# Technical Support Document (TSD)

# Preparation of Emissions Inventories for the Version 7, 2014 Emissions Modeling Platform for NATA

**--DRAFT--**

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# TABLE OF CONTENTS

# List of Tables

# List of Figures



# List of Appendices

# Acronyms

| | |
|---|---|
| **AE5** | CMAQ Aerosol Module, version 5, introduced in CMAQ v4.7 |
| **AE6** | CMAQ Aerosol Module, version 6, introduced in CMAQ v5.0 |
| **AEO** | Annual Energy Outlook |
| **AERMOD** | American Meteorological Society/Environmental Protection Agency Regulatory Model |
| **NBAFM** | Naphthalene, Benzene, Acetaldehyde, Formaldehyde and Methanol |
| **BEIS** | Biogenic Emissions Inventory System |
| **BELD** | Biogenic Emissions Land use Database |
| **Bgal** | Billion gallons |
| **BPS** | Bulk Plant Storage |
| **BTP** | Bulk Terminal (Plant) to Pump |
| **C1/C2** | Category 1 and 2 commercial marine vessels |
| **C3** | Category 3 (commercial marine vessels) |
| **CAEP** | Committee on Aviation Environmental Protection |
| **CAIR** | Clean Air Interstate Rule |
| **CAMD** | EPA's Clean Air Markets Division |
| **CAMx** | Comprehensive Air Quality Model with Extensions |
| **CAP** | Criteria Air Pollutant |
| **CARB** | California Air Resources Board |
| **CB05** | Carbon Bond 2005 chemical mechanism |
| **CBM** | Coal-bed methane |
| **CEC** | North American Commission for Environmental Cooperation |
| **CEMS** | Continuous Emissions Monitoring System |
| **CEPAM** | California Emissions Projection Analysis Model |
| **CISWI** | Commercial and Industrial Solid Waste Incinerators |
| **Cl** | Chlorine |
| **CMAQ** | Community Multiscale Air Quality |
| **CMV** | Commercial Marine Vessel |
| **CO** | Carbon monoxide |
| **CSAPR** | Cross-State Air Pollution Rule |
| **E0, E10, E85** | 0%, 10% and 85% Ethanol blend gasoline, respectively |
| **EBAFM** | Ethanol, Benzene, Acetaldehyde, Formaldehyde and Methanol |
| **ECA** | Emissions Control Area |
| **EEZ** | Exclusive Economic Zone |
| **EF** | Emission Factor |
| **EGU** | Electric Generating Units |
| **EIS** | Emissions Inventory System |
| **EISA** | Energy Independence and Security Act of 2007 |
| **EPA** | Environmental Protection Agency |
| **EMFAC** | Emission Factor (California's onroad mobile model) |
| **FAA** | Federal Aviation Administration |
| **FAPRI** | Food and Agriculture Policy and Research Institute |
| **FASOM** | Forest and Agricultural Section Optimization Model |
| **FCCS** | Fuel Characteristic Classification System |
| **FF10** | Flat File 2010 |
| **FIPS** | Federal Information Processing Standards |
| **FHWA** | Federal Highway Administration |
| **HAP** | Hazardous Air Pollutant |

| | |
|---|---|
| **HCl** | Hydrochloric acid |
| **HDGHG** | Heavy-Duty Vehicle Greenhouse Gas |
| **Hg** | Mercury |
| **HMS** | Hazard Mapping System |
| **HPMS** | Highway Performance Monitoring System |
| **HWC** | Hazardous Waste Combustion |
| **HWI** | Hazardous Waste Incineration |
| **ICAO** | International Civil Aviation Organization |
| **ICI** | Industrial/Commercial/Institutional (boilers and process heaters) |
| **ICR** | Information Collection Request |
| **IDA** | Inventory Data Analyzer |
| **I/M** | Inspection and Maintenance |
| **IMO** | International Marine Organization |
| **IPAMS** | Independent Petroleum Association of Mountain States |
| **IPM** | Integrated Planning Model |
| **ITN** | Itinerant |
| **LADCO** | Lake Michigan Air Directors Consortium |
| **LDGHG** | Light-Duty Vehicle Greenhouse Gas |
| **LPG** | Liquefied Petroleum Gas |
| **MACT** | Maximum Achievable Control Technology |
| **MARAMA** | Mid-Atlantic Regional Air Management Association |
| **MATS** | Mercury and Air Toxics Standards |
| **MCIP** | Meteorology-Chemistry Interface Processor |
| **Mgal** | Million gallons |
| **MMS** | Minerals Management Service (now known as the Bureau of Energy Management, Regulation and Enforcement (BOEMRE) |
| **MOVES** | Motor Vehicle Emissions Simulator |
| **MSA** | Metropolitan Statistical Area |
| **MSAT2** | Mobile Source Air Toxics Rule |
| **MTBE** | Methyl tert-butyl ether |
| **MWRPO** | Mid-west Regional Planning Organization |
| **NCD** | National County Database |
| **NEEDS** | National Electric Energy Database System |
| **NEI** | National Emission Inventory |
| **NESCAUM** | Northeast States for Coordinated Air Use Management |
| **NESHAP** | National Emission Standards for Hazardous Air Pollutants |
| **$NH_3$** | Ammonia |
| **NIF** | NEI Input Format |
| **NLCD** | National Land Cover Database |
| **NLEV** | National Low Emission Vehicle program |
| **nm** | nautical mile |
| **NMIM** | National Mobile Inventory Model |
| **NOAA** | National Oceanic and Atmospheric Administration |
| **NODA** | Notice of Data Availability |
| **NONROAD** | OTAQ's model for estimation of nonroad mobile emissions |
| **$NO_X$** | Nitrogen oxides |
| **NSPS** | New Source Performance Standards |
| **NSR** | New Source Review |
| **OAQPS** | EPA's Office of Air Quality Planning and Standards |
| **OHH** | Outdoor Hydronic Heater |

| | |
|---|---|
| **OTAQ** | EPA's Office of Transportation and Air Quality |
| **ORIS** | Office of Regulatory Information System |
| **ORD** | EPA's Office of Research and Development |
| **ORL** | One Record per Line |
| **OTC** | Ozone Transport Commission |
| **PADD** | Petroleum Administration for Defense Districts |
| **PF** | Projection Factor, can account for growth and/or controls |
| **PFC** | Portable Fuel Container |
| **$PM_{2.5}$** | Particulate matter less than or equal to 2.5 microns |
| **$PM_{10}$** | Particulate matter less than or equal to 10 microns |
| **ppb, ppm** | Parts per billion, parts per million |
| **RBT** | Refinery to Bulk Terminal |
| **RFS2** | Renewable Fuel Standard |
| **RIA** | Regulatory Impact Analysis |
| **RICE** | Reciprocating Internal Combustion Engine |
| **RWC** | Residential Wood Combustion |
| **RPO** | Regional Planning Organization |
| **RVP** | Reid Vapor Pressure |
| **SCC** | Source Classification Code |
| **SEMAP** | Southeastern Modeling, Analysis, and Planning |
| **SESARM** | Southeastern States Air Resource Managers |
| **SESQ** | Sesquiterpenes |
| **SMARTFIRE** | Satellite Mapping Automated Reanalysis Tool for Fire Incident Reconciliation |
| **SMOKE** | Sparse Matrix Operator Kernel Emissions |
| **$SO_2$** | Sulfur dioxide |
| **SOA** | Secondary Organic Aerosol |
| **SI** | Spark-ignition |
| **SIP** | State Implementation Plan |
| **SPDPRO** | Hourly Speed Profiles for weekday versus weekend |
| **SPPD** | Sector Policies and Programs Division |
| **TAF** | Terminal Area Forecast |
| **TCEQ** | Texas Commission on Environmental Quality |
| **TOG** | Total Organic Gas |
| **TSD** | Technical support document |
| **ULSD** | Ultra Low Sulfur Diesel |
| **USDA** | United States Department of Agriculture |
| **VOC** | Volatile organic compounds |
| **VMT** | Vehicle miles traveled |
| **VPOP** | Vehicle Population |
| **WRAP** | Western Regional Air Partnership |
| **WRF** | Weather Research and Forecasting Model |

# 1 Introduction

The U.S. Environmental Protection Agency (EPA) developed an air quality modeling platform that represents the year 2014 based on the 2014 National Emissions Inventory (NEI), version 1 (2014NEIv1). The air quality modeling platform consists of all the emissions inventories and ancillary data files used for emissions modeling, as well as the meteorological, initial condition, and boundary condition files needed to run the air quality model. This document focuses on the emissions modeling component of the 2014 modeling platform, which includes the emission inventories, the ancillary data files, and the approaches used to transform inventories for use in air quality modeling. Many emissions inventory components of this air quality modeling platform are based on the 2014NEIv1, although there are some differences between the platform inventories and the 2014NEIv1 emissions as a result of addressing known issues and the incorporation of newly available data and improved methods.

This 2014 modeling platform includes all criteria air pollutants and precursors (CAPs) and two groups of hazardous air pollutants (HAPs). The first group are HAPs explicitly used by the chemical mechanism in the Community Multiscale Air Quality (CMAQ) model for ozone/particulate matter (PM): chlorine (Cl), hydrogen chloride (HCl), benzene, acetaldehyde, formaldehyde, methanol, naphthalene. The second group consists of 51 HAPs or HAP groups (such as polycyclic aromatic hydrocarbon groups) added to CMAQ for the purposes of air quality modeling for the 2014 National Air Toxics Assessment (NATA). The latter five HAPs in the first group are also abbreviated as NBAFM in subsequent sections of the document. A list of all HAPs is in Appendix A. This platform is called the "2014 NATA-Based Platform, version 7.0" (2014v7.0) because it is a multipollutant platform used primarily for NATA. Here, "version 7.0" denotes an evolution from the latest version of the 2011-based platform, version 6.3, which was the starting point for a number of the ancillary data files. The 2011v6.3 Technical Support Document (TSD) is available on the EPA's Air Emissions Modeling website for the version 6 platforms, https://www.epa.gov/air-emissions-modeling/2011-version-6-air-emissions-modeling-platforms, under the section entitled "2011v6.3 Platform."

For the rest of this document, the platform that is described is referred to as the "2014 v7.0 platform" or "2014v7.0."

The 2014v7.0 platform was used to support version 1 of the 2014 NATA, the focus of which is multipollutant modeling of HAPs and CAPs using CMAQ version 5.2 multipollutant (Appel, 2016). The modeling domain includes the lower 48 states and parts of Canada and Mexico. The 2014 NATA also utilizes the American Meteorological Society/Environmental Protection Agency Regulatory Model (AERMOD), which is an air dispersion modeling system, for all NEI HAPs (about 130 more than covered by CMAQ) across all 50 states, Puerto Rico and the Virgin Islands. Emissions preparation for AERMOD is discussed elsewhere.

The CMAQ model requires hourly and gridded emissions of chemical species that correspond to CAPs and specific HAPs. The chemical mechanism used by CMAQ for this platform is called Carbon Bond version 6 -CMAQ (CB6-CMAQ) and includes important reactions for simulating ozone formation, nitrogen oxides (NOx) cycling, and formation of secondary aerosol species. It is basically the same as the CB6 used in the 2011v6.3 platform described in (Hildebrant Ruiz and Yarwood, 2013) except that CMAQ-CB6 removes naphthalene from the XYL lumped species group and treats it explicitly. In addition, many additional HAPs are included to support the NATA analysis.

The 2014v7.0 platform consists of one 'complete' emissions case: the 2014 base case (i.e., 2014fa_nata_cb6cmaq_14j). In the case abbreviations, 2014 is the year represented by the emissions; the "f" represents the base year platform iteration (the previous platform, which was a 2011-based platform, was "e") and the "a" stands for the first set of emissions modeled for a 2014-based modeling platform (the next case will be 2014fb). Table 1-1 summarizes this emissions case. The purpose of this 2014 base case is to provide actual 2014 emissions for air quality modeling of the HAPs in the 2014 NEI within a multipollutant framework that accounts for atmospheric chemistry and transport within a state of the art photochemical grid model.

**Table 1-1.** List of cases in the 2014 Version 7.0 Emissions Modeling Platform

| Case Name | Abbreviation | Description |
|---|---|---|
| 2014 base case | 2014fa_cb6v2_v6 | 2014 case relevant for air quality model evaluation purposes. Uses 2014NEIv1 along with some other inventory data, with hourly 2014 continuous emissions monitoring system (CEMS) data for electrical generating units (EGUs), hourly onroad mobile emissions, and 2014 day-specific wild and prescribed fire data. |

The emissions data in the 2014v7.0 platform are primarily based on the 2014NEIv1 for point sources, nonpoint sources, commercial marine vessels (CMV), onroad and nonroad mobile sources, and fires. Some platform categories are based on more disaggregated data than that 2014NEI such as onroad mobile source emissions, which use hourly emissions by vehicle type, fuel type process and road type. For the 2014NEI, which uses the same modeling and inputs, the emissions are provided as vehicle type/fuel type totals at annual temporal resolution. In addition, emissions from Canada and Mexico are used for the platform but are not part of the NEI. Temporal, spatial and other changes in emissions between the 2014NEI and the emissions input into the platform are described in Section 2 of this TSD.

The primary emissions modeling tool used to create the air quality model-ready emissions was the Sparse Matrix Operator Kernel Emissions (SMOKE) modeling system (http://www.smoke-model.org/). Primarily SMOKE version 4.0 was used, though to enable some speciation enhancements discussed in Section 3, a beta version of SMOKE 4.5 was used for some modeling sectors. This emission modeling created emissions files for a 12-km national grid that includes all of the contiguous states "12US2," shown in Figure 3-1. Electronic copies of the data used as input to SMOKE for the 2014 Platform are available from the EPA Air Emissions Modeling website, https://www.epa.gov/air-emissions-modeling/2014-version-7-air-emissions-modeling-platforms, under the 2014v7.0 section.

The gridded meteorological model used for the emissions modeling was developed using the Weather Research and Forecasting Model (WRF, http://wrf-model.org) version 3.8, Advanced Research WRF core (Skamarock, et al., 2008). The WRF Model is a mesoscale numerical weather prediction system developed for both operational forecasting and atmospheric research applications. The WRF was run for 2014 over a domain covering the continental U.S. at a 12km resolution with 35 vertical layers. The WRF data were collapsed to 25 layers prior to running the emissions and air quality models. The run for this platform included high resolution sea surface temperature data from the Group for High Resolution Sea Surface Temperature (GHRSST) (see https://www.ghrsst.org/) and is given the EPA meteorological case label "14j." The full case name includes this abbreviation following the emissions portion of the case name to fully specifiy the name of the case as "2014fa_nata_cb6cmaq_14j."

This document contains five sections and several appendices. Section 2 describes the 2014 inventories input to SMOKE. Section 3 describes the emissions modeling and the ancillary files used with the emission inventories. Data summaries are provided in Section 4. Section 5 provides references. The Appendices provide additional details about specific technical methods.

# 2 2014 Emission Inventories and Approaches

This section describes the 2014 emissions data that make up the 2014 platform. The starting point for the 2014 stationary source emission inputs is the 2014NEIv1 or more detailed temporal/spatial resolution data used to build the NEI, with adjustments to account for corrections of errors identified by the EPA. Documentation for the 2011NEIv1, including a TSD, is available at [https://www.epa.gov/air-emissions-inventories/2014-national-emissions-inventory-nei-documentation](https://www.epa.gov/air-emissions-inventories/2014-national-emissions-inventory-nei-documentation).

The NEI data for CAPs are largely compiled from data submitted by state, local and tribal (S/L/T) air agencies. HAP emissions data are also from the S/L/T agencies, but are often augmented by the EPA because they are voluntarily submitted. The EPA uses the Emissions Inventory System (EIS) to compile the NEI. The EIS includes hundreds of automated quality assurance (QA) checks to help improve data quality, and also supports tracking release point (e.g., stack) coordinates separately from facility coordinates. The EPA collaborated extensively with S/L/T agencies to ensure a high quality of data in the 2014NEIv1.

Onroad and nonroad mobile source emissions in the 2014NEIv1 were developed using the Motor Vehicle Emission Simulator (MOVES). MOVES2014a was used with S/L inputs, where provided, or EPA defaults. The 2014 NEI is the first use of MOVES for nonroad emissions. MOVES2014a essentially replaces the National Mobile Inventory Model (NMIM) as the interface for using the NONROAD2008 model, ensuring that the gasoline fuels used for nonroad equipment are consistent with those used for onroad vehicles and using newer data to estimate the HAPs than had been used in NMIM.

The 2014 NEI includes five data categories: point sources, nonpoint (formerly called "stationary area") sources, nonroad mobile sources, onroad mobile sources, and events consisting of fires. The NEI uses 60 sectors to further describe the emissions, with an additional biogenic sector generated from a summation of the gridded, hourly 2014 biogenic data used in the emissions modeling platform. In addition to the NEI data, emissions from the Canadian and Mexican inventories and several other non-NEI data sources are included in the 2014emissions modeling platform. Many sectors for 2014 used improved emission approaches and/or updated emission factors including nonroad, commercial marine vessels, residential wood combustion, oil and gas, agricultural ammonia (including both livestock and fertilizer sources), and fires (including wild, prescribed and agricultural burning).

As explained below, the major differences between the 2014 NEIv1 and the 2014v7.0 platform include: meteorologically-adjusted road dust emissions, CEMS data for EGUs, updates implemented to a few sectors as a result of corrections identified by the EPA, and emissions for areas outside the U.S. In addition, the modeling platform uses more temporally-resolved emissions than the NEI for many sectors.

For the purposes of preparing the air quality model-ready emissions, the 2014NEIv1 was split into finer-grained sectors used for emissions modeling. The significance of an emissions modeling or "platform sector" is that the data are run through all of the SMOKE programs except the final merge (Mrggrid) independently from the other sectors. The final merge program then combines the sector-specific gridded, speciated, hourly emissions together to create CMAQ-ready emission inputs.

Table 2-1 presents the sectors in the 2014 platform and how they generally relate to the 2014NEIv1 as a starting point. As discussed in greater detail in Table 2-2, the emissions in some of these sectors were modified from the 2014NEIv1 emissions for the 2014 modeling platform. The platform sector abbreviations are provided in italics. These abbreviations are used in the SMOKE modeling scripts, inventory file names, and throughout the remainder of this document.

**Table 2-1. Platform sectors for the 2014v7.0 emissions modeling platform**

| Platform Sector: *abbreviation* | NEI Data Category | Description and resolution of the data input to SMOKE |
|---|---|---|
| **EGU units:** ***ptegu*** | Point | 2014NEIv1 point source EGUs. The 2014NEIv1 emissions are replaced with hourly 2014 CEMS values for $NO_X$ and $SO_2$ for any units that are matched to the NEI. Other pollutants are scaled from 2014NEIv1 using CEMS heat input. Emissions for all sources not matched to CEMS data come from 2014NEIv1. Annual resolution for sources not matched to CEMS data, hourly for CEMS sources. |
| **Point source oil and gas:** ***pt_oilgas*** | Point | 2014NEIv1 point sources that include oil and gas production emissions processes based on facilities with the following NAICS: 211* (Oil and Gas Extraction), 213111 (Drilling Oil and Gas Wells) 213112 (Support Activities for Oil and Gas Operations), 4861* (Pipeline Transportation of Crude Oil), 4862* (Pipeline Transportation of Natural Gas). Annual resolution. |
| **Remaining non-EGU point:** ***ptnonipm*** | Point | All 2014NEIv1 point source records not matched to the ptegu or pt_oilgas sectors, except for offshore point sources that are in the othpt sector. Includes all aircraft and airport ground support emissions and some rail yard emissions. Annual resolution. |
| **Agricultural:** ***ag*** | Nonpoint | Ammonia emissions from 2014NEIv1 nonpoint livestock and fertilizer application, county and daily resolution for livestock; county and annual resolution for fertilizer. |
| **Agricultural fires with point resolution:** ***ptagfire*** | Nonpoint | 2014NEIv1 agricultural fire sources that were developed by EPA as point and day-specific emissions; they were put into the nonpoint NEI data category, but in the platform, they are treated as point sources. This sector was not in the 2011v6.3 platform since day-specific emissions for agricultural burning via the EPA estimation method were not available for the 2011 NEI. |
| **Agricultural fires:** ***agfire*** | Nonpoint | 2014NEIv1 agricultural fire sources reported by S/L agencies. County and annual resolution. Monthly profiles derived from annual S/L data using day-specific information from the EPA-derived data for these states. |
| **Area fugitive dust:** ***afdust*** | Nonpoint | $PM_{10}$ and $PM_{2.5}$ fugitive dust sources from the 2014NEIv1 nonpoint inventory; including building construction, road construction, agricultural dust, and road dust. The emissions modeling adjustment applies a transport fraction and a meteorology-based (precipitation and snow/ice cover) zero-out. County and annual resolution. |
| **Biogenic:** ***Beis*** | Nonpoint | Year 2014, hour-specific, grid cell-specific emissions generated from the BEIS3.61 model within SMOKE, including emissions in Canada and Mexico using BELD v4.1 land use data. |
| **Category 1, 2 and 3 CMV:** ***cmv*** | Nonpoint | Category 1 (C1), category 2 (C2) and category 3 (C3) CMV emissions sources from the 2014NEIv1 nonpoint inventory, except that it does not use C3 from the 2014 NEI in Federal Waters. County and annual resolution; see othpt sector for all non-U.S. C3 emissions. |
| **locomotives:** ***rail*** | Nonpoint | Rail locomotives emissions from the 2014NEIv1. County and annual resolution. |
| **Remaining nonpoint:** ***nonpt*** | Nonpoint | 2014NEIv1 nonpoint sources not included in other platform sectors with adjustments to remove chromium from fugitive dust categories (paved and unpaved roads, construction and crops and livestock). County and annual resolution. |

| Platform Sector: *abbreviation* | NEI Data Category | Description and resolution of the data input to SMOKE |
|---|---|---|
| **Nonpoint source oil and gas:** ***np_oilgas*** | Nonpoint | 2014NEIv1 nonpoint sources from oil and gas-related processes with specific adjustment in four unitah basin counties in Utah to correct EPA augmented benzene, toluene, ethylbenzene and xylenes. County and annual resolution. |
| **Residential Wood Combustion:** ***rwc*** | Nonpoint | 2014NEIv1 nonpoint sources with residential wood combustion (RWC) processes. County and annual resolution. |
| **Nonroad:** ***nonroad*** | Nonroad | 2014NEIv1 nonroad equipment emissions developed with the MOVES2014a using NONROAD2008 version NR08a and new HAP emission factors than had been used in the 2011NEI. MOVES was used for all states except California, which submitted their own emissions for the 2014NEIv1. County and monthly resolution. |
| **Onroad:** ***onroad*** | Onroad | 2014 onroad mobile source gasoline and diesel vehicles from parking lots and moving vehicles. Includes the following modes: exhaust, extended idle, auxiliary power units, evaporative, permeation, refueling, and brake and tire wear. For all states except California, based on monthly MOVES emissions tables produced by MOVES2014a. |
| **Onroad California:** ***onroad_ca_adj*** | Onroad | 2014 California-provided CAP and metal HAP onroad mobile source gasoline and diesel vehicles from parking lots and moving vehicles based on Emission Factor (EMFAC), gridded and temporalized using MOVES2014a. Volatile organic compound (VOC) HAP emissions derived from California-provided VOC emissions and MOVES-based speciation. |
| **Point source fires-smoldering:** ***Ptfire_s*** | Fires | Point source day-specific wildfires and prescribed fires for 2014 computed using SMARTFIRE2 for smoldering processes (i.e., SCCs 281XXXX001), except for Georgia-submitted emissions. Consistent with 2014NEIv1. |
| **Point source fires-flaming:** ***Ptfire_f*** | Fires | Point source day-specific wildfires and prescribed fires for 2014 computed using SMARTFIRE2 for flaming processes (i.e., SCCs 281XXXX002), except for Georgia-submitted emissions. Consistent with 2014NEIv1. |
| **Non-US. fires:** ***ptfire_mxca*** | N/A | Point source day-specific wildfires and prescribed fires for 2014 provided by Environment Canada with data for missing months and for Mexico filled in using fires from the Fire INventory (FINN) from National Center for Atmospheric Research (NCAR) fires (NCAR, 2016 and Wiedinmyer, C., 2011). |
| **Other dust sources not from the 2014 NEI:** ***othafdust*** | N/A | Fugitive dust sources from Canada's 2010 inventory. The emissions modeling adjustment applies a transport fraction and a meteorology-based (precipitation and snow/ice cover) zero-out. County and annual resolution. |
| **Other point sources not from the 2014 NEI:** ***othpt*** | N/A | Point sources from Canada's 2010 inventory and Mexico's 2014 inventory, annual resolution. Also includes all non-U.S. C3 CMV and U.S. offshore oil production. |
| **Other non-NEI nonpoint and nonroad:** ***othar*** | N/A | Monthly year 2010 Canada (province resolution) and year 2014 Mexico (municipio resolution) nonpoint and nonroad mobile inventories. 2010 Canada nonroad mobile inventory projected to 2014. |

| Platform Sector: *abbreviation* | NEI Data Category | Description and resolution of the data input to SMOKE |
|---|---|---|
| **Other non-NEI onroad sources:** ***onroad_can*** | N/A | Monthly year 2010 Canada (province resolution) onroad mobile inventory, projected to 2014. |
| **Other non-NEI onroad sources:** ***onroad_mex*** | N/A | Monthly year 2014 Mexico (municipio resolution) onroad mobile inventory. |

Table 2-2 provides a brief by-sector overview of the most significant differences between the 2014 emissions platform and the 2011v6.3 platform methodologies. Only those sectors with significant differences between the 2014NEIv1 and the 2011 emissions modeling platform are listed. The specific by-sector updates to the 2011 platform are described in greater detail later in this section under each by-sector subsection. For all sectors with VOC emissions in the U.S., speciation of VOC was done differently from the 2011v6.3. In 2014v7.0 and in all NATA platforms, we use the inventory HAPs that are explicit in the chemical mechanism for speciation (NBAFM) and we remove these compounds from the speciation profiles input to the Speciation Tool so as not to double count the mass.

**Table 2-2. Summary of methodological differences between 2014v7.0 platform and 2011v6.3 emissions by sector**

| Platform Sector | Summary of Significant Methodological Differences of 2014v7.0 Platform vs. 2011v6.3 Platform |
|---|---|
| **EGU units:** ***ptegu*** | -Speciation relies on inventory HAP emissions for NBAFM rather than speciation of VOC |
| **Point source oil and gas:** ***pt_oilgas*** | -Speciation relies on inventory HAP emissions for NBAFM rather than speciation of VOC<br>-Sector excludes natural gas distribution |
| **Remaining non-EGU point:** ***ptnonipm*** | -Speciation relies on inventory HAP emissions for NBAFM rather than speciation of VOC |
| **Agricultural:** ***ag*** | -Created daily emissions for livestock. The EPA estimates were already developed as daily and were used to create daily estimates of state-reported data. |
| **Agriculture Burning:** ***ptagfire*** | -New sector. The 2014 EPA-estimated agricultural fires have specific geographic coordinates and day-specific temporal resolution.<br>-Speciation relies on inventory HAP emissions for NBAFM rather than speciation of VOC |
| **Agriculture Burning:** ***agfire*** | --This sector includes only the county-level data submitted by states for which we do not have specific geographic coordinates or day specific temporal resolution and, therefore, does not represent the total emissions from agricultural burning.<br>-Speciation relies on inventory HAP emissions for NBAFM rather than speciation of VOC |
| **Point source fires-flaming:** ***ptfire_f*** | -Speciation relies on inventory HAP emissions for NBAFM rather than speciation of VOC<br>-We broke out the flaming part of the ptfire sector- previously flaming was not distinguished form smoldering. This was done in order to model the two with different vertical resolution.<br>-New regional profiles for VOC (same profiles used for flaming and smoldering) |

| Platform Sector | Summary of Significant Methodological Differences of 2014v7.0 Platform vs. 2011v6.3 Platform |
|---|---|
| **Point source fires-smoldering:** ***ptfire_s*** | -Speciation relies on inventory HAP emissions for NBAFM rather than speciation of VOC<br>-New regional profiles for VOC (same profiles used for flaming and smoldering) |
| **Remaining nonpoint sector:** ***nonpt*** | -New sector. We broke out the smoldering part of the ptfire sector- previously smolding was not distinguished form smoldering. This was done in order to model the two with different vertical resolution (though likely this will be reverted back to just the one ptfire sector for the next version of the platform). For the smoldering sector, we did not use plume rise for layering of smoldering, rather it was put into layer 1.<br>-Speciation relies on inventory HAP emissions for NBAFM rather than speciation of VOC |
| **Nonpoint oil and gas sector:** ***np_oilgas*** | -Used HAP integration for speciation<br>- Assign multiple speciation profiles to county/SCC to account for the different speciation of VOC coming from a controlled stream (flare) versus a process (e.g., pneumatic pump). |
| **Nonroad:** ***Nonroad*** | -Except for California, the MOVES2014a model provides NONHAPTOG along with the speciation profile code instead of speciating using an SCC-to-speciation profile cross reference (GSREF). |
| **Onroad sector:** ***Onroad*** | -Updated speciation profile for brake and tirewear emissions |
| **Other non-NEI sources: othafdust, othpt, othar, ptfire_mxca,** ***onroad_can and onroad_mex*** | -Separated Mexico onroad from Canada and used new inventory based on MOVES-Mexico.<br>- Included new ptfire_mxca sector to reflect point fires in Canada and Mexico.<br>-MOVES-Mexico emissions are fully integrated with all HAPs while remaining Mexico and Canada emissions use speciation to generate NBAFM.<br>- Used inventory HAP emissions for NBAFM rather than speciation of VOC for the US-based (NEI emissions) contained in othpt (i.e., CMV in Federal waters). |

The emission inventories in SMOKE input formats for the 2014 base case are available from the EPA's Air Emissions Modeling website for the version 7 platform: https://www.epa.gov/air-emissions-modeling/2014-version-7-air-emissions-modeling-platforms, under the section entitled "2014v7.0 Platform." The 2014v7.0 "README" file indicates the particular zipped files associated with each platform sector. A number of reports (i.e., summaries) are available with the data files for the 2014v7.0 platform. The types of reports include state summaries of inventory pollutants and model species by modeling platform sector and county annual totals by modeling platform sector.

The remainder of Section 2 provides details about the data contained in each of the 2014 platform sectors. Different levels of detail are provided for different sectors depending on the availability of reference information for the data, the degree of changes or manipulation of the data needed to prepare it for input to SMOKE, and whether the 2014 platform emissions are significantly different from the 2014NEIv1.

## 2.1 2014 NEI point sources (ptegu, pt_oilgas and ptnonipm)

Point sources are sources of emissions for which specific geographic coordinates (e.g., latitude/longitude) are specified, as in the case of an individual facility. A facility may have multiple emission release points that may be characterized as units such as boilers, reactors, spray booths, kilns, etc. A unit may have multiple processes (e.g., a boiler that sometimes burns residual oil and sometimes burns natural gas). With a couple of minor exceptions, this section describes only NEI point sources within the contiguous U.S. The offshore oil platform (othpt sector) emissions are processed by SMOKE as point source inventories, as described in Section 2.5.1. A comprehensive description of how EGU emissions were characterized and estimated in the 2014 NEI is located in Section 3.4 in the 2014NEIv1 TSD.

The point source file used for the modeling platform is exported from EIS into the Flat File 2010 (FF10) format that is compatible with SMOKE (see https://www.cmascenter.org/smoke/documentation/4.0/html/ch08s02s08.html).

A new step taken in the 2014v7.0 platform is to incorporate all changes to release parameters that would occur in SMOKE as a result of missing values or values outside SMOKE internally set ranges in the FF10 file prior to SMOKE run. This is done for two reasons: 1) to provide better transparency in the FF10 files with respect to the data used in the model, and 2) to ensure that emission inputs are consistent across CMAQ and AERMOD models since both use the FF10 as the starting point. Because SMOKE uses metric units (i.e., m and K) for defaults, these are converted to the English units (ft and F) as specified by the FF10 file format. For velocity, a maximum of 300 m/s was used to be consistent with what we chose for AERMOD modeling, even though the SMOKE maximum is 500 m/s.

Table 2-3 shows the changes made and why. The "Records changed" column indicates how many records were changed and provide the keywords used in the FF10 that indicate that a release parameter was changed and the situation. Even though SMOKE does not use the fugitive release point parameters, they are included in the table to make it complete.

**Table 2-3. Release parameter changes to the FF10 inventory files for point sources**

| **Field** | **Existing Value** | **New Value** | **Conditions/Notes** | **Number of records defaulted or changed and comment[1]** |
|---|---|---|---|---|
| **For point sources with stack releases (ERPtype NOT equal to "1")** | | | | |
| stkhgt | missing | use pstk[2] or global defaults[2] | | None |
| stkdiam | missing | use pstk[2] or global defaults[3] | | None |
| stkvel | missing | calculate from stkflow and stkdiam if not missing; otherwise reference by SCC from pstk[2] or global defaults[3] | vel = 4*stkflow/(pi*stkdiam^2) If the flow and diam are missing such that you cannot compute, then use new value based pstk or global defaults. | 1,396,220<br>No pstk values used<br>*ERPVelCompute* |
| stktemp | missing | use pstk[2] or global defaults[3] | | None |
| stkhgt | Outside SMOKE tolerance | use minimum value or maximum value in feet | Less than 0.5m (1.64ft) or greater than 5100 m (16732.28 ft) | Below min: 94,306<br>Above max: None<br>*ERPHtRange* |
| stkdiam | Outside SMOKE tolerance | use minimum value or maximum value in ft | Less than 0.01m (0.0328 ft) or greater than 100 m (328.08 ft) | Below min: 1,429<br>Above max: None<br>*ERPDiamRange* |

| | | | | |
|---|---|---|---|---|
| stkvel | Outside SMOKE tolerance[4] | use minimum value or maximum value in ft/s | Less than 0.0001m/s (0.000328 ft/s) or greater than 300 m/s (984.252 ft/s) | Below min: 14,019<br>Above max: 28,933<br>*ERPVelRange* |
| stktemp | Outside SMOKE tolerance | use minimum value or maximum value in F | Less than 260 K (8.3 F) or greater than 2000 K (3140.33 F) | Below min: 11,318<br>Above max:1181<br>*ERPTempRange* |
| **For Fugitive Release Points (not used in CMAQ)** | | | | |
| fug_width_ydim | missing | 32.808 ft | | 3,793,801; *ERPFugMissing* |
| fug_length_xdim | missing | 32.808 ft | | 3,825,359; *ERPFugMissing* |
| fug_angle | missing | 0 | | 3,865,422; *ERPFugMissing* |
| fug_height | missing | 10 ft | fug_width_ydim and fug_length_xdim are missing | 3,525,573; *ERPFugMissing* |
| fug_height | missing | 0 | WHEN fug_width_ydim and fug_length_xdim are not missing and > 0 | 11,904<br>*ERPFugHeight0* |
| **For Coke Ovens: Any release point that emits coke oven emissions (pollutant code 140)<br>-all pollutants at that release point are changed to the below-** | | | | |
| stkhgt | < 126 ft | 126 ft | erptype NOT = "1" | 88; *ERPCokeoven126* |
| fug_height | < 126 ft | 126 ft | erptype = "1" | 85; *ERPCokeoven126* |
| fug_length_xdim | < 50 ft | 50 ft | erptype = "1" | 81; *ERPCokeovenFug50* |
| fug_width_ydim | < 50 ft | 50 ft | erptype = "1" | 81; *ERPCokeovenFug50* |

1. Comments were put into the modeling file to indicate why a record was changed:
*ERPVelCompute* – velocity computed from the flowrate provided in the inventory
*ERPHtRange* – height in the inventory was out of range
*ERPDiamRange*– diameter in the inventory was out of range
*ERPVelRange* – velocity in the inventory or velocity calculated from the flowrate in the inventory was out of range
*ERPTempRange*– diameter in the inventory was out of range
*ERPFugHeight0* – fugitive height in the inventory was set to 0 because the width and length were not missing
*ERPFugMissing* – fugitive height, length and width are missing or fugitive length and/or width are missing.
*ERPCokeoven126* – fugitive or stack height of release point emitting coke oven emissions was less than 126 ft
*ERPCokeovenFug50* – fugitive length or width was less than 50 ft.
2. Pstk provides default stack parameters and is provided with other SMOKE ancillary files (ge_dat directory) on the website. The pstk file is formatted: region_cd, scc, stkhgt (m), stkdiam (m), stktemp (K), and stkvel (m/s)
3. Global defaults (converted to English): stkvel = 13.1234 ft; stktemp=72.05 F, stkdiam=0.6562 ft, stkhgt=9.8425 ft
4. For velocity, the SMOKE upper bound is 500 m/s but we changed to 300 m/s as that is the AERMOD upper bound

After moving offshore oil platforms into the othpt sector, and dropping sources without specific locations (i.e., their FIPS code ends in 777), initial versions of the other four platform point source sectors were created from the remaining 2014NEIv1 point sources. The point sectors are: the EGU sector (ptegu), point source oil and gas extraction-related emissions (pt_oilgas), and the remaining non-EGU sector also called the non-IPM (ptnonipm) sector. The EGU emissions are split out from the other sources to facilitate the use of distinct SMOKE temporal processing and future-year projection techniques. The oil and gas sector emissions (pt_oilgas) were processed separately for summary tracking purposes and distinct future-year projection techniques from the remaining non-EGU emissions (ptnonipm). The 2014v7.0 platform utilizes a smaller universe of facilities than the pt_oilgas sector of the 2011v6.3 platform: facilities with NAICS 2212* (natural gas distribution) are no longer included since this NAICS reflects the distribution of natural gas and is outside of the oil and gas categories covered by oil and gas production operations.

The inventory pollutants processed through SMOKE for all point source sectors were: carbon monoxide (CO), $NO_X$, VOC, sulfur dioxide ($SO_2$), ammonia ($NH_3$), particles less than 10 microns in diameter ($PM_{10}$), and particles less than 2.5 microns in diameter ($PM_{2.5}$), and all of the air toxics listed in Appendix A. The NBAFM are explicit in the CMAQ-CB6 chemical mechanism and are taken from the HAP emissions as opposed to generated through VOC speciation, as is normally done for non-toxics modeling applications such as the 2011v6.3 platform. To prevent double counting of mass, NBAFM is removed from VOC speciation profiles, thus resulting in speciation profiles that may sum to less than 1. This is called the "no-integrate" VOC speciation case and is discussed in detail in Section 3.2.1.1. The resulting VOC in the modeling system may be higher or lower than the VOC emissions in the NEI; they would only be the same if the HAP inventory and speciation profiles were exactly consistent. For HAPs other than NBAFM, there is no concern for double-counting since CMAQ handles these outside the CB6 mechanism.

The ptnonipm and pt_oilgas sector emissions were provided to SMOKE as annual emissions. For those ptegu sources with CEMS data (that could be matched to the 2014NEIv1), 2014 hourly CEMS $NO_X$ and $SO_2$ emissions were used rather than NEI emissions. For all other pollutants, annual emissions were used as-is from the NEI, but were allocated to hourly values using heat input CEMS data. For the sources in the ptegu sector not matched to CEMS data, daily emissions were created using an approach described in Section 2.1.1, and IPM region- and pollutant-specific diurnal profiles were applied to create hourly emissions.

In addition to the release parameter changes discussed above, the 2014NEIv1 point inventory was split into the ptnonipm, pt_oilgas and ptegu sectors. The split was done at the unit level for ptegu and facility level for pt_oilgas such that a facility may have units and processes in both ptnonipm and ptegu, but cannot be in both pt_oilgas and any other point sector. These sectors are discussed in more detail in the following sections.

### 2.1.1 EGU sector (ptegu)

The ptegu sector contains emissions from EGUs in the 2014NEIv1 point inventory that could be matched to units found in the National Electric Energy Data System (NEEDS) v5.16 database. The matching was prioritized according to the amount of the emissions produced by the source. It is customary to put these EGUs into separate sectors in the platform to support future year modeling even though future year modeling is not done for 2014 NATA. In the SMOKE point flat file, emission records for sources that have been matched to the NEEDS database have a value filled into the IPM_YN column based on the matches stored within EIS.

Some units in the ptegu sector are matched to CEMS data via ORIS facility codes and boiler ID. For matched units, SMOKE replaces the 2014 emissions of $NO_X$ and $SO_2$ with the CEMS emissions, thereby ignoring the annual values specified in the NEI. For other pollutants, the hourly CEMS heat input data are used to allocate the NEI annual emissions to hourly values. All stack parameters, stack locations, and Source Classification Codes (SCC) for these sources come from the NEI (except those changed as discussed in Table 2-3). Because these attributes are obtained from the NEI, the chemical speciation of VOC and $PM_{2.5}$ for the sources is selected based on the SCC or in some cases, based on unit-specific data. If CEMS data exists for a unit, but the unit is not matched to the NEI, the CEMS data for that unit is not used in the modeling platform. However, if the source exists in the NEI and is not matched to a CEMS unit, the emissions from that source are still modeled using the annual emission value in the NEI. The EIS stores many matches from EIS units to the ORIS facility codes and boiler IDs used to reference the CEMS data.

In the SMOKE point flat file, emission records for point sources matched to CEMS data have values prefilled into the ORIS_FACILITY_CODE and ORIS_BOILER_ID columns. The CEMS data in SMOKE-ready format is available at http://ampd.epa.gov/ampd/ near the bottom of the "Prepackaged Data" tab. Many smaller emitters in the CEMS program are not identified with ORIS facility or boiler IDs that can be matched to the NEI due to inconsistencies in the way a unit is defined between the NEI and CEMS datasets, or due to uncertainties in source identification such as inconsistent plant names in the two data systems. Also, the NEEDS database of units modeled by IPM includes many smaller emitting EGUs that are not included in the hourly CEMS programs. Therefore, there will be more units in the NEEDS database than have CEMS data. The temporalization of EGU units matched to CEMS is based on the CEMS data, whereas regional profiles are used for the remaining units. More detail can be found in Section 3.3.2.

For sources not matched to CEMS data, daily emissions were computed from the NEI annual emissions using average CEMS data profiles specific to fuel type, pollutant[2], and IPM region. To allocate emissions to each hour of the day, diurnal profiles were created using average CEMS data for heat input specific to fuel type and IPM region. See Section 3.3.2 for more details on the temporalization approach for ptegu sources.

### 2.1.2 Point source oil and gas sector (pt_oilgas)

The pt_oilgas sector was separated from the ptnonipm sector by selecting sources with specific NAICS codes shown in Table 2-4. This list was modified from the NAICS used in the 2011 platforms in that the 2014v7.0 platform excludes NAICS related to natural gas distribution which is not part of the oil and gas production category.

The emissions and other source characteristics in the pt_oilgas sector are submitted by states, while the EPA developed a dataset of nonpoint oil and gas emissions for each county in the U.S. with oil and gas activity that was available for states to use. Nonpoint oil and gas emissions can be found in the np_oilgas sector. More information on the development of the 2014 oil and gas emissions can be found in Section 4.16 of the 2014NEIv1 TSD.

**Table 2-4. Point source oil and gas sector NAICS Codes**

| NAICS | NAICS description |
|---:|---|
| 2111 | Oil and Gas Extraction |
| 4862 | Pipeline Transportation of Natural Gas |
| 21111 | Oil and Gas Extraction |
| 48611 | Pipeline Transportation of Crude Oil |
| 48621 | Pipeline Transportation of Natural Gas |
| 211111 | Crude Petroleum and Natural Gas Extraction |
| 211112 | Natural Gas Liquid Extraction |
| 213111 | Drilling Oil and Gas Wells |
| 213112 | Support Activities for Oil and Gas Operations |

[2] The year to day profiles use NOx and $SO_2$ CEMS for NOx and $SO_2$, respectively. For all other pollutants, they use heat input CEMS data.

| NAICS | NAICS description |
|---|---|
| 486110 | Pipeline Transportation of Crude Oil |
| 486210 | Pipeline Transportation of Natural Gas |

### 2.1.3 Non-IPM sector (ptnonipm)

With minor exceptions, the ptnonipm sector contains the 2014NEIv1 point sources that are not in the ptegu or pt_oilgas sectors. For the most part, the ptnonipm sector reflects the non-EGU sources of the NEI point inventory; however, it is likely that some small low-emitting EGUs not matched to the NEEDS database or to CEMS data are present in the ptnonipm sector.

The ptnonipm sector contains a small amount of fugitive dust PM emissions from vehicular traffic on paved or unpaved roads at industrial facilities, coal handling at coal mines, and grain elevators. Sources with state/county FIPS code ending with "777" are in the 2014NEIv1 but are not included in any modeling sectors. These sources typically represent mobile (i.e., temporary) asphalt plants that are only reported for some states, and are generally in a fixed location for only a part of the year, and are thus difficult to allocate to specific places and days as is needed for modeling. Therefore, these sources are dropped from the point-based sectors in the modeling platform.

**Table 2-5.** Summary of point sources with state/county FIPS ending with "777"

| State | VOC (TPY) | $NO_X$ (TPY) | $PM_{2.5}$ (TPY) | $SO_2$ (TPY) | Total HAP (TPY) |
|---|---|---|---|---|---|
| Alaska | 60 | 983 | 66 | 197 | 0.001 |
| Colorado | 472 | 3,043 | 283 | 319 | 49.5 |
| Florida | 68 | 107 | 9 | 42 | 2.1 |
| Kansas | 76 | 137 | 68 | 75 | 0.015 |
| Kentucky | 82 | 85 | 57 | 15 | 4.9 |
| Michigan | 34 | 348 | 91 | 43 | 2.1 |
| Minnesota | 186 | 471 | 109 | 217 | 48.7 |
| Nevada | 7 | 4 | 2 | 1 | 0.1 |
| Ohio | 257 | 162 | 179 | 77 | 1.8 |
| Texas | 2 | 1 | 0.2 | 1 | 0.1 |

## 2.2 2014 nonpoint sources (afdust, ag, agfire, ptagfire, np_oilgas, rwc, nonpt)

Several modeling platform sectors were created from the 2014NEIv1 nonpoint inventory. This section describes the *stationary* nonpoint sources. Locomotives, C1 and C2 CMV, and C3 CMV are also included the 2014NEIv1 nonpoint data category, but are mobile sources that are described in Sections 2.4.1 and 2.4.2 as the cmv and rail sectors, respectively. The 2014NEIv1 TSD, available from https://www.epa.gov/sites/production/files/2016-12/documents/nei2014v1_tsd.pdf, includes documentation for the nonpoint sector of the 2014NEIv1.

The nonpoint tribal-submitted emissions are dropped during spatial processing with SMOKE due to the configuration of the spatial surrogates. Part of the reason for this is to prevent possible double-counting with county-level emissions and also because spatial surrogates for tribal data are not currently available. These omissions are not expected to have an impact on the results of the air quality modeling at the 12-km scales used for this platform.

The following subsections describe how the sources in the 2014NEIv1 nonpoint inventory were separated into 2014 modeling platform sectors, along with any data that were updated replaced with non-NEI data.

### 2.2.1 Area fugitive dust sector (afdust)

The area-source fugitive dust (afdust) sector contains $PM_{10}$ and $PM_{2.5}$ emission estimates for nonpoint SCCs identified by EPA staff as dust sources. Categories included in the afdust sector are paved roads, unpaved roads and airstrips, construction (residential, industrial, road and total), agriculture production, and mining and quarrying. It does not include fugitive dust from grain elevators, coal handling at coal mines, or vehicular traffic on paved or unpaved roads at industrial facilities because these are treated as point sources so they are properly located.

The afdust sector is separated from other nonpoint sectors to allow for the application of a "transport fraction," and meteorological/precipitation reductions. These adjustments are applied with a script that applies land use-based gridded transport fractions followed by another script that zeroes out emissions for days on which at least 0.01 inches of precipitation occurs or there is snow cover on the ground. The land use data used to reduce the NEI emissions determines the amount of emissions that are subject to transport. This methodology is discussed in Pouliot, et al., 2010, and in "Fugitive Dust Modeling for the 2008 Emissions Modeling Platform" (Adelman, 2012). Both the transport fraction and meteorological adjustments are based on the gridded resolution of the platform (e.g., 12km grid cells); therefore, different emissions will result if the process were applied to different grid resolutions. A limitation of the transport fraction approach is the lack of monthly variability that would be expected with seasonal changes in vegetative cover. While wind speed and direction are not accounted for in the emissions processing, the hourly variability due to soil moisture, snow cover and precipitation is accounted for in the subsequent meteorological adjustment.

The sources in the afdust sector are for SCCs and pollutant codes (i.e., $PM_{10}$ and $PM_{2.5}$) that are considered to be "fugitive" dust sources. These SCCs are provided in Table 2-6.

**Table 2-6. SCCs in the afdust platform sector for NEI2014v1**

| SCC | SCC Description |
|---|---|
| 2275085000 | Mobile Sources;Aircraft;Unpaved Airstrips;Total |
| 2294000000 | Mobile Sources;Paved Roads;All Paved Roads;Total: Fugitives |
| 2294000002 | Mobile Sources;Paved Roads;All Paved Roads;Total: Sanding/Salting - Fugitives |
| 2296000000 | Mobile Sources;Unpaved Roads;All Unpaved Roads;Total: Fugitives |
| 2311000000 | Industrial Processes;Construction: SIC 15 - 17;All Processes;Total |
| 2311010000 | Industrial Processes;Construction: SIC 15 - 17;Residential;Total |
| 2311010070 | Industrial Processes;Construction: SIC 15 - 17;Residential;Vehicle Traffic |
| 2311020000 | Industrial Processes;Construction: SIC 15 - 17;Industrial/Commercial/Institutional;Total |
| 2311030000 | Industrial Processes;Construction: SIC 15 - 17;Road Construction;Total |
| 2325000000 | Industrial Processes;Mining and Quarrying: SIC 14;All Processes;Total |
| 2325060000 | Industrial Processes;Mining and Quarrying: SIC 10;Lead Ore Mining and Milling;Total |

| SCC | SCC Description |
|---|---|
| 2801000000 | Miscellaneous Area Sources;Agriculture Production - Crops;Agriculture - Crops;Total |
| 2801000003 | Miscellaneous Area Sources;Agriculture Production - Crops;Agriculture - Crops;Tilling |
| 2801000005 | Miscellaneous Area Sources;Agriculture Production - Crops;Agriculture - Crops;Harvesting |
| 2801000007 | Miscellaneous Area Sources;Agriculture Production - Crops;Agriculture - Crops;Loading |
| 2801000008 | Miscellaneous Area Sources;Agriculture Production - Crops;Agriculture - Crops;Transport |
| 2805001100 | Miscellaneous Area Sources;Agriculture Production - Livestock;Beef cattle - finishing operations on feedlots (drylots);Confinement |
| 2805001300 | Miscellaneous Area Sources;Agriculture Production - Livestock;Beef cattle - finishing operations on feedlots (drylots);Land application of manure |
| 2805002000 | Miscellaneous Area Sources;Agriculture Production - Livestock;Beef cattle production composite;Not Elsewhere Classified |
| 2805003100 | Miscellaneous Area Sources;Agriculture Production - Livestock;Beef cattle - finishing operations on pasture/range;Confinement |
| 2805007100 | Miscellaneous Area Sources;Agriculture Production - Livestock;Poultry production - layers with dry manure management systems;Confinement |
| 2805009100 | Miscellaneous Area Sources;Agriculture Production - Livestock;Poultry production - broilers;Confinement |
| 2805010100 | Miscellaneous Area Sources;Agriculture Production - Livestock;Poultry production - turkeys;Confinement |
| 2805018000 | Miscellaneous Area Sources;Agriculture Production - Livestock;Dairy cattle composite;Not Elsewhere Classified |
| 2805020002 | Miscellaneous Area Sources;Agriculture Production - Livestock;Cattle and Calves Waste Emissions;Beef Cows |
| 2805023100 | Miscellaneous Area Sources;Agriculture Production - Livestock;Dairy cattle - drylot/pasture dairy;Confinement |
| 2805030000 | Miscellaneous Area Sources;Agriculture Production - Livestock;Poultry Waste Emissions;Not Elsewhere Classified (see also 28-05-007, -008, -009) |
| 2805030007 | Miscellaneous Area Sources;Agriculture Production - Livestock;Poultry Waste Emissions;Ducks |
| 2805030008 | Miscellaneous Area Sources;Agriculture Production - Livestock;Poultry Waste Emissions;Geese |
| 2805035000 | Miscellaneous Area Sources;Agriculture Production - Livestock;Horses and Ponies Waste Emissions;Not Elsewhere Classified |
| 2805039100 | Miscellaneous Area Sources;Agriculture Production - Livestock;Swine production - operations with lagoons (unspecified animal age);Confinement |
| 2805040000 | Miscellaneous Area Sources;Agriculture Production - Livestock;Sheep and Lambs Waste Emissions;Total |
| 2805045000 | Miscellaneous Area Sources;Agriculture Production - Livestock;Goats Waste Emissions;Not Elsewhere Classified |
| 2805047100 | Miscellaneous Area Sources;Agriculture Production - Livestock;Swine production - deep-pit house operations (unspecified animal age);Confinement |
| 2805053100 | Miscellaneous Area Sources;Agriculture Production - Livestock;Swine production - outdoor operations (unspecified animal age);Confinement |

Typically, the NEI will also have applied a meteorological based adjustment (based on a coarser spatial and temporal resolution than the modeling platform adjustment), but this was inadvertently not done for the 2014 NEI v1. It will be corrected for the 2014 NEI v2.

Where states submitted afdust data, it was assumed that the state-submitted data were not met-adjusted and therefore the meteorological adjustments were applied. Thus, if states submitted data that were met-adjusted, these sources would have been adjusted for meteorology twice. Even with that possibility, air quality modeling shows that, in general, dust is frequently overestimated in the air quality modeling results.

The total impacts of the transport fraction and meteorological adjustments for the 2014NEIv1 are shown in Table 2-7. The amount of the reduction ranges from about 94 percent in New Hampshire to about 23 percent in Nevada. The afdust emissions adjustments are similar to previous platforms; in the 2011v6.3 the reduction ranged from 29 percent in Nevada to 93 percent in New Hampshire.

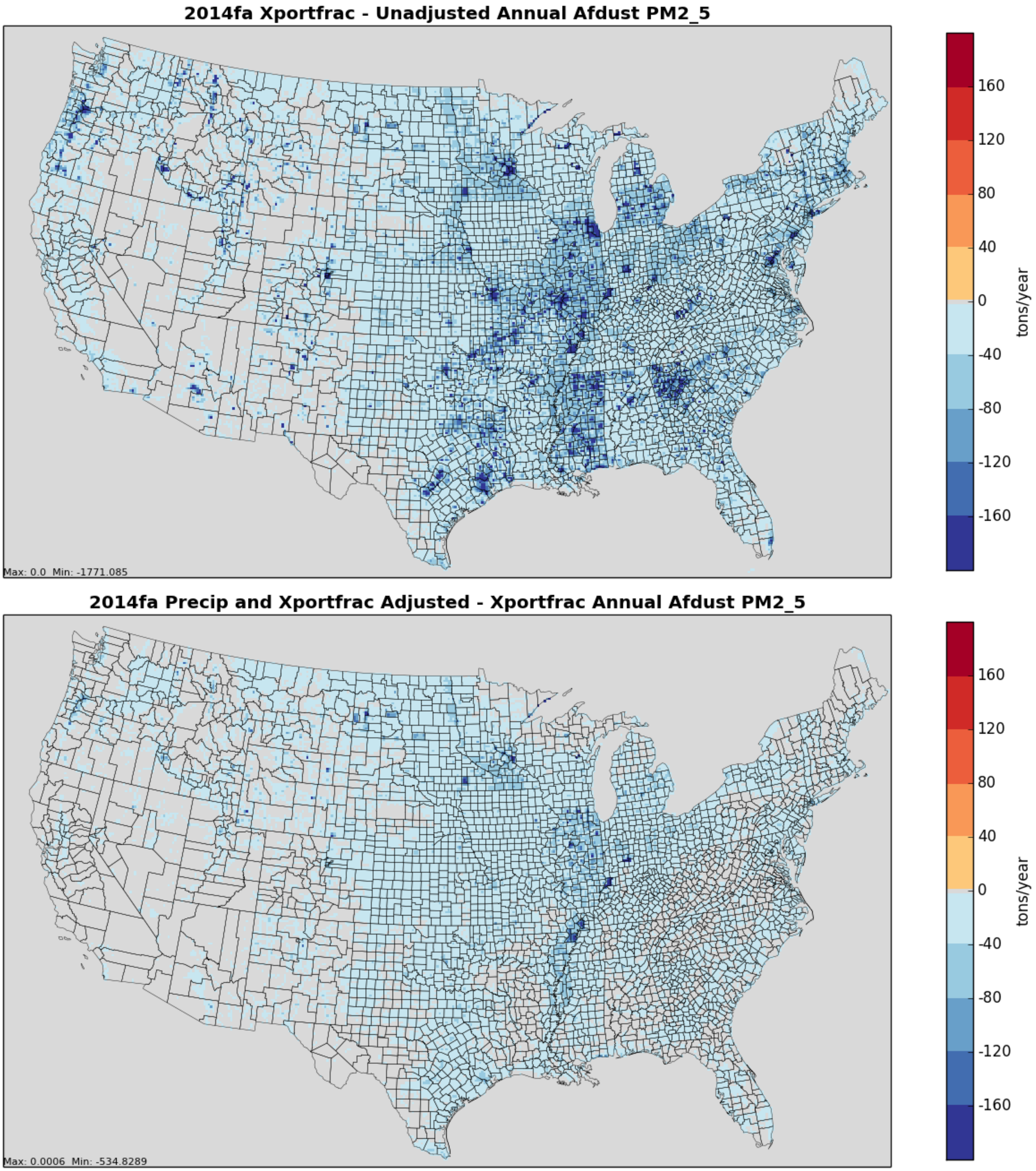
Figure 2-1 shows the impact of each step of the adjustment for 2014. The reductions due to the transport fraction adjustments alone are shown at the top of Figure 2-1. The reductions due to the precipitation adjustments are shown in the middle of Figure 2-1. The cumulative emission reductions after both transport fraction and meteorological adjustments are shown at the bottom of Figure 2-1. The top plot shows how the transport fraction has a larger reduction effect in the east, where forested areas are more effective at reducing PM transport than in many western areas. The middle plot shows how the meteorological impacts of precipitation, along with snow cover in the north, further reduce the dust emissions.

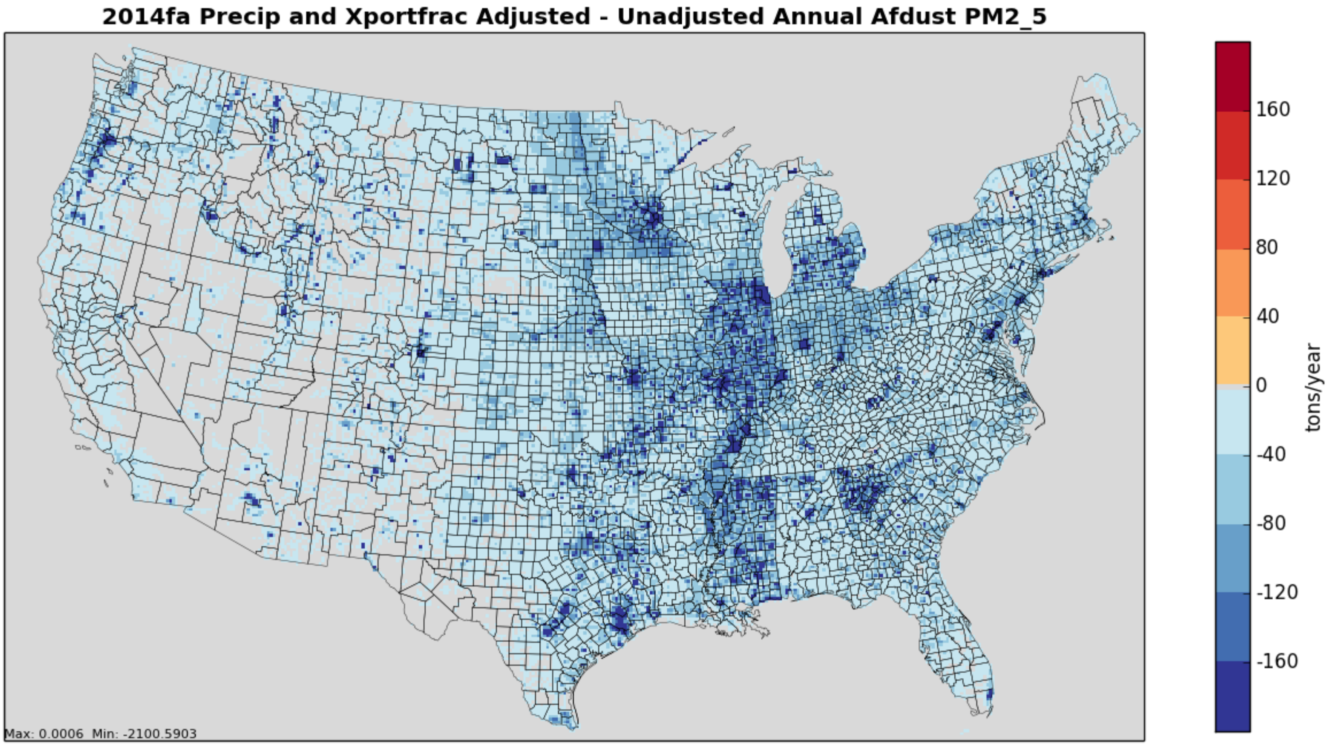
**Table 2-7. Total impact of fugitive dust adjustments to unadjusted 2014 inventory**

| State | Unadjusted $PM_{10}$ | Unadjusted $PM_{2.5}$ | Change in $PM_{10}$ | Change in $PM_{2.5}$ | $PM_{10}$ Reduction | $PM_{2.5}$ Reduction |
|---|---|---|---|---|---|---|
| Alabama | 301,066 | 39,238 | -247,604 | -32,323 | 82% | 82% |
| Arizona | 254,017 | 31,465 | -85,038 | -10,486 | 33% | 33% |
| Arkansas | 522,929 | 77,319 | -365,957 | -52,085 | 70% | 67% |
| California | 242,366 | 29,019 | -107,648 | -12,594 | 44% | 43% |
| Colorado | 320,178 | 46,675 | -186,191 | -26,305 | 58% | 56% |
| Connecticut | 24,763 | 3,443 | -21,689 | -3,025 | 88% | 88% |
| Delaware | 11,792 | 2,103 | -8,617 | -1,530 | 73% | 73% |
| District of Columbia | 2,724 | 385 | -2,098 | -301 | 77% | 78% |
| Florida | 267,505 | 35,137 | -166,740 | -21,719 | 62% | 62% |
| Georgia | 652,978 | 76,464 | -539,820 | -62,912 | 83% | 82% |
| Idaho | 394,948 | 42,204 | -264,567 | -27,673 | 67% | 66% |
| Illinois | 1,508,681 | 193,959 | -983,512 | -125,592 | 65% | 65% |
| Indiana | 334,337 | 64,063 | -238,264 | -45,678 | 71% | 71% |
| Iowa | 414,565 | 59,709 | -262,000 | -37,486 | 63% | 63% |
| Kansas | 730,033 | 109,224 | -348,062 | -50,327 | 48% | 46% |
| Kentucky | 246,960 | 40,288 | -193,555 | -31,519 | 78% | 78% |

| State | Unadjusted $PM_{10}$ | Unadjusted $PM_{2.5}$ | Change in $PM_{10}$ | Change in $PM_{2.5}$ | $PM_{10}$ Reduction | $PM_{2.5}$ Reduction |
|---|---|---|---|---|---|---|
| Louisiana | 253,283 | 37,433 | -177,236 | -25,625 | 70% | 68% |
| Maine | 52,659 | 7,289 | -47,311 | -6,580 | 90% | 90% |
| Maryland | 89,556 | 13,287 | -69,111 | -10,208 | 77% | 77% |
| Massachusetts | 84,833 | 10,444 | -73,006 | -8,949 | 86% | 86% |
| Michigan | 599,754 | 75,364 | -475,888 | -59,860 | 79% | 79% |
| Minnesota | 994,798 | 146,884 | -738,425 | -107,204 | 74% | 73% |
| Mississippi | 969,415 | 112,262 | -787,972 | -89,169 | 81% | 79% |
| Missouri | 1,192,487 | 155,430 | -856,307 | -109,633 | 72% | 71% |
| Montana | 503,025 | 73,674 | -313,862 | -43,850 | 62% | 60% |
| Nebraska | 672,131 | 100,677 | -337,364 | -49,948 | 50% | 50% |
| Nevada | 156,786 | 21,971 | -37,635 | -5,085 | 24% | 23% |
| New Hampshire | 23,647 | 3,499 | -22,125 | -3,274 | 94% | 94% |
| New Jersey | 24,165 | 5,413 | -18,985 | -4,257 | 79% | 79% |
| New Mexico | 542,948 | 58,691 | -187,942 | -20,307 | 35% | 35% |
| New York | 308,356 | 43,255 | -258,663 | -35,975 | 84% | 83% |
| North Carolina | 191,357 | 31,325 | -156,502 | -25,536 | 82% | 82% |
| North Dakota | 578,498 | 102,941 | -343,227 | -60,734 | 59% | 59% |
| Ohio | 412,523 | 63,677 | -313,565 | -48,094 | 76% | 76% |
| Oklahoma | 811,301 | 102,376 | -431,612 | -52,677 | 53% | 51% |
| Oregon | 483,334 | 57,107 | -360,980 | -40,719 | 75% | 71% |
| Pennsylvania | 186,345 | 32,785 | -159,152 | -28,248 | 85% | 86% |
| Rhode Island | 5,456 | 831.925 | -4,258 | -652 | 78% | 78% |
| South Carolina | 254,609 | 31,080 | -199,760 | -24,398 | 78% | 79% |
| South Dakota | 424,307 | 76,111 | -239,017 | -42,552 | 56% | 56% |
| Tennessee | 167,206 | 28,600 | -132,452 | -22,598 | 79% | 79% |
| Texas | 2,216,284 | 271,267 | -1,161,139 | -137,767 | 52% | 51% |
| Utah | 156,067 | 21,109 | -80,361 | -10,762 | 51% | 51% |
| Vermont | 67,204 | 7,491 | -61,705 | -6,868 | 92% | 92% |
| Virginia | 167,918 | 24,601 | -140,043 | -20,485 | 83% | 83% |
| Washington | 185,634 | 31,451 | -102,422 | -16,991 | 55% | 54% |
| West Virginia | 108,001 | 13,569 | -100,214 | -12,593 | 93% | 93% |
| Wisconsin | 284,614 | 50,548 | -219,653 | -39,216 | 77% | 78% |
| Wyoming | 474,706 | 51,957 | -252,122 | -27,579 | 53% | 53% |
| **Domain Total** | **19,873,047** | **2,715,097** | **-12,881,384** | **-1,739,951** | **65%** | **64%** |

**Figure 2-1. Impact of adjustments to fugitive dust emissions due to transport fraction, precipitation, and cumulative**






Agricultural ammonia sector (ag)Table 2-9. The “ag” sector includes all of the $NH_3$ emissions from fertilizer from the NEI. However, the “ag” sector does not include all of the livestock $NH_3$ emissions, as there is a very small amount of $NH_3$ emissions from livestock in the ptnonipm inventory (as point sources) in California (883 tons; less than 0.5 percent of state total) and Wisconsin (356 tons; about 1 percent of state total). The total ag sector (livestock plus fertilizer) in the 2014v7.0 platform has 3,140,259 tons $NH_3$ compared with 3,522,491 tons $NH_3$ in the 2011v6.3 platform.

**Table 2-8. Livestock SCCs extracted from the NEI to create the ag sector**

| SCC | SCC Description* |
|---|---|
| 2805001100 | Beef cattle - finishing operations on feedlots (drylots);Confinement |
| 2805001200 | Beef cattle - finishing operations on feedlots (drylots);Manure handling and storage |
| 2805001300 | Beef cattle - finishing operations on feedlots (drylots);Land application of manure |
| 2805002000 | Beef cattle production composite; Not Elsewhere Classified |
| 2805003100 | Beef cattle - finishing operations on pasture/range; Confinement |
| 2805007100 | Poultry production - layers with dry manure management systems;Confinement |
| 2805007300 | Poultry production - layers with dry manure management systems;Land application of manure |
| 2805008100 | Poultry production - layers with wet manure management systems;Confinement |
| 2805008200 | Poultry production - layers with wet manure management systems;Manure handling and storage |
| 2805008300 | Poultry production - layers with wet manure management systems;Land application of manure |
| 2805009100 | Poultry production - broilers;Confinement |
| 2805009200 | Poultry production - broilers;Manure handling and storage |
| 2805009300 | Poultry production - broilers;Land application of manure |
| 2805010100 | Poultry production - turkeys;Confinement |
| 2805010200 | Poultry production - turkeys;Manure handling and storage |
| 2805010300 | Poultry production - turkeys;Land application of manure |
| 2805018000 | Dairy cattle composite;Not Elsewhere Classified |
| 2805019100 | Dairy cattle - flush dairy;Confinement |
| 2805019200 | Dairy cattle - flush dairy;Manure handling and storage |
| 2805019300 | Dairy cattle - flush dairy;Land application of manure |

| SCC | SCC Description* |
|---|---|
| 2805020002 | Cattle and Calves Waste Emissions:Beef Cows |
| 2805021100 | Dairy cattle - scrape dairy;Confinement |
| 2805021200 | Dairy cattle - scrape dairy;Manure handling and storage |
| 2805021300 | Dairy cattle - scrape dairy;Land application of manure |
| 2805022100 | Dairy cattle - deep pit dairy;Confinement |
| 2805022200 | Dairy cattle - deep pit dairy;Manure handling and storage |
| 2805022300 | Dairy cattle - deep pit dairy;Land application of manure |
| 2805023100 | Dairy cattle - drylot/pasture dairy;Confinement |
| 2805023200 | Dairy cattle - drylot/pasture dairy;Manure handling and storage |
| 2805023300 | Dairy cattle - drylot/pasture dairy;Land application of manure |
| 2805025000 | Swine production composite;Not Elsewhere Classified (see also 28-05-039, -047, -053) |
| 2805030000 | Poultry Waste Emissions;Not Elsewhere Classified (see also 28-05-007, -008, -009) |
| 2805030007 | Poultry Waste Emissions;Ducks |
| 2805030008 | Poultry Waste Emissions;Geese |
| 2805035000 | Horses and Ponies Waste Emissions;Not Elsewhere Classified |
| 2805039100 | Swine production - operations with lagoons (unspecified animal age);Confinement |
| 2805039200 | Swine production - operations with lagoons (unspecified animal age);Manure handling and storage |
| 2805039300 | Swine production - operations with lagoons (unspecified animal age);Land application of manure |
| 2805040000 | Sheep and Lambs Waste Emissions;Total |
| 2805045000 | Goats Waste Emissions;Not Elsewhere Classified |
| 2805047100 | Swine production - deep-pit house operations (unspecified animal age);Confinement |
| 2805047300 | Swine production - deep-pit house operations (unspecified animal age);Land application of manure |
| 2805053100 | Swine production - outdoor operations (unspecified animal age);Confinement |

* All SCC Descriptions begin “Miscellaneous Area Sources;Agriculture Production – Livestock”

**Table 2-9. Fertilizer SCCs extracted from the NEI for inclusion in the “ag” sector**

| SCC | SCC Description* |
|---|---|
| 2801700001 | Anhydrous Ammonia |
| 2801700002 | Aqueous Ammonia |
| 2801700003 | Nitrogen Solutions |
| 2801700004 | Urea |
| 2801700005 | Ammonium Nitrate |
| 2801700006 | Ammonium Sulfate |
| 2801700007 | Ammonium Thiosulfate |
| 2801700010 | N-P-K (multi-grade nutrient fertilizers) |
| 2801700011 | Calcium Ammonium Nitrate |
| 2801700012 | Potassium Nitrate |
| 2801700013 | Diammonium Phosphate |
| 2801700014 | Monoammonium Phosphate |
| 2801700015 | Liquid Ammonium Polyphosphate |
| 2801700099 | Miscellaneous Fertilizers |

* All descriptions include “Miscellaneous Area Sources; Agriculture Production – Crops; Fertilizer Application” as the beginning of the description.

Agricultural $NH_3$ emissions in the platform are based on the 2014NEIv1, which is a mix of state-submitted data and EPA estimates. The EPA estimates used new methodologies for both livestock and fertilizer emissions. Livestock emissions were estimated based on daily emission factors by animal and county from a model developed by Carnegie Mellon University (CMU) (Pinder, 2004, McQuilling,

2015) and 2012 and 2014 U.S. Department of Agriculture (USDA) agricultural census data.  Details are provided in Section 4.5 of the 2014NEIv1 TSD.  For the NEI, these were summed to annual totals, but for the platform, they were used at the daily resolution.  State data, which were annual, were allocated to daily emissions using the county-specific EPA data for matching animal types.  For horses and goats (not estimated by EPA), the EPA's dairy cattle estimates were used.  For counties with no EPA dairy cattle estimates, the sum of all animals was used.  If there were no EPA county-level livestock data, the daily estimates were created using EPA state-level daily totals.

Annual fertilizer emissions were submitted by three states for all or part of the sector as shown in parentheses:  California (68 percent), Illinois (100 percent) and Georgia (58 percent).  The remainder, estimated by EPA, employed a methodology that uses the bidirectional (bi-di) version of CMAQ (v5.0.2) and the Fertilizer Emissions Scenario Tool for CMAQ FEST-C (v1.2).  This is described in Section 4.4 of the 2014 NEIv1 TSD.  These data were used at annual resolution.  The temporal allocation is discussed in Section 3.3.4.

### 2.2.2 Agricultural fires (agfire and ptagfire)

There are two agricultural fire sectors that together contain emissions from agricultural fires for 2014 based on the 2014NEIv1 emissions for SCCs starting with 28015:  agfire and ptagfire.  These emissions were placed into these sectors based on whether they were state data and had county resolution (agfire) or EPA data and had day-specific point source resolution.  The first three levels of descriptions for these SCCs are: 1) Fires - Agricultural Field Burning; Miscellaneous Area Sources; 2) Agriculture Production - Crops - as nonpoint; and 3) Agricultural Field Burning - whole field set on fire.  The SCC 2801500000 does not specify the crop type or burn method, while the more specific SCCs specify field or orchard crops and, in some cases, the specific crop being grown.  New agricultural field burning SCCs were added to the NEI for 2014 to account for grass/pasture burning (also known as rangeland burning) which is included the agriculture field burning sector of the NEI.  The EPA's estimation methods were improved from those used in the 2011 NEI and are documented in Section 4.11 of the 2014NEIv1 TSD.  Improvements include use of multiple satellite detection database and crop level land use information.

The ptagfire contains all agricultural fire emissions estimated by the EPA at point source and day-specific resolution.  For the NEI, these are summed to the county and national level, but because they are computed at this finer resolution, we chose to use the data at this level for the platform.  States covered in the ptagfire sector are:  AL, AR, CO, KS, KY, LA, MD, MA, MI, MN, MS, MO, MT, NE, NV, NM, NY, NC, ND, OH, OK, OR, PA, SD, TN, TX, UT, VA, WV, WI, and WY.

The agfire sector contains only emissions that were submitted by state agencies and were not able to be modeled with finer resolution than county/annual.  These states are:  AZ, CA, FL, GA, HI, ID, IL, IN, IA, NJ, SC and WA.

### 2.2.3 Nonpoint source oil and gas sector (np_oilgas)

The nonpoint oil and gas (np_oilgas) sector contains onshore and offshore oil and gas emissions.  The EPA estimated emissions for all counties with 2014 oil and gas activity data with the Oil and Gas Tool, and many S/L/T agencies also submitted nonpoint oil and gas data.  Where S/L/T submitted nonpoint CAPS but no HAPs, the EPA augmented the HAPs using HAP augmentation factors (county and SCC level) created from the Oil and Gas Tool.  The types of sources covered include drill rigs, workover rigs, artificial lift, hydraulic fracturing engines, pneumatic pumps and other devices, storage tanks, flares, truck loading, compressor engines, and dehydrators.  Nonpoint oil and gas emissions of benzene, ethyl benzene, xylenes and toluene were corrected in the 2014v7.0 platform for four counties in the Uinta due to an error discoved in the Uinta-basin specific speciation profiles for oil and condensate tanks which was used in the oil and gas tool for generating the HAP augmentation factors. The updates affected the following SCCs: 2310010200 (Oil Well Tanks - Flashing & Standing/Working/Breathing); 2310011201 (Tank Truck/Railcar Loading: Crude Oil); 2310021010 (Storage Tanks: Condensate); and 2310021030 (Tank Truck/Railcar Loading: Condensate), and generally reduced these HAPs from the 2 condensate-related SCCs and increased benzene (by a factor of 3) from the two oil tank-related SCCs. Overall, the np_oilgas emissions in Utah in the platform are 31 tons lower for benzene, 29 tons lower for ethylbenzene, 213 tons lower for toluene, and 335 tons lower for xylenes than the 2014NEIv1.

A complete list of SCCs for the np_oilgas modeling platform sector is provided in Appendix B. See the pt_oilgas sector (section 2.1.2) for more information on point source oil and gas sources. Updates were made to the speciation, and spatial allocation of sources from the 2011v6.3 platform based on updated speciation and spatial surrogate data. Sections 3.2, 3.3, and 3.4 provide additional details.

### 2.2.4 Residential wood combustion sector (rwc)

The residential wood combustion (rwc) sector 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 firepots and chimneas. Free standing woodstoves and inserts are further differentiated into three categories: 1) conventional (not EPA certified); 2) EPA certified, catalytic; and 3) EPA certified, noncatalytic. Generally speaking, the conventional units were constructed prior to 1988. Units constructed after 1988 have to meet EPA emission standards and they are either catalytic or non-catalytic. As with the other nonpoint categories, a mix of S/L and EPA estimates were used. The EPA's estimates use updated methodologies for activity data and some changes to emission factors. For more information on the development of the residential wood combustion emissions, see Section 4.14 of the 2014NEIv1 TSD.

**Table 2-10.** SCCs in the residential wood combustion sector (rwc)*

| SCC | SCC Description |
|---|---|
| 2104008100 | SSFC;Residential;Wood;Fireplace: general |
| 2104008210 | SSFC;Residential;Wood;Woodstove: fireplace inserts; non-EPA certified |
| 2104008220 | SSFC;Residential;Wood;Woodstove: fireplace inserts; EPA certified; non-catalytic |
| 2104008230 | SSFC;Residential;Wood;Woodstove: fireplace inserts; EPA certified; catalytic |
| 2104008310 | SSFC;Residential;Wood;Woodstove: freestanding, non-EPA certified |
| 2104008320 | SSFC;Residential;Wood;Woodstove: freestanding, EPA certified, non-catalytic |
| 2104008330 | SSFC;Residential;Wood;Woodstove: freestanding, EPA certified, catalytic |
| 2104008400 | SSFC;Residential;Wood;Woodstove: pellet-fired, general (freestanding or FP insert) |
| 2104008510 | SSFC;Residential;Wood;Furnace: Indoor, cordwood-fired, non-EPA certified |
| 2104008610 | SSFC;Residential;Wood;Hydronic heater: outdoor |
| 2104008700 | SSFC;Residential;Wood;Outdoor wood burning device, NEC (fire-pits, chimeas, etc) |
| 2104009000 | SSFC;Residential;Firelog;Total: All Combustor Types |

* SSFC=Stationary Source Fuel Combustion

### 2.2.5 Other nonpoint sources sector (nonpt)

Stationary nonpoint sources that were not subdivided into the afdust, ag, np_oilgas, or rwc sectors were assigned to the "nonpt" sector. Locomotives and CMV mobile sources from the 2014NEIv1 nonpoint inventory are described in Section 2.4.1. There are too many SCCs in the nonpt sector to list all of them individually, but the types of sources in the nonpt sector include:

- stationary source fuel combustion, including industrial, commercial, and residential and orchard heaters;
- chemical manufacturing;
- industrial processes such as commercial cooking, metal production, mineral processes, petroleum refining, wood products, fabricated metals, and refrigeration;
- solvent utilization for surface coatings such as architectural coatings, auto refinishing, traffic marking, textile production, furniture finishing, and coating of paper, plastic, metal, appliances, and motor vehicles;
- solvent utilization for degreasing of furniture, metals, auto repair, electronics, and manufacturing;
- solvent utilization for dry cleaning, graphic arts, plastics, industrial processes, personal care products, household products, adhesives and sealants;
- solvent utilization for asphalt application and roofing, and pesticide application;
- storage and transport of petroleum for uses such as portable gas cans, bulk terminals, gasoline service stations, aviation, and marine vessels;
- storage and transport of chemicals;
- waste disposal, treatment, and recovery via incineration, open burning, landfills, and composting;
- miscellaneous area sources such as cremation, hospitals, lamp breakage, and automotive repair shops.

## 2.3 2014 onroad mobile sources (onroad)

Onroad mobile source emissions result from motorized vehicles that are normally operated on public roadways. These include passenger cars, motorcycles, minivans, sport-utility vehicles, light-duty trucks, heavy-duty trucks, and buses. The sources are further divided between diesel, gasoline, E-85, and compressed natural gas (CNG) vehicles. The sector characterizes emissions from parked vehicle processes (e.g., starts, hot soak, and extended idle) as well as from on-network processes (i.e., from vehicles moving along the roads). Except for California, all onroad emissions are generated using the SMOKE-MOVES emissions modeling framework that leverages MOVES generated emission factors (http://www.epa.gov/otaq/models/moves/index.htm), county and SCC-specific activity data, and hourly meteorological data. The onroad SCCs in the modeling platform are more resolved than those in the NEI, because the NEI SCCs distinguish vehicles and fuels, but in the platform, they also distinguish between off-network, extended idle, and the various MOVES road-types. For more details on the approach and for a summary of the inputs submitted by states, see the section 6.4.1 of the 2014NEIv1 TSD.

One difference between the preparation of 2014 onroad emissions inventories as compared to those for previous years is that the 2014 inventories (i.e., both NEI and platform) contain diesel PM for diesel-fueled vehicles. The pollutants DIESEL-PM10 and DIESEL-PM25 were set equal to the $PM_{10}$ and $PM_{2.5}$ emissions for all diesel vehicles.

### 2.3.1 Onroad (onroad)

For the continental U.S., the EPA used a modeling framework that took into account the temperature sensitivity of the on-road emissions. Specifically, the EPA used MOVES inputs for representative counties, vehicle miles traveled (VMT), vehicle population (VPOP), and hoteling data for all counties, along with tools that integrated the MOVES model with SMOKE. In this way, it was possible to take advantage of the gridded hourly temperature information available from meteorology modeling used for air quality modeling. The “SMOKE-MOVES” integration tool was developed by the EPA in 2010 and is used for regional air quality modeling of onroad mobile sources.

SMOKE-MOVES requires that emission rate “lookup” tables be generated by MOVES, which differentiates emissions by process (i.e., 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., the EPA used an automated process to run MOVES to produce emission factors for a series of temperatures and speeds for a set of “representative counties,” to which every other county is mapped. Representative counties are used because it is impractical to generate a full suite of emission factors for the more than 3,000 counties in the U.S. The representative counties for which emission factors are generated are selected according to their state, elevation, fuels, age distribution, ramp fraction, and inspection and maintenance programs. Each county is then mapped to a representative county based on its similarity to the representative county with respect to those attributes. For the 2014v7.0 platform, there are 297 representative counties, a slight increase from the 285 representative counties in the 2011v6.3 platform. A detailed discussion of the representative counties is in the 2014NEIv1 TSD, Section 6.6.2.

Once representative counties have been identified, emission factors are generated with MOVES for each representative county and for two “fuel months” – January to represent winter months, and July to represent summer months – due to the different types of fuels used. SMOKE selects the appropriate MOVES emissions rates for each county, hourly temperature, SCC, and speed bin and multiplies the emission rate by appropriate activity data: VMT (vehicle miles travelled), VPOP (vehicle population), or HOTELING (hours of extended idle) to produce emissions. These calculations are done for every county and grid cell in the continental U.S. for each hour of the year.

The SMOKE-MOVES process for creating the model-ready emissions consists of the following steps:

1) Determine which counties will be used to represent other counties in the MOVES runs.
2) Determine which months will be used to represent other month’s fuel characteristics.
3) Create inputs needed only by MOVES. MOVES requires county-specific information on vehicle populations, age distributions, and inspection-maintenance programs for each of the representative counties.
4) Create inputs needed both by MOVES and by SMOKE, including temperatures and activity data.
5) Run MOVES to create emission factor tables for the temperatures found in each county.
6) Run SMOKE to apply the emission factors to activity data (VMT, VPOP, and HOTELING) to calculate emissions based on the gridded hourly temperatures in the meteorological data.
7) Aggregate the results to the county-SCC level for summaries and QA.

The onroad emissions are processed in four processing streams that are merged together into the onroad sector emissions after each of the four streams have been processed:

- rate-per-distance (RPD) uses VMT as the activity data plus speed and speed profile information to compute on-network emissions from exhaust, evaporative, permeation, refueling, and brake and tire wear processes;
- rate-per-vehicle (RPV) uses VPOP activity data to compute off-network emissions from exhaust, evaporative, permeation, and refueling processes;
- rate-per-profile (RPP) uses VPOP activity data to compute off-network emissions from evaporative fuel vapor venting, including hot soak (immediately after a trip) and diurnal (vehicle parked for a long period) emissions; and
- rate-per-hour (RPH) uses hoteling hours activity data to compute off-network emissions for idling of long-haul trucks from extended idling and auxiliary power unit process.

The onroad emissions inputs for the platform are the same as for the emissions in the onroad data category of the 2014NEIv1, described in more detail in Sections 6.4 and 6.5 of the 2014NEIv1 TSD. These inputs are:

- MOVES County databases (CDBs) including Low Emission Vehicle (LEV) table
- Representative counties
- Fuel months
- Meteorology
- Activity data (VMT, VPOP, speed, HOTELING)

The key differences between the 2014v7.0 platform onroad emission inventories and the 2014NEIv1 inventories are:

- The 2014 platform uses a different post-processor to create emission factors for SMOKE because the pollutants needed for speciation and running CMAQ are different than what is needed for the NEI. For example, the NEI needs a much larger set of HAPs and the modeling platform requires emissions for the components of $PM_{2.5}$.

- The NEI includes emissions for Alaska, Hawaii, Puerto Rico, and the Virgin Islands, whereas the modeling platform does not.

- The treatment of California emissions differs between the two inventories (see below for more details). Due to this treatment, the California HAP VOC emissions are different in the platform than what was submitted to the NEI (See Table 2-13, below).

- Manganese emissions for brake and tirewear are different, except for California, which submitted their own emissions. Other than in California, the platform manganese was computed using speciation profiles for brake and tirewear that were updated from those used for the NEI. For the platform, we used profiles 95462 (Composite - Brake Wear) and 95460 (Composite - Tire Dust), which were added to SPECIATE4.5. For the NEI, we used profiles 91134 (Brake Lining Dust – Composite) and 91150 (Tire Dust – Composite), which are from SPECIATE4.3.

**Table 2-11. Brake and tirewear manganese emissions**

| | 2014 Brake and Tirewear Manganese Emissions, tons | | |
|---|---|---|---|
| | Sum of 49 states, Puerto Rico, Virgin Islands | | California |
| | Using Platform Speciation | Using NEI Speciation | |
| Brakewear | 19.3 | 14.9 | 26.1 |
| Tirewear | 0.0070 | 0.5 | 0.32 |
| Total | 19.3 | 15.4 | 26.4 |

- The list of emission modes and SCCs differ between the two inventories. Both SMOKE-MOVES runs were generated at the same level of detail, but the NEI emissions were aggregated into 2 all-inclusive modes: refueling and all other modes. In addition, the NEI SCCs were aggregated over roads to all parking and all road emissions. The list of modes (or aggregate processes) used in the 2011v6.3 platform and the corresponding MOVES processes mapped to them are listed in Table 2-12.

**Table 2-12. Onroad emission aggregate processes**

| Aggregate process | Description | MOVES process IDs |
|---|---|---|
| 40 | All brake and tire wear | 9;10 |
| 53 | All extended idle exhaust | 17;90 |
| 62 | All refueling | 18;19 |
| 72 | All exhaust and evaporative except refueling and hoteling | 1;2;11;12;13;15;16 |
| 91 | Auxiliary Power Units | 91 |

An additional step was taken for the refueling emissions. Colorado submitted point emissions for refueling for some counties[3]. For these counties, the EPA zeroed out the onroad estimates of refueling (i.e., SCCs =220xxxxx62) so that the states' point emissions would take precedence. The onroad refueling emissions were zeroed out using the adjustment factor file (CFPRO) and Movesmrg.
For more detailed information on the methods used to develop the 2014 onroad mobile source emissions and the input data sets, see the 2014NEIv1 TSD.

California is the only state agency for which submitted onroad emissions were used in the 2014 NEI v1 and 2014v7.0 platform. California uses their own emission model, EMFAC, which uses emission inventory codes (EICs) to characterize the emission processes instead of SCCs. The EPA and California worked together to develop a code mapping to better match EMFAC's EICs to EPA MOVES' detailed set of SCCs that distinguish between off-network and on-network and brake and tire wear emissions. This detail is needed for modeling but not for the NEI. This code mapping is provided in "2014v1_EICtoEPA_SCCmapping.xlsx." California then provided their CAP and HAP emissions by county using EPA SCCs after applying the mapping. There was one change made after the mapping: the vehicle/fuel type combination gas intercity buses (first 6 digits of the SCC = 220141), that is not generated using MOVES, was changed to gasoline single unit short-haul trucks (220152) for consistency with the modeling inventory.

[3] There were 52 counties in Colorado that had point emissions for refueling. Outside Colorado, it was determined that refueling emissions in the 2014 NEIv1 point did not significantly duplicate the refueling emissions in onroad.

California also submitted onroad refueling VOC emissions. For the NEI, the mapped California emissions were summed to the level of fuel type and MOVES source type. For the modeling platform, the emissions were used to adjust the MOVES-based California onroad emissions (including refueling) as described below. MOVES provides chemical-mechanism specific emissions that, for onroad, use the MOVES-based HAPs, and ethanol, and the speciation of the remainder of the VOC based on model-year information. For California, we adjusted the MOVES-based emissions using California VOC, $NO_X$, PM and metal HAPs. This preserved the MOVES speciation but it did not allow for use of the California-submitted VOC HAPs that are in the 2014NEIv1.

The California onroad mobile source emissions were created through a hybrid approach of combining state-supplied annual emissions with EPA-developed SMOKE-MOVES runs. Through this approach, the platform was able to reflect the unique rules in California, while leveraging the more detailed SCCs and the highly resolved spatial patterns, temporal patterns, and speciation from SMOKE-MOVES. The basic steps involved in temporally allocating onroad emissions from California based on SMOKE-MOVES results were:

1) Run CA using EPA inputs through SMOKE-MOVES to produce hourly 2014 emissions hereafter known as “EPA estimates.” These EPA estimates for CA are run in a separate sector called “onroad_ca.”
2) Calculate ratios between state-supplied emissions and EPA estimates[4]. These were calculated for each county/SCC/pollutant combination. Unlike in previous platforms, the California data separated off and on-network emissions and extended idling. However, the on-network did not provide specific road types, and California’s emissions did not include information for vehicles fueled by E-85, so these differentiations were obtained using MOVES.
3) Create an adjustment factor file (CFPRO) that includes EPA-to-state estimate ratios.
4) Rerun CA through SMOKE-MOVES using EPA inputs and the new adjustment factor file.

Through this process, adjusted model-ready files were created that sum to annual totals from California, but have the temporal and spatial patterns reflecting the highly resolved meteorology and SMOKE-MOVES. After adjusting the emissions, this sector is called “onroad_ca_adj.” Note that in emission summaries, the emissions from the “onroad” and “onroad_ca_adj” sectors are summed and designated as the emissions for the onroad sector.

**Table 2-13. Differences in California VOC HAP emissions between 2014v7.0 platform and the 2014NEIv1**

| Pollutant | NEI | Platform |
|---|---|---|
| 1,3-Butadiene | 348 | 285 |
| 2,2,4-Trimethylpentane | 2,691 | 2,833 |
| Acetaldehyde | 1,346 | 1,074 |
| Acrolein | 55 | 97 |
| Benzene | 3,075 | 2,582 |

[4] These ratios were created for all matching pollutants. These ratios were duplicated for all appropriate modeling species. For example, the EPA used the $NO_X$ ratio for NO, $NO_2$, HONO and used the $PM_{2.5}$ ratio for PEC, $PNO_3$, POC, $PSO_4$, etc. (For more details on $NO_X$ and PM speciation, see Sections 3.2.2, and 3.2.3. For VOC model-species, if there was an exact match (e.g., BENZENE), the EPA used that HAP pollutant ratio. For other VOC-based model-species that didn’t exist in the NEI inventory, the EPA used VOC ratios.)

| Pollutant | NEI | Platform |
|---|---|---|
| Ethylbenzene | 1,380 | 2,004 |
| Formaldehyde | 2,809 | 1,628 |
| Hexane | 1,389 | 2,838 |
| Methanol | 3,334 | 0 |
| Methyl tert-butyl ether | 111 | 0 |
| Naphthalene | 182 | 204 |
| Styrene | 137 | 68 |
| Toluene | 8,034 | 12,714 |
| Xylenes | 6,635 | 7,389 |

## 2.4 2014 nonroad mobile sources (cmv, rail, nonroad)

The nonroad mobile source emission modeling sectors consist of nonroad equipment emissions (nonroad), locomotive (rail) and CMV emissions.

### 2.4.1 Category 1, Category 2, Category 3 Commercial Marine Vessels (cmv)

The cmv sector contains Category 1, 2 and 3 CMV emissions from the 2014 NEIv1, but excludes C3 emissions from the NEI that originate in Federal Waters (FIPs beginning with 85). Instead, we used the more spatially resolved emissions from the Emissions Control Area-International Marine Organization (ECA-IMO)-based C3 CMV. The ECA-IMO emissions are in the othpt sector. All emissions in this sector are annual and at county-SCC resolution; however, in the NEI they are provided at the sub-county level (port or underway shape ids) and by SCC and emission type (e.g., hoteling, maneuvering). This sub-county data in the NEI are used to create spatial surrogates. Table 2-12 provides the SCCs extracted from the NEI for the cmv sector. Category 1 and 2 vessels are the diesel ships; Category 3 vessels are the residual oil ships.

**Table 2-14. 2014NEIv1 SCCs extracted for the cmv sector**

| SCC | Sector | Description: Mobile Sources prefix for all |
|---|---|---|
| 2280002100 | cmv | Marine Vessels; Commercial; Diesel; Port |
| 2280002200 | cmv | Marine Vessels; Commercial; Diesel; Underway |
| 2280003100 | cmv | Marine Vessels, Commercial; Residual; Port emissions |
| 2280003200 | cmv | Marine Vessels, Commercial; Residual; Underway emissions |

Emissions estimates are a mix of state-submitted values and EPA-developed emissions in areas where states did not submit. The emissions developed by EPA use a new “bottom up” procedure based on activity details from the U.S. Coast Guard and Army Corps of Engineers databases. See section 4.19 of the 2014NEIv1 TSD for a description of the methodology.

The cmv sector includes C1 and C2 vessels outside of state waters, but that are in Federal waters (FIPS = 85). These areas include parts of the Gulf of Mexico and East and West Coasts of the U.S. Federal waters around Puerto Rico and Alaska are outside the CONUS modeling domain and are not used in the platform. As stated earlier, the cmv sector does not include emissions from C3 sources in Federal waters, even though these emissions are included in the NEI.

For all sources in this sector, DIESEL-PM10 and DIESEL-PM2.5 were set equal to the $PM_{10}$ and $PM_{2.5}$ for each source. These pollutants are included in both the NEI and the FF10 input to SMOKE.

### 2.4.2 Railroad sources: (rail)

The rail sector includes all locomotives in the NEI nonpoint data category. This sector excludes railway maintenance locomotives and point source yard locomotives. Railway maintenance emissions are included in the nonroad sector. The point source yard locomotives are included in the ptnonipm sector.

The nonpoint rail data are a mix of S/L and EPA data. For 2014NEIv1, the EPA data were carried forward from the 2011 NEI. DIESEL-PM10 and DIESEL-PM2.5 are included in the NEI and are equivalent to the $PM_{10}$ and $PM_{2.5}$ from all sources in this sector. For more information on locomotive sources in the NEI, see Section 4.20 of the 2014NEIv1 TSD.

**Table 2-15. 2014NEIv1 SCCs extracted for the starting point in rail development**

| SCC | Sector | Description: Mobile Sources prefix for all |
|---|---|---|
| 2285002006 | rail | Railroad Equipment;Diesel;Line Haul Locomotives: Class I Operations |
| 2285002007 | rail | Railroad Equipment;Diesel;Line Haul Locomotives: Class II / III Operations |
| 2285002008 | rail | Railroad Equipment;Diesel;Line Haul Locomotives: Passenger Trains (Amtrak) |
| 2285002009 | rail | Railroad Equipment;Diesel;Line Haul Locomotives: Commuter Lines |
| 2285002010 | rail | Railroad Equipment;Diesel;Yard Locomotives |

### 2.4.3 Nonroad mobile equipment sources: (nonroad)

The nonroad equipment emissions in the platform and the NEI result primarily from running the MOVES2014a model, which incorporates the NONROAD2008 model. MOVES2014a replaces NMIM, which was used for 2011 and earlier NEIs. MOVES2014a provides a complete set of HAPs and incorporates updated nonroad emission factors for HAPs. MOVES2014a was used for all states other than California, which uses their own model. As with other mobile diesel sources, the EPA added DIESEL-PM10 and DIESEL-PM25 for all diesel fuel SCCs and they were set equal to the $PM_{10}$ and $PM_{2.5}$ emissions from these diesel SCCs. Additional details on the development of the 2014NEIv1 nonroad emissions are available in Section 4.5 the 2014NEIv1 TSD.

The magnitude of the annual emissions in the nonroad platform are equivalent to the emissions in the nonroad data category of the 2014NEIv1. However, the platform has monthly emission totals, which are provided by MOVES2014a and contain additional pollutants used in the emissions modeling. The emissions in the modeling platform include NONHAPTOG and ETHANOL, which are not included in the NEI. NONHAPTOG is the difference between total organic gases (TOG) and explicit species that are estimated separately such as benzene, toluene, styrene, ethanol, and numerous other compounds and are integrated into the chemical speciation process. MOVES2014a provides estimates of NONHAPTOG along with the speciation profile code for the NONHAPTOG emsission source. This is accomplished by using NHTOG#### as the pollutant code in the FF10 inventory file, where #### is a speciation profile code. Since speciation profiles are applied by SCC and pollutant, no changes to SMOKE were needed in order to use the FF10 with this profile information. This approach is not used for California, because their model provides VOC. Therefore, the profiles used in the 2011v6.3 profile were used for all California VOC sources.

The CARB-supplied nonroad annual inventory emissions values were temporalized to monthly values using monthly temporal profiles applied in SMOKE by SCC. Some VOC emissions were added to California to account for situations when VOC HAP emissions were included in the inventory, but VOC emissions were either less than the sum of the VOC HAP emissions, or were missing entirely. These additional VOC emissions were computed by summing benzene, acetaldehyde, formaldehyde, and naphthalene for the specific sources.

## *2.5 "Other Emissions": Offshore Category 3 commercial marine vessels, drilling platforms and non-U.S. sources*

The emissions from Canada, Mexico, and non-U.S. offshore Category 3 CMV (C3 CMV) and drilling platforms are included as part of four emissions modeling sectors: othpt, othar, othafdust, and othon. The "oth" refers to the fact that these emissions are usually "other" than those in the U.S. state-county geographic FIPS, and the remaining characters provide the SMOKE source types: "pt" for point, "ar" for "area and nonroad mobile," "afdust" for area fugitive dust (Canada only), and "on" for onroad mobile.

### 2.5.1 Point sources from offshore C3 CMV, drilling platforms, Canada and Mexico (othpt)

The othpt sector contains a variety of point sources that are located in Federal Waters, Canada or Mexico. It includes the ECA-IMO-based C3 CMV inventory, which consists of C3 CMV emissions outside of state waters, and non-U.S. emissions farther offshore than U.S. waters. These are the same emissions as were used in the 2011v6.3 platform and are described below. Because these emissions are treated as point sources, shipping lane routes can be preserved and they may be allocated to air quality model layers higher than layer 1.

The EPA-estimated C3 CMV emissions were developed based on a 4-km resolution ASCII raster format dataset that preserves shipping lanes. This dataset has been used since the ECA-IMO project began in 2005, although it was then known as the Sulfur Emissions Control Area (SECA). The ECA-IMO emissions consist of large marine diesel engines (at or above 30 liters/cylinder) that, until recently, were allowed to meet relatively modest emission requirements and, as a result, these ships would often burn residual fuel in that region. The emissions in this sector are comprised of primarily foreign-flagged ocean-going vessels, referred to as C3 CMV ships. The cmv inventory sector includes these ships in several intra-port modes (i.e., cruising, hoteling, reduced speed zone, maneuvering, and idling) and an underway mode, and includes near-port auxiliary engine emissions.

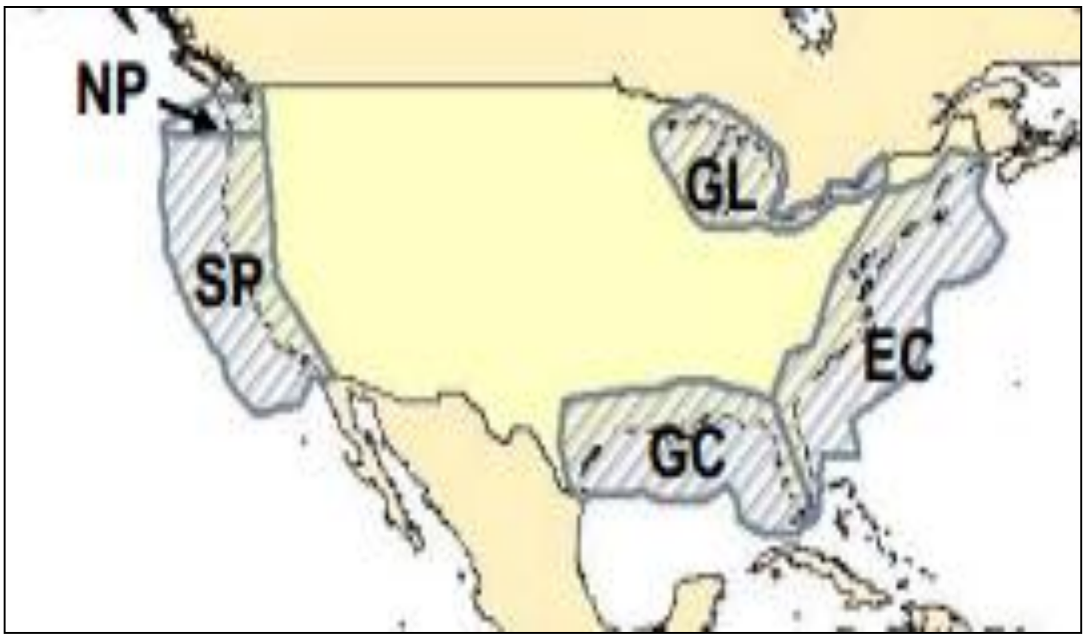
An overview of the C3 ECA Proposal to the International Maritime Organization project (EPA-420-F-10-041, August 2010) and future-year goals for reduction of $NO_X$, $SO_2$, and PM C3 emissions can be found at: http://www.epa.gov/oms/regs/nonroad/marine/ci/420r09019.pdf. The resulting ECA-IMO coordinated strategy, including emission standards under the Clean Air Act for new marine diesel engines with per-cylinder displacement at or above 30 liters, and the establishment of ECA is available from http://www.epa.gov/oms/oceanvessels.htm. The base-year ECA inventory is 2002 and consists of these CAPs: $PM_{10}$, $PM_{2.5}$, CO, $CO_2$, $NH_3$, $NO_X$, $SO_X$ (assumed to be $SO_2$), and hydrocarbons (assumed to be VOC). The EPA developed regional growth (activity-based) factors that were applied to create the 2011 inventory from the 2002 data. These growth factors are provided in Table 2-16**Error! Reference**

**source not found.**. The geographic regions listed in the table are shown in Figure 2-2**Error! Reference source not found.**. The East Coast and Gulf Coast regions were divided along a line roughly through Key Largo (longitude 80° 26' West). Technically, the Exclusive Economic Zone (EEZ) FIPS are not really "FIPS" state-county codes, but are treated as such in the inventory and emissions processing.

**Table 2-16. Growth factors to project the 2002 ECA-IMO inventory to 2011**

| Region | **EEZ FIPS** | **$NO_X$** | **$PM_{10}$** | **$PM_{2.5}$** | **VOC** | **CO** | **$SO_2$** |
|---|---|---|---|---|---|---|---|
| East Coast (EC) | 85004 | 1.301 | 0.500 | 0.496 | 1.501 | 1.501 | 0.536 |
| Gulf Coast (GC) | 85003 | 1.114 | 0.428 | 0.423 | 1.288 | 1.288 | 0.461 |
| North Pacific (NP) | 85001 | 1.183 | 0.467 | 0.458 | 1.353 | 1.353 | 0.524 |
| South Pacific (SP) | 85002 | 1.367 | 0.525 | 0.521 | 1.565 | 1.562 | 0.611 |
| Great Lakes (GL) | n/a | 1.072 | 0.394 | 0.390 | 1.177 | 1.176 | 0.415 |
| Outside ECA | 98001 | 1.341 | 1.457 | 1.457 | 1.457 | 1.457 | 1.457 |

**Figure 2-2. Illustration of regional modeling domains in ECA-IMO study**




The emissions were converted to SMOKE point source inventory format as described in http://www.epa.gov/ttn/chief/conference/ei17/session6/mason.pdf, allowing for the emissions to be allocated to modeling layers above the surface layer. As described in the paper, the ASCII raster dataset was converted to latitude-longitude, mapped to state/county FIPS codes that extended up to 200 nautical miles (nm) from the coast, assigned stack parameters, and monthly ASCII raster dataset emissions were used to create monthly temporal profiles. All non-US, non-EEZ emissions (i.e., in waters considered outside of the 200 nm EEZ and, hence, out of the U.S. and Canadian ECA-IMO controllable domain) were simply assigned a dummy state/county FIPS code=98001, and were projected to year 2011 using the "Outside ECA" factors**Error! Reference source not found.**.

No data from this inventory were used for State waters which extend approximately 3 to 10 miles offshore, since all CMV emissions in state waters are in the cmv sector. Also, the SMOKE-ready data have been cropped from the original ECA-IMO entire northwestern quarter of the globe to cover only the large continental U.S. 36-km “36US1” air quality model domain, the largest Continental U.S. domain used by the EPA in recent years[5].

The original ECA-IMO inventory did not delineate between ports and underway emissions (or other C3 modes such as hoteling, maneuvering, reduced-speed zone, and idling). However, a U.S. ports spatial surrogate dataset was used to assign the ECA-IMO emissions to ports and underway SCCs 2280003100 and 2280003200, respectively. This had no effect on temporal allocation or speciation because all C3 CMV emissions, unclassified/total, port and underway, share the same temporal and speciation profiles. See Section 3.2.1.3 for more details on C3 speciation in the cmv sector and Section 3.3.8 for details on temporal allocation.

For Canadian point sources, 2010 emissions provided by Environment Canada were used. Other than for upstream oil and gas and oil sands, they were provided as CB05 speciated emissions. In order to use CB6 speciation for CMAQ, the individual CB05 model species were summed to total VOC, and then re-speciated to CB6-CMAQ model species. We summed all species, including non-VOC species such as CH4, and called it “VOC”. Because these CB05 speciated emissions have a single SCC (39999999, which is Industrial Not elswhere classified), they receive a single profile, “Automotive Painting” profile (2546). The upstream oil and gas and oil sands SCCs were provided as VOC emissions using more detailed SCCs. Temporal profiles were also provided. Point sources in Mexico were compiled based on a year 2014 inventory (ERG, 2016a). The point source emissions in the 2014 inventory were converted to English units and into the FF10 format that could be read by SMOKE, missing stack parameters were gapfilled using SCC-based defaults, and latitude and longitude coordinates were verified and adjusted if they were not consistent with the reported municipality. Note that there are no explicit HAP emissions in this inventory.

The othpt sector also includes point source offshore oil and gas drilling platforms that are in Federal Waters beyond U.S. state-county boundaries in the Gulf of Mexico. For these offshore emissions, data from the 2014NEIv1 were used.

### 2.5.2 Area and nonroad mobile sources from Canada and Mexico (othar, othafdust)

For Canadian area and sources, month-specific year-2010 emissions provided by Environment Canada were used, including C3 CMV emissions. The Canadian inventory included fugitive dust emissions that do not incorporate either a transportable fraction or meteorological-based adjustments. To properly account for this, a separate sector called othafdust was created and modeled using the same adjustments as are done for U.S. sources (see Section 2.2.1 for more details). Updated Shapefiles used for creating spatial surrogates for Canada were also provided. For Canada nonroad mobile sources, 2014 emissions were estimated by projecting from 2010 using national US (minus California) projection factors by SCC7/pollutant, based on the 2011NEIv2 and 2014NEIv1 nonroad inventories.

For Mexico, emissions projected to the year 2014 based on Mexico’s 2008 inventory were used for area, point and nonroad sources (ERG, 2016a). The resulting inventory was written using English units to the nonpoint FF10 format that could be read by SMOKE. Note that unlike the U.S. inventories, there are no

[5] The extent of the “36US1” domain is similar to the full geographic region shown in Figure 3-1. Note that this domain is not specifically used in this 2011 platform, although spatial surrogates that can be used with it are provided.

explicit HAPs in the nonpoint or nonroad inventories for Canada and Mexico and, therefore, all HAPs are created from speciation.

### 2.5.3 Onroad mobile sources from Canada and Mexico (onroad_can, onroad_mex)

For Mexico, a version of the MOVES model for Mexico was run that provided the same VOC HAPs and speciated VOCs as for the U.S. MOVES model (ERG, 2016a). This includes NBAFM plus several other VOC HAPs such as toluene, xylene, ethylbenzene and others. Except for VOC HAPs that are part of the speciation, no other HAPs are included in the Mexico onroad inventory (but not particulate HAPs nor diesel particulate matter).

For Canada, month-specific year-2010 emissions provided by Environment Canada were used, projected to 2014 based on the trend of U.S. onroad mobile emissions from 2011 to 2014. Ratios of 2011-to-2014 U.S. onroad emissions were calculated by fuel, vehicle type, and pollutant for the entire Continential U.S. except California, and then applied to the 2010 Canada onroad inventory to project to 2014. Note that unlike the U.S. and Mexico inventories, there are no explicit HAPs in the onroad inventories for Canada and, therefore, NBAFM HAPs are created from speciation.

### 2.5.4 Fires from Canada and Mexico (*ptfire_mxca*)

Annual 2014 wildland emissions for Mexico and Canada in the 2014v7.0 platform were developed from a combination of FINN (Fire Inventory from NCAR) daily fire emissions and fire data provided by Environment Canada when available. Environment Canada emissions were used for Canada wildland fire emissions for June through November and FINN fire emissions were used to fill in the annual gaps from January through May and December. Only CAP emissions are provided in the Canada and Mexico fire inventories.

For FINN fires, listed vegetation type codes of 1 and 9 are defined as agricultural burning, all other fire detections and assumed to be wildfires. All wildland fires that are not defined as agricultural are assumed to be wild fires rather than prescribed. FINN fire detects less than 50 square meters (0.012 acres) are removed from the inventory. The locations of FINN fires are geocoded from latitude and longitude to FIPS code.

## *2.6 Fires (ptfire_f, ptfire_s)*

In the 2014v7.0 platform, both the wildfires and prescribed burning emissions are contained in the sectors ptfire_f and ptfire_s, which contain emissions from flaming and smoldering, respectively. Fire emissions in these sectors are specified at geographic coordinates (point locations) and have daily emissions values. The ptfire sectors exclude agricultural burning and other open burning sources that are included in the agfire and nonpt sectors, respectively. They are consistent with the fires stored in the events data category of the 2014NEIv1. The NEI SCCs for the ptfire sectors are showin in Table 2-17. As can be seen in the table, the 2014 NEI distinguishes between flaming and smoldering; they were put into separate sectors in order to use different vertical layering structure. This was done to force smoldering into layer 1, and vertically distribute flaming based on plume rise. Parameters associated with the emissions such as acres burned and fuel load allow estimation of plume rise. For more information on the development of the 2014NEIv1 fire inventory, see Section 7 of the 2014NEIv1 TSD.

**Table 2-17. 2014 Platform SCCs representing emissions in the ptfire modeling sectors**

| SCC | SCC Description* |
|---|---|
| 2810001001 | Other Combustion-as Event; Forest Wildfires; Smoldering |
| 2810001002 | Other Combustion-as Event; Forest Wildfires; Flaming |
| 2811015001 | Other Combustion-as Event; Prescribed Forest Burning; Smoldering |
| 2811015002 | Other Combustion-as Event; Prescribed Forest Burning; Flaming |

* The first tier level of the SCC Description is "Miscellaneous Area Sources."

Preparation of the 2014 wildland fire EI begins with raw input fire activity data and ends with daily estimates of emissions from each included fire location. Following on the use of local data sets for the 2011 NEI, input data sets from 22 states and one Indian Nation were used to calculate fire activity. State, local, and tribal agencies that provided input data were also asked to complete the NEI Wildland Fire Inventory Database Questionnaire, which consisted of a self-assessment of data completeness. Based on input from SLT data providers, submitted data sets were supplemented with up to seven data sets from national sources. The data sets were cleaned to eliminate errors and to achieve standardized formatting. Cleaned data sets were reconciled into a single, comprehensive fire location data set using the SmartFire2 (SF2) data processing system (airfire.org/smartfire). The SF2 reconciles multiple data sets to retain the best available information for each aspect of each fire event. The reconciled fire locations, along with fuel moisture and fuel loading data, were used in the BlueSky Framework (Larkin et al., 2009) to estimate smoke emissions. BlueSky Framework is a modeling framework that "links a variety of independent models of fire information, fuel loading, fire consumption, fire emissions, and smoke dispersion." (airfire.org/bluesky. For the 2014 NEI, wildland fire emissions estimates were estimated separately for flaming and smoldering combustion phases of fire to facilitate better understanding emission characteristics and to assist modeling efforts.

SMARTFIRE2 estimates were used directly for all states except Georgia. For Georgia, the satellite-derived emissions were removed from the ptfire inventory and replaced with a separate state-supplied ptfire inventory.

As was done with the 2011 platform, fires over 20,000 acres were split into the respective grid cells that they overlapped. The idea of this was to prevent all emissions from going into a single grid cell when, in reality, the fire was more dispersed than a single point. The large fires were each projected as a circle over the area centered on the specified latitude and longitude, and then apportioned into the grid cells they overlapped. The area of each of the "subfires" was computed in proportion to the overlap with that grid cell. These "subfires" were given new names that were the same as the original, but with "_a", "_b", "_c", and "_d" appended as needed. The FIPS state and county codes and fire IDs for the ten fires apportioned to multiple grid cells are shown in Table 2-18.

**Table 2-18. Large fires apportioned to multiple grid cells**

| County FIPS[a] | Fire ID |
|---|---|
| 02122 | nei140018117 |
| 02122 | nei140018197 |
| 06017 | nei140125469 |
| 12011 | nei140014500 |
| 16063 | nei140105145 |
| 27007 | nei140082399 |

| County FIPS[a] | Fire ID |
|---|---|
| 41025 | nei140105167 |
| 41025 | nei140105172 |
| 49001 | nei140097811 |
| 53047 | nei140105851 |
| [a]We split fires in Alaska even though it was outsited our modeling domain. | |

## 2.7 Biogenic sources (beis)

Biogenic emissions were computed based on the same 14j version of the 2014 meteorology data used for the air quality modeling, and were developed using the Biogenic Emission Inventory System version 3.61 (BEIS3.61) within SMOKE. The BEIS3.61 creates gridded, hourly, model-species emissions from vegetation and soils. It estimates CO, VOC (most notably isoprene, terpene, and sesquiterpene), and NO emissions for the contiguous U.S. and for portions of Mexico and Canada.

The BEIS3.61 was used in conjunction with Version 4.1 of the Biogenic Emissions Landuse Database (BELD4) and incorporates a canopy two-layer canopy model to estimate leaf-level temperatures (Pouliot and Bash, 2015). In the BEIS 3.61 two-layer canopy model, the layer structure varies with light intensity and solar zenith angle. Both layers include estimates of sunlit and shaded leaf area based on solar zenith angle and light intensity, direct and diffuse solar radiation, and leaf temperature (Bash et al., 2015). The new algorithm requires additional meteorological variables over previous versions of BEIS. The variables output from the Meteorology-Chemistry Interface Processor (MCIP) that are used to convert WRF outputs to CMAQ inputs are shown in Table 2-19.

**Table 2-19. Meteorological variables required by BEIS 3.61**

| Variable | Description |
|---|---|
| LAI | leaf-area index |
| PRSFC | surface pressure |
| Q2 | mixing ratio at 2 m |
| RC | convective precipitation per met TSTEP |
| RGRND | solar rad reaching sfc |
| RN | nonconvective precipitation per met TSTEP |
| RSTOMI | inverse of bulk stomatal resistance |
| SLYTP | soil texture type by USDA category |
| SOIM1 | volumetric soil moisture in top cm |
| SOIT1 | soil temperature in top cm |
| TEMPG | skin temperature at ground |
| USTAR | cell averaged friction velocity |
| RADYNI | inverse of aerodynamic resistance |
| TEMP2 | temperature at 2 m |

The BELD version 4.1 is based on an updated version of the USDA-USFS Forest Inventory and Analysis (FIA) vegetation speciation based data from 2001 to 2014 from the FIA version 5.1. Canopy coverage is based on the Landsat satellite National Land Cover Database (NLCD) product from 2011. The FIA includes approximately 250,000 representative plots of species fraction data that are within approximately 75 km of one another in areas identified as forest by the NLCD canopy coverage. The 2011 NLCD provides land cover information with a native data grid spacing of 30 meters. For land areas outside the conterminous United States, 500 meter grid spacing land cover data from the Moderate Resolution Imaging Spectroradiometer (MODIS) is used. BELDv4.1 also incorporates the following:

- 30 meter NASA's Shuttle Radar Topography Mission (SRTM) elevation data (http://www2.jpl.nasa.gov/srtm/) to more accurately define the elevation ranges of the vegetation species than in previous versions; and
- 2011 30 meter USDA Cropland Data Layer (CDL) data (http://www.nass.usda.gov/research/Cropland/Release/).

To provide a sense of the scope and spatial distribution of the emissions, plots of annual BEIS outputs for NO, isoprene, acetaldehyde, and formaldehyde for 2014 are shown in Figure 2-3, Figure 2-4, Figure 2-5, and Figure 2-6, respectively.

**Figure 2-3. Annual NO emissions output from BEIS 3.61 for 2014**

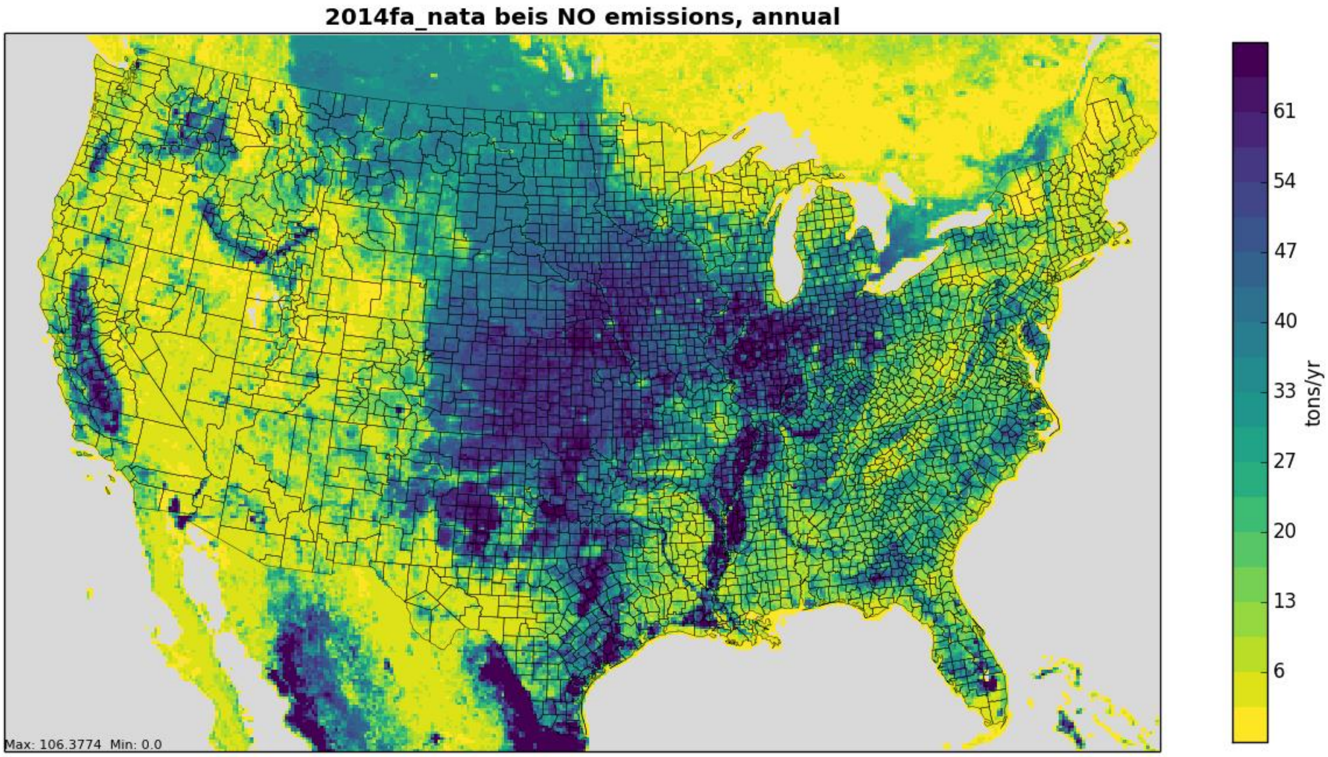



**Figure 2-4. Annual isoprene emissions output from BEIS 3.61 for 2014**

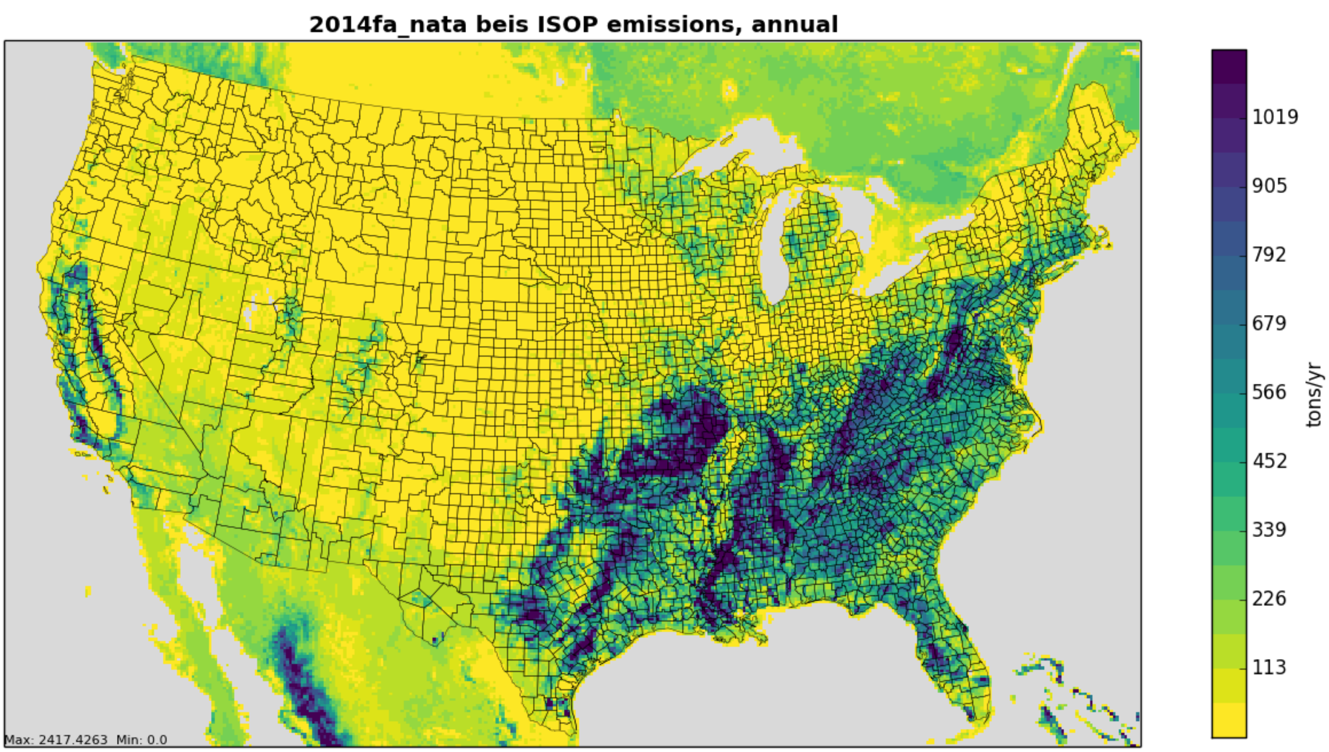


**Figure 2-5. Annual acetaldehyde emissions output from BEIS 3.61 for 2014**

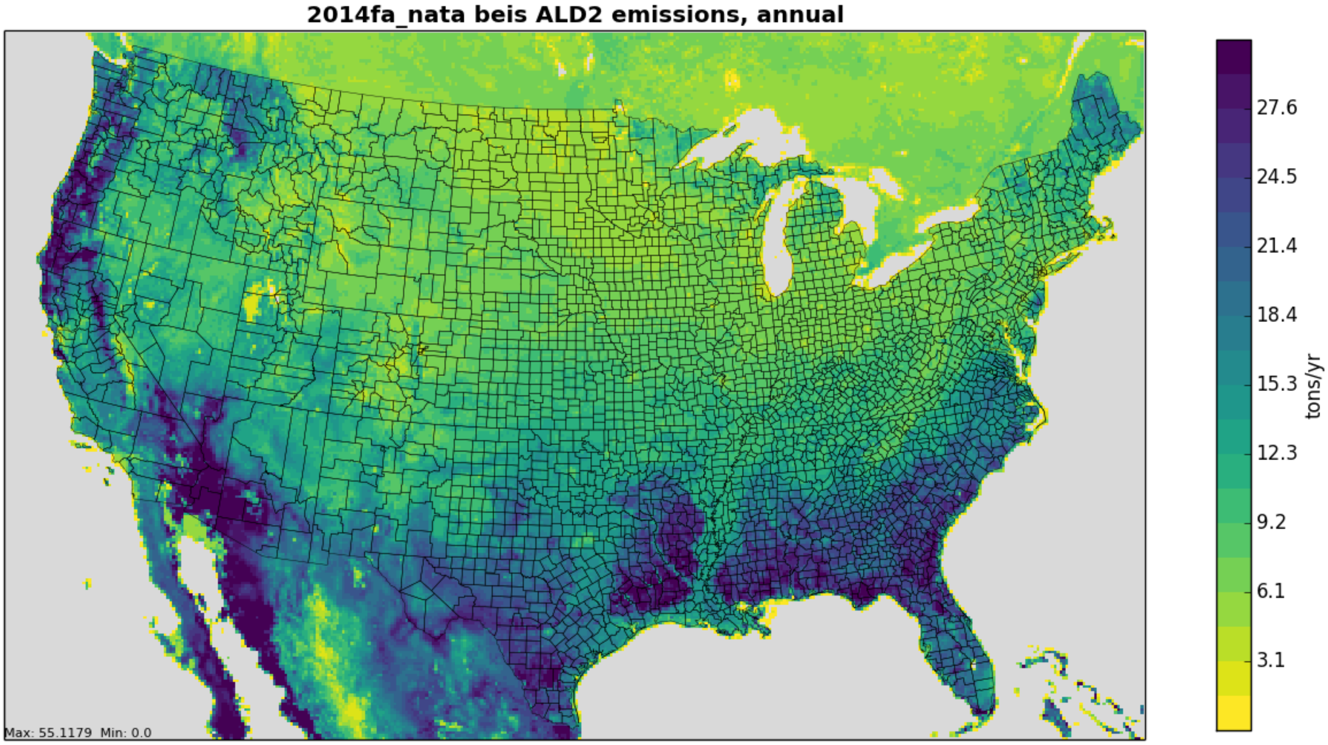
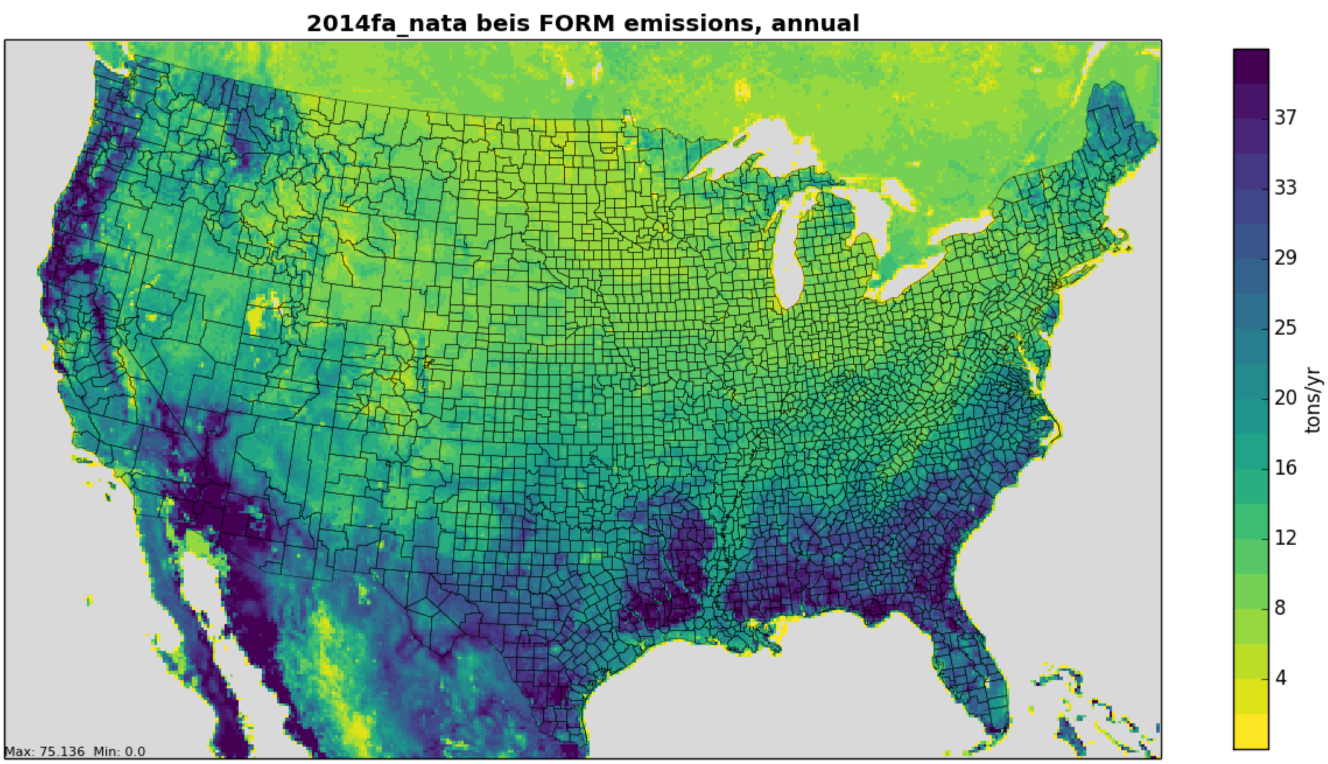



**Figure 2-6. Annual formaldehyde emissions output from BEIS 3.61 for 2014**



## 2.8 SMOKE-ready non-anthropogenic inventories for chlorine

The ocean chlorine gas emission estimates are based on the build-up of molecular chlorine ($Cl_2$) concentrations in oceanic air masses (Bullock and Brehme, 2002). Data at 36 km and 12 km resolution were available and were not modified other than the model-species name “CHLORINE” was changed to “CL2” to support CMAQ modeling.

# 3 Emissions Modeling Summary

The CMAQ model requires hourly emissions of specific gas and particle species for the horizontal and vertical grid cells contained within the modeled region (i.e., modeling domain). To provide emissions in the form and format required by the model, it is necessary to "pre-process" the "raw" emissions (i.e., emissions input to SMOKE) for the sectors described above in Section 2. In brief, the process of emissions modeling transforms the emissions inventories from their original temporal resolution, pollutant resolution, and spatial resolution into the hourly, speciated, gridded resolution required by the air quality model. Emissions modeling includes temporal allocation, spatial allocation, and pollutant speciation. In some cases, emissions modeling also includes the vertical allocation of point sources, but many air quality models also perform this task because it greatly reduces the size of the input emissions files if the vertical layers of the sources are not included.

As seen in Section 2, the temporal resolutions of the emissions inventories input to SMOKE vary across sectors and may be hourly, daily, monthly, or annual total emissions. The spatial resolution, may be individual point sources, county/province/municipio totals, or gridded emissions and varies by sector. This section provides some basic information about the tools and data files used for emissions modeling as part of the modeling platform. In Section 2, the emissions inventories and how they differ from the the previous platform are described. In Section 3, the descriptions of data are limited to the ancillary data SMOKE uses to perform the emissions modeling steps. Note that all SMOKE inputs for the 2014 platform are available from the CHIEF Emissions Modeling Clearinghouse website (see Section 1).

SMOKE version 4.5 was used to pre-process the raw emissions inventories into emissions inputs for each modeling sector in a format compatible with CMAQ. For sectors that have plume rise, the in-line emissions capability of the air quality models was used, which allows the creation of source-based and two-dimensional gridded emissions files that are much smaller than full three-dimensional gridded emissions files. For QA of the emissions modeling steps, emissions totals by specie for the entire model domain are output as reports that are then compared to reports generated by SMOKE on the input inventories to ensure that mass is not lost or gained during the emissions modeling process.

## *3.1 Emissions modeling Overview*

When preparing emissions for the air quality model, emissions for each sector are processed separately through SMOKE, and then the final merge program (Mrggrid) is run to combine the model-ready, sector-specific emissions across sectors. The SMOKE settings in the run scripts and the data in the SMOKE ancillary files control the approaches used by the individual SMOKE programs for each sector. Table 3-1 summarizes the major processing steps of each platform sector. The "Spatial" column shows the spatial approach used: "point" indicates that SMOKE maps the source from a point location (i.e., latitude and longitude) to a grid cell; "surrogates" indicates that some or all of the sources use spatial surrogates to allocate county emissions to grid cells; and "area-to-point" indicates that some of the sources use the SMOKE area-to-point feature to grid the emissions (further described in Section 3.4.2). The "Speciation" column indicates that all sectors use the SMOKE speciation step, though biogenics speciation is done within the Tmpbeis3 program and not as a separate SMOKE step. The "Inventory resolution" column shows the inventory temporal resolution from which SMOKE needs to calculate hourly emissions. Note that for some sectors (e.g., onroad, beis), there is no input inventory; instead, activity data and emission factors are used in combination with meteorological data to compute hourly emissions.

Finally, the "plume rise" column indicates the sectors for which the "in-line" approach is used. These sectors are the only ones with emissions in aloft layers based on plume rise. The term "in-line" means that the plume rise calculations are done inside of the air quality model instead of being computed by SMOKE. The air quality model computes the plume rise using the stack data and the hourly air quality model inputs found in the SMOKE output files for each model-ready emissions sector. The height of the plume rise determines the model layer into which the emissions are placed. The othpt sector has only "in-line" emissions, meaning that all of the emissions are treated as elevated sources and there are no emissions for those sectors in the two-dimensional, layer-1 files created by SMOKE. Day-specific point fires' flaming emissions are treated separately. After plume rise is applied, there will be emissions in every layer from the ground up to the top of the plume.

**Table 3-1. Key emissions modeling steps by sector.**

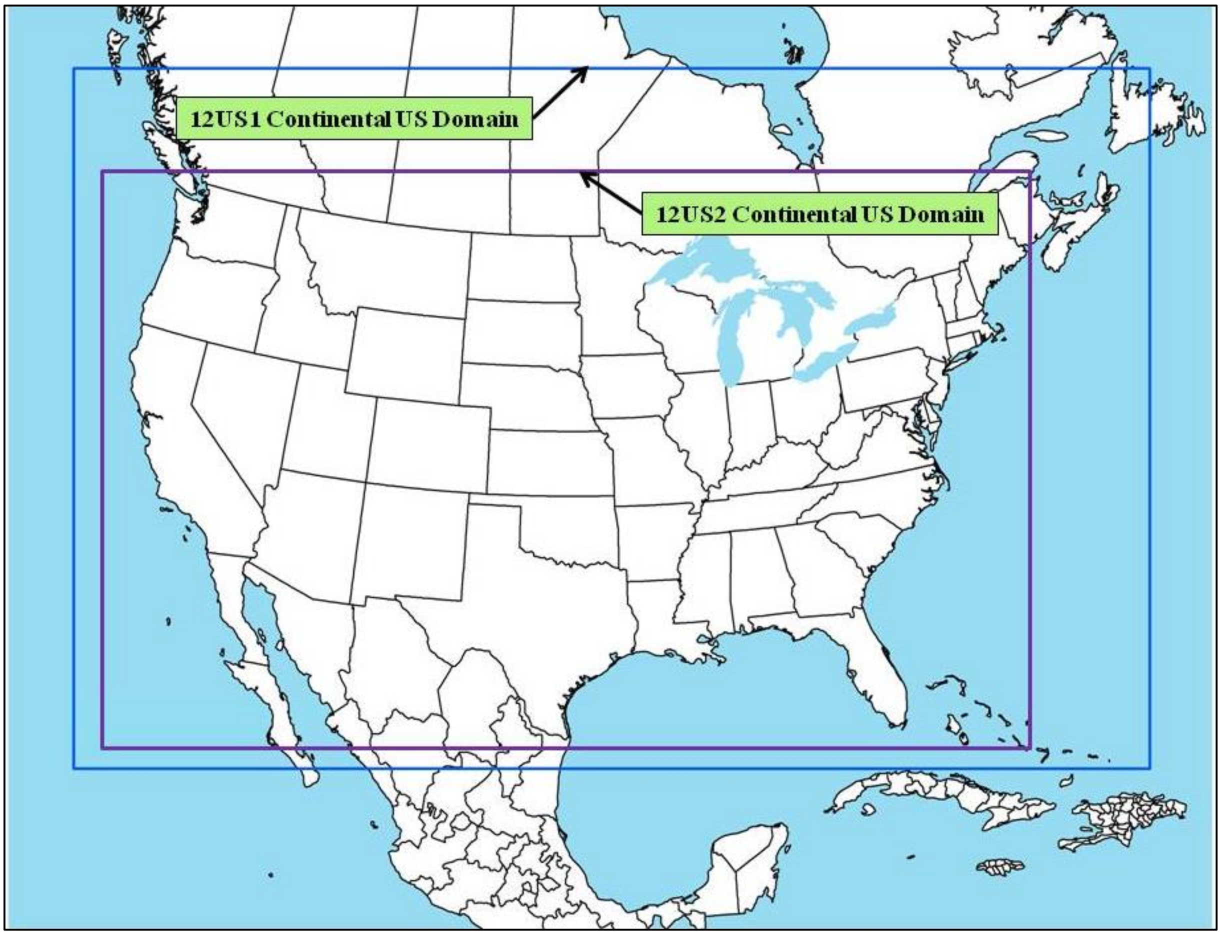
| Platform sector | Spatial | Speciation | Inventory resolution | Plume rise |
|---|---|---|---|---|
| afdust | Surrogates | Yes | annual | |
| ag | Surrogates | Yes | annual & daily[1] | |
| agfire | Surrogates | Yes | annual | |
| beis | Pre-gridded land use | in BEIS3.61 | computed hourly | |
| rail | Surrogates | Yes | annual | |
| cmv | Surrogates | Yes | annual | |
| nonpt | Surrogates & area-to-point | Yes | annual | |
| nonroad | Surrogates & area-to-point | Yes | monthly | |
| np_oilgas | Surrogates | Yes | annual | |
| onroad | Surrogates | Yes | monthly activity, computed hourly | |
| othafdust | Surrogates | Yes | annual | |
| othar | Surrogates | Yes | annual & monthly | |
| onroad_can | Surrogates | Yes | monthly | |
| onroad_mex | Surrogates | Yes | monthly | |
| othpt | Point | Yes | annual | in-line |
| ptagfire | Point | Yes | daily | Forced to layer 1 |
| pt_oilgas | Point | Yes | annual | in-line |
| ptegu | Point | Yes | daily & hourly | in-line |
| ptfire_f | Point | Yes | daily | in-line |
| ptfire_s | Point | Yes | daily | Forced to layer 1 |
| ptfire_mxca | Point | Yes | daily | in-line |
| ptnonipm | Point | Yes | annual | in-line |
| rwc | Surrogates | Yes | annual | |

1. Livestock is daily, fertilizer is annual

SMOKE has the option of grouping sources so that they are treated as a single stack when computing plume rise. For this platform, no grouping was performed because grouping combined with "in-line" processing will not give identical results as "offline" processing (i.e., when SMOKE creates 3-dimensional files). This occurs when stacks with different stack parameters or latitudes/longitudes are grouped, thereby changing the parameters of one or more sources. The most straightforward way to get the same results between in-line and offline is to avoid the use of grouping.

SMOKE was run for the smaller 12-km CONtinental United States "CONUS" modeling domain (12US2) shown in Figure 3-1 and boundary conditions for some model species including formaldehyde and acetaldehyde were obtained from a 2014 run of GEOS-Chem (others such as benzene relied on ambient measurements or were set to 0). Section 3.4 provides the details on the spatial surrogates and area-to-point data used to accomplish spatial allocation with SMOKE.

**Figure 3-1. Air quality modeling domains**




Both grids use a Lambert-Conformal projection, with Alpha = 33º, Beta = 45º and Gamma = -97º, with a center of X = -97º and Y = 40º. Table 3-2 describes the grids for the two domains.

**Table 3-2. Descriptions of the platform grids**

| Common Name | Grid Cell Size | Description (see Figure 3-1) | Grid name | Parameters listed in SMOKE grid description (GRIDDESC) file: projection name, xorig, yorig, xcell, ycell, ncols, nrows, nthik |
|---|---|---|---|---|
| Continental 12km grid | 12 km | Entire conterminous US plus some of Mexico/Canada | 12US1_459X299 | 'LAM_40N97W', -2556000, -1728000, 12.D3, 12.D3, 459, 299, 1 |
| US 12 km or "smaller" CONUS-12 | 12 km | Smaller 12km CONUS plus some of Mexico/Canada | 12US2 | 'LAM_40N97W', -2412000 , -1620000, 12.D3, 12.D3, 396, 246, 1 |

## 3.2 Chemical Speciation

The emissions modeling step for chemical speciation creates the "model species" needed by the air quality model for a specific chemical mechanism. These model species are either individual chemical compounds (i.e., "explicit species") or groups of species (i.e., "lumped species"). The chemical mechanism used for the 2014 platform is the CB6 mechanism (Yarwood, 2010). We used a particular version of CB6 that we refer to as "CMAQ CB6" that breaks out naphthalene from XYL as an explicit model species, resulting in model species NAPHTHALENE and XYLMN instead of XYL and uses SOAALK. Otherwise it is the same as the CB6 used in the 2011v6.3 platform. This platform generates the $PM_{2.5}$ model species associated with the CMAQ Aerosol Module version 6 (AE6), which were also used for the 2011v6.3 platform. Table 3-3 through Table 3-5 list the model species produced by SMOKE in the 2014 platform. Per Table 3-4, many HAPs added as tracer species (not participating in the CB6 chemistry) are used. These species are not generated through speciation but rather mapped or aggregated from inventory species directly to model species. Eight species were added to CMAQ (these are shown with an asterisk) since the version that was used in the 2011 NATA. The HAP metals, also from the inventory, are speciated within SMOKE into coarse and fine components.

The TOG and $PM_{2.5}$ speciation factors that are the basis of the chemical speciation approach were developed from the SPECIATE 4.5 database (https://www.epa.gov/air-emissions-modeling/speciate-version-45-through-32), which is the EPA's repository of TOG and PM speciation profiles of air pollution sources. The SPECIATE database development and maintenance is a collaboration involving the EPA's Office of Research and Development (ORD), Office of Transportation and Air Quality (OTAQ), and the Office of Air Quality Planning and Standards (OAQPS), in cooperation with Environment Canada (EPA, 2016). The SPECIATE database contains speciation profiles for TOG, speciated into individual chemical compounds, VOC-to-TOG conversion factors associated with the TOG profiles, and speciation profiles for $PM_{2.5}$. Appendix C provides a summary of the new/revised TOG profiles in SPECIATE version 4.5 profiles that were used in this platform[6]; there were just 2 new $PM_{2.5}$ profiles used – brake and tirewear.

Some key features and updates to speciation from previous platforms include the following (the subsections below contain more details on the specific changes):

- VOC speciation profile cross reference assignments for point and nonpoint oil and gas sources were updated to (1) make corrections to the 2011v6.3 cross references, (2) use new and revised

[6] Excluding onroad mobile since speciation is done, other than for brake and tire, within MOVES. Two new-to-SPECIATE4.5 brake and tirewear profiles were used in this platform: 95462 (Composite - Brake Wear) and 95460 (Composite - Tire Dust).

profiles that were added to SPECIATE4.5 and (3) account for the portion of VOC estimated to come from flares, based on data from the Oil and Gas estimation tool used to estimate emissions for the NEI. The new/revised profiles included oil and gas operations in specific regions of the country and a national profile for natural gas flares;

- the Western Regional Air Partnership (WRAP) speciation profiles (**Error! Reference source not found.**) used for the np_oilgas sector were revised;
- VOC speciation for nonroad mobile has been updated to include a different speciation profile assignment method for VOC (profiles are assigned to SCCs within MOVES2014a which outputs the emissions with those assignments) and updated profiles;
- VOC and PM speciation for onroad mobile sources occurs within MOVES2014a;
- Speciation for onroad mobile sources in Mexico is done within MOVES and is more consistent with that used in the United States; and
- As with the 2011 platforms, the 2010 Canadian point source inventories, other than upstream oil & gas and oil sands, in the othpt sector are derived from CB05 pre-speciated emissions as these were provided from Environment Canada.

Speciation profiles and cross-references for the 2014 platform are available in the SMOKE input files for the 2014 platform. Emissions of VOC and $PM_{2.5}$ emissions by county, sector and profile for all sectors other than onroad mobile can be found in the sector summaries for the case. Totals of each model species by state and sector can be found in the state-sector totals workbook for this case.

**Table 3-3. Emission model species produced for CMAQ CB6**

| **Inventory Pollutant** | **Model Species** | **Model species description** |
|---|---|---|
| $Cl_2$ | CL2 | Atomic gas-phase chlorine |
| HCl | HCL | Hydrogen Chloride (hydrochloric acid) gas |
| CO | CO | Carbon monoxide |
| $NO_X$ | NO | Nitrogen oxide |
| | NO2 | Nitrogen dioxide |
| | HONO | Nitrous acid |
| $SO_2$ | SO2 | Sulfur dioxide |
| | SULF | Sulfuric acid vapor |
| $NH_3$ | NH3 | Ammonia |
| VOC | ACET | Acetone |
| | ALD2 | Acetaldehyde |
| | ALDX | Propionaldehyde and higher aldehydes |
| | BENZ | Benzene |
| | CH4 | Methane[7] |
| | ETH | Ethene |
| | ETHA | Ethane |
| | ETHY | Ethyne |
| | ETOH | Ethanol |
| | FORM | Formaldehyde |

[7] Technically, $CH_4$ is not a VOC but part of TOG. Although emissions of $CH_4$ are derived, the AQ models do not use these emissions because the anthropogenic emissions are dwarfed by the $CH_4$ already in the atmosphere.

| Inventory Pollutant | Model Species | Model species description |
|---|---|---|
| | KET | Ketone Groups |
| | IOLE | Internal olefin carbon bond (R-C=C-R) |
| | ISOP | Isoprene |
| | MEOH | Methanol |
| | NAPH | Naphthalene |
| | OLE | Terminal olefin carbon bond (R-C=C) |
| | PAR | Paraffin carbon bond |
| | PRPA | Propane |
| | TOL | Toluene and other monoalkyl aromatics |
| | XYLMN | Xylene and other polyalkyl aromatics, minus naphthalene |
| | SOAALK | Lumped SOA tracer |
| Naphthalene | NAPH | Naphthalene from inventory |
| Benzene | BENZ | Benzene from the inventory |
| Acetaldehyde | ALD2 | Acetaldehyde from inventory |
| Formaldehyde | FORM | Formaldehyde from inventory |
| Methanol | MEOH | Methanol from inventory |
| VOC species from the biogenics model that do not map to model species above | SESQ | Sesquiterpenes |
| | TERP | Terpenes |
| $PM_{10}$ | PMC | Coarse PM > 2.5 microns and ≤ 10 microns |
| $PM_{2.5}$ | PAL | Aluminum |
| | PCA | Calcium |
| | PCL | Chloride |
| | PEC | Particulate elemental carbon ≤ 2.5 microns |
| | PFE | Iron |
| | PK | Potassium |
| | PH2O | Water |
| | PMG | Magnesium |
| | PMN | Manganese |
| | PMOTHR | $PM_{2.5}$ not in other AE6 species |
| | PNA | Sodium |
| | PNCOM | Non-carbon organic matter |
| | PNO3 | Particulate nitrate ≤ 2.5 microns |
| | PNH4 | Ammonium |
| | POC | Particulate organic carbon (carbon only) ≤ 2.5 microns |
| | PSI | Silica |
| | PSO4 | Particulate Sulfate ≤ 2.5 microns |
| | PTI | Titanium |
| Sea-salt species (non – anthropogenic) [8] | PCL | Particulate chloride |
| | PNA | Particulate sodium |

*Notes:
1. naphthalene, benzene, acetaldehyde, formaldehyde and methanol (NBAFM) is produced via VOC speciation for Canada and Mexico, for other than onroad mobile sources in Mexico, or, in very small quantities due to mixtures in the speciation profiles as is discussed in 3.2.1.1 from profiles listed in Appendix E.

[8] These emissions are created outside of SMOKE

| Inventory Pollutant | Model Species | Model species description |
|---|---|---|
| 2. Additional HAPs used outside of CMAQ-CB6 for NATA are provided in Table 3-4. | | |

**Table 3-4. Additional HAP Gaseous model species produced for CMAQ multipollutant specifically for NATA (not used within CB6)**

| Inventory Pollutant | Model Species |
|---|---|
| Acetaldehyde | ALD2_PRIMARY |
| Formaldehyde | FORM_PRIMARY |
| Acetonitrile * | ACETONITRILE |
| Acrolein | ACROLEIN |
| Acrylic acid * | ACRYLICACID |
| Acrylonitrile | ACRYLONITRILE |
| 1,3-Butadiene | BUTADIENE13 |
| Carbon tetrachloride | CARBONTET |
| Carbonyl Sulfide * | CARBSULFIDE |
| Chloroform | CHCL3 |
| Chloroprene * | CHLOROPRENE |
| 1,4-Dichlorobenzene(p) | DICHLOROBENZENE |
| 1,3-Dichloropropene | DICHLOROPROPENE |
| Ethylbenzene * | ETHYLBENZ |
| Ethylene dibromide (Dibromoethane) | BR2_C2_12 |
| Ethylene dichloride (1,2-Dichloroethane) | CL2_C2_12 |
| Ethylene oxide | ETOX |
| Hexamethylene-1,6-diisocyanate | HEXAMETH_DIIS |
| Hexane * | HEXANE |
| Hydrazine | HYDRAZINE |
| Maleic Anyhydride | MAL_ANYHYDRIDE |
| Methyl Chloride * | METHCLORIDE |
| Methylene chloride (Dichloromethane) | CL2_ME |
| Specific PAHs assigned with URE =0 | PAH_000E0 |
| Specific PAHs assigned with URE =1.76E-5 | PAH_176E5 |
| Specific PAHs assigned with URE =8.80E-5 | PAH_880E5 |
| Specific PAHs assigned with URE =1.76E-4 | PAH_176E4 |
| Specific PAHs assigned with URE =1.76E-3 | PAH_176E3 |
| Specific PAHs assigned with URE =1.76E-2 | PAH_176E2 |
| Specific PAHs assigned with URE =1.01E-2 | PAH_101E2 |
| Specific PAHs assigned with URE =1.14E-1 | PAH_114E1 |
| Specific PAHs assigned with URE =1.92E-3 | PAH_192E3 |
| Propylene dichloride (1,2-Dichloropropane) | PROPDICHLORIDE |
| Quinoline | QUINOLINE |
| Styrene * | STYRENE |
| 1,1,2,2-Tetrachloroethane | CL4_ETHANE1122 |
| Tetrachloroethylene (Perchloroethylene) | CL4_ETHE |
| Toluene | TOLU |
| 2,4-Toluene diisocyanate | TOL_DIIS |
| Trichloroethylene | CL3_ETHE |
| Triethylamine | TRIETHYLAMINE |
| m-xylene, o-xylene, p-xylene, xylenes (mixed isomers) ** | XYLENES |
| Vinyl chloride | CL_ETHE |
| *new to CMAQ5.2 – version of CMAQ used for 2011 NATA did not include these HAPs. ** In 2011 NATA, these were separated into 3 model species: MXYL, OXYL and PXYL; in 2014 they are combined into XYLENES | |

**Table 3-5. Additional HAP Particulate* model species produced for CMAQ multipollutant specifically for NATA**

| Inventory Pollutant | Model Species |
|---|---|
| Arsenic | ARSENIC_C, ARSENIC_F |
| Beryllium | BERYLLIUM_C, BERYLLIUM_F |
| Cadmium | CADMIUM_C, CADMIUM_F |
| Chromium VI, Chromic Acid (VI), Chromium Trioxide | CHROMHEX_C, CHROMHEX_F |
| Chromium III | CHROMTRI_C, CHROMTRI_F |
| Lead | LEAD_C, LEAD_F |
| Manganese | MANGANESE_C, MANGANESE_F |
| Mercury | HGIIGAS, HGNRVA, PHGI |
| Nickel, Nickel Oxide, Nickel Refinery Dust | NICKEL_C, NICKEL_F |
| Diesel-PM10, Diesel-PM25 | DIESEL_PMC , DIESEL_PMFINE, DIESEL_PMEC, DIESEL_PMOC, DIESEL_PMNO3, DIESEL_PMSO4 |
| *mercury is multi-phase | |

### 3.2.1 VOC speciation

The concept of VOC speciation is to use emission source-related speciation profiles to convert VOC to TOG, to speciate TOG into individual chemical compounds, and to use a chemical mechanism mapping file to aggregate the chemical compounds to the chemical mechanism model species. The chemical mechanism mapping file is typically developed by the developer of the chemical mechanism.

SMOKE uses profiles that convert inventory species and TOG directly to the model species. The SMOKE-ready profiles are generated from the Speciation Tool which uses the “raw” (TOG to chemical compounds) SPECIATE profiles and the chemical mechanism mapping file.

For the 2014v7.0 platform, we updated the CB6 chemical mapping file to add assignments for compounds in SPECIATE4.5 that had not been assigned (see Appendix D), and we added molecular weights to some compounds which were missing. In addition, we revised the speciation cross reference and used updated profiles from the SPECIATE4.5 database for oil and gas, livestock waste and nonroad mobile sources. Appendix E provides a list of these profiles. Similar to previous platforms, HAP VOC inventory species were used in the VOC speciation process for some sectors as described below.

#### 3.2.1.1 The combination of HAP NBAFM (naphthalene, benzene, acetaldehyde, formaldehyde and methanol) and VOC for VOC speciation

The VOC speciation includes HAP emissions from the 2014NEIv1 in the speciation process. Instead of speciating VOC to generate all of the species listed in Table 3-3, emissions of five specific HAPs: naphthalene, benzene, acetaldehyde, formaldehyde and methanol (collectively known as “NBAFM”) from the NEI were “integrated” with the NEI VOC. The integration combines these HAPs with the VOC in a way that does not double count emissions and uses the HAP inventory directly in the speciation process. The basic process is to subtract the specified HAPs emissions mass from the VOC emissions mass, and to then use a special “integrated” profile to speciate the remainder of VOC to the model species excluding the specific HAPs. The EPA believes that the HAP emissions in the NEI are often more representative of emissions than HAP emissions generated via VOC speciation, although this varies by sector.

The NBAFM HAPs were chosen for integration because they are the only explicit VOC HAPs in the CMAQ version 5.2 multipollutant. Explicit means that they are not lumped chemical groups like PAR, IOLE and several other CB6 model species. These "explicit VOC HAPs" are model species that participate in the modeled chemistry using the CB6 chemical mechanism. The use of inventory HAP emissions along with VOC is called "HAP-CAP integration."

The integration of HAP VOC with VOC is a feature available in SMOKE for all inventory formats other than PTDAY (the format used for the ptfire sector). SMOKE allows the user to specify both the particular HAPs to integrate via the INVTABLE. This is done by setting the "VOC or TOG component" field to "V" for all HAP pollutants chosen for integration. SMOKE allows the user to also choose the particular sources to integrate via the NHAPEXCLUDE file (which actually provides the sources to be *excluded* from integration[9]). For the "integrated" sources, SMOKE subtracts the "integrated" HAPs from the VOC (at the source level) to compute emissions for the new pollutant "NONHAPVOC." The user provides NONHAPVOC-to-NONHAPTOG factors and NONHAPTOG speciation profiles[10]. SMOKE computes NONHAPTOG and then applies the speciation profiles to allocate the NONHAPTOG to the other air quality model VOC species not including the integrated HAPs. After determining if a sector is to be integrated, if all sources have the appropriate HAP emissions, then the sector is considered fully integrated and does not need a NHAPEXCLUDE file. If, on the other hand, certain sources do not have the necessary HAPs, then an NHAPEXCLUDE file must be provided based on the evaluation of each source's pollutant mix. The EPA considered CAP-HAP integration for all sectors determined whether sectors would have full, no or partial integration (see Table 3-6). For sectors with partial integration, all sources are integrated other than those that have either the sum of NBAFM > VOC or the sum of NBAFM = 0. Section 3.2.1.3 provides additional sector-specific details.

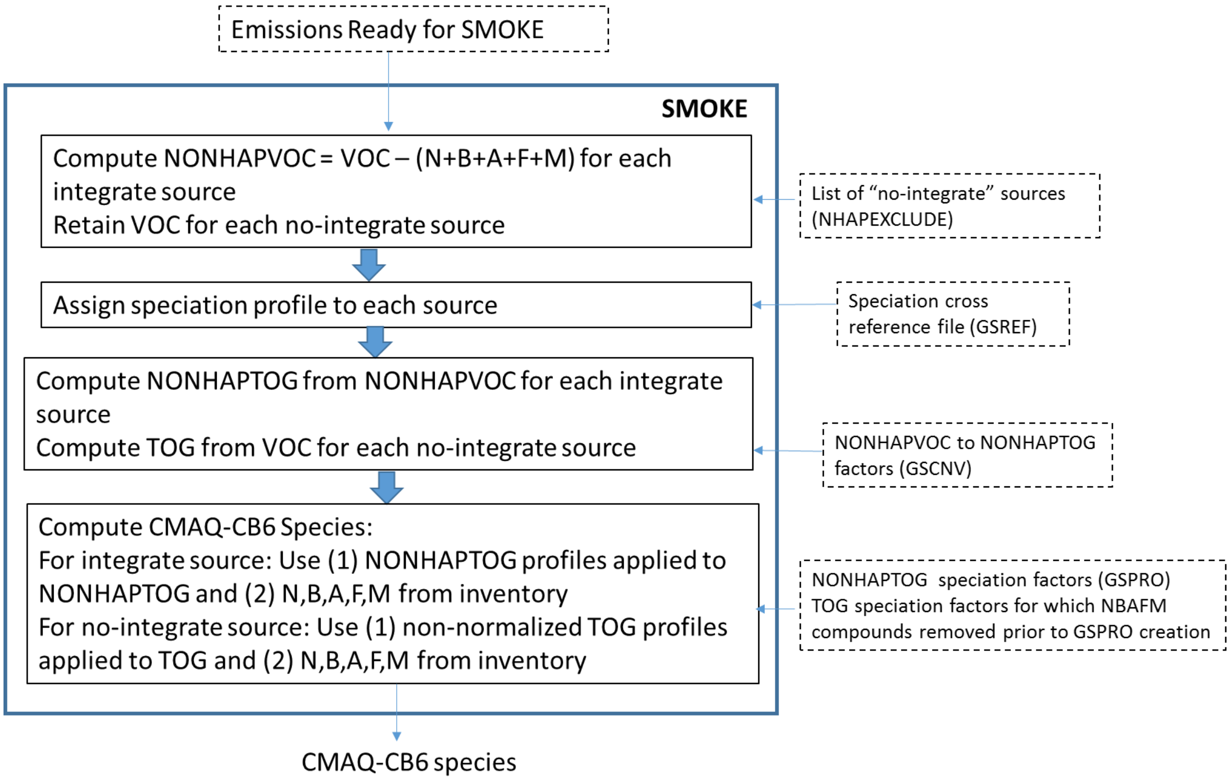
For the 2014v7.0 case, the no-integrate sources are treated differently from the 2011v6.3 platform. In 2014v7.0, we remove the integrate HAPs from the profile, but use the emissions from the NEI. In 2011v6.3, we did not keep any HAPs from the no-integrate sources; instead, we created them from the no-integrate source VOC emissions. For NATA, we are modeling using both CMAQ and AERMOD and we can only get the HAPs from one source (speciation or the inventory). We chose to use the HAPs in the inventory since these are the data that are used to represent HAP emissions in the U.S. Also, HAP emissions in the NEI may be developed using more site-specific data (e.g., source testing, material balance) that would not be reflected by applying a speciation profile to VOC emissions. In addition, we have applied numerous HAP augmentation measures in the NEI. Figure 3-2 illustrates the integrate and no-integrate processes for U.S. Sources. Since Canada and Mexico inventories do not contain HAPs, we use the 2011v6.3 approach of generating the HAPs via speciation, except for Mexico onroad mobile sources where emissions for integrate HAPs were available.

[9] Since SMOKE version 3.7, the options to specify sources for integration are expanded so that a user can specify the particular sources to include or exclude from integration, and there are settings to include or exclude all sources within a sector. In addition, the error checking is significantly stricter for integrated sources. If a source is supposed to be integrated, but it is missing BAFM or VOC, SMOKE will now raise an error.

[10] These ratios and profiles are typically generated from the Speciation Tool when it is run with integration of a specified list of pollutants, for example NBAFM.

It should be noted that even though NBAFM were removed from the SPECIATE profiles used to create the GSPRO for both the NONHAPTOG and no-integrate TOG profiles, there still may be small fractions for “BENZENE”, “FORM”, “ALD2”, “METHANOL” present. This is because these model species may have come from species in SPECIATE that are mixtures. The quantity of these model species is expected to be very small compared to the BAFM in the NEI. These profiles are listed in Appendix E. There are no NONHAPTOG profiles that produce “NAPHTHALENE.”

**Figure 3-2. Process of integrating NBAFM with VOC for use in VOC Speciation for U.S. Sources**



Integration for the mobile sources estimated from MOVES (onroad and nonroad sectors, other than for California) is done differently, and is discussed in more detail in 3.2.1.3. Briefly there are three major differences: 1) for these sources integration is done using more than just NBAFM, 2) all sources from the MOVES model are integrated and 3) integration is done fully or partially within MOVES. For onroad mobile, speciation is done fully within MOVES2014a such that the MOVES model outputs emission factors for individual VOC model species along with the HAPs. This requires MOVES to be run for a specific chemical mechanism. For nonroad mobile, speciation is partially done within MOVES such that it does not need to be run for a specific chemical mechanism. For nonroad, MOVES outputs emissions of HAPs and NONHAPTOG split by speciation profile. Taking into account that integrated species were subtracted out by MOVES already, the appropriate speciation profiles are then applied in SMOKE to get the VOC model species. HAP integration for nonroad uses the same additional HAPs and ethanol as for onroad.

**Table 3-6. Integration approach for NBAFM for each platform sector**

| Platform Sector | Approach for Integrating NEI emissions of Naphthalene (N), Benzene (B), Acetaldehyde (A), Formaldehyde (F), and Methanol (M) |
|---|---|
| ptegu | No integration, use NBAFM from inventory and not speciation |
| ptnonipm | No integration, use NBAFM from inventory and not speciation |
| othafdust | N/A – sector contains no VOC |
| othar | No integration, no NBAFM in inventory, create NBAFM from speciation |
| onroad_can | No integration, no NBAFM in inventory, create NBAFM from speciation |
| onroad_mex | Full integration (internal to MOVES-Mexico)[1]; however, MOVES-MEXICO speciation was CB6-CAMx, not CB6-CMAQ, so post-SMOKE we converted the emissions to CB6-CMAQ |
| ag | N/A – sector contains no VOC |
| afdust | N/A – sector contains no VOC |
| beis | N/A – sector contains no inventory pollutant "VOC"; but rather specific VOC species |
| agfire | Partial integration (NBAFM)[2], Use NBAFM in inventory for no-integrate sources |
| ptagfire | No integration, use NBAFM from inventory and not speciation |
| cmv | Full integration (NBAFM) |
| rail | Partial integration (NBAFM)[3] ; no-integrate sources have no NBAFM so it is missing |
| nonpt | Partial integration (NBAFM)[4] Use NBAFM in inventory for no-integrate sources |
| nonroad | Full integration (NBAFM in California, internal to MOVES elsewhere)[1] |
| np_oilgas | Partial integration (NBAFM)[5] Use NBAFM in inventory for no-integrate sources |
| pt_oilgas | No integration Use NBAFM in inventory for no-integrate sources |
| rwc | Partial integration (NBAFM) Use NBAFM in inventory for no-integrate sources |
| othpt | Partial integration (NBAFM) – offshore c3 marine (FIPS =85 and FIPS = 98) NBAFM comes from inventory but for Canada point and Mexico (not integrated), create NBAFM from speciation |
| onroad | Full integration (internal to MOVES)[1] |
| ptfire_f | No integration, Use NBAFM in inventory for no-integrate sources |
| ptfire_s | No integration, Use NBAFM in inventory for no-integrate sources |
| ptfire_mxca | No integration, no NBAFM in inventory, create NBAFM from speciation |

[1]For the integration that is internal to MOVES or MOVES-Mexico, an extended list of HAPs are integrated, not just BAFM. See 3.2.1.3

[2] 322 tons VOC from SCC 2801500170 (Miscellaneous Area Sources;Agriculture Production - Crops - as nonpoint;Agricultural Field Burning - whole field set on fire;Field Crop is Grasses: Burning Techniques Not Important) with no NBAFM, reported in a few counties in Florida and New Jersey

[3] 762 tons VOC from SCCs 2285002008,2285002009,2285002010, with no NBAFM, primarily in California and Massachusetts

[4]940,000 tons VOCs without BAFM from a large variety of SCCs, some of which are not expected to have any BAFM

| |
|---|
| [5] 535,000 tons VOCs without BAFM<br>[6] no VOC without BAFM, some sources where BAFM > VOC; largest source is 7 tons BAFM (exceeds VOC by about 6 tons) |

More details on the integration of specific sectors and additional details of the speciation are provided in Section 3.2.1.3.

#### 3.2.1.2 County specific profile combinations

SMOKE can compute speciation profiles from mixtures of other profiles in user-specified proportions via two different methods. The first method, GSPRO_COMBO was used in previous platforms since the 2005, and the second method (GSPRO with fraction) is used for the first time in this 2014v7.0 as it required a SMOKE update. The GSPRO_COMBO method uses profile combinations specified in the GSPRO_COMBO ancillary file by pollutant (which can include emissions mode, e.g., EXH__VOC), state and county (i.e., state/county FIPS code) and time period (i.e., month). Different GSPRO_COMBO files can be used by sector, allowing for different combinations to be used for different sectors but within a sector, different profiles cannot be applied based on SCC. The GSREF file indicates that a specific source uses a combination file with the profile code “COMBO.” SMOKE computes the resultant profile using the fraction of each specific profile assigned by county, month and pollutant.

In previous platforms, the GSPRO_COMBO feature was used to speciate nonroad mobile and gasoline-related stationary sources that use fuels with varying ethanol content. In these cases, the speciation profiles require different combinations of gasoline profiles, e.g. E0 and E10 profiles. Since the ethanol content varies spatially (e.g., by state or county), temporally (e.g., by month), and by modeling year (future years have more ethanol), the GSPRO_COMBO feature allows combinations to be specified at various levels for different years. For the 2014v7.0 platform, GSPRO_COMBO is still used for nonroad sources in California and for certain gasoline-related stationary sources nationwide. The feature is also used to combine exhaust and evaporative profiles to use with Canadian mobile sources, which do not include the mode in the SCC or pollutant. GSPRO_COMBO is no longer needed for nonroad sources outside of California because nonroad emissions within MOVES have the speciation profiles built into the results, so there is no need to assign them via the GSREF or GSPRO_COMBO feature.

A new method to combine multiple profiles is available in SMOKE4.5. It allows multiple profiles to be combined by by pollutant, state and county (i.e., state/county FIPS code) and SCC. This was used specifically for the oil and gas sectors (pt_oilgas and np_oilgas) because SCCs include both controlled and uncontrolled oil and gas operations which use different profiles.

#### 3.2.1.3 Additional sector specific considerations for integrating HAP emissions from inventories into speciation

The decision to integrate HAPs into the speciation was made on a sector by sector basis. For some sectors, there is no integration and VOC is speciated directly; for some sectors, there is full integration meaning all sources are integrated; and for other sectors, there is partial integration, meaning some sources are not integrated and other sources are integrated. The integrated HAPs are either NBAFM or, in the case of MOVES (onroad, nonroad and MOVES-Mexico), a larger set of HAPs plus ethanol are integrated. Table 3-6 above summarizes the integration method for each platform sector.

For the rail sector, the EPA integrated NBAFM for most sources. Some SCCs had zero BAFM and, therefore, they were not integrated. These were SCCs provided by states for which EPA did not do HAP augmentation (2285002008, 2285002009 and 2285002010) because EPA does not create emissions for these SCCs. The VOC for these sources sum to 762 tons, and most of the mass is in California.

For the othpt sector, the C3 marine sources (see Section 2.4.2) are integrated. HAPs in this sector are derived identically to the U.S. C3 in the cmv sector. The rest of the sources in othpt are not integrated, thus the sector is partially integrated.

For the onroad sector, there are series of unique speciation issues. First, SMOKE-MOVES (see Section 2.3.1) is used to create emissions for these sectors and both the MEPROC and INVTABLE files are involved in controlling which pollutants are processed. Second, the speciation occurs within MOVES itself, not within SMOKE. The advantage of using MOVES to speciate VOC is that during the internal calculation of MOVES, the model has complete information on the characteristics of the fleet and fuels (e.g., model year, ethanol content, process, etc.), thereby allowing it to more accurately make use of specific speciation profiles. This means that MOVES produces EF tables that include inventory pollutants (e.g., TOG) and model-ready species (e.g., PAR, OLE, etc)[11]. SMOKE essentially calculates the model-ready species by using the appropriate emission factor without further speciation[12]. Third, MOVES' internal speciation uses full integration of an extended list of HAPs beyond NBAFM (called "M-profiles"). The M-profiles integration is very similar to NBAFM integration explained above except that the integration calculation (see Figure 3-2) is performed on emissions factors instead of on emissions, and a much larger set of pollutants are integrated besides NBAFM. The list of integrated pollutants is described in Table 3-7. An additional run of the Speciation Tool was necessary to create the M-profiles that were then loaded into the MOVES default database. Fourth, for California, the EPA applied adjustment factors to SMOKE-MOVES to produce California adjusted model-ready files (see Section 2.3.1 for details). By applying the ratios through SMOKE-MOVES, the CARB inventories are essentially speciated to match EPA estimated speciation. This resulted in changes to the VOC HAPs from what CARB submitted to the EPA.

**Table 3-7. MOVES integrated species in M-profiles**

| MOVES ID | Pollutant Name |
|---|---|
| 5 | Methane (CH4) |
| 20 | Benzene |
| 21 | Ethanol |
| 22 | MTBE |
| 24 | 1,3-Butadiene |
| 25 | Formaldehyde |
| 26 | Acetaldehyde |
| 27 | Acrolein |
| 40 | 2,2,4-Trimethylpentane |
| 41 | Ethyl Benzene |
| 42 | Hexane |
| 43 | Propionaldehyde |
| 44 | Styrene |

[11] Because the EF table has the speciation "baked" into the factors, all counties that are in the county group (i.e., are mapped to that representative county) will have the same speciation.
[12] For more details on the use of model-ready EF, see the SMOKE 3.7 documentation: https://www.cmascenter.org/smoke/documentation/3.7/html/.

| | |
|---|---|
| 45 | Toluene |
| 46 | Xylene |
| 185 | Naphthalene gas |

For the nonroad sector, all sources are integrated, using the same list of integrated pollutants as shown in Table 3-7. Outside California, the integration calculations are performed within MOVES. For California, integration calculations are handled by SMOKE. The CARB-based nonroad inventory includes VOC HAP estimates for all sources, so every source in California was integrated as well. Some sources in the original CARB inventory had lower VOC emissions compared to sum of all VOC HAPs. For those sources, VOC was augmented to be equal to the VOC HAP sum, ensuring that every source in California could be integrated. The CARB-based nonroad data includes exhaust and evaporative mode-specific data for VOC, but does not contain refueling.

MOVES-MEXICO for onroad used the same speciation approach as for the U.S. in that the larger list of species shown in Table 3-7 ws used. However, MOVES-MEXICO used CB6-CAMx, not CB6-CMAQ, so post-SMOKE we converted the emissions to CB6-CMAQ as follows:

- XYLMN = XYL[1]-0.966*NAPHTHALENE[1]
- PAR = PAR[1]-0.00001*NAPHTHALENE[1]
- SOAALK = 0.108*PAR[1]

For most sources in the rwc sector, the VOC emissions were greater than or equal to NBAFM, and NBAFM was not zero, so those sources were integrated, although a few specific sources that did not meet these criteria could not be integrated. In all cases, these sources had NBAFM > VOC, but not by a significant amount. In total, the no-integrate rwc sector sources summed to 5 tons VOC and 85 tons of NBAFM. Because for the NATA case the NBAFM are used from the inventory, these no-integrate NBAFM emissions were used in the speciation.

There is a substantial amount of mass in the nonpt sector that is not integrated: 942,000 tons. It is likely that there would be sources in nonpt that are not integrated because the emission source is not expected to have NBAFM. It would be useful to estimate the NBAFM that might be in the profiles (and that would have been dropped from the profiles per the procedure in Figure 3-2) for these no-integrrate sources.

For the biog sector, the speciation profiles used by BEIS are not included in SPECIATE. The 2011 platform uses BEIS3.61, which includes a new species (SESQ) that was mapped to the model species SESQT. The profile code associated with BEIS3.61 for use with CB05 is “B10C5,” while the profile for use with CB6 is “B10C6.” The main difference between the profiles is the explicit treatment of acetone emissions in B10C6.

For the nonpt sector, sources for which VOC emissions were greater than or equal to BAFM and BAFM was not zero were integrated.

#### 3.2.1.4 Oil and gas related speciation profiles

A new national flare profile, FLR99, Natural Gas Flare Profile with DRE >98% was developed from a Flare Test study and used. Most of the new VOC profiles from SPECIATE4.5 listed in Appendix C are for the oil and gas sector. For the oil and gas sources in the np_oilgas and pt_oilgas sectors, several counties were assigned to newly available basin or area-specific profiles in SPECIATE4.5 that account for measured or modeled from measured compositions specific a particular region of the country. In the 2011 platform, the only county-specific profiles were for the WRAP, but in 2014, several new profiles were added for other parts of the country. In addition, some of the WRAP profiles were revised to correct for errors such as mole fractions being used for mass fractions and VOCtoTOG factors or replaced with newer data. All WRAP profiles codes were renamed to include an "_R" to distinguish between the previous set of profiles (even those that did not change). For the Uintah basin and Denver-Julesburg Basin, Colorado, more updated profiles were used instead of the WRAP Phase III profiles. **Error! Reference source not found.** lists the region-specific profiles assigned to particular counties or g roups of counties. Although this platform increases the use of regional profiles, many counties still rely on the national profiles.

In addition to region-specific assignments, multiple profiles were assigned to particular county/SCC combinations using the SMOKE feature discussed in 3.2.1.2. The profile fractions were computed from VOC emissions provided in an intermediate file generated by the 2014 Nonpoint Oil and Gas Emission Estimation Tool used for the 2014NEIv1. The intermediate file provides flare, non-flare (process), and reboiler (for dehydrators) emissions for six source categories that have flare emissions: Associated Gas, Condensate Tanks, Crude Oil Tanks, Dehydrators, Liquids Unloading and Well Completions by county FIPS and SCC code for the U.S. to account for portions of VOC for a particular VOC that were from controlled emissions or reboiler.

**Table 3-8. Basin/Region-specific profiles for oil and gas**

| Profile Code | Description | Region (if not in the profile name) |
|---|---|---|
| DJVNT_R | Denver-Julesburg Basin Produced Gas Composition from Non-CBM Gas Wells | |
| PNC01_R | Piceance Basin Produced Gas Composition from Non-CBM Gas Wells | |
| PNC02_R | Piceance Basin Produced Gas Composition from Oil Wells | |
| PNC03_R | Piceance Basin Flash Gas Composition for Condensate Tank | |
| PNCDH | Piceance Basin, Glycol Dehydrator | |
| PRBCB_R | Powder River Basin Produced Gas Composition from CBM Wells | |
| PRBCO_R | Powder River Basin Produced Gas Composition from Non-CBM Wells | |
| PRM01_R | Permian Basin Produced Gas Composition for Non-CBM Wells | |
| SSJCB_R | South San Juan Basin Produced Gas Composition from CBM Wells | |
| SSJCO_R | South San Juan Basin Produced Gas Composition from Non-CBM Gas Wells | |
| SWFLA_R | SW Wyoming Basin Flash Gas Composition for Condensate Tanks | |
| SWVNT_R | SW Wyoming Basin Produced Gas Composition from Non-CBM Wells | |
| UNT01_R | Uinta Basin Produced Gas Composition from CBM Wells | |
| WRBCO_R | Wind River Basin Produced Gagres Composition from Non-CBM Gas Wells | |
| 95087a | Oil and Gas - Composite - Oil Field - Oil Tank Battery Vent Gas | East Texas |
| 95109a | Oil and Gas - Composite - Oil Field - Condensate Tank Battery Vent Gas | East Texas |

| | | |
|---|---|---|
| 95417 | Uinta Basin, Untreated Natural Gas | |
| 95418 | Uinta Basin, Condensate Tank Natural Gas | |
| 95419 | Uinta Basin, Oil Tank Natural Gas | |
| 95420 | Uinta Basin, Glycol Dehydrator | |
| 95398 | Composite Profile - Oil and Natural Gas Production - Condensate Tanks | Denver-Julesburg Basin |
| 95399 | Composite Profile - Oil Field - Wells | State of California |
| 95400 | Composite Profile - Oil Field - Tanks | State of California |
| 95403 | Composite Profile - Gas Wells | San Joaquin Basin |

#### 3.2.1.5 Mobile source related speciation profiles

The VOC speciation approach for mobile source and mobile source-related source categories is customized to account for the impact of fuels and engine type and technologies. The impact of fuels also affects the parts of the nonpt and ptnonipm sectors that are related to mobile sources such as portiable fuel containers and gasoline distribution.

The VOC speciation profiles for the nonroad sector other than for California are listed in Table 3-9. They include new profiles (i.e., those that begin with “953”) for 2-stroke and 4-stroke gasoline engines running on E0 and E10 and compression ignition engines with different technologies developed from recent EPA test programs, which also supported the updated toxics emission factor in MOVES2014a (Reichle, 2015 and EPA, 2015b). California nonroad source profiles are presented in Table 3-10.

**Table 3-9. TOG MOVES-SMOKE Speciation for nonroad emissions in MOVES2014 used for the 2014v7.0 Platform**

| Profile | Profile Description | Engine Type | Engine Technology | Engine Size | Horse-power category | Fuel | Fuel Sub-type | Emission Process |
|---|---|---|---|---|---|---|---|---|
| 95327 | SI 2-stroke E0 | SI 2-stroke | all | all | all | Gasoline | E0 | exhaust |
| 95328 | SI 2-stroke E10 | SI 2-stroke | all | all | all | Gasoline | E10 | exhaust |
| 95329 | SI 4-stroke E0 | SI 4-stroke | all | all | all | Gasoline | E0 | exhaust |
| 95330 | SI 4-stroke E10 | SI 4-stroke | all | all | all | Gasoline | E10 | exhaust |
| 95331 | CI Pre-Tier 1 | CI | Pre-Tier 1 | all | all | Diesel | all | exhaust |
| 95332 | CI Tier 1 | CI | Tier 1 | all | all | Diesel | all | exhaust |
| 95333 | CI Tier 2 | CI | Tier 2 and 3 | all | all | Diesel | all | exhaust |
| 95333 | CI Tier 2 | CI | Tier 4 | <56 kW (75 hp) | S | Diesel | all | exhaust |
| 8775 | ACES Phase 1 Diesel Onroad | CI Tier 4 | Tier 4 | >=56 kW (75 hp) | L | Diesel | all | exhaust |
| 8753 | E0 Evap | SI | all | all | all | Gasoline | E0 | evaporative |
| 8754 | E10 Evap | SI | all | all | all | Gasoline | E10 | evaporative |
| 8766 | E0 evap permeation | SI | all | all | all | Gasoline | E0 | permeation |
| 8769 | E10 evap permeation | SI | all | all | all | Gasoline | E10 | permeation |
| 8869 | E0 Headspace | SI | all | all | all | Gasoline | E0 | headspace |
| 8870 | E10 Headspace | SI | all | all | all | Gasoline | E10 | headspace |

| | | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| 1001 | CNG Exhaust | All | all | all | all | CNG | all | exhaust |
| 8860 | LPG exhaust | All | all | all | all | LPG | all | exhaust |

Speciation profiles for VOC in the nonroad sector account for the ethanol content of fuels across years. A description of the actual fuel formulations for 2014 can be found in the 2014NEIv1 TSD. For 2014, the EPA used "COMBO" profiles to model combinations of profiles for E0 and E10 fuel use.

Combination profiles reflecting a combination of E10 and E0 fuel use are also used for sources upstream of mobile sources such as portable fuel containers (PFCs) and other fuel distribution operations associated with the transfer of fuel from bulk terminals to pumps (BTP) which are in the nonpt sector. They are also used for California nonroad soruces. For these sources, ethanol may be mixed into the fuels, in which case speciation would change across years. The speciation changes from fuels in the ptnonipm sector include BTP distribution operations inventoried as point sources. Refinery-to-bulk terminal (RBT) fuel distribution and bulk plant storage (BPS) speciation does not change across the modeling cases because this is considered upstream from the introduction of ethanol into the fuel. The mapping of fuel distribution SCCs to PFC, BTP, BPS, and RBT emissions categories can be found in Appendix F.

Table 3-10 summarizes the different profiles utilized for the fuel-related sources in each of the sectors for 2014. The term "COMBO" indicates that a combination of the profiles listed was used to speciate that subcategory using the GSPRO_COMBO file.

**Table 3-10. Select mobile-related VOC profiles 2014**

| Sector | Sub-category | 2014 | |
|---|---|---|---|
| Nonroad- California & non US | gasoline exhaust | COMBO | |
| | | 8750a | Pre-Tier 2 E0 exhaust |
| | | 8751a | Pre-Tier 2 E10 exhaust |
| Nonroad-California | gasoline evap-orative | COMBO | |
| | | 8753 | E0 evap |
| | | 8754 | E10 evap |
| Nonroad-California | gasoline refueling | COMBO | |
| | | 8869 | E0 Headspace |
| | | 8870 | E10 Headspace |
| Nonroad-California | diesel exhaust | 8774 | Pre-2007 MY HDD exhaust |
| Nonroad-California | diesel evap-orative and diesel refueling | 4547 | Diesel Headspace |
| nonpt/ ptnonipm | PFC and BTP | COMBO | |
| | | 8869 | E0 Headspace |
| | | 8870 | E10 Headspace |
| nonpt/ ptnonipm | BPS/RBT | 8869 | E0 Headspace |

The speciation of onroad VOC occurs within MOVES. MOVES takes into account fuel type and properties, emission standards as they affect different vehicle types and model years, and specific emission processes. Table 3-11 describes all of the M-profiles available to MOVES depending on the model year range, MOVES process (processID), fuel sub-type (fuelSubTypeID), and regulatory class (regClassID). Table 3-12 throughTable 3-14 describe the meaning of these MOVES codes. For a specific representative county and future year, there will be a different mix of these profiles. For example, for HD diesel exhaust, the emissions will use a combination of profiles 8774M and 8775M depending on the proportion of HD vehicles that are pre-2007 model years (MY) in that particular county. As that county is projected farther into the future, the proportion of pre-2007 MY vehicles will decrease. A second example, for gasoline exhaust (not including E-85), the emissions will use a combination of profiles 8756M, 8757M, 8758M, 8750aM, and 8751aM. Each representative county has a different mix of these key properties and, therefore, has a unique combination of the specific M-profiles. More detailed information on how MOVES speciates VOC and the profiles used is provided in the technical document, "Speciation of Total Organic Gas and Particulate Matter Emissions from On-road Vehicles in MOVES2014" (EPA, 2015c).

**Table 3-11. Onroad M-profiles**

| Profile | Profile Description | Model Years | ProcessID | FuelSubTypeID | RegClassID |
|---|---|---|---|---|---|
| 1001M | CNG Exhaust | 1940-2050 | 1,2,15,16 | 30 | 48 |
| 4547M | Diesel Headspace | 1940-2050 | 11 | 20,21,22 | 0 |
| 4547M | Diesel Headspace | 1940-2050 | 12,13,18,19 | 20,21,22 | 10,20,30,40,41, 42,46,47,48 |
| 8753M | E0 Evap | 1940-2050 | 12,13,19 | 10 | 10,20,30,40,41,42, 46,47,48 |
| 8754M | E10 Evap | 1940-2050 | 12,13,19 | 12,13,14 | 10,20,30,40,41, 42,46,47,48 |
| 8756M | Tier 2 E0 Exhaust | 2001-2050 | 1,2,15,16 | 10 | 20,30 |
| 8757M | Tier 2 E10 Exhaust | 2001-2050 | 1,2,15,16 | 12,13,14 | 20,30 |
| 8758M | Tier 2 E15 Exhaust | 1940-2050 | 1,2,15,16 | 15,18 | 10,20,30,40,41, 42,46,47,48 |
| 8766M | E0 evap permeation | 1940-2050 | 11 | 10 | 0 |
| 8769M | E10 evap permeation | 1940-2050 | 11 | 12,13,14 | 0 |
| 8770M | E15 evap permeation | 1940-2050 | 11 | 15,18 | 0 |
| 8774M | Pre-2007 MY HDD exhaust | 1940-2006 | 1,2,15,16,17,90 | 20, 21, 22 | 40,41,42,46,47, 48 |
| 8774M | Pre-2007 MY HDD exhaust | 1940-2050 | 91[13] | 20, 21, 22 | 46,47 |
| 8774M | Pre-2007 MY HDD exhaust | 1940-2006 | 1,2,15,16 | 20, 21, 22 | 20,30 |
| 8775M | 2007+ MY HDD exhaust | 2007-2050 | 1,2,15,16 | 20, 21, 22 | 20,30 |
| 8775M | 2007+ MY HDD exhaust | 2007-2050 | 1,2,15,16,17,90 | 20, 21, 22 | 40,41,42,46,47,48 |
| 8855M | Tier 2 E85 Exhaust | 1940-2050 | 1,2,15,16 | 50, 51, 52 | 10,20,30,40,41, 42,46,47,48 |
| 8869M | E0 Headspace | 1940-2050 | 18 | 10 | 10,20,30,40,41, 42,46,47,48 |
| 8870M | E10 Headspace | 1940-2050 | 18 | 12,13,14 | 10,20,30,40,41, 42,46,47,48 |
| 8871M | E15 Headspace | 1940-2050 | 18 | 15,18 | 10,20,30,40,41, 42,46,47,48 |
| 8872M | E15 Evap | 1940-2050 | 12,13,19 | 15,18 | 10,20,30,40,41, 42,46,47,48 |

[13] 91 is the processed for APUs which are diesel engines not covered by the 2007 Heavey-Duty Rule, so the older technology applieds to all years.

| Profile | Profile Description | Model Years | ProcessID | FuelSubTypeID | RegClassID |
|---|---|---|---|---|---|
| 8934M | E85 Evap | 1940-2050 | 11 | 50,51,52 | 0 |
| 8934M | E85 Evap | 1940-2050 | 12,13,18,19 | 50,51,52 | 10,20,30,40,41, 42,46,47,48 |
| 8750aM | Pre-Tier 2 E0 exhaust | 1940-2000 | 1,2,15,16 | 10 | 20,30 |
| 8750aM | Pre-Tier 2 E0 exhaust | 1940-2050 | 1,2,15,16 | 10 | 10,40,41,42,46,47,48 |
| 8751aM | Pre-Tier 2 E10 exhaust | 1940-2000 | 1,2,15,16 | 11,12,13,14 | 20,30 |
| 8751aM | Pre-Tier 2 E10 exhaust | 1940-2050 | 1,2,15,16 | 11,12,13,14,15, 18[14] | 10,40,41,42,46,47,48 |

## Table 3-12. MOVES process IDs

| Process ID | Process Name |
|---|---|
| 1 | Running Exhaust |
| 2 | Start Exhaust |
| 9 | Brakewear |
| 10 | Tirewear |
| 11 | Evap Permeation |
| 12 | Evap Fuel Vapor Venting |
| 13 | Evap Fuel Leaks |
| 15 | Crankcase Running Exhaust |
| 16 | Crankcase Start Exhaust |
| 17 | Crankcase Extended Idle Exhaust |
| 18 | Refueling Displacement Vapor Loss |
| 19 | Refueling Spillage Loss |
| 20 | Evap Tank Permeation |
| 21 | Evap Hose Permeation |
| 22 | Evap RecMar Neck Hose Permeation |
| 23 | Evap RecMar Supply/Ret Hose Permeation |
| 24 | Evap RecMar Vent Hose Permeation |
| 30 | Diurnal Fuel Vapor Venting |
| 31 | HotSoak Fuel Vapor Venting |
| 32 | RunningLoss Fuel Vapor Venting |
| 40 | Nonroad |
| 90 | Extended Idle Exhaust |
| 91 | Auxiliary Power Exhaust |

## Table 3-13. MOVES Fuel subtype IDs

| Fuel Subtype ID | Fuel Subtype Descriptions |
|---|---|
| 10 | Conventional Gasoline |
| 11 | Reformulated Gasoline (RFG) |
| 12 | Gasohol (E10) |
| 13 | Gasohol (E8) |

[14] The profile assingments for pre-2001 gasoline vehicles fueled on E15/E20 fuels (subtypes 15 and 18) were corrected for MOVES2014a. This model year range, process, fuelsubtype regclass combinate is already assigned to profile 8758.

| | |
|---|---|
| 14 | Gasohol (E5) |
| 15 | Gasohol (E15) |
| 18 | Ethanol (E20) |
| 20 | Conventional Diesel Fuel |
| 21 | Biodiesel (BD20) |
| 22 | Fischer-Tropsch Diesel (FTD100) |
| 30 | Compressed Natural Gas (CNG) |
| 50 | Ethanol |
| 51 | Ethanol (E85) |
| 52 | Ethanol (E70) |

**Table 3-14. MOVES regclass IDs**

| Reg. Class ID | Regulatory Class Description |
|---|---|
| 0 | Doesn’t Matter |
| 10 | Motorcycles |
| 20 | Light Duty Vehicles |
| 30 | Light Duty Trucks |
| 40 | Class 2b Trucks with 2 Axles and 4 Tires (8,500 lbs < GVWR <= 10,000 lbs) |
| 41 | Class 2b Trucks with 2 Axles and at least 6 Tires or Class 3 Trucks (8,500 lbs < GVWR <= 14,000 lbs) |
| 42 | Class 4 and 5 Trucks (14,000 lbs < GVWR <= 19,500 lbs) |
| 46 | Class 6 and 7 Trucks (19,500 lbs < GVWR <= 33,000 lbs) |
| 47 | Class 8a and 8b Trucks (GVWR > 33,000 lbs) |
| 48 | Urban Bus (see CFR Sec 86.091_2) |

For portable fuel containers (PFCs) and fuel distribution operations associated with the bulk-plant-to-pump (BTP) distribution, ethanol may be mixed into the fuels; therefore, county- and month-specific COMBO speciation was used (via the GSPRO_COMBO file). Refinery to bulk terminal (RBT) fuel distribution and bulk plant storage (BPS) speciation are considered upstream from the introduction of ethanol into the fuel; therefore, a single profile is sufficient for these sources. No refined information on potential VOC speciation differences between cellulosic diesel and cellulosic ethanol sources was available; therefore, cellulosic diesel and cellulosic ethanol sources used the same SCC (30125010: Industrial Chemical Manufacturing, Ethanol by Fermentation production) for VOC speciation as was used for corn ethanol plants.

### 3.2.2 PM speciation

In addition to VOC profiles, the SPECIATE database also contains the $PM_{2.5}$ speciated into both individual chemical compounds (e.g., zinc, potassium, manganese, lead), and into the “simplified” $PM_{2.5}$ components used in the air quality model. We speciated $PM_{2.5}$ into the AE6 species associated with CMAQ 5.0.1 and later versions. The majority of the 2014 platform PM profiles come from the 911XX series, which include updated AE6 speciation[15].

[15] The exceptions are 5674 (Marine Vessel – Marine Engine – Heavy Fuel Oil) used for cmv and 92018 (Draft Cigarette Smoke – Simplified) used in nonpt.

For the onroad sector, for all processes except brake and tire wear, PM speciation occurs within MOVES itself, not within SMOKE (similar to the VOC speciation described above). The advantage of using MOVES to speciate PM is that during the internal calculation of MOVES, the model has complete information on the characteristics of the fleet and fuels (e.g., model year, sulfur content, process, etc.) to accurately match to specific profiles. This means that MOVES produces EF tables that include total PM (e.g., $PM_{10}$ and $PM_{2.5}$) and speciated PM (e.g., PEC, PFE, etc). SMOKE essentially calculates the PM components by using the appropriate EF without further speciation[16]. The specific profiles used within MOVES include two compressed natural gas (CNG) profiles, 45219 and 45220, which were added to SPECIATE4.5. A list of profiles is provided in the technical document, "Speciation of Total Organic Gas and Particulate Matter Emissions from On-road Vehicles in MOVES2014" (EPA, 2015c).

For onroad brake and tire wear, the PM is speciated in the *moves2smk* postprocessor that prepares the emission factors for processing in SMOKE. The formulas for this are based on the standard speciation factors from break and tirewear profiles. These profiles were updated based on data from a Health Effects Institute report (Schauer, 2006).

**Table 3-15. SPECIATE4.5 brake and tire profiles compared to those used in the 2011v6.3 Platform**

| Inventory Pollutant | Model Species | Previous brakewear profile: 91134 | SPECIATE4.5 brakewear profile: 95462 from Schauer (2006) | Previous tirewear profile: 91150 | SPECIATE4.5 tirewear profile: 95460 from Schauer (2006) |
|---|---|---|---|---|---|
| PM2_5 | PAL | 0.00124 | 0.000793208 | 6.05E-04 | 3.32401E-05 |
| PM2_5 | PCA | 0.01 | 0.001692177 | 0.00112 | |
| PM2_5 | PCL | 0.001475 | | 0.0078 | |
| PM2_5 | PEC | 0.0261 | 0.012797085 | 0.22 | 0.003585907 |
| PM2_5 | PFE | 0.115 | 0.213901692 | 0.0046 | 0.00024779 |
| PM2_5 | PH2O | 0.0080232 | | 0.007506 | |
| PM2_5 | PK | 1.90E-04 | 0.000687447 | 3.80E-04 | 4.33129E-05 |
| PM2_5 | PMG | 0.1105 | 0.002961309 | 3.75E-04 | 0.000018131 |
| PM2_5 | PMN | 0.001065 | 0.001373836 | 1.00E-04 | 1.41E-06 |
| PM2_5 | PMOTHR | 0.4498 | 0.691704999 | 0.0625 | 0.100663209 |
| PM2_5 | PNA | 1.60E-04 | 0.002749787 | 6.10E-04 | 7.35312E-05 |
| PM2_5 | PNCOM | 0.0428 | 0.020115749 | 0.1886 | 0.255808124 |
| PM2_5 | PNH4 | 3.00E-05 | | 1.90E-04 | |
| PM2_5 | PNO3 | 0.0016 | | 0.0015 | |
| PM2_5 | POC | 0.107 | 0.050289372 | 0.4715 | 0.639520309 |
| PM2_5 | PSI | 0.088 | | 0.00115 | |
| PM2_5 | PSO4 | 0.0334 | | 0.0311 | |
| PM2_5 | PTI | 0.0036 | 0.000933341 | 3.60E-04 | 5.04E-06 |

that would otherwise be used in SMOKE via the profiles 91134 for brake wear and 91150 for tire wear:

```
POC = 0.6395 * PM25TIRE + 0.0503 * PM25BRAKE
PEC = 0.0036 * PM25TIRE + 0.0128 * PM25BRAKE
```

16 Unlike previous platforms, the PM components (e.g., POC) are now consistently defined between MOVES2014 and CMAQ. For more details on the use of model-ready EF, see the SMOKE 3.7 documentation: https://www.cmascenter.org/smoke/documentation/3.7/html/.

```
PNO3 = 0.000 * PM25TIRE + 0.000 * PM25BRAKE
PSO4 = 0.0 * PM25TIRE + 0.0 * PM25BRAKE
PNH4 = 0.000 * PM25TIRE + 0.0000 * PM25BRAKE
PNCOM = 0.2558 * PM25TIRE + 0.0201 * PM25BRAKE
```

For California onroad emissions, adjustment factors were applied to SMOKE-MOVES to produce California adjusted model-ready files (see Section 2.3.1 for details). California did not supply speciated PM, therefore, the adjustment factors applied to PM2.5 were also applied to the speciated PM components. By applying the ratios through SMOKE-MOVES, the CARB inventories are essentially speciated to match EPA estimated speciation.

### 3.2.3 $NO_X$ speciation

NOx emission factors and therefore NOx inventories are developed on a $NO_2$ weight basis. For air quality modeling, $NO_X$ is speciated into NO, $NO_2$, and/or HONO. For the non-mobile sources, the EPA used a single profile "NHONO" to split $NO_X$ into NO and $NO_2$.

The importance of HONO chemistry, identification of its presence in ambient air and the measurements of HONO from mobile sources have prompted the inclusion of HONO in NOx speciation for mobile sources. Based on tunnel studies, a HONO to NOx ratio of 0.008 was chosen (Sarwar, 2008). For the mobile sources, except for onroad (including nonroad, cmv, rail, othon sectors), and for specific SCCs in othar and ptnonipm, the profile "HONO" is used. Table 3-16 gives the split factor for these two profiles. The onroad sector does not use the "HONO" profile to speciate $NO_X$. MOVES2014 produces speciated NO, $NO_2$, and HONO by source, including emission factors for these species in the emission factor tables used by SMOKE-MOVES. Within MOVES, the HONO fraction is a constant 0.008 of $NO_X$. The NO fraction varies by heavy duty versus light duty, fuel type, and model year. The $NO_2$ fraction = 1 – NO – HONO. For more details on the $NO_X$ fractions within MOVES, see https://nepis.epa.gov/Exe/ZyPDF.cgi?Dockey=P100F1A5.pdf .

**Table 3-16. $NO_X$ speciation profiles**

| Profile | pollutant | species | split factor |
|---|---|---|---|
| HONO | NOX | NO2 | 0.092 |
| HONO | NOX | NO | 0.9 |
| HONO | NOX | HONO | 0.008 |
| NHONO | NOX | NO2 | 0.1 |
| NHONO | NOX | NO | 0.9 |

## *3.3 Temporal Allocation*

Temporal allocation (i.e., temporalization) is the process of distributing aggregated emissions to a finer temporal resolution, thereby converting annual emissions to hourly emissions. While the total emissions are important, the timing of the occurrence of emissions is also essential for accurately simulating ozone, PM, and other pollutant concentrations in the atmosphere. Many emissions inventories are annual or monthly in nature. Temporalization takes these aggregated emissions and, if needed, distributes them to the month, and then distributes the monthly emissions to the day and the daily emissions to the hours of each day. This process is typically done by applying temporal profiles to the inventories in this order: monthly, day of the week, and diurnal.

The temporal factors applied to the inventory are selected using some combination of country, state, county, SCC, and pollutant. Table 3-17 summarizes the temporal aspects of emissions modeling by comparing the key approaches used for temporal processing across the sectors. In the table, "Daily temporal approach" refers to the temporal approach for getting daily emissions from the inventory using the SMOKE Temporal program. The values given are the values of the SMOKE L_TYPE setting. The "Merge processing approach" refers to the days used to represent other days in the month for the merge step. If this is not "all," then the SMOKE merge step runs only for representative days, which could include holidays as indicated by the right-most column. The values given are those used for the SMOKE M_TYPE setting (see below for more information).

**Table 3-17. Temporal settings used for the platform sectors in SMOKE**

| Platform sector short name | Inventory resolutions | Monthly profiles used? | Daily temporal approach | Merge processing approach | Process Holidays as separate days |
|---|---|---|---|---|---|
| afdust_adj | Annual | Yes | week | all | Yes |
| ag | Annual and Daily | Yes | all | all | Yes |
| agfire | Annual | Yes | mwdss | mwdss | Yes |
| ptagfire | Daily | | all | all | Yes |
| beis | Hourly | | n/a | all | Yes |
| cmv | Annual | Yes | aveday | aveday | |
| rail | Annual | Yes | aveday | aveday | |
| nonpt | Annual | Yes | week | week | Yes |
| nonroad | Monthly | | mwdss | mwdss | Yes |
| np_oilgas | Annual | Yes | week | week | Yes |
| onroad | Annual & monthly[1] | | all | all | Yes |
| onroad_ca_adj | Annual & monthly[1] | | all | all | Yes |
| othafdust_adj | Annual | Yes | week | all | |
| othar | Annual & monthly | Yes | week | week | |
| onroad_can | Monthly | | week | week | |
| onroad_mex | Monthly | | week | week | |
| othpt | Annual | yes | mwdss | mwdss | |
| pt_oilgas | Annual | yes | mwdss | mwdss | Yes |
| ptegu | Daily & hourly | | all | all | Yes |
| ptnonipm | Annual | yes | mwdss | mwdss | Yes |
| ptfire_f | Daily | | all | all | Yes |
| ptfire_s | Daily | | all | all | Yes |
| ptfire_mxca | Daily | | all | all | Yes |
| rwc | Annual | no | met-based | all | Yes |

1. Note the annual and monthly "inventory" actually refers to the activity data (VMT and VPOP) for onroad. The actual emissions are computed on an hourly basis.

The following values are used in the table. The value "all" means that hourly emissions are computed for every day of the year and that emissions potentially have day-of-year variation. The value "week" means that hourly emissions computed for all days in one "representative" week, representing all weeks for each month. This means emissions have day-of-week variation, but not week-to-week variation within the month. The value "mwdss" means hourly emissions for one representative Monday, representative weekday (Tuesday through Friday), representative Saturday, and representative Sunday for each month.

This means emissions have variation between Mondays, other weekdays, Saturdays and Sundays within the month, but not week-to-week variation within the month. The value “aveday” means hourly emissions computed for one representative day of each month, meaning emissions for all days within a month are the same. Special situations with respect to temporalization are described in the following subsections.

In addition to the resolution, temporal processing includes a ramp-up period for several days prior to January 1, 2014, which is intended to mitigate the effects of initial condition concentrations. The ramp-up period was 10 days (December 22-31, 2013). For most sectors, emissions from December 2014 were used to fill in surrogate emissions for the end of December 2013. In particular, December 2014 emissions (representative days) were used for December 2013. For biogenic emissions, December 2013 emissions were processed using 2013 meteorology.

### 3.3.1 Use of FF10 format for finer than annual emissions

The FF10 inventory format for SMOKE provides a consolidated format for monthly, daily, and hourly emissions inventories. With the FF10 format, a single inventory file can contain emissions for all 12 months and the annual emissions in a single record. This helps simplify the management of numerous inventories. Similarly, daily and hourly FF10 inventories contain individual records with data for all days in a month and all hours in a day, respectively.

SMOKE prevents the application of temporal profiles on top of the “native” resolution of the inventory. For example, a monthly inventory should not have annual-to-month temporalization applied to it; rather, it should only have month-to-day and diurnal temporalization. This becomes particularly important when specific sectors have a mix of annual, monthly, daily, and/or hourly inventories. The flags that control temporalization for a mixed set of inventories are discussed in the SMOKE documentation. The modeling platform sectors that make use of monthly values in the FF10 files are nonroad, onroad, onroad_can, onroad_mex, othar and ptegu.

### 3.3.2 Electric Generating Utility temporalization (ptegu)

#### 3.3.2.1 Base year temporal allocation of EGUs

The 2014NEIv1 annual EGU emissions not matched to CEMS sources use region/fuel specific profiles based on average houly emissions for the region and fuel. Peaking units were removed during the averaging to mimimized the spikes generated by those units. The non-matched units are allocated to hourly emissions using the following 3-step methodology: annual value to month, month to day, and day to hour. First, the CEMS data were processed using a tool that reviewed the data quality flags that indicate the data were not measured. Unmeasured data can cause erroneously high values in the CEMS data. If the data were not measured at specific hours, and those values were found to be more than three times the annual mean for that unit, the data for those hours were replaced with annual mean values (Adelman et al., 2012). These adjusted CEMS data were then used for the remainder of the temporalization process described below (see Figure 3-3 for an example). Winter and summer seasons are included in the development of the diurnal profiles as opposed to using data for the entire year because analysis of the hourly CEMS data revealed that there were different diurnal patterns in winter versus summer in many areas. Typically, a single mid-day peak is visible in the summer, while there are morning and evening peaks in the winter as shown in Figure 3-4.

The temporal allocation procedure is differentiated by whether or not the source could be directly matched to a CEMS unit via ORIS facility code and boiler ID. Note that for units matched to CEMS data, annual totals of their emissions may be different than the annual values in 2014NEIv1 because the CEMS data actually replaces the inventory data for the seasons in which the CEMS are operating. If a CEMS-matched unit is determined to be a partial year reporter, as can happen for sources that run CEMS only in the summer, emissions totaling the difference between the annual emissions and the total CEMS emissions are allocated to the non-summer months.

**Figure 3-3. Eliminating unmeasured spikes in CEMS data**

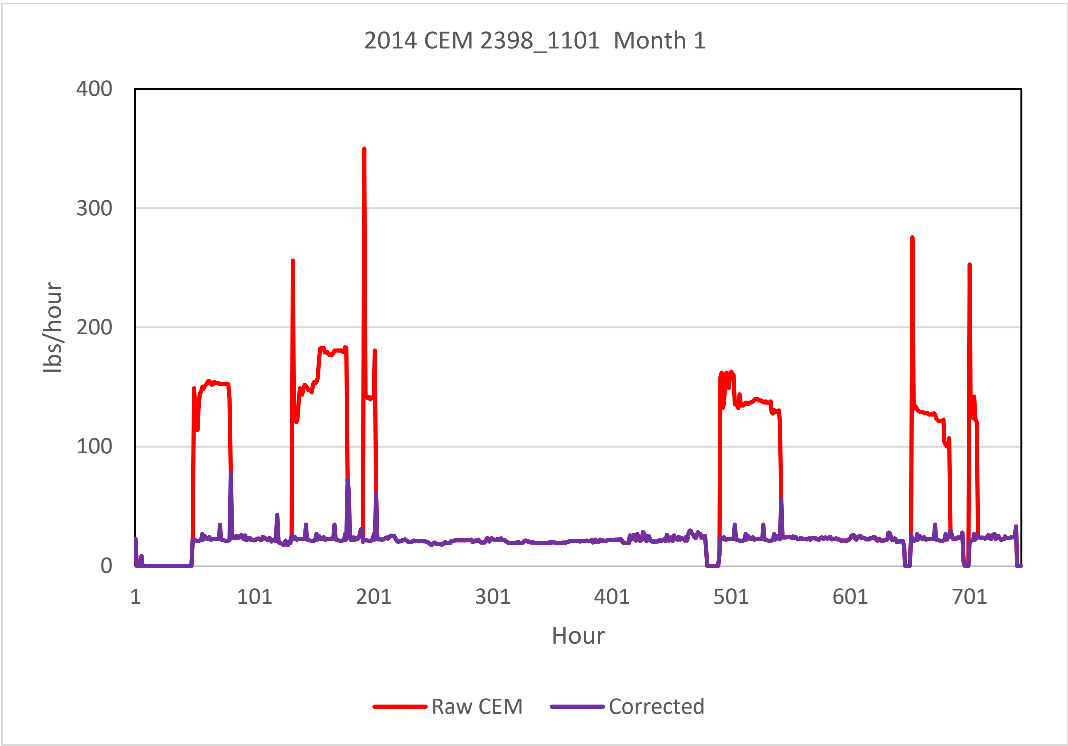
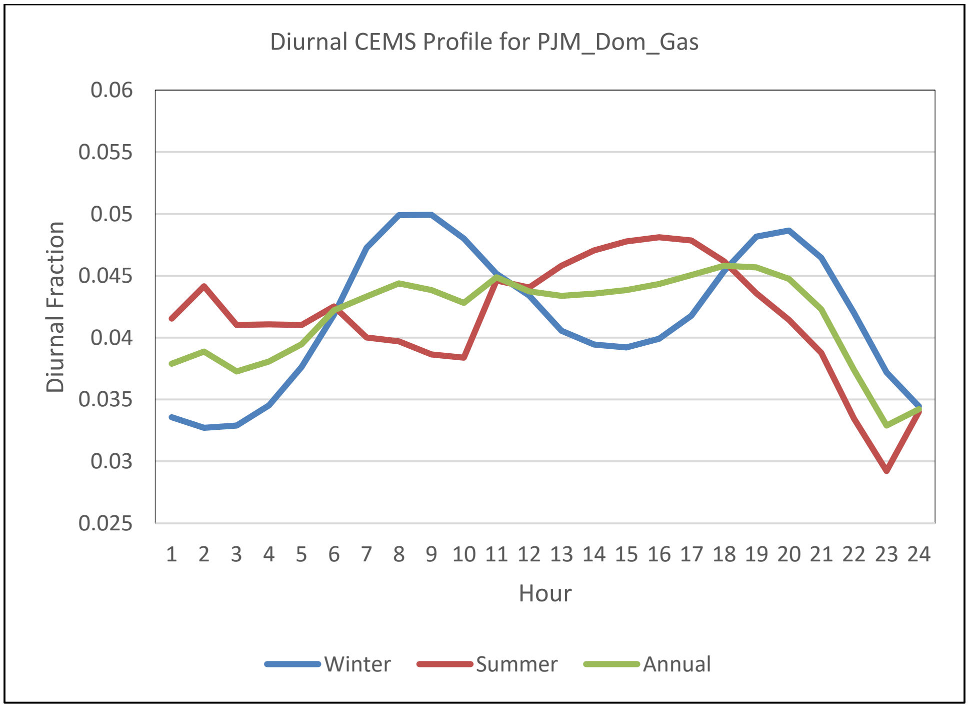
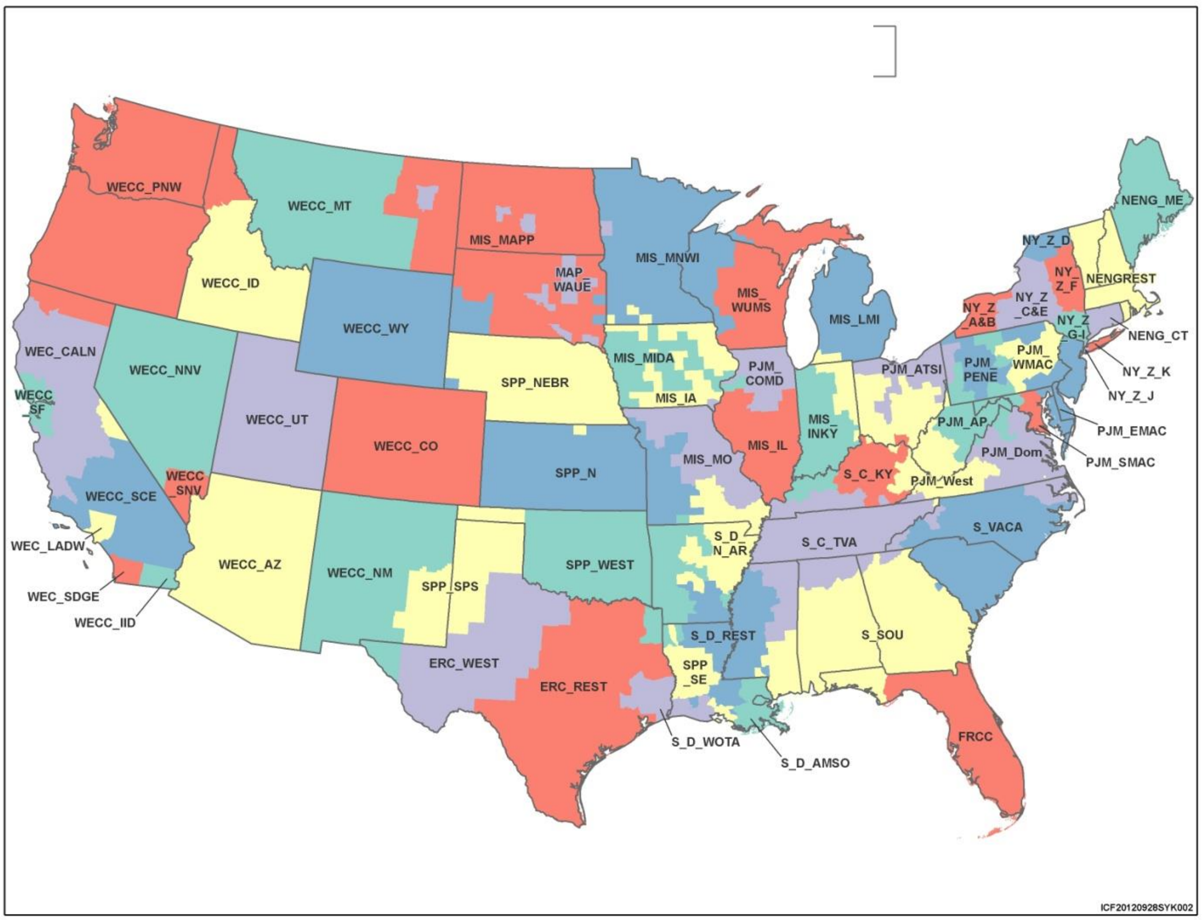



**Figure 3-4. Seasonal diurnal profiles for EGU emissions in a Virginia Region**



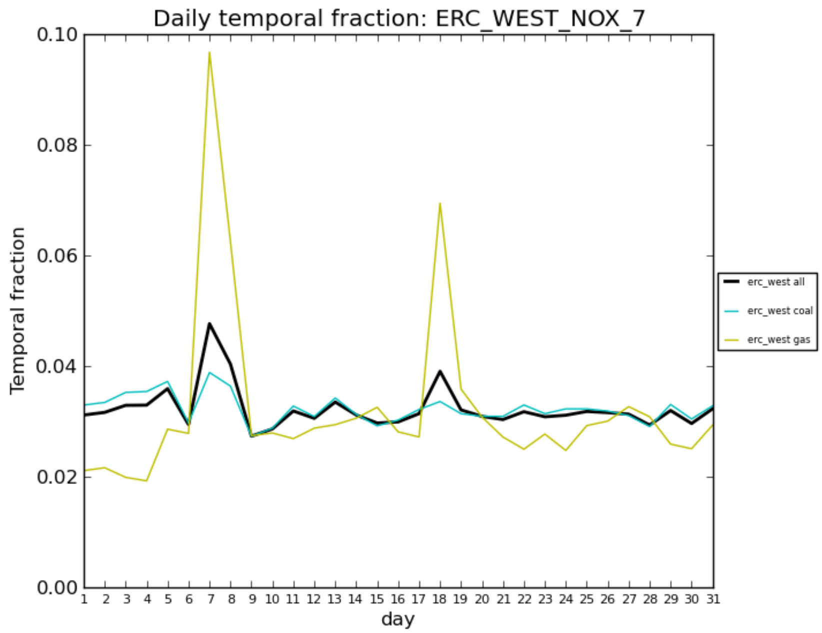
For sources not matched to CEMS units, the allocation of annual emissions to months and then days is done outside of SMOKE and then daily emissions are output to day-specific inventory files. For these units, the allocation of the inventory annual emissions to months is done using average fuel-specific season-to-month factors generated for each of the 64 IPM regions shown in Figure 3-5. These factors are based 2014 CEMS data only. In each region, separate factors were developed for the fuels: coal, natural gas, and "other," where the types of fuels included in "other" vary by region. Separate profiles were computed for $NO_X$, $SO_2$, and heat input. An overall composite profile was also computed and used when there were no CEMS units with the specified fuel in the region containing the unit. For both CEMS-matched units and units not matched to CEMS, $NO_X$ and $SO_2$ CEMS data are used to allocate $NO_X$ and $SO_2$ emissions to monthly emissions, respectively, while heat input data are used to allocate emissions of all other pollutants and to allocate emissions of all pollutants from monthly to daily emissions.

**Figure 3-5. IPM Regions used to Create Temporal Profiles**




Daily temporal allocation of units matched to CEMS was performed using a procedure similar to the approach to allocate emissions to months in that the CEMS data replaces the inventory data for each pollutant. For units without CEMS data, emissions were allocated from month to day using IPM-region and fuel-specific average month-to-day factors based on the 2014 CEMS data. Separate month-to-day allocation factors were computed for each month of the year using heat input for the fuels coal, natural gas, and "other" in each region. For both CEMS and non-CEMS matched units, $NO_X$ and $SO_2$ CEMS data are used to allocate $NO_X$ and $SO_2$ emissions, while CEMS heat input data are used to allocate all other pollutants. An example of month-to-day profiles for gas, coal, and an overall composite for a region in western Texas is shown in Figure 3-6.

**Figure 3-6. Month-to-day profiles for different fuels in a West Texas Region**




For units matched to CEMS data, hourly emissions use the hourly CEMS values for $NO_X$ and $SO_2$, while other pollutants are allocated according to heat input values. For units not matched to CEMS data, temporal profiles from days to hours are computed based on the season-, region- and fuel-specific average day-to-hour factors derived from the CEMS data for those fuels and regions using the appropriate subset of data. For the unmatched units, CEMS heat input data are used to allocate *all* pollutants (including $NO_X$ and $SO_2$) because the heat input data was generally found to be more complete than the pollutant-specific data. SMOKE then allocates the daily emissions data to hours using the temporal profiles obtained from the CEMS data for the analysis base year (i.e., 2014 in this case).

### 3.3.3 Airport Temporalization (ptnonipm)

Airport temporal profiles were updated. All airport SCCs (i.e., 2275*, 2265008005, 2267008005, 2268008005 and 2270008005) were given the same hourly, weekly and monthly profile for all airports other than Alaska seaplanes. Hourly airport operations data were obtained from the Aviation System Performance Metrics (ASPM) Airport Analysis website (https://aspm.faa.gov/apm/sys/AnalysisAP.asp). A report of 2014 hourly Departures and Arrivals for Metric Computation was generated. An overview of the ASPM metrics is at http://aspmhelp.faa.gov/index.php/Aviation_Performance_Metrics_%28APM%29. Figure 3-7 shows the diurnal airport profile.

Weekly and monthly temporal profiles are based on 2014 data from the FAA Operations Network Air Traffic Activity System (http://aspm.faa.gov/opsnet/sys/Terminal.asp). A report of all airport operations (takeoffs and landings) by day for 2014 was generated. These data were then summed to month and day-of-week to derive the monthly and weekly temporal profiles shown in Figure 3-7, Figure 3-8, and Figure 3-9. An overview of the Operations Network data system is at http://aspmhelp.faa.gov/index.php/Operations_Network_%28OPSNET%29.

Alaska seaplanes, which are outside the CONUS domain use the same monthly profile as in the 2011 platform shown in Figure 3-10. These were assigned based on the facility ID.

**Figure 3-7. Diurnal Profile for all Airport SCCs**

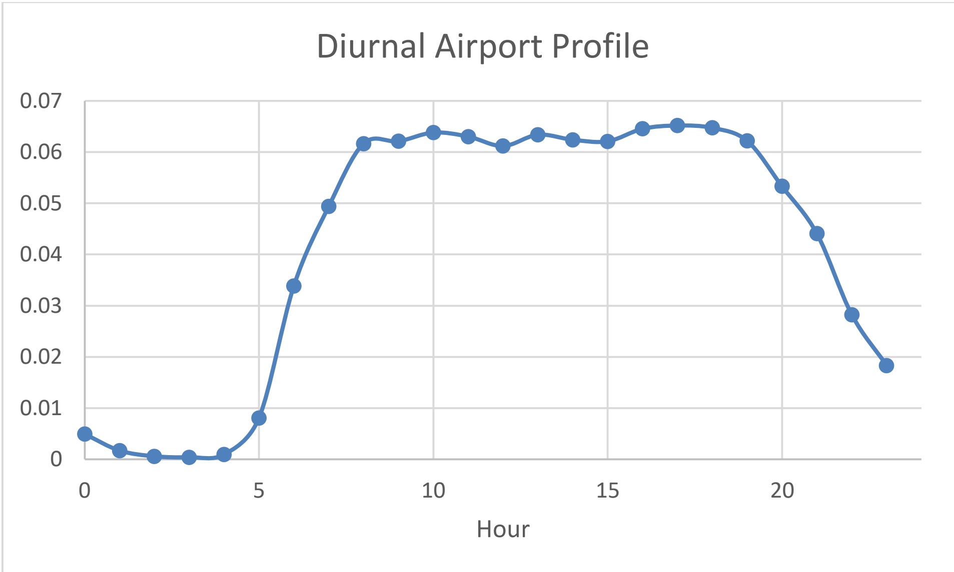



**Figure 3-8. Weekly profile for all Airport SCCs**

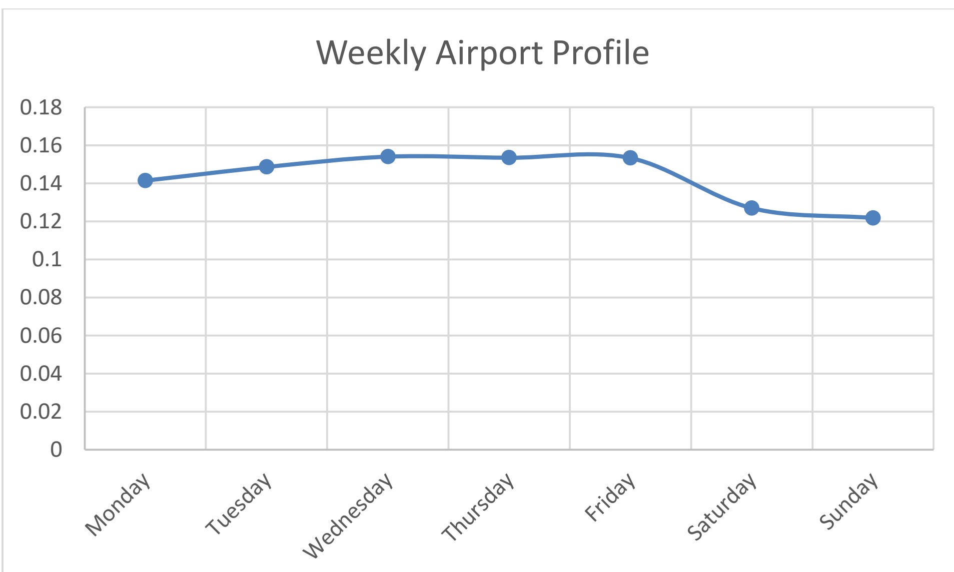


**Figure 3-9. Monthly Profile for all Airport SCCs**

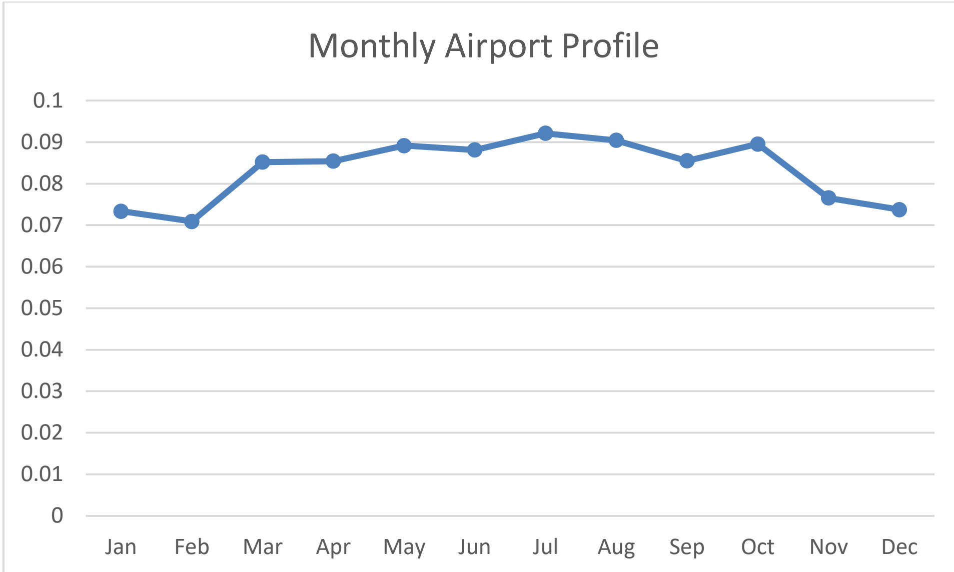
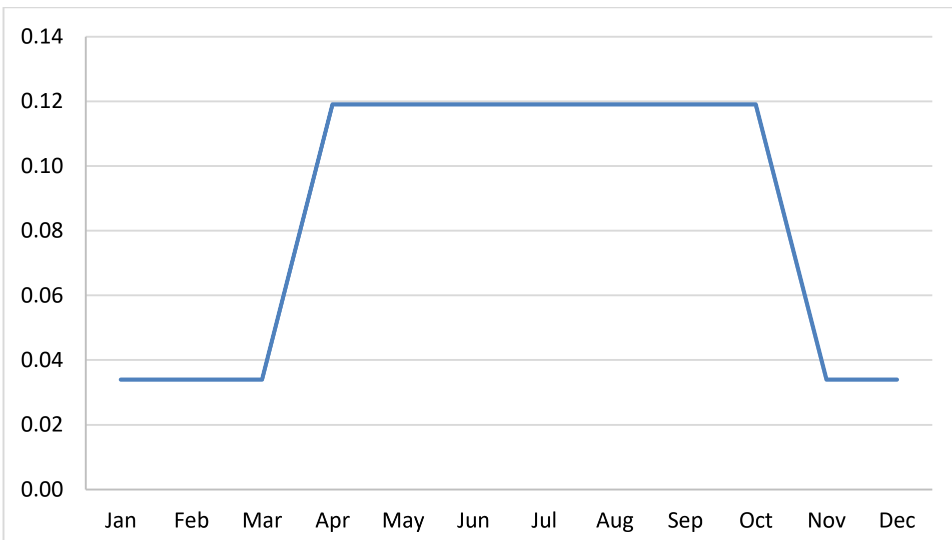



**Figure 3-10. Alaska Seaplane Profile**




### 3.3.4 Residential Wood Combustion Temporalization (rwc)

There are many factors that impact the timing of when emissions occur, and for some sectors this includes meteorology. The benefits of utilizing meteorology as method for temporalization are: (1) a meteorological dataset consistent with that used by the AQ model is available (e.g., outputs from WRF); (2) the meteorological model data are highly resolved in terms of spatial resolution; and (3) the meteorological variables vary at hourly resolution and can, therefore, be translated into hour-specific temporalization.

The SMOKE program GenTPRO provides a method for developing meteorology-based temporalization. Currently, the program can utilize three types of temporal algorithms: annual-to-day temporalization for residential wood combustion (RWC); month-to-hour temporalization for agricultural livestock $NH_3$; and a generic meteorology-based algorithm for other situations. Meteorological-based temporalization was used for portions of the rwc sector and for livestock within the ag sector.

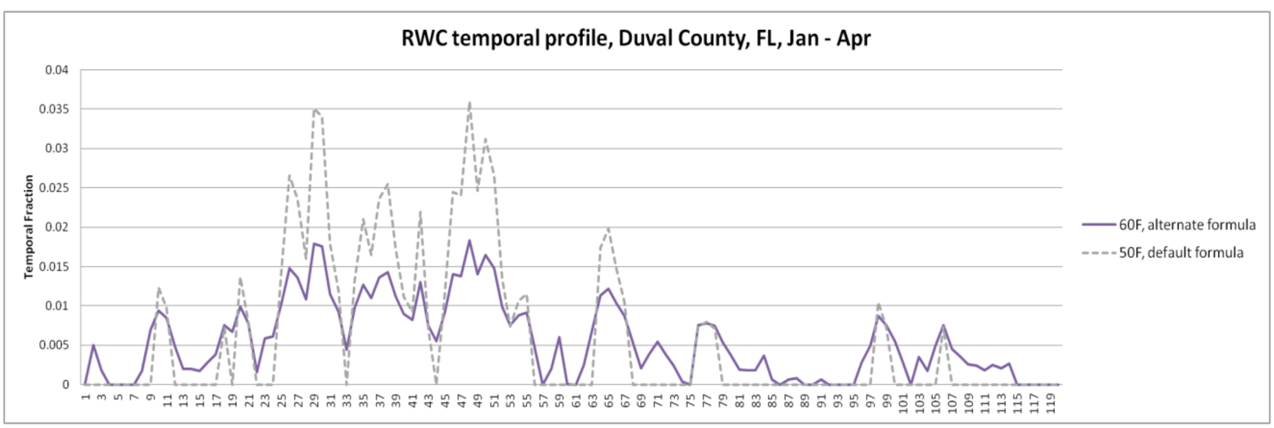
GenTPRO reads in gridded meteorological data (output from MCIP) along with spatial surrogates, and uses the specified algorithm to produce a new temporal profile that can be input into SMOKE. The meteorological variables and the resolution of the generated temporal profile (hourly, daily, etc.) depend on the selected algorithm and the run parameters. For more details on the development of these algorithms and running GenTPRO, see the GenTPRO documentation and the SMOKE documentation at http://www.cmascenter.org/smoke/documentation/3.1/GenTPRO_TechnicalSummary_Aug2012_Final.pdf and https://www.cmascenter.org/smoke/documentation/3.7/html/ch05s03s06.html, respectively.

As of the 2011v6.2 platform and in SMOKE 3.6.5, the temporal profile format was updated. GenTPRO now produces separate files including the monthly temporal profiles (ATPRO_MONTHLY) and day-of-month temporal profiles (ATPRO_DAILY), instead of a single ATPRO_DAILY with day-of-year temporal profiles as it did in SMOKE 3.5. The results are the same either way, so the temporal profiles themselves are effectively the same in 2011v6.2 as they were in 2011v6.0 since the meteorology is the same, but they are formatted differently.

For the RWC algorithm, GenTPRO uses the daily minimum temperature to determine the temporal allocation of emissions to days. GenTPRO was used to create an annual-to-day temporal profile for the RWC sources. These generated profiles distribute annual RWC emissions to the coldest days of the year. On days where the minimum temperature does not drop below a user-defined threshold, RWC emissions for most sources in the sector are zero. Conversely, the program temporally allocates the largest percentage of emissions to the coldest days. Similar to other temporal allocation profiles, the total annual emissions do not change, only the distribution of the emissions within the year is affected. The temperature threshold for rwc emissions was 50 ˚F for most of the country, and 60 ˚F for the following states: Alabama, Arizona, California, Florida, Georgia, Louisiana, Mississippi, South Carolina, and Texas.

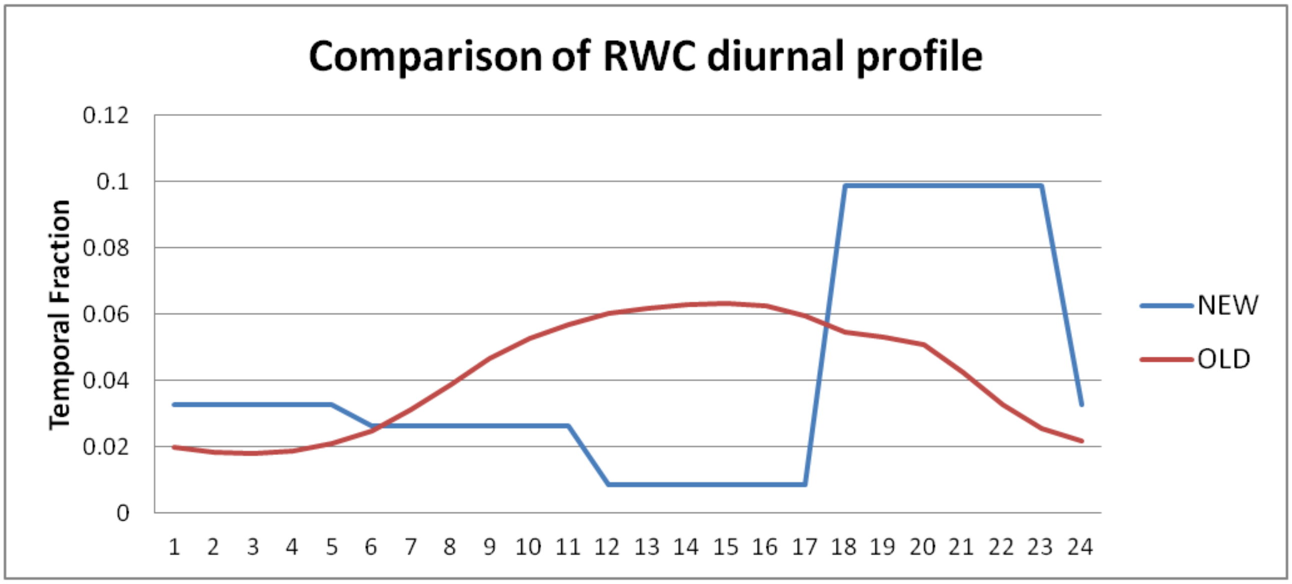
Figure 3-11 illustrates the impact of changing the temperature threshold for a warm climate county. The plot shows the temporal fraction by day for Duval County, Florida, for the first four months of 2007. The default 50 ˚F threshold creates large spikes on a few days, while the 60 ˚F threshold dampens these spikes and distributes a small amount of emissions to the days that have a minimum temperature between 50 and 60 ˚F.

**Figure 3-11. Example of RWC temporalization in 2007 using a 50 versus 60 ˚F threshold**



The diurnal profile for used for most RWC sources (see Figure 3-12) places more of the RWC emissions in the morning and the evening when people are typically using these sources. This profile is based on a 2004 MANE-VU survey based temporal profiles (see http://www.marama.org/publications_folder/ResWoodCombustion/Final_report.pdf). This profile was created by averaging three indoor and three RWC outdoor temporal profiles from counties in Delaware and aggregating them into a single RWC diurnal profile. This new profile was compared to a concentration based analysis of aethalometer measurements in Rochester, New York (Wang *et al.* 2011) for various seasons and days of the week and was found that the new RWC profile generally tracked the concentration based temporal patterns.

**Figure 3-12.** RWC diurnal temporal profile




The temporalization for “Outdoor Hydronic Heaters” (i.e., “OHH,” SCC=2104008610) and “Outdoor wood burning device, NEC (fire-pits, chimneas, etc.)” (i.e., “recreational RWC,” SCC=21040087000) is not based on temperature data, because the meteorological-based temporalization used for the rest of the rwc sector did not agree with observations for how these appliances are used.

For OHH, the annual-to-month, day-of-week and diurnal profiles were modified based on information in the New York State Energy Research and Development Authority’s (NYSERDA) “Environmental, Energy Market, and Health Characterization of Wood-Fired Hydronic Heater Technologies, Final Report” (NYSERDA, 2012), as well as a Northeast States for Coordinated Air Use Management (NESCAUM) report “Assessment of Outdoor Wood-fired Boilers” (NESCAUM, 2006). A Minnesota 2008 Residential Fuelwood Assessment Survey of individual household responses (MDNR, 2008) provided additional annual-to-month, day-of-week and diurnal activity information for OHH as well as recreational RWC usage.

The diurnal profile for OHH, shown in Figure 3-13, is based on a conventional single-stage heat load unit burning red oak in Syracuse, New York. As shown in Figure 3-14, the NESCAUM report describes how for individual units, OHH are highly variable day-to-day but that in the aggregate, these emissions have no day-of-week variation. In contrast, the day-of-week profile for recreational RWC follows a typical “recreational” profile with emissions peaked on weekends.

Annual-to-month temporalization for OHH as well as recreational RWC were computed from the MDNR 2008 survey and are illustrated in Figure 3-15. The OHH emissions still exhibit strong seasonal variability, but do not drop to zero because many units operate year round for water and pool heating. In contrast to all other RWC appliances, recreational RWC emissions are used far more frequently during the warm season.

**Figure 3-13. Diurnal profile for OHH, based on heat load (BTU/hr)**

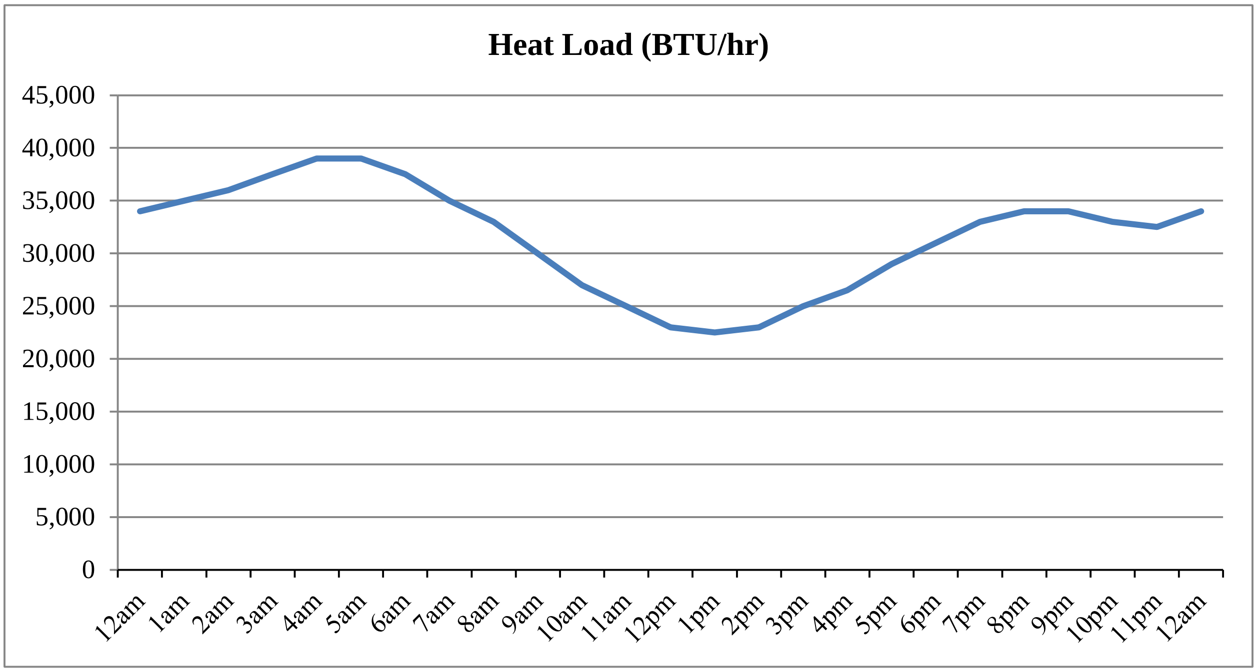



**Figure 3-14. Day-of-week temporal profiles for OHH and Recreational RWC**

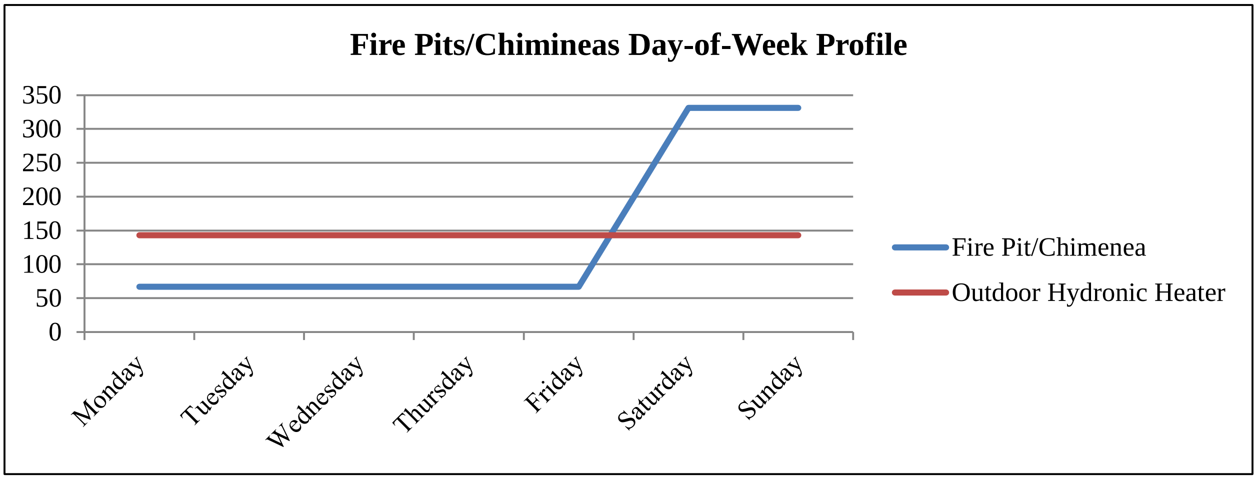
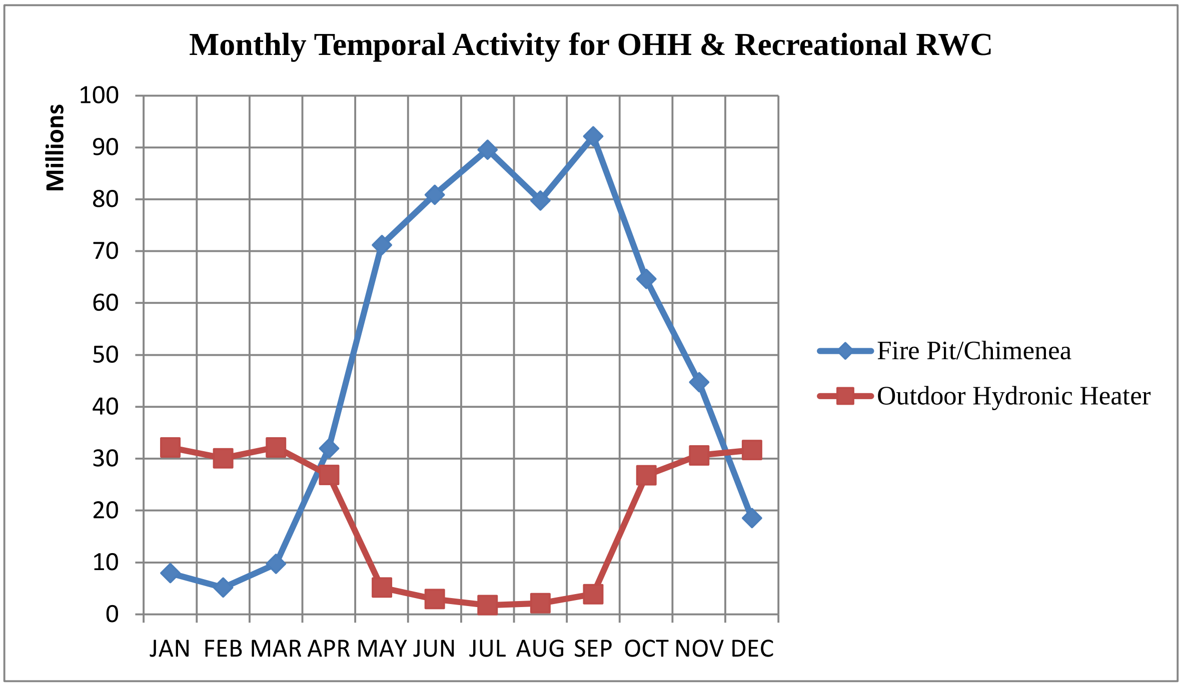


**Figure 3-15. Annual-to-month temporal profiles for OHH and recreational RWC**




### 3.3.5 Agricultural Ammonia Temporal Profiles (ag)

For the agricultural livestock $NH_3$ algorithm, the GenTPRO algorithm is based on an equation derived by Jesse Bash of the EPA's ORD based on the Zhu, Henze, et al. (2013) empirical equation. This equation is based on observations from the TES satellite instrument with the GEOS-Chem model and its adjoint to estimate diurnal $NH_3$ emission variations from livestock as a function of ambient temperature, aerodynamic resistance, and wind speed. The equations are:

$$E_{i,h} = [161500/T_{i,h} \text{ x } e^{(-1380/T_{i,h})}] \text{ x } AR_{i,h}$$

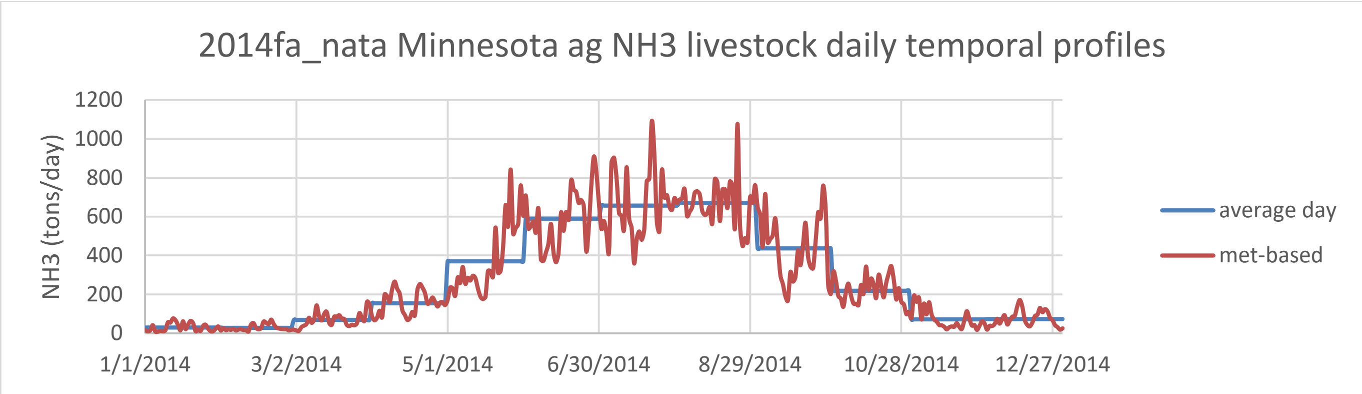
$$PE_{i,h} = E_{i,h} / \text{Sum}(E_{i,h})$$

where

- $PE_{i,h}$ = Percentage of emissions in county *i* on hour *h*
- $E_{i,h}$ = Emission rate in county *i* on hour *h*
- $T_{i,h}$ = Ambient temperature (Kelvin) in county *i* on hour *h*
- $V_{i,h}$ = Wind speed (meter/sec) in county *i* (minimum wind speed is 0.1 meter/sec)
- $AR_{i,h}$ = Aerodynamic resistance in county *i*

GenTPRO was run using the "BASH_NH3" profile method to create month-to-hour temporal profiles for these sources. Because these profiles distribute to the hour based on monthly emissions, the monthly emissions are obtained from a monthly inventory, or from an annual inventory that has been temporalized to the month. Figure 3-16 compares the daily emissions for Minnesota from the "old" approach (uniform monthly profile) with the "new" approach (GenTPRO generated month-to-hour profiles). Although the GenTPRO profiles show daily (and hourly variability), the monthly total emissions are the same between the two approaches.

**Figure 3-16. Example of animal $NH_3$ emissions temporalization approach, summed to daily emissions**




### 3.3.6 Oil and gas temporalization (np_oilgas)

The same county monthly oil and gas temporal profiles developed for the 2011 Platform were used for the 2014 Platform. These were developed at the same time as the 2011 surrogates and were based primarily on activity data extracted from the "DI Desktop Database powered by HPDI." (Drillinginfo, 2015). Data from state Oil and Gas Commission websites and from the RigData website (rigdata.com) were also used.

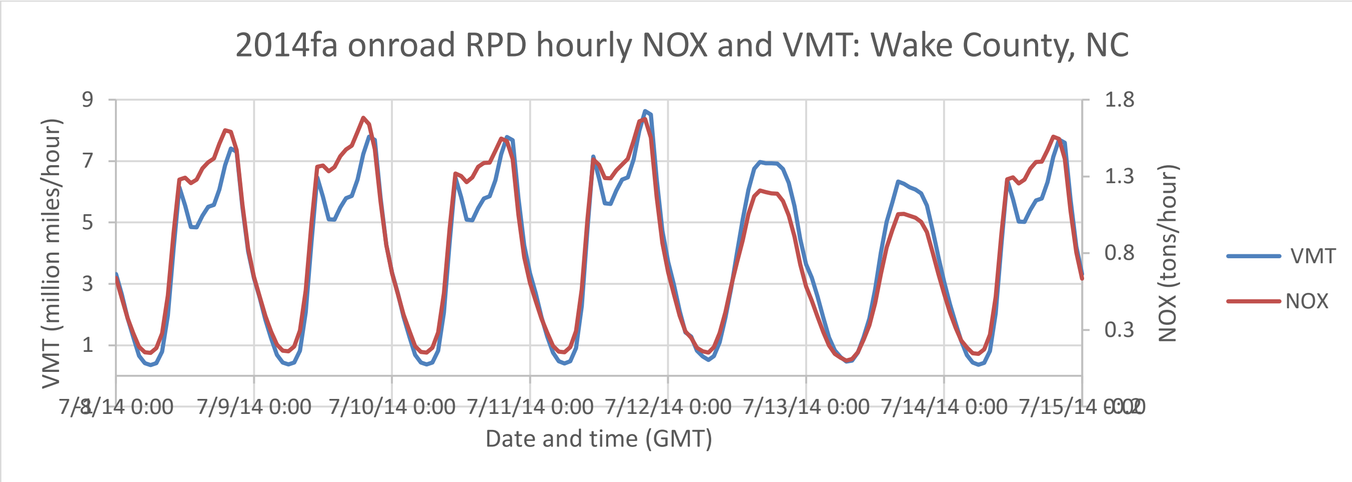
### 3.3.7 Onroad mobile temporalization (onroad)

For the onroad sector, the temporal distribution of emissions is a combination of more traditional temporal profiles and the influence of meteorology. This section will discuss both the meteorological influences and the diurnal temporal profiles for this platform.

Meteorology is not used in the development of the temporal profiles, but rather it impacts the calculation of the hourly emissions through the program Movesmrg. The result is that the emissions vary at the hourly level by grid cell. More specifically, the on-network (RPD) and the off-network parked vehicle (RPV, RPH, and RPP) processes use the gridded meteorology (MCIP) either directly or indirectly. For RPD, RPV, and RPH, Movesmrg determines the temperature for each hour and grid cell and uses that information to select the appropriate emission factor for the specified SCC/pollutant/mode combination. For RPP, instead of reading gridded hourly meteorology, Movesmrg reads gridded daily minimum and maximum temperatures. The combination of these four processes (RPD, RPV, RPH, and RPP) is the total onroad sector emissions. The onroad sector shows a strong meteorological influence on its temporal patterns.

Figure 3-17 illustrates the temporalization of the onroad sector and the meteorological influence via SMOKE-MOVES. Similar temporalization is done for the VMT in SMOKE-MOVES, but the meteorologically varying emission factors add variation on top of the temporalization.

**Figure 3-17. Example of SMOKE-MOVES temporal variability of NOx emissions**

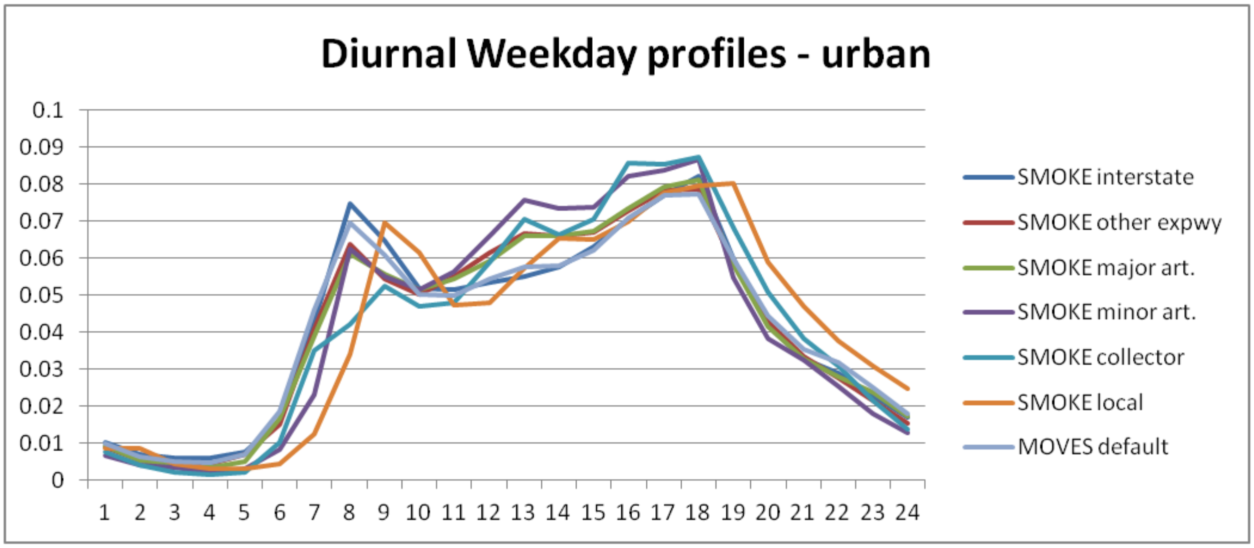



For the onroad sector, the "inventories" referred to in Table 3-17 actually consist of activity data, not emissions. For RPP and RPV processes, the VPOP inventory is annual and does not need temporalization. For RPD, the VMT inventory is annual for some sources and monthly for other sources, depending on the source of the data. Sources without monthly VMT were temporalized from annual to month through temporal profiles. VMT was also temporalized from month to day of the week, and then to hourly through temporal profiles. The RPD processes require a speed profile (SPDPRO) that consists of vehicle speed by hour for a typical weekday and weekend day. Unlike other sectors, the temporal profiles and SPDPRO will impact not only the distribution of emissions through time but also the total emissions. Because SMOKE-MOVES (for RPD) calculates emissions from VMT, speed and meteorology, if one shifted the VMT or speed to different hours, it would align with different temperatures and hence different emission factors. In other words, two SMOKE-MOVES runs with identical annual VMT, meteorology, and MOVES emission factors, will have different total emissions if the temporalization of VMT changes. For RPH, the HOTELING inventory is annual and was temporalized to month, day of the week, and hour of the day through temporal profiles. This is an analogous process to RPD except that speed is not included in the calculation of RPH.

In older platforms, the diurnal profile for VMT[17] varied by road type but not by vehicle type (see Figure 3-18). These profiles were used throughout the nation.

[17] These profiles were used in the 2007 platform and proceeding platforms.

**Figure 3-18. Previous onroad diurnal weekday profiles for urban roads**




Diurnal profiles that could differentiate by vehicle type as well as by road type and would potentially vary over geography were desired. In the development of the 2011v6.0[18] platform, the EPA updated these profiles to include information submitted by states in their MOVES county databases (CDBs). The 2011NEIv2 process provided an opportunity to update these diurnal profile with new information submitted by states, to supplement the data with additional sources, and to refine the methodology.

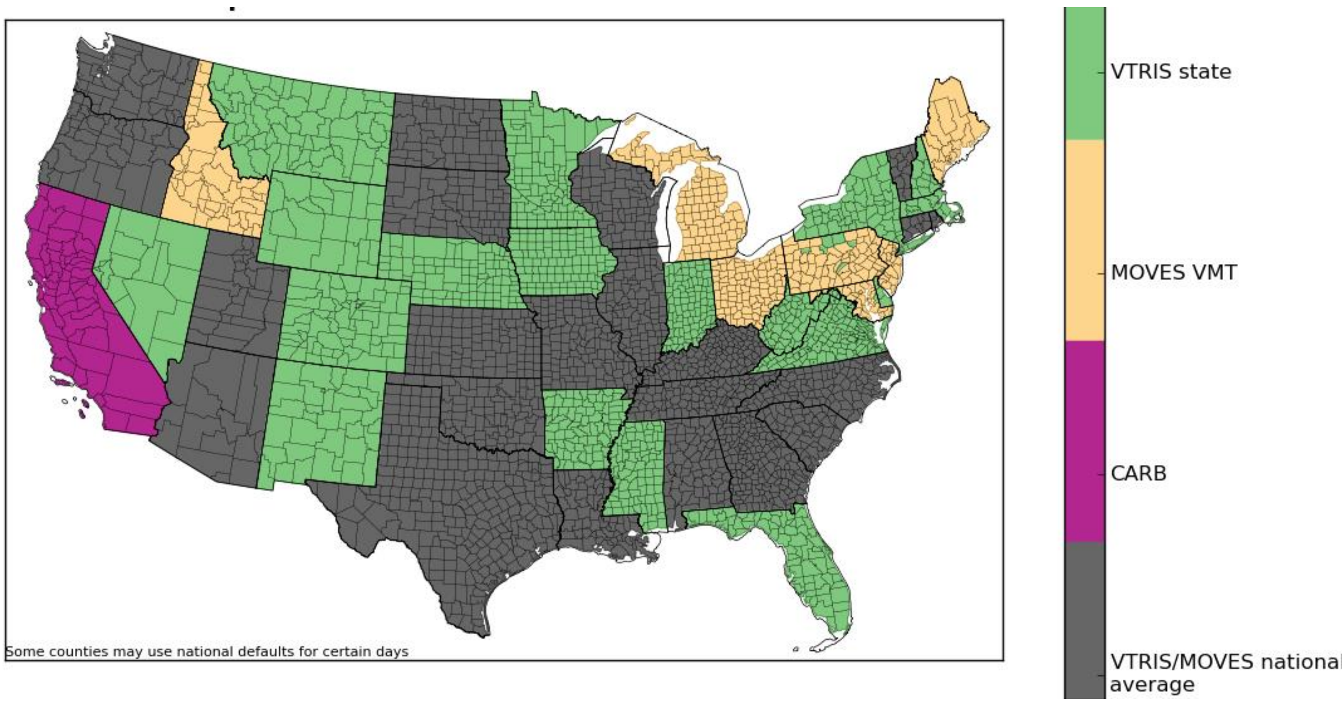
States submitted MOVES county databases (CDBs) that included information on the distribution of VMT by hour of day and by day of week[19] (see the 2011NEIv2 TSD for details on the submittal process for onroad). The EPA mined the state submitted MOVES CDBs for non-default diurnal profiles[20]. The list of potential diurnal profiles was then analyzed to see whether the profiles varied by vehicle type, road type, weekday versus weekend, and by county within a state. For the MOVES diurnal profiles, the EPA only considered the state profiles that varied significantly by both vehicle and road types. Only those profiles that passed this criteria were used in that state or used in developing default temporal profiles. The Vehicle Travel Information System (VTRIS) is a repository for reported traffic count data to the Federal Highway Administration (FHWA). The EPA used 2012 VTRIS data to create additional temporal profiles for states that did not submit temporal information in their CDBs or where those profiles did not pass the variance criteria. The VTRIS data were used to create state specific diurnal profiles by HPMS vehicle and road type. The EPA created distinct diurnal profiles for weekdays, Saturday and Sunday along with day of the week profiles[21]. In comparison to the temporal profiles from the 2011 emissions modeling platform, the profiles for the 2014 platform include the same 2012 VTRIS data, but updated data from MOVES CDBs for 2014.

The EPA attempted to maximize the use of state and/or county specific diurnal profiles (either from MOVES or VTRIS). Where there was no MOVES or VTRIS data, then a new default profile would be used (see below for description of new profiles). This analysis was done separately for weekdays and for

[18] These profiles that were generated from MOVES submittals only, without consideration of VTRIS data, were used for the v6 and v6.1 platforms. See their respective TSDs for more details.
[19] The MOVES tables are the hourvmtfraction and the dayvmtfraction.
[20] Further QA was done to remove duplicates and profiles that were missing two or more hours. If they were missing a single hour, the missing hour could be calculated by subtracting all other hours fractions from 1.
[21] Note, the day of the week profiles (i.e., Monday vs Tuesday vs etc) are only from the VTRIS data. The MOVES CDBs only have weekday versus weekend profiles so they were not included in calculating a new national default day of the week profile.

weekends and, therefore, some areas had submitted profiles for weekdays but defaults for weekends.  The result was a set of profiles that varied geographically depending on the source of the profile and the characteristics of the profiles (see Figure 3-19).

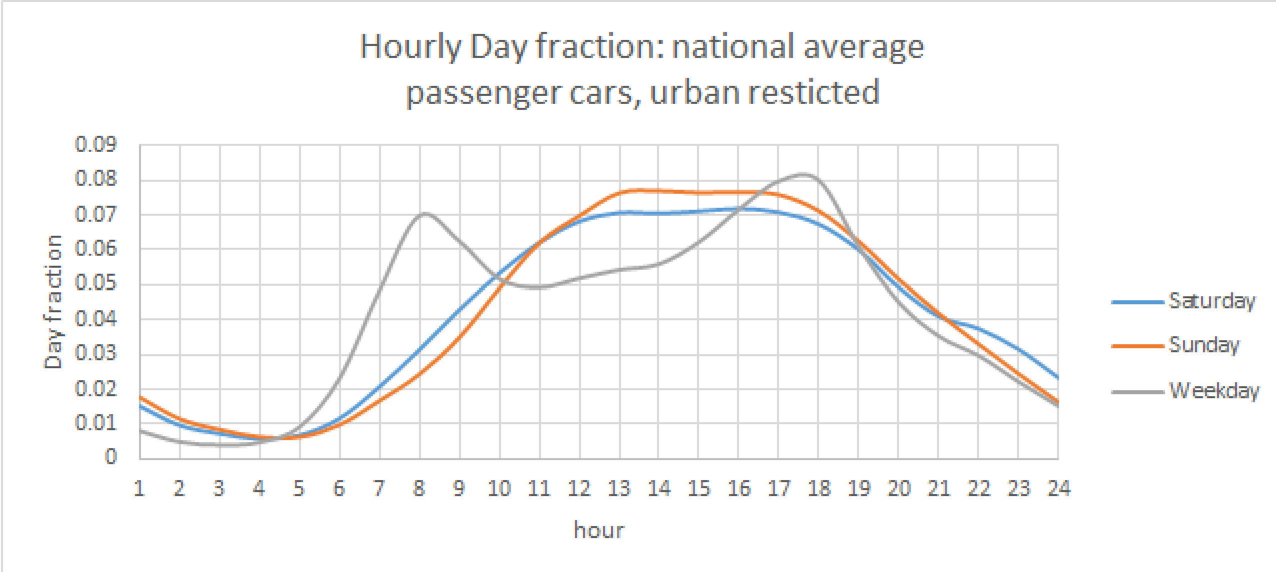
**Figure 3-19.  Use of submitted versus new national default profiles**

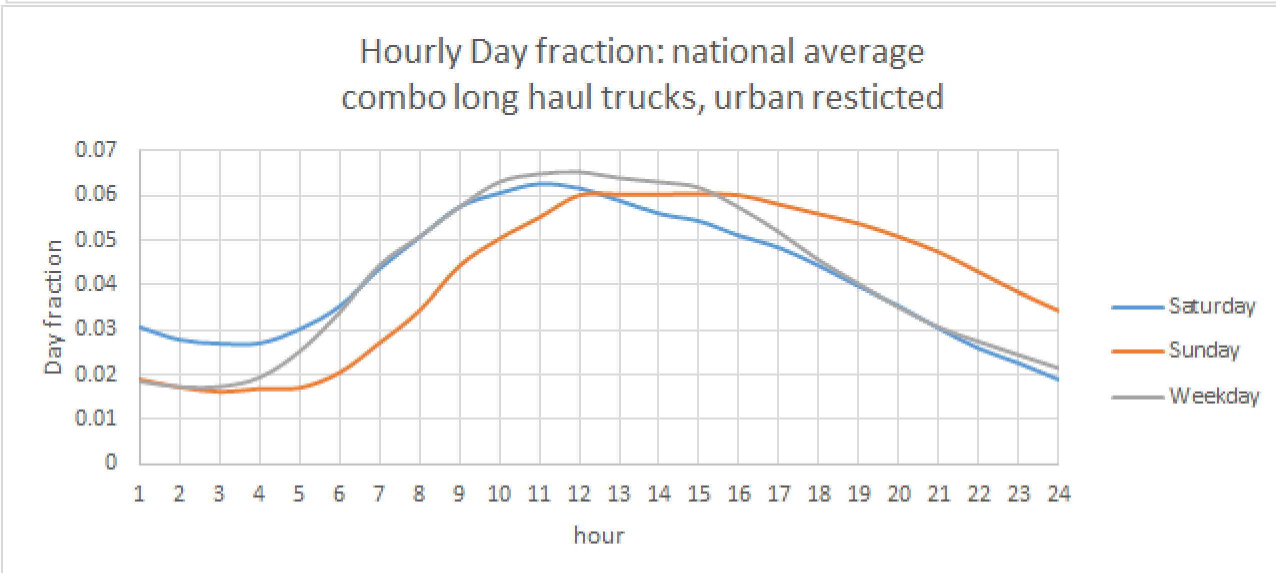



A new set of diurnal profiles was developed for the 2011v6.2 platform from the submitted profiles that varied by both vehicle type and road type.  For the purposes of constructing the national default diurnal profiles, the EPA created individual profiles for each state (averaging over the counties within) to create a single profile by state, vehicle type, road type, and the day (i.e., weekday versus Saturday versus Sunday).  The source of the underlying profiles was either 2014 MOVES or 2012 VTRIS data (see Figure 3-19).  The states' individual profiles were averaged together to create a new default profile[22].  The 2014 platform national default profiles were computed by the same method as the 2011 platform defaults, except that they incorporate 2014 MOVES data instead of 2011 MOVES, resulting in only minor changes to the default profiles compared to the 2011 platform.  Figure 3-20 shows two 2014 platform national default profiles for light duty gas vehicles (LDGV, SCC6 220121) and combination long-haul diesel trucks (HHDDV, SCC6 220262) on restricted urban roadways (interstates and freeways).

**Figure 3-20.  2014 national default profiles for LDGV vs. HHDDV, urban restricted**

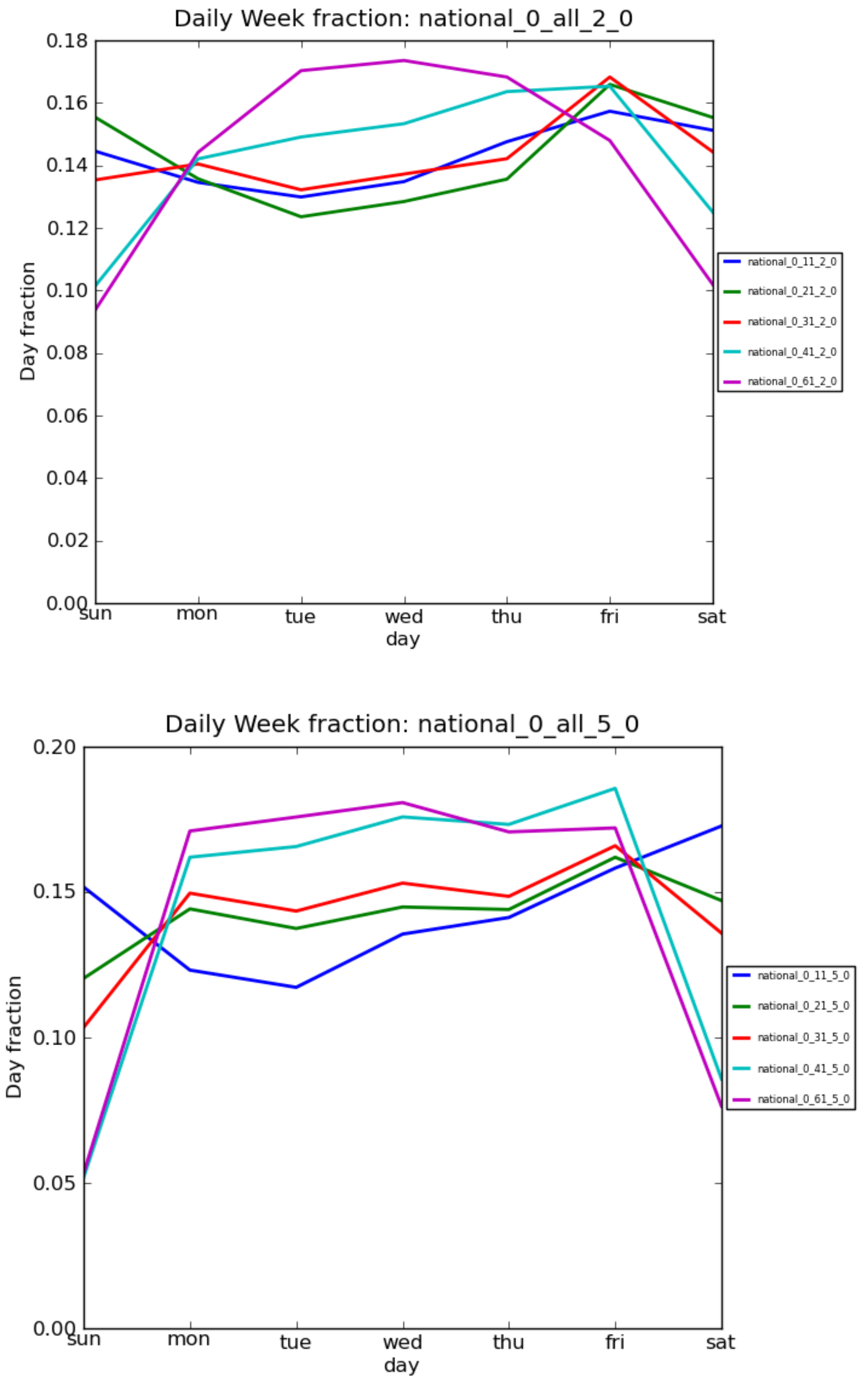
[22] Note that the states were weighted equally in the average independent of the size of the state or the variation in submitted county data.



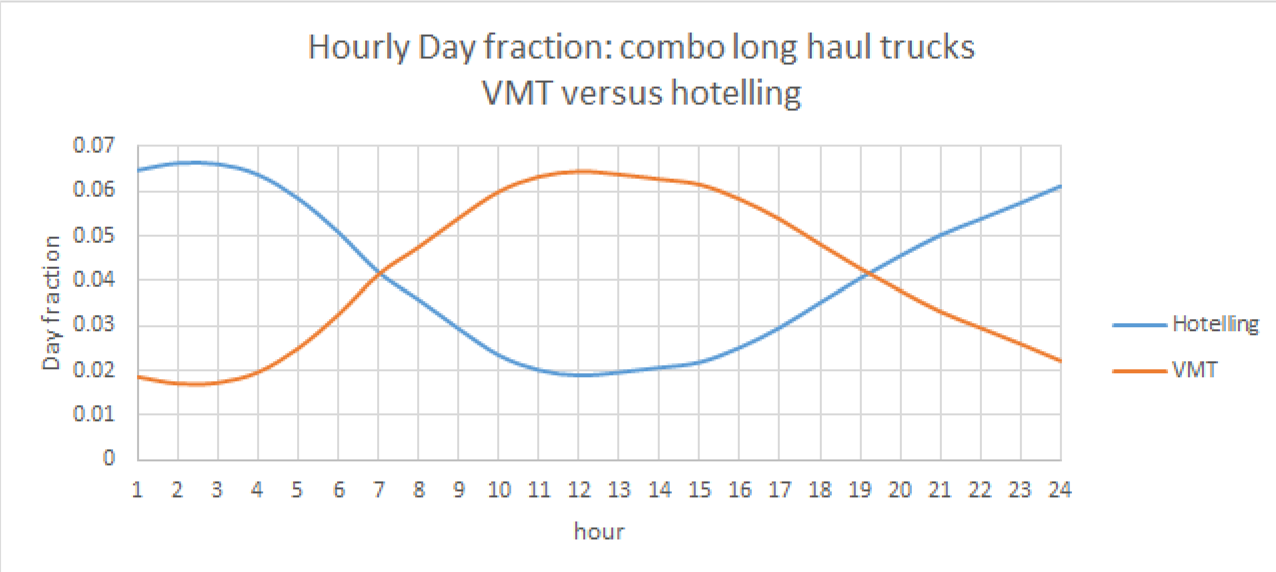

The gray lines of Figure 3-20 indicate the weekday profile, the blue the Saturday profile, and the orange the Sunday profile. In comparison, the new default profiles for weekdays places more LDGV VMT (upper plot) in the rush hours while placing HHDDV VMT (lower plot) predominately in the middle of the day with a longer tail into the evening hours and early morning. In addition to creating diurnal profiles, the EPA developed day of week profiles using the VTRIS data. The creation of the state and national profiles was similar to the diurnal profiles (described above). Figure 3-21 shows a set of national default profiles for rural restricted roads (top plot) and urban unrestricted roads (lower plot). Each vehicle type is a different color on the plots.

**Figure 3-21. Updated national default profiles for day of week**




The EPA also developed a national profile for hoteling by averaging all the combination long-haul truck profiles on restricted roads (urban and rural) for weekdays to create a single national restricted profile (orange line in Figure 3-22). This was then inverted to create a profile for hoteling (blue line in Figure 3-22). This single national profile was used for hoteling irrespective of location.

**Figure 3-22. Combination long-haul truck restricted and hoteling profile**




For California, CARB supplied diurnal profiles that varied by vehicle type, day of the week[23], and air basin. These CARB-specific profiles were used in developing EPA estimates for California. Although the EPA adjusted the total emissions to match California's submittal to the 2014NEIv1, the temporalization of these emissions took into account both the state-specific VMT profiles and the SMOKE-MOVES process of incorporating meteorology. For more details on the adjustments to California's onroad emissions, see Section 2.3.1.

### 3.3.8 Additional sector specific details (afdust, beis, cmv, rail, nonpt, ptnonipm, ptfire, np_oilgas)

For the afdust sector, meteorology is not used in the development of the temporal profiles, but it is used to reduce the total emissions based on meteorological conditions. These adjustments are applied through sector-specific scripts, beginning with the application of land use-based gridded transport fractions and then subsequent zero-outs for hours during which precipitation occurs or there is snow cover on the ground. The land use data used to reduce the NEI emissions explains the amount of emissions that are subject to transport. This methodology is discussed in (Pouliot et al., 2010, http://www3.epa.gov/ttn/chief/conference/ei19/session9/pouliot_pres.pdf), and in "Fugitive Dust Modeling for the 2008 Emissions Modeling Platform" (Adelman, 2012). The precipitation adjustment is applied to remove all emissions for days where measureable rain occurs. Therefore, the afdust emissions vary day-to-day based on the precipitation and/or snow cover for that grid cell and day. Both the transport fraction and meteorological adjustments are based on the gridded resolution of the platform; therefore, somewhat different emissions will result from different grid resolutions. Application of the transport fraction and meteorological adjustments prevents the overestimation of fugitive dust impacts in the grid modeling as compared to ambient samples.

Biogenic emissions in the beis sector vary by every day of the year because they are developed using meteorological data including temperature, surface pressure, and radiation/cloud data. The emissions are

[23] California's diurnal profiles varied within the week. Monday, Friday, Saturday, and Sunday had unique profiles and Tuesday, Wednesday, Thursday had the same profile.

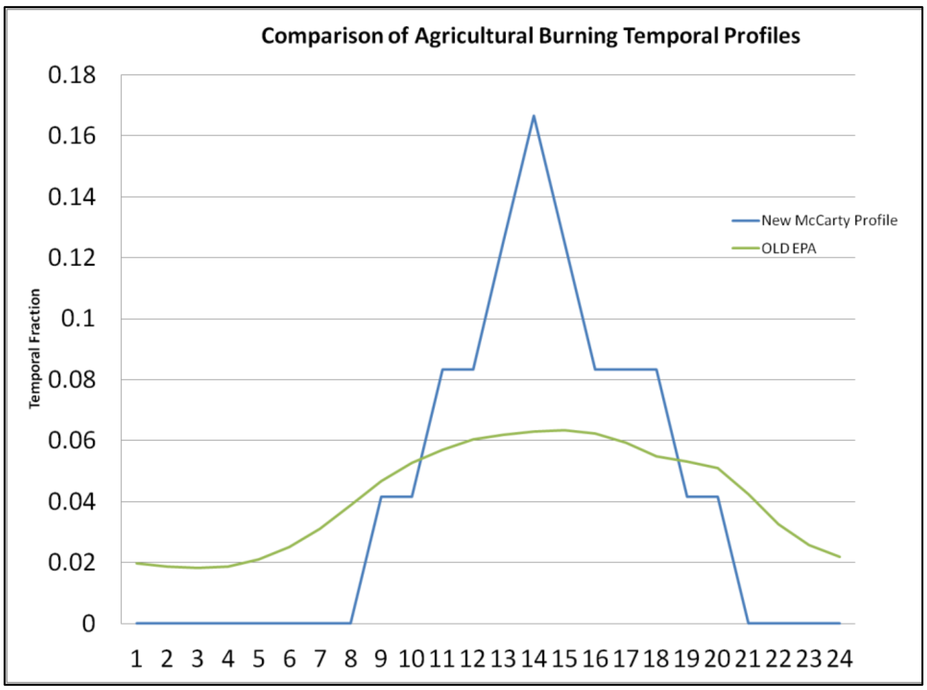
computed using appropriate emission factors according to the vegetation in each model grid cell, while taking the meteorological data into account.

For the cmv sector, emissions are allocated with flat day of week and flat hourly profiles. The C1 and C2 emissions are allocated with a flat monthly profile, while C3 emissions are allocated with a monthly profile developed specifically for C3.

For the rail sector, new monthly profiles were developed for the 2014 platform. Monthly temporalization for rail freight emissions is based on AAR Rail Traffic Data, Total Carloads and Intermodal, for 2014. For passenger trains, monthly temporalization is based on rail passenger miles data for 2014 from the Bureau of Transportation Statistics. Rail emissions are allocated with flat day of week profiles, and most emissions are allocated with flat hourly profiles.

For the agfire sector, we used the EPA-generated day-specific $PM_{2.5}$ emissions to develop state specific monthly profiles. For both agfire and ptagfire, the diurnal temporal profile used reflected the fact that burning occurs during the daylight hours (see Figure 3-23 (McCarty et al., 2009)). This puts most of the emissions during the work day and suppresses the emissions during the middle of the night. A uniform profile for each day of the week was used for all agricultural burning emissions in the agfire sector, except in Iowa, where the EPA used state-specific day of week profiles.

**Figure 3-23. Agricultural burning diurnal temporal profile**




Updates were made to temporal profiles for the ptnonipm sector in the 2011v6.2 platform based on comments and data review by EPA staff. Temporal profiles for small airports (i.e., non-commercial) were updated to eliminate emissions between 10pm and 6am due to a lack of tower operations. Industrial processes that are not likely to shut down on Sundays, such as those at cement plants, were assigned to other more realistic profiles that included emissions on Sundays. This also affected emissions on holidays because Sunday emissions are also used on holidays.

For the ptfire sectors, the inventories are in the daily point fire format ORL PTDAY. The ptfire sector is used in the model evaluation case (2011ek) and in the future base case (2017ek). The 2007 and earlier platforms had additional regulatory cases that used averaged fires and temporally averaged EGU emissions, but the 2011 platform uses base year-specific (i.e., 2011) data for both cases.

For the nonroad sector, while the NEI only stores the annual totals, the modeling platform uses monthly inventories from output from MOVES. For California, CARB's annual inventory was temporalized to monthly using monthly temporal profiles applied in SMOKE by SCC. This is an improvement over the 2011 platform, which applied monthly temporalization in California at the broader SCC7 level.

Some cross reference updates for temporalization of the np_oilgas sector were made in the 2011v6.2 and 2011v6.3 platform to assign np_oilgas sources to 24 hour per day, 7 days a week based on comments received.

## 3.4 Spatial Allocation

The methods used to perform spatial allocation are summarized in this section. For the modeling platform, spatial factors are typically applied by county and SCC. As described in Section 3.1, spatial allocation was performed for a national 12-km domain. To accomplish this, SMOKE used national 12-km spatial surrogates and a SMOKE area-to-point data file. For the U.S., the EPA updated surrogates to use circa 2010-2011 data wherever possible. For Mexico, updated spatial surrogates were used as described below. For Canada, surrogates provided by Environment Canada were used and are unchanged from the 2007 platform. The U.S., Mexican, and Canadian 12-km surrogates cover the entire CONUS domain 12US1 shown in Figure 3-1.

With the exception of some updates to the spatial surrogate cross reference, the spatial surrogates for the U.S. and Mexico used in the 2011v6.3 platform are the same as the surrogates used for the 2011v6.2 platform. The details regarding how the 2011v6.2 platform surrogates were created are available from ftp://ftp.epa.gov/EmisInventory/2011v6/v2platform/spatial_surrogates/ in the files *US_SpatialSurrogate_Workbook_v072115.xlsx* and *US_SpatialSurrogate_Documentation_v070115.pdf*, and *SurrogateTools_Scripts_2014.zip* available. The remainder of this subsection provides further detail on the origin of the data used for the spatial surrogates and the area-to-point data.

### 3.4.1 Spatial Surrogates for U.S. emissions

There are more than 100 spatial surrogates available for spatially allocating U.S. county-level emissions to the 12-km grid cells used by the air quality model. As described in Section 3.4.2, an area-to-point approach overrides the use of surrogates for a limited set of sources. Table 3-18 lists the codes and descriptions of the surrogates. Surrogate names and codes listed in *italics* are not directly assigned to any sources for the 2014v7.0 platform, but they are sometimes used to gapfill other surrogates, or as an input for merging two surrogates to create a new surrogate that is used.

Many surrogates were updated or newly developed for use in the 2014v7.0 platform (Adelman, 2016). They include the use of the 2011 National Land Cover Database (the previous platform used 2006) and development of various development density levels such as open, low, medium high and various combinations of these. These landuse surrogates largely replaced the FEMA category surrogates that were used in the 2011 platform. Additionally, onroad surrogates were developed using average annual daily traffic counts from the highway monitoring performance system (HPMS). Previously, the "activity" for the onroad surrogates was length of road miles. This and other surrogates are described in the reference Adelman, 2016.

Similar to 2011, the Surrogates for ports (801) and shipping lanes (802) were developed based on the shapes in the NEI; however they were updated using 2014NEIv1 shapefiles and activity data. The creation of surrogates and shapefiles for the U.S. was generated via the Surrogate Tool. The tool and documentation for it is available at https://www.cmascenter.org/sa-tools/documentation/4.2/SurrogateToolUserGuide_4_2.pdf.

**Table 3-18. U.S. Surrogates available for the 2014 modeling platform**

| Code | Surrogate Description | Code | Surrogate Description |
|---|---|---|---|
| N/A | Area-to-point approach (see 3.3.1.2) | 505 | Industrial Land |
| 100 | Population | 506 | Education |
| *110* | *Housing* | *507* | *Heavy Light Construction Industrial Land* |
| *131* | *urban Housing* | *510* | *Commercial plus Industrial* |
| *132* | *Suburban Housing* | *515* | *Commercial plus Institutional Land* |
| *134* | *Rural Housing* | *520* | *Commercial plus Industrial plus Institutional* |
| *137* | *Housing Change* | *525* | *Golf Courses plus Institutional plus Industrial plus Commercial* |
| *140* | *Housing Change and Population* | *526* | *Residential - Non-Institutional* |
| 150 | Residential Heating - Natural Gas | *527* | *Single Family Residential* |
| *160* | *Residential Heating - Wood* | 535 | Residential + Commercial + Industrial + Institutional + Government |
| 170 | Residential Heating - Distillate Oil | *540* | *Retail Trade (COM1)* |
| 180 | Residential Heating - Coal | *545* | *Personal Repair (COM3)* |
| 190 | Residential Heating - LP Gas | *555* | *Professional/Technical (COM4) plus General Government (GOV1)* |
| *201* | *Urban Restricted Road Miles* | 560 | Hospital (COM6) |
| 202 | Urban Restricted AADT | *575* | *Light and High Tech Industrial (IND2 + IND5)* |
| 205 | Extended Idle Locations | *580* | *Food Drug Chemical Industrial (IND3)* |
| *211* | *Rural Restricted Road Miles* | *585* | *Metals and Minerals Industrial (IND4)* |
| 212 | Rural Restricted AADT | *590* | *Heavy Industrial (IND1)* |
| *221* | *Urban Unrestricted Road Miles* | *595* | *Light Industrial (IND2)* |
| 222 | Urban Unrestricted AADT | *596* | *Industrial plus Institutional plus Hospitals* |
| *231* | *Rural Unrestricted Road Miles* | 650 | Refineries and Tank Farms |
| 232 | Rural Unrestricted AADT | 670 | Spud Count - CBM Wells |
| 239 | Total Road AADT | 671 | Spud Count - Gas Wells |
| 240 | Total Road Miles | 672 | Gas Production at Oil Wells |
| *241* | *Total Restricted Road Miles* | 673 | Oil Production at CBM Wells |
| 242 | All Restricted AADT | 674 | Unconventional Well Completion Counts |
| *243* | *Total Unrestricted Road Miles* | *676* | *Well Count - All Producing* |
| 244 | All Unrestricted AADT | *677* | *Well Count - All Exploratory* |
| 258 | Intercity Bus Terminals | 678 | Completions at Gas Wells |
| 259 | Transit Bus Terminals | 679 | Completions at CBM Wells |
| *260* | *Total Railroad Miles* | 681 | Spud Count - Oil Wells |
| 261 | NTAD Total Railroad Density | 683 | Produced Water at All Wells |
| 271 | NTAD Class 1 2 3 Railroad Density | 685 | Completions at Oil Wells |
| *272* | *NTAD Amtrak Railroad Density* | *686* | *Completions at All Wells* |
| *273* | *NTAD Commuter Railroad Density* | 687 | Feet Drilled at All Wells |
| *275* | *ERTAC Rail Yards* | 691 | Well Counts - CBM Wells |
| *280* | *Class 2 and 3 Railroad Miles* | 692 | Spud Count - All Wells |
| 300 | NLCD Low Intensity Development | 693 | Well Count - All Wells |

| Code | Surrogate Description | Code | Surrogate Description |
|---|---|---|---|
| *301* | *NLCD Med Intensity Development* | 694 | Oil Production at Oil Wells |
| *302* | *NLCD High Intensity Development* | 695 | Well Count - Oil Wells |
| *303* | *NLCD Open Space* | 696 | Gas Production at Gas Wells |
| 304 | NLCD Open + Low | 697 | Oil Production at Gas Wells |
| 305 | NLCD Low + Med | 698 | Well Count - Gas Wells |
| 306 | NLCD Med + High | 699 | Gas Production at CBM Wells |
| 307 | NLCD All Development | *710* | *Airport Points* |
| 308 | NLCD Low + Med + High | 711 | Airport Areas |
| 309 | NLCD Open + Low + Med | 801 | Port Areas |
| 310 | NLCD Total Agriculture | *805* | *Offshore Shipping Area* |
| *318* | *NLCD Pasture Land* | 806 | Offshore Shipping NEI2014 Activity |
| 319 | NLCD Crop Land | *807* | *Navigable Waterway Miles* |
| 320 | NLCD Forest Land | *820* | *Ports NEI2014 Activity* |
| 321 | NLCD Recreational Land | 850 | Golf Courses |
| *340* | *NLCD Land* | 860 | Mines |
| 350 | NLCD Water | *890* | *Commercial Timber* |
| *500* | *Commercial Land* | | |

For the onroad sector, the on-network (RPD) emissions were allocated differently from the off-network (RPP and RPV).  On-network used average annual daily traffic (AADT) data and off network used land use surrogates as shown in **Table 3-19**. Starting with the 2011v6.2 platform, emissions from the extended (i.e., overnight) idling of trucks were assigned to a new surrogate 205 that is based on locations of overnight truck parking spaces.  The underlying data in this surrogate was updated for use in the 2014v7.0 platform to include additional data sources and corrections based on comments received on the 2011 NATA.

**Table 3-19.  Off-Network Mobile Source Surrogates**

| Source type | Source Type name | **Surrogate ID** | **Description** |
|---|---|---|---|
| 11 | Motorcycle | 307 | NLCD All Development |
| 21 | Passenger Car | 307 | NLCD All Development |
| 31 | Passenger Truck | 307 | NLCD All Development |
| 32 | Light Commercial Truck | 308 | NLCD Low + Med + High |
| 41 | Intercity Bus | 258 | Intercity Bus Terminals |
| 42 | Transit Bus | 259 | Transit Bus Terminals |
| 43 | School Bus | 506 | Education |
| 51 | Refuse Truck | 306 | NLCD Med + High |
| 52 | Single Unit Short-haul Truck | 306 | NLCD Med + High |
| 53 | Single Unit Long-haul Truck | 306 | NLCD Med + High |
| 54 | Motor Home | 304 | NLCD Open + Low |
| 61 | Combination Short-haul Truck | 306 | NLCD Med + High |
| 62 | Combination Long-haul Truck | 306 | NLCD Med + High |

For the oil and gas sources in the np_oilgas sector, the spatial surrogates were updated to those shown in Table 3-20 using 2014 data consistent with what was used to develop the 2014NEI nonpoint oil and gas emissions.  The primary activity data source used for the development of the oil and gas spatial surrogates was data from Drilling Info (DI) Desktop's HPDI database (Drilling Info, 2015).  This database contains well-level location, production, and exploration statistics at the monthly level. Due to a proprietary agreement with DI Desktop, individual well locations and ancillary production cannot be made publicly available, but aggregated statistics are allowed. These data were supplemented with data from state Oil and Gas Commission (OGC) websites (Illinois, Idaho, Indiana, Kentucky, Missouri, Nevada, Oregon and Pennsylvania, Tennessee). In many cases, the correct surrogate parameter was not available (e.g., feet drilled), but an alternative surrogate parameter was available (e.g., number of spudded wells) and downloaded. Under that methodology, both completion date and date of first production from HPDI were used to identify wells completed during 2011. In total, over 1.43 million unique wells were compiled from the above data sources. The wells cover 34 states and 1,158 counties. (ERG, 2016b).

**Table 3-20. Spatial Surrogates for Oil and Gas Sources**

| Surrogate Code | Surrogate Description |
|---|---|
| 670 | Spud Count - CBM Wells |
| 671 | Spud Count - Gas Wells |
| 672 | Gas Production at Oil Wells |
| 673 | Oil Production at CBM Wells |
| 674 | Unconventional Well Completion Counts |
| 676 | Well Count - All Producing |
| 677 | Well Count - All Exploratory |
| 678 | Completions at Gas Wells |
| 679 | Completions at CBM Wells |
| 681 | Spud Count - Oil Wells |
| 683 | Produced Water at All Wells |
| 685 | Completions at Oil Wells |
| 686 | Completions at All Wells |
| 687 | Feet Drilled at All Wells |
| 691 | Well Counts - CBM Wells |
| 692 | Spud Count - All Wells |
| 693 | Well Count - All Wells |
| 694 | Oil Production at Oil Wells |
| 695 | Well Count - Oil Wells |
| 696 | Gas Production at Gas Wells |
| 697 | Oil Production at Gas Wells |
| 698 | Well Count - Gas Wells |
| 699 | Gas Production at CBM Wells |

Not all of the available surrogates are used to spatially allocate sources in the modeling platform; that is, some surrogates shown in Table 3-18 were not assigned to any SCCs, although many of the "unused" surrogates are actually used to "gap fill" other surrogates that are used. When the source data for a surrogate has no values for a particular county, gap filling is used to provide values for the surrogate in those counties to ensure that no emissions are dropped when the spatial surrogates are applied to the emission inventories. Table 3-22 shows the CAP emissions (i.e., $NH_3$, NOx, $PM_{2.5}$, $SO_2$, and VOC) by sector, with rows for each sector listed in order of most emissions to least CAP emissions. To look at the relative importance of the surrogates within the platform sectors for HAPs, we computed the toxicity-weighted emissions for the CMAQ HAPs for the surrogates used in CMAQ (i.e., based on the SCC-to-surrogate assignments for CMAQ); these are shown Table 3-22.

**Table 3-21. Selected 2014 CAP emissions by sector for U.S. Surrogates (CONUS domain totals)**

| Sector | ID | Description | NH3 | NOX | PM2_5 | SO2 | VOC |
|---|---|---|---|---|---|---|---|
| afdust | 240 | Total Road Miles | | | 253,093 | | |
| afdust | 304 | NLCD Open + Low | | | 1,116,883 | | |
| afdust | 306 | NLCD Med + High | | | 45,958 | | |
| afdust | 308 | NLCD Low + Med + High | | | 139,554 | | |
| afdust | 310 | NLCD Total Agriculture | | | 1,169,400 | | |
| ag | 310 | NLCD Total Agriculture | 3,135,285 | | | | |
| agfire | 310 | NLCD Total Agriculture | 51,422 | 10,807 | 28,598 | 3,627 | 20,194 |
| agfire | 319 | NLCD Crop Land | 273 | 224 | 234 | 28 | 229 |
| agfire | 320 | NLCD Forest Land | 7 | 30 | 94 | 12 | 105 |
| cmv | 801 | Port Areas | 24 | 48,600 | 1,745 | 13,428 | 1,971 |
| cmv | 806 | Offshore Shipping NEI2014 Activity | 285 | 553,705 | 16,145 | 30,848 | 12,719 |
| nonpt | 100 | Population | 32,222 | 0 | 0 | 0 | 1,137,409 |
| nonpt | 150 | Residential Heating - Natural Gas | 47,296 | 219,671 | 3,593 | 1,445 | 13,311 |
| nonpt | 170 | Residential Heating - Distillate Oil | 1,726 | 34,923 | 3,680 | 64,628 | 1,153 |
| nonpt | 180 | Residential Heating - Coal | 20 | 101 | 53 | 1,086 | 111 |
| nonpt | 190 | Residential Heating - LP Gas | 121 | 34,025 | 175 | 675 | 1,321 |
| nonpt | 239 | Total Road AADT | 0 | 25 | 552 | 0 | 276,354 |
| nonpt | 240 | Total Road Miles | 0 | 0 | 0 | 0 | 36,941 |
| nonpt | 242 | All Restricted AADT | 0 | 0 | 0 | 0 | 5,451 |
| nonpt | 244 | All Unrestricted AADT | 0 | 0 | 0 | 0 | 95,327 |
| nonpt | 271 | NTAD Class 1 2 3 Railroad Density | 0 | 0 | 0 | 0 | 2,252 |
| nonpt | 300 | NLCD Low Intensity Development | 5,183 | 24,399 | 107,748 | 2,982 | 76,167 |
| nonpt | 304 | NLCD Open + Low | 0 | 0 | 0 | 0 | 0 |
| nonpt | 306 | NLCD Med + High | 22,268 | 239,863 | 290,187 | 181,982 | 864,662 |
| nonpt | 307 | NLCD All Development | 24 | 53,320 | 144,940 | 16,485 | 611,569 |
| nonpt | 308 | NLCD Low + Med + High | 1,205 | 187,485 | 17,977 | 31,506 | 72,126 |
| nonpt | 310 | NLCD Total Agriculture | 0 | 0 | 37 | 0 | 242,713 |
| nonpt | 319 | NLCD Crop Land | 0 | 0 | 95 | 71 | 293 |
| nonpt | 320 | NLCD Forest Land | 3,984 | 13 | 54 | 0 | 61 |
| nonpt | 505 | Industrial Land | 0 | 0 | 0 | 0 | 174 |
| nonpt | 535 | Residential + Commercial + Industrial + Institutional + Government | 0 | 2 | 130 | 0 | 39 |
| nonpt | 560 | Hospital (COM6) | 0 | 0 | 0 | 0 | 0 |
| nonpt | 650 | Refineries and Tank Farms | 0 | 22 | 0 | 0 | 101,206 |
| nonpt | 711 | Airport Areas | 0 | 0 | 0 | 0 | 277 |
| nonpt | 801 | Port Areas | 0 | 0 | 0 | 0 | 7,862 |
| nonroad | 261 | NTAD Total Railroad Density | 3 | 2,593 | 273 | 4 | 503 |

| Sector | ID | Description | NH3 | NOX | PM2_5 | SO2 | VOC |
|---|---|---|---|---|---|---|---|
| nonroad | 304 | NLCD Open + Low | 4 | 2,205 | 191 | 6 | 3,245 |
| nonroad | 305 | NLCD Low + Med | 110 | 23,017 | 4,557 | 146 | 149,863 |
| nonroad | 306 | NLCD Med + High | 345 | 243,170 | 15,750 | 526 | 126,354 |
| nonroad | 307 | NLCD All Development | 101 | 36,090 | 15,361 | 132 | 169,762 |
| nonroad | 308 | NLCD Low + Med + High | 673 | 458,488 | 38,060 | 886 | 69,386 |
| nonroad | 309 | NLCD Open + Low + Med | 111 | 22,350 | 1,257 | 148 | 44,500 |
| nonroad | 310 | NLCD Total Agriculture | 479 | 419,553 | 31,921 | 667 | 48,098 |
| nonroad | 320 | NLCD Forest Land | 19 | 8,900 | 1,377 | 25 | 8,628 |
| nonroad | 321 | NLCD Recreational Land | 157 | 20,841 | 15,119 | 229 | 553,747 |
| nonroad | 350 | NLCD Water | 215 | 144,088 | 8,855 | 361 | 448,425 |
| nonroad | 693 | Well Count - All Wells | 10 | 5,845 | 229 | 12 | 1,566 |
| nonroad | 850 | Golf Courses | 13 | 2,176 | 115 | 17 | 5,668 |
| nonroad | 860 | Mines | 2 | 2,760 | 298 | 4 | 549 |
| np_oilgas | 670 | Spud Count - CBM Wells | 0 | 0 | 0 | 0 | 267 |
| np_oilgas | 671 | Spud Count - Gas Wells | 0 | 0 | 0 | 0 | 10,989 |
| np_oilgas | 672 | Gas Production at Oil Wells | 0 | 2,863 | 0 | 21,709 | 127,494 |
| np_oilgas | 673 | Oil Production at CBM Wells | 0 | 35 | 0 | 0 | 1,795 |
| np_oilgas | 674 | Unconventional Well Completion Counts | 0 | 47,606 | 1,823 | 47 | 3,150 |
| np_oilgas | 678 | Completions at Gas Wells | 0 | 3,735 | 26 | 6,328 | 74,408 |
| np_oilgas | 679 | Completions at CBM Wells | 0 | 16 | 0 | 601 | 2,155 |
| np_oilgas | 681 | Spud Count - Oil Wells | 0 | 0 | 0 | 0 | 66,565 |
| np_oilgas | 683 | Produced Water at All Wells | 0 | 10 | 0 | 0 | 67,101 |
| np_oilgas | 685 | Completions at Oil Wells | 0 | 3,107 | 130 | 2,181 | 50,785 |
| np_oilgas | 687 | Feet Drilled at All Wells | 0 | 109,487 | 4,004 | 628 | 8,130 |
| np_oilgas | 691 | Well Counts -  CBM Wells | 0 | 38,117 | 603 | 15 | 34,187 |
| np_oilgas | 692 | Spud Count - All Wells | 0 | 8,628 | 258 | 135 | 366 |
| np_oilgas | 693 | Well Count - All Wells | 0 | 0 | 0 | 0 | 166 |
| np_oilgas | 694 | Oil Production at Oil Wells | 0 | 4,375 | 0 | 5,468 | 1,104,120 |
| np_oilgas | 695 | Well Count - Oil Wells | 0 | 122,856 | 3,091 | 63 | 455,552 |
| np_oilgas | 696 | Gas Production at Gas Wells | 0 | 59,634 | 3,131 | 251 | 112,335 |
| np_oilgas | 697 | Oil Production at Gas Wells | 0 | 1,360 | 0 | 26 | 354,406 |
| np_oilgas | 698 | Well Count - Gas Wells | 15 | 388,677 | 6,726 | 310 | 623,925 |
| np_oilgas | 699 | Gas Production at CBM Wells | 0 | 3,094 | 403 | 32 | 6,578 |
| onroad | 202 | Urban Restricted AADT | 24,687 | 790,075 | 30,439 | 5,846 | 149,645 |
| onroad | 205 | Extended Idle Locations | 748 | 273,106 | 4,425 | 104 | 56,079 |
| onroad | 212 | Rural Restricted AADT | 10,867 | 684,006 | 20,322 | 2,853 | 77,075 |
| onroad | 222 | Urban Unrestricted AADT | 42,001 | 1,223,593 | 54,345 | 11,950 | 376,209 |
| onroad | 232 | Rural Unrestricted AADT | 25,027 | 987,683 | 33,882 | 6,434 | 201,764 |
| onroad | 239 | Total Road AADT | | | | | 6,573 |
| onroad | 242 | All Restricted AADT | | | | | 315 |
| onroad | 258 | Intercity Bus Terminals | | 165 | 2 | 0 | 38 |
| onroad | 259 | Transit Bus Terminals | | 58 | 5 | 0 | 171 |
| onroad | 304 | NLCD Open + Low | | 821 | 22 | 1 | 2,683 |

| Sector | ID | Description | NH3 | NOX | PM2_5 | SO2 | VOC |
|---|---|---|---|---|---|---|---|
| onroad | 306 | NLCD Med + High | | 18,500 | 384 | 20 | 22,396 |
| onroad | 307 | NLCD All Development | | 560,112 | 12,560 | 1,001 | 1,142,592 |
| onroad | 308 | NLCD Low + Med + High | | 83,977 | 1,583 | 113 | 133,883 |
| onroad | 506 | Education | | 664 | 29 | 1 | 1,107 |
| rail | 261 | NTAD Total Railroad Density | 2 | 12,494 | 297 | 282 | 736 |
| rail | 271 | NTAD Class 1 2 3 Railroad Density | 362 | 767,307 | 22,868 | 6,704 | 39,121 |
| rwc | 300 | NLCD Low Intensity Development | 16,221 | 32,174 | 332,700 | 8,087 | 351,696 |

# Table 3-22. Total and Toxicity-weighted Emissions of CMAQ HAPs Based on the CMAQ Surrogate Assignments

| Surrogate Code | Surrogate Description | Total CMAQ Emissions (HAP and Diesel PM): Fraction of Sector and Total | | | | | | | | | Cancer-weighted CMAQ Emissions: Fraction of Sector and Total | | | | | | | | | Respiratory-weighted CMAQ Emissions: Fraction of Sector and Total | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | agfire | cmv | nonpt | nonroad | np_oilgas | onroad | rail | rwc | Total (TPY) | agfire | cmv | nonpt | nonroad | np_oilgas | onroad | rail | rwc | Total (TPY) | agfire | cmv | nonpt | nonroad | np_oilgas | onroad | rail | rwc | Total (TPY) |
| 100 | Population | | | 1.00 | | | | | | 175,749 | | | 1.00 | | | | | | 142,136 | | | 1.00 | | | | | | 10,617 |
| 150 | Residential Heating - Natural Gas | | | 1.00 | | | | | | 813 | | | 1.00 | | | | | | 2,021 | | | 1.00 | | | | | | 845 |
| 170 | Residential Heating - Distillate Oil | | | 1.00 | | | | | | 82 | | | 1.00 | | | | | | 3,838 | | | 1.00 | | | | | | 185 |
| 180 | Residential Heating - Coal | | | 1.00 | | | | | | 13 | | | 1.00 | | | | | | 9 | | | 1.00 | | | | | | 3 |
| 190 | Residential Heating - LP Gas | | | 1.00 | | | | | | 45 | | | 1.00 | | | | | | 204 | | | 1.00 | | | | | | 38 |
| 202 | Urban Restricted AADT | | | | | | 1.00 | | | 59,103 | | | | | | 1.00 | | | 47,686 | | | | | | 1.00 | | | 55,572 |
| 205 | Extended Idle Locations | | | | | | 1.00 | | | 18,087 | | | | | | 1.00 | | | 44,128 | | | | | | 1.00 | | | 80,817 |
| 212 | Rural Restricted AADT | | | | | | 1.00 | | | 36,468 | | | | | | 1.00 | | | 25,869 | | | | | | 1.00 | | | 41,375 |
| 222 | Urban Unrestricted AADT | | | | | | 1.00 | | | 132,474 | | | | | | 1.00 | | | 98,825 | | | | | | 1.00 | | | 103,245 |
| 232 | Rural Unrestricted AADT | | | | | | 1.00 | | | 78,599 | | | | | | 1.00 | | | 57,406 | | | | | | 1.00 | | | 73,498 |
| 239 | Total Road AADT | | | 0.89 | | | 0.11 | | | 17,406 | | | 0.94 | | | 0.06 | | | 2,570 | | | 1.00 | | | 0.00 | | | 2,173 |
| 240 | Total Road Miles | | | 1.00 | | | | | | 2,816 | | | 1.00 | | | | | | 1 | | | 1.00 | | | | | | 0 |
| 242 | All Restricted AADT | | | 0.94 | | | 0.06 | | | 274 | | | 0.95 | | | 0.05 | | | 92 | | | 1.00 | | | 0.00 | | | 0 |
| 244 | All Unrestricted AADT | | | 1.00 | | | | | | 3,910 | | | 1.00 | | | | | | 783 | | | 1.00 | | | | | | 0 |
| 258 | Intercity Bus Terminals | | | | | | 1.00 | | | 11 | | | | | | 1.00 | | | 29 | | | | | | 1.00 | | | 53 |
| 259 | Transit Bus Terminals | | | | | | 1.00 | | | 47 | | | | | | 1.00 | | | 89 | | | | | | 1.00 | | | 132 |
| 261 | NTAD Total Railroad Density | | | | 0.61 | | | 0.39 | | 813 | | | | 1.00 | | | 0.00 | | 587 | | | | 0.89 | | | 0.11 | | 2,144 |
| 271 | NTAD Class 1 2 3 Railroad Density | | | 0.00 | | | | 1.00 | | 28,020 | | | 0.00 | | | | 1.00 | | 10,818 | | | 0.00 | | | | 1.00 | | 35,854 |
| 300 | NLCD Low Intensity Development | | | 0.31 | | | | | 0.69 | 77,479 | | | 0.13 | | | | | 0.87 | 291,399 | | | 0.19 | | | | | 0.81 | 194,627 |
| 304 | NLCD Open + Low | | | 0.00 | 0.61 | | 0.39 | | | 1,843 | | | 0.00 | 0.74 | | 0.26 | | | 1,453 | | | 0.00 | 0.89 | | 0.11 | | | 1,945 |
| 305 | NLCD Low + Med | | | | 1.00 | | | | | 43,820 | | | | 1.00 | | | | | 32,065 | | | | 1.00 | | | | | 7,499 |
| 306 | NLCD Med + High | | | 0.59 | 0.36 | | 0.05 | | | 133,824 | | | 0.53 | 0.42 | | 0.05 | | | 135,209 | | | 0.09 | 0.83 | | 0.08 | | | 95,250 |
| 307 | NLCD All Development | | | 0.08 | 0.14 | | 0.78 | | | 404,405 | | | 0.20 | 0.11 | | 0.68 | | | 360,756 | | | 0.23 | 0.12 | | 0.65 | | | 204,290 |
| 308 | NLCD Low + Med + High | | | 0.05 | 0.61 | | 0.34 | | | 109,665 | | | 0.05 | 0.66 | | 0.29 | | | 113,067 | | | 0.00 | 0.90 | | 0.09 | | | 211,239 |
| 309 | NLCD Open + Low + Med | | | | 1.00 | | | | | 14,387 | | | | 1.00 | | | | | 15,410 | | | | 1.00 | | | | | 4,941 |
| 310 | NLCD Total Agriculture | 0.24 | | 0.03 | 0.73 | | | | | 72,364 | 0.49 | | 0.03 | 0.48 | | | | | 118,012 | 0.56 | | 0.05 | 0.39 | | | | | 410,821 |
| 319 | NLCD Crop Land | 0.91 | | 0.09 | | | | | | 259 | 0.41 | | 0.59 | | | | | | 2,077 | 1.00 | | 0.00 | | | | | | 1,912 |
| 320 | NLCD Forest Land | 0.02 | | 0.00 | 0.98 | | | | | 3,623 | 0.09 | | 0.00 | 0.91 | | | | | 3,312 | 0.22 | | 0.00 | 0.78 | | | | | 3,983 |
| 321 | NLCD Recreational Land | | | | 1.00 | | | | | 182,261 | | | | 1.00 | | | | | 89,067 | | | | 1.00 | | | | | 40,247 |
| 350 | NLCD Water | | | | 1.00 | | | | | 139,898 | | | | 1.00 | | | | | 84,122 | | | | 1.00 | | | | | 44,840 |
| 505 | Industrial Land | | | | | | | | | 0 | | | | | | | | | 0 | | | | | | | | | 0 |
| 506 | Education | | | | | | 1.00 | | | 302 | | | | | | 1.00 | | | 443 | | | | | | 1.00 | | | 607 |

| Surrogate Code | Surrogate Description | Total CMAQ Emissions (HAP and Diesel PM): Fraction of Sector and Total | | | | | | | | | Cancer-weighted CMAQ Emissions: Fraction of Sector and Total | | | | | | | | | Respiratory-weighted CMAQ Emissions: Fraction of Sector and Total | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | agfire | cmv | nonpt | nonroad | np_oilgas | onroad | rail | rwc | Total (TPY) | agfire | cmv | nonpt | nonroad | np_oilgas | onroad | rail | rwc | Total (TPY) | agfire | cmv | nonpt | nonroad | np_oilgas | onroad | rail | rwc | Total (TPY) |
| 535 | Residential + Commercial + Industrial + Institutional + Government | | | | | | | | | 0 | | | | | | | | | 0 | | | | | | | | | 0 |
| 560 | Hospital (COM6) | | | | | | | | | 0 | | | | | | | | | 0 | | | | | | | | | 0 |
| 650 | Refineries and Tank Farms | | | 1.00 | | | | | | 4,337 | | | 1.00 | | | | | | 1,315 | | | 1.00 | | | | | | 0 |
| 670 | Spud Count - CBM Wells | | | | | 1.00 | | | | 1 | | | | | 1.00 | | | | 1 | | | | | | | | | 0 |
| 671 | Spud Count - Gas Wells | | | | | 1.00 | | | | 31 | | | | | 1.00 | | | | 34 | | | | | | | | | 0 |
| 672 | Gas Production at Oil Wells | | | | | 1.00 | | | | 321 | | | | | 1.00 | | | | 1,005 | | | | | 1.00 | | | | 64 |
| 673 | Oil Production at CBM Wells | | | | | 1.00 | | | | 37 | | | | | 1.00 | | | | 103 | | | | | 1.00 | | | | 7 |
| 674 | Unconventional Well Completion Counts | | | | | 1.00 | | | | 642 | | | | | 1.00 | | | | 1,639 | | | | | 1.00 | | | | 202 |
| 678 | Completions at Gas Wells | | | | | 1.00 | | | | 458 | | | | | 1.00 | | | | 1,460 | | | | | 1.00 | | | | 99 |
| 679 | Completions at CBM Wells | | | | | 1.00 | | | | 18 | | | | | 1.00 | | | | 52 | | | | | 1.00 | | | | 3 |
| 681 | Spud Count - Oil Wells | | | | | 1.00 | | | | 182 | | | | | 1.00 | | | | 270 | | | | | | | | | 0 |
| 683 | Produced Water at All Wells | | | | | 1.00 | | | | 192 | | | | | 1.00 | | | | 291 | | | | | | | | | 0 |
| 685 | Completions at Oil Wells | | | | | 1.00 | | | | 532 | | | | | 1.00 | | | | 1,878 | | | | | 1.00 | | | | 130 |
| 687 | Feet Drilled at All Wells | | | | | 1.00 | | | | 1,727 | | | | | 1.00 | | | | 4,691 | | | | | 1.00 | | | | 2,223 |
| 691 | Well Counts - CBM Wells | | | | | 1.00 | | | | 1,315 | | | | | 1.00 | | | | 3,949 | | | | | 1.00 | | | | 13,587 |
| 692 | Spud Count - All Wells | | | | | 1.00 | | | | 9 | | | | | 1.00 | | | | 21 | | | | | 1.00 | | | | 1 |
| 693 | Well Count - All Wells | | | | 1.00 | 0.00 | | | | 681 | | | | 1.00 | 0.00 | | | | 1,057 | | | | 1.00 | 0.00 | | | | 1,158 |
| 694 | Oil Production at Oil Wells | | | | | 1.00 | | | | 17,393 | | | | | 1.00 | | | | 29,554 | | | | | 1.00 | | | | 507 |
| 695 | Well Count - Oil Wells | | | | | 1.00 | | | | 8,548 | | | | | 1.00 | | | | 24,933 | | | | | 1.00 | | | | 84,624 |
| 696 | Gas Production at Gas Wells | | | | | 1.00 | | | | 48,651 | | | | | 1.00 | | | | 43,667 | | | | | 1.00 | | | | 2,452 |
| 697 | Oil Production at Gas Wells | | | | | 1.00 | | | | 5,897 | | | | | 1.00 | | | | 12,806 | | | | | 1.00 | | | | 770 |
| 698 | Well Count - Gas Wells | | | | | 1.00 | | | | 15,815 | | | | | 1.00 | | | | 36,698 | | | | | 1.00 | | | | 115,595 |
| 699 | Gas Production at CBM Wells | | | | | 1.00 | | | | 2,441 | | | | | 1.00 | | | | 1,806 | | | | | 1.00 | | | | 170 |
| 711 | Airport Areas | | | 1.00 | | | | | | 12 | | | 1.00 | | | | | | 9 | | | 1.00 | | | | | | 0 |
| 801 | Port Areas | | 1.00 | 0.00 | | | | | | 2,195 | | 1.00 | 0.00 | | | | | | 4,831 | | 1.00 | 0.00 | | | | | | 2,332 |
| 806 | Offshore Shipping NEI2014 Activity | | 1.00 | | | | | | | 18,486 | | 1.00 | | | | | | | 13,272 | | 1.00 | | | | | | | 16,553 |
| 850 | Golf Courses | | | | 1.00 | | | | | 1,816 | | | | 1.00 | | | | | 1,884 | | | | 1.00 | | | | | 398 |
| 860 | Mines | | | | 1.00 | | | | | 573 | | | | 1.00 | | | | | 787 | | | | 1.00 | | | | | 2,610 |

### 3.4.2 Allocation method for airport-related sources in the U.S.

There are numerous airport-related emission sources in the NEI, such as aircraft, airport ground support equipment, and jet refueling. The modeling platform includes the aircraft and airport ground support equipment emissions as point sources. For the modeling platform, the EPA used the SMOKE "area-to-point" approach for only jet refueling in the nonpt sector. The following SCCs use this approach: 2501080050 and 2501080100 (petroleum storage at airports), and 2810040000 (aircraft/rocket engine firing and testing). The ARTOPNT approach is described in detail in the 2002 platform documentation: http://www3.epa.gov/scram001/reports/Emissions%20TSD%20Vol1_02-28-08.pdf. The ARTOPNT file that lists the nonpoint sources to locate using point data were unchanged from the 2005-based platform.

### 3.4.3 Surrogates for Canada and Mexico emission inventories

The surrogates for Canada to spatially allocate the 2010 Canadian emissions have been updated in the 2011v6.2 platform. The spatial surrogate data came from Environment Canada, along with cross references. The surrogates they provided were outputs from the Surrogate Tool (previously referenced). The Canadian surrogates used for this platform are listed in Table 3-23. The leading "9" was added to the surrogate codes to avoid duplicate surrogate numbers with U.S. surrogates. Surrogates for Mexico are circa 1999 and 2000 and were based on data obtained from the Sistema Municpal de Bases de Datos (SIMBAD) de INEGI and the Bases de datos del Censo Economico 1999. Most of the CAPs allocated to the Mexico and Canada surrogates are shown in Table 3-24. The entries in this table are for the othar sector except for the "MEX Total Road Miles" and the "CAN traffic" rows, which are for the othon sector.

**Table 3-23. Canadian Spatial Surrogates**

| Code | Canadian Surrogate Description | Code | Description |
|---|---|---|---|
| 9100 | Population | 92424 | BARLEY |
| 9101 | total dwelling | 92425 | BUCWHT |
| 9103 | rural dwelling | 92426 | CANARY |
| 9106 | ALL_INDUST | 92427 | CANOLA |
| 9111 | Farms | 92428 | CHICPEA |
| 9113 | Forestry and logging | 92429 | CORNGR |
| 9211 | Oil and Gas Extraction | 92425 | BUCWHT |
| 9212 | Mining except oil and gas | 92430 | CORNSI |
| 9221 | Total Mining | 92431 | DFPEAS |
| 9222 | Utilities | 92432 | FLAXSD |
| 9233 | Total Land Development | 92433 | FORAGE |
| 9308 | Food manufacturing | 92434 | LENTIL |
| 9321 | Wood product manufacturing | 92435 | MUSTSD |
| 9323 | Printing and related support activities | 92436 | MXDGRN |
| 9324 | Petroleum and coal products manufacturing | 92437 | OATS |
| 9327 | Non-metallic mineral product manufacturing | 92438 | ODFBNS |
| 9331 | Primary Metal Manufacturing | 92439 | OTTAME |
| 9412 | Petroleum product wholesaler-distributors | 92440 | POTATS |
| 9416 | Building material and supplies wholesaler-distributors | 92441 | RYEFAL |

| Code | Canadian Surrogate Description | Code | Description |
|---|---|---|---|
| 9447 | Gasoline stations | 92442 | RYESPG |
| 9448 | clothing and clothing accessories stores | 92443 | SOYBNS |
| 9481 | Air transportation | 92444 | SUGARB |
| 9482 | Rail transportation | 92445 | SUNFLS |
| 9562 | Waste management and remediation services | 92446 | TOBACO |
| 9921 | Commercial Fuel Combustion | 92447 | TRITCL |
| 9924 | Primary Industry | 92448 | WHITBN |
| 9925 | Manufacturing and Assembly | 92449 | WHTDUR |
| 9932 | CANRAIL | 92450 | WHTSPG |
| 9941 | PAVED ROADS | 92451 | WHTWIN |
| 9942 | UNPAVED ROADS | 92452 | BEANS |
| 9945 | Commercial Marine Vessels | 92453 | CARROT |
| 9946 | Construction and mining | 92454 | GRPEAS |
| 9948 | Forest | 92455 | OTHVEG |
| 9950 | Combination of Forest and Dwelling | 92456 | SWCORN |
| 9955 | UNPAVED_ROADS_AND_TRAILS | 92457 | TOMATO |
| 9960 | TOTBEEF | 92430 | CORNSI |
| 9970 | TOTPOUL | 92431 | DFPEAS |
| 9980 | TOTSWIN | 92432 | FLAXSD |
| 9990 | TOTFERT | 92433 | FORAGE |
| 9996 | urban_area | 92434 | LENTIL |
| 9997 | CHBOISQC | 92435 | MUSTSD |
| 91201 | traffic_bcw | 92436 | MXDGRN |
| 92401 | BULLS | 92437 | OATS |
| 92402 | BFCOWS | 92438 | ODFBNS |
| 92403 | BFHEIF | 92439 | OTTAME |
| 92404 | CALFU1 | 92440 | POTATS |
| 92405 | FDHEIF | 92441 | RYEFAL |
| 92406 | STEERS | 92442 | RYESPG |
| 92407 | MLKCOW | 92443 | SOYBNS |
| 92408 | MLKHEIF | 92444 | SUGARB |
| 92409 | MBULLS | 92445 | SUNFLS |
| 92410 | MCALFU1 | 92446 | TOBACO |
| 92412 | BROILER | 92447 | TRITCL |
| 92413 | LAYHEN | 92448 | WHITBN |
| 92414 | TURKEY | 92449 | WHTDUR |
| 92416 | BOARS | 92450 | WHTSPG |
| 92417 | GRWPIG | 92451 | WHTWIN |
| 92418 | NURPIG | 92452 | BEANS |
| 92419 | SOWS | 92453 | CARROT |
| 92421 | IMPAST | 92454 | GRPEAS |
| 92422 | UNIMPAST | 92455 | OTHVEG |
| 92423 | ALFALFA | 92456 | SWCORN |
| | | 92457 | TOMATO |

**Table 3-24. CAPs Allocated to Mexican and Canadian Spatial Surrogates**

| Code | Mexican or Canadian Surrogate Description | $NH_3$ | $NO_X$ | $PM_{2\_5}$ | $SO_2$ | VOC |
|---|---|---|---|---|---|---|
| 10 | MEX Population | 0 | 190 | 5 | 1 | 382 |
| 12 | MEX Housing | 22,251 | 100,483 | 3,592 | 404 | 124,046 |
| 14 | MEX Residential Heating – Wood | 0 | 1,047 | 13,415 | 161 | 92,226 |
| 16 | MEX Residential Heating - Distillate Oil | 0 | 11 | 0 | 3 | 0 |
| 20 | MEX Residential Heating - LP Gas | 0 | 5,043 | 153 | 0 | 87 |
| 22 | MEX Total Road Miles | 2,324 | 314,011 | 8,477 | 4,788 | 65,593 |
| 24 | MEX Total Railroads Miles | 0 | 18,474 | 413 | 162 | 721 |
| 26 | MEX Total Agriculture | 151,745 | 106,403 | 22,474 | 5,170 | 8,474 |
| 32 | MEX Commercial Land | 0 | 65 | 1,405 | 0 | 18,989 |
| 34 | MEX Industrial Land | 4 | 1,003 | 1,726 | 0 | 103,122 |
| 36 | MEX Commercial plus Industrial Land | 0 | 1,782 | 26 | 4 | 87,825 |
| 38 | MEX Commercial plus Institutional Land | 3 | 1,611 | 77 | 4 | 51 |
| 40 | MEX Residential (RES1-4)+Comercial+Industrial+Institutional+Government | 0 | 4 | 9 | 0 | 66,174 |
| 42 | MEX Personal Repair (COM3) | 0 | 0 | 0 | 0 | 4,833 |
| 44 | MEX Airports Area | 0 | 2,489 | 67 | 316 | 793 |
| 50 | MEX Mobile sources - Border Crossing - Mexico | 4 | 130 | 1 | 2 | 241 |
| 9100 | CAN Population | 583 | 19 | 607 | 11 | 243 |
| 9101 | CAN total dwelling | 266 | 26,532 | 6,819 | 4,937 | 17,532 |
| 9103 | CAN rural dwelling | 2 | 340 | 71 | 2 | 2,004 |
| 9106 | CAN ALL_INDUST | 5 | 5,895 | 257 | 6 | 1,219 |
| 9111 | CAN Farms | 31 | 23,269 | 1,890 | 29 | 2,799 |
| 9113 | CAN Forestry and logging | 576 | 5,242 | 268 | 630 | 15,295 |
| 9211 | CAN Oil and Gas Extraction | 1 | 1,275 | 72 | 1 | 132 |
| 9212 | CAN Mining except oil and gas | 0 | 0 | 2,074 | 0 | 0 |
| 9221 | CAN Total Mining | 39 | 9,808 | 41,214 | 1,212 | 940 |
| 9222 | CAN Utilities | 60 | 3,831 | 305 | 652 | 164 |
| 9233 | CAN Total Land Development | 16 | 10,779 | 1,134 | 14 | 1,788 |
| 9308 | CAN Food manufacturing | 0 | 0 | 4,324 | 0 | 7,548 |
| 9321 | CAN Wood product manufacturing | 0 | 0 | 537 | 0 | 0 |
| 9323 | CAN Printing and related support activities | 0 | 0 | 0 | 0 | 33,802 |
| 9324 | CAN Petroleum and coal products manufacturing | 0 | 784 | 835 | 410 | 2,751 |
| 9327 | CAN Non-metallic mineral product manufacturing | 0 | 0 | 4,362 | 0 | 0 |
| 9331 | CAN Primary Metal Manufacturing | 0 | 142 | 5,279 | 46 | 17 |
| 9412 | CAN Petroleum product wholesaler-distributors | 0 | 0 | 0 | 0 | 44,247 |
| 9448 | CAN clothing and clothing accessories stores | 0 | 0 | 0 | 0 | 132 |
| 9481 | CAN Air transportation | 5 | 7,692 | 130 | 787 | 6,112 |
| 9482 | CAN Rail transportation | 3 | 4,247 | 94 | 136 | 94 |
| 9562 | CAN Waste management and remediation services | 1,111 | 1,497 | 1,837 | 2,183 | 13,868 |
| 9921 | CAN Commercial Fuel Combustion | 478 | 123,718 | 10,306 | 29,081 | 70,997 |
| 9924 | CAN Primary Industry | 0 | 0 | 0 | 0 | 220,319 |
| 9925 | CAN Manufacturing and Assembly | 0 | 0 | 0 | 0 | 71,914 |
| 9932 | CAN CANRAIL | 67 | 62,928 | 2,373 | 1,431 | 1,846 |

| Code | Mexican or Canadian Surrogate Description | $NH_3$ | $NO_X$ | PM $_{2\_5}$ | $SO_2$ | VOC |
|---|---|---|---|---|---|---|
| 9941 | CAN PAVED ROADS | 2 | 1,069 | 158,390 | 2 | 2,065 |
| 9942 | CAN UNPAVED ROADS | 23 | 4,557 | 1,201 | 28 | 51,436 |
| 9945 | CAN Commercial Marine Vessels | 30 | 40,951 | 3,337 | 27,661 | 4,641 |
| 9946 | CAN Construction and mining | 0 | 2 | 9 | 0 | 75 |
| 9950 | CAN Combination of Forest and Dwelling | 267 | 2,899 | 31,312 | 424 | 44,340 |
| 9955 | CAN UNPAVED_ROADS_AND_TRAILS | 0 | 0 | 242,537 | 0 | 0 |
| 9990 | CAN TOTFERT | 0 | 0 | 29,267 | 0 | 159,859 |
| 9996 | CAN urban_area | 0 | 0 | 618 | 0 | 0 |
| 9997 | CAN CHBOISQC | 442 | 4,912 | 48,653 | 702 | 71,051 |
| 91201 | CAN traffic_bcw | 15,579 | 285,138 | 10,197 | 1,776 | 144,243 |
| 92401 | CAN BULLS | 4,394 | 0 | 0 | 0 | 0 |
| 92402 | CAN BFCOWS | 46,101 | 0 | 0 | 0 | 0 |
| 92403 | CAN BFHEIF | 7,398 | 0 | 0 | 0 | 0 |
| 92404 | CAN CALFU1 | 17,987 | 0 | 0 | 0 | 0 |
| 92406 | CAN STEERS | 24,551 | 0 | 0 | 0 | 0 |
| 92407 | CAN MLKCOW | 37,604 | 0 | 0 | 0 | 0 |
| 92408 | CAN MLKHEIF | 2,617 | 0 | 0 | 0 | 0 |
| 92409 | CAN MBULLS | 35 | 0 | 0 | 0 | 0 |
| 92410 | CAN MCALFU1 | 11,988 | 0 | 0 | 0 | 0 |
| 92412 | CAN BROILER | 7,049 | 0 | 0 | 0 | 0 |
| 92413 | CAN LAYHEN | 8,044 | 0 | 0 | 0 | 0 |
| 92414 | CAN TURKEY | 3,220 | 0 | 0 | 0 | 0 |
| 92416 | CAN BOARS | 139 | 0 | 0 | 0 | 0 |
| 92417 | CAN GRWPIG | 51,078 | 0 | 0 | 0 | 0 |
| 92418 | CAN NURPIG | 13,047 | 0 | 0 | 0 | 0 |
| 92419 | CAN SOWS | 5,376 | 0 | 0 | 0 | 0 |
| 92421 | CAN IMPAST | 1,949 | 0 | 0 | 0 | 0 |
| 92422 | CAN UNIMPAST | 2,081 | 0 | 0 | 0 | 0 |
| 92423 | CAN ALFALFA | 1,622 | 0 | 0 | 0 | 0 |
| 92424 | CAN BARLEY | 7,576 | 0 | 0 | 0 | 0 |
| 92425 | CAN BUCWHT | 21 | 0 | 0 | 0 | 0 |
| 92426 | CAN CANARY | 282 | 0 | 0 | 0 | 0 |
| 92427 | CAN CANOLA | 7,280 | 0 | 0 | 0 | 0 |
| 92428 | CAN CHICPEA | 449 | 0 | 0 | 0 | 0 |
| 92429 | CAN CORNGR | 15,655 | 0 | 0 | 0 | 0 |
| 92430 | CAN CORNSI | 2,328 | 0 | 0 | 0 | 0 |
| 92431 | CAN DFPEAS | 703 | 0 | 0 | 0 | 0 |
| 92432 | CAN FLAXSD | 1,667 | 0 | 0 | 0 | 0 |
| 92433 | CAN FORAGE | 526 | 0 | 0 | 0 | 0 |
| 92434 | CAN LENTIL | 547 | 0 | 0 | 0 | 0 |
| 92435 | CAN MUSTSD | 722 | 0 | 0 | 0 | 0 |
| 92436 | CAN MXDGRN | 658 | 0 | 0 | 0 | 0 |
| 92437 | CAN OATS | 4,452 | 0 | 0 | 0 | 0 |
| 92438 | CAN ODFBNS | 254 | 0 | 0 | 0 | 0 |
| 92439 | CAN OTTAME | 5,985 | 0 | 0 | 0 | 0 |

| Code | Mexican or Canadian Surrogate Description | $NH_3$ | $NO_X$ | $PM_{2\_5}$ | $SO_2$ | VOC |
|---|---|---|---|---|---|---|
| 92440 | CAN POTATS | 1,268 | 0 | 0 | 0 | 0 |
| 92441 | CAN RYEFAL | 153 | 0 | 0 | 0 | 0 |
| 92442 | CAN RYESPG | 7 | 0 | 0 | 0 | 0 |
| 92443 | CAN SOYBNS | 1,775 | 0 | 0 | 0 | 0 |
| 92444 | CAN SUGARB | 30 | 0 | 0 | 0 | 0 |
| 92445 | CAN SUNFLS | 383 | 0 | 0 | 0 | 0 |
| 92446 | CAN TOBACO | 72 | 0 | 0 | 0 | 0 |
| 92447 | CAN TRITCL | 73 | 0 | 0 | 0 | 0 |
| 92448 | CAN WHITBN | 288 | 0 | 0 | 0 | 0 |
| 92449 | CAN WHTDUR | 5,524 | 0 | 0 | 0 | 0 |
| 92450 | CAN WHTSPG | 13,929 | 0 | 0 | 0 | 0 |
| 92451 | CAN WHTWIN | 2,785 | 0 | 0 | 0 | 0 |
| 92452 | CAN BEANS | 109 | 0 | 0 | 0 | 0 |
| 92453 | CAN CARROT | 73 | 0 | 0 | 0 | 0 |
| 92454 | CAN GRPEAS | 113 | 0 | 0 | 0 | 0 |
| 92455 | CAN OTHVEG | 294 | 0 | 0 | 0 | 0 |
| 92456 | CAN SWCORN | 297 | 0 | 0 | 0 | 0 |
| 92457 | CAN TOMATO | 98 | 0 | 0 | 0 | 0 |

# 4 Emission Summaries

The following tables summarize emissions for the 2014v7.0 platform. These summaries are provided at the national level by sector for the contiguous U.S. and for the portions of Canada and Mexico inside the smaller 12km domain (12US2) discussed in Section 3.1. The afdust sector emissions represent the summaries *after* application of both the land use (transport fraction) and meteorological adjustments (see Section 2.2.1); therefore, this sector is called "afdust_adj" in these summaries. The onroad sector totals are post-SMOKE-MOVES totals, representing air quality model-ready emission totals, and include CARB emissions for California (except HAPs were adjusted as discussed in 2.3.1). The cmv sector includes U.S. emissions within state waters only; these extend to roughly 3-5 miles offshore and includes CMV emissions at U.S. ports. "Offshore to EEZ" represents CMV emissions that are within the (up to) 200 nautical mile Exclusive Economic Zone (EEZ) boundary but are outside of U.S. state waters along with the offshore oil platform emissions from the NEI. Finally, the "Non-US SECA C3" represents all non-U.S. and non-Canada emissions outside of the (up to) 200nm offshore boundary, including all Mexican CMV emissions. Canadian CMV emissions are included in the othar sector.

National emission totals by air quality model-ready sector are provided for all CAP emissions in Table 4-1. The total of all sectors is listed as "Con U.S. Total." **Error! Reference source not found.**

**Error! Reference source not found.** provides summaries of select VOC HAPs: NBAFM (including p ost-speciated NBAFM in the U.S., Canada and Mexico) and 1,3 butadiene and acrolein. Table 4-3 provides a summary of diesel PM and selected metal HAPs. County monthly summaries are on the ftp site.

**Table 4-1. National by-sector CAP emissions summaries for the 2014v7.0 Platform**

| Sector | CO | $NH_3$ | $NO_X$ | $PM_{10}$ | $PM_{2.5}$ | $SO_2$ | VOC |
|---|---|---|---|---|---|---|---|
| afdust_adj | | | | 6,991,664 | 975,147 | | |
| ag | | 3,135,284 | | | | | |
| agfire | 275,781 | 51,703 | 11,061 | 36,751 | 28,925 | 3,667 | 20,527 |
| ptagfire | 301,331 | 37,954 | 8,923 | 49,907 | 35,324 | 2,570 | 18,817 |
| cmv | 56,107 | 138 | 340,287 | 10,199 | 9,546 | 42,108 | 9,736 |
| nonpt | 2,894,351 | 114,049 | 794,416 | 712,611 | 569,249 | 300,871 | 3,571,099 |
| nonroad | 12,425,532 | 2,244 | 1,392,082 | 140,863 | 133,362 | 3,163 | 1,630,321 |
| np_oilgas | 820,021 | 15 | 793,601 | 20,628 | 20,196 | 37,794 | 3,104,473 |
| onroad | 21,548,865 | 103,333 | 4,622,761 | 307,113 | 157,997 | 28,324 | 2,170,529 |
| ptegu | 735,537 | 25,933 | 1,759,009 | 236,039 | 183,024 | 3,241,505 | 35,502 |
| ptfire_f | 5,809,858 | 93,817 | 197,066 | 703,768 | 598,115 | 77,636 | 1,334,362 |
| ptfire_s | 10,978,140 | 177,445 | 48,154 | 1,026,465 | 870,276 | 51,403 | 2,548,830 |
| ptnonipm | 2,055,868 | 64,812 | 1,193,939 | 525,317 | 292,831 | 880,638 | 828,209 |
| pt_oilgas | 190,104 | 330 | 398,376 | 11,637 | 11,155 | 43,571 | 132,770 |
| rail | 119,252 | 364 | 779,801 | 25,094 | 23,166 | 6,986 | 39,857 |
| rwc | 2,156,051 | 16,221 | 32,174 | 333,219 | 332,700 | 8,087 | 351,696 |
| **Con U.S. Total** | **60,366,800** | **3,823,642** | **12,371,652** | **11,131,276** | **4,241,012** | **4,728,322** | **15,796,729** |
| Canada othafdust | | | | 691,390 | 100,114 | | |
| Canada othar | 2,850,991 | 326,903 | 339,975 | 156,762 | 128,890 | 70,236 | 844,963 |
| Canada onroad_can | 2,529,869 | 15,577 | 285,257 | 15,726 | 10,201 | 1,780 | 144,253 |
| Canada othpt | 489,485 | 13,070 | 247,732 | 68,380 | 28,300 | 497,500 | 357,766 |
| Canada ptfire_mxca | 717,703 | 1,619 | 16,918 | 81,549 | 69,397 | 7,325 | 174,656 |
| Mexico othar | 188,542 | 174,005 | 174,602 | 91,707 | 42,818 | 6,091 | 434,539 |
| Mexico onroad_mex | 1,580,773 | 2,324 | 378,196 | 12,579 | 9,012 | 4,925 | 138,957 |
| Mexico othpt | 184,332 | 4,184 | 449,067 | 68,984 | 54,925 | 525,750 | 63,694 |
| Mexico ptfire_mxca | 172,046 | 2,729 | 8,475 | 31,444 | 18,729 | 1,059 | 54,860 |
| Offshore cmv | 52,300 | 172 | 261,816 | 8,611 | 8,353 | 2,169 | 4,959 |
| Offshore othpt | 134,813 | 0 | 811,501 | 33,241 | 30,515 | 256,078 | 82,098 |
| **Non-US Total** | **8,900,854** | **540,582** | **2,973,540** | **1,260,371** | **501,254** | **1,372,913** | **2,300,745** |

## Table 4-2. National by-sector VOC HAP emissions summaries for the 2014v7.0 Platform

| Sector | Acetaldehyde | Benzene | Formaldehyde | Methanol | Naphthalene | Acrolein | 1,3-Butadiene |
|---|---|---|---|---|---|---|---|
| afdust_adj | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| ag | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| agfire | 4,510 | 2,227 | 5,319 | 128 | 0 | 1,298 | 1,068 |
| ptagfire | 2,726 | 1,346 | 6,364 | 0 | 0 | 800 | 669 |
| cmv | 268 | 73 | 545 | 0.5 | 6.1 | 10 | 3 |
| nonpt | 6,447 | 13,641 | 6,434 | 130,740 | 9,606 | 422 | 502 |
| nonroad | 15,442 | 37,756 | 39,008 | 1,986 | 3,007 | 2,762 | 6,260 |
| np_oilgas | 2,198 | 26,504 | 18,251 | 1,235 | 47 | 1,235 | 276 |
| onroad | 26,617 | 53,247 | 35,546 | 3,040 | 4,716 | 2,426 | 8,255 |
| ptegu | 405 | 711 | 2,098 | 73 | 73 | 324 | 2 |
| ptfire_f | 64,350 | 23,633 | 131,911 | 111,161 | 19,771 | 23,690 | 14,826 |
| ptfire_s | 46,561 | 15,151 | 89,101 | 81,053 | 13,812 | 15,701 | 8,986 |
| ptnonipm | 7,585 | 3,995 | 10,663 | 55,694 | 1,630 | 1,890 | 1,323 |
| pt_oilgas | 2,359 | 1,358 | 10,750 | 1,733 | 24 | 1,818 | 146 |
| rail | 621 | 85 | 1,430 | 0 | 62 | 103 | 107 |
| rwc | 8,255 | 17,814 | 17,334 | 0 | 2,072 | 838 | 2,352 |
| **Con U.S. Total** | **188,344** | **197,543** | **374,755** | **386,843** | **54,826** | **53,318** | **44,774** |
| Canada othafdust | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Canada othar | 13,779 | 22,498 | 11,291 | 21,208 | 1,584 | 0 | 0 |
| Canada onroad_can | 1,709 | 6,261 | 2,425 | 0 | 51 | 0 | 0 |
| Canada othpt | 51 | 13,294 | 78 | 20,389 | 0 | 0 | 0 |
| Canada ptfire_mxca | 4,523 | 4,164 | 18,749 | 16,843 | 0 | 0 | 0 |
| Mexico othar | 12,721 | 6,034 | 8,907 | 10,547 | 1,739 | 0 | 0 |
| Mexico onroad_mex | 624 | 3,542 | 1,461 | 412 | 219 | 102 | 539 |
| Mexico othpt | 169 | 1,454 | 5,592 | 411 | 27 | 0 | 0 |
| Mexico ptfire_mxca | 1,342 | 1,312 | 5,908 | 5,367 | 0 | 0 | 0 |
| Offshore cmv | 230 | 63 | 464 | 0 | 7 | 11 | 0 |
| Offshore othpt | 13 | 187 | 273 | 0 | 0 | 0 | 0 |
| **Non-US Total** | **35,162** | **58,810** | **55,148** | **75,177** | **3,627** | **113** | **539** |

**Table 4-3. National by-sector Diesel PM and metal emissions summaries for the 2014v7.0 Platform**

| Sector | Diesel $PM_{10}$ | Diesel $PM_{2.5}$ | Chromium Hex | Arsenic | Cadmium | Nickel | Manganese |
|---|---|---|---|---|---|---|---|
| afdust_adj | | | | | | | |
| ag | | | | | | | |
| agfire | | | | 0.01 | 0.08 | 0.01 | 0.74 |
| ptagfire | | | | | | | |
| cmv | 10,199 | 9,546 | 0.50 | 1.10 | 0.12 | 38.68 | 0.28 |
| nonpt | | | 3.79 | 13.51 | 5.86 | 25.17 | 28.43 |
| nonroad | 85,340 | 82,523 | 0.01 | 0.83 | | 6.43 | 1.76 |
| np_oilgas | | | 0.12 | 0.47 | 0.25 | 0.12 | 0.25 |
| onroad | 99,392 | 91,555 | 0.09 | 6.95 | | 16.37 | 50.25 |
| ptegu | | | 12.54 | 41.26 | 7.30 | 142.02 | 203.86 |
| ptfire_f | | | | | | | |
| ptfire_s | | | | | | | |
| ptnonipm | 9,229 | 2,735 | 29.78 | 29.96 | 15.94 | 177.31 | 635.24 |
| pt_oilgas | | | 0.03 | 0.09 | 0.27 | 5.33 | 1.96 |
| rail | 25,094 | 23,166 | 0.05 | 0.01 | 0.70 | 0.16 | 0.05 |
| rwc | | | | 0.02 | 0.15 | 0.09 | 1.04 |
| **Con U.S. Total[a]** | **229,253** | **209,525** | **46.92** | **94.22** | **30.67** | **411.71** | **923.86** |

**[a]Canada and Mexico do not have any of these pollutants**

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# Appendix A: Pollutants in the 2014v7.0 Platform

| 2014 cmaq species name(s) | pollcode | 2014 NEI -Event | 2014NEI-Nonpoint | 2014NEI - Point | 2014NEI - Nonroad | 2014NEI - Onroad | NEI Pollutant Category Name (if different from description) | Description | SMOKEshortname |
|---|---|---|---|---|---|---|---|---|---|
| PAH_880E5 | 83329 | | 1 | 1 | 1 | 1 | Polycyclic Organic Matter | Acenaphthene | PAH_880E5 |
| PAH_880E5 | 208968 | | 1 | 1 | 1 | 1 | Polycyclic Organic Matter | Acenaphthylene | PAH_880E5 |
| ALD2,ALD2_PRIMARY | 75070 | 1 | 1 | 1 | 1 | 1 | | Acetaldehyde | ACETALD |
| ACETONITRILE | 75058 | 1 | 1 | 1 | | | | Acetonitrile | ACETONIT |
| ACROLEIN, ACROLEIN_PRIMARY | 107028 | 1 | 1 | 1 | 1 | 1 | | Acrolein | ACROLEI |
| ACRYLICACID | 79107 | 1 | 1 | 1 | | | | Acrylic Acid | ACRYLCACID |
| ACRYLONITRILE | 107131 | | 1 | 1 | | | | Acrylonitrile | ACRYLONITRL |
| PAH_000E0 | 120127 | 1 | 1 | 1 | 1 | 1 | Polycyclic Organic Matter | Anthracene | PAH_000E0 |
| AASI, AASJ, and ASSK | 7440382 | | 1 | 1 | 1 | 1 | Arsenic Compounds | Arsenic | ARSENIC |
| PAH_176E4 | 56553 | 1 | 1 | 1 | 1 | 1 | Polycyclic Organic Matter | Benz[a]Anthracene | PAH_176E4 |
| BENZENE | 71432 | 1 | 1 | 1 | 1 | 1 | | Benzene | BENZENE |
| PAH_176E4 | 203338 | 1 | 1 | 1 | | | Polycyclic Organic Matter | Benzo(a)Fluoranthene | PAH_176E4 |
| PAH_880E5 | 195197 | 1 | 1 | | | | Polycyclic Organic Matter | Benzo(c)phenanthrene | PAH_880E5 |
| PAH_880E5 | 192972 | 1 | 1 | 1 | | | Polycyclic Organic Matter | Benzo[e]Pyrene | PAH_880E5 |
| PAH_176E4 | 203123 | | 1 | 1 | | | Polycyclic Organic Matter | Benzo(g,h,i)Fluoranthene | PAH_176E4 |
| PAH_880E5 | 191242 | 1 | 1 | 1 | 1 | 1 | Polycyclic Organic Matter | Benzo[g,h,i,]Perylene | PAH_880E5 |
| PAH_176E3 | 50328 | 1 | 1 | 1 | 1 | 1 | Polycyclic Organic Matter | Benzo[a]Pyrene | PAH_176E3 |
| PAH_176E4 | 205992 | | 1 | 1 | 1 | 1 | Polycyclic Organic Matter | Benzo[b]Fluoranthene | PAH_176E4 |
| PAH_176E4 | 205823 | | | 1 | | | Polycyclic Organic Matter | Benzo[j]fluoranthene | PAH_176E4 |
| PAH_176E4 | 207089 | 1 | 1 | 1 | 1 | 1 | Polycyclic Organic Matter | Benzo[k]Fluoranthene | PAH_176E4 |
| PAH_176E4 | 56832736 | 1 | 1 | 1 | | | Polycyclic Organic Matter | Benzofluoranthenes | PAH_176E4 |
| ABEK, ABEI, ABEJ | 7440417 | | 1 | 1 | | | Beryllium Compounds | Beryllium | BERYLLIUM |
| BUTADIENE13 | 106990 | 1 | 1 | 1 | 1 | 1 | | 1,3-Butadiene | BUTADIE |
| ACDI,ACDJ,ACDK | 7440439 | | 1 | 1 | | | Cadmium Compounds | Cadmium | CADMIUM |
| PAH_176E5 | 86748 | | 1 | 1 | | | Polycyclic Organic Matter | Carbazole | PAH_176E5 |
| CARBONTET | 56235 | | 1 | 1 | | | | Carbon Tetrachloride | CARBONTET |
| CARBONYLSULFIDE | 463581 | 1 | 1 | 1 | | | | Carbonyl Sulfide | CARBNYLSUL |
| CL2 | 7782505 | | 1 | 1 | | | | Chlorine | CHLORIINE |
| CHCL3 | 67663 | | 1 | 1 | | | | Chloroform | CHCL3 |
| PAH_880E5 | 91587 | | 1 | 1 | | | Polycyclic Organic Matter | 2-Chloronaphthalene | PAH_880E5 |
| CHLOROPRENE | 126998 | | 1 | 1 | | | | Chloroprene | CHLOROPRENE |
| ACR_VIK,ACR_VIJ,ACR_VII | 7738945 | | | 1 | | | Chromium Compounds | Chromic Acid (VI) | CHROMHEX |
| ACR_IIIK,ACR_IIII,ACR_IIIJ | 16065831 | | 1 | 1 | 1 | 1 | Chromium Compounds | Chromium III | CHROMTRI |
| ACR_VIK,ACR_VIJ,ACR_VII | 18540299 | | 1 | 1 | 1 | 1 | Chromium Compounds | Chromium (VI) | CHROMHEX |

| | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| ACR_VIK,ACR_VIJ,ACR_VII | 1333820 | | | 1 | | | Chromium Compounds | Chromium Trioxide | CHROMHEX |
| PAH_176E5 | 218019 | 1 | 1 | 1 | 1 | 1 | Polycyclic Organic Matter | Chrysene | PAH_176E5 |
| PAH_880E5 | 8007452 | | | 1 | | | Polycyclic Organic Matter | Coal Tar | PAH_880E5 |
| PAH_176E4 | 226368 | | | 1 | | | Polycyclic Organic Matter | Dibenz[a,h]acridine | PAH_176E4 |
| PAH_176E4 | 224420 | | | 1 | | | Polycyclic Organic Matter | Dibenzo[a,j]Acridine | PAH_176E4 |
| PAH_176E3 | 192654 | | | 1 | | | Polycyclic Organic Matter | Dibenzo[a,e]Pyrene | PAH_176E3 |
| PAH_192E3 | 53703 | | 1 | 1 | 1 | 1 | Polycyclic Organic Matter | Dibenzo[a,h]Anthracene | PAH_192E3 |
| PAH_176E2 | 189640 | | | 1 | | | Polycyclic Organic Matter | Dibenzo[a,h]Pyrene | PAH_176E2 |
| PAH_176E2 | 189559 | | | 1 | | | Polycyclic Organic Matter | Dibenzo[a,i]Pyrene | PAH_176E2 |
| PAH_176E2 | 191300 | | | 1 | | | Polycyclic Organic Matter | Dibenzo[a,l]Pyrene | PAH_176E2 |
| PAH_176E3 | 194592 | | | 1 | | | Polycyclic Organic Matter | 7H-Dibenzo[c,g]carbazole | PAH_176E3 |
| DICHLOROBENZENE | 106467 | | 1 | 1 | | | | 1,4-Dichlorobenzene | DICHLRBNZN |
| DICHLOROPROPENE | 542756 | | 1 | 1 | | | | 1,3-Dichloropropene | DICLPRO13 |
| PAH_114E1 | 57976 | | 1 | 1 | | | Polycyclic Organic Matter | 7,12-Dimethylbenz[a]Anthracene | PAH_114E1 |
| ETHYLBENZ | 100414 | | 1 | 1 | 1 | 1 | | Ethyl Benzene | ETHYLBENZ |
| BR2_C2_12 | 106934 | | 1 | 1 | | | | Ethylene Dibromide | ETHDIBROM |
| CL2_C2_12 | 107062 | | 1 | 1 | | | | Ethylene Dichloride | CL2_C2_12 |
| ETOX | 75218 | | 1 | 1 | | | | Ethylene Oxide | ETOX |
| PAH_880E5 | 284 | | 1 | 1 | | | POM as non-15 PAH | Extractable Organic Matter (EOM) | PAH_880E5 |
| PAH_880E5 | 206440 | 1 | 1 | 1 | 1 | 1 | Polycyclic Organic Matter | Fluoranthene | PAH_880E5 |
| PAH_880E5 | 86737 | | 1 | 1 | 1 | 1 | Polycyclic Organic Matter | Fluorene | PAH_880E5 |
| FORM, FORM_PRIMARY | 50000 | 1 | 1 | 1 | 1 | 1 | | Formaldehyde | FORMALD |
| HEXAMETHY_DIIS | 822060 | | 1 | 1 | | | | Hexamethylene Diisocyanate | HEXAMTHLE |
| HEXANE | 110543 | 1 | 1 | 1 | 1 | 1 | | Hexane | HEXANE |
| HYDRAZINE | 302012 | | | 1 | | | | Hydrazine | HYDRAZINE |
| HCL | 7647010 | | 1 | 1 | | | | Hydrochloric Acid | HCL |
| PAH_176E4 | 193395 | 1 | 1 | 1 | 1 | 1 | Polycyclic Organic Matter | Indeno[1,2,3-c,d]Pyrene | PAH_176E4 |
| APBK,APBJ,APBI | 7439921 | | 1 | 1 | | | Lead Compounds | Lead | LEAD |
| MAL_ANHYDRIDE | 108316 | | 1 | 1 | | | | Maleic Anhydride | MALANHYD |
| AMN_HAPSK,AMN_HAPSJ,AMN_HAPSI | 7439965 | | 1 | 1 | 1 | 1 | Manganese Compounds | Manganese | MANGANESE |
| HG,HGIIGAS,APHGI,APHGJ (there is no APHGK) | 7439976 | | 1 | 1 | 1 | 1 | Mercury Compounds | Mercury | HGSUM |
| MEOH | 67561 | 1 | 1 | 1 | | | | Methanol | METHANOL |
| PAH_880E5 | 779022 | | | | | | Polycyclic Organic Matter | 9-Methyl Anthracene | PAH_880E5 |
| METHYLCHLORIDE | 74873 | 1 | 1 | 1 | | | | Methyl Chloride | MTHYLCHLRD |
| PAH_880E5 | 26914181 | 1 | 1 | 1 | | | Polycyclic Organic Matter | Methylanthracene | PAH_880E5 |
| PAH_880E5 | 2422799 | | | | | | Polycyclic Organic Matter | 12-Methylbenz(a)Anthracene | PAH_880E5 |
| PAH_880E5 | 65357699 | 1 | 1 | | | | Polycyclic Organic Matter | Methylbenzopyrene | PAH_880E5 |
| PAH_101E2 | 56495 | | 1 | 1 | | | Polycyclic Organic Matter | 3-Methylcholanthrene | PAH_101E2 |
| PAH_176E3 | 3697243 | | 1 | 1 | | | Polycyclic Organic Matter | 5-Methylchrysene | PAH_176E3 |
| CL2_ME | 75092 | | 1 | 1 | | | | Methylene Chloride | MECL |
| PAH_880E5 | 90120 | | | 1 | | | Polycyclic Organic Matter | 1-Methylnaphthalene | PAH_880E5 |
| PAH_880E5 | 91576 | | 1 | 1 | 1 | | Polycyclic Organic Matter | 2-Methylnaphthalene | PAH_880E5 |

| | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| PAH_880E5 | 832699 | | | | | | Polycyclic Organic Matter | 1-Methylphenanthrene | PAH_880E5 |
| PAH_880E5 | 2381217 | 1 | 1 | | | | Polycyclic Organic Matter | 1-Methylpyrene | PAH_880E5 |
| NAPHTHALENE | 91203 | 1 | 1 | 1 | 1 | 1 | | Naphthalene | NAPHTH |
| ANIK, ANII, ANIJ | 7440020 | | 1 | 1 | 1 | 1 | Nickel Compounds | Nickel | NICKEL |
| ANIK, ANII, ANIJ | 1313991 | | | 1 | | | Nickel Compounds | Nickel Oxide | NICKEL |
| ANIK, ANII, ANIJ | 604 | | | 1 | | | Nickel Compounds | Nickel Refinery Dust | NICKEL |
| PAH_176E4 | 5522430 | | | | | | Polycyclic Organic Matter | 1-Nitropyrene | PAH_176E4 |
| PAH_880E5 | 1.3E+08 | | 1 | 1 | 1 | 1 | Polycyclic Organic Matter | PAH, total | PAH_880E5 |
| PAH_880E5 | 198550 | 1 | 1 | 1 | | | Polycyclic Organic Matter | Perylene | PAH_880E5 |
| PAH_000E0 | 85018 | 1 | 1 | 1 | 1 | 1 | Polycyclic Organic Matter | Phenanthrene | PAH_000E0 |
| PROPDICHLORIDE | 78875 | | 1 | 1 | | | | Propylene Dichloride | PROPDICLR |
| PAH_000E0 | 129000 | 1 | 1 | 1 | 1 | 1 | Polycyclic Organic Matter | Pyrene | PAH_000E0 |
| QUINOLINE | 91225 | | | 1 | | | | Quinoline | QUINOLINE |
| STYRENE | 100425 | 1 | 1 | 1 | 1 | 1 | | Styrene | STYRENE |
| CL4_ETHANE1122 | 79345 | | 1 | 1 | | | | 1,1,2,2-Tetrachloroethane | TTCLE1122 |
| CL4_ETHE | 127184 | | 1 | 1 | | | | Tetrachloroethylene | PERC |
| TOLU | 108883 | 1 | 1 | 1 | 1 | 1 | | Toluene | TOLUENE |
| TOL_DIIS | 584849 | | 1 | 1 | | | | 2,4-Toluene Diisocyanate | TOL_DIIS |
| CL3_ETHE | 79016 | | 1 | 1 | | | | Trichloroethylene | CL3_ETHE |
| TRIETHYLAMINE | 121448 | | 1 | 1 | | | | Triethylamine | TRIETHLAMN |
| CL_ETHE | 75014 | | 1 | 1 | | | | Vinyl Chloride | VINYCHLRI |
| XYLENES | 108383 | | 1 | 1 | 1 | 1 | Xylenes (Mixed Isomers) | m-Xylene | XYLENES |
| XYLENES | 95476 | | 1 | 1 | 1 | 1 | Xylenes (Mixed Isomers) | o-Xylene | XYLENES |
| XYLENES | 106423 | | 1 | 1 | 1 | 1 | Xylenes (Mixed Isomers) | p-Xylene | XYLENES |
| XYLENES | 1330207 | 1 | 1 | 1 | 1 | 1 | Xylenes (Mixed Isomers) | Xylenes (Mixed Isomers) | XYLENES |
| ADE_ECI,ADE_ECJ,ADE_OCI,ADE_OCJ,ADE_SO4J,ADE_NO3J,ADE_OTHRI,ADE_OTHRK,ADE_K | DIESEL-PM10 | | 1 | 1 | 1 | 1 | | Diesel PM | DIESEL_PM10 |
| PAH_176E3 | 41637905 | 1 | 1 | | | | Polycyclic Organic Matter | Methylchrysene | PAH_176E3 |
| PAH_880E5 | 250 | | 1 | 1 | | | Polycyclic Organic Matter | PAH/POM - Unspecified | PAH_880E5 |
| ADE_ECI,ADE_ECJ,ADE_OCI,ADE_OCJ,ADE_SO4J,ADE_NO3J,ADE_OTHRI,ADE_OTHRK,ADE_K | DIESEL-PM25 | | 1 | 1 | 1 | 1 | Not in the NEI | Diesel PM | DIESEL_PM25 |

## Appendix B: Nonpoint Oil and Gas (np_oilgas) SCCs

The table below shows the SCCs in the nonpoint oil and gas sector (np_oilgas).

| SCC | SCC description |
|---|---|
| 2310000000 | Industrial Processes;Oil and Gas Exploration and Production;All Processes;Total: All Processes |
| 2310000220 | Industrial Processes;Oil and Gas Exploration and Production;All Processes;Drill Rigs |
| 2310000230 | Industrial Processes;Oil and Gas Exploration and Production;All Processes;Workover Rigs |
| 2310000330 | Industrial Processes;Oil and Gas Exploration and Production;All Processes;Artificial Lift |
| 2310000550 | Industrial Processes;Oil and Gas Exploration and Production;All Processes;Produced Water |
| 2310000660 | Industrial Processes;Oil and Gas Exploration and Production;All Processes;Hydraulic Fracturing Engines |
| 2310001000 | Industrial Processes;Oil and Gas Exploration and Production;All Processes : On-shore;Total: All Processes |
| 2310002000 | Industrial Processes;Oil and Gas Exploration and Production;Off-Shore Oil And Gas Production;Total: All Processes |
| 2310002401 | Industrial Processes;Oil and Gas Exploration and Production;Off-Shore Oil And Gas Production;Pneumatic Pumps: Gas And Oil Wells |
| 2310002411 | Industrial Processes;Oil and Gas Exploration and Production;Off-Shore Oil And Gas Production;Pressure/Level Controllers |
| 2310002421 | Industrial Processes;Oil and Gas Exploration and Production;Off-Shore Oil And Gas Production;Cold Vents |
| 2310010000 | Industrial Processes;Oil and Gas Exploration and Production;Crude Petroleum;Total: All Processes |
| 2310010100 | Industrial Processes;Oil and Gas Exploration and Production;Crude Petroleum;Oil Well Heaters |
| 2310010200 | Industrial Processes;Oil and Gas Exploration and Production;Crude Petroleum;Oil Well Tanks - Flashing & Standing/Working/Breathing |
| 2310010300 | Industrial Processes;Oil and Gas Exploration and Production;Crude Petroleum;Oil Well Pneumatic Devices |
| 2310010700 | Industrial Processes;Oil and Gas Exploration and Production;Crude Petroleum;Oil Well Fugitives |
| 2310010800 | Industrial Processes;Oil and Gas Exploration and Production;Crude Petroleum;Oil Well Truck Loading |
| 2310011000 | Industrial Processes;Oil and Gas Exploration and Production;On-Shore Oil Production;Total: All Processes |
| 2310011020 | Industrial Processes;Oil and Gas Exploration and Production;On-Shore Oil Production;Storage Tanks: Crude Oil |
| 2310011100 | Industrial Processes;Oil and Gas Exploration and Production;On-Shore Oil Production;Heater Treater |
| 2310011201 | Industrial Processes;Oil and Gas Exploration and Production;On-Shore Oil Production;Tank Truck/Railcar Loading: Crude Oil |
| 2310011500 | Industrial Processes;Oil and Gas Exploration and Production;On-Shore Oil Production;Fugitives: All Processes |
| 2310011501 | Industrial Processes;Oil and Gas Exploration and Production;On-Shore Oil Production;Fugitives: Connectors |
| 2310011502 | Industrial Processes;Oil and Gas Exploration and Production;On-Shore Oil Production;Fugitives: Flanges |
| 2310011503 | Industrial Processes;Oil and Gas Exploration and Production;On-Shore Oil Production;Fugitives: Open Ended Lines |
| 2310011504 | Industrial Processes;Oil and Gas Exploration and Production;On-Shore Oil Production;Fugitives: Pumps |
| 2310011505 | Industrial Processes;Oil and Gas Exploration and Production;On-Shore Oil Production;Fugitives: Valves |
| 2310011506 | Industrial Processes;Oil and Gas Exploration and Production;On-Shore Oil Production;Fugitives: Other |
| 2310012000 | Industrial Processes;Oil and Gas Exploration and Production;Off-Shore Oil Production;Total: All Processes |
| 2310012020 | Industrial Processes;Oil and Gas Exploration and Production;Off-Shore Oil Production;Storage Tanks: Crude Oil |
| 2310012525 | Industrial Processes;Oil and Gas Exploration and Production;Off-Shore Oil Production;Fugitives, Valves: Oil/Water |
| 2310012526 | Industrial Processes;Oil and Gas Exploration and Production;Off-Shore Oil Production;Fugitives, Other: Oil/Water |
| 2310020000 | Industrial Processes;Oil and Gas Exploration and Production;Natural Gas;Total: All Processes |

| SCC | SCC description |
|---|---|
| 2310020600 | Industrial Processes;Oil and Gas Exploration and Production;Natural Gas;Compressor Engines |
| 2310020700 | Industrial Processes;Oil and Gas Exploration and Production;Natural Gas;Gas Well Fugitives |
| 2310020800 | Industrial Processes;Oil and Gas Exploration and Production;Natural Gas;Gas Well Truck Loading |
| 2310021010 | Industrial Processes;Oil and Gas Exploration and Production;On-Shore Gas Production;Storage Tanks: Condensate |
| 2310021011 | Industrial Processes;Oil and Gas Exploration and Production;On-Shore Gas Production;Condensate Tank Flaring |
| 2310021030 | Industrial Processes;Oil and Gas Exploration and Production;On-Shore Gas Production;Tank Truck/Railcar Loading: Condensate |
| 2310021100 | Industrial Processes;Oil and Gas Exploration and Production;On-Shore Gas Production;Gas Well Heaters |
| 2310021101 | Industrial Processes;Oil and Gas Exploration and Production;On-Shore Gas Production;Natural Gas Fired 2Cycle Lean Burn Compressor Engines < 50 HP |
| 2310021102 | Industrial Processes;Oil and Gas Exploration and Production;On-Shore Gas Production;Natural Gas Fired 2Cycle Lean Burn Compressor Engines 50 To 499 HP |
| 2310021103 | Industrial Processes;Oil and Gas Exploration and Production;On-Shore Gas Production;Natural Gas Fired 2Cycle Lean Burn Compressor Engines 500+ HP |
| 2310021201 | Industrial Processes;Oil and Gas Exploration and Production;On-Shore Gas Production;Natural Gas Fired 4Cycle Lean Burn Compressor Engines <50 HP |
| 2310021202 | Industrial Processes;Oil and Gas Exploration and Production;On-Shore Gas Production;Natural Gas Fired 4Cycle Lean Burn Compressor Engines 50 To 499 HP |
| 2310021203 | Industrial Processes;Oil and Gas Exploration and Production;On-Shore Gas Production;Natural Gas Fired 4Cycle Lean Burn Compressor Engines 500+ HP |
| 2310021251 | Industrial Processes;Oil and Gas Exploration and Production;On-Shore Gas Production;Lateral Compressors 4 Cycle Lean Burn |
| 2310021300 | Industrial Processes;Oil and Gas Exploration and Production;On-Shore Gas Production;Gas Well Pneumatic Devices |
| 2310021301 | Industrial Processes;Oil and Gas Exploration and Production;On-Shore Gas Production;Natural Gas Fired 4Cycle Rich Burn Compressor Engines <50 HP |
| 2310021302 | Industrial Processes;Oil and Gas Exploration and Production;On-Shore Gas Production;Natural Gas Fired 4Cycle Rich Burn Compressor Engines 50 To 499 HP |
| 2310021303 | Industrial Processes;Oil and Gas Exploration and Production;On-Shore Gas Production;Natural Gas Fired 4Cycle Rich Burn Compressor Engines 500+ HP |
| 2310021310 | Industrial Processes;Oil and Gas Exploration and Production;On-Shore Gas Production;Gas Well Pneumatic Pumps |
| 2310021351 | Industrial Processes;Oil and Gas Exploration and Production;On-Shore Gas Production;Lateral Compressors 4 Cycle Rich Burn |
| 2310021400 | Industrial Processes;Oil and Gas Exploration and Production;On-Shore Gas Production;Gas Well Dehydrators |
| 2310021402 | Industrial Processes;Oil and Gas Exploration and Production;On-Shore Gas Production;Nat Gas Fired 4Cycle Rich Burn Compressor Engines 50 To 499 HP w/NSCR |
| 2310021403 | Industrial Processes;Oil and Gas Exploration and Production;On-Shore Gas Production;Nat Gas Fired 4Cycle Rich Burn Compressor Engines 500+ HP w/NSCR |
| 2310021411 | Industrial Processes;Oil and Gas Exploration and Production;On-Shore Gas Production;Gas Well Dehydrators - Flaring |
| 2310021450 | Industrial Processes;Oil and Gas Exploration and Production;On-Shore Gas Production;Wellhead |
| 2310021500 | Industrial Processes;Oil and Gas Exploration and Production;On-Shore Gas Production;Gas Well Completion - Flaring |
| 2310021501 | Industrial Processes;Oil and Gas Exploration and Production;On-Shore Gas Production;Fugitives: Connectors |
| 2310021502 | Industrial Processes;Oil and Gas Exploration and Production;On-Shore Gas Production;Fugitives: Flanges |
| 2310021503 | Industrial Processes;Oil and Gas Exploration and Production;On-Shore Gas Production;Fugitives: Open Ended Lines |
| 2310021504 | Industrial Processes;Oil and Gas Exploration and Production;On-Shore Gas Production;Fugitives:  Pumps |
| 2310021505 | Industrial Processes;Oil and Gas Exploration and Production;On-Shore Gas Production;Fugitives:  Valves |

| SCC | SCC description |
|---|---|
| 2310021506 | Industrial Processes;Oil and Gas Exploration and Production;On-Shore Gas Production;Fugitives: Other |
| 2310021509 | Industrial Processes;Oil and Gas Exploration and Production;On-Shore Gas Production;Fugitives: All Processes |
| 2310021600 | Industrial Processes;Oil and Gas Exploration and Production;On-Shore Gas Production;Gas Well Venting |
| 2310021601 | Industrial Processes;Oil and Gas Exploration and Production;On-Shore Gas Production;Gas Well Venting - Initial Completions |
| 2310021602 | Industrial Processes;Oil and Gas Exploration and Production;On-Shore Gas Production;Gas Well Venting - Recompletions |
| 2310021603 | Industrial Processes;Oil and Gas Exploration and Production;On-Shore Gas Production;Gas Well Venting - Blowdowns |
| 2310021604 | Industrial Processes;Oil and Gas Exploration and Production;On-Shore Gas Production;Gas Well Venting - Compressor Startups |
| 2310021605 | Industrial Processes;Oil and Gas Exploration and Production;On-Shore Gas Production;Gas Well Venting - Compressor Shutdowns |
| 2310021700 | Industrial Processes;Oil and Gas Exploration and Production;On-Shore Gas Production;Miscellaneous Engines |
| 2310022000 | Industrial Processes;Oil and Gas Exploration and Production;Off-Shore Gas Production;Total: All Processes |
| 2310022010 | Industrial Processes;Oil and Gas Exploration and Production;Off-Shore Gas Production;Storage Tanks: Condensate |
| 2310022051 | Industrial Processes;Oil and Gas Exploration and Production;Off-Shore Gas Production;Turbines: Natural Gas |
| 2310022090 | Industrial Processes;Oil and Gas Exploration and Production;Off-Shore Gas Production;Boilers/Heaters: Natural Gas |
| 2310022105 | Industrial Processes;Oil and Gas Exploration and Production;Off-Shore Gas Production;Diesel Engines |
| 2310022410 | Industrial Processes;Oil and Gas Exploration and Production;Off-Shore Gas Production;Amine Unit |
| 2310022420 | Industrial Processes;Oil and Gas Exploration and Production;Off-Shore Gas Production;Dehydrator |
| 2310022506 | Industrial Processes;Oil and Gas Exploration and Production;Off-Shore Gas Production;Fugitives, Other: Gas |
| 2310023010 | Industrial Processes;Oil and Gas Exploration and Production;Coal Bed Methane Natural Gas;Storage Tanks: Condensate |
| 2310023030 | Industrial Processes;Oil and Gas Exploration and Production;Coal Bed Methane Natural Gas;Tank Truck/Railcar Loading: Condensate |
| 2310023100 | Industrial Processes;Oil and Gas Exploration and Production;Coal Bed Methane Natural Gas;CBM Well Heaters |
| 2310023102 | Industrial Processes;Oil and Gas Exploration and Production;Coal Bed Methane Natural Gas;CBM Fired 2Cycle Lean Burn Compressor Engines 50 To 499 HP |
| 2310023202 | Industrial Processes;Oil and Gas Exploration and Production;Coal Bed Methane Natural Gas;CBM Fired 4Cycle Lean Burn Compressor Engines 50 To 499 HP |
| 2310023251 | Industrial Processes;Oil and Gas Exploration and Production;Coal Bed Methane Natural Gas;Lateral Compressors 4 Cycle Lean Burn |
| 2310023300 | Industrial Processes;Oil and Gas Exploration and Production;Coal Bed Methane Natural Gas;Pneumatic Devices |
| 2310023302 | Industrial Processes;Oil and Gas Exploration and Production;Coal Bed Methane Natural Gas;CBM Fired 4Cycle Rich Burn Compressor Engines 50 To 499 HP |
| 2310023310 | Industrial Processes;Oil and Gas Exploration and Production;Coal Bed Methane Natural Gas;Pneumatic Pumps |
| 2310023351 | Industrial Processes;Oil and Gas Exploration and Production;Coal Bed Methane Natural Gas;Lateral Compressors 4 Cycle Rich Burn |
| 2310023400 | Industrial Processes;Oil and Gas Exploration and Production;Coal Bed Methane Natural Gas;Dehydrators |
| 2310023509 | Industrial Processes;Oil and Gas Exploration and Production;Coal Bed Methane Natural Gas;Fugitives |
| 2310023511 | Industrial Processes;Oil and Gas Exploration and Production;Coal Bed Methane Natural Gas;Fugitives: Connectors |
| 2310023512 | Industrial Processes;Oil and Gas Exploration and Production;Coal Bed Methane Natural Gas;Fugitives: Flanges |

| SCC | SCC description |
|---|---|
| 2310023513 | Industrial Processes;Oil and Gas Exploration and Production;Coal Bed Methane Natural Gas;Fugitives: Open Ended Lines |
| 2310023515 | Industrial Processes;Oil and Gas Exploration and Production;Coal Bed Methane Natural Gas;Fugitives: Valves |
| 2310023516 | Industrial Processes;Oil and Gas Exploration and Production;Coal Bed Methane Natural Gas;Fugitives: Other |
| 2310023600 | Industrial Processes;Oil and Gas Exploration and Production;Coal Bed Methane Natural Gas;CBM Well Completion: All Processes |
| 2310023603 | Industrial Processes;Oil and Gas Exploration and Production;Coal Bed Methane Natural Gas;CBM Well Venting - Blowdowns |
| 2310023606 | Industrial Processes;Oil and Gas Exploration and Production;Coal Bed Methane Natural Gas;Mud Degassing |
| 2310030401 | Industrial Processes;Oil and Gas Exploration and Production;Natural Gas Liquids;Gas Plant Truck Loading |
| 2310111100 | Industrial Processes;Oil and Gas Exploration and Production;On-Shore Oil Exploration;Mud Degassing |
| 2310111401 | Industrial Processes;Oil and Gas Exploration and Production;On-Shore Oil Exploration;Oil Well Pneumatic Pumps |
| 2310111700 | Industrial Processes;Oil and Gas Exploration and Production;On-Shore Oil Exploration;Oil Well Completion: All Processes |
| 2310112401 | Industrial Processes;Oil and Gas Exploration and Production;Off-Shore Oil Exploration;Oil Well Pneumatic Pumps |
| 2310121100 | Industrial Processes;Oil and Gas Exploration and Production;On-Shore Gas Exploration;Mud Degassing |
| 2310121401 | Industrial Processes;Oil and Gas Exploration and Production;On-Shore Gas Exploration;Gas Well Pneumatic Pumps |
| 2310121700 | Industrial Processes;Oil and Gas Exploration and Production;On-Shore Gas Exploration;Gas Well Completion: All Processes |
| 2310122100 | Industrial Processes;Oil and Gas Exploration and Production;Off-Shore Gas Exploration;Mud Degassing |
| 2310321010 | Industrial Processes;Oil and Gas Exploration and Production;On-Shore Gas Production - Conventional;Storage Tanks: Condensate |
| 2310321400 | Industrial Processes;Oil and Gas Exploration and Production;On-Shore Gas Production - Conventional;Gas Well Dehydrators |
| 2310321603 | Industrial Processes;Oil and Gas Exploration and Production;On-Shore Gas Production - Conventional;Gas Well Venting - Blowdowns |
| 2310400220 | Industrial Processes;Oil and Gas Exploration and Production;All Processes - Unconventional;Drill Rigs |
| 2310421010 | Industrial Processes;Oil and Gas Exploration and Production;On-Shore Gas Production - Unconventional;Storage Tanks: Condensate |
| 2310421100 | Industrial Processes;Oil and Gas Exploration and Production;On-Shore Gas Production - Unconventional;Gas Well Heaters |
| 2310421400 | Industrial Processes;Oil and Gas Exploration and Production;On-Shore Gas Production - Unconventional;Gas Well Dehydrators |
| 2310421603 | Industrial Processes;Oil and Gas Exploration and Production;On-Shore Gas Production - Unconventional;Gas Well Venting - Blowdowns |

## Appendix C: Profiles (other than onroad) that are new or revised in SPECIATE4.5 that were used in the 2014 v7.0 Platform

| sector | pollutant | profile | profile desc |
|---|---|---|---|
| nonpt | VOC | 95223 | Poultry Production - Average of Production Cycle |
| nonpt | VOC | 95240 | Beef Cattle Farm and Animal Waste |
| nonpt | VOC | 95241 | Swine Farm and Animal Waste |
| nonroad | VOC | 95328 | Spark-Ignition Exhaust Emissions from 2-stroke off-road engines - E10 ethanol gasoline |
| nonroad | VOC | 95330 | Spark-Ignition Exhaust Emissions from 4-stroke off-road engines - E10 ethanol gasoline |
| nonroad | VOC | 95331 | Diesel Exhaust Emissions from Pre-Tier 1 Off-road Engines |
| nonroad | VOC | 95332 | Diesel Exhaust Emissions from Tier 1 Off-road Engines |
| nonroad | VOC | 95333 | Diesel Exhaust Emissions from Tier 2 Off-road Engines |
| np_oilgas | VOC | 95087a | Oil and Gas - Composite - Oil Field - Oil Tank Battery Vent Gas |
| np_oilgas | VOC | 95109a | Oil and Gas - Composite - Oil Field - Condensate Tank Battery Vent Gas |
| np_oilgas | VOC | 95398 | Composite Profile - Oil and Natural Gas Production - Condensate Tanks |
| np_oilgas | VOC | 95403 | Composite Profile - Gas Wells |
| np_oilgas | VOC | 95417 | Oil and Gas Production - Composite Profile - Untreated Natural Gas, Uinta Basin |
| np_oilgas | VOC | 95418 | Oil and Gas Production - Composite Profile - Condensate Tank Vent Gas, Uinta Basin |
| np_oilgas | VOC | 95419 | Oil and Gas Production - Composite Profile - Oil Tank Vent Gas, Uinta Basin |
| np_oilgas | VOC | 95420 | Oil and Gas Production - Composite Profile - Glycol Dehydrator, Uinta Basin |
| np_oilgas | VOC | DJVNT_R | Oil and Gas -Denver-Julesburg Basin Produced Gas Composition from Non-CBM Gas Wells |
| np_oilgas | VOC | FLR99 | Natural Gas Flare Profile with DRE >98% |
| np_oilgas | VOC | PNC01_R | Oil and Gas -Piceance Basin Produced Gas Composition from Non-CBM Gas Wells |
| np_oilgas | VOC | PNC02_R | Oil and Gas -Piceance Basin Produced Gas Composition from Oil Wells |
| np_oilgas | VOC | PNC03_R | Oil and Gas -Piceance Basin Flash Gas Composition for Condensate Tank |
| np_oilgas | VOC | PNCDH | Oil and Gas Production - Composite Profile - Glycol Dehydrator, Piceance Basin |
| np_oilgas | VOC | PRBCB_R | Oil and Gas -Powder River Basin Produced Gas Composition from CBM Wells |
| np_oilgas | VOC | PRBCO_R | Oil and Gas -Powder River Basin Produced Gas Composition from Non-CBM Wells |
| np_oilgas | VOC | PRM01_R | Oil and Gas -Permian Basin Produced Gas Composition for Non-CBM Wells |
| np_oilgas | VOC | SSJCB_R | Oil and Gas -South San Juan Basin Produced Gas Composition from CBM Wells |
| np_oilgas | VOC | SSJCO_R | Oil and Gas -South San Juan Basin Produced Gas Composition from Non-CBM Gas Wells |
| np_oilgas | VOC | SWFLA_R | Oil and Gas -SW Wyoming Basin Flash Gas Composition for Condensate Tanks |
| np_oilgas | VOC | SWVNT_R | Oil and Gas -SW Wyoming Basin Produced Gas Composition from Non-CBM Wells |
| np_oilgas | VOC | UNT01_R | Oil and Gas -Uinta Basin Produced Gas Composition from CBM Wells |
| np_oilgas | VOC | WRBCO_R | Oil and Gas -Wind River Basin Produced Gas Composition from Non-CBM Gas Wells |
| pt_oilgas | VOC | 95325 | Chemical Manufacturing Industry Wide Composite |
| pt_oilgas | VOC | 95326 | Pulp and Paper Industry Wide Composite |
| pt_oilgas | VOC | 95399 | Composite Profile - Oil Field - Wells |
| pt_oilgas | VOC | 95403 | Composite Profile - Gas Wells |
| pt_oilgas | VOC | 95417 | Oil and Gas Production - Composite Profile - Untreated Natural Gas, Uinta Basin |
| pt_oilgas | VOC | DJVNT_R | Oil and Gas -Denver-Julesburg Basin Produced Gas Composition from Non-CBM Gas Wells |
| pt_oilgas | VOC | FLR99 | Natural Gas Flare Profile with DRE >98% |

| | | | |
|---|---|---|---|
| pt_oilgas | VOC | PNC01_R | Oil and Gas -Piceance Basin Produced Gas Composition from Non-CBM Gas Wells |
| pt_oilgas | VOC | PNC02_R | Oil and Gas -Piceance Basin Produced Gas Composition from Oil Wells |
| pt_oilgas | VOC | PNCDH | Oil and Gas Production - Composite Profile - Glycol Dehydrator, Piceance Basin |
| pt_oilgas | VOC | PRBCO_R | Oil and Gas -Powder River Basin Produced Gas Composition from Non-CBM Wells |
| pt_oilgas | VOC | PRM01_R | Oil and Gas -Permian Basin Produced Gas Composition for Non-CBM Wells |
| pt_oilgas | VOC | SSJCO_R | Oil and Gas -South San Juan Basin Produced Gas Composition from Non-CBM Gas Wells |
| pt_oilgas | VOC | SWVNT_R | Oil and Gas -SW Wyoming Basin Produced Gas Composition from Non-CBM Wells |
| ptfire_f | VOC | 95421 | Composite Profile - Prescribed fire southeast conifer forest |
| ptfire_f | VOC | 95422 | Composite Profile - Prescribed fire southwest conifer forest |
| ptfire_f | VOC | 95423 | Composite Profile - Prescribed fire northwest conifer forest |
| ptfire_f | VOC | 95424 | Composite Profile - Wildfire northwest conifer forest |
| ptfire_f | VOC | 95425 | Composite Profile - Wildfire boreal forest |
| ptfire_s | VOC | 95421 | Composite Profile - Prescribed fire southeast conifer forest |
| ptfire_s | VOC | 95422 | Composite Profile - Prescribed fire southwest conifer forest |
| ptfire_s | VOC | 95423 | Composite Profile - Prescribed fire northwest conifer forest |
| ptfire_s | VOC | 95424 | Composite Profile - Wildfire northwest conifer forest |
| ptfire_s | VOC | 95425 | Composite Profile - Wildfire boreal forest |
| ptnonipm | VOC | 95240 | Beef Cattle Farm and Animal Waste |
| ptnonipm | VOC | 95325 | Chemical Manufacturing Industry Wide Composite |
| ptnonipm | VOC | 95326 | Pulp and Paper Industry Wide Composite |
| ptnonipm | VOC | 95399 | Composite Profile - Oil Field - Wells |
| ptnonipm | VOC | FLR99 | Natural Gas Flare Profile with DRE >98% |
| ptnonipm | VOC | PRBCO_R | Oil and Gas -Powder River Basin Produced Gas Composition from Non-CBM Wells |
| ptnonipm | VOC | PRM01_R | Oil and Gas -Permian Basin Produced Gas Composition for Non-CBM Wells |
| ptnonipm | VOC | SWVNT_R | Oil and Gas -SW Wyoming Basin Produced Gas Composition from Non-CBM Wells |

# Appendix D: CB6 Assignment for New Species

September 27, 2016

## MEMORANDUM

To: Alison Eyth and Madeleine Strum, OAQPS, EPA
From: Ross Beardsley and Greg Yarwood, Ramboll Environ
Subject: Species Mappings for CB6 and CB05 for use with SPECIATE 4.5

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### Summary

Ramboll Environ (RE) reviewed version 4.5 of the SPECIATE database, and created CB05 and CB6 mechanism species mappings for newly added compounds. In addition, the mapping guidelines for Carbon Bond (CB) mechanisms were expanded to promote consistency in current and future work.


### Background

The Environmental Protection Agency's SPECIATE repository contains gas and particulate matter speciation profiles of air pollution sources, which are used in the generation of emissions data for air quality models (AQM) such as CMAQ (http://www.cmascenter.org/cmaq/) and CAMx (http://www.camx.com). However, the condensed chemical mechanisms used within these photochemical models utilize fewer species than SPECIATE to represent gas phase chemistry, and thus the SPECIATE compounds must be assigned to the AQM model species of the condensed mechanisms. A chemical mapping is used to show the representation of organic chemical species by the model compounds of the condensed mechanisms.

This memorandum describes how chemical mappings were developed from SPECIATE 4.5 compounds to model species of the CB mechanism, specifically CB05 (http://www.camx.com/publ/pdfs/CB05_Final_Report_120805.pdf) and CB6 (http://aqrp.ceer.utexas.edu/projectinfoFY12_13/12-012/12-012%20Final%20Report.pdf).

### Methods

#### CB Model Species

Organic gases are mapped to the CB mechanism either as explicitly represented individual compounds (e.g. ALD2 for acetaldehyde), or as a combination of model species that represent common structural groups (e.g. ALDX for other aldehydes, PAR for alkyl groups). Table 1 lists all of the explicit and structural model species in CB05 and CB6 mechanisms, each of which represents a defined number of carbon atoms allowing for carbon to be conserved in all cases. CB6 contains four more explicit model species than CB05 and an additional structural group to represent ketones. The CB05 representation of the five additional CB6 species is provided in the '*Included in CB05*' column of Table 1.

In addition to the explicit and structural species, there are two model species that are used to represent organic gases that are not treated by the CB mechanism:

NVOL – Very low volatility SPECIATE compounds that reside predominantly in the particle phase and should be excluded from the gas phase mechanism. These compounds are mapped by setting NVOL equal to the molecular weight (e.g. decabromodiphenyl oxide is mapped as 959.2 NVOL), which allows for the total mass of all NVOL to be determined.

UNK – Compounds that are unable to be mapped to CB using the available model species. This approach should be avoided unless absolutely necessary, and will lead to a warning message in the speciation tool.

**Table 1. Model species in the CB05 and CB6 chemical mechanisms.**

| Model Species Name | Description | Number of Carbons | Included in CB05 (structural mapping) | Included in CB6 |
|---|---|---|---|---|
| **Explicit model species** | | | | |
| ACET | Acetone (propanone) | 3 | No (3 PAR) | Yes |
| ALD2 | Acetaldehyde (ethanal) | 2 | Yes | Yes |
| BENZ | Benzene | 6 | No (1 PAR, 5 UNR) | Yes |
| CH4 | Methane | 1 | Yes | Yes |
| ETH | Ethene (ethylene) | 2 | Yes | Yes |
| ETHA | Ethane | 2 | Yes | Yes |
| ETHY | Ethyne (acetylene) | 2 | No (1 PAR, 1 UNR) | Yes |
| ETOH | Ethanol | 2 | Yes | Yes |
| FORM | Formaldehyde (methanal) | 1 | Yes | Yes |
| ISOP | Isoprene (2-methyl-1,3-butadiene) | 5 | Yes | Yes |
| MEOH | Methanol | 1 | Yes | Yes |
| PRPA | Propane | 3 | No (1.5 PAR, 1.5 UNR) | Yes |
| **Common Structural groups** | | | | |
| ALDX | Higher aldehyde group (-C-CHO) | 2 | Yes | Yes |
| IOLE | Internal olefin group ($R_1R_2$>C=C<$R_3R_4$) | 4 | Yes | Yes |
| KET | Ketone group ($R_1R_2$ >C=O) | 1 | No (1 PAR) | Yes |
| OLE | Terminal olefin group ($R_1R_2$>C=C) | 2 | Yes | Yes |
| PAR | Paraffinic group ($R_1$-C<$R_2R_3$) | 1 | Yes | Yes |
| TERP | Monoterpenes | 10 | Yes | Yes |
| TOL | Toluene and other monoalkyl aromatics | 7 | Yes | Yes |
| UNR | Unreactive carbon groups (e.g., halogenated carbons) | 1 | Yes | Yes |
| XYL | Xylene and other polyalkyl aromatics | 8 | Yes | Yes |
| **Not mapped to CB model species** | | | | |
| NVOL | Very low volatility compounds | * | Yes | Yes |
| UNK | Unknown | * | Yes | Yes |

*Each NVOL represents 1 g $mol^{-1}$ and low volatility compounds are assigned to NVOL based on molecular weight. UNK is unmapped and thus does not represent any carbon.

### Mapping guidelines for non-explicit organic gases using CB model species

SPECIATE compounds that are not treated explicitly are mapped to CB model species that represent common structural groups. Table 2 lists the carbon number and general mapping guidelines for each of the structure model species.

**Table 2. General Guidelines for mapping using CB6 structural model species.**

| CB6 Species Name | Number of Carbons | Represents |
|---|---|---|
| ALDX | 2 | Aldehyde group. ALDX represents 2 carbons and additional carbons are represented as alkyl groups (mostly PAR), e.g. propionaldehyde is ALDX + PAR |
| IOLE | 4 | Internal olefin group. IOLE represents 4 carbons and additional carbons are represented as alkyl groups (mostly PAR), e.g. 2-pentene isomers are IOLE + PAR.<br>*Exceptions:*<br>• IOLE with 2 carbon branches on both sides of the double bond are downgraded to OLE |
| KET | 1 | Ketone group. KET represents 1 carbon and additional carbons are represented as alkyl groups (mostly PAR), e.g. butanone is 3 PAR + KET |
| OLE | 2 | Terminal olefin group. OLE represents 2 carbons and additional carbons are represented as alkyl groups (mostly PAR), e.g. propene is OLE + PAR. Alkyne group, e.g. butyne isomers are OLE + 2 PAR. |
| PAR | 1 | Alkanes and alkyl groups. PAR represents 1 carbon, e.g. butane is 4 PAR. See UNR for exceptions. |
| TERP | 10 | All monoterpenes are represented as 1 TERP. |
| TOL | 7 | Toluene and other monoalkyl aromatics. TOL represents 7 carbons and any additional carbons are represented as alkyl groups (mostly PAR), e.g. ethylbenzene is TOL + PAR. Cresols are represented as TOL and PAR. Styrenes are represented using TOL, OLE and PAR. |
| UNR | 1 | Unreactive carbons are 1 UNR such as quaternary alkyl groups (e.g., neo-pentane is 4 PAR + UNR), carboxylic acid groups (e.g., acetic acid is PAR + UNR), ester groups (e.g., methyl acetate is 2 PAR + UNR), halogenated carbons (e.g., trichloroethane isomers are 2 UNR), carbons of nitrile groups (-C≡N). |
| XYL | 8 | Xylene isomers and other polyalkyl aromatics. XYL represents 8 carbons and any additional carbons are represented as alkyl groups (mostly PAR), e.g. trimethylbenzene isomers are XYL + PAR |

Some compounds that are multifunctional and/or include hetero-atoms lack obvious CB mappings. We developed guidelines for some of these compound classes to promote consistent representation in this work and future revisions. Approaches for several compound classes are explained in Table 3. We developed guidelines as needed to address newly added species in SPECIATE 4.5 but did not systematically review existing mappings for "difficult to assign" compounds that could benefit from developing a guideline.

Table 3. Mapping guidelines for some difficult to map compound classes and structural groups

| Compound Class/Structural group | CB model species representation |
|---|---|
| Chlorobenzenes and other halogenated benzenes | Guideline:<br>• 3 or less halogens – 1 PAR, 5 UNR<br>• 4 or more halogens – 6 UNR<br>Examples:<br>• 1,3,5-Chlorobenzene – 1 PAR, 5 UNR<br>• Tetrachlorobenzenes – 6 UNR |
| Cyclodienes | Guideline:<br>• 1 IOLE with additional carbons represented as alkyl groups (generally PAR)<br>Examples:<br>• Methylcyclopentadiene – 1 IOLE, 2 PAR<br>• Methylcyclohexadiene – 1 IOLE, 3 PAR |
| Furans/Pyrroles | Guideline:<br>• 2 OLE with additional carbons represented as alkyl groups (generally PAR)<br>Examples:<br>• 2-Butylfuran – 2 OLE, 4 PAR<br>• 2-Pentylfuran – 2 OLE, 5 PAR<br>• Pyrrole – 2 OLE<br>• 1-Methylpyrrole – 2 OLE, 1 PAR |
| Heterocyclic aromatic compounds containing 2 non-carbon atoms | Guideline:<br>• 1 OLE with remaining carbons represented as alkyl groups (generally PAR)<br>Examples:<br>• Ethylpyrazine – 1 OLE, 4 PAR<br>• 1-methylpyrazole – 1 OLE, 2 PAR<br>• 4,5-Dimethyloxazole – 1 OLE, 3 PAR |
| Triple bond(s) | Guideline:<br>• Triple bonds are treated as PAR unless they are the only reactive functional group. If a compound contains more than one triple bond and no other reactive functional groups, then one of the triple bonds is treated as OLE with additional carbons treated as alkyl groups.<br>Examples:<br>• 1-Penten-3-yne – 1 OLE, 3 PAR<br>• 1,5-Hexadien-3-yne – 2 OLE, 2 PAR<br>• 1,6-Heptadiyne – 1 OLE, 5 PAR |

These guidelines were used to map the new species from SPEICATE4.5, and also to revise some previously mapped compounds. Overall, a total of 175 new species from SPECIATEv4.5 were mapped and 7 previously mapped species were revised based on the new guidelines.

## Recommendation

1. Complete a systematic review of the mapping of all species to ensure conformity with current mapping guidelines. The assignments of existing compounds that are similar to new species were reviewed and revised to promote consistency in mapping approaches, but the majority of existing species mappings were not reviewed as it was outside the scope of this work.
2. Develop a methodology for classifying and tracking larger organic compounds based on their volatility (semi, intermediate, or low volatility) to improve support for secondary organic aerosol (SOA) modeling using the volatility basis set (VBS) SOA model, which is available in both CMAQ and CAMx. A preliminary investigation of the possibility of doing so has been performed, and is discussed in a separate memorandum.

## Appendix E: NONHAPTOG profiles that that produce NBAFM via compound mixtures

| Profile code | Inventory Species | Mechanism species | Numerator | Divisor | Mass Fraction | Used in 2014v7.0 platform? |
|---|---|---|---|---|---|---|
| 0000 | NONHAPTOG | ALD2 | 5.67E-04 | 40.1466 | 5.67E-04 | YES |
| 1089 | NONHAPTOG | ALD2 | 0.1651 | 40.1466 | 0.1651 | YES |
| 4710 | NONHAPTOG | ALD2 | 2.01E-06 | 40.1466 | 2.01E-06 | |
| 4715 | NONHAPTOG | ALD2 | 5.22E-06 | 40.1466 | 5.22E-06 | |
| 4716 | NONHAPTOG | ALD2 | 2.81E-06 | 40.1466 | 2.81E-06 | |
| 8861 | NONHAPTOG | ALD2 | 2.41E-06 | 40.1466 | 2.41E-06 | |
| 8862 | NONHAPTOG | ALD2 | 4.82E-06 | 40.1466 | 4.82E-06 | |
| 8500 | NONHAPTOG | FORM | 2.12E-04 | 30.026 | 2.12E-04 | |
| 8526 | NONHAPTOG | FORM | 9.22E-04 | 30.026 | 9.22E-04 | |
| 8530 | NONHAPTOG | FORM | 6.13E-03 | 30.026 | 6.13E-03 | |
| 3001 | NONHAPTOG | BENZ | 9.02E-04 | 86.0788 | 9.02E-04 | YES |
| 8500 | NONHAPTOG | BENZ | 8.00E-04 | 86.0788 | 8.00E-04 | |
| 8511 | NONHAPTOG | BENZ | 6.28E-05 | 86.0788 | 6.28E-05 | |
| 8512 | NONHAPTOG | BENZ | 7.75E-05 | 86.0788 | 7.75E-05 | |
| 8514 | NONHAPTOG | BENZ | 1.46E-05 | 86.0788 | 1.46E-05 | |
| 8516 | NONHAPTOG | BENZ | 9.21E-05 | 86.0788 | 9.21E-05 | |
| 8517 | NONHAPTOG | BENZ | 3.87E-05 | 86.0788 | 3.87E-05 | |
| 8519 | NONHAPTOG | BENZ | 1.64E-04 | 86.0788 | 1.64E-04 | |
| 8520 | NONHAPTOG | BENZ | 5.93E-03 | 86.0788 | 5.93E-03 | YES |
| 8521 | NONHAPTOG | BENZ | 5.89E-03 | 86.0788 | 5.89E-03 | |
| 8522 | NONHAPTOG | BENZ | 5.93E-03 | 86.0788 | 5.93E-03 | |
| 8523 | NONHAPTOG | BENZ | 4.82E-05 | 86.0788 | 4.82E-05 | |
| 8524 | NONHAPTOG | BENZ | 5.34E-05 | 86.0788 | 5.34E-05 | |
| 8526 | NONHAPTOG | BENZ | 9.55E-04 | 86.0788 | 9.55E-04 | |
| 8527 | NONHAPTOG | BENZ | 9.61E-04 | 86.0788 | 9.61E-04 | |
| 8528 | NONHAPTOG | BENZ | 1.82E-03 | 86.0788 | 1.82E-03 | |
| 8529 | NONHAPTOG | BENZ | 1.43E-03 | 86.0788 | 1.43E-03 | |
| 8530 | NONHAPTOG | BENZ | 1.46E-05 | 86.0788 | 1.46E-05 | |
| 8532 | NONHAPTOG | BENZ | 1.37E-04 | 86.0788 | 1.37E-04 | |
| 8534 | NONHAPTOG | BENZ | 3.74E-04 | 86.0788 | 3.74E-04 | |
| 8535 | NONHAPTOG | BENZ | 1.23E-04 | 86.0788 | 1.23E-04 | |
| 8536 | NONHAPTOG | BENZ | 3.52E-04 | 86.0788 | 3.52E-04 | |
| 2543 | NONHAPTOG | MEOH | 1.66E-03 | 14.3806 | 1.66E-03 | |
| 2544 | NONHAPTOG | MEOH | 1.66E-03 | 14.3806 | 1.66E-03 | YES |
| 3018 | NONHAPTOG | MEOH | 1.84E-05 | 14.3806 | 1.84E-05 | |
| 3020 | NONHAPTOG | MEOH | 7.49E-05 | 14.3806 | 7.49E-05 | |
| 3021 | NONHAPTOG | MEOH | 1.09E-04 | 14.3806 | 1.09E-04 | |
| 3022 | NONHAPTOG | MEOH | 4.31E-05 | 14.3806 | 4.31E-05 | |
| 3023 | NONHAPTOG | MEOH | 5.46E-05 | 14.3806 | 5.46E-05 | |
| 3029 | NONHAPTOG | MEOH | 3.80E-05 | 14.3806 | 3.80E-05 | |
| 3030 | NONHAPTOG | MEOH | 3.66E-04 | 14.3806 | 3.66E-04 | |
| 3031 | NONHAPTOG | MEOH | 3.11E-04 | 14.3806 | 3.11E-04 | |
| 3048 | NONHAPTOG | MEOH | 8.10E-04 | 14.3806 | 8.10E-04 | |
| 3049 | NONHAPTOG | MEOH | 1.45E-03 | 14.3806 | 1.45E-03 | |
| 3050 | NONHAPTOG | MEOH | 1.45E-03 | 14.3806 | 1.45E-03 | |
| 3051 | NONHAPTOG | MEOH | 4.10E-04 | 14.3806 | 4.10E-04 | |
| 3052 | NONHAPTOG | MEOH | 1.07E-04 | 14.3806 | 1.07E-04 | |
| 3053 | NONHAPTOG | MEOH | 9.30E-04 | 14.3806 | 9.30E-04 | |
| 3054 | NONHAPTOG | MEOH | 9.31E-04 | 14.3806 | 9.31E-04 | |

| Profile code | Inventory Species | Mechanism species | Numerator | Divisor | Mass Fraction | Used in 2014v7.0 platform? |
|---|---|---|---|---|---|---|
| 3055 | NONHAPTOG | MEOH | 8.05E-04 | 14.3806 | 8.05E-04 | |
| 3064 | NONHAPTOG | MEOH | 4.09E-04 | 14.3806 | 4.09E-04 | |
| 3066 | NONHAPTOG | MEOH | 1.50E-04 | 14.3806 | 1.50E-04 | YES |
| 3067 | NONHAPTOG | MEOH | 1.46E-04 | 14.3806 | 1.46E-04 | |
| 3078 | NONHAPTOG | MEOH | 1.37E-03 | 14.3806 | 1.37E-03 | |
| 3079 | NONHAPTOG | MEOH | 1.38E-03 | 14.3806 | 1.38E-03 | |
| 3081 | NONHAPTOG | MEOH | 4.72E-04 | 14.3806 | 4.72E-04 | |
| 3082 | NONHAPTOG | MEOH | 4.69E-04 | 14.3806 | 4.69E-04 | |
| 3086 | NONHAPTOG | MEOH | 4.40E-05 | 14.3806 | 4.40E-05 | |
| 3087 | NONHAPTOG | MEOH | 4.50E-05 | 14.3806 | 4.50E-05 | |
| 3089 | NONHAPTOG | MEOH | 7.36E-05 | 14.3806 | 7.36E-05 | |
| 3091 | NONHAPTOG | MEOH | 3.11E-04 | 14.3806 | 3.11E-04 | |
| 3092 | NONHAPTOG | MEOH | 7.09E-04 | 14.3806 | 7.09E-04 | |
| 3143 | NONHAPTOG | MEOH | 4.73E-05 | 14.3806 | 4.73E-05 | |
| 3145 | NONHAPTOG | MEOH | 5.35E-04 | 14.3806 | 5.35E-04 | YES |
| 3146 | NONHAPTOG | MEOH | 9.51E-05 | 14.3806 | 9.51E-05 | YES |
| 8500 | NONHAPTOG | MEOH | 5.46E-05 | 14.3806 | 5.46E-05 | |
| 8501 | NONHAPTOG | MEOH | 2.57E-05 | 14.3806 | 2.57E-05 | |
| 8507 | NONHAPTOG | MEOH | 3.72E-05 | 14.3806 | 3.72E-05 | |
| 8509 | NONHAPTOG | MEOH | 4.03E-06 | 14.3806 | 4.03E-06 | |
| 8510 | NONHAPTOG | MEOH | 1.89E-04 | 14.3806 | 1.89E-04 | |
| 8511 | NONHAPTOG | MEOH | 6.57E-05 | 14.3806 | 6.57E-05 | |
| 8512 | NONHAPTOG | MEOH | 1.28E-05 | 14.3806 | 1.28E-05 | |
| 8513 | NONHAPTOG | MEOH | 4.26E-05 | 14.3806 | 4.26E-05 | |
| 8514 | NONHAPTOG | MEOH | 4.63E-05 | 14.3806 | 4.63E-05 | |
| 8516 | NONHAPTOG | MEOH | 6.39E-05 | 14.3806 | 6.39E-05 | |
| 8517 | NONHAPTOG | MEOH | 4.31E-07 | 14.3806 | 4.31E-07 | |
| 8518 | NONHAPTOG | MEOH | 4.31E-06 | 14.3806 | 4.31E-06 | |
| 8519 | NONHAPTOG | MEOH | 2.24E-04 | 14.3806 | 2.24E-04 | |
| 8520 | NONHAPTOG | MEOH | 9.17E-05 | 14.3806 | 9.17E-05 | YES |
| 8521 | NONHAPTOG | MEOH | 2.02E-04 | 14.3806 | 2.02E-04 | |
| 8522 | NONHAPTOG | MEOH | 8.15E-05 | 14.3806 | 8.15E-05 | |
| 8523 | NONHAPTOG | MEOH | 7.42E-05 | 14.3806 | 7.42E-05 | |
| 8524 | NONHAPTOG | MEOH | 7.89E-05 | 14.3806 | 7.89E-05 | |
| 8525 | NONHAPTOG | MEOH | 3.51E-05 | 14.3806 | 3.51E-05 | |
| 8526 | NONHAPTOG | MEOH | 8.15E-05 | 14.3806 | 8.15E-05 | |
| 8527 | NONHAPTOG | MEOH | 3.00E-04 | 14.3806 | 3.00E-04 | |
| 8528 | NONHAPTOG | MEOH | 3.12E-05 | 14.3806 | 3.12E-05 | |
| 8529 | NONHAPTOG | MEOH | 5.75E-06 | 14.3806 | 5.75E-06 | |
| 8531 | NONHAPTOG | MEOH | 4.31E-05 | 14.3806 | 4.31E-05 | |
| 8532 | NONHAPTOG | MEOH | 2.37E-05 | 14.3806 | 2.37E-05 | |
| 8533 | NONHAPTOG | MEOH | 7.19E-07 | 14.3806 | 7.19E-07 | |
| 8534 | NONHAPTOG | MEOH | 6.43E-05 | 14.3806 | 6.43E-05 | |
| 8535 | NONHAPTOG | MEOH | 2.24E-05 | 14.3806 | 2.24E-05 | |
| 8536 | NONHAPTOG | MEOH | 6.40E-05 | 14.3806 | 6.40E-05 | |

## Appendix F: Mapping of Fuel Distribution SCCs to BTP, BPS and RBT

The table below provides a crosswalk between fuel distribution SCCs and classification type for portable fuel containers (PFC), fuel distribution operations associated with the bulk-plant-to-pump (BTP), refinery to bulk terminal (RBT) and bulk plant storage (BPS).

| SCC | Type | Description |
|---|---|---|
| 40301001 | RBT | Petroleum and Solvent Evaporation; Petroleum Product Storage at Refineries; Fixed Roof Tanks (Varying Sizes); Gasoline RVP 13: Breathing Loss (67000 Bbl. Tank Size) |
| 40301002 | RBT | Petroleum and Solvent Evaporation; Petroleum Product Storage at Refineries; Fixed Roof Tanks (Varying Sizes); Gasoline RVP 10: Breathing Loss (67000 Bbl. Tank Size) |
| 40301003 | RBT | Petroleum and Solvent Evaporation; Petroleum Product Storage at Refineries; Fixed Roof Tanks (Varying Sizes); Gasoline RVP 7: Breathing Loss (67000 Bbl. Tank Size) |
| 40301004 | RBT | Petroleum and Solvent Evaporation; Petroleum Product Storage at Refineries; Fixed Roof Tanks (Varying Sizes); Gasoline RVP 13: Breathing Loss (250000 Bbl. Tank Size) |
| 40301006 | RBT | Petroleum and Solvent Evaporation; Petroleum Product Storage at Refineries; Fixed Roof Tanks (Varying Sizes); Gasoline RVP 7: Breathing Loss (250000 Bbl. Tank Size) |
| 40301007 | RBT | Petroleum and Solvent Evaporation; Petroleum Product Storage at Refineries; Fixed Roof Tanks (Varying Sizes); Gasoline RVP 13: Working Loss (Tank Diameter Independent) |
| 40301101 | RBT | Petroleum and Solvent Evaporation; Petroleum Product Storage at Refineries; Floating Roof Tanks (Varying Sizes); Gasoline RVP 13: Standing Loss (67000 Bbl. Tank Size) |
| 40301102 | RBT | Petroleum and Solvent Evaporation; Petroleum Product Storage at Refineries; Floating Roof Tanks (Varying Sizes); Gasoline RVP 10: Standing Loss (67000 Bbl. Tank Size) |
| 40301103 | RBT | Petroleum and Solvent Evaporation; Petroleum Product Storage at Refineries; Floating Roof Tanks (Varying Sizes); Gasoline RVP 7: Standing Loss (67000 Bbl. Tank Size) |
| 40301105 | RBT | Petroleum and Solvent Evaporation; Petroleum Product Storage at Refineries; Floating Roof Tanks (Varying Sizes); Gasoline RVP 10: Standing Loss (250000 Bbl. Tank Size) |
| 40301151 | RBT | Petroleum and Solvent Evaporation; Petroleum Product Storage at Refineries; Floating Roof Tanks (Varying Sizes); Gasoline: Standing Loss - Internal |
| 40301202 | RBT | Petroleum and Solvent Evaporation; Petroleum Product Storage at Refineries; Variable Vapor Space; Gasoline RVP 10: Filling Loss |
| 40301203 | RBT | Petroleum and Solvent Evaporation; Petroleum Product Storage at Refineries; Variable Vapor Space; Gasoline RVP 7: Filling Loss |
| 40400101 | RBT | Petroleum and Solvent Evaporation; Petroleum Liquids Storage (non-Refinery); Bulk Terminals; Gasoline RVP 13: Breathing Loss (67000 Bbl Capacity) - Fixed Roof Tank |
| 40400102 | RBT | Petroleum and Solvent Evaporation; Petroleum Liquids Storage (non-Refinery); Bulk Terminals; Gasoline RVP 10: Breathing Loss (67000 Bbl Capacity) - Fixed Roof Tank |
| 40400103 | RBT | Petroleum and Solvent Evaporation; Petroleum Liquids Storage (non-Refinery); Bulk Terminals; Gasoline RVP 7: Breathing Loss (67000 Bbl. Capacity) - Fixed Roof Tank |
| 40400104 | RBT | Petroleum and Solvent Evaporation; Petroleum Liquids Storage (non-Refinery); Bulk Terminals; Gasoline RVP 13: Breathing Loss (250000 Bbl Capacity)-Fixed Roof Tank |
| 40400105 | RBT | Petroleum and Solvent Evaporation; Petroleum Liquids Storage (non-Refinery); Bulk Terminals; Gasoline RVP 10: Breathing Loss (250000 Bbl Capacity)-Fixed Roof Tank |
| 40400106 | RBT | Petroleum and Solvent Evaporation; Petroleum Liquids Storage (non-Refinery); Bulk Terminals; Gasoline RVP 7: Breathing Loss (250000 Bbl Capacity) - Fixed Roof Tank |
| 40400107 | RBT | Petroleum and Solvent Evaporation; Petroleum Liquids Storage (non-Refinery); Bulk Terminals; Gasoline RVP 13: Working Loss (Diam. Independent) - Fixed Roof Tank |
| 40400108 | RBT | Petroleum and Solvent Evaporation; Petroleum Liquids Storage (non-Refinery); Bulk Terminals; Gasoline RVP 10: Working Loss (Diameter Independent) - Fixed Roof Tank |
| 40400109 | RBT | Petroleum and Solvent Evaporation; Petroleum Liquids Storage (non-Refinery); Bulk Terminals; Gasoline RVP 7: Working Loss (Diameter Independent) - Fixed Roof Tank |
| 40400110 | RBT | Petroleum and Solvent Evaporation; Petroleum Liquids Storage (non-Refinery); Bulk Terminals; Gasoline RVP 13: Standing Loss (67000 Bbl Capacity)-Floating Roof Tank |

| SCC | Type | Description |
|---|---|---|
| 4040011<br>1 | RBT | Petroleum and Solvent Evaporation; Petroleum Liquids Storage (non-Refinery); Bulk Terminals; Gasoline RVP 10: Standing Loss (67000 Bbl Capacity)-Floating Roof Tank |
| 4040011<br>2 | RBT | Petroleum and Solvent Evaporation; Petroleum Liquids Storage (non-Refinery); Bulk Terminals; Gasoline RVP 7: Standing Loss (67000 Bbl Capacity)- Floating Roof Tank |
| 4040011<br>3 | RBT | Petroleum and Solvent Evaporation; Petroleum Liquids Storage (non-Refinery); Bulk Terminals; Gasoline RVP 13: Standing Loss (250000 Bbl Cap.) - Floating Roof Tank |
| 4040011<br>4 | RBT | Petroleum and Solvent Evaporation; Petroleum Liquids Storage (non-Refinery); Bulk Terminals; Gasoline RVP 10: Standing Loss (250000 Bbl Cap.) - Floating Roof Tank |
| 4040011<br>5 | RBT | Petroleum and Solvent Evaporation; Petroleum Liquids Storage (non-Refinery); Bulk Terminals; Gasoline RVP 7: Standing Loss (250000 Bbl Cap.) - Floating Roof Tank |
| 4040011<br>6 | RBT | Petroleum and Solvent Evaporation; Petroleum Liquids Storage (non-Refinery); Bulk Terminals; Gasoline RVP 13/10/7: Withdrawal Loss (67000 Bbl Cap.) - Float Rf Tnk |
| 4040011<br>7 | RBT | Petroleum and Solvent Evaporation; Petroleum Liquids Storage (non-Refinery); Bulk Terminals; Gasoline RVP 13/10/7: Withdrawal Loss (250000 Bbl Cap.) - Float Rf Tnk |
| 4040011<br>8 | RBT | Petroleum and Solvent Evaporation; Petroleum Liquids Storage (non-Refinery); Bulk Terminals; Gasoline RVP 13: Filling Loss (10500 Bbl Cap.) - Variable Vapor Space |
| 4040011<br>9 | RBT | Petroleum and Solvent Evaporation; Petroleum Liquids Storage (non-Refinery); Bulk Terminals; Gasoline RVP 10: Filling Loss (10500 Bbl Cap.) - Variable Vapor Space |
| 4040012<br>0 | RBT | Petroleum and Solvent Evaporation; Petroleum Liquids Storage (non-Refinery); Bulk Terminals; Gasoline RVP 7: Filling Loss (10500 Bbl Cap.) - Variable Vapor Space |
| 4040013<br>0 | RBT | Petroleum and Solvent Evaporation; Petroleum Liquids Storage (non-Refinery); Bulk Terminals; Specify Liquid: Standing Loss - External Floating Roof w/ Primary Seal |
| 4040013<br>1 | RBT | Petroleum and Solvent Evaporation; Petroleum Liquids Storage (non-Refinery); Bulk Terminals; Gasoline RVP 13: Standing Loss - Ext. Floating Roof w/ Primary Seal |
| 4040013<br>2 | RBT | Petroleum and Solvent Evaporation; Petroleum Liquids Storage (non-Refinery); Bulk Terminals; Gasoline RVP 10: Standing Loss - Ext. Floating Roof w/ Primary Seal |
| 4040013<br>3 | RBT | Petroleum and Solvent Evaporation; Petroleum Liquids Storage (non-Refinery); Bulk Terminals; Gasoline RVP 7: Standing Loss - External Floating Roof w/ Primary Seal |
| 4040014<br>0 | RBT | Petroleum and Solvent Evaporation; Petroleum Liquids Storage (non-Refinery); Bulk Terminals; Specify Liquid: Standing Loss - Ext. Float Roof Tank w/ Secondy Seal |
| 4040014<br>1 | RBT | Petroleum and Solvent Evaporation; Petroleum Liquids Storage (non-Refinery); Bulk Terminals; Gasoline RVP 13: Standing Loss - Ext. Floating Roof w/ Secondary Seal |
| 4040014<br>2 | RBT | Petroleum and Solvent Evaporation; Petroleum Liquids Storage (non-Refinery); Bulk Terminals; Gasoline RVP 10: Standing Loss - Ext. Floating Roof w/ Secondary Seal |
| 4040014<br>3 | RBT | Petroleum and Solvent Evaporation; Petroleum Liquids Storage (non-Refinery); Bulk Terminals; Gasoline RVP 7: Standing Loss - Ext. Floating Roof w/ Secondary Seal |
| 4040014<br>8 | RBT | Petroleum and Solvent Evaporation; Petroleum Liquids Storage (non-Refinery); Bulk Terminals; Gasoline RVP 13/10/7: Withdrawal Loss - Ext. Float Roof (Pri/Sec Seal) |
| 4040014<br>9 | RBT | Petroleum and Solvent Evaporation; Petroleum Liquids Storage (non-Refinery); Bulk Terminals; Specify Liquid: External Floating Roof (Primary/Secondary Seal) |
| 4040015<br>0 | RBT | Petroleum and Solvent Evaporation; Petroleum Liquids Storage (non-Refinery); Bulk Terminals; Miscellaneous Losses/Leaks: Loading Racks |
| 4040015<br>1 | RBT | Petroleum and Solvent Evaporation; Petroleum Liquids Storage (non-Refinery); Bulk Terminals; Valves, Flanges, and Pumps |
| 4040015<br>2 | RBT | Petroleum and Solvent Evaporation; Petroleum Liquids Storage (non-Refinery); Bulk Terminals; Vapor Collection Losses |
| 4040015<br>3 | RBT | Petroleum and Solvent Evaporation; Petroleum Liquids Storage (non-Refinery); Bulk Terminals; Vapor Control Unit Losses |
| 4040016<br>0 | RBT | Petroleum and Solvent Evaporation; Petroleum Liquids Storage (non-Refinery); Bulk Terminals; Specify Liquid: Standing Loss - Internal Floating Roof w/ Primary Seal |
| 4040016<br>1 | RBT | Petroleum and Solvent Evaporation; Petroleum Liquids Storage (non-Refinery); Bulk Terminals; Gasoline RVP 13: Standing Loss - Int. Floating Roof w/ Primary Seal |
| 4040016<br>2 | RBT | Petroleum and Solvent Evaporation; Petroleum Liquids Storage (non-Refinery); Bulk Terminals; Gasoline RVP 10: Standing Loss - Int. Floating Roof w/ Primary Seal |
| 4040016<br>3 | RBT | Petroleum and Solvent Evaporation; Petroleum Liquids Storage (non-Refinery); Bulk Terminals; Gasoline RVP 7: Standing Loss - Internal Floating Roof w/ Primary Seal |

| SCC | Type | Description |
|---|---|---|
| 4040017 0 | RBT | Petroleum and Solvent Evaporation; Petroleum Liquids Storage (non-Refinery); Bulk Terminals; Specify Liquid: Standing Loss - Int. Floating Roof w/ Secondary Seal |
| 4040017 1 | RBT | Petroleum and Solvent Evaporation; Petroleum Liquids Storage (non-Refinery); Bulk Terminals; Gasoline RVP 13: Standing Loss - Int. Floating Roof w/ Secondary Seal |
| 4040017 2 | RBT | Petroleum and Solvent Evaporation; Petroleum Liquids Storage (non-Refinery); Bulk Terminals; Gasoline RVP 10: Standing Loss - Int. Floating Roof w/ Secondary Seal |
| 4040017 3 | RBT | Petroleum and Solvent Evaporation; Petroleum Liquids Storage (non-Refinery); Bulk Terminals; Gasoline RVP 7: Standing Loss - Int. Floating Roof w/ Secondary Seal |
| 4040017 8 | RBT | Petroleum and Solvent Evaporation; Petroleum Liquids Storage (non-Refinery); Bulk Terminals; Gasoline RVP 13/10/7: Withdrawal Loss - Int. Float Roof (Pri/Sec Seal) |
| 4040017 9 | RBT | Petroleum and Solvent Evaporation; Petroleum Liquids Storage (non-Refinery); Bulk Terminals; Specify Liquid: Internal Floating Roof (Primary/Secondary Seal) |
| 4040019 9 | RBT | Petroleum and Solvent Evaporation; Petroleum Liquids Storage (non-Refinery); Bulk Terminals; See Comment ** |
| 4040020 1 | BTP/B PS | Petroleum and Solvent Evaporation; Petroleum Liquids Storage (non-Refinery); Bulk Plants; Gasoline RVP 13: Breathing Loss (67000 Bbl Capacity) - Fixed Roof Tank |
| 4040020 2 | BTP/B PS | Petroleum and Solvent Evaporation; Petroleum Liquids Storage (non-Refinery); Bulk Plants; Gasoline RVP 10: Breathing Loss (67000 Bbl Capacity) - Fixed Roof Tank |
| 4040020 3 | BTP/B PS | Petroleum and Solvent Evaporation; Petroleum Liquids Storage (non-Refinery); Bulk Plants; Gasoline RVP 7: Breathing Loss (67000 Bbl. Capacity) - Fixed Roof Tank |
| 4040020 4 | BTP/B PS | Petroleum and Solvent Evaporation; Petroleum Liquids Storage (non-Refinery); Bulk Plants; Gasoline RVP 13: Working Loss (67000 Bbl. Capacity) - Fixed Roof Tank |
| 4040020 5 | BTP/B PS | Petroleum and Solvent Evaporation; Petroleum Liquids Storage (non-Refinery); Bulk Plants; Gasoline RVP 10: Working Loss (67000 Bbl. Capacity) - Fixed Roof Tank |
| 4040020 6 | BTP/B PS | Petroleum and Solvent Evaporation; Petroleum Liquids Storage (non-Refinery); Bulk Plants; Gasoline RVP 7: Working Loss (67000 Bbl. Capacity) - Fixed Roof Tank |
| 4040020 7 | BTP/B PS | Petroleum and Solvent Evaporation; Petroleum Liquids Storage (non-Refinery); Bulk Plants; Gasoline RVP 13: Standing Loss (67000 Bbl Cap.) - Floating Roof Tank |
| 4040020 8 | BTP/B PS | Petroleum and Solvent Evaporation; Petroleum Liquids Storage (non-Refinery); Bulk Plants; Gasoline RVP 10: Standing Loss (67000 Bbl Cap.) - Floating Roof Tank |
| 4040021 0 | BTP/B PS | Petroleum and Solvent Evaporation; Petroleum Liquids Storage (non-Refinery); Bulk Plants; Gasoline RVP 13/10/7: Withdrawal Loss (67000 Bbl Cap.) - Float Rf Tnk |
| 4040021 1 | BTP/B PS | Petroleum and Solvent Evaporation; Petroleum Liquids Storage (non-Refinery); Bulk Plants; Gasoline RVP 13: Filling Loss (10500 Bbl Cap.) - Variable Vapor Space |
| 4040021 2 | BTP/B PS | Petroleum and Solvent Evaporation; Petroleum Liquids Storage (non-Refinery); Bulk Plants; Gasoline RVP 10: Filling Loss (10500 Bbl Cap.) - Variable Vapor Space |
| 4040021 3 | BTP/B PS | Petroleum and Solvent Evaporation; Petroleum Liquids Storage (non-Refinery); Bulk Plants; Gasoline RVP 7: Filling Loss (10500 Bbl Cap.) - Variable Vapor Space |
| 4040023 0 | BTP/B PS | Petroleum and Solvent Evaporation; Petroleum Liquids Storage (non-Refinery); Bulk Plants; Specify Liquid: Standing Loss - External Floating Roof w/ Primary Seal |
| 4040023 1 | BTP/B PS | Petroleum and Solvent Evaporation; Petroleum Liquids Storage (non-Refinery); Bulk Plants; Gasoline RVP 13: Standing Loss - Ext. Floating Roof w/ Primary Seal |

| SCC | Type | Description |
|---|---|---|
| 40400232 | BTP/BPS | Petroleum and Solvent Evaporation; Petroleum Liquids Storage (non-Refinery); Bulk Plants; Gasoline RVP 10: Standing Loss - Ext. Floating Roof w/ Primary Seal |
| 40400233 | BTP/BPS | Petroleum and Solvent Evaporation; Petroleum Liquids Storage (non-Refinery); Bulk Plants; Gasoline RVP 7: Standing Loss - External Floating Roof w/ Primary Seal |
| 40400240 | RBT | Petroleum and Solvent Evaporation; Petroleum Liquids Storage (non-Refinery); Bulk Plants; Specify Liquid: Standing Loss - Ext. Floating Roof w/ Secondary Seal |
| 40400241 | BTP/BPS | Petroleum and Solvent Evaporation; Petroleum Liquids Storage (non-Refinery); Bulk Plants; Gasoline RVP 13: Standing Loss - Ext. Floating Roof w/ Secondary Seal |
| 40400248 | BTP/BPS | Petroleum and Solvent Evaporation; Petroleum Liquids Storage (non-Refinery); Bulk Plants; Gasoline RVP 10/13/7: Withdrawal Loss - Ext. Float Roof (Pri/Sec Seal) |
| 40400249 | RBT | Petroleum and Solvent Evaporation; Petroleum Liquids Storage (non-Refinery); Bulk Plants; Specify Liquid: External Floating Roof (Primary/Secondary Seal) |
| 40400250 | BTP/BPS | Petroleum and Solvent Evaporation; Petroleum Liquids Storage (non-Refinery); Bulk Plants; Loading Racks |
| 40400251 | BTP/BPS | Petroleum and Solvent Evaporation; Petroleum Liquids Storage (non-Refinery); Bulk Plants; Valves, Flanges, and Pumps |
| 40400252 | BTP/BPS | Petroleum and Solvent Evaporation; Petroleum Liquids Storage (non-Refinery); Bulk Plants; Miscellaneous Losses/Leaks: Vapor Collection Losses |
| 40400253 | BTP/BPS | Petroleum and Solvent Evaporation; Petroleum Liquids Storage (non-Refinery); Bulk Plants; Miscellaneous Losses/Leaks: Vapor Control Unit Losses |
| 40400260 | RBT | Petroleum and Solvent Evaporation; Petroleum Liquids Storage (non-Refinery); Bulk Plants; Specify Liquid: Standing Loss - Internal Floating Roof w/ Primary Seal |
| 40400261 | BTP/BPS | Petroleum and Solvent Evaporation; Petroleum Liquids Storage (non-Refinery); Bulk Plants; Gasoline RVP 13: Standing Loss - Int. Floating Roof w/ Primary Seal |
| 40400262 | BTP/BPS | Petroleum and Solvent Evaporation; Petroleum Liquids Storage (non-Refinery); Bulk Plants; Gasoline RVP 10: Standing Loss - Int. Floating Roof w/ Primary Seal |
| 40400263 | BTP/BPS | Petroleum and Solvent Evaporation; Petroleum Liquids Storage (non-Refinery); Bulk Plants; Gasoline RVP 7: Standing Loss - Internal Floating Roof w/ Primary Seal |
| 40400270 | BTP/BPS | Petroleum and Solvent Evaporation; Petroleum Liquids Storage (non-Refinery); Bulk Plants; Specify Liquid: Standing Loss - Int. Floating Roof w/ Secondary Seal |
| 40400271 | BTP/BPS | Petroleum and Solvent Evaporation; Petroleum Liquids Storage (non-Refinery); Bulk Plants; Gasoline RVP 13: Standing Loss - Int. Floating Roof w/ Secondary Seal |
| 40400272 | BTP/BPS | Petroleum and Solvent Evaporation; Petroleum Liquids Storage (non-Refinery); Bulk Plants; Gasoline RVP 10: Standing Loss - Int. Floating Roof w/ Secondary Seal |
| 40400273 | BTP/BPS | Petroleum and Solvent Evaporation; Petroleum Liquids Storage (non-Refinery); Bulk Plants; Gasoline RVP 7: Standing Loss - Int. Floating Roof w/ Secondary Seal |
| 40400278 | BTP/BPS | Petroleum and Solvent Evaporation; Petroleum Liquids Storage (non-Refinery); Bulk Plants; Gasoline RVP 10/13/7: Withdrawal Loss - Int. Float Roof (Pri/Sec Seal) |

| SCC | Type | Description |
|---|---|---|
| 4040027 9 | BTP/B PS | Petroleum and Solvent Evaporation; Petroleum Liquids Storage (non-Refinery); Bulk Plants; Specify Liquid: Internal Floating Roof (Primary/Secondary Seal) |
| 4040040 1 | BTP/B PS | Petroleum and Solvent Evaporation; Petroleum Liquids Storage (non-Refinery); Petroleum Products - Underground Tanks; Gasoline RVP 13: Breathing Loss |
| 4040040 2 | BTP/B PS | Petroleum and Solvent Evaporation; Petroleum Liquids Storage (non-Refinery); Petroleum Products - Underground Tanks; Gasoline RVP 13: Working Loss |
| 4040040 3 | BTP/B PS | Petroleum and Solvent Evaporation; Petroleum Liquids Storage (non-Refinery); Petroleum Products - Underground Tanks; Gasoline RVP 10: Breathing Loss |
| 4040040 4 | BTP/B PS | Petroleum and Solvent Evaporation; Petroleum Liquids Storage (non-Refinery); Petroleum Products - Underground Tanks; Gasoline RVP 10: Working Loss |
| 4040040 5 | BTP/B PS | Petroleum and Solvent Evaporation; Petroleum Liquids Storage (non-Refinery); Petroleum Products - Underground Tanks; Gasoline RVP 7: Breathing Loss |
| 4040040 6 | BTP/B PS | Petroleum and Solvent Evaporation; Petroleum Liquids Storage (non-Refinery); Petroleum Products - Underground Tanks; Gasoline RVP 7: Working Loss |
| 4060010 1 | BTP/B PS | Petroleum and Solvent Evaporation; Transportation and Marketing of Petroleum Products; Tank Cars and Trucks; Gasoline: Splash Loading ** |
| 4060012 6 | BTP/B PS | Petroleum and Solvent Evaporation; Transportation and Marketing of Petroleum Products; Tank Cars and Trucks; Gasoline: Submerged Loading ** |
| 4060013 1 | BTP/B PS | Petroleum and Solvent Evaporation; Transportation and Marketing of Petroleum Products; Tank Cars and Trucks; Gasoline: Submerged Loading (Normal Service) |
| 4060013 6 | BTP/B PS | Petroleum and Solvent Evaporation; Transportation and Marketing of Petroleum Products; Tank Cars and Trucks; Gasoline: Splash Loading (Normal Service) |
| 4060014 1 | BTP/B PS | Petroleum and Solvent Evaporation; Transportation and Marketing of Petroleum Products; Tank Cars and Trucks; Gasoline: Submerged Loading (Balanced Service) |
| 4060014 4 | BTP/B PS | Petroleum and Solvent Evaporation; Transportation and Marketing of Petroleum Products; Tank Cars and Trucks; Gasoline: Splash Loading (Balanced Service) |
| 4060014 7 | BTP/B PS | Petroleum and Solvent Evaporation; Transportation and Marketing of Petroleum Products; Tank Cars and Trucks; Gasoline: Submerged Loading (Clean Tanks) |
| 4060016 2 | BTP/B PS | Petroleum and Solvent Evaporation; Transportation and Marketing of Petroleum Products; Tank Cars and Trucks; Gasoline: Loaded with Fuel (Transit Losses) |
| 4060016 3 | BTP/B PS | Petroleum and Solvent Evaporation; Transportation and Marketing of Petroleum Products; Tank Cars and Trucks; Gasoline: Return with Vapor (Transit Losses) |
| 4060019 9 | BTP/B PS | Petroleum and Solvent Evaporation; Transportation and Marketing of Petroleum Products; Tank Cars and Trucks; Not Classified ** |
| 4060023 1 | RBT | Petroleum and Solvent Evaporation; Transportation and Marketing of Petroleum Products; Marine Vessels; Gasoline: Loading Tankers: Cleaned and Vapor Free Tanks |
| 4060023 2 | RBT | Petroleum and Solvent Evaporation; Transportation and Marketing of Petroleum Products; Marine Vessels; Gasoline: Loading Tankers |

| SCC | Type | Description |
|---|---|---|
| 4060023 3 | BTP/B PS | Petroleum and Solvent Evaporation; Transportation and Marketing of Petroleum Products; Marine Vessels; Gasoline: Loading Barges: Cleaned and Vapor Free Tanks |
| 4060023 4 | RBT | Petroleum and Solvent Evaporation; Transportation and Marketing of Petroleum Products; Marine Vessels; Gasoline: Loading Tankers: Ballasted Tank |
| 4060023 5 | BTP/B PS | Petroleum and Solvent Evaporation;Transportation and Marketing of Petroleum Products;Marine Vessels;Gasoline: Ocean Barges Loading - Ballasted Tank |
| 4060023 6 | RBT | Petroleum and Solvent Evaporation; Transportation and Marketing of Petroleum Products; Marine Vessels; Gasoline: Loading Tankers: Uncleaned Tanks |
| 4060023 7 | RBT | Petroleum and Solvent Evaporation;Transportation and Marketing of Petroleum Products;Marine Vessels;Gasoline: Ocean Barges Loading - Uncleaned Tanks |
| 4060023 8 | RBT | Petroleum and Solvent Evaporation; Transportation and Marketing of Petroleum Products; Marine Vessels; Gasoline: Loading Barges: Uncleaned Tanks |
| 4060023 9 | RBT | Petroleum and Solvent Evaporation; Transportation and Marketing of Petroleum Products; Marine Vessels; Gasoline: Tankers: Ballasted Tank |
| 4060024 0 | RBT | Petroleum and Solvent Evaporation; Transportation and Marketing of Petroleum Products; Marine Vessels; Gasoline: Loading Barges: Average Tank Condition |
| 4060024 1 | BTP/B PS | Petroleum and Solvent Evaporation; Transportation and Marketing of Petroleum Products; Marine Vessels; Gasoline: Tanker Ballasting |
| 4060029 9 | RBT | Petroleum and Solvent Evaporation; Transportation and Marketing of Petroleum Products; Marine Vessels; Not Classified ** |
| 4060030 1 | BTP/B PS | Petroleum and Solvent Evaporation; Transportation and Marketing of Petroleum Products; Gasoline Retail Operations - Stage I; Splash Filling |
| 4060030 2 | BTP/B PS | Petroleum and Solvent Evaporation; Transportation and Marketing of Petroleum Products; Gasoline Retail Operations - Stage I; Submerged Filling w/o Controls |
| 4060030 5 | BTP/B PS | Petroleum and Solvent Evaporation; Transportation and Marketing of Petroleum Products; Gasoline Retail Operations - Stage I; Unloading ** |
| 4060030 6 | BTP/B PS | Petroleum and Solvent Evaporation; Transportation and Marketing of Petroleum Products; Gasoline Retail Operations - Stage I; Balanced Submerged Filling |
| 4060030 7 | BTP/B PS | Petroleum and Solvent Evaporation; Transportation and Marketing of Petroleum Products; Gasoline Retail Operations - Stage I; Underground Tank Breathing and Emptying |
| 4060039 9 | BTP/B PS | Petroleum and Solvent Evaporation; Transportation and Marketing of Petroleum Products; Gasoline Retail Operations - Stage I; Not Classified ** |
| 4060040 1 | BTP/B PS | Petroleum and Solvent Evaporation; Transportation and Marketing of Petroleum Products; Filling Vehicle Gas Tanks - Stage II; Vapor Loss w/o Controls |
| 4060050 1 | RBT | Petroleum and Solvent Evaporation; Transportation and Marketing of Petroleum Products; Pipeline Petroleum Transport - General - All Products; Pipeline Leaks |
| 4060050 2 | RBT | Petroleum and Solvent Evaporation; Transportation and Marketing of Petroleum Products; Pipeline Petroleum Transport - General - All Products; Pipeline Venting |
| 4060050 3 | RBT | Petroleum and Solvent Evaporation; Transportation and Marketing of Petroleum Products; Pipeline Petroleum Transport - General - All Products; Pump Station |
| 4060050 4 | RBT | Petroleum and Solvent Evaporation; Transportation and Marketing of Petroleum Products; Pipeline Petroleum Transport - General - All Products; Pump Station Leaks |
| 4060060 2 | BTP/B PS | Petroleum and Solvent Evaporation; Transportation and Marketing of Petroleum Products; Consumer (Corporate) Fleet Refueling - Stage II; Liquid Spill Loss w/o Controls |

| SCC | Type | Description |
|---|---|---|
| 4060070 1 | BTP/B PS | Petroleum and Solvent Evaporation; Transportation and Marketing of Petroleum Products; Consumer (Corporate) Fleet Refueling - Stage I; Splash Filling |
| 4060070 2 | BTP/B PS | Petroleum and Solvent Evaporation; Transportation and Marketing of Petroleum Products; Consumer (Corporate) Fleet Refueling - Stage I; Submerged Filling w/o Controls |
| 4060070 6 | BTP/B PS | Petroleum and Solvent Evaporation; Transportation and Marketing of Petroleum Products; Consumer (Corporate) Fleet Refueling - Stage I; Balanced Submerged Filling |
| 4060070 7 | BTP/B PS | Petroleum and Solvent Evaporation; Transportation and Marketing of Petroleum Products; Consumer (Corporate) Fleet Refueling - Stage I; Underground Tank Breathing and Emptying |
| 4068880 1 | BTP/B PS | Petroleum and Solvent Evaporation; Transportation and Marketing of Petroleum Products; Fugitive Emissions; Specify in Comments Field |
| 2501050 120 | RBT | Storage and Transport; Petroleum and Petroleum Product Storage; Bulk Terminals: All Evaporative Losses; Gasoline |
| 2501055 120 | BTP/B PS | Storage and Transport; Petroleum and Petroleum Product Storage; Bulk Plants: All Evaporative Losses; Gasoline |
| 2501060 050 | BTP/B PS | Storage and Transport; Petroleum and Petroleum Product Storage; Gasoline Service Stations; Stage 1: Total |
| 2501060 051 | BTP/B PS | Storage and Transport; Petroleum and Petroleum Product Storage; Gasoline Service Stations; Stage 1: Submerged Filling |
| 2501060 052 | BTP/B PS | Storage and Transport; Petroleum and Petroleum Product Storage; Gasoline Service Stations; Stage 1: Splash Filling |
| 2501060 053 | BTP/B PS | Storage and Transport; Petroleum and Petroleum Product Storage; Gasoline Service Stations; Stage 1: Balanced Submerged Filling |
| 2501060 200 | BTP/B PS | Storage and Transport; Petroleum and Petroleum Product Storage; Gasoline Service Stations; Underground Tank: Total |
| 2501060 201 | BTP/B PS | Storage and Transport; Petroleum and Petroleum Product Storage; Gasoline Service Stations; Underground Tank: Breathing and Emptying |
| 2501995 000 | BTP/B PS | Storage and Transport; Petroleum and Petroleum Product Storage; All Storage Types: Working Loss; Total: All Products |
| 2505000 120 | RBT | Storage and Transport; Petroleum and Petroleum Product Transport; All Transport Types; Gasoline |
| 2505020 120 | RBT | Storage and Transport; Petroleum and Petroleum Product Transport; Marine Vessel; Gasoline |
| 2505020 121 | RBT | Storage and Transport; Petroleum and Petroleum Product Transport; Marine Vessel; Gasoline - Barge |
| 2505030 120 | BTP/B PS | Storage and Transport; Petroleum and Petroleum Product Transport; Truck; Gasoline |
| 2505040 120 | RBT | Storage and Transport; Petroleum and Petroleum Product Transport; Pipeline; Gasoline |
| 2660000 000 | BTP/B PS | Waste Disposal, Treatment, and Recovery; Leaking Underground Storage Tanks; Leaking Underground Storage Tanks; Total: All Storage Types |