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<td>Air Emissions Reporting Rule</td>
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<tr>
<td>APU</td>
<td>Auxiliary power unit</td>
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<td>BEIS</td>
<td>Biogenics Emissions Inventory System</td>
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<td>C1</td>
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<td>CAMD</td>
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<tr>
<td>CAP</td>
<td>Criteria Air Pollutant</td>
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<tr>
<td>CBM</td>
<td>Coal bed methane</td>
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<td>CDL</td>
<td>Cropland Data Layer</td>
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<td>CEC</td>
<td>North American Commission for Environmental Cooperation</td>
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<td>CEM</td>
<td>Continuous Emissions Monitoring</td>
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<td>Carnegie Mellon University</td>
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<td>CMV</td>
<td>Commercial marine vessels</td>
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<td>CNG</td>
<td>Compressed natural gas</td>
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<td>CO</td>
<td>Carbon monoxide</td>
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<td>CO2</td>
<td>Carbon dioxide</td>
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<td>CSV</td>
<td>Comma Separated Variable</td>
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<tr>
<td>dNBR</td>
<td>Differenced normalized burned ratio</td>
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<tr>
<td>E10</td>
<td>10% ethanol gasoline</td>
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<td>EDMS</td>
<td>Emissions and Dispersion Modeling System</td>
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<td>EF</td>
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<td>Electric arc furnace</td>
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GHG    Greenhouse gas
GIS    Geographic information systems
GPA    Geographic phase-in area
GSE    Ground support equipment
HAP    Hazardous Air Pollutant
HCl    Hydrogen chloride (hydrochloric acid)
Hg     Mercury
HMS    Hazard Mapping System
ICR    Information collection request
I/M    Inspection and maintenance
IPM    Integrated Planning Model
KMZ    Keyhole Markup Language, zipped (used for displaying data in Google Earth
LRTAP  Long-range Transboundary Air Pollution
LTO    Landing and takeoff
LPG    Liquified Petroleum Gas
MARAMA Mid-Atlantic Regional Air Management Association
MATS   Mercury and Air Toxics Standards
MCIP   Meteorology-Chemistry Interface Processor
MMT    Manure management train
MOBILE6 Mobile Source Emission Factor Model, version 6
MODIS  Moderate Resolution Imaging Spectroradiometer
MOVES  Motor Vehicle Emissions Simulator
MW     Megawatts
MWC    Municipal waste combustors
NAA    Nonattainment area
NAAQS  National Ambient Air Quality Standards
NAICS  North American Industry Classification System
NARAP  North American Regional Action Plan
NASF   National Association of State Foresters
NASS   USDA National Agriculture Statistical Service
NATA   National Air Toxics Assessment
NCD    National County Database
NEEDS  National Electric Energy Data System (database)
NEI    National Emissions Inventory
NESCAUM Northeast States for Coordinated Air Use Management
NFEI   National Fire Emissions Inventory
NG     Natural gas
NH₃    Ammonia
NMIM   National Mobile Inventory Model
NO     Nitrous oxide
NO₂    Nitrogen dioxide
NOAA   National Oceanic and Atmospheric Administration
NOₓ    Nitrogen oxides
O₃     Ozone
OAQPS  Office of Air Quality Standards and Planning (of EPA)
OEI    Office of Environmental Information (of EPA)
<table>
<thead>
<tr>
<th>Acronym</th>
<th>Definition</th>
</tr>
</thead>
<tbody>
<tr>
<td>ORIS</td>
<td>Office of Regulatory Information Systems</td>
</tr>
<tr>
<td>OTAQ</td>
<td>Office of Transportation and Air Quality (of EPA)</td>
</tr>
<tr>
<td>PADD</td>
<td>Petroleum Administration for Defense Districts</td>
</tr>
<tr>
<td>PAH</td>
<td>Polycyclic aromatic hydrocarbons</td>
</tr>
<tr>
<td>Pb</td>
<td>Lead</td>
</tr>
<tr>
<td>PCB</td>
<td>Polychlorinated biphenyl</td>
</tr>
<tr>
<td>PM</td>
<td>Particulate matter</td>
</tr>
<tr>
<td>PM25-CON</td>
<td>Condensable PM$_{2.5}$</td>
</tr>
<tr>
<td>PM25-FIL</td>
<td>Filterable PM$_{2.5}$</td>
</tr>
<tr>
<td>PM25-PRI</td>
<td>Primary PM$_{2.5}$ (condensable plus filterable)</td>
</tr>
<tr>
<td>PM$_{2.5}$</td>
<td>Particulate matter 2.5 microns or less in diameter</td>
</tr>
<tr>
<td>PM$_{10}$</td>
<td>Particulate matter 10 microns or less in diameter</td>
</tr>
<tr>
<td>PM10-FIL</td>
<td>Filterable PM$_{10}$</td>
</tr>
<tr>
<td>PM10-PRI</td>
<td>Primary PM$_{10}$</td>
</tr>
<tr>
<td>POM</td>
<td>Polycyclic organic matter</td>
</tr>
<tr>
<td>POTW</td>
<td>Publicly Owned Treatment Works</td>
</tr>
<tr>
<td>PSC</td>
<td>Program system code (in EIS)</td>
</tr>
<tr>
<td>RFG</td>
<td>Reformulated gasoline</td>
</tr>
<tr>
<td>RPD</td>
<td>Rate per distance</td>
</tr>
<tr>
<td>RPP</td>
<td>Rate per profile</td>
</tr>
<tr>
<td>RPV</td>
<td>Rate per vehicle</td>
</tr>
<tr>
<td>RVP</td>
<td>Reid Vapor Pressure</td>
</tr>
<tr>
<td>Rx</td>
<td>Prescribed (fire)</td>
</tr>
<tr>
<td>SCC</td>
<td>Source classification code</td>
</tr>
<tr>
<td>SEDS</td>
<td>State Energy Data System</td>
</tr>
<tr>
<td>SFv1</td>
<td>SMARTFIRE version 1</td>
</tr>
<tr>
<td>SFv2</td>
<td>SMARTFIRE version 2</td>
</tr>
<tr>
<td>S/L/T</td>
<td>State, local, and tribal (agencies)</td>
</tr>
<tr>
<td>SMARTFIRE</td>
<td>Satellite Mapping Automated Reanalysis Tool for Fire Incident Reconciliation</td>
</tr>
<tr>
<td>SMOKE</td>
<td>Sparse Matrix Operator Kernel Emissions</td>
</tr>
<tr>
<td>SO$_2$</td>
<td>Sulfur dioxide</td>
</tr>
<tr>
<td>SO$_4$</td>
<td>Sulfate</td>
</tr>
<tr>
<td>TAF</td>
<td>Terminal Area Forecasts</td>
</tr>
<tr>
<td>TEISS</td>
<td>Tribal Emissions Inventory Software Solution</td>
</tr>
<tr>
<td>TRI</td>
<td>Toxics Release Inventory</td>
</tr>
<tr>
<td>UNEP</td>
<td>United Nations Environment Programme</td>
</tr>
<tr>
<td>USDA</td>
<td>United States Department of Agriculture</td>
</tr>
<tr>
<td>VMT</td>
<td>Vehicle miles traveled</td>
</tr>
<tr>
<td>VOC</td>
<td>Volatile organic compounds</td>
</tr>
<tr>
<td>USFS</td>
<td>United States Forest Service</td>
</tr>
<tr>
<td>WebFIRE</td>
<td>Factor Information Retrieval System</td>
</tr>
<tr>
<td>WFU</td>
<td>Wildland fire use</td>
</tr>
<tr>
<td>WLF</td>
<td>Wildland fire</td>
</tr>
<tr>
<td>WRAP</td>
<td>Western Regional Air Partnership</td>
</tr>
<tr>
<td>WRF</td>
<td>Weather Research and Forecasting Model</td>
</tr>
</tbody>
</table>
1 Introduction

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

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

The pollutants included in the NEI are the pollutants associated with the National Ambient Air Quality Standards (NAAQS), known as criteria air pollutants (CAPs), as well as hazardous air pollutants (HAPs) associated with EPA’s Air Toxics Program. The CAPs have ambient concentration limits or are precursors for pollutants with such limits from the NAAQS program. These pollutants include lead (Pb), carbon monoxide (CO), nitrogen oxides (NOx), volatile organic compounds (VOC), sulfur dioxide (SO2), particulate matter 10 microns or less (PM10), particulate matter 2.5 microns or less (PM2.5) and ammonia (NH3), technically not a CAP, but an important PM precursor. The HAP pollutants include the 187 remaining HAP pollutants (hydrogen sulfide was removed) from the original 188 listed in Section 112(b) of the 1990 Clean Air Act Amendments1. Key HAP emissions sources include mercury (Hg), hydrochloric acid (HCl) and other acid gases, heavy metals such as nickel and cadmium, and hazardous organic compounds such as benzene, formaldehyde, and acetaldehyde.

1.2 What is included in this documentation?

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

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

1 The current list of HAPs is available at [http://www.epa.gov/ttn/atw/188polls.html](http://www.epa.gov/ttn/atw/188polls.html).
1.3 Where can I obtain the 2011 v2 NEI data?

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

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 v2 NEI in the EIS is called “2011 NEI V2”. Note that if you run facility, unit or process level reports in the EIS, you will get the 2011 v2 emissions, but the facility inventory, which is dynamic in the EIS, will reflect more current information. For example, if an Agency ID has been changed since the time we ran the reports for the public website (March 2015), then that new Agency ID will be in the Facility Inventory or a Facility Configuration report in the EIS but not in the report on the public website nor the Facility Emissions Summary reports run on the “2011 NEI V2” in the EIS.

1.3.2 2011 NEI main webpage

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”

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

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

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

1.3.4 Modeling files

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

1.4 Why is the NEI created?

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

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

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

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

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

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

<table>
<thead>
<tr>
<th>Pollutant</th>
<th>2011 NEI thresholds: potential to emit (tons/yr)</th>
<th>NAA sources(^1)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Everywhere (Type B sources)</td>
<td>NAA sources</td>
</tr>
<tr>
<td>1 SO(_2)</td>
<td>≥ 100</td>
<td>≥ 100</td>
</tr>
<tr>
<td>2 VOC</td>
<td>≥ 100</td>
<td>O(_3) (moderate) ≥ 100</td>
</tr>
<tr>
<td>3 VOC</td>
<td></td>
<td>O(_3) (serious) ≥ 50</td>
</tr>
<tr>
<td>4 VOC</td>
<td></td>
<td>O(_3) (severe) ≥ 25</td>
</tr>
<tr>
<td>5 VOC</td>
<td></td>
<td>O(_3) (extreme) ≥ 10</td>
</tr>
<tr>
<td>6 NO(_X)</td>
<td>≥ 100</td>
<td>≥ 100</td>
</tr>
<tr>
<td>7 CO</td>
<td>≥ 1000</td>
<td>O(_3) (all areas) ≥ 100</td>
</tr>
<tr>
<td>8 CO</td>
<td></td>
<td>CO (all areas) ≥ 100</td>
</tr>
<tr>
<td>9 Pb</td>
<td>≥ 5</td>
<td>≥ 5</td>
</tr>
<tr>
<td>10 PM(_{10})</td>
<td>≥ 100</td>
<td>PM(_{10}) (moderate) ≥ 100</td>
</tr>
<tr>
<td>11 PM(_{10})</td>
<td></td>
<td>PM(_{10}) (serious) ≥ 70</td>
</tr>
<tr>
<td>12 PM(_{2.5})</td>
<td>≥ 100</td>
<td>≥ 100</td>
</tr>
<tr>
<td>13 NH(_3)</td>
<td>≥ 100</td>
<td>≥ 100</td>
</tr>
</tbody>
</table>

\(^1\) NAA = Nonattainment Area. Special point source reporting thresholds apply for certain pollutants by type of nonattainment area. The pollutants by nonattainment area are: Ozone: VOC, NO\(_X\), CO; CO; PM\(_{10}\): PM\(_{10}\)

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

1.5.1 NEI 2011 v2 point source updates

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

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

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

A. S/L/T air agencies

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

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

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

A set of emissions modeling platform files based on the 2011 v1 was made available for public review and comment in early 2014. Twenty-seven comment letters were received as a result that resulted in edits being made to either the EIS facility inventory or the v1 emissions values. Many of these comments were from companies or facilities that operated electric generating units, although a few were from the State air agencies who also had access to the EIS data system and its submittal and edit processes. The most significant comment was to add PM-Condensible emissions values (and therefore to increase PM2.5-Primary and PM10-Primary emissions values) at eight coal-fired electric power plants located in Pennsylvania. Other comments were to some of the HAP emissions values for 3 power plants located in New Jersey, to add or revise the unit IDs used by the IPM model for electric generating units, to revise generating unit design capacities, and edits to release
One comment was received from a regional modeling center suggesting that stack parameters from their 2007-based modeling platform should be used in the EPA 2011 platform. The 2007-based files were accessed and compared and evaluated against the 2011 facility inventory coordinates and release point parameters, for the instances where this could be done based on common State identifiers between the two. Where significant differences in release point coordinates or parameters were identified and where the EIS facility inventory data (reported by the same State air agencies as the 2007 platform but at a later date) were also found to be highly suspect, edits were made to the EIS facility inventory. As part of this review it was noted that one State had significantly modified the EIS facility inventory for their sources by re-routing many combustion emission processes to fugitive emission release points, despite the fact that stack release points were already available in EIS and had been used previously for these same emission processes. A subset of these anomalies that could be individually reviewed were therefore reset such that the largest combustion processes were routed to the earlier-used stack release points.

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

C. NATA 2011 reviewers

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

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

D. EPA/OAQPS initiated reviews and updates

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

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

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

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

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

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

6. A revised table of factors for splitting total chromium emissions values into chromium VI and chromium III values by SCC was received and applied to the 2011 data in May 2014 for use in v2. This work was done outside of the EIS data system and did not use the EIS function for chromium speciation, because the EIS factor table has not been updated. The impacts due to the revised factors were negligible, but one large chromium emitting process in Ohio was noticed as a consequence of re-running these splits. The chromium values for this one process were confirmed to be erroneous and were tagged out so as not to be used in v2.
7. An internal EPA review of facilities appearing on the preliminary NATA list of highest risk sources in November 2013 was done to identify anomalies. Part of this review focused on landfills where EPA was the source of the emissions values, because the location data for many of these landfills was potentially using a county centroid value. Locational data and some stack parameter edits were made to a small number of these preliminary high-risk facilities as a result of this review.

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

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

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

11. Approximately 1200 IPM unique IDs from the NEEDs v5.13 draft file were added to the EIS emission units. July 2014. Approximately 200 of the IPM ids previously existing in the EIS were revised so that they match exactly to those seen in NEEDs. These revisions will facilitate future checks and updating to revisions to the NEEDs file, although the previous non-matching IPM ID in the EIS were still being separated out to the PTIPM modeling file as intended. Approximately 300 CAMD CEM IDs were also added to EIS units. These units allow the hourly CEM emissions values to be used in modeling applications. The 300 additions were for very small annual emitters however, as earlier work had focused on having all CEM IDs for the larger SO2 and NOx sources matched.

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

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

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

1.5.2 NEI 2011 v2 nonpoint source updates

There were many changes in the nonpoint data category between 2011 v1 and 2011 v2 of the NEI; highlights are given here. As oil and gas was a large focus for the 2011 NEI, EPA continued to make improvements to the EPA Nonpoint Oil and Gas Emissions Estimation Tool (ftp://ftp.epa.gov/EmisInventory/2011nei/doc/Tool_and_Report112614.zip) for 2011 v2. Some of the more significant efforts included 1) better aligning the inputs and emission factors between the EPA’s Office of Atmospheric Program (OAP) work on the Greenhouse Gas (GHG) Emissions Inventory (EI) / GHG Reporting Program and the NEI on condensate tanks, liquids unloading, pneumatic devices and well completions, 2) additional information from the Western Regional Air Partnership (WRAP) based on new survey data and studies, 3) improved resolution of data (to county level rather than basin), and 4) new SCCs, including the distinction between Coal Bed Methane (CBM) wells from other natural gas (NG) wells. Furthermore, some states, including CO, WV, OK, TX, and WY made improvements to their oil and gas submissions in this time period, and these emissions were included in 2011 v2.

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

1.5.3 NEI 2011 v2 mobile source updates

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

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

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

1.5.4 NEI 2011 v2 fires updates

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

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

1.6 Who are the target audiences for the 2011 NEI?

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

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

<table>
<thead>
<tr>
<th>Audience</th>
<th>Purposes</th>
<th>Last NEI data used</th>
</tr>
</thead>
<tbody>
<tr>
<td>U.S. Public</td>
<td>Learn about sources of air emissions</td>
<td>2011 v2</td>
</tr>
<tr>
<td>EPA – NAAQS</td>
<td>Regulatory Impact Analysis – benefits estimates using air quality modeling</td>
<td>Modified 2005 v2, for PM NAAQS Proposal, Modified 2008 v2, for PM NAAQS Final 2011 v1 for Ozone NAAQS Proposal</td>
</tr>
<tr>
<td></td>
<td>PM and SO₂ NAAQS Implementation</td>
<td>2011 v1</td>
</tr>
<tr>
<td></td>
<td>SO₂ NAAQS Monitoring Implementation - Population Weighted Emissions Index</td>
<td>2008 v3 with some 2009 data</td>
</tr>
<tr>
<td></td>
<td>Pb Monitoring Rule</td>
<td>2005 v2</td>
</tr>
<tr>
<td></td>
<td>Pb NAAQS final designations</td>
<td>2008 v3</td>
</tr>
<tr>
<td></td>
<td>Pb NAAQS Policy Assessment</td>
<td>Modified 2008 v3</td>
</tr>
<tr>
<td></td>
<td>Transport Rule air quality modeling (e.g., Clean Air Interstate Rule, Cross-State Air Pollution Rule)</td>
<td>2011 v2</td>
</tr>
<tr>
<td></td>
<td>State Implementation Plans – source of emissions data for regions outside of the state jurisdiction</td>
<td>2011 v2</td>
</tr>
<tr>
<td>EPA – Air toxics</td>
<td>National Air Toxics Assessment (NATA)</td>
<td>2011 v2</td>
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<tr>
<td></td>
<td>Residual Risk and Technology Review – starting point for inventory development</td>
<td>2011 v1</td>
</tr>
<tr>
<td>EPA - other</td>
<td>Inspector General – review of oil and gas industry</td>
<td>2008 v1.5</td>
</tr>
<tr>
<td>Audience</td>
<td>Purposes</td>
<td>Last NEI data used</td>
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<td>----------------------------------</td>
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</tr>
<tr>
<td>NEI Report – analysis of emissions inventory data</td>
<td><strong>NEI Report – analysis of emissions inventory data</strong></td>
<td>2011 v1</td>
</tr>
<tr>
<td>Air Emissions website for providing graphical access to CAP emissions for state maps and Google Earth views of facility total emissions</td>
<td><strong>Air Emissions website for providing graphical access to CAP emissions for state maps and Google Earth views of facility total emissions</strong></td>
<td>2011 v2</td>
</tr>
<tr>
<td>Department of Transportation, national transportation sector summaries of CAPs</td>
<td><strong>Department of Transportation, national transportation sector summaries of CAPs</strong></td>
<td>2008 v1.5</td>
</tr>
<tr>
<td>Black Carbon Report to Congress</td>
<td><strong>Black Carbon Report to Congress</strong></td>
<td>Modified 2005 v2</td>
</tr>
<tr>
<td>Other federal or regional agencies</td>
<td>Western Regional Air Partnership – modeling in support of Regional Haze SIPs and other air quality issues</td>
<td>Modified 2008 v2 (including different oil &amp; gas, fire and biogenic emissions)</td>
</tr>
<tr>
<td></td>
<td>United Nations Environment Programme (UNEP) – global mercury program</td>
<td>2008 v2</td>
</tr>
<tr>
<td>Other outside parties</td>
<td>Researchers and graduate students</td>
<td>2011 v2</td>
</tr>
</tbody>
</table>

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

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

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

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\(^2\) See [http://www.epa.gov/otaq/models/moves/index.htm](http://www.epa.gov/otaq/models/moves/index.htm)

\(^3\) See [http://www.epa.gov/otaq/m6.htm](http://www.epa.gov/otaq/m6.htm)
Other significant emissions sectors which have seen improvements and therefore inconsistent trend data through the years include paved and unpaved road PM emissions, animal waste ammonia emissions, oil and gas production, and residential wood combustion emissions. In addition, the 2011 NEI uses updated emissions factors (EFs) for several metal HAPs and acid gases from coal-fired utility boilers as well as EFs for PM based on site specific measurements for some units. These EFs were not incorporated in previous year inventories (however, all 2011 updated EFs except for PM$_{2.5}$ and HCN were used in the 2008 NEI) so trends may for these pollutants are influenced by method changes as well as actual reductions or increases in emissions.

**Outstanding Issues**

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

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

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

- There were several corrections provided for data augmented using the TRI. Comments mostly addressed chromium and other metals and in most cases, the emissions were found to be overestimated. Updated data were provided due to miscalculations by the reporting facility, or the use of a mid-point value which overestimated the actual emissions. In addition, for chromium, comments were received on the speciation into hexavalent and trivalent forms. In most cases, the speciation was changed to a higher percent (in some cases to 100%) of trivalent chromium based on product formulation or testing. Many SLT agencies revised their emissions due to corrections to emission factors, errors or because they had received updated data from their facilities for 2011. In most cases the revisions were emissions decreases, but in some cases emissions increased. In a few cases emissions were zeroed out (e.g., ethylene oxide from certain hospital sterilizers) because data that the state had carried forward from previous years was found to be no longer valid.
- Revised emissions based on facility and process-specific information were provided by SLT agencies to replace some HAPs augmented data SCC-specific emission factor ratios.
- Some HAPs were found to be inappropriately augmented via the emission factor ratio approach
  - Nickel from SCC 20300201 – emission factor units for PM and nickel were based on different throughput units (input versus output) hence nickel should not be augmented for this SCC
Ethylene dichloride from the following SCCs since this pollutant is associated with leaded gasoline which is no longer used other than in aviation fuel:
'40600136','40600144','40600301','40600302','40600306','40600402'

- Some HAPs augmented for oil and gas used default emission factor ratios applied to state-supplied VOC emission estimates; Uinta basin specific speciation data showed significantly lower HAP fractions than the default ratios used for the NEI.
2 2011 inventory contents overview

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

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

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

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

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

<table>
<thead>
<tr>
<th>Sector name</th>
<th>Point</th>
<th>Nonpoint</th>
<th>On-road</th>
<th>Nonroad</th>
<th>Event</th>
<th>Document Section</th>
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<tbody>
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<td>Agriculture - Crops &amp; Livestock Dust</td>
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<td>Bulk Gasoline Terminals</td>
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<td>Dust - Construction Dust</td>
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<td>Dust - Paved Road Dust</td>
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<td>Dust - Unpaved Road Dust</td>
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### Table 2-1: Sector Data Sources

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<th>Sector name</th>
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<th>Nonpoint</th>
<th>On-road</th>
<th>Nonroad</th>
<th>Event</th>
<th>Document Section</th>
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<td></td>
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</tr>
<tr>
<td>Mobile - On-road – Gasoline Heavy Duty Vehicles</td>
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<td></td>
<td>✔</td>
<td></td>
<td>4.6</td>
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<tr>
<td>Mobile - On-road – Gasoline Light Duty Vehicles</td>
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#### 2.2 What do the data show about the sources of data in the 2011 NEI?

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

Figure 2-1 shows the proportion of criteria pollutant emissions from various data sources in the NEI for point and nonpoint sources. For the nonpoint data in the figure (left 7 bars), most of the emissions come from EPA sources of data, with S/L/T agency data the majority for VOC and SO₂. The large “EPA Nonpoint” bar for PM₁₀ 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 PM₂.₅ with the EPA PM Augmentation dataset (“EPA PM Aug” in the figure, see Section 3.1.2. The data sources shown in the figure are described in more detail in Section 3.
Figure 2-1: Data sources for point and nonpoint emissions for criteria pollutants

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

1 Nonpoint emission shown here exclude biogenic sources, which are all EPA data
In Figure 2-3, the nonpoint acid gases are very small, with 4,400 tons from both S/L/T agencies and the EPA nonpoint dataset. For point sources, the bulk of the acid gases emissions (primarily HCl) comes from two EPA EGU datasets (73,000 tons) in addition to 45,000 tons from S/L/T agencies, while most of the HAP VOC emissions come from the S/L/T/ agency data (165,000 tons) and just 30,000 tons from TRI.
Figure 2-4 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 (250 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 (1,300 tons), with the rest from the EPA EGU dataset (800 tons), TRI (300 tons), and other EPA datasets (400 tons).

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

The figures below provide more detail about which states submitted data to the NEI for the stationary and mobile categories. In Sections 3 through 5, we explain more about what data 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 2-5 shows that all states submitted point source CAP emissions. All states except Utah, South Dakota and Alaska submitted point source HAP emissions (at least one HAP pollutant). Though not shown in the figure, Georgia submitted point HAPs only for airports and only a local agency in Nevada (not the state agency) 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 shown in Figure 2-5. Puerto Rico submitted point source CAP emissions for 2011. Virgin Islands did not emissions for any data category.

4 Though the Nevada Division of Environmental Protection does not submit HAPs to EIS, they do provide mercury emissions data to EPA for gold mines from their annual emissions reporting program (EPA NV Gold Mines dataset listed in Table 3-1)
Figure 2-6 shows the states and/or local agencies that submitted nonpoint emissions. Forty-two states submitted CAPs and thirty-four also submitted HAPs. Only eight states did not submit any nonpoint emissions, and at least some of these notified EPA that EPA’s estimates were acceptable for the source types that EPA estimated. Puerto Rico and Virgin Islands did not submit any nonpoint emissions. The state of Nevada did not submit nonpoint CAPs or HAPs, but the state is colored light blue because of local agency submittals in that state.

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

---

\(^5\) See “EMFAC Overview” link available at [http://www.arb.ca.gov/msei/onroad/background.htm](http://www.arb.ca.gov/msei/onroad/background.htm)
Figure 2-6: Nonpoint inventory – submission types – includes local agencies

Figure 2-7: On-road inventory – states/locals (dark blue) that submitted activity data
As seen in Figure 2-8, Texas and California are the only states for which state-submitted emissions are used in the NEI for the nonroad data category (i.e., nonroad equipment). Again, California has provided EPA CAP and HAP emissions based on a different model than the other states – the OFFROAD model\(^6\). Texas provided CAP and HAP emissions using the NONROAD model with finer granularity than the National Mobile Inventory Model (NMIM) that EPA used. Twelve states submitted NONROAD model inputs that EPA used to generate emissions, and the remaining states accepted EPA estimates. More detail on the states and local agencies that submitted inputs is provided in Section 4.5.

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 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.

\(^6\) The OFFROAD model and documentation are available at [http://www.arb.ca.gov/msei/offroad/offroad.htm](http://www.arb.ca.gov/msei/offroad/offroad.htm).
Table 2-2: EIS sectors and associated CAP emissions and total HAP (1000 short tons/year)
1000 short tons / year
Sector
Agriculture - Crops & Livestock Dust
Agriculture - Fertilizer Application
Agriculture - Livestock Waste
Bulk Gasoline Terminals
Commercial Cooking
Dust - Construction Dust
Dust - Paved Road Dust
Dust - Unpaved Road Dust
Fires - Agricultural Field Burning
Fires - Prescribed Fires
Fires - Wildfires
Fuel Comb - Comm/Institutional - Biomass
Fuel Comb - Comm/Institutional - Coal
Fuel Comb - Comm/Institutional - Natural Gas
Fuel Comb - Comm/Institutional - Oil
Fuel Comb - Comm/Institutional - Other
Fuel Comb - Electric Generation - Biomass
Fuel Comb - Electric Generation - Coal
Fuel Comb - Electric Generation - Natural Gas
Fuel Comb - Electric Generation - Oil
Fuel Comb - Electric Generation - Other
Fuel Comb - Industrial Boilers, ICEs - Biomass
Fuel Comb - Industrial Boilers, ICEs - Coal
Fuel Comb - Industrial Boilers, ICEs - Natural Gas
Fuel Comb - Industrial Boilers, ICEs - Oil
Fuel Comb - Industrial Boilers, ICEs - Other
Fuel Comb - Residential - Natural Gas
Fuel Comb - Residential - Oil
Fuel Comb - Residential - Other
Fuel Comb - Residential - Wood
Gas Stations
Industrial Processes - Cement Manuf
Industrial Processes - Chemical Manuf
Industrial Processes - Ferrous Metals
Industrial Processes - Mining
Industrial Processes - NEC
Industrial Processes - Non-ferrous Metals
Industrial Processes - Oil & Gas Production
Industrial Processes - Petroleum Refineries
Industrial Processes - Pulp & Paper
Industrial Processes - Storage and Transfer
Miscellaneous Non-Industrial NEC
Mobile - Aircraft
Mobile - Commercial Marine Vessels
Mobile - Locomotives
Mobile - Non-Road Equipment - Diesel
Mobile - Non-Road Equipment - Gasoline
Mobile - Non-Road Equipment - Other
Mobile - On-Road Diesel Heavy Duty Vehicles
Mobile - On-Road Diesel Light Duty Vehicles
Mobile - On-Road non-Diesel Heavy Duty Vehicles
Mobile - On-Road non-Diesel Light Duty Vehicles
Solvent - Consumer & Commercial Solvent Use

CO

0.13
0.75
31
0.08

966
10,092
12,831
19
6.57
113
15
9.09
21
616
101
13
34
281
40
350
29
122
94
11
58
2,525
0.04
77
185
417
33
208
330
654
50
106
19
11
423
76
132
624
9,764
546
899
451
1,040
29,472
0.03

NH3
1,183
2,344
0.02
2.93E-03

3.47
162
205
0.14
0.06
1.54
0.74
0.03
0.97
9.04
11
1.09
2.94
2.78
0.61
6.40
0.56
1.09
41
2.08
0.46
20
2.13E-04
0.91
24
0.22
0.09
28
0.53
0.11
2.57
5.78
5.99
2.74
0.25
0.37
0.99
0.66
0.61
6.71
0.93
1.11
138

24

NOX

0.13
0.33
5.38E-04
0.08

43
168
187
8.39
17
154
60
7.95
11
1,791
172
89
26
102
148
690
100
56
219
41
40
35
0.03
119
75
56
33
180
15
673
76
71
15
2.73
111
448
865
1,098
198
87
2,951
149
111
3,588
0.01

PM2.5
897

PM10
4,506

SO2

VOC

0.19
0.02
85
163
270
833
96
903
1,137
11
1.34
6.21
5.72
0.63
1.88
170
25
5.92
2.51
128
14
26
8.51
24
4.79
4.59
0.98
382
1.79E-03
6.54
20
29
74
89
16
17
21
33
19
2.12
7.33
20
26
86
42
1.68
140
7.74
1.87
81
0.01

0.34
0.02
89
1,510
1,131
8,339
143
1,063
1,340
13
3.29
7.09
7.88
0.66
2.17
242
25
8.04
2.86
154
33
27
11
26
6.10
5.74
1.47
383
1.9E-03
12
25
35
486
150
20
19
24
42
51
2.26
8.63
22
28
89
46
1.68
184
11
4.11
237
0.02

8.32E-03
4.11E-03
8.28E-05
0.02

0.19
157
13
0.04

16
83
97
1.08
59
1.64
56
1.24
2.35
4,521
5.71
76
20
24
405
16
91
53
1.45
90
8.93
8.97
1.51E-03
60
133
29
2.04
139
103
74
86
32
8.97
0.24
14
100
8.53
2.42
0.89
0.62
3.67
0.32
0.58
31
7.7E-03

76
2,320
2,922
0.64
0.22
11
1.99
0.95
0.75
25
9.85
2.13
3.25
9.51
1.24
68
3.13
7.87
13
1.42
2.98
444
712
4.37
96
17
1.63
195
15
2,730
55
117
236
201
30
14
46
111
1,496
20
248
51
50
2,741
1,677

Lead

8.33E-04

4.5E-04

3.27E-04
2.46E-03
2.48E-03
8.42E-04
2.81E-04
8.9E-04
0.03
7.86E-04
1.44E-03
1.59E-03
8.33E-03
0.01
3.71E-03
3.32E-03
3.91E-03
1.1E-04
2.99E-03
8.15E-06
3.73E-04
3.79E-03
4.64E-03
0.05
6.21E-03
0.06
0.08
1.2E-04
2.95E-03
3.74E-03
6.92E-03
7.1E-04
0.49
1.65E-03
2.23E-03
1.05E-05

Total
HAPs1

0.04
7.94
5.37
0.05

55
255
296
0.26
1.75
1.48
0.12
0.13
1.66
91
3.52
0.52
1.15
5.72
15
22
0.58
2.04
0.98
0.10
0.26
68
86
2.36
29
2.32
0.77
45
9.44
101
6.20
51
14
23
8.04
1.64
5.00
25
334
0.09
46
8.61
14
767
314


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.

Many similarities between the 2011 NEI approaches and past NEI approaches exists, notably that the data are largely compiled from data submitted by S/L/T agencies for CAPs, and that the HAP emissions have greater augmentation by EPA because they are a voluntary contribution from the partner agencies. 2011 S/L/T augmentation by EPA because they are a voluntary contribution from the partner agencies. 2011 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 How does this NEI compare to past inventories?

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$_{10}$ to be greater than or equal to PM$_{2.5}$, and we required PM$_{10}$ to be reported if PM$_{2.5}$ was reported for the same process. If either of these criteria were not met (HAP group, or PM$_{10}$ vs PM$_{2.5}$ magnitude) then none of the pollutants submitted for
the process were allowed into the EIS for that process. Another new check was to allow only certain pollutant-emission type combinations to be reported for on-road and nonroad data categories.

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

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

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

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

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

The point source augmentation approach for using TRI changed in the 2011 NEI. In the 2008 NEI, we summed the TRI “stack” and “fugitive” emission estimates and apportioned the total based on the corresponding CAP emissions (PM was used for metal HAPs; VOC for VOC HAPs). In 2011, we kept the TRI breakout of stack and
fugitive for the NEI and assigned to generic placeholder stack and fugitive processes in the EIS. We assigned an SCC code based on the SCC codes used for CAPS (see Section 3.1.4 for further details). The primary difference in this approach is that in 2008 NEI, the TRI-based HAP emissions were apportioned and present at processes with CAPs (with the exception of high risk facilities and mercury-emitting facilities⁷), whereas in the 2011 NEI, the TRI-based HAP emissions are grouped at a one or two processes with TRI HAP emissions only. In addition, we added ammonia, a CAP, using the TRI in 2011, but not for 2008. In both years, if a S/L/T agency reported a pollutant matching TRI at any process at the facility, then the TRI data for that pollutant was not used in the NEI.

### 2.4.2 Differences in emissions between 2011 and 2008 NEI

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

In Figure 2-9 through Figure 2-12, the y-axis shows the emissions difference as estimated by subtracting the 2008 emissions from the 2011 emissions. Values greater than zero indicate that 2011 emissions are larger than 2008 values. Note in Figure 2-9 that the emission units for CO, SO₂, NOₓ and VOC are in units of millions of tons (x10⁶), while PM₂.⁵ and PM₁₀ are in units of hundred thousands of tons (x10⁵) and NH₃ is in units of tens of thousands of tons (x10⁴). Similarly, y-axis scales vary in Figure 2-11 from thousands of tons (x10³) for HAPs like formaldehyde, to actual tons for arsenic. Table 2-3 and Table 2-4 show the emission changes for CAPs and HAPs respectively, for each pollutant/sector combination; these tables contain the underlying numbers used in Figure 2-9 through Figure 2-12.

CAP emissions are overall lower in 2011 than in 2008, though some specific sector/pollutants increased in 2011 from 2008. Except for wildfires, the increases in NOₓ, PM₂.⁵, VOC and CO are off-set by more substantial decreases to result in an overall emissions decrease. Mobile source sector emissions are lower in 2011 than 2008. Wildfire CAP emissions are higher in 2011 than in 2008, with the most substantial increase for CO. CAP emission increases in 2011 occur for the following sectors:

- Miscellaneous – agricultural field burning (PM₂.⁵, SO₂, CO, NOₓ, VOC); waste disposal (CO); prescribed fires (CO, VOC)
- Fuel Combustion – biomass (CO, VOC)
- Industrial Processes – oil and gas production (VOC, CO, NOₓ).

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

---

⁷ For the 2008 NEI, we added TRI pollutants that were determined to be risk drivers at high risk facilities based on the 2005 NATA, and we added TRI Hg for several key Hg categories regardless of whether CAPs were reported.
- Miscellaneous - agricultural field burning (formaldehyde, acetaldehyde, 1,3-butadiene); prescribed fires (formaldehyde, acetaldehyde, 1,3-butadiene, acrolein); gas stations (ethyl benzene)
- Industrial Processes – industrial surface coating and solvent use (ethyl benzene)

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

<table>
<thead>
<tr>
<th>Sector</th>
<th>CO</th>
<th>NH₃</th>
<th>NOₓ</th>
<th>PM₁₀</th>
<th>PM₂.₅</th>
<th>SO₂</th>
<th>VOC</th>
</tr>
</thead>
<tbody>
<tr>
<td>Miscellaneous</td>
<td>1,879,866</td>
<td>-99,646</td>
<td>29,757</td>
<td>-670,863</td>
<td>115,923</td>
<td>26,118</td>
<td>94,222</td>
</tr>
<tr>
<td>Industrial Processes</td>
<td>238,316</td>
<td>-19,056</td>
<td>179,548</td>
<td>-331,910</td>
<td>-85,591</td>
<td>-213,929</td>
<td>972,700</td>
</tr>
<tr>
<td>Nonroad Mobile</td>
<td>-2,946,001</td>
<td>-317</td>
<td>-559,336</td>
<td>-48,203</td>
<td>-36,844</td>
<td>-182,345</td>
<td>-393,257</td>
</tr>
<tr>
<td>Highway Vehicle</td>
<td>-5,801,073</td>
<td>-13,990</td>
<td>-1,071,088</td>
<td>38,926</td>
<td>-55,075</td>
<td>-9,958</td>
<td>-409,578</td>
</tr>
<tr>
<td>Total Difference, excluding wildfires</td>
<td>-6,413,915</td>
<td>-132,521</td>
<td>-2,613,003</td>
<td>-1,016,433</td>
<td>-51,373</td>
<td>-3,974,497</td>
<td>340,498</td>
</tr>
<tr>
<td>Total % Difference, excluding wildfires</td>
<td>-9%</td>
<td>-3%</td>
<td>-15%</td>
<td>-5%</td>
<td>-1%</td>
<td>-37%</td>
<td>2%</td>
</tr>
</tbody>
</table>

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

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

Fires - Wildfires 5,380 5,423 5,633 34,208
Additional information about sources within each sector that drive the decrease or increase observed by pollutant / sector combination, including where some differences are also due to method changes – are
described in this technical support document, or are included in the EPA’s “2011 NEI Report”; however, the 2011 NEI report was developed for the v1 of the 2011 NEI and updating this report to the current 2011 v2 is not planned.

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

Figure 2-12: Comparison of wildfire HAP emissions, 2011 minus 2008
2.5 How well are tribal data and regions represented in the 2011 NEI?
Sixteen tribes submitted data to the EIS for 2011 as shown in Table 2-5. In this table, a “CAP, HAP” designation indicates that both criteria and hazardous air pollutants were submitted by the tribe. CAP indicates that only criteria pollutants were submitted. Facilities on Tribal land were augmented using TRI, HAPs and PM in the same manner as facilities under the state and local jurisdictions, as explained in Section 3.1; therefore Tribal Nations in Table 2-5 with just a CAP flag will also have some HAP emissions in most cases.

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

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

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

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


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

### 2.6 What does this NEI tell us about mercury?

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

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

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

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

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

None of these categories are distinct regulatory sectors and are therefore put into the “Other” category in Table 2-8. Previous-year emissions were not revised to include these new emissions or method changes. Detailed documentation on the methods is provided in a memorandum “Nonpoint Sources of Mercury - documentation 6-26-2014.docx” provided in the supplemental documentation.
The data sources used to create the 2011 v2 Hg inventory are shown in Figure 2-13. The datasets are described in more detail starting in Section 3.1.1, and we highlight some key datasets here.

For EGUs, we used unit specific and “bin”-average emission factors collected from a test program conducted primarily in 2010 to support the MATS rule8, and used 2011-specific activity from the Clean Air Markets Division Data and the Department of Energy. The MATS-based Hg data are labeled “EPA EGU” in the figure; all 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 agency reported the calculation method to be based either on continuous emissions monitors (CEMs) or test data. In addition, S/L/T agency data were used for 65% of the other stationary source emissions, and is represented by “S/L/T” in the figure. We used several other datasets developed by EPA including TRI (see Section 3.1.4), EPA HAP Augmentation or “HAP Aug” in the figure (see Section 3.1.5), and other EPA data developed for gap filling (see Section 3.1.1).

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

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

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

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

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

<table>
<thead>
<tr>
<th>Data Category</th>
<th>Dataset short name</th>
<th>Mercury Emissions (tons/yr)</th>
<th>Grouped Data Source for Chart</th>
</tr>
</thead>
<tbody>
<tr>
<td>Nonpoint</td>
<td>2011EPA_NP_Mercury</td>
<td>4.40</td>
<td>EPA other</td>
</tr>
<tr>
<td></td>
<td>S/L/T</td>
<td>1.54</td>
<td>S/L/T</td>
</tr>
<tr>
<td></td>
<td>2011EPA_NP_NoOvrlp</td>
<td>0.71</td>
<td>EPA Nonpoint</td>
</tr>
<tr>
<td></td>
<td>2011EPA_Rail</td>
<td>0.58</td>
<td>EPA Air/Rail/CMV</td>
</tr>
<tr>
<td></td>
<td>2011EPA_HAP-Aug</td>
<td>0.41</td>
<td>EPA other</td>
</tr>
<tr>
<td></td>
<td>2011EPA_NP_Ovrlp</td>
<td>0.06</td>
<td>EPA Nonpoint</td>
</tr>
<tr>
<td></td>
<td>2011EPA_CMV</td>
<td>0.04</td>
<td>EPA Air/Rail/CMV</td>
</tr>
<tr>
<td></td>
<td>2011EPA_CMVLADCO</td>
<td>0.00</td>
<td>EPA Air/Rail/CMV</td>
</tr>
<tr>
<td>Point</td>
<td>S/L/T</td>
<td>25.5</td>
<td>S/L/T</td>
</tr>
<tr>
<td></td>
<td>2011 EPA EGUs</td>
<td>16.5</td>
<td>EPA EGU</td>
</tr>
<tr>
<td></td>
<td>2011EPA_TRI</td>
<td>4.07</td>
<td>TRI</td>
</tr>
<tr>
<td></td>
<td>2011_NVGLD</td>
<td>0.80</td>
<td>EPA NV Goldmines</td>
</tr>
<tr>
<td></td>
<td>2011EPA_CarryForward</td>
<td>0.72</td>
<td>EPA other</td>
</tr>
<tr>
<td></td>
<td>2011EPA_Other</td>
<td>0.35</td>
<td>EPA other</td>
</tr>
<tr>
<td></td>
<td>2011EPA_HAP-Aug</td>
<td>0.30</td>
<td>EPA other</td>
</tr>
<tr>
<td></td>
<td>2011EPA_Rail</td>
<td>0.05</td>
<td>EPA Air/Rail/CMV</td>
</tr>
<tr>
<td></td>
<td>2011 EPA Landfills</td>
<td>0.005</td>
<td>EPA other</td>
</tr>
<tr>
<td>Nonroad</td>
<td>S/L/T</td>
<td>0.03</td>
<td>S/L/T</td>
</tr>
<tr>
<td></td>
<td>2011EPAMOBILE</td>
<td>0.01</td>
<td>EPA Nonroad</td>
</tr>
<tr>
<td>Onroad</td>
<td>2011EPAMOVES2014</td>
<td>0.40</td>
<td>EPA Onroad</td>
</tr>
<tr>
<td></td>
<td>S/L/T</td>
<td>0.08</td>
<td>S/L/T</td>
</tr>
</tbody>
</table>
Figure 2-14: States with state- or local-provided Hg emissions in the point data category of the 2011 v2

Table 2-8 shows the 2011 v2 mercury emissions for the key categories of interest in comparison to 1990. Also shown are the most recent 2005 emissions, which were used in support of the MATS rule. The Microsoft® 2013 ACCESS® database included in the zip file 2011nei_supdata_mercury.zip 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>
<thead>
<tr>
<th></th>
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<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Utility Coal Boilers (Electricity Generation Units – EGUs, combusting coal)</td>
<td>58.8</td>
<td>52.2</td>
<td>29.4</td>
<td>26.8</td>
<td>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</td>
</tr>
<tr>
<td>Hospital/Medical/Infectious Waste Incineration</td>
<td>51</td>
<td>0.2</td>
<td>0.1</td>
<td>0.1</td>
<td>Regulatory code: Hospital, Medical, Infectious Waste Incineration (HMIWI)</td>
</tr>
<tr>
<td>Municipal Waste Combustors</td>
<td>57.2</td>
<td>2.3</td>
<td>1.3</td>
<td>1.0</td>
<td>Regulatory codes: Section 129 rules for Small Municipal Waste Combustors (MWC) and Large MWC</td>
</tr>
<tr>
<td>Industrial, Commercial Institutional Boilers and Process Heaters</td>
<td>14.4</td>
<td>6.4</td>
<td>4.2</td>
<td>3.6</td>
<td>SCC list- chose only processes with these SCCs that were not already tagged with rule or via manual approach</td>
</tr>
<tr>
<td>Mercury Cell Chlor-Alkali Plants</td>
<td>10</td>
<td>3.1</td>
<td>1.3</td>
<td>0.5</td>
<td>Regulatory code: NESHAP, Mercury Cell Chlor-Alkali Plants.</td>
</tr>
<tr>
<td>Electric Arc Furnaces</td>
<td>7.5</td>
<td>7.0</td>
<td>4.8</td>
<td>5.4</td>
<td>Regulatory code: Area Source rule for “Stainless &amp; Non-stainless Steel Manufacturing: Electric Arc Furnaces” plus 2 major sources that have EAFs</td>
</tr>
</tbody>
</table>
The top emitting 2011 Mercury categories are: EGUs (rank 1), electric arc furnaces (rank 2), industrial, commercial and institutional boilers and process heaters (rank 3) and Portland cement excluding hazardous waste kilns (rank 4).

As shown in Table 2-8, 2011 mercury emissions are 5 tons lower than in the 2008. Almost three tons of this difference is due to lower mercury emissions from EGUs covered by MATS; three other categories with large decreases are Portland Cement Manufacturing, Gold Mining and Chlor-Alkali plants. The lower emissions in 2011 are due to a combination of voluntary agreements, state rules, consent decrees, activity levels (e.g., lower cement production in 2011) and reductions that occurred from facilities prior to MACT compliance dates. For EGUs, the decrease is due primarily to the installation of Hg controls to comply with state rules and voluntary reductions, and the co-benefits of Hg reductions from control devices installed for the reduction of SO₂ 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 SO₂.

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

For electric arc furnaces (EAFs), emissions increased from 2008 by about a half a ton. The largest increase for this category occurs in Alabama which relied heavily on EPA estimates for 2008 and solely on estimates from the state and local agency (Jefferson County Health Department) in 2011. Increases occur at existing facilities in this state. Ohio also shows large increases in emissions, again from existing facilities. However, the data from Ohio

<table>
<thead>
<tr>
<th></th>
<th></th>
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<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Commercial/Industrial Sold Waste</td>
<td>Not available</td>
<td>1.1</td>
<td>0.02</td>
<td>0.01</td>
<td>Source Classification Code (50200101) and manually assigned based on how it was categorized in previous inventories</td>
</tr>
<tr>
<td>Incineration</td>
<td></td>
<td>3/15/2011</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Hazardous Waste Incineration</td>
<td>6.6</td>
<td>3.2</td>
<td>1.3</td>
<td>0.7</td>
<td>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.</td>
</tr>
<tr>
<td>Portland Cement Non-Hazardous</td>
<td>5.0</td>
<td>7.5</td>
<td>4.2</td>
<td>2.9</td>
<td>Regulatory code: NESHAP, Portland Cement Manufacturing</td>
</tr>
<tr>
<td>Waste</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Gold Mining</td>
<td>4.4</td>
<td>2.5</td>
<td>1.7</td>
<td>0.8</td>
<td>Regulatory code: NESHAP, Gold Mine Ore Processing and Production</td>
</tr>
<tr>
<td>Sewage Sludge Incineration</td>
<td>2</td>
<td>0.3</td>
<td>0.3</td>
<td>0.3</td>
<td>Source Classification Code: 50100506, 50100515, 50100516, 50382501, 50100701, 50100793</td>
</tr>
<tr>
<td>Mobile Sources</td>
<td>Not available</td>
<td>1.2</td>
<td>1.8</td>
<td>1.3</td>
<td>Sum of all of onroad, nonroad, locomotives and commercial marine vessels (locomotives and marine used SCC code)</td>
</tr>
<tr>
<td>Other Categories</td>
<td>29.5</td>
<td>18</td>
<td>10.7</td>
<td>13</td>
<td></td>
</tr>
<tr>
<td>Total (all categories)</td>
<td>246</td>
<td>105</td>
<td>61</td>
<td>56</td>
<td></td>
</tr>
</tbody>
</table>
(for both 2008 and 2011) is predominantly from the TRI. For situations where neither the state nor TRI provided Hg, EPA estimated Hg using 2011 activity data provided by the state with emission factors from a test program conducted in support of rule development for the EAF industry. These were included in the “2011EPA_Other” dataset in the EIS. The EFs are provided in the file electric_arc_furnace_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 non-EGU categories, the 2011 NEI primarily uses data submitted by S/L/T agencies. Where S/L/T agency data are missing EPA supplemented the information using the TRI for the year 2011 and, as discussed in Section 3.1, other datasets developed by EPA, particularly those for “working face” landfill emissions as well as switches and relays.

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

3 Stationary sources

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

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

3.1 Stationary source approaches

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

3.1.1 Sources of data overview and selection hierarchies

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

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

The hierarchy or “order” provided in the tables below defines which data are to be used for situations where multiple datasets provide emissions for the same pollutant and emissions process. The dataset with the lowest order on the list is preferentially used over other datasets. In addition to the order of the datasets, the hierarchy was also influenced by the new EIS feature of data tagging. Any data that were tagged by EPA in any of the datasets were not used. S/L/T agency data were tagged for two reasons: 1) if they were deemed to be likely outliers and were not addressed during the S/L/T agency data reviews, 2) to set the hierarchy to use the Mercury and Air Toxics Standard (MATS) data ahead of the S/L/T agency data where the S/L/T agency data were not from either source test or continuous emission monitoring sources. The MATS data covered acid gases (except HCN which was deemed unreliable and tagged from the EPA dataset), metal HAPs (including lead), and PM. MATS PM data were used only for units in which both PM2.5-FIL and PM-CON were tested during the MATS test program. The tables include the rationale for why each dataset was assigned its position in the hierarchy.
We excluded pollutants from stationary sources in the 2011 NEI as shown in the last row of both tables: we excluded greenhouse gases and pollutants in the pollutant groups “dioxins/furans” and “radionuclides”\(^9\).

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

<table>
<thead>
<tr>
<th>Dataset name (Short name(^4) provided if different)</th>
<th>Description and Rationale for the Order of the Selected Datasets</th>
<th>Order</th>
</tr>
</thead>
<tbody>
<tr>
<td>2011EPA_PM-Augmentation (2011EPA_PM-AUG)</td>
<td>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.</td>
<td>1</td>
</tr>
<tr>
<td>2011 Responsible Agency Selection</td>
<td>S/L/T agency submitted data; multiple datasets – one for each reporting agency. These data are selected ahead of other datasets except the 2011EPA_PM-Augmentation (above). The only other situation where S/L/T agency emissions are not used is where tagged in the EIS (at the specific source/pollutant level). This occurs: 1) for hierarchy purposes to allow the Mercury and Air Toxics Standard (MATS) to be used ahead of S/L/T agency data except where S/L/T agency data were from source test or continuous emission monitors and 2) where S/L/T agency data were suspected outliers that were not addressed.</td>
<td>2</td>
</tr>
<tr>
<td>2011EPA_EGU</td>
<td>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 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 SO₂ and NOₓ 3. EFs used in previous year inventories from AP-42 and other sources along with CAMD heat input data.</td>
<td>3</td>
</tr>
<tr>
<td>2011EPA_chrom_split</td>
<td>Hexavalent and trivalent chromium speciated from S/L/T agency reported chromium. New EIS augmentation function creates the dataset by applying multiplication factors by SCC, facility, process or North American Industry Classification System (NAICS) code to S/L/T agency chromium. See Section 3.1.3.</td>
<td>4</td>
</tr>
</tbody>
</table>

\(^9\) Dioxins/furans include all pollutants with pollutant category name of: Dioxins/Furans as 2,3,7,8-TCDD TEQs, or Dioxins/Furans as 2,3,7,8-TCDD TEQs – WHO2005, both of which were valid pollutant groups for reporting 2011 emissions. Radionuclides have the pollutant category name of “radionuclides” The specific compounds and codes are in the pollutant code tables in EIS 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>
<thead>
<tr>
<th>Dataset name (Short name provided if different)</th>
<th>Description and Rationale for the Order of the Selected Datasets</th>
<th>Order</th>
</tr>
</thead>
<tbody>
<tr>
<td>2011EPA_Other</td>
<td>Variety of EPA gap fill data including: coke oven emissions using state – provided information for facilities in Kentucky, Michigan and Pennsylvania; electric arc furnace mercury emissions using activity reported to the EIS by states and EFs from the ICR test program or S/L/T agency provided information, emissions for several New Mexico facilities that were provided by NM after the submission deadline (EPA used the CAP data only), mercury emissions for Iowa sources that were below Iowa thresholds and were reported by Iowa as zero, mercury emissions for a boiler in Missouri using state-provided data.</td>
<td>6</td>
</tr>
<tr>
<td>2011EPA_TRI</td>
<td>Toxics Release Inventory data for the year 2011 (see Section 3.1.4). These data are selected for a facility only when alternative emissions are not included in the S/L/T agency data.</td>
<td>7</td>
</tr>
<tr>
<td>2011EPA_Airports</td>
<td>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.</td>
<td>8</td>
</tr>
<tr>
<td>2011EPA_Rail</td>
<td>Emissions of CAP and HAP for diesel rail yard locomotives at 753 rail yards. CAP emissions computed using yard-specific emission factors using yard-specific fleet information and on national fuel values allocated to rail yards using an approximation of line haul activity within the yard. HAP emissions computed using HAP-to-CAP emission ratios. See Section 4.4. EPA Rail data are selected for a county only if S/L/T agency data are not. This dataset also contains county-level emissions used in the nonpoint selection (Table 3-2).</td>
<td>9</td>
</tr>
<tr>
<td>2011EPA_LF (2011 EPA Landfills)</td>
<td>Landfill emissions developed by EPA using methane data from the EPA’s Greenhouse Gas reporting rule program. Dataset contains landfills only for which no pollutants were reported by S/L/T agency in the 2011 reporting year.</td>
<td>10</td>
</tr>
<tr>
<td>2011EPA_CarryForward-PreviousYearData (2011EPA_CarryForward)</td>
<td>Variety of estimates used to gap fill important sources/pollutants: 1) coke oven missing from S/L/T agency data and not in the EPA_Other dataset. 2) Mercury from MWCs and boilers (in 2008 it was in the dataset called “2008 EPA Rule Data from OAQPS/SPPD” 3) Numerous HAPs from an MWC in California.</td>
<td>11</td>
</tr>
<tr>
<td>2011EPA_HAP-Augmentation (2011EPA_HAP-Aug)</td>
<td>HAP data computed from S/L/T agency criteria pollutant data using HAP/CAP emission factor ratios based on the EPA Factor Information Retrieval System (WebFIRE) database as described in Section 3.1.5. These data are selected below the TRI data and 2011EPA_CarryForward-PreviousYearData because the TRI data are expected to be better. These data are selected for a facility only when not included in the S/L/T agency data.</td>
<td>12</td>
</tr>
<tr>
<td>Dataset name (Short name\textsuperscript{a} provided if different)</td>
<td>Description and Rationale for the Order of the Selected Datasets</td>
<td>Order</td>
</tr>
<tr>
<td>---</td>
<td>---</td>
<td>---</td>
</tr>
</tbody>
</table>

**Exceptions to the hierarchy**

1. Excluded dioxin/furan individual pollutants and groups, greenhouse gas pollutants, and radionuclides. USEPA has not evaluated the completeness or accuracy of the S/L/T agency dioxin and furan values nor radionuclides, and does not have plans to supplement these reported emissions with other data sources in order to compile a complete estimate for dioxin and furans or radionuclides as part of the NEI.

\textsuperscript{a} The dataset short name is the name that the EIS will list in its process-level reports

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

<table>
<thead>
<tr>
<th>Dataset name (Short Name\textsuperscript{a} provided if different)</th>
<th>Description and Rationale for the Order of the Selected Datasets</th>
<th>Order</th>
</tr>
</thead>
<tbody>
<tr>
<td>2011EPA_PM-Augmentation (2011EPA_PM-AUG)</td>
<td>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).</td>
<td>1</td>
</tr>
<tr>
<td>2011EPA_AgBurningSF2</td>
<td>Agricultural fire emission estimates developed by EPA. See Section 5.2.</td>
<td>2</td>
</tr>
<tr>
<td>2011 Responsible Agency Selection</td>
<td>S/L/T agency submitted data; multiple datasets – one for each reporting agency. These data are selected ahead of other datasets. The only other situation where S/L/T agency emissions are not used is where tagged in the EIS (at the specific source/pollutant level). This occurs: 1) for hierarchy purposes to allow EPA nonpoint emissions to be used ahead of S/L/T agency data where states asked for EPA data to be used in place of their data and 2) where S/L/T agency data were suspected outliers.</td>
<td>3</td>
</tr>
<tr>
<td>2011EPA_chrom_split</td>
<td>Hexavalent and trivalent chromium speciated from S/L/T agency reported chromium. New EIS augmentation function creates the dataset by applying multiplication factors by SCC, facility, process or NAICS code to S/L/T agency chromium. See Section 3.1.3.</td>
<td>4</td>
</tr>
<tr>
<td>2011EPA_HAP-Augmentation (2011EPA_HAP-Aug)</td>
<td>HAP data computed from S/L/T agency criteria pollutant data using HAP/CAP emission factor ratios based on ratios of HAP to CAP emission factors used in the EPA estimates. This dataset is below the S/L/T agency data so that the S/L/T agency HAP data are used first.</td>
<td>5</td>
</tr>
<tr>
<td>2011EPA_CMVLADCO</td>
<td>Submitted by the Lake Michigan Air Directors Consortium (LADCO) for state’s that approved. See Section 4.3</td>
<td>6</td>
</tr>
<tr>
<td>2011EPA_CMV</td>
<td>EPA commercial marine vessel emissions estimates. See Section 4.3.</td>
<td>7</td>
</tr>
<tr>
<td>2011EPA_Rail</td>
<td>EPA locomotive (referred to as “rail” in this document) emissions estimates. See Section 4.4.</td>
<td>8</td>
</tr>
<tr>
<td>Dataset name (Short Name provided if different)</td>
<td>Description and Rationale for the Order of the Selected Datasets</td>
<td>Order</td>
</tr>
<tr>
<td>------------------------------------------------</td>
<td>---------------------------------------------------------------</td>
<td>-------</td>
</tr>
<tr>
<td>2011EPA_NP_NoOverlap_w_Pt (2011EPA_NP_NoOvrlp)</td>
<td>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 includes 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).</td>
<td>9</td>
</tr>
<tr>
<td>2011EPA_NP_Overlap_w_Pt (2011EPA_NP_Ovrlp)</td>
<td>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.</td>
<td>10</td>
</tr>
<tr>
<td>2011EPA_biogenics</td>
<td>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.</td>
<td>11</td>
</tr>
<tr>
<td>2011EPA_NP_Mercury</td>
<td>Mercury only data for select source categories within the waste disposal (see Section 3.32) and Miscellaneous Non-Industrial NEC (see Section 3.26) sectors.</td>
<td>12</td>
</tr>
</tbody>
</table>

**Exceptions to the hierarchy**

1. Excluded dioxin/furan individual pollutants and groups, greenhouse gas pollutants, and radionuclides. The EPA has not evaluated the completeness or accuracy of the S/L/T agency dioxin and furan values nor radionuclides, and does not have plans to supplement these reported emissions with other data sources in order to compile a complete estimate for dioxin and furans nor radionuclides as part of the NEI.

### 3.1.2 Particulate matter augmentation

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

In general, emissions for PM species missing from S/L/T agency inventories were calculated by applying factors to the PM emissions data supplied by the S/L/T agencies. These conversion factors were first used in the 1999 NEI’s “PM Calculator” as described in an NEI conference paper [ref 2]. The resulting methodology allows EPA to derive missing PM10-FIL or PM25-FIL emissions from incomplete S/L/T agency submissions based on the SCC.
and PM controls that describe the emissions process. In cases where condensable emissions are not reported, conversion factors developed are applied to S/L/T agency reported PM species or species derived from the PM Calculator databases. The PM Calculator is a Microsoft® Access® database, available under the “Emission Inventory Tools” heading 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 3-3.

<table>
<thead>
<tr>
<th>Pollutant Code</th>
<th>Description</th>
<th>Pollutant Category Name</th>
<th>Speciated?</th>
</tr>
</thead>
<tbody>
<tr>
<td>1333820</td>
<td>Chromium Trioxide</td>
<td>Chromium Compounds</td>
<td>yes</td>
</tr>
<tr>
<td>16065831</td>
<td>Chromium III</td>
<td>Chromium Compounds</td>
<td>yes</td>
</tr>
<tr>
<td>18540299</td>
<td>Chromium (VI)</td>
<td>Chromium Compounds</td>
<td>yes</td>
</tr>
<tr>
<td>7440473</td>
<td>Chromium</td>
<td>Chromium Compounds</td>
<td>no</td>
</tr>
<tr>
<td>7738945</td>
<td>Chromic Acid (VI)</td>
<td>Chromium Compounds</td>
<td>yes</td>
</tr>
</tbody>
</table>

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

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

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

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

3.1.4 Use of the 2011 Toxics Release Inventory

EPA used air emissions data from the 2011 Toxic Release Inventory (TRI) to supplement point source HAP and NH₃ emissions provided to EPA by S/L/T agencies. The resulting augmentation dataset is labeled as “2011EPA_TRI” in the Table 3-1 selection hierarchy shown above. For 2011, all TRI emissions values that could reasonably be matched to an EIS facility were loaded into the EIS for viewing and comparison if desired, but only those pollutants that were not reported anywhere at the EIS facility by the S/L/T agency were considered for inclusion in the 2011 NEI.

The basis of the 2011EPA_TRI dataset is the US EPA’s 2011 Toxic Release Inventory (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 the EIS (and the NEI) as facility-total stack and facility-total fugitive emissions processes, which reflected the aggregation detail of the TRI database. Double-counting of TRI and other data sources was prevented by tagging (and not using) any TRI pollutant emissions for a facility where the S/L/T agency or a higher priority (as per Table 3-1) EPA dataset also had a pollutant emissions value for any unit and process within that facility.

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

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

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

1. Develop a TRI_ID to EIS_ID facility-level crosswalk

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

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

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

2. **Map TRI pollutant codes to valid EIS pollutant codes and sum where necessary**

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

3. **Split TRI total chromium emissions into hexavalent and trivalent emissions**

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

Unfortunately, not all SIC-based fractions could be assigned this way, so we computed NAICS-based split fractions for any NAICS codes in the 2011 TRI data that did not already have 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 agency-reported total chromium by USEPA using the procedures described in section 3.1.3. Those procedures largely rely on either SCC-based or Regulatory code-based split factors. The derived NAICS split factors therefore represent a weighted average of the SCC and Regulatory code-based split factors, weighted according to the mass of each chromium valence in the 2011 draft NEI for that NAICS.

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

4. **Review high TRI emissions values for and exclude any data suspected to be outliers**

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

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

5. Write the 2011 TRI emissions to EIS Process IDs with stack and fugitive release points

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

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

The 2002 and 2005 NEIs had assigned all 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 agency-reported emissions in the 2011 draft NEI. Within the largest EIS sector for the facility and release type, we then determined which single SCC had the largest emissions. The emissions values used were sums of emissions across all pollutants except CO, CO2, and NOx, with all units converted to tons11. Excluding CO and CO2 was done because their high mass would overwhelm the contribution of the other criteria pollutants, and NOx was excluded because the HAPs that we are trying to assign to an appropriate summation sector are more closely associated with SO2 or PM emissions. The usage of the default 39999999 SCC has not been completely eliminated as a result of this approach, because there remain a number of S/L/T agency-reported criteria emissions for some

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11 In fact, a “SMOKE” modeling file was used as the easiest way to get the file in the right format for this step.
facilities in EIS for which that is the most viable SCC choice. In the rare cases that the S/L/T agency used 39999999 for the majority of their emissions, this approach did not work.

7. Tag TRI pollutant emissions in EIS to avoid double counting with other datasets
Because the 2011 NEI does not attempt to place the TRI emissions at the same processes used by the S/L/T agency datasets or other EPA datasets that are higher in the EIS selection hierarchy, it is necessary to tag any TRI emissions values stored in the EIS wherever the same pollutant is already reported by a S/L/T agency or one of the more preferred EPA datasets for a given EIS facility. In addition to a direct comparison of individually matching pollutants between these datasets, it is also necessary to compare to any of the related EIS pollutant codes that are in the same pollutant group.

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

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

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<thead>
<tr>
<th>TRI CAS</th>
<th>TRI Pollutant Name</th>
<th>EIS Pollutant Code</th>
<th>EIS Pollutant Name</th>
<th>New in 2011</th>
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<td>1330207</td>
<td>XYLENE (MIXED ISOMERS)</td>
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<td>XYLENES (MIXED ISOMERS)</td>
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Table 3-5: Pollutant groups

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<tbody>
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<td></td>
<td>1333820</td>
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<td>7738945</td>
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<td>18540299</td>
<td>Chromium (VI)</td>
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<td></td>
<td>16065831</td>
<td>Chromium III</td>
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<td><strong>Xylenes (Mixed Isomers)</strong></td>
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<td>Xylenes (Mixed Isomers)</td>
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<td></td>
<td>95476</td>
<td>o-Xylene</td>
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<td>p-Xylene</td>
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<td></td>
<td>108383</td>
<td>m-Xylene</td>
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<td><strong>Cresol/Cresylic Acid (Mixed Isomers)</strong></td>
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<td>Cresol/Cresylic Acid (Mixed Isomers)</td>
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<td>o-Cresol</td>
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<td>108394</td>
<td>m-Cresol</td>
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<td>p-Cresol</td>
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<td><strong>Polychlorinated Biphenyls</strong></td>
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<td>Polychlorinated Biphenyls (PCBs)</td>
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51
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<thead>
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<th>Group Name</th>
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<td>Benzo(a)Fluoranthene</td>
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<td>604</td>
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**3.1.5 HAP augmentation based on emission factor ratios**

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

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

A key facet of our approach is that the resulting HAP augmentation dataset does duplicate HAPs from the S/L/T agency data or other EPA datasets. The extra step of data tagging of the HAP augmentation dataset was taken to ensure the NEI would not use the data from the HAP augmentation dataset for facilities where the HAP was reported by an S/L/T agency at any process at the facility or where the HAP was included in the EPA TRI dataset. For example, if a facility reported formaldehyde at process A only, and the WebFIRE emission factor database yields formaldehyde emissions for processes A, B, and C, then we would not use any records from the HAP augmentation dataset containing formaldehyde from any processes at the facility. If that facility had no formaldehyde, but the TRI dataset had formaldehyde for any processes at that facility, then the NEI would still not use formaldehyde from the HAP augmentation dataset for any of the processes (it would use the TRI data).

If the EPA EGU dataset contained formaldehyde for that facility we would use the HAP augmentation set but not for any process at the same unit as EPA EGU dataset. If the EPA EGU dataset contained formaldehyde 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).

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

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

<table>
<thead>
<tr>
<th>State</th>
<th>EIS Facility ID</th>
<th>EIS Process ID</th>
<th>Nickel species in HAP Augmentation Dataset</th>
<th>Emissions (lbs)</th>
<th>Data Set</th>
<th>Potential Double Count With:</th>
</tr>
</thead>
<tbody>
<tr>
<td>Minnesota</td>
<td>7146811</td>
<td>27576114</td>
<td>Nickel Oxide</td>
<td>16.5</td>
<td>2011EPA_HAP-Aug</td>
<td>State</td>
</tr>
<tr>
<td>Illinois</td>
<td>7337911</td>
<td>43356414</td>
<td>Nickel Oxide</td>
<td>1.3</td>
<td>2011EPA_HAP-Aug</td>
<td>State</td>
</tr>
<tr>
<td>Ohio</td>
<td>13429911</td>
<td>100593714</td>
<td>Nickel Oxide</td>
<td>0.034</td>
<td>2011EPA_HAP-Aug</td>
<td>State</td>
</tr>
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<td>Louisiana</td>
<td>7355411</td>
<td>105681714</td>
<td>Nickel</td>
<td>2.3</td>
<td>2011EPA_HAP-Aug</td>
<td>State</td>
</tr>
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<td>Louisiana</td>
<td>7355411</td>
<td>105679214</td>
<td>Nickel</td>
<td>4.1</td>
<td>2011EPA_HAP-Aug</td>
<td>State</td>
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<td>Louisiana</td>
<td>7355411</td>
<td>105683114</td>
<td>Nickel</td>
<td>6.3</td>
<td>2011EPA_HAP-Aug</td>
<td>State</td>
</tr>
<tr>
<td>Iowa</td>
<td>12807811</td>
<td>94016314</td>
<td>Nickel Oxide</td>
<td>0.5</td>
<td>2011EPA_HAP-Aug</td>
<td>TRI</td>
</tr>
<tr>
<td>Iowa</td>
<td>12807811</td>
<td>94016314</td>
<td>Nickel Oxide</td>
<td>0.0</td>
<td>2011EPA_HAP-Aug</td>
<td>TRI</td>
</tr>
</tbody>
</table>

We also tagged all point source HAP augmentation values that met one or more of the following criteria: a) the HAP augmentation value exceeded the maximum emissions reported by any S/L/T agency for the same SCC/pollutant combination, or if no S/L/T agency reported any values for the same SCC/pollutant, b) SCCs for coke ovens (potential double count with the “Coke oven emissions” pollutant) and c) waste oil (due to insufficient information about the waste which would likely impact the ratio), d) if greater than 0.05 tons lead would have been added from coal combustion. This last criterion impacted 3 sources, as shown in Table 3-7. We tagged these due to the uncertainty in the WebFIRE emission factor. The value 0.05 tons lead was selected because it was at the top end of the HAP augmentation values for coal combustion.
Table 3-7: Lead from HAP-augmentation from coal combustion that was not used.

<table>
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<th>EIS Facility ID</th>
<th>EIS Unit ID</th>
<th>EIS Process ID</th>
<th>SCC</th>
<th>State</th>
<th>County</th>
<th>St/Co FIPS</th>
<th>Facility Name</th>
<th>Unused Lead (tons)</th>
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<td>30874213</td>
<td>67784214</td>
<td>10200203</td>
<td>WI</td>
<td>Brown</td>
<td>55009</td>
<td>Georgia-Pacific Consumer Products LP</td>
<td>0.1800</td>
</tr>
<tr>
<td>6478511</td>
<td>87095313</td>
<td>117793514</td>
<td>10200222</td>
<td>WY</td>
<td>Sweet water</td>
<td>56037</td>
<td>Green River Trona Plant</td>
<td>0.1500</td>
</tr>
<tr>
<td>6478511</td>
<td>87095513</td>
<td>117793714</td>
<td>10200222</td>
<td>WY</td>
<td>Sweet water</td>
<td>56037</td>
<td>Green River Trona Plant</td>
<td>0.0600</td>
</tr>
</tbody>
</table>

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

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

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

3.1.6 Priority Facility List

For the 2011 NEI, EPA developed a Priority Facility List and posted it for reference in order to provide S/L/T agencies an indication of important facilities on which to focus. EPA constructed the priority facility list (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 agency reporting completeness and preliminary risk modeling was not restricted or focused on solely the priority facility list for 2011.

3.1.7 EPA nonpoint data

For the 2011 NEI, the EPA developed emission estimates for many nonpoint sectors in collaboration with a consortium of state and regional planning organizations called the Eastern Regional Technical Advisory Committee (ERTAC, 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].
One dataset was created for 2011 v2 that represented mercury emissions from nonpoint categories that span different sectors. This dataset is called 2011EPA_NP_Mercury and comes at the end of the hierarchy in the selection. It represents emissions from various mercury sources, described in Table 3-8. Methodologies for these specific source categories are included in the Sector sections for Waste Disposal (3.32) and Miscellaneous Non-Industrial NEC (3.25).

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

<table>
<thead>
<tr>
<th>Sector</th>
<th>Source Category Description</th>
<th>SCC</th>
<th>Emissions (lbs.)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Waste Disposal</td>
<td>Switches and Relays</td>
<td>26500000002</td>
<td>4,292.8</td>
</tr>
<tr>
<td>Miscellaneous Non-Industrial NEC</td>
<td>Human Cremation</td>
<td>2810060100</td>
<td>2,291.5</td>
</tr>
<tr>
<td>Waste Disposal</td>
<td>Landfills</td>
<td>2620030001</td>
<td>828.0</td>
</tr>
<tr>
<td>Miscellaneous Non-Industrial NEC</td>
<td>Fluorescent Lamp Breakage</td>
<td>2861000000</td>
<td>802.7</td>
</tr>
<tr>
<td>Miscellaneous Non-Industrial NEC</td>
<td>Dental Amalgam</td>
<td>2850001000</td>
<td>803.8</td>
</tr>
<tr>
<td>Miscellaneous Non-Industrial NEC</td>
<td>General Laboratory Activities*</td>
<td>2851001000</td>
<td>600.0</td>
</tr>
<tr>
<td>Waste Disposal</td>
<td>Thermostats</td>
<td>2650000000</td>
<td>228.2</td>
</tr>
<tr>
<td>Miscellaneous Non-Industrial NEC</td>
<td>Animal Cremation</td>
<td>2810060200</td>
<td>80.2</td>
</tr>
<tr>
<td>Waste Disposal</td>
<td>Thermometers</td>
<td>2650000000</td>
<td>14.4</td>
</tr>
<tr>
<td>Miscellaneous Non-Industrial NEC</td>
<td>Fluorescent Lamp Recycling</td>
<td>2861000010</td>
<td>0.2</td>
</tr>
<tr>
<td>TOTAL</td>
<td></td>
<td></td>
<td>9,941.8</td>
</tr>
</tbody>
</table>

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

Table 3-9 and Table 3-10 describe the sectors for which EPA developed emission estimates. They separately list emissions sectors entirely comprised of data in the nonpoint (and not point source) data category (Table 3-9), such as residential heating, from sectors that may overlap with the point sources (Table 3-10). For sectors that overlap, some emissions will be submitted as point sources and other emissions in the same state or county are submitted as nonpoint, for example, fuel combustion at commercial or institutional facilities. Unlike in 2008, EPA attempted to include all 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 3-9 and Table 3-10. Emission sources using data from former EPA inventories are identified in the column “Carried Forward” in these tables. The SCCs associated with the EPA nonpoint data categories are in the excel file list_of_sources_2011v1_nonpoint_20131127.xlsx. The file “2011nei_np_matrix_submittals.xlsx” 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.

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

<table>
<thead>
<tr>
<th>EPA-estimated emissions source description</th>
<th>Carried Forward?</th>
<th>EIS Sector Name</th>
<th>Name of supporting data file or other reference</th>
</tr>
</thead>
<tbody>
<tr>
<td>Residential Heating; bituminous and anthracite coal</td>
<td></td>
<td>Fuel Comb – Residential – Other</td>
<td>residential_consumption_coal.zip</td>
</tr>
<tr>
<td>Residential Heating; distillate oil</td>
<td></td>
<td>Fuel Comb – Residential – Oil</td>
<td>residential_consumption_oil_revised_06272012.zip</td>
</tr>
<tr>
<td>EPA-estimated emissions source description</td>
<td>Carried Forward?</td>
<td>EIS Sector Name</td>
<td>Name of supporting data file or other reference</td>
</tr>
<tr>
<td>------------------------------------------</td>
<td>-----------------</td>
<td>----------------</td>
<td>-----------------------------------------------</td>
</tr>
<tr>
<td>Residential Heating; Kerosene</td>
<td></td>
<td>Fuel Comb – Residential – Oil</td>
<td>residential_consumption_kerosene.zip</td>
</tr>
<tr>
<td>Residential Heating; natural gas</td>
<td></td>
<td>Fuel Comb – Residential – Natural Gas</td>
<td>residential_consumption_ng_revised_06222012.zip</td>
</tr>
<tr>
<td>Residential Heating; liquefied petroleum gas</td>
<td></td>
<td>Fuel Comb – Residential – Other</td>
<td>residential_consumption_lpg.zip</td>
</tr>
<tr>
<td>Paved Roads</td>
<td></td>
<td>Dust – Paved Road Dust</td>
<td>roads_paved_2011.zip</td>
</tr>
<tr>
<td>Unpaved Roads</td>
<td></td>
<td>Dust – Unpaved Road Dust</td>
<td>roads_unpaved_2011.zip</td>
</tr>
<tr>
<td>Dust from Residential Construction</td>
<td></td>
<td>Dust – Construction Dust</td>
<td>construction_residential_2011.zip</td>
</tr>
<tr>
<td>Dust from Commercial Institutional</td>
<td></td>
<td>Dust – Construction Dust</td>
<td>construction_nonresidential_2011.zip</td>
</tr>
<tr>
<td>Dust from Road Construction</td>
<td></td>
<td>Dust – Construction Dust</td>
<td>construction_road_2011.zip</td>
</tr>
<tr>
<td>Commercial Cooking</td>
<td></td>
<td>Commercial Cooking</td>
<td>commercial_cooking_2302002nnn_2011.zip</td>
</tr>
<tr>
<td>Mining and Quarrying</td>
<td></td>
<td>Industrial Processes – Mining</td>
<td>mining_and_quarrying.zip</td>
</tr>
<tr>
<td>Architectural Coatings</td>
<td></td>
<td>Solvent – Non-Industrial Surface Coating</td>
<td>surface_coatings_arch_coatings_whaps_2011.zip</td>
</tr>
<tr>
<td>Traffic Markings</td>
<td></td>
<td>Solvent – Industrial Surface Coating &amp; Solvent Use</td>
<td>traffic_markings_whaps_2011.zip</td>
</tr>
<tr>
<td>Railroad surface coating</td>
<td></td>
<td>Solvent - Industrial Surface Coating &amp; Solvent Use</td>
<td>surface_coating_railroad_whaps_2011.zip</td>
</tr>
<tr>
<td>Consumer &amp; Commercial – All personal care products</td>
<td></td>
<td>Solvent – Consumer &amp; Commercial Solvent Use</td>
<td>cons_comm_personal_care_products_whaps_2011.zip</td>
</tr>
<tr>
<td>Consumer &amp; Commercial – All household products</td>
<td></td>
<td>Solvent – Consumer &amp; Commercial Solvent Use</td>
<td>cons_comm_misc_products_whaps_2011.zip</td>
</tr>
<tr>
<td>Consumer &amp; Commercial – All coatings and related products</td>
<td></td>
<td>Solvent – Consumer &amp; Commercial Solvent Use</td>
<td>cons_comm_coatings_and_related_products_whaps_2011.zip</td>
</tr>
<tr>
<td>Consumer &amp; Commercial – All adhesives and sealants</td>
<td></td>
<td>Solvent – Consumer &amp; Commercial Solvent Use</td>
<td>cons_comm_adhesives SEALANTS_whaps_2011.zip</td>
</tr>
<tr>
<td>Consumer &amp; Commercial – All FIFRA related products</td>
<td></td>
<td>Solvent – Consumer &amp; Commercial Solvent Use</td>
<td>cons_comm_fifra_whaps_2011.zip</td>
</tr>
<tr>
<td>Cutback Asphalt Paving</td>
<td>x</td>
<td>Solvent – Consumer &amp; Commercial Solvent Use</td>
<td>asphalt_paving_cutback_2011.zip</td>
</tr>
<tr>
<td>Emulsified Asphalt Paving</td>
<td>x</td>
<td>Solvent – Consumer &amp; Commercial Solvent Use</td>
<td>asphalt_paving_emulsified_2011.zip</td>
</tr>
<tr>
<td>Consumer Pesticide Application</td>
<td></td>
<td>Solvent – Consumer &amp; Commercial Solvent Use</td>
<td>cons_comm_fifra_whaps_2011.zip</td>
</tr>
<tr>
<td>Commercial Pesticide Application</td>
<td>x</td>
<td>Solvent – Consumer &amp; Commercial Solvent Use</td>
<td>agricultural_pesticides_2011_eis_format.zip</td>
</tr>
<tr>
<td>EPA-estimated emissions source description</td>
<td>Carried Forward?</td>
<td>EIS Sector Name</td>
<td>Name of supporting data file or other reference</td>
</tr>
<tr>
<td>-------------------------------------------</td>
<td>-----------------</td>
<td>----------------</td>
<td>-----------------------------------------</td>
</tr>
<tr>
<td>Residential Portable Gas Cans</td>
<td></td>
<td>Miscellaneous Non-Industrial NEC</td>
<td>portable_fuel_containers_2011.zip</td>
</tr>
<tr>
<td>Commercial Portable Gas Cans</td>
<td></td>
<td>Miscellaneous Non-Industrial NEC</td>
<td>portable_fuel_containers_2011.zip</td>
</tr>
<tr>
<td>Aviation Gasoline Stage 1</td>
<td>x</td>
<td>Gas Stations</td>
<td>av_gasoline_distribution_stage1.zip</td>
</tr>
<tr>
<td>Aviation Gasoline Stage 2</td>
<td>x</td>
<td>Gas Stations</td>
<td>av_gasoline_distribution_stage2.zip</td>
</tr>
<tr>
<td>Open Burning – Leaves</td>
<td></td>
<td>Waste Disposal</td>
<td>open_burning_yard_waste_2011.zip</td>
</tr>
<tr>
<td>Open Burning – Brush</td>
<td></td>
<td>Waste Disposal</td>
<td>open_burning_yard_waste_2011.zip</td>
</tr>
<tr>
<td>Publicly Owned Treatment Works</td>
<td></td>
<td>Waste Disposal</td>
<td>potw_2011_rev.zip</td>
</tr>
<tr>
<td>Agricultural Tilling</td>
<td></td>
<td>Agriculture – Crops &amp; Livestock Dust</td>
<td>agricultural_tilling_2801000003_2011.zip</td>
</tr>
<tr>
<td>Fertilizer Application</td>
<td></td>
<td>Agriculture – Fertilizer Application</td>
<td>ag_fertilizer_application_2011.zip</td>
</tr>
<tr>
<td>Animal Husbandry</td>
<td>x</td>
<td>Agriculture – Livestock Waste</td>
<td>animal_livestock_emissions_2011.zip</td>
</tr>
</tbody>
</table>

“Carried Forward” indicates whether EPA data were carried forward from the 2008 or other previous year inventory.

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

<table>
<thead>
<tr>
<th>EPA-estimated emissions source description</th>
<th>Carried Forward?</th>
<th>EIS Sector Name</th>
<th>Link to supporting data file</th>
</tr>
</thead>
<tbody>
<tr>
<td>Industrial, Commercial/Institutional Fuel Combustion</td>
<td></td>
<td>Fuel Comb – Industrial Boilers, ICEs – All Fuels</td>
<td>ici_fuel_combustion_by_state/</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Fuel Comb – Comm/ Institutional – All Fuels</td>
<td></td>
</tr>
<tr>
<td>Industrial Surface Coating – Auto Refinishing</td>
<td></td>
<td>Solvent – Industrial Surface Coating &amp; Solvent Use</td>
<td>surface_coating_automobile_refinishing_2011whaps.zip</td>
</tr>
<tr>
<td>Industrial Surface Coating – Factory Finished Wood</td>
<td></td>
<td>Solvent – Industrial Surface Coating &amp; Solvent Use</td>
<td>surface_coating_factory_finished_wood_2011whaps.zip</td>
</tr>
<tr>
<td>EPA-estimated emissions source description</td>
<td>Carried Forward?</td>
<td>EIS Sector Name</td>
<td>Link to supporting data file</td>
</tr>
<tr>
<td>------------------------------------------</td>
<td>-----------------</td>
<td>----------------</td>
<td>----------------------------</td>
</tr>
<tr>
<td>Industrial Surface Coating – Wood Furniture</td>
<td></td>
<td>Solvent – Industrial Surface Coating &amp; Solvent Use</td>
<td>surface_coating_wood_furniture_2011whaps_rev_4.zip</td>
</tr>
<tr>
<td>Industrial Surface Coating – Metal Furniture</td>
<td></td>
<td>Solvent – Industrial Surface Coating &amp; Solvent Use</td>
<td>surface_coating_metal_furn_2011whaps.zip</td>
</tr>
<tr>
<td>Industrial Surface Coating – Paper Foil and Film</td>
<td></td>
<td>Solvent – Industrial Surface Coating &amp; Solvent Use</td>
<td>surface_coating_paper_film_foil_2011whaps.zip</td>
</tr>
<tr>
<td>Industrial Surface Coating – Metal Can Coating</td>
<td></td>
<td>Solvent – Industrial Surface Coating &amp; Solvent Use</td>
<td>surface_coatings_metal_can_whaps_2011.zip</td>
</tr>
<tr>
<td>Industrial Surface Coating – Machinery and Equipment</td>
<td></td>
<td>Solvent – Industrial Surface Coating &amp; Solvent Use</td>
<td>surface_coating_machinery_and_equip_whaps2011.zip</td>
</tr>
<tr>
<td>Industrial Surface Coating – Large Appliances</td>
<td></td>
<td>Solvent – Industrial Surface Coating &amp; Solvent Use</td>
<td>surface_coating_appliances_2011whaps.zip</td>
</tr>
<tr>
<td>Industrial Surface Coating – Electronic and other Electric Coatings</td>
<td></td>
<td>Solvent – Industrial Surface Coating &amp; Solvent Use</td>
<td>surface_coating_electronic_and_other_electrical_coatings_whaps_2011.zip</td>
</tr>
<tr>
<td>Industrial Surface Coating – Motor Vehicles</td>
<td></td>
<td>Solvent – Industrial Surface Coating &amp; Solvent Use</td>
<td>surface_coating_motor%20vehicles_whaps_2011.zip</td>
</tr>
<tr>
<td>Industrial Surface Coating – Aircraft</td>
<td></td>
<td>Solvent – Industrial Surface Coating &amp; Solvent Use</td>
<td>surface_coating_aircraft_mfg_2011whaps.zip</td>
</tr>
<tr>
<td>Industrial Surface Coating – Marine</td>
<td></td>
<td>Solvent – Industrial Surface Coating &amp; Solvent Use</td>
<td>surface_coating_marine_mfgwhaps2011.zip</td>
</tr>
<tr>
<td>Industrial Surface Coating – Railroad</td>
<td></td>
<td>Solvent – Industrial Surface Coating &amp; Solvent Use</td>
<td>surface_coating_railroad_whaps_2011.zip</td>
</tr>
<tr>
<td>Industrial Surface Coating – Miscellaneous Manufacturing</td>
<td></td>
<td>Solvent – Industrial Surface Coating &amp; Solvent Use</td>
<td>surface_coating_misc_mfg_2011whaps.zip</td>
</tr>
<tr>
<td>Industrial Maintenance Coatings</td>
<td></td>
<td>Solvent – Industrial Surface Coating &amp; Solvent Use</td>
<td>surface_coating_ind_maint_coating_2011whaps.zip</td>
</tr>
<tr>
<td>Other Special Purpose Coatings</td>
<td></td>
<td>Solvent – Industrial Surface Coating &amp; Solvent Use</td>
<td>surface_coating_other_special_purpose_whaps_2011.zip</td>
</tr>
<tr>
<td>Degreasing</td>
<td></td>
<td>Solvent – Degreasing</td>
<td>degreasing_whaps_2011_eisformat.zip</td>
</tr>
<tr>
<td>Graphic Arts</td>
<td></td>
<td>Solvent – Graphic Arts</td>
<td>graphic_arts_w_haps_2011.zip</td>
</tr>
<tr>
<td>Dry Cleaning</td>
<td></td>
<td>Solvent – Dry Cleaning</td>
<td>dry_cleaning_emissions_2011_rev.zip</td>
</tr>
<tr>
<td>Gasoline Distribution – Stage 1 Bulk Plants</td>
<td>x</td>
<td>Bulk Gasoline Terminals</td>
<td>gasoline_distribution_stage_1_bulk_plants_2011.zip</td>
</tr>
<tr>
<td>Gasoline Distribution – Stage 1 Bulk Terminals</td>
<td>x</td>
<td>Bulk Gasoline Terminals</td>
<td>gasoline_distribution_stage%201%20bulk_terminals_2011.zip</td>
</tr>
<tr>
<td>Gasoline Distribution – Stage 1 Pipelines</td>
<td></td>
<td>Industrial Processes – Storage and Transfer</td>
<td>gasoline_distribution_stage_1_pipelines_2011.zip</td>
</tr>
<tr>
<td>Gasoline Distribution – Stage 1 Service Station Unloading</td>
<td></td>
<td>Gas Stations</td>
<td>gasoline_distribution_service_station_unloading_eis_format.zip</td>
</tr>
<tr>
<td>Gasoline Distribution – Stage 1 Underground Storage Tanks</td>
<td></td>
<td>Gas Stations</td>
<td>gasoline_distribution_stage1_ust_2011.zip</td>
</tr>
<tr>
<td>Gasoline Distribution – Stage 1 Trucks In Transit</td>
<td>x</td>
<td>Industrial Processes – Storage and Transfer</td>
<td>gasoline_distribution_stage_1_tank_trucks_2011.zip</td>
</tr>
<tr>
<td>Gasoline Distribution – Stage 2 Refueling at Pump</td>
<td></td>
<td>Gas Stations</td>
<td>gasoline_distribution_stage_2.zip</td>
</tr>
</tbody>
</table>

“Carried Forward” indicates whether EPA data were carried forward from the 2008 or other previous year inventory.
To determine whether EPA nonpoint data should be added for the categories with possible point/nonpoint overlap, EPA used information provided by S/L/T agencies regarding their submitted nonpoint data. Specifically, EPA used a survey of state and local agencies to get details about whether they had performed point/nonpoint reconciliation, whether they did nonpoint estimates for each SCC, what SCCs they used, whether the state had any nonpoint sources in a sector, and whether a state preferred to use EPA estimates. This information was used, in conjunction with a few assumptions, to determine whether EPA should augment the data submitted by the S/L/T agency with EPA-generated data. Using the Industrial Fuel Combustion sector as an example, because the EPA-generated data were based on activity data that would cover all industrial combustion sources (both point and nonpoint), it was necessary to use this methodology so that double counting of emissions would not occur. This comparison was done on a state level basis, except where county agencies are responsible for their own submissions. The algorithm for determining whether to augment data in the 2011 NEI is given in Table 3-11 and Table 3-12.

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

<table>
<thead>
<tr>
<th>Survey Data</th>
<th>State Submitted to Point?</th>
<th>State Submitted to Nonpoint?</th>
<th>EPA Action</th>
<th>Rationale</th>
</tr>
</thead>
<tbody>
<tr>
<td>State indicates that category is fully covered by their point inventory for an SCC</td>
<td>Yes</td>
<td>Yes or No</td>
<td>Do not augment nonpoint data. Tag EPA data so that it does not get put into NEI.</td>
<td>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.</td>
</tr>
<tr>
<td></td>
<td>No</td>
<td>No</td>
<td>Augment with EPA estimates for nonpoint category.</td>
<td>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.</td>
</tr>
<tr>
<td></td>
<td>No</td>
<td>Yes</td>
<td>Do not augment</td>
<td>Assume that they filled out the survey incorrectly, and that they meant that the category is fully covered by nonpoint.</td>
</tr>
<tr>
<td>State indicates that category is fully covered by their nonpoint inventory for an SCC</td>
<td>No</td>
<td>Yes</td>
<td>Do not augment</td>
<td>Augmenting would double count nonpoint emissions.</td>
</tr>
<tr>
<td></td>
<td>No</td>
<td>No</td>
<td>Augment</td>
<td>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.</td>
</tr>
<tr>
<td></td>
<td>Yes</td>
<td>Yes or No</td>
<td>Do not augment</td>
<td>Assume that they filled out the survey incorrectly.</td>
</tr>
<tr>
<td>State indicates that they do point/ nonpoint reconciliation</td>
<td>Yes</td>
<td>No</td>
<td>Augment</td>
<td>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.</td>
</tr>
<tr>
<td>Survey Data</td>
<td>State Submitted to Point?</td>
<td>State Submitted to Nonpoint?</td>
<td>EPA Action</td>
<td>Rationale</td>
</tr>
<tr>
<td>-------------</td>
<td>---------------------------</td>
<td>-------------------------------</td>
<td>------------</td>
<td>-----------</td>
</tr>
<tr>
<td></td>
<td>Yes or No</td>
<td>Yes</td>
<td>Do not augment</td>
<td>No augmentation is necessary, since either both point and nonpoint were submitted, or nonpoint would be double counted.</td>
</tr>
<tr>
<td></td>
<td>No</td>
<td>No</td>
<td>Augment</td>
<td>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.</td>
</tr>
</tbody>
</table>

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

<table>
<thead>
<tr>
<th>Survey Data</th>
<th>State Submitted to Point?</th>
<th>State Submitted to Nonpoint?</th>
<th>EPA Action</th>
<th>Rationale</th>
</tr>
</thead>
<tbody>
<tr>
<td>State indicates that category is fully covered by their point inventory for an SCC</td>
<td>Yes</td>
<td>No</td>
<td>Sum up their submissions for point, and if this number is not very large (the sum of the point submissions are &lt;20% of the EPA estimate for nonpoint), augment their data.</td>
<td>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.</td>
</tr>
<tr>
<td>No</td>
<td>No</td>
<td>Augment</td>
<td></td>
<td>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.</td>
</tr>
<tr>
<td>Yes or No</td>
<td>Yes</td>
<td>Do not augment</td>
<td></td>
<td>Assume that either they filled out the survey incorrectly, or they submitted for both point and nonpoint, and we do not need to augment.</td>
</tr>
<tr>
<td>No</td>
<td>Yes</td>
<td>Do not augment</td>
<td></td>
<td>Augmenting would double count nonpoint emissions.</td>
</tr>
<tr>
<td>No</td>
<td>No</td>
<td>Augment</td>
<td></td>
<td>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.</td>
</tr>
<tr>
<td>Yes</td>
<td>Yes</td>
<td>Do not augment</td>
<td></td>
<td>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.</td>
</tr>
<tr>
<td>Yes</td>
<td>No</td>
<td>Augment</td>
<td></td>
<td>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.</td>
</tr>
<tr>
<td>State claims that they do point/</td>
<td>Yes</td>
<td>No</td>
<td>Augment</td>
<td>Assume that they intended to submit nonpoint. Though there will be some double counting, we believe that their submitted emissions for point would be</td>
</tr>
<tr>
<td>Survey Data</td>
<td>State Submitted to Point?</td>
<td>State Submitted to Nonpoint?</td>
<td>EPA Action</td>
<td>Rationale</td>
</tr>
<tr>
<td>--------------------</td>
<td>---------------------------</td>
<td>------------------------------</td>
<td>------------</td>
<td>---------------------------------------------------------------------------</td>
</tr>
<tr>
<td>nonpoint reconciliation</td>
<td>Yes or No</td>
<td>Yes</td>
<td>Do not augment</td>
<td>No augmentation is necessary, since either both point and nonpoint were submitted, or nonpoint would be double counted.</td>
</tr>
<tr>
<td>nonpoint reconciliation</td>
<td>No</td>
<td>No</td>
<td>Augment</td>
<td>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.</td>
</tr>
</tbody>
</table>

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

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

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

### 3.1.8 References for Stationary sources


3.2 Agriculture – Crops & Livestock Dust

3.2.1 Sector description

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

<table>
<thead>
<tr>
<th>SCC</th>
<th>SCC Level 2</th>
<th>SCC Level 3</th>
<th>SCC Level 4</th>
</tr>
</thead>
<tbody>
<tr>
<td>2801000000</td>
<td>Agriculture Production - Crops</td>
<td>Agriculture - Crops</td>
<td>Total</td>
</tr>
<tr>
<td>2801000002</td>
<td>Agriculture Production - Crops</td>
<td>Agriculture - Crops</td>
<td>Planting</td>
</tr>
<tr>
<td>2801000003</td>
<td>Agriculture Production - Crops</td>
<td>Agriculture - Crops</td>
<td>Tilling</td>
</tr>
<tr>
<td>2801000005</td>
<td>Agriculture Production - Crops</td>
<td>Agriculture - Crops</td>
<td>Harvesting</td>
</tr>
<tr>
<td>2801000008</td>
<td>Agriculture Production - Crops</td>
<td>Agriculture - Crops</td>
<td>Transport</td>
</tr>
<tr>
<td>2801600000</td>
<td>Agriculture Production - Crops</td>
<td>Country Grain Elevators</td>
<td>Total</td>
</tr>
<tr>
<td>2805001000</td>
<td>Agriculture Production - Livestock</td>
<td>Beef cattle - finishing operations on feedlots (drylots)</td>
<td>Dust Kicked-up by Hooves (use 28-05-020, -001, -002, or -003 for Waste)</td>
</tr>
</tbody>
</table>

*SCC Level 1 for all is “Miscellaneous Area Sources”

3.2.2 Sources of data overview and selection hierarchy

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

<table>
<thead>
<tr>
<th>Agency</th>
<th>Type</th>
<th>2801000000</th>
<th>2801000002</th>
<th>2801000003</th>
<th>2801000005</th>
<th>2801000008</th>
<th>2801600000</th>
<th>2805001000</th>
</tr>
</thead>
<tbody>
<tr>
<td>EPA - PM augmentation</td>
<td>EPA</td>
<td>x</td>
<td>x</td>
<td>x</td>
<td>x</td>
<td>0</td>
<td>x</td>
<td>x</td>
</tr>
<tr>
<td>EPA – estimated (section 3.2.4)</td>
<td>EPA</td>
<td>x</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>California Air Resources Board</td>
<td>S</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Coeur d’Alene Tribe</td>
<td>T</td>
<td></td>
<td>x</td>
<td>x</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Connecticut Department Of Environmental Protection</td>
<td>S</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Delaware Department of Natural Resources and Environmental Control</td>
<td>S</td>
<td></td>
<td></td>
<td>x</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Georgia Department of Natural Resources</td>
<td>S</td>
<td>x</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Hawaii Department of Health Clean Air Branch</td>
<td>S</td>
<td>x</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Idaho Department of Environmental Quality</td>
<td>S</td>
<td>x</td>
<td>x</td>
<td>x</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Illinois Environmental Protection Agency</td>
<td>S</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Kansas Department of Health and Environment</td>
<td>S</td>
<td>x</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Kootenai Tribe of Idaho</td>
<td>T</td>
<td>x</td>
<td>x</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Louisiana Department of Environmental Quality</td>
<td>S</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Maricopa County Air Quality Department</td>
<td>L</td>
<td>x</td>
<td>x</td>
<td>x</td>
<td>x</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

63
<table>
<thead>
<tr>
<th>Agency</th>
<th>Type</th>
<th>2801000000</th>
<th>2801000002</th>
<th>2801000003</th>
<th>2801000005</th>
<th>2801000008</th>
<th>2801600000</th>
<th>2805001000</th>
</tr>
</thead>
<tbody>
<tr>
<td>Maryland Department of the Environment</td>
<td>S</td>
<td>x</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Metro Public Health of Nashville/Davidson County</td>
<td>L</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>x</td>
<td></td>
</tr>
<tr>
<td>New Hampshire Department of Environmental Services</td>
<td>S</td>
<td>x</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>New Jersey Department of Environment Protection</td>
<td>S</td>
<td>x</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Nez Perce Tribe</td>
<td>T</td>
<td>x</td>
<td>x</td>
<td>x</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Sac and Fox Nation of Missouri in Kansas and Nebraska Reservation</td>
<td>T</td>
<td>x</td>
<td>x</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Shoshone-Bannock Tribes of the Fort Hall Reservation of Idaho</td>
<td>T</td>
<td>x</td>
<td>x</td>
<td>x</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Utah Division of Air Quality</td>
<td>S</td>
<td>x</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>x</td>
</tr>
<tr>
<td>Virginia Department of Environmental Quality</td>
<td>S</td>
<td>x</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>x</td>
</tr>
<tr>
<td>West Virginia Division of Air Quality</td>
<td>S</td>
<td>x</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>x</td>
</tr>
</tbody>
</table>

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

<table>
<thead>
<tr>
<th>Priority</th>
<th>Dataset Name</th>
<th>Dataset Content</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Responsible Agency Data Set</td>
<td>State and Local Agency submitted emissions</td>
</tr>
<tr>
<td>2</td>
<td>2011EPA_PM-Augmentation</td>
<td>Augments PM emissions</td>
</tr>
<tr>
<td>3</td>
<td>2011EPA_NP_NoOverlap_w_Pt</td>
<td>EPA-generated data</td>
</tr>
</tbody>
</table>

3.2.3 Spatial coverage and data sources for the sector

![Agriculture - Crops & Livestock Dust](image)

3.2.4 EPA-developed agricultural crops and livestock dust emissions data

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

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

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

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

where:

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

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

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

<table>
<thead>
<tr>
<th>Soil Type</th>
<th>Silt Content (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Silt Loam</td>
<td>52</td>
</tr>
<tr>
<td>Sandy Loam</td>
<td>33</td>
</tr>
<tr>
<td>Sand</td>
<td>12</td>
</tr>
<tr>
<td>Loamy Sand</td>
<td>12</td>
</tr>
<tr>
<td>Clay</td>
<td>29</td>
</tr>
<tr>
<td>Clay Loam</td>
<td>29</td>
</tr>
<tr>
<td>Organic Material</td>
<td>10-82</td>
</tr>
<tr>
<td>Loam</td>
<td>40</td>
</tr>
</tbody>
</table>

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

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

<table>
<thead>
<tr>
<th>Crop</th>
<th>Conservation Use</th>
<th>Conventional Use</th>
</tr>
</thead>
<tbody>
<tr>
<td>Barley</td>
<td>3</td>
<td>5</td>
</tr>
<tr>
<td>Beans and Peas</td>
<td>3</td>
<td>3</td>
</tr>
<tr>
<td>Canola</td>
<td>3</td>
<td>3</td>
</tr>
<tr>
<td>Corn</td>
<td>2</td>
<td>6</td>
</tr>
<tr>
<td>Cotton</td>
<td>5</td>
<td>8</td>
</tr>
<tr>
<td>Cover</td>
<td>1</td>
<td>1</td>
</tr>
<tr>
<td>Fallow</td>
<td>1</td>
<td>1</td>
</tr>
<tr>
<td>Fall-seeded Wheat</td>
<td>3</td>
<td>5</td>
</tr>
<tr>
<td>Forage</td>
<td>3</td>
<td>3</td>
</tr>
<tr>
<td>Hay</td>
<td>3</td>
<td>3</td>
</tr>
<tr>
<td>Crop</td>
<td>Conservation Use</td>
<td>Conventional Use</td>
</tr>
<tr>
<td>------------------</td>
<td>------------------</td>
<td>------------------</td>
</tr>
<tr>
<td>Oats</td>
<td>3</td>
<td>5</td>
</tr>
<tr>
<td>Peanuts</td>
<td>3</td>
<td>3</td>
</tr>
<tr>
<td>Permanent Pasture</td>
<td>1</td>
<td>1</td>
</tr>
<tr>
<td>Potatoes</td>
<td>3</td>
<td>3</td>
</tr>
<tr>
<td>Rice</td>
<td>5</td>
<td>5</td>
</tr>
<tr>
<td>Rye</td>
<td>3</td>
<td>5</td>
</tr>
<tr>
<td>Sorghum</td>
<td>1</td>
<td>6</td>
</tr>
<tr>
<td>Soybeans</td>
<td>1</td>
<td>6</td>
</tr>
<tr>
<td>Spring Wheat</td>
<td>1</td>
<td>4</td>
</tr>
<tr>
<td>Sugar beets</td>
<td>3</td>
<td>3</td>
</tr>
<tr>
<td>Sugarcane</td>
<td>3</td>
<td>3</td>
</tr>
<tr>
<td>Sunflowers</td>
<td>3</td>
<td>3</td>
</tr>
<tr>
<td>Tobacco</td>
<td>3</td>
<td>3</td>
</tr>
</tbody>
</table>

**Activity Data**

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

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

<table>
<thead>
<tr>
<th>CRM Category</th>
<th>USDA Data Items</th>
</tr>
</thead>
<tbody>
<tr>
<td>Barley</td>
<td>BARLEY - ACRES HARVESTED</td>
</tr>
<tr>
<td>Beans and Peas</td>
<td>SUM OF BEANS AND PEAS HARVESTED</td>
</tr>
<tr>
<td>Canola</td>
<td>CANOLA - ACRES HARVESTED</td>
</tr>
<tr>
<td>Corn</td>
<td>CORN, GRAIN - ACRES HARVESTED</td>
</tr>
<tr>
<td>Cotton</td>
<td>COTTON - ACRES HARVESTED</td>
</tr>
<tr>
<td>Cover</td>
<td>TOTAL ACRES HARVESTED</td>
</tr>
<tr>
<td>Fallow</td>
<td>TOTAL ACRES HARVESTED</td>
</tr>
<tr>
<td>Forage</td>
<td>FORAGE, ALFALFA, HAY - ACRES HARVESTED</td>
</tr>
<tr>
<td>Hay</td>
<td>FORAGE (EXCL ALFALFA), HAY - ACRES HARVESTED</td>
</tr>
<tr>
<td>Oats</td>
<td>OATS - ACRES HARVESTED</td>
</tr>
<tr>
<td>Peanuts</td>
<td>PEANUTS - ACRES HARVESTED</td>
</tr>
<tr>
<td>Permanent Pasture</td>
<td>TOTAL ACRES HARVESTED</td>
</tr>
<tr>
<td>Potatoes</td>
<td>POTATOES - ACRES HARVESTED</td>
</tr>
<tr>
<td>Rice</td>
<td>RICE - ACRES HARVESTED</td>
</tr>
<tr>
<td>Rye</td>
<td>RYE - ACRES HARVESTED</td>
</tr>
<tr>
<td>Sorghum</td>
<td>SORGHUM, GRAIN - ACRES HARVESTED</td>
</tr>
<tr>
<td>Soybeans</td>
<td>SOYBEANS - ACRES HARVESTED</td>
</tr>
<tr>
<td>Sugar beets</td>
<td>SUGAR BEETS - ACRES HARVESTED</td>
</tr>
<tr>
<td>Sugarcane</td>
<td>SUGARCANE, SUGAR &amp; SEED - ACRES HARVESTED</td>
</tr>
<tr>
<td>Sunflower</td>
<td>SUNFLOWER - ACRES HARVESTED</td>
</tr>
</tbody>
</table>
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 3-20. Due to data nondisclosure agreements with CTIC, the EPA cannot release the county-level tillage data by crop type.

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

The following equation was used to determine the emissions from agricultural tilling [ref 1], [ref 2]. The county-level activity data are the acres of land tilled for a given crop and tilling type. The equation is adjusted to estimate PM$_{10}$ and PM$_{2.5}$ emissions using the following parameters: a particle size multiplier, the silt content of the surface soil, the number of tillings per year for a given crop and tilling type, and the acres of land tilled for a given crop and tilling type.
\[ E = \sum c \times k \times s^{0.6} \times p_{\text{crop,tiling type}} \times a_{\text{crop,tiling type}} \]

where:
- \( E \) = PM10-FIL or PM25-FIL emissions
- \( c \) = constant 4.8 lbs/acre-pass
- \( k \) = dimensionless particle size multiplier (PM10=0.21; PM2.5=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)

Controls

No controls were accounted for in the EPA emission estimations.

3.2.5 Summary of quality assurance methods

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

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

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

3.2.6 References for Agriculture – Crop & Livestock Dust


3.3 Agriculture – Fertilizer Application

3.3.1 Sector description

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

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

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

The agricultural fertilizer application sector includes data from the S/L/T agency submitted data and the default EPA generated agricultural fertilizer emissions. The agencies listed in
Table 3-23 submitted emissions for this sector. Note that not all agencies submitted all of the different fertilizer types. Where only zero emissions were submitted (sum across all pollutants submitted), these are shown as zeroes (“0”) in the table. Table 3-24 shows the selection hierarchy for the agricultural fertilizer application sector.
### Table 3-23: Agencies that submitted Agricultural Fertilizer Application data

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

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

<table>
<thead>
<tr>
<th>Priority</th>
<th>Dataset Name</th>
<th>Dataset Content</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Responsible Agency Data Set</td>
<td>State and Local Agency submitted emissions</td>
</tr>
<tr>
<td>2</td>
<td>2011EPA_NP_NoOverlap_w_Pt</td>
<td>EPA-generated data</td>
</tr>
</tbody>
</table>
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.

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

<table>
<thead>
<tr>
<th>CMU Ammonia Model Fertilizer Group</th>
<th>Commercial Fertilizers Report - Fertilizer Code</th>
<th>Description 1</th>
<th>Description 2</th>
</tr>
</thead>
<tbody>
<tr>
<td>Ammonium Nitrate</td>
<td>10</td>
<td>Ammonium Nitrate</td>
<td>Ammoniumnitrate</td>
</tr>
<tr>
<td>Ammonium Sulfate</td>
<td>24</td>
<td>Ammonium Sulfate</td>
<td>Ammoniumsulfate</td>
</tr>
<tr>
<td>Ammonium Thiosulfate</td>
<td>31</td>
<td>Ammonium Thiosulfate</td>
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</tr>
<tr>
<td>Anhydrous Ammonia</td>
<td>2</td>
<td>Anhydrous Ammonia</td>
<td>Anhy Ammonia</td>
</tr>
<tr>
<td>Aqueous Ammonia</td>
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<td>Aqua Ammonia</td>
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<tr>
<td>Calcium Ammonium Nitrate</td>
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<td>Calcium Ammonium Nit</td>
<td>Calcium Amm Nit</td>
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<td>Diammonium Phosphate</td>
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<td>Diammonium Phosphate</td>
<td>DAP</td>
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<td>Liquid Ammonium Polyphosphate</td>
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<td>Liquid Ammonium Poly</td>
<td>Liq Amm Poly</td>
</tr>
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<td>Miscellaneous</td>
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<td>Ammonium Nitrate Sol</td>
<td>Amm Nit Solution</td>
</tr>
<tr>
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<td>13</td>
<td>Ammonium Nitrate-Lim</td>
<td>Amm Nit Lime Mix</td>
</tr>
<tr>
<td></td>
<td>16</td>
<td>Ammonium Nitrate-Sul</td>
<td>Ammoniumnit-Sul</td>
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<tr>
<td></td>
<td>20</td>
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<td>Ammonium Sulfate Sol</td>
<td>Amm Sul Solution</td>
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<td></td>
<td>27</td>
<td>Ammonium Sulfate-Nit</td>
<td>Ammoniumsul-Nit</td>
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<td>Ammonium Sulfate-Ure</td>
<td>Ammoniumsul-Urea</td>
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<tr>
<td></td>
<td>46</td>
<td>Calcium Nitrate-Urea</td>
<td>Calcium Nit-Urea</td>
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<tr>
<td></td>
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<td>Magnesium Nitrate</td>
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<td>Nitric Acid</td>
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<td>Sodium Nitrate</td>
<td>Sodium Nitrate</td>
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<td>Sulfur Coated Urea</td>
<td>Sul Ctd Urea</td>
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<td>67</td>
<td>Urea Solution</td>
<td>Urea Solution</td>
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<td>68</td>
<td>Urea-Formaldehyde</td>
<td>Urea-Form</td>
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<td>97</td>
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<td></td>
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<td>241</td>
<td>Nitric Phosphate</td>
<td>Nitric Phos</td>
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<td>413</td>
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<td>458</td>
<td>Potassium-Sodium Nit</td>
<td>Pot-Sod Nitrate</td>
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<tr>
<td></td>
<td>617</td>
<td>Fish Scrap</td>
<td>Fish Scrap</td>
</tr>
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<td></td>
<td>629</td>
<td>Guano</td>
<td>Guano</td>
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<tr>
<td></td>
<td>649</td>
<td>Manure</td>
<td>Manure</td>
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<td>652</td>
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<td>Peat</td>
</tr>
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<td>Sewage Sludge, Activ</td>
<td>Act Sew Sludge</td>
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<td>Ht Driedsew Slge</td>
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<td>667</td>
<td>Sewage Sludge, Other</td>
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<td>Tankage, Animal</td>
<td>Animal Tankage</td>
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<td></td>
<td>675</td>
<td>Tankage, Process</td>
<td>Process Tankage</td>
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</tbody>
</table>
The average nitrogen content for each fertilizer group, reported in Table 3-26, was calculated by summing the county-level fertilizer quantities for all counties from the CMU Ammonia Model activity files to generate total nitrogen applied. For each fertilizer group, the total nitrogen applied was then divided by the 2002 fertilizer consumption data from the 2002 Commercial Fertilizers report to obtain the percent nitrogen content for each fertilizer group. For any county with fertilizer consumption in 2007, but not in 2002, the fertilizer quantity obtained from the 2007 Commercial Fertilizer’s report was multiplied by the percent nitrogen content of each fertilizer group to determine tons of nitrogen. The tons of nitrogen were then converted to kilograms and allocated temporally by month according to the state-level percentage of total fertilizer in that group applied each month. The state-level percentage was calculated using data in the CMU Ammonia Model input files.

<table>
<thead>
<tr>
<th>Fertilizer</th>
<th>Nitrogen Content (percent)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Ammonium Nitrate</td>
<td>36</td>
</tr>
<tr>
<td>Ammonium Sulfate</td>
<td>22</td>
</tr>
<tr>
<td>Ammonium Thiosulfate</td>
<td>12</td>
</tr>
<tr>
<td>Anhydrous Ammonia</td>
<td>82</td>
</tr>
<tr>
<td>Aqueous Ammonia</td>
<td>21</td>
</tr>
<tr>
<td>Calcium Ammonium Nitrate</td>
<td>17</td>
</tr>
<tr>
<td>Diammonium Phosphate</td>
<td>18</td>
</tr>
<tr>
<td>Liquid Ammonium Polyphosphate</td>
<td>10</td>
</tr>
<tr>
<td>Miscellaneous</td>
<td>8</td>
</tr>
<tr>
<td>Mix</td>
<td>12</td>
</tr>
</tbody>
</table>
Table 3-27: Fertilizer NH3 emission factors

<table>
<thead>
<tr>
<th>Fertilizer Description</th>
<th>Emission Factor (varies by county for some fertilizers)</th>
<th>Emission Factor Unit</th>
<th>Emission Factor Reference</th>
</tr>
</thead>
<tbody>
<tr>
<td>Ammonium Nitrate</td>
<td>Min=1.0 Max=3.0 Average=1.91 % N volatized as NH3</td>
<td>% N volatized as NH3</td>
<td>1</td>
</tr>
<tr>
<td>Ammonium Sulfate</td>
<td>Min=5.0 Max=15.0 Average=9.53 % N volatized as NH3</td>
<td>% N volatized as NH3</td>
<td>1</td>
</tr>
<tr>
<td>Ammonium Thiosulfate</td>
<td>Min=2.5 Max=2.5 Average=2.5 % N volatized as NH3</td>
<td>% N volatized as NH3</td>
<td>1</td>
</tr>
<tr>
<td>Anhydrous Ammonia</td>
<td>Min=4.0 Max=4.0 Average=4.0 % N volatized as NH3</td>
<td>% N volatized as NH3</td>
<td>1</td>
</tr>
<tr>
<td>Aqueous Ammonia</td>
<td>Min=4.0 Max=4.0 Average=4.0 % N volatized as NH3</td>
<td>% N volatized as NH3</td>
<td>1</td>
</tr>
<tr>
<td>Calcium Ammonium Nitrate</td>
<td>Min=1.0 Max=3.0 Average=1.91 % N volatized as NH3</td>
<td>% N volatized as NH3</td>
<td>1</td>
</tr>
<tr>
<td>Diammonium Phosphate</td>
<td>Min=5.0 Max=5.0 Average=5.0 % N volatized as NH3</td>
<td>% N volatized as NH3</td>
<td>1</td>
</tr>
<tr>
<td>Liquid Ammonium Polyphosphate</td>
<td>Min=5.0 Max=5.0 Average=5.0 % N volatized as NH3</td>
<td>% N volatized as NH3</td>
<td>1</td>
</tr>
<tr>
<td>Miscellaneous Fertilizers</td>
<td>Min=6.0 Max=8.0 Average=6.59 % N volatized as NH3</td>
<td>% N volatized as NH3</td>
<td>1</td>
</tr>
<tr>
<td>Monoammonium Phosphate</td>
<td>Min=5.0 Max=5.0 Average=5.0 % N volatized as NH3</td>
<td>% N volatized as NH3</td>
<td>1</td>
</tr>
<tr>
<td>Nitrogen Solutions</td>
<td>Min=8.0 Max=8.0 Average=8.0 % N volatized as NH3</td>
<td>% N volatized as NH3</td>
<td>1</td>
</tr>
<tr>
<td>N-P-K (multi-grade nutrient fertilizers)</td>
<td>Min=1.0 Max=3.0 Average=1.91 % N volatized as NH3</td>
<td>% N volatized as NH3</td>
<td>1</td>
</tr>
<tr>
<td>Potassium Nitrate</td>
<td>Min=2.0 Max=2.0 Average=2.0 % N volatized as NH3</td>
<td>% N volatized as NH3</td>
<td>1</td>
</tr>
<tr>
<td>Urea</td>
<td>Min=15.0 Max=20.0 Average=15.8 % N volatized as NH3</td>
<td>% N volatized as NH3</td>
<td>1</td>
</tr>
</tbody>
</table>

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.

\[ \text{N applied} \times \% \text{ N volatized as NH}_3 \times \frac{17 \text{ g}}{14 \text{ g}} = \text{NH}_3 \text{ emissions} \]

Sample Calculations

**Allocation of Fertilizer Quantities from Unknown Counties**

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

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

Growing the CMU Ammonia Model Input Files

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

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

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

<table>
<thead>
<tr>
<th>Month</th>
<th>Applied</th>
<th>Percent Change</th>
<th>Nitrogen (kg)</th>
</tr>
</thead>
<tbody>
<tr>
<td>July</td>
<td>3,250 kg</td>
<td>1.09</td>
<td>3,543 kg</td>
</tr>
<tr>
<td>August</td>
<td>3,210 kg</td>
<td>1.09</td>
<td>3,499 kg</td>
</tr>
<tr>
<td>September</td>
<td>9,640 kg</td>
<td>1.09</td>
<td>10,508 kg</td>
</tr>
<tr>
<td>October</td>
<td>6,320 kg</td>
<td>1.09</td>
<td>6,889 kg</td>
</tr>
<tr>
<td>November</td>
<td>2,600 kg</td>
<td>1.09</td>
<td>2,834 kg</td>
</tr>
<tr>
<td>December</td>
<td>1,380 kg</td>
<td>1.09</td>
<td>1,504 kg</td>
</tr>
</tbody>
</table>

Calculation of Nitrogen Content in a Fertilizer Group

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

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

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

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

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

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

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

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

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

<table>
<thead>
<tr>
<th>Agency</th>
<th>Number of Values Tagged</th>
<th>Tag Reason</th>
</tr>
</thead>
<tbody>
<tr>
<td>Georgia Department of Natural Resources</td>
<td>2,226</td>
<td>State requested that we replace their submitted data with EPA’s estimates.</td>
</tr>
<tr>
<td>Louisiana Department of Environmental Quality</td>
<td>256</td>
<td>State requested that we replace their data with EPA estimates.</td>
</tr>
<tr>
<td>West Virginia Division of Air Quality</td>
<td>1</td>
<td>Outlier</td>
</tr>
</tbody>
</table>

3.3.6 References for Agriculture – Fertilizer Application


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.\textsuperscript{12}

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

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

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

\textsuperscript{12} California does have some point sources appropriately assigned to 30202001.
<table>
<thead>
<tr>
<th>SCC</th>
<th>SCC Level Two</th>
<th>SCC Level Three</th>
<th>SCC Level Four</th>
<th>EPA</th>
<th>Local</th>
<th>State</th>
<th>Tribe</th>
</tr>
</thead>
<tbody>
<tr>
<td>2805018000</td>
<td>Agriculture Production Livestock</td>
<td>Dairy cattle composite</td>
<td>Not Elsewhere Classified</td>
<td></td>
<td></td>
<td></td>
<td>X</td>
</tr>
<tr>
<td>2805019100</td>
<td>Agriculture Production Livestock</td>
<td>Dairy cattle - flush dairy</td>
<td>Confinement</td>
<td></td>
<td>X</td>
<td>X</td>
<td>X</td>
</tr>
<tr>
<td>2805019200</td>
<td>Agriculture Production Livestock</td>
<td>Dairy cattle - flush dairy</td>
<td>Manure handling and storage</td>
<td>X</td>
<td>X</td>
<td>X</td>
<td></td>
</tr>
<tr>
<td>2805019300</td>
<td>Agriculture Production Livestock</td>
<td>Dairy cattle - flush dairy</td>
<td>Land application of manure</td>
<td></td>
<td>X</td>
<td>X</td>
<td></td>
</tr>
<tr>
<td>2805020000</td>
<td>Agriculture Production Livestock</td>
<td>Cattle and Calves Waste Emissions</td>
<td>Total (see also 28-05-001, -002, -003)</td>
<td></td>
<td></td>
<td></td>
<td>X</td>
</tr>
<tr>
<td>2805021100</td>
<td>Agriculture Production Livestock</td>
<td>Dairy cattle - scrape dairy</td>
<td>Confinement</td>
<td></td>
<td>X</td>
<td>X</td>
<td>X</td>
</tr>
<tr>
<td>2805021200</td>
<td>Agriculture Production Livestock</td>
<td>Dairy cattle - scrape dairy</td>
<td>Manure handling and storage</td>
<td>X</td>
<td>X</td>
<td>X</td>
<td></td>
</tr>
<tr>
<td>2805021300</td>
<td>Agriculture Production Livestock</td>
<td>Dairy cattle - scrape dairy</td>
<td>Land application of manure</td>
<td></td>
<td>X</td>
<td>X</td>
<td></td>
</tr>
<tr>
<td>2805022100</td>
<td>Agriculture Production Livestock</td>
<td>Dairy cattle - deep pit dairy</td>
<td>Confinement</td>
<td></td>
<td>X</td>
<td>X</td>
<td>X</td>
</tr>
<tr>
<td>2805022200</td>
<td>Agriculture Production Livestock</td>
<td>Dairy cattle - deep pit dairy</td>
<td>Manure handling and storage</td>
<td></td>
<td>X</td>
<td>X</td>
<td>X</td>
</tr>
<tr>
<td>2805022300</td>
<td>Agriculture Production Livestock</td>
<td>Dairy cattle - deep pit dairy</td>
<td>Land application of manure</td>
<td></td>
<td>X</td>
<td>X</td>
<td></td>
</tr>
<tr>
<td>2805023100</td>
<td>Agriculture Production Livestock</td>
<td>Dairy cattle - drylot/pasture dairy</td>
<td>Confinement</td>
<td></td>
<td>X</td>
<td>X</td>
<td>X</td>
</tr>
<tr>
<td>2805023200</td>
<td>Agriculture Production Livestock</td>
<td>Dairy cattle - drylot/pasture dairy</td>
<td>Manure handling and storage</td>
<td></td>
<td>X</td>
<td>X</td>
<td></td>
</tr>
<tr>
<td>2805023300</td>
<td>Agriculture Production Livestock</td>
<td>Dairy cattle - drylot/pasture dairy</td>
<td>Land application of manure</td>
<td></td>
<td>X</td>
<td>X</td>
<td></td>
</tr>
<tr>
<td>2805025000</td>
<td>Agriculture Production Livestock</td>
<td>Swine production composite</td>
<td>Not Elsewhere Classified (see also 28-05-039, -047, -053)</td>
<td>0</td>
<td>X</td>
<td></td>
<td>0</td>
</tr>
<tr>
<td>2805030000</td>
<td>Agriculture Production Livestock</td>
<td>Poultry Waste Emissions</td>
<td>Not Elsewhere Classified (see also 28-05-007, -008, -009)</td>
<td>X</td>
<td>X</td>
<td>X</td>
<td></td>
</tr>
<tr>
<td>2805030001</td>
<td>Agriculture Production Livestock</td>
<td>Poultry Waste Emissions</td>
<td>Pullet Chicks and Pullets less than 13 weeks old</td>
<td></td>
<td></td>
<td></td>
<td>0</td>
</tr>
<tr>
<td>2805030002</td>
<td>Agriculture Production Livestock</td>
<td>Poultry Waste Emissions</td>
<td>Pullets 13 weeks old and older but less than 20 weeks old</td>
<td></td>
<td></td>
<td></td>
<td>0</td>
</tr>
<tr>
<td>2805030003</td>
<td>Agriculture Production Livestock</td>
<td>Poultry Waste Emissions</td>
<td>Layers</td>
<td></td>
<td></td>
<td></td>
<td>0</td>
</tr>
<tr>
<td>2805030004</td>
<td>Agriculture Production Livestock</td>
<td>Poultry Waste Emissions</td>
<td>Broilers</td>
<td></td>
<td></td>
<td></td>
<td>0</td>
</tr>
<tr>
<td>2805030007</td>
<td>Agriculture Production Livestock</td>
<td>Poultry Waste Emissions</td>
<td>Ducks</td>
<td>X</td>
<td>X</td>
<td></td>
<td>X</td>
</tr>
<tr>
<td>2805030008</td>
<td>Agriculture Production Livestock</td>
<td>Poultry Waste Emissions</td>
<td>Geese</td>
<td>X</td>
<td>X</td>
<td></td>
<td>X</td>
</tr>
<tr>
<td>2805030009</td>
<td>Agriculture Production Livestock</td>
<td>Poultry Waste Emissions</td>
<td>Turkeys</td>
<td></td>
<td></td>
<td></td>
<td>0</td>
</tr>
</tbody>
</table>
Table 3-30: Point SCCs with 2011 NEI emissions in the Livestock Waste sector – reported only by States

<table>
<thead>
<tr>
<th>SCC</th>
<th>SCC Level Two</th>
<th>SCC Level Three</th>
<th>SCC Level Four</th>
<th>EPA</th>
<th>Local</th>
<th>State</th>
<th>Tribe</th>
</tr>
</thead>
<tbody>
<tr>
<td>2805035000</td>
<td>Agriculture Production Livestock</td>
<td>Horses and Ponies Waste Emissions</td>
<td>Not Elsewhere Classified</td>
<td>X</td>
<td>X</td>
<td>X</td>
<td>X</td>
</tr>
<tr>
<td>2805039100</td>
<td>Agriculture Production Livestock</td>
<td>Swine production - operations with lagoons (unspecified animal age)</td>
<td>Confinement</td>
<td>X</td>
<td>X</td>
<td>X</td>
<td>X</td>
</tr>
<tr>
<td>2805039200</td>
<td>Agriculture Production Livestock</td>
<td>Swine production - operations with lagoons (unspecified animal age)</td>
<td>Manure handling and storage</td>
<td>X</td>
<td>X</td>
<td></td>
<td>X</td>
</tr>
<tr>
<td>2805039300</td>
<td>Agriculture Production Livestock</td>
<td>Sheep and Lambs Waste Emissions</td>
<td>Total</td>
<td>X</td>
<td>X</td>
<td>X</td>
<td></td>
</tr>
<tr>
<td>2805040000</td>
<td>Agriculture Production Livestock</td>
<td>Goats Waste Emissions</td>
<td>Not Elsewhere Classified</td>
<td>X</td>
<td>X</td>
<td>X</td>
<td>X</td>
</tr>
<tr>
<td>2805040002</td>
<td>Agriculture Production Livestock</td>
<td>Goats Waste Emissions</td>
<td>Angora Goats</td>
<td></td>
<td></td>
<td></td>
<td>0</td>
</tr>
<tr>
<td>2805040003</td>
<td>Agriculture Production Livestock</td>
<td>Goats Waste Emissions</td>
<td>Milk Goats</td>
<td></td>
<td></td>
<td></td>
<td>0</td>
</tr>
<tr>
<td>2805047100</td>
<td>Agriculture Production Livestock</td>
<td>Swine production - deep-pit house operations (unspecified animal age)</td>
<td>Confinement</td>
<td>X</td>
<td>X</td>
<td></td>
<td>X</td>
</tr>
<tr>
<td>2805047300</td>
<td>Agriculture Production Livestock</td>
<td>Swine production - deep-pit house operations (unspecified animal age)</td>
<td>Land application of manure</td>
<td>X</td>
<td>X</td>
<td></td>
<td>X</td>
</tr>
<tr>
<td>2805053100</td>
<td>Agriculture Production Livestock</td>
<td>Swine production - outdoor operations (unspecified animal age)</td>
<td>Confinement</td>
<td>X</td>
<td>X</td>
<td></td>
<td>X</td>
</tr>
<tr>
<td>2806010000</td>
<td>Domestic Animals Waste Emissions</td>
<td>Cats</td>
<td>Total</td>
<td>X</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>2806015000</td>
<td>Domestic Animals Waste Emissions</td>
<td>Dogs</td>
<td>Total</td>
<td>X</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>2807025000</td>
<td>Wild Animals Waste Emissions</td>
<td>Elk</td>
<td>Total</td>
<td>X</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>2807030000</td>
<td>Wild Animals Waste Emissions</td>
<td>Deer</td>
<td>Total</td>
<td></td>
<td></td>
<td></td>
<td>X</td>
</tr>
</tbody>
</table>

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

<table>
<thead>
<tr>
<th>SCC</th>
<th>SCC Level Two</th>
<th>SCC Level Three</th>
<th>SCC Level Four</th>
<th>CA</th>
<th>CO</th>
<th>WI</th>
</tr>
</thead>
<tbody>
<tr>
<td>30202001</td>
<td>Food and Agriculture</td>
<td>Beef Cattle Feedlots</td>
<td>Feedlots: General</td>
<td>X</td>
<td>X</td>
<td>X</td>
</tr>
<tr>
<td>30202101</td>
<td>Food and Agriculture</td>
<td>Eggs and Poultry Production</td>
<td>Manure Handling: Dry</td>
<td></td>
<td></td>
<td>X</td>
</tr>
</tbody>
</table>

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

Table 3-31: Agencies that submitted Livestock Waste data

<table>
<thead>
<tr>
<th>Agency</th>
<th>Type</th>
</tr>
</thead>
<tbody>
<tr>
<td>California Air Resources Board</td>
<td>State</td>
</tr>
<tr>
<td>Clark County Department of Air Quality and Environmental Management</td>
<td>Local</td>
</tr>
<tr>
<td>Connecticut Department Of Environmental Protection</td>
<td>State</td>
</tr>
<tr>
<td>Delaware Department of Natural Resources and Environmental Control</td>
<td>State</td>
</tr>
</tbody>
</table>
Table 3-32 shows the selection hierarchy that applies to the nonpoint datasets included in this sector. The point source datasets are not included in the table. The point hierarchy includes the EPA PM-Augmentation dataset first, the Responsible Agency Data Set second, and the other EPA datasets behind the Responsible Agency Data Set.

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

<table>
<thead>
<tr>
<th>Priority</th>
<th>Dataset Name</th>
<th>Dataset Content</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Responsible Agency Data Set</td>
<td>State and Local Agency submitted emissions</td>
</tr>
<tr>
<td>2</td>
<td>2011EPA_PM-Augmentation</td>
<td>Augments PM emissions</td>
</tr>
<tr>
<td>3</td>
<td>2011EPA_NP_NoOverlap_w_Pt</td>
<td>EPA-generated data</td>
</tr>
</tbody>
</table>
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.

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.

**Apportion activity data to manure management trains**

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

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

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

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

**Emission Factors**

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

<table>
<thead>
<tr>
<th>Description</th>
<th>Emission Factor</th>
<th>Emission Factor Unit</th>
<th>Emission Factor Reference</th>
</tr>
</thead>
<tbody>
<tr>
<td>Beef Cattle – Composite</td>
<td>county</td>
<td>kg NH₃/cow/month</td>
<td>ref 5</td>
</tr>
<tr>
<td>Beef Cattle – Drylot Operation – Confinement</td>
<td>9.45E-01</td>
<td>kg NH₃/cow/month</td>
<td>ref 1</td>
</tr>
<tr>
<td>Beef Cattle – Drylot Operation – Land Application</td>
<td>state</td>
<td>kg NH₃/cow/month</td>
<td>ref 1</td>
</tr>
<tr>
<td>Beef Cattle – Drylot Operation – Manure Storage</td>
<td>3.78E-04</td>
<td>kg NH₃/cow/month</td>
<td>ref 1</td>
</tr>
<tr>
<td>Beef Cattle – Pasture Operation – Confinement</td>
<td>county</td>
<td>kg NH₃/cow/month</td>
<td>ref 1</td>
</tr>
<tr>
<td>Dairy Cattle – Composite</td>
<td>county</td>
<td>kg NH₃/cow/month</td>
<td>ref 5</td>
</tr>
<tr>
<td>Dairy Cattle – Deep Pit Dairy Confinement</td>
<td>2.42E+00</td>
<td>kg NH₃/cow/month</td>
<td>ref 1</td>
</tr>
<tr>
<td>Dairy Cattle – Deep Pit Dairy Land Application</td>
<td>state</td>
<td>kg NH₃/cow/month</td>
<td>ref 1</td>
</tr>
<tr>
<td>Dairy Cattle – Deep Pit Dairy Manure Storage</td>
<td>1.13E-01</td>
<td>kg NH₃/cow/month</td>
<td>ref 1</td>
</tr>
<tr>
<td>Dairy Cattle – Drylot Dairy Confinement</td>
<td>state</td>
<td>kg NH₃/cow/month</td>
<td>ref 1</td>
</tr>
<tr>
<td>Dairy Cattle – Drylot Dairy Land Application</td>
<td>state</td>
<td>kg NH₃/cow/month</td>
<td>ref 1</td>
</tr>
<tr>
<td>Dairy Cattle – Drylot Dairy Manure Storage</td>
<td>2.00E+00</td>
<td>kg NH₃/cow/month</td>
<td>ref 1</td>
</tr>
<tr>
<td>Dairy Cattle – Flush Dairy Confinement</td>
<td>state</td>
<td>kg NH₃/cow/month</td>
<td>ref 1</td>
</tr>
<tr>
<td>Dairy Cattle – Flush Dairy Land Application</td>
<td>state</td>
<td>kg NH₃/cow/month</td>
<td>ref 1</td>
</tr>
<tr>
<td>Dairy Cattle – Flush Dairy Manure Storage</td>
<td>state</td>
<td>kg NH₃/cow/month</td>
<td>ref 1</td>
</tr>
<tr>
<td>Dairy Cattle – Scrape Dairy Confinement</td>
<td>state</td>
<td>kg NH₃/cow/month</td>
<td>ref 1</td>
</tr>
<tr>
<td>Dairy Cattle – Scrape Dairy Land Application</td>
<td>state</td>
<td>kg NH₃/cow/month</td>
<td>ref 1</td>
</tr>
<tr>
<td>Dairy Cattle – Scrape Dairy Manure Storage</td>
<td>state</td>
<td>kg NH₃/cow/month</td>
<td>ref 1</td>
</tr>
<tr>
<td>Ducks</td>
<td>7.67E-02</td>
<td>kg NH₃/duck/month</td>
<td>ref 1</td>
</tr>
<tr>
<td>Geese</td>
<td>7.67E-02</td>
<td>kg NH₃/goose/month</td>
<td>ref 1</td>
</tr>
<tr>
<td>Goats</td>
<td>5.29E-01</td>
<td>kg NH₃/goat/month</td>
<td>ref 1</td>
</tr>
<tr>
<td>Horses</td>
<td>1.02E+00</td>
<td>kg NH₃/horse/month</td>
<td>ref 1</td>
</tr>
<tr>
<td>Poultry – Broiler Operation – Confinement</td>
<td>8.32E-03</td>
<td>kg NH₃/bird/month</td>
<td>ref 1</td>
</tr>
<tr>
<td>Poultry – Broiler Operation – Land Application</td>
<td>6.80E-03</td>
<td>kg NH₃/bird/month</td>
<td>ref 1</td>
</tr>
<tr>
<td>Poultry – Broiler Operation – Manure Storage</td>
<td>1.51E-03</td>
<td>kg NH₃/bird/month</td>
<td>ref 1</td>
</tr>
<tr>
<td>Poultry – Composite</td>
<td>2.00E-02</td>
<td>kg NH₃/bird/month</td>
<td>ref 4</td>
</tr>
<tr>
<td>Poultry – Layers – Dry Manure Operation – Confinement</td>
<td>1.36E-02</td>
<td>kg NH₃/bird/month</td>
<td>ref 1</td>
</tr>
<tr>
<td>Poultry – Layers – Dry Manure Operation – Land Application</td>
<td>county</td>
<td>kg NH₃/bird/month</td>
<td>ref 1</td>
</tr>
<tr>
<td>Poultry – Layers – Wet Manure Operation – Confinement</td>
<td>9.45E-03</td>
<td>kg NH₃/bird/month</td>
<td>ref 1</td>
</tr>
<tr>
<td>Description</td>
<td>Emission Factor</td>
<td>Emission Factor Unit</td>
<td>Reference</td>
</tr>
<tr>
<td>--------------------------------------------------</td>
<td>-----------------</td>
<td>----------------------------</td>
<td>-----------</td>
</tr>
<tr>
<td>Poultry – Layers – Wet Manure Operation – Land Application</td>
<td>county</td>
<td>kg NH₃/bird/month</td>
<td>ref 1</td>
</tr>
<tr>
<td>Poultry – Layers – Wet Manure Operation – Manure Storage</td>
<td>county</td>
<td>kg NH₃/bird/month</td>
<td>ref 1</td>
</tr>
<tr>
<td>Poultry – Turkey Operation – Confinement</td>
<td>3.78E-02</td>
<td>kg NH₃/bird/month</td>
<td>ref 1</td>
</tr>
<tr>
<td>Poultry – Turkey Operation – Land Application</td>
<td>3.40E-02</td>
<td>kg NH₃/bird/month</td>
<td>ref 1</td>
</tr>
<tr>
<td>Poultry – Turkey Operation – Storage</td>
<td>6.80E-03</td>
<td>kg NH₃/bird/month</td>
<td>ref 1</td>
</tr>
<tr>
<td>Sheep</td>
<td>2.65E-01</td>
<td>kg NH₃/sheep/month</td>
<td>ref 1</td>
</tr>
<tr>
<td>Swine – Composite</td>
<td>county</td>
<td>kg NH₃/pig/month</td>
<td>ref 1</td>
</tr>
<tr>
<td>Swine – Deep Pit Operation – Confinement</td>
<td>2.65E-01</td>
<td>kg NH₃/pig/month</td>
<td>ref 1</td>
</tr>
<tr>
<td>Swine – Deep Pit Operation – Land Application</td>
<td>county</td>
<td>kg NH₃/pig/month</td>
<td>ref 1</td>
</tr>
<tr>
<td>Swine – Lagoon Operation – Confinement</td>
<td>2.27E-01</td>
<td>kg NH₃/pig/month</td>
<td>ref 1</td>
</tr>
<tr>
<td>Swine – Lagoon Operation – Land Application</td>
<td>county</td>
<td>kg NH₃/pig/month</td>
<td>ref 1</td>
</tr>
<tr>
<td>Swine – Lagoon Operation – Manure Storage</td>
<td>county</td>
<td>kg NH₃/pig/month</td>
<td>ref 1</td>
</tr>
<tr>
<td>Swine – Outdoor Operation – Confinement</td>
<td>county</td>
<td>kg NH₃/pig/month</td>
<td>ref 1</td>
</tr>
</tbody>
</table>

**Emissions**

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

**Sample Calculations**

*Allocation of Undisclosed Data*

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

Total number of beef cattle undisclosed at the county-level = 678,949 – 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.

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

3.4.5 Summary of quality assurance methods

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

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

3.4.6 References for Agriculture – Livestock Waste


3.5 Bulk Gasoline Terminals and Gas Stations

3.5.1 Sector description

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

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

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

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

3.5.2 Source of data overview and selection hierarchy

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

<table>
<thead>
<tr>
<th>Priority</th>
<th>Dataset Name</th>
<th>Dataset Content</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>2011EPA_PM-Augmentation</td>
<td>Augments PM data in 47 states and some tribes</td>
</tr>
<tr>
<td>2</td>
<td>Responsible Agency Data Set</td>
<td>State and Local Agency submitted emissions</td>
</tr>
<tr>
<td>4</td>
<td>2011EPA_HAP-Augmentation</td>
<td>Adds Pb and other HAP emissions in 46 states</td>
</tr>
<tr>
<td>5</td>
<td>2011EPA_NP_Overlap_w_Pt</td>
<td>EPA-generated data</td>
</tr>
</tbody>
</table>
Table 3-36: Agencies that submitted data for the sector Bulk Gasoline Terminals and Gasoline Stations

<table>
<thead>
<tr>
<th>Agency Name</th>
<th>Bulk Gasoline Terminals</th>
<th>Gasoline Stations</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Point</td>
<td>Point</td>
</tr>
<tr>
<td>Alabama Department of Environmental Management</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Alaska Department of Environmental Conservation</td>
<td>X</td>
<td></td>
</tr>
<tr>
<td>City of Albuquerque</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Allegheny County Health Department</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Arkansas Department of Environmental Quality</td>
<td></td>
<td></td>
</tr>
<tr>
<td>California Air Resources Board</td>
<td>X</td>
<td>X</td>
</tr>
<tr>
<td>Chattanooga Air Pollution Control Bureau (CHCAPCB)</td>
<td>X</td>
<td></td>
</tr>
<tr>
<td>Clark County Department of Air Quality and Environmental Management</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Colorado Department of Public Health and Environment</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Connecticut Department Of Environmental Protection</td>
<td></td>
<td></td>
</tr>
<tr>
<td>DC-District Department of the Environment</td>
<td>X</td>
<td></td>
</tr>
<tr>
<td>Delaware Department of Natural Resources and Environmental Control</td>
<td></td>
<td></td>
</tr>
<tr>
<td>HAP Augmentation EPA</td>
<td></td>
<td></td>
</tr>
<tr>
<td>No Overlap EPA</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Overlap EPA</td>
<td></td>
<td></td>
</tr>
<tr>
<td>PM Augmentation EPA</td>
<td></td>
<td></td>
</tr>
<tr>
<td>TRI EPA</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Florida Department of Environmental Protection</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Georgia Department of Natural Resources</td>
<td>X</td>
<td>X</td>
</tr>
<tr>
<td>Hawaii Department of Health Clean Air Branch</td>
<td>X</td>
<td></td>
</tr>
<tr>
<td>Iowa Department of Natural Resources</td>
<td>X</td>
<td></td>
</tr>
<tr>
<td>Idaho Department of Environmental Quality</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Illinois Environmental Protection Agency</td>
<td>X</td>
<td>X</td>
</tr>
<tr>
<td>Indiana Department of Environmental Management</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Jefferson County (AL) Department of Health</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Knox County Department of Air Quality Management</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Kansas Department of Health and Environment</td>
<td>X</td>
<td>X</td>
</tr>
<tr>
<td>Kentucky Division for Air Quality</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Louisiana Department of Environmental Quality</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Louisville Metro Air Pollution Control District</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Massachusetts Department of Environmental Protection</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Maricopa County Air Quality Department</td>
<td>X</td>
<td>X</td>
</tr>
<tr>
<td>Maryland Department of the Environment</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Mecklenburg County Air Quality</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Maine Department of Environmental Protection</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Memphis and Shelby County Health Department - Pollution Control</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Michigan Department of Environmental Quality</td>
<td>X</td>
<td>X</td>
</tr>
<tr>
<td>Agency Name</td>
<td>Bulk Gasoline Terminals</td>
<td>Gasoline Stations</td>
</tr>
<tr>
<td>----------------------------------------------------------------------------</td>
<td>------------------------</td>
<td>------------------</td>
</tr>
<tr>
<td>Minnesota Pollution Control Agency</td>
<td></td>
<td>X</td>
</tr>
<tr>
<td>Missouri Department of Natural Resources</td>
<td></td>
<td>X</td>
</tr>
<tr>
<td>Mississippi Dept of Environmental Quality</td>
<td></td>
<td>X</td>
</tr>
<tr>
<td>Metro Public Health of Nashville/Davidson County</td>
<td></td>
<td></td>
</tr>
<tr>
<td>North Carolina Department of Environment and Natural Resources</td>
<td></td>
<td>X</td>
</tr>
<tr>
<td>New Hampshire Department of Environmental Services</td>
<td></td>
<td>X</td>
</tr>
<tr>
<td>New Jersey Department of Environment Protection</td>
<td>X</td>
<td>X</td>
</tr>
<tr>
<td>New Mexico Environment Department Air Quality Bureau</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Nevada Division of Environmental Protection</td>
<td></td>
<td>X</td>
</tr>
<tr>
<td>New York State Department of Environmental Conservation</td>
<td>X</td>
<td>X</td>
</tr>
<tr>
<td>Ohio Environmental Protection Agency</td>
<td></td>
<td>X</td>
</tr>
<tr>
<td>Oklahoma Department of Environmental Quality</td>
<td></td>
<td>X</td>
</tr>
<tr>
<td>Oregon Department of Environmental Quality</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Pennsylvania Department of Environmental Protection</td>
<td></td>
<td>X</td>
</tr>
<tr>
<td>Philadelphia Air Management Services</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Pinal County</td>
<td></td>
<td>X</td>
</tr>
<tr>
<td>Rhode Island Department of Environmental Management</td>
<td></td>
<td>X</td>
</tr>
<tr>
<td>South Carolina Department of Health and Environmental Control</td>
<td></td>
<td>X</td>
</tr>
<tr>
<td>Southwest Clean Air Agency</td>
<td></td>
<td>X</td>
</tr>
<tr>
<td>Tennessee Department of Environmental Conservation</td>
<td></td>
<td>X</td>
</tr>
<tr>
<td>Shoshone-Bannock Tribes of the Fort Hall Reservation of Idaho</td>
<td></td>
<td>X</td>
</tr>
<tr>
<td>Coeur d’Alene Tribe</td>
<td></td>
<td>X</td>
</tr>
<tr>
<td>Nez Perce Tribe</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Kootenai Tribe of Idaho</td>
<td></td>
<td>X</td>
</tr>
<tr>
<td>Bishop Paiute Tribe</td>
<td></td>
<td>X</td>
</tr>
<tr>
<td>Washoe Tribe of California and Nevada</td>
<td></td>
<td>X</td>
</tr>
<tr>
<td>Texas Commission on Environmental Quality</td>
<td>X</td>
<td>X</td>
</tr>
<tr>
<td>Utah Division of Air Quality</td>
<td>X</td>
<td>X</td>
</tr>
<tr>
<td>Virginia Department of Environmental Quality</td>
<td>X</td>
<td>X</td>
</tr>
<tr>
<td>Vermont Department of Environmental Conservation</td>
<td>X</td>
<td></td>
</tr>
<tr>
<td>Washington State Department of Ecology</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Washoe County Health District</td>
<td></td>
<td>X</td>
</tr>
<tr>
<td>Wisconsin Department of Natural Resources</td>
<td></td>
<td>X</td>
</tr>
<tr>
<td>West Virginia Division of Air Quality</td>
<td></td>
<td>X</td>
</tr>
<tr>
<td>Wyoming Department of Environmental Quality</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Kickapoo Tribe of Indians of the Kickapoo Reservation in Kansas</td>
<td></td>
<td>X</td>
</tr>
</tbody>
</table>
3.5.3 Spatial coverage and data sources for the sector

3.5.4 EPA-developed emission estimates

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

<table>
<thead>
<tr>
<th>SCC</th>
<th>SCC Level 3</th>
<th>SCC Level 4</th>
</tr>
</thead>
<tbody>
<tr>
<td>2501050120</td>
<td>Bulk Terminals: All Evaporative Losses</td>
<td>Gasoline</td>
</tr>
<tr>
<td>2501055120</td>
<td>Bulk Plants: All Evaporative Losses</td>
<td>Gasoline</td>
</tr>
<tr>
<td>2501060051</td>
<td>Gasoline Service Stations</td>
<td>Stage 1: Submerged Filling</td>
</tr>
<tr>
<td>2501060052</td>
<td>Gasoline Service Stations</td>
<td>Stage 1: Splash Filling</td>
</tr>
<tr>
<td>2501060053</td>
<td>Gasoline Service Stations</td>
<td>Stage 1: Balanced Submerged Filling</td>
</tr>
<tr>
<td>2501060201</td>
<td>Gasoline Service Stations</td>
<td>Underground Tank: Breathing and Emptying</td>
</tr>
<tr>
<td>2505030120</td>
<td>Truck</td>
<td>Gasoline</td>
</tr>
<tr>
<td>2505040120</td>
<td>Pipeline</td>
<td>Gasoline</td>
</tr>
</tbody>
</table>
**Bulk Terminals and Pipelines**

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

<table>
<thead>
<tr>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Pipelines</td>
<td>79,830</td>
<td>1.1023</td>
<td>87,997</td>
<td>1.089</td>
<td>95,844</td>
</tr>
<tr>
<td>Bulk Terminals</td>
<td>137,555</td>
<td>1.1023</td>
<td>151,627</td>
<td></td>
<td>165,149</td>
</tr>
</tbody>
</table>

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

<table>
<thead>
<tr>
<th>HAP</th>
<th>Pollutant Code</th>
<th>Percentage of VOC Emissions</th>
<th>Reference</th>
<th>2008 National Emissions (tons)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td>Bulk Terminals</td>
</tr>
<tr>
<td>Benzene</td>
<td>71432</td>
<td>0.27</td>
<td>7</td>
<td>4.46E+02</td>
</tr>
<tr>
<td>2,2,4-Trimethylpentane</td>
<td>540841</td>
<td>0.75</td>
<td>7</td>
<td>1.24E+03</td>
</tr>
<tr>
<td>Cumene</td>
<td>98828</td>
<td>0.012</td>
<td>7</td>
<td>1.98E+01</td>
</tr>
<tr>
<td>Ethyl Benzene</td>
<td>100414</td>
<td>0.053</td>
<td>7</td>
<td>8.75E+01</td>
</tr>
<tr>
<td>n-Hexane</td>
<td>110543</td>
<td>1.8</td>
<td>7</td>
<td>2.97E+03</td>
</tr>
<tr>
<td>Naphthalene</td>
<td>91203</td>
<td>0.00027</td>
<td>7</td>
<td>4.46E-01</td>
</tr>
<tr>
<td>Toluene</td>
<td>108883</td>
<td>1.4</td>
<td>7</td>
<td>2.31E+03</td>
</tr>
<tr>
<td>Xylenes</td>
<td>1330207</td>
<td>0.56</td>
<td>7</td>
<td>9.25E+02</td>
</tr>
</tbody>
</table>

For both categories, EPA allocated national VOC and HAP emissions for these categories in a two-step manner. First, EPA allocated emissions based on 2008 gasoline supply data reported by the U.S. Department of Energy (DOE). Next, EPA allocated emissions based on employment data reported in the 2007 County Business Patterns [ref 8].
For pipelines, EPA allocated emissions to Petroleum Administration for Defense (PAD) Districts based on the total amount of finished motor gasoline moved by pipeline in each PAD in year 2008. There are five PAD Districts across the United States: PAD District 1 comprises seventeen states plus the District of Columbia along the Atlantic Coast; PAD District 2 comprises fifteen states in the Midwest; PAD District 3 comprises six states in South Central U.S.; PAD District 4 comprises five states in the Rocky Mountains; and PAD District 5 comprises seven states along the West Coast. These data, which are displayed below in Table 3-40, are reported in Table 35 of Volume 1 of Petroleum Supply Annual 2008 [ref 9]. Next, EPA allocated pipeline emissions in each PAD District to counties based on County Business Patterns employment data. Because employment data for NAICS code 48691 (Pipeline Transportation of Refined Petroleum Products) are often withheld due to confidentiality reasons, EPA used the number of employees in NAICS code 42471 (Petroleum Bulk Stations and Terminals) for this allocation. To better account for the location of refined petroleum pipelines, however, EPA did not allocate any activity to States which had employees in this NAICS code, but did not have employees in NAICS code 48691 (i.e., District of Columbia, Idaho, Maine, New Hampshire, Vermont, and West Virginia).

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

<table>
<thead>
<tr>
<th>From</th>
<th>To I</th>
<th>To II</th>
<th>To III</th>
<th>To IV</th>
<th>To V</th>
</tr>
</thead>
<tbody>
<tr>
<td>From I</td>
<td>n/a</td>
<td>393</td>
<td>333,462</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>From II</td>
<td>70,895</td>
<td>n/a</td>
<td>99,167</td>
<td>7,442</td>
<td>0</td>
</tr>
<tr>
<td>From III</td>
<td>0</td>
<td>9,193</td>
<td>n/a</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>From IV</td>
<td>0</td>
<td>8,680</td>
<td>5,778</td>
<td>n/a</td>
<td>0</td>
</tr>
<tr>
<td>From V</td>
<td>0</td>
<td>0</td>
<td>25,453</td>
<td>9,287</td>
<td>n/a</td>
</tr>
</tbody>
</table>

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

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

<table>
<thead>
<tr>
<th>State</th>
<th>Motor Gasoline (Thousand Barrels)</th>
<th>State</th>
<th>Motor Gasoline (Thousand Barrels)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Alabama</td>
<td>1,090</td>
<td>Montana</td>
<td>872</td>
</tr>
<tr>
<td>Alaska</td>
<td>616</td>
<td>Nebraska</td>
<td>658</td>
</tr>
<tr>
<td>Arizona</td>
<td>470</td>
<td>Nevada</td>
<td>102</td>
</tr>
<tr>
<td>Arkansas</td>
<td>819</td>
<td>New Hampshire</td>
<td>0</td>
</tr>
<tr>
<td>California</td>
<td>460</td>
<td>New Jersey</td>
<td>2,956</td>
</tr>
<tr>
<td>Colorado</td>
<td>748</td>
<td>New Mexico</td>
<td>350</td>
</tr>
<tr>
<td>Connecticut</td>
<td>0</td>
<td>New York</td>
<td>1,469</td>
</tr>
<tr>
<td>Delaware</td>
<td>105</td>
<td>North Carolina</td>
<td>1,724</td>
</tr>
<tr>
<td>District of Columbia</td>
<td>0</td>
<td>North Dakota</td>
<td>291</td>
</tr>
<tr>
<td>Florida</td>
<td>1,877</td>
<td>Ohio</td>
<td>2,724</td>
</tr>
<tr>
<td>Georgia</td>
<td>1,724</td>
<td>Oklahoma</td>
<td>1,245</td>
</tr>
<tr>
<td>Hawaii</td>
<td>12</td>
<td>Oregon</td>
<td>525</td>
</tr>
<tr>
<td>Idaho</td>
<td>181</td>
<td>Pennsylvania</td>
<td>3,595</td>
</tr>
<tr>
<td>Illinois</td>
<td>1,940</td>
<td>Rhode Island</td>
<td>0</td>
</tr>
<tr>
<td>Indiana</td>
<td>2,464</td>
<td>South Carolina</td>
<td>720</td>
</tr>
<tr>
<td>Iowa</td>
<td>1,090</td>
<td>South Dakota</td>
<td>283</td>
</tr>
</tbody>
</table>
It is important to reiterate that the above discussion addresses the calculation of total VOC emissions. The 2008 point source NEI reports VOC emissions related to bulk terminal and pipeline processes. To obtain nonpoint emissions, States should subtract the 2008 point source VOC emission estimates from the total VOC emission estimates reported here. The relevant point source SCCs are listed in Table 3-42 and Table 3-43; the SCC level 1 description for all SCCs in both tables is “Petroleum and Solvent Evaporation”.

### Table 3-42: Pipeline Point Source SCCs

<table>
<thead>
<tr>
<th>SCC</th>
<th>SCC Level 2</th>
<th>SCC Level 3</th>
<th>SCC Level 4</th>
</tr>
</thead>
<tbody>
<tr>
<td>40600501</td>
<td>Transportation and Marketing of Petroleum Products</td>
<td>Pipeline Petroleum Transport - General - All Products</td>
<td>Pipeline Leaks</td>
</tr>
<tr>
<td>40600502</td>
<td>Transportation and Marketing of Petroleum Products</td>
<td>Pipeline Petroleum Transport - General - All Products</td>
<td>Pipeline Venting</td>
</tr>
<tr>
<td>40600503</td>
<td>Transportation and Marketing of Petroleum Products</td>
<td>Pipeline Petroleum Transport - General - All Products</td>
<td>Pump Station</td>
</tr>
<tr>
<td>40600504</td>
<td>Transportation and Marketing of Petroleum Products</td>
<td>Pipeline Petroleum Transport - General - All Products</td>
<td>Pump Station Leaks</td>
</tr>
</tbody>
</table>

### Table 3-43: Bulk Terminal Point Source SCCs

<table>
<thead>
<tr>
<th>SCC</th>
<th>SCC Level 2</th>
<th>SCC Level 3</th>
<th>SCC Level 4</th>
</tr>
</thead>
<tbody>
<tr>
<td>40400101</td>
<td>Petroleum Liquids Storage (non-Refinery)</td>
<td>Bulk Terminals</td>
<td>Gasoline RVP 13: Breathing Loss (67000 Bbl Capacity) - Fixed Roof Tank</td>
</tr>
<tr>
<td>40400102</td>
<td>Petroleum Liquids Storage (non-Refinery)</td>
<td>Bulk Terminals</td>
<td>Gasoline RVP 10: Breathing Loss (67000 Bbl Capacity) - Fixed Roof Tank</td>
</tr>
<tr>
<td>40400103</td>
<td>Petroleum Liquids Storage (non-Refinery)</td>
<td>Bulk Terminals</td>
<td>Gasoline RVP 7: Breathing Loss (67000 Bbl. Capacity) - Fixed Roof Tank</td>
</tr>
<tr>
<td>40400104</td>
<td>Petroleum Liquids Storage (non-Refinery)</td>
<td>Bulk Terminals</td>
<td>Gasoline RVP 13: Breathing Loss (250000 Bbl Capacity)-Fixed Roof Tank</td>
</tr>
<tr>
<td>40400105</td>
<td>Petroleum Liquids Storage (non-Refinery)</td>
<td>Bulk Terminals</td>
<td>Gasoline RVP 10: Breathing Loss (250000 Bbl Capacity)-Fixed Roof Tank</td>
</tr>
<tr>
<td>40400106</td>
<td>Petroleum Liquids Storage (non-Refinery)</td>
<td>Bulk Terminals</td>
<td>Gasoline RVP 7: Breathing Loss (250000 Bbl Capacity) - Fixed Roof Tank</td>
</tr>
<tr>
<td>40400107</td>
<td>Petroleum Liquids Storage (non-Refinery)</td>
<td>Bulk Terminals</td>
<td>Gasoline RVP 13: Working Loss (Diam. Independent) - Fixed Roof Tank</td>
</tr>
<tr>
<td>40400108</td>
<td>Petroleum Liquids Storage (non-Refinery)</td>
<td>Bulk Terminals</td>
<td>Gasoline RVP 10: Working Loss (Diameter Independent) - Fixed Roof Tank</td>
</tr>
<tr>
<td>SCC Number</td>
<td>SCC Description</td>
<td>SCC Level 2</td>
<td>SCC Level 3</td>
</tr>
<tr>
<td>------------</td>
<td>----------------</td>
<td>-------------</td>
<td>-------------</td>
</tr>
<tr>
<td>40400109</td>
<td>Petroleum Liquids Storage (non-Refinery)</td>
<td>Bulk Terminals</td>
<td>Bulk Terminals</td>
</tr>
<tr>
<td>40400110</td>
<td>Petroleum Liquids Storage (non-Refinery)</td>
<td>Bulk Terminals</td>
<td>Bulk Terminals</td>
</tr>
<tr>
<td>40400111</td>
<td>Petroleum Liquids Storage (non-Refinery)</td>
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<td>Bulk Terminals</td>
</tr>
<tr>
<td>40400112</td>
<td>Petroleum Liquids Storage (non-Refinery)</td>
<td>Bulk Terminals</td>
<td>Bulk Terminals</td>
</tr>
<tr>
<td>40400113</td>
<td>Petroleum Liquids Storage (non-Refinery)</td>
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<td>40400114</td>
<td>Petroleum Liquids Storage (non-Refinery)</td>
<td>Bulk Terminals</td>
<td>Bulk Terminals</td>
</tr>
<tr>
<td>40400115</td>
<td>Petroleum Liquids Storage (non-Refinery)</td>
<td>Bulk Terminals</td>
<td>Bulk Terminals</td>
</tr>
<tr>
<td>40400116</td>
<td>Petroleum Liquids Storage (non-Refinery)</td>
<td>Bulk Terminals</td>
<td>Bulk Terminals</td>
</tr>
<tr>
<td>40400117</td>
<td>Petroleum Liquids Storage (non-Refinery)</td>
<td>Bulk Terminals</td>
<td>Bulk Terminals</td>
</tr>
<tr>
<td>40400118</td>
<td>Petroleum Liquids Storage (non-Refinery)</td>
<td>Bulk Terminals</td>
<td>Bulk Terminals</td>
</tr>
<tr>
<td>40400119</td>
<td>Petroleum Liquids Storage (non-Refinery)</td>
<td>Bulk Terminals</td>
<td>Bulk Terminals</td>
</tr>
<tr>
<td>40400120</td>
<td>Petroleum Liquids Storage (non-Refinery)</td>
<td>Bulk Terminals</td>
<td>Bulk Terminals</td>
</tr>
<tr>
<td>40400131</td>
<td>Petroleum Liquids Storage (non-Refinery)</td>
<td>Bulk Terminals</td>
<td>Bulk Terminals</td>
</tr>
<tr>
<td>40400132</td>
<td>Petroleum Liquids Storage (non-Refinery)</td>
<td>Bulk Terminals</td>
<td>Bulk Terminals</td>
</tr>
<tr>
<td>40400133</td>
<td>Petroleum Liquids Storage (non-Refinery)</td>
<td>Bulk Terminals</td>
<td>Bulk Terminals</td>
</tr>
<tr>
<td>40400143</td>
<td>Petroleum Liquids Storage (non-Refinery)</td>
<td>Bulk Terminals</td>
<td>Bulk Terminals</td>
</tr>
<tr>
<td>40400148</td>
<td>Petroleum Liquids Storage (non-Refinery)</td>
<td>Bulk Terminals</td>
<td>Bulk Terminals</td>
</tr>
<tr>
<td>40400150</td>
<td>Petroleum Liquids Storage (non-Refinery)</td>
<td>Bulk Terminals</td>
<td>Bulk Terminals</td>
</tr>
<tr>
<td>40400151</td>
<td>Petroleum Liquids Storage (non-Refinery)</td>
<td>Bulk Terminals</td>
<td>Bulk Terminals</td>
</tr>
<tr>
<td>40400152</td>
<td>Petroleum Liquids Storage (non-Refinery)</td>
<td>Bulk Terminals</td>
<td>Bulk Terminals</td>
</tr>
<tr>
<td>40400153</td>
<td>Petroleum Liquids Storage (non-Refinery)</td>
<td>Bulk Terminals</td>
<td>Bulk Terminals</td>
</tr>
<tr>
<td>40400161</td>
<td>Petroleum Liquids Storage (non-Refinery)</td>
<td>Bulk Terminals</td>
<td>Bulk Terminals</td>
</tr>
</tbody>
</table>
### Bulk Plants

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

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

It is important to reiterate that the above discussion addresses the calculation of total VOC emissions. The 2008 point source NEI reports VOC emissions related to bulk plants. To obtain nonpoint emissions, States should subtract the 2008 point source VOC emission estimates from the total VOC emission estimates reported here.
The relevant point source SCCs are listed in Table 3-45; SCC level 1 descriptions are “Petroleum and Solvent Evaporation” for all SCCs.

<table>
<thead>
<tr>
<th>SCC</th>
<th>SCC Level 2</th>
<th>SCC Level 3</th>
<th>SCC Level 4</th>
</tr>
</thead>
<tbody>
<tr>
<td>40400201</td>
<td>Petroleum Liquids Storage (non-Refinery)</td>
<td>Bulk Plants</td>
<td>Gasoline RVP 13: Breathing Loss (67000 Bbl Capacity) - Fixed Roof Tank</td>
</tr>
<tr>
<td>40400202</td>
<td>Petroleum Liquids Storage (non-Refinery)</td>
<td>Bulk Plants</td>
<td>Gasoline RVP 10: Breathing Loss (67000 Bbl Capacity) - Fixed Roof Tank</td>
</tr>
<tr>
<td>40400203</td>
<td>Petroleum Liquids Storage (non-Refinery)</td>
<td>Bulk Plants</td>
<td>Gasoline RVP 7: Breathing Loss (67000 Bbl. Capacity) - Fixed Roof Tank</td>
</tr>
<tr>
<td>40400204</td>
<td>Petroleum Liquids Storage (non-Refinery)</td>
<td>Bulk Plants</td>
<td>Gasoline RVP 13: Working Loss (67000 Bbl Capacity) - Fixed Roof Tank</td>
</tr>
<tr>
<td>40400205</td>
<td>Petroleum Liquids Storage (non-Refinery)</td>
<td>Bulk Plants</td>
<td>Gasoline RVP 10: Working Loss (67000 Bbl Capacity) - Fixed Roof Tank</td>
</tr>
<tr>
<td>40400206</td>
<td>Petroleum Liquids Storage (non-Refinery)</td>
<td>Bulk Plants</td>
<td>Gasoline RVP 7: Working Loss (67000 Bbl Capacity) - Fixed Roof Tank</td>
</tr>
<tr>
<td>40400207</td>
<td>Petroleum Liquids Storage (non-Refinery)</td>
<td>Bulk Plants</td>
<td>Gasoline RVP 13: Standing Loss (67000 Bbl Cap.) - Floating Roof Tank</td>
</tr>
<tr>
<td>40400208</td>
<td>Petroleum Liquids Storage (non-Refinery)</td>
<td>Bulk Plants</td>
<td>Gasoline RVP 10: Standing Loss (67000 Bbl Cap.) - Floating Roof Tank</td>
</tr>
<tr>
<td>40400209</td>
<td>Petroleum Liquids Storage (non-Refinery)</td>
<td>Bulk Plants</td>
<td>Gasoline RVP 7: Standing Loss (67000 Bbl Cap.) - Floating Roof Tank</td>
</tr>
<tr>
<td>40400210</td>
<td>Petroleum Liquids Storage (non-Refinery)</td>
<td>Bulk Plants</td>
<td>Gasoline RVP 13/10/7: Withdrawal Loss (67000 Bbl Cap.) - Float Rf Tnk</td>
</tr>
<tr>
<td>40400211</td>
<td>Petroleum Liquids Storage (non-Refinery)</td>
<td>Bulk Plants</td>
<td>Gasoline RVP 13: Filling Loss (10500 Bbl Cap.) - Variable Vapor Space</td>
</tr>
<tr>
<td>40400212</td>
<td>Petroleum Liquids Storage (non-Refinery)</td>
<td>Bulk Plants</td>
<td>Gasoline RVP 10: Filling Loss (10500 Bbl Cap.) - Variable Vapor Space</td>
</tr>
<tr>
<td>40400213</td>
<td>Petroleum Liquids Storage (non-Refinery)</td>
<td>Bulk Plants</td>
<td>Gasoline RVP 7: Filling Loss (10500 Bbl Cap.) - Variable Vapor Space</td>
</tr>
<tr>
<td>40400231</td>
<td>Petroleum Liquids Storage (non-Refinery)</td>
<td>Bulk Plants</td>
<td>Gasoline RVP 13: Standing Loss - Ext. Floating Roof w/ Primary Seal</td>
</tr>
<tr>
<td>40400232</td>
<td>Petroleum Liquids Storage (non-Refinery)</td>
<td>Bulk Plants</td>
<td>Gasoline RVP 10: Standing Loss - Ext. Floating Roof w/ Primary Seal</td>
</tr>
<tr>
<td>40400233</td>
<td>Petroleum Liquids Storage (non-Refinery)</td>
<td>Bulk Plants</td>
<td>Gasoline RVP 7: Standing Loss - External Floating Roof w/ Primary Seal</td>
</tr>
<tr>
<td>40400242</td>
<td>Petroleum Liquids Storage (non-Refinery)</td>
<td>Bulk Plants</td>
<td>Gasoline RVP 10: Standing Loss - Ext. Floating Roof w/ Secondary Seal</td>
</tr>
<tr>
<td>40400243</td>
<td>Petroleum Liquids Storage (non-Refinery)</td>
<td>Bulk Plants</td>
<td>Gasoline RVP 7: Standing Loss - Ext. Floating Roof w/ Secondary Seal</td>
</tr>
<tr>
<td>SCC</td>
<td>SCC Level 2</td>
<td>SCC Level 3</td>
<td>SCC Level 4</td>
</tr>
<tr>
<td>-------</td>
<td>------------------------------------------</td>
<td>----------------------</td>
<td>-------------------------------------------------------</td>
</tr>
<tr>
<td>40400248</td>
<td>Petroleum Liquids Storage (non-Refinery)</td>
<td>Bulk Plants</td>
<td>Gasoline RVP 10/13/7: Withdrawal Loss - Ext. Float Roof (Pri/Sec Seal)</td>
</tr>
<tr>
<td>40400250</td>
<td>Petroleum Liquids Storage (non-Refinery)</td>
<td>Bulk Plants</td>
<td>Loading Racks</td>
</tr>
<tr>
<td>40400251</td>
<td>Petroleum Liquids Storage (non-Refinery)</td>
<td>Bulk Plants</td>
<td>Valves, Flanges, and Pumps</td>
</tr>
<tr>
<td>40400252</td>
<td>Petroleum Liquids Storage (non-Refinery)</td>
<td>Bulk Plants</td>
<td>Miscellaneous Losses/Leaks: Vapor Collection Losses</td>
</tr>
<tr>
<td>40400253</td>
<td>Petroleum Liquids Storage (non-Refinery)</td>
<td>Bulk Plants</td>
<td>Miscellaneous Losses/Leaks: Vapor Control Unit Losses</td>
</tr>
<tr>
<td>40400261</td>
<td>Petroleum Liquids Storage (non-Refinery)</td>
<td>Bulk Plants</td>
<td>Gasoline RVP 13: Standing Loss - Int. Floating Roof w/ Primary Seal</td>
</tr>
<tr>
<td>40400262</td>
<td>Petroleum Liquids Storage (non-Refinery)</td>
<td>Bulk Plants</td>
<td>Gasoline RVP 10: Standing Loss - Int. Floating Roof w/ Primary Seal</td>
</tr>
<tr>
<td>40400263</td>
<td>Petroleum Liquids Storage (non-Refinery)</td>
<td>Bulk Plants</td>
<td>Gasoline RVP 7: Standing Loss - Internal Floating Roof w/ Primary Seal</td>
</tr>
<tr>
<td>40400271</td>
<td>Petroleum Liquids Storage (non-Refinery)</td>
<td>Bulk Plants</td>
<td>Gasoline RVP 13: Standing Loss - Int. Floating Roof w/ Secondary Seal</td>
</tr>
<tr>
<td>40400272</td>
<td>Petroleum Liquids Storage (non-Refinery)</td>
<td>Bulk Plants</td>
<td>Gasoline RVP 10: Standing Loss - Int. Floating Roof w/ Secondary Seal</td>
</tr>
<tr>
<td>40400273</td>
<td>Petroleum Liquids Storage (non-Refinery)</td>
<td>Bulk Plants</td>
<td>Gasoline RVP 7: Standing Loss - Int. Floating Roof w/ Secondary Seal</td>
</tr>
<tr>
<td>40400278</td>
<td>Petroleum Liquids Storage (non-Refinery)</td>
<td>Bulk Plants</td>
<td>Gasoline RVP 10/13/7: Withdrawal Loss - Int. Float Roof (Pri/Sec Seal)</td>
</tr>
<tr>
<td>40400401</td>
<td>Petroleum Liquids Storage (non-Refinery)</td>
<td>Petroleum Products - Underground Tanks</td>
<td>Gasoline RVP 13: Breathing Loss</td>
</tr>
<tr>
<td>40400403</td>
<td>Petroleum Liquids Storage (non-Refinery)</td>
<td>Petroleum Products - Underground Tanks</td>
<td>Gasoline RVP 10: Breathing Loss</td>
</tr>
<tr>
<td>40400404</td>
<td>Petroleum Liquids Storage (non-Refinery)</td>
<td>Petroleum Products - Underground Tanks</td>
<td>Gasoline RVP 10: Working Loss</td>
</tr>
<tr>
<td>40400405</td>
<td>Petroleum Liquids Storage (non-Refinery)</td>
<td>Petroleum Products - Underground Tanks</td>
<td>Gasoline RVP 7: Breathing Loss</td>
</tr>
<tr>
<td>40400406</td>
<td>Petroleum Liquids Storage (non-Refinery)</td>
<td>Petroleum Products - Underground Tanks</td>
<td>Gasoline RVP 7: Working Loss</td>
</tr>
<tr>
<td>40600101</td>
<td>Transportation and Marketing of Petroleum Products</td>
<td>Tank Cars and Trucks</td>
<td>Gasoline: Splash Loading **</td>
</tr>
<tr>
<td>40600126</td>
<td>Transportation and Marketing of Petroleum Products</td>
<td>Tank Cars and Trucks</td>
<td>Gasoline: Submerged Loading **</td>
</tr>
<tr>
<td>40600131</td>
<td>Transportation and Marketing of Petroleum Products</td>
<td>Tank Cars and Trucks</td>
<td>Gasoline: Submerged Loading (Normal Service)</td>
</tr>
</tbody>
</table>
**Tank Trucks in Transit**

The EPA calculated VOC emissions from Tank Trucks in Transit by multiplying county-level tank truck gasoline throughput by a 0.06 lb of VOC per 1,000 gallon emission factor. As noted in Table 3-46, this emission factor is the sum of the individual emission factors reported in the Gasoline Distribution EIIP guidance document for gasoline-filled trucks (traveling to service station/bulk plant for delivery) and vapor-filled trucks (traveling to bulk terminal/plant for reloading) [ref 3]. County-level gasoline consumption was estimated by summing county-level onroad and nonroad estimates. County-level onroad consumption was estimated by subtracting the NMIM-derived national nonroad consumption from the EIA’s estimate of finished motor gasoline supplied and then allocating to counties using NMIM-derived onroad county-level CO₂ emissions [ref 11, ref 13]. County-level nonroad consumption was estimated by allocating NMIM-derived state/SCC-level nonroad gasoline consumption to the county-level based on nonroad county/SCC-level CO₂ emissions [ref 13]. Gasoline throughput for tank trucks was computed by multiplying the county-level gasoline consumption estimates by a factor of 1.09 to account for gasoline that is transported more than once in a given area (i.e., transported from bulk terminal to bulk plant and then from bulk plant to service station) [ref 10]. Benzene emission estimates were calculated by multiplying county-level NMIM speciation profiles by the VOC emission estimates [ref 12]. Emissions for the remaining HAPs were calculated by multiplying VOC emissions by the national speciation profiles presented in Table 3-47.

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

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

<table>
<thead>
<tr>
<th>VOC Emission Factor</th>
</tr>
</thead>
<tbody>
<tr>
<td>Vapor-Filled Trucks</td>
</tr>
<tr>
<td>Gasoline Filled Trucks</td>
</tr>
<tr>
<td>Total</td>
</tr>
</tbody>
</table>

**Table 3-47: Tank Trucks in Transit HAP Speciation Profiles and Total Emission Estimates**
It is important to reiterate that the above discussion addresses the calculation of total VOC emissions. The 2008 point source NEI reports VOC emissions related to tank trucks in transit. To obtain nonpoint emissions, States should subtract the 2008 point source VOC emission estimates from the total VOC emission estimates reported here. The relevant point source SCCs are listed in Table 3-48; the SCC level 1 description is “Petroleum and Solvent Evaporation” for all SCCs.

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

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

### Underground Storage Tank (UST) Breathing and Emptying

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

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

<table>
<thead>
<tr>
<th>Pollutant</th>
<th>Pollutant Code</th>
<th>Emission Factor</th>
<th>Reference</th>
<th>National Emissions (tpy)</th>
</tr>
</thead>
<tbody>
<tr>
<td>VOC</td>
<td>VOC</td>
<td>1 lb./1,000 gallons</td>
<td>3</td>
<td>6.89E+04</td>
</tr>
<tr>
<td>2,2,4-Trimethylpentane</td>
<td>540841</td>
<td>0.75% of VOC</td>
<td>7</td>
<td>5.17E+02</td>
</tr>
<tr>
<td>Cumene</td>
<td>98828</td>
<td>0.012% of VOC</td>
<td>7</td>
<td>8.27E+00</td>
</tr>
<tr>
<td>Ethyl Benzene</td>
<td>100414</td>
<td>0.053% of VOC</td>
<td>7</td>
<td>3.65E+01</td>
</tr>
<tr>
<td>n-Hexane</td>
<td>110543</td>
<td>1.8% of VOC</td>
<td>7</td>
<td>1.24E+03</td>
</tr>
<tr>
<td>Naphthalene</td>
<td>91203</td>
<td>0.00027% of VOC</td>
<td>7</td>
<td>1.86E-01</td>
</tr>
<tr>
<td>Toluene</td>
<td>108883</td>
<td>1.4% of VOC</td>
<td>7</td>
<td>9.65E+02</td>
</tr>
<tr>
<td>Xylenes</td>
<td>1330207</td>
<td>0.56% of VOC</td>
<td>7</td>
<td>3.86E+02</td>
</tr>
<tr>
<td>Benzene</td>
<td>71432</td>
<td>county-specific % of VOC</td>
<td>12</td>
<td>4.78E+02</td>
</tr>
</tbody>
</table>
It is important to reiterate that the above discussion addresses the calculation of total VOC emissions. The 2008 point source NEI reports VOC emissions related to UST breathing and emptying. To obtain nonpoint emissions, States should subtract the 2008 point source VOC emission estimates from the total VOC emission estimates reported here. The relevant point source SCCs are listed in Table 3-50; SCC level 1 and 2 descriptions are “Petroleum and Solvent Evaporation; Transportation and Marketing of Petroleum Products” for both SCCs.

<table>
<thead>
<tr>
<th>SCC</th>
<th>SCC Level 3</th>
<th>SCC Level 4</th>
</tr>
</thead>
<tbody>
<tr>
<td>40600307</td>
<td>Gasoline Retail Operations - Stage I</td>
<td>Underground Tank Breathing and Emptying</td>
</tr>
<tr>
<td>40600707</td>
<td>Consumer (Corporate) Fleet Refueling - Stage I</td>
<td>Underground Tank Breathing and Emptying</td>
</tr>
</tbody>
</table>

**Gasoline Service Station Unloading**

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

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

\[ L = \frac{12.46 \times S \times P \times M}{T} \]

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

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

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

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

\[ P = \exp \left\{ 0.7553 - \left( \frac{413}{T + 459.6} \right) S^{0.5} \log_{10}(RVP) - \left[ 1.854 - \left( \frac{1.042}{T + 459.6} \right) S^{0.5} \right] \right\} \]

\[ + \left[ \left( \frac{2.416}{T + 459.6} \right) - 2.013 \right] \log_{10}(RVP) - \left( \frac{8.742}{T + 459.6} \right) + 15.64 \]

\[ P = \text{Stock true vapor pressure, in pounds per square inch absolute.} \]

\[ T = \text{Stock temperature, in degrees Fahrenheit.} \]

\[ RVP = \text{Reid vapor pressure, in pounds per square inch.} \]

\[ S = \text{Slope of the ASTM distillation curve at 10 percent evaporated, in degrees Fahrenheit per percent} \]

\[ \text{assumed that } S = 3.0 \text{ for gasoline per Figure 7.1-14a of AP-42) [ref 17].} \]

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

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

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

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


Region 2: Alabama, Arkansas, Florida, Georgia, Hawaii, Louisiana, Mississippi, N. Carolina, S. Carolina, Tennessee

Region 3: Arizona, New Mexico, Oklahoma, Texas

Region 4: Colorado, Iowa, Kansas, Minnesota, Missouri, Montana, Nebraska, N. Dakota, S. Dakota, Wyoming

Region 5: California, Nevada, Utah

Region 6: Idaho, Oregon, Washington

The EPA incorporated the effect of Stage I Gasoline Service Station vapor balancing controls based on the county-level control efficiency values (either 90 or 95 percent) that were compiled for the EIIP study [ref 16].

Table 3-52 presents the HAP speciation profiles and total VOC and HAP emission estimates calculated using these procedures.

Emissions are reported by SCC based on the filling methods used in each county as determined from the EIIP study: SCC 2501060051 (Submerged Filling); SCC 2501060052 (Splash Filling); and SCC 2501060053 (Balanced Submerged Filling).
Table 3-52: Stage I Service Station Unloading HAP Speciation Profiles and Total Emission Estimates

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

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

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

<table>
<thead>
<tr>
<th>SCC</th>
<th>SCC Level 3</th>
<th>SCC Level 4</th>
</tr>
</thead>
<tbody>
<tr>
<td>40600302</td>
<td>Gasoline Retail Operations - Stage I</td>
<td>Submerged Filling w/o Controls</td>
</tr>
<tr>
<td>40600702</td>
<td>Consumer (Corporate) Fleet Refueling - Stage I</td>
<td>Submerged Filling w/o Controls</td>
</tr>
</tbody>
</table>

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

<table>
<thead>
<tr>
<th>SCC</th>
<th>SCC Level 3</th>
<th>SCC Level 4</th>
</tr>
</thead>
<tbody>
<tr>
<td>40600301</td>
<td>Gasoline Retail Operations - Stage I</td>
<td>Splash Filling</td>
</tr>
<tr>
<td>40600701</td>
<td>Consumer (Corporate) Fleet Refueling - Stage I</td>
<td>Splash Filling</td>
</tr>
</tbody>
</table>

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

<table>
<thead>
<tr>
<th>SCC</th>
<th>SCC Level 3</th>
<th>SCC Level 4</th>
</tr>
</thead>
<tbody>
<tr>
<td>40600305</td>
<td>Gasoline Retail Operations - Stage I</td>
<td>Unloading **</td>
</tr>
<tr>
<td>40600306</td>
<td>Gasoline Retail Operations - Stage I</td>
<td>Balanced Submerged Filling</td>
</tr>
<tr>
<td>40600706</td>
<td>Consumer (Corporate) Fleet Refueling - Stage I</td>
<td>Balanced Submerged Filling</td>
</tr>
</tbody>
</table>

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

Example Emission Calculations

Bulk Terminals

2008 national benzene emissions = VOC emissions x HAP speciation factor

\[
1.65E+05 \text{ tons} \times 0.0027 \approx 4.46E+02 \text{ tons}
\]

Pipelines

2008 national cumene emissions = VOC emissions x HAP speciation factor

\[
\text{VOC emissions x HAP speciation factor}
\]
9.58E+04 tons x 0.00012
1.15E+01 tons

**Bulk Plants**

2008 national VOC emissions

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

**Tank Trucks in Transit**

2008 Alamance County, North Carolina VOC emissions

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

**UST Breathing and Emptying**

2008 Alamance County, North Carolina VOC emissions

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

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

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

Incorporate effect of control (vapor balancing requirement)

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

3.5.5 References for Bulk Gasoline Terminals and Gas Stations


3.6 Commercial Cooking

3.6.1 Sector description

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

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

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

3.6.2 Sources of data overview and selection hierarchy

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

Table 3-57: Agencies that submitted Commercial Cooking data

<table>
<thead>
<tr>
<th>Agency</th>
<th>Type</th>
<th>Charbroiling Total</th>
<th>Conveyorized Charbroiling</th>
<th>Under-fired Charbroiling</th>
<th>Deep Fat Frying</th>
<th>Flat Griddle Frying</th>
<th>Clamshell Griddle Frying</th>
</tr>
</thead>
<tbody>
<tr>
<td>EPA Chromium Speciation</td>
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<tr>
<td>EPA HAP Augmentation</td>
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<td>EPA Commercial Cooking data (Section 3.6.4)</td>
<td>EPA</td>
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<td>EPA PM Augmentation</td>
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<tr>
<td>Agency</td>
<td>Type</td>
<td>Char-broiling Total</td>
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<td>Memphis and Shelby County Health</td>
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<td>Nez Perce Tribe</td>
<td>T</td>
<td>X</td>
<td>X</td>
<td>X</td>
<td>X</td>
<td>X</td>
<td>X</td>
</tr>
<tr>
<td>Shoshone-Bannock Tribes of the Fort Hall</td>
<td>T</td>
<td>X</td>
<td>X</td>
<td>X</td>
<td>X</td>
<td>X</td>
<td>X</td>
</tr>
<tr>
<td>Reservation of Idaho</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Texas Commission on Environmental Quality</td>
<td>S</td>
<td>X</td>
<td>X</td>
<td>X</td>
<td>X</td>
<td>X</td>
<td>X</td>
</tr>
<tr>
<td>Virginia Department of Environmental Quality</td>
<td>S</td>
<td>X</td>
<td>X</td>
<td>X</td>
<td>X</td>
<td>X</td>
<td>X</td>
</tr>
<tr>
<td>West Virginia Division of Air Quality</td>
<td>S</td>
<td>X</td>
<td>X</td>
<td>X</td>
<td>X</td>
<td>X</td>
<td>X</td>
</tr>
</tbody>
</table>

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

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

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

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:

\[ REST_i^{2002} = \frac{E_{ijm,2002}}{FRAC_j \times UNITS_j \times AVG_{EMISSIONS}_{jm}} \]  

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 \( j \)
\[ UNITS_j = \text{the average number of units of source category } j \text{ in each restaurant} \]

\[ AVG_{EMISSIONS_{jm}} = \text{the average emissions of pollutant } m \text{ from food cooked on source category } j, \text{ based on summing the average amount of food cooked on source category } j \text{ multiplied by the emission factor for pollutant } m \text{ from source category } j \]

The values of \( FRAC_i \) and \( UNITS_j \) 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:

\[
REST_{i,2011} = REST_{i,2002} \times GF_i
\]

(2)

where \( GF_i \) is the growth factor for county \( i \).

Emission Factors

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

<table>
<thead>
<tr>
<th>Cooking Device</th>
<th>SCC</th>
<th>PM25-FIL / PM25-PRI</th>
<th>PM10-FIL / PM10-PRI</th>
</tr>
</thead>
<tbody>
<tr>
<td>Conveyorized Charbroiling</td>
<td>2302002100</td>
<td>0.00321</td>
<td>0.00331</td>
</tr>
<tr>
<td>Underfired Charbroiling</td>
<td>2302002200</td>
<td>0.00287</td>
<td>0.00297</td>
</tr>
<tr>
<td>Flat Griddle Frying</td>
<td>2302003100</td>
<td>0.00201</td>
<td>0.00264</td>
</tr>
<tr>
<td>Clamshell Griddle Frying</td>
<td>2302003200</td>
<td>0.00241</td>
<td>0.00283</td>
</tr>
</tbody>
</table>

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:

\[
E_{ijm,2011} = REST_{i,2011} \times FRAC_j \times UNITS_j \times AVG_{EMISSIONS_{jm}}
\]

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

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

<table>
<thead>
<tr>
<th>Source Category</th>
<th>SCC</th>
<th>Percent of Restaurants with Equipment (FRAC)</th>
<th>Average Number of Units Per Restaurant (UNITS)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Conveyorized Charbroiling</td>
<td>2302002100</td>
<td>3.6%</td>
<td>1.3</td>
</tr>
<tr>
<td>Under-fired Charbroiling</td>
<td>2302002200</td>
<td>12.5%</td>
<td>1.5</td>
</tr>
<tr>
<td>Deep Fat Frying</td>
<td>2302003000</td>
<td>28.0%</td>
<td>2.5</td>
</tr>
<tr>
<td>Flat Griddle Frying</td>
<td>2302003100</td>
<td>18.4%</td>
<td>1.6</td>
</tr>
<tr>
<td>Clamshell Griddle Frying</td>
<td>2302003200</td>
<td>2.8%</td>
<td>1.7</td>
</tr>
</tbody>
</table>

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

Sample Calculations

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

\[
REST_{i,2002} = \frac{E_{ijm,2002}}{FRAC_j \times UNITS_j \times AVG.EMISSONS_{jm}}
\]

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

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

Determining the Number of Restaurants in Each County in 2011

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

\[
REST_{i,2011} = REST_{i,2002} \times GF_i
\]

138 restaurants = 100 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 \( R_{ij,2011} \) 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:

\[
E_{ijm,2011} = R_{ij,2011} \times FRAc_j \times UNITS_j \times AVG\_EMISSIONS_{jm}
\]

\[
12.06 \text{ tons PM2.5} = 138 \times 0.125 \times 1.54 \times 0.454
\]

There were 138 restaurants in Autauga County, AL in 2011. This was multiplied by the fraction of restaurants that use underfired charbroilers (0.125), the average number of underfired charbroilers used at each restaurant (1.54), and the average emissions from each establishment from underfired charbroilers (0.454 tons PM2.5). The result shows that the emissions of PM2.5 in Autauga County, AL were 12.06 tons in 2011.

### 3.6.5 Summary of quality assurance methods

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

**Table 3-61: Agencies tagged values for Commercial Cooking**

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

### 3.6.6 References for Commercial Cooking

3.7 Dust – Construction Dust

3.7.1 Sector description

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

<table>
<thead>
<tr>
<th>SCC</th>
<th>SCC Level One</th>
<th>SCC Level Two</th>
<th>SCC Level Three</th>
<th>SCC Level Four</th>
</tr>
</thead>
<tbody>
<tr>
<td>2311010000</td>
<td>Industrial Processes</td>
<td>Construction: SIC 15 - 17</td>
<td>Residential</td>
<td>Total</td>
</tr>
<tr>
<td>2311020000</td>
<td>Industrial Processes</td>
<td>Construction: SIC 15 - 17</td>
<td>Industrial/Commercial/Institutional</td>
<td>Total</td>
</tr>
<tr>
<td>2311030000</td>
<td>Industrial Processes</td>
<td>Construction: SIC 15 - 17</td>
<td>Road Construction</td>
<td>Total</td>
</tr>
<tr>
<td>2311040000</td>
<td>Industrial Processes</td>
<td>Construction: SIC 15 - 17</td>
<td>Special Trade Construction</td>
<td>Total</td>
</tr>
<tr>
<td>31100101</td>
<td>Industrial Processes</td>
<td>Building Construction</td>
<td>Construction: Building Contractors</td>
<td>Site Preparation: Topsoil Removal</td>
</tr>
<tr>
<td>31100102</td>
<td>Industrial Processes</td>
<td>Building Construction</td>
<td>Construction: Building Contractors</td>
<td>Site Preparation: Earth Moving (Cut and Fill)</td>
</tr>
<tr>
<td>31100103</td>
<td>Industrial Processes</td>
<td>Building Construction</td>
<td>Construction: Building Contractors</td>
<td>Site Preparation: Aggregate Hauling (On Dirt)</td>
</tr>
<tr>
<td>31100199</td>
<td>Industrial Processes</td>
<td>Building Construction</td>
<td>Construction: Building Contractors</td>
<td>Other Not Classified</td>
</tr>
<tr>
<td>31100202</td>
<td>Industrial Processes</td>
<td>Building Construction</td>
<td>Demolitions/Special Trade Contracts</td>
<td>Mechanical or Explosive Dismemberment</td>
</tr>
<tr>
<td>31100206</td>
<td>Industrial Processes</td>
<td>Building Construction</td>
<td>Demolitions/Special Trade Contracts</td>
<td>On-site Truck Traffic</td>
</tr>
</tbody>
</table>
### 3.7.2 Sources of data overview and selection hierarchy

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

#### Table 3-63: Agencies that submitted Construction Dust data

<table>
<thead>
<tr>
<th>Agency</th>
<th>Type</th>
<th>Nonpoint SCCs</th>
<th>Point SCCs</th>
</tr>
</thead>
<tbody>
<tr>
<td>Allegheny County Health Department</td>
<td>L</td>
<td></td>
<td>X</td>
</tr>
<tr>
<td>California Air Resources Board</td>
<td>S</td>
<td>X X</td>
<td>X X X X</td>
</tr>
<tr>
<td>Chattanooga Air Pollution Control Bureau (CHCAPCB)</td>
<td>L</td>
<td></td>
<td>X</td>
</tr>
<tr>
<td>Clark County Department of Air Quality and</td>
<td>L</td>
<td></td>
<td>X X X</td>
</tr>
<tr>
<td>Environmental Management</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Coeur d’Alene Tribe</td>
<td>T</td>
<td></td>
<td>X X X</td>
</tr>
<tr>
<td>Delaware Department of Natural Resources and</td>
<td>S</td>
<td></td>
<td>X X X</td>
</tr>
<tr>
<td>Environmental Control</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Florida Department of Environmental Protection</td>
<td>S</td>
<td></td>
<td>X</td>
</tr>
<tr>
<td>Georgia Department of Natural Resources</td>
<td>S</td>
<td></td>
<td>X X</td>
</tr>
<tr>
<td>Hawaii Department of Health Clean Air Branch</td>
<td>S</td>
<td>X X</td>
<td>X X</td>
</tr>
<tr>
<td>Idaho Department of Environmental Quality</td>
<td>S</td>
<td>X X X</td>
<td>0 X X</td>
</tr>
<tr>
<td>Illinois Environmental Protection Agency</td>
<td>S</td>
<td>X X X</td>
<td>X X</td>
</tr>
<tr>
<td>Indiana Department of Environmental Management</td>
<td>S</td>
<td></td>
<td>X X</td>
</tr>
<tr>
<td>Kansas Department of Health and Environment</td>
<td>S</td>
<td>X X X</td>
<td>X</td>
</tr>
<tr>
<td>Kentucky Division for Air Quality</td>
<td>S</td>
<td></td>
<td>X</td>
</tr>
<tr>
<td>Kootenai Tribe of Idaho</td>
<td>T</td>
<td>X 0</td>
<td>X</td>
</tr>
<tr>
<td>Maricopa County Air Quality Department</td>
<td>L</td>
<td>X X X</td>
<td>X</td>
</tr>
<tr>
<td>Maryland Department of the Environment</td>
<td>S</td>
<td>X X</td>
<td></td>
</tr>
<tr>
<td>Metro Public Health of Nashville/Davidson County</td>
<td>L</td>
<td>X X X</td>
<td>X</td>
</tr>
<tr>
<td>Michigan Department of Environmental Quality</td>
<td>S</td>
<td></td>
<td>X</td>
</tr>
<tr>
<td>Missouri Department of Natural Resources</td>
<td>S</td>
<td></td>
<td>X</td>
</tr>
<tr>
<td>Nevada Division of Environmental Protection</td>
<td>S</td>
<td></td>
<td>X</td>
</tr>
<tr>
<td>New Hampshire Department of Environmental</td>
<td>S</td>
<td></td>
<td>X</td>
</tr>
<tr>
<td>Services</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>New Jersey Department of Environment Protection</td>
<td>S</td>
<td>X X X</td>
<td></td>
</tr>
<tr>
<td>Nez Perce Tribe</td>
<td>T</td>
<td>X X</td>
<td></td>
</tr>
<tr>
<td>Ohio Environmental Protection Agency</td>
<td>S</td>
<td></td>
<td>X</td>
</tr>
<tr>
<td>Pennsylvania Department of Environmental</td>
<td>S</td>
<td></td>
<td>X</td>
</tr>
<tr>
<td>Protection</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Agency</td>
<td>Type</td>
<td>Nonpoint SCCs</td>
<td>Point SCCs</td>
</tr>
<tr>
<td>-------------------------------------------------------</td>
<td>------</td>
<td>---------------</td>
<td>------------</td>
</tr>
<tr>
<td>Philadelphia Air Management Services</td>
<td>L</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Puget Sound Clean Air Agency</td>
<td>L</td>
<td></td>
<td>X</td>
</tr>
<tr>
<td>Shoshone-Bannock Tribes of the Fort Hall Reservation of Idaho</td>
<td>T</td>
<td>X X X</td>
<td></td>
</tr>
<tr>
<td>Texas Commission on Environmental Quality</td>
<td>S</td>
<td></td>
<td>X</td>
</tr>
<tr>
<td>Utah Division of Air Quality</td>
<td>S</td>
<td></td>
<td>X</td>
</tr>
<tr>
<td>Virginia Department of Environmental Quality</td>
<td>S</td>
<td>X X X X</td>
<td>X</td>
</tr>
<tr>
<td>West Virginia Division of Air Quality</td>
<td>S</td>
<td></td>
<td>X</td>
</tr>
</tbody>
</table>

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

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

<table>
<thead>
<tr>
<th>Priority</th>
<th>Dataset Name</th>
<th>Dataset Content</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Responsible Agency Data Set</td>
<td>State and Local Agency submitted emissions</td>
</tr>
<tr>
<td>2</td>
<td>2011EPA_PM-Augmentation</td>
<td>Augments PM data</td>
</tr>
<tr>
<td>5</td>
<td>2011EPA_NP_NoOverlap_w_Pt</td>
<td>EPA-generated data</td>
</tr>
</tbody>
</table>

**Nonpoint Data Category**

<table>
<thead>
<tr>
<th>Priority</th>
<th>Dataset Name</th>
<th>Dataset Content</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>2011EPA_PM-Augmentation</td>
<td>Augments PM data</td>
</tr>
<tr>
<td>2</td>
<td>Responsible Agency Data Set</td>
<td>State and Local agency submitted emissions</td>
</tr>
<tr>
<td>3</td>
<td>2011EPA_chrom_split</td>
<td>Speciates S/L/T agency submitted chromium</td>
</tr>
<tr>
<td>4</td>
<td>EPA NV Gold Mines</td>
<td>Mercury emissions at Nevada gold mine facilities (likely incorrect SCC used)</td>
</tr>
<tr>
<td>5</td>
<td>2011EPA_TRI</td>
<td>EPA TRI data (likely incorrect SCC used)</td>
</tr>
</tbody>
</table>
3.7.3 Spatial coverage and data sources for the sector

3.7.4 Construction - Non-Residential – EPA estimates

3.7.4.1 Source category description

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

<table>
<thead>
<tr>
<th>SCC</th>
<th>SCC Level One</th>
<th>SCC Level Two</th>
<th>SCC Level Three</th>
<th>SCC Level Four</th>
</tr>
</thead>
<tbody>
<tr>
<td>2311020000</td>
<td>Industrial Processes</td>
<td>Construction: SIC 15 - 17</td>
<td>Heavy Construction</td>
<td>Total</td>
</tr>
</tbody>
</table>

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

\[
2011 \text{ acres per } $10^6 = 1999 \text{ acres per } $10^6 \times (1999 \text{ PPI} / 2011 \text{ PPI}) = 2 \text{ acres/$10^6} \times (132.9 / 229.3) = 1.159 \text{ acres per } $10^6
\]

**Emission Factors**

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

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

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

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

The equation for PM$_{10}$ emissions corrected for soil moisture and silt content is:

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

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$_{10}$.

**Example Calculation**

\[
E_{emissionsPM_{10}} = N_{Spending} \times (Emp_{county} / Emp_{National}) \times Apd \times EF_{Adj} \times M
\]

where:

\[
N_{Spending} = \text{National spending on nonresidential construction (million dollars)}

Emp_{county} = \text{County level employment in nonresidential construction}
\]
Emp_{National} = National level employment in nonresidential construction
Apd = Acres per million dollars (national data)
EF_{Adj} = Adjusted PM\textsubscript{10} emission factor (ton/acre-month)
M = duration of construction activity (months)

As an example, in Grand Traverse County, Michigan, 2011 acres disturbed and PM\textsubscript{10} emissions from nonresidential construction are calculated as follows:

\[
Emission_{PM10} = 269,045 \times 10^6 \times (130/651,996) \times 1.159 \times 0.059 \times EF_{Adj} \times M
\]
\[
= 62.2 \times 0.059 \times 11 \text{ months}
\]
\[
= 40.4 \text{ tons PM10}
\]

where \(EF_{Adj}\) is calculated as follows:

\[
EF_{Adj} = 0.19 \times \frac{24}{103.6} \times \frac{12}{9}
\]
\[
= 0.059 \text{ ton/acre-month}
\]

3.7.4.2 References for Construction – Non-Residential

2. County Business Patterns: http://www.census.gov/econ/cbp/index.html

3.7.5 Construction – Residential – EPA estimates

3.7.5.1 Source category description

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

<table>
<thead>
<tr>
<th>Table 3-66: SCC for Residential Construction</th>
</tr>
</thead>
<tbody>
<tr>
<td>SCC</td>
</tr>
<tr>
<td>-----</td>
</tr>
<tr>
<td>2311010000</td>
</tr>
</tbody>
</table>

Activity Data

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

Surface soil disturbed

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

**Table 3-67: Surface soil removed per unit type**

<table>
<thead>
<tr>
<th>Unit Type</th>
<th>Surface Acres Disturbed</th>
</tr>
</thead>
<tbody>
<tr>
<td>1-Unit</td>
<td>1/4 acre/structure</td>
</tr>
<tr>
<td>2-Unit</td>
<td>1/3 acre/structure</td>
</tr>
<tr>
<td>Apartment</td>
<td>1/2 acre/structure</td>
</tr>
</tbody>
</table>

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

**Basement soil removal**

To calculate basement soil removal, 2010 *Characteristics of New Houses* [ref 9] is used to estimate the percentage of 1 unit structures that have a basement (on the regional level). The county level estimate of number of 1 unit starts is multiplied by the percent of 1 unit houses in the region that have a basement to get the number of basements in a county. Basement volume is calculated by assuming a 2000 square foot house has a basement dug to a depth of 8 feet (making 16,000 ft³ per basement). An additional 10% is added for peripheral dirt bringing the total to 17,600 ft³ per basement.

**Emission Factors**

Initial PM₁₀ emissions from construction of single family, two family, and apartments structures are calculated using the emission factors given in Table 3-68 [ref 10]. The duration of construction activity for houses is assumed to be 6 months and the duration of construction for apartments is assumed to be 12 months.

**Table 3-68: Emission factors for Residential Construction**

<table>
<thead>
<tr>
<th>Type of Structure</th>
<th>Emission Factor</th>
<th>Duration of Construction</th>
</tr>
</thead>
<tbody>
<tr>
<td>Apartments</td>
<td>0.11 tons PM₁₀/acre-month</td>
<td>12 months</td>
</tr>
<tr>
<td>2-Unit Structures</td>
<td>0.032 tons PM₁₀/acre-month</td>
<td>6 months</td>
</tr>
<tr>
<td>1-Unit Structures w/o Basements</td>
<td>0.032 tons PM₁₀/acre-month</td>
<td>6 months</td>
</tr>
<tr>
<td>1-unit Structures with Basements</td>
<td>0.011 tons PM₁₀/acre-month</td>
<td>6 months</td>
</tr>
<tr>
<td></td>
<td>0.059 tons PM₁₀/1000 cubic yards</td>
<td>6 months</td>
</tr>
</tbody>
</table>

Regional variances in construction emissions are corrected using soil moisture level and silt content. These correction parameters are applied to initial PM₁₀ emissions from residential construction to develop the final emissions inventory.
To account for the soil moisture level, the PM$_{10}$ emissions are weighted using the 30-year average precipitation-evaporation (PE) values from Thornthwaite’s PE Index [ref 11]. Average precipitation evaporation values for each State were estimated based on PE values for specific climatic divisions within a State.

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

The equation for PM$_{10}$ emissions corrected for soil moisture and silt content is:

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

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, PM2.5-FIL emissions are estimated by applying a particle size multiplier of 0.10 to PM10-FIL emissions [ref 7]. Primary PM emissions are equal to filterable emissions since there are no condensable emissions from residential construction.

**Example Calculation**

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

where  
$A_{unit} = HS_{Unit} \times SM_{Unit}$  
$HS_{Unit} = Regional\ Housing\ Starts \times (county\ building\ permits/Regional\ building\ permits)$  
$SM_{Unit} = Area\ or\ volume\ of\ soil\ moved\ for\ the\ given\ unit\ type$  
$T_{Construction} = Construction\ time\ (in\ months)\ for\ given\ unit\ type$  
$EF_{Unit} = Unadjusted\ emission\ factor\ for\ PM_{10}\ for\ the\ given\ unit\ type$  
$Adj_{PM} = PM\ Adjustment\ factor$

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

$A_{unit} = 247,000 \times (211/232,280) \times 0.907 \times 0.25\ acres/unit \times 0.25\ acres/unit = 50.9\ acres$  
$Adj_{PM} = (24/110.1) \times (10/9) = 0.242$

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

**Summary of Quality Assurance Methods**

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

3.7.5.2 References for Construction - Residential

3.7.6 Construction – Road- EPA estimates

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

3.7.6.1 Source category description

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

<table>
<thead>
<tr>
<th>SCC</th>
<th>SCC Level One</th>
<th>SCC Level Two</th>
<th>SCC Level Three</th>
<th>SCC Level Four</th>
</tr>
</thead>
<tbody>
<tr>
<td>2311030000</td>
<td>Industrial Processes</td>
<td>Construction: SIC 15 - 17</td>
<td>Road Construction</td>
<td>Total</td>
</tr>
</tbody>
</table>

Activity Data

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

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

The State expenditure data are then converted to new miles of road constructed using $/mile conversions obtained from the North Carolina Department of Transportation (NCDOT) in 2000. A conversion of $4 million/mile is applied to the interstate expenditures. For expenditures on other arterial and collectors, a conversion factor of $1.9 million/mile is applied, which corresponds to all other projects.
The new miles of road constructed are used to estimate the acreage disturbed due to road construction. The total area disturbed in each state is calculated by converting the new miles of road constructed to acres using an acres disturbed/mile conversion factor for each road type as given in Table 3-70.

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

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

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

**Emission Factors**

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

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

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

To account for the silt content, the PM$_{10}$ emissions are weighted using average silt content for each county. A data base containing county-level dry silt values was 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 15].

The equation for PM$_{10}$ 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 PM10 adjustments have been made, PM2.5 emissions are set to 10% of PM10. Primary PM emissions are equal to filterable emissions since there are no condensable emissions from road construction.

Example Calculation

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

where:
- HD_{rt} = Highway Spending for a specific road type
- MC_{rt} = Mileage conversion for a specific road type
- AC_{rt} = Acreage conversion for a specific road type
- HS_{County} = Housing Starts in a given county
- HS_{State} = Housing Starts in a given State
- EF_{Adj} = Adjusted PM10 Emission Factor
- M = duration of construction activity

As an example in 2010, in Newport County, Rhode Island, acres disturbed and PM10 emissions from urban interstate and urban other arterial road construction are calculated as follows:

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

where EF_{Adj} is calculated as follows:

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

3.7.6.2 References for Construction - Road


3.8 Dust – Paved Road Dust

3.8.1 Sector description

The SCCs that belong to this sector are provided in Table 3-71. EPA estimates emissions for particulate matter for the first SCC in this table.
Table 3-71: SCCs used for Paved Road Dust – 2011 NEI

<table>
<thead>
<tr>
<th>SCC</th>
<th>SCC Level 1</th>
<th>SCC Level 2</th>
<th>SCC Level 3</th>
<th>SCC Level 4</th>
</tr>
</thead>
<tbody>
<tr>
<td>2294000000</td>
<td>Mobile Sources</td>
<td>Paved Roads</td>
<td>All Paved Roads</td>
<td>Total: Fugitives</td>
</tr>
<tr>
<td>2294005000</td>
<td>Mobile Sources</td>
<td>Paved Roads</td>
<td>Interstate/Arterial</td>
<td>Total: Fugitives</td>
</tr>
<tr>
<td>2294010000</td>
<td>Mobile Sources</td>
<td>Paved Roads</td>
<td>All Other Public Paved Roads</td>
<td>Total: Fugitives</td>
</tr>
</tbody>
</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 3-72 submitted emissions for this sector. Table 3-73 shows the selection hierarchy for the datasets included in the paved road dust sector.

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

<table>
<thead>
<tr>
<th>AGENCY</th>
<th>Type</th>
<th>All Other Public Paved Roads</th>
<th>All Paved Roads</th>
<th>Interstate/Arterial</th>
</tr>
</thead>
<tbody>
<tr>
<td>EPA- paved road estimates</td>
<td>EPA</td>
<td>X</td>
<td>X</td>
<td></td>
</tr>
<tr>
<td>EPA- PM-augmentation</td>
<td>EPA</td>
<td>X</td>
<td>X</td>
<td>X</td>
</tr>
<tr>
<td>Bishop Paiute Tribe</td>
<td>T</td>
<td>X</td>
<td></td>
<td></td>
</tr>
<tr>
<td>California Air Resources Board</td>
<td>S</td>
<td></td>
<td>X</td>
<td></td>
</tr>
<tr>
<td>Clark County Department of Air Quality and Environmental Management</td>
<td>L</td>
<td></td>
<td>X</td>
<td></td>
</tr>
<tr>
<td>Coeur d’Alene Tribe</td>
<td>T</td>
<td></td>
<td>X</td>
<td></td>
</tr>
<tr>
<td>Colorado Department of Public Health and Environment</td>
<td>S</td>
<td></td>
<td>X</td>
<td></td>
</tr>
<tr>
<td>Delaware Department of Natural Resources and Environmental Control</td>
<td>S</td>
<td></td>
<td>X</td>
<td></td>
</tr>
<tr>
<td>Hawaii Department of Health Clean Air Branch</td>
<td>S</td>
<td></td>
<td>X</td>
<td></td>
</tr>
<tr>
<td>Idaho Department of Environmental Quality</td>
<td>S</td>
<td></td>
<td>X</td>
<td></td>
</tr>
<tr>
<td>Kansas Department of Health and Environment</td>
<td>S</td>
<td></td>
<td>X</td>
<td></td>
</tr>
<tr>
<td>Kickapoo Tribe of Indians of the Kickapoo Reservation in Kansas</td>
<td>T</td>
<td>X</td>
<td>X</td>
<td></td>
</tr>
<tr>
<td>Kootenai Tribe of Idaho</td>
<td>T</td>
<td></td>
<td>X</td>
<td></td>
</tr>
<tr>
<td>Maricopa County Air Quality Department</td>
<td>L</td>
<td></td>
<td>X</td>
<td></td>
</tr>
<tr>
<td>Maryland Department of the Environment</td>
<td>S</td>
<td></td>
<td>X</td>
<td></td>
</tr>
<tr>
<td>Metro Public Health of Nashville/Davidson County</td>
<td>L</td>
<td></td>
<td>X</td>
<td></td>
</tr>
<tr>
<td>New Hampshire Department of Environmental Services</td>
<td>S</td>
<td></td>
<td>X</td>
<td></td>
</tr>
<tr>
<td>New Jersey Department of Environment Protection</td>
<td>S</td>
<td></td>
<td>X</td>
<td></td>
</tr>
<tr>
<td>Nez Perce Tribe</td>
<td>T</td>
<td></td>
<td>X</td>
<td></td>
</tr>
<tr>
<td>Northern Cheyenne Tribe</td>
<td>T</td>
<td></td>
<td>X</td>
<td></td>
</tr>
<tr>
<td>Sac and Fox Nation of Missouri in Kansas and Nebraska Reservation</td>
<td>T</td>
<td></td>
<td>X</td>
<td></td>
</tr>
<tr>
<td>Shoshone-Bannock Tribes of the Fort Hall Reservation of Idaho</td>
<td>T</td>
<td></td>
<td>X</td>
<td></td>
</tr>
<tr>
<td>Virginia Department of Environmental Quality</td>
<td>S</td>
<td></td>
<td>X</td>
<td></td>
</tr>
<tr>
<td>Washington State Department of Ecology</td>
<td>S</td>
<td></td>
<td>X</td>
<td></td>
</tr>
<tr>
<td>West Virginia Division of Air Quality</td>
<td>S</td>
<td></td>
<td>X</td>
<td></td>
</tr>
</tbody>
</table>
Table 3-73: 2011 NEI Paved Road Dust data selection hierarchy

<table>
<thead>
<tr>
<th>Priority</th>
<th>Dataset Name</th>
<th>Dataset Content</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Responsible Agency Data Set</td>
<td>State and Local Agency submitted emissions</td>
</tr>
<tr>
<td>2</td>
<td>2011EPA_PM-Augmentation</td>
<td>Augments PM data in 47 states and some tribes</td>
</tr>
<tr>
<td>3</td>
<td>2011EPA_NP_NoOverlap_w_Pt</td>
<td>EPA-generated data</td>
</tr>
</tbody>
</table>

3.8.3 Spatial coverage and data sources for the sector

[Map of the United States showing dust-paved road distribution]

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 PM10 nonattainment area counties. Emissions and VMT by roadway class were then totaled to the county level for reporting in the NEI. The following provides further details on the emission factor equation, determination of paved road VMT, and controls.

Emission Factor Equation

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

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

where:

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

The uncontrolled PM10-PRI/-FIL and PM25-PRI/-FIL emission factors by county, roadway class, and year are provided in the tab “Emission Factors” in the calculation workbook “2011_paved_roads_2294000000_cap_emissions.xlsx”, available at 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 3-74.

**Table 3-74: 2011 Silt loadings by state and roadway class used in paved road emission factor calculations (g/m²)**

<table>
<thead>
<tr>
<th>State</th>
<th>Rural</th>
<th>Urban</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Interstate</td>
<td>Other</td>
</tr>
<tr>
<td>Alabama</td>
<td>0.015</td>
<td>0.06</td>
</tr>
<tr>
<td>Alaska</td>
<td>0.015</td>
<td>0.2</td>
</tr>
<tr>
<td>Arizona</td>
<td>0.015</td>
<td>0.06</td>
</tr>
<tr>
<td>Arkansas</td>
<td>0.015</td>
<td>0.06</td>
</tr>
<tr>
<td>California</td>
<td>0.015</td>
<td>0.03</td>
</tr>
<tr>
<td>Colorado</td>
<td>0.015</td>
<td>0.2</td>
</tr>
<tr>
<td>Connecticut</td>
<td>0.015</td>
<td>0.06</td>
</tr>
<tr>
<td>Delaware</td>
<td>0.015</td>
<td>0.03</td>
</tr>
<tr>
<td>Dist. of Columbia</td>
<td>0.015</td>
<td>0.6</td>
</tr>
<tr>
<td>Florida</td>
<td>0.015</td>
<td>0.06</td>
</tr>
<tr>
<td>Georgia</td>
<td>0.015</td>
<td>0.06</td>
</tr>
<tr>
<td>Hawaii</td>
<td>0.015</td>
<td>0.03</td>
</tr>
<tr>
<td>Idaho</td>
<td>0.015</td>
<td>0.2</td>
</tr>
<tr>
<td>Illinois</td>
<td>0.015</td>
<td>0.2</td>
</tr>
<tr>
<td>Indiana</td>
<td>0.015</td>
<td>0.06</td>
</tr>
<tr>
<td>Iowa</td>
<td>0.015</td>
<td>0.2</td>
</tr>
<tr>
<td>Kansas</td>
<td>0.015</td>
<td>0.2</td>
</tr>
<tr>
<td>Kentucky</td>
<td>0.015</td>
<td>0.06</td>
</tr>
<tr>
<td>Louisiana</td>
<td>0.015</td>
<td>0.06</td>
</tr>
<tr>
<td>Maine</td>
<td>0.015</td>
<td>0.06</td>
</tr>
<tr>
<td>Maryland</td>
<td>0.015</td>
<td>0.03</td>
</tr>
<tr>
<td>Massachusetts</td>
<td>0.015</td>
<td>0.06</td>
</tr>
<tr>
<td>Michigan</td>
<td>0.015</td>
<td>0.2</td>
</tr>
<tr>
<td>Minnesota</td>
<td>0.015</td>
<td>0.06</td>
</tr>
<tr>
<td>Mississippi</td>
<td>0.015</td>
<td>0.06</td>
</tr>
<tr>
<td>Missouri</td>
<td>0.015</td>
<td>0.2</td>
</tr>
<tr>
<td>Montana</td>
<td>0.015</td>
<td>0.2</td>
</tr>
<tr>
<td>Nebraska</td>
<td>0.015</td>
<td>0.2</td>
</tr>
</tbody>
</table>
To better estimate paved road fugitive dust emissions, the average vehicle weight was estimated by road type for each county in the U.S. (plus Puerto Rico and the U.S. Virgin Islands) based on the mix of VMT by vehicle type from the 2008 onroad NEI. For state and local agencies that provided VMT data to EPA for use in the 2008 NEI, those data are included in this data set. Additionally, if a state/local agency did not provide VMT data for the 2008 NEI, but had provided information for either the 2005 or 2002 NEI, the state/local-supplied data were grown to 2008 based on 2008 VMT data from the Federal Highway Administration (FHWA). The VMT data for the remaining counties were based on 2008 Federal Highway Administration data. (See the NEI onroad documentation for more details on how the default VMT data were calculated from the FHWA data set.)

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

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

<table>
<thead>
<tr>
<th>Vehicle Class Abbreviation</th>
<th>Vehicle Class Description</th>
<th>Vehicle Weight Estimate (lbs)</th>
</tr>
</thead>
<tbody>
<tr>
<td>LDGV</td>
<td>Light-Duty Gasoline Vehicles (Passenger Cars)</td>
<td>3,369</td>
</tr>
<tr>
<td>LDGT1</td>
<td>Light-Duty Gasoline Trucks 1 (0-6,000 lbs. GVWR, 0-3750 lbs. LVW)</td>
<td>4,150</td>
</tr>
<tr>
<td>LDGT2</td>
<td>Light-Duty Gasoline Trucks 2 (0-6,000 lbs. GVWR, 3751-5750 lbs. LVW)</td>
<td>4,150</td>
</tr>
<tr>
<td>LDGT3</td>
<td>Light-Duty Gasoline Trucks 3 (6,001-8,500 lbs. GVWR, 0-5750 lbs. ALVW)</td>
<td>5,327</td>
</tr>
<tr>
<td>LDGT4</td>
<td>Light-Duty Gasoline Trucks 4 (6,001-8,500 lbs. GVWR, 5751 lbs. and greater ALVW)</td>
<td>5,327</td>
</tr>
<tr>
<td>HDGV2B</td>
<td>Class 2b Heavy-Duty Gasoline Vehicles (8501-10,000 lbs. GVWR)</td>
<td>9,250</td>
</tr>
<tr>
<td>HDGV3</td>
<td>Class 3 Heavy-Duty Gasoline Vehicles (10,001-14,000 lbs. GVWR)</td>
<td>12,000</td>
</tr>
<tr>
<td>HDGV4</td>
<td>Class 4 Heavy-Duty Gasoline Vehicles (14,001-16,000 lbs. GVWR)</td>
<td>15,000</td>
</tr>
<tr>
<td>HDGV5</td>
<td>Class 5 Heavy-Duty Gasoline Vehicles (16,001-19,500 lbs. GVWR)</td>
<td>17,750</td>
</tr>
<tr>
<td>HDGV6</td>
<td>Class 6 Heavy-Duty Gasoline Vehicles (19,501-26,000 lbs. GVWR)</td>
<td>22,750</td>
</tr>
<tr>
<td>HDGV7</td>
<td>Class 7 Heavy-Duty Gasoline Vehicles (26,001-33,000 lbs. GVWR)</td>
<td>29,500</td>
</tr>
<tr>
<td>HDGV8A</td>
<td>Class 8a Heavy-Duty Gasoline Vehicles (33,001-60,000 lbs. GVWR)</td>
<td>48,000</td>
</tr>
<tr>
<td>HDGV8B</td>
<td>Class 8b Heavy-Duty Gasoline Vehicles (&gt;60,000 lbs. GVWR)</td>
<td>71,900</td>
</tr>
<tr>
<td>LDDV</td>
<td>Light-Duty Diesel Vehicles (Passenger Cars)</td>
<td>3,369</td>
</tr>
<tr>
<td>LDDT12</td>
<td>Light-Duty Diesel Trucks 1 and 2 (0-6,000 lbs. GVWR)</td>
<td>4,150</td>
</tr>
<tr>
<td>HDDV2B</td>
<td>Class 2b Heavy-Duty Diesel Vehicles (8501-10,000 lbs. GVWR)</td>
<td>9,250</td>
</tr>
<tr>
<td>HDDV3</td>
<td>Class 3 Heavy-Duty Diesel Vehicles (10,001-14,000 lbs. GVWR)</td>
<td>12,000</td>
</tr>
<tr>
<td>HDDV4</td>
<td>Class 4 Heavy-Duty Diesel Vehicles (14,001-16,000 lbs. GVWR)</td>
<td>15,000</td>
</tr>
<tr>
<td>HDDV5</td>
<td>Class 5 Heavy-Duty Diesel Vehicles (16,001-19,500 lbs. GVWR)</td>
<td>17,750</td>
</tr>
<tr>
<td>HDDV6</td>
<td>Class 6 Heavy-Duty Diesel Vehicles (19,501-26,000 lbs. GVWR)</td>
<td>22,750</td>
</tr>
<tr>
<td>HDDV7</td>
<td>Class 7 Heavy-Duty Diesel Vehicles (26,001-33,000 lbs. GVWR)</td>
<td>29,500</td>
</tr>
<tr>
<td>HDDV8A</td>
<td>Class 8a Heavy-Duty Diesel Vehicles (33,001-60,000 lbs. GVWR)</td>
<td>48,000</td>
</tr>
<tr>
<td>HDDV8B</td>
<td>Class 8b Heavy-Duty Diesel Vehicles (&gt;60,000 lbs. GVWR)</td>
<td>71,900</td>
</tr>
<tr>
<td>MC</td>
<td>Motorcycles (Gasoline)</td>
<td>500</td>
</tr>
<tr>
<td>HDGB</td>
<td>Gasoline Buses (School, Transit and Urban)</td>
<td>32,500</td>
</tr>
<tr>
<td>HDDBT</td>
<td>Diesel Transit and Urban Buses</td>
<td>32,500</td>
</tr>
<tr>
<td>HDBBS</td>
<td>Diesel School Buses</td>
<td>25,000</td>
</tr>
<tr>
<td>LDDT34</td>
<td>Light-Duty Diesel Trucks 3 and 4 (6,001-8,500 lbs. GVWR)</td>
<td>5,327</td>
</tr>
</tbody>
</table>

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

Activity

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

Controls

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

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

<table>
<thead>
<tr>
<th>PM$_{10}$ Nonattainment Status</th>
<th>Roadway Class</th>
<th>Vacuum Sweeping Penetration Rate (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Moderate</td>
<td>Urban Freeway &amp; Expressway</td>
<td>67</td>
</tr>
<tr>
<td>Moderate</td>
<td>Urban Minor Arterial</td>
<td>67</td>
</tr>
<tr>
<td>Moderate</td>
<td>Urban Collector</td>
<td>64</td>
</tr>
<tr>
<td>Moderate</td>
<td>Urban Local</td>
<td>88</td>
</tr>
<tr>
<td>Serious</td>
<td>Rural Minor Arterial</td>
<td>71</td>
</tr>
<tr>
<td>Serious</td>
<td>Rural Major Collector</td>
<td>83</td>
</tr>
<tr>
<td>Serious</td>
<td>Rural Minor Collector</td>
<td>59</td>
</tr>
<tr>
<td>Serious</td>
<td>Rural Local</td>
<td>35</td>
</tr>
<tr>
<td>Serious</td>
<td>Urban Freeway &amp; Expressway</td>
<td>67</td>
</tr>
<tr>
<td>Serious</td>
<td>Urban Minor Arterial</td>
<td>67</td>
</tr>
<tr>
<td>Serious</td>
<td>Urban Collector</td>
<td>64</td>
</tr>
<tr>
<td>Serious</td>
<td>Urban Local</td>
<td>88</td>
</tr>
</tbody>
</table>

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

### 3.8.5 Summary of quality assurance methods

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


3.9 Dust – Unpaved Road Dust

3.9.1 Sector description

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

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

<table>
<thead>
<tr>
<th>SCC</th>
<th>SCC Level 1</th>
<th>SCC Level 2</th>
<th>SCC Level 3</th>
<th>SCC Level 4</th>
</tr>
</thead>
<tbody>
<tr>
<td>2296000000</td>
<td>Mobile Sources</td>
<td>Unpaved Roads</td>
<td>All Unpaved Roads</td>
<td>Total: Fugitives</td>
</tr>
<tr>
<td>2296005000</td>
<td>Mobile Sources</td>
<td>Unpaved Roads</td>
<td>Public Unpaved Roads</td>
<td>Total: Fugitives</td>
</tr>
<tr>
<td>2296010000</td>
<td>Mobile Sources</td>
<td>Unpaved Roads</td>
<td>Industrial Unpaved Roads</td>
<td>Total: Fugitives</td>
</tr>
</tbody>
</table>

3.9.2 Sources of data overview and selection hierarchy

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

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

<table>
<thead>
<tr>
<th>Agency</th>
<th>Type</th>
<th>All Unpaved Roads</th>
<th>Industrial Unpaved Roads</th>
<th>Public Unpaved Roads</th>
</tr>
</thead>
<tbody>
<tr>
<td>2011EPA Unpaved Road estimates</td>
<td>EPA</td>
<td>X</td>
<td></td>
<td></td>
</tr>
<tr>
<td>EPA PM Augmentation</td>
<td>EPA</td>
<td>X</td>
<td>0</td>
<td>X</td>
</tr>
<tr>
<td>Bishop Paiute Tribe</td>
<td>T</td>
<td>X</td>
<td></td>
<td></td>
</tr>
<tr>
<td>California Air Resources Board</td>
<td>S</td>
<td>X</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Clark County Department of Air Quality and Environmental Management</td>
<td>L</td>
<td>X</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Colorado Department of Public Health and Environment</td>
<td>S</td>
<td>X</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Eastern Band of Cherokee Indians</td>
<td>T</td>
<td>X</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Hawaii Department of Health Clean Air Branch</td>
<td>S</td>
<td>X</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Kansas Department of Health and Environment</td>
<td>S</td>
<td>X</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Kickapoo Tribe of Indians of the Kickapoo Reservation in Kansas</td>
<td>T</td>
<td>X</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Maricopa County Air Quality Department</td>
<td>L</td>
<td>X</td>
<td>X</td>
<td></td>
</tr>
</tbody>
</table>
Table 3-79 shows the selection hierarchy for the datasets used in the unpaved roads sector.

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

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 PM10 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.

Emission Factor Equation

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

\[
E = \left[ k \times \left( \frac{s}{12} \right)^{1} \times \left( \frac{SPD}{30} \right)^{0.5} \right] \div \left( \frac{M}{0.5} \right)^{0.2} - C
\]

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

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

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

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

Average State-level unpaved road silt content values, developed as part of the 1985 NAPAP Inventory, were obtained from the Illinois State Water Survey [ref 2]. Silt contents of over 200 unpaved roads from over 30 States were obtained. Average silt contents of unpaved roads were calculated for each 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 3-80: Constants for Unpaved Roads re-entrained dust emission factor Equation [ref 1]

<table>
<thead>
<tr>
<th>Constant</th>
<th>PM25-PRI/PM25-FIL</th>
<th>PM10-PRI/PM10-FIL</th>
</tr>
</thead>
<tbody>
<tr>
<td>k (lb/VMT)</td>
<td>0.18</td>
<td>1.8</td>
</tr>
<tr>
<td>C</td>
<td>0.00036</td>
<td>0.00047</td>
</tr>
</tbody>
</table>
Table 3-81 lists the speeds modeled on the unpaved roads by roadway class. These speeds were determined based on the average speeds modeled for onroad emission calculations and weighted to determine a single average speed for each of the roadway classes.

<table>
<thead>
<tr>
<th>Unpaved Roadway Type</th>
<th>Speed (mph)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Rural Minor Arterial</td>
<td>39</td>
</tr>
<tr>
<td>Rural Major Collector</td>
<td>34</td>
</tr>
<tr>
<td>Rural Minor Collector</td>
<td>30</td>
</tr>
<tr>
<td>Rural Local</td>
<td>30</td>
</tr>
<tr>
<td>Urban Other Principal Arterial</td>
<td>20</td>
</tr>
<tr>
<td>Urban Minor Arterial</td>
<td>20</td>
</tr>
<tr>
<td>Urban Collector</td>
<td>20</td>
</tr>
<tr>
<td>Urban Local</td>
<td>20</td>
</tr>
</tbody>
</table>

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

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

$$E_{corr} = E \times \left(\frac{D-p}{D}\right)$$

where:

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

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

**Activity**

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

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

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

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

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

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

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

<table>
<thead>
<tr>
<th>Volume Category (vehicles per day per mile)</th>
<th>&lt; 50</th>
<th>50-199</th>
<th>200-499</th>
<th>&gt; 500</th>
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<tr>
<td>Assumed ADTV</td>
<td>5*</td>
<td>125**</td>
<td>350**</td>
<td>550***</td>
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#### Rural Roads

#### Urban Roads

<table>
<thead>
<tr>
<th>Volume Category (vehicles per day per mile)</th>
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<th>500-1999</th>
<th>&gt; 2000</th>
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<td>1250**</td>
<td>2200***</td>
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</table>

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

### Allocation

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

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

\[
EMI_{SxY} = \left( \frac{CL_x}{SL} \right) \times EMIS_Y
\]

where:

- \(EMI_{SxY}\) = unpaved road emissions (tons) for county x and roadway class y
- \(CL_x\) = rural population in county x
- \(SL\) = rural population in the State
- \(EMIS_Y\) = unpaved road emissions in entire State for roadway class y

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

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

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

3.9.5 Summary of quality assurance methods

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

3.9.6 References for Dust – Unpaved Road Dust

3.10 Fuel Combustion – Electric Generation

This section includes the description of five EIS sectors:

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

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

3.10.1 Sector description

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

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

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

3.10.2 Sources of data overview and selection hierarchy

The primary sources of data for the EGU sectors were the S/L/T agency-submitted data and EPA’s EGU dataset. The EPA EGU dataset emissions for a suite of 15 HAP pollutants that were tested as part of the Mercury and Air Toxics Standard (MATS) rule development were used ahead of S/L/T agency-submitted data except where the S/L/T agency submittal indicated that it was based on either a CEM or recent stack testing. Additional emissions data in the EPA EGU dataset from either CAMD’s SO₂ and NOₓ CEM data or from AP-42 emissions factors were
only used where the responsible S/L/T agency did not report a pollutant for a given unit. In addition to these two primary sources of data, the EGU sectors also have contributions from the EPA PM Augmentation, EPA Chromium Split, EPA TRI, and EPA HAP Augmentation datasets. A smaller amount of contributions were also from the EPA Carry Forward, EPA other, and EPA’s Nevada Gold datasets.

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

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

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<th>Type</th>
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<th>Natural Gas</th>
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<td>X</td>
</tr>
<tr>
<td>Western North Carolina Regional Air Quality Agency</td>
<td>Local</td>
<td>X</td>
<td>X</td>
<td></td>
<td></td>
<td>X</td>
</tr>
<tr>
<td>Wisconsin Department of Natural Resources</td>
<td>State</td>
<td>X</td>
<td>X</td>
<td></td>
<td></td>
<td>X</td>
</tr>
</tbody>
</table>

137
Table 3-84 shows the selection hierarchy for the EGU sectors. A box with an “X” means that the dataset contributed to the EGU sector for that fuel group.

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

<table>
<thead>
<tr>
<th>Priority</th>
<th>Data Set Name</th>
<th>Data Set Contents and Impact</th>
<th>Coal</th>
<th>Oil</th>
<th>Natural</th>
<th>Biomass</th>
<th>Other</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>2011EPA_PM-Augmentation</td>
<td>Augments PM data in 47 states and some tribes (see Section 3.1.2)</td>
<td>X</td>
<td>X</td>
<td>X</td>
<td>X</td>
<td>X</td>
</tr>
<tr>
<td>2</td>
<td>2011 Responsible Agency Selection</td>
<td>S/L/T agency submitted emissions</td>
<td>X</td>
<td>X</td>
<td>X</td>
<td>X</td>
<td>X</td>
</tr>
<tr>
<td>3</td>
<td>2011EPA_EGU</td>
<td>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)</td>
<td>X</td>
<td>X</td>
<td>X</td>
<td>X</td>
<td>X</td>
</tr>
<tr>
<td>4</td>
<td>2011EPA_chrom_split</td>
<td>Splits total chromium into speciated chromium in 37 states (see Section 3.1.3)</td>
<td>X</td>
<td>X</td>
<td>X</td>
<td>X</td>
<td>X</td>
</tr>
<tr>
<td>5</td>
<td>EPA NV Gold Mines</td>
<td>EPA-generated data</td>
<td>X</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>6</td>
<td>2011EPA_Other</td>
<td>EPA-generated data</td>
<td>X</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>7</td>
<td>2011EPA_TRI</td>
<td>Adds Pb and HAP emissions in 53 states and 4 tribes(see Section 3.1.4)</td>
<td>X</td>
<td>X</td>
<td>X</td>
<td></td>
<td>X</td>
</tr>
<tr>
<td>8</td>
<td>2011EPA_CarryForward-PreviousYearData</td>
<td>EPA-generated data</td>
<td>X</td>
<td></td>
<td></td>
<td></td>
<td>X</td>
</tr>
<tr>
<td>9</td>
<td>2011EPA_HAP -Augmentation</td>
<td>Adds Pb and HAP emissions in 26 states (see Section 3.1.5)</td>
<td>X</td>
<td>X</td>
<td>X</td>
<td>X</td>
<td>X</td>
</tr>
</tbody>
</table>
3.10.3 Spatial coverage and data sources for the sector
3.10.4 PM Augmentation for EGUs

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

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

In addition to the S/L/T-reported data, EPA developed a single combined dataset of emission estimates for EGUs to be used to fill gaps for pollutants and emission units not reported by S/L/T agencies and in some cases to be used instead of S/L/T agency submitted data. The 2011EPA_EGU dataset was developed from three separate estimation sources. The three sources were: the 2010 MATS testing program emission factors for 15 HAPs with annual throughputs primarily from EPA’s Clean Air Market Division (CAMD) but also from the Department of Energy’s Energy Information Administration (EIA) and data provided by Puerto Rico; SO₂ and NOₓ emissions from CAMD’s CEM database; and emission factors used in the 2008 NEI that were built from AP-42 emission factors and 2008 fuel heat and sulfur contents with 2011 annual throughputs from CAMD. A small number of the AP-42 based estimates were not included in the 2011EPA-EGU dataset because the primary fuel burned or the control devices used by the units in 2011 were found to be different than in 2008, which would render the 2008 emission factors non-representative of 2011 operations for these emission units.

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

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

In summary, the 2011 NEI for EGUs is comprised of largely S/L/T agency-reported data for the CAPs and any HAPs that the S/L/T agencies reported other than the fifteen MATS-estimated pollutants. For those fifteen MATS-estimated pollutants, the 2011 NEI is comprised largely of the EPA estimates, except S/L/T agency data were used where it was believed to be based upon use of a CEM or unit-specific test. Other HAPs for the MATS-regulated units, and all HAPs for units not part of MATS, include S/L/T agency emissions values where they were reported (with PM and Chromium augmentation, if needed), or include the 2011EPA_EGU emissions where no S/L/T agency emissions were reported.
The matching of the 2011EPA_EGU dataset to the responsible agency facility, unit and process IDs was done largely by using the ORIS plant and CAMD boiler IDs as found in the CAMD heat input activity dataset, and linking these to the same two IDs as had been stored in EIS. We also compared the facility names and counties for agreement, and revisions were made wherever discrepancies were noted. As a final confirmation that the correct emissions unit and a reasonable process ID in the EIS had been matched to the EPA data, the magnitudes of the SO₂ and NOₓ emissions for all preliminary matches were compared between the S/L/T agency-reported datasets and the EPA dataset. Several discrepancies were identified and resolved from this emissions comparison.

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

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

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

3.10.7 Summary of quality assurance methods

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

3.11 Fuel Combustion – Industrial Boilers, ICEs

This section includes the description of five EIS sectors:

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

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

3.11.1 Sector description

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

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

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

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

3.11.2 Sources of data overview and selection hierarchy

The industrial fuel combustion sectors include data from S/L/T agencies and 9 EPA datasets that cover both point and nonpoint data categories. Table 3-86 shows the agencies that submitted data in each of the data categories for each of the fuel combustion – industrial boilers and ICE sectors. Where only emission values of zero were submitted (sum across all pollutants submitted), these are shown as zeroes in the table. No “X” or “0” indicates that nothing was submitted by the agency for that data category and fuel combination for the industrial boilers sector.
<table>
<thead>
<tr>
<th>Agency</th>
<th>TYPE</th>
<th>Nonpoint</th>
<th>Point</th>
</tr>
</thead>
<tbody>
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<td>US Environmental Protection Agency</td>
<td>EPA</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Alabama Department of Environmental Management</td>
<td>S</td>
<td>X</td>
<td>X</td>
</tr>
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<td>S</td>
<td>0</td>
<td>X</td>
</tr>
<tr>
<td>Allegheny County Health Department</td>
<td>L</td>
<td>X</td>
<td>X</td>
</tr>
<tr>
<td>Arizona Department of Environmental Quality</td>
<td>S</td>
<td>X</td>
<td>X</td>
</tr>
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<td>S</td>
<td>X</td>
<td>X</td>
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<td>S</td>
<td>X</td>
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<td>L</td>
<td>X</td>
<td>X</td>
</tr>
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<td>L</td>
<td>X</td>
<td>X</td>
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</tr>
<tr>
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<td>X</td>
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<td></td>
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<td></td>
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<td>Navajo Nation</td>
<td>T</td>
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</tr>
</tbody>
</table>

Table 3-86: Agencies that submitted data for the Fuel Combustion - Industrial Boilers, ICEs sectors
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<th>TYPE</th>
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</tr>
<tr>
<td>Shoshone-Bannock Tribes of the Fort Hall Reservation of Idaho</td>
<td>T</td>
<td>X</td>
<td>X</td>
<td>X</td>
<td>X</td>
<td>X</td>
<td>X</td>
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</tr>
<tr>
<td>South Carolina Department of Health and Environmental Control</td>
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<td>X</td>
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<td>South Dakota Department of Environment and Natural Resources</td>
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<td>Southern Ute Indian Tribe</td>
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<tr>
<td>Southwest Clean Air Agency</td>
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<td>X</td>
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<tr>
<td>Tennessee Department of Environmental Conservation</td>
<td>S</td>
<td>X</td>
<td>X</td>
<td>X</td>
<td>X</td>
<td>X</td>
<td>X</td>
<td>X</td>
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<td>X</td>
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<td>Texas Commission on Environmental Quality</td>
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<td>Utah Division of Air Quality</td>
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<td>Vermont Department of Environmental Conservation</td>
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<td>Washington State Department of Ecology</td>
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<td>Washoe County Health District</td>
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<td>West Virginia Division of Air Quality</td>
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<td>X</td>
<td>X</td>
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<tr>
<td>Western North Carolina Regional Air Quality Agency (Buncombe Co.)</td>
<td>L</td>
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</tr>
<tr>
<td>Wisconsin Department of Natural Resources</td>
<td>S</td>
<td>0</td>
<td>0</td>
<td>X</td>
<td>X</td>
<td>X</td>
<td>X</td>
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<tr>
<td>Wyoming Department of Environmental Quality</td>
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</tr>
</tbody>
</table>

Table 3-87 shows the selection hierarchy for all datasets contributing emissions to the Fuel Comb - Industrial Boilers, ICEs Sectors. This selection hierarchy combines the S/L/T agency data with the EPA datasets. As can be seen, most of the datasets used for this selection have data for the point source data category only.
Table 3-87: 2011 NEI selection hierarchy for datasets used by Fuel Comb - Industrial Boilers, ICEs sectors

<table>
<thead>
<tr>
<th>Data Set Name</th>
<th>Description</th>
<th>Point</th>
<th>Non-point</th>
</tr>
</thead>
<tbody>
<tr>
<td>2011EPA_PM-Augmentation</td>
<td>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.</td>
<td>1</td>
<td>2</td>
</tr>
<tr>
<td>Responsible Agency Data Set</td>
<td>S/L/T agency submitted data</td>
<td>2</td>
<td>1</td>
</tr>
<tr>
<td>2011EPA_EGU</td>
<td>EPA MATS EGU data developed from CAMD heat input and EFs.</td>
<td>3</td>
<td></td>
</tr>
<tr>
<td>2011EPA_chrom_split</td>
<td>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.</td>
<td>4</td>
<td>3</td>
</tr>
<tr>
<td>2011EPA_Other</td>
<td>Data added to boiler and ICE SCCs resulting mercury emissions for a boiler in Missouri using state-provided data</td>
<td>5</td>
<td></td>
</tr>
<tr>
<td>2011EPA_TRI</td>
<td>Toxics Release Inventory data for the year 2011.</td>
<td>6</td>
<td></td>
</tr>
<tr>
<td>2011EPA_CarryForward-PreviousYear Data</td>
<td>Variety of estimates used to gap fill important sources/pollutants.</td>
<td>7</td>
<td></td>
</tr>
<tr>
<td>2011EPA_HAP-Augmentation</td>
<td>HAP data computed from S/L/T agency criteria pollutant data using HAP/CAP emission factor ratios.</td>
<td>8</td>
<td>4</td>
</tr>
<tr>
<td>2011EPA_NP_Overlap_w_Pt</td>
<td>EPA generated emissions for nonpoint sources</td>
<td>5</td>
<td></td>
</tr>
</tbody>
</table>

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

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

<table>
<thead>
<tr>
<th>Survey Data</th>
<th>State Submitted to Point?</th>
<th>State Submitted to Nonpoint?</th>
<th>EPA Action</th>
<th>Rationale</th>
</tr>
</thead>
<tbody>
<tr>
<td>State claims that category is fully covered by their point inventory for an SCC</td>
<td>Yes</td>
<td>Yes or No</td>
<td>Don’t augment their nonpoint data. Tag EPA data so that it doesn’t get put into the EIS</td>
<td>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.</td>
</tr>
<tr>
<td>Survey Data</td>
<td>State Submitted to Point?</td>
<td>State Submitted to Nonpoint?</td>
<td>EPA Action</td>
<td>Rationale</td>
</tr>
<tr>
<td>-------------</td>
<td>--------------------------</td>
<td>-------------------------------</td>
<td>------------</td>
<td>-----------</td>
</tr>
<tr>
<td></td>
<td>No</td>
<td>No</td>
<td>Augment with EPA estimates for nonpoint category</td>
<td>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.</td>
</tr>
<tr>
<td></td>
<td>No</td>
<td>Yes</td>
<td>Don’t augment</td>
<td>Assume that they filled out the survey incorrectly, and that they meant that the category is fully covered by nonpoint.</td>
</tr>
<tr>
<td>State claims that category is fully covered by their nonpoint inventory for an SCC</td>
<td>No</td>
<td>Yes</td>
<td>Don’t augment</td>
<td>Augmenting would double-count nonpoint emissions.</td>
</tr>
<tr>
<td></td>
<td>No</td>
<td>No</td>
<td>Augment</td>
<td>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.</td>
</tr>
<tr>
<td></td>
<td>Yes or No</td>
<td>Yes</td>
<td>Don’t augment</td>
<td>Assume that they filled out the survey incorrectly.</td>
</tr>
<tr>
<td>State claims that they do point/nonpoint reconciliation</td>
<td>Yes</td>
<td>No</td>
<td>Augment</td>
<td>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.</td>
</tr>
<tr>
<td></td>
<td>Yes or No</td>
<td>Yes</td>
<td>Don’t augment</td>
<td>No augmentation is necessary, since either both point and nonpoint were submitted, or nonpoint would be double-counted.</td>
</tr>
<tr>
<td></td>
<td>No</td>
<td>No</td>
<td>Augment</td>
<td>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.</td>
</tr>
<tr>
<td></td>
<td>Yes</td>
<td>No</td>
<td>Augment</td>
<td>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.</td>
</tr>
<tr>
<td>State claims that they do point/nonpoint reconciliation</td>
<td>Yes</td>
<td>No</td>
<td>Augment</td>
<td>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.</td>
</tr>
<tr>
<td></td>
<td>Yes or No</td>
<td>Yes</td>
<td>Don’t augment</td>
<td>No augmentation is necessary, since either both point and nonpoint were submitted, or nonpoint would be double-counted.</td>
</tr>
<tr>
<td></td>
<td>No</td>
<td>No</td>
<td>Augment</td>
<td>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.</td>
</tr>
</tbody>
</table>
3.11.3 Spatial coverage and data sources for the sector
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 v2 NEI. Other states agreed that the tagged values seemed incorrect, and that EPA should use the EPA generated estimates in its place. Table 3-89 summarizes the number of tagged process-level emissions values from each agency affected by this QA in 2011 v1. This analysis was not repeated for the 2011 v2 but any differences in number of tags are suspected to be minor.
### Table 3-89: Agencies tagged values for Industrial Fuel Combustion in 2011 NEI v1

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

#### 3.11.6 References for Fuel Combustion – Industrial Boilers, ICEs

3.12 Fuel Combustion – Commercial/Institutional

This section includes the description of five EIS sectors:

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

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

3.12.1 Sector description

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

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

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

3.12.2 Sources of data overview and selection hierarchy

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

<table>
<thead>
<tr>
<th>Agency</th>
<th>Type</th>
<th>Nonpoint</th>
<th></th>
<th>Point</th>
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153
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<td>Puget Sound Clean Air Agency</td>
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</tr>
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<td>Rhode Island Department of Environmental Management</td>
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<td>Shoshone-Bannock Tribes of the Fort Hall Reservation of Idaho</td>
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<td>X</td>
<td>X</td>
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<td>Southern Ute Indian Tribe</td>
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<td>X</td>
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<td>O</td>
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<td>West Virginia Division of Air Quality</td>
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<td>X</td>
<td>X</td>
</tr>
<tr>
<td>Wisconsin Department of Natural Resources</td>
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<td>Wyoming Department of Environmental Quality</td>
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<td>X</td>
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</table>

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

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

<table>
<thead>
<tr>
<th>Data Set Name</th>
<th>Description</th>
<th>Point</th>
<th>Non-point</th>
</tr>
</thead>
<tbody>
<tr>
<td>2011EPA_PM-Augmentation</td>
<td>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.</td>
<td>1</td>
<td>2</td>
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<tr>
<td>Responsible Agency Data Set</td>
<td>S/L/T agency submitted data</td>
<td>2</td>
<td>1</td>
</tr>
<tr>
<td>Data Set Name</td>
<td>Description</td>
<td>Point</td>
<td>Non-point</td>
</tr>
<tr>
<td>----------------------------</td>
<td>-----------------------------------------------------------------------------</td>
<td>-------</td>
<td>-----------</td>
</tr>
<tr>
<td>2011EPA_EGU</td>
<td>EPA MATS EGU data developed from CAMD heat input and EFs.</td>
<td>3</td>
<td></td>
</tr>
<tr>
<td>2011EPA_chrom_split</td>
<td>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.</td>
<td>4</td>
<td>3</td>
</tr>
<tr>
<td>2011EPA_TRI</td>
<td>Toxics Release Inventory data for the year 2011.</td>
<td>5</td>
<td></td>
</tr>
<tr>
<td>2011EPA_CarryForward-PreviousYear Data</td>
<td>Variety of estimates used to gap fill important sources/pollutants.</td>
<td>6</td>
<td></td>
</tr>
<tr>
<td>2011EPA_HAP-Augmentation</td>
<td>HAP data computed from S/L/T agency criteria pollutant data using HAP/CAP emission factor ratios.</td>
<td>7</td>
<td>4</td>
</tr>
<tr>
<td>2011EPA_NP_Overlap_w_Pt</td>
<td>EPA generated emissions for nonpoint sources</td>
<td>5</td>
<td></td>
</tr>
</tbody>
</table>

3.12.3 Spatial coverage and data sources for the sector

![Maps showing spatial coverage and data sources for the sector](image)

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3.12.4 EPA-developed commercial/institutional fuel combustion data

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

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

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

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

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

<table>
<thead>
<tr>
<th>Sector</th>
<th>Distillate Fuel Type</th>
<th>% of Total Consumption from Stationary Sources</th>
</tr>
</thead>
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<tr>
<td>Commercial</td>
<td>No. 1 Distillate Fuel Oil</td>
<td>80</td>
</tr>
<tr>
<td></td>
<td>No. 2 Distillate Fuel Oil</td>
<td>100</td>
</tr>
<tr>
<td></td>
<td>No. 2 Distillate/Ultra-Low, Low, and High Sulfur Diesel</td>
<td>0a</td>
</tr>
<tr>
<td></td>
<td>No. 4 Distillate Fuel Oil</td>
<td>100</td>
</tr>
</tbody>
</table>

Year 2009 county-level activity estimates were developed by allocating the state-level activity resulting from the adjustments to the SEDS data described above. The EPA compiled 2006 estimates of commercial sector (NAICS codes 42 through 81) employment from the Bureau of Census’ *County Business Patterns 2009* [ref 4] for use in this procedure. A separate document [ref 5] describes how withheld *County Business Patterns* employment data were estimated. The EPA also developed 2006 county-level estimates of institutional sector (NAICS code 92) employment from 2007 local government employment data in the 2007 *Census of Governments* [ref 6] and adjustments reflecting each state’s 2006/2007 local government employment ratio. State-level commercial/institutional fuel combustion by fuel type was allocated to each county using the ratio of the number of commercial/institutional sector employees in each county to the total number of commercial/institutional sector employees in the state.

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

### 3.12.5 Summary of quality assurance methods

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

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

<table>
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<th>Agency</th>
<th>Number of Values Tagged</th>
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<td>Minnesota Pollution Control Agency</td>
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<tr>
<td>Nebraska Environmental Quality</td>
<td>1</td>
<td>Outlier</td>
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</table>

3.12.6 References for Fuel Combustion – Commercial/Institutional


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

The EIS sectors to be documented here are:

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

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

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

3.13.2 Sources of data overview and selection hierarchy

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

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

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

3.13.3 Spatial coverage and data sources for the sector
3.13.4 EPA Residential Heating estimates for oil, natural gas and other fuels

Documentation on residential heating emissions estimates are provided for coal, natural gas, distillate oil, kerosene and liquefied petroleum gas (LPG) are provided on the main 2011 NEI website under “2011 NEI Documentation” and then under the “Data and documentation” FTP link under “Nonpoint Emissions Tools and Methods”. Specific links to each fuel type for this category are provided below:


3.13.5 Summary of quality assurance methods

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

3.14.1 Sector description

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

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

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

<table>
<thead>
<tr>
<th>SCC</th>
<th>SCC Level Three*</th>
<th>SCC Level Four</th>
</tr>
</thead>
<tbody>
<tr>
<td>2104008100</td>
<td>Wood</td>
<td>Fireplace: general</td>
</tr>
<tr>
<td>2104008210</td>
<td>Wood</td>
<td>Woodstove: fireplace inserts; non-EPA certified</td>
</tr>
<tr>
<td>2104008220</td>
<td>Wood</td>
<td>Woodstove: fireplace inserts; EPA certified; non-catalytic</td>
</tr>
<tr>
<td>2104008230</td>
<td>Wood</td>
<td>Woodstove: fireplace inserts; EPA certified; catalytic</td>
</tr>
<tr>
<td>2104008300</td>
<td>Wood</td>
<td>Woodstove: freestanding, general</td>
</tr>
<tr>
<td>2104008310</td>
<td>Wood</td>
<td>Woodstove: freestanding, non-EPA certified</td>
</tr>
<tr>
<td>2104008320</td>
<td>Wood</td>
<td>Woodstove: freestanding, EPA certified, non-catalytic</td>
</tr>
<tr>
<td>2104008330</td>
<td>Wood</td>
<td>Woodstove: freestanding, EPA certified, catalytic</td>
</tr>
<tr>
<td>2104008400</td>
<td>Wood</td>
<td>Woodstove: pellet-fired, general (freestanding or FP insert)</td>
</tr>
<tr>
<td>2104008510</td>
<td>Wood</td>
<td>Furnace: Indoor, cordwood-fired, non-EPA certified</td>
</tr>
<tr>
<td>2104008610</td>
<td>Wood</td>
<td>Hydronic heater: outdoor</td>
</tr>
<tr>
<td>2104008700</td>
<td>Wood</td>
<td>Outdoor wood burning device, NEC (fire-pits, chimeneas, etc)</td>
</tr>
<tr>
<td>2104009000</td>
<td>Firelog</td>
<td>Total: All Combustor Types</td>
</tr>
</tbody>
</table>

*SCC Level One is “Stationary Source Fuel Combustion” and SCC Level Two is “Residential”

3.14.2 Sources of data overview and selection hierarchy

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

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

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

<table>
<thead>
<tr>
<th>Agency Name</th>
<th>Agency Type</th>
</tr>
</thead>
<tbody>
<tr>
<td>Bishop Paiute Tribe</td>
<td>Tribal</td>
</tr>
<tr>
<td>California Air Resources Board</td>
<td>State</td>
</tr>
<tr>
<td>Clark County Department of Air Quality and Environmental Management</td>
<td>Local Agency</td>
</tr>
<tr>
<td>Eastern Band of Cherokee Indians</td>
<td>Tribal</td>
</tr>
<tr>
<td>Illinois Environmental Protection Agency</td>
<td>State</td>
</tr>
<tr>
<td>Kootenai Tribe of Idaho</td>
<td>Tribal</td>
</tr>
<tr>
<td>Maine Department of Environmental Protection</td>
<td>State</td>
</tr>
<tr>
<td>Maryland Department of the Environment</td>
<td>State</td>
</tr>
<tr>
<td>Metro Public Health of Nashville/Davidson County</td>
<td>Local Agency</td>
</tr>
<tr>
<td>Minnesota Pollution Control Agency</td>
<td>State</td>
</tr>
<tr>
<td>Nez Perce Tribe</td>
<td>Tribal</td>
</tr>
<tr>
<td>Northern Cheyenne Tribe</td>
<td>Tribal</td>
</tr>
<tr>
<td>Oregon Department of Environmental Quality</td>
<td>State</td>
</tr>
<tr>
<td>Sac and Fox Nation of Missouri in Kansas and Nebraska Reservation</td>
<td>Tribal</td>
</tr>
<tr>
<td>Shoshone-Bannock Tribes of the Fort Hall Reservation of Idaho</td>
<td>Tribal</td>
</tr>
<tr>
<td>Washington State Department of Ecology</td>
<td>State</td>
</tr>
<tr>
<td>Washington State Department of Ecology</td>
<td>State</td>
</tr>
<tr>
<td>West Virginia Division of Air Quality</td>
<td>State</td>
</tr>
</tbody>
</table>

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

<table>
<thead>
<tr>
<th>Dataset Short Name</th>
<th>Order</th>
</tr>
</thead>
<tbody>
<tr>
<td>2011 Responsible Agency Selection</td>
<td>1</td>
</tr>
<tr>
<td>2011EPA_PM-AUG</td>
<td>2</td>
</tr>
<tr>
<td>2011EPA_chrom_split</td>
<td>3</td>
</tr>
<tr>
<td>2011EPA_HAP-Aug</td>
<td>4</td>
</tr>
<tr>
<td>2011EPA_NP_NoOverlap_w_Pt</td>
<td>6</td>
</tr>
</tbody>
</table>
3.14.3 Spatial coverage and data sources for the sector

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 3-96. The appliance profiles used for most counties (approximately 83%) are constructed using data from the American Housing Survey (AHS), while other state- and local-level surveys are used for the other counties, as described below. Appliance profiles are constructed by dividing the number of survey respondents that use a particular appliance into the total number of respondents. The appliance profiles are used with Census data on the number of occupied homes in each county to estimate the number of appliances in use in each county.

The AHS (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 3-100 lists the MSAs using updated AHS survey data for the 2011 NEI.
The area contained in a MSA will usually contain an urban core and surrounding areas that are more sub-urban than urban. One of the problems noted in previous versions of the tool is that applying the MSA information to all the counties in the MSA usually results in the overestimation of residential wood combustion emissions in the urban core and underestimation in the suburban counties. For future versions of the NEI (2014), we plan to address this by separating the urban core county from the sub-urban counties and allocating a higher proportion of the emissions to the suburban counties.

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

EPA added additional state- and regional-level survey data, which are deemed more accurate and specific than the survey data used in most counties in the tool. The main sources of data are the American Housing Survey

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

<table>
<thead>
<tr>
<th>MSA</th>
<th>Year of American Housing Survey Data</th>
</tr>
</thead>
<tbody>
<tr>
<td>Seattle</td>
<td>2009</td>
</tr>
<tr>
<td>Philadelphia</td>
<td>2009</td>
</tr>
<tr>
<td>New Orleans</td>
<td>2009</td>
</tr>
<tr>
<td>New York City</td>
<td>2009</td>
</tr>
<tr>
<td>Detroit</td>
<td>2009</td>
</tr>
<tr>
<td>Chicago</td>
<td>2009</td>
</tr>
<tr>
<td>Northeast</td>
<td>2009</td>
</tr>
<tr>
<td>Midwest</td>
<td>2009</td>
</tr>
<tr>
<td>West</td>
<td>2009</td>
</tr>
<tr>
<td>South</td>
<td>2009</td>
</tr>
</tbody>
</table>
(AHS), various state-level surveys (Minnesota, Oregon, and Vermont) and regional-level surveys (Mid-Atlantic Regional Air Management Association [MARAMA] and the tri-state area of Washington, Oregon, and Idaho), and expert judgment. These survey data are used to estimate the number of each type of wood-burning appliance and the amount of wood burned in each appliance in each county. The source of the data and the specific location within the data source where these data can be found are now listed in the Burn Rates, Appliance Profiles, and Other Appliance Populations tables in the accompanying Excel workbook.

The counties for which EPA added data include the following:

- All counties in California;
- All counties in Washington;
- Ada, Canyon, and Elmore Counties, Idaho;
- Silver Bow County and Lincoln Counties, Montana;
- Klamath and Lane Counties, Oregon; and
- Washoe County, Nevada.

In all, this represents 163 counties. EPA attempted to collect recent survey data from Alaska, but were unable to make contact with the state agency staff. EPA also received data from Minnesota from their 2011-2012 wood combustion survey, but the data arrived too late to incorporate into the tool. However, these data are available to analyze and include in the tool for the 2014 National Emissions Inventory.

Using the survey data obtained, EPA updated the appliance fractions and burn rates for all appliances for which these surveys collected data. For any appliances for which the surveys did not specifically ask questions, which typically included outdoor wood boilers (OWBs), indoor furnaces, and outdoor appliances not elsewhere classified (NEC), EPA kept the existing appliance and burn rate data.

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

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

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14 Minnesota Department of Natural Resources. Residential Fuelwood Assessment: 2002–2003 Heating Season. Available at: [http://files.dnr.state.mn.us/forestry/um/fuelwoodreport02_03.pdf](http://files.dnr.state.mn.us/forestry/um/fuelwoodreport02_03.pdf) (accessed July 2014) (Note: Minnesota conducted another residential wood combustion survey in 2012, but these data were not available for analysis in time to include in the tool.)
16 Data provided by Vermont Division of Forestry. For more information, see: [http://www.vtfpr.org/energy/for_energy_reshealth.cfm](http://www.vtfpr.org/energy/for_energy_reshealth.cfm) (accessed July 2014).
sales is 2005 in which 67,564 of these units were sold. In 2004, 24,560 were sold. In 2003, 15,342 units were sold. These data indicate a significant increasing trend. In EPA’s earlier estimates for 2008, it was assumed that sales did not increase in 2006 or 2007; we held sales constant at 67,564 units sold per year, which we thought was a conservative estimate at the time. Since then, we have decreased the assumed sales, based partly on the Frost and Sullivan report dated 2010 which reported declining growth since 2008 due to the weak economy, decline in residential new construction, and the lack of credit. However, Ellen Burkhard with the New York State Energy Research and Development Authority has higher estimates for NY than the EPA tool. She estimates that there are 49,000 units in 2010 in NY, versus tool’s 2011 estimates of 28,626. Also, we have 2033 OWB units in the state of Vermont in 2005 and 4014 units in 2008, an almost 100% increase in 3 years from 2005 to 2008 (Note: the source for the 2008 number is the Vermont Residential Fuel survey for the 2007-2008 heating season, released in August 2011 by the VT Department of Forestry, Parks and Recreation; the source for the 2005 number is the cumulative sales data from NESCAUM). In MN, a 9% increase in OWB population from 2002 to 2008 is reported, which is about a 1.6% increase per year. EPA based its growth projection on this and the Frost and Sullivan report. Consequently, for the 2011 NEI, we grew the OWB county population from 2008 to 2011 by a factor of 1.1 for the following states; IL, IN, ME, MA, MN, MI, NH, NY, OH, VT, and WI. We assumed no growth for WA, OR, and HI. All other states were grown from 2008 to 2011 by a factor of 1.067. The factor 1.067 was chosen because it was 50% of the growth rate we used to grow 2005 to 2008. The 1.1 factor was chosen because it was conservative, which was in line with comments provided by MI. For the 2011 v2, we expect to change the growth rate using sales data reported to EPA by vendors. This sales data shows that sales were stronger than expected, so this will result in higher emissions from OWBs.

We did not have sales data for Indoor furnaces. Based on a conversation with an industry representative who indicated that that sales were not good, we assumed no growth from 2008.

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 NEI 2008 v3, and then this was the baseline data for the 2011 updates.

The other appliance types (fireplaces, woodstoves, and inserts) did not need to be allocated to the county level, because the data from the AHS and other surveys allowed the populations of these appliances to be estimated at the county level.

Outdoor wood boiler emission factors

For 2011, we updated emission factors for OWB. The factors for all other SCCs which were not updated were a mix of factors used by MARAMA and for non-certified conventional wood stoves. The emission factor for mercury was from the EPA’s Report to Congress on Mercury (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. In general, the emissions for PM increased. Prior to the 2011 NEI, in lieu of specific data, EPA used the emissions factors for the conventional woodstoves. For the 2011 NEI, EPA used the emission factors developed
in reference 4. Essentially, the emission factor for outdoor wood boilers for primary PM$_{2.5}$ doubled from 30.6 to 64 lbs primary PM$_{2.5}$/ton wood burned.

**Tool Interface**

EPA created a user-friendly interface that simplifies the process of running the RWC Tool. This interface allows users to select the states for which they would like to estimate emissions. This feature reduces the run time if the user is only interested in the emissions from one or a few states. Once the desired states are selected, the user needs only to click a single button to calculate the inventory.

The interface includes easy options for displaying the following:

- County-level input data and Primary PM$_{2.5}$ emissions by SCC and burn type;
- County-level number of appliances by appliance type;
- State-level number of appliances by appliance type;
- Emission factors by SCC; and
- A flow diagram of the calculation methodology.

The ease-of-use provided by this interface could allow for a public release of the tool so that state, local, and tribal agencies could use it to estimate residential wood combustion emissions in their own locales.

**Hazardous Air Pollutant Emission Factors**

There are several emission factors for hazardous air pollutants that were not listed uniformly across wood stove types. For example, some of the emission factors were listed for EPA-certified wood stoves, but not for conventional (uncertified) wood stoves. Following discussion with EPA, EPA updated the emissions factors listed in Table 3-101 from all freestanding wood stove and fireplace insert categories with emission factors derived from Hays et al.\(^\text{18}\) These emission factors included factors for seven pollutants that were not previously included in the tool. They are marked as “n/a” in Table 3-101. EPA did not change the emission factors, or add new emission factors, for any of these pollutants for any of the other SCCs.

**Table 3-101:** Emission factors for selected hazardous air pollutants in the RWC tool. The emission factors updated or added for woodstoves (freestanding and inserts) but were left unchanged for all other SCCs.

<table>
<thead>
<tr>
<th>Pollutant</th>
<th>Code</th>
<th>Original Emission Factor</th>
<th>Updated Emission Factor</th>
</tr>
</thead>
<tbody>
<tr>
<td>Benzo[a]anthracene</td>
<td>56553</td>
<td>n/a</td>
<td>0.000577</td>
</tr>
<tr>
<td>Benzo[a]fluoranthene</td>
<td>203338</td>
<td>n/a</td>
<td>0.000321</td>
</tr>
<tr>
<td>Benzo[a]Pyrene</td>
<td>50328</td>
<td>0.00248</td>
<td>0.000979</td>
</tr>
<tr>
<td>Benzo[b]fluoranthene</td>
<td>205992</td>
<td>n/a</td>
<td>0.000592</td>
</tr>
<tr>
<td>Benzo[e]Pyrene</td>
<td>192972</td>
<td>0.00745</td>
<td>0.000589</td>
</tr>
<tr>
<td>Benzo[g,h,i]Perylene</td>
<td>191242</td>
<td>0.00248</td>
<td>0.000201</td>
</tr>
<tr>
<td>Benzo[k]Fluoranthene</td>
<td>207089</td>
<td>0.00124</td>
<td>0.000509</td>
</tr>
<tr>
<td>Chrysene</td>
<td>218019</td>
<td>0.00745</td>
<td>0.000472</td>
</tr>
<tr>
<td>Dibenzo[ah]anthracene</td>
<td>53703</td>
<td>n/a</td>
<td>0.000039</td>
</tr>
</tbody>
</table>

Changes to Appliance Fractions and Burn Rates for Densely Populated Counties

Following discussion with EPA on the estimation of emissions in densely populated urban areas, EPA made adjustments to the appliance fractions and burn rates of certain counties based on their population density to ensure that the tool does not overestimate emissions in those areas.

Specifically, EPA zeroed the burn rates and appliance fractions for all appliances in New York County (FIPS 36061). For counties with more than 1,500 but less than 4,000 homes per square mile, EPA zeroed the burn rate and appliance fractions for OWBs, indoor furnaces, and outdoor burning (NEC). The burn rates and appliance fractions for all other appliances were left unchanged for these counties.

For counties with more than 4,000 homes per square mile (except New York County), EPA made several changes, summarized in the Table 3-102. All counties affected by these changes are shown in Table 3-103.

Table 3-102: Updates to burn rates and appliance fractions in counties with more than 4,000 homes per square mile (except New York County).

<table>
<thead>
<tr>
<th>Appliance</th>
<th>Burn Type</th>
<th>Updated Burn Rate</th>
<th>Updated Appliance Fraction</th>
</tr>
</thead>
<tbody>
<tr>
<td>Fireplaces</td>
<td>Main</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td></td>
<td>Secondary</td>
<td>0.5 (^{(a)})</td>
<td>kept as is</td>
</tr>
<tr>
<td></td>
<td>Pleasure</td>
<td>0.069 (^{(b)})</td>
<td>kept as is</td>
</tr>
<tr>
<td>Noncertified Woodstoves/</td>
<td>Main</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>Inserts</td>
<td>Secondary</td>
<td>1.5 (^{(c)})</td>
<td>kept as is</td>
</tr>
<tr>
<td></td>
<td>Pleasure</td>
<td>0</td>
<td>kept as is</td>
</tr>
<tr>
<td>Certified Woodstoves/</td>
<td>Main</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>Inserts</td>
<td>Secondary</td>
<td>1.2 (^{(d)})</td>
<td>kept as is</td>
</tr>
<tr>
<td></td>
<td>Pleasure</td>
<td>0</td>
<td>kept as is</td>
</tr>
<tr>
<td>Pellet Stoves</td>
<td>Main</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td></td>
<td>Secondary</td>
<td>1.5 (^{(c)})</td>
<td>kept as is</td>
</tr>
<tr>
<td></td>
<td>Pleasure</td>
<td>0</td>
<td>kept as is</td>
</tr>
<tr>
<td>Firelogs</td>
<td>Main</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td></td>
<td>Secondary</td>
<td>0</td>
<td>kept as is</td>
</tr>
<tr>
<td></td>
<td>Pleasure</td>
<td>kept as is</td>
<td>kept as is</td>
</tr>
</tbody>
</table>

(a) Assumes approximately one fire per week for 7 months
(b) Assumes approximately four fires per year
(c) Based on engineering judgment
(d) Scaled using the difference in efficiency from AP-42

Emissions for New York County were zeroed out entirely. All other counties with more than 4,000 housing units per square mile were updated with the appliance fractions and burn rates shown in Table 3-102, and the burn rates and appliance populations of OWBs, indoor furnaces, and other outdoor burning were zeroed. For counties with between 1,500 and 4,000 housing units per square mile, the burn rates and appliance populations
of OWBs, indoor furnaces, and other outdoor burning were zeroed, and the burn rates and appliance fractions for all other appliances were left untouched.

### Outdoor Wood Boiler Distribution

The OWB populations in the RWC tool were originally based on a combination of data from the Northeast States for Coordinated Air Use Management (NESCAUM) report Assessment of Outdoor Wood-fired Boilers,\(^19\) the 2008 Minnesota Residential Fuelwood Assessment,\(^20\) and the 2008 Vermont Residential Fuel Assessment.\(^21\)

In November, EPA supplied EPA with sales data from 80% of the manufacturers of OWBs showing that 28,075 boilers were sold over a three-year period ending in July 2012 (Table 3-104).\(^22\) Scaling these numbers to estimate 100% of OWB sales (by dividing the total number of OWBs sold by 0.8) suggests that there have been

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\(^{22}\) EPA’s Burnwise Program has established partnerships with approximately 80% of OWB manufacturers in which the manufacturers voluntarily report sales data to EPA. See [http://www.epa.gov/burnwise/pdfs/owhhphase2agreement.pdf](http://www.epa.gov/burnwise/pdfs/owhhphase2agreement.pdf) (accessed July 2014).
approximately 35,000 OWBs added to the national population since the 2008 National Emissions Inventory. Because the data were rolled up to the national level, EPA distributed the OWBs to counties using the methodology described below, which was developed and approved by the Eastern Regional Technical Advisory Committee (ERTAC).

Table 3-104: Outdoor wood boilers sold from 80% of manufacturers between August 2009 and July 2012.

<table>
<thead>
<tr>
<th>Time Period</th>
<th>Number of OWBs Sold</th>
</tr>
</thead>
<tbody>
<tr>
<td>8/2010 – 7/2011</td>
<td>10,469</td>
</tr>
<tr>
<td>8/2011 – 7/2012</td>
<td>10,754</td>
</tr>
<tr>
<td>Total</td>
<td>28,386</td>
</tr>
</tbody>
</table>

First, EPA distributed the 35,000 boilers to all states except Connecticut, Hawaii, Oregon, and Washington, based on their existing proportion of OWBs. For example, if a state had 3% of all OWBs in 2008, then it received 3% of the new OWBs, or 1,050 boilers.

Once the boilers were distributed to the states, EPA then distributed the state-level OWBs to counties based on a county’s proportion of rural households in the state. Note that this is slightly different from the method used to distribute OWBs to counties for the 2008 NEI, in which they were distributed based on rural population, rather than households.

The U.S. Census Bureau collects information at the county level on the urban and rural population, and the total households, but it does not break the household data down into urban and rural data. Therefore, EPA estimated the number of rural households by multiplying the total number of households in each county by the percentage of the rural population in each county. For example, if 60% of the county’s total population is listed as rural, then the number of households would be multiplied by 0.6 to estimate the number of rural households.

Then EPA distributed each state’s population of OWBs to each county based on that county’s proportion of rural households. OWBs were only distributed to counties with an average population density of less than 300 people per square mile.

EPA used a different methodology to distribute OWBs in the states of Michigan and Ohio, which was also developed and approved by ERTAC. In keeping with the previous methodology used for the 2008 NEI, state-level OWBs in Michigan and Ohio were distributed to counties based on inverse population density. Therefore, in these states, the counties with the lowest population density received the highest number of OWBs, but in keeping with the previous methodology, a cap was employed to ensure that no county would be allocated more OWBs than 10% of its population. In other words, if a county has a population of 1,000 people and if the inverse population density method would distribute more than 100 boilers to that county, then the number of boilers in that county would be set to 100. To ensure that all OWBs estimated for Michigan and Ohio were distributed to the counties, the boilers in the counties with numbers below the cap were adjusted using the inverse population density method.

Gas Log Adjustments

After reviewing the AHS questionnaire, EPA determined that the AHS does not distinguish between gas and wood-burning fireplaces in the data it collects. For this reason, the appliance fractions constructed from AHS

23 These states were excluded based on conversations with the states suggesting no growth in OWBs.
data are likely overestimating the number of wood-burning fireplaces in use. Based on data from Houck (2003), Abt estimated that approximately 30% of fireplaces use gas. Queries were constructed in the RWC Tool to adjust the AHS appliance fractions to reflect the number of gas-burning fireplaces. These queries can be adjusted so that the fraction of gas-burning fireplaces can be changed in the future, and the appliance fractions will be updated accordingly.

**Urban Core Pleasure Burning Adjustments**

Many of the appliance profiles in the RWC tool are based on AHS data from Metropolitan Statistical Area (MSA) surveys. These appliance profiles are typically applied equally across all counties within the relevant MSA. For example, the appliance profile for Denver was applied equally to all counties in the MSA, even though Denver County itself is much more densely populated than many of the outlying counties in the MSA.

To address this issue, EPA identified the “urban core” of the MSA based on the county in the MSA with the highest proportion of multi-family homes (defined here as buildings with three or more living units). EPA then adjusted the pleasure burning profiles in those counties to account for the proportion of multi-family homes. For example, if the urban core of the county had 30% of its occupied units in multi-family homes, then EPA multiplied the appliance fraction by 0.7. EPA also zeroed out the populations of OWBs and indoor furnaces in the urban core counties.

**St. Louis, MO, Adjustments**

Following discussions over the high level of RWC emissions in St. Louis, Missouri, EPA revisited the assumptions about that county. The appliance fractions in the tool were exactly double what they should be using AHS data. EPA corrected this issue by returning the appliance profile value to the values that agree with AHS data.

**3.14.5 Summary of quality assurance methods**

EPA expected to see an increase in RWC emissions due to the slow economy and an increase in the price of alternative heating fuels, like fuel oil and natural gas. Additionally, there were numerous articles in the newspapers about the increased use of home heating with wood. The RWC tool generates a spreadsheet that shows the burn rates (cords/year) and the appliance counts for every SCC in every county. That spreadsheet was sent to ERTAC and other EPA offices for review. The 2011 v2 RWC inventory was compared to 2008 values. One comment that we received was that emissions were too high in the urban centers in some cities. Additionally, we were told that CA had some detailed county-level RWC emission data. Adjustments were made to address the urban core issue (described earlier in this document), and we were able to obtain the CA and put it in our tool. The EPA also looked for double counting caused by the inconsistent use of SCCs. If a state submitted data using an SCC that was different than the one EPA used, then the EIS could select both estimates, causing a double count of emissions. This was the situation for CA. CA submitted RWC data to two SCCs; 2104008100 for fireplaces and 2104008300 for woodstoves and neither SCC is used by the EPA. The EPA used 12 SCCs. The CA data do not have the detail that the EPA has, so EPA tagged the CA data and used the EPA tool data. The state level emission totals were similar, plus the underlying EPA RWC tool data had been revised with data from CA, so EPA believes the use of the RWC tool data is reasonable. The EPA also tagged the RWC data from UT (per a request from UT) and used the RWC data generated from the EPA RWC tool for UT. UT preferred the EPA estimates to their own. The EPA also tagged RWC data submitted by CT, ID, MO, and KS because the data was actually EPA Tool data that the state submitted back to EPA. We believe it better to use EPA data so that the data source is correctly seen to be generated by EPA. The EPA also tagged numerous PMxx-FIL and PM-CON data that were erroneously generated by the EPA’s PM augmentation tool. The EPA does not have the information to determine filterable or condensable emissions from primary PM.


3.15 Industrial Processes – Cement Manufacturing

3.15.1 Sector description

This sector is defined by some, but not all SCCs beginning with 305006, 305007 plus 39000201 (In-Process Fuel Use /Bituminous Coal /Cement Kiln/Dryer), 39000402 (In-Process Fuel Use /Residual Oil /Cement Kiln/Dryer), 39000502 (In-Process Fuel Use /Distillate Oil /Cement Kiln/Dryer) and 39000602 (In-Process Fuel Use /Natural Gas /Cement Kiln/Dryer). The processes associated with this sector from 305006 (dry process) and 305007 (wet process) include the kilns including preheater and pre-calciner kilns, coal kiln feed units, crushing, screening, raw material grinding and drying, clinker cooler, clinker grinding, cement loadout, pre-dryer, and raw mill processes.

3.15.2 Sources of data overview and selection hierarchy

Cement Manufacturing is covered fully in point. EPA did not provide estimates for nonpoint for this sector. The selection hierarchy for all datasets contributing to this sector are provided in Table 3-1: Data sources and selection hierarchy used for point sources.
3.16 Industrial Processes – Chemical Manufacturing

3.16.1 Sector description

This sector involves creating products by transforming organic and inorganic raw materials with chemical processes. More information on chemical manufacturing can be found at [http://www.epa.gov/sectors/sectorinfo/sectorprofiles/chemical.html](http://www.epa.gov/sectors/sectorinfo/sectorprofiles/chemical.html). This sector is defined by most point SCCs beginning with 301 and 302, and most “MACT Source Category” SCCs (beginning with 631, 641, 646, 645, 646, 648, 649, 651, 684 and 685). Most non-chemical manufacturing SCCs in these ranges deal with “Storage and Transfer” processes (see Section 3.23). This sector also includes a handful of nonpoint SCCs (beginning with 230100, 230101, 230102, 230103 and 231004).

3.16.2 Sources of data overview and selection hierarchy

Chemical Manufacturing is covered almost completely in point. EPA did not provide estimates for nonpoint for this sector. The selection hierarchy for all point inventory datasets contributing to this sector are provided in Table 3-1: Data sources and selection hierarchy used for point sources. The selection hierarchy for all nonpoint inventory datasets contributing to this sector are provided in Table 3-2: Data sources and selection hierarchy used for nonpoint sources.
3.17 Industrial Processes – Ferrous Metals

3.17.1 Sector description

This sector is defined by the processing of iron ores to metals. This sector includes primary and secondary metal production processes such as taconite iron ore processing (SCCs beginning with 303023), grey iron foundries (SCCs beginning with 304003), steel foundries (SCCs beginning with 304007) and malleable iron (SCCs beginning with 304009). Most non-ferrous metals SCCs in these SCC ranges deal with “Storage and Transfer” processes (see Section 3.23).

3.17.2 Sources of data overview and selection hierarchy

Ferrous Metals is covered fully in the point data category. EPA did not provide estimates for nonpoint data category for this sector. The selection hierarchy for all point inventory datasets contributing to this sector are provided in Table 3-1: Data sources and selection hierarchy used for point sources.

3.17.3 Spatial coverage and data sources for the sector
### 3.18 Industrial Processes – Mining

#### 3.18.1 Sector description
Mining and quarrying activities produce particulate emissions due to the variety of processes used to extract the ore and associated overburden, including drilling and blasting, loading and unloading, and overburden replacement. Fugitive dust emissions for mining and quarrying operations are the sum of emissions from the mining of metallic and nonmetallic ores and coal. Each of these mining operations has specific emission factors accounting for the different means by which the resources are extracted.

The 2011 NEI has emissions for the SCCs shown in Table 3-105 for this sector. The first 4 SCCs are in the nonpoint data category and the remaining are point. The EPA-estimated emissions cover only SCC 2325000000 (first row of the table). Emissions for all other SCCs were submitted by S/L/T agency.

<table>
<thead>
<tr>
<th>SCC</th>
<th>SCC Level Two</th>
<th>SCC Level Three</th>
<th>SCC Level Four</th>
</tr>
</thead>
<tbody>
<tr>
<td>2325000000</td>
<td>Mining and Quarrying: SIC 14</td>
<td>All Processes</td>
<td>Total</td>
</tr>
<tr>
<td>2325020000</td>
<td>Mining and Quarrying: SIC 14</td>
<td>Crushed and Broken Stone</td>
<td>Total</td>
</tr>
<tr>
<td>2325030000</td>
<td>Mining and Quarrying: SIC 14</td>
<td>Sand and Gravel</td>
<td>Total</td>
</tr>
<tr>
<td>2325060000</td>
<td>Mining and Quarrying: SIC 14</td>
<td>Lead Ore Mining and Milling</td>
<td>Total</td>
</tr>
<tr>
<td>30302401</td>
<td>Primary Metal Production</td>
<td>Metal Mining (General Processes)</td>
<td>Primary Crushing: Low Moisture Ore</td>
</tr>
<tr>
<td>30302402</td>
<td>Primary Metal Production</td>
<td>Metal Mining (General Processes)</td>
<td>Secondary Crushing: Low Moisture Ore</td>
</tr>
<tr>
<td>30302403</td>
<td>Primary Metal Production</td>
<td>Metal Mining (General Processes)</td>
<td>Tertiary Crushing: Low Moisture Ore</td>
</tr>
<tr>
<td>30302404</td>
<td>Primary Metal Production</td>
<td>Metal Mining (General Processes)</td>
<td>Material Handling: Low Moisture Ore</td>
</tr>
<tr>
<td>30302405</td>
<td>Primary Metal Production</td>
<td>Metal Mining (General Processes)</td>
<td>Primary Crushing: High Moisture Ore</td>
</tr>
<tr>
<td>30302406</td>
<td>Primary Metal Production</td>
<td>Metal Mining (General Processes)</td>
<td>Secondary Crushing: High Moisture Ore</td>
</tr>
<tr>
<td>30302407</td>
<td>Primary Metal Production</td>
<td>Metal Mining (General Processes)</td>
<td>Tertiary Crushing: High Moisture Ore</td>
</tr>
<tr>
<td>30302408</td>
<td>Primary Metal Production</td>
<td>Metal Mining (General Processes)</td>
<td>Material Handling: High Moisture Ore</td>
</tr>
<tr>
<td>30302409</td>
<td>Primary Metal Production</td>
<td>Metal Mining (General Processes)</td>
<td>Dry Grinding with Air Conveying</td>
</tr>
<tr>
<td>30302410</td>
<td>Primary Metal Production</td>
<td>Metal Mining (General Processes)</td>
<td>Dry Grinding without Air Conveying</td>
</tr>
<tr>
<td>30302411</td>
<td>Primary Metal Production</td>
<td>Metal Mining (General Processes)</td>
<td>Ore Drying</td>
</tr>
<tr>
<td>30303102</td>
<td>Primary Metal Production</td>
<td>Leadbearing Ore Crushing and Grinding</td>
<td>Zinc Ore w/ 0.2% Lead Content</td>
</tr>
<tr>
<td>30303107</td>
<td>Primary Metal Production</td>
<td>Leadbearing Ore Crushing and Grinding</td>
<td>Copper-Lead-Zinc w/ 2% Lead Content</td>
</tr>
<tr>
<td>30501001</td>
<td>Mineral Products</td>
<td>Coal Mining, Cleaning, and Material Handling</td>
<td>Fluidized Bed Reactor</td>
</tr>
<tr>
<td>30501002</td>
<td>Mineral Products</td>
<td>Coal Mining, Cleaning, and Material Handling</td>
<td>Flash or Suspension Dryer</td>
</tr>
<tr>
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<td>Multilouvered Dryer</td>
</tr>
<tr>
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<td>Mineral Products</td>
<td>Coal Mining, Cleaning, and Material Handling</td>
<td>Rotary Dryer</td>
</tr>
<tr>
<td>30501005</td>
<td>Mineral Products</td>
<td>Coal Mining, Cleaning, and Material Handling</td>
<td>Cascade Dryer</td>
</tr>
<tr>
<td>30501006</td>
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<td>Coal Mining, Cleaning, and Material Handling</td>
<td>Continuous Carrier/Conveyor</td>
</tr>
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<td>Coal Mining, Cleaning, and Material Handling</td>
<td>Unloading</td>
</tr>
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<td>30501009</td>
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<td>Coal Mining, Cleaning, and Material Handling</td>
<td>Raw Coal Storage</td>
</tr>
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### Table 3-106: Agencies that submitted data for the Industrial Processes – Mining sector

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SCC Level 1 is "Industrial Processes" for all SCCS

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

The industrial processes-mining sector includes data from S/L/T agency and EPA datasets that cover both point and nonpoint data categories. Table 3-106 shows the agencies that submitted data in each of the data categories for the Industrial Processes - Mining sector. Where only zero emissions were submitted (sum across all pollutants submitted), these are shown as zeroes ("0") in the table.
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## NONPOINT
Nonpoint: Mining and quarrying
SIC 24

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EPA data for most categories is due to PM augmentation of S/L/T agency data (see Section 3.1.2). EPA estimates for SCC 2325000000 is described in Section 3.18.4.
The below sections explain how the PM$_{10}$ and PM$_{2.5}$ emissions for the EPA data (SCC 2325000000; Industrial Processes; Mining and Quarrying: SIC 14; All Processes; Total) were developed.

### 3.18.4.1 Metallic Ore Mining - emission factors and equations

The emissions factor for metallic ore mining includes overburden removal, drilling and blasting, and loading and unloading activities. The TSP emission factors developed for copper ore mining are applied to all three activities with PM$_{10}$/TSP ratios of 0.35 for overburden removal, 0.81 for drilling and blasting, and 0.43 for loading and unloading operations [ref 1]. The emissions factor equation for metallic ore mining is:

$$\text{EF}_{\text{mo}} = \text{EF}_o + (B \times \text{EF}_b) + \text{EF}_l + \text{EF}_d$$

where,

- $\text{EF}_{\text{mo}}$ = metallic ore mining emissions factor (lbs/ton)
- $\text{EF}_o$ = PM$_{10}$ open pit overburden removal emission factor for copper ore (lbs/ton)
- $B$ = fraction of total ore production that is obtained by blasting at metallic ore mines
- $\text{EF}_b$ = PM$_{10}$ drilling/blasting emission factor for copper ore (lbs/ton)
- $\text{EF}_l$ = PM$_{10}$ loading emission factor for copper ore (lbs/ton)
- $\text{EF}_d$ = PM$_{10}$ truck dumping emission factor for copper ore (lbs/ton)

Applying the copper ore mining TSP emissions factors [ref 2] and PM$_{10}$/TSP ratios yields the following metallic ore mining emissions factor:

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

### 3.18.4.2 Non-Metallic Ore Mining - emission factors and equations

The emissions factor for non-metallic ore mining includes overburden removal, drilling and blasting, and loading and unloading activities. The emissions factor is based on western surface coal mining operations.

$$\text{EF}_{\text{mmo}} = \text{EF}_v + (D \times \text{EF}_f) + \text{EF}_o + 0.5 (\text{EF}_o + \text{EF}_f)$$
where,

\[ EF_{nmo} = \text{non-metallic ore mining emissions factor (lbs/ton)} \]
\[ EF_v = \text{PM}_{10} \text{ open pit overburden removal emission factor at western surface coal mining operations (lbs/ton)} \]
\[ D = \text{fraction of total ore production that is obtained by blasting at non-metallic ore mines} \]
\[ EF_r = \text{PM}_{10} \text{ drilling/blasting emission factor at western surface coal mining operations (lbs/ton)} \]
\[ EF_a = \text{PM}_{10} \text{ loading emission factor at western surface coal mining operations (lbs/ton)} \]
\[ EF_e = \text{PM}_{10} \text{ truck unloading: end dump-coal emission factor at western surface coal mining operations (lbs/ton)} \]
\[ EF_t = \text{PM}_{10} \text{ truck unloading: bottom dump-coal emission factor at western surface coal mining operations (lbs/ton)} \]

Applying the TSP emissions factors developed for western surface coal mining operations from AP-42 [ref 3] and a PM$_{10}$/TSP ratio of 0.4 [ref 4] yields the following non-metallic ore mining emissions factor:

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

### 3.18.4.3 Coal Mining- emission factors and equations

The emissions factor for coal mining includes overburden removal, drilling and blasting, loading and unloading and overburden replacement activities. The amount of overburden material handled is assumed to equal ten times the quantity of coal mined and coal unloading is assumed to split evenly between end-dump and bottom-dump operations. The emissions factor equation for coal mining is:

\[ EF_c = (10 \times (EF_{to} + EF_{or} + EF_{dt})) + EF_v + EF_r + EF_a + (0.5 \times (EF_e + EF_t)) \]

where,

\[ EF_c = \text{coal mining emissions factor (lbs/ton)} \]
\[ EF_{to} = \text{PM}_{10} \text{ emission factor for truck loading overburden at western surface coal mining operations (lbs/ton of overburden)} \]
\[ EF_{or} = \text{PM}_{10} \text{ emission factor for overburden replacement at western surface coal mining operations (lbs/ton of overburden)} \]
\[ EF_{dt} = \text{PM}_{10} \text{ emission factors for truck unloading: bottom dump-overburden at western surface coal mining operations (lbs/ton of overburden)} \]
\[ EF_v = \text{PM}_{10} \text{ open pit overburden removal emission factor at western surface coal mining operations (lbs/ton)} \]
\[ EF_r = \text{PM}_{10} \text{ drilling/blasting emission factor at western surface coal mining operations (lbs/ton)} \]
\[ EF_a = \text{PM}_{10} \text{ loading emission factor at western surface coal mining operations (lbs/ton)} \]
\[ EF_e = \text{PM}_{10} \text{ truck unloading: end dump-coal emission factor at western surface coal mining operations (lbs/ton)} \]
\[ EF_t = \text{PM}_{10} \text{ truck unloading: bottom dump-coal emission factor at western surface coal mining operations (lbs/ton)} \]

Applying the PM$_{10}$ emissions factors developed for western surface coal mining operations [ref 3] yields the following coal mining emissions factor:

\[ EF_c = (10 \times (0.015 + 0.001 + 0.006)) + 0.225 + 0.00005 + 0.05 + (0.5 \times (0.0035 + 0.033)) = 0.513 \text{ lbs/ton} \]
PM-FIL emissions factors are assumed to be the same as PM-PRI emissions factors; however, in reality, there is a small amount of PM-CON emissions included in the PM-PRI emissions but insufficient data exists to tease out the PM-CON portion. In 2006, the EPA adopted new PM$_{2.5}$/PM$_{10}$ ratios for several fugitive dust categories and concluded that the PM$_{2.5}$/PM$_{10}$ ratios for fugitive dust categories should be in the range of 0.1 to 0.15 [ref 5]. Consequently, a ratio of 0.125 was applied to the PM$_{10}$ emissions factors to estimate PM$_{2.5}$ emissions factors for mining and quarrying. A summary of emissions factors is presented in Table 3-107.

### Table 3-107: Summary of emission factors

<table>
<thead>
<tr>
<th>Mining Type</th>
<th>Pollutant Code</th>
<th>Factor Numeric Value</th>
<th>Factor Unit Numerator</th>
<th>Factor Unit Denominator</th>
</tr>
</thead>
<tbody>
<tr>
<td>Coal</td>
<td>PM10-PRI</td>
<td>0.513</td>
<td>LB</td>
<td>TON</td>
</tr>
<tr>
<td>Coal</td>
<td>PM10-FIL</td>
<td>0.513</td>
<td>LB</td>
<td>TON</td>
</tr>
<tr>
<td>Coal</td>
<td>PM25-PRI</td>
<td>0.064</td>
<td>LB</td>
<td>TON</td>
</tr>
<tr>
<td>Coal</td>
<td>PM25-FIL</td>
<td>0.064</td>
<td>LB</td>
<td>TON</td>
</tr>
<tr>
<td>Metallic</td>
<td>PM10-PRI</td>
<td>0.0548</td>
<td>LB</td>
<td>TON</td>
</tr>
<tr>
<td>Metallic</td>
<td>PM10-FIL</td>
<td>0.0548</td>
<td>LB</td>
<td>TON</td>
</tr>
<tr>
<td>Metallic</td>
<td>PM25-PRI</td>
<td>0.0068</td>
<td>LB</td>
<td>TON</td>
</tr>
<tr>
<td>Metallic</td>
<td>PM25-FIL</td>
<td>0.0068</td>
<td>LB</td>
<td>TON</td>
</tr>
<tr>
<td>Non-Metallic</td>
<td>PM10-PRI</td>
<td>0.293</td>
<td>LB</td>
<td>TON</td>
</tr>
<tr>
<td>Non-Metallic</td>
<td>PM10-FIL</td>
<td>0.293</td>
<td>LB</td>
<td>TON</td>
</tr>
<tr>
<td>Non-Metallic</td>
<td>PM25-PRI</td>
<td>0.037</td>
<td>LB</td>
<td>TON</td>
</tr>
<tr>
<td>Non-Metallic</td>
<td>PM25-FIL</td>
<td>0.037</td>
<td>LB</td>
<td>TON</td>
</tr>
</tbody>
</table>

3.18.4.4 **EPA activity data**

Emissions were estimated by obtaining state-level metallic and non-metallic crude ore handled at surface mines from the U.S. Geologic Survey (USGS) [ref 6] and mine specific coal production data for surface mines from the Energy Information Administration (EIA) [ref 7]. Since some of the USGS metallic and non-metallic minerals waste data associated with ore production are withheld to avoid disclosing company proprietary data, an allocation procedure was developed to estimate the withheld data. For states with withheld waste data, the state fraction of national ore production was multiplied by the national undisclosed waste value to estimate the state withheld data. In addition, the USGS only reports metallic and non-metallic minerals production data separately at the national-level (e.g., the production data is combined at the state-level). To estimate metallic versus non-metallic ore production and associated waste at the state-level, the state-level total production and waste data were multiplied by the national metallic or non-metallic percentage of total production.

3.18.4.5 **Activity allocation procedure**

State-level metallic and non-metallic crude ore and associated waste handled was allocated to the county-level using employment. Specifically, state-level activity data was multiplied by the ratio of county- to state-level number of employees in the metallic and non-metallic mining industries (see Table 3-108 for a list of NAICS codes).

### Table 3-108: NAICS codes for Metallic and Non-Metallic Mining

<table>
<thead>
<tr>
<th>NAICS Code</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>2122</td>
<td>Metal Ore Mining</td>
</tr>
<tr>
<td>212210</td>
<td>Iron Ore Mining</td>
</tr>
</tbody>
</table>

183
<table>
<thead>
<tr>
<th>NAICS Code</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>21222</td>
<td>Gold Ore and Silver Ore Mining</td>
</tr>
<tr>
<td>212221</td>
<td>Gold Ore Mining</td>
</tr>
<tr>
<td>212222</td>
<td>Silver Ore Mining</td>
</tr>
<tr>
<td>21223</td>
<td>Copper, Nickel, Lead, and Zinc Mining</td>
</tr>
<tr>
<td>212231</td>
<td>Lead Ore and Zinc Ore Mining</td>
</tr>
<tr>
<td>212234</td>
<td>Copper Ore and Nickel Ore Mining</td>
</tr>
<tr>
<td>21229</td>
<td>Other Metal Ore Mining</td>
</tr>
<tr>
<td>212291</td>
<td>Uranium-Radium-Vanadium Ore Mining</td>
</tr>
<tr>
<td>212299</td>
<td>All Other Metal Ore Mining</td>
</tr>
<tr>
<td>2123</td>
<td>Nonmetallic Mineral Mining and Quarrying</td>
</tr>
<tr>
<td>21231</td>
<td>Stone Mining and Quarrying</td>
</tr>
<tr>
<td>212311</td>
<td>Dimension Stone Mining and Quarrying</td>
</tr>
<tr>
<td>212312</td>
<td>Crushed and Broken Limestone Mining and Quarrying</td>
</tr>
<tr>
<td>212313</td>
<td>Crushed and Broken Granite Mining and Quarrying</td>
</tr>
<tr>
<td>212319</td>
<td>Other Crushed and Broken Stone Mining and Quarrying</td>
</tr>
<tr>
<td>21232</td>
<td>Sand, Gravel, Clay, and Ceramic and Refractory Minerals Mining and Quarrying</td>
</tr>
<tr>
<td>212321</td>
<td>Construction Sand and Gravel Mining</td>
</tr>
<tr>
<td>212322</td>
<td>Industrial Sand Mining</td>
</tr>
<tr>
<td>212324</td>
<td>Kaolin and Ball Clay Mining</td>
</tr>
<tr>
<td>212325</td>
<td>Clay and Ceramic and Refractory Minerals Mining</td>
</tr>
<tr>
<td>21239</td>
<td>Other Nonmetallic Mineral Mining and Quarrying</td>
</tr>
<tr>
<td>212391</td>
<td>Potash, Soda, and Borate Mineral Mining</td>
</tr>
<tr>
<td>212392</td>
<td>Phosphate Rock Mining</td>
</tr>
<tr>
<td>212393</td>
<td>Other Chemical and Fertilizer Mineral Mining</td>
</tr>
<tr>
<td>212399</td>
<td>All Other Nonmetallic Mineral Mining</td>
</tr>
</tbody>
</table>

Employment data was obtained from the U.S. Census Bureau’s 2009 County Business Patterns (CBP) [ref 8]. Due to concerns with releasing confidential business information, the CBP does not release exact numbers for a given NAICS code if there are enough data that individual businesses could be identified. Instead a series of range codes is used. To estimate withheld counties the following procedure was used for each NAICS code being computed.

1. County level data for counties with known employment were totaled by state.
2. #1 subtracted from the state total reported in state-level CBP.
3. Each of the withheld counties is assigned the midpoint of the range code (e.g., A: 1-19 employees would be assigned 10).
4. These midpoints are then summed to the state level.
5. #2 is divided by #4 as an adjustment factor to the midpoints.
6. #5 is multiplied by #3 to get the adjusted county-level employment.

For example, take the 2006 CBP data for NAICS 31-33 (Manufacturing) in Maine provided in Table 3-109.
Table 3-109: 2006 County Business Pattern for NAICS 31-33 in Maine

<table>
<thead>
<tr>
<th>State FIPS</th>
<th>County FIPS</th>
<th>NAICS</th>
<th>Midpoint flag</th>
<th>Total Employees</th>
</tr>
</thead>
<tbody>
<tr>
<td>23</td>
<td>001</td>
<td>31----</td>
<td></td>
<td>6,774</td>
</tr>
<tr>
<td>23</td>
<td>003</td>
<td>31----</td>
<td></td>
<td>3,124</td>
</tr>
<tr>
<td>23</td>
<td>005</td>
<td>31----</td>
<td></td>
<td>10,333</td>
</tr>
<tr>
<td>23</td>
<td>007</td>
<td>31----</td>
<td></td>
<td>1,786</td>
</tr>
<tr>
<td>23</td>
<td>009</td>
<td>31----</td>
<td></td>
<td>1,954</td>
</tr>
<tr>
<td>23</td>
<td>011</td>
<td>31----</td>
<td></td>
<td>2,535</td>
</tr>
<tr>
<td>23</td>
<td>013</td>
<td>31----</td>
<td></td>
<td>1,418</td>
</tr>
<tr>
<td>23</td>
<td>015</td>
<td>31----</td>
<td>F</td>
<td>0</td>
</tr>
<tr>
<td>23</td>
<td>017</td>
<td>31----</td>
<td></td>
<td>2,888</td>
</tr>
<tr>
<td>23</td>
<td>019</td>
<td>31----</td>
<td></td>
<td>4,522</td>
</tr>
<tr>
<td>23</td>
<td>021</td>
<td>31----</td>
<td></td>
<td>948</td>
</tr>
<tr>
<td>23</td>
<td>023</td>
<td>31----</td>
<td>I</td>
<td>0</td>
</tr>
<tr>
<td>23</td>
<td>025</td>
<td>31----</td>
<td></td>
<td>4,322</td>
</tr>
<tr>
<td>23</td>
<td>027</td>
<td>31----</td>
<td></td>
<td>1,434</td>
</tr>
<tr>
<td>23</td>
<td>029</td>
<td>31----</td>
<td></td>
<td>1,014</td>
</tr>
<tr>
<td>23</td>
<td>031</td>
<td>31----</td>
<td></td>
<td>9,749</td>
</tr>
</tbody>
</table>

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. \( \frac{6521}{19250} = 0.33875 \).
6. The adjusted employment for county 015 is 1750*0.33875 = 592.82. County 023 has an adjusted employment of 17500*0.33875 = 5928.18.

In the event that data at the state level is withheld, a similar procedure is first performed going from the U.S. level to the state level. For example, known state-level employees are subtracted from the U.S. total yielding the total withheld employees. Next the estimated midpoints of the withheld states are added together and compared (by developing a ratio) to the U.S. total withheld employees. The midpoints are then adjusted by the ratio to give an improved estimate of the state total.

3.18.4.6 Controls

No controls were accounted for in the emissions estimation.

3.18.4.7 EPA approach - emissions equation and sample calculation

Fugitive dust emissions for mining and quarrying operations are the sum of emissions from the mining of metallic and nonmetallic ores and coal:

\[
E = E_m + E_n + E_c
\]

where,

\[ E = \text{PM}_{10} \text{ emissions from mining and quarrying operations} \]
\[ E_m = \text{PM}_{10} \text{ emissions from metallic ore mining operations} \]
\[ E_n = \text{PM}_{10} \text{ emissions from non-metallic ore mining} \]
\[ E_c = \text{PM}_{10} \text{ emissions from coal mining operations} \]

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,

- \( E \) = \( \text{PM}_{10} \) emissions from operation (e.g., metallic ore, non-metallic ore, or coal mining; lbs)
- \( EF \) = emissions factor associated with operation (lbs/ton)
- \( A \) = ore handled in mining operation (tons)

As an example, in 2009 Autauga County, Alabama handled 456,346 tons of metallic ore and associated waste, 714,718 tons of non-metallic ore and associated waste, and 0 tons of coal. Mining and quarrying \( \text{PM}_{10} \)-PRI emissions for Autauga County are:

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

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

### 3.18.5 References for Industrial Processes - Mining

3.19 Industrial Processes – Non-ferrous Metals

3.19.1 Sector description

This sector is defined by the processing of non-iron various types of metals. This sector includes, but is not limited to: primary and secondary metal production processes such as alumina electrolytic reduction (SCCs beginning with 303001 and 303040), primary copper smelting (303005x), lead production (303010x), gold processing (303013x), barium ore processing (303014x), zinc production (303030x), aluminum (304001) copper (304002x), lead (304004x), lead battery manufacture (304005x), magnesium (304006x), zinc (304008x) and nickel (304010x) and numerous other primary and secondary metal production processes with SCCs beginning with 303 and 304. Most other SCCs in these ranges not related to non-ferrous metals deal with “Storage and Transfer” processes (see Section 3.23).

3.19.2 Sources of data overview and selection hierarchy

Non-ferrous metals is covered mostly in the point data category. EPA did not provide estimates for nonpoint for this sector. The selection hierarchy for all point inventory datasets contributing to this sector are provided in Table 3-1: Data sources and selection hierarchy used for point sources. The selection hierarchy for all nonpoint inventory datasets contributing to this sector are provided in Table 3-2: Data sources and selection hierarchy used for nonpoint sources.

3.19.3 Spatial coverage and data sources for the sector

3.20 Industrial Processes – Oil & Gas Production

3.20.1 Sector description

This sector includes processes associated with the exploration and drilling at oil and gas wells and the equipment used at the well sites to extract the product from the well and deliver it to a central collection point or processing facility. Table 3-110 lists the processes below with their corresponding SCCs; the SCCs used by EPA to estimate nonpoint emissions marked in second column. Note also that the SCCs in this list are only the SCCs that either the EPA used or the submitting State agencies used in the 2011 NEI. All of the SCCs that the EPA oil and gas tool uses are nonpoint SCCs.
<table>
<thead>
<tr>
<th>Data Category</th>
<th>EPA uses</th>
<th>SCC</th>
<th>SCC Description (Abbreviated)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Nonpoint</td>
<td>Y</td>
<td>2310000000</td>
<td>Total: All Processes (doesn’t distinguish oil or gas)</td>
</tr>
<tr>
<td>Nonpoint</td>
<td></td>
<td>2310000220</td>
<td>Drill Rigs</td>
</tr>
<tr>
<td>Nonpoint</td>
<td></td>
<td>2310000230</td>
<td>Workover Rigs</td>
</tr>
<tr>
<td>Nonpoint</td>
<td>Y</td>
<td>2310000330</td>
<td>Artificial Lift</td>
</tr>
<tr>
<td>Nonpoint</td>
<td>Y</td>
<td>2310000550</td>
<td>Produced Water</td>
</tr>
<tr>
<td>Nonpoint</td>
<td></td>
<td>2310000660</td>
<td>Hydraulic Fracturing Engines</td>
</tr>
<tr>
<td>Nonpoint</td>
<td></td>
<td>2310020000 through 2310002421</td>
<td>Off-Shore Oil &amp; Gas Production; Total: All Processes, Flares: Continuous Pilot Light, Flares: Flaring Operations, Pneumatic Pumps: Gas And Oil Wells, Pressure/Level Controllers, Cold Vents</td>
</tr>
<tr>
<td>Nonpoint</td>
<td></td>
<td>2310010000</td>
<td>Nonpoint: Crude Petroleum; Total: All Processes</td>
</tr>
<tr>
<td>Nonpoint</td>
<td></td>
<td>2310010100</td>
<td>Crude Petroleum; Oil Well Heaters</td>
</tr>
<tr>
<td>Nonpoint</td>
<td></td>
<td>2310010200</td>
<td>Crude Petroleum; Oil Well Tanks - Flashing &amp; Standing/Working/Breathing</td>
</tr>
<tr>
<td>Nonpoint</td>
<td></td>
<td>2310010300</td>
<td>Crude Petroleum; Oil Well Pneumatic Devices</td>
</tr>
<tr>
<td>Nonpoint</td>
<td></td>
<td>2310010700</td>
<td>Crude Petroleum; Oil Well Fugitives</td>
</tr>
<tr>
<td>Nonpoint</td>
<td></td>
<td>2310010800</td>
<td>Crude Petroleum; Oil Well Truck Loading</td>
</tr>
<tr>
<td>Nonpoint</td>
<td>Y</td>
<td>2310011000</td>
<td>On-shore oil production; Total: All Processes</td>
</tr>
<tr>
<td>Nonpoint</td>
<td></td>
<td>2310011020</td>
<td>On-shore oil production; Storage Tanks: Crude Oil</td>
</tr>
<tr>
<td>Nonpoint</td>
<td></td>
<td>2310011100</td>
<td>On-shore oil production; Heater Treater</td>
</tr>
<tr>
<td>Nonpoint</td>
<td>Y</td>
<td>2310011201</td>
<td>On-shore oil production; Tank Truck/Railcar Loading: Crude Oil</td>
</tr>
<tr>
<td>Nonpoint</td>
<td></td>
<td>2310011450</td>
<td>On-shore oil production; Wellhead</td>
</tr>
<tr>
<td>Nonpoint</td>
<td></td>
<td>2310011500</td>
<td>On-shore oil production; Fugitives: All Processes</td>
</tr>
<tr>
<td>Nonpoint</td>
<td>Y</td>
<td>2310011501</td>
<td>On-shore oil production; Fugitives: Connectors</td>
</tr>
<tr>
<td>Nonpoint</td>
<td>Y</td>
<td>2310011502</td>
<td>On-shore oil production; Fugitives: Flanges</td>
</tr>
<tr>
<td>Nonpoint</td>
<td>Y</td>
<td>2310011503</td>
<td>On-shore oil production; Fugitives: Open Ended Lines</td>
</tr>
<tr>
<td>Nonpoint</td>
<td></td>
<td>2310011504</td>
<td>On-shore oil production; Fugitives: Pumps</td>
</tr>
<tr>
<td>Nonpoint</td>
<td>Y</td>
<td>2310011505</td>
<td>On-shore oil production; Fugitives: Valves</td>
</tr>
<tr>
<td>Nonpoint</td>
<td></td>
<td>2310011506</td>
<td>On-shore oil production; Fugitives: Other</td>
</tr>
<tr>
<td>Nonpoint</td>
<td></td>
<td>2310012000 through 2310012526</td>
<td>Off-Shore Oil Production; Total: All Processes, Storage Tanks: Crude Oil, Fugitives, Connectors: Oil Streams, Fugitives, Flanges: Oil, Fugitives, Valves: Oil, Fugitives, Other: Oil, Fugitives, Connectors: Oil/Water Streams, Fugitives, Flanges: Oil/Water, Fugitives, Other: Oil/Water</td>
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<td>On-Off Gas Production; Gas Well Dehydrators - Flaring</td>
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<td>On-Off Gas Production; Gas Well Completion - Flaring</td>
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<td>On-Off Gas Production; Fugitives: Connectors</td>
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<td>On-Off Gas Production; Fugitives: Flanges</td>
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<td>On-Off Gas Production; Fugitives: Open Ended Lines</td>
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<td>On-Off Gas Production; Fugitives: Pumps</td>
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<td>On-Off Gas Production; Fugitives: Other</td>
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<td>On-Off Gas Production; Fugitives: All Processes</td>
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<td>On-Off Gas Production; Gas Well Venting - Recompletions</td>
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<td>On-Off Gas Production; Gas Well Venting - Blowdowns</td>
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<td>2310021604</td>
<td>On-Off Gas Production; Gas Well Venting - Compressor Startups</td>
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<td>On-Off Gas Production; Gas Well Venting - Compressor Shutdowns</td>
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<td>On-Off Gas Production; Miscellaneous Engines</td>
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<td>Off-Off Gas Production; Total: All Processes, Storage Tanks: Condensate, Turbines: Natural Gas Boilers/Heaters: Natural Gas, Diesel Engines, Amine Unit Dehydrator, Fugitives, Connectors: Gas Streams, Fugitives, Flanges: Gas Streams, Fugitives, Valves: Gas, Fugitives, Other: Gas</td>
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<td>Off-Off Gas Production; Total: All Processes, Gas Well Tanks - Flashing &amp; Standing/Working/ Breathing, Uncontrolled, Gas Well Water Tank Losses, Gas Plant Truck Loading</td>
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<td>On-shore Oil Exploration; Mud Degassing</td>
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<td>Y</td>
<td>23101111401</td>
<td>On-shore Oil Exploration; Oil Well Pneumatic Pumps</td>
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3.20.2 Sources of data overview and selection hierarchy

The S/L/T agencies that submitted data to the EPA are listed in Table 3-111 below, as well as in the charts. A number of states submitted both point and nonpoint emissions. In all cases, the majority of emissions are in the nonpoint data category.

<table>
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<th>Data Set Name</th>
<th>State</th>
<th>Dataset Short Name</th>
<th>Data Category</th>
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<td>Navajo Nation, Arizona, New Mexico &amp; Utah</td>
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<td>Southern Ute Indian Tribe</td>
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<td>Point</td>
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Table 3-112 shows the selection hierarchy for datasets included in the Industrial Processes – Oil & Gas Production sector.

Table 3-112: 2011 NEI Industrial Processes – Oil & Gas Production data selection hierarchy

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<th>Priority</th>
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<th>Dataset Content</th>
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<td>2011EPA_PM-Augmentation</td>
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<tr>
<td>2</td>
<td>Responsible Agency Data Set</td>
<td>State and Local Agency submitted emissions</td>
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<tr>
<td>3</td>
<td>2011EPA_chrom_split</td>
<td>Speciates chromium</td>
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<tr>
<td>4</td>
<td>2011EPA_Other</td>
<td>New Mexico emissions that state was unable to submit to the EIS due to submittal issues</td>
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<td>5</td>
<td>2011EPA_TRI</td>
<td>Toxics Release Inventory data for the year 2011.</td>
</tr>
<tr>
<td>6</td>
<td>2011EPA_HAP-Augmentation</td>
<td>Augments HAP emissions</td>
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<tr>
<td>7</td>
<td>2008 MMS Data</td>
<td>Off shore Platforms from the Bureau of Ocean and Energy Management, carried forward from 2008</td>
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<td><strong>Nonpoint Hierarchy</strong></td>
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<td>State and Local Agency submitted emissions</td>
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<tr>
<td>2</td>
<td>2011EPA_PM-Augmentation</td>
<td>Augments PM emissions</td>
</tr>
<tr>
<td>3</td>
<td>2011EPA_NP_Overlap_w_Pt</td>
<td>EPA-generated data</td>
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3.20.3 Spatial coverage and data sources for the sector

![Industrial Processes - Oil & Gas Production](image1.png)

![Industrial Processes - Oil & Gas Production](image2.png)
3.20.4 EPA emissions calculation approach

The EPA developed a methodology to estimate nonpoint emissions for the oil and gas production sector. This development started in April 2012 and was done in collaboration with a national workgroup, which includes state and regional emissions developers. The tool can produce county-level emissions for calendar year 2011 for criteria pollutants and their precursors including volatile organic compounds and ammonia, as well as for hazardous air pollutants (HAPs). This methodology was used by EPA to estimate emissions for use in the NEI for field exploration, production, and gathering activities. The tool allows the S/L/T agency inventory developers to subtract out point source emissions from the nonpoint estimates to avoid double counted emissions.

For the 2011 NEI, the tool was used by both states and EPA to estimate emissions. As was the case in previous NEI cycles, states can use their own methodologies to estimate oil & gas emissions. States can also use the tool by either using the default tool inputs, or by providing their own basin- and/or county-specific inputs. Custom inputs to the tool allows for customized emissions from the tool. The tool is pre-populated with basin- and state-specific inputs where those are available, and it uses default EPA inputs when nothing else is available. The EPA default inputs are based on data developed during the recent rulemaking for this industry.

In the maps provided in Section 3.20.3, EPA data are considered as “EPA” even when they are based on state-specific inputs from the tool. The EPA tool contains within its database descriptions of the sources for all data used. So, the tool is the best place to better understand the underlying origin of the emissions data (see below for tool access information).

The EPA oil and gas tool considers all significant sources of oil and gas industry emissions, such as:

- Drill rigs
- Workover rigs
- Well completions (flaring/venting for both conventional and green completions)
- Well hydraulic fracturing and completion engines
- Heaters (separator, line, tank, reboilers)
- Storage tanks (condensate, black oil, produced water)
- Mud degassing
- Dehydration units
- Pneumatics (pumps, all other devices)
- Well venting/blow downs (liquid unloading)
- Fugitives
- Truck loading
- Wellhead engines
- Pipeline compressor engines
- Flaring
- Artificial lifts
- Gas actuated pumps

More information about the tool and directions on how to use it can be found at ftp://ftp.epa.gov/EmisInventory/2011nei/doc/Tool_and_Report112614.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.
3.20.5 Summary of data quality assurance methods

We reviewed data comparisons between the 2008 and 2011 NEIs and between state-submitted data and EPA generated data. Table 3-113 below lists some comments and the resolution. Many more comments were received through the national workgroup while building the oil & gas tool. Generally speaking, emissions comparisons between 2008 and 2011 were not very informative because not many states submitted to EPA in 2008, and the industry is changing so fast that 3 years can make a big difference.

<table>
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<th>State</th>
<th>EIS Sector</th>
<th>Pollutant</th>
<th>Comment</th>
</tr>
</thead>
<tbody>
<tr>
<td>UT</td>
<td>Oil and gas</td>
<td>all</td>
<td>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.</td>
</tr>
<tr>
<td>TX</td>
<td>Oil and gas</td>
<td>all</td>
<td>We added emissions from 5 SCCs from EPA tool to the NEI, at Texas staff request, since they did not cover that process. The SCCs are 2310000660 (hydro-fracturing engines), 2310111100 (oil well mud degassing), 2310111401 (Oil well pneumatic pumps), 2310121100 (mud degassing), and 2310121401 (gas well pneumatic pumps). Since Texas had submitted emissions values of zero for this process, they asked EPA to tag the state data so the EPA data would be selected ahead of the Texas-provided zero values.</td>
</tr>
<tr>
<td>CA</td>
<td>Oil and gas</td>
<td>all</td>
<td>We noted that California estimates look very different compared to EPA's estimates. Emissions are lower (about one tenth of EPA estimates) and SCC coverage is different than EPA's. We have discussed this with California and they have reviewed their data, and we are using the California-submitted data in the 2011 v1 NEI. We also tagged EPA's oil well completions data, which blocked them from merging to the NEI. These data were not ready for use in the NEI because the available emission factors are not known to be applicable to oil well completions. There are no emission factors that are specific to oil-well completions available from EPA at this time.</td>
</tr>
</tbody>
</table>

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 NOx).

We noted several states where there were large differences between EPA’s estimates and the state submittals. We selected 2 states that had good emission inventory programs and therefore, the staff at each state (WY and CO) have a lot of confidence in their own estimates. We believed it would be a good calculation check on the tool if we compared emissions submitted by these states to emissions from the tool.

We compared county level EPA tool data to state submitted data for Sublette County in WY. We picked Sublette County because of the high activity in that county plus some large differences in emission estimates between the EPA tool and the state. In the tool for Sublette County, we populated some of the basin factors with data from the WRAP III study, which the committee considered good data and certainly better than default data from the CenSARA (Central States Air Resources Agencies) states. In several instances, this turned out not to be true. For condensate tanks, according to the WRAP III data, none of the emissions from condensate tanks were
controlled by flares, and VOC emissions were calculated at 67,985 tons for condensate tanks for just Sublette County. That is much higher than the emissions reported by WY (453 tons VOC). WY informed us that all condensate tanks in Sublette County were controlled by flares. When we changed the basin factor in the tool to match this new information, the tool calculated 1,622 tons VOC, which is still higher than what was reported by the state but much more in line with the states estimates. For well completions, again for Sublette County, the WRAP III data had no green completions in Sublette County and the tool calculated emissions of 4240 tons of VOC. The state submitted emissions of 54 tons of VOC. WY informed us that all well completions in Sublette County were green, so with this new information, the tool now calculates zero VOC emissions from green completions. This change brought the tool pretty much in line with the state estimates.

One of the problems with comparing the tool data to WY data is that WY submits a significant portion of their oil and gas production emissions to the point source sector and it is not trivial to query and analyze. Currently the tool still estimates about 12,000 more tons of VOC in Sublette County than the state submitted in the nonpoint, and the discrepancy may be the emission submitted by WY in the point source sector. Another case in point, for wellhead compressor engines, we noticed that the tool estimates 4,561 tons of NOX for Sublette County and WY submitted zero emissions to the nonpoint sector. WY told us that all of their emissions from wellhead compressors were submitted to the point source inventory.

In Natrona County, WY, the tool has little condensate production so emissions are low, but WY reports high condensate tank emissions in Natrona County. The discrepancy was traced to the fact that the HPDI database called the liquid produced in Natrona County “oil” and WY called the liquid produced “condensate”. The difference is that the emission factor for condensate is about 10 times higher than the emission factor for oil, so emissions for condensate are going to be a lot higher for condensate. We made the appropriate adjustments in the tool and then the tool calculation more closely matched WY data, the emissions from the tool matched the state submitted emissions for condensate tanks a lot better.

### 3.21 Industrial Processes – Petroleum Refineries

#### 3.21.1 Sector description

This sector includes petroleum industry processes except non-storage and handling processes (see Section 3.23) with SCCs beginning with 3060x. A couple of nonpoint SCCs for “Petroleum Refining: SIC 29” (2306000000 and 2306010000) are also assigned to this sector. Petroleum refinery processes include but are not limited to: process heaters, catalytic cracking units, wastewater treatment, cooling towers, flares, distillation, blending and treating units, incineration, and various fugitive sources at locations such as pipelines, drains and compressors.

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

This sector is covered almost completely in the point data category. EPA does not provide estimates for this sector in nonpoint. The selection hierarchy for all point inventory datasets contributing to this sector are provided in Table 3-1: Data sources and selection hierarchy used for point sources. The selection hierarchy for all nonpoint inventory datasets contributing to this sector are provided in Table 3-2: Data sources and selection hierarchy used for nonpoint sources.
3.21.3 Spatial coverage and data sources for the sector

3.22 Industrial Processes – Pulp & Paper

3.22.1 Sector description

This sector includes pulp and paper wood products processes except non-storage and handling processes (see Section 3.23) with SCCs beginning with 307x. Pulp and paper processes include but are not limited to: sulfate (Kraft) pulping, sulfite pulping, neutral sulfite semi-chemical pulping, semi-chemical (non-sulfur), soda, wood pressure treating, particleboard manufacture, plywood and sawmill operations, medium density fiberboard (MDF), oriented strand board (OSB), laminated strand lumber, fiberboard and hardboard (HB) manufacture, and miscellaneous wood working operations.

3.22.2 Sources of data overview and selection hierarchy

This sector covered completely in point. The selection hierarchy for all point inventory datasets contributing to this sector are provided in Table 3-1: Data sources and selection hierarchy used for point sources.

3.22.3 Spatial coverage and data sources for the sector
3.23 Industrial Processes – Storage and Transfer

3.23.1 Sector description
This sector includes storage and transport activities at industrial sources and includes emissions categorized as nonpoint and point. Much of the emissions in this sector are related to working/breathing loss of various fuels and inorganic and organic chemicals –both liquid and solid. Processes in this sector include those at chemical manufacturing, primary and secondary metal production and cement mineral processing (e.g., cement manufacturing) facilities. There is considerable overlap in emissions calculations and methodology with the processes in the Bulk Gasoline Terminals and Gas Stations sector, particularly for bulk terminals and pipelines discussed in Section 3.5.4.

3.23.2 Sources of data overview and selection hierarchy
The wide range of processes that define this sector impact most types of industrial facilities and therefore, most states report both (at least some) point and nonpoint emissions for both CAPs and HAPs. The selection hierarchy for all point inventory datasets contributing to this sector are provided in Table 3-1: Data sources and selection hierarchy used for point sources. The selection hierarchy for all nonpoint inventory datasets contributing to this sector are provided in Table 3-2: Data sources and selection hierarchy used for nonpoint sources.

3.23.3 Spatial coverage and data sources for the sector

3.24 Industrial Processes – NEC (Other)

3.24.1 Sector description
This Industrial Processes NEC (not elsewhere classified) sector includes all industrial processes not covered in other NEI/EIS sectors (i.e., sectors discussed in Section 3.15 through Section 3.23. These processes are ubiquitous in the point and nonpoint data categories. Some point inventory processes (SCCs) include: internal combustion engines wastewater and equipment leaks (2018x, 2028x, 2038x, 2048x), food and agriculture coffee roasting, cotton ginning, feed and grain terminal elevators, grain millings, beer production, meat smokehouses, sugar cane refining, and vegetable oil processing (3020x), by-product coke manufacturing (303003x), asphalt roofing manufacture (305001x), brick manufacture (305003x), fiberglass manufacture (30501x), glass manufacture (305014x), lime manufacture (305016x), mineral wood manufacturing (305017x), phosphate rock
(305019x), industrial sand and gravel (305027x), tire manufacture (308001x), plastic products manufacturing (308010x), vinyl floor tile manufacturing (308050x) and hundreds of other industrial processes. Some nonpoint inventory processes (SCCs) include: food and kindred products (23020x), wood products (23070x) and fabricated metals (2309x).

3.24.2 Sources of data overview and selection hierarchy

Most of the data in this sector is point sources. EPA does not generate nonpoint emissions for this sector. The selection hierarchy for all point inventory datasets contributing to this sector are provided in Table 3-1: Data sources and selection hierarchy used for point sources. The selection hierarchy for all nonpoint inventory datasets contributing to this sector are provided in Table 3-2: Data sources and selection hierarchy used for nonpoint sources.

3.24.3 Spatial coverage and data sources for the sector

3.25 Miscellaneous Non-industrial NEC (Other)

3.25.1 Sector description

This sector includes primarily nonpoint processes and 4 point processes (waste disposal...firefighting, SCCs=5010060x). The nonpoint sources include portable fuel containers (SCCs like 250101101x and 250101201x), structure and motor vehicle fires, catastrophic/accidental releases, and human and animal cremation (280100x), automotive repair shops (28400x), miscellaneous repair shops (28410x), health services (285000x), fluorescent lamp breakage (28610000x) and swimming pools (286200x).

3.25.2 Sources of data overview and selection hierarchy

The miscellaneous non-industrial not elsewhere classified (NEC) sector includes data from S/L/T agency and EPA datasets that cover both point and nonpoint data categories. Table 3-114 shows the data categories and SCCs submitted by each agency in this sector. Note that there are a wide range of sources in this sector, including new (to 2011 v2) nonpoint mercury emissions provided by the EPA. Much of the EPA nonpoint data in this table are discussed in section 3.1.7. The only EPA data in the point inventory in this sector is limited to PM and chromium augmentation (see Section 3.1.2 and Section 3.1.3). The selection hierarchy for all point inventory datasets contributing to this sector are provided in Table 3-1: Data sources and selection hierarchy used for point
The selection hierarchy for all nonpoint inventory datasets contributing to this sector are provided in Table 3-2: Data sources and selection hierarchy used for nonpoint sources.

<table>
<thead>
<tr>
<th>Data Set Name</th>
<th>Data Category</th>
<th>SCC</th>
<th>SCC Level One</th>
<th>SCC Level Two</th>
<th>SCC Level Three</th>
<th>SCC Level Four</th>
</tr>
</thead>
<tbody>
<tr>
<td>EPA Nonpoint Mercury</td>
<td>Nonpoint</td>
<td>2810060100</td>
<td>Miscellaneous Area Sources</td>
<td>Other Combustion</td>
<td>Cremation</td>
<td>Humans</td>
</tr>
<tr>
<td>EPA Nonpoint Mercury</td>
<td>Nonpoint</td>
<td>2810060200</td>
<td>Miscellaneous Area Sources</td>
<td>Other Combustion</td>
<td>Cremation</td>
<td>Animals</td>
</tr>
<tr>
<td>EPA Nonpoint Mercury</td>
<td>Nonpoint</td>
<td>2850001000</td>
<td>Miscellaneous Area Sources</td>
<td>Health Services</td>
<td>Dental Alloy Production</td>
<td>Overall Process</td>
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<tr>
<td>EPA Nonpoint Mercury</td>
<td>Nonpoint</td>
<td>2861000000</td>
<td>Miscellaneous Area Sources</td>
<td>Fluorescent Lamp Breakage</td>
<td>Non-recycling Related Emissions</td>
<td>Total</td>
</tr>
<tr>
<td>EPA Nonpoint Mercury</td>
<td>Nonpoint</td>
<td>2861000010</td>
<td>Miscellaneous Area Sources</td>
<td>Fluorescent Lamp Breakage</td>
<td>Recycling Related Emissions</td>
<td>Total</td>
</tr>
<tr>
<td>2011EPA_chrom_split</td>
<td>Nonpoint</td>
<td>2810050000</td>
<td>Miscellaneous Area Sources</td>
<td>Other Combustion</td>
<td>Motor Vehicle Fires</td>
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</tr>
<tr>
<td>2011EPA_chrom_split</td>
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<td>Cremation</td>
<td>Humans</td>
</tr>
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<td>Cremation</td>
<td>Animals</td>
</tr>
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<td>Cremation</td>
<td>Humans</td>
</tr>
<tr>
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<td>Miscellaneous Area Sources</td>
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<td>Cremation</td>
<td>Humans</td>
</tr>
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<td>Bench Scale Reagents</td>
<td>Total</td>
</tr>
<tr>
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<td>Structure Fires</td>
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</tr>
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<td>Other Combustion</td>
<td>Cremation</td>
<td>Animals</td>
</tr>
<tr>
<td>2011EPA_NP_Overlap_w_Pt</td>
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<td>Miscellaneous Area Sources</td>
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<td>Hospitals</td>
<td>Sterilization Operations</td>
</tr>
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<td>2011EPA_PM-Augmentation</td>
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<td>2810003000</td>
<td>Miscellaneous Area Sources</td>
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<td>Cigarette Smoke</td>
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</tr>
<tr>
<td>2011EPA_PM-Augmentation</td>
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<td>2810025000</td>
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<td>Other Combustion</td>
<td>Charcoal Grilling - Residential (see 23-02-002-xxx for Commercial)</td>
<td>Total</td>
</tr>
<tr>
<td>2011EPA_PM-Augmentation</td>
<td>Nonpoint</td>
<td>2810030000</td>
<td>Miscellaneous Area Sources</td>
<td>Other Combustion</td>
<td>Structure Fires</td>
<td>Unspecified</td>
</tr>
<tr>
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<td>Nonpoint</td>
<td>2810035000</td>
<td>Miscellaneous Area Sources</td>
<td>Other Combustion</td>
<td>Firefighting Training</td>
<td>Total</td>
</tr>
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<td>2810040000</td>
<td>Miscellaneous Area Sources</td>
<td>Other Combustion</td>
<td>Aircraft/Rocket Engine</td>
<td>Total</td>
</tr>
<tr>
<td>2011EPA_PM-Augmentation</td>
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<td>SCC Level Two</td>
<td>SCC Level Three</td>
<td>SCC Level Four</td>
</tr>
<tr>
<td>---------------------------------------</td>
<td>---------------</td>
<td>-----------------</td>
<td>----------------------------------------</td>
<td>--------------------------</td>
<td>-----------------</td>
<td>----------------</td>
</tr>
<tr>
<td>2011EPA_PM-Augmentation</td>
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<td>Other Combustion</td>
<td>Cremation</td>
<td>Humans</td>
</tr>
<tr>
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<td>Cremation</td>
<td>Animals</td>
</tr>
<tr>
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<td>Hospitals</td>
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<td>Miscellaneous Area Sources</td>
<td>Other Combustion</td>
<td>Structure Fires</td>
<td>Unspecified</td>
</tr>
<tr>
<td>California Air Resources Board</td>
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<td>Miscellaneous Area Sources</td>
<td>Other Combustion</td>
<td>Motor Vehicle Fires</td>
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</tr>
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<td>Point</td>
<td>50100601</td>
<td>Waste Disposal</td>
<td>Solid Waste Disposal - Government</td>
<td>Fire Fighting</td>
<td>Structure: Jet Fuel</td>
</tr>
<tr>
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<td>Point</td>
<td>50100602</td>
<td>Waste Disposal</td>
<td>Solid Waste Disposal - Government</td>
<td>Fire Fighting</td>
<td>Structure: Distillate Oil</td>
</tr>
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<td>Miscellaneous Area Sources</td>
<td>Other Combustion</td>
<td>Cremation</td>
<td>Humans</td>
</tr>
<tr>
<td>Clark County Department of Air Quality and Environmental Management</td>
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<td>Structure Fires</td>
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</tr>
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<td>Miscellaneous Area Sources</td>
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<td>Miscellaneous Area Sources</td>
<td>Other Combustion</td>
<td>Charcoal Grilling - Residential (see 23-02-002-xxx for Commercial)</td>
<td>Total</td>
</tr>
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<td>Other Combustion</td>
<td>Structure Fires</td>
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<td>Miscellaneous Area Sources</td>
<td>Other Combustion</td>
<td>Motor Vehicle Fires</td>
<td>Unspecified</td>
</tr>
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<td>Cremation</td>
<td>Humans</td>
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<td>Cremation</td>
<td>Animals</td>
</tr>
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<td>Miscellaneous Area Sources</td>
<td>Other Combustion</td>
<td>Cremation</td>
<td>Humans</td>
</tr>
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<td>Miscellaneous Area Sources</td>
<td>Other Combustion</td>
<td>Structure Fires</td>
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</tr>
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<td>SCC Level One</td>
<td>SCC Level Two</td>
<td>SCC Level Three</td>
<td>SCC Level Four</td>
</tr>
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<td>---------------</td>
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<td>DC Department of Health Air Quality Division</td>
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<td>Miscellaneous Area Sources</td>
<td>Other Combustion</td>
<td>Firefighting Training</td>
<td>Total</td>
</tr>
<tr>
<td>DC Department of Health Air Quality Division</td>
<td>Nonpoint</td>
<td>2810050000</td>
<td>Miscellaneous Area Sources</td>
<td>Other Combustion</td>
<td>Motor Vehicle Fires</td>
<td>Unspecified</td>
</tr>
<tr>
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<td>Miscellaneous Area Sources</td>
<td>Other Combustion</td>
<td>Cremation</td>
<td>Animals</td>
</tr>
<tr>
<td>Delaware Department of Natural Resources and Environmental Control</td>
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<td>2810030000</td>
<td>Miscellaneous Area Sources</td>
<td>Other Combustion</td>
<td>Structure Fires</td>
<td>Unspecified</td>
</tr>
<tr>
<td>Delaware Department of Natural Resources and Environmental Control</td>
<td>Nonpoint</td>
<td>2810035000</td>
<td>Miscellaneous Area Sources</td>
<td>Other Combustion</td>
<td>Firefighting Training</td>
<td>Total</td>
</tr>
<tr>
<td>Delaware Department of Natural Resources and Environmental Control</td>
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<td>2810050000</td>
<td>Miscellaneous Area Sources</td>
<td>Other Combustion</td>
<td>Motor Vehicle Fires</td>
<td>Unspecified</td>
</tr>
<tr>
<td>Eastern Band of Cherokee Indians</td>
<td>Nonpoint</td>
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<td>Miscellaneous Area Sources</td>
<td>Other Combustion</td>
<td>Charcoal Grilling - Residential (see 23-02-002-xxx for Commercial)</td>
<td>Total</td>
</tr>
<tr>
<td>Georgia Department of Natural Resources</td>
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<td>2810030000</td>
<td>Miscellaneous Area Sources</td>
<td>Other Combustion</td>
<td>Structure Fires</td>
<td>Unspecified</td>
</tr>
<tr>
<td>Georgia Department of Natural Resources</td>
<td>Nonpoint</td>
<td>2810050000</td>
<td>Miscellaneous Area Sources</td>
<td>Other Combustion</td>
<td>Motor Vehicle Fires</td>
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<td>Nonpoint</td>
<td>2810010000</td>
<td>Miscellaneous Area Sources</td>
<td>Other Combustion</td>
<td>Human Perspiration and Respiration</td>
<td>Total</td>
</tr>
<tr>
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<td>Nonpoint</td>
<td>2810030000</td>
<td>Miscellaneous Area Sources</td>
<td>Other Combustion</td>
<td>Structure Fires</td>
<td>Unspecified</td>
</tr>
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<td>Hawaii Department of Health Clean Air Branch</td>
<td>Nonpoint</td>
<td>2810050000</td>
<td>Miscellaneous Area Sources</td>
<td>Other Combustion</td>
<td>Motor Vehicle Fires</td>
<td>Unspecified</td>
</tr>
<tr>
<td>Idaho Department of Environmental Quality</td>
<td>Nonpoint</td>
<td>2810025000</td>
<td>Miscellaneous Area Sources</td>
<td>Other Combustion</td>
<td>Charcoal Grilling - Residential (see 23-02-002-xxx for Commercial)</td>
<td>Total</td>
</tr>
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3.25.3 Spatial coverage and data sources for the sector

3.26 Solvent – Consumer & Commercial Solvent Use

3.26.1 Sector description

Consumer products are those products used around the home, office, institution, or similar settings. The commercial and institutional use of these products is included under "consumer products." The solvent-containing products in this category include personal care products, household products, automotive aftermarket products, adhesives and sealants, pesticides, some coatings, and other commercial and consumer products that may emit VOCs. Products not included in this category are products used as non-aerosol traffic.
marks, architectural and industrial maintenance coatings, autobody refinishing coatings, and products used in industrial processes.

Volatile organic compounds (VOC) are ingredients of consumer and commercial products that serve as propellants, aid in product drying (through evaporation), act as co-solvents and cleaning agents, and are emitted during product use. Typically these VOC sources are large in number, highly dispersed, and individually emit relatively small amounts of VOC. It is important to note here that not all organic compounds contained in consumer and commercial products are considered reactive VOCs by the EPA due to their negligible photochemical reactivity. For more information on Consumer Solvents, see the EIIP document, Consumer and Commercial Solvent Use, Final Report, 1996 (http://www.epa.gov/ttn/chief/eiip/techreport/volume03/iii05.pdf).

SCCs that are used by state, local and tribal agencies are provided in Table 3-115. The SCCs that EPA estimates emissions for are marked in column 2. Because of the different nature of the activity inputs, the methodology description for estimating emissions for this sector will be divided into three parts: 1) Personal Care, Household, Automotive Aftermarket, Coatings, Adhesives and Sealants Products, NEC and FIFRA Related Products (Household Pesticide); 2) Asphalt Paving, and 3) Agricultural Pesticides. SCC level 1 descriptions for all SCCs in this table are “Solvent Utilization”. SCC level 2 descriptions are “Miscellaneous Non-industrial: “, and one the following: “Commercial”, “Consumer” or “Consumer and Commercial”.

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3.26.2 Sources of data overview and selection hierarchy

The S/L/T agencies that submitted data to the EPA are listed in Table 3-116. A number of states submitted nonpoint emissions for this sector. Table 3-117 shows the selection hierarchy included in the Solvent – Commercial and Consumer sector.
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</tbody>
</table>
Table 3-117: Data selection hierarchy for the Solvent –Commercial and Consumer Solvent Use sector

<table>
<thead>
<tr>
<th>Priority</th>
<th>Dataset Name</th>
<th>Dataset Content</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Responsible Agency Data Set</td>
<td>State and Local Agency submitted emissions</td>
</tr>
<tr>
<td>2</td>
<td>2011EPA_HAP-Augmentation</td>
<td>Adds Pb and other HAP emissions in 46 states</td>
</tr>
<tr>
<td>3</td>
<td>2011EPA_NP_NoOverlap_w_Pt</td>
<td>EPA-generated data, including agricultural crops and livestock dust emissions</td>
</tr>
</tbody>
</table>

3.26.3 Spatial coverage and data sources for the sector

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

3.26.4 Development of EPA Emissions for Consumer and Commercial Solvents

EPA developed emission estimates for the 10 SCCs given in Table 3-118. SCC level 1 descriptions for these SCCs are “Solvent Utilization”. SCC level 2 descriptions are “Miscellaneous Non-industrial: “, and one the following: “Commercial” or “Consumer and Commercial”.

Table 3-118: Nonpoint SCC estimates developed by EPA for Consumer & Commercial Solvents sector

<table>
<thead>
<tr>
<th>SCC</th>
<th>SCC Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>2460100000</td>
<td>All Personal Care Products</td>
</tr>
<tr>
<td>2460200000</td>
<td>All Household Products</td>
</tr>
<tr>
<td>2460400000</td>
<td>All Automotive Aftermarket Products</td>
</tr>
<tr>
<td>2460500000</td>
<td>All Coatings and Related Products</td>
</tr>
<tr>
<td>2460600000</td>
<td>All Adhesives and Sealants</td>
</tr>
<tr>
<td>2460900000</td>
<td>Miscellaneous Products (Not Otherwise Covered)</td>
</tr>
<tr>
<td>2460800000</td>
<td>All FIFRA Related Products</td>
</tr>
<tr>
<td>2461021000</td>
<td>Cutback Asphalt</td>
</tr>
<tr>
<td>2461022000</td>
<td>Emulsified Asphalt</td>
</tr>
<tr>
<td>2461850000</td>
<td>Pesticide Application: Agricultural</td>
</tr>
</tbody>
</table>

Because of the different nature of the activity factors that go into the methodology, this sector’s methodology description for estimating emissions will be divided into three parts: 1) Personal Care, Household, Automotive Aftermarket, Coatings, Adhesives and Sealants Products, NEC and FIFRA Related Products (Household Pesticide); 2) Asphalt Paving, and 3) Agricultural Pesticides.
Emissions were calculated in accordance with the alternative method in EIIP Volume 3, Chapter 5 [ref 2]. Emissions are calculated for each county using emission factors and activity as:

\[ E_{x,p} = A_x \times EF_{x,p} \]

where:

- \( E_{x,p} \) = annual emissions for category \( x \) and pollutant \( p \)
- \( A_x \) = population data associated with category \( x \)
- \( EF_{x,p} \) = emission factor for category \( x \) and pollutant \( p \)

**Example:**

According to the U.S. Census Bureau, Ada County had a total population of 392,365 people. The emission factor for personal care products VOC is 1.9 lb/ person:

\[ E_{VOC} = 392,365 \text{ people} \times 1.9 \text{ lb VOC/ person} \]
\[ = 732.7 \text{ tons VOC} \]

**Activity Data**

This category uses population and emissions factors to calculate emissions. National population data were collected from the 2010 Census Bureau Interactive Population Search [ref 1] for each county.

**Emission Factors**

EPA, through the ERTAC committee process, chose emission factors for consumer and commercial solvent use from the Emission Inventory Improvement Program (EIIP) [ref 2] and a Freedonia 2007 report. The emission factors are based on national population (lb/person). Two of the VOC factors were updated with information from the EPA ERTAC 2008 calculations for this category [ref 3]. Information about the EIIP can be found on the CHIEF website at this address (http://www.epa.gov/ttn/chief/eiip/techreport/). Emission factors EPA used in the 2011 NEI are provided in Table 3-119. The emission factors from Freedonia were taken from the Freedonia report for 2007. For all SCCs, the leading SCC description is “Solvent Utilization; Miscellaneous Non-Industrial: Consumer and Commercial” and the level 4 description is “Total: All Solvent Types”.

<table>
<thead>
<tr>
<th>SCC</th>
<th>Description</th>
<th>Pollutant Code</th>
<th>Pollutant Description</th>
<th>Emission Factor</th>
<th>EF units</th>
<th>source</th>
</tr>
</thead>
<tbody>
<tr>
<td>2460100000</td>
<td>All Personal Care Products</td>
<td>108883</td>
<td>Toluene</td>
<td>0.5092</td>
<td>LB/person</td>
<td>HAP speciation profile</td>
</tr>
<tr>
<td>2460100000</td>
<td>All Personal Care Products</td>
<td>67561</td>
<td>Methanol</td>
<td>0.2546</td>
<td>LB/person</td>
<td>HAP speciation profile</td>
</tr>
<tr>
<td>2460100000</td>
<td>All Personal Care Products</td>
<td>VOC</td>
<td>VOC</td>
<td>1.9</td>
<td>LB/person</td>
<td>Freedonia, 2007</td>
</tr>
<tr>
<td>2460200000</td>
<td>All Household Products</td>
<td>108883</td>
<td>Toluene</td>
<td>0.4824</td>
<td>LB/person</td>
<td>HAP speciation profile</td>
</tr>
<tr>
<td>2460200000</td>
<td>All Household Products</td>
<td>67561</td>
<td>Methanol</td>
<td>0.2412</td>
<td>LB/person</td>
<td>HAP speciation profile</td>
</tr>
<tr>
<td>2460200000</td>
<td>All Household Products</td>
<td>VOC</td>
<td>VOC</td>
<td>1.8</td>
<td>LB/person</td>
<td>Freedonia, 2007</td>
</tr>
<tr>
<td>2460400000</td>
<td>All Automotive Aftermarket Products</td>
<td>107211</td>
<td>Ethylene Glycol</td>
<td>0.39712</td>
<td>LB/person</td>
<td>HAP speciation profile</td>
</tr>
<tr>
<td>2460400000</td>
<td>All Automotive Aftermarket Products</td>
<td>108883</td>
<td>Toluene</td>
<td>0.36448</td>
<td>LB/person</td>
<td>HAP speciation profile</td>
</tr>
</tbody>
</table>
### 3.26.4.2 Asphalt Paving - Cutback and Emulsified

While Asphalt Paving is part of Consumer and Commercial Solvents sector, the nature of its methodology is significantly different from most of the other sources in this sector.

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

Asphalt cements thinned with petroleum distillates are known as cutback asphalts (SCC=246102100). The primary uses of cutback asphalt include tack and seal operations, priming roadbeds, and paving operations for pavements up to several inches thick. Cut-back asphalt is produced by thinning the binder in a diluent containing 25 to 45 percent petroleum distillates by volume prior to mixing with the aggregate. This reduces the viscosity of the asphalt making it easier to work with the mixture. Emissions from cutback asphalt result from the evaporation of VOCs and HAPS after the mixture is laid down. Of all asphalt types, cutback asphalt has the highest diluent content and, as a result, emits the highest levels of VOCs per ton used. The timeframe and quantity of VOC and HAP emissions depend on the type and the quantity of organic solvent used as a diluent.

Asphalt cements thinned with water and an emulsifying agent are known as emulsified asphalts (SCC=246102200). This thinning reduces the viscosity of the asphalt making it easier to work with the mixture. The primary uses of emulsified asphalt include tack and seal operations, priming roadbeds, and paving operations for pavements up to several inches thick. Emulsified asphalt may contain up to 12 percent organic solvents by volume. Emissions from emulsified asphalt result from the evaporation of VOCs after the mixture is laid down. Compared to cutback asphalt, emulsified asphalt has lower VOCs emissions per ton used.
Emissions were calculated by multiplying the county-level asphalt usage (barrels) by the emission factors listed in Table 3-120 [ref 4] and then dividing by 2000 to convert pounds to tons.

\[ \text{Emissions}_{x,y} = (\text{Asphalt Usage}_x \times \text{EF}_y) / 2000 \]

where:

\[ \text{Emissions}_{x,y} = \text{emissions (tons) of pollutant y in county x} \]
\[ \text{Asphalt Usage}_x = \text{emulsified asphalt (barrels) used in county x} \]
\[ \text{EF}_y = \text{emission factor for pollutant y} \]

To convert tons of asphalt reported in the 2008 Asphalt Usage Survey to barrels, it was assumed that the density of asphalt is similar to that of water, 8.34 lbs/gal, and that one barrel equals 42 gallons.

\[ \text{Barrels of Asphalt} = (\text{tons of asphalt} \times 2000 \text{ lbs} / 8.34 \text{ lbs per gal}) / 42 \text{ gal per barrel} \]

Note that one barrel of asphalt weights approximately 350 pounds.

**Example:**
Nez Perce County was allocated 3,413.16 barrels of emulsified asphalt for 2011. The emission factor for VOC is 9.2 lb/Barrel of emulsified asphalt.

\[ E_{\text{VOC}} = 3,413.16 \text{ barrels of emulsified asphalt} \times 9.2 \text{ lb VOC/Barrel}. \]
\[ = 15.7 \text{ Tons VOC for Nez Perce County.} \]

**Activity Data**

The activity data required to calculate the emissions from asphalt paving are the number of barrels of cutback asphalt and emulsified asphalt used in each county. To determine the amount of each kind of asphalt used in each county, the total number of barrels of asphalt used in each state was required. The amount of cutback and emulsified asphalt used was obtained from the 2008 Asphalt Usage Survey, from the Asphalt Institute [ref 5]. The 2008 data was used for 2011 due to the Asphalt Institute no longer publishing a state by state report, and no other data was found for a more recent year due to time constraints. The barrels of asphalt used per state were then allocated to county-level according to the fraction of paved road vehicle miles traveled (VMT) in each county.

Total annual VMT estimates by State and roadway class were obtained from the Federal Highway Administration’s (FHWA) annual Highway Statistics report [ref 6]. Paved road VMT was calculated by subtracting the State/roadway class unpaved road VMT from total State/roadway class VMT. State-level paved road VMT was spatially allocated to counties according to the fraction of total VMT in each county for the specific roadway class as shown by the following equation:

\[ \text{VMT}_{x,\text{total}} = \sum \text{VMT}_{ST,y} \times \text{VMT}_{x,y} / \text{VMT}_{ST,y} \]

where:

\[ \text{VMT}_{x,\text{total}} = \text{VMT (million miles) in county x on all paved roadways} \]
\[ \text{VMT}_{ST,y} = \text{paved road VMT for the entire State for roadway class y} \]
\[ VMT_{x,y} = \text{total VMT (million miles) in county } x \text{ and roadway class } y \]
\[ VMT_{ST,y} = \text{total VMT (million miles) in entire State for roadway class } y \]

The county-level total VMT by roadway class used in this calculation was previously developed by E.H. Pechan and Associates, Inc. to support the onroad national emissions inventory [ref 7]. To convert tons of asphalt reported in the 2008 Asphalt Usage Survey to barrels, it was assumed that the density of asphalt is similar to that of water, 8.34 lbs/gal, and that one barrel equals 42 gallons.

**Emission Factors**

Emission factors for cutback and emulsified asphalt usage, provided in Table 3-120, were obtained from the EIIP Technical Report Series produced by the U.S. EPA’s Emission Inventory Improvement Program and are reported in [ref 4].

<table>
<thead>
<tr>
<th>Source Category</th>
<th>Pollutant</th>
<th>Emission Factor (lb/bbl)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Emulsified Asphalt</td>
<td>VOC</td>
<td>9.2</td>
</tr>
<tr>
<td>Cutback Asphalt</td>
<td>VOC</td>
<td>88.00</td>
</tr>
<tr>
<td></td>
<td>Ethylbenzene</td>
<td>2.02</td>
</tr>
<tr>
<td></td>
<td>Toluene</td>
<td>5.63</td>
</tr>
<tr>
<td></td>
<td>Xylenes (mix of o, m, p isomers)</td>
<td>10.74</td>
</tr>
</tbody>
</table>

**3.26.4.3 Agricultural Pesticide Application**

While Agricultural Pesticide Application (SCC=246185000, “Solvent Utilization; Miscellaneous Non-industrial: Commercial; Pesticide Application: Agricultural; All Processes”) is part of Consumer and Commercial Solvents sector, the nature of its methodology is significantly different from most of the other sources in this sector. Pesticides are substances used to control nuisance species and can be classified by targeted pest group: weeds (herbicides), insects (insecticides), fungi (fungicides), and rodents (rodenticides). They can be further described by their chemical characteristics: synthetics, non-synthetics (petroleum products), and inorganics. Different pesticides are made through various combinations of the pest-killing material, also called the active ingredient (AI), and various solvents (which serve as carriers for the AI). Both types of ingredients contain volatile organic compounds (VOC) that may be emitted to the air during application or after application as a result of evaporation.

Approximately 68 to 75 percent of pesticides used in the United States are applied to agricultural lands, both cropland and pasture. Agricultural pesticides continue to be a cost-effective means of controlling weeds, insects, and other threats to the quality and yield of food production. Since application rates for a particular pesticide may vary from crop to crop and from region to region, the crop-specific, regional application rates should be considered when estimating potential VOC emissions.

**Emissions Factors**

The default emissions factor for pesticide application (0.751) is expressed as the pounds of VOC that evaporate per pound of pesticide active ingredient (AI) applied and was calculated using the following equation:

\[ EF = ER \times VOC \]
where:

\[
\begin{align*}
\text{EF} & = \text{emissions factor (lb VOC / lb AI)} \\
\text{ER} & = \text{evaporation rate of applied pesticide (expressed as a fraction)} \\
\text{VOC} & = \text{weighted pesticide VOC content (lb VOC / lb AI)}
\end{align*}
\]

The evaporation rate was assumed to be 0.9 (or 90 percent) and is based on EPA recommendations provided in the Emissions Inventory Improvement Program guidance [ref 8]. As discussed below in the section on activity data, The Crop Life Foundation (CLF) has compiled a state-level dataset of fungicide, herbicide, and insecticide use based on survey data from 1999 to 2004 [ref 9]. A default VOC content was calculated as the weighted average VOC content for all pesticides reported in the Crop Life Foundation database for which there were pesticide matches to the California Department of Pesticide Regulation's (DPR) Pesticide Product Emission Potential database [ref 10]. Each record in the DPR database is for a specific pesticide product, and provides product name, primary active ingredient, emission potential (EP), registration number, and method used to estimate the EP. The pesticide specific VOC EP of reactive organic gases (i.e., the weight percentage of product that contributes to VOC emissions) and the weight percent of active ingredient from the DPR database were used to calculate the weighted average VOC content.

\[
\text{VOC} = \sum_{\text{pesticides}} \left[ \left( \frac{\text{AI}}{\%\text{AI}/100} \right) \times \left( \frac{\text{EP}/100}{\text{AI}} \right) \times \left( \frac{\text{AI}}{\%\text{AI}/100} \right) \right] / \text{T}
\]

where:

\[
\begin{align*}
\text{VOC} & = \text{weighted pesticide VOC content (lb VOC / lb AI)} \\
\text{AI} & = \text{active ingredient applied (lb)} \\
\%\text{AI} & = \text{weight percent of AI in pesticide mixture} \\
\text{EP} & = \text{emissions potential of reactive organic gases (expressed as \% of pesticide weight)} \\
\text{T} & = \text{total weight of all pesticides applied (lb)}
\end{align*}
\]

The active ingredient applied (AI) was calculated from the active ingredient application rates reported in the CLF database and the harvested acres reported in the 2007 Census of Agriculture [ref11]. The national pesticide usage (T), reported as pounds of pesticides applied, was calculated using the following equation:

\[
\text{T} = \sum_{\text{pesticides}} \frac{\text{AI}}{\%\text{AI}/100}
\]

Activity

The activity for pesticide application is the pounds of active ingredient applied and is calculated using the following equation:

\[
\text{A} = \text{HA} \times \text{R} \times \text{I} \times \text{AT}
\]

where:

\[
\begin{align*}
\text{A} & = \text{pounds of active ingredient applied by pesticide by county} \\
\text{HA} & = \text{crop-specific harvested acres in county} \\
\text{R} & = \text{crop-specific pounds of pesticide applied per year per harvested acre} \\
\text{I} & = \text{pounds of active ingredient per pound of pesticide} \\
\text{AT} & = \text{percent of crop acres in the state treated with the active ingredient}
\end{align*}
\]
The application rate, $R \times I$, is simply the pounds of active ingredient per harvested acre per year. This rate data, as well as the percent of crop acres in a state treated with the active ingredient, are available in the CLF database [ref 9]. The county-level harvested acres per crop in 2007 are available in the Department of Agriculture’s 2007 Census of Agriculture [ref 11]. In cases where there was not a direct match between the crop type provided in the CLF and the Census of Agriculture databases, the crop type from the CLF database was matched to a general crop category from the Census of Agriculture using the crosswalk provided in Table 3-121. This crosswalk enabled the assignment of pesticides to certain crops or crop types and allowed estimation of the quantity of pesticide applied by crop at the county level by linking the rate and AT data from the CLF database with the harvested acreage data from the Census of Agriculture.

**Activity Allocation Procedure**

To prevent disclosing proprietary data, some crop-specific harvested acre information in the Census of Agriculture is withheld. Estimates for these withheld data were developed in a three-step process, starting with estimating values for data withheld at the national-level, then at the state-level and finally at the county-level. Where data are withheld at the national-level for a given crop, the average harvested acres per farm from all disclosed farms at the national-level was multiplied by the total national-level number of undisclosed farms harvesting that crop and added to the national disclosed number of acres to estimate the national total. If a value is withheld at the state-level, the difference between the national total and the sum of disclosed state totals was evenly distributed among withheld states. Similarly, if a value is withheld at the county level, the difference between the state total and the sum of disclosed county totals was evenly distributed among withheld counties.

For example, as shown in Table 2, the data on total harvested acres of bentgrass seed are withheld at the national level. Taking the disclosed harvested acres of bentgrass seed at the national-level (6,374) and dividing by the total number of disclosed harvested farms at the national-level (58) yields an average of ~110 harvested acres per farm. This value was then applied to the total number of undisclosed farms harvesting bentgrass seed at the national level (6) and the result added to the national-level disclosed acres (6,374) to estimate the total number of acres of bentgrass at the national level (7,033). Subtracting the total number of bentgrass acres associated with disclosed state totals (6,809) from the estimated national total (7,033) yields 224 acres which were then distributed evenly across the undisclosed states.

<table>
<thead>
<tr>
<th>Estimated Harvested Acres (Total)</th>
<th>Harvested Acres (Disclosed)</th>
<th>Farms (Total)</th>
<th>Farms (Disclosed)</th>
<th>Farms (Undisclosed)</th>
<th>Average Harvested Acres per Disclosed Farm</th>
</tr>
</thead>
<tbody>
<tr>
<td>7,033</td>
<td>6,374</td>
<td>64</td>
<td>58</td>
<td>6</td>
<td>110</td>
</tr>
</tbody>
</table>

Bentgrass seed is only grown in two states (Oregon and Illinois). The allocation procedure for Oregon is discussed and presented in Table 3-122. The state-level data from the Census of Agriculture indicate that there are 6,809 harvested acres in Oregon associated with 63 total harvested farms. At the county-level there are 6,374 harvested acres associated with 58 disclosed farms. To fill in values for the undisclosed farms, the sum of the disclosed county values (6,374) was subtracted from the total state value (6,809) yielding a difference of 435 harvested acres. Dividing these remaining 435 acres by the 5 undisclosed farms gives an average value of 87 harvested acres per farm.
Table 3-122: Estimation of county-level harvested acres of bentgrass seed

<table>
<thead>
<tr>
<th>State-level Harvested Acres (Total)</th>
<th>County-level Harvested Acres (Disclosed)</th>
<th>State-level Farms (Total)</th>
<th>County-level Farms (Disclosed)</th>
<th>Farms (Undisclosed)</th>
<th>Difference</th>
</tr>
</thead>
<tbody>
<tr>
<td>6,809</td>
<td>6,374</td>
<td>63</td>
<td>58</td>
<td>5</td>
<td>435</td>
</tr>
</tbody>
</table>

Note: The difference is then allocated evenly to the undisclosed farms, in this case 87 acres per farm.

Controls

No controls were accounted for in the emissions estimation.

Emissions Equation and Sample Calculation

Emissions were estimated by summing the product of the activity data and the emissions factor for each pesticide and crop type at the county-level:

\[
\text{Total VOC Emissions}_{\text{county}} = \sum (A_{\text{pesticide,crop}} \times EF)
\]

Taking Autauga County, Alabama as an example, the first step was to determine the amount of active ingredient per pesticide being applied in the county by multiplying each crop type by pesticide specific application rates and the percent of acres treated. For Trifluralin application to green lima beans in Autauga County, there were 5 acres harvested and 50 percent of those acres had pesticide applied. Taking the number of acres to which Trifluralin was applied (2.5) and multiplying by the Trifluralin application rate of 0.5 lbs of AI applied per acre yields 1.25 lbs of AI due to Trifluralin application to green lima beans in Autauga County.

\[
5 \text{ acres harvested} \times 50\% \text{ (acres treated)} \times 0.5 \text{ (lbs of AI per acre)} = 1.25 \text{ lbs of AI}
\]

This process was then repeated for every crop and pesticide combination present in the county (~600 for Autauga County) and the values were summed to determine the amount of AI applied across the county. For Autauga County this aggregate value was determined to be 60,125 lbs of AI. This value was then multiplied by the emissions factor of 0.751 lb VOC per lb AI to estimate VOC emissions.

\[
60,125 \text{ (lbs of AI applied in Autauga County)} \times 0.751 \text{ (lb VOC per lb AI)} = 45,179 \text{ lb of VOC}
\]

This is equivalent to approximately 23 tons of VOC emitted due to agricultural pesticide application in Autauga County.

3.26.5 Summary of data quality assurance methods

The EPA compared EPA generated emissions from this category to previous inventories and found an error that was noted and corrected in 2011 v2. Emissions for toluene for consumer/commercial solvent emissions were mistakenly calculated too high in the EPA dataset. This error was caused by a bad emission factor that other states used. VA noted some errors and EPA assisted VA in resubmitting and the toluene error was corrected at that time. This problem could still be an issue for other states in the cases where they used the bad emission factor for toluene.

The EPA also compared state submitted data to EPA data and found some overlap and instances where possible double counting could occur. To eliminate the double counting in Clarke County, NV, EPA tagged emissions in the EPA dataset for a number of SCCs: 2460100000, 2460200000, 2460400000, 2460500000, 2460600000, and...
Ethylene Glycol (pollutant code = 107211) emissions were erroneously applied to all consumer & commercial solvents (this pollutant should only be applied to automotive aftermarket), and these EPA emissions were tagged and removed for 2011 v2.

### References for Solvent – Consumer & Commercial Solvent Use


### 3.27 Solvent – Non-Industrial Surface Coating

#### 3.27.1 Sector description

Architectural coating (AC) operations consist of applying a thin layer of coating such as paint, paint primer, varnish, or lacquer to architectural surfaces, and the use of solvents as thinners and for cleanup. Architectural surface coatings protect the substrates to which they are applied from corrosion, abrasion, decay, ultraviolet light damage, and/or the penetration of water. Some architectural coatings also increase the aesthetic value of a structure by changing the color or texture of its surface. Architectural coatings are also important in construction of structures. Examples of the latter are concrete form release compounds, which prevent concrete from sticking to forms, and concrete curing compounds, which allow concrete to cure properly. It should be
noted that this category does not include auto refinishing, traffic marking, surface coating during manufacturing, industrial maintenance coatings, special purpose coatings, or paints used in graphic arts applications.

Volatile organic compounds (VOCs) that are used as solvents in the coatings are emitted during application of the coating and as the coating dries. The amount of coating used and the VOC content of the coating are the factors that primarily determine emissions from architectural surface coating operations. Secondary sources of VOC emissions are from the solvents used to clean the architectural coating application equipment and VOC released as reaction byproducts while the coating dries and hardens. VOC emitted from this chemical reaction is determined by the resins used in a particular coating. The VOC emitted from any of these sources could include HAPs. The 2011 NEI does not include any byproduct emissions.

Table 3-123 lists the SCCs that are included in the 2011 NEI v2. EPA estimates use the highlighted SCC below.

<table>
<thead>
<tr>
<th>SCC</th>
<th>SCC Level One</th>
<th>SCC Level Two</th>
<th>SCC Level Three</th>
<th>SCC Level Four</th>
</tr>
</thead>
<tbody>
<tr>
<td>2401001000</td>
<td>Solvent Utilization</td>
<td>Surface Coating</td>
<td>Architectural Coatings</td>
<td>Total: All Solvent Types</td>
</tr>
<tr>
<td>2401002000</td>
<td>Solvent Utilization</td>
<td>Surface Coating</td>
<td>Architectural Coatings - Solvent-based</td>
<td>Total: All Solvent Types</td>
</tr>
<tr>
<td>2401003000</td>
<td>Solvent Utilization</td>
<td>Surface Coating</td>
<td>Architectural Coatings - Water-based</td>
<td>Total: All Solvent Types</td>
</tr>
</tbody>
</table>

3.27.2 Sources of data overview and selection hierarchy

Table 3-124 shows the selection hierarchy for all datasets contributing to the architectural coatings sector. Table 3-125 shows the agencies that submitted data used by the 2011 NEI. In some cases, the EPA PM and HAP augmentation were used to fill in PM species and HAP pollutants based on S/L/T agency data. There was no point data submitted to this category.

<table>
<thead>
<tr>
<th>Priority</th>
<th>Dataset Name</th>
<th>Dataset Content</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>2011EPA_PM-Augmentation</td>
<td>Augments PM data in 47 states and some tribes</td>
</tr>
<tr>
<td>2</td>
<td>Responsible Agency Data Set</td>
<td>State and Local Agency submitted emissions</td>
</tr>
<tr>
<td>3</td>
<td>2011EPA_HAP-Augmentation</td>
<td>Adds Pb and other HAP emissions in 46 states</td>
</tr>
<tr>
<td>4</td>
<td>2011EPA_NP_NoOverlap_w_Pt</td>
<td>EPA-generated data</td>
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</table>

Table 3-125: Agencies that submitted data for the Architectural Coatings sector

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<tr>
<td>2011EPA_HAP-Augmentation</td>
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<td>2011EPA_HAP-Augmentation</td>
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<td>Northern Cheyenne Tribe</td>
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3.27.3 Spatial coverage and data sources for the sector

Solvent - Non-Industrial Surface Coating

Solvent - Non-Industrial Surface Coating

3.27.4 EPA-developed emissions

EPA uses the SCC code 2401001000 for its emissions estimation development. EPA calculated emissions in accordance with the alternative method in EIIP Volume 3, Chapter 3 [ref 1]. Emissions are calculated for each county using emission factors and activity as:

\[ E_{x,p} = A_x \times EF_{x,p} \]

where:

- \( E_{x,p} \) = annual emissions for category \( x \) and pollutant \( p \)
- \( A_x \) = population data associated with category \( x \)
- \( EF_{x,p} \) = emission factor for category \( x \) and pollutant \( p \)

Example:

According to the U.S. Census Bureau, Ada County had a total population of 392,365 people. The emission factor for VOC is 2.3 lb/person:

\[ E_{\text{VOC}} = 392,365 \times 2.3 \text{ lb VOC/ person} \]
\[ = 461.03 \text{ tons VOC} \]

Activity Data

Since this category is so pervasive, this category uses population and emissions factors to calculate emissions. US population data were collected from the 2010 Census Bureau Interactive Population Search [ref 2] on each county.

Emission Factors

The emission factors for 2011, shown in Table 3-126, were derived by adjusting the 2008 emission factor by the change in the amount of solvent sold from 2007 to 2010 according to the US Census (see the “AC” tab in the spreadsheet “2011_NEI_EFs_Revision_v2_JCS_062612.xlsx” which can be found on CHIEF at
ftp://ftp.epa.gov/EmisInventory/2011nei/doc/). The 2008 emission factor was derived by using the amount of solvents sold for architectural coating in the US in 2007 (Freedonia). That amount was scaled upwards by 19% to account for solvents used in cleanup, thinning, and additives (CARB, 2005). ERTAC used a value of 2.41 lb VOC/person to calculate the solvents used (aka emissions) in the 16 states (see Table 3-127) that have rules that limit the VOC in coatings. That number was subtracted from the total used in the US, and then the remainder population of the 34 states that do not have VOC limits on architectural coatings (AC) was used to derive an emission factor for the states with no rules.

| Table 3-126: Emission Factors for Architectural Coatings used in the 2011 NEI |
|-------------------------------|-------------------|-------------------|
|                               | 2008 NEI          | 2011 NEI          |
| States with architectural coatings rules | 2.41 lb VOC/person | 1.88 lb VOC/person |
| States without architectural coatings rules | 3.09 lb VOC/person | 2.35 lb VOC/person |

| Table 3-127: States with Architectural Coatings rules |
|---------------------------------|-----------------|
| Region  | States            |
| 1       | CT, MA, ME, NH, RI, VT |
| 2       | NJ, NY             |
| 3       | DC, DE, MD, PA, VA  |
| 6       | TX                |
| 9       | AZ, CA            |

3.27.5 Summary of quality assurance methods

For a number of states, plus Clark County, NV, it was necessary to tag EPA data to avoid a double count for AC. This is a case of the states using different SCCs. The SCCs that were used by these states are 2401002000 (solvent based) and 2401003000 (water based). EPA uses the more general SCC of 2401001000. The agencies that submitted using these more detailed SCCs are CA, DE, HI, MD, NH, and Clark County, NV.

3.27.6 References for Solvent – Non-Industrial Surface Coating


3.28 Solvent – Degreasing

3.28.1 Sector description

Solvent cleaning (degreasing) operations are an integral part of many industries and involve the use of solvents or solvent vapor to remove water-insoluble contaminants such as grease, oils, waxes, carbon deposits, fluxes, and tars from metal, plastic, glass, and other surfaces. Solvent cleaning is usually performed prior to painting, plating, inspection, repair, assembly, heat treating, and machining. For this sector, the EPA developed estimates for the nonpoint general SCC, 2415000000, highlighted in Table 3-128. The nonpoint SCC descriptions begin with “Solvent Utilization; Degreasing;” and the point SCC descriptions begin with “Petroleum and Solvent Evaporation; Organic Solvent Evaporation”.

222
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<th>SCC level 3 &amp; 4 Description</th>
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<td>All Solvents/All Industries; All Processes</td>
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<td>Furniture and Fixtures; All Processes</td>
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<td>Primary Metal Industries; All Processes</td>
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<td>Fabricated Metal Products; All Processes</td>
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<td>Degreasing; Perchloroethylene: Open-top Vapor Degreasing</td>
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<td>Degreasing; Methylene Chloride: Open-top Vapor Degreasing</td>
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<td>Degreasing; Trichloroethylene: Open-top Vapor Degreasing</td>
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<td>Degreasing; Toluene: Open-top Vapor Degreasing</td>
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<td>Degreasing; Trichlorotrifluoroethane (Freon): Open-top Vapor Degreasing</td>
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<td>Degreasing; Methylene Chloride: General Degreasing Units</td>
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<td>Degreasing; Trichloroethylene: General Degreasing Units</td>
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### Sources of data overview and selection hierarchy

The degreasing sector includes emissions from both S/L/T agencies and from the EPA overlap nonpoint dataset. The hierarchy of datasets used in the 2011 NEI for this sector is provided in Table 3-129. In some cases, the EPA PM and HAP augmentation as well as chromium split datasets were used to fill in PM species and HAP pollutants based on S/L/T agency data. The S/L/T agencies that submitted data to the EPA are listed in Table 3-116.

#### Table 3-129: Data selection hierarchy for the Solvent –Degreasing sector

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<td>2011EPA_PM-Augmentation</td>
<td>Augments PM data in 47 states and some tribes</td>
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<td>2</td>
<td>Responsible Agency Data Set</td>
<td>State and Local Agency submitted emissions</td>
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<td>Adds Pb and other HAP emissions in 46 states</td>
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#### Table 3-130: Agencies that submitted data for Solvent –Degreasing sector

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<td>X</td>
<td></td>
</tr>
<tr>
<td>Ohio Environmental Protection Agency</td>
<td>X</td>
<td>X</td>
</tr>
<tr>
<td>Oklahoma Department of Environmental Quality</td>
<td></td>
<td>X</td>
</tr>
<tr>
<td>Olympic Region Clean Air Agency</td>
<td></td>
<td>X</td>
</tr>
<tr>
<td>Omaha Air Quality Control Division</td>
<td></td>
<td>X</td>
</tr>
<tr>
<td>Oregon Department of Environmental Quality</td>
<td>X</td>
<td>X</td>
</tr>
<tr>
<td>Pennsylvania Department of Environmental Protection</td>
<td>X</td>
<td>X</td>
</tr>
<tr>
<td>Philadelphia Air Management Services</td>
<td></td>
<td>X</td>
</tr>
<tr>
<td>Puerto Rico</td>
<td>X</td>
<td></td>
</tr>
<tr>
<td>Puget Sound Clean Air Agency</td>
<td></td>
<td>X</td>
</tr>
<tr>
<td>Rhode Island Department of Environmental Management</td>
<td></td>
<td>X</td>
</tr>
<tr>
<td>Shoshone-Bannock Tribes of the Fort Hall Reservation of Idaho</td>
<td></td>
<td>X</td>
</tr>
<tr>
<td>Data Set Name</td>
<td>Point</td>
<td>Nonpoint</td>
</tr>
<tr>
<td>------------------------------------------------------------------------------</td>
<td>-------</td>
<td>----------</td>
</tr>
<tr>
<td>South Carolina Department of Health and Environmental Control</td>
<td>X</td>
<td></td>
</tr>
<tr>
<td>Southwest Clean Air Agency</td>
<td>X</td>
<td></td>
</tr>
<tr>
<td>Tennessee Department of Environmental Conservation</td>
<td>X</td>
<td>X</td>
</tr>
<tr>
<td>Texas Commission on Environmental Quality</td>
<td>X</td>
<td>X</td>
</tr>
<tr>
<td>Utah Division of Air Quality</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Vermont Department of Environmental Conservation</td>
<td></td>
<td>X</td>
</tr>
<tr>
<td>Virginia Department of Environmental Quality</td>
<td>X</td>
<td>X</td>
</tr>
<tr>
<td>Washington State Department of Ecology</td>
<td></td>
<td>X</td>
</tr>
<tr>
<td>Washoe County Health District</td>
<td></td>
<td>X</td>
</tr>
<tr>
<td>West Virginia Division of Air Quality</td>
<td></td>
<td>X</td>
</tr>
<tr>
<td>Western North Carolina Regional Air Quality Agency (Buncombe Co.)</td>
<td></td>
<td>X</td>
</tr>
<tr>
<td>Wisconsin Department of Natural Resources</td>
<td>X</td>
<td>X</td>
</tr>
<tr>
<td>Wyoming Department of Environmental Quality</td>
<td></td>
<td>X</td>
</tr>
</tbody>
</table>

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

#### Solvent - Degreasing

![Map of Solvent - Degreasing](image1)

**All CAPs**

**P** - Point

**N** - Nonpoint

**PN** - P&N

![Map of Solvent - Degreasing](image2)

**All HAPs**

**P** - Point

**N** - Nonpoint

**PN** - P&N

### 3.28.4 EPA-developed emissions

#### Activity Data

The activity data needed for this category is the number of employees from several categories of industry listed by the North American Industrial Classification Standard (NAICS) code(s) to determine county-level employment for the category. County data were gathered from NAICS categories: 331, 332, 333, 334, 335, 336, 337, 339, 441, 483, 484, 485, 488, 8111, and 8112. NAICS data was gathered from the 2010 Census County Business Patterns (CBP) [ref 1].

Due to concerns with releasing confidential business information, the Census CBP does not release exact numbers for a given NAICS code if there is enough data that individual businesses could be identified. Instead a series of range codes are used. Because employment data is a key factor in determining emissions, it is important to estimate the number of employees for each county.
To estimate the number of employees in counties where data was withheld, EPA used the following procedure for each NAICS code being computed:

1. County level data for each NAICS were obtained and any numerical values were summed.
2. The sum generated in step 1 was subtracted from the state total number of employees in that NAICS reported in the state-level CBP.
3. The county level CBP report includes the number of establishments in the county within a specific employee range. For each of the counties with withheld data, EPA multiplied the number of establishments in a particular employee range (1 – 4, 5 – 9, etc.) by the midpoint of the range code (5 - 9 employees would be assigned 7) and summed the results.
4. An adjustment factor (to ensure the total number of estimated employees matches the state reported total) is calculated by dividing the sum of all the county level generated in step 2 by the sum of the county calculations in step 3. If there are no numerical values at the county level the adjustment factor is calculated by dividing the state total number of employees by the sum of the calculations in step 3.
5. The estimated number of employees, in counties where data was withheld, is calculated by multiplying the sum from step 3 by the adjustment factor calculated in step 4.

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

\[ E_{x,p} = A_x \times EF_{x,p} \]

where:

- \( E_{x,p} \) = annual emissions for category x and pollutant p
- \( A_x \) = employment data associated with category x
- \( EF_{x,p} \) = emission factor for category x and pollutant p

Example:
According to the U.S. Census Bureau, Kootenai County had a total of 557 employees in NAICS 335 – Electrical Equipment/Appliance/Component industry.

The emission factor for VOC is 36.97 lb /employee.

\[ EVOC = 557 \text{ employees} \times 36.97 \text{ lb VOC/employee} \]
\[ = 10.296 \text{ tons VOC} \]

3.28.5 References for Solvent - Degreasing


3.29 Solvent – Dry Cleaning

3.29.1 Sector description

The dry cleaning industry is a service industry for the cleaning of garments, draperies, leather goods, and other fabric items. Dry cleaning operations do not use water that can swell textile fibers, but typically use either synthetic halogenated or petroleum distillate organic solvents for cleaning purposes. Use of solvents rather than water prevents wrinkles and shrinkage of fabrics. The dry cleaning industry is the most significant emission source of perchloroethylene (PERC) in the United States.
The two major types of dry cleaning operations are coin-operated (coin-op) and commercial. Industrial launderers are usually associated with soap and detergent cleaning, but also use large capacity dry cleaning units. Coin-operated dry cleaning units are self-service machines that are usually found in laundromats. Commercial dry cleaners are independent small businesses that offer dry cleaning services to the public. Some commercial dry cleaning businesses provide numerous drop-off/pick-up outlet stores that are serviced by a single dry cleaning plant, and thus some sites identified as dry cleaners may not be emissions sources. Industrial launderers who use dry cleaning solvents are usually part of a business operation that generates soiled fabrics, where it is convenient or cost-effective to perform dry cleaning on site. Industrial launderers can also be large businesses that provide uniform and other rental services to business, industrial, and institutional customers.

For this sector, the EPA developed estimates for the nonpoint general SCC, 2420000000, highlighted in Table 3-131. The nonpoint SCC descriptions begin with “Solvent Utilization;” and the point SCC descriptions begin with “Petroleum and Solvent Evaporation”.  

<table>
<thead>
<tr>
<th>Data Category</th>
<th>SCC</th>
<th>SCC Level 2, 3 &amp; 4 Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>Nonpoint</td>
<td>2420000000</td>
<td>Dry Cleaning; All Processes; Total: All Solvent Types</td>
</tr>
<tr>
<td>Nonpoint</td>
<td>2420000055</td>
<td>Dry Cleaning; All Processes; Perchloroethylene</td>
</tr>
<tr>
<td>Nonpoint</td>
<td>242000370</td>
<td>Dry Cleaning; All Processes; Special Naphthas</td>
</tr>
<tr>
<td>Nonpoint</td>
<td>2420100000</td>
<td>Dry Cleaning; Commercial/Industrial Cleaners; Total: All Solvent Types</td>
</tr>
<tr>
<td>Nonpoint</td>
<td>242010055</td>
<td>Dry Cleaning; Commercial/Industrial Cleaners; Perchloroethylene</td>
</tr>
<tr>
<td>Nonpoint</td>
<td>242010370</td>
<td>Dry Cleaning; Commercial/Industrial Cleaners; Special Naphthas</td>
</tr>
<tr>
<td>Nonpoint</td>
<td>2420200000</td>
<td>Dry Cleaning; Coin-operated Cleaners; Total: All Solvent Types</td>
</tr>
<tr>
<td>Point</td>
<td>40100101</td>
<td>Organic Solvent Evaporation; Dry Cleaning</td>
</tr>
<tr>
<td>Point</td>
<td>40100102</td>
<td>Organic Solvent Evaporation; Dry Cleaning; Stoddard (Petroleum Solvent)</td>
</tr>
<tr>
<td>Point</td>
<td>40100104</td>
<td>Organic Solvent Evaporation; Dry Cleaning; Stoddard (Petroleum Solvent)</td>
</tr>
<tr>
<td>Point</td>
<td>40100146</td>
<td>Organic Solvent Evaporation; Dry Cleaning; Stoddard:Filtr Disp/Cooked Muck(Drained)</td>
</tr>
<tr>
<td>Point</td>
<td>40100198</td>
<td>Organic Solvent Evaporation; Dry Cleaning; Other Not Classified</td>
</tr>
<tr>
<td>Point</td>
<td>40100199</td>
<td>Organic Solvent Evaporation; Dry Cleaning; See Comment **</td>
</tr>
<tr>
<td>Point</td>
<td>41000101</td>
<td>Dry Cleaning; Petroleum Solvent - Industrial; Stoddard</td>
</tr>
<tr>
<td>Point</td>
<td>41000130</td>
<td>Dry Cleaning; Petroleum Solvent - Industrial; Dryer</td>
</tr>
<tr>
<td>Point</td>
<td>41000143</td>
<td>Dry Cleaning; Petroleum Solvent - Industrial; Filtration, Diatomite: Regenerative</td>
</tr>
<tr>
<td>Point</td>
<td>41000202</td>
<td>Dry Cleaning; Petroleum Solvent - Commercial; Stoddard</td>
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<tr>
<td>Point</td>
<td>41000230</td>
<td>Dry Cleaning; Petroleum Solvent - Commercial; Dryer</td>
</tr>
<tr>
<td>Point</td>
<td>41000231</td>
<td>Dry Cleaning; Petroleum Solvent - Commercial; Dryer: Loading/Unloading</td>
</tr>
<tr>
<td>Point</td>
<td>41000244</td>
<td>Dry Cleaning; Petroleum Solvent - Commercial; Filtration, Cartridge, Carbon Core, Batch Operation</td>
</tr>
<tr>
<td>Point</td>
<td>41082001</td>
<td>Dry Cleaning; Petroleum Solvent - Wastewater, Aggregate; Process Area Drains</td>
</tr>
</tbody>
</table>

3.29.2 Sources of data overview and selection hierarchy

The dry cleaning sector includes emissions from both S/L/T agencies and from the EPA overlap nonpoint dataset. The hierarchy of datasets used in the 2011 NEI for this sector is provided in Table 3-132. In some cases, the EPA PM and HAP augmentation datasets were used to fill in PM species and HAP pollutants based on S/L/T agency data. The S/L/T agencies that submitted data to the EPA are listed in Table 3-116 Table 3-133. Several agencies submitted nonpoint emissions for this sector.
### Table 3-132: Data selection hierarchy for the Solvent – Dry Cleaning sector

<table>
<thead>
<tr>
<th>Priority</th>
<th>Dataset Name</th>
<th>Dataset Content</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>2011EPA_PM-Augmentation</td>
<td>Augments PM data in 47 states and some tribes</td>
</tr>
<tr>
<td>2</td>
<td>Responsible Agency Data Set</td>
<td>State and Local Agency submitted emissions</td>
</tr>
<tr>
<td>3</td>
<td>2011EPA_HAP-Augmentation</td>
<td>Adds Pb and other HAP emissions in 46 states</td>
</tr>
<tr>
<td>4</td>
<td>2011EPA_NP_Overlap_w_Pt</td>
<td>EPA-generated data</td>
</tr>
</tbody>
</table>

### Table 3-133: Agencies that submitted data for Solvent – Dry Cleaning sector

<table>
<thead>
<tr>
<th>Data Set Name</th>
<th>Point</th>
<th>Nonpoint</th>
</tr>
</thead>
<tbody>
<tr>
<td>Delaware Department of Natural Resources and Environmental Control</td>
<td></td>
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</tr>
<tr>
<td>Florida Department of Environmental Protection</td>
<td>X</td>
<td></td>
</tr>
<tr>
<td>Georgia Department of Natural Resources</td>
<td></td>
<td>X</td>
</tr>
<tr>
<td>Hawaii Department of Health Clean Air Branch</td>
<td></td>
<td>X</td>
</tr>
<tr>
<td>Idaho Department of Environmental Quality</td>
<td></td>
<td>X</td>
</tr>
<tr>
<td>Illinois Environmental Protection Agency</td>
<td>X</td>
<td>X</td>
</tr>
<tr>
<td>Indiana Department of Environmental Management</td>
<td>X</td>
<td></td>
</tr>
<tr>
<td>Iowa Department of Natural Resources</td>
<td></td>
<td>X</td>
</tr>
<tr>
<td>Kansas Department of Health and Environment</td>
<td></td>
<td>X</td>
</tr>
<tr>
<td>Kentucky Division for Air Quality</td>
<td></td>
<td>X</td>
</tr>
<tr>
<td>Kootenai Tribe of Idaho</td>
<td></td>
<td>X</td>
</tr>
<tr>
<td>Louisville Metro Air Pollution Control District</td>
<td>X</td>
<td></td>
</tr>
<tr>
<td>Maine Department of Environmental Protection</td>
<td></td>
<td>X</td>
</tr>
<tr>
<td>Maricopa County Air Quality Department</td>
<td></td>
<td>X</td>
</tr>
<tr>
<td>Maryland Department of the Environment</td>
<td></td>
<td>X</td>
</tr>
<tr>
<td>Massachusetts Department of Environmental Protection</td>
<td>X</td>
<td>X</td>
</tr>
<tr>
<td>Metro Public Health of Nashville/Davidson County</td>
<td>X</td>
<td>X</td>
</tr>
<tr>
<td>Michigan Department of Environmental Quality</td>
<td>X</td>
<td>X</td>
</tr>
<tr>
<td>Minnesota Pollution Control Agency</td>
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<td>X</td>
</tr>
<tr>
<td>New Hampshire Department of Environmental Services</td>
<td></td>
<td>X</td>
</tr>
<tr>
<td>New Jersey Department of Environment Protection</td>
<td></td>
<td>X</td>
</tr>
<tr>
<td>New York State Department of Environmental Conservation</td>
<td></td>
<td>X</td>
</tr>
<tr>
<td>Nez Perce Tribe</td>
<td></td>
<td>X</td>
</tr>
<tr>
<td>North Carolina Department of Environment and Natural Resources</td>
<td>X</td>
<td>X</td>
</tr>
<tr>
<td>Ohio Environmental Protection Agency</td>
<td>X</td>
<td>X</td>
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<tr>
<td>Oregon Department of Environmental Quality</td>
<td></td>
<td>X</td>
</tr>
<tr>
<td>Pennsylvania Department of Environmental Protection</td>
<td></td>
<td>X</td>
</tr>
<tr>
<td>Rhode Island Department of Environmental Management</td>
<td></td>
<td>X</td>
</tr>
<tr>
<td>Shoshone-Bannock Tribes of the Fort Hall Reservation of Idaho</td>
<td></td>
<td>X</td>
</tr>
<tr>
<td>South Carolina Department of Health and Environmental Control</td>
<td></td>
<td>X</td>
</tr>
<tr>
<td>Texas Commission on Environmental Quality</td>
<td>X</td>
<td>X</td>
</tr>
<tr>
<td>Vermont Department of Environmental Conservation</td>
<td></td>
<td>X</td>
</tr>
<tr>
<td>Virginia Department of Environmental Quality</td>
<td></td>
<td>X</td>
</tr>
</tbody>
</table>
Data Set Name | Point | Nonpoint
---|---|---
Washington State Department of Ecology | X | |
Washoe County Health District | X | |
West Virginia Division of Air Quality | X | |
Wisconsin Department of Natural Resources | | X

3.29.3 Spatial coverage and data sources for the sector

Solvent - Dry Cleaning

3.29.4 EPA-developed emissions

Activity Data

This category uses dry cleaning employees per county from NAICS 81232 and emissions factors to calculate emissions. National dry cleaning employee data were collected from the 2010 Census Bureau County Business Patterns [ref 1] for each county.

Due to concerns with releasing confidential business information, the Census CBP does not release exact numbers for a given NAICS code if there is enough data that individual businesses could be identified. Instead, a series of range codes are used. Because employment data is a key factor in determining emissions, it is important to estimate the number of employees for each county.

To estimate the number of employees in counties where data was withheld, EPA used the following procedure for each NAICS code being computed:

- County level data for each NAICS were obtained and any numerical values were summed.
- The sum generated in step 1 was subtracted from the state total number of employees in that NAICS reported in the state-level CBP.
- The county level CBP report includes the number of establishments in the county within a specific employee range. For each of the counties with withheld data, Idaho multiplied the number of establishments in a particular employee range (1 – 4, 5 – 9, etc.) by the midpoint of the range code (5 - 9 employees would be assigned 7) and summed the results.
- An adjustment factor (to ensure the total number of estimated employees matches the state reported total) is calculated by dividing the sum of all the county level generated in step 2 by the sum of the
county calculations in step 3. If there are no numerical values at the county level the adjustment factor is calculated by dividing the state total number of employees by the sum of the calculations in step 3.

- The estimated number of employees, in counties where data was withheld, is calculated by multiplying the sum from step 3 by the adjustment factor calculated in step 4.

Emission Factors

The VOC and tetrachloroethylene emissions factors are from EPA ERTAC 2011 calculations [ref 2]. A VOC factor is computed based on national population (lb/person).

Calculations

EPA calculated emissions in accordance with the alternative method in EIIP Volume 3, Chapter 4, alternative method two [ref 3]. Emissions are calculated for each county using emission factors and activity as:

\[ E_{x,p} = A_x \times EF_{x,p} \]

where:

- \( E_{x,p} \) = annual emissions for category \( x \) and pollutant \( p \)
- \( A_x \) = employee data associated with category \( x \)
- \( EF_{x,p} \) = emission factor for category \( x \) and pollutant \( p \)

Example:

According to the U.S. Census Bureau County Business Patterns, Ada County had a total of 239 dry cleaning employees. The emission factor for VOC is 10 lb/employee:

\[ E_{VOC} = 239 \text{ dry cleaning employees} \times 10 \text{ lb VOC/employee} \]

= 1.195 tons VOC in Ada County

3.29.5 References for Solvent – Dry Cleaning


3.30 Solvent – Graphic Arts

3.30.1 Sector description

Graphic arts operations are performed on printing presses that are made up of one or more "units." Each unit can print only one color. The substrate in graphic arts operations is either individual pieces of substrate called "sheets", or continuous and called a "web" [ref 1; ref 2]. The pattern that is printed on the substrate is called the "image". For this source category, the following SCCs were used in the 2011 NEI, with the highlighted SCC used for EPA’s estimates:
For this source category, the EPA developed estimates for the nonpoint general SCC, 2425000000, highlighted in Table 3-134. The nonpoint SCC descriptions begin with “Solvent Utilization;” and the point SCC descriptions begin with “Petroleum and Solvent Evaporation”.

**Table 3-134**: Graphic Arts SCCs used in the 2011 NEI

<table>
<thead>
<tr>
<th>SCC</th>
<th>SCC Level 2, 3 &amp; 4 Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>2425000000</td>
<td>Graphic Arts; All Processes; Total: All Solvent Types</td>
</tr>
<tr>
<td>2425010000</td>
<td>Graphic Arts; Lithography; Total: All Solvent Types</td>
</tr>
<tr>
<td>2425020000</td>
<td>Graphic Arts; Letterpress; Total: All Solvent Types</td>
</tr>
<tr>
<td>2425030000</td>
<td>Graphic Arts; Rotogravure; Total: All Solvent Types</td>
</tr>
<tr>
<td>2425040000</td>
<td>Graphic Arts; Flexography; Total: All Solvent Types</td>
</tr>
<tr>
<td>40500101</td>
<td>Printing/Publishing; Drying; Dryer</td>
</tr>
<tr>
<td>40500201</td>
<td>Printing/Publishing; Letter Press; Printing</td>
</tr>
<tr>
<td>40500203</td>
<td>Printing/Publishing; Letter Press; Ink Thinning Solvents, Mineral Solvents</td>
</tr>
<tr>
<td>40500215</td>
<td>Printing/Publishing; Letter Press; Cleaning Solution</td>
</tr>
<tr>
<td>40500301</td>
<td>Printing/Publishing; Flexographic; Printing</td>
</tr>
<tr>
<td>40500302</td>
<td>Printing/Publishing; Flexographic; Ink Thinning Solvent, Carbitol</td>
</tr>
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<td>40500303</td>
<td>Printing/Publishing; Flexographic; Ink Thinning Solvent, Cellosolve</td>
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<tr>
<td>40500304</td>
<td>Printing/Publishing; Flexographic; Ink Thinning Solvent, Ethyl Alcohol</td>
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<tr>
<td>40500305</td>
<td>Printing/Publishing; Flexographic; Ink Thinning Solvent, Isopropyl Alcohol</td>
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<tr>
<td>40500306</td>
<td>Printing/Publishing; Flexographic; Ink Thinning Solvent, n-Propyl Alcohol</td>
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<td>40500307</td>
<td>Printing/Publishing; Flexographic; Ink Thinning Solvent, Naphtha</td>
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<td>40500314</td>
<td>Printing/Publishing; Flexographic; Propyl Alcohol Cleanup</td>
</tr>
<tr>
<td>40500315</td>
<td>Printing/Publishing; Flexographic; Steam: Water-based</td>
</tr>
<tr>
<td>40500318</td>
<td>Printing/Publishing; Flexographic; Steam: Water-based in Ink</td>
</tr>
<tr>
<td>40500401</td>
<td>Printing/Publishing; Lithographic; Printing</td>
</tr>
<tr>
<td>40500413</td>
<td>Printing/Publishing; Lithographic; Isopropyl Alcohol Cleanup</td>
</tr>
<tr>
<td>40500415</td>
<td>Printing/Publishing; Offset Lithography; Dampening Solution with Alcohol Substitute</td>
</tr>
<tr>
<td>40500416</td>
<td>Printing/Publishing; Offset Lithography; Dampening Solution with High Solvent Content</td>
</tr>
<tr>
<td>40500417</td>
<td>Printing/Publishing; Offset Lithography; Cleaning Solution: Water-based</td>
</tr>
<tr>
<td>40500418</td>
<td>Printing/Publishing; Offset Lithography; Dampening Solution with Isopropyl Alcohol</td>
</tr>
<tr>
<td>40500421</td>
<td>Printing/Publishing; Offset Lithography; Heatset Ink Mixing</td>
</tr>
<tr>
<td>40500422</td>
<td>Printing/Publishing; Offset Lithography; Heatset Solvent Storage</td>
</tr>
<tr>
<td>40500431</td>
<td>Printing/Publishing; Offset Lithography; Nonheated Lithographic Inks</td>
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<tr>
<td>40500502</td>
<td>Printing/Publishing; Gravure; Ink Thinning Solvent, Dimethylformamide</td>
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<td>40500503</td>
<td>Printing/Publishing; Gravure; Ink Thinning Solvent, Ethyl Acetate</td>
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<td>40500506</td>
<td>Printing/Publishing; Gravure; Ink Thinning Solvent, Methyl Ethyl Ketone</td>
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<td>40500510</td>
<td>Printing/Publishing; Gravure; Ink Thinning Solvent, Toluene</td>
</tr>
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<td>Printing/Publishing; Gravure; Printing</td>
</tr>
<tr>
<td>40500514</td>
<td>Printing/Publishing; Gravure; Cleanup Solvent</td>
</tr>
<tr>
<td>40500597</td>
<td>Printing/Publishing; General; Other Not Classified</td>
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<td>40500599</td>
<td>Printing/Publishing; Printing; Ink Thinning Solvent</td>
</tr>
<tr>
<td>40500601</td>
<td>Printing/Publishing; Printing; Ink Mixing</td>
</tr>
</tbody>
</table>
3.30.2 Sources of data overview and selection hierarchy

The graphic arts sector includes emissions from both S/L/T agencies and from the EPA overlap nonpoint dataset. The hierarchy of datasets used in the 2011 NEI for this sector is provided in Table 3-135. In some cases, the EPA PM and HAP augmentation as well as TRI and chromium split datasets were used to fill in PM species and HAP pollutants based on S/L/T agency data. The S/L/T agencies that submitted data to the EPA are listed in Table 3-116.

Several agencies submitted nonpoint emissions for this sector.

Table 3-135: Data selection hierarchy for the Solvent –Graphic Arts sector

<table>
<thead>
<tr>
<th>Priority</th>
<th>Dataset Name</th>
<th>Dataset Content</th>
</tr>
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<tbody>
<tr>
<td>1</td>
<td>2011EPA_PM-Augmentation</td>
<td>Augments PM data in 47 states and some tribes</td>
</tr>
<tr>
<td>2</td>
<td>Responsible Agency Data Set</td>
<td>State and Local Agency submitted emissions</td>
</tr>
<tr>
<td>3</td>
<td>2011EPA_chrom_split</td>
<td>Splits total chromium into speciated chromium in 37 states</td>
</tr>
<tr>
<td>4</td>
<td>2011EPA_TRI</td>
<td>Toxics Release Inventory data for the year 2011. These data are selected for a facility only when alternative emissions are not included in the S/L/T agency data.</td>
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<tr>
<td>5</td>
<td>2011EPA_HAP-Augmentation</td>
<td>Adds Pb and other HAP emissions in 46 states</td>
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<tr>
<td>6</td>
<td>2011EPA_NP_Overlap_w_Pt</td>
<td>EPA-generated data</td>
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Table 3-136: Agencies that submitted data for Solvent –Graphic Arts sector

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<tr>
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<tr>
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<tr>
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### Data Set Name

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<td>Texas Commission on Environmental Quality</td>
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<td>Utah Division of Air Quality</td>
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</tr>
<tr>
<td>Washington State Department of Ecology</td>
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</tr>
<tr>
<td>Western North Carolina Regional Air Quality Agency (Buncombe Co.)</td>
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<tr>
<td>Wisconsin Department of Natural Resources</td>
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</tr>
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</table>

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

**Solvent - Graphic Arts**

**Solvent - Graphic Arts**

**3.30.4 EPA-developed emissions**

EPA calculated emissions using EPA’s EIIP Volume 3, Chapter 7 Alternate Method 1 [ref 3]. Emissions are calculated for each county using emission factors and activity as:

\[ E_{x,p} = A_x \times EF_{x,p} \]

where:

- \( E_{x,p} \) = annual emissions for category \( x \) and pollutant \( p \)
- \( A_x \) = employment data associated with category \( x \)
- \( EF_{x,p} \) = emission factor for category \( x \) and pollutant \( p \)

**Activity Data**

Graphic arts employment data is listed by the North American Industrial Classification Standard (NAICS) code(s) that were used to determine county-level employment for the category. County data were gathered from NAICS categories: 32311, and 3222. NAICS data was gathered from the 2010 Census County Business Patterns (CBP) [ref 4].
Due to concerns with releasing confidential business information, the Census CBP does not release exact numbers for a given NAICS code if there is enough data that individual businesses could be identified. Instead, a series of range codes are used. Because employment data is a key factor in determining emissions, it is important to estimate the number of employees for each county.

To estimate the number of employees in counties where data was withheld, EPA used the following procedure for each NAICS code being computed:

1. County level data for each NAICS were obtained and any numerical values were summed.
2. The sum generated in step 1 was subtracted from the state total number of employees in that NAICS reported in the state-level CBP.
3. The county level CBP report includes the number of establishments in the county within a specific employee range. For each of the counties with withheld data, EPA multiplied the number of establishments in a particular employee range (1 – 4, 5 – 9, etc.) by the midpoint of the range code (5 - 9 employees would be assigned 7) and summed the results.
4. An adjustment factor (to ensure the total number of estimated employees matches the state reported total) is calculated by dividing the sum of all the county level generated in step 2 by the sum of the county calculations in step 3. If there are no numerical values at the county level the adjustment factor is calculated by dividing the state total number of employees by the sum of the calculations in step 3.
5. The estimated number of employees, in counties where data was withheld, is calculated by multiplying the sum from step 3 by the adjustment factor calculated in step 4.

**Emission Factors**

The VOC emission factor is from EPA’s ERTAC Penna Graphic Arts study for 2011 [ref 5]. Additional emission factors were developed by ERTAC in 2011 [ref 6].

**Sample Calculation**

According to the U.S. Census Bureau, Kootenai County had a total of 80 employees in the graphic arts industry. The emission factor for VOC is 200.82 lb/employee

\[
E_{\text{VOC}} = 80 \times 200.82 \text{ lb VOC/employee} \\
= 8.033 \text{ tons VOC}
\]

3.30.5 References for Solvent – Graphic Arts

5. ERTAC 2011 Final Penna Graphic Arts EI Study, Final Penna Graphic Arts EF Study.xlsx, from an email from Roy Huntley on 2/29/12.
3.31 Solvent – Industrial Surface Coating

3.31.1 Sector description

Surface coating operations involve applying a thin layer of coating (e.g., paint, lacquer, enamel, varnish, etc.) to an object for decorative or protective purposes. The surface coating products include either a water-based or solvent-based liquid carrier that generally evaporates in the drying or curing process.

Emissions result from the evaporation of the paint solvent and any additional solvent used to thin the coating. Emissions also result from the use of solvents in cleaning the surface prior to coating and in cleaning coating equipment after use.

Ideally, all industrial surface coating facilities would be inventoried as point sources. Preferred and alternative methods for estimating point source emissions from industrial surface coating operations are given in EIIP Volume II, Chapter 7 [ref 1]. That chapter also includes more detailed discussion of surface coatings technology and controls, as well as process descriptions for industries having significant point source emissions. As a practical matter, it is not usually possible to account for all industrial surface coating facilities as point sources. Although the majority of industrial surface coating emissions may be inventoried as point sources, remaining emissions of volatile organic compounds (VOCs) and hazardous air pollutants (HAPs) from industrial surface coating operations must be accounted for as nonpoint sources. Since the use of surface coatings by manufacturing industries is so widespread, it is extremely difficult to identify all of the industries in which coating materials are consumed.

The SCCs in this sector are listed in Table 3-137; SCC descriptions do not include level 4 descriptions for many point SCCs. The “x” in several point source SCCs indicates that all SCCs are included; this was done to avoid listing 300+ point source SCCs in this sector.

Table 3-137: Industrial Solvent Use SCCs in the 2011 NEI

<table>
<thead>
<tr>
<th>SCC</th>
<th>SCC Description</th>
</tr>
</thead>
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<td>2401075000</td>
<td>Solvent Utilization; Surface Coating; All Solvent Types; Aircraft</td>
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<tr>
<td>2401060000</td>
<td>Solvent Utilization; Surface Coating; All Solvent Types; Appliances</td>
</tr>
<tr>
<td>2401065000</td>
<td>Solvent Utilization; Surface Coating; All Solvent Types; Electronic and Other Electrical</td>
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<tr>
<td>2401015000</td>
<td>Solvent Utilization; Surface Coating; All Solvent Types; Factory Finished Wood</td>
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<td>2401100000</td>
<td>Solvent Utilization; Surface Coating; All Solvent Types; Industrial Maintenance Coatings</td>
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<td>Solvent Utilization; Surface Coating; All Solvent Types; Metal Furniture</td>
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3.31.2 Sources of data overview and selection hierarchy

The industrial surface coating sector includes emissions from both S/L/T agencies and from the EPA overlap nonpoint dataset. This sector is present in the point and nonpoint data category. The hierarchy of datasets used in the 2011 NEI for this sector is provided in Table 3-138. In some cases, the EPA PM and HAP augmentation datasets were used to fill in PM species and HAP pollutants based on S/L/T agency data. All S/L/T agencies that submitted data to the EPA are listed in Table 3-139 Table 3-116. Several agencies submitted nonpoint emissions for this sector; these nonpoint sources are broken out by different types of categories in this table. EPA datasets are individually listed.

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<th>Priority</th>
<th>Dataset Name</th>
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<td>1</td>
<td>2011EPA_PM-Augmentation</td>
<td>Augments PM data in 47 states and some tribes</td>
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Table 3-139: EPA and S/L/T agency-submitted point and nonpoint data for Industrial Surface Coating sector

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3.31.3 Spatial coverage and data sources for the sector

EPA-developed emissions

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

\[ E_{x,p} = A_x \times EF_{x,p} \]

where:

- \( E_{x,p} \) = annual emissions for category \( x \) and pollutant \( p \)
- \( A_x \) = employment or population data associated with category \( x \)
- \( EF_{x,p} \) = emission factor for category \( x \) and pollutant \( p \)

**Activity Data**

There are two types of activity data that are used in this category. The first is employment data listed by the North American Industrial Classification Standard (NAICS) codes used to determine county-level employment for the various categories. NAICS data was gathered from the 2010 Census County Business Patterns (CBP) for the US [ref 2].

Due to concerns with releasing confidential business information, the Census CBP does not release exact numbers for a given NAICS code if individual businesses could be identified. Instead a series of range codes are used. Because employment data is a key factor in determining emissions it is important to estimate the number of employees for each county.

To estimate the number of employees in counties where data was withheld, EPA used the following procedure for each NAICS code being computed:

1. County level data for each NAICS were obtained and any numerical values were summed.
2. The sum generated in step 1 was subtracted from the state total number of employees in that NAICS reported in the state-level CBP.
3. The county level CBP report includes the number of establishments in the county within a specific employee range. For each of the counties with withheld data, EPA multiplied the number of establishments in a particular employee range (1 – 4, 5 – 9, etc.) by the midpoint of the range code (5 - 9 employees would be assigned 7) and summed the results.
4. An adjustment factor (to ensure the total number of estimated employees matches the state reported total) is calculated by dividing the sum of all the county level generated in step 2 by the sum of the county calculations in step 3. If there are no numerical values at the county level the adjustment factor is calculated by dividing the state total number of employees by the sum of the calculations in step 3.

5. The estimated number of employees, in counties where data was withheld, is calculated by multiplying the sum from step 3 by the adjustment factor calculated in step 4.

The second category of activity data used to estimate emissions from industrial solvent use was 2010 county-level population data, which was obtained from the US Census Bureau’s interactive population search for the 2010 Census [ref 3]. The per capita emission factors were then multiplied by the 2010 county-level population estimates. This method was used when there was no applicable NAICS category or enough employees in a NAICS category (Industrial Maintenance Coatings, Miscellaneous Finished Metals, Metal Sheet/Strip/Coil, and Other Special Purpose Coatings).

Emission Factors

EPA emission factors for Industrial Surface Coatings, available in the SPECIATE v4.3 database [ref 4], are provided in Table 3-140.

Table 3-140: EPA emission factors for Industrial Surface Coating used in 2011 NEI

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<tr>
<th>SCC</th>
<th>Description</th>
<th>Pollutant Code</th>
<th>Pollutant Description</th>
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The total volume of coatings sold was obtained from the Census Bureau, Paint and Allied Products, 2010 [ref 5]. The volume of architectural and powder coatings were subtracted from the total to obtain the total non-architectural coating volume. The volume of coatings sold for a particular category, like Automotive, Other Transportation and Machinery Refinish Paints and Enamels Including Primers, was obtained from the same source and used to determine a percentage of category coatings to total non-architectural coating. This percentage was applied to the amount of solvents in tons used for non-architectural Paint and Coatings, obtained from the Freedonia Group (Report #2357, Solvents to 2012, June 2008) [ref 6]. The result is the tons of solvents sold for the particular category. An assumption is made that all of the solvent is eventually emitted, so the result is considered VOC emissions in tons. The emission factor units needs to be lb of VOC per employee, so employment data is obtained from the National American Industry Classification System (NAICS) for the appropriate NAICS employment codes and a value per employee is determined. The HAP emission factors were determined using HAP speciation profiles obtained from EPA’s SPPD. EIAG received a database from SPPD, which originated from the Aerosol Coatings Rule that EPA promulgated on March 24, 2008. Manufacturers, importers, and distributors of aerosol coatings were required to submit initial notifications of product formulations by July 1, 2009 to their EPA Regional Offices. From this database, EIAG developed speciated HAPs [ref 4] for industrial surface coating categories.

**Example Calculation**

According to the U.S. Census Bureau, Kootenai County had a total of 492 employees in the factory finished wood industry. According to EPA’s 2011 calculations, the solvent use emission factor for VOC is 48.07 lb/employee.

\[
E_{VOC} = 492 \times 48.07 \text{ lb VOC/ employee} = 11.83 \text{ tons VOC}
\]
3.31.5 Summary of data quality assurance methods

The EPA compared the 2011 dataset to previous year EPA dataset and found no significant issues. Since this source category overlaps with the point source inventory, the submitting agency has the responsibility for reconciling the emissions and submitting nonpoint data to EPA that has the point sources emissions accounted for. Some effort was made by EPA to determine if point sources were properly accounted for. The EPA used state responses to EPA surveys and personal communication, if necessary, to determine the status of point source reconciliation for these categories.

Colorado asked EPA to tag the EPA nonpoint emissions for industrial surface coating, because they determined that they had these sources covered in the point data category.

3.31.6 References for Solvent – Industrial Surface Coating


3.32 Waste Disposal

3.32.1 Sector description

Waste disposal covers a wide range of source categories, from incineration, open burning, landfills, wastewater treatment, soil and groundwater remediation, scrap and waste materials, hazardous waste treatment storage and disposal facilities (TSDFs), and leaking underground storage tanks. SCCs that are included in the 2011 NEI v2 in the Waste Disposal sector are provided in Table 3-141. The leading SCC description is “Waste Disposal, Treatment, and Recovery” for nonpoint SCCs and “Waste Disposal” for point source SCCs. EPA estimates emissions from the highlighted SCCs below, which include in the nonpoint category: open burning of municipal solid waste, land clearing debris, and yard waste; publicly owned treatment works (POTW); and a few specific mercury sources in landfills. The column “Hg only?” denotes categories where only mercury was estimated by EPA. EPA also estimated landfill emissions in point, where S/L/T agencies did not include landfill emissions in their point source submissions. The methodologies for the select source categories in the Waste Disposal sector that EPA estimates are provided in separate subsections (reflected in the table) within this chapter. SCCs with an “x” denote that all SCC level 4 descriptions have been removed and that the “Remaining SCC Description” covers all SCCs under the Level 3 SCC description.
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### 3.32.2 Spatial coverage and data sources for the sector

![Spatial coverage map](image)

### 3.32.3 Selection hierarchy

The waste disposal sector includes data from the S/L/T agency submitted data and the default EPA generated emissions. The agencies listed in Table 3-142 submitted emissions for this sector.

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### Table 3-142: Agencies that submitted Waste Disposal data

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<tr>
<td>Sac and Fox Nation of Missouri in Kansas and Nebraska Reservation</td>
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<td>Shoshone-Bannock Tribes of the Fort Hall Reservation of Idaho</td>
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</table>
Table 3-143 shows the selection hierarchy for datasets included in the waste disposal sector. The waste disposal sector includes emissions from both S/L/T agencies and from the EPA no overlap nonpoint dataset. The table below lists the hierarchy of datasets used in the 2011 NEI for this sector. In some cases, the EPA PM and HAP augmentation as well as TRI and chromium split datasets were used to fill in PM species and HAP pollutants based on S/L/T agency data. In addition, if states did not report landfill emissions to their point source inventories, EPA estimated these emissions and gap-filled the NEI to account for these in the dataset called 2011EPA_LF. Finally, EPA also estimated mercury emissions that end up in landfills and in shredding and crushing operations, and if states did not include emissions of this nature, EPA gap-filled these data as well.
Table 3-143: 2011 NEI Waste Disposal data selection hierarchy

<table>
<thead>
<tr>
<th>Priority</th>
<th>Dataset Name</th>
<th>Dataset Content</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>2011EPA_PM-Augmentation</td>
<td>Augments PM data in 47 states and some tribes</td>
</tr>
<tr>
<td>2</td>
<td>Responsible Agency Data Set</td>
<td>State and Local Agency submitted emissions</td>
</tr>
<tr>
<td>3</td>
<td>2011EPA_chrom_split</td>
<td>Splits total chromium into speciated chromium in 37 states</td>
</tr>
<tr>
<td>4</td>
<td>2011EPA_TRI</td>
<td>Toxics Release Inventory data for the year 2011. These data are selected for a facility only when alternative emissions are not included in the S/L/T agency data.</td>
</tr>
<tr>
<td>5</td>
<td>2011EPA_LF</td>
<td>Landfills generated from GHG data</td>
</tr>
<tr>
<td>6</td>
<td>2011EPA_HAP-Augmentation</td>
<td>Adds Pb and other HAP emissions in 46 states</td>
</tr>
<tr>
<td>7</td>
<td>2011EPA_NP_NoOverlap_w_Pt</td>
<td>EPA-generated data</td>
</tr>
<tr>
<td>8</td>
<td>2011EPA_Mercury</td>
<td>Mercury only data for certain nonpoint categories</td>
</tr>
</tbody>
</table>

The following sections explain the EPA methodologies for those source categories for which EPA estimated emissions.

3.32.4 EPA-developed emissions of Open Burning of Leaf and Brush Species

County-level criteria pollutant and HAP emissions were calculated by multiplying the total amount of yard waste (either leaf or brush) burned per year by an emission factor. Emissions for leaves and residential brush were calculated separately, since emission factors vary by yard waste type.

Source Category Description

Open burning of yard waste is the purposeful burning of leaf and brush species in outdoor areas. Criteria air pollutant (CAP) and hazardous air pollutant (HAP) emission estimates for leaf and brush waste burning are a function of the amount of waste burned per year. For this source category, the SCCs provided in Table 3-144 were assigned and estimated by EPA for the 2011 NEI.

Table 3-144: Open Burning, Leaf and Brush Species SCCs estimated by EPA in the 2011 NEI

<table>
<thead>
<tr>
<th>SCC</th>
<th>SCC Level 1</th>
<th>SCC Level 2</th>
<th>SCC Level 3</th>
<th>SCC Level 4</th>
</tr>
</thead>
<tbody>
<tr>
<td>2610000100</td>
<td>Waste Disposal, Treatment, and Recovery</td>
<td>Open Burning</td>
<td>All Categories</td>
<td>Yard Waste – Leaf Species Unspecified</td>
</tr>
<tr>
<td>2610000400</td>
<td>Waste Disposal, Treatment, and Recovery</td>
<td>Open Burning</td>
<td>All Categories</td>
<td>Yard Waste – Brush Species Unspecified</td>
</tr>
</tbody>
</table>

Activity Data

The amount of leaf and brush waste burned was estimated using data from EPA’s report Municipal Solid Waste Generation, Recycling, and Disposal in the United States: Facts and Figures for 2010 [ref 1]. The report presents the total mass of waste generated from the residential and commercial sectors, including yard waste, in the United States by type of waste for the calendar year 2010. According to the EPA report, residential waste generation accounts for 55-65 percent of the total waste from the residential and commercial sectors [ref 2]. For the calculation of per capita yard waste subject to burning, the median value of 60 percent was assumed. This information was used to calculate a daily estimate of the per capita yard waste of 0.36 lbs./person/day. Of the total amount of yard waste generated, the yard waste composition was assumed to be 25 percent leaves, 25 percent brush, and 50 percent grass by weight [ref 3].
Open burning of grass clippings is not typically practiced by homeowners, and as such only estimates for leaf burning and brush burning were developed. Approximately 25 to 32 percent of all waste that is subject to open burning is actually burned [ref 3]. A median value of 28 percent is assumed to be burned in all counties in the United States.

The per capita estimate was then multiplied by the 2010 population in each county that is expected to burn waste. Since open burning is generally not practiced in urban areas, only the rural population of each county was assumed to practice open burning. The ratio of urban to rural population was obtained from 2010 U.S. Census data [ref 4]. This ratio was then multiplied by the 2010 U.S. Census Bureau estimate of the population in each county to obtain the county-level rural population for 2010 [ref 5].

The percentage of forested acres from Version 2 of BELD2 within BEIS was used to adjust for variations in vegetation. The percentage of forested acres per county (including rural forest and urban forest) was then determined. To better account for the native vegetation that would likely be occurring in the residential yards of farming States, agricultural land acreage was subtracted before calculating the percentage of forested acres. Table 3-145 presents the ranges that were used to make adjustments to the amount of yard waste that is assumed to be generated per county. All municipios in Puerto Rico and counties in the U.S. Virgin Islands, Hawaii, and Alaska were assumed to have greater than 50 percent forested acres.

<table>
<thead>
<tr>
<th>Percent Forested Acres per County</th>
<th>Adjustment for Yard Waste Generated</th>
</tr>
</thead>
<tbody>
<tr>
<td>&lt; 10%</td>
<td>0% generated</td>
</tr>
<tr>
<td>&gt;= 10%, and &lt; 50%</td>
<td>50% generated</td>
</tr>
<tr>
<td>&gt;= 50%</td>
<td>100% generated</td>
</tr>
</tbody>
</table>

Controls

Controls for yard waste burning are generally in the form of a ban on open burning of waste in a given municipality or county. Counties that were more than 80% urban were assumed not to practice any open burning. Therefore, criteria pollutant and HAP emissions from residential yard waste burning are zero in these counties. In addition, the State of Colorado implemented a state-wide ban on open burning. Emissions from open burning of residential yard waste in all Colorado counties were assumed to be zero.

Emission Factors

Emission factors for CAPs were developed by the U.S. Environmental Protection Agency (EPA) in consultation with the Eastern Regional Technical Advisory Committee [ref 6]. For leaf burning, emission factors for PM$_{2.5}$ were calculated by multiplying the PM$_{10}$ leaf burning emission factors by the PM$_{2.5}$ to PM$_{10}$ emission factor ratio for brush burning (0.7709). Emission factors for HAPs are from an EPA Control Technology Center report [ref 7]. Forest fire simulation emission factors were used to estimate emissions for 17 dioxin congeners [ref 8].

Example Calculations

VOC emissions in Autauga County, Alabama from open burning of leaf waste:

- Population of Autauga County in 2010 = 54,571
- Rural fraction of Autauga County population = 0.42
- Per capita waste yard waste generated (lb/person/day) = 0.3557
- Leaf fraction of waste = 0.25
Fraction of rural population that burns yard waste = 0.28
Adjustment factor based on % forested acres = 1
Number of days in a year = 365
Factor to convert from lbs to tons = 1/2000

2010 leaf burning activity in Autauga County = 54,571 * 0.42 * 0.3557 * 0.25 * 0.28 * 1 * 365 /2000
2010 leaf burning activity in Autauga County = 104.15 tons

VOC emissions = tons of leaves burned * VOC emission factor
VOC emission factor = 28 lb/ton

VOC emissions in Autauga County in 2010 = 104.15 tons * 28 lbs/ton * 1 ton/2000 lbs
VOC emissions in Autauga County in 2010 = 1.46 tons

3.32.5 EPA-developed emissions of Open Burning of Municipal Solid Waste (MSW)

County-level criteria pollutant and HAP emissions were calculated by multiplying the total amount of residential municipal solid waste burned per year by an emission factor.

Source Category Description

Open burning of residential municipal solid waste (MSW) is the purposeful burning of MSW in outdoor areas. Criteria air pollutant (CAP) and hazardous air pollutant (HAP) emission estimates for MSW burning are a function of the amount of waste burned per year.

For this source category, the following SCC was assigned and emissions were estimated for the 2011 NEI:
SCC=2610030000, SCC description=“Waste Disposal, Treatment, and Recovery; Open Burning; Residential; Household Waste (use 26-10-000-xxx for Yard Wastes).”

Activity Data

The amount of household MSW burned was estimated using data from EPA’s report *Municipal Solid Waste Generation, Recycling, and Disposal in the United States: Facts and Figures for 2010* [ref 1]. The report presents the total mass of waste generated from the residential and commercial sectors in the United States by type of waste for the calendar year 2010. According to the EPA report, residential waste generation accounts for 55-65 percent of the total waste from the residential and commercial sectors [ref 2]. For the calculation of per capita household waste subject to burning, the median value of 60 percent was assumed. This information was used to calculate a daily estimate of the per capita household waste subject to burning of 1.94 lbs./person/day. Non-combustible waste, such as glass and metals, was not considered to be waste subject to burning. Burning of yard waste is included in SCC 2610000100 and SCC 2610000400; therefore, it is not part of residential MSW. Approximately 25 to 32 percent of all waste that is subject to open burning is actually burned [ref 4, ref 9]. A median value of 28 percent is assumed to be burned in all counties in the United States.

Since open burning is generally not practiced in urban areas, only the rural population of each county was assumed to practice open burning. The ratio of urban to rural population was obtained from 2010 U.S. Census data [ref 4]. This ratio was then multiplied by the 2010 U.S. Census Bureau estimate of the population in each county to obtain the county-level rural population for 2010 [ref 5]. The county-level rural population was then multiplied by the per capita household waste subject to burning to determine the amount of rural household MSW generated in each county in 2010.
Controls

Controls for residential MSW burning are generally in the form of a ban on open burning of waste in a given municipality or county. Counties that were more than 80% urban were assumed not to practice any open burning. Therefore, criteria pollutant and HAP emissions from residential municipal solid waste burning are zero in these counties. In addition, the State of Colorado implemented a state-wide ban on open burning. Emissions from open burning of residential waste in all Colorado counties were assumed to be zero.

Emission Factors

Emission factors for CAPs were developed by the U.S. Environmental Protection Agency (EPA) in consultation with the Eastern Regional Technical Advisory Committee and based primarily on the AP-42 report [ref 10]. Emission factors for HAPs are from an EPA Control Technology Center report and emission factors for 17 dioxin congeners were obtained from an EPA dioxin report [ref 11]. These emission factors are provided in Table 3-146.

<table>
<thead>
<tr>
<th>Pollutant</th>
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<th>Emission Factor (lb/ton)</th>
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<td>CO</td>
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<td>PM10-FIL</td>
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<td>PM25-FIL</td>
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<td>PM25-PRI</td>
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<td>SO2</td>
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<td>Emission Factor (lb/ton)</td>
<td>Emission Factor Reference</td>
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<td>Reference 10</td>
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<td>Benzene</td>
<td>71432</td>
<td>2.48E+00</td>
<td>Reference 10</td>
</tr>
<tr>
<td>Benzo[a]pyrene</td>
<td>50328</td>
<td>4.24E-03</td>
<td>Reference 10</td>
</tr>
<tr>
<td>Benzo[b]fluoranthene</td>
<td>205992</td>
<td>5.26E-03</td>
<td>Reference 10</td>
</tr>
<tr>
<td>Benzo[g,h,i,]Perylene</td>
<td>191242</td>
<td>3.95E-03</td>
<td>Reference 10</td>
</tr>
<tr>
<td>Benzo[k]fluoranthene</td>
<td>207089</td>
<td>2.05E-03</td>
<td>Reference 10</td>
</tr>
<tr>
<td>Chlorobenzene</td>
<td>108907</td>
<td>8.48E-04</td>
<td>Reference 10</td>
</tr>
<tr>
<td>Chrysene</td>
<td>218019</td>
<td>5.07E-03</td>
<td>Reference 10</td>
</tr>
<tr>
<td>Dibenzo[a,h]anthracene</td>
<td>53703</td>
<td>6.46E-04</td>
<td>Reference 10</td>
</tr>
<tr>
<td>Fluoranthene</td>
<td>206440</td>
<td>8.14E-03</td>
<td>Reference 10</td>
</tr>
<tr>
<td>Fluorene</td>
<td>86737</td>
<td>7.31E-03</td>
<td>Reference 10</td>
</tr>
<tr>
<td>Hexachlorobenzene</td>
<td>118741</td>
<td>4.40E-05</td>
<td>Reference 10</td>
</tr>
<tr>
<td>Hydrochloric Acid</td>
<td>7647010</td>
<td>5.68E-01</td>
<td>Reference 10</td>
</tr>
<tr>
<td>Hydrogen Cyanide</td>
<td>74908</td>
<td>9.36E-01</td>
<td>Reference 10</td>
</tr>
<tr>
<td>Indeno[1,2,3-c,d]pyrene</td>
<td>193395</td>
<td>3.75E-03</td>
<td>Reference 10</td>
</tr>
<tr>
<td>Naphthalene</td>
<td>91203</td>
<td>3.51E-02</td>
<td>Reference 10</td>
</tr>
<tr>
<td>Octachlorodibenzofuran</td>
<td>39001020</td>
<td>7.28E-08</td>
<td>Reference 11</td>
</tr>
<tr>
<td>Octachlorodibenzofuro-p-dioxin</td>
<td>3268879</td>
<td>9.94E-08</td>
<td>Reference 11</td>
</tr>
<tr>
<td>Pentachlorophenol</td>
<td>87865</td>
<td>1.06E-04</td>
<td>Reference 10</td>
</tr>
<tr>
<td>Phenanthrene</td>
<td>85018</td>
<td>1.46E-02</td>
<td>Reference 10</td>
</tr>
<tr>
<td>Phenol</td>
<td>108952</td>
<td>2.80E-01</td>
<td>Reference 10</td>
</tr>
<tr>
<td>Polychlorinated Biphenyis</td>
<td>1336363</td>
<td>5.72E-03</td>
<td>Reference 10</td>
</tr>
<tr>
<td>Pyrene</td>
<td>129000</td>
<td>9.66E-03</td>
<td>Reference 10</td>
</tr>
<tr>
<td>Styrene</td>
<td>100425</td>
<td>1.48E+00</td>
<td>Reference 10</td>
</tr>
</tbody>
</table>

Example Calculations

VOC emissions in Autauga County, Alabama from open burning of residential MSW:

Population of Autauga County in 2010 = 54,571
Rural fraction of Autauga County population = 0.42
Per capita MSW generated (lb/person/day) = 1.9435
Fraction of rural population that burns MSW = 0.28
Number of days in a year = 365
Factor to convert from lbs to tons = 1/2000

2010 MSW burning activity in Autauga County = 54,571 * 0.42 * 1.9435 * 0.28 * 365 /2000
2010 MSW activity in Autauga County = 2,276 tons

VOC emissions = MSW burned * VOC emission factor
VOC emission factor = 8.56 lb/ton

VOC emissions in Autauga County = 2,276 tons * 8.56 lbs/ton * 1 ton/2000 lbs
VOC emissions in Autauga County in 2010 = 9.74 tons
3.32.6  EPA-developed emissions of Open Burning of Land Clearing Debris

County-level criteria pollutant and HAP emissions were calculated by multiplying the total mass of land clearing debris burned per year by an emission factor.

**Source Category Description**

Open burning of land clearing debris is the purposeful burning of debris, such as trees, shrubs, and brush, from the clearing of land for the construction of new buildings and highways. Criteria air pollutant (CAP) and hazardous air pollutant (HAP) emission estimates from open burning of land clearing debris are a function of the amount of material or fuel subject to burning per year.

For this source category, the following SCC was assigned and estimated by EPA for the 2011 NEI:
SCC=2610000500, SCC description=” Waste Disposal, Treatment, and Recovery; Open Burning; All Categories; Land Clearing Debris (use 28-10-005-000 for Logging Debris Burning)”.

**Activity Data**

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

**Acres Disturbed from Residential Construction**

The US Census Bureau has 2010 data for Housing Starts - New Privately Owned Housing Units Started [ref 12] which provides regional level housing starts based on the groupings of 1 unit, 2-4 units, 5 or more units. A consultation with the Census Bureau in 2002 gave a breakdown of approximately 1/3 of the housing starts being for 2 unit structures, and 2/3 being for 3 and 4 unit structures. The 2-4 unit category was divided into 2-units, and 3-4 units based on this ratio. To determine the number of structures for each grouping, the 1 unit category was divided by 1, the 2 unit category was divided by 2, and the 3-4 unit category was divided by 3.5. The 5 or more unit category may be made up of more than one structure. New Privately Owned Housing Units Authorized Unadjusted Units [ref 13] gives a conversion factor to determine the ratio of structures to units in the 5 or more unit category. For example if a county has one 40 unit apartment building, the ratio would be 40/1. If there are 5 different 8 unit buildings in the same project, the ratio would be 40/5. Structures started by category are then calculated at a regional level. The table Annual Housing Units Authorized by Building Permit [ref 14] has 2010 data at the county level to allocate regional housing starts to the county level. This results in county level housing starts by number of units. The surface areas were assumed disturbed for each unit type shown in Table 3-147.

<table>
<thead>
<tr>
<th>Unit Type</th>
<th>Surface Acres Disturbed</th>
</tr>
</thead>
<tbody>
<tr>
<td>1-Unit</td>
<td>1/4 acre/structure</td>
</tr>
<tr>
<td>2-Unit</td>
<td>1/3 acre/structure</td>
</tr>
<tr>
<td>Apartment</td>
<td>1/2 acre/structure</td>
</tr>
</tbody>
</table>

The 3-4 unit and 5 or more unit categories were considered to be apartments. Multiplication of housing starts to surface acres disturbed results in total number of acres disturbed for each unit category.
Acres Disturbed from Non-Residential Construction

*Annual Value of Construction Put in Place in the U.S [ref 15]* has the 2011 National Value of Non-residential construction. The national value of non-residential construction put in place (in millions of dollars) was allocated to counties using county-level non-residential construction (NAICS Code 2362) employment data obtained from *County Business Patterns (CBP)* [ref 16]. Because some county employment data was withheld due to privacy concerns, the following procedure was adopted:

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

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

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

In 1999 a figure of 2 acres/$1 million ($10^6) was developed. The Bureau of Labor Statistics *Producer Price Index* [ref 17] lists costs of the construction industry from 1999-2011.

\[
2011 \text{ acres per } $10^6 = 1999 \text{ acres per } $10^6 \times \left( \frac{1999 \text{ PPI}}{2011 \text{ PPI}} \right)
\]

\[
= 2 \text{ acres}/$10^6 \left( \frac{132.9}{229.3} \right)
\]

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

**Acres Disturbed by Road Construction**

The Federal Highway Administration provides data on spending by state in several different categories of road construction and maintenance in *Highway Statistics, Section IV - Highway Finance, Table SF-12A, State Highway Agency Capital Outlay* [ref 18] for 2008. (Note that this table has not been available in subsequent versions of *Highway Statistics*. Thus, 2008 is the latest data currently available.) For this SCC, the following sets of data (or columns) are used: New Construction, Relocation, Added Capacity, Major Widening, and Minor Widening. Each of these data sets are also differentiated according to the following six roadway classifications:

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

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

The new miles of road constructed are used to estimate the acreage disturbed due to road construction. The total area disturbed in each state was calculated by converting the new miles of road constructed to acres using an acres disturbed/mile conversion factor for each road type as given in Table 3-148.
Table 3-148: Spending per mile and acres disturbed per mile by highway type

<table>
<thead>
<tr>
<th>Road Type</th>
<th>Dollars per mile</th>
<th>Acres Disturbed per mile</th>
</tr>
</thead>
<tbody>
<tr>
<td>Urban Areas, Interstate</td>
<td>$4,000,000</td>
<td>15.2</td>
</tr>
<tr>
<td>Rural Areas, Interstate</td>
<td>$4,000,000</td>
<td>15.2</td>
</tr>
<tr>
<td>Urban Areas, Other Arterials</td>
<td>$1,900,000</td>
<td>15.2</td>
</tr>
<tr>
<td>Rural Areas, Other Arterials</td>
<td>$1,900,000</td>
<td>12.7</td>
</tr>
<tr>
<td>Urban Areas, Collectors</td>
<td>$1,900,000</td>
<td>9.8</td>
</tr>
<tr>
<td>Rural Areas, Collectors</td>
<td>$1,900,000</td>
<td>7.9</td>
</tr>
</tbody>
</table>

County-level building permits data are used to allocate the state-level acres disturbed by road construction to the county [ref 19]. A ratio of the number of building starts in each county to the total number of building starts in each state was applied to the state-level acres disturbed to estimate the total number of acres disturbed by road construction in each county.

Converting Acres Disturbed to Tons of Land Clearing Debris Burned

Version 2 of the Biogenic Emissions Land cover Database (BELD2) within EPA’s Biogenic Emission Inventory System (BEIS) was used to identify the acres of hardwoods, softwoods, and grasses in each county. Table 3 presents the average fuel loading factors by vegetation type. The average loading factors for slash hardwood and slash softwood were adjusted by a factor of 1.5 to account for the mass of tree that is below the soil surface that would be subject to burning once the land is cleared [ref 20]. Weighted average county-level loading factors, provided in Table 3-149, were calculated by multiplying the average loading factors by the percent contribution of each type of vegetation class to the total land area for each county.

Table 3-149: Fuel loading factors by vegetation type

<table>
<thead>
<tr>
<th>Vegetation Type</th>
<th>Unadjusted Average Fuel Loading Factor (Tons/acre)</th>
<th>Adjusted Average Fuel Loading Factor (Tons/acre)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Hardwood</td>
<td>66</td>
<td>99</td>
</tr>
<tr>
<td>Softwood</td>
<td>38</td>
<td>57</td>
</tr>
<tr>
<td>Grass</td>
<td>4.5</td>
<td>Not Applicable</td>
</tr>
</tbody>
</table>

The total acres disturbed by all construction types was calculated by summing the acres disturbed from residential, non-residential, and road construction. The county-level total acres disturbed were then multiplied by the weighted average loading factor to derive tons of land clearing debris.

Controls

Controls for land clearing debris burning are generally in the form of a ban on open burning of waste in a given municipality or county. Counties that were more than 80% urban were assumed not to practice any open burning. Therefore, criteria pollutant and HAP emissions from open burning of land clearing debris are zero in these counties. In addition, the State of Colorado implemented a state-wide ban on open burning. Emissions from open burning of land clearing debris in all Colorado counties were assumed to be zero.

Emission Factors

Emission factors for CAPs were developed by the U.S. Environmental Protection Agency (EPA) in consultation with the Eastern Regional Technical Advisory Committee and based primarily on the AP-42 report [ref 6, ref 10]. The PM$_{2.5}$ to PM$_{10}$ emission factor ratio for brush burning (0.7709) was multiplied by the PM$_{10}$ emission factors for land clearing debris burning to develop PM$_{2.5}$ emission factors.
Emission factors for HAPs are from an EPA Control Technology Center report [ref 7] and emission factors for 17 dioxin congeners were obtained from an EPA dioxin report [ref 8]. The dioxin emission factors were multiplied by 0.002 to convert from mg/kg to lb/ton. Emission factors for open burning land clearing debris are provided in Table 3-150.

### Table 3-150: Emission factors for Open Burning of Land Clearing Debris (SCC 2610000500)

<table>
<thead>
<tr>
<th>Pollutant</th>
<th>Pollutant Code</th>
<th>Emission Factor (lb/ton)</th>
<th>Emission Factor Reference</th>
</tr>
</thead>
<tbody>
<tr>
<td>VOC</td>
<td>VOC</td>
<td>11.6</td>
<td>Reference 10</td>
</tr>
<tr>
<td>NOX</td>
<td>NOX</td>
<td>5</td>
<td>Reference 10</td>
</tr>
<tr>
<td>CO</td>
<td>CO</td>
<td>169</td>
<td>Reference 10</td>
</tr>
<tr>
<td>PM10-FIL</td>
<td>PM10-FIL</td>
<td>17</td>
<td>Reference 10</td>
</tr>
<tr>
<td>PM25-FIL</td>
<td>PM25-FIL</td>
<td>13.1</td>
<td>Reference 10</td>
</tr>
<tr>
<td>PM10-PRI</td>
<td>PM10-PRI</td>
<td>17</td>
<td>Reference 10</td>
</tr>
<tr>
<td>PM25-PRI</td>
<td>PM25-PRI</td>
<td>13.1</td>
<td>Reference 10</td>
</tr>
<tr>
<td>1,2,3,4,6,7,8-HpCDD</td>
<td>35822469</td>
<td>3.33E-07</td>
<td>Reference 13</td>
</tr>
<tr>
<td>1,2,3,4,6,7,8-HpCDF</td>
<td>67562394</td>
<td>5.08E-08</td>
<td>Reference 13</td>
</tr>
<tr>
<td>1,2,3,4,7,8-9-HpCDF</td>
<td>55673897</td>
<td>6.12E-09</td>
<td>Reference 13</td>
</tr>
<tr>
<td>1,2,3,4,7,8-HxCDD</td>
<td>39227286</td>
<td>1.14E-08</td>
<td>Reference 13</td>
</tr>
<tr>
<td>1,2,3,4,7,8-HxCDF</td>
<td>70648269</td>
<td>3.34E-08</td>
<td>Reference 13</td>
</tr>
<tr>
<td>1,2,3,6,7,8-HxCDF</td>
<td>57653857</td>
<td>2.14E-08</td>
<td>Reference 13</td>
</tr>
<tr>
<td>1,2,3,6,7,8-9-HxCDD</td>
<td>57117449</td>
<td>1.43E-08</td>
<td>Reference 13</td>
</tr>
<tr>
<td>1,2,3,7,8,9-HxCDF</td>
<td>19408743</td>
<td>3.47E-08</td>
<td>Reference 13</td>
</tr>
<tr>
<td>1,2,3,7,8,9-HxCDD</td>
<td>72918219</td>
<td>2.23E-09</td>
<td>Reference 13</td>
</tr>
<tr>
<td>1,2,3,7,8-PeCDD</td>
<td>40321764</td>
<td>7.66E-09</td>
<td>Reference 13</td>
</tr>
<tr>
<td>1,2,3,7,8-PeCDF</td>
<td>57117416</td>
<td>1.27E-08</td>
<td>Reference 13</td>
</tr>
<tr>
<td>2,3,4,6,7,8-HxCDF</td>
<td>60851345</td>
<td>1.96E-08</td>
<td>Reference 13</td>
</tr>
<tr>
<td>2,3,4,7,8-PeCDF</td>
<td>57117314</td>
<td>2.02E-08</td>
<td>Reference 13</td>
</tr>
<tr>
<td>2,3,7,8-TCDD</td>
<td>1746016</td>
<td>2.30E-09</td>
<td>Reference 13</td>
</tr>
<tr>
<td>2,3,7,8-TCDF</td>
<td>51207319</td>
<td>1.40E-08</td>
<td>Reference 13</td>
</tr>
<tr>
<td>Cumene</td>
<td>98828</td>
<td>1.33E-02</td>
<td>Reference 12</td>
</tr>
<tr>
<td>Dibenzofuran</td>
<td>132649</td>
<td>6.75E-03</td>
<td>Reference 12</td>
</tr>
<tr>
<td>Ethyl Benzene</td>
<td>100414</td>
<td>4.80E-02</td>
<td>Reference 12</td>
</tr>
<tr>
<td>OCDD</td>
<td>3268879</td>
<td>1.33E-06</td>
<td>Reference 13</td>
</tr>
<tr>
<td>OCDF</td>
<td>39001020</td>
<td>2.05E-08</td>
<td>Reference 13</td>
</tr>
<tr>
<td>Phenol</td>
<td>108952</td>
<td>1.15E-01</td>
<td>Reference 12</td>
</tr>
<tr>
<td>Styrene</td>
<td>100425</td>
<td>1.02E-01</td>
<td>Reference 12</td>
</tr>
</tbody>
</table>

### Example Calculations

VOC emissions in Autauga County, Alabama from open burning of land clearing debris:

Rural fraction of Autauga County population = 0.42, so no emission controls  
Acres disturbed by residential, non-residential, and road construction in Autauga County = 84.83  
Weighted average fuel loading factor for Autauga County = 65.48 tons/acre  
Mass of land clearing debris burned = 84.83 acres * 65.48 tons/acre = 5,555 tons
VOC emission factor = 11.6 lbs/ton
Factor to convert from lbs to tons = 1/2000

VOC emissions = tons of land clearing debris burned * VOC emission factor
VOC emissions = 5,555 tons * 11.6 lbs/ton * 1 ton /2000 lbs
VOC emissions (from land clearing debris burning in Autauga County in 2010) = 32 tons

3.32.7 EPA-developed emissions of Publicly Owned Treatment Works (POTW)

Source Category Description

Due to resource constraints, POTW emissions were not estimated for the 2011 NEI. The emissions from 2008 NEI were assumed to be similar in nature and were used in lieu of recalculated emissions. The below describes the methods used in the 2008 NEI EPA estimates for POTWs.

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

The general approach to calculating emissions for POTWs is to estimate the POTW flow rate using methods described below and then multiply the estimated flow rate by the emission factors for VOCs, ammonia, and numerous HAPs. The emissions are allocated to the county level using methods described below. It is important to note that the emission estimates for this category represent total emissions. It may be necessary to determine whether there are point source emissions in SCCs 50100701 through 50100781 and 50100791 through 50182599 that need to be subtracted to yield the nonpoint source emission estimates for this category.

For this source category, the following SCC was assigned and EPA estimated emissions for the NEI:
SCC=2630020000, SCC description=“Waste Disposal, Treatment and Recovery - Wastewater Treatment - Public Owned - Total Processed”.

Activity Data

A nationwide projected flow rate in 2010 of 39,780 million gallons per day (MMGD) was available from an EPA report [ref 21]. Of this, POTWs account for 98.5 percent of the flow rate or 39,180 MMGD, with privately owned treatment works accounting for the rest. The EPA Clean Watersheds Needs Survey reports the existing flow rate in 2004 for POTWs as 34,370 MMGD [ref 22]. The interpolated 2008 nationwide flow rate (using a linear regression) was calculated at 37,580 MMGD, or 13,754,280 million gallons annually. The nationwide flow rate includes Puerto Rico and the U.S. Virgin Islands.

Emissions were allocated to the county-level by the county proportion of the U.S. population [ref 23].

Emission Factors

The ammonia emission factor was obtained from a report to EPA [ref 24], while the VOC emission factor was based on a TriTAC (technical advisory committee representing three California associations, for more see: http://www.tritac.org/) study [ref 25]. Emission factors for the 53 HAPs were derived using 1996 area source emissions estimates that were provided by the EPA Sector Policies and Programs Division [ref 26] and the 1996 nationwide flow rate [ref 27]. These HAP emission factors were then multiplied by the 2008 to 2002 VOC emission factor ratio (0.85/9.9) to obtain the final HAP emission factors applied in the 2008 inventory.
Example Calculations

The 1996 flow rate per day was 32,175 MMGD. (1996 was a leap year.) Annually, this computes to:

\[ 32,175 \text{ MMGD treated} \times 366 \text{ days} = 11,776,050 \text{ million gallons treated} \]

Benzene emissions in 1996 for area source POTWs were estimated to be 461.44 tons per year. The derived benzene emission factor is calculated as follows:

\[ \text{Benzene emission factor} = \frac{(461.44 \text{ tons} \times 2000 \text{ lb/ton})}{(11,776,050 \text{ million gallons treated})} \times \frac{0.85}{9.9} \]
\[ \text{Benzene emission factor} = 0.0067287 \text{ lb/million gallons treated} \]

National total benzene emissions for 2008 for area source POTWs are calculated as follows:

\[ \text{2008 benzene emissions} = (37,580 \text{ MMGD} \times 366 \text{ days}) \times (0.0067287 \text{ lb/million gallons treated}) \]
\[ \text{2008 benzene emissions} = 92,548 \text{ pounds} / 2000 \text{ pounds} = 46.27 \text{ tons/year} \]

Total national 2008 benzene emissions from area source POTWs are allocated to county-level by the county proportion of the U.S. population. The total U.S. population in 2008 is 308,123,578. Benzene emissions for Autauga County, Alabama (2008 population of 50,364) are calculated as follows:

\[ \text{2008 benzene emissions} = 46.27 \text{ tons/year} \times \frac{50,364}{308,123,578} = 0.0076 \text{ tons/year} \]

3.32.8 EPA-developed emissions of Landfills

Source Category Description

Most landfill emissions are developed by EPA using methane data from the EPA’s Greenhouse Gas reporting rule program. This dataset is called 2011 EPA Landfills, and was presumed to contain landfills only for which no pollutants were reported by S/L/T in the 2011 reporting year.

Mercury emissions for landfills are accounted for with an EPA estimated dataset called 2011EPA_NP_Mercury. This methodology was not developed until 2011 v2, so these emissions are not accounted for in 2011 v1. These Hg-only SCCs are provided in Table 3-151; the SCC Level 1 description is “Waste Disposal, Treatment, and Recovery”.

<table>
<thead>
<tr>
<th>Subcategory</th>
<th>SCC</th>
<th>SCC Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>Landfill working face</td>
<td>2620030001</td>
<td>Landfills; Municipal; Dumping/Crushing/Spreading of New Materials (working face)</td>
</tr>
<tr>
<td>Thermostats and thermometers</td>
<td>2650000000</td>
<td>Scrap and Waste Materials; Scrap and Waste Materials; Total: All Processes</td>
</tr>
<tr>
<td>Switches and Relays</td>
<td>2650000002</td>
<td>Scrap and Waste Materials; Scrap and Waste Materials; Shredding</td>
</tr>
</tbody>
</table>

Mercury from the Working Face of Landfills

While the amount of mercury in products placed in landfills has tended to decrease in recent years, there is still a significant amount of mercury in place at landfills across the country. There are three main pathways for mercury emissions at landfills: (1) emissions from landfill gas (LFG) systems, including flare and vented systems; (2) emissions from the working face of landfills where new waste is placed; and (3) emissions from the closed, covered portions of landfills [ref 28]. Emissions from LFG systems are considered point sources and are already included in the NEI as submissions from SLT agencies or from the point source dataset that gap fills these landfill...
emissions (2011EPA_LF). Lindberg et al. (2005) [ref 28] found that emissions from the closed, covered portions of landfills are negligible and are similar to background soil emission rates. Therefore, this methodology focuses on emissions from the working face of landfills.

**Activity Data**

The US EPA’s Landfill Methane Outreach Program (LMOP) maintains a database of the landfills in the United States with information on the total amount of waste in place, as well as the opening and closing years of the landfill and the county where the landfill is located [ref 29]. The average number of tons of waste each landfill receives is estimated by dividing the total waste in place by the number of years the landfill has been operating. Only landfills that were open in 2011 are included in the analysis.

**Allocation Approach**

The EPA LMOP database provides data at the county level.

**Emission Factor**

Lindberg et al. (2005) [ref 29], measured mercury emissions from the working face of four landfills in Florida and determined emission factors per ton of waste placed in a landfill annually, ranging from 1-6 mg per ton of waste. The average of these emission factors is 2.5 mg/ton of waste, or $5.51 \times 10^{-6}$ lbs. / ton of waste.

**Example Calculation**

The City of Durham landfill in Durham County, NC is estimated to receive approximately 144,000 tons of waste annually.

$$144,000 \text{ tons of waste} \times 5.51 \times 10^{-6} \text{ lbs. Hg/ton of waste} = 0.79 \text{ lbs. Hg emissions}$$

**Quality Assurance**

EPA noted some issues with point and nonpoint overlap for landfills after the 2011 v1 was published. EPA estimates landfill emissions for the point source inventory, and believed that nonpoint SCCs were not being used by the S/L/T agencies. However, approximately 15 states or tribes do use these nonpoint SCCs, and, when using the EIS report for QA, some potential overlap was noted. Some tribal agencies submitted nonpoint landfill emissions after the 2011 v1, after this EPA point landfills dataset was created, so this was not resolved until 2011 v2.

EPA has proposed to resolve this in future inventories by retiring the nonpoint SCCs, and using EPA’s point inventory landfill dataset to fill in where S/L/T agencies do not report these as point sources. This would remove the need for point-nonpoint reconciliation in the future. However, EPA created a new nonpoint SCC for working face of landfills (currently restricted to Hg), so EPA is struggling with this question: does it really make sense to retire the other nonpoint SCCs for landfills?

EPA’s short term solution has been to propose tagging out any point landfills where agencies report landfills to the nonpoint inventory. This solution means that EPA would not retire the nonpoint landfill SCCs, which would be consistent with the fact that we are adding a nonpoint landfill SCC.

**EPA-Developed Emissions of Thermostats**

Mercury has been used in thermostats to switch on or off a heater or air conditioner based on the temperature of a room. Most of the historic production of mercury thermostats came from three corporations: Honeywell,
In 1998 these corporations formed the Thermostat Recycling Corporation (TRC), a voluntary program that attempts to collect and recycle mercury thermostats as they come out of service.

**Activity Data**

The 2002 EPA report estimated that 2-3 million thermostats came out of service in 1994 [ref 30]. A 2013 report from a consortium of environmental groups assumes that the estimate from the 2002 report remains viable and it estimates that the TRC collects at most 8% of the retired thermostats each year [ref 31]. Therefore, using this estimate, there are approximately 2.3 million thermostats that are not recycled each year.

**Allocation Approach**

The national-level mercury emissions are apportioned to each county based on population.

**Emission Factor**

The 2002 EPA report estimates that there are 3 grams of mercury per thermostat [ref 30]. Cain et al. (2007) [ref 32] estimate that 1.5% of mercury in “control devices,” including thermostats, is emitted to the air before it is disposed of at a landfill or incinerator. Therefore the amount of mercury emitted is 0.045 grams per thermostat, or $9.9 \times 10^{-5}$ lbs. per thermostat.

**Example Calculation**

$\text{2.3 million improperly disposed thermostats} \times 9.9 \times 10^{-5} \text{ lbs. per thermostat} = 228 \text{ lbs. mercury emissions}$

Shelby County, TN has 933,902 people, or 0.3% of the national population. The mercury emissions from thermostats in Shelby County, TN are estimated by the following:

$228 \text{ lbs. national mercury emissions} \times 0.3\% = 0.684 \text{ lbs. mercury emissions}$

3.3.8.3 **EPA-Developed Emissions of Thermometers**

Mercury thermometers have all but been phased out in the United States, with the USEPA and National Institute of Standards and Technology (NIST) working to phase out mercury thermometers in industrial and laboratory settings. NIST issued notice in 2011 that it would no longer calibrate mercury-in-glass thermometers for traceability purposes. EPA issued a rule in 2012 that provides flexibility to use alternatives to mercury thermometers when complying with certain regulations pertaining to petroleum refining, power generation, and PCB waste disposal [ref 33]. Furthermore, thirteen states have laws that limit the manufacture, sale, and/or distribution of mercury-containing fever thermometers [ref 33].

Nevertheless, given the historical prevalence of mercury thermometers, it is likely that a significant amount of mercury remains in thermometers in homes in the United States.

**Activity Data**

Data from the Northeast Waste Management Officials’ Association (NEWMOA) Interstate Mercury Education & Reduction Clearinghouse (IMERC) database suggests that there were 713 lbs. of mercury used in thermometers in 2007 [ref 34]. We assume that this value is held constant each year through 2011.
The US EPA assumes that the average lifespan of a glass thermometer is 5 years, and that 5% of glass thermometers are broken each year [ref 30]. Therefore, if 713 lbs. of mercury are used in thermometers each year there would be an estimated 3,228 lbs. of mercury remaining in thermometers in 2011 (accounting for the breakage rate each year).

NEWMOA [ref 34] estimates that during the period 2000-2006 there were 350 lbs. of mercury from thermometers collected in recycling programs.

Therefore, there were 2,878 lbs. (1.44 tons) of mercury available for release in 2011.

 Allocation Approach

The national-level mercury emissions from thermometers are allocated to the county level based on population.

Emission Factor

Cain et al. (2007) [ref 32] estimates that 10% of mercury from thermometers is emitted to the air before disposal in a landfill, and Leopold (2002) [ref 30] estimates that 5% of thermometers are broken each year. Therefore the emission factor is estimated to be 10 lbs. of mercury emissions per ton of mercury in thermometers.

Example Calculation

1.44 tons of mercury in broken thermometers × 10 lbs. emissions per ton = 14.4 lbs. of emissions

Boise County, ID has 7,028 people, or 0.0023% of the national population. The mercury emissions from broken thermometers for Boise County are estimated by the following:

14.4 lbs. national emissions × 0.0023% = 0.00033 lbs. emissions

3.32.8.4 EPA-Developed Emissions of Switches and Relays

Switches and relays make up the largest potential source of mercury from products that intentionally contain mercury. Mercury is an excellent electrical conductor and is liquid at room temperature, making it useful in a variety of products, including switches used to indicate motion or tilt, as the mercury will flow when the switch is in a certain position, completing the circuit.

While mercury switches in cars were phased out as of the 2002 model year, there are still millions of cars on the road that contain them, which are potential emissions sources when the cars are recycled at the end of their useful lives, which involves crushing and shredding cars. The shredded material is then sent to an arc furnace to recycle the steel. To avoid double counting point source emissions from arc furnaces, this source category only includes an estimate of nonpoint emissions from crushing/shredding operations.

Activity Data

A 2011 report from the North Carolina Department of Environment and Natural Resources [35] provides information on the estimated number of switches available for recovery in each state and the amount of switches actually recovered in 2011. There were 3.4 million mercury-containing automobile switches available nationwide in 2011 and 664,690 switches collected for recycling, for a collection rate of 19.4%. These

---

24 The US EPA does not explain what happens to the remaining 75% of unbroken thermometers after the estimated 5-year lifespan, but it does suggest that recycling, such as through Fisher Scientific’s thermometer trade-in program, may account for some of the remaining thermometers.
nationwide estimates are supported by similar data from the Quicksilver Caucus [36]. Therefore, there were approximately 2.7 million unrecycled automotive switches in 2011.

Allocation Approach

The number of unrecovered switches is apportioned to each county based on the number of car recycling facilities (NAICS 423930) from the 2011 US Census Bureau County Business Patterns.

Emission Factor

The response to comments for the 2007 EPA Significant New Use Rule on Mercury Switches (72 Fed. Reg. 56903), suggests that the weighted average amount of mercury in switches is 1.2 grams (0.0026 lbs.). A 201 report by Griffith et al. [ref 37] shows that 60% of mercury in switches is released at the shredding operation, while 40% is sent to arc furnaces for smelting. Therefore, the emission factor for switches is 0.00156 lbs. per switch.

Example Calculation

Alabama had 80,892 unrecovered vehicle switches in 2011. Baldwin County, AL has 3 car recycling facilities, which represents 1.53% of the facilities in the state. Therefore, that county is apportioned switches as follows:

\[
\text{80,892 switches in AL } \times 1.53\% = 1,238 \text{ switches in Baldwin County, AL}
\]

Emissions are estimated as follows:

\[
1,238 \text{ switches } \times 0.00156 \text{ lbs./switch } = 1.93 \text{ lbs. Hg emissions}
\]

3.32.9 References for Waste Disposal


4. U.S. Census Bureau, Decennial Censuses, 2010 Census: SF1, Table P2


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 EPA estimates, which S/L/T agencies provided model inputs or emissions data for each sector, and how the EPA data and S/L/T agency data were blended to produce the NEI.

In general, EPA used the data submitted by S/L/T agencies unless EPA determined that the data caused double counting or invalid pollutant or pollutant/emission type combinations inclusion.

4.2 Aircraft
EPA estimated emissions related to aircraft activity for all known US airports, including seaplane ports and heliports, in the 50 states, Puerto Rico, and US Virgin Islands. All 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 Revisions for the NEI 2011 v2
There were minimal aircraft sector changes between 2011 v1 and 2011 v2. Military aircraft emissions for one airport in Virginia were updated. One airport in Chicago was removed.

4.2.2 Sector description
The aircraft sector includes all aircraft types used for public, private, and military purposes. This includes four types of aircraft: (1) Commercial, (2) Air Taxis (AT), (3) General Aviation (GA), and (4) Military. A critical detail about the aircraft is whether each aircraft is turbine- or piston-driven, which allows the emissions estimation model to assign the fuel used, jet fuel or aviation gas, respectively. The fraction of turbine- and piston-driven aircraft is either collected or assumed for all aircraft types.

Commercial aircraft include those used for transporting passengers, freight, or both. Commercial aircraft tend to be larger aircraft powered with jet engines. Air Taxis carry passengers, freight, or both, but usually are smaller aircraft and operate on a more limited basis than the commercial aircraft. General Aviation includes most other
aircraft used for recreational flying and personal transportation. Finally, military aircraft are associated with military purposes, and they sometimes have activity at non-military airports.

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

The 2011 NEI also includes emission estimates for aircraft auxiliary power units (APUs) and aircraft ground support equipment (GSE) typically found at airports, such as aircraft refueling vehicles, baggage handling vehicles, and equipment, aircraft towing vehicles, and passenger buses. These APUs and GSE are located at the airport facilities as point sources along with the aircraft exhaust emissions. However, these emissions are included in the EIS Sectors for Non-road equipment (gasoline, diesel, and other), described in Section 4.5. This sector includes the SCCs listed in Table 4-1.

Table 4-1: Source classification codes for the aircraft sector in the 2011 NEI

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

4.2.3 Sources of data overview and selection hierarchy

The aircraft sector includes data from two data components: S/L/T agency-provided emissions data, and an EPA dataset that is enhanced with state- and local-provided model inputs. The S/L/T agency emissions data were received from agencies listed in Table 4-2. States that provided activity data for use in the EPA method are listed in Section 4.2.5.
Table 4-2: Agencies that submitted 2011 Aircraft emissions or emissions at facilities identified as “Airports”

<table>
<thead>
<tr>
<th>Agency</th>
<th>Agency Type</th>
<th>Notes</th>
</tr>
</thead>
<tbody>
<tr>
<td>California Air Resources Board</td>
<td>State</td>
<td>1 county, 20 airports included</td>
</tr>
<tr>
<td>Illinois Environmental Protection Agency</td>
<td>State</td>
<td></td>
</tr>
<tr>
<td>Michigan Department of Environmental Quality</td>
<td>State</td>
<td></td>
</tr>
<tr>
<td>Pinal County</td>
<td>Local</td>
<td>Non-aircraft SCCs: see Section 4.2.6</td>
</tr>
<tr>
<td>Tennessee Department of Environmental Conservation</td>
<td>State</td>
<td></td>
</tr>
<tr>
<td>Texas Commission on Environmental Quality</td>
<td>State</td>
<td></td>
</tr>
</tbody>
</table>

The selection hierarchy used for aircraft is shown below in Table 4-3. This hierarchy pulls the relevant datasets for this sector from the overall point sources hierarchy listed in Section 3. The aircraft emissions also have a nonpoint component (in-flight lead) which is discussed in 4.2.5.3 and uses only EPA data.

Table 4-3: 2011 NEI Aircraft data selection hierarchy

<table>
<thead>
<tr>
<th>Priority</th>
<th>Dataset Name</th>
<th>Dataset Content</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>State/Local/Tribal Data</td>
<td>Submitted aircraft emissions</td>
</tr>
<tr>
<td>2</td>
<td>2011EPA_Airports</td>
<td>EPA data (Section 4.2.5)</td>
</tr>
</tbody>
</table>

4.2.4 Spatial coverage and data sources for the sector

The aircraft sector includes emissions in every state, Puerto Rico, and the US Virgin Islands as well as six tribes.

4.2.5 EPA-developed aircraft emissions estimates

EPA developed emissions estimates associated with aircrafts’ landing and takeoff (LTO) cycle. The cycle begins when the aircraft approaches the airport on its descent from cruising altitude, lands, taxis to the gate, and idles during passenger deplaning. It continues as the aircraft idles during passenger boarding, taxis back out onto the runway for subsequent takeoff, and ascent (climb out) to cruising altitude. Thus, the five specific operating modes in an LTO are (1) Approach, (2) Taxi/idle-in, (3) Taxi/idle-out, (4) Takeoff, and (5) Climbout.

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

In fall of 2012, the EPA posted preliminary LTO data for review prior to developing the aircraft inventory. EPA encouraged the S/L/T agencies to review the materials and provide comments on any necessary corrections to:

- Airport names and locations for airports to be included in the EIS facility inventory;
- LTO information that will be used to estimate emissions for each airport;
- Aircraft/engine combinations to link to FAA LTO data including default assumptions and AircraftEngineCodeTypes for EIS submittals; and

Refer to Development of 2011 Aircraft Component for National Emissions Inventory, June 17, 2013 [ref 1] for more detail on preparing the LTO data and running the Emissions and Dispersion Modeling System (EDMS), including a summary of EPA default values and S/L/T agency replacement/revisions. As shown in Table 4-4, the following S/L/T agencies submitted aircraft activity data that EPA incorporated as inputs to the final EPA dataset model run.

**Table 4-4: Agencies that submitted Aircraft activity data for EPA’s emissions calculation**

<table>
<thead>
<tr>
<th>State</th>
<th>Affiliation</th>
</tr>
</thead>
<tbody>
<tr>
<td>CA</td>
<td>Planning &amp; Evaluation Division, Ventura County APCD</td>
</tr>
<tr>
<td>CT</td>
<td>Technical Services Group, Bureau of Air Management, Connecticut Department</td>
</tr>
<tr>
<td></td>
<td>of Energy and Environmental Protection</td>
</tr>
<tr>
<td>GA</td>
<td>Air Branch, Planning &amp; Support GA Environmental Protection Division</td>
</tr>
<tr>
<td>KS</td>
<td>Air Inventory Modeling Unit, Kansas Department of Health &amp; Environment</td>
</tr>
<tr>
<td>MD</td>
<td>Maryland Department of the Environment</td>
</tr>
<tr>
<td>NH</td>
<td>New Hampshire Department of Environmental Services</td>
</tr>
<tr>
<td>NJ</td>
<td>NJ Department of Environmental Protection</td>
</tr>
<tr>
<td>NV</td>
<td>Air Quality Management Division, Washoe County Health District</td>
</tr>
<tr>
<td>VA</td>
<td>Virginia Department of Environmental Quality</td>
</tr>
<tr>
<td>VT</td>
<td>Vermont Air Pollution Control Division</td>
</tr>
<tr>
<td>WA</td>
<td>Air Quality Program, Department of Ecology</td>
</tr>
<tr>
<td>WI</td>
<td>Regional Pollutant and Mobile Sources Section, Bureau of Air Management,</td>
</tr>
<tr>
<td></td>
<td>Wisconsin Department of Natural Resources</td>
</tr>
</tbody>
</table>

**4.2.5.1 Emissions for aircraft with detailed aircraft-specific activity data**

For airports where the available LTO, from agencies or FAA data bases, included detailed aircraft-specific make and model information (e.g., Boeing 747-200 series), EPA used the FAA’s EDMS, Version 5.1 [ref 2]. This type of detail is available for most LTOs at approximately three thousand larger airports that have commercial air traffic. Smaller and most general-aviation-only airports would not have aircraft specific activity detail available.

Emissions for GSE and APUs associated with aircraft-specific activity were also estimated by EDMS, using the assumptions and defaults incorporated in the model. EPA’s NONROAD model also estimates GSE emissions, but that method is deemed less accurate than EDMS’s LTO-based estimates and an EIS critical error check prohibits GSE SCCs from being submitted to the non-road equipment data category which would duplicate emissions. More on Non-road equipment is described in Section 4.5. Thus, the 2011 NEI uses only data for GSEs and APUs from EDMS.
4.2.5.2 Emissions for airports without detailed aircraft-specific activity data

EPA estimated emissions for aircraft where detailed aircraft-specific activity data were not available by combining aircraft operations data from FAA’s Terminal Area Forecasts (TAF) and 5010 forms (See 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.

4.2.5.3 Aviation lead emissions

Lead (Pb) emission estimates were handled differently than the other pollutants. Lead emissions are associated with leaded aviation fuel used in piston driven aircraft associated with general aviation. EDMS has a limited number of piston engine aircraft in its aircraft data and is currently not set up to calculate metal emissions; therefore, we did not use it to estimate aircraft lead emissions. Lead emissions are instead based on per-LTO emissions factors, assumptions about lead content in the fuel, and lead retention rates in the piston engines and oil. The general equation is:

\[
\text{LTO Pb (tons)} = (\text{piston – engine LTO})(\text{avgas Pb g/LTO})(1-\text{Pb retention})
\]

\[
907,180 \text{ g/ton}
\]

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 short tons nationwide, but the merged EPA and S/L/T data total to 237 tons for the 2011NEv1. EPA’s estimate for out-of-LTO or “in-flight” Pb is 238 tons. A summary of national EPA-only lead estimates is available [ref 5].

In-flight lead emissions were calculated based on national aviation gasoline consumption and similar assumptions noted above about lead fuel content and retention rates. These emissions are included in the nonpoint data category under SCC 227508700 (Mobile Sources; Aircraft; In-flight non-Landing-Takeoff cycle; Total). Lead emissions associated with airport LTO activities were subtracted from the national fuel-based lead emissions to approximate in-flight lead emissions which were allocated to individual states and noted with the county code 777. This county code is not used to identify any actual counties and; therefore, county code 777 provides a way of uniquely identifying all in-flight emissions from other sources in the nonpoint data category in the NEI.

4.2.6 Summary of quality assurance methods

The agency-submitted aircraft emission estimates were compared to EPA’s estimates by pollutant and SCC at the unit (e.g., commercial, general aviation, military, air taxi) and process (SCC).

Findings and impacts:

1. Aircraft-related records were tagged (and excluded from the NEI selection) as follows:
- California records with outlier high values:
  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.

4.2.7 References for Aircraft


4.3 Commercial Marine Vessels

The 2011 NEI includes emissions from commercial marine vessel (CMV) activity in the 50 states, Puerto Rico, and US Virgin Isles, out to 200 nautical miles from the US coastline.

4.3.1 Revisions for the NEI 2011 v2

Substantial revisions were made for 2011 v2:

- All EPA CMV C1 and C2 estimates were revised with geographic allocation updates (national totals remained the same).
- All EPA CMV C3 estimates within Emission Control Areas (ECA) were revised because v1 had been calculated as if the sulfur ECA was in effect, but it did not actually take effect until August 2012. This change in fuel type increased SO\textsubscript{2}, PM, and NO\textsubscript{x} emissions for C3 vessels in these areas.
- SLT emissions were resubmitted to prohibit double counting where EPA and SLT locations/shapes were in conflict and became additive when they were merged.
- California VOC-HAPs were found to be erroneously high and were tagged and replaced using “HAP-augmentation” that calculates VOC-HAPs from the California VOC submittals.
- Port of Angeles (Washington State) emissions were revised, including a port shape file addition.
- Alaska emissions in retired FIP counties were reallocated to existing counties.
- Oregon had their marine vessel submission deleted in favor of EPA-only estimates for that state.

4.3.2 Sector description

The CMV sector includes boats and ships used either directly or indirectly in the conduct of commerce or military activity. The majority of vessels in this category are powered by diesel engines that are either fueled with distillate or residual fuel oil blends. For the purpose of this inventory, we assume that Category 3 (C3) vessels primarily use residual blends while Category 1 and 2 (C1 and C2) vessels typically used distillate fuels.

The C3 inventory includes vessels which use C3 engines for propulsion. C3 engines are defined as having displacement above 30 liters per cylinder. The resulting inventory includes emissions from both propulsion and auxiliary engines used on these vessels, as well as those on gas and steam turbine vessels. Geographically, the inventories include port and interport emissions that occur within the area that extends 200 nautical miles (nm) from the official U.S. shoreline, which is roughly equivalent to the border of the U.S. Exclusive Economic Zone. Only some of these emissions are allocated to states based on official state boundaries that typically extend 3 miles offshore (see Section 4.3.4).

The C1 and C2 vessels tend to be smaller ships that operate closer to shore, and along inland and intercoastal waterways. Naval vessels are not included in this inventory, though Coast Guard vessels are included as part of the C1 and C2 vessels.

The CMV source category does not include recreational marine vessels, which are generally less than 100 feet in length, most being less than 30 feet, and powered by either inboard or outboard. These emissions are included in those calculated by the NONROAD model; they reside in the nonroad data category and EIS “Mobile - Non-Road Equipment” sectors of the 2011 NEI.

Each of the commercial marine SCCs requires an appropriate emissions type (M=maneuvering, H=hotelling, C=cruise, Z=reduced speed zone) because emission factors vary by emission type. Each SCC and emissions type combination was allocated to a shape file identifier in the nonpoint inventory. The allowed combinations are shown in Table 4-5. The default values are those assumed when the actual emission type may be unknown; for
example, emissions that occur in shipping lanes are assumed to be ‘cruising’ and cannot be ‘hotelling’, which only occurs at ports.

Table 4-5: Commercial Marine Vessel SCCs and emission types in EPA estimates

<table>
<thead>
<tr>
<th>SCC</th>
<th>SCC Description</th>
<th>Allowed</th>
<th>Default</th>
</tr>
</thead>
<tbody>
<tr>
<td>2280002100</td>
<td>Marine Vessels, Commercial Diesel Port</td>
<td>M</td>
<td>M</td>
</tr>
<tr>
<td>2280002200</td>
<td>Marine Vessels, Commercial Diesel Underway</td>
<td>C</td>
<td>C</td>
</tr>
<tr>
<td>2280003100</td>
<td>Marine Vessels, Commercial Residual Port</td>
<td>H</td>
<td>H</td>
</tr>
<tr>
<td>2280003100</td>
<td>Marine Vessels, Commercial Residual Port</td>
<td>M</td>
<td>H</td>
</tr>
<tr>
<td>2280003200</td>
<td>Marine Vessels, Commercial Residual Underway</td>
<td>C</td>
<td>C</td>
</tr>
<tr>
<td>2280003200</td>
<td>Marine Vessels, Commercial Residual Underway</td>
<td>Z</td>
<td>C</td>
</tr>
</tbody>
</table>

Shown in Table 4-6, gasoline CMV emissions were submitted by Washington State and included in the NEI.

Table 4-6: Additional Commercial Marine Vessel SCC used by Washington

<table>
<thead>
<tr>
<th>SCC</th>
<th>SCC Description</th>
<th>States</th>
</tr>
</thead>
<tbody>
<tr>
<td>2280004000</td>
<td>Mobile Sources, Marine Vessels, Commercial, Gasoline, Total, All Vessel Types</td>
<td>WA</td>
</tr>
</tbody>
</table>

4.3.3 Sources of data overview and selection hierarchy

EPA received emissions data from the agencies identified in Table 4-7.

Table 4-7: Agencies that submitted Commercial Marine Vessels emissions data

<table>
<thead>
<tr>
<th>Agency</th>
<th>Agency Type</th>
</tr>
</thead>
<tbody>
<tr>
<td>California Air Resources Board</td>
<td>State</td>
</tr>
<tr>
<td>Delaware Department of Natural Resources and Environmental Control</td>
<td>State</td>
</tr>
<tr>
<td>Illinois Environmental Protection Agency</td>
<td>State</td>
</tr>
<tr>
<td>Maryland Department of the Environment</td>
<td>State</td>
</tr>
<tr>
<td>New Hampshire Department of Environmental Services</td>
<td>State</td>
</tr>
<tr>
<td>New Jersey Department of Environment Protection</td>
<td>State</td>
</tr>
<tr>
<td>Oregon Department of Environmental Quality*</td>
<td>State</td>
</tr>
<tr>
<td>South Carolina Department of Health and Environmental Control</td>
<td>State</td>
</tr>
<tr>
<td>Texas Commission on Environmental Quality</td>
<td>State</td>
</tr>
<tr>
<td>Washington State Department of Ecology</td>
<td>State</td>
</tr>
</tbody>
</table>

*Oregon estimate were removed for 2011 v2

Table 4-8 shows the selection hierarchy for the CMV sector. This hierarchy pulls the relevant datasets for this sector from the overall nonpoint sources hierarchy listed in Section 3.

Table 4-8: 2011 NEIv2 commercial marine vehicle selection hierarchy

<table>
<thead>
<tr>
<th>Priority</th>
<th>Dataset Name</th>
<th>Dataset Content</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>State/Local/Tribal Data</td>
<td>Submitted commercial marine vessel emissions</td>
</tr>
<tr>
<td>2</td>
<td>2011EPA_HAP-Augmentation</td>
<td>Uses emission factors to calculate HAP values based on S/L/T agency submitted criteria estimates (VOC or PM species)</td>
</tr>
<tr>
<td>3</td>
<td>2011EPA_CMVLADCO</td>
<td>Submitted by LADCO for state’s that approved</td>
</tr>
<tr>
<td>4</td>
<td>2011EPA_CMV</td>
<td>EPA data (Section 4.3.5)</td>
</tr>
</tbody>
</table>
4.3.4 Spatial coverage and data sources for the sector

The commercial marine vessel sector includes emissions in every US state except Arizona, Colorado, Montana, Nevada, New Mexico, North Dakota, South Dakota, Utah, Vermont, and Wyoming. It also includes emissions for Puerto Rico and US Virgin Islands, as well as emissions in federal waters.

4.3.5 EPA-developed commercial marine vessel emissions data

EPA estimated CMV emission estimates as a collaborative effort between the Office of Transportation and Air Quality (OTAQ) and OAQPS. EPA developed the Category 3 commercial marine inventories for a base year of 2002 and then projected to 2011 by applying regional adjustment factors to account for growth. In addition, EPA developed and applied NOX adjustment factors to account for implementation of the NOX Tier 1 standard. The C3 growth factors, NOX adjustment factors by tier and calendar year, and NOX adjustment factors by engine type and speed are defined in Appendix A of the project report Documentation for the Commercial Marine Vessel Component of the National Emissions Inventory Methodology, March 30, 2010 [ref 1]. For Category 1 and 2 marine diesel engines, the emission estimates were consistent with the 2011 Locomotive and Marine federal rule making [ref 2]). EPA derived HAP estimates by applying toxic fractions to VOC or PM estimates.

EPA then allocated these emissions to individual GIS polygons (see Section 4.3.5.1) using methods that varied by operating mode (i.e., hotelling, maneuvering, reduced speed zone, and underway). For example, port emissions appear only in port polygons, federal water emissions in federal waters. HAP emissions were estimated by applying speciation profiles to each polygon’s VOC and PM estimates; see also Appendix B of the 2008 NEI CMV documentation [ref 1].

EPA allocated emissions estimates based on activity to GIS polygons representing port and waterway. GIS polygons allowed the estimation/allocation of emissions to defined port, waterway, and coastal areas.

4.3.5.1 Allocation of port and underway emissions

EPA developed port boundaries using a variety of resources to identify the most accurate port boundaries. First, GIS data or maps provided directly from the port were used. Next, maps or port descriptions from local port authorities, port districts, etc. were used in combination with existing GIS data to identify port boundaries. Finally, satellite imagery from tools such as Google Earth and street layers from StreetMap USA were used to delineate port areas. We placed primary emphasis on mapping the 117 ports with Category 3 vessel activity using available shape files of the port area. The shape file used for 2011 incorporated the efforts made in 2008.
During the 2008 NEI development, the Port of Huntington was developed independently, given its large extent and limited available map data. The state of West Virginia provided a revised shape file of US Army Corps of Engineers port terminals reported to be part of the Port of Huntington-Tristate area. The revised shape that includes a 200 meter buffer of the water features near these port terminals was created to identify the port area.

In all cases, polygons were created on land, bordering waterways and coastal areas, and were split by county boundary, such that no shape file crosses county lines and county total emission can be easily summed. Each polygon was identified by the port name and state and county FIPS in addition to a unique ShapeID. Smaller ports with Category 1 and 2 activities were mapped as small circles, such that the port is much like a point source, but without the complication of emissions appearing in both point and nonpoint inventories. Note that no Category 3 emissions were mapped to small circles. The final set of port and underway shapefile GIS data is posted at http://www.epa.gov/ttn/chief/net/2011inventory.html#inventorydoc.

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). See ref 3, ref 4 and ref 5.

These updates changed the allocation fractions of emissions to underway and port county/shapeID combinations. Agencies were given an opportunity to resubmit their emissions allocated in proportion to EPA’s.

The C3 estimates were grown in gridded Emissions Control Area (ECA) model data from 2002 to 2011. The 2002 data are documented in Technical Support Document (TSD) Preparation of Emissions Inventories for the Version 5.0, 2007, December 14, 2012 (see 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.

4.3.5.1 LADCO emissions

The regional organization Lake Michigan Air Directors Consortium (LADCO) provided an alternative data set, labeled in the NEI as 2011EPA_CMVLADCO. For state’s that approved the use of these estimates, they were used as the highest priority. Those states are Indiana, Michigan, Minnesota, Ohio, and Wisconsin.

4.3.6 Summary of quality assurance methods

EPA compared shape-, state-, and county-level sums in (1) EPA default data, (2) S/L/T agency submittals and (3) the resultant 2011 NEI selection by

- Included pollutants, SCCs, SCC-Emission Types
- Emissions summed to agency and SCC level
Findings:

The EIS generated a critical error and did not allow county-wide emission records for CMV, except when the S/L/T submitted to counties for which EPA had no shape ID available for that SCC. S/L/T agencies were encouraged to use the EPA-provided shape-to-county fractions provided at http://www.epa.gov/ttn/chief/net/2011inventory.html#inventorydoc if they were unsure how to distribute county emissions to shapes. For 2011 v2, all SLT emissions were updated to insure no duplication (additive results) when EPA and SLT data were merged in the selection.

1. California VOC HAPs were found to be out of agreement and erroneously high in comparison to their submitted VOCs. EPA used “HAP Augmentation” to create HAP species from CA’s submitted VOC values.
2. California submitted CMV values also to counties for which EPA had no shape IDs or emissions. CA submitted several HAPs, and only some CAP (no VOC)

4.3.7 References for Commercial Marine Vessels


4.4 Locomotives

4.4.1 Revisions for the NEI 2011 v2

Changes to this sector were limited to new SLT submittal updates from Virginia, New Jersey, and Washoe County NV. Alaska emissions in retired FIP counties were reallocated to existing counties.

4.4.2 Sector description

The locomotive sector includes railroad locomotives powered by diesel-electric engines. A diesel-electric locomotive uses 2-stroke or 4-stroke diesel engines and an alternator or a generator to produce the electricity required to power its traction motors. The locomotive source category is further divided up into categories: Class I line haul, Class II/III line haul, Passenger, Commuter, and Yard. Table 4-9 below indicates locomotive SCCs and whether EPA estimated emissions. If EPA did not estimate the emissions, then all emissions from that SCC that appear in the inventory are from S/L/T agencies.
Table 4-9: Locomotive SCCs, descriptions, and EPA estimation status

<table>
<thead>
<tr>
<th>SCC</th>
<th>Description</th>
<th>EPA Estimated?</th>
<th>Data Category</th>
</tr>
</thead>
<tbody>
<tr>
<td>2285002006</td>
<td>Mobile Sources Railroad Equipment Diesel Line Haul Locomotives: Class I Operations</td>
<td>Yes – in shape files</td>
<td>Nonpoint</td>
</tr>
<tr>
<td>2285002007</td>
<td>Mobile Sources Railroad Equipment Diesel Line Haul Locomotives: Class II / III Operations</td>
<td>Yes - in shape files</td>
<td>Nonpoint</td>
</tr>
<tr>
<td>2285002008</td>
<td>Mobile Sources Railroad Equipment Diesel Line Haul Locomotives: Passenger Trains (Amtrak)</td>
<td>No</td>
<td>Nonpoint</td>
</tr>
<tr>
<td>2285002009</td>
<td>Mobile Sources Railroad Equipment Diesel Line Haul Locomotives: Commuter Lines</td>
<td>No</td>
<td>Nonpoint</td>
</tr>
<tr>
<td>2285002010</td>
<td>Railroad Equipment Diesel Yard Locomotives</td>
<td>No</td>
<td>Nonpoint</td>
</tr>
<tr>
<td>28500201</td>
<td>Internal Combustion Engines Railroad Equipment Diesel Yard</td>
<td>Yes – as point sources</td>
<td>Point</td>
</tr>
</tbody>
</table>

4.4.3 Sources of data overview and selection hierarchy

The locomotives sector includes data from S/L/T agency-provided emissions data, and an EPA dataset of locomotive emissions. EPA estimated emissions from select locomotive SCCs as indicated in Table 4-9. The agencies listed in Table 4-10 also submitted emissions to locomotive SCCs.

Table 4-10: Agencies that submitted Locomotives emissions to the 2011 NEI

<table>
<thead>
<tr>
<th>Agency Name</th>
<th>Data Set Short Name</th>
<th>Agency FIP or Tribal Code</th>
<th>Rail</th>
<th>Point Yard</th>
<th>Nonpoint Yard</th>
</tr>
</thead>
<tbody>
<tr>
<td>Alaska</td>
<td>2011AKDEC</td>
<td>02</td>
<td>X</td>
<td></td>
<td></td>
</tr>
<tr>
<td>California</td>
<td>2011CARB</td>
<td>06</td>
<td>X</td>
<td>X</td>
<td></td>
</tr>
<tr>
<td>Connecticut</td>
<td>2011CTBAM</td>
<td>09</td>
<td>X</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Illinois</td>
<td>2011ILEPA</td>
<td>17</td>
<td>X</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Maricopa Co Arizona</td>
<td>2011Maricopa</td>
<td>04013</td>
<td>X</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Maryland</td>
<td>2011MDDOE</td>
<td>24</td>
<td>X</td>
<td>X</td>
<td>X</td>
</tr>
<tr>
<td>Massachusetts</td>
<td>2011MADEP</td>
<td>25</td>
<td>X</td>
<td></td>
<td></td>
</tr>
<tr>
<td>New Jersey</td>
<td>2011NJDEP</td>
<td>34</td>
<td>X</td>
<td></td>
<td></td>
</tr>
<tr>
<td>North Carolina</td>
<td>2011NCDAQ</td>
<td>37</td>
<td>X</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Sac &amp; Fox Nation of Missouri in Kansas and Nebraska</td>
<td>2011TR863</td>
<td>863</td>
<td>X</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Texas</td>
<td>2011TXCEQ</td>
<td>48</td>
<td>X</td>
<td>X</td>
<td>X</td>
</tr>
<tr>
<td>Utah</td>
<td>2011UTDAQ</td>
<td>49</td>
<td>X</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Virginia</td>
<td>2011VADEQ</td>
<td>51</td>
<td>X</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Washington</td>
<td>2011WADOE</td>
<td>53</td>
<td>X</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Washoe Co Nevada</td>
<td>2011WashoeCty</td>
<td>32031</td>
<td>X</td>
<td>X</td>
<td></td>
</tr>
</tbody>
</table>

4.4.4 Spatial coverage and data sources for the sector

The locomotives sector includes emissions in all states, DC, Puerto Rico, and some tribes.
4.4.5 EPA-developed locomotive emissions data

EPA’s 2011 national rail estimates were developed by applying growth factors to the 2008NEI values based on railroad freight traffic data from the 2008 and 2011 R-1 reports submitted by all Class I rail lines to the Surface Transportation Board and employment statistics from the American Short Lines and Regional Railroad Association for class II and III. See ERG project report *Development of 2011 Railroad Component for National Emissions Inventory, September 5, 2012* [ref 1] for details. For more information on the 2008 methodology, refer to the 2008 documentation [ref 2]. The emissions were allocated to line haul shape IDs and yard locations based on 2008 allocations.

4.4.5.1 Hazardous Air Pollutant emissions estimates

HAP emissions were estimated by applying speciation profiles to the VOC or PM estimates. Since California uses low sulfur diesel fuel and emission factors specific for California railroad fuels were available, calculations of California’s emissions were done separately from the other states. HAP estimates were calculated at the yard and link level, after the criteria emissions had been allocated.

4.4.6 Summary of quality assurance methods

EPA and Agency submitted emissions were compared at shape, state, and county to EPA default values.

Findings:

- California rail emissions had suspiciously high HAP values. These HAP data were tagged and therefore are not included in the 2011 v2.
- California submitted rail records that duplicated identical CA submittal but with the addition of an emission type = C (which is intended only for cruising CMV records). These records were tagged.
- Though EPA’s estimates are intended to include activity in all tribe and non-tribal areas, the EPA dataset does not break out the data into tribal areas. Therefore the 2011 NEI emissions in tribal areas are equal to the tribal submission only, and do not have consistent SCCs and pollutants as are present in counties.

EPA and Agency rail yard emissions were compared. All EPA’s rail yard estimates are point sources. S/L/T agencies were allowed to submit nonpoint county-level estimates, but were asked to verify they did not conflict with EPA’s, or they could submit point estimates that would be chosen over EPA’s. No obvious conflicts were noted.
As with CMV, where S/L/T agency and EPA estimates did not use identical county/shape/SCC combinations, the resultant selection may equal to neither EPA’s nor the SLT agencies value. For example, see AZ and NJ SCC =2285002007, and MD SCC = 2285002007 in Table 4-11.

Table 4-11: Comparison of NOx emissions (tons) among EPA, S/L/T agency, and 2011v1NEI selection for Rail

<table>
<thead>
<tr>
<th>State</th>
<th>Tribal Code</th>
<th>SCC</th>
<th>EPA</th>
<th>SLT</th>
<th>2011v1 Selection</th>
<th>2011v2 Selection</th>
</tr>
</thead>
<tbody>
<tr>
<td>AK</td>
<td>2285002006</td>
<td>863</td>
<td>417</td>
<td>3</td>
<td>3</td>
<td>3</td>
</tr>
<tr>
<td>AK</td>
<td>2285002007</td>
<td>703</td>
<td>703</td>
<td>703</td>
<td>703</td>
<td>703</td>
</tr>
<tr>
<td>AZ</td>
<td>2285002006</td>
<td>22,181</td>
<td>1,263</td>
<td>22,030</td>
<td>22,030</td>
<td>22,030</td>
</tr>
<tr>
<td>AZ</td>
<td>2285002007</td>
<td>529</td>
<td>0</td>
<td>485</td>
<td>485</td>
<td>485</td>
</tr>
<tr>
<td>AZ</td>
<td>2285002008</td>
<td>9</td>
<td>9</td>
<td>9</td>
<td>9</td>
<td>9</td>
</tr>
<tr>
<td>CA</td>
<td>2285002006</td>
<td>29,642</td>
<td>31,225</td>
<td>31,225</td>
<td>31,225</td>
<td>31,225</td>
</tr>
<tr>
<td>CA</td>
<td>2285002007</td>
<td>1,714</td>
<td>0</td>
<td>0</td>
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<td>0</td>
</tr>
<tr>
<td>CA</td>
<td>2285002008</td>
<td>2,667</td>
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<td>2,667</td>
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<td>2,667</td>
</tr>
<tr>
<td>CA</td>
<td>2285002009</td>
<td>1,078</td>
<td>1,078</td>
<td>1,078</td>
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</tr>
<tr>
<td>CA</td>
<td>2285002010</td>
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</tr>
<tr>
<td>CT</td>
<td>2285002006</td>
<td>639</td>
<td>639</td>
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<td>CT</td>
<td>2285002007</td>
<td>241</td>
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<td>358</td>
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<tr>
<td>IL</td>
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<td>MA</td>
<td>2285002009</td>
<td>2,589</td>
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<tr>
<td>MD</td>
<td>2285002006</td>
<td>3,419</td>
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<td>MD</td>
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<tr>
<td>NJ</td>
<td>2285002006</td>
<td>1,194</td>
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</tr>
<tr>
<td>NJ</td>
<td>2285002007</td>
<td>652</td>
<td>738</td>
<td>652</td>
<td>815</td>
<td>815</td>
</tr>
<tr>
<td>NJ</td>
<td>2285002009</td>
<td>2,606</td>
<td>2,606</td>
<td>2,606</td>
<td>2,606</td>
<td>2,606</td>
</tr>
<tr>
<td>NY</td>
<td>2285002006</td>
<td>12,070</td>
<td>12,070</td>
<td>12,070</td>
<td>12,070</td>
<td>12,070</td>
</tr>
<tr>
<td>NY</td>
<td>2285002007</td>
<td>1,922</td>
<td>1,922</td>
<td>1,922</td>
<td>1,922</td>
<td>1,922</td>
</tr>
<tr>
<td>TX</td>
<td>2285002006</td>
<td>60,389</td>
<td>58,762</td>
<td>58,762</td>
<td>58,762</td>
<td>58,762</td>
</tr>
<tr>
<td>TX</td>
<td>2285002007</td>
<td>2,168</td>
<td>2,633</td>
<td>2,633</td>
<td>2,633</td>
<td>2,633</td>
</tr>
<tr>
<td>TX</td>
<td>2285002010</td>
<td>2,225</td>
<td>2,225</td>
<td>2,225</td>
<td>2,225</td>
<td>2,225</td>
</tr>
<tr>
<td>UT</td>
<td>2285002006</td>
<td>6,287</td>
<td>5,878</td>
<td>5,878</td>
<td>5,878</td>
<td>5,878</td>
</tr>
<tr>
<td>UT</td>
<td>2285002007</td>
<td>244</td>
<td>244</td>
<td>244</td>
<td>244</td>
<td>244</td>
</tr>
<tr>
<td>VA</td>
<td>2285002006</td>
<td>15,603</td>
<td>15,603</td>
<td>15,603</td>
<td>15,603</td>
<td>15,603</td>
</tr>
<tr>
<td>VA</td>
<td>2285002007</td>
<td>387</td>
<td>387</td>
<td>387</td>
<td>387</td>
<td>387</td>
</tr>
<tr>
<td>State</td>
<td>Tribal Code</td>
<td>SCC</td>
<td>EPA</td>
<td>SLT</td>
<td>2011v1 Selection</td>
<td>2011v2 Selection</td>
</tr>
<tr>
<td>-------</td>
<td>-------------</td>
<td>-----</td>
<td>-----</td>
<td>-----</td>
<td>-----------------</td>
<td>-----------------</td>
</tr>
<tr>
<td>VA</td>
<td>2285002008</td>
<td></td>
<td></td>
<td>622</td>
<td>622</td>
<td></td>
</tr>
<tr>
<td>VA</td>
<td>2285002009</td>
<td></td>
<td></td>
<td>267</td>
<td>267</td>
<td></td>
</tr>
<tr>
<td>WA</td>
<td>2285002006</td>
<td>14,445</td>
<td>12,420</td>
<td>12,420</td>
<td>12,420</td>
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</tr>
<tr>
<td>WA</td>
<td>2285002007</td>
<td>978</td>
<td></td>
<td>978</td>
<td>978</td>
<td></td>
</tr>
<tr>
<td>WA</td>
<td>2285002009</td>
<td></td>
<td></td>
<td>534</td>
<td>534</td>
<td></td>
</tr>
</tbody>
</table>

4.4.7 References for Locomotives


4.5 Nonroad Equipment – Diesel, Gasoline and other

Although “nonroad” is used to refer to all transportation sources that are not on-highway, these EIS sectors and this section address nonroad equipment other than locomotives, aircraft, or commercial marine vehicles.

4.5.1 Revisions for the NEI 2011 v2

Only Delaware was updated for 2011 v2, to reflect revised inputs provided by the state.

4.5.2 Sector description

This section deals specifically with emissions processes calculated by the EPA’s NONROAD model ([http://www.epa.gov/otaq/nonrdmdl.htm](http://www.epa.gov/otaq/nonrdmdl.htm)) and the OFFROAD model ([http://www.arb.ca.gov/msei/offroad/offroad.htm](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/otaq/nmim.htm](http://www.epa.gov/otaq/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 4-12.
### Table 4-12: NMIM Nonroad Equipment and fuel types

<table>
<thead>
<tr>
<th>Equipment Types</th>
<th>Fuel Types</th>
</tr>
</thead>
<tbody>
<tr>
<td>Recreational</td>
<td></td>
</tr>
<tr>
<td>Construction</td>
<td></td>
</tr>
<tr>
<td>Industrial</td>
<td></td>
</tr>
<tr>
<td>Lawn and Garden</td>
<td></td>
</tr>
<tr>
<td>Agriculture</td>
<td></td>
</tr>
<tr>
<td>Commercial</td>
<td></td>
</tr>
<tr>
<td>Logging</td>
<td></td>
</tr>
<tr>
<td>Airport Support (GSE) (excludes aircraft)</td>
<td>CNG</td>
</tr>
<tr>
<td>Underground Mining</td>
<td>Diesel</td>
</tr>
<tr>
<td>Oilfield</td>
<td>Gasoline</td>
</tr>
<tr>
<td>Pleasure Craft (recreational marine) (excludes commercial marine vessels)</td>
<td>LPG</td>
</tr>
<tr>
<td>Railroad (excludes locomotives)</td>
<td></td>
</tr>
</tbody>
</table>

NMIM estimates monthly emissions for total hydrocarbons (THC), nitrogen oxides, carbon monoxide, particulate matter, and sulfur dioxide, as well as calculating monthly fuel consumption. NMIM uses ratios from some of these emissions to calculate emissions for an additional 33 hazardous air pollutants (HAPs) and 17 dioxin/furan congeners. All of the input and activity data required to run NMIM are contained within the NCD, which is distributed with the model. S/L/T agencies are able to update the data within the NCD to create emissions estimates that accurately reflect local conditions and equipment usage.

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

Table 4-13 shows the selection hierarchy for the nonroad data category. EPA’s NMIM estimates using S/L inputs are used other than in California and Texas. California-submitted emissions were used along with an EPA correction dataset containing only VOC. For Texas, Texas-submitted data were used ahead of the EPA’s NMIM estimates, which were used second to gap fill any missing data/pollutants from the Texas dataset.

EPA asked S/L/T agencies to provide model inputs (NCDs) instead of emissions for 2011. However, some agencies also submitted nonroad emissions. In addition to EPA’s estimates, the agencies included in Table 4-14 submitted inputs and/or emissions to the 2011 NEI.
Table 4-13: Selection hierarchy for the Nonroad mobile Equipment data category

<table>
<thead>
<tr>
<th>Priority</th>
<th>Dataset</th>
<th>Notes</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>2011_EPA_Mobile</td>
<td>Contains emissions from EPA’s NMIM run using S/L-provided inputs as shown in Table 4-14 and NMIM defaults where S/L accepted EPA default.</td>
</tr>
<tr>
<td>2</td>
<td>2011EPA_CAmodeledata</td>
<td>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.</td>
</tr>
</tbody>
</table>

California

<table>
<thead>
<tr>
<th>Priority</th>
<th>Dataset</th>
<th>Notes</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>California Air Resources Board</td>
<td>Uses CA-specific model, OFFROAD</td>
</tr>
<tr>
<td>2</td>
<td>2011_EPA_Mobile</td>
<td>EPA estimates (same dataset described above)</td>
</tr>
</tbody>
</table>

Texas

<table>
<thead>
<tr>
<th>Priority</th>
<th>Dataset</th>
<th>Notes</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Texas Commission on Environmental Quality</td>
<td>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.</td>
</tr>
<tr>
<td>2</td>
<td>2011_EPA_Mobile</td>
<td>EPA estimates (same dataset described above)</td>
</tr>
</tbody>
</table>

Table 4-14 shows the submission dates for the S/L/T agency-submitted nonroad emissions and/or NCD activity data for the 2011 NEI via the Emission Inventory System (EIS) Gateway.

<table>
<thead>
<tr>
<th>Agency Organization</th>
<th>Nonroad Emissions</th>
<th>Nonroad NCD</th>
<th>Notes</th>
</tr>
</thead>
<tbody>
<tr>
<td>California Air Resources Board</td>
<td>4/23/13</td>
<td></td>
<td>Uses model specific to CA</td>
</tr>
<tr>
<td>Coeur d’Alene Tribe</td>
<td>12/7/12</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Connecticut Department Of Environmental Protection</td>
<td></td>
<td>1/8/13</td>
<td></td>
</tr>
<tr>
<td>Delaware Department of Natural Resources and Environmental Control*</td>
<td></td>
<td>4/1/13</td>
<td></td>
</tr>
<tr>
<td>Eastern Band of Cherokee Indians</td>
<td>10/23/12</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Georgia Department of Natural Resources</td>
<td>12/12/12</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Idaho Department of Environmental Quality</td>
<td>12/5/12</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Illinois Environmental Protection Agency</td>
<td>10/24/12</td>
<td>10/24/12</td>
<td>Submitted NCD was used rather than emissions</td>
</tr>
<tr>
<td>Kootenai Tribe of Idaho</td>
<td>12/14/12</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Maryland Department of the Environment</td>
<td>12/21/12</td>
<td>2/22/13</td>
<td></td>
</tr>
<tr>
<td>Metro Public Health of Nashville/Davidson County</td>
<td>12/18/12</td>
<td></td>
<td>Accepted EPA Emission Estimates</td>
</tr>
<tr>
<td>Nevada Division of Environmental Protection</td>
<td>12/31/12</td>
<td></td>
<td></td>
</tr>
<tr>
<td>New Hampshire Department of Environmental Services</td>
<td>10/17/12</td>
<td></td>
<td></td>
</tr>
<tr>
<td>New Jersey Department of Environment Protection</td>
<td>5/14/13</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Nez Perce Tribe</td>
<td>12/10/12</td>
<td></td>
<td></td>
</tr>
<tr>
<td>North Carolina Department of Environment and Natural Resources</td>
<td>12/19/12</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Agency Organization</td>
<td>Nonroad Emissions</td>
<td>Nonroad NCD</td>
<td>Notes</td>
</tr>
<tr>
<td>-------------------------------------------------------------------------</td>
<td>-------------------</td>
<td>-------------</td>
<td>----------------------------</td>
</tr>
<tr>
<td>Sac and Fox Nation of Missouri in Kansas and Nebraska Reservation</td>
<td>10/5/12</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Shoshone-Bannock Tribes of the Fort Hall Reservation of Idaho</td>
<td>12/6/12</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Texas Commission on Environmental Quality</td>
<td>12/11/12</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Utah Division of Air Quality</td>
<td>1/7/13</td>
<td>Accepted EPA Emission Estimates</td>
<td></td>
</tr>
<tr>
<td>Washington State Department of Ecology</td>
<td>1/9/13</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Washoe County Health District</td>
<td>12/26/12</td>
<td>Accepted EPA Emission Estimates</td>
<td></td>
</tr>
<tr>
<td>Wisconsin Department of Natural Resources</td>
<td></td>
<td>1/9/13</td>
<td></td>
</tr>
</tbody>
</table>

*Original Nonroad NCD submission was January 7, 2013. The updated NCD to reflect this update is named NCD20140620_nei2011v2.*

4.5.4 Spatial coverage and data sources for the sector

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

4.5.5 EPA-developed NMIM-based nonroad emissions data

EPA uses the activity data within NIMIM as a basis for air quality modeling, rule development, international reporting, air quality trends analysis, and other activities. To that end, a single NCD for the 2011 NEI was developed to represent, as accurately as possible, the activity data upon which the 2011 NEI emissions are based. This newly developed NCD, named NCD20130531_nei2011v1, was created using the approach discussed in the following sections. Like the emissions, the updates to the NCD were determined using a hierarchy decision model, where defaults were replaced with S/L-supplied data. The exception to hierarchy decision model is that EPA-supplied fuel and meteorological data were used for all 2011 NMIM modeling runs, as explained below. However, as a matter of record, a copy of NCD20101201a includes all the state-supplied updates, including fuel and meteorological data was provided to EPA and is named NCD20130531. Once 2011 v1 was posted, S/L/T agencies had the opportunity to submit updates. The state of Delaware submitted an update for the activity data used for developing the nonroad emissions. The final version of the NCD, reflecting all of the updates for the 2011 NEI are reflected in the NCD named NCD20140620_nei2011v2. The development of the NCD for the 2011 NEI is explained in the following sections. See file “2011NEIt2_supdata_nr_RunNotesChangeLog” for a description of the update history of the NMIM NCD for the most recent updates made to NMIM. A comprehensive history of updates is recorded in the file Change Log.docx, which is included in the NCD Readme folder.

4.5.5.1 Default NCD

The default 2011 NCD, NCD20130531_nei2011v1, is based upon NCD20101201a. EPA provided updated fuel and meteorological data for inclusion in the new 2011 NCD. Using the fuel data provided by EPA in the file named RegionalFuels_2011_20130208fueilsNMIM.zip, the countyyearmonth, gasoline, and diesel tables were replaced. However, the fuel updates provided by EPA did not contain fuel data for Alaska, Hawaii, Puerto Rico, or the U.S. Virgin. For these areas, fuel data from the original NCD20101201a was retained. The meteorological

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25 NCD20101201a is the NCD that is included in the current download of NMIM.

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data provided by EPA in the file named countymonthhour2011.zip were used to replace the countymonthhour table.

The NCD for 2011 v2 is a copy of the 2011 v1 NCD, NCD20130531_nei2011v1, but includes the second round updated submitted by the state of Delaware. This new NCD is titled NCD20140620_nei2011v2. The following sections describe all of the updates made to create the 2011 NEI v02.

4.5.5.2 State-submitted NCDs

NCD activity data submitted by state and local agencies via the EIS Gateway were used to replace default data, except for fuel and meteorological data. Even if an agency submitted fuel and meteorological data, per the instructions provided by EPA, the default values for these data parameters were retained. NCD tables updated using state and local NCD submissions are presented in Table 4-15. Again, more detailed information regarding specific updates can be found in the abbreviated NCD update history presented in “2011NEIv2_updata_nr_RunNotesChangeLog”, which also contains a table of external files updated using state-specific data.

<table>
<thead>
<tr>
<th>State Name</th>
<th>DataSource</th>
<th>CountyNRFile</th>
<th>County</th>
<th>CountyYearMonth*</th>
<th>Diesel*</th>
<th>Gasoline*</th>
<th>External Files</th>
<th>CountyYearMonthHour*</th>
</tr>
</thead>
<tbody>
<tr>
<td>Maryland</td>
<td>✓</td>
<td>✓</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>New Jersey</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Connecticut</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Delaware</td>
<td>✓</td>
<td>✓</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Georgia</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Idaho</td>
<td></td>
<td>✓</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Illinois</td>
<td></td>
<td>✓</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Nevada</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td></td>
<td>✓</td>
<td>✓</td>
<td></td>
<td></td>
</tr>
<tr>
<td>New Hampshire</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td></td>
<td>✓</td>
<td>✓</td>
<td></td>
<td></td>
</tr>
<tr>
<td>North Carolina</td>
<td></td>
<td>✓</td>
<td>✓</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Washington</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td></td>
<td>✓</td>
<td>✓</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Wisconsin</td>
<td></td>
<td>✓</td>
<td></td>
<td></td>
<td>✓</td>
<td>✓</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

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

4.5.5.3 State-assisted NCD development

Some State and Local agencies possessed activity data that could be incorporated into the 2011 NCD. However, the data were not formatted appropriately for inclusion into the NCD. In these instances, ERG worked with the state and local agencies to obtain the data and incorporate as much as possible into the 2011 NCD. A summary of the tables updated using this approach is presented in Table 4-16.
Table 4-16: State-assisted NCD table updates

<table>
<thead>
<tr>
<th>State Name</th>
<th>DataSource</th>
<th>CountyNRFile</th>
<th>County</th>
<th>CountyYearMonth*</th>
<th>Diesel*</th>
<th>Gasoline*</th>
<th>External Files</th>
<th>CountyYearMonthHour*</th>
</tr>
</thead>
<tbody>
<tr>
<td>Davidson County (Tennessee)</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td></td>
<td></td>
</tr>
<tr>
<td>New York</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td></td>
</tr>
<tr>
<td>Texas</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td></td>
</tr>
</tbody>
</table>

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

4.5.5.4 Nashville/Davidson County Tennessee

Nashville Pollution Control Division provided all 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 RVP and sulfur values in the fuel data tables within NMIM. Using EPA fuel data instead of agency-supplied fuel inputs for the 2011 NEI NCD, these updates were provided as a matter of record to EPA in NCD20130531.

4.5.5.5 New York

The New York Department of Environmental Conservation provided a state-specific allocation file for new housing developments (36000hou.alo). These data represent single and double (duplex) family homes. This data was updated using the U.S. Census data. These updates are reflected in the NMIM database NCD20140620_nei2011v2.

New York also provided copies of their NONROAD option files used to create their 2011 emissions inventory. The fuel data contained within the option files were extracted and used to update the RVP and sulfur values in the fuel data tables within NMIM. Using EPA fuel data instead of agency-supplied fuel inputs for the 2011 NEI NCD, these updates were provided as a matter of record to EPA in NCD20130531.

4.5.5.6 Texas

The Texas Commission on Environmental Quality (TCEQ) uses the Texas NONROAD (TexN) model to create their emissions estimates. TexN allows Texas to calculate emissions at a more granular level than what NMIM is able to accommodate. In addition to including state-specific climate and fuel profiles, TexN contains a separate activity profile for 25 different subsectors of diesel construction equipment (DCE). Diesel construction equipment is found in many different types of construction. However, their population and use profiles are unique within each of the sectors defined by the TexN model. TexN processes each of these subsectors separately and sums the emissions across all subsectors at the end of the processing. Furthermore, TexN applies post-processing adjustments to the calculated emissions based on several factors such as Texas Low Emission Diesel (TxLED) use, ground cover variation, altitude, and humidity corrections to name a few. Furthermore, Texas has done studies specific to certain areas within the state and have compiled activity data specific to...

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26 U.S. Census data file dc_acs_2009_5yr_g00__data1.txt, which is based on the 2005-2009 American Community Survey 5-Year Estimates (http://factfinder.census.gov/servlet/DTTable?_bm=y&-geo_id=01000US&-ds_name=ACS_2009_5YR_G00_&-mt_name=ACS_2009_5YR_G2000_B25024).
specific areas (e.g., Houston-Galveston-Brazoria and Dallas-Fort Worth). These activity values are denoted using a county flag within TexN. In order to create the NCD activity tables for Texas, data from TexN was queried and used to create an NCD that approximates Texas emissions. The approach used to develop the NCD for Texas is presented below.

Population data were extracted for the year 2011 for all sectors contained within TexN. The population data were then summed by SCC and horsepower bin. Average horsepower values within the TexN population data, weighted by equipment population, were calculated by SCC and horsepower bin. These data were used to update the external population file and are included in NCD20140620_nei2011v2.

The external growth file for the 2011 NCD was updated using population profiles from TexN. Population data from TexN was summed by year and SCC and assigned the appropriate indicator code, according to the default indicator code mapping with the NONROAD model. These data were used to update the external growth file and are included in NCD20140620_nei2011v2.

The activity data from TexN was processed using a statistical analysis software program (SAS©). A weighted average activity value was calculated for each equipment SCC using horsepower-hours as the weighting factor. (HP-hours were selected as the weighting factor as this value should correlate reasonably closely with total exhaust emissions.) The first step in this process was to calculate the cumulative hp-hrs over the entire population. Next, the population and hp-hrs were summed over each unique SCC-DCE Subsector-County Flag-Load Factor combination. Then, the fraction of hp-hrs for each SCC within each DCE Subsector and County Flag was calculated and applied to the total activity value. The resulting SAS outputs were then formatted according to the external file format for activity used by NMIM. These updates are included in NCD20140620_nei2011v2.

The geographic allocation of equipment populations 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 (XRF) value. These values were then used to build new allocation files for inclusion into NMIM and are included in NCD20140620_nei2011v2.

The fuel data within TexN contains fuel properties specific to Texas obtained through multiple fuel sampling surveys conducted by the State. These fuel properties were used to update the fuel data within NMIM for:

- gasoline RVP,
- diesel sulfur,
- gasoline sulfur,
- marine diesel sulfur,
- CNG and LPG sulfur,
- MTBE volume, ETBE volume, TAME volume, EtOH volume, and
- MTBE, ETBE, TAME, and EtOH market share.

Once again, the final NEI used EPA fuel data instead of agency-supplied fuel inputs, though the state updates were provided as a matter of record to EPA in NCD20130531.

4.5.5.7 Quality assurance

After the NMIM completed its execution, the resulting output databases were checked to ensure that no error messages were created during the runs for each geographical area. Furthermore, the NMIM generates the same number of output records for each RunID-FIPSCountyID-FIPSStateID-Year-Month combination. Therefore each of the output tables was checked to ensure the number of records for this combination of fields summed to the
correct record count. As expected, zero error messages were recorded by NMIM and every county produced the same number of output records.

Once the NMIM outputs were exported from the NMIM database, ERG created SAS programs to read in the detailed NMIM outputs and produce emissions summaries, plots, and charts to help identify outliers in emissions. As a part of this process, ERG also created programs to compare the 2011 emissions generated under this effort against other emission datasets. Comparisons were made between the 2011 emissions generated under this effort, 2011 emission estimates generated using all default input, the 2011 emissions submitted by state and local agencies for the 2011 NEI, as well as the 2008 NEI emissions.

Upon completion of the review and approval by EPA, ERG generated MOVES SMOKE-formatted files using the emissions generated by NMIM using the NCD20130531_nei2011v1, which includes all the required updates (excluding state-submitted fuel and meteorological data) submitted for 2011 v1. Later, updated SMOKE files were generated to reflect Delaware’s update for 2011 v2 using the NCD20140620_nei2011v2.

4.5.5.8 Summary of quality assurance on S/L/T agency emissions

Because EPA emphasized the submittal of inputs and helped agencies develop those inputs, there were only 2 states (TX and CA) and no tribes that submitted emissions data. Tribal emissions are accepted as is into the EIS, but are not included in the 2011 NEI because they may duplicate emissions already accounted for at the county-level.

For Texas, we compared state and county EPA defaults, agency submittals and selection results by (1) included pollutants, SCCs, SCC-Emission Types (nonroad emission types are R=refueling, E=evap, X=exhaust), and (2) emissions summed to agency level.

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 4-17.

| Table 4-17: SCC and emissions type with missing VOC in CA submittal |
|-----------------------|----------------------|
| SCC                   | Emissions Type       |
| 2260001020            | Evaporation          |
| 2260001020            | Exhaust              |
| 2265001010            | Evaporation          |
| 2265001010            | Exhaust              |
| 2265001030            | Evaporation          |
| 2265001030            | Exhaust              |
| 2265001060            | Evaporation          |
| 2265001060            | Exhaust              |
| 2270001060            | Evaporation          |
| 2270001060            | Exhaust              |
Separately from the EIS submittal, the California Air Resources Board (CARB) modeling group provided nonroad emissions data to EPA’s emissions modeling group in July 2012. This CARB “modelers” dataset was different than the data the CARB inventory group submitted to the EIS in that it contained total organic gases (TOG) instead of VOC, and TOG was present where the VOC was missing from the EIS CARB data. We chose to compute VOC for Table 4-17 SCC/emission types using the TOG from the “modelers” dataset. The original format of the “modelers” dataset was a text file with annual mobile emissions totals at the county level and for California source categories. The nonroad emissions were extracted from this file based on a California source category crosswalk to EPA’s SCCs. TOG was converted to VOC using VOC/TOG factors based on the SCC and emission type. Prior to using the “modelers” -based VOC for the missing SCCs, we compared VOC between the “modelers” dataset (after the conversion from TOG to VOC) and the EIS CARB data for SCCs with non-missing VOC. Because they were not identical, we chose to adjust the “modelers” VOC before adding submitting it to the EIS. The “modelers” data were adjusted by multiplying by the ratio of EIS CARB VOC to “modelers” VOC from common non-missing SCCs in both datasets. Ratios were computed for each county using VOC from the non-missing SCCs at the “SCC7” level (first 7 digits of the SCC). We submitted this adjusted “modelers” VOC to the EIS in the dataset “2011EPA_CAModelerdata”.

4.5.6 References for Nonroad Equipment


4.6 On-road mobile –All Vehicles and Refueling

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.

The 2008 NEI v1 and past NEIs included emissions from the MOBILE6 model. The 2011 NEI v1 included emissions from the MOVES2010b model. The 2011 NEI v2 used the latest available model, MOVES2014.

4.6.2 Sources of data overview, selection hierarchy, and changes to default data in NEI 2011 v2

EPA calculated the on-road emissions for the 2011 v2 for all states using MOVES. California emissions were later replaced with estimates based on California’s emissions submittal, as described in Section 4.6.2.2. Many states submitted county level input data for MOVES. The following states or counties provided inputs for v2: NY, Clark County NV, GA, NC, NH, NJ, OR, UT, VA, and WI. Table 4-25 lists the agencies who submitted 2011 data and their submittal dates to the EIS. This agency submission list includes the previous v1 submittals as well as the new and revised data states provided for 2011 v2. For counties in the lower 48 states, EPA used the SMOKE-MOVES integration tools (SMOKE-MOVES) to generate emission inventories sources. Section 4.6.3.7 describes SMOKE-MOVES processing steps. EPA ran MOVES in “inventory mode” to directly estimate county level emissions for
states and territories outside the lower 48 states (i.e., AK, HI, PR, and VI). California provided EPA with complete emissions based on the EMFAC2011 model.\textsuperscript{27}

The selection hierarchy for v2 favored local input data over EPA default input data. For California, EPA used the California ARB-provided emissions. For other states, EPA preferentially selected submitted local data over default data for use in MOVES runs.

As part of v2 updates of default data, EPA introduced new nationwide datasets of recent county-specific data to replace the older NEI EPA-default inputs. The Coordinating Research Council (CRC) and ERG conducted CRC project A-88 to compile and develop improved on-road datasets to improve the defaults used the NEI.\textsuperscript{28} The NEI default data updates focused on three specific areas: light-duty age distribution, light-duty population, and long-haul VMT fractions. Section 4.6.2.3 (EPA Default MOVES Inputs) describes these new data in detail.

EPA generated emissions using the latest available version of MOVES2014 (code version 20140925 and database version movesdb20140918).

4.6.2.1 Updated Source Classification Codes (SCC)

For 2011 NEIv2, EPA revised the source classification codes (SCCs) for the on-road sector. Previous inventories’ SCCs were consistent with the MOBILE6 model, while this model-ready inventory utilizes detailed SCCs that are more consistent with the source types and fuels that are in MOVES. The new SCCs have the form:

\[220FSSRRPP\]

Where “F” is the fuel type, “SS” is the source type, “RR” is the road type, and “PP” is the process type. For example, gas passenger cars on urban unrestricted roads running exhaust has SCC 2201210501 and diesel combination long-haul trucks parked in extended idle has SCC 2202620190.

For the underlying modeling (described below), EPA used these more detailed SCCs\textsuperscript{29}. For the NEI, the results were aggregated to more general SCCs which do not include road type and have more aggregated processes. For example, in the posted annual 2011 v2 emissions data, gas commercial trucks for all roads and parked emissions for all process (except refueling) has SCC 2201320080.

The previous SCCs from 2011 v1 do not map directly to the current set of SCCs. Therefore, it was necessary to create a third set of SCCs, comparison SCCs, which would allow for comparison across the inventories. The MOBILE6 era SCCs need to be aggregated to these comparison SCCs and the MOVES2014 based SCCs need to be aggregated to these comparison SCCs to create an equivalent set of aggregate source types. Detailed mappings between both set of SCCs and the comparison SCCs are provided in the supplementary material (see Table 4-26 for access information).

\textsuperscript{27} The EMFAC2011 model the supporting documentation can be found at http://www.arb.ca.gov/msei/modeling.htm
\textsuperscript{29} For the modeling, EPA used a set of aggregate processes: 62 (all refueling), 91 (Auxiliary Power Units), 53 (all extended idle), and 81 (all exhaust, evaporative, brake, and tire except refueling and hotelling).
4.6.2.2 California submitted on-road emissions

California submitted on-road emissions data directly according to SCC-level formatting requirements. EPA instituted a quality assurance process to ensure the submitted data were complete and correctly formatted. California’s submissions were generated by ARB using the EMFAC2011 model.

California submissions were based on the older MOBILE6 SCCs. To maintain consistency with the rest of the county, EPA converted these emissions to the new SCCs through a two-step process. First, EPA estimated California emissions using MOVES2014 (same process as the rest of the lower 48 states). Second, EPA aggregated California’s submissions to comparison SCC6 (aggregate fuel and source type) and then redistributed those emissions to the new SCCs based on EPA’s distribution of emissions. This distribution from comparison SCC6 to new SCCs was done by county, SCC, and pollutant. All VOC HAPs used the VOC adjustment factor to convert from EPA estimates to CARB estimates for that county/SCC. This preserved the speciation in MOVES2014 (i.e. the relationship between each of the VOC HAPs and total VOC was consistent with EPA estimates). EPA estimated PAHs were summed and adjusted to match CARB submitted total PAH. The distribution between the individual PAHs was preserved to match EPA estimates.  

4.6.2.3 Agency-submitted MOVES inputs

State and local (S/L) agencies provided inputs for MOVES at the county level in the form of county databases (CDBs). This established format requirement in which states must submit data (as a CDB) enables EPA to more efficiently identify errors and manage the input datasets. EPA screened the submitted data using several quality assurance (QA) scripts that analyze the individual tables in each CDB to look for missing data or unrealistic values.

Overview of MOVES Input Submissions

S/L agencies prepared complete sets of MOVES input data in the form of one CDB per county using the MOVES county data manager (CDM). Table 4-18 lists each table in a MOVES CDB and describes its content.

<table>
<thead>
<tr>
<th>CDB Table</th>
<th>Description of Content</th>
</tr>
</thead>
<tbody>
<tr>
<td>auditlog</td>
<td>Information about the creation of the database</td>
</tr>
<tr>
<td>avft</td>
<td>Fuel type sales fractions</td>
</tr>
<tr>
<td>avgspeeddistribution</td>
<td>Average speed distributions</td>
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<td>county</td>
<td>Description of the county</td>
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<td>VMT distribution across the type of day</td>
</tr>
<tr>
<td>fuelformulation</td>
<td>Fuel properties</td>
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<td>Fuel differences by month of the year</td>
</tr>
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<td>fuelsupplyyear</td>
<td>Year for the fuel properties</td>
</tr>
<tr>
<td>hourvmtfraction</td>
<td>VMT distribution across the hours of the day</td>
</tr>
<tr>
<td>hpsvtytypeyear</td>
<td>Total annual VMT by HPMS vehicle type</td>
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<tr>
<td>imcoverage</td>
<td>Description of the Inspection and Maintenance program</td>
</tr>
<tr>
<td>monthvmtfraction</td>
<td>VMT distribution across the months of the year</td>
</tr>
<tr>
<td>roadtype</td>
<td>Description of the road types</td>
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<tr>
<td>roadtypedistribution</td>
<td>VMT distribution across the road types</td>
</tr>
</tbody>
</table>

Table 4-18: MOVES CDB tables

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30 Chromium in MOVES2014 is chromium trivalent only. CARB submitted chromium total. EPA calculated the faction of chromium trivalent as 0.18*chromium total. The emissions in the NEI therefore represent the portion of California’s submission that is approximately chromium trivalent.
Previously during v1, agencies submitted 1,363 CDBs. Adding in the new submittals for v2, the total number of submitted CDBs became 1,426. Agencies submitting data through the EIS provided complete CDBs with all database tables filled as well as documentation and a submission checklist indicating which of CDB tables contained local data.

Table 4-19 summarizes these submission checklists, showing the number of counties within each State/County submission for which the information was local data. Empty records in the table below indicate that the State/County did not provide local data for that particular CDB table. The grand totals of submittals across all states show that VMT and population (‘hpmvtypeyear’ and ‘sourcetypeyear’ tables, respectively) were the most commonly provided local data.

Table 4-19: Number of counties with submitted data, by state and MOVES CDB input table

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<th>State/County</th>
<th>avft</th>
<th>avgspeeddistribution</th>
<th>dayvmtfraction</th>
<th>fuelsupply</th>
<th>hourvmtfraction</th>
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<th>imcoverage</th>
<th>monthvmtfraction</th>
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<th>roadtypedistribution</th>
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* Not part of CDB but included for NEI since state-specific data is applicable.
### Table

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<td>South Carolina</td>
<td>46</td>
<td>46</td>
<td>46</td>
<td>46</td>
<td>46</td>
<td>46</td>
<td></td>
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<td></td>
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<td></td>
<td></td>
</tr>
<tr>
<td>Tennessee (Knox County)</td>
<td>1</td>
<td>1</td>
<td>1</td>
<td>1</td>
<td>1</td>
<td></td>
<td></td>
<td></td>
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</tr>
<tr>
<td>Utah</td>
<td>29</td>
<td>29</td>
<td>29</td>
<td>29</td>
<td>29</td>
<td>29</td>
<td></td>
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<td></td>
<td>29</td>
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<td></td>
<td></td>
</tr>
<tr>
<td>Vermont</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>14</td>
<td>14</td>
<td></td>
<td></td>
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<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Virginia</td>
<td>134</td>
<td>40</td>
<td>34</td>
<td>34</td>
<td>34</td>
<td>10</td>
<td>40</td>
<td>134</td>
<td>134</td>
<td>134</td>
<td>134</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>West Virginia</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>13</td>
<td>13</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Wisconsin</td>
<td>7</td>
<td>6</td>
<td>72</td>
<td>72</td>
<td>72</td>
<td>7</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td>280</td>
<td>774</td>
<td>875</td>
<td>761</td>
<td>959</td>
<td>797</td>
<td>1390</td>
<td>429</td>
<td>884</td>
<td>428</td>
<td>1214</td>
<td>1224</td>
<td>1388</td>
<td>281</td>
</tr>
</tbody>
</table>

* EIS checklist submitted blank, determined from documentation  
** Submitted directly to EPA staff, not through the EIS

As shown above, some states supplied local data for only a subset of CDB tables. The other tables contained old or default information.

**Figure 4-1** shows geographic coverage of CDB submissions the S/L agencies submitting any local data at the county level in dark blue. The light blue areas indicate counties where the MOVES runs used EPA default data.
EPA developed a QA process in the form of MySQL scripts which EPA’s contractor ERG supplemented with additional scripted checks to evaluate the reasonableness of data values compared to expected ranges in user inputs. EPA’s QA scripts read the database tables in each agency-submitted CDB and recorded warnings and errors indicating the table’s completeness and reasonableness. The EIS submission process required agencies to run one of the QA scripts on each CDB and report results, but EPA performed the supplemental QA checks using a second QA script to evaluate on reasonableness of data after receiving the submitted CDBs. The second QA script that checked data reasonableness included the following:

1. Calculate average speeds by RoadType and SourceType using avgSpeedFraction values in the AvgSpeedDistribution table; compare to the national average values in the MOVES default database table. Flag differences > 10 miles per hour.

2. Flag RVP values in the FuelFormulation table if > 9 psi in the summer months (monthID=5 through 9); or > 10 psi for E10.

3. Flag hourVMTFraction in the HourVMTFraction table if the sum of HourID=6 through 18 (daytime hours) if < 0.5; or if values for individual hours = 0, or > 0.8.

4. Flag monthVMTFraction in the MonthVMTFraction table if the sum of summer months (4<MonthID<10) is < 0.5, or if values for individual months = 0, or > 0.8.
5. Flag rampFraction in the RoadType table for roadTypeID=2 and 4 if = 0, or > 0.2; or > 0 roadTypeID=1, 3 and 5.
6. Flag ageFractions in the SourceTypeAgeDistribution table for SourceTypes where the sum across ageID 0-15 is < 0.5; or for individual ageFraction = zero or > 0.8.
7. Flag DayVMT values where weekday VMT > weekend VMT
8. Flag gasoline sulfur in FuelFormulation for values > 80ppm
9. Flag EtOH Volume in FuelFormulation for values > 10
10. Flag sourceType Population in SourceTypeYear table where sum of population for SourceTypeIDs 21 and 31 is < 0.5
11. Flag HPMSBaseYearVMT in HPMSVTypeYear table where sum of VMT for SourceTypeIDs 21 and 31 is < 0.5
12. Calculate VMT/Population ratios by sourcetype, and compare to national default ratios. Flag ratios that differ from default > 50% [note: this was increased from original flag of 10% after this threshold flagged most of the submitted data].

During v2 development, EPA refined a number of the v1 QA checks including the screening of the Inspection/Maintenance (I/M) coverage table. The I/M Coverage QA check flagged errors related to sequence, gaps, and overlaps in model year coverage of exhaust and evaporative I/M programs. For example, the I/M checking script flagged counties where two exhaust I/M programs were applied to the same set of model years for passenger cars. EPA’s contractor identified these errors, recommended specific corrections, and EPA confirmed the proposed corrections with individual states when possible prior to implementation. As a result of these efforts, the I/M tables were corrected for many counties in several states, including Rhode Island, Oregon, Virginia, and Indiana.

Aside from I/M checks, the general QA scripts flagged errors in the new v2 data. For example, several counties had speeds that were unrealistically low for restricted access road types (for example, 15 mph for all hours of day). In these cases, EPA contacted the responsible agency for CDB submission and requested an additional review. The outcome of review resulted in either the S/L agency opting to use EPA default speeds in the NEI in place of submitted data or correcting their data.

Another common category of error was distributions that did not sum to 1. For example, age distributions for specific source types summed to 0.96 instead of 1. EPA corrected this type of data problem by renormalizing the distribution. The QA scripts also flagged distributions with atypical patterns, such as hourly VMT fractions with a higher fraction in nighttime hours than daytime. EPA evaluated and addressed these potential errors on a case-by-case basis.

### 4.6.2.4 EPA default MOVES inputs

EPA developed the CDBs for counties that did not submit any input data. Table 4-20 describes the source of default data used for 2011 v2 for each table in a CDB for which states have the option to supply alternate data. There are additional tables in a CDB, not listed below, that are informational only (i.e., state, county, year etc.) that EPA populated. The new EPA default data in v2 applies to light-duty source type data in the age distribution and vehicle population tables.

<table>
<thead>
<tr>
<th>CDB Table</th>
<th>Description of Content</th>
<th>Default CDB Table Content</th>
</tr>
</thead>
<tbody>
<tr>
<td>avgspeeddistribution</td>
<td>Average speed distributions</td>
<td>MOVES2010b national default</td>
</tr>
<tr>
<td>dayvmtfraction</td>
<td>VMT distribution across the type of day</td>
<td>2011 NEI v1</td>
</tr>
<tr>
<td>CDB Table</td>
<td>Description of Content</td>
<td>Default CDB Table Content</td>
</tr>
<tr>
<td>--------------------</td>
<td>------------------------------------------------------------</td>
<td>------------------------------------------------------------------------------------------</td>
</tr>
<tr>
<td>fuelformulation</td>
<td>Fuel properties</td>
<td>Based on EPA estimates for each county from calendar year 2011 refinery data</td>
</tr>
<tr>
<td>fuelsupply</td>
<td>Fuel differences by month of the year</td>
<td>Based on EPA estimates for each county from calendar year 2011</td>
</tr>
<tr>
<td>hourvmtfraction</td>
<td>VMT distribution across the hours of the day</td>
<td>MOVES2010b national default</td>
</tr>
<tr>
<td>hpmstypeyear</td>
<td>Total annual VMT by HPMS vehicle type</td>
<td>2011 county-level data from FHWA</td>
</tr>
<tr>
<td>imcoverage</td>
<td>Description of the Inspection and Maintenance program</td>
<td>2011 NEI v1</td>
</tr>
<tr>
<td>monthvmtfraction</td>
<td>VMT distribution across the months of the year</td>
<td>MOVES2010b national default</td>
</tr>
<tr>
<td>roadtype</td>
<td>Ramp fractions by road type</td>
<td>0.08 fraction (8 percent) of vehicle operating hours on urban and rural restricted access roads</td>
</tr>
<tr>
<td>roadtypedistribution</td>
<td>VMT distribution across the road types</td>
<td>2011 NEI v1</td>
</tr>
<tr>
<td>sourcetypeagedistribution</td>
<td>Distribution of vehicle ages</td>
<td>For source types 21, 31, and 32: CRC A-88 estimates for each county; For all other source types: MOVES2010b national default for 2011</td>
</tr>
<tr>
<td>sourcetypeyear</td>
<td>Vehicle populations</td>
<td>For source types 21, 31, and 32: CRC A-88 estimates for each county; For all other source types: Calculated from county-level VMT based on ratios of population to VMT from state-level FHWA data</td>
</tr>
<tr>
<td>zonemonthhour</td>
<td>Temperature and relative humidity values</td>
<td>Temperature and humidity data are EPA provided data for each county from calendar year 2011</td>
</tr>
<tr>
<td>emissionratebyage</td>
<td>Implementation of California standards</td>
<td>The EmissionRateByAge tables for some counties have been populated using the appropriate data described in the guidance for states adopting California emission standards.</td>
</tr>
</tbody>
</table>

**Default California Emission Standards**

EPA populated an alternative MOVES database table ‘EmissionRateByAge’ for some counties in states that adopted emission standards California’s Low Emission Vehicle (LEV) program. Table 4-21 shows which states adopted the California standards and the year it began.

**Table 4-21: States adopting California LEV standards, start years**

<table>
<thead>
<tr>
<th>FIPS State ID</th>
<th>State Name</th>
<th>LEV Program Start Year</th>
</tr>
</thead>
<tbody>
<tr>
<td>6</td>
<td>California</td>
<td>1994</td>
</tr>
<tr>
<td>9</td>
<td>Connecticut</td>
<td>2008</td>
</tr>
<tr>
<td>10</td>
<td>Delaware</td>
<td>2014</td>
</tr>
<tr>
<td>23</td>
<td>Maine</td>
<td>2001</td>
</tr>
<tr>
<td>24</td>
<td>Maryland</td>
<td>2011</td>
</tr>
<tr>
<td>25</td>
<td>Massachusetts</td>
<td>1995</td>
</tr>
<tr>
<td>34</td>
<td>New Jersey</td>
<td>2009</td>
</tr>
<tr>
<td>36</td>
<td>New York</td>
<td>1996</td>
</tr>
<tr>
<td>FIPS State ID</td>
<td>State Name</td>
<td>LEV Program Start Year</td>
</tr>
<tr>
<td>--------------</td>
<td>-------------</td>
<td>------------------------</td>
</tr>
<tr>
<td>41</td>
<td>Oregon</td>
<td>2009</td>
</tr>
<tr>
<td>42</td>
<td>Pennsylvania</td>
<td>2008</td>
</tr>
<tr>
<td>44</td>
<td>Rhode Island</td>
<td>2008</td>
</tr>
<tr>
<td>50</td>
<td>Vermont</td>
<td>2000</td>
</tr>
<tr>
<td>53</td>
<td>Washington</td>
<td>2009</td>
</tr>
</tbody>
</table>

Updated defaults from CRC A-88

Light Duty Age Distribution and Population

EPA updated light-duty default data in 2011 v2 CDBs for two specific inputs—age distribution (the `sourceTypeAgeDistribution` table) and population (the `sourceTypeYear` table). The affected light-duty source types included passenger cars, passenger trucks, and light-duty commercial trucks (source types 21, 31, and 32). Historically, EPA’s default data source for fleet age has been a nationwide average age distribution applied to all counties. For light-duty vehicles in 2011, the default data average age was 9 years old. The updated default age distributions from CRC A-88 show a range in average age of 4 to 16 years old by county. EPA previously determined default data population using a single national ratio of population to VMT for each source type; the ratio did not vary geographically. The CRC project A-88 population data replacing this default is based on state-reported vehicle registrations.

In order to improve the county resolution and to use more recent data, EPA incorporated county-level data from CRC project A-88. The CRC project team procured vehicle populations from IHS Automotive (formerly R.L. Polk). IHS compiled their data from state vehicle registrations provided to IHS by state departments of motor vehicles. The IHS database provided vehicle population for each county separately for cars and light trucks by model years 1981 through 2012. A limitation of the IHS data is that it did not include vehicles for model years 1980 or earlier as these models did not have a standardized Vehicle Identification Number (VIN) schema. To adjust for this, the CRC project team added population to the oldest age category (1981 representing the 30+ vehicles) by until the “tail” of the age distribution reached the median of data provided by states. CRC normalized the modified by-model-year populations to produce the light-duty age distributions for cars (applicable to source type 21) and light trucks (applicable to both source types 31 and 32). CRC summed the populations over the same set of modified population data to calculate the total population for passenger cars and light trucks. The light-duty truck population was split into source types 31 and 32 using the MOVES national average split of 75% and 25%, respectively.

Updated fraction of Long-Haul Truck VMT

CRC data improvements also addressed a third default data parameter in the on-road NEI—the fraction of long-haul truck VMT. EPA’s approach for determining the default allocations of truck VMT to the long-haul categories has relied on national average rates of annual mileage accumulation and the relative vehicle population by source types within an HPMS vehicle group, listed in Table 4-22.
Table 4-22: HPMS truck categories and their MOVES source types

<table>
<thead>
<tr>
<th>HPMS Vehicle Type ID</th>
<th>HPMS Vehicle Name</th>
<th>Source Type ID</th>
<th>Source Type Name</th>
</tr>
</thead>
<tbody>
<tr>
<td>50</td>
<td>Single Unit Trucks</td>
<td>51</td>
<td>Refuse Truck</td>
</tr>
<tr>
<td></td>
<td></td>
<td>52</td>
<td>Single Unit Short-haul Truck</td>
</tr>
<tr>
<td></td>
<td></td>
<td>53</td>
<td>Single Unit Long-haul Truck</td>
</tr>
<tr>
<td></td>
<td></td>
<td>54</td>
<td>Motor Home</td>
</tr>
<tr>
<td>60</td>
<td>Combination Unit Trucks</td>
<td>61</td>
<td>Combination Unit Short-haul Truck</td>
</tr>
<tr>
<td></td>
<td></td>
<td>62</td>
<td>Combination Unit Long-haul Truck</td>
</tr>
</tbody>
</table>

These default methods resulted in a static value of 59 percent of long-haul VMT from combination unit trucks and 12 percent long-haul VMT from single unit trucks nationwide with no geographic variability. The CRC A-88 analysis of the Freight Analysis Framework (FAF) data set suggested variability in the allocations of long-haul VMT by region of the U.S. and by road type. The updated allocations show a range of 30 to 90 percent long-haul VMT from combination unit trucks and a range of 2 to 50 percent long-haul VMT from single unit trucks, depending on region and road type.

Because a MOVES CDB input table does not exist for long-haul VMT, EPA implemented the updated VMT fractions by post-processing the SMOKE-ready activity files (see Section 4.6.3.4). EPA also estimated the hotelling hours from the combination unit long-haul trucks based on their updated VMT values resulting from the CRC A-88 data.

4.6.3 Calculation of EPA Emissions

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

For the 2011 NEI, EPA estimated emissions for every county as discussed below. California had additional processing (see Sections 4.6.2.2 for details). For the continental U.S., EPA used a modeling framework that took into account the strong temperature sensitivity of the on-road emissions. Specifically, EPA used county-specific inputs and tools that integrated the MOVES model with the SMOKE emission inventory model to take advantage of the gridded hourly temperature information available from meteorology modeling used for air quality modeling. This integrated “SMOKE-MOVES” tool was developed by EPA in 2010 and is in use by states and regional planning organizations for regional air quality modeling. SMOKE-MOVES requires emission rate “lookup” tables generated by MOVES that differentiate emissions by process (running, start, vapor venting, etc.), vehicle type, road type, temperature, speed, hour of day, etc. To generate the MOVES emission rates that could be applied across the U.S., EPA used an automated process to run MOVES to produce emission factors by temperature and speed for 284 “representative counties,” to which every other county could be mapped, as detailed below. Using the MOVES emission rates, SMOKE selected appropriate emissions rates for each county, hourly temperature, SCC, and speed bin and multiplied the emission rate by activity (VMT (vehicle miles travelled), vehicle population, or hotelling hours) to produce emissions. These calculations were done for every county, grid cell, and hour in the continental U.S. and aggregated to produce continental U.S. emissions. The


32 SMOKE v3.6 was used for the 2011 v2. The current version of SMOKE is available at: http://www.smoke-model.org/index.cfm
MOVES “RunSpec” files (that tells MOVES what to run for each representative county) are provided in the supplementary materials (see Table 4-26 for access information).

EPA used a different approach for states and territories outside the lower 48 states. For Alaska, Hawaii, Puerto Rico and the Virgin Islands, EPA ran MOVES in “inventory mode” for each county and month, using county-specific inputs. More information is provided Section 4.6.4.

SMOKE-MOVES can be used with different versions of the MOVES model. For the 2011 v2, EPA used the latest publically released version: MOVES2014 (http://www.epa.gov/otaq/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 4.6.1.1)
- Create MOVES inputs needed only for the MOVES runs (see Section 4.6.2.4). MOVES requires county-specific information on vehicle populations, age distributions, and inspection-maintenance programs for each of the representative counties.
- Create inputs needed both by MOVES and by SMOKE, including a list of temperatures and activity data (see Sections 4.6.3.3 and 4.6.3.4).
- Run MOVES to create emission factor tables (see Section 4.6.3.6)
- Run SMOKE to apply the emission factors to activities to calculate emissions (see Section 4.6.3.7)
- Aggregate the results at the county-SCC level for the NEI, summaries, and quality assurance (see Section 4.6.3.8)

4.6.3.2 Representative counties

Although EPA compiles county-specific database for all counties in the nation, EPA runs MOVES for a subset of these because the important emissions-determining differences among counties can be accounted for by assigning counties to groups with similar properties (e.g., similar fleet age, shared I/M programs, shared specific fuel controls such as low RVP for summer gasoline, same state). This approach of running representative counties helps manage computation time by reducing the number of MOVES runs needed to generate a nationwide inventory.

Within the SMOKE-MOVES framework, lookup tables of representative county emission factors are multiplied with the county-level activity for all counties within the representative country group. The activity specific to each county in the inventory includes VMT, population, speed distributions, and hotelling hours.

EPA increased the number of representative counties for v2. The first update to the v1 representative county groups was to accommodate requests from five states, including CO, ME, MD, NC, and AK. EPA then undertook new analysis to further subdivide the approximately 164 county groups based on ramp fractions and updated default age distributions resulting from CRC A-88 data. After the conclusion of EPA’s v2 representative county analysis, other states requested changes including GA and AL, and EPA implemented these minor changes. The final number of representative counties for 2011 v2 increased to 284. Figure 4-2 is a map of the representative counties by state and their corresponding county groups.
Ramp Fractions

During the 2011 on-road NEI development cycle, agencies had the option to provide the CDB table `roadType` which specifies the fraction of restricted access road operating time that occurs on ramps. The `roadType` table is optional in a CDB; if the CDB table is empty, MOVES will revert to its nationwide default value of a 0.08 fraction (8 percent) of vehicle operation time that occurs on ramps.

A ramp fraction value of 0 is possible for a county where a single highway passes through the edge of the county without having any exits. Conversely, a busy urban county with many flyovers and entrance/exit ramps could have a much higher ramp fraction than the average of 8 percent. Because emission factors are higher on ramps compared to highway driving and there exists a potential for wide variation in the county data, EPA added this parameter in the consideration for county groups in 2011 v2.

S/L agencies provided ramp fractions for 716 counties out of the approximately 1,400 submitted CDBs. The ramp fraction values ranged from 0 to 1 although most (97 percent) of the values were less than 0.13. After examining the distribution of the data, EPA grouped the ramp fractions values according to the 5-bin scheme shown below in Table 4-23.
Table 4-23: Binning scheme for submitted ramp fraction data

<table>
<thead>
<tr>
<th>Bin</th>
<th>Description (Fractions from 0 to 1)</th>
<th>Number of Counties</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>0 ≤ ramp fraction &lt; 0.05</td>
<td>244</td>
</tr>
<tr>
<td>2</td>
<td>0.05 ≤ ramp fraction &lt; 0.09</td>
<td>336</td>
</tr>
<tr>
<td>3</td>
<td>0.09 ≤ ramp fraction &lt; 0.13</td>
<td>120</td>
</tr>
<tr>
<td>4</td>
<td>0.13 ≤ ramp fraction &lt; 0.17</td>
<td>7</td>
</tr>
<tr>
<td>5</td>
<td>0.17 ≤ ramp fraction</td>
<td>9</td>
</tr>
</tbody>
</table>

EPA assigned counties to one of the 5 bins according to the ramp fraction on either road type 2 (Rural Restricted Access) or road type 4 (Urban Restricted Access), selecting the road type that had the higher VMT. Next, EPA split the county groups on the basis of the new ramp fraction bin assignments. This process resulted in the addition of more than 30 new representative counties in v2.

Mean Age of Light Duty Vehicles

Age distribution was previously a factor in the selection of representative counties in the 2011 v1, but the binning at that time effectively only distinguished among submitted data because the default age distributions did not vary by county in the states that did not submit data. Given the introduction of new nationwide county specific age distributions from CRC A-88 to replace the default, the mean age parameter needed to be re-evaluated in 2011 v2.

Just as for the ramp fraction analysis, EPA evaluated mean age with the intent to further subdivide existing county groups where differences would likely affect emission factors within the group. The counties in v2 using the default age distributions from CRC A-88 are those that either did not submit a CDB (see light blue in Figure 4-1) or did submit but elected to use the CRC age distributions or a modified version thereof instead of submitted data. The latter category includes the following states and/or counties: GA, ME, MN, Washoe County NV, RI, SC, VT, and WV. In total, EPA binned 2,082 counties based on light-duty mean age of the IHS-derived data from CRC A-88. Table 4-24 shows the definitions of the 6 bins. The mean age binning process added nearly 70 new representative counties to the NEI.

Table 4-24: Binning scheme for CRC A-88 age distribution data

<table>
<thead>
<tr>
<th>Bin</th>
<th>Description (Mean age in number of years old in 2011)</th>
<th>Number of Counties</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>0.0 ≤ Mean Age &lt; 7.0</td>
<td>1</td>
</tr>
<tr>
<td>2</td>
<td>7.0 ≤ Mean Age &lt; 9.0</td>
<td>140</td>
</tr>
<tr>
<td>3</td>
<td>9.0 ≤ Mean Age &lt; 11.0</td>
<td>994</td>
</tr>
<tr>
<td>4</td>
<td>11.0 ≤ Mean Age &lt; 13.0</td>
<td>920</td>
</tr>
<tr>
<td>5</td>
<td>13.0 ≤ Mean Age &lt; 15.0</td>
<td>25</td>
</tr>
<tr>
<td>6</td>
<td>15.0 ≤ Mean Age</td>
<td>2</td>
</tr>
</tbody>
</table>

Validation of the average-age approach to binning similar counties

Following the analysis of grouping counties based on mean light duty vehicle age, EPA examined the full age distribution of each representative county to determine how similar it was to the age distributions of its

33 RI, SC, and VT used their own state supplied population data and used CRC data only for age distribution. WV did not use CRC data for the following 13 counties: Berkeley (54003), Brook (54009), Cabell (54011), Hancock (54029), Kanawha (54039), Marshall (54051), Mason (54053), Monongalia (54061), Ohio (54069), Pleasants (54073), Putnam (54079), Wayne (54099), and Wood (54107). For all other counties, WV elected to use CRC data.
member counties. Unlike the ramp fraction or mean age analysis, the purpose of examining the full age distributions was not to add any new county groups, but rather identify whether any atypical age distribution shapes that exist in the representative county set. The parameter used to analyze the age distribution, termed “vector angle,” indicates how similar a particular age distribution (or vector) is to a reference vector by calculating their “angle,” resulting in a value between 0° (very similar distribution) and 90° (maximum difference). In general, most county age distributions matched well with their representative county age distribution in overall shape, with approximately 95 percent of all vector angles below 7°, a value which upon visual inspection corresponded to reasonable agreement between the full distributions. The remaining 5 percent of county vector angles were mostly clustered around the range of 8 to 10°, with exception of one county vector angle of 19.6° (the maximum angle). These relatively high vector angles for particular counties occurred in a distributed fashion, among various county groups, in groups where other member counties showed good agreement with the representative county. Therefore, EPA made no changes to the representative county selection based on the vector angle validation check.

**Fuel Months**

The concept of a fuel month is used to indicate when a particular set of fuel properties should be used in a MOVES simulation. Similar to the reference county, the fuel month reduces the computational time of MOVES by using a single month to represent a set of months. Because there are winter fuels and summer fuels, EPA used January to represent October through April and July to represent May through September. For example, if the grams/mile exhaust emission rates in January are identical to February’s rates for a given reference county, and temperature (as well as other factors), then we use a single fuel month to represent January and February. In other words, only one of the months needs to be modeled through MOVES. The hour-specific VMT, temperature and other factors for February are still used to calculate emissions in February, but the emission factors themselves do not need to be created since one month can represent the other month sufficiently. The fuel months used for each representative county are provided in the supplementary materials (see Table 4-26 for access information).

**Fuels**

Although state-submitted MOVES input data may have included information about fuel properties, the MOVES runs for the 2011 NEI v2 were run using a set of fuel properties for a set of fuel regions generated by EPA. EPA developed these data using a combination of purchased fuel survey data, proprietary fuel refinery information and known federal and local regulatory constraints.

The steps used to determine the fuel properties in each fuel region are as follows:

1) Fuel properties from proprietary refinery certification data were compiled on a regional basis (based on typical pipeline delivery areas).
2) Properties within a region for finished fuel batches (e.g. no CBOB, RBOB or OBO fuel batches) produced in 2010, excluding RFG, were averaged to generate non-ethanol conventional gasoline fuel properties within that region, for a given month.
3) RFG fuel properties were based on RFG fuel compliance survey data, and oxygenate levels were assumed to be 10% ethanol (E10, no MTBE).
4) Refinery modeling results generated for the RFS2 rulemaking were used to adjust the regional conventional gasoline fuel properties to account for ethanol blending up to E10, for a given month.
5) Additional adjustments to fuel properties were performed on individual counties within a region, based on refinery modeling, for known local regulatory constraints such as low-RVP or oxygenate level mandates.

6) Appropriate E10 and conventional gasoline fuel market shares were calculated on a regional basis for the level of ethanol produced in 2011, after ethanol required for RFG compliance was taken into account.

7) Gasoline fuel properties and ethanol market shares were applied to each county regionally and accounting for known local regulatory constraints.

8) Diesel properties were assumed to be 15 ppm nationally with no significant biodiesel penetration.

The regional fuel supply database is provided in the supplementary materials (see Table 4-26 for access information).

4.6.3.3 Temperature and humidity

Ambient temperature can have a large impact on emissions. Low temperatures are associated with high start emissions for many pollutants. High temperatures and high relative humidity are associated with greater running emissions due to the increase in the heat index and resulting higher engine load for air conditioning. High temperatures also are associated with higher evaporative emissions.

The 12-km gridded meteorological input data for the entire year of 2011 covering the continental United States were derived from simulations of version 3.4 of the Weather Research and Forecasting Model (WRF, 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) was used as the software for maintaining dynamic consistency between the meteorological model, the emissions model, and air quality chemistry model.

EPA applied the SMOKE-MOVES tool Met4moves to the gridded, hourly meteorological data (output from MCIP) to generate a list of the maximum temperature ranges, average relative humidity, and temperature profiles that are needed for MOVES to create the emission-factor lookup tables. “Temperature profiles” are arrays of 24 temperatures that describe how temperatures change over a day, and they are used by MOVES to estimate vapor venting emissions. The hourly gridded meteorological data (output from MCIP) was also used directly by SMOKE (4.6.3.6).

The temperature lists were organized based on the representative counties and fuel months as described in Sections 4.6.3.2 and 4.6.1.1, respectively. Temperatures were analyzed for all of the counties that are mapped to the representative counties, i.e., for the county groups, and for all the months that were mapped to the fuel months. EPA used Met4moves to determine the minimum and maximum temperatures in a county group for the January fuel month and for the July fuel month, and the minimum and maximum temperatures for each hour of the day. Met4moves also generated idealized temperature profiles using the minimum and maximum temperatures and 10 °F intervals. In addition to the meteorological data, the representative counties and the fuel months, Met4moves uses spatial surrogates to determine which grid cells from the meteorological data to collect temperature and relative humidity statistics. For example, if a county had a mountainous area with no roads, this would be excluded from the meteorological statistics.

To account for changes in relative humidity, there is a pairing of relative humidity to temperature bins. Met4moves calculated an average relative humidity for the county group for all grid cells that make up that
temperature bin. In other words, for all grid cells and hours within a single temperature bin and county group, it
extracts and averages the corresponding relative humidity. Met4moves repeats this calculation for each
temperature bin and county group, and finally repeats the whole process for each fuel month. When the
emission factors are applied by SMOKE (Section 4.6.3.6), the appropriate temperature bin and fuel month
specific relative humidity was used for all runs of the county group. EPA used a 5 °F temperature bin size for
RPD, RPV, and RPH.

Met4moves can be run in daily or monthly mode for producing SMOKE input. In monthly mode, the
temperature range is determined by looking at the range of temperatures over the whole month for that
specific grid cell. Therefore, there is one temperature range per grid cell per month. While in daily mode, the
temperature range is determined by evaluating the range of temperatures in that grid cell for each day. The
output for the daily mode is one temperature range per grid cell per day and is a more detailed approach for
modeling the vapor venting (RPP) based emissions. EPA ran Met4moves in daily mode for 2011 NEI.

The resulting temperatures provided to the representative counties are provided in the supplementary
materials (see Table 4-26 for access information). The gridded, hourly temperature data used are publicly
available only upon request and with provision of a disk media to copy these very large datasets (contact
info.chief@epa.gov).

4.6.3.4 VMT, vehicle population, speed, and hotelling for SMOKE

EPA prepared SMOKE-ready activity files in FF10 formats for all the activity types used by SMOKE-MOVES. The
activity files include FF10 tables for VMT, population, average speed, and hotelling. The script also produced
weekday and weekend hourly speed profiles, an optional input to SMOKE-MOVES.

EPA and its contractor ERG developed scripts that automated the creation of FF10 tables based on submitted
CDBs and supplemental information in the MOVES database. For clarity, it should be noted that the speed
profile input to SMOKE (spdpro) is not an FF10 file, but it was generated by the same script that produces the
FF10s. Regardless of activity type, the objective of the script was to transform all user-supplied activity from CDB
input table format into the level of detail required for SMOKE input. SMOKE inputs require activity by SCC which
includes detail of MOVES source type, fuel type, and road type34. The script looped through the submitted CDBs
and reported results to each FF10 table, collating results for all counties.

VMT FF10 file creation

EPA’s script included several calculation steps to produce SCC-level VMT. First, the script calculated travel
fractions by source type and model year that sum to one (1) for each HPMS vehicle type. The script generated
these travel fractions using the CDB tables ‘sourceTypeAgeDistribution’ and ‘sourceTypeYear’ and the MOVES
database table of annual mileage accumulation rates. Next, the script further divided the travel fractions by
model year into fuel types of gasoline, diesel, ethanol (E85), and compressed natural gas (CNG) based on MOVES
database table containing national sales of these engine types by model year and source type. Following that
step, the script multiplied the travel fractions with the corresponding HPMS vehicle type’s VMT in the CDB table
‘HPMSVtypeYear’ resulting in VMT disaggregated into source type, fuel type and model year. The script then
aggregated over model years and multiplied the resulting VMT at the source type level by road type fractions of

34 The activity is by county and SCC8 (i.e. fuel, source type, and road type). The activity did not need to be by process as well
(last 2 digits of the SCC). For example, the VMT for exhaust would be identical to the VMT for brake and tire wear. Because
the EF tables are by full SCC (including process), SMOKE internally maps the activity by SCC8 to full SCCs using the SCCXREF
file. Note, for hotelling the activity is by full SCC because the number of hours for extended idle is different than the
number of hours for APU.
VMT using the CDB table `roadTypeDistribution`. The end result of these various calculations and table joins was the annual total VMT by SCC consistent with the CDB tables. The script also used the CDB table `monthVMTFraction` to divide annual totals into monthly VMT for January through December in the FF10 table.

Population FF10 file creation

The script’s calculation of vehicle population (POP) was simpler than for VMT because the CDB table of population was much closer to the SCC format – it already contained source type detail and road types are not relevant for population activity SCCs. The only change needed was to incorporate fuel type detail into the source type population.

In order to augment the fuel type information into population data, the script first disaggregated the source type populations from the CDB table `sourceTypeYear` into model years using the CDB table `sourceTypeAgeDistribution`. Next, the script split the population into fuel types using the same MOVES national fuel type fractions of gasoline, diesel, E85, and CNG by model year previously described for the VMT FF10 file creation. In a third and final step, the script aggregated over model year for each source type and fuel type to arrive at the SCC level populations. Unlike the VMT FF10, population is only available at the annual level, without variation by month, because the registered populations are considered to be constant over the year.

Speed FF10 file creation

The script calculates average speed (SPEED) by SCC for each month and an annual average using primarily the CDB table `averageSpeedDistribution` which contains fractions of VMT by 16 speed bins for each source type by hour of weekday and weekend day types. The script first calculated the weighted average speed for each hour and then aggregated over hours up to the annual and month level using the various CDB tables for VMT distributions (i.e., `hourVMTFraction`, `dayVMTFraction`, and `monthVMTFraction`).

Hotelling FF10 file creation

“Hotelling” is the time spent by long-haul combination trucks during federally required rest periods during long-haul trips. The MOVES model assumes that only diesel combination unit trucks are used in long-haul operations that result in hotelling. EPA calculated the national rate of hotelling to be 0.033807 hours per mile on all restricted access roads (urban and rural together), and the script applied this rate to combination unit long-haul VMT in each county to estimate county-level hotelling.

The MOVES model database includes a “HotellingActivityDistribution” table that identifies whether the main engine or an auxiliary power unit (APU) was used during the hotelling activity. This engine description of the activity is a function of model year because not all trucks are equipped with APUs. MOVES2014 and the NEI assume that 100 percent of the hotelling hours from pre-2010 model year trucks use the main engine, but only 70 percent of hotelling hours are main engine beginning with model year 2010 into the future. The other 30 percent are assumed to operate on APUs with the main engine turned off. EPA’s FF10 creation script calculated the main engine hours of extended idle (EXT) and APU hours for each county according to the equations below:

\[
\text{Hotelling Hours} = 0.003807 \times \text{VMT}_{\text{restricted}} \\
\text{EXT Hours} = \text{Hotelling Hours} \times \text{EXT Fraction} \\
\text{APU Hours} = \text{Hotelling Hours} \times \text{APU Fraction}
\]

where:

- \(\text{Hotelling Hours}\) = total extended idle hours (hours)
- \(0.003807\) = national rate of hotelling (hours/mile)
VMT\textsubscript{restricted} = vehicle-miles traveled by diesel combination unit long-haul trucks on both urban and rural restricted access road types (miles)

EXT Hours = extended idle hours operating the main engine as the power source (hours)

APU Hours = extended idle hours operating an APU as the power source (hours)

EXT Fraction = weighted fraction of main engine hotelling hours, a value ranging from 0.7 to 1 depending on the age distribution (dimensionless)

APU Fraction = weighted fraction of APU hotelling hours, a value ranging from 0 to 0.3 depending on the age distribution (dimensionless)

A few states provided their own estimates of total hotelling hours based on their own analysis. These states include: GA, NC, PA, and VA\textsuperscript{35}. EPA used the state provided hotelling hours over EPA’s estimates. Due to the possibility of mismatches at the county level, if a state provided hotelling hours, the state-submitted data was used for all counties in the state. States did not provide separate extended idle vs APU hours. EPA used the APU fraction based on EPA estimates for each county to calculate the APU hours in the state submitted data, while conserving the total number of hotelling hours (EXT + APU).\textsuperscript{36}

**Speed Profile file creation**

The speed profile (SPDPRO) input to SMOKE is optional and allows the user to provide SMOKE with hour-specific speeds by SCC and weekday/weekend day types. Similar to the SPD FF10 file creation, EPA’s script calculated a weighted average speed over the 16 speed bins for each hour by day type. For the 2011 NEI v2, the SPDPRO file contained speed profiles for every county, source type, and road type in the country and it takes precedence over the SPEED FF10 input.

**VMT adjustments based on CRC A-88**

As previously described for NEI v2 default data inputs, EPA updated the long-haul fractions of VMT based on data from CRC project A-88. The CRC A-88 data resulted from an analysis of the FAF dataset for single unit (source types 52 and 53) and combination unit (source types 61 and 62) trucks and found significant regional differences in the relative amount of long-haul activity. EPA implemented the long-haul VMT reallocation by updating the VMT activity files for SMOKE in a processing step prior to running SMOKE. Specifically, EPA’s contractor processed the SMOKE-ready VMT files using a script that summed VMT over the affected source types (i.e., 52+53, and 61+62) and reapportioned the combined VMT totals to the constituent source types using a lookup table of relative VMT fractions that varied by region and summed to 1 for single unit (52+53) and combination unit (61+62) trucks. After calculating new long-haul VMT, EPA re-calculated the hotelling hours in order to be consistent with the revised long-haul VMT resulting from the CRC A-88 data incorporation.

**Population adjustments based on CRC A-88**

EPA incorporated the county level CRC A-88 light duty vehicle populations for source types 21, 31, and 32 in areas using “EPA default” data or where S/L/T agencies elected to use CRC data over their own previously submitted data. The CRC A-88 population and age distribution data impacts the distribution of light duty vehicle VMT between the three MOVES source types (21, 31, and 32). Total light duty is conserved and would match the

\textsuperscript{35} CT and NJ also provided data. After consultation with the states, they accepted EPA’s revised estimates for 2011 NEIv2 hotelling based on rural + urban restricted VMT.

\textsuperscript{36} Additional modifications were made to the state data. For GA, NC, and VA, the states provided annual data. EPA used the EPA estimates to distribute the annual to monthly data by county. PA did provide monthly data, but the sum of the months was slightly different than the annual estimates. EPA renormalized their monthly estimates so that it equaled the annual value. After consulting with the state, NC accepted EPA’s revised 2011 NEIv2 estimate for the statewide total hotelling hours. EPA distributed the statewide total to county using NC’s distribution.
HPMS vehicle type (25) VMT, but the distribution between the MOVES light duty source types depends on both the age distribution and population tables.

Default data for SMOKE

The data for SMOKE obtained from state provided CDBs is the source for much of the data used for the 2011 NEI. However, CDBs were not provided for all counties in all states. The necessary information for the SMOKE FF10 files for these counties was derived from EPA default information used in the MOVES model tables and other EPA sources. All of the EPA default data was processed in a similar manner to the state supplied data and added to the state supplied data in the FF10 formatted files for use with SMOKE.

The average speeds, speed profiles, road type distribution and day type, hour and monthly distributions of VMT default values are all taken from the default MOVES database (movesdb20141021). VMT is obtained from the 2011 NEI Version 1 analysis and vehicle populations were derived from those VMT values. The source and handling of VMT and populations is described in the documentation for the 2011 NEI Version 1.

The age distributions and populations used for the default case were obtained from the CRC A-88 for source types 21, 31 and 32. The default MOVES database age distributions were used for all other source types. Similar to the submitted data, the incorporation of the CRC A-88 age distribution and population impacts the distribution of VMT between the three light duty source types.

The same VMT adjustments to account for long haul fractions that were applied to state supplied data were also applied to VMT in the default case. All hotelling hours and extended idle and APU usage fractions were derived in the same manner as for state supplied data from the VMT estimates.

The SMOKE-ready activity data used for the 2011 NEIv2 are provided in the supplementary materials (see Table 4-26 for access information).

4.6.3.5 Public release of the NEI county databases

Two sets of 2011 CDBs are available for download: (1) the representative county CDBs and (2) all county CDBs. See Table 4-26 for access details. EPA converted all submitted and default CDBs to MOVES2014 formats using the database conversion script available in the MOVES GUI, described in the MOVES model user guide37.

Representative CDBs

The representative counties are the counties for which EPA ran the MOVES model to generate emission factor lookup tables for SMOKE-MOVES. EPA performed special processing on the CDBs for these counties to prepare them for MOVES modeling. This processing “seeded” the databases to produce emission factors for every SCC regardless of whether the representative county has all of the categories. The seeding step was necessary because counties mapping to this representative county may require the emission factor. The seeding script updated every 0 value to 1e-15, and also added missing categories to the various tables and set their data values to 1e-15.

The following describes how the seeding process might affect a representative CDB. For example, a particular submitted representative county may have only gasoline school buses (i.e., no diesel ones). A submitted CDB would reflect this local information through a fraction of value set to 0 for diesel fuel in the alternative vehicle and fuel technologies (AVFT) table. EPA’s seeding script updated this 0 value to a small value of 1e-15 so that MOVES could calculate an emission rate for diesel school buses. The small value of 1e-15 ensures that all

distributions still sum to very close to one (1). The fact that this particular county in reality has no diesel school buses would be incorporated in the NEI, but on the SMOKE side of processing. The SCC for diesel school buses for the county would have zero activity because EPA created the FF10 SMOKE activity files for each county based on the unseeded CDBs provided by S/L agencies or EPA default.

**All county CDBs**

The full set of CDBs includes both S/L-submitted CDBs as well as EPA default data CDBs. The submitted CDBs include minor changes in some counties resulting from the QA process described previously. All CDBs, submitted or default, were converted to MOVES2014 format, which altered the format of same tables and added some new ones including the ‘hotellinghours’ CDB table. EPA inserted the final FF10 hotelling activity into the new ‘hotellinghours’ table from the FF10 format so that users would have access to the same activity used in the NEI already incorporated into a MOVES input database format. EPA also inserted the default population and VMT into the EPA default CDBs, so these are consistent with the FF10 files used in the NEI with one exception − the long-haul vs. short-haul VMT. The long-haul fractions could not straightforwardly be put into a MOVES CDB. However, the long-haul VMT allocations are available from the CRC project A-88 report or alternatively could be derived from the VMT FF10 files provided with the NEI modeling platform.

**4.6.3.6 Run MOVES to create emission factors**

EPA ran MOVES for each representative county using January fuels and July fuels for the range of temperatures spanned by the represented county group and set of months associated with each fuel set (January and July). The runspec generator created a series of runspecs (MOVES jobs) based on the outputs from Met4moves. Specifically, the script used a 5 degree bin and the minimum and maximum temperature ranges from Met4moves and used the idealized diurnal profiles from Met4moves to generate a series of MOVES runs that captured the full range of temperatures for the county group for the months assigned to each fuel. The MOVES runs resulted in four emission factors (EF) tables for each representative county and fuel month: rate per distance (RPD), rate per vehicle (RPV), rate per hour (RPH), and rate per profile (RPP). After the MOVES runs were completed, the post-processor Moves2smk converted the MySQL tables into EF files that can be read by SMOKE. For more details, see the SMOKE documentation: [https://www.cmascenter.org/smoke/documentation/3.6/html/ch05s02.html](https://www.cmascenter.org/smoke/documentation/3.6/html/ch05s02.html)

**4.6.3.7 Run SMOKE to create emissions**

Lastly, EPA generated air quality model ready emissions at a gridded and hourly resolution. The Movesmrg SMOKE-MOVES program performs this function by combining activity data, meteorological data, and emission factors to produce gridded, hourly emissions. EPA ran Movesmrg for each of the four sets of emission factor tables (RPD, RPV, RPH, and RPP). During the Movesmrg run, the program used the hourly, gridded temperature (for RPD, RPV, and RPH) or daily, gridded temperature profile (for RPP) to select the proper emissions rates and compute emissions. These calculations were done for all counties and SCCs in the SMOKE inputs, covering the continental U.S.

The emissions process RPD is for modeling the driving emissions. This includes the following modes: vehicle exhaust, evaporation, evaporative permeation, refueling, brake wear, and tire wear. For RPD, the activity data is monthly VMT, monthly speed (SPEED), and hourly speed profiles for weekday versus weekend (SPDPRO). The SMOKE program Temporal takes vehicle and roadtype specific temporal profiles and distributes the monthly emissions. 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.
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 parked emissions. This includes the following modes: vehicle exhaust, evaporative, evaporative permeation, and refueling. For RPV, the activity data is vehicle population (VPOP). Movesmrg reads the temperature from the gridded hourly data and uses the temperature plus SCC and the hour of the day to look up the appropriate EF from the representative county’s EF table. It then multiplies this EF by the gridded VPOP for that SCC to calculate the emissions for that grid cell and hour. This repeats for each pollutant and SCC in that grid cell.

The emission process RPH is for modeling the parked emissions for combination long-haul trucks (source type 62) that are hotelling\textsuperscript{39}. This includes the following modes: extended idle and auxiliary power units (APU). For RPH, the activity data is monthly HOTELLING hours. The SMOKE program Temporal takes a temporal profile and distributes the monthly HOTELLING hours to day of the week and hour. Movesmrg reads the temperature from the gridded hourly (MCIP) data and uses these values to look-up the appropriate emission factors (EFs) from the representative county’s EF table. It then multiplies this EF by temporalized and gridded HOTELLING hours for that SCC to calculate the emissions for that grid cell and hour. This repeats for each pollutant and SCC in that grid cell.

The emission process RPP is for modeling the parked emissions for vehicles that are key-off. This includes the mode vehicle evaporative (fuel vapor venting). For RPP, the activity data is VPOP. Movesmrg reads the gridded diurnal temperature range (Met4moves’ output for SMOKE). It uses this temperature range to determine a similar idealized diurnal profile from the EF table using the temperature min and max, SCC, and hour of the day. It then multiplies this EF by the gridded VPOP for that SCC to calculate the emissions for that grid cell and hour. This repeats for each pollutant and SCC in that grid cell.

The result of the Movesmrg processing is hourly, gridded data suitable for use in air quality modeling as well as daily reports for the four processing streams (RPD, RPV, RPH, and RPP). The results include emissions for every county in the continental U.S., rather than just for the representative counties.

4.6.3.8 Post-processing to create annual inventory

For the purposes of the NEI, EPA needed emissions data by county, SCC, pollutant\textsuperscript{40}. EPA developed and used a set of scripts to combine the emissions from the four sets of reports and from all days to create the annual inventory.

The on-road emissions for Alaska, Hawaii, Puerto Rico and the Virgin Islands, which EPA generated via MOVES in inventory mode (see Section 4.6.4) were appended to the on-road inventory generated from SMOKE-MOVES to

\textsuperscript{39} The hotelling emissions is differentiated from simple idling emissions. These are the emissions for trucks that are parked for an extended period of time while the driver rests.

\textsuperscript{40} EPA ran SMOKE-MOVES at a more detailed level including road type and emission processes (e.g. extended idle) and summed over the road types and processes to create the more aggregate NEI SCCs.
create the final emissions. This complete inventory was submitted to the EIS as the EPA estimates for the on-road sector. The resulting EIS dataset is named “2011_EPA_MOBILE”41.

4.6.4 On-road mobile emissions data for Alaska, Hawaii, Puerto Rico and the Virgin Islands

Since the meteorology domain used by EPA for running SMOKE-MOVES covers only the continental U.S., EPA used the MOVES “inventory mode” to create emissions for Alaska, Hawaii, Puerto Rico and the Virgin Islands. These runs used the average monthly hourly temperatures and humidity values derived from the National Climatic Data Center temperature and humidity data from calendar year 2011. These emissions characterized all pollutants including a full set of metals and dioxins.

These emission inventory estimates were not derived using the same SMOKE-MOVES process used for the other counties. Instead, each county was run independently using the inventory scale mode of the MOVES2014 model. This approach directly calculates the inventory in each county using the inputs provided in each of the county databases. For Hawaii, Puerto Rico, and the Virgin Islands, MOVES was run for January and July only due to the relatively modest temperature variation over the year for these islands. All other months were mapped to those months to create an annual estimate of the emissions. Due to the greater meteorological variation in Alaska, MOVES was run for every month of the year.

The MOVES inputs used for these emissions are the MOVES county database manager databases, the run specifications used to run MOVES, and the MySQL database containing the tables that describe the temperatures and relative humidity values used for these states and territories. These inputs are provided in the supplementary materials (Table 4-26 for access information).

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

- Checked the VMT data by comparing the 2011v2 with 2011v1 based activity data. Compared the VMT at various resolutions including: state, county, vehicle type (comparison SCC6), and road type. Also analyzed the ratio of VMT to vehicle population to look for extreme values.
- Checked the VMT data by comparing the 2011 NEIv2 (state supplied) with 2011 NEIv2 (default) for those states that submitted activity data. Compared the VMT at various resolutions including: state, county, and road type.
- Checked the VPOP data by comparing the 2011v2 with 2011v1 based activity data. Compared the VPOP at various resolutions including: state, county, and vehicle type (comparison SCC6).
- Checked the consistency of VMT with vehicle population to ensure that all counties with VMT for a vehicle type also had VPOP for that vehicle type.
- Compared the on-road emission results to similar results for 2011 NEIv1. As expected, found numerous differences between the two sets of results. Detailed comparisons by state, county and vehicle type (comparison SCC6) showed that most of the differences were due to updated input data from the states, updated age distributions for the EPA defaults, updated hotelling data, or due to differences between how the two models were run in terms of representative counties. Additionally, compared the results

41 The corresponding EMF datasets are 2011eg_NEIv2_onroad_SMOKE-MOVES_MOVES2014_forNEI (v4) and 2011_NEIv2_onroad_AK_HI_PR_VI_MOVES2014_forNEI (v2).
using difference maps both at the county level and gridded (after spatially allocating the emissions to grid cells using SMOKE).

- Identified that E-85 emission factors were missing from a significant number of representative counties. Decided to reclassify E-85 vehicles to gas vehicles for the purposes of the NEIv2. Added the E-85 VMT to gas VMT by county/source type (repeated for VPOP) and re-estimated the emissions for the new set of gas activity.

- Some Idaho representative counties were missing RPD emission factors for CNG, and so emission factors for CNG needed to be appended from other counties’ emission factor tables. For the initial run, an error was made when adding these CNG emission factors. This was corrected, and then the affected counties were rerun through SMOKE.

- In the initial run, NH3 emissions were dropped from RPH due to an error in the SMOKE pollutant list (MEPROC). This was corrected in a SMOKE rerun.

- Diesel refueling included both evaporative headspace and spillage emissions. It should only have included spillage.

- Diesel refueling emission factors for benzene were all zero. To correct this, benzene for diesel refueling was calculated using a constant emission factor multiplied by VOC (benzene = VOC * 0.00410).

- The I/M programs were incorrectly characterized in the following counties: CO (for county FIPS 8001, 8005, 8013, 8014, 8031, 8035, 8041, 8059, 8069, 8097, and 8123), LA (for county FIPS 22005, 22047, and 22063), and PA (for county FIP 42073). This was identified too late to be corrected in v2.

- Worked with the states as part of the MOVES working group to evaluate these national runs in comparison to individual states’ runs using MOVES in inventory mode.

### 4.6.6 Supporting data

Onroad 2011 v2 emissions came from EPA estimates exclusively, except in CA. Emissions and/or county database submittal history and notes are provided in Table 4-25. Onroad reference data files are listed in Table 4-26. These datasets are available at ftp://ftp.epa.gov/EmisInventory/2011/doc.

#### Table 4-25: Agency submittal history for onroad inputs and emissions

<table>
<thead>
<tr>
<th>Agency Organization</th>
<th>Onroad Emissions Submission Date</th>
<th>Onroad CDB Submission Date</th>
<th>Notes</th>
</tr>
</thead>
<tbody>
<tr>
<td>Alaska Department of Environmental Conservation</td>
<td>12/11/2012</td>
<td>12/18/2012</td>
<td></td>
</tr>
<tr>
<td>Alabama Department of Environmental Management</td>
<td>N/A</td>
<td>N/A</td>
<td>AL supplied county level VMT directly to EPA staff.</td>
</tr>
<tr>
<td>California Air Resources Board</td>
<td>4/16/2013</td>
<td>N/A</td>
<td>CA uses a CA-specific model (EMFAC). CA emissions are included in NEI.</td>
</tr>
<tr>
<td>Clark County Department of Air Quality and Environmental Management</td>
<td>N/A</td>
<td>6/3/2014</td>
<td></td>
</tr>
<tr>
<td>Coeur d’Alene Tribe</td>
<td>11/28/2012</td>
<td>N/A</td>
<td>EPA does not currently break out tribal areas in EPA estimates; however, tribal emissions submittals are included in the NEI.</td>
</tr>
<tr>
<td>Agency Organization</td>
<td>Onroad Emissions Submission Date</td>
<td>Onroad CDB Submission Date</td>
<td>Notes</td>
</tr>
<tr>
<td>----------------------------------------------------------</td>
<td>----------------------------------</td>
<td>----------------------------</td>
<td>---------------------------------------------------------------------------------------------------------------------------------------</td>
</tr>
<tr>
<td>Colorado Department of Public Health and Environment</td>
<td>N/A</td>
<td>?</td>
<td>CO supplied updated IM coverage data directly to EPA staff.</td>
</tr>
<tr>
<td>Connecticut Department Of Environmental Protection</td>
<td>N/A</td>
<td>5/10/2013</td>
<td>In addition to submitting CDBs, CT supplied updated CDBs directly to EPA staff.</td>
</tr>
<tr>
<td>DC-District Department of the Environment</td>
<td>N/A</td>
<td>1/8/2013</td>
<td></td>
</tr>
<tr>
<td>Delaware Department of Natural Resources and Environmental Control</td>
<td>N/A</td>
<td>1/7/2013</td>
<td></td>
</tr>
<tr>
<td>Eastern Band of Cherokee Indians</td>
<td>10/23/2012</td>
<td>N/A</td>
<td>EPA does not currently break out tribal areas in EPA estimates; however, tribal emissions submittals are included in the NEI.</td>
</tr>
<tr>
<td>Florida Department of Environmental Protection</td>
<td>N/A</td>
<td>N/A</td>
<td>FL requested directly from EPA staff to replace their default data for I/M coverage and Stage II refueling to effectively turn off all programs.</td>
</tr>
<tr>
<td>Georgia Department of Natural Resources</td>
<td>N/A</td>
<td>6/10/2014</td>
<td>In addition to submitting CDBs for v2, GA provided age distributions and populations for source types 21, 31, and 32 for each county in GA directly to EPA staff.</td>
</tr>
<tr>
<td>Idaho Department of Environmental Quality</td>
<td>12/18/2012</td>
<td>12/5/2012</td>
<td>ID submitted both input and emissions. ID emissions included only a subset of HAPs and had SCC-emtype combinations that do not occur in EPA estimates. ID CDB was used in NEI estimates instead of emission submittal.</td>
</tr>
<tr>
<td>Illinois Environmental Protection Agency</td>
<td>N/A</td>
<td>2/19/2013</td>
<td></td>
</tr>
<tr>
<td>Knox County Department of Air Quality Management</td>
<td>N/A</td>
<td>1/7/2013</td>
<td></td>
</tr>
<tr>
<td>Kootenai Tribe of Idaho</td>
<td>12/14/2012</td>
<td>N/A</td>
<td>EPA does not currently break out tribal areas in EPA estimates; however, tribal emissions submittals are included in the NEI.</td>
</tr>
<tr>
<td>Louisville Metro Air Pollution Control District</td>
<td>N/A</td>
<td>2/19/2013</td>
<td></td>
</tr>
<tr>
<td>Maine Department of Environmental Protection</td>
<td>N/A</td>
<td>11/19/2012</td>
<td></td>
</tr>
<tr>
<td>Maricopa County Air Quality Department</td>
<td>N/A</td>
<td>12/18/2012</td>
<td></td>
</tr>
<tr>
<td>Maryland Department of the Environment</td>
<td>N/A</td>
<td>12/24/2012</td>
<td></td>
</tr>
<tr>
<td>Massachusetts Department of Environmental Protection</td>
<td>N/A</td>
<td>6/5/2013</td>
<td>CDB was submitted late after deadline to the NEI, but was available to EPA prior to submittal and used on EPA NEI estimates.</td>
</tr>
<tr>
<td>Agency Organization</td>
<td>Onroad Emissions Submission Date</td>
<td>Onroad CDB Submission Date</td>
<td>Notes</td>
</tr>
<tr>
<td>----------------------</td>
<td>---------------------------------</td>
<td>----------------------------</td>
<td>-------</td>
</tr>
<tr>
<td>Metro Public Health of Nashville/Davidson County</td>
<td>12/18/2012</td>
<td>N/A</td>
<td>EPA assisted Metro in creating CDB from their inputs to EPA estimation. Submitted emissions were not used in NEI</td>
</tr>
<tr>
<td>Michigan Department of Environmental Quality</td>
<td>N/A</td>
<td>1/8/2013</td>
<td></td>
</tr>
<tr>
<td>Minnesota Pollution Control Agency</td>
<td>N/A</td>
<td>12/13/2012; 5/20/2013</td>
<td>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.</td>
</tr>
<tr>
<td>Missouri Department of Natural Resources</td>
<td>N/A</td>
<td>12/21/2012</td>
<td></td>
</tr>
<tr>
<td>New Hampshire Department of Environmental Services</td>
<td>N/A</td>
<td>3/26/2014</td>
<td></td>
</tr>
<tr>
<td>New Jersey Department of Environment Protection</td>
<td>N/A</td>
<td>6/20/2014</td>
<td></td>
</tr>
<tr>
<td>New York State Department of Environmental Conservation</td>
<td>N/A</td>
<td>4/9/2014</td>
<td></td>
</tr>
<tr>
<td>Nez Perce Tribe</td>
<td>11/29/2012</td>
<td>N/A</td>
<td>EPA does not currently break out tribal areas in EPA estimates; however, tribal emissions submittals are included in the NEI.</td>
</tr>
<tr>
<td>North Carolina Department of Environment and Natural Resources</td>
<td>N/A</td>
<td>3/25/2014</td>
<td></td>
</tr>
<tr>
<td>Northern Cheyenne Tribe</td>
<td>1/28/2013</td>
<td>N/A</td>
<td>EPA does not currently break out tribal areas in EPA estimates; however, tribal emissions submittals are included in the NEI.</td>
</tr>
<tr>
<td>Ohio Environmental Protection Agency</td>
<td>N/A</td>
<td>5/16/2013</td>
<td></td>
</tr>
<tr>
<td>Oregon Department of Environmental Quality</td>
<td>1/7/2013</td>
<td>8/12/2014</td>
<td></td>
</tr>
<tr>
<td>Pennsylvania Department of Environmental Protection</td>
<td>N/A</td>
<td>12/31/2012</td>
<td></td>
</tr>
<tr>
<td>Rhode Island Department of Environmental Management</td>
<td>N/A</td>
<td>1/10/2013</td>
<td></td>
</tr>
<tr>
<td>Shoshone-Bannock Tribes of the Fort Hall Reservation of Idaho</td>
<td>11/27/2012</td>
<td>N/A</td>
<td>EPA does not currently break out tribal areas in EPA estimates; however, tribal emissions submittals are included in the NEI.</td>
</tr>
<tr>
<td>Agency Organization</td>
<td>Onroad Emissions Submission Date</td>
<td>Onroad CDB Submission Date</td>
<td>Notes</td>
</tr>
<tr>
<td>----------------------------------------------------------</td>
<td>---------------------------------</td>
<td>----------------------------</td>
<td>---------------------------------------------------------------------------------------------------------------------------------------</td>
</tr>
<tr>
<td>South Carolina Department of Health and Environmental Control</td>
<td>N/A</td>
<td>12/13/2012</td>
<td></td>
</tr>
<tr>
<td>Texas Commission on Environmental Quality</td>
<td>12/21/2012</td>
<td>N/A</td>
<td>Texas’ v1 submissions used MOVES2010b. For v2, EPA estimated the emissions using MOVES2014 to provide consistency with the other states.</td>
</tr>
<tr>
<td>Utah Division of Air Quality</td>
<td>N/A</td>
<td>4/14/2014</td>
<td></td>
</tr>
<tr>
<td>Vermont Department of Environmental Conservation</td>
<td>N/A</td>
<td>12/14/2012</td>
<td></td>
</tr>
<tr>
<td>Virginia Department of Environmental Quality</td>
<td>N/A</td>
<td>4/18/2014</td>
<td>In addition to submitting CDBs, VA supplied activity data (by SMOKE SCCs) for all counties directly to EPA staff.</td>
</tr>
<tr>
<td>Washington State Department of Ecology</td>
<td>N/A</td>
<td>12/19/2012</td>
<td></td>
</tr>
<tr>
<td>Washoe County Health District</td>
<td>12/26/2012</td>
<td>1/8/2013</td>
<td></td>
</tr>
<tr>
<td>West Virginia Division of Air Quality</td>
<td>N/A</td>
<td>1/4/2013</td>
<td></td>
</tr>
<tr>
<td>Wisconsin Department of Natural Resources</td>
<td>N/A</td>
<td>4/1/2014</td>
<td></td>
</tr>
<tr>
<td>NEI 2011 v2 Supporting Data File Name</td>
<td>Description of Contents</td>
<td></td>
<td></td>
</tr>
<tr>
<td>--------------------------------------</td>
<td>-------------------------</td>
<td></td>
<td></td>
</tr>
<tr>
<td>2011neiv2_supdata_or_RepCounty_Runspecs.zip</td>
<td>The MOVES2014 run specifications (runspecs) for the representative counties. This is for running MOVES in emissions rate mode (for SMOKE-MOVES).</td>
<td></td>
<td></td>
</tr>
<tr>
<td>2011neiv2_supdata_or_FuelCR.zip</td>
<td>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.</td>
<td></td>
<td></td>
</tr>
<tr>
<td>2011neiv2_supdata_or_RegFuel.zip</td>
<td>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.</td>
<td></td>
<td></td>
</tr>
<tr>
<td>2011neiv2_supdata_or_RepCounty_temperatures.zip</td>
<td>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</td>
<td></td>
<td></td>
</tr>
<tr>
<td>2011neiv2_supdata_or_AKHIPRVI_Runspecs.zip</td>
<td>The MOVES2014 run specifications (runspecs) for all counties in Alaska, Hawaii, Puerto Rico and the Virgin Islands. This is for running MOVES in inventory mode.</td>
<td></td>
<td></td>
</tr>
<tr>
<td>2011neiv2_supdata_or_CountyCR.zip</td>
<td>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.</td>
<td></td>
<td></td>
</tr>
<tr>
<td>MOVES_CDBs_by_State Directory</td>
<td>MOVES2014 county database. Includes all agency submittals thru the EIS, and all subsequent revisions and EPA replacements (e.g., fuel and age distributions)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>2011neiv2_supdata_or_CDB_RepCnty.zip</td>
<td>MOVES county databases (CDBs) for the representative counties. These CDBs include all agency submittals through the EIS in addition to subsequent revisions and EPA replacements to prepare counties to run in rates mode.</td>
<td></td>
<td></td>
</tr>
<tr>
<td>2011neiv2_supdata_or_VPOP.zip</td>
<td>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.</td>
<td></td>
<td></td>
</tr>
<tr>
<td>2011neiv2_supdata_or_VMT.zip</td>
<td>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.</td>
<td></td>
<td></td>
</tr>
<tr>
<td>2011neiv2_supdata_or_Speed.zip</td>
<td>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.</td>
<td></td>
<td></td>
</tr>
<tr>
<td>NEI 2011 v2 Supporting Data File Name</td>
<td>Description of Contents</td>
<td></td>
<td></td>
</tr>
<tr>
<td>---------------------------------------</td>
<td>-------------------------</td>
<td></td>
<td></td>
</tr>
<tr>
<td>2011neiv2_supdata_or_SpdProf.zip</td>
<td>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.</td>
<td></td>
<td></td>
</tr>
<tr>
<td>2011neiv2_supdata_or_Hotelling.zip</td>
<td>Hotelling hours (HOTELLING) annual and monthly by county covering every county in the US. This includes hours of extended idle and hours of auxiliary power units for combination long-haul trucks only. Data is in FF10 format for SMOKE and is a combination of EPA estimates, agency submittals, and corrections.</td>
<td></td>
<td></td>
</tr>
<tr>
<td>2011neiv2_supdata_or_CALEV.zip</td>
<td>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.</td>
<td></td>
<td></td>
</tr>
<tr>
<td>2011neiv2_supdata_or_MySQL.zip</td>
<td>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.</td>
<td></td>
<td></td>
</tr>
<tr>
<td>2011neiv2_supdata_or_SCC.zip</td>
<td>A set of tables that describe the new MOVES2014 based SCCs. Additional tables show the cross reference between MOBILE6 SCCs and a set of comparison SCCs as well as a cross reference between MOVES2014 SCCs and a set of comparison SCCs.</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

4.6.7 References for On-road Mobile

5 Fires

Fire sources in this section are sources of pollution caused by the inadvertent or intentional burning of biomass including forest, rangeland (e.g., grasses and shrubs), and agricultural vegetative residue. This section describes the 2011 NEI wildfires (Section 5.1), prescribed burning (also Section 5.1), and agricultural burning (Section 5.2). Other types of fires are included in other EIS sectors, such as “Fuel Combustion – Residential – Wood” (Section 3.13.4), the “Waste Disposal” (Section 3.32) sector, which includes fires from burning yard waste, land clearing, residential household waste, logging debris, and commercial, institutional, industrial, and “open dump” burning of biomass and other refuse; and “Miscellaneous Non-Industrial NEC” sector (Section 3.25), which includes structure fires, firefighting as part of waste disposal, firefighting training fires, motor vehicle fires, and other open fires.

Collectively, the fires data included in this section have come to be known by the fire emissions community as the National Fire Emissions Inventory (NFEI). This inventory is not a separate product, but rather the highest-emitting fires component of the NEI.

5.1 Wildfires and Prescribed Burning

This section describes the 2011 NEI approach for wildfires, prescribed burning, and wild land fire use, collectively called “wild land” fires (WLFs). Precise definitions of these types of fires are provided below in Section 5.1.1. These are included in the same section because the approach used is exactly the same.

Unlike in the 2008 NEI, when the EIS database contained wildfires and prescribed fires as both event-based (point source, day-specific) data and nonpoint data, the 2011 contains all of these data in day-specific events-based format. The 2011 NEI website (see Section 1.3.2) provides separately wildfire and prescribed fire data at the county-SCC resolution, it can also be obtained in the EIS through a summary of the “2011 NEI v1 with biogenics” EIS selection for the EVENT data category. A day-specific events summary is also available in the EIS, however, it should only be run for a small geographic area such as one or two counties due to the size of the data.

5.1.1 Sector description

WLFs are generally defined as any non-structural fire that occurs in wild lands. Included in WLFs are the following types of fires:

- Prescribed (Rx) fire: Any fire ignited by management actions to meet specific objectives, generally related to the reduction of the biomass potentially available for wildfires.

- Wildfire (WF): An unplanned, unwanted WLF including unauthorized human-caused fires, escaped prescribed fire projects, or other inadvertent fire situation where objective is to put the fire out.

- Wildland Fire Use (WFU): The application of appropriate management response to naturally-ignited WLFs to accomplish specific resource management objective in pre-designated areas outlined in fire management plans. In other words, an unplanned fire that is subsequently controlled and used as a Rx fire to meet specific objectives. This category existed in 2008, but no longer is used as a way to classify fires in 2011, and thus will not be discussed further in this section.

For 2011, EPA continues to use the SMARTFIRE2 (SF2) system (which includes the BlueSky modeling framework) to estimate wild land fire emission estimates. Significant improvements were made from 2005 to 2008 to SF2 as
documented in the 2008 NEI TSD. From 2008 to 2011, smaller improvements and refinements were made to the SF2 system as outlined in Reid [ref 1]. In 2011, the most significant improvement made was in collecting local activity data (acres burned, types of fuels, fuel consumption values, etc.) to make emission estimates for both wild and prescribed fires more accurate in the 2011 NEI. This is documented further in section 5.1.4. Also, in 2011, EPA estimates included the states of AK and HI, unlike in previous NEI cycles.

Table 5-1 lists the SCCs that define the different types of WLFs in the 2011 NEI, both for EPA data and for S/L/T agency data. Note that EPA data have only one unique SCC for each of these types of fires. Data submitted by S/L/T agencies can have several different SCCs that define prescribed fires. As described below, EPA’s approach to combine EPA data with S/L/T agency data for the 2011 NEI considers all SCCs that define any one type of fire and appropriately combines emissions from those SCCs.

<table>
<thead>
<tr>
<th>Data Origin</th>
<th>Wildfires</th>
<th>Prescribed Burns</th>
</tr>
</thead>
<tbody>
<tr>
<td>EPA</td>
<td>2810001000</td>
<td>2811015000</td>
</tr>
<tr>
<td>States/Locals/Tribes</td>
<td>2810001000 (&quot;wildland fire use&quot;)</td>
<td>2810001000 (&quot;forested&quot;)</td>
</tr>
<tr>
<td></td>
<td></td>
<td>2811020000 (&quot;rangeland&quot;)</td>
</tr>
</tbody>
</table>

5.1.2 Sources of data overview and selection hierarchy

The wildfire and Rx fire EIS sectors include data only from two components: S/L/T agency-provided emissions data (day specific data in Events format) for Georgia and North Carolina, and the EPA dataset created from SFv2 (see Section 5.1.4) which used available state inputs. Only the combination (rather than the individual datasets) of these data are available as summary information on the 2011 NEI website and in the EIS.

S/L/T agency data were received in event format from two agencies (GA and NC) as listed in Table 5-2.

<table>
<thead>
<tr>
<th>Agency</th>
<th>Agency Type</th>
<th>Rx provided</th>
<th>Wildfire provided</th>
</tr>
</thead>
<tbody>
<tr>
<td>Georgia</td>
<td>State</td>
<td>as event</td>
<td>as event</td>
</tr>
<tr>
<td>North Carolina</td>
<td>State</td>
<td>as event</td>
<td>as event</td>
</tr>
</tbody>
</table>

In 2011, no tribes submitted wild land fire emissions data, and EPA did not assign any fires based on the tribal land boundaries. These fires were assigned to the states within which the tribal lands fall. Table 5-3 shows the selection hierarchy for the wildfire and Rx burning sectors. There were no overlapping data in the above datasets. Georgia and North Carolina were excluded from the 2011EPA_Event dataset and the State/Local/Tribal Data contained only Georgia and North Carolina.
Table 5-3: 2011 NEI wildfire and prescribed fires selection hierarchy

<table>
<thead>
<tr>
<th>Priority</th>
<th>Dataset Name</th>
<th>Dataset Content</th>
<th>Is Dataset in EIS?</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>State/Local/Tribal Data</td>
<td>Submitted data as listed above.</td>
<td>Yes</td>
</tr>
<tr>
<td>2</td>
<td>2011EPA_Event</td>
<td>Emissions from SF2</td>
<td>Yes</td>
</tr>
</tbody>
</table>

5.1.3 Spatial coverage and data sources for the sector

The 2011 NEI includes wildfire and Rx fire emissions for all continental US states, Alaska, and Hawaii. These emissions represent a combination of state-submitted information and EPA-estimated emissions from these fires. The EPA methods are described in Section 5.1.4 below. The simple way we blend these emissions is summarized in Table 5-3 above. As discussed above, only GA and NC reported wildfire and prescribed fire emissions to the NEI in 2011. GA and NC data were used as submitted, and no backfilling was done with EPA data for any counties that were missing or null.

5.1.4 EPA-developed fire emissions estimates

For the dataset developed by EPA for the 2011 NEI, we used the following general equation to estimate wildfires and prescribed fires. Accurate estimates of fire emissions rely on accurate estimates of the terms in the equation below.

\[
\text{Emissions} = \text{Area burned} \times \text{Fuel Load Available} \times \text{Fuel Consumed (Burn Efficiency)} \times \text{Emission Factors}
\]

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/](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 5-4 below. CAPs were estimated via SF2 as just described. In addition, a set of 29 HAPs are estimated by applying the activity levels estimated from the methods above with the emission factors shown in the table [ref 4]. These same 29 HAPs have been estimated for fires over the past 10 years or so for the NEI by EPA. In 2011, only GA and NC submitted their own emissions data. Both agencies used the same FEPS system as EPA did to estimate all the CAP emissions. EPA sent to GA and NC the HAP EFs to use, so that the set of HAPs reported from WLFs is consistent throughout the US. Thus, there was no need to do any further HAP augmentation as had been done with previous NEIs. GA nor NC submitted CO₂ nor CH₄ (GHGs) so these pollutants are not available for these two
states but in general are available for all the other states for which we used EPAs methods to estimate WLF emissions.

**Table 5-4**: Pollutants estimated by EPA* for wildland fires and HAP emission factors

<table>
<thead>
<tr>
<th>Pollutant</th>
<th>HAP Emission factor (lb/ton fuel consumed)</th>
</tr>
</thead>
<tbody>
<tr>
<td>PM$_{2.5}$</td>
<td></td>
</tr>
<tr>
<td>PM$_{10}$</td>
<td></td>
</tr>
<tr>
<td>CO</td>
<td></td>
</tr>
<tr>
<td>CO$_2$</td>
<td></td>
</tr>
<tr>
<td>CH$_4$</td>
<td></td>
</tr>
<tr>
<td>NO$_x$</td>
<td></td>
</tr>
<tr>
<td>NH$_3$</td>
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</tr>
<tr>
<td>SO$_2$</td>
<td></td>
</tr>
<tr>
<td>VOC</td>
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<td>1,3-butadiene</td>
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<tr>
<td>Acrolein</td>
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</tr>
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<td>Pyrene</td>
<td>0.00929</td>
</tr>
<tr>
<td>o,m,p-xylene</td>
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<tr>
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<tr>
<td>indeno(1,2,3-cd)pyrene</td>
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<td>Chrysene</td>
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<tr>
<td>Phenanthrene</td>
<td>0.005</td>
</tr>
</tbody>
</table>

*Other than CO$_2$ and CH$_4$, these pollutants were also submitted by GA, the only state that submitted its own data for wildfires and prescribed burning.
One of the big improvements made in the 2011 process was the collection and use of WLF activity data submitted by State and Local Agencies. Through funding supplied by the USDA Forest Service (USFS), states were invited to submit fire occurrence data in any format for use in developing the 2011 NEI for WLFs. The spatial and temporal qualities of each data set were assessed to determine the usability of the data. A written assessment of each data set was sent to each submitting state, regardless of whether the data set was ultimately included in the NFEI. Suitable data sets were processed through the SF2 fire information system along with other traditional or new fire data sets at national or regional scales to reconcile the various fire information data sets.

EPA assessed a total of 50 data sets from 20 individual states and one regional data set from the Fire Emissions Tracking System (FETS). The FETS data set was provided by Air Sciences Inc. (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 5-1 shows the states that submitted fire activity data and identifies states that provided usable data and states covered by the FETS data set.

**Figure 5-1:** The coverage of state-submitted fire activity data sets

In addition to submitting fire activity data, the following states provided comments on the on the draft version of the NFEI, all of these comments were addressed in the final version of the 2011 NFEI. Details of how these comments were addressed can be found in Reid [ref 1].

- The Lake States (Michigan, Minnesota, and Wisconsin) recommended using the boreal equation in Consume instead of the western equation for all fires in these states.
- Minnesota recommended the use of local values for duff depth for the state’s two largest wildfires (7 inches for the Pagami Creek fire and 5 inches for the Juneberry 3 fire).

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42 Additional details on these other data sets are provided in the “Other Data Sources” section that follows.
The Hawaii Department of Health Clean Air Branch (HIDOHCAB) determined that certain prescribed burns in the draft NFEI are Hawaiian Commercial and Sugar (HC&S) agricultural burns. They recommended removing these prescribed burns from the final 2011 NFEI since HI submitted these emissions as part of their nonpoint agricultural fires.

Colorado found a discrepancy in fire size for a prescribed burn between draft NFEI and their data, and recommended use of the latter.

Other Supporting Data Sources

In addition to the data provided by state, local, and tribal agencies, fire information from the following data sources was also used to develop the final 2011 NFEI:

- **Inputs to SmartFire2**
  - **Hazard Mapping System (HMS)** data were acquired daily from the National Oceanic and Atmospheric Administration's (NOAA) HMS via FTP as part of a routine process. Data were acquired in ASCII text format from [http://satepsanone.nesdis.noaa.gov/FIRE/fire.html](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/](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/](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/](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](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](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 5-5 lists the acres burned the SF2 process arrived at for FL (which took into account the activity data FL sent as well as some ancillary data) and the amount of acres burned FL reported as activity data (FL did not want us to supplement that data in any way and wanted us to match it exactly for wild and prescribed fires). EPA scaled the information by computing the acres burned difference between what EPA estimated using SF2 and what the FL activity data indicated it should be. EPA apportioned the difference on a fire by fire basis, separately for prescribed and wildfires. Then, fire-by-fire, the resulting percentage difference in acres burned was applied to each fire to arrive at the correct total. More specifics are given below on the algorithm used, separately for prescribed and wildfires.

**Table 5-5: SF2 and State-submitted acres burned for FL WLFs**

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

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

In sum, the adjustments to the Florida data caused acres burned to go up by about 19% and total emissions by about 12% (due to varying Rx and WF changes). We confirmed with Florida staff that they were satisfied with this scaling algorithm.
We have caveated the 2011 NEI data for Maryland. Well after the final estimates were developed and released to the public, Maryland staff commented that EPA’s estimate of acres burned for prescribed fires in 2011 is too high. They are satisfied with EPA’s estimates for wildfires. EPA estimates that in Maryland there was about 10,925 acres burned for prescribed fires; whereas, Maryland staff have data that show this should be closer to 700 acres. Because this information came to EPA late in the process, we could not include these Maryland-specific activity data into the final SF2 model runs. Instead we are reporting in the documentation that Maryland believes that acres burned in 2011 for prescribed fires should be reduced by 90% from what EPA estimates. It is expected that the emissions associated with prescribed fires using Maryland-reported acres burned in the fire emissions models, would also decrease by a significant amount. We could use a scaling approach (as done for Florida above) to estimate the decreased emissions; however, for 2011 v2, EPA was unable to make this revision prior to releasing the data.

Washington state staff accepted all of our wild and prescribed fire data to help maintain consistency nationally. However, they provided comments which indicated they are not in total agreement with how the county distribution of acres burned compares with their own data. They indicated that they expected a closer match since at the county level since FETS data for WA were used in EPA’s processing. Note that statewide total acres burned match well between their estimates and EPS’s estimates. In future inventories, Washington staff have indicated they will set aside extra time to understand why the differences in county allocation of acres burned.

Kansas state staff provided a comment that all of their prescribed fires identified using EPA methodology should correctly be stored in the EIS/NEI using SCC 2811020000 (which is “prescribed rangeland burning”). We currently store all EPA-estimated prescribed fires under SCC 2811015000 (which is “prescribed forest burning”). We have indicated that we will fix this in future versions of the NEI (2014).

After v1 was complete, DE commented that we have misidentified one of the large fires as wildfire when in fact it should be a prescribed fire (with much lower emissions). The name of the fire in question in the SF2 dataset is “Phragmites fire” and per DE’s comment that fire has been moved from wildfire to prescribed fire in v2, and since we did not rerun SF2 to compute emissions, we used emissions generated by DE for this fire (as a prescribed fire), which result in much lower emissions for DE in general for wild land fires in the 2011 v2. In the example of PM$_{2.5}$ emissions, when this fire was moved over to a prescribed fire in v2, the emission went from 502 tons as wildfire to 19.9 tons as a prescribed fire (and all other pollutants were decreased by a similar percentage amount in v2 for this fire). In addition, in accordance with DE comments, we removed all the 100 acre fires that were identified by EPA methods in Sussex county, since the comments indicated these fires did not occur at all (false detects by satellites due to small size of fires). These changes result in PM$_{2.5}$ emissions for prescribed fires going up from 92 to 96 tons for DE and Wild fire PM$_{2.5}$ emissions going down from 502 to 8.5 tons for DE in going from v1 to v2.

Using the SF2 approach, EPA’s 2011 emissions data are shown in several summary maps below. In each of these maps, all of the data reflect output from SF2 other than for Georgia and North Carolina, which submitted their own data. These data also reflect the changes made to the Florida and Delaware data as detailed above. These data thus reflect what is in the NEI for wild and prescribed fires.

First, Figure 5-2 shows the proportion of acres burned for each type of fire by state. In the West, there are more wildfires than in the East (with AK showing almost entirely wild fire activity), where most of the burning is seen to be from prescribed burning. Kansas and Oklahoma also show a high level of acres burned for prescribed fires. Texas, Oklahoma, Georgia, and Kansas have among the highest total acres burned (width of circles). In the 2011
NEI, there are an estimated 24.6 million acres burned from prescribed and wildfires. Of these 24.6 million acres, about half is estimated to be prescribed fires and half wild fires.

**Figure 5-2:** Proportion of acres burned by type of fire

In the 2011 NEI, there is an estimated total of 6.1 million tons of PM$_{2.5}$ emissions. Of this total, 1.13 million is estimated to be from wildfires and about 903,000 tons from prescribed fires. The total of ~2.1 million tons of PM$_{2.5}$ from these fires are mapped in Figure 5-3 on a county basis. For emissions, the pattern is based on not only on acres burned, but also on fuel consumption, fuel loading, and how emission factors vary by fire type and other dynamic processes that occur in a given type of fire. Wildfire PM$_{2.5}$ emissions account for 58% of the total emissions and prescribed burns account for 42%. Certain areas in the country (eastern NC, northern MN and northern CA) stand out for emissions but not necessarily for acres burned. This is likely due to the relationship between fire characteristics and emission factors: prescribed fires likely have lower amounts of emissions on a per-acre basis due to lower burn temperatures than wildfires; prescribed fires have less smoldering than wildfires, which causes wildfire emissions to accumulate over time; peat type wildfires burning extensive duff; and wildfires burning very hot and for a long duration causing higher emissions.
5.1.5 Summary of quality assurance methods

- WLF emissions developed using the methods above were compared to EPA’s 2008 estimates, since the models used are very consistent. The spatial (and temporal) patterns seen in the data correspond to what was expected in 2011, and how the domains changed from 2008 –Alaska and Hawaii are new to the domain in 2011. 2011 was a “worse” fire year than 2008, as more acres were burned (about 30% more), so the emissions are expected to be higher in 2011 compared to 2008.

- Georgia and NC were the only state to submit emissions data. A comparison of the data between the GA submitted and SF2-generated emissions for GA showed a very good match for wildfires, but a marginal match for prescribed fires. Due to that concern and some concerns that GA had on the spatial extent of emissions estimate on a county basis for GA in SF2, they submitted their own emissions in 2011. In future NEI cycles, the methods used by SF2 to estimate emissions from prescribed fires deserve additional review and improvement. A comparison of the data between the NC submitted and SF2-generated emissions for NC shows that SF2 estimates are much higher (emissions an order of magnitude higher for both wild and prescribed fires). Although for the 2011 NEI v2, we decided to accept NC’s estimates over EPA estimates, in the future a closer evaluation will be done between state-submitted data and EPA estimates to ensure that the State-submitted data is in accordance with known activity data for the state as well as to check whether the state-submitted data covers the entire domain of the state as well as all fires that occur over this area.
In Figure 5-4, we show a county by county map of PM$_{2.5}$ emissions density (per square mile) that reflects the difference in total PM$_{2.5}$ emissions in 2011 NEI with and without wild and prescribed fire PM$_{2.5}$ emissions. The resulting density difference map highlights those counties in which these large fires dominate the PM$_{2.5}$ emissions load. The areas identified in this map align well with known areas of very high fire activity in 2011.

**Figure 5-4:** Difference map of 2011 NEI v2 PM$_{2.5}$ emissions, with and without large fires

As shown in Figure 5-5, we compared total mass of PM$_{2.5}$ emissions (the sum of all WLFs) to past EPA inventories which used SF2 to estimate emissions. This generally shows that all pollutants were in a reasonable range that would be expected from these types of fires, given the expected year to year variability. The figure shows SF2-based PM$_{2.5}$ emissions from 2007 to 2011. Though the SF2 model has undergone improvements over this time frame, the overall model is the same and, as such, the agreement across years for total emissions is still relevant. As shown in the figure, the total of 2.1 million tons of PM$_{2.5}$ estimated in 2011 is in line with past estimates. However, 2011 had more fires than did 2008, and 2011 has the second highest emissions in the time frame shown. As expected, wildfires are seen to drive most of the variation year-to-year.
**Figure 5-5:** 2011 PM$_{2.5}$ wild land fire emissions using EPA methods

- Changes between v1 and v2 for wild land fires: In accordance with the changes made between v1 and v2 identified above (North Carolina submitting their own emissions in v2 and Delaware data being altered based on comments), Table 5-6 highlights the PM$_{2.5}$ emission changes (other pollutants will behave the same way) in going from v1 to v2 of the 2011 wild land fire inventory

<table>
<thead>
<tr>
<th></th>
<th>Prescribed Fires</th>
<th>Wild Fires</th>
</tr>
</thead>
<tbody>
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<td>2011 v2</td>
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<tr>
<td>Alabama</td>
<td>50,537</td>
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<td>State</td>
<td>Prescribed Fires</td>
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</tr>
<tr>
<td>---------------</td>
<td>-----------------</td>
<td>------------</td>
</tr>
<tr>
<td></td>
<td>2011 v1</td>
<td>2011 v2</td>
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<td>Vermont</td>
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<tr>
<td>West Virginia</td>
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<td>Wisconsin</td>
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<td>Wyoming</td>
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<td><strong>Total</strong></td>
<td><strong>924,482</strong></td>
<td><strong>903,048</strong></td>
</tr>
</tbody>
</table>

### 5.1.6 References for Wildfires and Prescribed Burning


5.2 Fires – Agricultural field Burning
An EPA approach to estimate agricultural fire emissions was developed for the first time for the 2008 NEI. In the 2008 effort, only CAPs were estimated for this sector. In 2011, EPA changed its methods for this sector to those based on the peer-reviewed approach of Jessica McCarthy [ref 1]. In 2011, 17 HAPs were also included in the suite of pollutants estimated for this sector in the EPA data. In addition to the data submitted by S/L/T agencies, EPA developed a nationally consistent agricultural fires estimate based on the McCarthy methods, which relies on remote sensing, crop-usage maps and appropriate emission factors to estimate CAP (all CAPs except for ammonia) and 17 HAPs for this sector. Within the EIS, the EPA annual agricultural fire estimates are county-totals and are included in the dataset “2011EPA_NP_NoOverlap_w_Pt.” They are also available outside of the EIS as monthly totals upon request.

5.2.1 Sector description
Agricultural burning refers to fires that occur over lands used for cultivating crops and agriculture. The SCCs that pertain to this source in the NEI are listed in Table 5-7. EPA data are all put into one SCC, while state-submitted data are entered into one or more of 25 different SCCs shown in Table 5-7. These other SCCs have more specific details about the type of crop burned.

Table 5-7: SCCs in the NEI for Agricultural Burning

<table>
<thead>
<tr>
<th>Data Origin</th>
<th>Agricultural Fires – SCCs used</th>
</tr>
</thead>
<tbody>
<tr>
<td>EPA</td>
<td>2801500000</td>
</tr>
<tr>
<td>States/Locals/Tribes</td>
<td>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</td>
</tr>
</tbody>
</table>
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, NOx, SO2, CO, PM2.5, CO2 and methane because we had emission factors available for these. The CO2 and methane emissions were not included in the final 2011 NEI, but are available upon request. Table 5-8 lists the state and tribal agencies that submitted agricultural fire emissions.

<table>
<thead>
<tr>
<th>Agency</th>
<th>Agency Type</th>
</tr>
</thead>
<tbody>
<tr>
<td>Arizona Department of Environmental Quality</td>
<td>State</td>
</tr>
<tr>
<td>California Air Resources Board</td>
<td>State</td>
</tr>
<tr>
<td>Delaware Department of Natural Resources and Environmental Control</td>
<td>State</td>
</tr>
<tr>
<td>Georgia Department of Natural Resources</td>
<td>State</td>
</tr>
<tr>
<td>Hawaii Department of Health Clean Air Branch</td>
<td>State</td>
</tr>
<tr>
<td>Idaho Department of Environmental Quality</td>
<td>State</td>
</tr>
<tr>
<td>Indiana Department of Environmental Management</td>
<td>State</td>
</tr>
<tr>
<td>Kansas Department of Health and Environment</td>
<td>State</td>
</tr>
<tr>
<td>Louisiana Department of Environmental Quality</td>
<td>State</td>
</tr>
<tr>
<td>New Jersey Department of Environment Protection</td>
<td>State</td>
</tr>
<tr>
<td>North Carolina Department of Environmental Quality</td>
<td>State</td>
</tr>
<tr>
<td>Oregon Department of Environmental Quality</td>
<td>State</td>
</tr>
<tr>
<td>South Carolina Department of Health and Environmental Control</td>
<td>State</td>
</tr>
<tr>
<td>Washington State Department of Ecology</td>
<td>State</td>
</tr>
<tr>
<td>Coeur d’Alene Tribe of Idaho</td>
<td>Tribal</td>
</tr>
<tr>
<td>Kootenai Tribe of Idaho</td>
<td>Tribal</td>
</tr>
<tr>
<td>Nez Perce Tribe</td>
<td>Tribal</td>
</tr>
<tr>
<td>Shoshone-Bannock Tribes of the Fort Hall Reservation of Idaho</td>
<td>Tribal</td>
</tr>
</tbody>
</table>

When we created the 2011 NEI, the EPA data were combined with the other data in such a way that any counties or pollutants that were null in the S/L/T agency data were backfilled with EPA-based county estimates. Any “zero” submissions were left as zero in the 2011 NEI for those counties and pollutants. In addition, EPA augmented HAPs for those states that did not submit any of the HAPs (listed in the first paragraph of Section 5.2.3) using a simple ratio of state-based VOC to the HAP in question in the EPA emissions database. These ratios were applied to the state submitted VOC emission values (all counties in a given state used the same EPA-data based VOC:HAP ratio to estimate HAP emissions). The actual EPA-data based ratios provided along with all of the other HAP augmentation ratios described in Section 3.1.5, and can be accessed via the supplemental data file described in that section. For states that reported any of the HAPs that EPA estimates or any other HAPs, they were left as is in the final NEI (as long as they passed the QA checks). The hierarchy used to select data for this sector is outlined in Table 5-9.
Table 5-9: Data source and selection hierarchy used for agricultural fire emissions

<table>
<thead>
<tr>
<th>Dataset name (Short Name provided if different)</th>
<th>Description and Rationale for the Order of the Selected Datasets</th>
<th>Order</th>
</tr>
</thead>
<tbody>
<tr>
<td>2011 Responsible Agency Selection</td>
<td>S/L/T agency submitted data for agricultural burning; multiple datasets – one for each reporting agency. These data are selected ahead of other datasets.</td>
<td>1</td>
</tr>
<tr>
<td>2011EPA_PM-Augmentation (2011EPA_PM-AUG)</td>
<td>Adds PM species to fill in missing S/L/T agency data or make corrections where S/L/T agency data have inconsistent emissions across PM species. Uses the PM calculator for processes covered by that database. See Section 3.1.1 for additional details.</td>
<td>2</td>
</tr>
<tr>
<td>2011EPA_chrom_split</td>
<td>Hexavalent and trivalent chromium speciated from S/L/T agency reported chromium. New EIS augmentation function creates the dataset by applying multiplication factors by SCC, facility, process or NAICS code to S/L/T agency chromium. See 3.1.3.</td>
<td>3</td>
</tr>
<tr>
<td>2011EPA_HAP-Augmentation (2011EPA_HAP-Aug)</td>
<td>HAP data computed from S/L/T agency criteria pollutant data using HAP/CAP emission factor ratios based on ratios of HAP to CAP emission factors used in the EPA estimates. This dataset is below the S/L/T agency data in order that the S/L/T agency HAP data are used first.</td>
<td>4</td>
</tr>
<tr>
<td>2011EPA_AgBurningSF2</td>
<td>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.</td>
<td>5</td>
</tr>
</tbody>
</table>

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 NH₃ were estimated with EPA methods. Table 5-10 summarizes these CAP estimates by state. For example, total PM₂.₅ emissions for the 48 contiguous states in the US based on EPA methods is about 148,000 tons. EPA also estimated emissions for the following 17 HAPs: 1,3-butadiene, acetaldehyde, anthracene, benz(a)anthracene, benzo(a)pyrene, benzene, benzo(e)pyrene, benzo(g,h,i)perylene, benzo(k)fluoranthene, chrysene, fluoroanthene, formaldehyde, indeno(1,2,3-cd)pyrene, perylene, phenanthrene, pyrene, and toluene.
As an example of data contained in the 2011 NEI for this sector, the PM$_{2.5}$ emissions data in Table 5-10 are combined (using the hierarchy discussed earlier) with the S/L agency submissions (excluding tribal) shown in Table 5-8 and summarized in Figure 5-6 below. For this sector, Louisiana, Kansas, and the Dakotas, all show high

<table>
<thead>
<tr>
<th>State</th>
<th>CO</th>
<th>NOx</th>
<th>SO2</th>
<th>PM2.5</th>
<th>PM10</th>
<th>VOC</th>
</tr>
</thead>
<tbody>
<tr>
<td>Alabama</td>
<td>4,065.5</td>
<td>152.3</td>
<td>60.3</td>
<td>420.4</td>
<td>644.5</td>
<td>284.6</td>
</tr>
<tr>
<td>Arizona</td>
<td>7,600.2</td>
<td>339.4</td>
<td>142.8</td>
<td>684.0</td>
<td>1,079.5</td>
<td>603.6</td>
</tr>
<tr>
<td>Arkansas</td>
<td>74,423.7</td>
<td>3,673.4</td>
<td>1,721.1</td>
<td>7,291.5</td>
<td>9,774.6</td>
<td>5,987.2</td>
</tr>
<tr>
<td>California</td>
<td>78,693.4</td>
<td>3,560.1</td>
<td>1,385.0</td>
<td>7,134.4</td>
<td>11,499.6</td>
<td>5,434.6</td>
</tr>
<tr>
<td>Colorado</td>
<td>33,958.2</td>
<td>1,427.8</td>
<td>615.0</td>
<td>3,165.8</td>
<td>5,940.6</td>
<td>2,337.6</td>
</tr>
<tr>
<td>Connecticut</td>
<td>50.4</td>
<td>1.9</td>
<td>0.8</td>
<td>5.3</td>
<td>9.6</td>
<td>3.1</td>
</tr>
<tr>
<td>Delaware</td>
<td>848.8</td>
<td>37.5</td>
<td>17.6</td>
<td>79.1</td>
<td>149.9</td>
<td>60.6</td>
</tr>
<tr>
<td>Florida</td>
<td>32,324.5</td>
<td>1,497.7</td>
<td>746.8</td>
<td>2,799.8</td>
<td>3,512.6</td>
<td>2,434.2</td>
</tr>
<tr>
<td>Georgia</td>
<td>15,343.7</td>
<td>656.6</td>
<td>294.0</td>
<td>1,431.8</td>
<td>2,353.8</td>
<td>1,130.1</td>
</tr>
<tr>
<td>Idaho</td>
<td>51,079.7</td>
<td>2,042.2</td>
<td>735.5</td>
<td>4,904.8</td>
<td>7,864.3</td>
<td>3,830.8</td>
</tr>
<tr>
<td>Illinois</td>
<td>16,139.2</td>
<td>741.1</td>
<td>373.9</td>
<td>1,532.7</td>
<td>2,817.3</td>
<td>1,218.3</td>
</tr>
<tr>
<td>Indiana</td>
<td>87,776.5</td>
<td>4,011.5</td>
<td>2,001.8</td>
<td>8,386.7</td>
<td>15,118.4</td>
<td>6,685.0</td>
</tr>
<tr>
<td>Iowa</td>
<td>132,348.4</td>
<td>6,071.7</td>
<td>3,074.3</td>
<td>12,588.6</td>
<td>23,175.6</td>
<td>9,969.6</td>
</tr>
<tr>
<td>Kansas</td>
<td>131,752.6</td>
<td>5,296.8</td>
<td>2,059.0</td>
<td>12,828.9</td>
<td>21,516.4</td>
<td>9,390.6</td>
</tr>
<tr>
<td>Kentucky</td>
<td>10,079.9</td>
<td>452.1</td>
<td>213.9</td>
<td>977.3</td>
<td>1,648.0</td>
<td>788.8</td>
</tr>
<tr>
<td>Louisiana</td>
<td>49,115.0</td>
<td>2,361.2</td>
<td>1,105.8</td>
<td>4,758.4</td>
<td>6,839.1</td>
<td>3,747.1</td>
</tr>
<tr>
<td>Maine</td>
<td>22.8</td>
<td>0.7</td>
<td>0.2</td>
<td>2.7</td>
<td>4.1</td>
<td>1.4</td>
</tr>
<tr>
<td>Maryland</td>
<td>1,605.0</td>
<td>67.5</td>
<td>30.6</td>
<td>156.4</td>
<td>280.6</td>
<td>113.3</td>
</tr>
<tr>
<td>Massachusetts</td>
<td>25,814.7</td>
<td>670.3</td>
<td>155.1</td>
<td>3,200.4</td>
<td>4,375.2</td>
<td>1,615.1</td>
</tr>
<tr>
<td>Michigan</td>
<td>1,305.2</td>
<td>56.7</td>
<td>26.0</td>
<td>125.0</td>
<td>221.3</td>
<td>96.4</td>
</tr>
<tr>
<td>Minnesota</td>
<td>180,964.6</td>
<td>8,259.1</td>
<td>3,776.6</td>
<td>16,838.7</td>
<td>28,923.8</td>
<td>14,297.5</td>
</tr>
<tr>
<td>Missouri</td>
<td>47,915.5</td>
<td>2,276.7</td>
<td>1,083.0</td>
<td>4,567.7</td>
<td>6,975.8</td>
<td>3,926.2</td>
</tr>
<tr>
<td>Mississippi</td>
<td>74,587.9</td>
<td>3,268.5</td>
<td>1,531.1</td>
<td>7,420.6</td>
<td>12,111.0</td>
<td>5,757.9</td>
</tr>
<tr>
<td>Montana</td>
<td>23,296.4</td>
<td>967.8</td>
<td>297.7</td>
<td>2,083.5</td>
<td>3,208.3</td>
<td>1,828.1</td>
</tr>
<tr>
<td>Nebraska</td>
<td>81,242.6</td>
<td>3,598.3</td>
<td>1,747.1</td>
<td>7,604.8</td>
<td>14,704.6</td>
<td>5,711.0</td>
</tr>
<tr>
<td>Nevada</td>
<td>6,625.1</td>
<td>174.6</td>
<td>39.4</td>
<td>811.2</td>
<td>1,120.1</td>
<td>411.3</td>
</tr>
<tr>
<td>New Hampshire</td>
<td>167.3</td>
<td>6.1</td>
<td>2.7</td>
<td>17.7</td>
<td>32.0</td>
<td>10.2</td>
</tr>
<tr>
<td>New Jersey</td>
<td>191.2</td>
<td>8.2</td>
<td>3.9</td>
<td>18.6</td>
<td>34.1</td>
<td>13.5</td>
</tr>
<tr>
<td>New Mexico</td>
<td>6,555.3</td>
<td>283.7</td>
<td>115.2</td>
<td>585.2</td>
<td>1,072.8</td>
<td>476.4</td>
</tr>
<tr>
<td>New York</td>
<td>3,949.6</td>
<td>149.0</td>
<td>65.5</td>
<td>411.3</td>
<td>728.0</td>
<td>255.4</td>
</tr>
<tr>
<td>North Carolina</td>
<td>18,678.2</td>
<td>841.9</td>
<td>399.2</td>
<td>1,724.2</td>
<td>3,130.3</td>
<td>1,375.3</td>
</tr>
<tr>
<td>North Dakota</td>
<td>110,207.0</td>
<td>4,902.2</td>
<td>1,902.0</td>
<td>10,001.7</td>
<td>16,048.0</td>
<td>8,810.1</td>
</tr>
<tr>
<td>Ohio</td>
<td>1,771.1</td>
<td>78.3</td>
<td>36.8</td>
<td>173.4</td>
<td>291.9</td>
<td>136.9</td>
</tr>
<tr>
<td>Oklahoma</td>
<td>15,520.1</td>
<td>661.1</td>
<td>229.8</td>
<td>1,373.1</td>
<td>2,326.2</td>
<td>1,123.1</td>
</tr>
<tr>
<td>Pennsylvania</td>
<td>3,050.6</td>
<td>119.2</td>
<td>53.8</td>
<td>314.4</td>
<td>553.2</td>
<td>204.8</td>
</tr>
<tr>
<td>Rhode Island</td>
<td>7.6</td>
<td>0.2</td>
<td>0.0</td>
<td>0.9</td>
<td>1.2</td>
<td>0.5</td>
</tr>
<tr>
<td>South Carolina</td>
<td>4,064.7</td>
<td>177.3</td>
<td>82.8</td>
<td>381.8</td>
<td>688.3</td>
<td>292.1</td>
</tr>
<tr>
<td>South Dakota</td>
<td>119,293.1</td>
<td>5,058.6</td>
<td>2,219.9</td>
<td>11,479.8</td>
<td>20,281.2</td>
<td>8,543.5</td>
</tr>
<tr>
<td>Tennessee</td>
<td>8,508.6</td>
<td>390.2</td>
<td>185.5</td>
<td>828.9</td>
<td>1,303.1</td>
<td>708.1</td>
</tr>
<tr>
<td>Texas</td>
<td>42,269.2</td>
<td>1,779.4</td>
<td>725.6</td>
<td>3,962.5</td>
<td>6,759.4</td>
<td>2,913.6</td>
</tr>
<tr>
<td>Utah</td>
<td>5,719.3</td>
<td>186.9</td>
<td>61.1</td>
<td>631.1</td>
<td>978.0</td>
<td>369.8</td>
</tr>
<tr>
<td>Vermont</td>
<td>331.2</td>
<td>10.4</td>
<td>3.8</td>
<td>38.0</td>
<td>60.5</td>
<td>20.2</td>
</tr>
<tr>
<td>Virginia</td>
<td>2,852.3</td>
<td>112.9</td>
<td>48.2</td>
<td>291.4</td>
<td>483.5</td>
<td>201.3</td>
</tr>
<tr>
<td>Washington</td>
<td>33,475.5</td>
<td>1,261.3</td>
<td>383.8</td>
<td>3,277.8</td>
<td>5,032.2</td>
<td>2,428.0</td>
</tr>
<tr>
<td>West Virginia</td>
<td>620.5</td>
<td>18.8</td>
<td>6.3</td>
<td>72.9</td>
<td>108.9</td>
<td>39.2</td>
</tr>
<tr>
<td>Wisconsin</td>
<td>4,246.8</td>
<td>181.4</td>
<td>87.4</td>
<td>411.9</td>
<td>772.3</td>
<td>295.0</td>
</tr>
<tr>
<td>Wyoming</td>
<td>6,564.0</td>
<td>216.3</td>
<td>70.0</td>
<td>718.9</td>
<td>1,114.5</td>
<td>426.4</td>
</tr>
</tbody>
</table>

| Totals:         | 1,556,997.1 | 68,107.1 | 29,917.6 | 148,515.8 | 247,668.0 | 116,307.5 |

Table 5-10: Emission estimates for Agricultural Burning (short tons/year) using EPA methods.
levels of emissions compared to areas in the Northeast and Western US. The Midwest region shows very low agricultural burning emissions due to very limited activity.

**Figure 5-6:** 2011 NEI state-total PM$_{2.5}$ emissions from agricultural fires

![Map showing PM$_{2.5}$ emissions from agricultural fires](map.png)

Figure 5-7 below shows states that submitted agricultural burning data to the NEI, corresponding to the list shown in Table 5-8. States in gray submitted some data to the NEI for this sector, while states in yellow submitted none and were reliant on emission estimates based on EPA methods. For the states in blue (all LADCO states plus MO, NE and IA), the EPA data were adjusted to be more compliant with local information we got on amounts of agricultural burning occurring in these states [ref 2]. This adjustment procedure is discussed in more detail in Section 5.2.4. AK is not shown, because AK does not have any agricultural burning activity. In addition, states that submitted other pollutants not in the list of EPA-based HAPs and CAPs discussed in Section 5.2.3, were left as is in the NEI (this mainly included other PAHs, phenol, ethyl benzene, some trace metals, ammonia, and lead emissions).
In the 2008 NEI for this sector, a method similar to that used for estimating wild land fires (relying on the “SMARTFIRE” model) was used to develop emission estimates. In the current 2011 NEI, a different method was used to estimate emissions for this sector. This caused the EPA-based emission estimates to be significantly higher in 2011 (a factor of 2-3 times higher) for many states. The 2011 approach is based on the peer-reviewed methods of Dr. Jessica McCarthy. This method relies mainly on satellite-based methods to develop the burned area and then uses an assigned crop type to estimate final emissions. Readers should consult the references provided at the end of this section for in-depth details on this method.

**Burned Area:** A differenced Normalized Burned Ratio (dNBR) was used to map potential cropland burned area using 500 m MOD09A1 8-day surface reflectance of the MODIS. This method was published in McCarty et al. [ref 1] with results published in McCarty et al. [ref 3] and McCarty [ref 4]. This product represents a weekly product, not a daily product. For the 2011 v2, a higher difference Normalized Burn Ratio (“dNBR,” Key and Benson, 2006) [ref 5] threshold of 425 was applied across the CONUS. This threshold was set based on burn scars in cropland areas derived from 2011 Landsat data. These burn scars were digitized in cropland areas of Florida, Minnesota, North Dakota, California, and Wyoming. Active fire data from the MODIS sensor (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 retained from previous NEI development. With the aid of a flow diagram, Figure 5-8 shows the overall geospatial method for producing the remote sensing-based cropland emission estimates.

Figure 5-8: EPA’s Geospatial method for producing Cropland Burning emissions for 2011 NEI

The initial version of the emissions database was shared by Dr. McCarthy with EPA for consideration and initial dissemination to the states in July 2012. From July 2012 to January 2013, based on state partner comments, we further analyzed Wyoming and Indiana results using other satellite sources of burned area at higher resolution (30-meter Landsat and very high resolution commercial datasets) to determine if this dataset was appropriately quantifying burn conditions on the ground. For the corn belt portion of the U.S (Iowa, Indiana, Illinois), state-
level feedback and the analysis of Indiana led to a reduction of 20% in all cropland burning emissions as there was an initial overestimation of the burn scars in which dark soils (i.e., plowed and/or irrigated black soils) were incorrectly classified as burned areas. The EPA emission estimates in the 2011 NEI reflects these changes: the emission estimates for the states of Indiana, Illinois, and Iowa were all lowered by 20% based on the “dark soil” issue. All satellite data processing was performed using ENVI IDL (http://www.exelisvis.com/), the MODIS Reprojection Tool (MRT: 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, Iowa, Missouri, and Ohio) based on comments received from LADCO that questioned the quality of satellite data’s ability to detect small agricultural fires in the mid-western region of the US. When the states confirmed this information, EPA reduced all emissions by a factor of 0.000189 for all these states, resulting in near-nil emissions. For MN, we had different reduction rates they supplied based on their information: MN emissions were reduced by 87%. This ratio approach led to a reduction of between 95-99% of emissions for Wisconsin, Michigan, Ohio, Missouri, and Illinois. These changes are reflected in the results shown in Figure 5-6. Figure 5-9 below shows the resulting PM$_{2.5}$ emissions for the lower 48 states based on EPA methods (it can be compared to Figure 5-6 which is a combination of EPA results and state submitted data). Table 5-11 below outlines the changes in ag burning PM$_{2.5}$ emissions state-by-state in going from NEI v1 to NEI v2. Nationwide there is about a 34% reduction in PM$_{2.5}$ emissions (other pollutants will show similar reductions) with the states outlined about showing much larger reductions and many states staying unchanged.

<table>
<thead>
<tr>
<th>State</th>
<th>2011 v1</th>
<th>2011 v2</th>
<th>Difference (v2 - v1)</th>
</tr>
</thead>
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<td>466</td>
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<td>State</td>
<td>2011 v1</td>
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<td>Difference (v2 - v1)</td>
</tr>
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</tr>
<tr>
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</tr>
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<td>UT</td>
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</tr>
<tr>
<td>VA</td>
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<td>291</td>
<td>0</td>
</tr>
<tr>
<td>VT</td>
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<td>WY</td>
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<tr>
<td>Total</td>
<td>140,857</td>
<td>95,399</td>
<td>-45,458</td>
</tr>
</tbody>
</table>
The McCarthy methodology used by EPA only included emission estimates for the lower 48 contiguous States (no agricultural burning activity was detected in Oregon based on these methods). Alaska does not have any agricultural burning activity, and Hawaii submitted their own emissions as noted in Table 5-8.

5.2.5 Summary of quality assurance methods

- We compared EPA estimates to State submitted estimates, and discovered discrepancies in the Midwestern States, where EPA emission estimates were too high. A report by LADCO [ref 2] provided additional corroboration that EPA estimates may be too high for some of these states. We corrected by applying a ratio based on state submitted information for Indiana after confirming that the state based estimates are likely more accurate. Similarly, for the state of Idaho, EPA estimates were much higher than those submitted by the state; however, Idaho submitted a complete set of emissions which was used in the final 2011 NEI. Most of the states that had noted discrepancies between its estimates and EPA-based estimates have large areas of “dark soils” which can spectrally be confused with burned areas and thus produce overestimations of cropland burned area due to soil properties as well as tillage and irrigation practices. In the future, if the McCarthy methods are to be used further, this area of uncertainty has to be further investigated.

- 2011 EPA methods differed from the methods used by EPA in 2008, causing emissions in 2011 to be significantly higher overall and in some major crop burning areas. While there could have been some
increase in activity between 2008 and 2011, it is likely these new methods contributed most to the increased emissions noted.

- For other states that submitted agricultural burning data (see Table 5-8), we compared those data to EPA estimates in the same counties. The matches between state and EPA data varied, with Eastern states generally matching better. It is difficult to arrive at major conclusions because we have limited information on the methods used by states in estimating agricultural burning emissions. We tagged one emission value submitted by California in Santa Barbara County (2,040.47 tons of acrolein) because it was suspected to be incorrect. No other pollutants were reported for agricultural burning in this county, and this value is 6 times higher than all other county emissions for this pollutant emissions reported by California. In addition, EPA data were tagged to avoid double counting with SLT-submitted data (this was needed because SLT agencies submitted too many different SCCs (see Table 5-7) and EPA reported to only one SCC as shown in the same table). EPA data in DE, KS, LA, NJ, OR, WA, and ID were all tagged to avoid double counting with SLT-submitted data for those states.

- Finally, as a very rough check, Figure 5-10 below shows the percentage of PM$_{2.5}$ emissions associated with agricultural fires vs. wild vs. prescribed fires. Even though EPA methods in 2011 caused agricultural fire acres burned (and emissions) to increase significantly, the agricultural fires still should be very small in emissions magnitude compared to the large wild and prescribed fires. Figure 5-10 confirms this. Further, the figure shows the highest emissions in states known to have significant cropland burning activity.

**Figure 5-10:** Comparison of percentage of PM$_{2.5}$ emissions assigned to agricultural, prescribed and wild fires
5.2.6 References for Agricultural Field Burning


6 Biogenics – Vegetation and Soil

Biogenic emissions are emissions that come from natural sources. They need to be accounted for in photochemical grid models, as most types are widespread and ubiquitous contributors to background air chemistry. In the NEI, only the emissions from vegetation and soils are included, but other relevant sources include volcanic emissions, lightning, and sea salt.

Biogenic emissions from vegetation and soils are computed using a model which utilizes spatial information on vegetation and land use and environmental conditions of temperature and solar radiation. The model inputs are typically horizontally allocated (gridded) data, and the outputs are gridded biogenic emissions which can then be speciated and utilized as input to photochemical grid models.

6.1 Sector description

In the 2011 NEI, biogenic emissions are included in the nonpoint data category, in the EIS sector “Biogenics – Vegetation and Soil.” Table 6-1 lists the two SCCs used in the 2011 NEI that comprise this sector. These 2 SCCs have distinct pollutants: SCC 2701220000 has only NOx emissions, and SCC 2701200000 has emissions for CO, VOC and 3 VOC HAPs: formaldehyde, acetaldehyde and methanol.

<table>
<thead>
<tr>
<th>Source Classification Code</th>
<th>SCC Level One</th>
<th>SCC Level Two</th>
<th>SCC Level Three</th>
<th>SCC Level Four</th>
<th>Tier 1 Description</th>
<th>Tier 2 Description</th>
<th>Tier 3 Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>2701200000</td>
<td>Natural Sources</td>
<td>Biogenic Vegetation</td>
<td>Total</td>
<td>Natural Resources</td>
<td>Biogenic Vegetation</td>
<td></td>
<td></td>
</tr>
<tr>
<td>2701220000</td>
<td>Natural Sources</td>
<td>Biogenic Vegetation/Agriculture</td>
<td>Total</td>
<td>Natural Resources</td>
<td>Biogenic Vegetation</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

The biogenic emissions for the 2011 NEI were computed based on 2011 meteorology data from the Weather Research and Forecasting (WRF) Model using the Biogenic Emission Inventory System, version 3.6 (BEIS3.6) model within SMOKE. The BEIS3.6 model creates gridded, hourly, model-species emissions from vegetation and soils. The 12-kilometer gridded hourly data are summed to monthly and annual level, and are mapped from 12-kilometer grid cells to counties using a standard mapping file. BEIS produces biogenic emissions for a modeling domain which includes the contiguous 48 states in the U.S., parts of Mexico, and Canada. The NEI uses the biogenic emissions from counties from the contiguous 48 states and DC.

The model-species are those associated with the carbon bond 2005 chemical mechanism (CB05). The NEI pollutants produced are: CO, VOC, NOx, methanol, formaldehyde and acetaldehyde. VOC is the sum of all biogenic species except CO, NO, SESQ. Mapping of BEIS pollutants to NEI pollutants is as follows:
• NO maps to NOX
• FORM maps to formaldehyde;
• ALD2 maps to acetaldehyde;
• MEOH maps to methanol;
• VOC is the sum of all biogenic species except CO, NO, SESQ.


The inputs to BEIS include:

• Land-use data from the Biogenic Emissions Land use Database, version 4 (BELD4). BELD4 is derived from the 2006 National Land Cover Database (NLCD) and Moderate Resolution Imaging Spectroradiometer (MODIS) satellite data. Vegetation speciation information is based on data from 2002 to 2013 from the Forest Inventory and Analysis (FIA) version 5.1.6.

• The following meteorological variables that are also inputs to the air quality model are provided in Table 6-2.

   Table 6-2: Meteorological variables used by BEIS and air quality modeling

<table>
<thead>
<tr>
<th>BEIS Meteorological Inputs</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>LAI</td>
<td>leaf-area index</td>
</tr>
<tr>
<td>PRSFC</td>
<td>surface pressure</td>
</tr>
<tr>
<td>Q2</td>
<td>mixing ratio at 2 m</td>
</tr>
<tr>
<td>RC</td>
<td>convective pcpn per met TSTEP</td>
</tr>
<tr>
<td>RGRND</td>
<td>solar rad reaching sfc</td>
</tr>
<tr>
<td>RN</td>
<td>nonconv. pcpn per met TSTEP</td>
</tr>
<tr>
<td>RSTOMI</td>
<td>inverse of bulk stomatal resistance</td>
</tr>
<tr>
<td>SLYTP</td>
<td>soil texture type by USDA category</td>
</tr>
<tr>
<td>SOIM1</td>
<td>volumetric soil moisture in top cm</td>
</tr>
<tr>
<td>SOIT1</td>
<td>soil temperature in top one cm</td>
</tr>
<tr>
<td>TEMPG</td>
<td>skin temperature at ground</td>
</tr>
<tr>
<td>USTAR</td>
<td>cell averaged friction velocity</td>
</tr>
<tr>
<td>RADYNI</td>
<td>inverse of aerodynamic resistance</td>
</tr>
<tr>
<td>TEMP2</td>
<td>temperature at 2 meters</td>
</tr>
</tbody>
</table>

6.2 Sources of data overview and selection hierarchy

The only source of data for this sector is the EPA-estimated emissions from BEIS3.6. States are neither required nor encouraged to report emissions, and no state has done this. The name of the EPA dataset in the EIS is: 2011EPA_biogenics.
6.3 Spatial coverage and data sources for the sector

The spatial coverage of the biogenics emissions is governed by the “2011 platform” modeling domain which covers all counties in the lower 48 states. More information on this modeling platform is available at http://www.epa.gov/ttn/chief/emch/index.html#2011.

Table 6-3 shows state summaries for the biogenic emissions sector and the contribution of biogenics to the total 2011v2 NEI in that state. Biogenic emissions are a very large fraction of the total NEI VOC, methanol, formaldehyde and acetaldehyde emissions but a very small fraction of the CO and NOx.


<p>| Table 6-3: State summary of Biogenics – Vegetation and Soil emissions (short tons/year) |
|----------------------------------------|---|---|---|---|---|---|---|</p>
<table>
<thead>
<tr>
<th>State</th>
<th>formaldehyde</th>
<th>methanol</th>
<th>acetaldehyde</th>
<th>CO</th>
<th>NOx</th>
<th>VOC</th>
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<td>74%</td>
</tr>
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<td>97,626</td>
<td>82%</td>
<td>17,548</td>
<td>71%</td>
</tr>
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<td>237,270</td>
<td>86%</td>
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<td>79%</td>
</tr>
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<tr>
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<td>84%</td>
<td>8,663</td>
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<td>68%</td>
</tr>
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<td>90%</td>
<td>17,557</td>
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</tr>
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<td>21,259</td>
<td>75%</td>
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<td>77,308</td>
<td>80%</td>
<td>14,038</td>
<td>76%</td>
</tr>
<tr>
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<td>89%</td>
<td>7,189</td>
<td>69%</td>
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<td>85%</td>
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<td>92%</td>
<td>1,620</td>
<td>71%</td>
</tr>
<tr>
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<td>% of total</td>
<td>methanol</td>
<td>% of total</td>
<td>acetaldehyde</td>
<td>% of total</td>
</tr>
<tr>
<td>-------</td>
<td>--------------</td>
<td>------------</td>
<td>----------</td>
<td>------------</td>
<td>--------------</td>
<td>------------</td>
</tr>
<tr>
<td>NJ</td>
<td>1,924</td>
<td>41%</td>
<td>6,852</td>
<td>65%</td>
<td>1,411</td>
<td>41%</td>
</tr>
<tr>
<td>NM</td>
<td>43,642</td>
<td>82%</td>
<td>203,642</td>
<td>90%</td>
<td>32,004</td>
<td>82%</td>
</tr>
<tr>
<td>NV</td>
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<td>94%</td>
<td>132,715</td>
<td>98%</td>
<td>22,016</td>
<td>94%</td>
</tr>
<tr>
<td>NY</td>
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<td>70%</td>
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</tr>
<tr>
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</tr>
<tr>
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</tr>
<tr>
<td>OR</td>
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<td>64%</td>
<td>76,670</td>
<td>67%</td>
<td>19,255</td>
<td>64%</td>
</tr>
<tr>
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<td>31,011</td>
<td>78%</td>
<td>6,521</td>
<td>57%</td>
</tr>
<tr>
<td>RI</td>
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<td>793</td>
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<tr>
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</tr>
<tr>
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<td>9,835</td>
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<td>55,858</td>
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</tr>
<tr>
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</tr>
<tr>
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</tr>
<tr>
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<td>51,092</td>
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<td>9,596</td>
<td>69%</td>
</tr>
<tr>
<td>VT</td>
<td>2,048</td>
<td>75%</td>
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<td>94%</td>
<td>1,502</td>
<td>75%</td>
</tr>
<tr>
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<td>18,090</td>
<td>72%</td>
<td>43,492</td>
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<td>13,266</td>
<td>72%</td>
</tr>
<tr>
<td>WI</td>
<td>9,781</td>
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</tr>
<tr>
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<td>72%</td>
</tr>
<tr>
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<td>77%</td>
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<td>68%</td>
</tr>
</tbody>
</table>
7 Supporting data and summaries

The previous sections provide number references to both supporting data and key output summaries. All supporting input data and summaries referenced in the sections above can be obtained through the CHIEF ftp site at:


or, on the 2011 webpage:

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