calendar-years-1987-2011>.

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 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 11) 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 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 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 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 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 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 EIS<sup>10</sup>. 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 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 14 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 14. 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 14 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 14. 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 EIS.

## **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

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<sup>10</sup> 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”.



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 an 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-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 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/Ts for any suspect facilities identified by that review. Lastly, as part of the S/L/T review of the TRI-to-EIS facility matching described in step 1 above, we also provided to the S/L/Ts 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 NEI v1 selection, the EIS tags on these two classes of TRI emissions values were removed, allowing those TRI values to be used in the 2011 NEI wherever the S/L/T had not reported that pollutant for that facility.

#### **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 EIS, they were created.

#### **6. Revise SCCs on the EIS Processes used for the TRI emissions**

The 2002 and 2005 NEIs had assigned all of 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-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<sub>2</sub>, and NO<sub>x</sub>, with all units converted to tons<sup>11</sup>. Excluding CO and CO<sub>2</sub> was done because their high mass would overwhelm the contribution of the other criteria pollutants, and NO<sub>x</sub> was excluded because the HAPs that we are trying to assign to an appropriate summation sector are more closely associated with SO<sub>2</sub> 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-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.

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

## 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 datasets or other EPA datasets that are higher in the EIS selection hierarchy, it is necessary to tag any TRI emissions values stored in EIS wherever the same pollutant is already reported by a S/L/T 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 15 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 EIS as well as any “Xylenes (Mixed Isomers)”. Tagging an emissions value in EIS in any dataset makes that emissions value not available for selection to the NEI.

**Table 14: 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-AMINOBIIPHENYL	92671	4-AMINOBIIPHENYL	
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

TRI CAS	TRI Pollutant Name	EIS Pollutant Code	EIS Pollutant Name	New in 2011
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	
92875	BENZIDINE	92875	BENZIDINE	
98077	BENZOIC TRICHLORIDE	98077	BENZOTRICHORIDE	
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	DIMETHYLCARBAMOYL 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	

TRI CAS	TRI Pollutant Name	EIS Pollutant Code	EIS Pollutant Name	New in 2011
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	
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	

TRI CAS	TRI Pollutant Name	EIS Pollutant Code	EIS Pollutant Name	New in 2011
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	
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	VINYLDIENE CHLORIDE	75354	VINYLDIENE 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 15: 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

Group Name	Pollutant Code	Pollutant
	28655712	Heptachlorobiphenyl
	53742077	Nonachlorobiphenyl
	55722264	Octachlorobiphenyl
	7012375	2,4,4'-Trichlorobiphenyl (PCB-28)
Polycyclic Organic Matter (POM)	130498292	PAH, total
	120127	Anthracene
	129000	Pyrene
	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	Benzolphenanthrene
	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	Benzo[fluoranthenes
	57835924	4-Nitropyrene
	57976	7,12-Dimethylbenz[a]Anthracene
	602879	5-Nitroacenaphthene
	607578	2-Nitrofluorene
65357699	Methylbenzopyrene	
7496028	6-Nitrochrysene	

Group Name	Pollutant Code	Pollutant
	779022	9-Methyl Anthracene
	8007452	Coal Tar
	832699	1-Methylphenanthrene
	83329	Acenaphthene
	85018	Phenanthrene
	86737	Fluorene
	86748	Carbazole
	90120	1-Methylnaphthalene
	91576	2-Methylnaphthalene
	91587	2-Chloronaphthalene
Cyanide & Compounds	57125	Cyanide
	74908	Hydrogen Cyanide
Nickel & Compounds	7440020	Nickel
	12035722	Nickel Subulfide
	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 missing HAPs in the S/L/T-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 (<http://www.epa.gov/ttn/chief/webfire/index.html>) 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-submitted CAP to be the same as the HAP to CAP ratios, and the HAP emissions to be consistent with the S/L/T-reported CAP data.

A HAP augmentation feature was built into EIS for the 2011 cycle, and the HAP EF ratios are available to 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 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 15, 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 16.

**Table 16:** Nickel species in the NEI from the HAP-augmentation dataset which should not have been used

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 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 17. 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 17:** 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 water	56037	Green River Trona Plant	0.1500
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 EIS ensured that the S/L/T 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, 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 15.

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 version 1 (see issues list for details) 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. Therefore all augmented tetrachloroethylene from dry cleaners is incorrect.

### 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 ([http://www.epa.gov/ttn/chief/eis/2011nei/priority\\_facility\\_list.xls](http://www.epa.gov/ttn/chief/eis/2011nei/priority_facility_list.xls)) 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 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, <http://www.ertac.us/>). 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].

Table 18 and Table 19 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 18), such as residential heating, from sectors that may overlap with the point sources (Table 19). 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 of 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 posted at <ftp://ftp.epa.gov/EmisInventory/2011nei/doc/>, which is the directory containing all supporting data files listed in Table 18 and Table 19. 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](#).

**Table 18:** 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	<a href="#">residential_consumption_coal.zip</a>
Residential Heating; distillate oil		Fuel Comb – Residential – Oil	<a href="#">residential_consumption_oil_revised_06272012.zip</a>
Residential Heating; Kerosene		Fuel Comb – Residential – Oil	<a href="#">residential_consumption_kerosene.zip</a>
Residential Heating; natural gas		Fuel Comb – Residential – Natural Gas	<a href="#">residential_consumption_ng_revised_06222012.zip</a>
Residential Heating; liquefied petroleum gas		Fuel Comb – Residential – Other	<a href="#">residential_consumption_lpg.zip</a>
Residential Heating; Fireplaces, woodstoves, fireplace inserts, pellet stoves, indoor furnaces, outdoor hydronic heaters, and firelogs.		Fuel Comb – Residential – Wood	<a href="#">rwc_estimation_tool_2011v1_120612.zip</a>
Paved Roads		Dust – Paved Road Dust	<a href="#">roads_paved_2011.zip</a>
Unpaved Roads		Dust – Unpaved Road Dust	<a href="#">roads_unpaved_2011.zip</a>
Dust from Residential Construction		Dust – Construction Dust	<a href="#">construction_residential_2011.zip</a>

EPA-estimated emissions source description	Carried Forward?	EIS Sector Name	Name of supporting data file or other reference
Dust from Commercial Institutional		Dust – Construction Dust	<a href="#">construction_nonresidential_2011.zip</a>
Dust from Road Construction		Dust – Construction Dust	<a href="#">construction_road_2011.zip</a>
Commercial Cooking		Commercial Cooking	<a href="#">commercial_cooking_2302002nnn_2011.zip</a>
Mining and Quarrying		Industrial Processes – Mining	<a href="#">mining_and_quarrying.zip</a>
Architectural Coatings		Solvent – Non-Industrial Surface Coating	<a href="#">surface_coatings_arch_coatings_whaps_2011.zip</a>
Traffic Markings		Solvent – Industrial Surface Coating & Solvent Use	<a href="#">traffic_markings_whaps_2011.zip</a>
Railroad surface coating		Solvent - Industrial Surface Coating & Solvent Use	<a href="#">surface_coating_railroad_whaps_2011.zip</a>
Consumer & Commercial – All personal care products		Solvent – Consumer & Commercial Solvent Use	<a href="#">cons_comm_personal_care_products_whaps_2011.zip</a>
Consumer & Commercial – All household products		Solvent – Consumer & Commercial Solvent Use	<a href="#">cons_comm_misc_products_whaps_2011.zip</a> <a href="#">cons_comm_cleaning_products_whaps_2011.zip</a> <a href="#">cons_comm_auto_aftermarket_whaps_2011.zip</a>
Consumer & Commercial – All coatings and related products		Solvent – Consumer & Commercial Solvent Use	<a href="#">cons_comm_coatings_and_related_products_whaps_2011.zip</a>
Consumer & Commercial – All adhesives and sealants		Solvent – Consumer & Commercial Solvent Use	<a href="#">cons_comm_adhesives_sealants_whaps_2011.zip</a>
Consumer & Commercial – All FIFRA related products		Solvent – Consumer & Commercial Solvent Use	<a href="#">cons_comm_fifra_whaps_2011.zip</a>
Cutback Asphalt Paving	x	Solvent – Consumer & Commercial Solvent Use	<a href="#">asphalt_paving_cutback_2011.zip</a>
Emulsified Asphalt Paving	x	Solvent – Consumer & Commercial Solvent Use	<a href="#">asphalt_paving_emulsified_2011.zip</a>
Consumer Pesticide Application		Solvent – Consumer & Commercial Solvent Use	<a href="#">cons_comm_fifra_whaps_2011.zip</a>
Commercial Pesticide Application	x	Solvent – Consumer & Commercial Solvent Use	<a href="#">agricultural_pesticides_2011_eis_format.zip</a>
Residential Portable Gas Cans		Miscellaneous Non-Industrial NEC	<a href="#">portable_fuel_containers_2011.zip</a>
Commercial Portable Gas Cans		Miscellaneous Non-Industrial NEC	<a href="#">portable_fuel_containers_2011.zip</a>
Aviation Gasoline Stage 1	x	Gas Stations	<a href="#">av_gasoline_distribution_stage1.zip</a>
Aviation Gasoline Stage 2	x	Gas Stations	<a href="#">av_gasoline_distribution_stage2.zip</a>
Open Burning – Leaves		Waste Disposal	<a href="#">open_burning_yard_waste_2011.zip</a>
Open Burning – Brush		Waste Disposal	<a href="#">open_burning_yard_waste_2011.zip</a>
Open Burning – Residential Household Waste		Waste Disposal	<a href="#">open_burning_msw_2011.zip</a>
Open Burning – Land Clearing Debris		Waste Disposal	<a href="#">open_burning_land_clearing_debris_2011.zip</a>
Publicly Owned Treatment Works		Waste Disposal	<a href="#">potw_2011_rev.zip</a>
Agricultural Tilling		Agriculture – Crops & Livestock Dust	<a href="#">agricultural_tilling_280100003_2011.zip</a>

EPA-estimated emissions source description	Carried Forward?	EIS Sector Name	Name of supporting data file or other reference
Fertilizer Application		Agriculture – Fertilizer Application	<a href="#">ag_fertilizer_application_2011.zip</a>
Animal Husbandry	x	Agriculture – Livestock Waste	<a href="#">animal_livestock_emissions_2011.zip</a>
Dental Preparation and Use	x	Miscellaneous Non-Industrial NEC	Documentation for the 1999 Base Year Nonpoint area source National Emission Inventory for HAPs, page A-30
General Laboratory Activities	x	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)	x	Miscellaneous Non-Industrial NEC	Documentation for the Final 2002 Nonpoint Sector (Feb 06 version) National Emission Inventory for Criteria and HAPs, page A-109
Lamp (Fluorescent) Recycling	x	Miscellaneous Non-Industrial NEC	Documentation for the Final 2002 Nonpoint Sector (Feb 06 version) National Emission Inventory for Criteria and HAPs, page A-107
“Carried Forward” indicates whether EPA data were carried forward from the 2008 or other previous year inventory.			

**Table 19:** 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	<a href="#">ici_fuel_combustion_by_state/</a>
Oil and Gas Production		Industrial Processes - Oil & Gas Production	<a href="#">EPA_Oil_and_Gas_Production_Emission_Estimation_Tool_2011_NEI_V1_4_20130919.zip</a>
Industrial Surface Coating – Auto Refinishing		Solvent – Industrial Surface Coating & Solvent Use	<a href="#">surface_coating_automobile_refinishing_2011whaps.zip</a>
Industrial Surface Coating – Factory Finished Wood		Solvent – Industrial Surface Coating & Solvent Use	<a href="#">surface_coating_factory_finished_wood_2011whaps.zip</a>
Industrial Surface Coating – Wood Furniture		Solvent – Industrial Surface Coating & Solvent Use	<a href="#">surface_coating_wood_furniture_2011whaps_rev_4.zip</a>
Industrial Surface Coating – Metal Furniture		Solvent – Industrial Surface Coating & Solvent Use	<a href="#">surface_coating_metal_furn_2011whaps.zip</a>
Industrial Surface Coating – Paper Foil and Film		Solvent – Industrial Surface Coating & Solvent Use	<a href="#">surface_coating_paper_film_foil_2011_whaps.zip</a>
Industrial Surface Coating – Metal Can Coating		Solvent – Industrial Surface Coating & Solvent Use	<a href="#">surface_coatings_metal_can_whaps_2011.zip</a>
Industrial Surface Coating – Machinery and Equipment		Solvent – Industrial Surface Coating & Solvent Use	<a href="#">surface_coating_machinery_and equip_whaps2011.zip</a>
Industrial Surface Coating – Large Appliances		Solvent – Industrial Surface Coating & Solvent Use	<a href="#">surface_coating_appliances_2011whaps.zip</a>

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	<a href="#">surface_coating_electronic_and_other_electrical_coatings_whaps_2011.zip</a>
Industrial Surface Coating – Motor Vehicles		Solvent – Industrial Surface Coating & Solvent Use	<a href="#">surface_coating_motor%20vehicles_whaps_2011.zip</a>
Industrial Surface Coating – Aircraft		Solvent – Industrial Surface Coating & Solvent Use	<a href="#">surface_coating_aircraft_mfg_2011whaps.zip</a>
Industrial Surface Coating – Marine		Solvent – Industrial Surface Coating & Solvent Use	<a href="#">surface_coating_marine_mfgwhaps2011.zip</a>
Industrial Surface Coating – Railroad		Solvent – Industrial Surface Coating & Solvent Use	<a href="#">surface_coating_railroad_whaps_2011.zip</a>
Industrial Surface Coating – Miscellaneous Manufacturing		Solvent – Industrial Surface Coating & Solvent Use	<a href="#">surface_coating_misc_mfg_2011whaps.zip</a>
Industrial Maintenance Coatings		Solvent – Industrial Surface Coating & Solvent Use	<a href="#">surface_coating_ind_maint_coating_2011whaps.zip</a>
Other Special Purpose Coatings		Solvent – Industrial Surface Coating & Solvent Use	<a href="#">surface_coating_other_special_purpose_whaps_2011.zip</a>
Degreasing		Solvent – Degreasing	<a href="#">degreasing_whaps_2011_eisformat.zip</a>
Graphic Arts		Solvent – Graphic Arts	<a href="#">graphic_arts_w_haps_2011.zip</a>
Dry Cleaning		Solvent – Dry Cleaning	<a href="#">dry_cleaning_emissions_2011_rev.zip</a>
Gasoline Distribution – Stage 1 Bulk Plants	x	Bulk Gasoline Terminals	<a href="#">gasoline_distribution_stage_1_bulk_plants_2011.zip</a>
Gasoline Distribution – Stage 1 Bulk Terminals	x	Bulk Gasoline Terminals	<a href="#">gasoline_distribution_stage%20%20bulk_terminals_2011.zip</a>
Gasoline Distribution – Stage 1 Pipelines		Industrial Processes – Storage and Transfer	<a href="#">gasoline_distribution_stage_1_pipelines_2011.zip</a>
Gasoline Distribution – Stage 1 Service Station Unloading		Gas Stations	<a href="#">gas_distribution_service_station_unloading_eis_format.zip</a>
Gasoline Distribution – Stage 1 Underground Storage Tanks		Gas Stations	<a href="#">gasoline_distribution_stage1_ust_2011.zip</a>
Gasoline Distribution – Stage 1 Trucks In Transit	x	Industrial Processes – Storage and Transfer	<a href="#">gasoline_distribution_stage_1_tank_trucks_2011.zip</a>
Gasoline Distribution – Stage 2 Refueling at Pump		Gas Stations	<a href="#">gasoline_distribution_stage_2.zip</a>
Human Cremation	x	Miscellaneous Non-Industrial NEC	<a href="#">cremation_2011.zip</a>
“Carried Forward” indicates whether EPA data were carried forward from the 2008 or other previous year inventory.			

The file “[2011nei\\_np\\_matrix\\_submittals.xlsx](#)” at <ftp://ftp.epa.gov/EmisInventory/2011/doc/> has a list of submitting S/L/T agencies and for what nonpoint sectors they submitted data.

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 20 and Table 21.

**Table 20:** 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 21:** 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 are <20% of the EPA estimate for nonpoint), augment their data.	We believe that the state filled out the survey incorrectly. There have to be small commercial/institutional sources or gas stations that were not covered by the point source inventory.
	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 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.
	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	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.
	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.
	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.



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 22 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 22:** SCCs used in past inventories that were not included in 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 found at, [ftp://ftp.epa.gov/EmisInventory/2008v3/doc/2008nei\\_references.zip](ftp://ftp.epa.gov/EmisInventory/2008v3/doc/2008nei_references.zip))
2. Strait et al. (2003). Strait, R.; MacKenzie, D.; and Huntley, R., 2003. *PM Augmentation Procedures for the 1999 Point and Area Source NEI*, 12<sup>th</sup> International Emission Inventory Conference – “Emission Inventories – Applying New Technologies”, San Diego, April 29 – May 1, 2003. (<http://www.epa.gov/ttn/chief/conference/ei12/point/strait.pdf>)
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*, 19<sup>th</sup> International Emission Inventory Conference – “Emissions Inventories – Informing Emerging Issues”, San Antonio, TX, September 27 – 30, 2010. (<http://www.epa.gov/ttn/chief/conference/ei19/session7/huntley.pdf>)

## 3.2 Agriculture – Crops & Livestock Dust

### 3.2.1 Sector Description

The 2011 NEI has emissions from the following SCCs that belong to this sector.

**Table 23:** 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"

EPA estimates emissions for fugitive dust emissions from agricultural tilling (SCC 2801000003), highlighted in the above table; the methodology is described in 3.2.4.

### 3.2.2 Sources of data overview and selection hierarchy

The agricultural crops and livestock dust sector includes data from the S/L/T agency submitted data and the default EPA generated emissions. The agencies listed in Table 24 submitted emissions for this sector.

**Table 24:** 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				

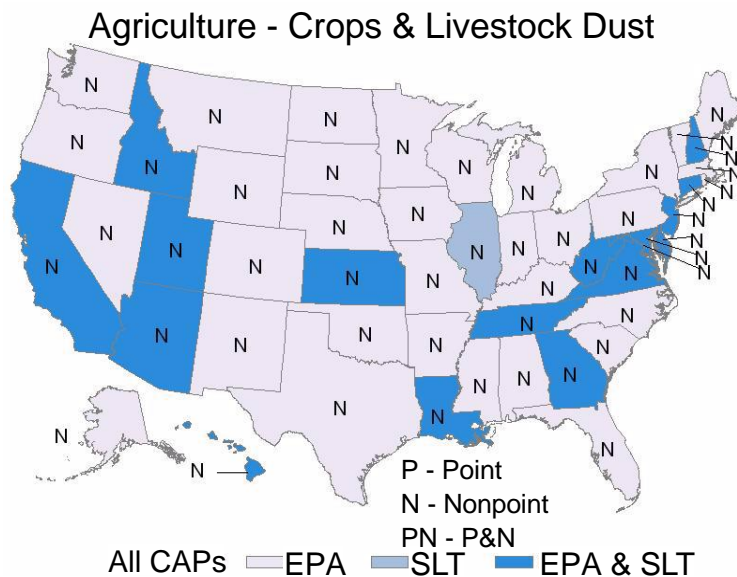
Agency	Type	280100000	280100002	280100003	280100005	280100008	280160000	2805001000
New Jersey Department of Environment Protection	S			x				
Nez Perce Tribe	T			x	x		x	
Sac and Fox Nation of Missouri in Kansas and Nebraska Reservation	T			x	x			
Shoshone-Bannock Tribes of the Fort Hall Reservation of 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 25 shows the selection hierarchy for datasets included in the agricultural crops and livestock dust sector.

**Table 25:** 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 280100003); 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<sub>10</sub> = 0.21; PM<sub>2.5</sub> = 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 26 shows silt content assumed for each soil type.

**Table 26: 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 27 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 27: 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

<b>Crop</b>	<b>Conservation Use</b>	<b>Conventional Use</b>
Forage	3	3
Hay	3	3
Oats	3	5
Peanuts	3	3
Permanent Pasture	1	1
Potatoes	3	3
Rice	5	5
Rye	3	5
Sorghum	1	6
Soybeans	1	6
Spring Wheat	1	4
Sugarbeets	3	3
Sugarcane	3	3
Sunflowers	3	3
Tobacco	3	3

### 3.2.4.1 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 28 for how USDA and CRM categories were matched.

**Table 28:** Crosswalk between Crop Residue Management Category and USDA Data

<b>CRM Category</b>	<b>USDA Data Items</b>
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

CRM Category	USDA Data Items
Soybeans	SOYBEANS - ACRES HARVESTED
Sugarbeets	SUGARBEETS - 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 at: <http://www.ctic.purdue.edu/CRM/>. The five types of tilling for which emission estimates were calculated are:

Conservation Till

No till/strip till

Mulch till

Ridge till

Conventional Till

0 to 15 percent residue till (Intensive till)

15 to 30 percent residue till (Reduced 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 29. Due to data nondisclosure agreements with CTIC, the EPA cannot release the county-level tillage data by crop type.

**Table 29:** 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)
<b>Conservation</b>		
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
<b>Conventional</b>		
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<sub>10</sub> and PM<sub>2.5</sub> 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.

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

where:  $E$  = PM10-FIL or PM25-FIL emissions  
 $c$  = constant 4.8 lbs/acre-pass  
 $k$  = dimensionless particle size multiplier (PM<sub>10</sub>=0.21; PM<sub>2.5</sub>=0.042)  
 $s$  = percent silt content of surface soil, defined as the mass fraction of particles smaller than 75 μm diameter 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)

### 3.2.4.2 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 30 summarizes the number of tagged process-level emissions values from each agency affected by this QA.

**Table 30:** 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 <http://www.ctic.purdue.edu/CTIC/CTIC.html> .
5. USDA Quickstats 2.0, <http://quickstats.nass.usda.gov/>, 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 2011 NEI has emissions for the following SCCs that belong to this category. The highlighted SCCs are those for which EPA estimates emissions as described in Section 3.3.4.

**Table 31: 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 32 submitted emissions for this sector. Note that not all agencies submitted all of the different fertilizer types.



**Table 32: Agencies that Submitted Agricultural Fertilizer Application Data**

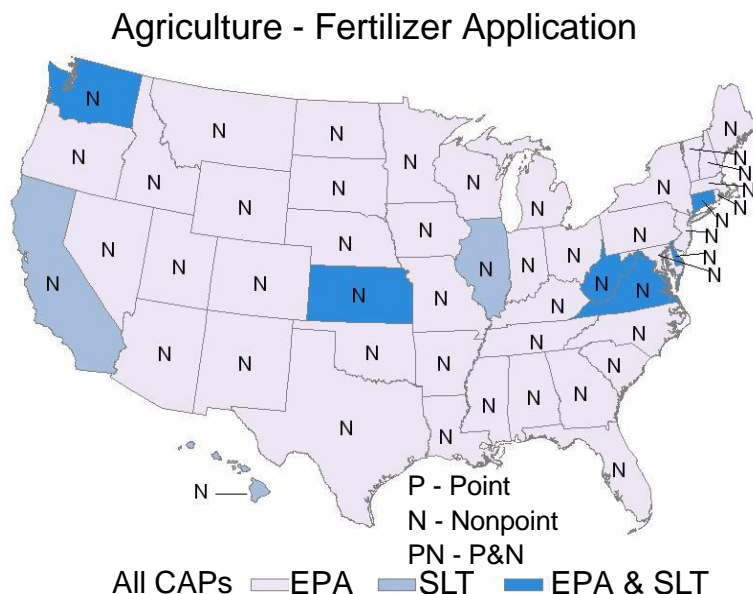
AGENCY	Type	Ammonium Nitrate	Ammonium	Ammonium Sulfate	Ammonium	Anhydrous Ammonia	Aqueous Ammonia	Calcium Ammonium Nitrate	Diammonium Phosphate	Liquid Ammonium Polyphosphate	Miscellaneous	Mono-Ammonium Phosphate	Nitrogen Solutions	N-P-K (multi-grade nutrient fertilizers)	Other Straight	Potassium Nitrate	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 33 shows the selection hierarchy for the agricultural fertilizer application sector.

**Table 33: 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.

#### 3.3.4.1 Activity Data

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 34 below. 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 34: Fertilizers Assigned to Fertilizer Groups**

<b>CMU Ammonia Model Fertilizer Group</b>	<b>Commercial Fertilizers Report - Fertilizer Code</b>	<b>Description 1</b>	<b>Description 2</b>
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-Urea	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	

<b>CMU Ammonia Model Fertilizer Group</b>	<b>Commercial Fertilizers Report - Fertilizer Code</b>	<b>Description 1</b>	<b>Description 2</b>
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
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 35, 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 35: 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
Monoammonium Phosphate	11
Nitrogen Solutions	29
Potassium Nitrate	14
Urea	46

### 3.3.4.2 Emission Factors

Emission factors for each fertilizer group were provided with the CMU Ammonia Model [ref 1] and are reported in Table 36 below.

**Table 36: Fertilizer Emission Factors**

Fertilizer Description	Pollutant Code	Emission Factor (varies by county for some fertilizers)			Emission Factor Unit	Emission Factor Reference
		Min	Max	Average		
Ammonium Nitrate	NH <sub>3</sub>	1.0	3.0	1.91	% N volatilized as NH <sub>3</sub>	1
Ammonium Sulfate	NH <sub>3</sub>	5.0	15.0	9.53	% N volatilized as NH <sub>3</sub>	1
Ammonium Thiosulfate	NH <sub>3</sub>	2.5	2.5	2.5	% N volatilized as NH <sub>3</sub>	1
Anhydrous Ammonia	NH <sub>3</sub>	4.0	4.0	4.0	% N volatilized as NH <sub>3</sub>	1
Aqueous Ammonia	NH <sub>3</sub>	4.0	4.0	4.0	% N volatilized as NH <sub>3</sub>	1
Calcium Ammonium Nitrate	NH <sub>3</sub>	1.0	3.0	1.91	% N volatilized as NH <sub>3</sub>	1
Diammonium Phosphate	NH <sub>3</sub>	5.0	5.0	5.0	% N volatilized as NH <sub>3</sub>	1
Liquid Ammonium Polyphosphate	NH <sub>3</sub>	5.0	5.0	5.0	% N volatilized as NH <sub>3</sub>	1
Miscellaneous Fertilizers	NH <sub>3</sub>	6.0	8.0	6.59	% N volatilized as NH <sub>3</sub>	1
Monoammonium Phosphate	NH <sub>3</sub>	5.0	5.0	5.0	% N volatilized as NH <sub>3</sub>	1
Nitrogen Solutions	NH <sub>3</sub>	8.0	8.0	8.0	% N volatilized as NH <sub>3</sub>	1
N-P-K (multi-grade nutrient fertilizers)	NH <sub>3</sub>	1.0	3.0	1.91	% N volatilized as NH <sub>3</sub>	1
Potassium Nitrate	NH <sub>3</sub>	2.0	2.0	2.0	% N volatilized as NH <sub>3</sub>	1
Urea	NH <sub>3</sub>	15.0	20.0	15.8	% N volatilized as NH <sub>3</sub>	1

### 3.3.4.3 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.

$$\text{N applied} \times \% \text{ N volatilized as NH}_3 \times 17 \text{ g} / 14 \text{ g} = \text{NH}_3 \text{ emissions}$$

### 3.3.4.4 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.

$$\text{Percent of cropland in CO located in Adams County} = (547,000 / 11,484,000) \times 100 = 4.76$$

$$\text{Ammonium nitrate allocated to Adams County} = 4,774,000 \text{ kg} \times .0476 = 227,240 \text{ kg}$$

#### *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.

$$\text{Percent change in ammonium nitrate applied} = (516,240 \text{ kg} / 473,180 \text{ kg}) \times 100 = 109$$

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.

$$\text{July: } 3,250 \text{ kg} \times 1.09 = 3,543 \text{ kg N}$$

$$\text{August: } 3,210 \text{ kg} \times 1.09 = 3,499 \text{ kg N}$$

$$\text{September: } 9,640 \text{ kg} \times 1.09 = 10,508 \text{ kg N}$$

$$\text{October: } 6,320 \text{ kg} \times 1.09 = 6,889 \text{ kg N}$$

$$\text{November: } 2,600 \text{ kg} \times 1.09 = 2,834 \text{ kg N}$$

$$\text{December: } 1,380 \text{ kg} \times 1.09 = 1,504 \text{ kg N}$$

#### *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.

$$\text{N content of ammonium nitrate} = (508,000,000 \text{ kg} / 1,420,000,000 \text{ kg}) \times 100 = 36 \%$$

*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.

$$\text{N applied} = 356,705 \text{ kg} \times 0.36 = 128,414 \text{ kg}$$

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.

$$\text{January: } (289,000 \text{ kg} / 17,000,000 \text{ kg}) \times 128,414 \text{ kg} = 2,183 \text{ kg N applied in Meade County}$$

$$\text{February: } (745,000 \text{ kg} / 17,000,000 \text{ kg}) \times 128,414 \text{ kg} = 5,600 \text{ kg N applied in Meade County}$$

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 37 summarizes the number of tagged process-level emissions values from each agency affected by this QA.

**Table 37: Agencies Tagged Values for Agriculture – Fertilizer**

<b>Agency</b>	<b>Number of Values Tagged</b>	<b>Tag Reason</b>
Georgia Department of Natural Resources	2226	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

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, at <http://www.cmu.edu/ammonia/>, 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*, at <http://www.aapfco.org/publications.html#comm>, accessed 2 May 2009.
3. U.S. Department of Agriculture, *2002 Census of Agriculture*, at <http://www.agcensus.usda.gov/>, accessed 30 April 2009.
4. U.S. Department of Agriculture, *2007 Census of Agriculture*, at <http://www.agcensus.usda.gov/>, 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<sup>12</sup>.

Table 38 shows the nonpoint SCCs covered by the EPA estimates (discussed in Section 0) and by the State/Local and Tribal agencies that submitted data. Table 39 presents the two 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 38: 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

<sup>12</sup> California does have some point sources appropriately assigned to 30202001



SCC	SCC Level Two	SCC Level Three	SCC Level Four	EPA	Local	State	Tribe
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
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

SCC	SCC Level Two	SCC Level Three	SCC Level Four	EPA	Local	State	Tribe
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	
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

SCC	SCC Level Two	SCC Level Three	SCC Level Four	EPA	Local	State	Tribe
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 39:** Point SCCs with 2011 NEI Emissions in the Livestock Waste Sector – reported only by States

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

The agencies listed in Table 40 submitted emissions for this sector.

**Table 40:** Agencies that Submitted Livestock Waste Data

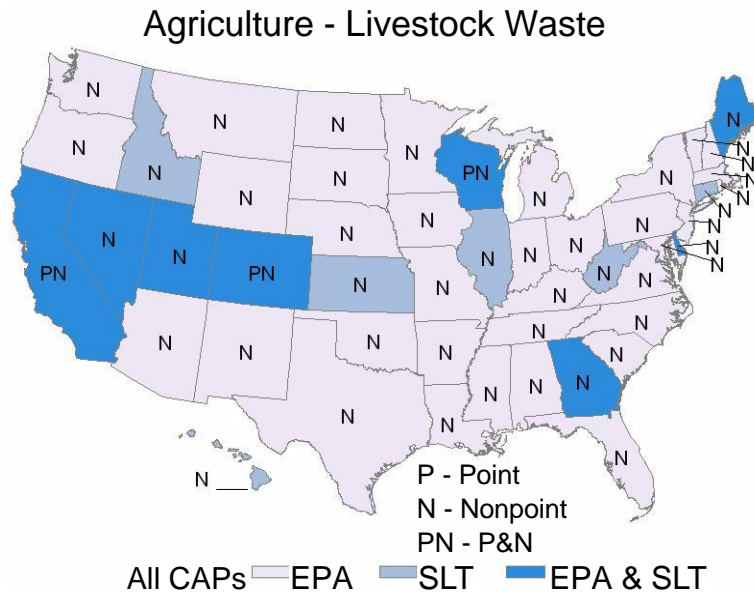
Agency	Type
California Air Resources Board	State
Clark County Department of Air Quality and Environmental Management	Local
Connecticut Department Of Environmental Protection	State
Delaware Department of Natural Resources and Environmental Control	State
Georgia Department of Natural Resources	State
Hawaii 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 41 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 41:** 2011 NEI agricultural livestock 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.

#### 3.4.4.1 Activity Data

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.

#### 3.4.4.2 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.

#### **3.4.4.3 Emission Factors**

Table 42 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 Dairy Component.xls” (see [ftp://ftp.epa.gov/EmisInventory/2008v3/doc/2008nei\\_supdata\\_3a.zip](ftp://ftp.epa.gov/EmisInventory/2008v3/doc/2008nei_supdata_3a.zip)). 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” (see [ftp://ftp.epa.gov/EmisInventory/2008v3/doc/2008nei\\_supdata\\_3a.zip](ftp://ftp.epa.gov/EmisInventory/2008v3/doc/2008nei_supdata_3a.zip)).

**Table 42:** Emission Factors for NH<sub>3</sub> emissions used for EPA’s agricultural livestock data

Description	Emission Factor	Emission Factor Unit	Emission Factor Reference (see footnotes)
Beef Cattle – Composite	county	kg NH <sub>3</sub> /cow/month	2
Beef Cattle – Drylot Operation – Confinement	9.45E-01	kg NH <sub>3</sub> /cow/month	1
Beef Cattle – Drylot Operation – Land Application	state	kg NH <sub>3</sub> /cow/month	1
Beef Cattle – Drylot Operation – Manure Storage	3.78E-04	kg NH <sub>3</sub> /cow/month	1
Beef Cattle – Pasture Operation – Confinement	county	kg NH <sub>3</sub> /cow/month	1
Dairy Cattle – Composite	county	kg NH <sub>3</sub> /cow/month	2
Dairy Cattle – Deep Pit Dairy Confinement	2.42E+00	kg NH <sub>3</sub> /cow/month	1
Dairy Cattle – Deep Pit Dairy Land Application	state	kg NH <sub>3</sub> /cow/month	1
Dairy Cattle – Deep Pit Dairy Manure Storage	1.13E-01	kg NH <sub>3</sub> /cow/month	1
Dairy Cattle – Drylot Dairy Confinement	state	kg NH <sub>3</sub> /cow/month	1
Dairy Cattle – Drylot Dairy Land Application	state	kg NH <sub>3</sub> /cow/month	1
Dairy Cattle – Drylot Dairy Manure Storage	state	kg NH <sub>3</sub> /cow/month	1
Dairy Cattle – Flush Dairy Confinement	2.00E+00	kg NH <sub>3</sub> /cow/month	1
Dairy Cattle – Flush Dairy Land Application	state	kg NH <sub>3</sub> /cow/month	1
Dairy Cattle – Flush Dairy Manure Storage	state	kg NH <sub>3</sub> /cow/month	1
Dairy Cattle – Scrape Dairy Confinement	state	kg NH <sub>3</sub> /cow/month	1
Dairy Cattle – Scrape Dairy Land Application	state	kg NH <sub>3</sub> /cow/month	1
Dairy Cattle – Scrape Dairy Manure Storage	state	kg NH <sub>3</sub> /cow/month	1
Ducks	7.67E-02	kg NH <sub>3</sub> /duck/month	1
Geese	7.67E-02	kg NH <sub>3</sub> /goose/month	1
Goats	5.29E-01	kg NH <sub>3</sub> /goat/month	1
Horses	1.02E+00	kg NH <sub>3</sub> /horse/month	1
Poultry – Broiler Operation – Confinement	8.32E-03	kg NH <sub>3</sub> /bird/month	1
Poultry – Broiler Operation – Land Application	6.80E-03	kg NH <sub>3</sub> /bird/month	1
Poultry – Broiler Operation – Manure Storage	1.51E-03	kg NH <sub>3</sub> /bird/month	1
Poultry – Composite	2.00E-02	kg NH <sub>3</sub> /bird/month	3
Poultry – Layers – Dry Manure Operation – Confinement	3.36E-02	kg NH <sub>3</sub> /bird/month	1
Poultry – Layers – Dry Manure Operation – Land Application	county	kg NH <sub>3</sub> /bird/month	1
Poultry – Layers – Wet Manure Operation – Confinement	9.45E-03	kg NH <sub>3</sub> /bird/month	1
Poultry – Layers – Wet Manure Operation – Land Application	county	kg NH <sub>3</sub> /bird/month	1
Poultry – Layers – Wet Manure Operation – Manure Storage	county	kg NH <sub>3</sub> /bird/month	1
Poultry – Turkey Operation – Confinement	3.78E-02	kg NH <sub>3</sub> /bird/month	1
Poultry – Turkey Operation – Land Application	3.40E-02	kg NH <sub>3</sub> /bird/month	1
Poultry – Turkey Operation – Storage	6.80E-03	kg NH <sub>3</sub> /bird/month	1
Sheep	2.65E-01	kg NH <sub>3</sub> /sheep/month	1
Swine – Composite	county	kg NH <sub>3</sub> /pig/month	1
Swine – Deep Pit Operation – Confinement	2.65E-01	kg NH <sub>3</sub> /pig/month	1
Swine – Deep Pit Operation – Land Application	county	kg NH <sub>3</sub> /pig/month	1
Swine – Lagoon Operation – Confinement	2.27E-01	kg NH <sub>3</sub> /pig/month	1
Swine – Lagoon Operation – Land Application	county	kg NH <sub>3</sub> /pig/month	1

Description	Emission Factor	Emission Factor Unit	Emission Factor Reference (see footnotes)
Swine – Lagoon Operation – Manure Storage	county	kg NH <sub>3</sub> /pig/month	1
Swine – Outdoor Operation – Confinement	county	kg NH <sub>3</sub> /pig/month	1

<sup>1</sup> Davidson, et al., 2004

<sup>2</sup> Dorn, 2009

<sup>3</sup> US EPA, 2005

#### 3.4.4.4 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 18, Section 3.1.7.

#### 3.4.4.5 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 – 388,827 = 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.

$$\text{Total beef and dairy cattle reported} = 216 + 9,096 = 9,312$$

$$\% \text{ of other cattle assigned to beef cattle} = (9,096/9,312)*100 = 97.68$$

$$\% \text{ of other cattle assigned to dairy cattle} = (216/9,312)*100 = 2.32$$

$$\text{Other cattle allocated to beef cattle} = 5,471 \times .9768 = 5,344$$

$$\text{Other cattle allocated to dairy cattle} = 5,471 \times 0.0232 = 127$$

### 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 43 summarizes the number of tagged process-level emissions values from each agency affected by this QA.

**Table 43:** Agencies Tagged Values for Agriculture Livestock

Agency	Number of Values Tagged	Tag Reason
California Air Resources Board	1653	Extraneous pollutants (no other states submitted)
California Air Resources Board	9	Outlier
Idaho Department of Environmental Quality	11088	Extraneous pollutants (no other states submitted)
Louisiana Department of Environmental Quality	2944	State requested that we replace their data with EPA estimates.

### 3.4.6 References

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2. U.S. Department of Agriculture, *2007 Census of Agriculture*, at <http://www.agcensus.usda.gov/>, accessed 30 April 2009.
3. U.S. Department of Agriculture, National Agricultural Statistics Service, at [http://www.nass.usda.gov/Data\\_and\\_Statistics/Quick\\_Stats/](http://www.nass.usda.gov/Data_and_Statistics/Quick_Stats/), accessed 28 January 2010.

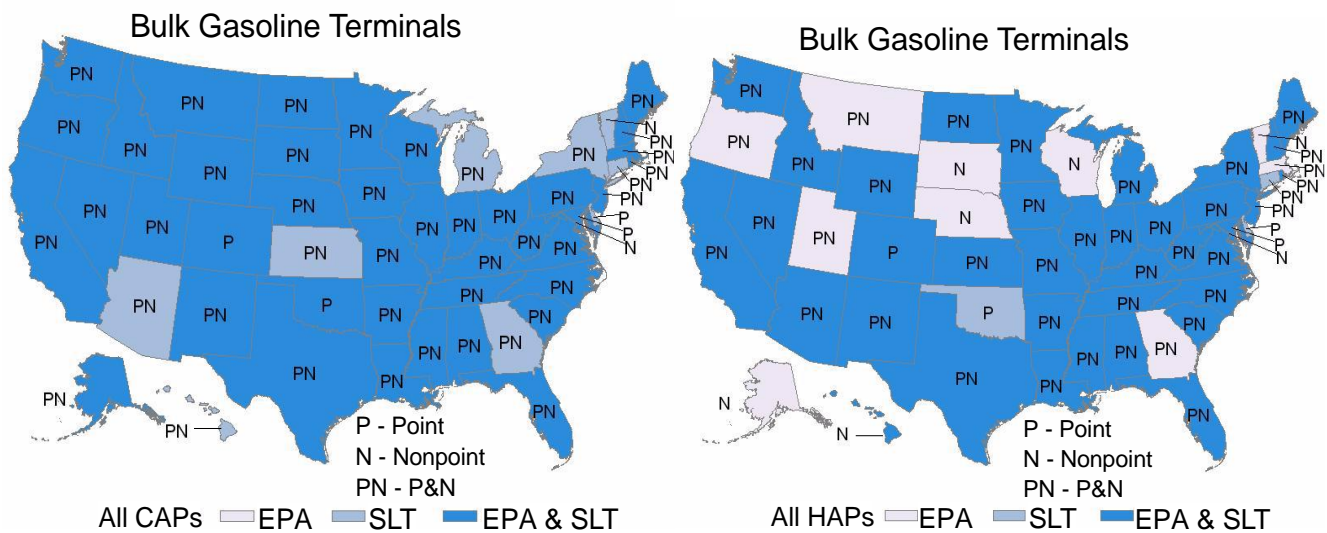
4. U.S. Environmental Protection Agency, *National Emission Inventory – Ammonia Emissions from Animal Agricultural Operations*, Revised Draft Report, 22 April 2005, p. 4-6, at <http://www.epa.gov/ttn/chief/net/2002inventory.html>, accessed 5 May 2009.
5. Jonathan Dorn, E.H. Pechan & Associates. 2009. A weighted average emission factor calculated using data from the 2002 CMU Ammonia Model v.3.6.

### 3.5 Bulk Gasoline Terminals

#### 3.5.1 Sector Description

#### 3.5.2 Sources of data overview and selection hierarchy

#### 3.5.3 Spatial coverage and data sources for the sector



### 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 44; EPA computes emissions for all except the first one (2302002000), since it’s a grouping of the two more detailed SCCs for charbroiling.

**Table 44:** Source Classification Codes 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 45 submitted emissions for this sector. EPA datasets are individually listed.

**Table 45: 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
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

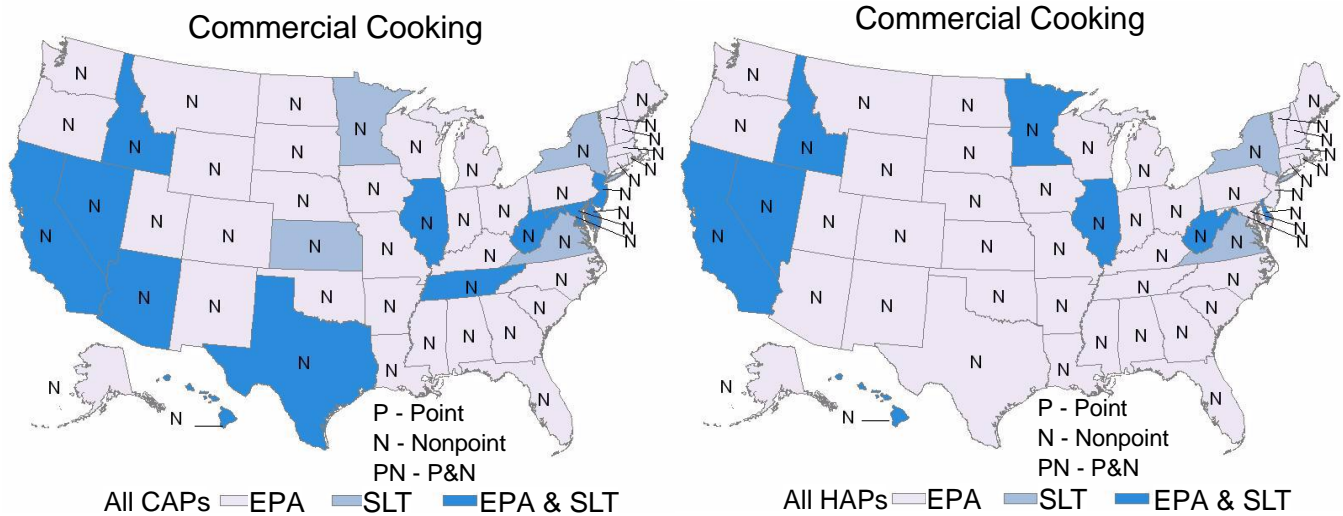
Agency	Type	Char-broiling Total	Convey- orized Char- broiling	Under- fired Char- broiling	Deep Fat Frying	Flat Griddle Frying	Clamshell Griddle Frying
Nez Perce Tribe	T		X	X	X	X	X
Shoshone-Bannock Tribes of the Fort Hall Reservation of Idaho	T		X	X	X	X	X
Texas Commission on Environmental Quality	S		X	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 46 shows the selection hierarchy for the datasets included in the commercial cooking sector.

**Table 46: 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.

#### 3.6.4.1 Activity Data

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:

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

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

### 3.6.4.2 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 47). The condensable particulate matter (PM-CON) emission factors were derived by subtracting PM10-FIL from PM10-PRI.

**Table 47:** Ratio of filterable particulate matter to primary particulate matter for PM<sub>2.5</sub> and PM<sub>10</sub> 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

### 3.6.4.3 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 48. 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 48.** Fraction of restaurants with source category equipment and average number of units per restaurant.

Source Category	SCC	Percent of Restaurants with Equipment ( <i>FRAC<sub>j</sub></i> )	Average Number of Units Per Restaurant ( <i>UNITS<sub>j</sub></i> )
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.

#### 3.6.4.4 Sample Calculations

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

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

$$100 \text{ restaurants} = \frac{8.76_{PM2.5, Underfired-Charbroilers}}{0.125 \times 1.54 \times 0.454}$$

Emissions of PM<sub>2.5</sub> 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<sub>2.5</sub>). 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.

$$REST_{i,2011} = REST_{i,2002} \times GF_i$$

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

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:

$$E_{ijm,2011} = REST_{i,2011} \times FRAC_j \times UNITS_j \times AVG\_EMISSIONS_{jm}$$

$$12.06 \text{ tons PM}_{2.5} = 138 \times 0.125 \times 1.54 \times 0.454$$

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 v1 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 49 summarizes the number of tagged process-level emissions values from each agency affected by this QA.



**Table 49: Agencies Tagged Values for Commercial Cooking**

<b>Agency</b>	<b>Number of Values Tagged</b>	<b>Tag Reason</b>
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

1. County Business Patterns: <http://www.census.gov/econ/cbp/index.html>
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. [ftp://ftp.epa.gov/EmisInventory/2002finalnei/documentation/nonpoint/2002nei\\_final\\_nonpoint\\_documentation0206version.pdf](ftp://ftp.epa.gov/EmisInventory/2002finalnei/documentation/nonpoint/2002nei_final_nonpoint_documentation0206version.pdf)
3. Potepan, M. 2001. Charbroiling Activity Estimation. Public Research Institute, report for the California Air Resources Board and the California Environmental Protection Agency. <http://www.arb.ca.gov/research/apr/reports/l943.pdf>
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. [http://daq.state.nc.us/planning/triad\\_maintenance\\_plan/Appendix%20B-Emissions%20Inventory%20Documentation.pdf](http://daq.state.nc.us/planning/triad_maintenance_plan/Appendix%20B-Emissions%20Inventory%20Documentation.pdf)

## 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 50 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 50: SCCs in the 2011 NEI in the Dust - Construction Dust Sector**

SCC	SCC Level One	SCC Level Two	SCC Level Three	SCC Level Four
<b>NONPOINT</b>				
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
<b>POINT</b>				
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 51 submitted emissions for this sector.

**Table 51: Agencies that Submitted Construction Dust Data**

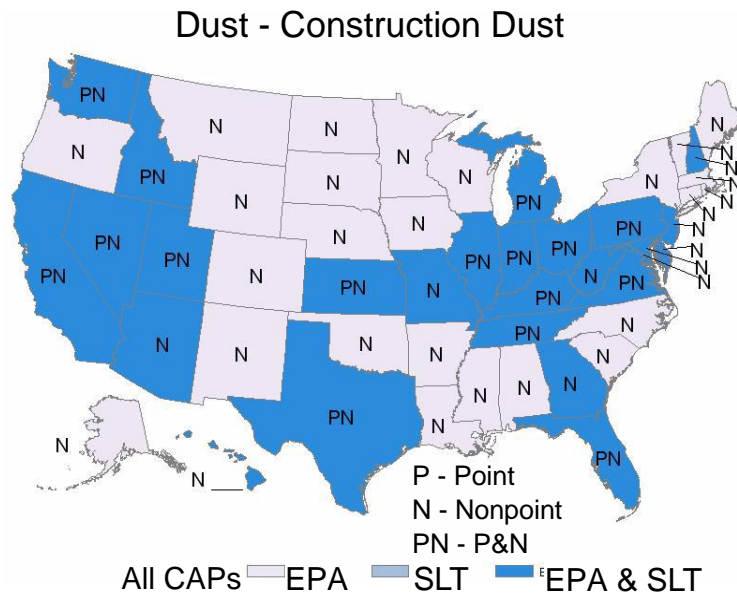
Agency	Type	Nonpoint SCCs				Point SCCs						
		2311010000	2311020000	2311030000	2311040000	31100101	31100102	31100103	31100199	31100202	31100206	31100299
Allegheny County Health Department	L								X			X
California Air Resources Board	S	X		X		X			X	X	X	
Chattanooga Air Pollution Control Bureau (CHCAPCB)	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 52 shows the selection hierarchy for datasets included in the construction dust sector.

**Table 52: 2011 NEI Construction Dust Data Selection Hierarchy**

Priority	Dataset Name	Dataset Content
<b>Nonpoint Data Category</b>		
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
<b>Point Data Category</b>		
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.

For this source category, the following SCC was used:

**Table 53: SCC for Non-Residential Construction**

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

#### 3.7.4.2 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 employees 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<sup>6</sup> 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<sup>6</sup> = 1999 acres per \$10<sup>6</sup> x (1999 PPI / 2011 PPI)

$$= 2 \text{ acres}/\$10^6 * (132.9 / 229.3)$$

$$= 1.159 \text{ acres per } \$10^6$$

#### 3.7.4.3 Emission Factors

Initial PM<sub>10</sub> 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<sub>10</sub> emissions from non-residential construction to develop the final emissions inventory.

To account for the soil moisture level, the PM<sub>10</sub> 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<sub>10</sub> 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 5].

The equation for PM<sub>10</sub> 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<sub>PM10</sub> = PM<sub>10</sub> 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<sub>10</sub> adjustments have been made, PM<sub>2.5</sub> emissions are set to 10% of PM<sub>10</sub>.

#### 3.7.4.4 Example Calculation

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

where N<sub>Spending</sub> = National spending on nonresidential construction (million dollars)  
 Emp<sub>county</sub> = County level employment in nonresidential construction  
 Emp<sub>National</sub> = National level employment in nonresidential construction  
 Apd = Acres per million dollars (national data)  
 EF<sub>Adj</sub> = Adjusted PM<sub>10</sub> emission factor (ton/acre-month)  
 M = duration of construction activity (months)

As an example, in Grand Traverse County, Michigan, 2011 acres disturbed and PM<sub>10</sub> emissions from non-residential construction are calculated as follows:

$$\begin{aligned} Emissions_{PM10} &= 269,045 \times 10^6 \$ \times (130/651,996) \times 1.159 \text{ acres}/10^6\$ \times EF_{Adj} \times M \\ &= 62.2 \text{ acres} \times 0.059 \text{ ton/acre-month} \times 11 \text{ months} \\ &= 40.4 \text{ tons PM}_{10} \end{aligned}$$

Where EF<sub>Adj</sub> is calculated as follows:

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

$$= 0.059 \text{ ton/acre-month}$$

### 3.7.4.5 References

1. Annual Value of Construction Put in Place: <http://www.census.gov/const/C30/priv2011.pdf>
2. County Business Patterns: <http://www.census.gov/econ/cbp/index.html>
3. Bureau of Labor Statistics: <http://data.bls.gov/pdq/SurveyOutputServlet> 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.

For this source category, the following SCC was used:

**Table 54:** SCC for Residential Construction

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

### 3.7.5.2 Activity Data

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

#### 3.7.5.2.1 Surface soil disturbed

The US Census Bureau has 2010 data for *Housing Starts - New Privately Owned Housing Units Started* [ref 1] 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 2] 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 3] 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 following surface areas were assumed disturbed for each unit type:

**Table 55: Surface Soil removed per unit type**

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

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

### 3.7.5.2.2 Basement soil removal

To calculate basement soil removal, 2010 *Characteristics of New Houses* [ref 4] 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<sup>3</sup> per basement). An additional 10% is added for peripheral dirt bringing the total to 17,600 ft<sup>3</sup> per basement.

### 3.7.5.3 Emission Factors

Initial PM<sub>10</sub> emissions from construction of single family, two family, and apartments structures are calculated using the emission factors given in Table 56 [ref 5]. 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 56: Emission Factors for Residential Construction**

Type of Structure	Emission Factor	Duration of Construction
Apartments	0.11 tons PM <sub>10</sub> /acre-month	12 months
2-Unit Structures	0.032 tons PM <sub>10</sub> /acre-month	6 months
1-Unit Structures w/o Basements	0.032 tons PM <sub>10</sub> /acre-month	6 months
1-unit Structures with Basements	0.011 tons PM <sub>10</sub> /acre-month	6 months
	0.059 tons PM <sub>10</sub> /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<sub>10</sub> emissions from residential construction to develop the final emissions inventory.

To account for the soil moisture level, the PM<sub>10</sub> emissions are weighted using the 30-year average precipitation-evaporation (PE) values from Thornthwaite’s PE Index [ref 5]. 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<sub>10</sub> 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 6].



The equation for PM<sub>10</sub> emissions corrected for soil moisture and silt content is:

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

where: Corrected E<sub>PM10</sub> = PM<sub>10</sub> 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<sub>10</sub> 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.

### 3.7.5.4 Example Calculation

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

where A<sub>unit</sub> = HS<sub>unit</sub> x SM<sub>unit</sub>  
 HS<sub>unit</sub> = Regional Housing Starts x (county building permits/Regional building permits)  
 SM<sub>unit</sub> = Area or volume of soil moved for the given unit type  
 T<sub>Construction</sub> = Construction time (in months) for given unit type  
 EF<sub>unit</sub> = Unadjusted emission factor for PM<sub>10</sub> for the given unit type  
 Adj<sub>PM</sub> = PM Adjustment factor

As an example, in Beaufort County, North Carolina, 2010 acres disturbed and PM<sub>10</sub> emissions from 1-unit housing starts without a basement are calculated as follows:

$$A_{\text{unit}} = 247,000 \times (211/232,280) \times 0.907_{(\text{Fraction without basement})} * 0.25 \text{ acres/unit}$$

$$= 203 \text{ units} * 0.25 \text{ acres/unit} = 50.9 \text{ acres}$$

$$Adj_{PM} = (24/110.1) * (10/9) = 0.242$$

$$PM_{10} \text{ Emissions} = (50.9 \text{ acres} \times 6 \text{ months} \times 0.032 \text{ tons PM}_{10}/\text{acre-month}) \times 0.242 = 2.37 \text{ tons PM}_{10}$$

### 3.7.5.5 References

6. New Privately Owned Housing Units Started for 2010 (Not seasonally adjusted), available at: <http://www.census.gov/const/startsua.pdf>
7. Table 2au. New Privately Owned Housing Units Authorized - Unadjusted Units for Regions, Divisions, and States, Annual 2010, available at: <http://www.census.gov/const/C40/Table2/tb2u2010.txt>
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, available at: <http://www.census.gov/const/C25Ann/sfttotalfoundation.pdf>
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.  
<http://www.epa.gov/ttn/chief/conference/ei15/session14/cowherd.pdf>

### 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).

For this category, the following SCC was used:

**Table 57: SCC for Road Construction**

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

#### 3.7.6.2 Activity Data

The Federal Highway Administration has *Highway Statistics, Section IV - Highway Finance, Table SF-12A, State Highway Agency Capital Outlay* [ref 1] 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 the table below:

**Table 58: 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 58 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 2] 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.

### 3.7.6.3 Emission Factors

Initial PM<sub>10</sub> emissions from construction of roads are calculated using an emission factor of 0.42 tons/acre-month [ref 3]. 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<sub>10</sub> emissions from road construction to develop the final emissions inventory.

To account for the soil moisture level, the PM<sub>10</sub> 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<sub>10</sub> 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 3].

The equation for PM<sub>10</sub> emissions corrected for soil moisture and silt content is:

$$Corrected E_{PM_{10}} = Initial E_{PM_{10}} \times \frac{24}{PE} \times \frac{S}{9\%}$$

where: Corrected  $E_{PM_{10}}$  =  $PM_{10}$  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.

### 3.7.6.4 Example Calculation

$$\text{Emissions}_{PM_{10}} = \sum(HD_{rt} \times MC_{rt} \times AC_{rt}) \times (HS_{\text{County}} / HS_{\text{State}}) \times EF_{\text{Adj}} \times M$$

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  
 $HS_{\text{County}}$  = Housing Starts in a given county  
 $HS_{\text{State}}$  = Housing Starts in a given State  
 $EF_{\text{Adj}}$  = 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:

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

where  $EF_{\text{Adj}}$  is calculated as follows:

$$\begin{aligned} EF_{\text{Adj}} &= 0.42 \text{ ton}/\text{acre-month} * (24/110.1 * 33/9) \\ &= 0.28 \text{ ton}/\text{acre-month} \end{aligned}$$

### 3.7.6.5 References

1. 2008 Highway Spending : <http://www.fhwa.dot.gov/policyinformation/statistics/2008/sf12a.cfm>
2. 2008 Building Permits data from US Census "BPS01", <http://www.census.gov/support/USACdataDownloads.html>
3. Midwest Research Institute. Improvement of Specific Emission Factors (BACM Project No. 1). Prepared for South Coast Air Quality Management District. March 29, 1996.
4. 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.

### 3.7.7 Summary of Quality Assurance Methods

## 3.8 Dust – Paved Road Dust

### 3.8.1 Sector Description

The 2011 NEI has emissions for the following SCCs in this sector.

**Table 59:** 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

EPA estimates emissions for particulate matter for the first SCC in this table.

### 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 60 submitted emissions for this sector.

**Table 60:** 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
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	

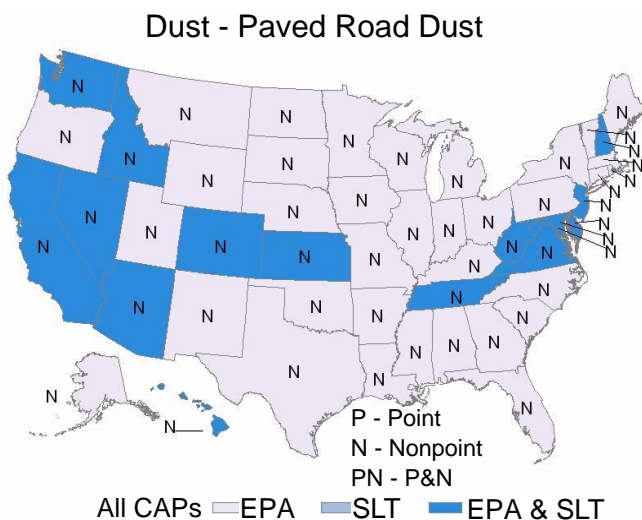
AGENCY	Type	All Other Public Paved Roads	All Paved Roads	Interstate/ Arterial
Northern Cheyenne Tribe	T		X	
Sac and Fox Nation of Missouri in Kansas and Nebraska Reservation	T	X		
Shoshone-Bannock Tribes of the Fort Hall Reservation of Idaho	T		X	
Virginia Department of Environmental Quality	S		X	
Washington State Department of Ecology	S		X	
West Virginia Division of Air Quality	S		X	

Table 61 shows the selection hierarchy for the datasets included in the paved road dust sector.

**Table 61: 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
5	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<sub>10</sub> 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.

#### 3.8.4.1 Emission Factor Equation

Reentrained 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 PM<sub>10</sub>-PRI/-FIL and .25 g/VMT for PM<sub>25</sub>-PRI/-FIL)  
 sL = road surface silt loading (g/square meter [m<sup>2</sup>]) (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 PM<sub>10</sub>-PRI/-FIL and PM<sub>25</sub>-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 [ftp://ftp.epa.gov/EmisInventory/2011/doc/roads\\_paved\\_2011.zip](ftp://ftp.epa.gov/EmisInventory/2011/doc/roads_paved_2011.zip). 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 63.

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 64. 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.

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.

### 3.8.4.2 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.

### 3.8.4.3 Controls

Paved road dust controls were applied by county to urban and rural roads in serious PM<sub>10</sub> nonattainment areas and to urban roads in moderate PM<sub>10</sub> 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<sub>10</sub> nonattainment area classification (serious or moderate). The rule penetration rates are shown in Table 62.

**Table 62:** Rule effectiveness was assumed to be 100% for all counties where this control was applied.

PM <sub>10</sub> 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



PM <sub>10</sub> Nonattainment Status	Roadway Class	Vacuum Sweeping Penetration Rate (%)
Serious	Rural Major Collector	83
Serious	Rural Minor Collector	59
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.

**Table 63: 2011 Silt Loadings by State and Roadway Class Modeled in Paved Road Emission Factor Calculations (g/m<sup>2</sup>)**

State	Rural						Urban					
	Interstate	Other Principal Arterial	Minor Arterial	Major Collector	Minor Collector	Local	Interstate	Other Freeways and Expressways	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
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

State	Rural						Urban					
	Interstate	Other Principal Arterial	Minor Arterial	Major Collector	Minor Collector	Local	Interstate	Other Freeways and Expressways	Other Principal Arterial	Minor Arterial	Collectors	Local
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

**Table 64: 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

<b>Vehicle Class Abbreviation</b>	<b>Vehicle Class Description</b>	<b>Vehicle Weight Estimate (lbs)</b>
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
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

**Table 65:** Penetration Rate of Paved Road Vacuum Sweeping

<b>PM<sub>10</sub> Nonattainment Status</b>	<b>Roadway Class</b>	<b>Vacuum Sweeping Penetration Rate</b>
Moderate	Urban Freeway & Expressway	0.67
Moderate	Urban Minor Arterial	0.67
Moderate	Urban Collector	0.64
Moderate	Urban Local	0.88
Serious	Rural Minor Arterial	0.71
Serious	Rural Major Collector	0.83
Serious	Rural Minor Collector	0.59
Serious	Rural Local	0.35
Serious	Urban Freeway & Expressway	0.67
Serious	Urban Minor Arterial	0.67
Serious	Urban Collector	0.64
Serious	Urban Local	0.88

### 3.8.5 Summary of Quality Assurance Methods

### 3.8.6 References

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. Available at

<http://www.fhwa.dot.gov/policyinformation/statistics/2010/>.

3. U.S. Department of Commerce, National Oceanic and Atmospheric Administration. "2011 Local Climatological Data Annual Summaries with Comparative Data": Available at: <http://www7.ncdc.noaa.gov/IPS/lcd/lcd.html>, 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 66 for this sector. EPA estimates emissions for particulate matter for the first SCC (2296000000) in Table 66.

**Table 66:** 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 67 submitted emissions for this sector.

**Table 67:** Agencies that Submitted Unpaved Road 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

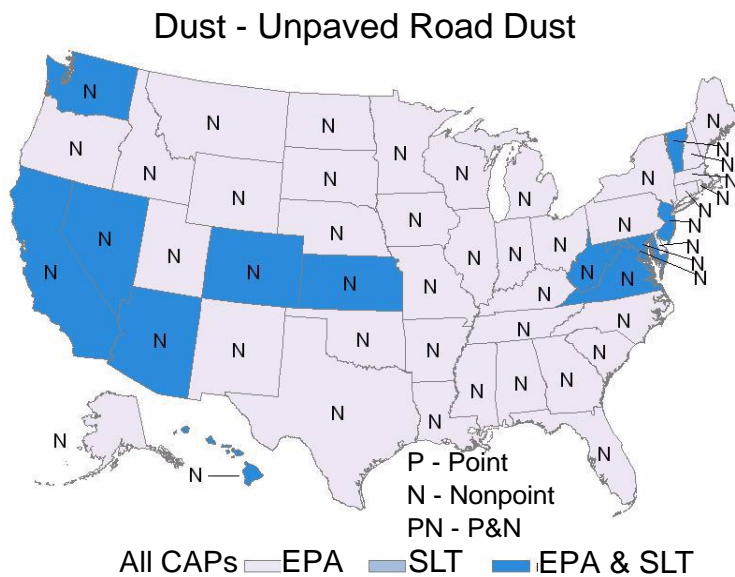
Agency	Type	All Unpaved Roads	Industrial Unpaved Roads	Public Unpaved Roads
Vermont Department of Environmental Conservation	S	X		
Virginia Department of Environmental Quality	S	X		
Washington State Department of Ecology	S	X		
West Virginia Division of Air Quality	S	X		

Table 68 shows the selection hierarchy for the datasets used in the unpaved roads sector.

**Table 68: 2011 NEI Unpaved Roads 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<sub>10</sub> 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.

#### 1.1.1.1 Emission Factor Equation

Reentrained 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]:

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

where k and C are empirical constants given in Table 69, 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 69 [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 state that had three or more samples for that State. For States that did not have three or more samples, the average for all samples from all States 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 69:** Constants for Unpaved Roads Reentrained 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 70 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 70:** 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 resuspension. Monthly corrected emission factors by State and roadway classification were calculated using the following equation:

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

where:  $E_{\text{corr}}$  = 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.

#### 3.9.4.1 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 71: Assumed Values for Average Daily Traffic Volume (ADTV) by Volume Group

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 71: Assumed Values for Average Daily Traffic Volume (ADTV) by Volume Group**

<b>Rural Roads</b>				
Volume Category (vehicles per day per mile)	< 50	50-199	200-499	> 500
Assumed ADTV	5*	125**	350**	550***
<b>Urban Roads</b>				
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.

### 3.9.4.2 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.

### 3.9.4.3 Controls

The controls assumed for unpaved roads varied by PM<sub>10</sub> nonattainment area classification and by urban and rural areas. On urban unpaved roads in moderate PM<sub>10</sub> 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 of 75 percent and a rule penetration of 50 percent, was assumed for rural areas in serious PM<sub>10</sub> 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<sub>10</sub> 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

### 3.9.6 References

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 80<sup>th</sup> 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. Available at <http://www.fhwa.dot.gov/policyinformation/statistics/2007/>.
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. Retrieved from <http://www.census.gov/geo/www/ua/2010urbanruralclass.html> 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

### 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 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 submitted data except where the S/L/T 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<sub>2</sub> and NO<sub>x</sub> CEM data or from AP-42 emissions factors were only used where the responsible S/L/T 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 were also from the EPA Carry Forward, EPA other, and EPA’s Nevada Gold datasets.

The agencies listed in Table 72 **Error! Reference source not found.** 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 72:** 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
Kentucky Division for Air Quality	State	X	X	X	X	X
Lane Regional Air Pollution Authority	Local				X	

<b>Agency</b>	<b>Type</b>	<b>Coal</b>	<b>Oil</b>	<b>Natural Gas</b>	<b>Biomass</b>	<b>Other</b>
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
Tennessee Department of Environmental Conservation	State	X	X	X	X	X

Agency	Type	Coal	Oil	Natural Gas	Biomass	Other
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

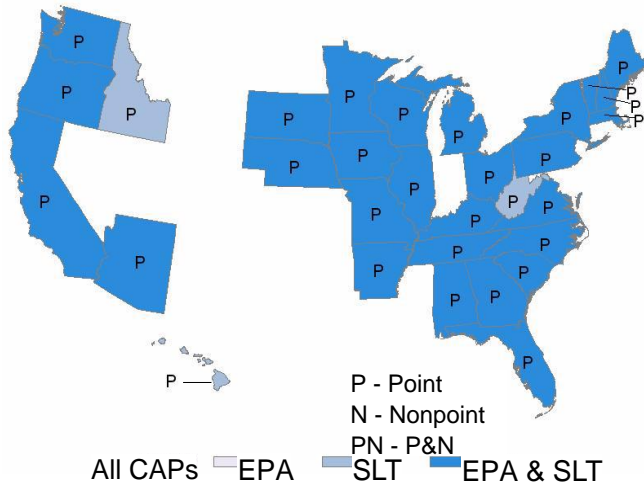
Table 73 shows the selection hierarchy for the EGU sectors. A box with an “X” means that the dataset contributed to the EGU sector for that fuel group.

**Table 73: 2011 NEI EGU data selection hierarchy by EGU fuel groups**

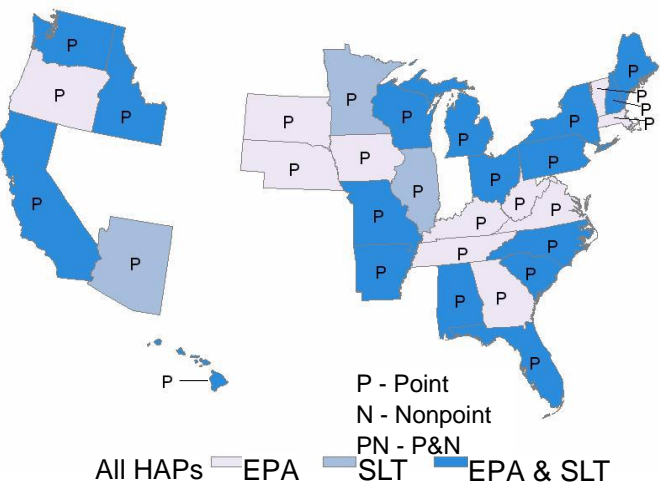
Priority	Data Set Name	Data Set Contents and Impact	Coal	Oil	Natural Gas	Biomass	Other
1	2011EPA_PM-Augmentation	Augments PM data in 47 states and some tribes (see Section 3.1.2)	X	X	X	X	X
2	2011 Responsible Agency Selection	S/L/T Agency submitted emissions	X	X	X	X	X
3	2011EPA_EGU	Overwrites Hg, other 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 0)	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 0)	X	X	X	X	X

### 3.10.3 Spatial coverage and data sources for the sector

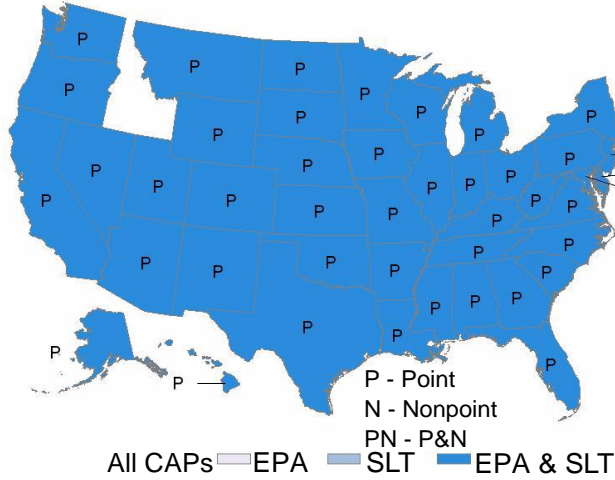
Fuel Comb - Electric Generation - Biomass



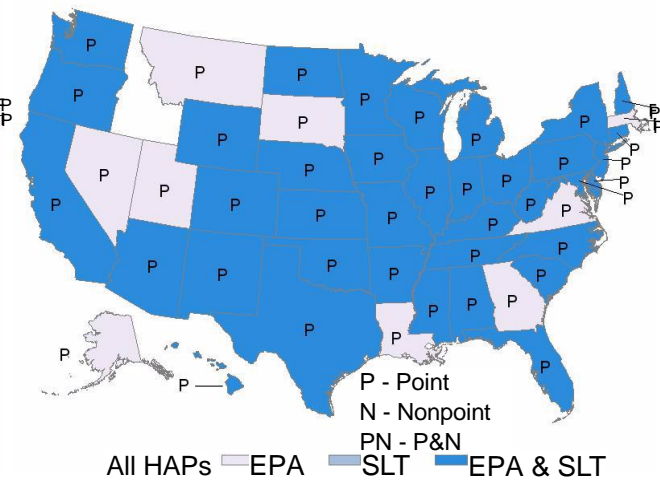
Fuel Comb - Electric Generation - Biomass



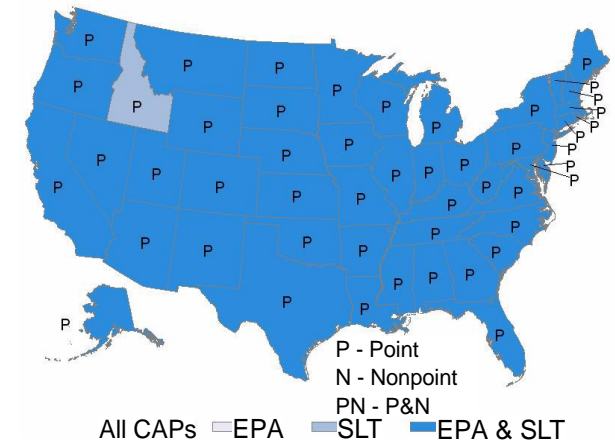
Fuel Comb - Electric Generation - Coal



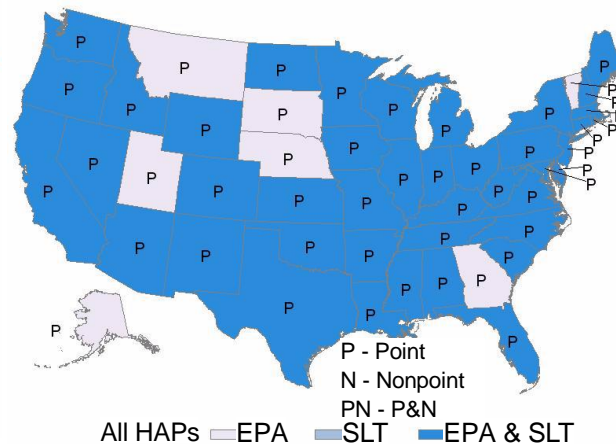
Fuel Comb - Electric Generation - Coal



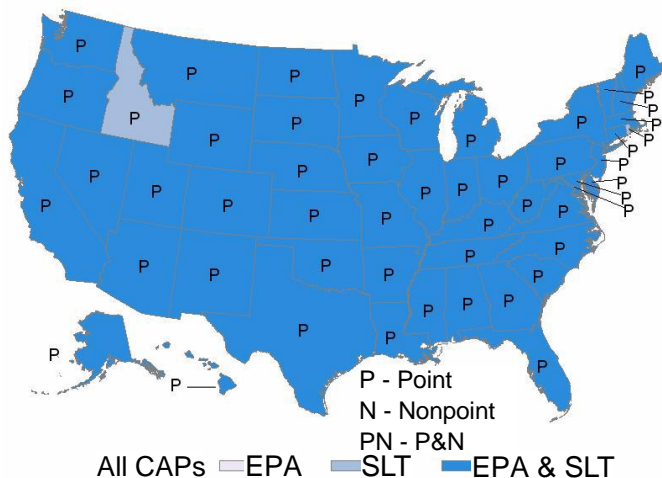
Fuel Comb - Electric Generation - Natural Gas



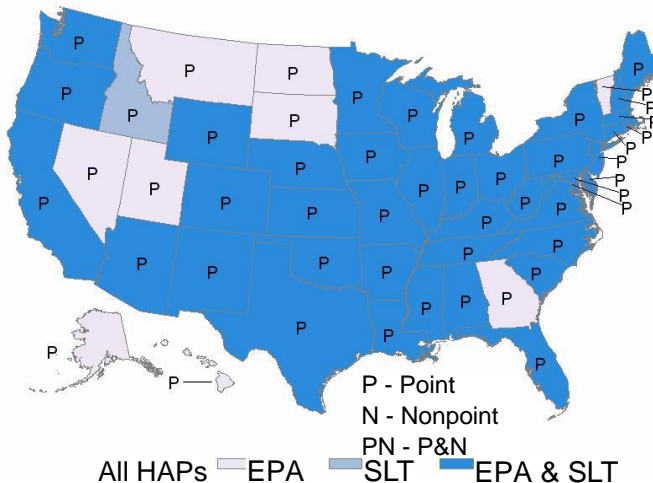
Fuel Comb - Electric Generation - Natural Gas



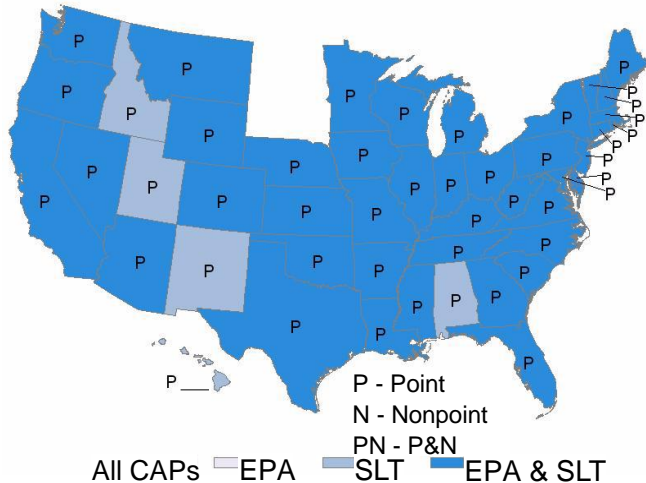
Fuel Comb - Electric Generation - Oil



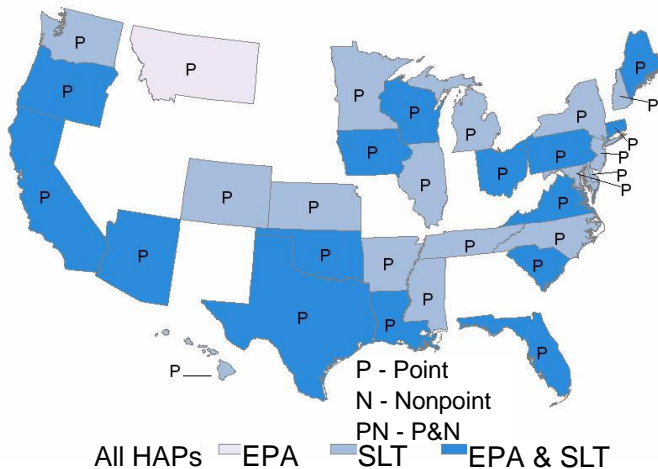
Fuel Comb - Electric Generation - Oil



Fuel Comb - Electric Generation - Other



Fuel Comb - Electric Generation - Other



### 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 submitted emissions for the various pieces of PM emissions in order to complete a consistent representation for both PM<sub>10</sub>-Primary and PM<sub>2.5</sub>-Primary emissions from all sectors. These steps may be as simple as adding S/L/T submitted filterable and condensable pieces together to create the PM<sub>10</sub> and PM<sub>2.5</sub> Primary species, or they may also include EPA estimates for the condensable piece if not submitted by the S/L/T. For the five EGU sectors as a whole, the 2011EPA\_PM-Augmentation dataset contributed 44% of the total PM<sub>10</sub>-Primary mass and 51% of the total PM<sub>2.5</sub>-Primary mass. Table 74 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 74:** Agency-submitted, PM Augmentation, and total PM<sub>10</sub> and PM<sub>2.5</sub> emissions for EGU sectors

EIS Sector	PM <sub>10</sub> Agency (tons)	PM <sub>10</sub> Aug (tons)	PM <sub>10</sub> Total (tons)	PM <sub>2.5</sub> Agency (tons)	PM <sub>2.5</sub> Aug (tons)	PM <sub>2.5</sub> Total (tons)
Fuel Comb - Electric Generation - Biomass	1,439	743	2,182	1,010	863	1,873
Fuel Comb - Electric Generation - Coal	130,611	106,873	237,484	80,670	85,967	166,637
Fuel Comb - Electric Generation - Natural Gas	12,604	13,027	25,632	10,875	13,946	24,821
Fuel Comb - Electric Generation - Oil	6,931	1,054	7,985	4,455	1,416	5,871
Fuel Comb - Electric Generation - Other	1,759	1,134	2,893	1,165	1,383	2,549
	<b>153,344</b>	<b>122,832</b>	<b>276,176</b>	<b>98,176</b>	<b>103,575</b>	<b>201,751</b>

### 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/Ts and in some cases to be used instead of S/L/T 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<sub>2</sub> and NO<sub>x</sub> 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 73, the selection hierarchy was set such that S/L/T-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 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 value, except where the S/L/T submittal indicated that the S/L/T value was from either a CEM or a recent stack test. The selection of the MATS-based emissions over the S/L/T emissions was accomplished by setting a “tag” on those S/L/T 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 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 NO<sub>x</sub> emissions. Wherever S/L/T 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 emissions for that pollutant be tagged.

In summary, the 2011 NEI for EGUs is comprised of largely S/L/T-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 EIS had been matched to the EPA data, the magnitudes of the SO<sub>2</sub> and NO<sub>x</sub> 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 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 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 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 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 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 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 liquified 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 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 above in 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 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 and 9 EPA datasets that cover both point and nonpoint data categories. Table 75 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 75:** Agencies that submitted data for the Fuel Combustion - Industrial Boilers, ICEs Sectors

Agency	TYPE	Nonpoint					Point				
		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

Agency	TYPE	Nonpoint					Point				
		Bio-mass	Coal	Natural Gas	Oil	Other	Bio-mass	Coal	Natural Gas	Oil	Other
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		
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 Department 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		

Agency	TYPE	Nonpoint					Point				
		Bio-mass	Coal	Natural Gas	Oil	Other	Bio-mass	Coal	Natural Gas	Oil	Other
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 76 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 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 76:** 2011 NEI selection hierarchy for datasets used by the 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
2008EPA_MMS	Same data as were used in 2008: 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 (Wilson et. al, 2010) in the National Inventory Input Format and converted to the CERS format by EPA.	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 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 77.

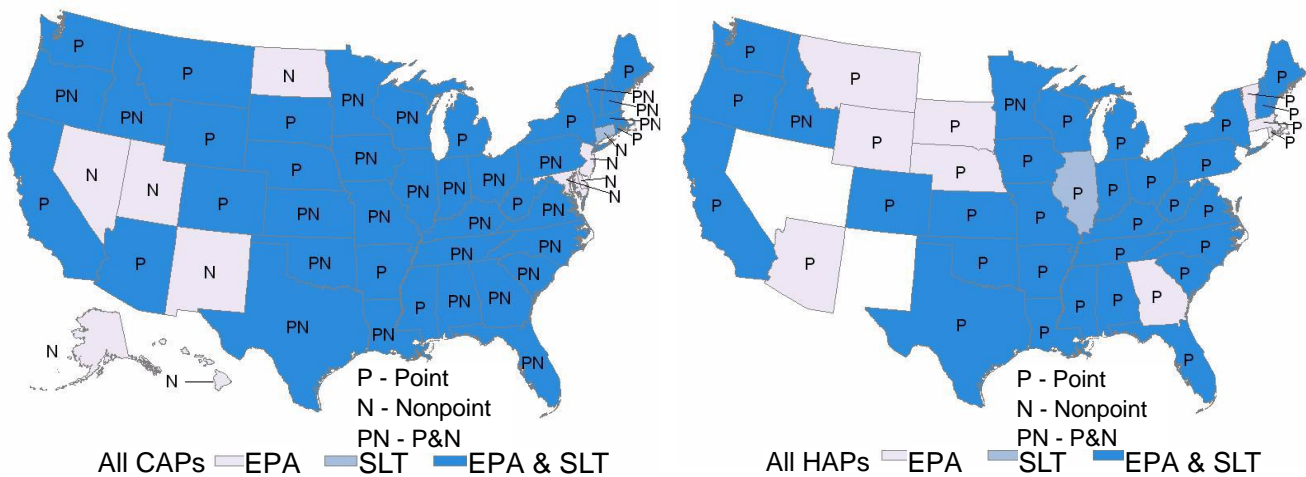
**Table 77:** Algorithm to determine whether to augment state data with EPA data for Industrial Boilers sector

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 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.
	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

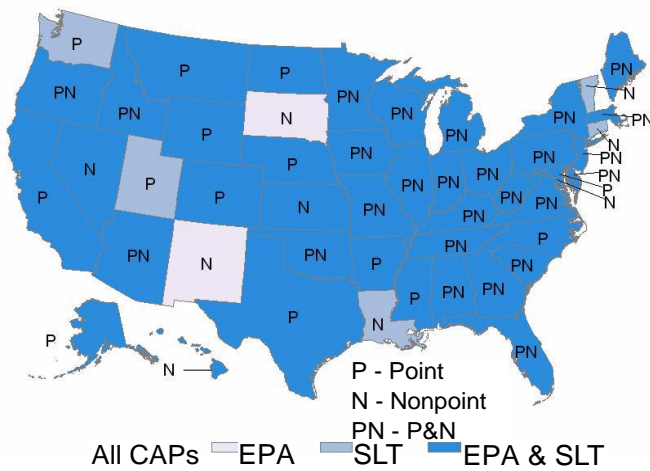
Survey Data	State Submitted to Point?	State Submitted to Nonpoint?	EPA Action	Rationale
				category is not covered by the state at all.
	Yes	No	Augment	While there would be some double-counting of point emissions, it would be small, and we believe that there would still be nonpoint emissions for this 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

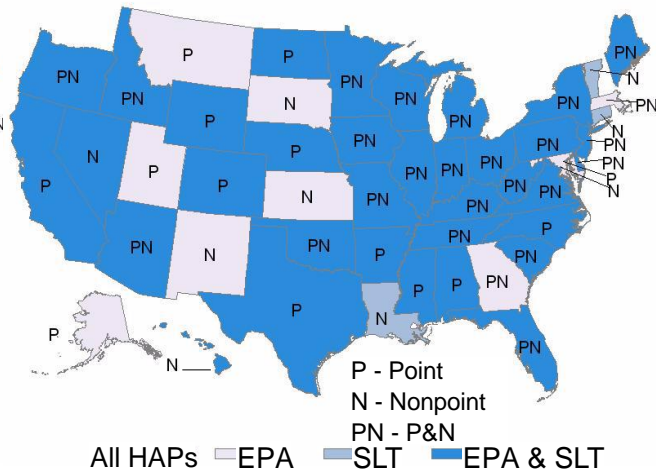
Fuel Comb - Industrial Boilers, ICEs - Biomass Fuel Comb - Industrial Boilers, ICEs - Biomass



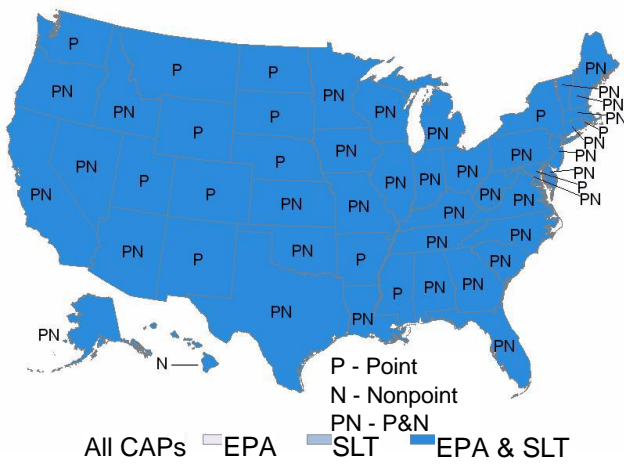
Fuel Comb - Industrial Boilers, ICEs - Coal



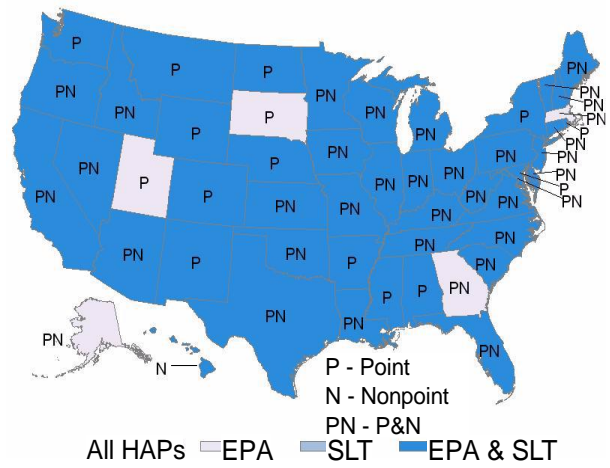
Fuel Comb - Industrial Boilers, ICEs - Coal



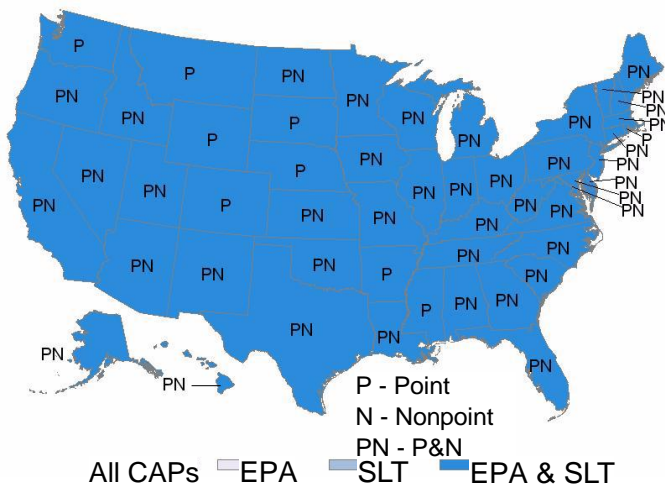
Fuel Comb - Industrial Boilers, ICEs - Natural Gas



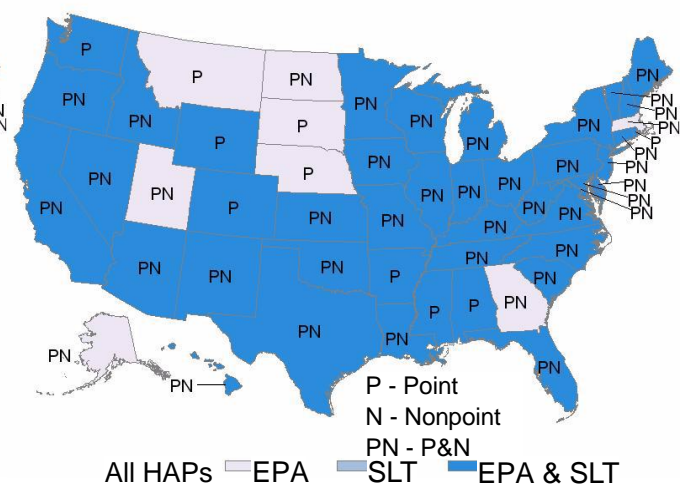
Fuel Comb - Industrial Boilers, ICEs - Natural Gas



Fuel Comb - Industrial Boilers, ICEs - Oil

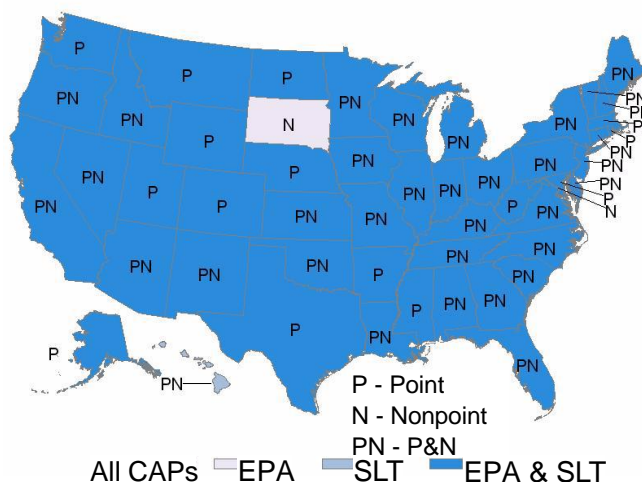


Fuel Comb - Industrial Boilers, ICEs - Oil

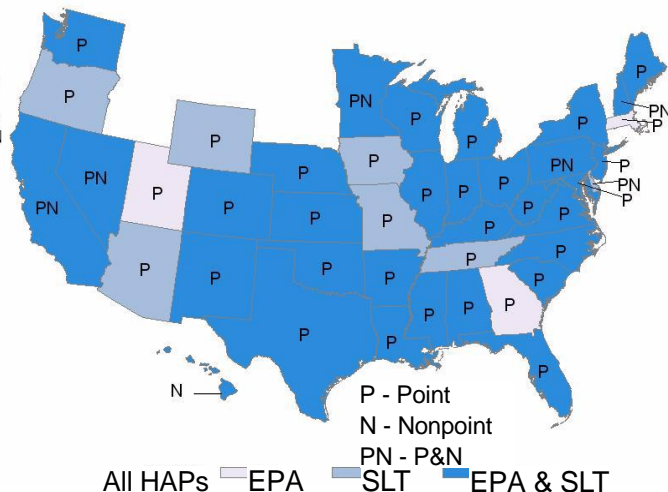




Fuel Comb - Industrial Boilers, ICEs - Other



Fuel Comb - Industrial Boilers, ICEs - Other



### 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 can be found in the documentation given in <ftp://ftp.epa.gov/EmisInventory/2011nei/doc/>. 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 v1 NEI. Other states agreed that the tagged values seemed incorrect, and that EPA should use the EPA generated estimates in its place. Table 78 summarizes the number of tagged process-level emissions values from each agency affected by this QA.

**Table 78:** Agencies Tagged Values for Industrial Fuel Combustion

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

Agency	Number of Values Tagged	Tag Reason
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 plans to resubmit for version 2
Wisconsin Department of Natural Resources	2	State did not report hex, so EPA data should be used

### 3.11.6 References

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, accessed from <http://www.eia.doe.gov/emeu/mecs/mecs2002/data02/shelltables.html>, 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*, data available from [http://tonto.eia.doe.gov/dnav/pet/pet\\_cons\\_821use\\_dcu\\_nus\\_a.htm](http://tonto.eia.doe.gov/dnav/pet/pet_cons_821use_dcu_nus_a.htm), accessed March, 2012.
5. Census, 2012: Bureau of the Census, U.S. Department of Commerce, *County Business Patterns 2009*, Washington, DC, available from: <http://www.census.gov/econ/cbp/index.html> 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 79 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 79: Agencies that Submitted Commercial/Institutional Fuel Combustion Data**

Agency	Type	Nonpoint					Point				
		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

Agency	Type	Nonpoint					Point				
		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 80 shows the selection hierarchy for the commercial/institutional fuel combustion sector.

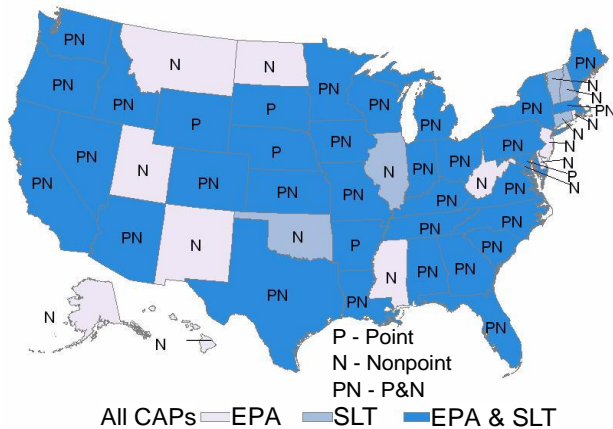
**Table 80:** 2011 NEI Commercial/Institutional Fuel Combustion Data Selection Hierarchy

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

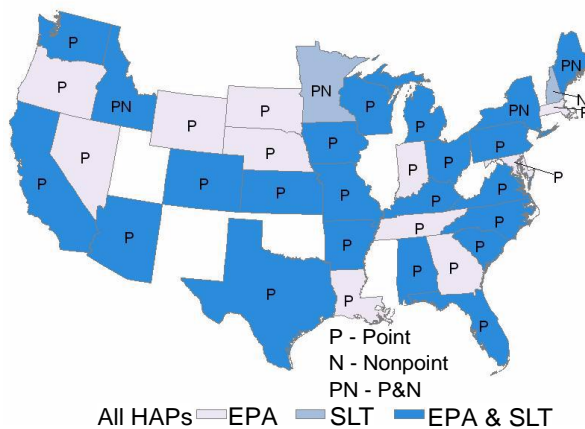
Data Set Name	Description	Point	Non-point
2011EPA_EGU	EPA MATS EGU data developed from CAMD heat input and EFs.	3	
2011EPA_chrom_split	Contains corrected and speciated hexavalent and trivalent chromium emissions derived from the S/L/T agency data for sources in which S/L/T agency reports the total (unspeciated) 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
2008EPA_MMS	Same data as were used in 2008: 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 (Wilson et. al, 2010) in the National Inventory Input Format and converted to the CERS format by EPA.	8	
2011EPA_NP_Overlap_w_Pt	EPA generated emissions for nonpoint sources		5

### 3.12.3 Spatial coverage and data sources for the sector

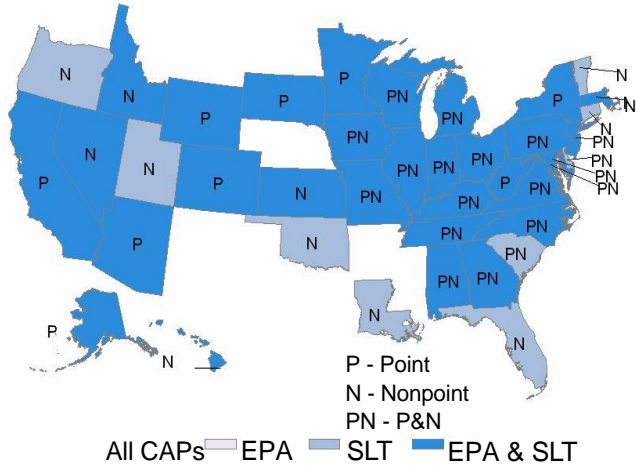
Fuel Comb - Comm/Institutional - Biomass



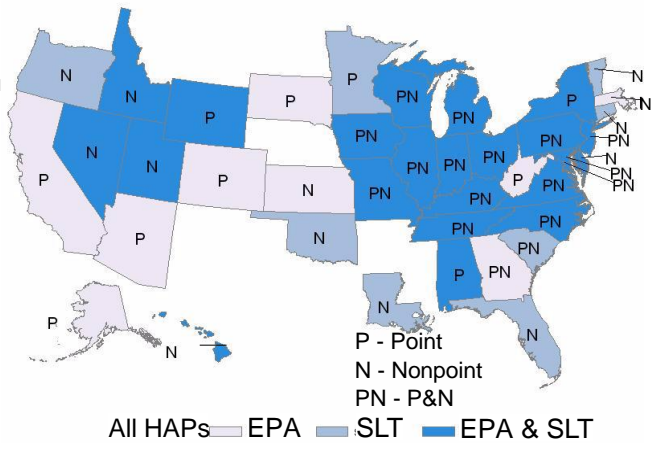
Fuel Comb - Comm/Institutional - Biomass



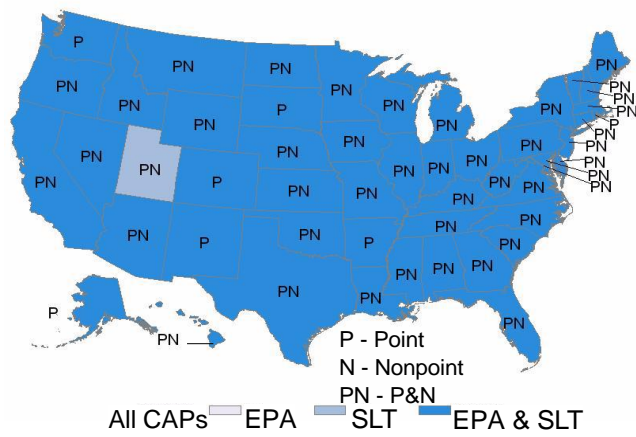
Fuel Comb - Comm/Instiutional - Coal



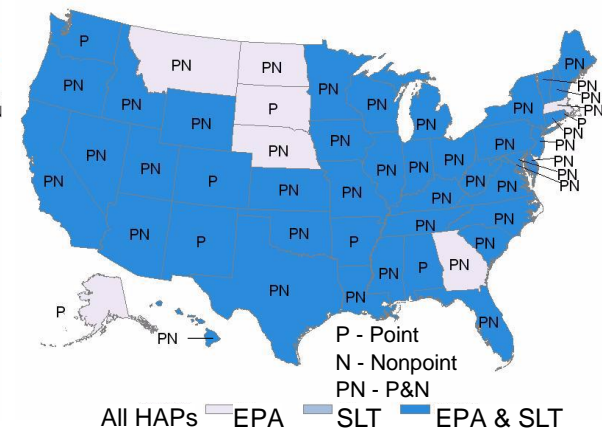
Fuel Comb - Comm/Instiutional - Coal



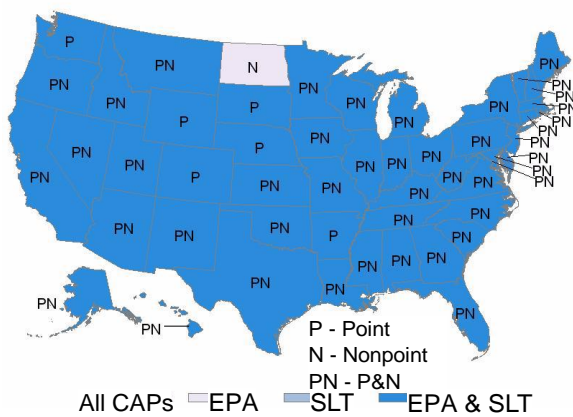
Fuel Comb - Comm/Instiutional - Natural Gas



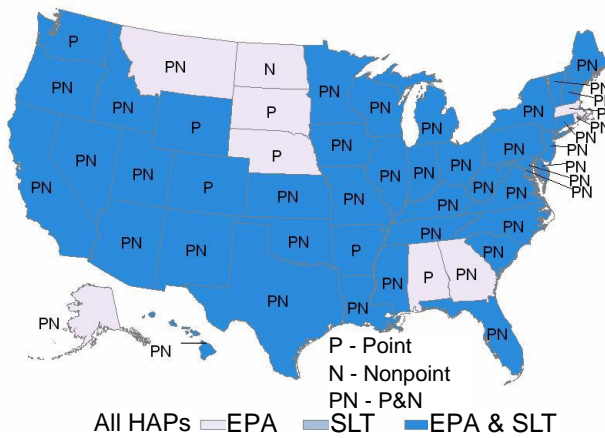
Fuel Comb - Comm/Instiutional - Natural Gas



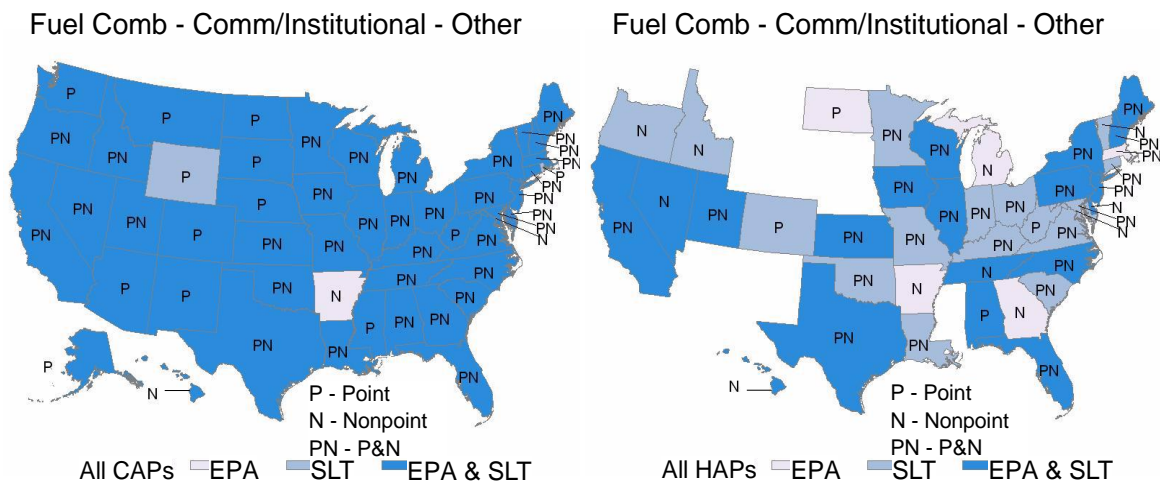
Fuel Comb - Comm/Instiutional - Oil



Fuel Comb - Comm/Instiutional - Oil







### 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 81 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 81 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 can be found in the documentation given in <ftp://ftp.epa.gov/EmisInventory/2011nei/doc/>. 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 81: Assumptions Used to Estimate Commercial/Institutional Sector 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 <sup>a</sup>
	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 82 summarizes the number of tagged process-level emissions values from each agency affected by this QA.

**Table 82:** Agencies Tagged Values for Commercial/Institutional Fuel Combustion

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

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*, data available from [http://tonto.eia.doe.gov/dnav/pet/pet\\_cons\\_821use\\_dcu\\_nus\\_a.htm](http://tonto.eia.doe.gov/dnav/pet/pet_cons_821use_dcu_nus_a.htm), 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, available from: <http://www.census.gov/econ/cbp/index.html> 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*, available from: <http://www.census.gov/govs/www/apesloc06.html>, 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 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 83 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 83:** 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

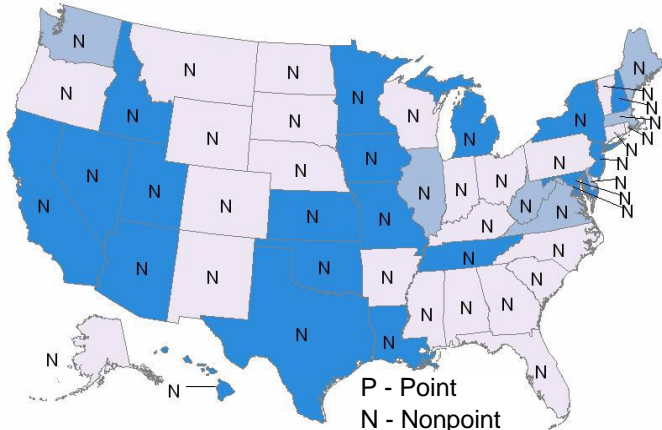
The residential fuel combustion sectors include data from the S/L/T agency submitted data and the default EPA generated emissions. This sector is contained solely in the nonpoint data category. The agencies listed in Table 84 submitted emissions for this sector. Where only emission values of zero were 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 84: Agencies that submitted data for Fuel Combustion – Residential Heating – Natural Gas, Oil and Other**

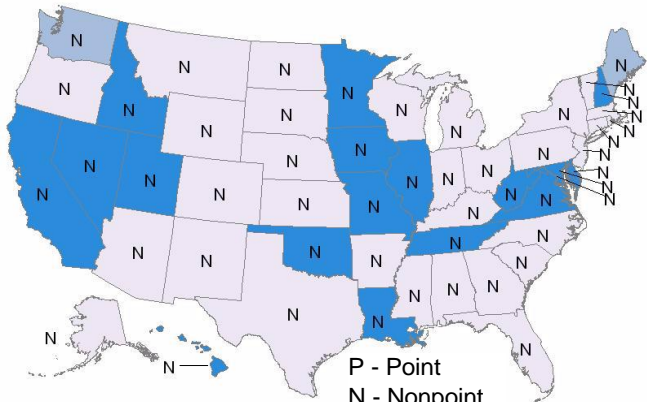
Agency	Type	Natural Gas	Oil			Other		
		Natural Gas	Distillate Oil	Kerosene	Residual Oil	Anthracite Coal	Bituminous/Subbituminous Coal	Liquified Petroleum Gas (LPG)
US Environmental Protection Agency (2011EPA_NP_NoOvrlp dataset, to be described in 3.13.4)	EPA	X	X	X		X	X	X
California Air Resources Board	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

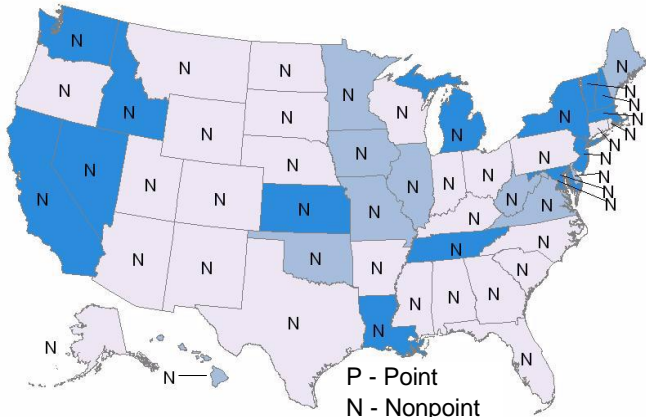
Fuel Comb - Residential - Other



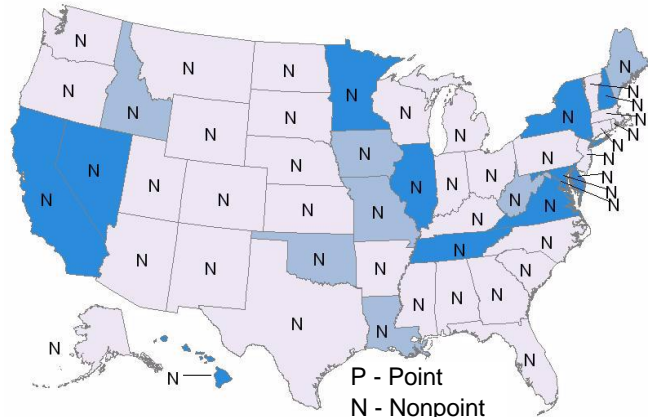
Fuel Comb - Residential - Other



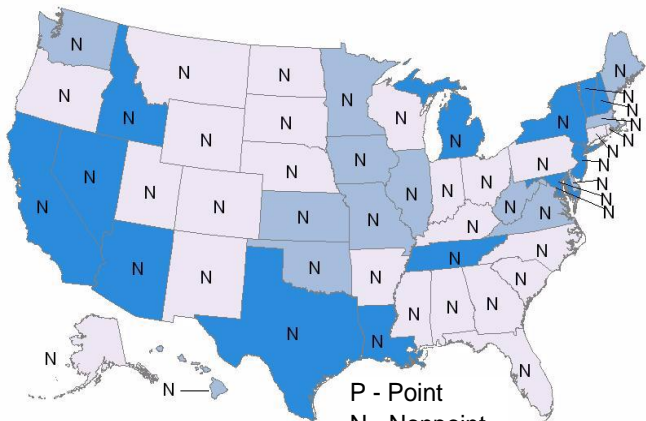
Fuel Comb - Residential - Oil



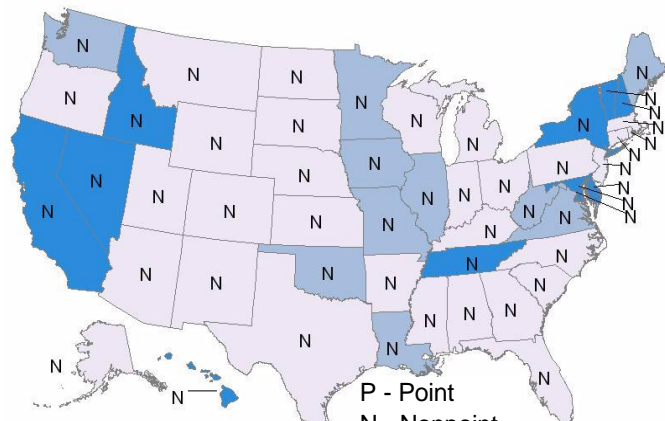
Fuel Comb - Residential - Oil



Fuel Comb - Residential - Natural Gas



Fuel Comb - Residential - Natural Gas



### 3.13.4 EPA Residential Heating estimates

### 3.13.5 Summary of quality assurance methods

## 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 85 shows the SCCs used in the 2011 NEI from in this sector. EPA estimates emission for all SCCs in Table 85 other than SCC=2104008300, which is a general woodstove SCC that provides no details on the category. Only the California Air Resources Board and the Sac and Fox Nation of Missouri in Kansas and Nebraska Reservation submit emissions for this general woodstove SCC.

**Table 85: 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, chimeas, 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 86 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 87 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 or both types of data are used for this sector. In cases where an agency is listed in Table 86 and "both" is shown in the figure, this means that one of the EPA augmentation datasets was used in that state.

**Table 86:** Agencies that submitted data for the sector Fuel Combustion – Residential Heating – Wood

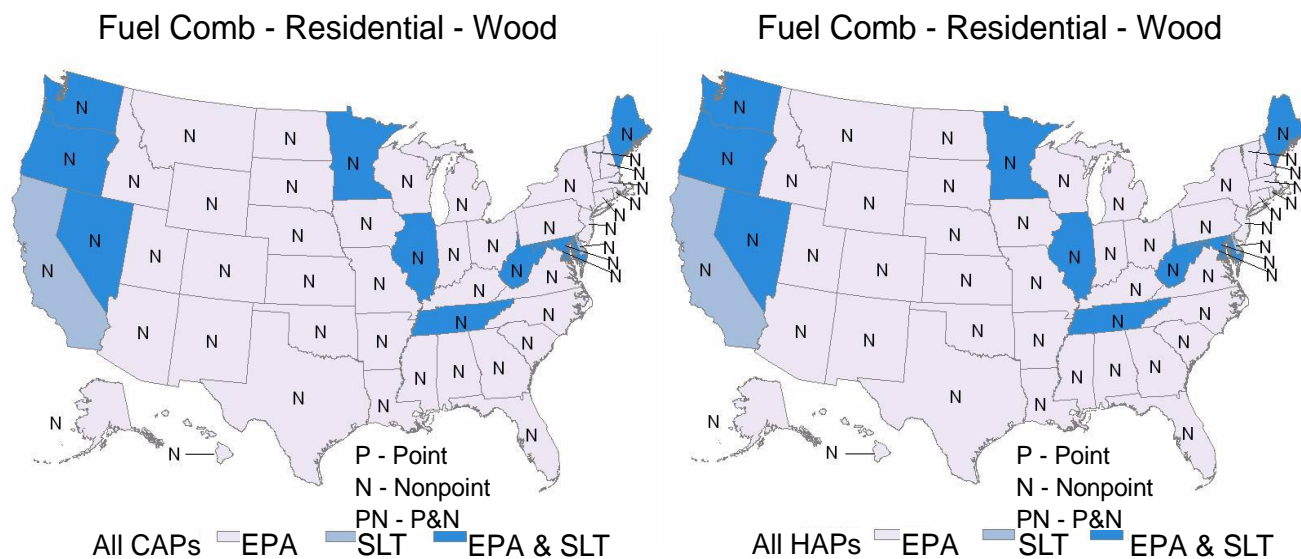
<b>Agency Name</b>	<b>Agency Type</b>
Bishop Paiute Tribe	Tribal
California Air Resources Board	State
Clark County Department of Air Quality and Environmental Management	Local Agency
Eastern Band of Cherokee Indians	Tribal
Illinois Environmental Protection Agency	State
Kootenai Tribe of Idaho	Tribal
Maine Department of Environmental Protection	State
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 87:** Datasets Included in the Fuel Comb – Residential – Wood sector

<b>Dataset Short Name</b>	<b>Order</b>
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.

#### Updated AHS appliance profile data

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 85. 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 (<http://www.census.gov/hhes/www/housing/ahs/ahs05/ahs05.html>), 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 does 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 88 lists the MSAs using updated AHS survey data for the 2011 NEI.

**Table 88: MSA’s using updated AHS data for residential wood combustion**

<b>MSA</b>	<b>Year of American Housing Survey Data</b>
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 2011 NEI, 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.

Decreases of emissions from RWC from 2008 occur in the southeast; we believe the 2008 version of the tool overestimated emissions in those states.

### Other appliance profile - outdoor wood boilers (OWBs) and indoor furnaces

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 NEI version 2, 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.

### Allocating OWBs and Indoor Furnaces to the county level

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 2008 version 3, 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 (<http://www.epa.gov/hg/report.htm>). 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.

### 3.14.5 Summary of quality assurance methods

#### 3.14.6 References

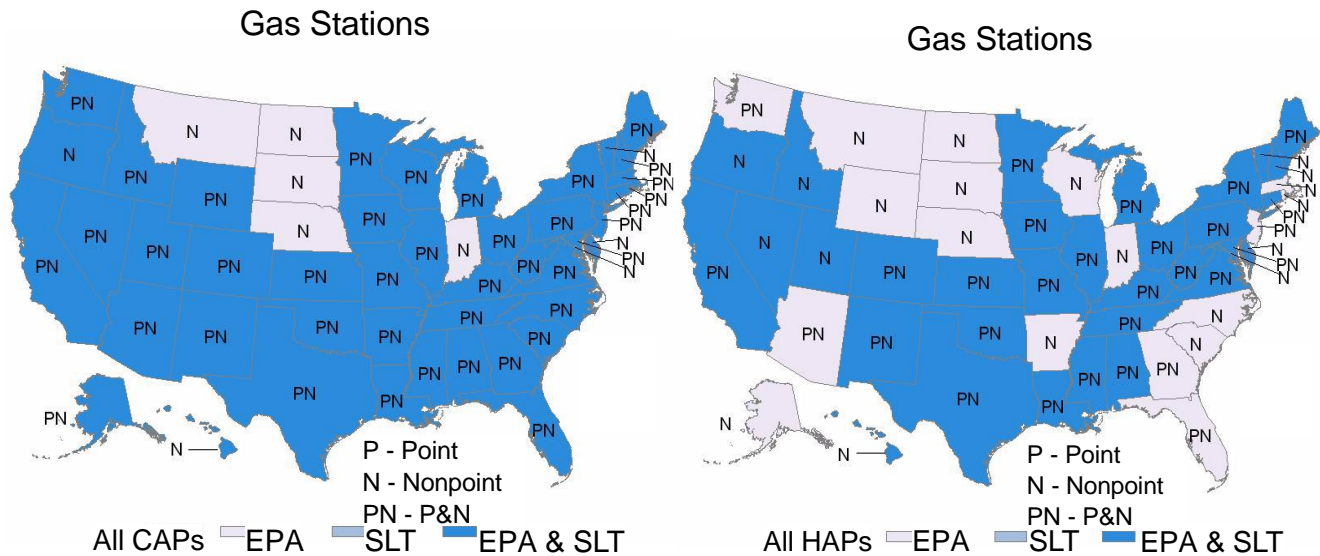
1. Huntley, Roy; Van Bruggen, J., Coldner, S., Divita, F.; "New Methodology for Estimating Emissions from Residential Wood Combustion", presented at the 17<sup>th</sup> International Emission Inventory Conference, Portland, Oregon, June 2008, <http://www.epa.gov/ttnchie1/conference/ei17/session2/huntley.pdf> . 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, available at [http://www.hearthandhome.com/James%20Houck%20Articles/HH\\_03\\_October.Wood%20or%20Gas.pdf](http://www.hearthandhome.com/James%20Houck%20Articles/HH_03_October.Wood%20or%20Gas.pdf), accessed June 23, 2014.
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. ([http://www.nyserda.ny.gov/Publications/Case-Studies/Biomass-Heating-Case-Studies.aspx?sc\\_database=web](http://www.nyserda.ny.gov/Publications/Case-Studies/Biomass-Heating-Case-Studies.aspx?sc_database=web)).

## 3.15 Gas Stations

### 3.15.1 Sector Description

### 3.15.2 Sources of data overview and selection hierarchy

### 3.15.3 Spatial coverage and data sources for the sector



## 3.16 Industrial Processes – Cement Manufacturing

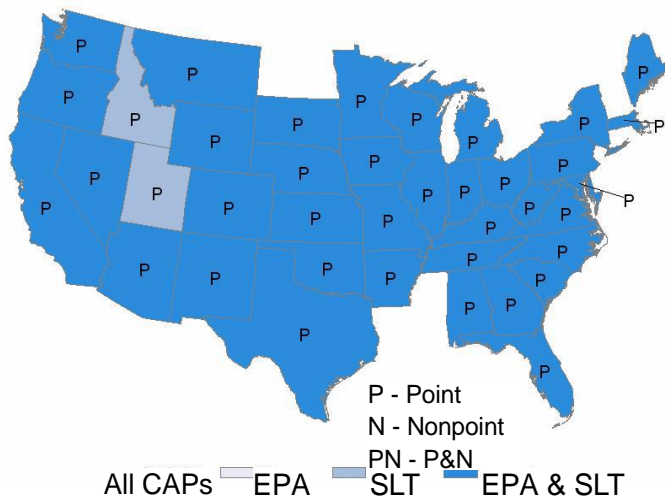
### 3.16.1 Sector Description

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.

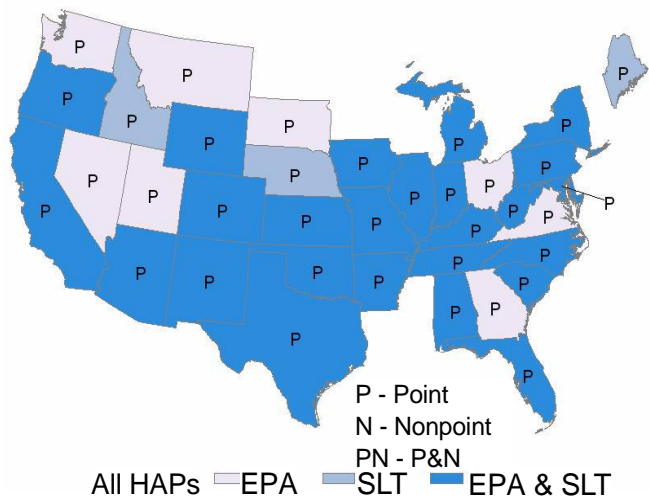
### 3.16.2 Sources of data overview and selection hierarchy

### 3.16.3 Spatial coverage and data sources for the sector

Industrial Processes - Cement Manuf



Industrial Processes - Cement Manuf



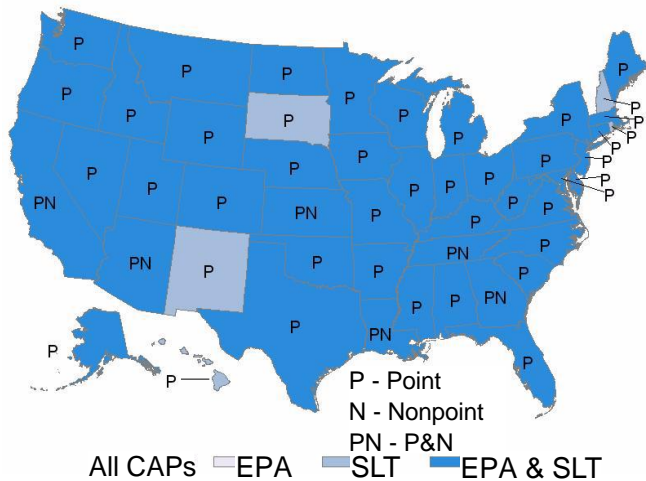
## 3.17 Industrial Processes - Chemical Manufacturing

### 3.17.1 Sector Description

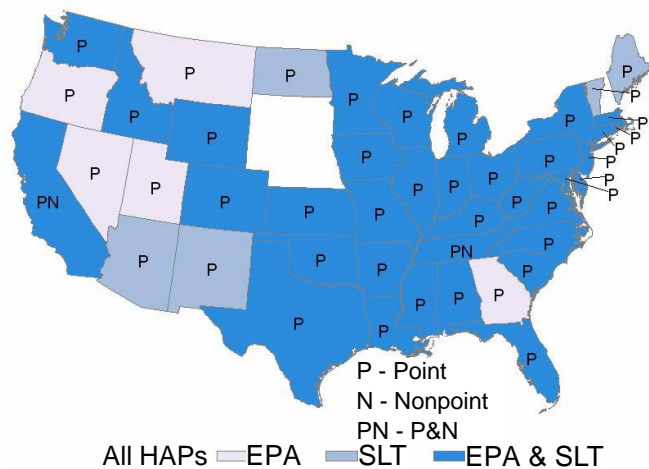
### 3.17.2 Sources of data overview and selection hierarchy

### 3.17.3 Spatial coverage and data sources for the sector

Industrial Processes - Chemical Manuf



Industrial Processes - Chemical Manuf

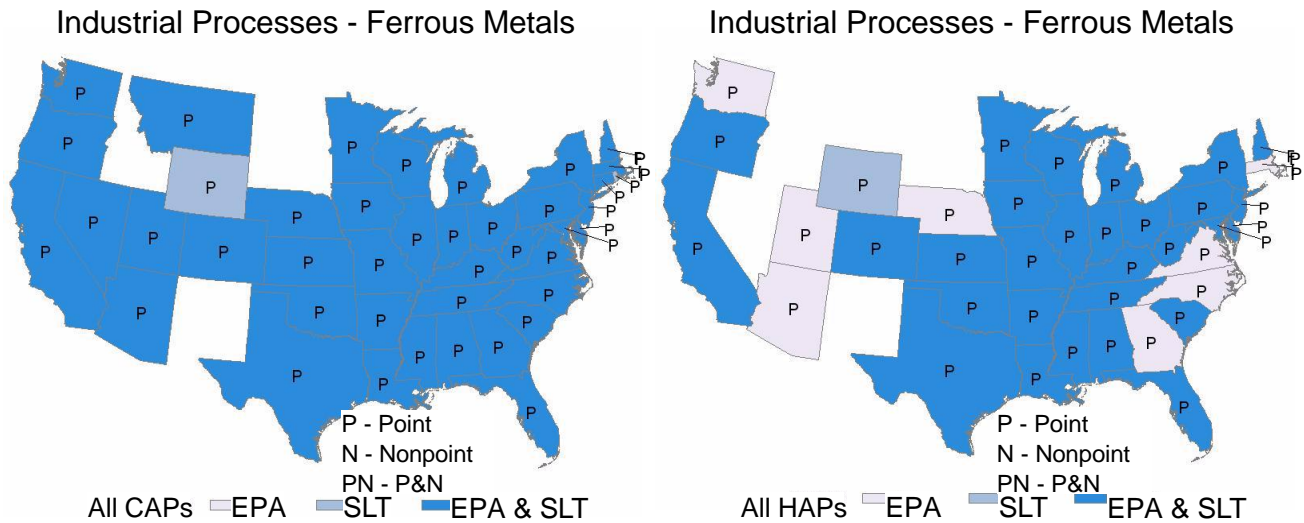


### 3.18 Industrial Processes – Ferrous Metals

#### 3.18.1 Sector Description

#### 3.18.2 Sources of data overview and selection hierarchy

#### 3.18.3 Spatial coverage and data sources for the sector



### 3.19 Industrial Processes – Mining

#### 3.19.1 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 emission for the SCCs shown in Table 89 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.

**Table 89: 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

SCC	SCC Level Two	SCC Level Three	SCC Level Four
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
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



SCC	SCC Level Two	SCC Level Three	SCC Level Four
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			

### 3.19.2 Sources of data overview and selection hierarchy

The industrial processes-mining sector includes data from S/L/T and EPA datasets that cover both point and nonpoint data categories. Table 90 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 90:** Agencies that submitted data for the Industrial Processes – Mining Sector

AGENCY_DESCRIPTION	NONPOINT					POINT							Primary metal production	
	Nonpoint: Mining and quarrying SIC 24					Mineral products							Leadbearing Ore Crushing and Grinding	Metal Mining (General Processes)
	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				
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			

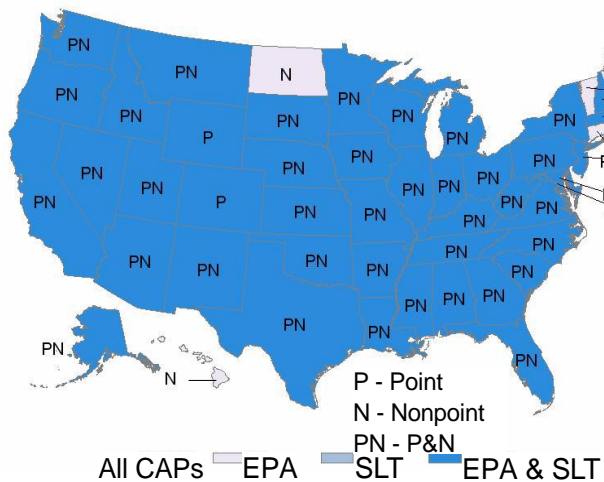
AGENCY DESCRIPTION	NONPOINT					POINT							
	Nonpoint: Mining and quarrying SIC 24					Mineral products							Primary metal production
	Lead Ore Mining and Milling	All Processes	Crushed and Broken Stone	Sand and Gravel	Clay processing: Bentonite	Clay processing: Common clay and shale, NEC	Coal Mining, 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)
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			
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						

AGENCY DESCRIPTION	NONPOINT					POINT							
	Nonpoint: Mining and quarrying SIC 24					Mineral products							
	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)
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		

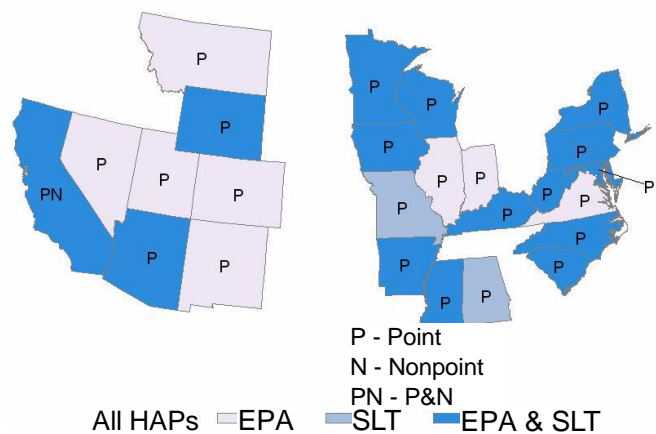
EPA data for most categories is due to PM augmentation of S/L/T data (see Section 3.1.2). EPA estimates for SCC 2325000000 is described in Section 3.19.4

### 3.19.3 Spatial coverage and data sources for the sector

Industrial Processes - Mining



Industrial Processes - Mining



### 3.19.4 EPA Emissions- Mining

The below sections explain how the PM<sub>10</sub> and PM<sub>2.5</sub> emissions for the EPA data (SCC 2325000000; Industrial Processes; Mining and Quarrying; SIC 14; All Processes; Total) were developed.

### 3.19.4.1 *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<sub>10</sub>/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<sub>10</sub> 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<sub>10</sub> drilling/blasting emission factor for copper ore (lbs/ton)  
 $EF_l$  = PM<sub>10</sub> loading emission factor for copper ore (lbs/ton)  
 $EF_d$  = PM<sub>10</sub> truck dumping emission factor for copper ore (lbs/ton)

Applying the copper ore mining TSP emissions factors [ref 2] and PM<sub>10</sub>/TSP ratios yields the following metallic ore mining emissions factor:

$$EF_{mo} = 0.0003 + (0.57625 \times 0.0008) + 0.022 + 0.032 = 0.0548 \text{ lbs/ton}$$

### 3.19.4.2 *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.

$$EF_{nmo} = EF_v + (D \times EF_r) + EF_a + 0.5 (EF_e + EF_t)$$

where,  $EF_{nmo}$  = non-metallic ore mining emissions factor (lbs/ton)  
 $EF_v$  = PM<sub>10</sub> 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<sub>10</sub> drilling/blasting emission factor at western surface coal mining operations (lbs/ton)  
 $EF_a$  = PM<sub>10</sub> loading emission factor at western surface coal mining operations (lbs/ton)  
 $EF_e$  = PM<sub>10</sub> truck unloading: end dump-coal emission factor at western surface coal mining operations (lbs/ton)  
 $EF_t$  = PM<sub>10</sub> 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<sub>10</sub>/TSP ratio of 0.4 [ref 4] yields the following non-metallic ore mining emissions factor:

$$EF_{nmo} = 0.225 + (0.61542 \times 0.00005) + 0.05 + 0.5 (0.0035 + 0.033) = 0.293 \text{ lbs/ton}$$

### 3.19.4.3 *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 91.

**Table 91: 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

#### 3.19.4.4 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.

#### 3.19.4.5 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 92 for a list of NAICS codes).

**Table 92: NAICS Codes for Metallic and Non-Metallic Mining**

NAICS Code	Description
2122	Metal Ore Mining
212210	Iron Ore Mining
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

NAICS Code	Description
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 93.

**Table 93:** 2006 County Business Pattern for NAICS 31-33 in Maine

fipsstate	fipscty	naics	empflag	emp
23	001	31----		6774
23	003	31----		3124
23	005	31----		10333

fipsstate	fipscty	naics	empflag	emp
23	007	31----		1786
23	009	31----		1954
23	011	31----		2535
23	013	31----		1418
23	015	31----	F	0
23	017	31----		2888
23	019	31----		4522
23	021	31----		948
23	023	31----	I	0
23	025	31----		4322
23	027	31----		1434
23	029	31----		1014
23	031	31----		9749

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.

#### 3.19.4.6 Controls

No controls were accounted for in the emissions estimation.

#### 3.19.4.7 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<sub>10</sub> 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 PM<sub>10</sub>-PRI emissions for Autauga County are:

$$E_{\text{PM}_{10}\text{-PRI, Autauga County}} = [(456,346 \times 0.0548) + (714,718 \times 0.293) + (0 \times 0.513)] / 2000 = 117 \text{ tons}$$

The division by 2000 is to convert from pounds to tons.

### 3.19.5 Quality Assurance Procedures

### 3.19.6 References

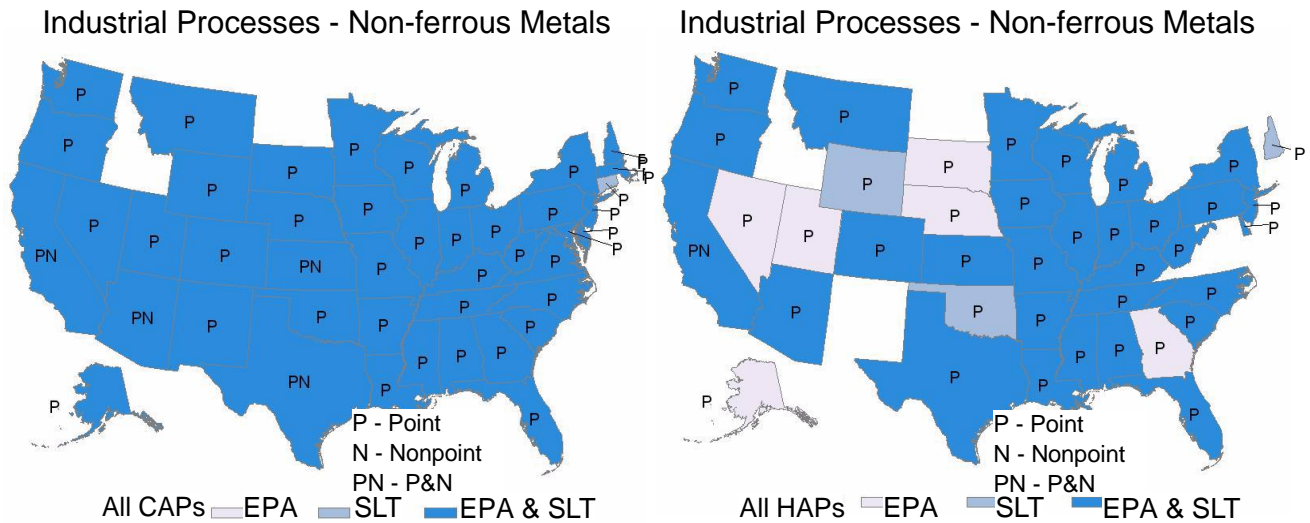
1. United States Environmental Protection Agency. *Generalized Particle Size Distributions for Use in Preparing Size-Specific Particulate Emissions Inventories*, EPA-450/4-86-013, July 1986.
2. United States Environmental Protection Agency, *National Air Pollutant Emission Trends Procedure Document for 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, available at <http://www.epa.gov/ttn/chief/ap42/ch11/final/c11s09.pdf> (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, available at <http://www.epa.gov/ttnchie1/ap42/ch13/bgdocs/b13s02.pdf> (accessed December 2011).
6. United States Geologic Survey, "Minerals Yearbook 2009", <http://minerals.usgs.gov/minerals/pubs/commodity/m&q/index.html#myb> (accessed April 2012).
7. Energy Information Administration, "Production by Company and Mine - 2009", <http://www.eia.gov/coal/data.cfm#production> (accessed April 2012).
8. U.S. Census Bureau, 2009 County Business Patterns, available at <http://www.census.gov/econ/cbp/download/index.htm> (accessed April 2012)

## 3.20 Industrial Processes – Non-ferrous Metals

### 3.20.1 Sector Description

### 3.20.2 Sources of data overview and selection hierarchy

### 3.20.3 Spatial coverage and data sources for the sector



## 3.21 Industrial Processes – Oil & Gas Production

### 3.21.1 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 94 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 94:** Point and nonpoint 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

<b>Data Category</b>	<b>EPA uses</b>	<b>SCC</b>	<b>SCC Description (Abbreviated)</b>
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	<u>Off-Shore Oil</u> 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
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

Data Category	EPA uses	SCC	SCC Description (Abbreviated)
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	<u>Off-Shore Gas</u> 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
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

Data Category	EPA uses	SCC	SCC Description (Abbreviated)
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

### 3.21.2 Sources of data overview and selection hierarchy

The S/L/T agencies that submitted data to the EPA are listed in Table 95 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 95:** 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
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

<b>Data Set Name</b>	<b>State</b>	<b>Dataset Short Name</b>	<b>Data Category</b>
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
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 96 shows the selection hierarchy for datasets included in the Industrial Processes – Oil & Gas Production sector.

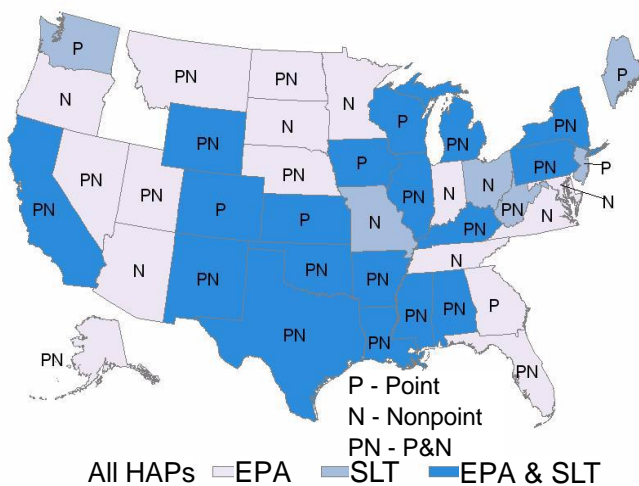
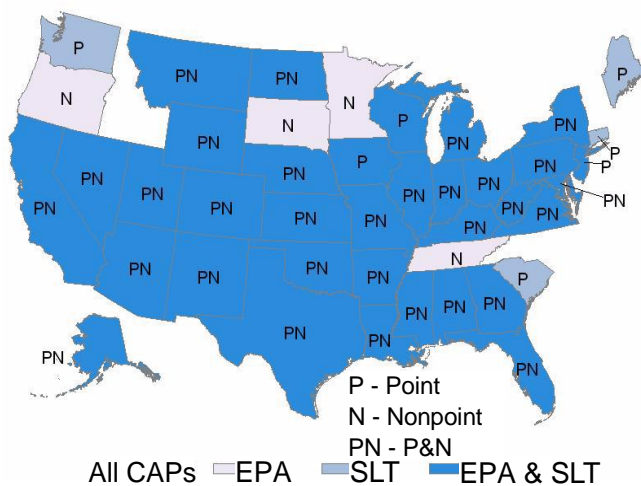
**Table 96: 2011 NEI Industrial Processes – Oil & Gas Production data selection hierarchy**

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 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

### 3.21.3 Spatial coverage and data sources for the sector

Industrial Processes - Oil & Gas Production

Industrial Processes - Oil & Gas Production



### 3.21.4 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 3.21.3, 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

More information about the tool and directions on how to use it can be found on the CHIEF website at <http://www.epa.gov/ttn/chief/net/2011inventory.html#inventorydoc>. At this page, the heading “2011 NEI Version 1 Documentation” section contains a list for “Nonpoint Emissions Tools and Methods”. There you will find a file called “Oil & Gas Emission Estimation Tool.zip”. 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. Recall that these emissions will not match the emissions in the NEI, because the NEI is a merge of S/L/T agency and EPA data. Usually, when an S/L/T agency submits data, we use the submitted data and use the EPA data as “back-fill”.



### 3.21.5 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 97 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 97:** 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 one SCC (2310121401, gas pneumatic pumps) from EPA tool to the NEI, at Texas staff request, since they did not cover that process. 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 with California and they have reviewed their data, and we are using the California-submitted data in the 2011 NEI v1.

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<sub>x</sub>).

We noted several states where there were large differences between EPA's estimates and the state submittals. We are not sure of why the differences exist, and we are continuing to work with states and the national workgroup to reconcile the differences.

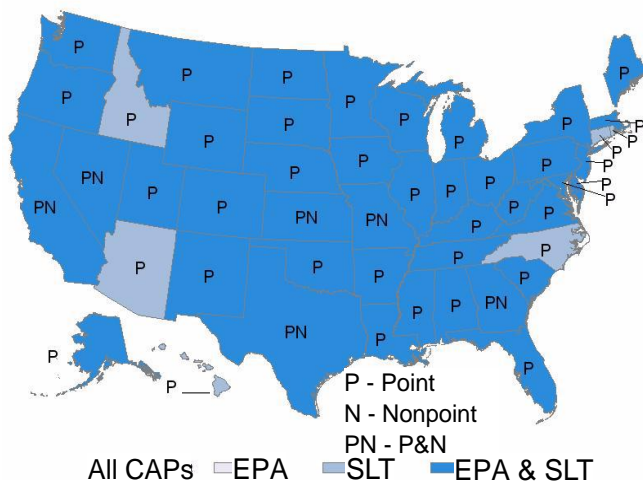
## 3.22 Industrial Processes – Petroleum Refineries

### 3.22.1 Sector Description

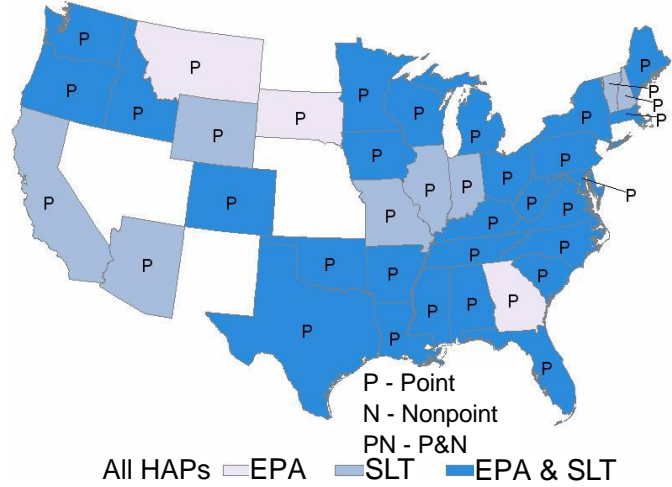
### 3.22.2 Sources of data overview and selection hierarchy

### 3.22.3 Spatial coverage and data sources for the sector

Industrial Processes - Petroleum Refineries



Industrial Processes - Petroleum Refineries



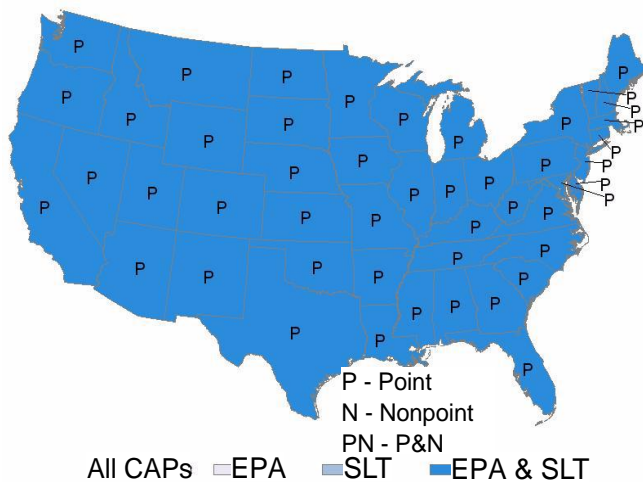
## 3.23 Industrial Processes – Pulp & Paper

### 3.23.1 Sector Description

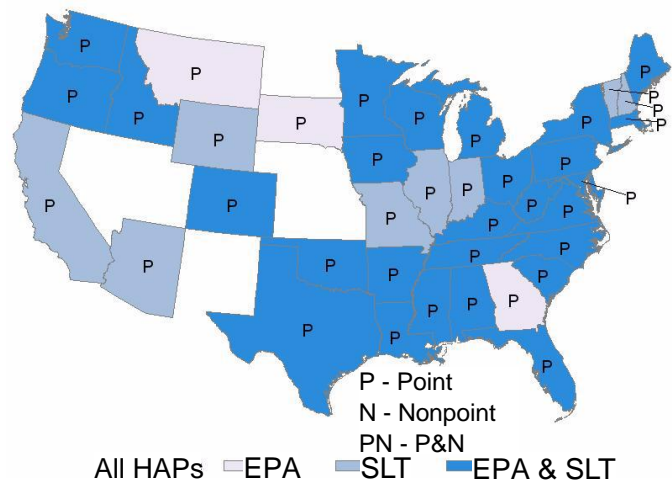
### 3.23.2 Sources of data overview and selection hierarchy

### 3.23.3 Spatial coverage and data sources for the sector

Industrial Processes - Pulp & Paper



Industrial Processes - Pulp & Paper



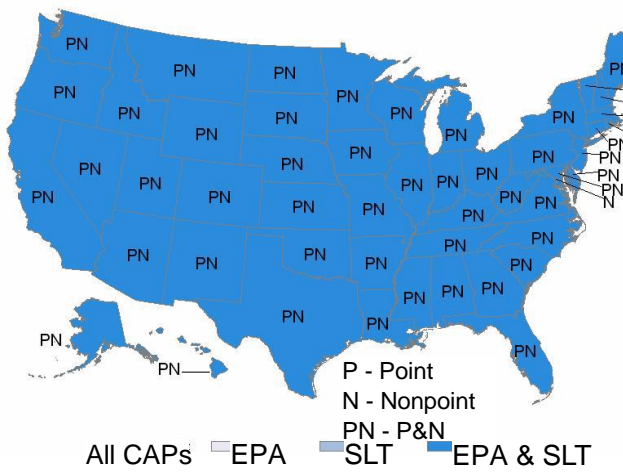
### 3.24 Industrial Processes – Storage and Transfer

#### 3.24.1 Sector Description

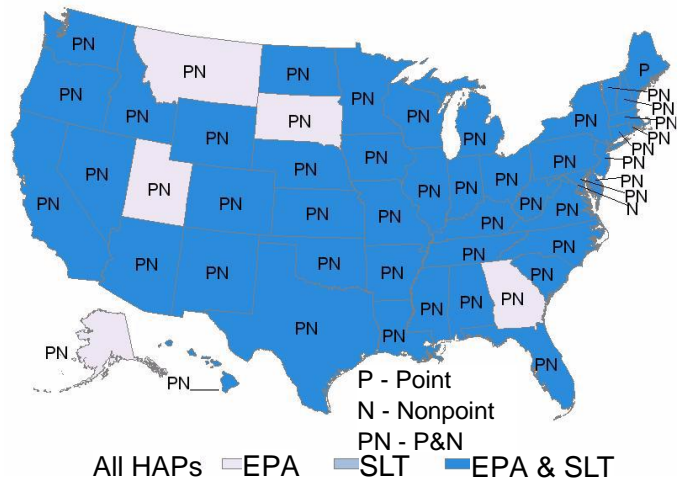
#### 3.24.2 Sources of data overview and selection hierarchy

#### 3.24.3 Spatial coverage and data sources for the sector

Industrial Processes - Storage and Transfer



Industrial Processes - Storage and Transfer



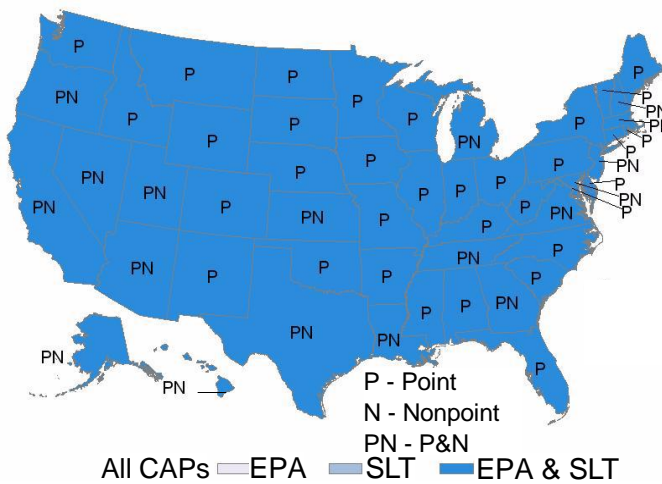
### 3.25 Industrial Processes – NEC (Other)

#### 3.25.1 Sector Description

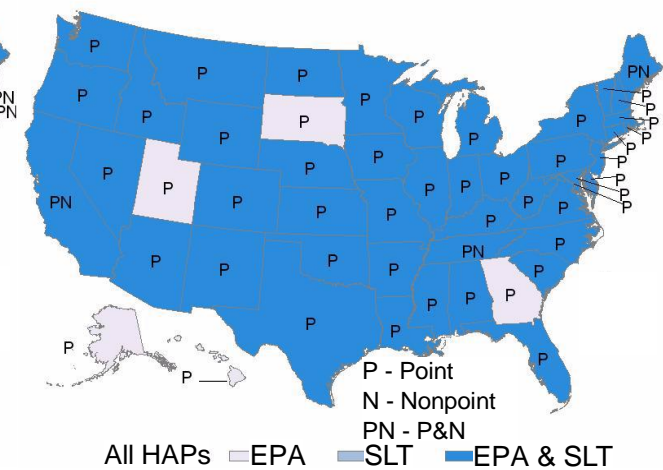
#### 3.25.2 Sources of data overview and selection hierarchy

#### 3.25.3 Spatial coverage and data sources for the sector

Industrial Processes - NEC



Industrial Processes - NEC

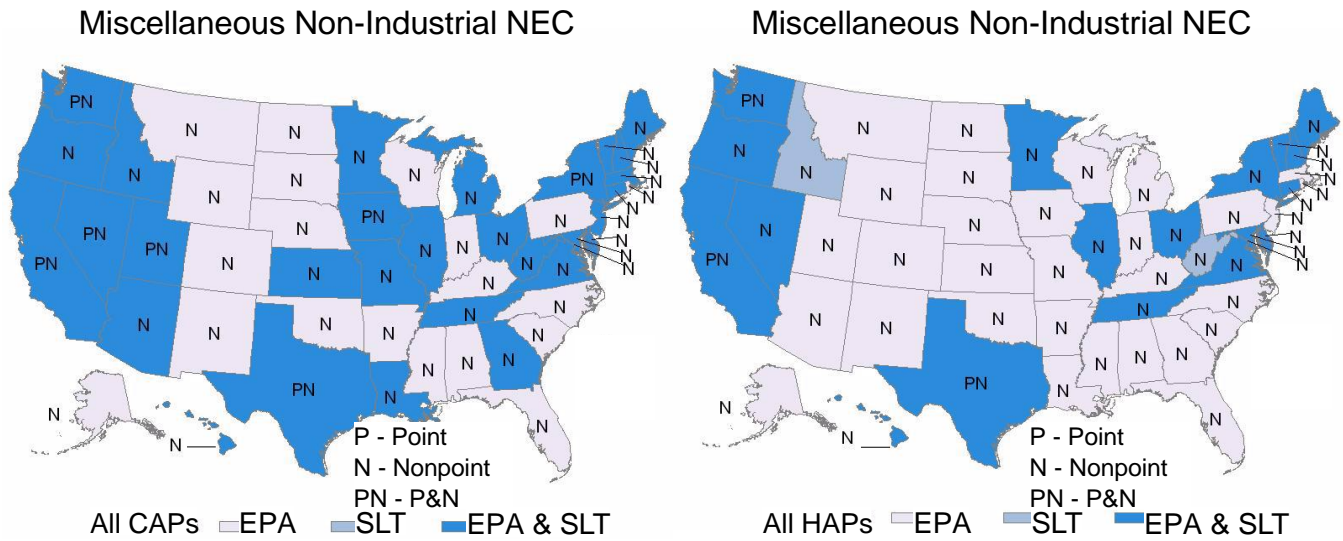


### 3.26 Miscellaneous Non-industrial NEC (Other)

#### 3.26.1 Sector Description

#### 3.26.2 Sources of data overview and selection hierarchy

#### 3.26.3 Spatial coverage and data sources for the sector



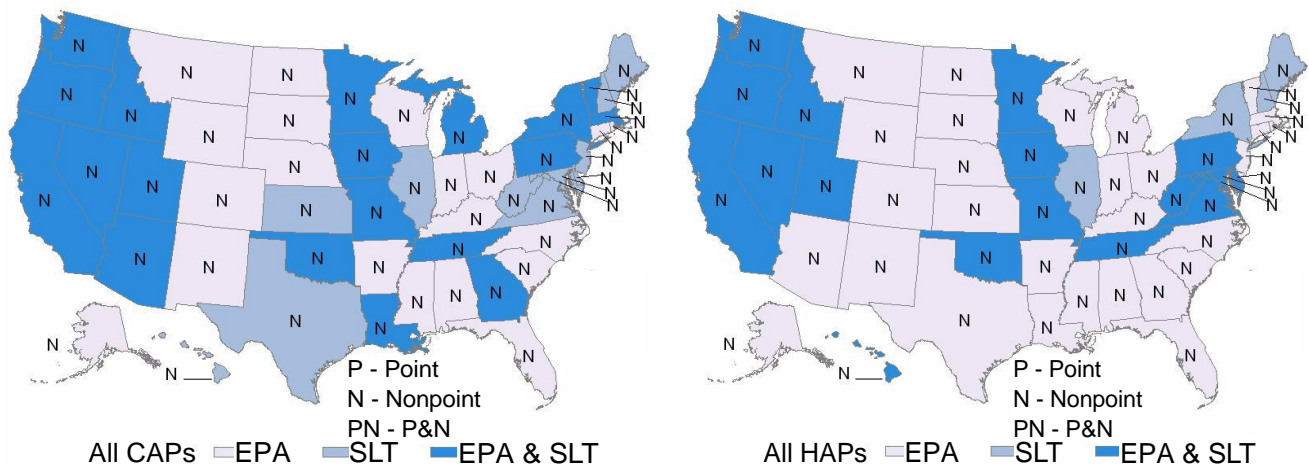
### 3.27 Solvent - Consumer & Commercial Solvent Use

#### 3.27.1 Sector Description

#### 3.27.2 Sources of data overview and selection hierarchy

#### 3.27.3 Spatial coverage and data sources for the sector

Solvent - Consumer & Commercial Solvent Use Solvent - Consumer & Commercial Solvent Use



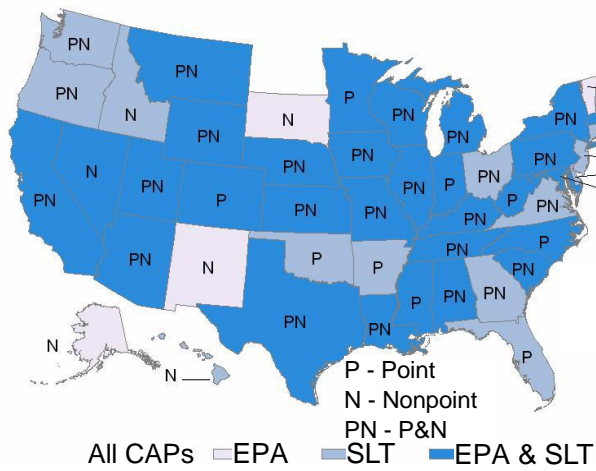
### 3.28 Solvent - Degreasing, Dry Cleaning, and Graphic Arts

#### 3.28.1 Sector Description

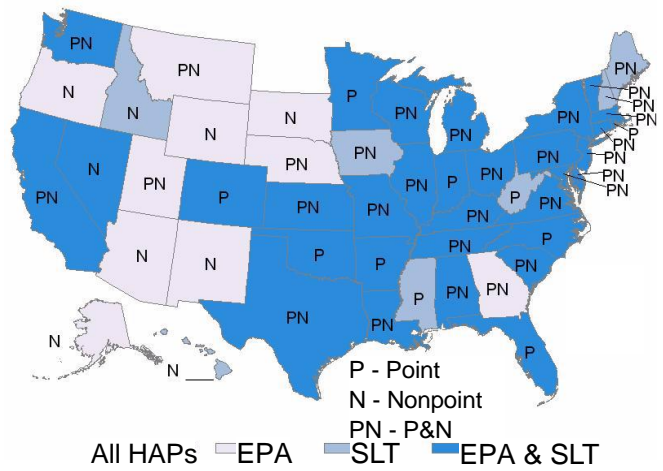
#### 3.28.2 Sources of data overview and selection hierarchy

#### 3.28.3 Spatial coverage and data sources for the sector

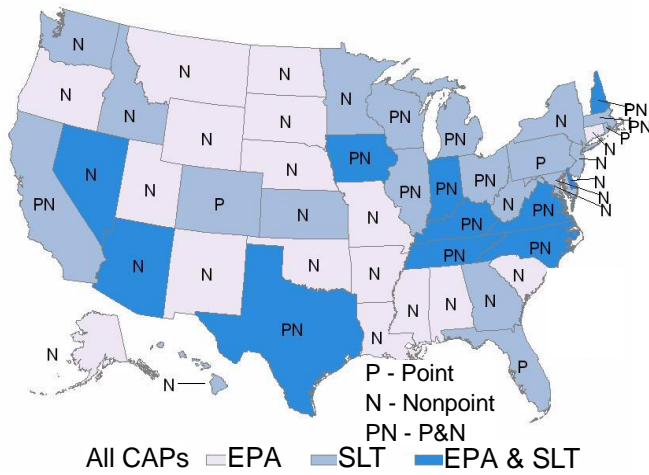
Solvent - Degreasing



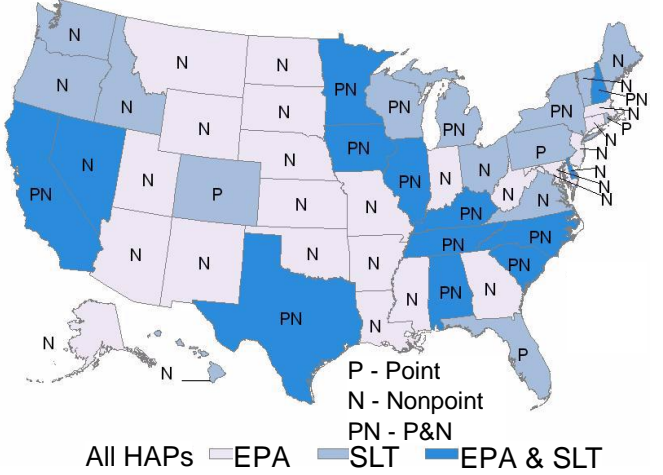
Solvent - Degreasing



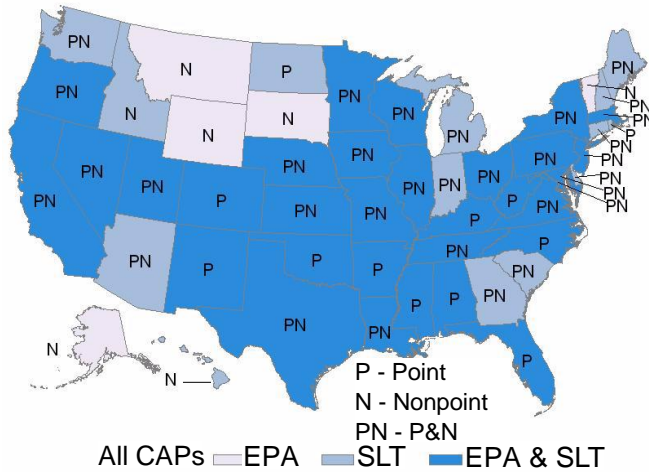
Solvent - Dry Cleaning



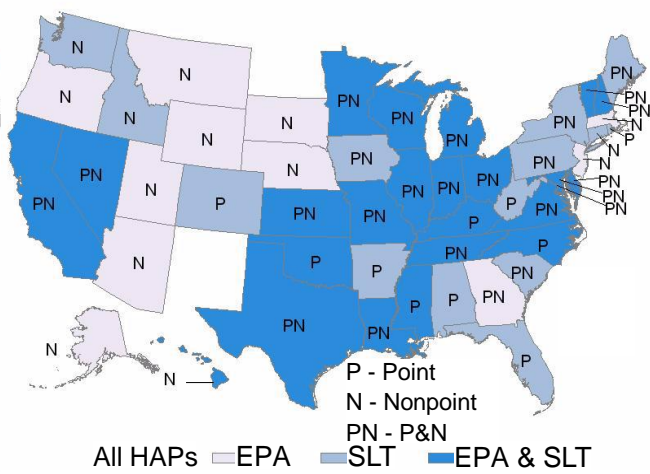
Solvent - Dry Cleaning



Solvent - Graphic Arts



Solvent - Graphic Arts



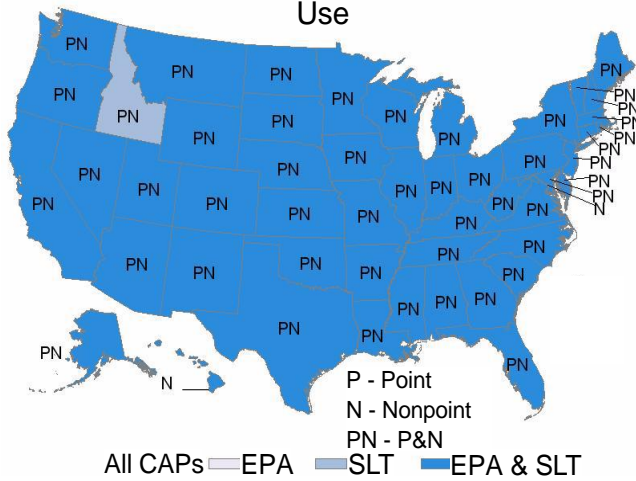
### 3.29 Solvent - Industrial and Non-Industrial Surface Coating

#### 3.29.1 Sector Description

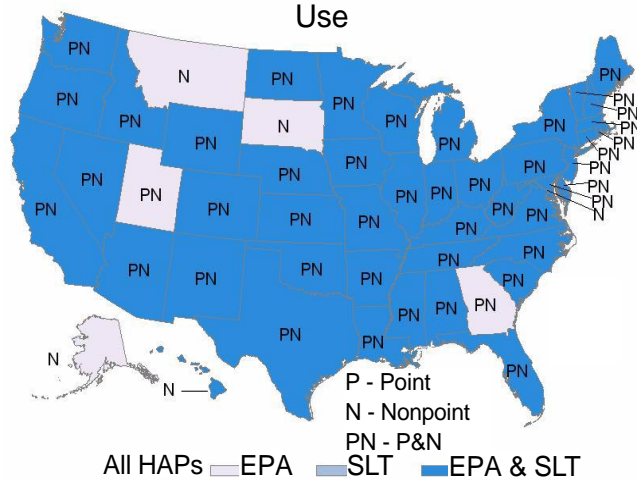
#### 3.29.2 Sources of data overview and selection hierarchy

#### 3.29.3 Spatial coverage and data sources for the sector

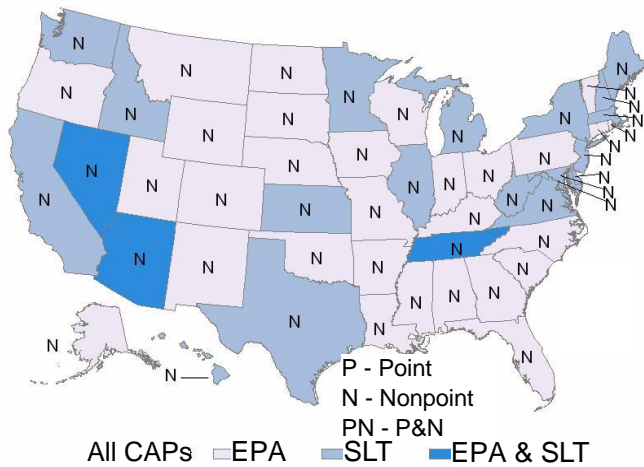
Solvent - Industrial Surface Coating & Solvent Use



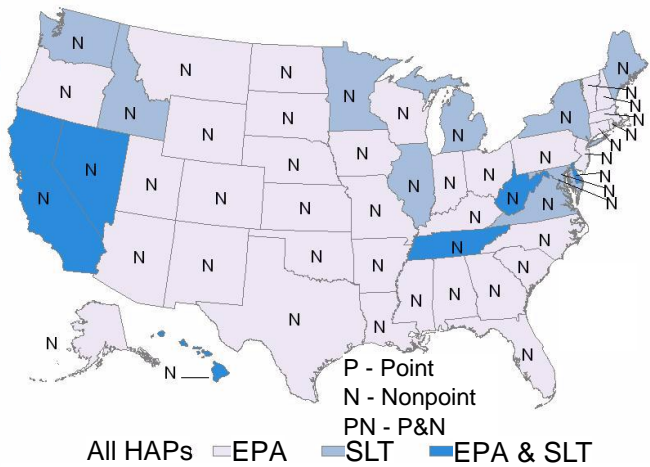
Solvent - Industrial Surface Coating & Solvent Use



### Solvent - Non-Industrial Surface Coating



### Solvent - Non-Industrial Surface Coating



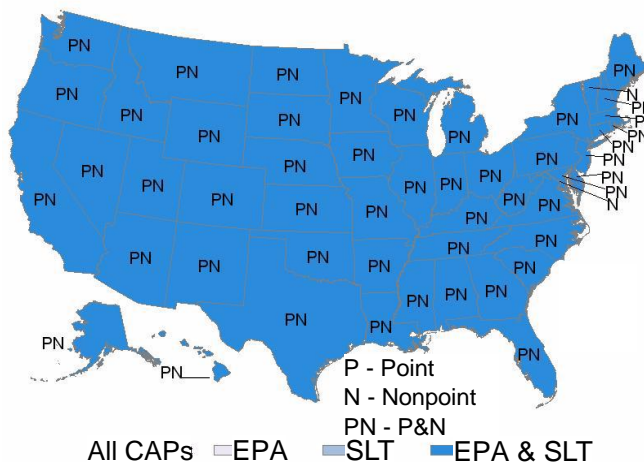
## 3.30 Waste Disposal

### 3.30.1 Sector Description

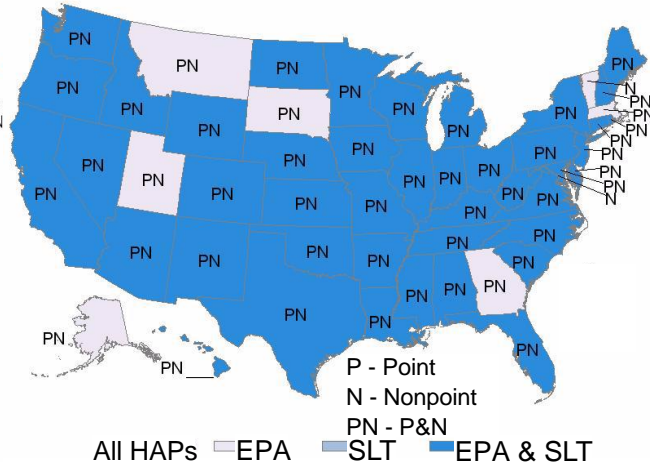
### 3.30.2 Sources of data overview and selection hierarchy

### 3.30.3 Spatial coverage and data sources for the sector

#### Waste Disposal



#### Waste Disposal



## 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 of those sectors, though without the benefit of local-specific model inputs in all cases. The sections below explain how we created the initial 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 of 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 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 98 below:

**Table 98:** 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

#### 4.2.2 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 99. States that provided activity data for use in the EPA method are listed in Section 4.2.4.

**Table 99: Agencies that submitted 2011 aircraft emissions data**

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 QA section
Tennessee Department of Environmental Conservation	State	
Texas Commission on Environmental Quality	State	

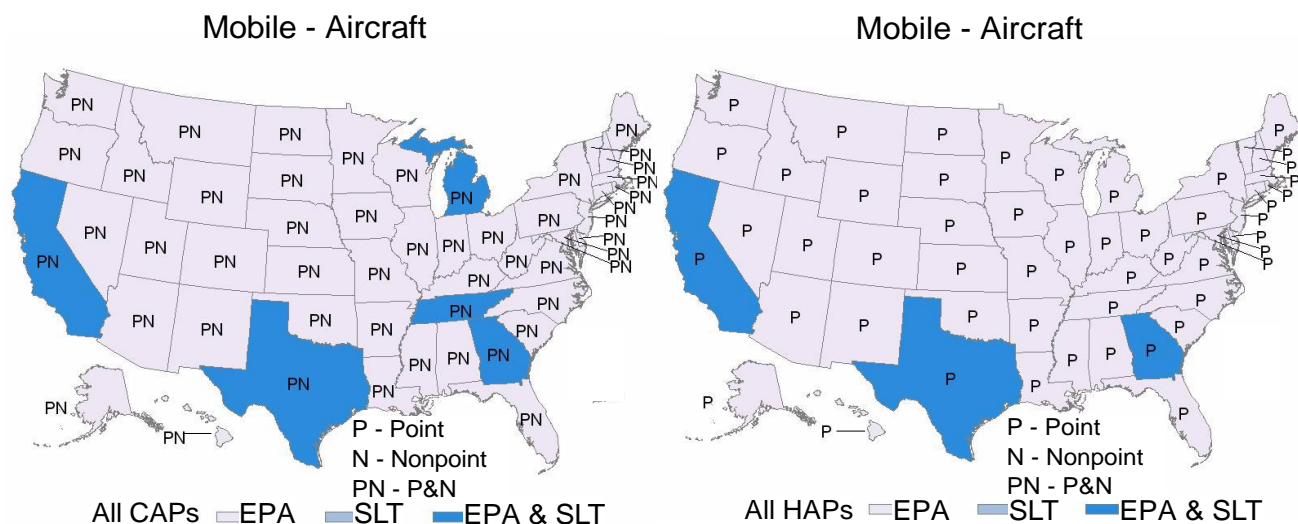
The selection hierarchy used for aircraft is shown below in Table 100. This hierarchy pulls the relevant datasets for this sector from the overall point sources hierarchy listed in Section 3, Table 11. The aircraft emissions also have a nonpoint component (in-flight lead) which is discussed in Section 4.2.4.2 and uses only EPA data.

**Table 100: 2011 NEI aircraft data selection hierarchy**

Priority	Dataset Name	Dataset Content
1	2011EPA_PM-Augmentation	PM augmentation was inadvertently applied to state-submitted aircraft data, creating values for PMXX-FIL and PM-CON but not impacting the S/L/T-provided PMXX-PRI. In all cases the PM augmentation value of PM-CON is 0 and the PMXX-FIL is equal to the S/L/T-provided PMXX-PRI. In the future, we will not create values for PM-CON or PMXX-FIL, as we do not calculate these for EPA aircraft estimates, only primary PM is calculated.
2	State/Local/Tribal Data	Submitted aircraft emissions
3	2011EPA_Airports	EPA data (Section 4.2.4)

### 4.2.3 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.



#### 4.2.4 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 replacement/revisions. As shown in Table 101, the following S/L/T agencies submitted aircraft activity data that EPA incorporated as inputs to the final EPA dataset model run.

**Table 101:** 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 Dept 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

#### 4.2.4.1 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.

#### 4.2.4.2 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 (See [http://www.faa.gov/airports/airport\\_safety/airportdata\\_5010/](http://www.faa.gov/airports/airport_safety/airportdata_5010/)). 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.

#### 4.2.4.3 Aviation lead emissions

Lead (Pb) emission estimates were handled differently from 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:

$$\text{LTO Pb (tons)} = \frac{(\text{piston} - \text{engine LTO})(\text{avgas Pb g/LTO})(1 - \text{Pb retention})}{907,180 \text{ g/ton}}$$

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" is available at <ftp://ftp.epa.gov/EmisInventory/2011/doc>. 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, but the merged EPA and S/L/T data total to 237 for the 2011NEV1. EPA's estimate for out-of-LTO or "in-flight" Pb is 238 tons.

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.

#### 4.2.5 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:
    - o 10 records for PM25-PRI and PM10-PRI in SCC 2265008005
    - o 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.
    - o 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
    - o 12992 records for SCC 2275050011
    - o 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.
    - o 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.

#### 4.2.6 References for Airports

1. Eastern Research Group (ERG), 2013. Memorandum: *Development of 2011 Aircraft Component for National Emissions Inventory*, June 17, 2013.  
[ftp://ftp.epa.gov/EmisInventory/2011/doc/2011nei\\_Aircraft\\_20130717.pdf](ftp://ftp.epa.gov/EmisInventory/2011/doc/2011nei_Aircraft_20130717.pdf)
2. Federal Aviation Administration (FAA), 2011. Emissions and Dispersion Modeling System, Version 5.1. September, 2011. [http://www.faa.gov/about/office\\_org/headquarters\\_offices/aep/models/edms\\_model/](http://www.faa.gov/about/office_org/headquarters_offices/aep/models/edms_model/)
3. Federal Aviation Administration (FAA), 2012. General Aviation and Part 135 Activity Survey – Calendar Year 2010. [http://www.faa.gov/data\\_research/aviation\\_data\\_statistics/general\\_aviation/CY2010/](http://www.faa.gov/data_research/aviation_data_statistics/general_aviation/CY2010/)
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.  
[ftp://ftp.epa.gov/EmisInventory/2011/doc/2011nei\\_AircraftLead\\_20130827](ftp://ftp.epa.gov/EmisInventory/2011/doc/2011nei_AircraftLead_20130827).

### 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 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 was allocated to a shape file identifier in the nonpoint inventory. The allowed combinations are shown in Table 102. 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 102:** Commercial Marine SCCs and Emission Types in EPA Estimates

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

Shown in Table 103, gasoline CMV emissions were submitted by Washington State and included in the NEI.

**Table 103:** Additional Commercial Marine SCCs used by Washington

SCC	SCC Description	States
2280004000	Mobile Sources, Marine Vessels, Commercial, Gasoline, Total, All Vessel Types	WA

#### 4.3.2 Sources of data overview and selection hierarchy

EPA received emissions data from the agencies identified in Table 104.

**Table 104:** Agencies that Submitted Commercial Marine 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

Table 105 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 12.

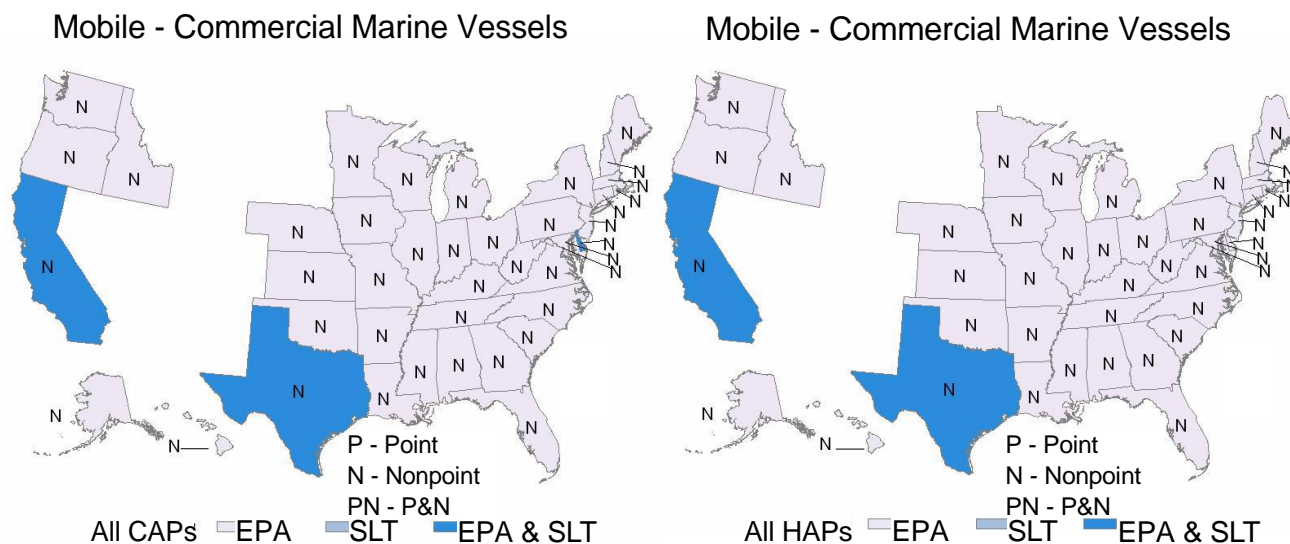
**Table 105:** 2011 NEI commercial marine vehicle selection hierarchy

Priority	Dataset Name	Dataset Content
1	State/Local/Tribal Data	Submitted commercial marine vessel emissions
2	2011EPA_PM-Augmentation	Completes PM species in WA submittal for additional SCC
3	2011EPA_HAP-Augmentation	Uses emission factors to calculate HAP values based on S/L/T submitted criteria estimates (VOC or PM species)
4	2011EPA_chrom_split	Splits submitted unspiciated chromium into hexavalent (chromium VI) and trivalent (chromium III) forms.

Priority	Dataset Name	Dataset Content
5	2011EPA_CMV	EPA data (Section 4.3.4)

### 4.3.3 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.



### 4.3.4 EPA-developed commercial marine vessel emissions data

EPA estimated CMV emission estimates [ref 11] 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<sub>x</sub> adjustment factors to account for implementation of the NO<sub>x</sub> Tier 1 standard. The C3 growth factors, NO<sub>x</sub> adjustment factors by tier and calendar year, and NO<sub>x</sub> 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 4.3.4.1) 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.

#### 4.3.4.1 *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 shapefile for 2011 NEI contained 237 ports (including 76 additional ports from 2008 NEI) and 275 polygons, considering that a single port can cross county boundaries and thus include multiple polygons. The set of port shapefile GIS data is posted at [http://www.epa.gov/ttn/chief/eis/2011nei/2011\\_ports\\_shapefile.zip](http://www.epa.gov/ttn/chief/eis/2011nei/2011_ports_shapefile.zip).

The shapefiles used for the underway emissions were unchanged from those used in the 2008 NEI and are available in the file [http://www.epa.gov/ttn/chief/eis/2011nei/shippinglanes\\_112812\\_shapefile.zip](http://www.epa.gov/ttn/chief/eis/2011nei/shippinglanes_112812_shapefile.zip).

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 (deepwater, ferries, fishing, government, Great Lake, offshore, research, and tugs) available in "*Category 2 Vessel Census, Activity, and Spatial Allocation Assessment and Category 1 and Category 2 In-port/At-sea Splits*," (Census Report) February 16, 2007 [ref 2]. This method, described in the August 22, 2012 Memorandum from Eastern Research Group [ref 3], shifts the distribution used in previous NEIs from majority in ports to majority in underway.

These updates changed the allocation fractions of emissions to underway and port county/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* (see

[http://epa.gov/ttn/chief/emch/2007v5/2007v5\\_2020base\\_EmisMod\\_TSD\\_13dec2012.pdf](http://epa.gov/ttn/chief/emch/2007v5/2007v5_2020base_EmisMod_TSD_13dec2012.pdf)). Emissions Modeling Platform Criteria pollutant estimates from combined C3 SCCs from model platform were allocated to shapes by ratio to 2008 county/shape/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 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:

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/Ts were encouraged to use the EPA-provided shape-to-county fractions (<http://www.epa.gov/ttn/chief/eis/2011nei/cmvrailshape20cntyfractions.zip>) if they were unsure how to distribute county emissions to shapes. When EPA and S/L/Ts did not use the same county/shape/SCC/emistype combinations, the resultant NEI selection gave a value that combined EPA and S/L/T values and may not be equal to either EPA's or the S/L/T's.

1. In assisting California allocate their county emissions to the EPA shapes, the California-submitted chromium was speciated with the EPA default speciation profiles. California did not agree with that speciation, but did not provide speciated chromium emissions in their submittal.
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)
3. Where S/L/T county/shape/SCC/emistype combinations matched exactly, the resultant selection matches the S/L/T submission; for example, see IL, NH and TX in the example in Table 106. When S/L/T did not use exact matches, the state sum may be different than either the S/L/T or EPA value. It may be intended (for example the S/L/T may have only had detailed data for a certain river system and not the entire state) or not.
4. Although not submitted to the 2011NEI, the LADCO regional program had significantly different values for CMV estimates in the Great Lakes region. EPA is re-evaluating C1 C2 estimates that may over estimate tug traffic in the Great Lakes, for example.

**Table 106:** Example of Selection Result in Merging EPA and S/L/T CMV (VOC in Tons)

State	State FIPs	SCC	Pollutant	EPA	S/L/T	2011NEIv1 Selection
DE	10	2280002100	VOC	28	12	7
DE	10	2280002200	VOC	130	40	40
DE	10	2280003100	VOC	24	8	10
DE	10	2280003200	VOC	63	77	77
IL	17	2280002100	VOC	7	1	1
IL	17	2280002200	VOC	102	154	154
MD	24	2280002100	VOC	13	3	3
MD	24	2280002200	VOC	137	29	51
MD	24	2280003100	VOC	64	26	30
MD	24	2280003200	VOC	121	236	307
NH	33	2280002100	VOC	4	0	0
NH	33	2280002200	VOC	1	0	0
NH	33	2280003100	VOC		12	12
NH	33	2280003200	VOC		2	2
NJ	34	2280002100	VOC	53	22	42
NJ	34	2280002200	VOC	122	213	227
NJ	34	2280003100	VOC	233	26	63
NJ	34	2280003200	VOC	65	93	103
OR	41	2280002100	VOC	30	59	76
OR	41	2280002200	VOC	40	64	95
SC	45	2280002100	VOC	15	9	10
SC	45	2280003100	VOC	93	37	39
SC	45	2280003200	VOC	18	57	79
TX	48	2280002100	VOC	301	2	2
TX	48	2280002200	VOC	954	161	161
TX	48	2280003100	VOC	240	339	338
TX	48	2280003200	VOC	171	282	282
WA	53	2280002100	VOC	149	243	251
WA	53	2280002200	VOC	283	0	32
WA	53	2280003100	VOC	261	59	91
WA	53	2280003200	VOC	646	341	391

#### 4.3.6 References for Commercial Marine

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. <http://www.epa.gov/ttn/chief/net/2008inventory.html#inventorydoc>
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. <http://www.epa.gov/otaq/oceanvessels.htm>

3. Eastern Research Group (ERG), 2007. Project report: *Category 2 Vessel Census, Activity, and Spatial Allocation Assessment and Category 2 and Category 2 In-port/At-Sea Splits*, February 16, 2007  
<ftp://ftp.epa.gov/EmisInventory/2011/doc/Category%20%20vessel%20census.pdf>
4. Eastern Research Group (ERG), 2012. Project report: *Category 1 / Category 2 Commercial Marine Activity Spatial Allocation*, August 22, 2012  
[ftp://ftp.epa.gov/EmisInventory/2011/doc/2011nei\\_CMV\\_Cat1%262\\_Activity\\_Spatial\\_Allocation\\_082212.pdf](ftp://ftp.epa.gov/EmisInventory/2011/doc/2011nei_CMV_Cat1%262_Activity_Spatial_Allocation_082212.pdf)

## 4.4 Locomotives

### 4.4.1 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 107 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 107:** 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

### 4.4.2 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 107. The agencies listed in Table 108 also submitted emissions to locomotive SCCs.

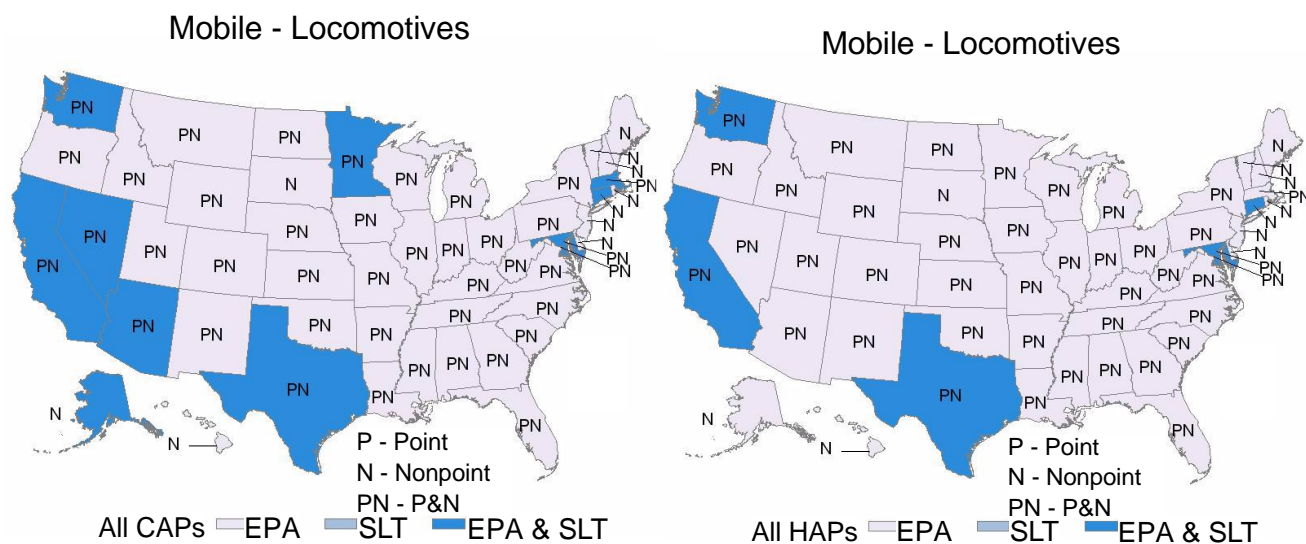
**Table 108:** Agencies that submitted Rail Emissions to the 2011 NEI

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		

Agency Name	Data Set Short Name	Agency FIP or Tribal Code	Rail	Point Yard	Nonpoint Yard
Maricopa Co Arizona	2011Maricopa	04013	X		
Maryland	2011MDDOE	24	X	X	X
Massachusetts	2011MADEP	25	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		
Washington	2011WADOE	53	X		
Washoe Co Nevada	2011WashoeCty	32031	X	X	

#### 4.4.3 Spatial coverage and data sources for the sector

The locomotives sector includes emissions in all states, DC, Puerto Rico, and some tribes.



#### 4.4.4 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.

##### 4.4.4.1 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.

#### 4.4.5 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 2011NEI
- 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 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 and EPA estimates did not use identical county/shape/SCC combinations, the resultant selection may equal to neither EPA’s nor the S/L/T’s value. For example, see AZ SCC =2285002006, and MD SCC = 2285002007 in Table 109 below.

**Table 109:** Compare NO<sub>x</sub> among EPA, S/L/T, and 2011v1NEI Selection for Rail

Tribal Code	State Name	SCC	NO <sub>x</sub> (tons)		
			EPA	S/L/T	2011v1 Selection
	Alaska	2285002009		703	703
	Arizona	2285002006	1,414	1,263	1,263
	Arizona	2285002007	89	0	45
	Arizona	2285002008		9	9
	California	2285002008		5,488	5,488
	California	2285002009		2,237	2,237
	California	2285002010		4,745	4,745
	Connecticut	2285002008		241	241
	Connecticut	2285002009		358	358
	Connecticut	2285002010		85	85
	Illinois	2285002006	36,886	39,841	39,841
	Illinois	2285002007	1,869	2,388	2,388
	Maryland	2285002006	3,419	2,154	2,154
	Maryland	2285002007	251	12	145
	Maryland	2285002008		20	20
	Maryland	2285002009		460	460
	Maryland	2285002010		134	134
	Massachusetts	2285002009		2,589	2,589

			NO <sub>x</sub> (tons)		
Tribal Code	State Name	SCC	EPA	S/L/T	2011v1 Selection
	Nevada	2285002006	506	398	398
	North Carolina	2285002008		448	448
	Texas	2285002006	60,389	58,762	58,762
	Texas	2285002007	2,168	2,633	2,633
	Texas	2285002010		2,225	2,225
	Utah	2285002006	6287	5,878	5,878
	Washington	2285002006	14,445	12,420	12,420
	Washington	2285002009		534	534
863		2285002006		6,789	6,789

#### 4.4.6 References for Locomotives

1. Eastern Research Group (ERG), 2012. Memorandum: Development of 2011 Railroad Component for National Emissions Inventory, September 5, 2012  
[ftp://ftp.epa.gov/EmisInventory/2011/doc/2011nei\\_Locomotive.pdf](ftp://ftp.epa.gov/EmisInventory/2011/doc/2011nei_Locomotive.pdf)
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.  
[ftp://ftp.epa.gov/EmisInventory/2011/doc/2008nei\\_locomotive\\_report.pdf](ftp://ftp.epa.gov/EmisInventory/2011/doc/2008nei_locomotive_report.pdf)

### 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 Sector Description

This section deals specifically with emissions processes calculated by the EPA’s NONROAD model (<http://www.epa.gov/otag/nonrdmdl.htm>) and the OFFROAD model (<http://www.arb.ca.gov/msei/offroad/offroad.htm>) 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) (<http://www.epa.gov/otag/nmim.htm>) 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 110.

**Table 110: NMIM Equipment and Fuel Types**

<b>Equipment Types</b>	<b>Fuel Types</b>
Recreational	
Construction	
Industrial	
Lawn and Garden	
Agriculture	CNG
Commercial	Diesel
Logging	Gasoline
Airport Support (GSE) (excludes aircraft)	LPG
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.

#### **4.5.2 Sources of data overview and selection hierarchy**

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 112 submitted inputs and/or emissions to the 2011 NEI.

Table 111 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.



**Table 111:** Selection Hierarchy for the Nonroad Data Category

Priority	Dataset	Notes
<i>Everywhere except California and Texas</i>		
1	2011_EPA_Mobile	Contains emissions from EPA's NMIM run using S/L-provided inputs as shown in Table 112 and NMIM defaults where S/L accepted EPA default.
<i>California</i>		
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.
<i>Texas</i>		
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 112 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 112:** S/L/T Agency Submitted Data for Nonroad

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		1/7/13	
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	
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	

Agency Organization	Nonroad Emissions	Nonroad NCD	Notes
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	

### 4.5.3 Spatial coverage and data sources for the sector

Nonroad equipment emissions are included in every state, DC, Puerto Rico, and the Virgin Islands.

### 4.5.4 EPA-developed NMIM-based nonroad emissions data

EPA uses the activity data within NMIM 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 the hierarchy decision model is that EPA-supplied fuel and meteorological data were used for all 2011 NMIM modeling runs, as explained below. A copy of NCD20130531\_nei2011v1 which includes all the state-supplied updates, as well as EPA's fuel and meteorological data is named NCD20130531 and is provided in the same zip file as the NCD used for the NEI. The zip file name is 2011nei\_supdata\_nonroad.zip, and it can be accessed at <ftp://ftp.epa.gov/EmisInventory/2011v1/doc>. The development of the NCD used for the 2011 NEI is explained in the following sections.

#### 4.5.4.1 Default NCD

The default 2011 NCD, NCD20130531\_nei2011 is available at <ftp://ftp.epa.gov/EmisInventory/2011v1/doc> in the zip file "2011nei\_supdata\_nonroad.zip" and is based upon NCD20101201a.<sup>13</sup> EPA updated fuel and meteorological data for inclusion in the new 2011 NCD.

#### 4.5.4.2 State-Submitted NCDs

NCD activity data submitted by state and local agencies 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

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<sup>13</sup> NCD20101201a is the NCD that is included in the current download of NMIM.

EPA, the default values for these data parameters were retained. NCD tables updated using state and local NCD submissions are presented in Table 113.

**Table 113:** NCD Tables Provided in State and Local NCD Submissions

State Name	Data Source	CountyNRFile	County	CountyYearMonth*	Diesel*	Gasoline*	External Files	CountyYearMonthHour*
Maryland	X	X					X	
New Jersey	X	X		X	X	X	X	
Connecticut	X	X		X		X	X	
Delaware	X	X					X	X
Georgia	X	X					X	
Idaho			X					X
Illinois								X
Nevada	X	X		X		X	X	
New Hampshire	X	X					X	
North Carolina				X	X	X		
Washington	X	X					X	
Wisconsin				X	X	X		

\*Updates to these tables were not used to develop the 2011 NEI NCD. Instead EPA-supplied data were used.

#### 4.5.4.3 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, EPA 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 114.

**Table 114: State-assisted NCD Table Updates**

State Name	DataSource	CountyNRFile	County	CountyYearMonth*	Diesel*	Gasoline*	External Files	CountyYearMonthHour*
Davidson County (Tennessee)	X			X	X	X		
New York	X	X		X	X	X	X	
Texas	X	X		X	X	X	X	

\*Updates to these tables were not used to develop the 2011 NEI NCD. Instead EPA-supplied data was used.

#### 4.5.4.4 *Nashville/Davidson County Tennessee*

Nashville Pollution Control Division provided all of 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 Reid Vapor Pressure (RVP) and sulfur values in the fuel data tables within NMIM. However, these data were not used because EPA fuel data was used for the whole country. However, these updates are contained in NCD20130531.

#### 4.5.4.5 *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. These data were updated using the U.S. Census data.<sup>14</sup> These updates were made to the NMIM database NCD20130531\_nei2011v1.

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. However, these data were not used because EPA fuel data was used for the whole country. However, these updates are contained in NCD20130531.

#### 4.5.4.6 *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 equipment is found in many different types of construction. However, their equipment population and use profiles are unique within each of the sectors defined by the TexN model. TexN processes each of these

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<sup>14</sup> 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/DTable?\\_bm=y&-geo\\_id=01000US&-ds\\_name=ACS\\_2009\\_5YR\\_G00\\_&-mt\\_name=ACS\\_2009\\_5YR\\_G2000\\_B25024](http://factfinder.census.gov/servlet/DTable?_bm=y&-geo_id=01000US&-ds_name=ACS_2009_5YR_G00_&-mt_name=ACS_2009_5YR_G2000_B25024)).

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.

Equipment 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 NCD20130531\_nei2011dv1.

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 NCD20130531\_nei2011dv1.

The activity data from TexN were 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 NCD20130531\_nei2011dv1.

The geographic allocation of equipment populations were 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 (known as "XRF") value. These values were then used to build new allocation files for inclusion into NMIM and are included in NCD20130531\_nei2011dv1.

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.

The final Texas dataset used EPA fuel data instead of state-supplied fuel inputs, though the state updates were provided to EPA in NCD20130531.

Note that this final Texas dataset was used in computing the EPA emissions (2011EPA\_MOBILE EIS dataset) but these emissions were selected for the 2011 NEI behind the Texas emissions as was shown in Table 111.

#### 4.5.5 Summary of quality assurance methods

##### 4.5.5.1 Summary of quality assurance on NCDs

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-FIPStateID-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.

##### 4.5.5.2 Summary of quality assurance on S/L/T 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 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.

#### Findings

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 115.

**Table 115: SCC/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
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 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 115 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 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 EIS in the dataset "2011EPA\_CAModelerdata".

#### **4.6 On-road – all Diesel and Gasoline vehicles**

This section includes the description of four EIS sectors:

- Mobile – On-road – Diesel Heavy Duty Vehicles
- Mobile – On-road – Diesel Light Duty Vehicles
- Mobile – On-road – Gasoline Heavy Duty Vehicles
- Mobile – On-road – Gasoline Light Duty Vehicles

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

##### **4.6.1 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.

SCCs starting with 22010 define the light duty gasoline vehicles including motorcycles, with the exception of SCCs starting with 220107, which define the heavy duty gasoline vehicles. SCCs starting with 22300 define the light duty diesel vehicles, with the exception of SCCs starting with 223007 that define the heavy duty diesel vehicles.

The 2008 NEI v1 and past NEIs included emissions from the MOBILE6 model. The 2008 NEI v2 and v3 are the first NEI to include emissions from the MOVES model. The 2011 NEI v1 is the first NEI to accept MOVES inputs directly as part of the NEI submittal process.

##### **4.6.2 Sources of data overview and selection hierarchy**

All of EPA's 2011 NEI on-road estimates were calculated by EPA using MOVES, except in California. Table 116 shows a list of all submissions to EIS for onroad sources. Agencies other than California submitted complete

emissions using MOVES2010b, or inputs that enabled EPA to generate emissions estimates using MOVES. California submitted complete emissions generated using the EMFAC2011 model.<sup>15</sup> For counties in the contiguous 48 for which onroad emission data was not submitted, EPA used SMOKE-MOVES to generate emission inventories from on-road sources; The SMOKE-MOVES process is described later in this section. For AK, HI, PR and VI EPA used MOVES directly (in inventory mode) to estimate emissions.

**Table 116: Agency Submission History for Onroad**

<b>Agency Organization</b>	<b>Onroad Emissions Submission Date</b>	<b>Onroad CDB Submission Date</b>	<b>Notes</b>
Alaska Department of Environmental Conservation	12/11/2012	12/18/2012	
California Air Resources Board	4/16/2013	N/A	CA uses a CA-specific model (EMFAC). CA emissions are included in NEI.
Coeur d'Alene Tribe	11/28/2012	N/A	EPA does not currently break out tribal areas in the EPA estimates, however, tribal emissions submittals are included in EIS.
Colorado	N/A	N/A	CO supplied updated IM coverage data directly to EPA staff.
Connecticut Department Of Environmental Protection	N/A	5/10/2013; 6/7/2013	In addition to submitting CDBs, CT supplied updated CDBs directly to EPA staff.
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 include tribal areas in EPA estimates; however, tribal emissions are included in the NEI.
Georgia Department of Natural Resources	N/A	5/31/2013; 6/6/2013	In addition to submitting CDBs, GA supplied activity data (by SMOKE SCCs) for all counties and hourly speed profiles for Atlanta counties 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-emistype combinations that do not occur in EPA estimates. ID CDB was used in NEI estimates instead of emis 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 include tribal areas in EPA estimates; however, tribal emissions are included in the NEI.

<sup>15</sup> The EMFAC2011 model the supporting documentation can be found at <http://www.arb.ca.gov/msei/modeling.htm>



<b>Agency Organization</b>	<b>Onroad Emissions Submission Date</b>	<b>Onroad CDB Submission Date</b>	<b>Notes</b>
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 EIS, but was available to EPA prior to submittal and used in 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	
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	10/31/2012	
New Jersey Department of Environment Protection	N/A	5/1/2013	
Nez Perce Tribe	11/29/2012	N/A	EPA does not currently include tribal areas in EPA estimates; however, tribal emissions are included in the NEI.
North Carolina Department of Environment and Natural Resources	N/A	1/8/2013	
Northern Cheyenne Tribe	1/28/2013	N/A	EPA does not currently include tribal areas in EPA estimates; however, tribal emissions are included in the NEI.
Ohio Environmental Protection Agency	N/A	5/16/2013	
Oregon Department of Environmental Quality	1/7/2013	1/26/2013	
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 include tribal areas in EPA estimates; however, tribal emissions are included in the NEI.

Agency Organization	Onroad Emissions Submission Date	Onroad CDB Submission Date	Notes
South Carolina Department of Health and Environmental Control	N/A	12/13/2012	
Texas Commission on Environmental Quality	12/21/2012	N/A	EPA assisted TX in creating CDB from their inputs to EPA estimation. However, TX emissions were used in the NEI because differences in model techniques resulted in significant differences between EPA and TX results.
Utah Division of Air Quality	N/A	1/10/2013	In addition to submitting CDBs, UT supplied an updated CDB for Washington County directly to EPA staff.
Vermont Department of Environmental Conservation	N/A	12/14/2012	
Virginia Department of Environmental Quality	N/A	12/5/2012; 7/29/2013	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	1/9/2013	

The selection hierarchy for the on-road data category is shown in Table 117. EPA's MOVES estimates using S/L inputs are used other than in California and Texas. For California, California-submitted emissions were used. For Texas, Texas-submitted data were used ahead of the EPA's (MOVES) estimates, which were used second to gap fill any missing data/pollutants from the Texas dataset.

**Table 117:** Selection Hierarchy for the On-road Data Category

Priority	Dataset	Notes
<i>Everywhere except California and Texas</i>		
1	2011_EPA_Mobile	Contains emissions from EPA's MOVES run using S/L-provided inputs as shown in Table 116 and MOVES defaults where S/L accepted EPA default
<i>California</i>		
1	California Air Resources Board	California does not use the EPA MOVES model. They use the EMFAC model and provided 2011 emissions based on this model.
<i>Texas</i>		
1	Texas Commission on Environmental Quality	
2	2011_EPA_Mobile	EPA estimates (same dataset described above)

#### 4.6.2.1 Agencies submitting completed on-road emissions data

California and Texas 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. Texas’ emissions were generated by TTI under contract with TCEQ using MOVES. The methodology for developing emission inventories was adapted from SIP-level modeling at the roadway link level for the major urban areas in Texas. Though TCEQ submitted final emissions through EIS, they also provided MOVES inputs and documentation used in the generation of their emission estimates.

#### 4.6.2.2 Agencies Submitting MOVES inputs

For states that did not submit completed on-road emissions results, EPA generated emissions using the latest publically released version of the EPA highway emissions model, MOVES2010b (20120410 version). For states within the contiguous 48, the SMOKE-MOVES emissions processing tool was used with output from MOVES in emission rate mode; for Alaska, Hawaii, Puerto Rico and Virgin Islands the MOVES model was used in emission inventory mode. EPA established a standard format for states to submit inputs into MOVES; submission results, QA and corrections are discussed in the next section. For states that did not submit emissions or MOVES inputs, default data were applied, as discussed in Section 4.6.3.

#### MOVES Input Submissions - Overview

MOVES emissions were generated using the “County Scale” option, which allows users to replace the defaults in the MOVES database with local county-level information, as encouraged by EPA’s technical guidance. These data are entered through the County Data Manager (CDM) interface, which defines a subset of the entire MOVES database generally available to local areas and most relevant for constructing local onroad emission inventories. The result of the process is a unique MOVES County Database (CDB) for each county submitting data. The data tables that make up a CDB are shown in Table 118.

**Table 118: MOVES CDB Tables**

<b>CDB Table</b>	<b>Description of Content</b>
auditlog	Information about the creation of the database
avft	Diesel 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

<b>CDB Table</b>	<b>Description of Content</b>
year	Year of the database
zone	Allocations of starts, extended idle and vehicle hours parked to the county
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]
Sccroadtypedistribution	Allocation of results to SCC categories

As part of the 2011 NEI plan, EPA provided guidance to agencies on the process and format of submitting local CDB data through EIS. This guidance did not include detailed technical specifications on how local data should be developed. However, for the development of State Implementation Plan (SIP) inventories, EPA has written a technical guidance document that discusses preferred data sources for each of these inputs, and fallback options where data isn't available.<sup>16</sup> Responsible agencies are not required to follow this guidance for the NEI, but because the guidance encompasses best practice and identifies the most readily available data sources for CDB inputs, many states submitting data follow EPA's technical guidance. A summary of the best practice SIP guidance for the primary CDB inputs (i.e. not informational inputs) is shown in Table 119.

**Table 119:** Summary of EPA's MOVES Technical Guidance for CDB Inputs

<b>Input</b>	<b>Best Practice</b>	<b>Suggested Fallbacks</b>
Source Type Population	Direct data from state registration data, local transit agencies, school districts, bus companies, refuse haulers	Ratio to VMT based on MOVES default VMT/Population ratios; MOVES default source type split; MOBILE6 inputs
Age Distribution	Unique registration data for each source type	Applying the same distribution to multiple source types; MOVES defaults; MOBILE6 inputs
VMT	State DOT data and/or Travel Demand Models calibrated to HPMS; EPA convertor to adjust to annual	Count-based programs, MOBILE6 inputs
Average Speed Distribution	Post-processing of Travel Demand Model output into each MOVES speed bin, by hour	Applying the same distribution to multiple source types (expected); single average speed; peak/off-peak or daily; MOBILE6 inputs
Speeds on Local Roads	Include local road speeds as part of unrestricted distributions	
Highways	Reflect speeds on the highway only, not ramps (handled separately)	
Road Type Distribution	"Consistent with transportation planning" (same sources as VMT)	Applying the same distribution to multiple source types within same

<sup>16</sup>Using MOVES to Prepare Emission Inventories in State Implementation Plans and Transportation Conformity: Technical Guidance for MOVES2010, 2010a and 2010b, U.S EPA, Report No. EPA-420-B-012-028, April 2012

<b>Input</b>	<b>Best Practice</b>	<b>Suggested Fallbacks</b>
		HPMS class (expected), or even across HPMS classes; MOBILE6 inputs
Ramp Fraction	Optional input, no specific guidance on data sources given	MOVES defaults
Fuel Type & Technology (gas/diesel/CNG mix)	VMT by fuel type	Population (expected); MOVES defaults; MOBILE6 inputs
Fuel Formulation (fuel properties)	Reformulated Gasoline (RFG) fuel property info for RFG areas; regulatory RVP level in RVP control areas, accounting for 1 psi waiver; fuel survey data for non-RFG areas (e.g. NIPER, AAM)	Modify fuel properties where data available, use defaults for others; using fuel with desired properties in same PADD/year; MOVES defaults
Fuel Supply (market share)	Volume data	MOVES defaults
Inspection/Maintenance (I/M) Program	Modify defaults to make consistent with actual program	MOVES defaults
Compliance Rate	Operating program data: sticker surveys, license plate surveys, no. of tests vs. potential tests	Should not use 100%; automatic registration denial program can assume 96%, but should update based on operating data when available
Waiver Rate	Historical waiver rates	
Meteorology	Local data via sources such as National Climatic Data Center	MOVES default
Month, Day & Hour VMT Fractions	No explicit guidance	MOVES defaults

A summary of the agency-submitted data is below, along with the QA steps and corrections made to submitted data before use in developing NEI emissions.

#### Agencies Submitted CDB data

County level data were obtained from state-supplied county databases (CDBs) submitted to the Emission Inventory System (EIS) as part of the 2011 National Emission Inventory (NEI) project. For the initial submissions, a total of 1,342 CDBs were submitted by agencies; during the second round of submission, New Jersey also provided CDBs, which brought the total to 1,363. A summary providing a count of counties with submitted data by CDB input and state is contained in Table 120.

**Table 120:** Number of counties with submitted data, by state and MOVES CDB input table

State/County	avft	Avg speed distribution	dayvmfraction	fuel formulation	fuelsupply	hourvmfraction	hpmstypyear	imcoverage	monthvmfraction	roadtype	Roadtype distribution	sourcetype distribution	sourcetype year	emission rate by age
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	21	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 (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	
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	7			72	72	72	
<b>Total</b>	<b>218</b>	<b>712</b>	<b>813</b>	<b>699</b>	<b>825</b>	<b>734</b>	<b>1327</b>	<b>355</b>	<b>821</b>	<b>346</b>	<b>1151</b>	<b>1157</b>	<b>1325</b>	<b>219</b>

Agencies submitting data through the Emissions Inventory System (EIS) filled out a checklist of CDB data tables for which local data was provided, along with documentation for how the local data were developed. A review of the documentation showed a considerable variety in state sources and approaches to producing the data. The benchmark for such submissions is technical guidance for MOVES developed by EPA discussed above. Some

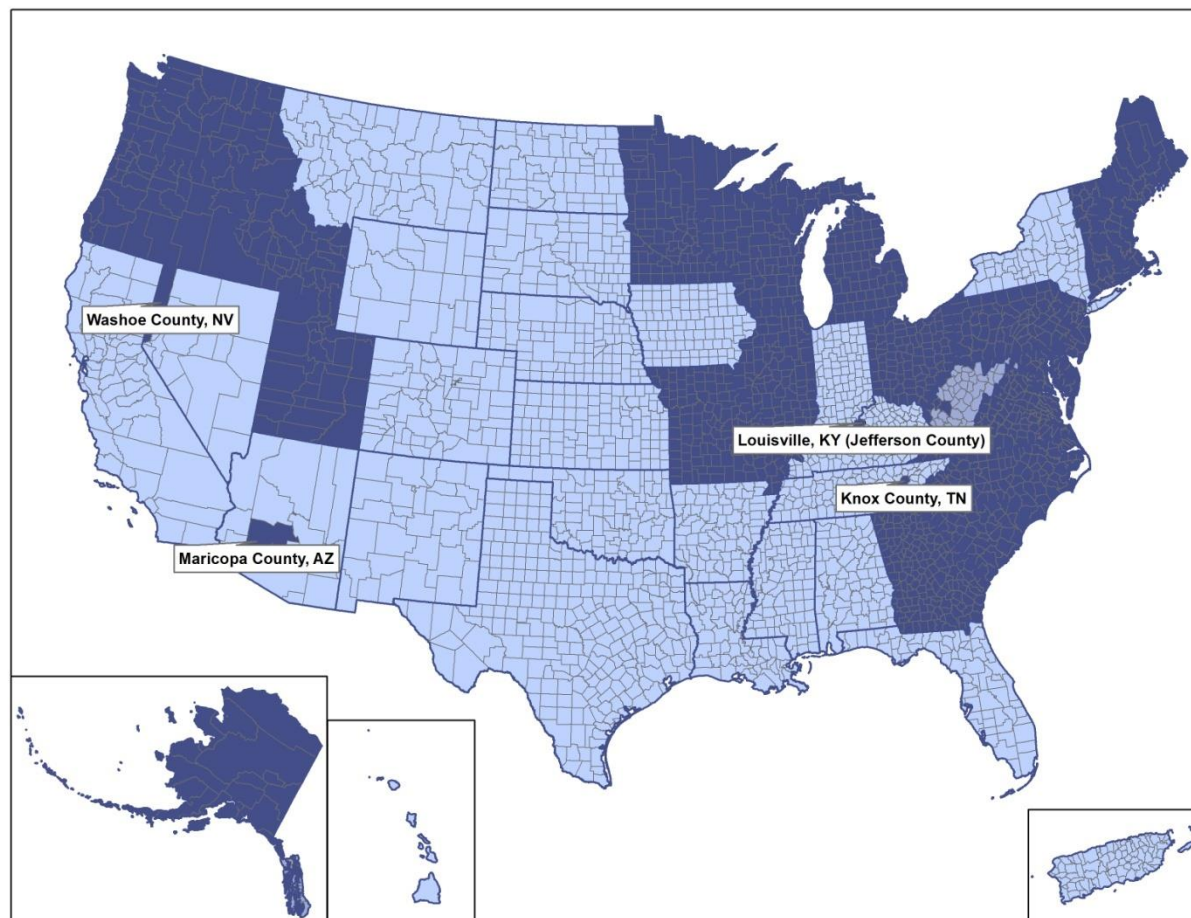
key inputs can rely on readily available data available in each state; examples would include VMT data from federal or state transportation departments, and age distribution data from state vehicle registration databases. Other inputs are less uniform, so the sources and quantity of data states submit vary more. Average speed is a primary example – some states rely on travel demand modeling at the link-level, in conjunction with SIP-level modeling, while others rely on more aggregate sources, including posted speed limits.

For many states, some inputs are available and provided, while if an input was more difficult to get states simply provided MOVES defaults. Some states submitted a subset of CDB inputs (for example, only data related to inspection/maintenance programs, or population data for a subset of source types); defaults were used for any CDB data not provided by states. This occurred even within a single field; for example, states may provide local data for a subset of source types (e.g., passenger cars), while using MOVES defaults for other source types. In the extreme cases, some states only provided a single input, such as I/M inputs, while submitting defaults for all other inputs.

Figure 16 shows the states/local agencies submitting data at the county level in dark blue. In some cases, only a subset of states was supplied. This map includes states that did not submit full local data, i.e. relied on defaults for some data.

Texas did not provide CDBs through EPA's submission process. They developed their own inventories using an approach that was unique to Texas, so the MOVES inputs didn't correspond directly to county-level inputs needed for the NEI. EPA's contractor did procure these databases from TCEQ, and provide these data to EPA for use in developing representing counties for Version 1. The data from TCEQ was used to inform the choice of representing counties for Texas for Version 1, but data from the CDBs was not used directly.

**Figure 16:** Dark blue indicates States/Counties that submitted at least 1 CDB input



#### Evaluation of Submissions vs EPA guidance

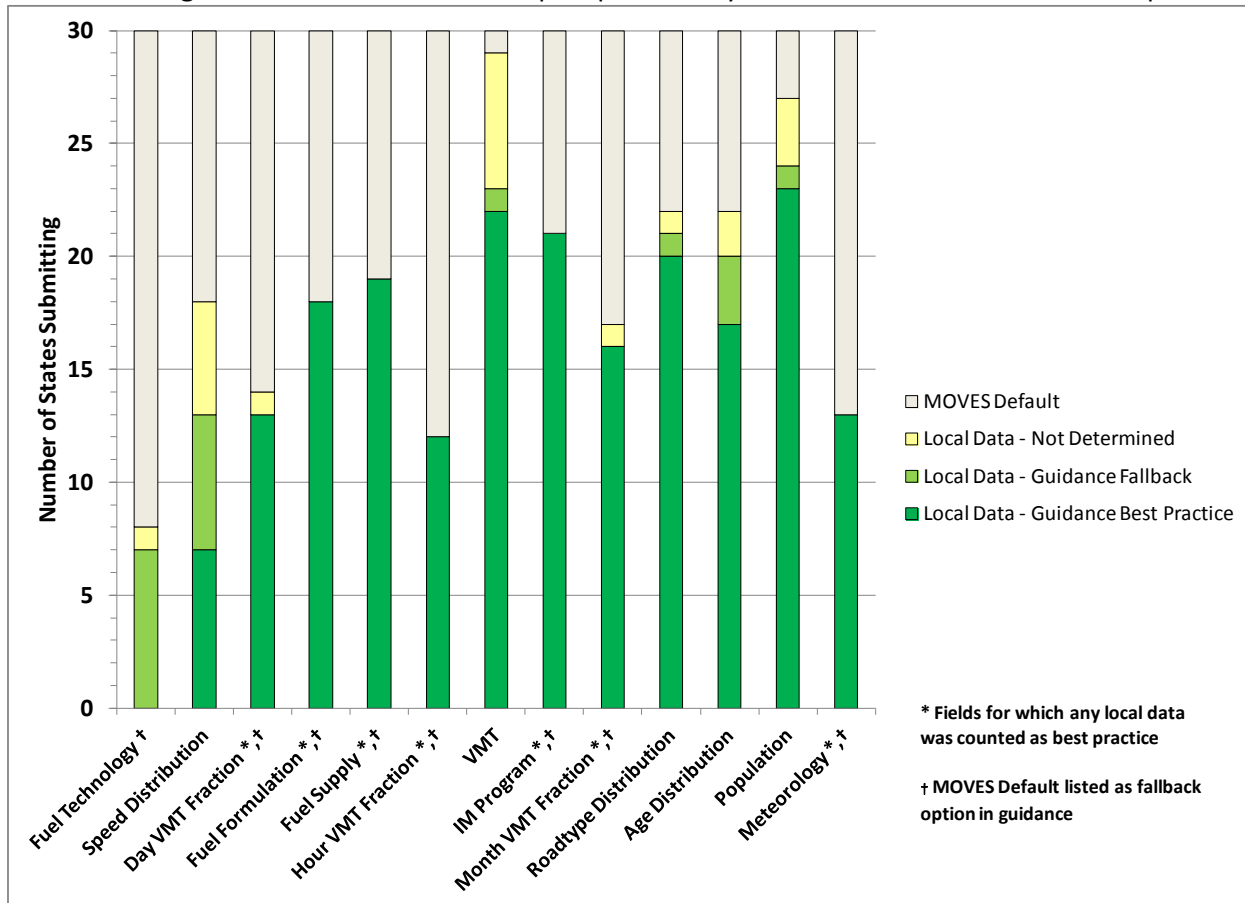
Under contract with the Coordinating Research Council (CRC), Eastern Research Group, Inc. (ERG) did a detailed assessment of the first round of MOVES data submitted by states, quantifying the distribution of inputs and their impact on MOVES emission estimates.<sup>17</sup> Part of this assessment was an evaluation of the sources of state-submitted data against best practice, as defined by the EPA technical guidance summarized in Table 119. Documentation provided by responsible agencies along with the MOVES CDBs submitted for the 30 states during the first round of submission was analyzed to determine whether states followed EPA's best practice guidance or suggested fallbacks, or used other approaches. This summary is presented in Figure 17, and provides insight into what states are doing to gather data for submission. While several states generated local data for the majority of inputs, no state provided custom data for all inputs. Where custom data wasn't provided, MOVES defaults were submitted (as noted, for some fields MOVES defaults are mentioned as a "fallback" option in the EPA guidance). The likelihood of states submitting custom data depends on the field, and is an indication of how readily available local data is for that field. State transportation departments collect

<sup>17</sup> "Study of MOVES information for the National Emissions Inventory", Report for Coordinating Research Council (CRC) by Eastern Research Group, Inc under CRC Project A-84; expected publication 2014



detailed activity information, providing a ready source for VMT and allocations by road type, month, day and hour. State vehicle registration databases are a ready source for vehicle population and age distribution inputs. The prevalence of local data for these inputs is therefore higher. Average speed distribution data required by MOVES is more challenging to obtain, particularly for rural areas and urban areas not employing travel demand models; VMT by fuel technology is also difficult to obtain. As a result, these inputs have lower prevalence of local data submitted.

**Figure 17: Breakdown of CDB inputs provided by States that submitted at least 1 input**



### Resubmission Process

Following posting of first round inputs, EIS was opened to a second round of submission ending in May 2013. Several states submitted new or corrected data during this time (or provided data directly to EPA staff), as follows:

- New Jersey provided CDBs for all 21 counties in the state
- Utah resubmitted a CDB for county 49053
- Colorado submitted an IMCoverage table for counties 08031, 08123, 08001, 08005, 08013, 08014, 08035, 08041, 08059, 08069, and 08097
- Connecticut submitted HPMSVMTBaseYear (VMT) data for counties 09003 09001, 09005, 09007, 09009, 09011, 09013, and 09015 and replaced sccroadtypedistribution data with EPA default data
- Minnesota submitted:

- sourceTypeAgeDistribution for counties 27053, 27003, 27111, and 27137
- HPMSVMTBaseYear (VMT) and sourceTypePopulation data for county 27065
- sourceTypePopulation data for county 27111
- Virginia resubmitted HPMSVMTBaseYear (VMT) and sourceTypePopulation data for county 51103

### QA Checks on MOVES inputs

A quality assurance (QA) process in the form of a MySQL script developed by EPA and supplemented by the EPA contractor ERG was implemented for each of the state-submitted MOVES CDBs. This tool generated a QA report that was submitted to EIS with any CDB input submission. The tool must confirm that all inputs passed QA in order for the submission to proceed. This process was also performed on any re-submitted or newly submitted data that followed draft release of the CDBs (including data submitted directly to EPA staff rather than through EIS). The initial QA checks repeated the checks required during submittal to EIS ensuring basic integrity of the input files. These checks focused on range checks for submitted data, making sure distributions summed to unity (one), and making sure that no empty tables were submitted. Submitting agencies ran this QA check at the time of submission.

Following loading into EIS, an additional set of checks were developed to further assess the “reasonableness” of the submitted data. These checks were meant to flag entries that contained more extreme values for further investigation, though not necessarily in error. A summary of these reasonableness checks is below:

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].

These checks set several flags; for example, many counties had individual age distribution values = 0, individual hour VMT fraction values = 0, and VMT/Population ratios that varied from national defaults by more than 50 percent. After review of all of the reasonableness check results, for Version 1 the majority of flagged data were deemed reasonable and as intended by the submitting agency. For a few cases, identified errors in submissions were corrected by states during the resubmission process.

A particular concern with data submission were cases where states submitted updated VMT data, but did not update vehicle population data accordingly. Check #12 was devised to flag unreasonable VMT/population ratios, but was too coarse to catch this specific case. Cases where states supplied local VMT data but default population (based on the previous 2008 NEI) data were identified through the submitted documentation and check of data against the national defaults from MOVES. The submissions were:

- Oregon
- Ohio (source types 41 and higher)
- Knox County, TN
- Washoe County, NV

For these areas, 2011 default population data as discussed in the following section was used instead of the submitted default data. Other results required correction by EPA prior to development of the emissions inventory, as discussed in the following sections.

#### *Case-by-case corrections*

Utah counties 49043 (Summit) and 49045 (Tooele) appeared to have AvgSpeedDistribution data incorrectly transposed from other counties. To address this, the 49045 AvgSpeedDistribution table was replaced with the one originally submitted for county 49043, while the AvgSpeedDistribution table for county 49043 was replaced with the one from county 49041 (Sevier).

#### *Updating submissions where Road Type VMT=0*

Several corrections were made to representing counties where states submitted placeholder averageSpeedFraction or hour VMTfraction data for roadtypes which did not have any VMT. While these were technically not errors from the state perspective, for SMOKE-MOVES application it was necessary to have realistic values for all road types in a representing county, so that emission rates calculated for these counties could be applied to all road types over a broader set of non-representing counties. To ensure consistency, for all representing counties, averageSpeedFraction and hourVMTfraction values for roadTypes where roadTypeVMTfraction = 0 were set to national defaults. This fix was not made for non-representing counties, as it wasn't a needed correction for application in the SMOKE-MOVES framework.

#### *Ramp fraction corrections*

62 counties had cases where RampFraction for restricted roadways (MOVES road type 2 or 4) was submitted as zero. For some of these cases the roadTypeVMTfraction for restricted roadways was submitted as zero as noted above, meaning that a zero RampFraction wasn't consequential. However, because a non-zero RampFraction is required for representing counties in the application in SMOKE-MOVES, values were updated using the national

default RampFraction (0.08) where rampFraction=0 and roadtypeid in (2,4). [Note: For 2 counties in GA (Fulton 13121 and Floyd 13115), EPA incorrectly gave them 0.8 ramp fraction instead of 0.08. Also, when GA resubmitted 13121, it actually had a non-zero ramp fraction but they previously had a 0. EPA erroneously replaced it as if it was 0 and replaced it with 0.8. These errors were not found in time for correction in 2011NEIv1 but will be fixed in version 2.]

#### 4.6.2.3 Default Inputs used for counties with no submitted CDBs

For counties which did not submit CDB data, default CDBs were developed. Table 121 describes the source of the defaults used for Version 1 of the 2011 NEI for each table in the CDB that states have the option to supply alternate data for (there are additional tables in the CDB that are informational only, i.e. state, county, year etc. that EPA prepopulated).

**Table 121: Source of Defaults for Data Tables in MOVES CDB**

<b>CDB Table</b>	<b>Description of Content</b>	<b>Default CDB Table Content</b>
avgspeeddistribution	Average speed distributions	MOVES2010b national default
dayvmtfraction	VMT distribution across the type of day	2008 NEI v3
fuelformulation	Fuel properties	Based on EPA estimates for each county based on calendar year 2011 refinery data.
Fuelsupply	Fuel differences by month of the year	Based on EPA estimates for each county based on calendar year 2011 refinery data.
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	2008 NEI v3
monthvmtfraction	VMT distribution across the months of the year	MOVES2010b national default
roadtypedistribution	VMT distribution across the road types	2008 NEI v3
Sourcetypeagedistribution	Distribution of vehicle ages	MOVES2010b national default for 2011
Sourcetypeyear	Vehicle populations	Calculated from county-level VMT based on ratios of VPOP:VMT from state-level FHWA data (see below)
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.

## Defaults California Emissions Standards

In addition to these CDB tables, the EmissionRateByAge table for some counties were populated using the appropriate data described in the guidance for states adopting California emission standards. The states that were given California LEV programs are shown in Table 122, along with the program date start years:

**Table 122: 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
41	Oregon	2009
42	Pennsylvania	2008
44	Rhode Island	2008
50	Vermont	2000
53	Washington	2009

The alternative base emission rates are available in the file “2011nei\_supdata\_or\_CALEV.zip” (see Section 4.6.5 for access information).

## Default VMT

The default 2011 National Emissions Inventory (NEI) vehicle miles traveled (VMT) data are developed primarily from information provided by the Federal Highway Administration (FHWA), along with the FHWA’s published *Highway Statistics 2011*, data from the Bureau of Census, and information provided by the US Environmental Protection Agency (EPA). This 2011 full VMT database was developed to provide default VMT at the county, road type, and vehicle type level of detail, to be used in the 2011 NEI in areas for which no state or local agency provided VMT data. The road types included were the 12 Highway Performance Monitoring System (HPMS) functional roadway types while the vehicle types used were the six MOVES HPMS vehicle types, for a total of 72 records per county. To be compatible with MOVES inputs and for easy import into the MOVES HPMSVtypeYear table, the data were also provided at the level of county and HPMSVtypeID. In both cases, the VMT data provided are annual data in units of millions of vehicle miles.

## Data Sources Used to Develop Default VMT

The 2011 VMT database was developed using data supplied directly by FHWA and as well as publicly available data from the 2011 version of FHWA’s *Highway Statistics* data series (<http://www.fhwa.dot.gov/policyinformation/statistics/2011/>). The FHWA data sets that were provided include a subset of fields from the 2011 HPMS database.

The HPMS database is at the link level of detail. Each link is coded with the corresponding state, county, and, if applicable, urban area code. The roadway functional system code is included. The beginning point and ending point mileage of the link are included, from which the length of the link can be calculated. In addition, the total average annual daily traffic (AADT) volume is included along with AADT for single-unit trucks and combination trucks. Annual VMT can then be calculated by multiplying the link length by the AADT and multiplying by 365.

The *Highway Statistics* data used in the VMT development include:

- Table VM-2, "Functional System Travel, Annual Vehicle-Miles,"
- Table VM-1, "Annual Vehicle Distance Traveled in Miles and Related Data by Highway Category and Vehicle Type," and
- Table HM-71, "Urbanized Areas, Miles and Daily Vehicle-Miles of Travel."

*Highway Statistics* Table VM-2 contains State-level summaries of 2011 miles of annual travel in each State. Rural VMT and urban VMT are provided at the state level for seven HPMS functional roadway types: interstate, other freeways and expressways, other principal arterial, minor arterial, major collector, minor collector, and local.

*Highway Statistics* Table VM-1 provides annual VMT summarized by five roadway groups (interstate rural, other arterial rural, other rural, interstate urban, and other urban) and by the following vehicle categories: light duty vehicles-short wheelbase, motorcycles, buses, light duty vehicles-long wheelbase, single-unit trucks, and combination trucks.

*Highway Statistics* Table HM-71 provides daily VMT data summarized by urban area for urban areas with a population of 50,000 or more in each of the seven urban functional roadway classes.

In addition to the FHWA data, Census population estimates were used in developing the VMT database. This includes estimates of 2011 population by county. Two additional Census files were used that include 2010 Census data, as these were data tables only available from the decennial census. One of these files provides the percentage of each county's population that fell within specific urban areas in 2010. The other included file provides the percentage of urban and rural population in each county. Ratios based on the 2010 population data, including the county-level percentage of population classified as urban versus rural and the percentage of a county's total population falling within a specific urban area, were applied to the 2011 county-level population data.

#### Default VMT Development Procedures

The procedures used in the development of the 2011 NEI default VMT are broken down into four parts:

1. Extracting the county and roadway type VMT from interstates, other freeways and expressways, and other principal arterials from the HPMS database;
2. Allocating rural VMT for minor arterial, major collector, minor collector, and local roadways from the state/roadway type level to the county/roadway type level using *Highway Statistics* Table VM-2 and Census data;

3. Allocating urban VMT for minor arterial, major collector, minor collector, and local roadways from the urban area/roadway type and state/roadway type level to the county/roadway type level using *Highway Statistics* Tables VM-2 and HM-71 and Census data; and
4. Allocating the county/roadway type VMT by vehicle type using *Highway Statistics* Table VM-1 and data from EPA.

Each of these procedures in the development of the 2011 VMT is discussed separately below.

#### Extracting VMT from HPMS database

The HPMS database is essentially complete for the three highest functional roadway classes—interstate, other freeways and expressways, and other principal arterial. In other words, the sum of the VMT for each of these three roadway classes is less than 0.0001 percent different than the national total for the same roadway class published in *Highway Statistics* Table VM-2. For the remaining roadway classes, the VMT estimated from the HPMS 2011 database represents only a small fraction of the total *Highway Statistics* Table VM-2 VMT for these roadway classes. Based on this assessment, the HPMS database was used to develop the county level VMT for the 2011 NEI for VMT on interstates, other freeways and expressways, and other principal arterial roadways. For the remaining roadway classes, *Highway Statistics* Tables VM-2 and HM-71 were used in combination with population data to allocate the VMT by county. This procedure is discussed below.

There were some cases in the HPMS database where county codes were null. In these cases, the VMT from counties with a null county code was allocated to any missing counties according to rural or urban population, depending on the roadway type. This occurred to some extent in nine states. The worst case of this was Iowa where only the null county code was used.

#### Allocating Rural VMT to Road Types

State-level rural VMT from *Highway Statistics* Table VM-2 was allocated to the county level for these four roadway types: minor arterial, major collector, minor collector, and local roadways. The allocation used rural population and rural functional system roadway length as surrogates. Counties with a roadway length of zero for a specified roadway type were not assigned any VMT for that roadway type. The allocation of VMT by county was essentially a two-step process. First, the rural population was estimated for each county by multiplying the 2011 county-level population by the 2010 rural population fraction for that county. In addition, using a database of county-level roadway lengths by functional system, the functional system roadway length was assigned to each county and roadway type combination. For each state and roadway type, the rural population from each county with a non-zero roadway length for the specified roadway type was then totaled. Next, to obtain the county/roadway type VMT, the state-level VMT total for a given roadway type was multiplied by the ratio of the rural population of the county (if the county had non-zero roadway length for the specified roadway type) divided by the total state-level rural population from counties with a non-zero roadway length for the specified roadway type. This is shown the equation below:

$$RVMT_{R,C} = RVMT_{R,S} * (RPOP_C / RPOP_S)$$

where:

$RVMT_{R,C}$  = VMT on rural roadtype R in county C (calculated)

$RVMT_{R,S}$  = VMT on rural roadtype R, State total (*Highway Statistics* Table VM-2)

$RPOP_C$  = Rural population in county C (0 if zero mileage from rural roadway type R in county C)  
(Census)

$RPOP_S$  = Rural population, State total of all counties with nonzero mileage from rural roadway type R  
(Census)

### Allocating Urban VMT to Road Types

The allocation procedure for roadway types in urban areas differs from the procedure used for rural areas. The difference in the procedures is due to the incorporation of the urban area VMT data from *Highway Statistics* Table HM-71. This table contains 2011 VMT by functional roadway type for each urban area with a population greater than 50,000. Note that for multistate urban areas, the 2011 version of the *Highway Statistics* Table HM-71 data does not provide separate totals for each state portion of a multistate urban area. The general procedure used to allocate urban VMT was to first allocate the *Highway Statistics* Table HM-71 data to the counties included in each urban area and then allocate the remaining state-level urban VMT to counties with urban populations not covered by these urban areas. This procedure is discussed in more detail below.

#### *Step 1. Allocate Urban Area VMT from Highway Statistics Table HM-71*

These were allocated to county based on county population percentage within the specific urban area. Remaining state-level urban VMT from *Highway Statistics* Table VM-2 was allocated to the remaining urban areas in the state based on urban population. Data from the 2010 Census provides the relation between each urban area and the counties that are included within the urban area. Note, this Census data file accounts for all urban population, not just the urban areas with population greater than 50,000. For each county included at least in part in an urban area, the Census data provides the percentage of the urban area's total population that falls within each county making up the urban area. This percentage was then multiplied by the 2011 urban area VMT on each of the four roadway classes in the following equation:

$$UVMT_{R,UA,C} = UVMT_{R,UA} * (UAPOPCT_{UA,C}/100)$$

where:

$UVMT_{R,UA,C}$  = VMT on urban roadtype R in urban area UA in county C (calculated)

$UVMT_{R,UA}$  = VMT on urban roadtype R in urban area UA (*Highway Statistics* Table HM-71)

$UAPOPCT_{UA,C}$  = Percent of urban area UA population within county C (Census)

#### *Step 2. Allocate Remaining Urban VMT from Highway Statistics Table VM-2*

The 2011 VMT allocated to large urban areas was totaled by state and roadway type. These state/roadway type VMT totals were then subtracted from the *Highway Statistics* Table VM-2 state urban VMT for each of the four



roadway types (see Equation 1). The remainder is the rest-of-state urban VMT to be allocated according to urban population not in large urban areas.

Similarly, the total 2010 urban population in urban areas with population greater than 50,000 was subtracted from each county's 2010 total urban population to obtain the urban population not accounted for by any of the large urban areas (see Equation 2). This remaining urban population was then totaled at the state level to obtain the rest-of-state urban population total in areas outside of large urban areas.

Once the portion of the state-level urban population that falls outside of large urban areas is estimated, the county-level fraction of the rest-of-state population is calculated for each county with an urban population that exceeds the total of the county urban population within large urban areas. This ratio of the county level urban population not included in large urban areas to the total state urban population outside of large urban areas is multiplied by the state/roadway type VMT total of urban VMT not in large urban areas (see Equation 3).

$$UVMT_{R,ROS} = UVMT_{R,S} - \sum UVMT_{R,UA,C,S} \quad (\text{Eq. 1})$$

$$UPOP_{ROC} = UPOP_C - \sum UPOP_{UA,C} \quad (\text{Eq. 2})$$

$$UVMT_{R,ROC} = UVMT_{R,ROS} * (UPOP_{ROC} / \sum UPOP_{ROC,S}) \quad (\text{Eq. 3})$$

where:

- $UVMT_{R,ROS}$  = Rest-of-state urban VMT on urban roadtype R in state S not included in a large urban area (calculated)
- $UVMT_{R,S}$  = Urban VMT on urban roadtype R in state S (*Highway Statistics* Table VM-2)
- $\sum UVMT_{R,UA,C,S}$  = Sum of urban VMT on urban roadtype R in a large urban area in county C in state S (from Equation 2)
- $UPOP_{ROC}$  = Rest-of-county urban population in county C not included in a large urban area
- $UPOP_C$  = Urban population in county C (Census)
- $\sum UPOP_{UA,C}$  = Sum of urban population within large urban areas in county C (Census)
- $UVMT_{R,ROC}$  = Rest-of-county urban VMT on urban roadtype R not included in a large urban area (calculated)
- $\sum UPOP_{ROC,S}$  = Sum of  $UPOP_{ROC}$  in state S

### Step 3. Combine Urban VMT

The urban VMT estimated from large urban areas on minor arterial, major collector, minor collector, and local roadways was then added to the remaining urban VMT outside of large urban areas for each of these four roadway classes and each county to obtain the county/roadtype level urban VMT.

Allocating VMT to Vehicle Type

*Step 1. Allocate VMT by Table VM-1 HPMS Vehicle Categories*

After allocating the 2011 VMT by county and roadtype, the VMT then needed to be allocated by the six vehicle types used in MOVES, known as the MOVES HPMS types. *Highway Statistics* Table VM-1 provides a summary of annual VMT for five groupings (interstate rural, other arterial rural, other rural, interstate urban, and other urban) and by six HPMS vehicle categories: light duty vehicles-short wheelbase, motorcycles, buses, light duty vehicles-long wheelbase, single-unit trucks, and combination trucks. The first step in allocating the 2011 county/road type VMT by vehicle type was to multiply the VMT at the county/road type level of detail by the fraction of *Highway Statistics* Table VM-1 VMT attributed to each vehicle type for the selected roadtype category. Table 123 shows the *Highway Statistics* Table VM-1 VMT for 2011 as fractions of 2011 VMT in each of the FHWA HPMS vehicle categories by the five roadway type categories, along with the roadway functional classes that are included in each roadway type category.

For the roadtypes for which the county-level VMT was available from the HPMS database (interstates, other freeways and expressways, and other principal arterials, the HPMS also included VMT for single-unit trucks plus buses and for combination trucks. In cases where these values were nonzero, these county-specific VMT data were used in place of the values derived as discussed above. In such cases, these VMT data were subtracted from the county/roadtype VMT total and the remaining VMT was renormalized among the remaining vehicle categories.

**Table 123: VMT Fraction by HPMS Vehicle Type**

Roadway Functional System	Table VM-1 Road Category	Light Duty Vehicles - Short Wheelbase	Motorcycles	Buses	Light Duty Vehicles - Long Wheelbase	Single-Unit Trucks	Combination Trucks
-Rural Interstate	Interstate Rural	0.577	0.005	0.007	0.176	0.039	0.195
-Rural Other Freeways and Expressways	Other Arterial Rural	0.623	0.008	0.005	0.240	0.045	0.079
-Rural Other Principal Arterial							
-Rural Minor Arterial							
-Rural Major Collector	Other Rural	0.633	0.008	0.006	0.261	0.051	0.041
-Rural Minor Collector							
-Rural Local							
-Urban Interstate	Interstate Urban	0.717	0.004	0.004	0.173	0.030	0.071

Roadway Functional System	Table VM-1 Road Category	Light Duty Vehicles - Short Wheelbase	Motorcycles	Buses	Light Duty Vehicles - Long Wheelbase	Single-Unit Trucks	Combination Trucks
-Urban Other Freeways and Expressways	Other Urban	0.737	0.006	0.004	0.197	0.030	0.026
-Urban Other Principal Arterial							
-Urban Minor Arterial							
-Urban Major Collector							
-Urban Minor Collector							
-Urban Local							

*Step 2. Convert from Table VM-1 HPMS Vehicle Categories to MOVES HPMS Vehicle Categories*

Although these HPMS vehicle categories shown in Table 123 are similar to the MOVES HPMS vehicle categories, FHWA has changed the definition of these categories over time, such that there is no longer a one-to-one match between the FHWA vehicle categories and the MOVES vehicle categories. Thus, EPA developed adjustment ratios to convert VMT from the FHWA vehicle categories to the MOVES vehicle categories (see Table 124). The VMT data by county, roadway type, and HPMS vehicle type derived in Step 1, above, were divided by the corresponding FHWA to MOVES Adjustment Factors shown in Table 124. The resulting VMT from Step 2, summed nationally, is also shown in Table 124.

**Table 124: Converting FHWA to MOVES Vehicle Types**

FHWA HPMS Vehicle Type Name	MOVES HPMS VtypeID	MOVES HPMSVtypeName	FHWA to MOVES Adjustment Factor	Step 2. Initial 2011 VMT* by MOVES HPMS VtypeID	Step 3. Normalized 2011 VMT* by MOVES HPMS VtypeID
Motorcycles	10	Motorcycles	1.0000	18,659	18,519
Light Duty Vehicles -Short Wheelbase	20	Passenger Cars	1.2627	1,632,912	1,630,613
Light Duty Vehicles – Long Wheelbase	30	Other 2-Axle, 4-Tire Vehicles	0.5441	1,118,093	1,111,198
Buses	40	Buses	2.0270	6,122	6,131
Single-Unit Trucks	50	Single Unit Trucks	1.5052	61,761	61,595
Combination Trucks	60	Combination Trucks	1.2963	120,102	121,894

\* million of miles

*Step 3. Normalize VMT to Original County-level VMT Totals*

The application of the conversion from FHWA to MOVES HPMS categories in Step 2 changes the total VMT. Thus, the final step in the VMT allocation by vehicle type is to normalize the VMT resulting from Step 2 at the county/roadway type level of detail. This was accomplished by multiplying the ratio of the VMT by MOVES

HPMS vehicle category for an individual county/roadway type/MOVES vehicle category to the total of the VMT from the six MOVES HPMS vehicle categories for that county/roadway type by the total county/roadway type VMT prior to allocating the VMT by vehicle type. The resulting, final 2011 VMT, summarized by MOVES HPMS VtypeID nationally is shown in the column to the far right of Table 124.

#### Default Source Type Population

Default Source type population estimates were developed based on FHWA's 2011 *Highway Statistics* summaries by state. Population for each state was derived from *Highway Statistics* Tables MV-2 and MV-9, and in some cases required additional processing to develop population estimates by MOVES source type. One exception was single unit trucks, for which state-level data could not be estimated from these tables. Estimates of population for each source type were derived as shown in Table 125.

**Table 125:** Mapping of MOVES Source Types to FHWA Vehicle Populations from *Highway Statistics* Tables MV-2 and MV-9

<b>MOVES Source Type</b>	<b>Method for estimating population from 2011 Highway Statistics</b>	<b>MOVES default factor for splitting HPMS level data into source type</b>
Motorcycle	Table MV-1, Private/Commercial + Publicly Owned	1.00
Passenger Car	Table MV-1, Automobiles, Total	1.00
Passenger Truck	Table MV-9, Pickups, Vans, SUVs, Other Light	0.75
Light Commercial Truck		0.25
Intercity Bus	Table MV-1, Buses, Total	0.12
Transit Bus		0.07
School Bus		0.81
Refuse Truck	Not able to break out single unit truck populations from MV-1 or MV-9 tables.	0.01
Motorhome		0.72
Single Unit Short Haul		0.10
Single Unit Long Haul		0.17
Combination Short Haul	Table VM-9, Truck Tractors	0.45
Combination Long Haul		0.55

Resulting state-level populations were paired with VMT data for two different applications in the NEI. For MOVES runs necessary to produce emission factors for use in SMOKE-MOVES, MOVES tables containing the state-level vehicle population data as well as state-level VMT compiled from Table VM-2 of FHWA's 2011 *Highway Statistics*. VMT for each state was taken directly from the vehicle classes reported out in *Highway Statistics* Table VM-2. These classes are the basis for vehicle classes in MOVES (HPMSVtype ID). These state-level databases were used for MOVES runs to update the VMT to vehicle population ratios (hence forward referred to as "VMT:VPOP" ratios) used in MOVES emission rate calculations, overriding county-level VMT and source type population data in the default CDBs. For single unit trucks, MOVES national default population and VMT was used in the absence of good state-level data.

Vehicle Population is also needed by SMOKE to calculate emissions for processes that rely on emission rates per vehicle (mainly start and evaporative emissions). Populations provided by states were used directly for these; for states not submitting data, default populations were estimate based on the same state-level VMT and

populations described above. Default source type population inputs were developed by multiplying default county-level VMT estimates by ratios of VPOP:VMT derived from the FHWA data. VMT:VPOP ratios were calculated at the HPMS class level for each state, and are shown in Table 126. Because population data were not published by FHWA for Puerto Rico and the U.S. Virgin Islands, MOVES national default VMT:VPOP ratios were applied in these territories. These calculated VMT:VPOP ratios are used only for states that did not supply data.

**Table 126:** Default State-level VMT:VPOP ratios derived from 2011 Highway Statistics

State	Motorcycle	Pass Car	Light Truck	Bus	Single Unit Truck*	Combination Truck
Alabama	3174	15130	11624	87909	11989	78464
Alaska	922	11454	3857	32805	11989	45004
Arizona	2072	13561	10367	84890	11989	64589
Arkansas	2688	17346	10584	164823	11989	38415
California	2439	11859	9806	145760	11989	58678
Colorado	1674	13935	8600	78054	11989	73310
Connecticut	1982	9759	13269	69736	11989	198235
Delaware	1842	9896	9234	48362	11989	123403
Dist. of Columbia	6275	8047	21832	21900	11989	3865699
Florida	2079	12929	11530	92001	11989	134811
Georgia	3381	17006	11763	66744	11989	71240
Hawaii	2054	10124	7038	72391	11989	162602
Idaho	1584	14038	7326	58650	11989	33730
Illinois	1834	9980	9852	51747	11989	32211
Indiana	2329	14274	11612	59559	11989	16346
Iowa	1117	10220	8322	58544	11989	19442
Kansas	2296	14145	11545	98964	11989	34665
Kentucky	3037	13726	12861	75694	11989	72716
Louisiana	4228	13888	8930	58045	11989	61615
Maine	1762	14459	10501	51553	11989	74308
Maryland	2913	14482	14483	64709	11989	204918
Massachusetts	2145	9268	9614	79214	11989	188891
Michigan	1912	10746	9538	78564	11989	66008
Minnesota	1468	13558	10211	54216	11989	38208
Mississippi	8611	19883	18012	72235	11989	77529
Missouri	3037	15159	11446	71650	11989	45656
Montana	1544	14398	7265	40795	11989	24000
Nebraska	2313	13400	9979	86187	11989	15023
Nevada	2183	12057	10069	121316	11989	139362
New Hampshire	999	11500	9131	66478	11989	108101
New Jersey	1376	8902	9665	59503	11989	81320
New Mexico	2448	19115	10996	101717	11989	98059
New York	2298	11710	13151	44269	11989	149930
North Carolina	2892	17098	16818	93575	11989	67473
North Dakota	1739	14950	11299	58483	11989	12849
Ohio	1785	11130	10943	66244	11989	51963
Oklahoma	2323	16767	13023	95935	11989	38327

State	Motorcycle	Pass Car	Light Truck	Bus	Single Unit Truck*	Combination Truck
Oregon	1918	12192	9277	124267	11989	59742
Pennsylvania	1525	9729	9677	65095	11989	58130
Rhode Island	1486	8056	9156	65316	11989	181401
South Carolina	2798	13213	11809	91951	11989	86336
South Dakota	804	12591	7346	58351	11989	17346
Tennessee	2614	14429	12241	92828	11989	68193
Texas	3340	14246	10073	74150	11989	48981
Utah	2746	16439	12143	81154	11989	41146
Vermont	1478	13425	10792	56202	11989	89911
Virginia	2573	11381	11574	64018	11989	97998
Washington	1605	10086	9455	79634	11989	60754
West Virginia	2050	15374	11003	61400	11989	102895
Wisconsin	1066	12096	9581	61113	11989	40006
Wyoming	1894	20550	7680	43833	11989	40550
MOVES Default	1701	13959	9918	6518	11989	51271

\*National average estimate used for Single Unit Trucks

### 4.6.3 Calculation of EPA Emissions

#### 4.6.3.1 EPA-developed on-road mobile emissions data for the continental U.S.

For the 2011 NEI, EPA estimated emissions for every county in the U.S. except for California and Texas. 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<sup>18</sup> 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 163 “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) or vehicle population) 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 available in the file “2011nei\_supdata\_or\_RepCounty\_Runspecs.zip” (see Section 4.6.5 for access information). A full listing of datasets available as supporting information for the on-road MOVES runs is available in Section 4.6.5 and these are referenced in the subsections below.

<sup>18</sup> A beta version of SMOKE v3.5 was used for the 2011 NEI v1. The current version is available at: <http://www.smoke-model.org/index.cfm>

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 NEI v1, EPA used the latest publically released version: MOVES2010b (<http://www.epa.gov/otag/models/moves/index.htm>). 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 4.6.3.3)
- Create MOVES inputs needed only for the MOVES runs (see Section 4.6.3.4). 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 4.6.3.5 and 4.6.3.6).
- Create a set of adjustment factors for distributing extended idle emissions from long haul trucks (see Section 4.6.3.7)
- Run MOVES to create emission factor tables (see Section 4.6.3.8)
- Run SMOKE to apply the emission factors to activities to calculate emissions (see Section 4.6.3.9)
- Aggregate the results at the county-SCC level for the NEI, summaries, and quality assurance (see Section 4.6.3.10)

#### **4.6.3.2 Representative counties**

Although EPA compiles county-specific databases for all counties in the nation, actual county-specific data is rare. Instead, much of our “county” data is based on state-wide estimates or national defaults. For the NEI, rather than explicitly modeling every county in the nation, we have done detailed modeling for some counties and less detailed estimates for the other counties. This approach dramatically reduces the number of modeling runs required to generate inventories and still takes into account important differences between counties.

In this approach, we group counties that have similar properties that would result in similar emission rates. We explicitly model only one county in the group (the “representative” county) to determine emission rates. These rates are then used in combination with county-specific activity and meteorology data, to generate inventories for all of the counties in the group. The grouping of counties was based on several characteristics as summarized in Table 127 below.

**Table 127:** Characteristics for grouping counties

<b>County Grouping Characteristic</b>	<b>Description</b>
Fuel Parameters	Weighted average gasoline fuel properties for January and July 2011, including RVP, sulfur level, ethanol fraction and percent benzene
Emission Standards	Some states have adopted California highway vehicle emission standards or plan to adopt them. Since implementation of the standards varies, each state with California standards is treated separately.
Inspection/Maintenance Programs	Counties were grouped within a state according to whether or not they had an inspection and maintenance (I/M) program. All I/M programs within a state were considered as a single program, even though each county may be administered separately and have a different program design.
Altitude	Counties were categorized as high or low altitude based on the criteria set forth by EPA certification procedures (4,000 feet above sea level).
Fleet Age	The weighted average age of passenger cars.
State	A county group, including the representative county, can only consist of counties from the same state

The result is a set of 163 county groups with similar fuel, emission standards, altitude, I/M programs and fleet age. For each group, the county with the highest total VMT was chosen as the representative county for the group (this VMT is not used to calculate the emissions however). The representative counties for the 2011 NEI v1 match those that were used for the “2011 emissions modeling platform” (2011v6 platform, available at: <http://www.epa.gov/ttn/chief/emch/index.html#2011>). However, the representative counties have a different mapping from what was used in the 2008 NEI v3. A summary of the representative counties is available in the spreadsheet included in “2011nei\_supdata\_or\_RepCnty.zip” and the MOVES County Database Manager databases are available in the file “2011nei\_supdata\_or\_CDB\_164RepCnty.zip” (see Section 4.6.5 for access information).

For each county group, SMOKE-MOVES generated a set of emission rates that varied by SCC (vehicle type and road type), fuel, speed, temperature, and humidity; thus, we did not need to consider the fleet mix, speed, temperature range, or humidity in our grouping characteristics. This greatly increased the number of counties that can be grouped, and reduced the number of MOVES runs required.

With help from the RPO’s, EPA solicited comments from the states on the set of representative counties used in the 2011 draft run. The following states provided with comments on the representative counties, and in most cases, any suggested changes were incorporated into the list of representative counties for Version 1 of the 2011 NEI: CO, CT, GA, IL, IN, MA, MD, ME, MN, MO, NC, NH, NJ, NY, OH, PA, TX and VA.

#### 4.6.3.3 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 available in the spreadsheet included in "2011nei\_supdata\_or\_FuelCR.zip" (see Section 4.6.5 for access information).

#### 4.6.3.4 *Fuels*

Although state-submitted NMIM and MOVES input data may have included information about fuel properties, the MOVES runs for the 2011 NEI were run using a set of fuel properties for a set of fuel regions generated by EPA. We 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 2010, 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 available in the file "2011nei\_supdata\_or\_RegFuel.zip" (see Section 4.6.5 for access information).

#### 4.6.3.5 *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, <http://wrf-model.org>), 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 ([http://www.cmascenter.org/help/model\\_docs/mcip/4.1/ReleaseNotes](http://www.cmascenter.org/help/model_docs/mcip/4.1/ReleaseNotes)) 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 (Section 4.6.3.8).

The temperature lists were organized based on the representative counties and fuel months as described in Sections 4.6.3.2 and 4.6.3.3, 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 4.6.3.8), 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 and RPV.

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 available in the file “2011nei\_supdata\_or\_RepCounty\_temperatures .zip” (see Section 4.6.5 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](mailto:info.chief@epa.gov)).

#### 4.6.3.6 VMT, vehicle population, and speed for SMOKE

SMOKE requires county-specific VMT, vehicle population (VPOP), and average speed by SCC to calculate the gridded or county emissions. Unlike the other inputs that are needed just for the representative counties, these inputs are needed for every county. In cases where this data was supplied by states in the CDBs, there needs to be a mapping between MOVES source and road types (the data classification within the CDBs) and SMOKE SCCs. All three types of data (VMT, VPOP, and speed) need to be translated into SCCs for use in SMOKE. The data for VMT, VPOP and speed were obtained either from EPA default estimate or from state supplied data. The state submitted input data are described in Section 4.6.2.2.

SMOKE requires estimates of VMT by county, month, and SCC. The annual VMT values were derived from the state supplied MOVES inputs or the EPA defaults (see Section 4.6.2.2 and 4.6.2.3, respectively). The conversion from MOVES source and road types is described below. In addition to state supplied VMT in MOVES CDB format, two states provided data already converted into SCCs: Virginia and Georgia. These state supplied annual VMT were distributed to monthly VMT by using EPA estimated month to annual ratios by county and SCC.

The CDBs provided by states and the EPA defaults do not contain vehicle miles traveled (VMT), vehicle population, road type or average speed data divided by SCC categories. MOVES normally allocates the user supplied data to the SCC categories internally when MOVES is run. It is not practical to run MOVES for each county to obtain the vehicle activity data by SCC. For the 2011 NEI v1, the data provided by the states in the CDBs was allocated to the SCC categories manually using the methods described in this section for use by SMOKE.

#### Calculating VMT by SCC from State Supplied County Databases

VMT is provided in the CDBs using the six vehicle classifications used in the Federal Highway Administration (FHWA) Highway Performance Monitoring System (HPMS). This data is provided annually to FHWA by the states. FHWA has changed the classification system they used in 2011, but MOVES2010b continues to use the old definition shown in Table 128.

**Table 128: MOVES Vehicle Types (HMPSVtypeID)**

HMPSVtypeID	HMPSVtypeName
10	Motorcycles
20	Passenger Cars
30	Other 2 axle-4 tire vehicles
40	Buses
50	Single Unit Trucks
60	Combination Trucks

Portions of each of the HPMS vehicle types can be matched to each of the 12 SCC vehicle types. The fraction of the HPMS vehicle type VMT that maps to each SCC vehicle type depends on the calendar year, since the mix of

vehicle types varies by model year. The twelve SCC vehicle types are shown in Table 129 with the first seven characters of their SCC (SCC7) which indicate their vehicle type.

**Table 129: SCC Vehicle Types (SCC7)**

SCCVtypeID	SCC7	SCCVtype	SCC Vtype Description
1	2201001	LDGV	Light Duty Gasoline Vehicles (LDGV)
2	2201020	LDGT1	Light Duty Gasoline Trucks 1 & 2
3	2201040	LDGT2	Light Duty Gasoline Trucks 3 and 4
4	2201070	HDGV	Heavy Duty Gasoline Vehicles 2B thru 8B and Gasoline Buses
5	2201080	MC	Motorcycles (MC)
6	2230001	LDDV	Light Duty Diesel Vehicles (LDDV)
7	2230060	LDDT	Light Duty Diesel Trucks 1 thru 4 (LDDT)
8	2230071	2BHDDV	Heavy Duty Diesel Vehicles (HDDV) Class 2B
9	2230072	LHDDV	Heavy Duty Diesel Vehicles (HDDV) Class 3, 4, and 5
10	2230073	MHDDV	Heavy Duty Diesel Vehicles (HDDV) Class 6 and 7
11	2230074	HHDDV	Heavy Duty Diesel Vehicles (HDDV) Class 8A and 8B
12	2230075	BUSES	Heavy Duty Diesel Buses (Intercity, School and Transit)

In order to obtain factors to map the HPMS to each of the SCC vehicle classes, MOVES was run using national totals for calendar year 2011 separately for each HPMS vehicle type (with the VMT for other HPMS vehicle types set to zero) and with the results reported by SCC. Using this method, the aggregate 2011 calendar year fraction of total national HPMS vehicle type VMT that is mapped to each of the SCC classifications by model year used by MOVES can be calculated from the MOVES output. These totals are used to calculate the fraction of each HPMS vehicle type total that is mapped to each SCC vehicle type (see Table 130). Using these fractions, the VMT by HPMS vehicle type in each CDB can be converted to VMT by SCC vehicle type.

**Table 130: Ratio of HPMS to SCC Vehicle Types**

HPMSVtypeID	SCC7	SCC Vehicle Type Miles	HPMS Total Miles	HPMS/SCC Fraction
10	2201080	15,795,702,944	15,795,702,944	1.00000
20	2201001	1,599,816,994,816	1,604,541,324,792	0.99706
20	2230001	4,724,329,976	1,604,541,324,792	0.00294
30	2201020	662,010,531,072	1,125,283,986,520	0.58831
30	2201040	341,035,309,568	1,125,283,986,520	0.30307
30	2201070	73,609,382,400	1,125,283,986,520	0.06541
30	2230060	13,005,392,016	1,125,283,986,520	0.01156
30	2230071	5,902,273,160	1,125,283,986,520	0.00525
30	2230072	29,721,098,304	1,125,283,986,520	0.02641
40	2201070	321,909,878	7,005,147,462	0.04595
40	2230075	6,683,237,584	7,005,147,462	0.95405
50	2201070	28,540,914,206	88,486,798,750	0.32254
50	2230073	43,362,661,178	88,486,798,750	0.49005
50	2230074	16,583,223,366	88,486,798,750	0.18741
60	2201070	36,810,973	133,753,812,445	0.00028
60	2230073	15,428,808,640	133,753,812,445	0.11535
60	2230074	118,288,192,832	133,753,812,445	0.88437

MOVES distributes the total VMT by HPMS vehicle type supplied in the state supplied CDB to the four MOVES road types, as shown in Table 131.

**Table 131: MOVES Road Types**

roadTypeID	MOVES Road Type Description
2	Rural Restricted Access
3	Rural Unrestricted Access
4	Urban Restricted Access
5	Urban Unrestricted Access

The distribution of VMT by source use type to road types is found in the RoadTypeDistribution table provided as part of the CDB. The distributions are by source type and not HPMS vehicle type or SCC vehicle type. However, the source types map cleanly into the six HPMS vehicle classifications, as shown in Table 132.

**Table 132: MOVES Source Types**

sourceTypeID	HPMSVtypeID	Source Type Description
11	10	Motorcycle
21	20	Passenger Car
31	30	Passenger Truck
32	30	Light Commercial Truck
41	40	Intercity Bus
42	40	Transit Bus
43	40	School Bus
51	50	Refuse Truck
52	50	Single Unit Short-haul Truck
53	50	Single Unit Long-haul Truck
54	50	Motor Home
61	60	Combination Short-haul Truck
62	60	Combination Long-haul Truck

The values in the state supplied RoadTypeDistribution tables were collapsed into the HPMS vehicle classes by grouping by HPMS vehicle types. This assumes that the road type distributions are the same for any of the subgroups of the HPMS vehicle types.

Once the road type distributions by HPMS vehicle type are known, the road type fraction information can be combined with the VMT by SCC vehicle type using the HPMS vehicle type to calculate the road type VMT for each SCC/HPMS vehicle type combination. When state supplied data was not provided, MOVES national average default values were used.

Although the SCCRoadTypeDistribution table is not part of the County Data Manager and is not normally included in the CDBs, states were encouraged to provide this table as part of their submissions to the 2011 NEI.

The SCCRoadTypeDistribution table has the fraction of each of the four MOVES road types that map into one of the 12 SCC road types, as shown in Table 133.

**Table 133: SCC Road Types**

SCCRoadTypeID	SCC Road Type Description
11	Rural Interstate
13	Rural Principal Arterial
15	Rural Minor Arterial
17	Rural Major Collector
19	Rural Minor Collector
21	Rural Local
23	Urban Interstate
25	Urban Freeway/Expressway
27	Urban Principal Arterial
29	Urban Minor Arterial
31	Urban Collector
33	Urban Local

These fractions are joined with the table that contains the VMT by HPMS vehicle type, SCC vehicle type and MOVES road type to allocate the VMT in each row to one of the 12 SCC road types. The VMT can now be aggregated to sum the VMT in each SCC vehicle type and road type category across all HPMS vehicle types and MOVES road types to provide VMT by the full SCC (vehicle type and road type) for each county. In those cases where the SCCRoadTypeDistribution table was not provided, the default MOVES distributions were used.

**Calculating VMT by SCC from Default VMT Estimates**

In cases where states did not provide CDBs, VMT by SCC was estimated from a nationwide set of county-specific VMT estimates developed by a contractor for EPA (see Section 4.6.2.3). The default VMT values by county are by HPMS vehicle type and by the 12 road types used in the HPMS. The road types used by HPMS are the same road types used in the SCC. Since only default SCC vehicle type distributions and road type distributions were used, the fractions to allocate the HPMS vehicle type VMT to the SCC categories was done in a single step using fractions developed from the national MOVES run for calendar year 2011. These fractions were applied to VMT for each HPMS vehicle type and SCC road type combination in each county. The distribution from HPMS vehicle type and road type to SCC was the same in all counties in cases where states did not provide CDBs.

The average speeds provided to SMOKE for each county were derived from the default national average speed distributions found in the default MOVES2010b database AvgSpeedDistribution table. These average speeds are the average speeds developed for the previous EPA highway vehicle emission factor model, MOBILE6. EPA used the MOVES distribution of average speeds for each hour of the day for each road type to calculate an overall average speed for each hour of the day. The default EPA average speed data does not vary by source type (vehicle type). These hourly speeds were used to create the speed profile (SPDPRO) input for SMOKE. In addition, these hourly average speeds were weighted together using the default national average hourly VMT distribution found in the MOVES default database HourlyVMTFraction table, to calculate an average speed for each road type. This average speed by road type was provided to SMOKE for each county as the speed

inventory<sup>19</sup>. In addition to state supplied speeds in MOVES CDB format, two states supplied data already converted into SCCs: Virginia supplied a state-wide speed inventory and Georgia supplied a speed profile (SPDPRO) for the greater Atlanta area.

SMOKE also requires vehicle population (VPOP) estimates for each county by SCC vehicle type. The VPOP values were derived from the state supplied MOVES inputs or the EPA defaults (see Sections 4.6.2.2 and 4.6.2.3, respectively). The process of converting MOVES vehicle types into SCC vehicle types is similar to the process for VMT described above<sup>20</sup>. In addition to state supplied VPOP in MOVES CDB format, two states provided data already translated into SCCs: Virginia and Georgia.

The MOVES MySQL databases that include the VMT and vehicle population used for the representative counties are listed in Section 4.6.3.2. The SMOKE input VMT, vehicle population, speed data, and hourly speed profiles used to estimate emissions for every county are available in the files “2011nei\_supdata\_or\_VMT.zip”, “2011nei\_supdata\_or\_VPOP.zip”, “2011nei\_supdata\_or\_Speed.zip”, and “2011nei\_supdata\_or\_SpdProf.zip” (see Section 4.6.5 for access information).

#### 4.6.3.7 *Extended idle adjustments*

The extended idling of long-haul trucks are a subset of the exhaust emissions. Although the NEI only reports total exhaust emissions (emis\_type = E), the development of the emissions tracks extended idle separately and sums it with other forms of exhaust to create total exhaust. These extended idle emissions are typically from trucks which have traveled across county and state boundaries. Federal rules require that truck drivers may not drive more than 10 hours without rest. These long-haul trucks are known to stop for these rest periods at truck stops along their routes and idle<sup>21</sup> their trucks for hours while they rest. The MOVES model generates an estimate of the total number of extended idling hours and emissions for every county. However, when MOVES is run using the County scale, the extended idling rate (in grams per hour per truck) is not adjusted to account for allocation of the extended idling to counties where interstate travel occurs.

MOVES calculates the total number of hours nationally that long haul heavy duty diesel trucks (SourceTypeID=62) are expected to spend stopped at rest areas, truck stops and other parking locations during operation based on the estimated number of miles traveled by this type of vehicle and average speeds. Long haul trucks typically travel interstate, so individual counties or even states cannot adequately account for the overall behavior of these vehicles. Instead, MOVES calculates the total hours of extended idling in the nation and these total hours of extended idle are allocated to each county in each state.

A national estimate of total long haul truck extended idle hours is estimated from the total hours of long haul truck operation calculated from total long haul truck vehicle miles traveled. The total national hours of extended idle operation are a function of these total operation hours. The extended idle hours are allocated to hours of the day based on the distribution of vehicle miles traveled to hours of the day for these long haul

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<sup>19</sup> The speed inventory has annual average and monthly average speed by county/SCC. It is in SMOKE FF10 format.

<sup>20</sup> For VPOP, there is no need to allocate to road type because all vehicle population for SMOKE is characterized as off-network (SCC3 390).

<sup>21</sup> For this section, all references to “idle” should be assumed to be extended idle from long haul trucks. This does not include idling from other types of trucks and/or other types of idling (e.g. buses idling outside schools).

trucks. The extended idle hours are then distributed to counties using estimates of demand for truck parking by state and the activity on interstate highways in counties.

The total hours of extended idling calculation begins with a calculation of the distribution of the number of trips that begin in each hour of the day. By federal law, long haul truck drivers are only allowed to travel 10 hours without a break, so all trips are assumed to be 10 hours long.

For each hour of the day, the calculation determines the number of trips that end in that hour. This is the same as the number of trips that started 10 hours earlier and the number of trucks that are eligible to begin extended idling in that hour. The hours of extended idling in that hour is the number that begin in that hour, plus the number that began in the previous hour, plus the number that began in the hour before that, and so on, until all of the idling is accounted for.

In the sample of trucks used for this calculation, the distribution of trip starts vs trip ends over the hours of the day is shown in Table 134.

**Table 134:** Distribution of Trip Starts and Ends

Hour of the day	trip starts	trip ends*
1	78	171
2	76	167
3	65	144
4	94	98
5	107	71
6	131	73
7	194	71
8	230	52
9	279	85
10	267	48
11	275	78
12	240	76
13	201	65
14	211	94
15	171	107
16	167	131
17	144	194
18	98	230
19	71	279
20	73	267
21	71	275
22	52	240
23	85	201
24	48	211

\* Assumes all trips are 10 hours long.

The distribution calculated above by this method is similar to the behavior observed in the study, “Effects of Heavy-Duty Diesel Vehicle Idling Emissions on Ambient Air Quality at a Truck Travel Center and Air Quality Benefits Associated with Advanced Truck Stop Electrification Technology,” a dissertation presented for the



Doctor of Philosophy Degree at the University of Tennessee, Knoxville, for Guenet Tilahun Indale (May 2005) [ref 2]. This study observed the trucks parking at the Petro truck travel center located at the I40/I75 and Watt Road interchange performed between mid-December 2003 and August 2004.

Not all trucks idle for the same amount of time. Another study, shown in Table 135, provided the distribution of idle time per stop for long haul trucks:

**Table 135:** Distribution of Length of Extended Idle

Idle Time (hours)	Fraction of time
2	0.227
4	0.135
6	0.199
8	0.191
10	0.156
12	0.057
14	0.014
16	0.021
Total	1.000

Using these fractions, EPA then calculates an estimate of the fraction of all trip ends in each hour to determine the number of trucks that begin extended idling in each hour and the number still idling in any hour of the day.

For each idle time bin (2, 4, 6, etc.), EPA calculates the number of trips of that length affecting that hour. For example, the first bin (trucks idling 2 hours) is the sum of the number of trips ending in the current hour and 40% of the previous hour trips. The 40% value accounts for the fact that not all idling in this bin was exactly 2 hours long. This assumes that all trucks are idling, so this fraction must be further adjusted by the fraction of all idling in that bin from the table above. Similarly, in the 4 hour bin, sum the number of trips ending in the previous four hours, but reduce the trip ends from 4 hours ago by 40%. These values represent the trucks that may be idling in the current hour as the result of trips ending in recent hours. EPA then performs similar calculations for all of the idle time bins for each hour of the day. After the results in each bin have been weighted by the fraction of all idling that fall into the bin using the above table, the sum is the total number of extended idle hours calculated for this sample in each hour of the day.

In order to use this number in MOVES, EPA calculates fractions that relate the extended idle hours to the hours operating calculated using vehicle miles traveled. The extended idle hours in each hour of the day are divided by the total vehicle operation hours based on travel from the sample. These fractions are the percent of total operating hours spent idling (long haul heavy duty diesel combination trucks only) in that hour. The resulting fractions of total source hours operating (SHO) are shown in Table 136.

**Table 136:** Fraction of Operating Hours Spent Idling

Hour	Fraction of SHO
1	0.037
2	0.036
3	0.034
4	0.031
5	0.027

Hour	Fraction of SHO
6	0.024
7	0.021
8	0.018
9	0.017
10	0.015
11	0.014
12	0.013
13	0.013
14	0.013
15	0.014
16	0.015
17	0.019
18	0.022
19	0.027
20	0.031
21	0.035
22	0.037
23	0.038
24	0.038

The total number of extended idle hours calculated using the method above amounts to a value about 59% of the total number of vehicle operation hours during travel measured in the sample. Driving schedules for heavy duty trucks do not include extended idle behavior, so extended idling hours are in addition to the hours accounted for by measurements of vehicle miles traveled. The MOVES model calculates the total hours of operation based on the vehicle miles traveled and the average speeds. These fractions are then used to calculate the additional hours of extended idle operation that occurs in each hour of the day. The same hourly allocation is used for all counties.

The above national calculations assume that all of the idling occurs somewhere in the nation, but does not determine where the trucks will stop and idle. It was necessary to take the total extended idle times calculated nationally and allocate them to states and then to counties.

The state allocations were obtained using data from the technical report, “Study of Adequacy of Commercial Truck Parking Facilities” (FHWA-RD-01-158, March 2002) written by Stephen A. Fleger, Robert P. Haas, Jeffrey W. Trombly, Rice H. Cross III, Juan E. Noltenius, Kelley K. Pécheux and Kathryn J. Chen of the Federal Highway Administration Office of Safety Research and Development (HRDS) [ref 3].

This report documents the findings of a study to investigate the adequacy of commercial truck parking facilities serving the National Highway System (NHS). Table 7 of the report, “Commercial truck parking demand,” details peak hour demand along interstates and other NHS routes carrying more than 1,000 trucks per day in calendar year 2000. Using these values, EPA calculated the distribution of demand across states, shown Table 137.

**Table 137: Distribution of Demand for Overnight Parking by State**

FIPS Code	State	Rest Stop	Truck Stop	Total	Distribution
1	Alabama	1,634	5,473	7,107	0.024736
2	Alaska	25	88	113	0.000393
4	Arizona	1,052	3,523	4,575	0.015923
5	Arkansas	1,783	5,968	7,751	0.026977
6	California	4,539	15,183	19,722	0.068642
8	Colorado	760	2,546	3,306	0.011506
9	Connecticut	616	2,060	2,676	0.009314
10	Delaware	206	694	900	0.003132
11	DC	0	0	0	0.000000
12	Florida	1,694	5,665	7,359	0.025613
13	Georgia	2,188	7,324	9,512	0.033106
15	Hawaii	0	0	0	0.000000
16	Idaho	734	2,462	3,196	0.011124
17	Illinois	3,338	11,172	14,510	0.050502
18	Indiana	4,299	14,400	18,699	0.065082
19	Iowa	688	2,302	2,990	0.010407
20	Kansas	566	1,907	2,473	0.008607
21	Kentucky	2,206	7,380	9,586	0.033364
22	Louisiana	2,060	6,910	8,970	0.031220
23	Maine	205	691	896	0.003119
24	Maryland	592	1,983	2,575	0.008962
25	Massachusetts	863	2,894	3,757	0.013076
26	Michigan	1,275	4,262	5,537	0.019271
27	Minnesota	872	2,925	3,797	0.013215
28	Mississippi	1,254	4,194	5,448	0.018962
29	Missouri	2,643	8,841	11,484	0.039970
30	Montana	462	1,550	2,012	0.007003
31	Nebraska	251	837	1,088	0.003787
32	Nevada	682	2,285	2,967	0.010327
33	New Hampshire	72	243	315	0.001096
34	New Jersey	457	1,528	1,985	0.006909
35	New Mexico	1,218	4,083	5,301	0.018450
36	New York	1,801	6,034	7,835	0.027270
37	North Carolina	1,270	4,262	5,532	0.019254
38	North Dakota	188	635	823	0.002864
39	Ohio	3,301	11,059	14,360	0.049980
40	Oklahoma	1,078	3,610	4,688	0.016317
41	Oregon	1,139	3,819	4,958	0.017256
42	Pennsylvania	2,360	7,903	10,263	0.035720
44	Rhode Island	167	566	733	0.002551
45	South Carolina	1,265	4,236	5,501	0.019146
46	South Dakota	199	666	865	0.003011
47	Tennessee	1,214	4,073	5,287	0.018401
48	Texas	8,305	27,797	36,102	0.125653

<b>FIPS Code</b>	<b>State</b>	<b>Rest Stop</b>	<b>Truck Stop</b>	<b>Total</b>	<b>Distribution</b>
49	Utah	391	1,307	1,698	0.005910
50	Vermont	27	91	118	0.000411
51	Virginia	1,772	5,932	7,704	0.026814
53	Washington	815	2,724	3,539	0.012317
54	West Virginia	468	1,572	2,040	0.007100
55	Wisconsin	633	2,115	2,748	0.009564
56	Wyoming	440	1,475	1,915	0.006665
72	Puerto Rico	0	0	0	0.000000
78	Virgin Islands	0	0	0	0.000000
	<b>TOTAL</b>	<b>66,067</b>	<b>221,249</b>	<b>287,316</b>	<b>1.000000</b>

The total number of extended idle hours over the nation are allocated to each state based on the distributions of demand shown above. The state specific number of extended idle hours are further allocated to individual counties within the state using EPA estimates of the total vehicle miles traveled (VMT). EPA starts with the VMT for long haul heavy duty diesel combination trucks (SourceTypeID=62) on rural or urban interstate roadways in each county and divide it by the state-wide VMT on rural or urban interstates, respectively, to get a distribution within the state. The distribution of interstate VMT by long haul diesel combination trucks within each state is used to distribute the portion of total national extended idle hours that has been allocated to the state.

This methodology predicts no extended idling hours in Washington D.C., Hawaii, the Virgin Islands or Puerto Rico. This is to be expected on the islands, since no overnight trips are needed and there is little opportunity to park overnight in Washington DC.

When running MOVES using the County scale (inventory mode), the hours of extended idle are calculated from the source hours operating (SHO) calculated for the long haul heavy duty diesel combination trucks as described above. However, the allocation used to scale the total hours to counties is not applicable. Instead, the total amount of extended idle calculated for the SHO in the county is assumed to result in extended idle hours in that county, without any allocation adjustments. This will conflict with estimates made using the National scale, which account for truck parking demand and the presence of interstate VMT by long haul heavy duty diesel combination trucks. Currently, these adjustments will need to be done manually outside the model for any MOVES runs using County scale.

For air quality analysis, the 2011 NEIv1, and other purposes emissions are calculated through SMOKE-MOVES instead of the inventory mode. As discussed earlier, MOVES results for extended idle using the County scale are not the same as the extended idle estimates made by MOVES at National scale, since only VMT for a single county is available, and the national allocation adjustment is not properly applied. In addition, even if the extended idle emissions for the representative county were correct, it would not be proper to use the same extended idle emission rates for all of the counties being represented, since the amount of extended idle will vary by county and some counties without interstate highways would have no extended idle emissions.

This problem was addressed by developing an adjustment to the extended idle emissions calculated in the representative counties that would appropriately adjust the extended idle emission rate to reflect the impact of the national allocation factors. The emission rate for extended idle reported by MOVES has units of grams per vehicle, where "vehicle" is all diesel long haul trucks and not just idling trucks. The extended idle emission rate

is based on vehicle populations, so the adjustment factor is based on national vehicle populations by county and will vary by calendar year.

MOVES stores the allocation factor used to allocate the national extended idle hours to counties in the Zone table. The sum of the idleAllocFactor fractions is one (1.0) for all of the counties in the nation. Knowing the national population and the population in a county, a new factor can be calculated which can be used to adjust the grams per vehicle in the representative county for each county in the county group. The calculation is:

$$\text{EIAdjust} = (\text{National Population} / \text{County Population}) * \text{idleAllocFactor}$$

where:

EIAdjust = multiplicative factor for adjusting the extended idle grams per vehicle.

national population = total national population of diesel long haul trucks.

county population = population of long haul trucks in the county.

idleAllocFactor = extended idle allocation factor from MOVES Zone table.

The extended idle adjustment factor is calculated for each county and is used to calibrate the grams per vehicle emission rate in each county before multiplying the emissions rate and the number of diesel long haul vehicles in the county.

$$\text{Inventory} = \text{Emission Rate (grams per vehicle)} * \text{EDAdjust} * \text{County Population}$$

SMOKE has an optional input that adjusts emissions (CFPRO) by county, SCC, and mode. To account for the extended idle adjustment, EPA created an adjustment file that applies these allocation factors (idleAllocFactor) by county for extended idle and for the long-haul type SCCs (SCC7 2230073 and 2230074) only. This SMOKE adjustment factor is available in the file "2011nei\_supdata\_or\_ExtIdle.zip" (See Section 4.6.5 for access information)

#### **4.6.3.8 Run MOVES to create emission factors**

EPA used the SMOKE-MOVES driver scripts to run MOVES for each of the representative counties, fuel-months, and the listed temperatures and temperature profiles. 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 each representative county. The SMOKE-MOVES driver scripts resulted in three emission factors (EF) tables for each representative county and fuel month: rate per distance (RPD), rate per vehicle (RPV), 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:

<http://www.cmascenter.org/smoke/documentation/3.5.1/html/ch05s02s04.html>.

#### **4.6.3.9 Run SMOKE to create emissions**

Lastly, EPA generated air quality model ready emissions at a gridded and hourly resolution. The Movemrg 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 three sets of emission factor tables (RPD, RPV, and RPP). During the Movesmrg run, the program used the hourly, gridded temperature (for RPD and RPV) or daily 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 on-network emissions. This includes the following modes: vehicle exhaust, evaporation, evaporative permeation, 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)<sup>22</sup>. 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 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 off-network emissions. This includes the following modes: vehicle exhaust, extended idle exhaust, evaporative, and evaporative permeation. 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. For extended idle, an additional adjustment is applied to account for the allocation of these emissions across county and state boundaries. Movesmrg reads in the adjustment file (CFPRO, see Section 4.6.3.7) and multiplies the extended idle specific emissions by the appropriate adjustment factor (by county, SCC, and mode).

The emission process RPP is for modeling the off-network emissions for parked vehicles. 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 three processing streams (RPD, RPV, and RPP). The results include emissions for every county in the continental U.S., rather than just for the representative counties.

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<sup>22</sup> 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.

#### 4.6.3.10 *Post-Processing to Generate Annual Inventory*

For the purposes of the NEI, EPA needed emissions data by county, SCC, pollutant, and emission type (exhaust, evaporative, brake wear, and tire wear)<sup>23</sup>. EPA developed and used a set of scripts to combine the emissions from the three 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”<sup>24</sup>.

#### 4.6.4 EPA-developed 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 for all months of the year using the inventory scale mode of the MOVES model. This approach directly calculates the inventory in each month using the inputs provided in each of the county databases.

The MOVES inputs used for these emissions are available as described in the file “AKHIPRVI\_Counties.zip” contains the MOVES county database manager databases, and the file “2011nei\_supdata\_or\_AKHIPRVI\_Runspeccs .zip” contains the run specifications used to run MOVES. Lastly, the file “2011nei\_supdata\_or\_akhiprvi\_temperatures.zip” contains the MySQL database containing the tables that describe the temperatures and relative humidity values used for these states and territories. Supplemental Input Data for MOVES2010b, used for the 2011NEI are listed in Table 138 and are available at <ftp://ftp.epa.gov/EmisInventory/2011/doc>.

**Table 138:** Supplemental Input Data for MOVES2010b for 2011NEI

	<b>Contents</b>	<b>Name for posting</b>
1	MOVES county database inputs. Includes all agency submittals thru EIS, but not all subsequent revisions and EPA replacements (e.g., fuel and met)	2011nei_supdata_or_CDB.zip

<sup>23</sup> EPA ran SMOKE-MOVES at a more detailed level of emission modes (e.g. evaporative permeation and extended idle) and combined these detailed emission modes to create the 4 emission types.

<sup>24</sup> The corresponding EMF datasets are 2011ec\_NEIv1\_onroad\_norfl\_SMOKE-MOVES\_2010b\_forNEI (v2) and 2011\_NEIv1\_onroad\_AK\_HI\_PR\_VI\_MOVES\_2010b\_forNEI (v0). Although SMOKE-MOVES estimated refueling, these emissions are in a separate EMF dataset and are in the EIS as part of the nonpoint estimates.

	<b>Contents</b>	<b>Name for posting</b>
2	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.	2011nei_supdata_or_RepCnty.zip
3	MOVES county databases (CDBs) for the representative counties. These CDBs include all agency submittals through EIS in addition to subsequent revisions and EPA replacements.	2011nei_supdata_or_CDB_164RepCnty.zip
4	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.	2011nei_supdata_or_VPOP.zip
5	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.	2011nei_supdata_or_VMT.zip
6	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.	2011nei_supdata_or_Speed.zip
7	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.	2011nei_supdata_or_SpdProf.zip
8	Extended idle adjustments factors to reallocate extended idle emissions. Factors are by county, heavy duty diesel vehicle SCCs (SCC7 2230073 and 2230074), and extended idle mode only and covers every county in the continental US. Data is a control factor file (CFPRO) for SMOKE-MOVES	2011nei_supdata_or_ExtIdle.zip
9	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.	2011nei_supdata_or_RegFuel.zip
10	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.	2011nei_supdata_or_CALEV.zip



	<b>Contents</b>	<b>Name for posting</b>
11	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.	2011nei_supdata_or_FuelCR.zip
12	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.	2011nei_supdata_or_VMTsrpt.zip
13	The MOVES2010b run specifications (runspecs) for the representative counties. This is for running MOVES in emissions rate mode (for SMOKE-MOVES).	2011nei_supdata_or_RepCounty_Runspecs.zip
14	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	2011nei_supdata_or_RepCounty_temperatures.zip
15	The MOVES2010b run specifications (runspecs) for all counties in Alaska, Hawaii, Puerto Rico and the Virgin Islands. This is for running MOVES in inventory mode	2011nei_supdata_or_AKHIPRVI_Runspecs.zip
16	The temperature and relative humidity values for all counties in Alaska, Hawaii, Puerto Rico and the Virgin Islands necessary for running MOVES in inventory mode.	2011nei_supdata_or_akhiprvi_temperatures.zip

#### 4.6.5 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 4.6.2.2). The following is a list of the more significant checks and resulting corrections:

- Checked the VMT data by comparing the 2011 with 2008 NEIv3 based activity data. Compared the VMT at various resolutions including: state, county, vehicle type (SCC7), and road type (ending SCC3). Also analyzed the ratio of VMT to vehicle population to look for extreme values.
- Checked the VMT data by comparing the 2011 NEIv1 with 2011 draft based activity data. Compared the VMT at various resolutions including: state, county, vehicle type (SCC7), and road type (ending SCC3). Also analyzed the ratio of VMT to vehicle population to look for extreme values.
- Checked the VMT data by comparing the 2011 NEIv1 (state supplied) with 2011 NEIv1 (default) for those states that submitted activity data. Compared the VMT at various resolutions including: state, county, and road type (ending SCC3).

- Checked the VPOP data by comparing the 2011 with 2008 NEIv3 based activity data. Compared the VPOP at various resolutions including: state, county and vehicle type (SCC7).
- Checked the VPOP data by comparing the 2011 NEIv1 with 2011 draft based activity data. Compared the VPOP at various resolutions including: state, county, and vehicle type (SCC7).
- 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.
- Identified one county in Virginia with unreasonable VMT (FIPS 51103). Virginia supplied updated VMT and VPOP which was included in the final run of 2011 NEIv1.
- Identified six counties in Utah that had no VMT on any of their rural roads, FIPS 49003, 49011, 49035, 49045, 49049 and 49057. Augmented the state supplied VMT with the EPA default VMT for those rural road types.
- Compared the on-road results to similar results from the previous version of the 2011 NEI draft. As expected, found numerous differences between the two sets of results. Detailed comparisons by state, county and SCC vehicle type showed that most of the differences were due to updated input data from the states or due to differences between how the two models were run in terms of representative counties.
- Compared the 2011 NEI v1 emissions with a similar run done for 2008 NEIv3 using 2008 inputs. Compared the results at various resolutions including: state, county, fuel type (SCC3) and vehicle type (SCC7). Additionally, compared the results using difference maps both at the county level and gridded (after spatially allocating the emissions to grid cells using SMOKE).
- Air toxic results were quality assured by back-calculating toxics ratios from inventory outputs to ensure they were consistent with inventory inputs.
- 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.

#### 4.6.6 Summary of quality assurance methods on emissions once selected to 2011NEIv1

Onroad emissions came from EPA estimates exclusively, except in CA and TX.

California emissions estimates were used without any merging with EPA data. Because of mapping differences, the SCCs used in CA are not consistent with those in the rest of US.

Texas onroad emissions may have been overestimated by adding EPA-estimated emissions data to SCCs not reported by Texas. Texas provided CDBs for EPA estimates, but they did not include VMT for every county. When EPA applied default VMT for those counties, County/SCC combinations that were not in TX emissions submittal were created, and then added to TX's in the selection process that merged EPA and TX emission estimates. 45 pollutants impacted. Potential overestimates for some key pollutants are as follows: 20 tons formaldehyde (out of 2,685 total); 20 tons benzene (out of 3,716 tons total); 12 tons acetaldehyde (out of 1,693 tons total); 17,837 tons CO (out of 1.8 million tons total); 134 tons NH<sub>3</sub> (out of 8,801 tons total), 5,657 tons NO<sub>x</sub> (out of 474,137 tons total); 275 tons PM<sub>10</sub> (out of 21,823 tons total); 205 tons PM<sub>2.5</sub> (out of 16,297 tons total); 35 tons SO<sub>2</sub> (out of 2,022 tons total); 849 tons VOC (out of 149,235 tons total).

#### 4.6.7 References for On-road vehicles

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*, available at [http://www2.mmm.ucar.edu/wrf/users/docs/arw\\_v3.pdf](http://www2.mmm.ucar.edu/wrf/users/docs/arw_v3.pdf)
2. Guenet, T.I., et al., University of Tennessee –Knoxville, May 2005, *Effects of Heavy-Duty Diesel Vehicle Idling Emissions on Ambient Air Quality at a Truck Travel Center and Air Quality Benefits Associated with Advanced Truck Stop Electrification Technology*, available at [http://trace.tennessee.edu/utk\\_graddiss/2085/](http://trace.tennessee.edu/utk_graddiss/2085/)
3. Fleger, S.A., et al., Federal Highway Administration, March 2002, FHWA-RD-01-158, *Study of Adequacy of Commercial Truck Parking Facilities*, available at <http://www.fhwa.dot.gov/publications/research/safety/01158/index.cfm>

## 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 3.30) 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 3.26), 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 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 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 to estimate wild land fire emission estimates. Significant improvements were made from 2005 to 2008 to SF2 as documented in the 2008 NEI TSD. In going 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 139 lists the SCCs that define the different types of WLFs in the 2011 NEI, both for EPA data and for S/L/T 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 data for the 2011 NEI considers all SCCs that define any one type of fire and appropriately combines emissions from those SCCs.

**Table 139: 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 just Georgia, 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 EIS.

S/L/T agency data were received in event format from only one agency (GA) as listed in Table 140.

**Table 140: Agency that submitted wildfire and prescribed burning emissions data**

Agency	Agency Type	Rx provided	Wildfire provided
Georgia	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 141 shows the selection hierarchy for the wildfire and Rx burning sectors.

**Table 141: 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

There were no overlapping data in the above datasets. Georgia was excluded from the 2011EPA\_Event dataset and the State/Local/Tribal Data contained only Georgia.

### 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 way we blended these emissions is summarized in above. As discussed above, only GA reported wildfire and prescribed fire emissions to the NEI in 2011. GA 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.

$$\text{Emissions} = \text{Area burned} * \text{Fuel Load Available} * \text{Fuel Consumed (Burn Efficiency)} * \text{Emission Factors}$$

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: <http://getbluesky.org/smartfire/>. 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 142 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 submitted their own emissions data. GA used the same FEPS system as EPA did to estimate all the CAP emissions. EPA sent to GA 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 did not submit CO<sub>2</sub> nor CH<sub>4</sub> (GHGs) so these pollutants are not available in GA.

**Table 142:** Pollutants estimated by EPA\* for wildland fires and HAP emission factors

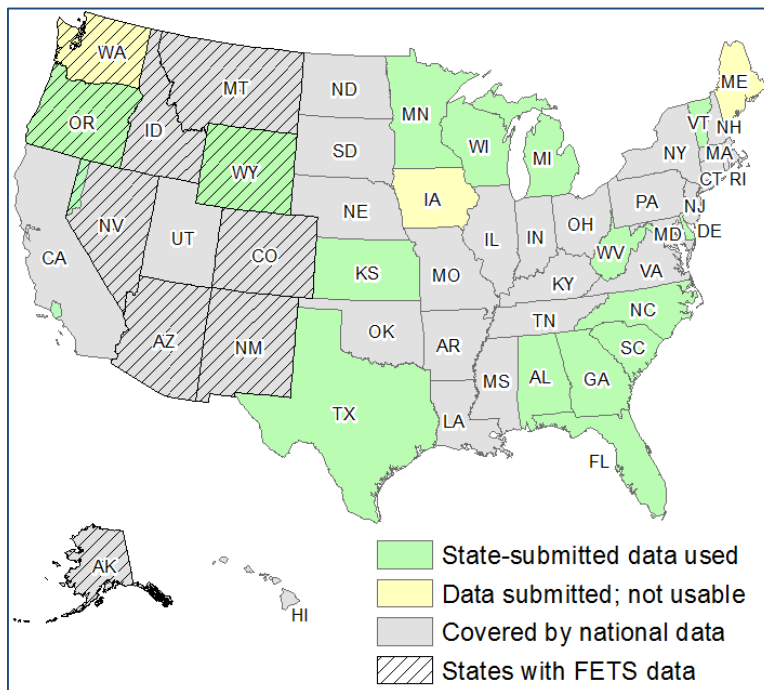
Pollutant	HAP Emission factor (lb/ton fuel consumed)
PM <sub>2.5</sub>	N/A
PM <sub>10</sub>	
CO	
CO <sub>2</sub>	
CH <sub>4</sub>	
NO <sub>x</sub>	
NH <sub>3</sub>	
SO <sub>2</sub>	
VOC	
1,3-butadiene	
Acrolein	0.424
Toluene	0.56825
n-hexane	0.0164025
Anthracene	0.005
Pyrene	0.00929
o,m,p-xylene	0.242
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
Methylantracene	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 <sub>2</sub> and CH <sub>4</sub> , 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<sup>25</sup> to reconcile the various fire information data sets. The NFEI data are available in EIS.

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. (<http://www.airsci.com>) 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 18 shows the states that submitted fire activity data and identifies states that provided usable data and states covered by the FETS data set.

**Figure 18:** 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 the 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 (HIDOH CAB) determined that certain prescribed burns in the draft NFEI are Hawaiian Commercial and Sugar (HC&S) agricultural burns. They recommended removing these prescribed burns from the final 2011 NFEI since HI submitted these emissions as part of their nonpoint agricultural fires.

<sup>25</sup> Additional details on these other data sets are provided in the “Other Data Sources” section that follows.



- 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 <http://satepsanone.nesdis.noaa.gov/FIRE/fire.html>. 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 (<https://fam.nwcg.gov/fam-web/sit/>).
  - *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 (<https://fam.nwcg.gov/fam-web/>).
  - *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 (<http://rmgsc.cr.usgs.gov/outgoing/GeoMAC/>).
  - *Moderate Resolution Imaging Spectroradiometer (MODIS)* satellite data were downloaded via the USFS Remote Sensing Applications Center website (<http://activefiremaps.fs.fed.us/gisdata.php>). 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 (<http://www.fs.fed.us/pnw/fera/fccs/maps.shtml>).

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 143 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 143: SF2 and State-Submitted acres burned for FL WLFs**

	<b>2011 Final SF2 estimates (EPA)</b>	<b>2011 Activity acreage from Florida Database</b>
Prescribed Fires	897,833	1,314,868 (Silviculture, authorized)
Wildfires	398,357	221,756
TOTAL	1,296,191	1,536,624

For Prescribed fires (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 Wildfires, 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  $[(\text{old acres} * 0.4) - 495.6]$ . Then, fire by fire adjust emissions accordingly down.
- For fires 1000 acres or bigger, adjust each fire’s acres burned by  $[(\text{old acres}) * 0.4]$ . Then, use the same adjustment to revise emissions.
- For fires 500 acres or bigger, adjust each fire’s acres burned by  $[(\text{old acres}) * 0.6]$ . Then, use the same adjustment to revise emissions.
- For fires 100 acres or bigger, adjust each fire’s acres burned by  $[(\text{old acres}) * 0.75]$ . Then, use the same adjustment to revise emissions.
- For fires 10 acres or bigger, adjust each fire’s acres burned by  $[(\text{old acres}) * 0.9]$ . Then, use the same adjustment to revise emissions.
- For all other remaining fires (many), adjust each fires acres burned by  $[(\text{old acres}) * 0.5]$ . 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.

A caveat to add to the 2011 NEI data is 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 this version of the 2011 NEI, 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 EPA'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 2011 NEI.

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, which submitted their own data. These data also reflect the changes made to the Florida data as detailed above. These data thus reflect what is in the NEI for wild and prescribed fires.

First, Figure 19 shows the proportion of acres burned for each type of fire by state. In the West, there are more wildfires than in the East, 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. In the 2011 NEI, there are an estimated 22.7 million acres burned from prescribed and wildfires. Of these 22.7 million acres, about 12.5 million are estimated to be prescribed fires and the remaining 10.2 million acres wildfires.

**Figure 19: Proportion of Fires by Type using EPA Methods**

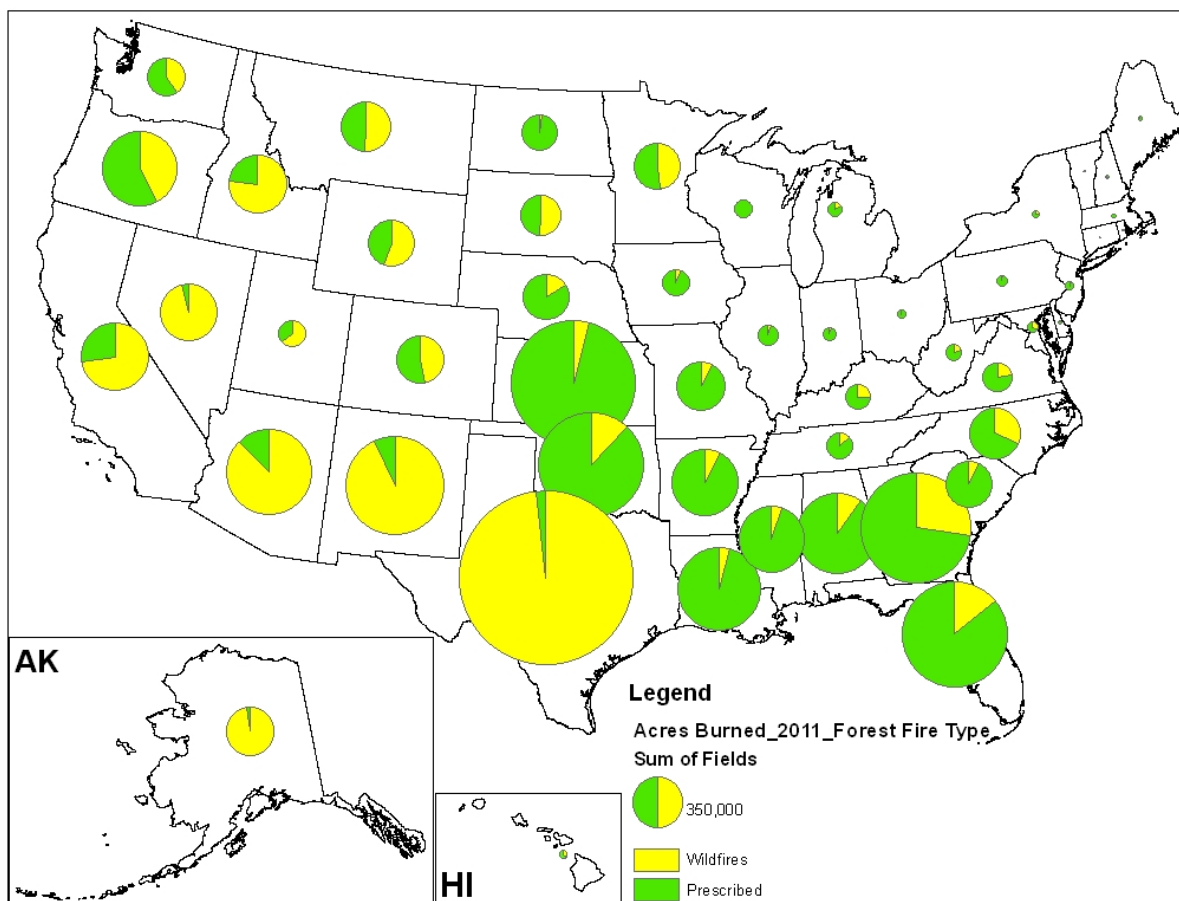


Figure 20 shows the total acres burned on a county-by-county basis. Active areas are seen in northern California and in some southeastern parts of the US. Shown immediately below the “acres burned” map is Figure 21, which shows  $PM_{2.5}$  emissions. In the 2011 NEI, there is an estimated total of 6.31 million tons of  $PM_{2.5}$  emissions. Of this total, 1.27 million is estimated to be from wildfires and about 921,000 tons from prescribed fires. The total of 2.19 million tons of  $PM_{2.5}$  from these fires are mapped in Figure 21 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 20: Acres burned using EPA Methods

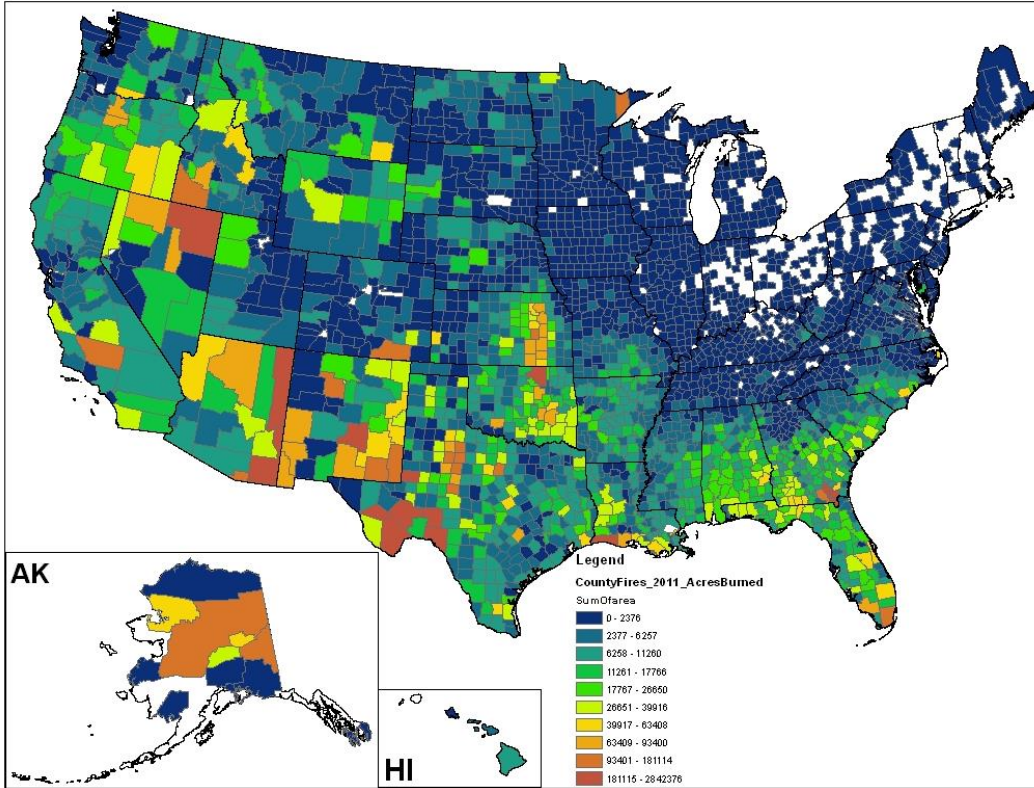
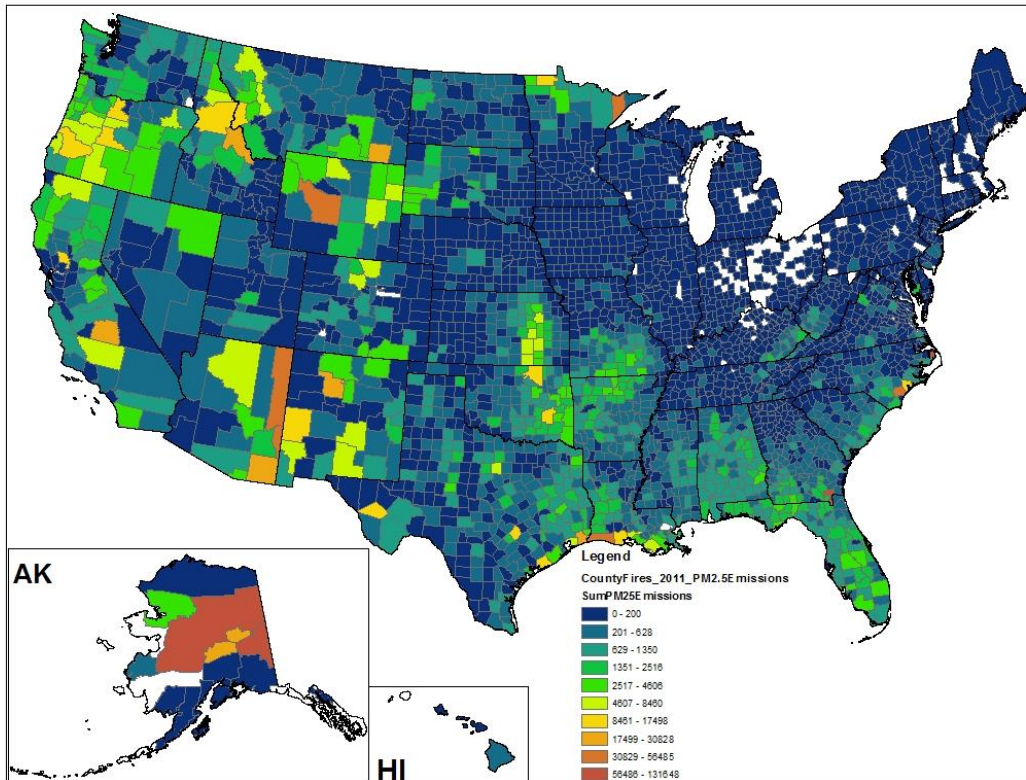


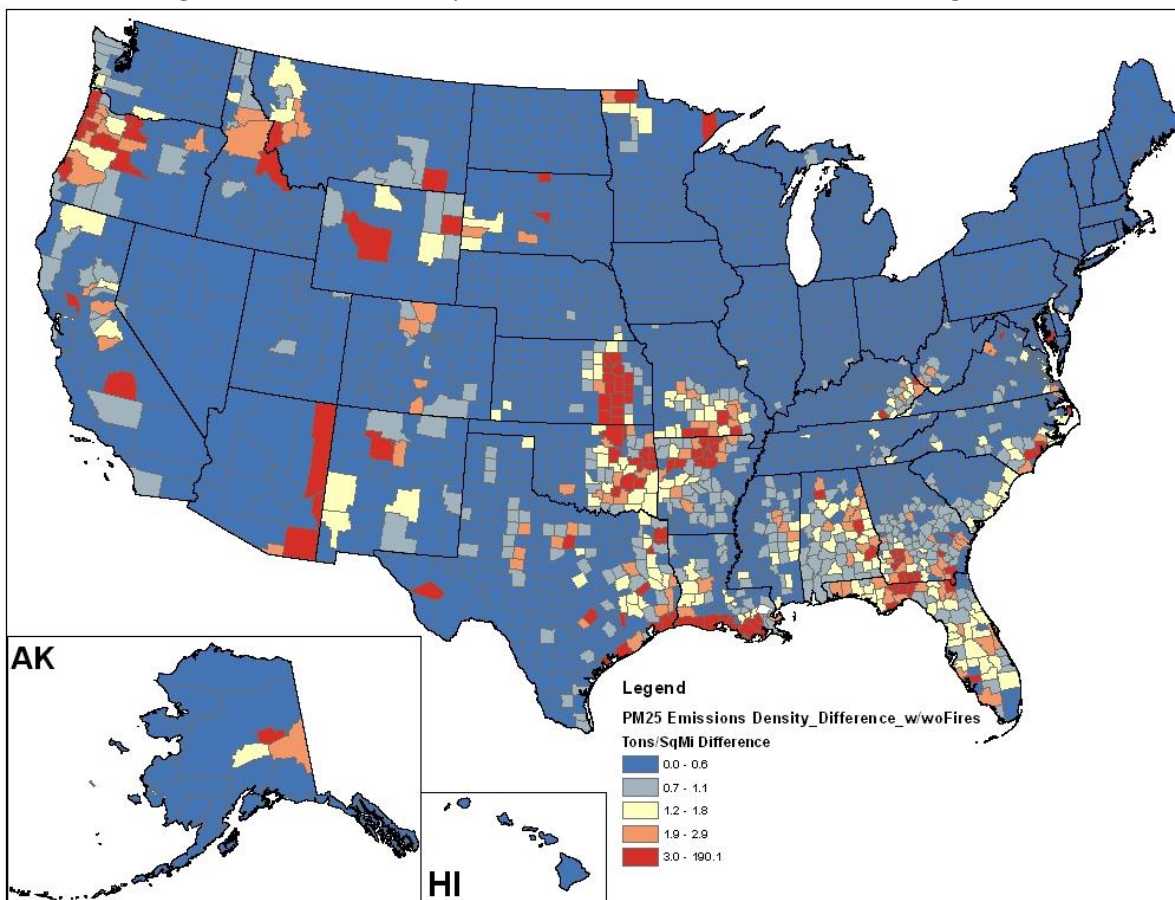
Figure 21: 2011 PM<sub>2.5</sub> Emissions using EPA methods



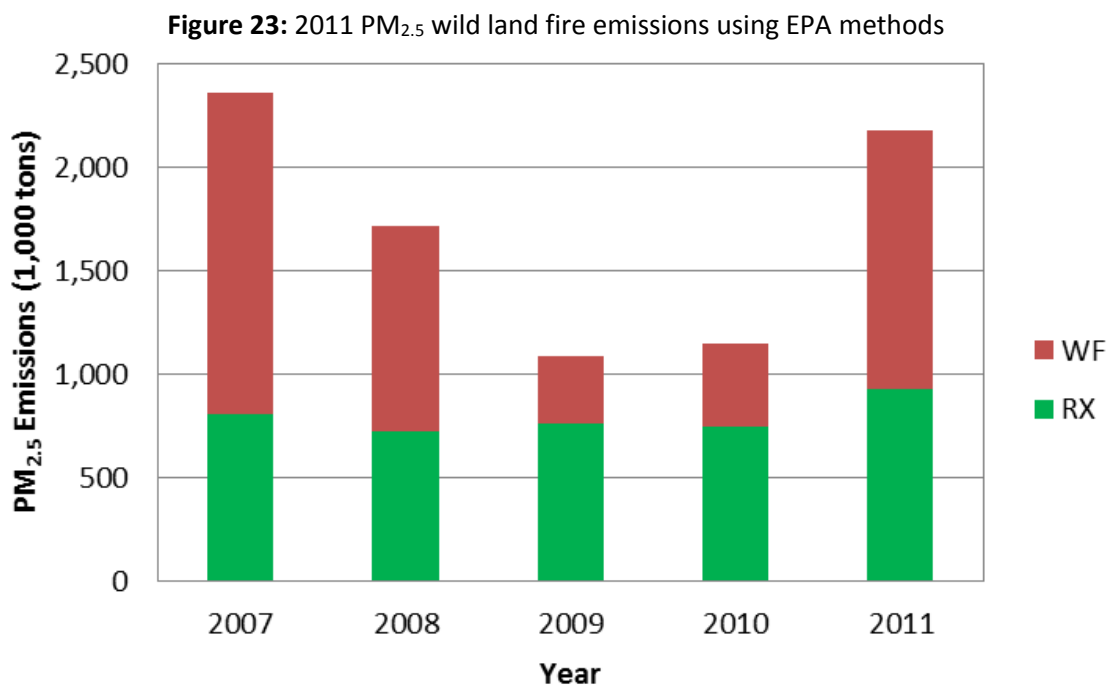
### 5.1.5 Summary of quality assurance methods

- WLFs' 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. 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 was 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 by 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.
- We created, as an example, a difference map for PM<sub>2.5</sub> emissions, in which we took the difference on a county by county basis of total (all sector) PM<sub>2.5</sub> emissions density (per square mile) in the 2011 NEI to PM<sub>2.5</sub> emissions density without wild and prescribed fire PM<sub>2.5</sub> emissions. The resulting density difference map highlights those counties in which these large fires dominate the PM<sub>2.5</sub> emissions load. That difference map is shown below in Figure 22. The areas identified in this map align well with known areas of very high fire activity in 2011.

**Figure 22:** Difference map of PM<sub>2.5</sub> Emissions, with and without large fires



- As shown in Figure 23 below, we compared total mass of 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<sub>2.5</sub> 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<sub>2.5</sub> 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.



### 5.1.6 References for Wildfires and Prescribed burning

- Reid, S.B., Technical Memorandum, Sonoma Technology, Inc., Preparation of Version 2 of the Wildland Fire Emissions Inventory for 2011, April 26, 2013.
- 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.
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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 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 below. 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 144. These other SCCs have more specific details about the type of crop burned.

**Table 144:** Source Classification Codes 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<sub>x</sub>, SO<sub>2</sub>, CO, PM<sub>2.5</sub>, CO<sub>2</sub> and methane because we had emission factors available for these. The CO<sub>2</sub> and methane emissions were not included in the final 2011 NEI, but are available upon request. Table 145 lists the state and tribal agencies that submitted agricultural fire emissions.



**Table 145:** Agencies that submitted agricultural fire emissions to the 2011 NEI

Agency	Agency Type
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
Kootenai Tribe of Idaho	Tribal
Louisiana Department of Environmental Quality	State
New Jersey Department of Environment Protection	State
Nez Perce Tribe	Tribal
Shoshone-Bannock Tribes of the Fort Hall Reservation of Idaho	Tribal
Washington State Department of Ecology	State
Coeur d'Alene Tribe of Idaho	Tribal
South Carolina Department of Health and Environmental Control	State
Oregon Department of Environmental Quality	State
Kansas Department of Health and Environment	State
Indiana Department of Environmental Management	State
Arizona Department of Environmental Quality	State

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 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 below 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 0, 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 146.

**Table 146:** 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 Table 12 for additional details.	2

<b>Dataset name (Short Name provided if different)</b>	<b>Description and Rationale for the Order of the Selected Datasets</b>	<b>Order</b>
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 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 data in order that the S/L/T agency HAP data are used first.	4
2011EPA_NP_NoOverla p_w_Pt (2011EPA_NP_NoOvr p)	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<sub>3</sub> were estimated with EPA methods. Table 147 summarizes these CAP estimates by state. For example, total PM<sub>2.5</sub> 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 147: 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
<b>Totals:</b>	<b>1,556,997.1</b>	<b>68,107.1</b>	<b>29,917.6</b>	<b>148,515.8</b>	<b>247,668.0</b>	<b>116,307.5</b>

As an example of data contained in the 2011 NEI for this sector, the PM<sub>2.5</sub> emissions data in Table 147 are combined (using the hierarchy discussed earlier) with the S/L agency submissions (excluding tribal) shown in Table 145 and summarized in Figure 24 below. For this sector, the states in the upper Midwest (Minnesota, North Dakota, South Dakota, and Kansas) as well as Louisiana and Arkansas all show high levels of emissions compared to areas in the Northeast and Western US.

**Figure 24: 2011 NEI state-total PM<sub>2.5</sub> emissions from agricultural fires**

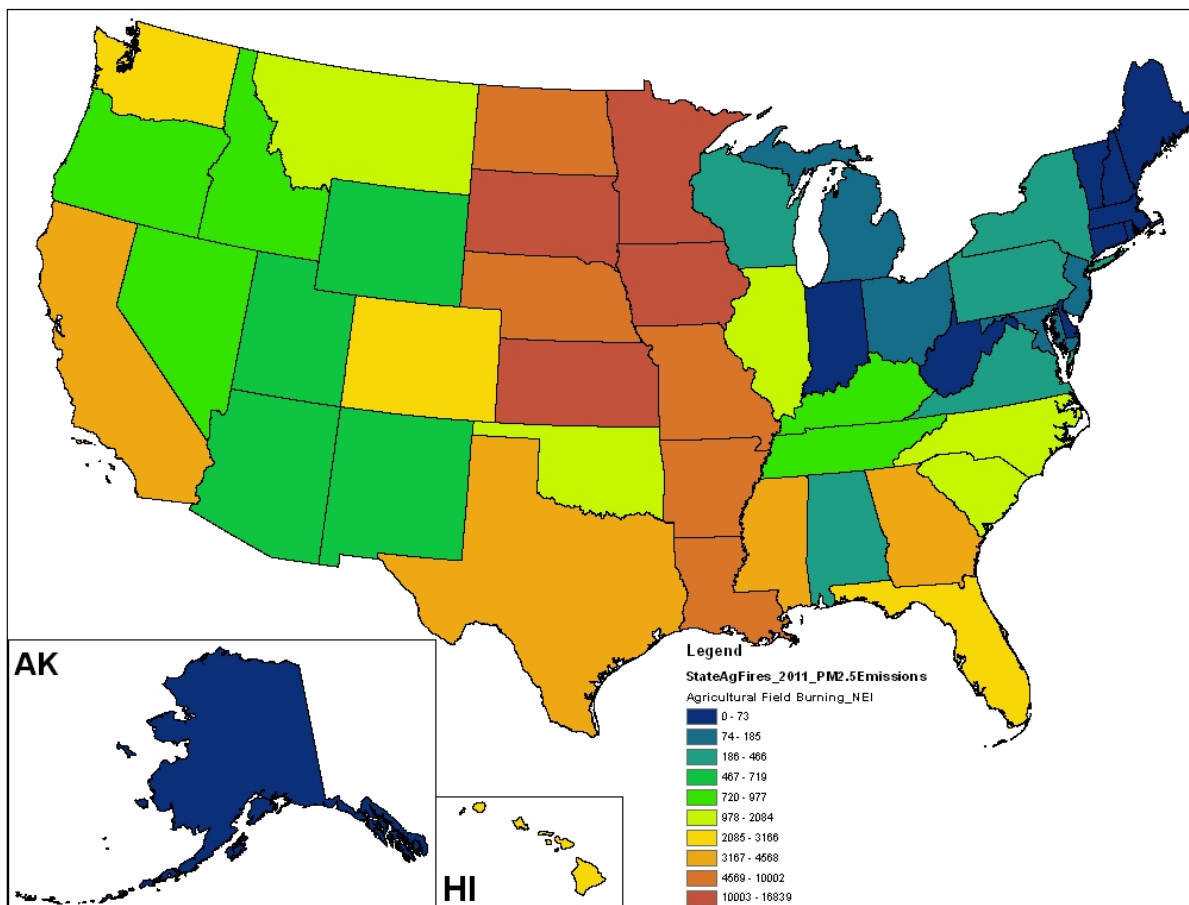
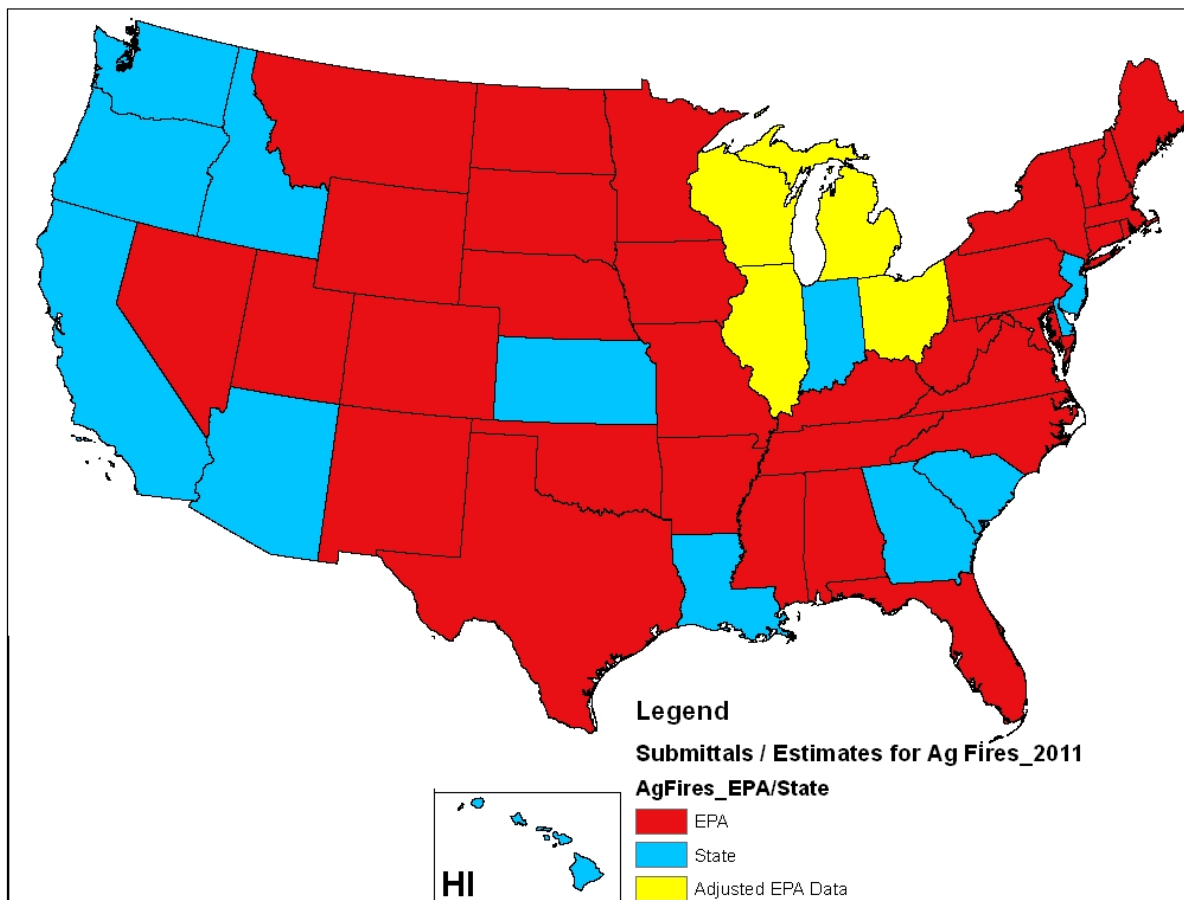


Figure 25 below shows states that submitted agricultural burning data to the NEI, corresponding to the list shown in Table 145. States in blue submitted some data to the NEI for this sector, while states in red submitted none and were reliant on emission estimates based on EPA methods. For the states in yellow (all LADCO states, except for MN), 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. 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 25:** 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.

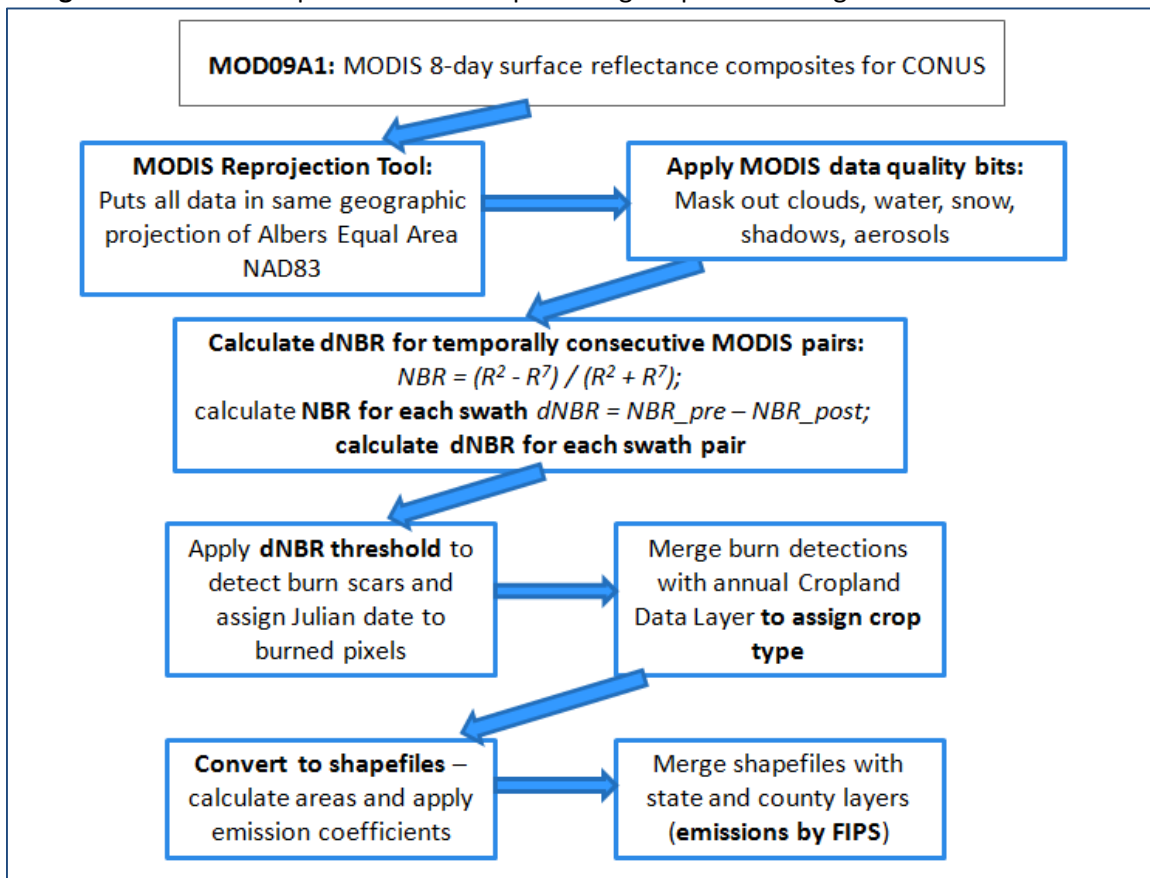
**Burned Area:** A differenced Normalized Burned Ratio (dNBR) was used to map potential cropland burned area using 500 m MOD09A1 8-day surface reflectance of the MODIS. This method was published in McCarthy et al. [ref 1] with results published in McCarthy et al. [ref 3] and McCarthy [ref 4]. This product represents a weekly product, not a daily product. For the 2011 version, 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 (<http://earthdata.nasa.gov/data/nrt-data/firms/active-fire-data>) 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. Information and data can be found here at <http://nassgeodata.gmu.edu/CropScape/>. Users of these emission estimates should note that Conservation Reserve Program (CRP: <http://www.fsa.usda.gov/FSA/webapp?area=home&subject=copr&topic=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 provided by Dr. Tesh Rao at the U.S. EPA. With the aid of a flow diagram, Figure 26 shows the overall geospatial method for producing the remote sensing-based cropland emission estimates.

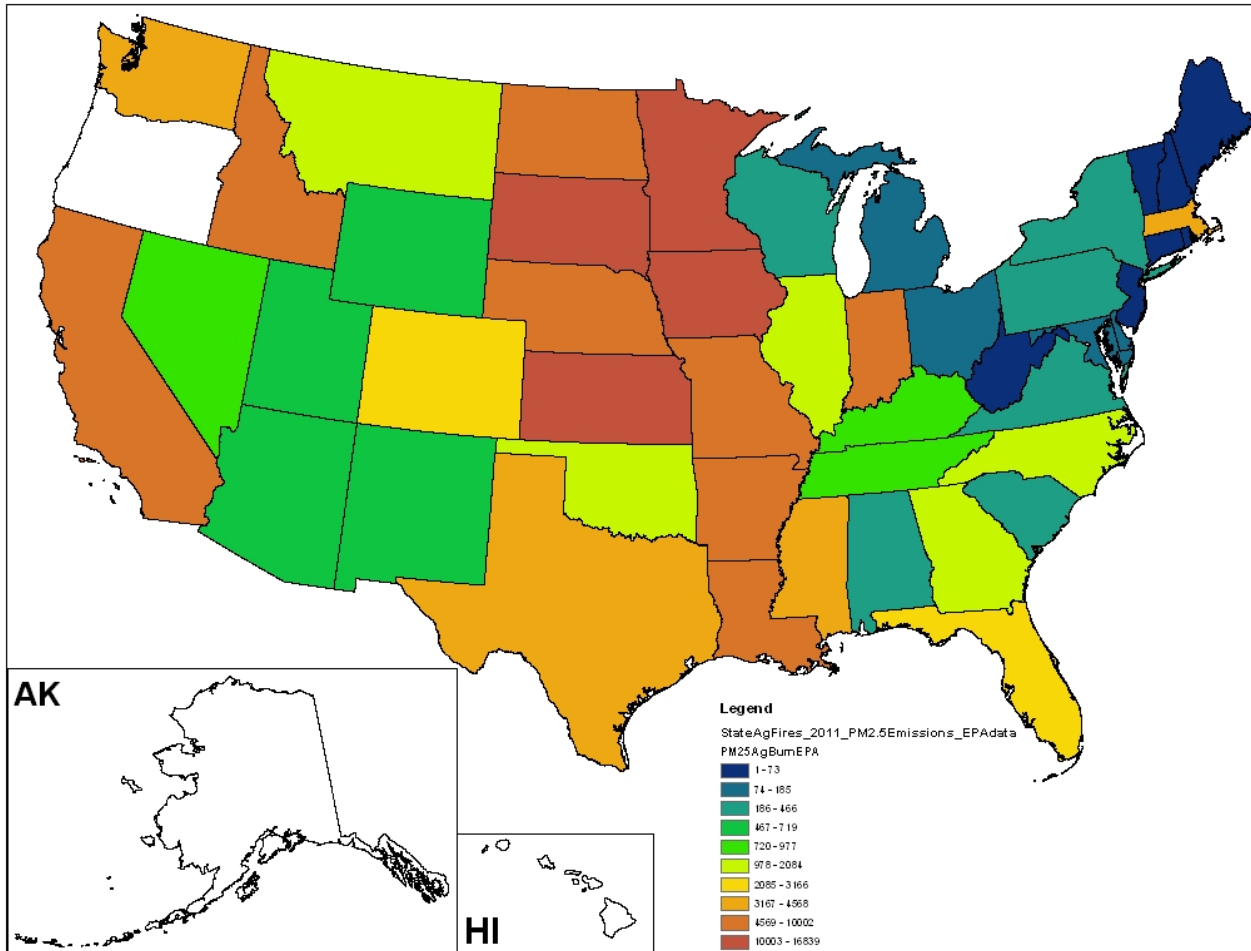
**Figure 26:** EPA’s Geospatial method for producing Cropland Burning Emissions for 2011 NEI



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 (<http://www.exelisvis.com/>), the MODIS Reprojection Tool (MRT: [https://lpdaac.usgs.gov/tools/modis\\_reprojection\\_tool](https://lpdaac.usgs.gov/tools/modis_reprojection_tool)), and Arc Python within ESRI ArcGIS (<http://resources.arcgis.com/en/communities/python/>).

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, and Ohio) based on the emission estimates submitted by the State of Indiana. In comparing the Indiana estimates to EPA estimates, it was discovered that the EPA estimates were unrealistically high, and information from local agencies in the Indiana vicinity (LADCO report, Private communication with Region 5 emissions inventory staff) indicated that EPA estimates are likely too high. Because we only received state-submissions from Indiana, a ratio of the state submitted emissions for Indiana to the estimates developed by EPA were applied to the other states listed above. For MN, we had confirmation from Minnesota staff that EPA-based estimates were accurate so we did not alter those emissions. This ratio approach led to a reduction of between 90-96% of emissions for Wisconsin, Michigan, Ohio, and Illinois. These changes are reflected in the results shown in Table 147 and in Figure 24. Figure 27 below shows the resulting PM<sub>2.5</sub> emissions for the lower 48 states based on these EPA methods (it can be compared to Figure 24 which is a combination of EPA results and state submitted data).

**Figure 27: PM<sub>2.5</sub> 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 145.

### 5.2.5 Summary of quality assurance methods

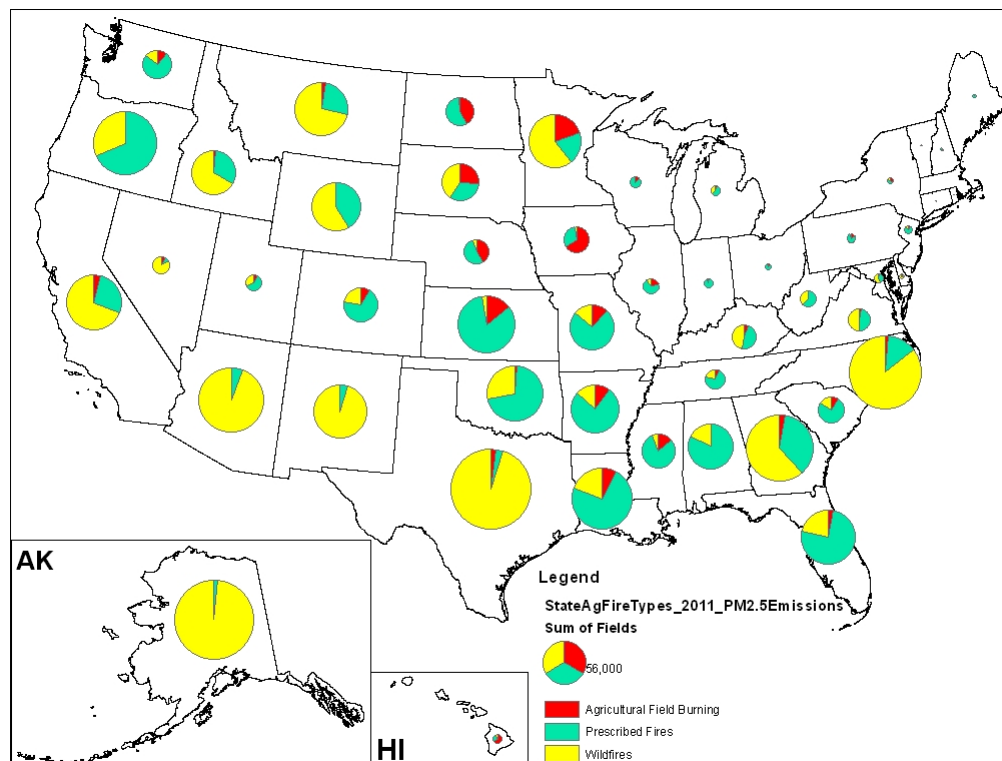
- We compared EPA estimates to State submitted estimates, and discovered discrepancies in the midwestern States, where EPA emission estimates were too high. A report by LADCO [ref 2] provided additional corroboration that EPA estimates may be too high for some of these states. We corrected by applying 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 145), 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 SLTs submitted too many different SCCs (see Table 144) 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 28 below shows the percentage of PM<sub>2.5</sub> 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 28 confirms this. Further, the figure shows the highest emissions in states known to have significant cropland burning activity.

**Figure 28:** Comparison of percentage of PM<sub>2.5</sub> emissions assigned to agricultural, prescribed and wild fires



### 5.2.6 References for Agricultural Burning

1. McCarty, J.L., Loboda, T., Trigg, S., 2008. A hybrid approach to quantifying crop residue burning in the US based on burned area and active fire data. *Appl. Eng. Agric.* 24: 515-527.

2. Boyer, L, Battye, W., Fudge, S., and R. Barrows, 2004. Fire Emissions Inventory Development for the Midwest Regional Planning Organization, Final Report, EC/R Incorporated, available upon request.
3. McCarty, J.L., Korontzi, S., Jutice, C.O., and Loboda, T., 2009. The spatial and temporal distribution of crop residue burning in the contiguous United States. *Science of the Total Environment*. 407 (21): 5701-5712.
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6. Roy, D.P., Boschetti, L., Jutice, C.O., and Ju, J. 2008. The collection 5 MODIS burned area product - Global evaluation by comparison with the MODIS active fire product. *Remote Sensing of Environment*. 112: 3690-3707.
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## 6 Biogenics – Vegetation and Soil

Biogenic emission sources 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 148 lists the two SCCs used in the 2011 NEI that comprise this sector. These 2 SCCs have distinct pollutants: SCC 2701220000 has only NO<sub>x</sub> emissions, and SCC 2701200000 has emissions for CO, VOC and 3 VOC HAPs: formaldehyde, acetaldehyde and methanol.

**Table 148:** Source classification codes for Biogenics – Vegetation and Soil

Source Classification Code	EI Sector	SCC Level One	SCC Level Two	SCC Level Three	SCC Level Four	Tier 1 Description	Tier 2 Description	Tier 3 Description
2701200000	Biogenics - Vegetation and Soil	Natural Sources	Biogenic	Vegetation	Total	Natural Resources	Biogenic	Vegetation
2701220000	Biogenics - Vegetation and Soil	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 3.14 (BEIS3.14) model within SMOKE. The BEIS3.14 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<sub>x</sub>, methanol, formaldehyde and acetaldehyde. VOC is the sum of all other biogenic species except CO, NO, SESQ. Mapping of BEIS pollutants to NEI pollutants is as follows:

- NO maps to NO<sub>x</sub>
- FORM maps to formaldehyde;
- ALD2 maps to acetaldehyde;
- MEOH maps to methanol;
- VOC is the sum of all other biogenic species except CO, NO, SESQ.

The BEIS3.14 model is described further in:

[http://www.cmascenter.org/conference/2011/slides/pouliot\\_tale\\_two\\_cmas08.ppt](http://www.cmascenter.org/conference/2011/slides/pouliot_tale_two_cmas08.ppt)

The inputs to BEIS include:

- Temperature data at 2 meters which were obtained from the WRF input files to the air quality model,
- Land-use data from the Biogenic Emissions Land use Database, version 3 (BELD3). BELD3 data provides data on the 230 vegetation classes at 1-km resolution over most of North America. These data are available at <http://www.epa.gov/ttnchie1/emch/biogenic/>.

## 6.2 Sources of data overview and selection hierarchy

The only source of data for this sector is the EPA-estimated emissions from BEIS3.14. States are neither required nor encouraged to report emissions, and no state has done this. The name of the EPA dataset in 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 is available at <http://www.epa.gov/ttn/chief/emch/index.html#2011>.

Table 149 shows state emissions summaries for the biogenic emissions sector and the contribution of biogenics to the total inventory 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<sub>x</sub>.

More detailed summaries of the BEIS model species at county level and monthly are available as a supporting summary on the 2011 web page ([ftp://ftp.epa.gov/EmisInventory/2011/2011\\_biogenic\\_reports.zip](ftp://ftp.epa.gov/EmisInventory/2011/2011_biogenic_reports.zip)).

**Table 149: State Summary of Biogenics – Vegetation and Soil Emissions (short tons/year)**

State	formaldehyde		methanol		acetaldehyde		CO		NO <sub>x</sub>		VOC	
	biogenics (tons)	percent of total	biogenics (tons)	percent of total	biogenics (tons)	percent of total	biogenics (tons)	percent of total	biogenics (tons)	percent of total	biogenics (tons)	percent of total
AL	24,601	69%	89,095	91%	18,040	86%	172,499	10%	11,415	3%	1,682,519	82%
AR	22,490	67%	82,504	95%	16,492	85%	157,639	10%	19,060	8%	1,303,104	80%
AZ	51,351	75%	221,217	98%	37,656	92%	359,527	13%	18,596	7%	1,769,969	78%
CA	56,359	70%	203,816	98%	41,329	84%	394,658	9%	36,558	5%	2,552,499	75%
CO	21,814	74%	79,259	95%	15,996	87%	152,726	10%	26,089	8%	841,461	63%
CT	1,073	53%	2,733	56%	787	59%	7,524	2%	456	1%	48,071	37%
DC	21	16%	79	18%	16	20%	149	0%	16	0%	1,346	14%
DE	528	62%	2,005	87%	387	70%	3,703	2%	794	2%	27,737	51%
FL	32,733	64%	127,019	90%	24,004	82%	229,319	5%	33,994	5%	1,703,874	67%

State	formaldehyde		methanol		acetaldehyde		CO		NO <sub>x</sub>		VOC	
	biogenics (tons)	percent of total	biogenics (tons)	percent of total	biogenics (tons)	percent of total	biogenics (tons)	percent of total	biogenics (tons)	percent of total	biogenics (tons)	percent of total
GA	30,130	62%	119,535	91%	22,095	82%	211,210	7%	18,304	4%	2,026,130	83%
IA	10,626	62%	43,198	96%	7,793	72%	74,456	8%	32,994	13%	337,518	64%
ID	23,908	76%	60,715	98%	17,532	91%	167,368	13%	11,754	11%	864,610	77%
IL	12,870	73%	52,826	87%	9,438	80%	90,196	5%	34,905	6%	479,020	56%
IN	8,216	75%	31,374	88%	6,025	79%	57,602	4%	20,063	5%	316,079	54%
KS	22,242	54%	101,091	98%	16,310	78%	155,758	9%	55,495	15%	599,015	57%
KY	11,407	71%	40,322	89%	8,365	84%	80,038	7%	14,783	4%	561,513	68%
LA	22,042	58%	85,431	90%	16,164	80%	154,508	6%	18,031	3%	1,314,747	66%
MA	1,657	49%	4,269	98%	1,215	56%	11,618	1%	939	1%	77,172	34%
MD	2,679	63%	9,166	85%	1,965	62%	18,788	2%	2,822	2%	150,670	54%
ME	9,778	92%	16,540	91%	7,170	93%	68,496	19%	1,943	3%	328,860	84%
MI	12,616	70%	35,615	79%	9,252	75%	88,430	4%	13,932	3%	546,264	55%
MN	16,616	50%	49,585	93%	12,185	68%	116,455	5%	27,088	8%	770,780	61%
MO	19,816	62%	77,941	96%	14,531	79%	138,954	7%	28,311	6%	1,168,254	75%
MS	22,636	76%	82,927	94%	16,599	89%	158,705	15%	14,279	7%	1,485,664	85%
MT	32,663	77%	97,384	99%	23,952	92%	228,651	15%	42,065	26%	1,129,984	78%
NC	18,767	51%	66,914	88%	13,762	75%	131,579	3%	12,437	3%	1,113,082	59%
ND	9,929	65%	35,839	96%	7,281	78%	69,531	13%	32,938	18%	248,782	57%
NE	15,100	75%	63,927	98%	11,073	85%	105,745	16%	44,439	18%	449,183	79%
NH	2,358	80%	5,032	100%	1,729	83%	16,529	6%	459	1%	94,681	68%
NJ	2,025	52%	6,307	97%	1,485	60%	14,199	1%	1,539	1%	125,687	41%
NM	39,351	76%	173,337	99%	28,857	92%	275,468	17%	28,739	12%	1,295,424	75%
NV	27,862	93%	114,094	99%	20,432	97%	195,033	28%	9,496	9%	882,412	91%
NY	9,801	68%	25,265	67%	7,187	74%	68,725	3%	7,597	2%	339,306	45%
OH	8,649	66%	30,887	81%	6,343	70%	60,660	2%	16,475	3%	314,846	44%
OK	24,890	59%	106,566	96%	18,253	84%	174,382	9%	40,464	9%	1,079,843	63%
OR	29,794	67%	69,906	95%	21,849	87%	208,584	9%	11,130	7%	1,086,280	69%
PA	9,423	64%	27,132	77%	6,910	74%	66,103	3%	8,244	1%	432,095	53%
RI	242	49%	626	50%	178	57%	1,698	1%	144	1%	12,358	36%
SC	14,251	76%	54,251	89%	10,450	86%	99,897	9%	8,872	4%	941,035	81%
SD	13,642	66%	55,153	99%	10,004	81%	95,535	12%	36,640	34%	428,859	74%
TN	13,879	79%	49,347	90%	10,178	86%	97,371	8%	12,929	4%	838,457	76%
TX	130,744	80%	602,237	97%	95,877	92%	915,571	14%	199,169	13%	4,252,162	66%
UT	20,528	92%	79,541	98%	15,054	96%	143,712	19%	8,527	4%	692,038	74%
VA	12,427	71%	41,680	88%	9,113	82%	87,151	6%	7,931	2%	761,044	72%
VT	2,378	84%	5,120	93%	1,744	86%	16,672	9%	1,001	5%	77,837	73%
WA	20,886	77%	41,336	89%	15,316	86%	146,219	8%	12,109	4%	624,247	67%
WI	10,817	75%	35,435	87%	7,932	79%	75,831	5%	18,230	6%	493,604	64%
WV	5,837	74%	16,849	93%	4,280	87%	40,987	8%	2,791	2%	344,906	72%
WY	17,425	68%	63,285	99%	12,778	88%	121,982	10%	10,704	5%	638,249	68%

## **7 Quality assessment**

[This section will be included in future versions of this documentation]

- 7.1 What are the quality criteria used to assess the inventory?**
- 7.2 How did the 2011 NEI compare to the quality criteria?**
- 7.3 What EIS sectors seem to be incomplete and for which key pollutants?**
- 7.4 How can the quality of the emissions data be further evaluated by users?**
- 7.5 What improvements in the NEI and EIS submission process are planned for the future?**

## 8 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 at:

<ftp://ftp.epa.gov/EmisInventory/2011/doc/>

or, on the 2011 webpage:

<http://www.epa.gov/ttn/chief/net/2011inventory.html>