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# Emissions Inventory for Air Quality Modeling Technical Support Document: 2017-2025 Light-Duty Vehicle Greenhouse Gas Final Rule

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# TABLE OF CONTENTS

# ACRONYMS

| | |
|---|---|
| **AEO** | Annual Energy Outlook |
| **BEIS** | Biogenic Emission Inventory System |
| **btp** | Bulk plant terminal-to-pump |
| **C3** | Category 3 (commercial marine vessels) |
| **CAP** | Criteria Air Pollutant |
| **CARB** | California Air Resources Board |
| **CMAQ** | Community Multiscale Air Quality |
| **CSAPR** | Cross-State Air Pollution (formerly Transport) Rule |
| **E0** | 0% Ethanol gasoline |
| **E10** | 10% Ethanol gasoline |
| **EISA** | Energy Independence and Security Act of 2007 |
| **EGU** | Electric Generating Utility |
| **FAA** | Federal Aviation Administration |
| **FIPS** | Federal Information Processing Standard |
| **HAP** | Hazardous Air Pollutant |
| **LDGHG** | Heavy Duty Greenhouse Gas |
| **HONO** | HNO2, nitrous acid |
| **IPM** | Integrated Planning Model |
| **LDGHG** | Light Duty Greenhouse Gas |
| **MOBILE6** | Mobile Source Emission Factor Model, version 6 |
| **MOVES** | Motor Vehicle Emissions Simulator |
| **MY** | Model Year |
| **NEEDS** | National Electric Energy Database System |
| **NEI** | National Emission Inventory |
| **NMIM** | National Mobile Inventory Model |
| **OAQPS** | EPA's Office of Air Quality Planning and Standards |
| **ORL** | One Record per Line (a SMOKE input format) |
| **MP** | Multipollutant |
| **NO** | Nitric oxide |
| **NO2** | Nitrogen dioxide |
| **NOX** | Nitrogen oxides |
| **PFC** | Portable Fuel Container |
| **PEC** | Elemental carbon component of PM2.5 |
| **PMFINE** | Leftover "Other", or "crustal" component of PM2.5 |
| **PNO3** | Particulate nitrate component of PM2.5 |
| **PSO4** | Particulate sulfate component of PM2.5 |
| **POC** | Organic carbon component of PM2.5 |
| **rbt** | Refinery-to-bulk terminal |
| **RFS2** | Revised annual renewable fuel standard |
| **SMOKE** | Sparse Matrix Operator Kernel Emissions |
| **SCC** | Source Category Code |
| **TAF** | Terminal Area Forecast |
| **TSD** | Technical Support Document |
| **VOC** | Volatile Organic Compound |
| **WRAP** | Western Regional Air Partnership |

# LIST OF TABLES



# LIST OF FIGURES

# LIST OF APPENDICES

# 1 Introduction

This document provides the details of emissions data processing done in support of the Environmental Protection Agency (EPA) and National Highway Traffic Safety Administration (NHTSA) joint rulemaking effort under the Clean Air Act (CAA) and the Energy Independence and Security Act of 2007 (EISA) to establish fuel efficiency and greenhouse gas emissions standards for passenger cars, light-duty trucks, and medium-duty passenger vehicles, beginning with the 2017 model year (MY). This rulemaking effort is hereafter referred to in this technical support document (TSD) as the Light Duty Vehicle Greenhouse Gas (LDGHG) rule and consists of three emissions cases. Table 1-1 provides of list of the emissions cases created for this modeling effort.

**Table 1-1.** List of cases run in support of the LDGHG air quality modeling

| Case Name | Internal EPA Abbreviation | Description |
|---|---|---|
| 2005 Base case | 2005ct_ldghg2 | 2005 case created using average year fires data and an average year temporal allocation approach for Electrical Generating Units (EGUs), used to compute relative response factors with 2030 scenarios. |
| 2030 Reference case | 2030ct_ldghg_ref | 2030 "reference" (baseline) scenario representing the best estimate for the future year without implementation of the new light duty GHG emissions standards. |
| 2030 Control case | 2030ct_ldghg_ctl2 | 2030 "control" case scenario representing implementation of national GHG emissions standards, phased in from 2017 to 2025, for passenger cars, light-duty trucks, and medium-duty passenger vehicles, |

The data used in the 2005 emissions cases are often the same as those described in the Transport Rule Final CAP-BAFM 2005-based, Version 4.2 Platform TSD (http://www.epa.gov/ttn/chief/emch/index.html#2005), but some different emissions data are used for this rulemaking. Specifically, the LDGHG modeling used data intended only for the rule development and not for general use. All of the documentation provided here describes what was done differently and specifically for the LDGHG effort in contrast to what is used in the v4.2 platform.

In LDGHG, we used a 2005 base case approach for the year 2005 emissions scenario. This approach is very similar to that used in the Cross State Air Pollution Rule (CSAPR) Final Rule (formerly known as the "Transport Rule"). A base case approach uses average year fires and EGU temporal profiles from three years of EGU data. We use a base case approach because we want to reduce year-specific variability in some components of the inventory. For example, large fires vary in location and day of the year each year, and EGU shutdowns and high use on high energy demand days also vary by year. By using a base case approach, these two aspects of the inventory are maintained in future year modeling and therefore do not introduce potentially spurious year-specific artifacts in air quality modeling estimates. For LDGHG, the same biogenic emissions data as the v4.2 platform was used for the 2005 case, and also for both future-year cases. The only significant data changes between the 2005 and the 2030 future-year LDGHG cases are the emission inventories and speciation approaches.

For this effort, we have created and provided county-level emission summaries for criteria pollutants and select hazardous air pollutants (e.g. benzene, acetaldehyde, formaldehyde, acrolein, 1,3-butadiene, ethanol, naphthalene) by emissions modeling sector for the cases listed above. Summaries were developed by month using average day emissions and separately with annual totals.  These data have been provided to the EPA docket for this rule.  .

In the remainder of this document, we provide a description of the approaches taken for the emissions in support of air quality modeling for LDGHG.  In Section 2, we describe the ancillary data and 2005 inventory differences from the v4.2 platform.  In Section 3, we describe the speciation differences among each of the cases run for LDGHG.  In Section 0, we describe the 2030 Reference case as compared to the 2005 base case, and in Section 5, we describe the 2030 Control Case in comparison to the 2030 Reference case.

# 2 2005 Emission inventories and their preparation

As mentioned previously, the 2005 emissions modeling approach for LDGHG used much of the same data and approaches as the 2005 v4.2 platform.  In this section, we identify the differences between the data used for LDGHG and that used for the 2005 v4.2 platform.  Section 2.1 provides ancillary data differences that impact multiple sectors and Sections 2.2 through 2.3 provides differences for the point, area, and mobile sectors.

Table 2-1 below lists the platform sectors used for the LDGHG modeling platform.  It also indicates which platform sectors include HAP emissions and the associated sectors from the National Emission Inventory (NEI).  Subsequent sections refer to these platform sectors for identifying the emissions differences between the v4.2 platform and the LDGHG platform.

**Table 2-1.** Sectors Used in Emissions Modeling for the LDGHG Platform

| **Platform Sector** | **2005 NEI Sector** | **Description** | **Contains HAP emissions?** |
|---|---|---|---|
| **IPM sector: *ptipm*** | Point | NEI EGU units at facilities mapped to the IPM model using the National Electric Energy Database System (NEEDS) database. | Yes |
| **Non-IPM sector: *ptnonipm*** | Point+ | All NEI point source units not matched to the ptipm sector, including aircraft. | Yes |
| **Average-fire sector: *avefire*** | N/A | Average-year wildfire and prescribed fire emissions, county and annual resolution. | Yes |
| **Agricultural sector: *ag*** | Nonpoint | $NH_3$ emissions from NEI nonpoint livestock and fertilizer application. | No |
| **Area fugitive dust sector: *afdust*** | Nonpoint | $PM_{10}$ and $PM_{2.5}$ emissions from fugitive dust sources in the NEI nonpoint inventory. | No |
| **Remaining nonpoint sector: *nonpt*** | Nonpoint+ | All nonpoint sources not otherwise included in other emissions modeling sectors. | Yes |
| **Nonroad sector: *nonroad*** | Mobile: Nonroad | Monthly nonroad emissions from the National Mobile Inventory Model (NMIM) using NONROAD2005 version nr05c-BondBase, which is equivalent to  NONROAD2008a, since it incorporated Bond rule revisions  to some of the base-case inputs and the Bond rule controls did not take effect until later. NMIM was used for all states except California.  Monthly emissions for California created from annual emissions submitted by the California Air Resources Board (CARB) for the 2005v2 NEI. | Yes |
| **Aircraft, locomotive, marine: *alm_no_c3*** | Mobile: Nonroad | Primarily 2002 NEI non-rail maintenance locomotives, and category 1 and category 2 commercial marine vessel (CMV) emissions sources, county and annual resolution.  Aircraft emissions are no longer in this sector and are now included in the Non-EGU sector (as point sources); also, category 3 CMV emissions are no longer in this sector and are now contained in the seca_c3 sector. | Yes |

| Platform Sector | 2005 NEI Sector | Description | Contains HAP emissions? |
|---|---|---|---|
| **C3 commercial marine: *seca_c3*** | Mobile: nonroad | Annual point source-formatted, year 2005 category 3 (C3) CMV emissions, developed for the rule called "Control of Emissions from New Marine Compression-Ignition Engines at or Above 30 Liters per Cylinder", usually described as the Emissions Control Area (ECA) study (http://www.epa.gov/otaq/oceanvessels.htm). Utilized final projections from 2002, developed for the C3 ECA Proposal to the International Maritime Organization (EPA-420-F-10-041, August 2010). | Yes |
| **Onroad, except gasoline PM: *on_noadj*** | Mobile: onroad+ | Three, monthly, county-level components:<br>1) California onroad, created using annual emissions for all pollutants, submitted by CARB for the 2005v2 NEI. $NH_3$ (not submitted by CARB) from MOVES2010a.<br>2) Onroad gasoline and diesel vehicle emissions from MOVES2010a not subject to temperature adjustments: exhaust CO, NOX, VOC, NH3, benzene, formaldehyde, acetaldehyde, 1,3-butadiene, acrolein, naphthalene, brake and tire wear PM, and evaporative VOC, benzene, and naphthalene. | Yes |
| **Onroad starting exhaust PM: *on_moves_startpm*** | Mobile: onroad+ | Monthly, county-level MOVES2010a-based onroad gasoline emissions subject to temperature adjustments. Limited to exhaust mode only for PM species and naphthalene. California emissions not included. This sector is limited to cold start mode emissions that contain different temperature adjustment curves from running exhaust (see on_moves_runpm sector). | No |
| **Onroad running exhaust PM *on_moves_runpm*** | Mobile: onroad+ | Monthly, county-level draft MOVES2010a-based onroad gasoline emissions subject to temperature adjustments. Limited to exhaust mode only for PM species and naphthalene. California emissions not included. This sector is limited to running mode emissions that contain different temperature adjustment curves from cold start exhaust (see on_moves_startpm sector). | No |
| **Biogenic: *biog*** | N/A | Hour-specific, grid cell-specific emissions generated from the BEIS3.14 model, including emissions in Canada and Mexico. Unchanged from the 2005v4 platform. | No |
| **Other point sources not from the NEI: *othpt*** | N/A | Point sources from Canada's 2006 inventory and Mexico's Phase III 1999 inventory, annual resolution. Also includes annual U.S. offshore oil 2005v2 NEI point source emissions. Unchanged from the 2005v4 platform. | No |
| **Other nonpoint and nonroad not from the NEI: *othar*** | N/A | Annual year 2006 Canada (province resolution) and year 1999 Mexico Phase III (municipio resolution) nonpoint and nonroad mobile inventories. Unchanged from the 2005v4 platform. | No |
| **Other onroad sources not from the NEI: *othon*** | N/A | Year 2006 Canada (province resolution) and year 1999 Mexico Phase III (municipio resolution) onroad mobile inventories, annual resolution. Unchanged from the 2005v4 platform. | No |

+ Some data included in modeling sector has been revised beyond what is included in the 2005 NEI v1 or v2.

As with the 2005 v4.2 platform, 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/index.cfm). We used SMOKE version 2.7 to create emissions files for a 36-km national grid, and 12-km Eastern and 12-km Western grids for the 2005 base case (also known as the "2005ct_ldghg 2_05b" case).

## 2.1 Custom configuration for emissions modeling for LDGHG

Unlike the 2005 v4.2 platform, the configuration for LDGHG modeling included additional hazardous air pollutants (HAPs) and used slightly revised ancillary speciation data. Both of these differences are described in this section.

Table 2-2 lists the additional HAP pollutants processed for the LDGHG platform, which were not included in the 2005 v4.2 platform. However, since using the full multipollutant HAP version of the Community Multiscale Air Quality (CMAQ) model would have taken longer than the time available for our project, we used a "lite" version of the multipollutant CMAQ (Version 4.7) that required emissions only for the species listed in the footnote of Table 2-2.

**Table 2-2.** Model species produced by SMOKE for CB05 with SOA for LDGHG platform

| Inventory Pollutant | Model Species | Model species description |
|---|---|---|
| CL2 | 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 | ACROLEIN* | Acrolein from the HAP inventory |
| | ALD2 | Acetaldehyde from VOC speciation |
| | ALD_PRIMARY* | Acetaldehyde from the HAP inventory |
| | ALDX | Propionaldehyde and higher aldehydes |
| | BENZENE | Benzene (not part of CB05) |
| | BUTADIENE13* | 1,3-butadiene from the HAP inventory |
| | ETH | Ethene |
| | ETHA | Ethane |
| | ETOH | Ethanol |
| | FORM | Formaldehyde |
| | FORM_PRIMARY* | Formaldehyde from the HAP inventory |
| | IOLE | Internal olefin carbon bond (R-C=C-R) |
| | ISOP | Isoprene |
| | MEOH | Methanol |
| | OLE | Terminal olefin carbon bond (R-C=C) |
| | PAR | Paraffin carbon bond |
| | TOL | Toluene and other monoalkyl aromatics |
| | XYL | Xylene and other polyalkyl aromatics |
| Various additional VOC species from the biogenics model which do not map to the above model species | SESQ | Sesquiterpenes |
| | TERP | Terpenes |
| $PM_{10}$ | PMC | Coarse PM > 2.5 microns and ≤ 10 microns |
| $PM_{2.5}$ | PEC | Particulate elemental carbon ≤ 2.5 microns |
| | PNO3 | Particulate nitrate ≤ 2.5 microns |
| | POC | Particulate organic carbon (carbon only) ≤ 2.5 microns |
| | PSO4 | Particulate Sulfate ≤ 2.5 microns |
| | PMFINE | Other particulate matter ≤ 2.5 microns |
| Sea-salt species (non – anthropogenic emissions) | PCL | Particulate chloride |
| | PNA | Particulate sodium |

- ACROLEIN, ALD2_PRIMARY, BUTADIENE13, and FORM_PRIMARY are the extra "CMAQ-lite" HAPs that are not in the v4.2 platform.

In addition to the model species differences, the LDGHG platform had a few additional custom aspects in the 2005 cases. Table 2-3 lists the datasets used by the LDGHG platform that are different from the v4.2 platform.

Another consideration is the speciation across the LDGHG future-year cases as compared to 2005. Section 3 provides a detailed account of these differences. Otherwise, the future-year ancillary data were largely the same as those in 2005, with no substantial differences. All ancillary data files can be found at the 2005-based platform website (http://www.epa.gov/ttn/chief/emch/index.html#2005).

**Table 2-3.** Description of differences in ancillary data between the LDGHG 2005 case and the 2005 v4.2 platform

| Ancillary Data Type | Difference between 2005 v4.2 platform and LDGHG platform |
|---|---|
| Speciation cross-references and Speciation profiles | The LDGHG data files are configured to support the multi-pollutant (MP) version of CMAQ, whereas the 2005 v4.2 platform data file is configured to support only the non-MP version. Therefore, the LDGHG data files include profiles for additional VOC HAP species. |
| Inventory tables | The LDGHG data file is configured to support the MP "lite" version of CMAQ, whereas the 2005 v4.2 platform data file is configured to support only the non-MP version. |

## 2.2 2005 Emissions Inventories and Processing

The LDGHG emissions for 2005 for many sectors except for U.S. onroad mobile sectors (on_noadj, on_moves_runpm, and on_moves_startpm) are similar to those provided in the 2005 Version 4.2-based Transport Rule Final TSD. Only minor adjustments were made to the point source sectors (ptnonipm, point), nonpoint source sectors (nonpt, afdust, ag, avefire), and nonroad sectors (alm_no_c3, nonroad, seca_c3). The Canada and Mexico sector (othar, othon, othpt) inventories are unchanged from the 2005v4.2 emissions modeling platform except for updated gridding surrogates used in the area based emissions. The 2005v4.2 TSD provides detailed documentation on the 2005v4.2 inventories and can be found at: ftp://ftp.epa.gov/EmisInventory/2005v4_2/transportrulefinal_eitsd_28jun2011.pdf.

## 2.3 2005 Onroad Mobile sources

Onroad mobile sources include three sectors for US onroad emissions (on_noadj, on_moves_startpm, on_moves_runpm). As discussed in the previous section, the three US nonroad sectors (nonroad, alm_no_c3, and seca_c3) and the Canada/Mexico onroad emissions (othon) are unchanged from the 2005v4.2 platform.

For onroad mobile, the MOVES-based emissions in the on_noadj sector and the on_moves_startpm and on_moves_runpm sectors (completely MOVES-based) emissions inventory data are from the Motor Vehicle Emission Simulator (MOVES2010, specifically, version MOVES2010a) model. In addition, for the MOVES PM sectors, the temperature adjustment calculations applied to $PM_{2.5}$ species were the same as in the v4.2 platform. The $NH_3$ onroad emissions in California (on_noadj sector) use MOVES2010(a)-based emissions. All other pollutants in California were supplied by CARB for the 2005 NEI v2. The LDGHG onroad emissions keep additional HAPs as described in Section 2.1.

For LDGHG, MOVES2010a was used in conjunction with an internal default databases (MOVESDB20100913_45_corr, MOVESDB20100913_ldt, and MOVESDB20100913_MHDHHD2b3_corr) which contained performance updates from MOVESDB20100826, the database originally released with MOVES2010a and used in the 2005v4.2 platform. The MOVES2010a default database used to model LDGHG also included improved heavy duty

PM exhaust estimates (particularly for future year estimates) and was further customized to allow separate calculation of heavy duty emissions of different weight categories as described in the "Final Rulemaking to Establish Greenhouse Gas Emissions Standards and Fuel Efficiency Standards for Medium- and Heavy-Duty Engines and Vehicles Regulatory Impact Analysis" (http://www.epa.gov/oms/climate/documents/420r11901.pdf).

In addition, we used NO and $NO_2$ directly from MOVES2010a for LDGHG, rather than the default NO/$NO_2$ speciation from $NO_X$ used in 2005v4.2 processing. Table 2-4 shows the default NO, $NO_2$, and HONO fractions used in 2005v4.2 versus the equations for LDGHG, where NO_MOVES and NO2_MOVES are the MOVES2010-provided NO and $NO_2$ emissions. The HONO, computed from total MOVES NOX (sum of NO and NO2 from MOVES) is subtracted out of MOVES NO2 to conserve mass. The speciation of MOVES HONO, NO and NO2 is based on the molecular weight of $NO_2$ (46); that is, these $NO_X$ components were speciated assuming they were inventoried as NO2-equivalent. All prior speciation of MOVES $NO_X$ was also based on NO2 molecular weight equivalency.

**Table 2-4.** HONO, NO, and NO2 computations in LDGHG versus 2005v4.2 platform

| CMAQ Specie | LDGHG | 2005v4.2 |
|---|---|---|
| NO | NO_MOVES | NOX * 0.9 |
| NO2 | 0.992 * NO2_MOVES – 0.008 * NO_MOVES | NOX * 0.092 |
| HONO | 0.008 * (NO2_MOVES + NO_MOVES) | NOX * 0.008 |

With one notable exception discussed here, for onroad gasoline exhaust PM emissions, the allocation of MOVES PM2.5 emissions to SMOKE-ready format PM species is the same as the 2005v4.2 platform and is documented in Appendix D of the 2005v4.1 TSD: http://www.epa.gov/ttn/chief/emch/toxics/2005v4.1_appendices.pdf. The exception to these equations is that for LDGHG processing, $NH_4$ (ammonium) is removed from the computation of POC ($PM_{2.5}$-based organic carbon) in equation 9, which in turn, affects the PMFINE ("other", or "crustal" $PM_{2.5}$) computation in equation 10. In short, MOVES2010a for LDGHG included improved PM exhaust estimates, and for diesel exhaust, the larger sulfate (PSO4) component was creating more $NH_4$ in equation 7 than available "PM25OM" from MOVES2010a, where MOVES-provided species are related as follows:

PM25_TOTAL = PM25EC + **PM25OM** + PSO4

CMAQ requires these five CMAQ species to sum to total PM2.5, i.e.:

PM2.5 = **POC**+PEC+PNO3+PSO4+PMFINE

Appendix A in this document contains the revised text and equations, specifically, equation 7b for diesel exhaust. A recent study (SRI, 2009) also showed that, despite being sampled for $NH_4$ and other ionic species in the particle phase, no particle phase $NH_4$ was found in downstream filter tests. OTAQ experts agreed that $NH_4$ for diesel exhaust must therefore removed, but we did not have time to reprocess gasoline exhaust PM (on_moves_runpm and on_moves_startpm sector) emissions with $NH_4$ removed so the gasoline exhaust PM emissions do include some ammonium. However, PSO4 for gasoline exhaust is considerably smaller than diesel exhaust so the impact is likely negligible for air quality modeling. It is important to note that total PM2.5 was conserved for both gasoline and diesel exhaust (e.g., PM2_5_TOTAL from MOVES and PM2.5 for CMAQ are identical). Note that PM emissions from these diesel sources are not subject to temperature adjustments like the on_moves_startpm and on_moves_runpm sectors.

## 2.4 Nonroad mobile sources (nonroad, alm_no_c3, seca_c3)

The nonroad sectors include a wide-range of mobile emission sources ranging from locomotives, marine vessels, construction and farming equipment to hand-held lawn tools. Emissions for this sector are the same as those in the 2005v4.2 emissions modeling platform. The 2005v4.2 TSD can be found at: ftp://ftp.epa.gov/EmisInventory/2005v4_2/transportrulefinal_eitsd_28jun2011.

### 2.4.1 Locomotives and commercial marine vessels (alm_no_c3, seca_c3)

The year 2005 emissions for locomotive and commercial marine vessel sources used for this rule are the same as they were for the Final Rulemaking: Greenhouse Gas Emissions Standards and Fuel Efficiency Standards for Medium- and Heavy-Duty Engines and Vehicles signed on August 9, 2011 and available at http://www.epa.gov/oms/climate/regulations.htm#1-2, and are also the same as those used for the Final Cross-State Air Pollution (CSAPR) Rule documented in: ftp://ftp.epa.gov/EmisInventory/2005v4_2/transportrulefinal_eitsd_28jun2011.pdf. The procedures for calculating emissions from locomotives and C1/C2 commercial marine were developed for the Locomotive Marine Rule (2008) and are detailed in the RIA "Final Rule: Control of Emissions of Air Pollution from Locomotives and Marine Compression-Ignition Engines Less Than 30 Liters per Cylinder", published May 6, 2008 and republished June 30, 2008, and can be found at: http://www.epa.gov/oms/locomotives.htm#2008final. The procedures used for calculating C3 commercial marine emissions are those developed in the recent C3 "Final Rule: Control of Emissions from New Marine Compression-Ignition Engines at or Above 30 Liters per Cylinder", published April 30, 2010 and can be found at: http://www.epa.gov/oms/oceanvessels.htm#car-ems.

## 2.5 2005 point sources (ptipm and ptnonipm sectors)

Point sources are sources of emissions for which geographic coordinates (e.g., latitude/longitude) are specified, as in the case of an individual facility. A facility may have multiple emission 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). Note that this section describes only NEI point sources within the contiguous United States. The offshore oil platform (othpt sector) and category 3 CMV emissions (seca_c3 sector) are also point source formatted inventories but are unchanged for the LDGHG modeling from the modeling of other recent rules. Discussion of the seca_c3 and othpt sector emissions can be found in the Final CSAPR TSD referenced in Section 2.3.2.

After removing offshore oil platforms (othpt sector), two platform sectors were created from the remaining 2005v2 NEI point sources to provide inputs into SMOKE: the EGU sector – also called the Integrated Planning Model (IPM) sector (i.e., ptipm) and the non-EGU sector – also called the non-IPM sector (i.e., ptnonipm). This split facilitates the use of different SMOKE temporal processing and future-year projection techniques for each of these sectors, along with the replacement of ptipm emissions with outputs from IPM in emissions cases for future years. The inventory pollutants processed through SMOKE for both ptipm and ptnonipm sectors were: CO, $NO_X$, VOC, $SO_2$, $NH_3$, $PM_{10}$, and $PM_{2.5}$ and the following HAPs: HCl (pollutant code = 7647010), and Cl2 (code = 7782505). We did not utilize BAFM from these sectors as we chose to speciate VOC without any use (i.e., integration) of VOC HAP pollutants from the inventory. Integration is discussed in detail in Section 3.

The ptnonipm emissions were provided to SMOKE as annual emissions. The ptipm emissions for the base case were input to SMOKE as daily emissions. The ptipm emissions are unchanged from those in the 2005v4.2 –the basis for the Final CSAPR and Heavy Duty Greenhouse Gas (HDGHG) FRM- emission modeling platform. However, for the ptnonipm sector for all LDGHG FRM scenarios, including year 2005 emissions, additional known ethanol plants were included that were not in 2005v4.2. We also removed all onroad refueling emissions as these were replaced with MOVES-based onroad refueling emissions (discussed in Section 2.5.2).

### 2.5.1 Ethanol plants (ptnonipm)

We replaced all ethanol plants that OTAQ had supplied from the RFS2 rule –see Section 2.1.2 in the CSAPR Final TSD- with those recently compiled for the 2005 case for the LDGHG FRM. These plants all produce corn ethanol and reflect a volume of approximately 4.1 billion gallons. All ethanol plants were assigned coordinates based on analysis using searches of company web sites and Google Earth verification for many sites. Emissions were calculated based on plant design capacity and emission factors based on production process and energy source (e.g. dry mill natural gas, wet mill coal, etc.). Finally, because benzene, acetaldehyde and formaldehyde (BAF) emissions were directly computed for these sources, we treated these ethanol plants as VOC integrate sources, unlike the rest of the ptnonipm sector. A summary of the ethanol plant emissions used in the 2005 scenario is provided in Table 2-5.

**Table 2-5.** 2005 ethanol plant emissions (tons)

| **Pollutant** | **Emissions** |
|---|---:|
| 1,3-Butadiene | 0.0003 |
| Acrolein | 10.5 |
| Formaldehyde | 13.3 |
| Benzene | 5.7 |
| Acetaldehyde | 314.4 |
| CO | 7,023 |
| $NO_X$ | 8,204 |
| $PM_{10}$ | 10,107 |
| $PM_{2.5}$ | 3,691 |
| $SO_2$ | 9,001 |
| VOC | 10,754 |

## *2.6 2005 nonpoint sources (afdust, ag, avefire, nonpt)*

The year 2005 area-source fugitive dust (afdust), agricultural animal and fertilizer $NH_3$ (ag), and average (typical)-year fires (avefire) emissions are the same as those used in the CSAPR Final (2005v4.2) emission modeling platform. Nonpoint sources that were not subdivided into the afdust, ag, or avefire sectors were assigned to the “nonpt” sector, and most of these sources are also unchanged for LDGHG FRM modeling. The 2005 nonpoint sources that change in this study are limited to portable fuel containers (PFCs) and onroad refueling.

### 2.6.1 Portable fuel containers

Year 2005 PFC emissions are unchanged from the CSAPR Final inventory except for the addition of ethanol. Ethanol emissions were not provided for 2005, but were supplied for future year scenarios. Therefore, we scaled year 2017 pre-RFS2 ethanol emissions by the ratio of 2005 to 2017 pre-RFS2 VOC emissions to compute year 2005 ethanol emissions as follows:

$$Ethanol\_2005 = Ethanol\_2017_{(pre\text{-}RFS2)} * [VOC\_2005 / VOC\_2017_{(pre\text{-}RFS2)}]$$

### 2.6.2 Onroad refueling

Refueling emissions were modeled using a modified draft version of EPA's Motor Vehicle Emissions Simulator (draft MOVES2010b) at the county level for all twelve months. The refueling inventory includes emissions from spillage loss and displacement vapor loss.

In an effort to reduce MOVES runtime, the "representing counties" approach was used instead of running every single county in the lower 48 states. We selected representing counties by grouping counties based on Petroleum Administration for Defense Districts (PADD), fuel parameters, usage of California emission standards, I/M programs, altitude, and temperature.

Temperature bins with increments of ten degrees Fahrenheit were created for the minimum and maximum temperatures for each month using the temperatures from the 2005 calendar year values in the CountyYearMonthHour table of the NMIM County Database (NCD) NCD20100602 NMIM database. All counties in each group had min and max temperatures for all twelve months in the same temperature bins.

Once counties were grouped, the representing county was chosen as the one with the highest VMT, resulting in total of 238 counties. The same set of county groups and representing counties was used for all years and scenarios.

MOVES was run in inventory mode for only the representing counties using the county-specific on-road data, such as vehicle miles travelled, fleet age distribution, speed distribution, and meteorology, available from the NCD. The customized fuel inputs, discussed in Section 2.2.2.1, were used for each of the representing counties.

The resulting refueling emission inventories for 238 representing counties in U.S. short tons were converted to emission factors by dividing the inventory by the corresponding activity in each representing county. Then, the calculated emission factors from the representing counties were applied to the represented counties and multiplied by the county-specific activity to generate the inventories for all counties.

## *2.7 Other sources (biogenics, othpt, othar, and othon)*

All emissions from Canada, Mexico, and Offshore Drilling platforms (othpt, othar, and othon), and all non-anthropogenic inventories (biogenics and ocean chlorine) are unchanged from the 2005v4.2 (used for the Final CSAPR and HDGHG FRM) emissions modeling platform. The one difference between LDGHG and these previous modeling is the use of updated gridding surrogates for othar and othon. The same emissions are used for all LDGHG FRM scenarios and years.

The biogenic emissions were computed based on 2005 meteorology data using the BEIS3.14 model within SMOKE. The 2002 platform used the BEIS3.13 model; otherwise, all underlying land use data and parameters are unchanged for the 2005 platform.

The BEIS3.14 model creates gridded, hourly, model-species emissions from vegetation and soils. It estimates CO, VOC, and $NO_X$ emissions for the U.S., Mexico, and Canada. The BEIS3.14 model is described further in: http://www.cmascenter.org/conference/2008/slides/pouliot_tale_two_cmas08.ppt

The inputs to BEIS include:

- Temperature data at 2 meters which were obtained from the meteorological input files to the air quality model,

- Land-use data from the Biogenic Emissions Landuse Database, version 3 (BELD3). BELD3 data provides data on the 230 vegetation classes at 1-km resolution over most of North America, which is the same land-use data were used for the 2002 platform.

The emissions from Canada, Mexico, and Offshore Drilling platforms are included as part of five sectors: othpt, othar, and othon.

The "oth" refers to the fact that these emissions are "other" than those in the 2005 NEI, and the third and fourth characters provide the SMOKE source types: "pt" for point, "ar" for "area and nonroad mobile", and "on" for onroad mobile.

For Canada, year 2006 inventories are used for the 2005 platform, although corresponding future-year emissions were not available. For Mexico we continued to use emissions for 1999 (Eastern Research Group Inc., 2006) developed as part of a partnership between Mexico's Secretariat of the Environment and Natural Resources (Secretaría de Medio Ambiente y Recursos Naturales-SEMARNAT) and National Institute of Ecology (Instituto Nacional de Ecología-INE), the U.S. EPA, the Western Governors' Association (WGA), and the North American Commission for Environmental Cooperation (CEC). This inventory includes emissions from all states in Mexico.

The offshore emissions include point source offshore oil and gas drilling platforms. We used updated emissions from the 2005v2 NEI point source inventory. The offshore sources were provided by the Mineral Management Services (MMS).

# 3 VOC speciation changes that represent fuel changes

A significant detail that is different in each of the LDGHG modeling cases than in the 2005v4.2 emissions modeling is the VOC speciation profiles used to split total VOC emissions into the VOC model species needed for CMAQ. In this section, we summarize the various speciation profile information used in configuring the various cases.

The VOC speciation approach used for the 2005 base-year case has some notable differences from the 2005 v4.2 platform for many emissions modes (e.g., evaporative, exhaust) and processes (e.g., diesel, gasoline, refueling). Two significant updates in the 2005 LDGHG are: 1) headspace vapor speciation utilizes a combination of the E10 headspace vapor profile (8763) and E0 headspace vapor profile (8762) as opposed to using solely E0 for 2005[1], and 2) a new Heavy Duty Diesel vehicle exhaust mode profile (8774) for pre-2007 model year (MY) vehicles that replaces an older 2004-vintage medium-duty diesel profile (4674). See Table 3-1 for more details.

The VOC speciation approach used for each of the future-year cases is customized to account for the impact of fuel changes. These changes affect the on_noadj sector, the nonroad sector, and parts of the nonpt and ptnonipm sectors. The speciation changes from fuels in the nonpt sector are for portable fuel containers (PFCs), onroad refueling, and fuel distribution operations associated with the bulk-plant-to-pump (btp) distribution. 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. Mapping of fuel distribution SCCs to btp, bps, and rbt emissions categories can be found in Appendix C.

[1] This was an oversight in the 2005v4.2 platform corrected for this modeling effort.

To differentiate when a source was integrating BAFM versus EBAFM (ethanol in addition to BAFM), the speciation profiles which do not include ethanol are referred to as an "E-profile", for example E10 headspace gasoline evaporative speciation profile 8763 where ethanol is speciated from VOC, versus 8763E where ethanol is obtained directly from the inventory. For fuel distribution operations associated with the bulk-plant-to-pump (btp) distribution, ethanol is speciated from VOC –thus a "BAFM" profile- because the fuel distribution operations in the nonpoint inventories are NEI-based and therefore do not include ethanol specifically because the NEI does not provide ethanol as a pollutant. For PFC and refueling, ethanol was present in the inventories and therefore EBAFM profiles were used to integrate ethanol in the speciation.

Table 3-1 summarizes the different profiles utilized for the fuel-related sources in each of the sectors for 2005 and the future year cases. A comparison of the 2005v4.2 platform with the LDGHG 2005 case is also included. This table does not indicate when "E-profiles" were used.

**Table 3-1.** Summary of VOC speciation profile approaches by sector across cases

| Inventory Type and Mode | VOC speciation approach by fuels | VOC Profile Codes | 2005 V4.2 | 2005 LDGHG | 2030 Reference & Control |
|---|---|---|---|---|---|
| **Mobile Exhaust Diesel** | medium-duty diesel exhaust, 2004-vintage | 4674 | onroad nonroad | | |
| | pre-2007 Heavy Duty profile | 8774 | | onroad nonroad | |
| | pre-2007 Medium Duty | 8775 | | | onroad except Class 6,7 & 8 start |
| | weighted year 2030 heavy-duty start (parking area) emissions **with** HD controls | 877CH | | | onroad class 8 start only |
| | weighted year 2030 medium-duty start (parking area) emissions **with** HD controls | 877CM | | | onroad class 6 & 7 start only |
| **Mobile Exhaust Gasoline** | Tier 1 E0 **and** E10 combinations | 8750 8751 | onroad nonroad | onroad nonroad | |
| | Tier 1 E10 | 8751 | | | nonroad |
| | Tier 2 E10 | 8757 | | | onroad |
| **Mobile Evaporative Diesel** | diesel evap headspace profile, Circle K Diesel single-sample | 4547 | onroad nonroad | onroad nonroad | onroad nonroad |
| **Mobile Evaporative Gasoline** | E0 **and** E10 combinations | 8753 8754 | onroad nonroad | onroad nonroad | |
| | E10 | 8754 | | | onroad nonroad |
| **Mobile Refueling, PFCs, gas distribution** | E0 headspace | 8762 | All listed | | |
| | E0 headspace **and** E10 headspace combinations | 8762 8763 | | All listed | |
| | E0 headspace **or** E15[2] | 8869 8871 | | | All listed |

[2] PFC and BTP are post addition of ethanol and hence use E15 profile (8871) and BTP and RPT are before the addition of ethanal and hence use E0 profile (8869).

# 4 2030 Reference Case

The 2030 reference case represents emissions in the future. The reference and control cases assume fuel and emission changes from the Energy Independence and Security Act of 2007 (EISA) and RFS2 for upstream sources. For highway vehicles, we assume all gasoline use is E10. The 2030 reference case uses many of the same growth and control assumptions as those for the Final Cross-State Air Pollution Rule (CSAPR). There are some differences between the shared projection inputs from the 2012 and 2014 base case projections in CSAPR and the 2030 reference case for LDGHG:

1) The 2030 reference case includes the HDGHG controls. That is, we use the onroad HDGHG control case emission inventory as the reference case emissions for the LDGHG rule.
2) Some additional controls that were promulgated after 2014, (e.g., post-2014 consent decrees and fuel sulfur rules in a couple of states) are included.
3) Growth factors for several sources are year-specific; so while the methodology is the same as CSAPR, the future year emissions estimates differ (e.g., oil and gas in a couple states, residential wood combustion).
4) Onroad refueling uses year and scenario-specific (i.e., reference versus control) MOVES emissions, rather than NEI emissions.
5) There is a new dataset of ethanol plants that replaces a limited set of NEI ethanol plants in 2005v4.2-based CSAPR 2012 and 2014 projections.
6) Minor errors identified after CSAPR modeling was complete were fixed (e.g, we include agricultural dust projections for the couple of states that provided point source farms).

There are other new inputs unique to the LDGHG reference case that were not part of the CSAPR projections. Examples of these are RFS2 upstream inputs such as biodiesel and cellulosic ethanol plants, and adjustments to refinery emissions and fuel transport and distribution emissions to account for impacts of EISA. These new inputs and projections for the reference case are discussed later in this section. The remainder of Section 4 is very similar to Section 4 in the CSAPR emissions modeling TSD, available from ftp://ftp.epa.gov/EmisInventory/2005v4_2/transportrulefinal_eitsd_28jun2011.pdf, but with the updates just discussed.

The future base-case projection methodologies vary by sector. The 2030 reference case represents predicted emissions in the absence of any further controls beyond those Federal and State measures already promulgated before emissions processing on the Transport Rule began in December, 2010. For EGU emissions (ptipm sector), the emissions reflect state rules and federal consent decrees through December 1, 2010. For mobile sources (on_noadj, on_moves_runpm, and on_moves_startpm sectors), all national measures for which data were available at the time of modeling have been included. The future base-case scenarios do reflect projected economic changes and fuel usage for EGU and mobile sectors. For nonEGU point (ptnonipm sector) and nonpoint stationary sources (nonpt, ag, and afdust sectors), local control programs that might have been necessary for areas to attain the 1997 $PM_{2.5}$ NAAQS annual standard, 2006 PM NAAQS (24-hour) standard, and the 1997 ozone NAAQS are generally not included in the future base-case projections for most states. One exception are some NOx and VOC reductions associated with the New York, Virginia, and Connecticut State Implementation Plans (SIP), which were added as part of the comments received from the CSAPR and a larger effort to start including more local control information on stationary non-EGU sources; this is described further in Section 4.2. The following bullets summarize the projection methods used for sources in the various sectors, while additional details and data sources are given in Table 4-1.

- IPM sector (ptipm): Unit-specific estimates from IPM, version 4.10, including CSAPR and the Mercury and Air Toxics Standards (MATS).
- Non-IPM sector (ptnonipm): Projection factors and percent reductions reflect CSAPR (Transport Rule) comments and emission reductions due to control programs, plant closures, consent decrees and settlements, and 1997 and 2001 ozone State Implementation Plans in NY, CT, and VA. We also used projection approaches for point-source livestock, and aircraft and gasoline stage II emissions that are consistent with projections used for the sectors that contain the bulk of these emissions. Terminal area forecast (TAF) data aggregated to the national level were used for aircraft to account for projected changes in landing/takeoff activity. Year-specific speciation was applied to some portions of this sector and was discussed in Section 3.
- Average fires sector (avefire): No growth or control.
- Agricultural sector (ag): Projection factors for livestock estimates based on expected changes in animal population from 2005 Department of Agriculture data; no growth or control for $NH_3$ emissions from fertilizer application.
- Area fugitive dust sector (afdust): Projection factors for dust categories related to livestock estimates based on expected changes in animal population; no growth or control for other categories in this sector.
- Remaining Nonpoint sector (nonpt): Projection factors that implement Transport Rule Proposal comments and reflect emission reductions due to control programs. Residential wood combustion projections based on growth in lower-emitting stoves and a reduction in higher emitting stoves. PFC projection factors reflecting impact of the final Mobile Source Air Toxics (MSAT2) rule. Gasoline stage II projection factors based on National Mobile Inventory Model (NMIM)-estimated VOC refueling estimates for future years. Oil and gas projection estimates are provided for the non-California Western Regional Air Partnership (WRAP) states as well as Oklahoma and Texas. Year-specific speciation was applied to some portions of this sector and was discussed in Section 3.
- Nonroad mobile sector (nonroad): Other than for California, this sector uses data from a run of NMIM that utilized the NR05d-Bond-final version of NONROAD (which is equivalent to NONROAD2008a), using future-year equipment population estimates and control programs to the year 2030 and using national level inputs. Final controls from the final locomotive-marine and small spark ignition OTAQ rules are included. California-specific data provided by the state of California, except $NH_3$ used 2030 NMIM. Year-specific speciation was applied to some portions of this sector and is discussed in Section 4.3.5.
- Locomotive, and non-Class 3 commercial marine sector (alm_no_c3): Projection factors for Class 1 and Class 2 commercial marine and locomotives which reflect Transport Rule comments and activity growth and final locomotive-marine controls.
- Class 3 commercial marine vessel sector (seca_c3): Base-year 2005 emissions grown and controlled to 2030, incorporating Transport Rule comments and controls based on Emissions Control Area (ECA) and International Marine Organization (IMO) global $NO_X$ and $SO_2$ controls.
- Onroad mobile sector with no adjustment for daily temperature (on_noadj): MOVES2010a run (state-month) for 2030 with results disaggregated to the county level in proportion to NMIM 2030 emissions estimates. The reference case does not include LDGHG or RFS2 impacts, but does include HDGHG impacts. Temperature impacts at the monthly average resolution. California-specific data provided by the state of California, except $NH_3$ which was obtained from MOVES2010a. Other than California, this sector includes all non-refueling onroad mobile emissions (exhaust, evaporative, brake wear and tire wear modes) except exhaust mode gasoline PM and naphthalene emissions that are provided in the on_moves_startpm and on_moves_runpm sectors.

- Onroad PM gasoline running mode sector (on_moves_startpm): Running mode MOVES2010a year 2030 future-year state-month estimates for PM and naphthalene, apportioned to the county level using NMIM 2030 state-county ratios matched to vehicle and road types. The reference case does not include 2017-LDGHG or RFS2 impacts, but does include HDGHG impacts. Use future-year temperature adjustment file for adjusting the 72°F emissions to ambient temperatures (for elemental and organic carbon) based on grid cell hourly temperature (note that lower temperatures result in increased emissions).
- Onroad PM gasoline start mode sector (on_moves_startpm): Cold start MOVES2010a future-year 2012 and 2014 state-month estimates for PM and naphthalene, apportioned to the county level using NMIM 2030 state-county ratios of local urban and rural roads by vehicle type. The reference case does not include 2017LDGHG or RFS2 impacts, but does include HDGHG impacts. Use future-year temperature adjustment file for adjusting the 72°F emissions (for elemental and organic carbon) to ambient temperatures based on grid cell hourly temperatures (lower temperatures result in increased emissions).
- Other nonroad/nonpoint (othar): No growth or control.
- Other onroad sector (othon): No growth or control.
- Other point (othpt): No growth or control.
- Biogenic: 2005 emissions used for all future-year scenarios.

Table 4-1 summarizes the control strategies and growth assumptions by source type that were used to create the 2030 base-case emissions from the 2005v4.2 base-case inventories. All Mexico, Canada, and offshore oil emissions are unchanged in all future cases from those in the 2005 base case. Note that mercury (Hg) is listed in the pollutants column; however, we did not include Hg in our v4.2-based LDGHG modeling.

Lists of the control, closures, projection packets (datasets) used to create the LDGHG 2030 future reference case scenario inventories from the 2005 LDGHG base case are provided in Appendix B.

The remainder of this section is organized either by source sector or by specific emissions category within a source sector for which a distinct set of data were used or developed for the purpose of projections for the LDGHG Rule. This organization allows consolidation of the discussion of the emissions categories that are contained in multiple sectors, because the data and approaches used across the sectors are consistent and do not need to be repeated. Sector names associated with the emissions categories are provided in parentheses.

**Table 4-1.** Control strategies and growth assumptions for creating the LDGHG 2030 Reference case emissions inventories from the 2005 base case

| Control Strategies and/or growth assumptions (grouped by affected pollutants or standard and approach used to apply to the inventory) | Pollutants affected | Approach/ Reference |
|---|---|---|
| **Non-EGU Point (ptnonipm sector) projection approaches** | | |
| MACT rules, national, VOC: national applied by SCC, MACT<br>Boat Manufacturing<br>Wood Building Products Surface Coating<br>Generic MACT II: Spandex Production, Ethylene manufacture<br>Large Appliances<br>Miscellaneous Organic NESHAP (MON): Alkyd Resins, Chelating Agents, Explosives, Phthalate Plasticizers, Polyester Resins, Polymerized Vinylidene Chloride<br>Reinforced Plastics<br>Asphalt Processing & Roofing<br>Iron & Steel Foundries<br>Metal: Can, Coil<br>Metal Furniture<br>Miscellaneous Metal Parts & Products<br>Municipal Solid Waste Landfills<br>Paper and Other Web<br>Plastic Parts<br>Plywood and Composite Wood Products<br>Carbon Black Production<br>Cyanide Chemical Manufacturing<br>Friction Products Manufacturing<br>Leather Finishing Operations<br>Miscellaneous Coating Manufacturing<br>Organic Liquids Distribution (Non-Gasoline)<br>Refractory Products Manufacturing<br>Sites Remediation | VOC | EPA, 2007a |
| Consent decrees on companies (based on information from the Office of Enforcement and Compliance Assurance – OECA) apportioned to plants owned/operated by the companies | VOC, CO, NOx, PM, $SO_2$ | 1 |
| DOJ Settlements: plant SCC controls for:<br>Alcoa, TX<br>Premcor (formerly Motiva), DE | All | 2 |
| Refinery Consent Decrees: plant/SCC controls | NOx, PM, $SO_2$ | 3 |
| Hazardous Waste Combustion | PM | 4 |
| Municipal Waste Combustor Reductions –plant level | PM | 5 |
| Hospital/Medical/Infectious Waste Incinerator Regulations | $NO_X$, PM, $SO_2$ | EPA, 2005 |
| Large Municipal Waste Combustors – growth applied to specific plants | All (including Hg) | 5 |
| MACT rules, plant-level, VOC: Auto Plants | VOC | 6 |
| MACT rules, plant-level, PM & $SO_2$: Lime Manufacturing | PM, $SO_2$ | 7 |
| MACT rules, plant-level, PM: Taconite Ore | PM | 8 |
| Livestock Emissions Growth from year 2002 to year 2030 (some farms in the point inventory) | $NH_3$, PM | 9 |
| NESHAP: Portland Cement (09/09/10) – plant level based on **Industrial Sector Integrated Solutions (ISIS)** policy emissions in 2013. The ISIS results are from the ISIS-Cement model runs for the NESHAP and NSPS analysis of July 28, 2010 and include closures. | Hg, $NO_X$, SO2, PM, HCl | 10; EPA, 2010 |
| New York ozone SIP controls | VOC, $NO_X$, HAP VOC | 11 |
| Additional plant and unit closures provided by state, regional, and the EPA agencies and additional consent decrees. Includes updates from CSAPR comments. | All | 12 |
| Emission reductions resulting from controls put on specific boiler units (not due to MACT) after 2005, identified through analysis of the control data gathered from the | $NO_X$, $SO_2$, HCl | Section 4.2.13.2 |

| | | |
|---|---|---|
| Information Collection Request (ICR) from the Industrial/Commercial/Institutional Boiler NESHAP. | | |
| Reciprocating Internal Combustion Engines (RICE) NESHAP | $NO_X$, CO, PM, $SO_2$ | 13 |
| Ethanol plants that account for increased ethanol production due to RFS2 mandate | All | 14 |
| State fuel sulfur content rules for fuel oil –*effective only in Maine, New Jersey, and New York* | $SO_2$ | 15 |
| **Nonpoint (nonpt sector) projection approaches** | | |
| Municipal Waste Landfills: projection factor of 0.25 applied | All | EPA, 2007a |
| Livestock Emissions Growth from year 2002 to year 2030 | $NH_3$, PM | 9 |
| New York, Connecticut, and Virginia ozone SIP controls | VOC | 11, 16 |
| RICE NESHAP | $NO_X$, CO, VOC, PM, $SO_2$ | 13 |
| State fuel sulfur content rules for fuel oil –*effective only in Maine, New Jersey, and New York* | $SO_2$ | 15 |
| Residential Wood Combustion Growth and Change-outs from year 2005 to year 2030 | All | 17 |
| Gasoline and diesel fuel Stage II refueling via MOVES2010 LDGHG month-specific inventories for 2030 with assumed RFS2 and LDGHG fuels | VOC, Benzene, Ethanol | 18 |
| Portable Fuel Container Mobile Source Air Toxics Rule 2 (MSAT2) inventory growth and control from year 2005 to year 2030 | VOC | 19 |
| Use Phase II WRAP 2018 Oil and Gas for year 2030 | VOC, $SO_2$, $NO_X$, CO | Section 4.2.14 |
| Use 2008 Oklahoma and Texas Oil and Gas, and apply year 2021 projections for TX (last year available used as surrogate for 2030), and RICE NESHAP controls to Oklahoma emissions. | VOC, $SO_2$, $NO_X$, CO, PM | Section 4.2.14 |

**APPROACHES/REFERENCES- Non-EGU Stationary Sources:**

1. Appendix B in the MATS Proposal TSD: http://www.epa.gov/ttn/chief/emch/toxics/proposed_toxics_rule_appendices.pdf
2. For Alcoa consent decree, used http:// cfpub.epa.gov/compliance/cases/index.cfm; for Motiva: used information sent by State of Delaware
3. Used data provided by the EPA, OAQPS, Sector Policies and Programs Division (SPPD).
4. Obtained from Anne Pope, the US EPA - Hazardous Waste Incinerators criteria and hazardous air pollutant controls carried over from 2002 Platform, v3.1.
5. Used data provided by the EPA, OAQPS SPPD expert.
6. Percent reductions and plants to receive reductions based on recommendations by rule lead engineer, and are consistent with the reference: EPA, 2007a
7. Percent reductions recommended are determined from the existing plant estimated baselines and estimated reductions as shown in the Federal Register Notice for the rule. $SO_2$ percent reduction are computed by 6,147/30,783 = 20% and $PM_{10}$ and $PM_{2.5}$ reductions are computed by 3,786/13,588 = 28%
8. Same approach as used in the 2006 Clean Air Interstate Rule (CAIR), which estimated reductions of "PM emissions by 10,538 tpy, a reduction of about 62%." Used same list of plants as were identified based on tonnage and SCC from CAIR: http://www.envinfo.com/caain/June04updates/tiop_fr2.pdf
9. Except for dairy cows and turkeys (no growth), based on animal population growth estimates from the US Department of Agriculture (USDA) and the Food and Agriculture Policy and Research Institute. See Section 4.2.10.
10. Data files for the cement sector provided by Elineth Torres, the EPA-SPPD, from the analysis done for the Cement NESHAP: The ISIS documentation and analysis for the cement NESHAP/NSPS is in the docket of that rulemaking-docket # EPA-HQ-OAR-2002-005. The Cement NESHAP is in the Federal Register: September 9, 2010 (Volume 75, Number 174, Page 54969-55066
11. New York $NO_X$ and VOC reductions obtained from Appendix J in NY Department of Environmental Conservation Implementation Plan for Ozone (February 2008): http://www.dec.ny.gov/docs/air_pdf/NYMASIP7final.pdf.
12. Appendix D of Cross-State Air Pollution Rule: ftp://ftp.epa.gov/EmisInventory/2005v4_2/transportrulefinal_eitsd_appendices_28jun2011.pdf
13. Appendix F in the Proposed (Mercury and Air) Toxics Rule TSD:

http://www.epa.gov/ttn/chief/emch/toxics/proposed_toxics_rule_appendices.pdf

14. The 2008 data used came from Illinois' submittal of 2008 emissions to the NEI.
15. Based on available, enforceable state sulfur rules as of November, 2010: http://www.ilta.org/LegislativeandRegulatory/MVNRLM/NEUSASulfur%20Rules_09.2010.pdf , http://www.mainelegislature.org/legis/bills/bills_124th/billpdfs/SP062701.pdf , http://switchboard.nrdc.org/blogs/rkassel/governor_paterson_signs_new_la.html , http://green.blogs.nytimes.com/2010/07/20/new-york-mandates-cleaner-heating-oil/
16. VOC reductions in Connecticut and Virginia obtained from CSAPR comments.
17. Growth and Decline in woodstove types based on industry trade group data, See Section 4.2.11.
18. MOVES (2010a) results for onroad refueling including activity growth from VMT, Stage II control programs at gasoline stations, and phase in of newer vehicles with onboard Stage II vehicle controls. http://www.epa.gov/otaq/models/moves/index.htm
19. VOC, benzene, and ethanol emissions for 2030 based on MSAT2 rule and ethanol fuel assumptions (EPA, 2007b)

| **Onroad mobile and nonroad mobile controls (list includes all key mobile control strategies but is not exhaustive)** | | |
|---|---|---|
| **National Onroad Rules:**<br>Tier 2 Rule: Signature date February, 2000<br>2007 Onroad Heavy-Duty Rule: February, 2009<br>Final Mobile Source Air Toxics Rule (MSAT2): February, 2007<br>Renewable Fuel Standard: March, 2010<br>Light Duty Greenhouse Gas Rule: May, 2010<br>Corporate Average Fuel Economy standards for 2008-2011<br>Heavy-Duty Vehicle Greenhouse Gas Rule: August 2011 | all | 1 |
| **Local Onroad Programs:**<br>National Low Emission Vehicle Program (NLEV): March, 1998<br>Ozone Transport Commission (OTC) LEV Program: January,1995 | VOC | 2 |
| **National Nonroad Controls:**<br>Clean Air Nonroad Diesel Final Rule – Tier 4: June, 2004<br>Control of Emissions from Nonroad Large-Spark Ignition Engines and Recreational Engines (Marine and Land Based): "Pentathalon Rule": November, 2002<br>Clean Bus USA Program: October, 2007<br>Control of Emissions of Air Pollution from Locomotives and Marine Compression-Ignition Engines Less than 30 Liters per Cylinder: October, 2008<br>Locomotive and marine rule (May 6, 2008)<br>Marine SI rule (October 4, 1996)<br>Nonroad large SI and recreational engine rule (November 8, 2002)<br>Nonroad SI rule (October 8, 2008)<br>Phase 1 nonroad SI rule (July 3, 1995)<br>Tier 1 nonroad diesel rule (June 17, 2004) | all | 3,4,5 |
| **Aircraft** (emissions are in the nonEGU point inventory)**:**<br>Itinerant (ITN) operations at airports to year 2030 | all | 6 |
| **Locomotives:**<br>Energy Information Administration (EIA) fuel consumption projections for freight rail<br>Clean Air Nonroad Diesel Final Rule – Tier 4: June 2004<br>Locomotive Emissions Final Rulemaking, December 17, 1997<br>Locomotive rule: April 16, 2008<br>Control of Emissions of Air Pollution from Locomotives and Marine: May 2008 | all | EPA, 2009; 3; 4; 5 |
| **Commercial Marine:**<br>Category 3 marine diesel engines Clean Air Act and International Maritime Organization standards (April, 30, 2010) –*also includes CSAPR comments.*<br>EIA fuel consumption projections for diesel-fueled vessels<br>Clean Air Nonroad Diesel Final Rule – Tier 4<br>Emissions Standards for Commercial Marine Diesel Engines, December 29, 1999<br>Locomotive and marine rule (May 6, 2008)<br>Tier 1 Marine Diesel Engines, February 28, 2003 | all | 7, 3; EPA, 2009 |

**APPROACHES/REFERENCES – Mobile Sources**

1. http://epa.gov/otaq/hwy.htm
2. Only for states submitting these inputs: http://www.epa.gov/otaq/lev-nlev.htm
3. http://www.epa.gov/nonroad-diesel/2004fr.htm
4. http://www.epa.gov/cleanschoolbus/
5. http://www.epa.gov/otaq/marinesi.htm
6. Federal Aviation Administration (FAA) Terminal Area Forecast (TAF) System, January 2010: http://www.apo.data.faa.gov/main/taf.asp
7. http://www.epa.gov/otaq/oceanvessels.htm

## 4.1 Stationary source projections: EGU sector (ptipm)

The future-year data for the ptipm sector used in the air quality modeling were created using version 4.10 (v4.10) of the Integrated Planning Model (IPM) (http://www.epa.gov/airmarkt/progsregs/epa-ipm/index.html). The IPM is a multiregional, dynamic, deterministic linear programming model of the U.S. electric power sector. Version 4.10 reflects state rules and consent decrees through December 1, 2010 and incorporates information on existing controls collected through the Information Collection Request (ICR), and information from comments received on the IPM-related Notice of Data Availability (NODA) published on September 1, 2010. The 2030 IPM emissions reflect the CSAPR as finalized in July 2011 and the final Mercury and Air Toxics (MATS) rule. They do not reflect the Boiler MACT regulatory assumptions because the rule was stayed at the time the modeling was performed. IPM v4.10 Final included the addition of over 20 GW of existing Activated Carbon Injection (ACI) reported to the EPA via the ICR. Units with $SO_2$ or $NO_X$ advanced controls (e.g., scrubber, SCR) that were not required to run for compliance with Title IV, New Source Review (NSR), state settlements, or state-specific rules were modeled by IPM to either operate those controls or not based on economic efficiency parameters.

IPM 4.10 includes adjustments to assumptions regarding the performance of acid gas control technologies, new costs imposed on fuel-switching (e.g., bituminous to sub-bituminous), correction of lignite availability to some plants, incorporation of additional planned retirements, a more inclusive implementation of the scrubber upgrade option, and the availability of a scrubber retrofit to waste-coal fired fluidized bed combustion units without an existing scrubber. Further details on the future-year EGU emissions inventory used for this rule can be found in the incremental documentation of the IPM v.4.10 platform, available at http://www.epa.gov/airmarkets/progsregs/epa-ipm/BaseCasev410.html. A complete list of state regulations, NSR settlements, and state settlements included in the IPM modeling is given in Appendices 3-2, 3-3, and 3-4 beginning on p. 68 of http://www.epa.gov/airmarkets/progsregs/epa-ipm/CSAPR/docs/DocSuppv410_FTransport.pdf.

Directly emitted PM emissions (i.e., $PM_{2.5}$ and $PM_{10}$) from the EGU sector are computed via a post processing routine which applies emission factors to the IPM-estimated fuel throughput based on fuel, configuration and controls to compute the filterable and condensable components of PM. This methodology is documented in the IPM CSAPR TSD.

## 4.2 Stationary source projections: non-EGU sectors (ptnonipm, nonpt, ag, afdust)

To project U.S. stationary sources other than the ptipm sector, we applied growth factors and/or controls to certain categories within the ptnonipm, nonpt, ag and afdust platform sectors. This subsection provides details on the data and projection methods used for these sectors. In estimating future-year emissions, we assumed that emissions growth does not track with economic growth for many stationary non-IPM sources.

This "no-growth" assumption is based on an examination of historical emissions and economic data. More details on the rationale for this approach can be found in Appendix D of the Regulatory Impact Assessment for the PM NAAQS rule (EPA, 2006).

The starting point was the emission projections done for the 2005v4.2 platform for the CSAPR, which incorporated responses to public comments on the modeling inventories. The 2012 and 2014 projection factors developed for the CSAPR (see http://www.epa.gov/ttn/chief/emch/index.html#final) were updated to reflect year 2030 projections.

Year-specific projection factors for year 2030 were used for creating the 2030 reference case unless noted otherwise. Growth factors (and control factors) are provided in the following sections where feasible. However, some sectors used growth or control factors that varied geographically and their contents could not be provided in the following sections (e.g., gasoline distribution varies by state and pollutant and has hundreds of records).

Table 4-2 lists the stationary non-EGU inputs and projection factors that were applied to account for year 2030 RFS2 mandate impacts on emissions to the reference and control cases. These inputs are discussed in more detail in Section 4.2.1 through Section 4.2.9. All other stationary non-EGU projections, controls and plant closure information not related to the RFS2 impacts are discussed in Section 4.2.10 through Section 4.2.14.

**Table 4-2.** LDGHG FRM reference case stationary non-EGU source-related projection methods

| **Input** | **Type** | **Sector(s)** | **Description** |
|---|---|---|---|
| Corn ethanol plants | SMOKE ORL file that replaces 2005 base case ORL file | ptnonipm | Based on RFS2 analysis and production volumes. Point source format. |
| Biodiesel plants | SMOKE ORL file | ptnonipm | Accounts for facilities with current production capacities, to support RFS2 biodiesel production. Point source format. |
| Cellulosic fuel production | SMOKE ORL file | nonpt | Accounts for cellulosic ethanol and cellulosic diesel to support RFS2 cellulosic production. County-level (nonpoint) format. |
| Ethanol transport and distribution | SMOKE ORL file | nonpt | Accounts for ethanol vapor losses and spillage at any point in the transport and distribution chain. County-level (nonpoint) format. |
| Portable Fuel Containers (PFCs) | SMOKE ORL | nonpt | NONROAD-model based emissions from PFCs, including vapor displacement, tank permeation, and diurnal evaporation. County-level (nonpoint) format. |
| Onroad refueling | SMOKE ORL file | nonpt | MOVES-based gasoline and diesel fuel spillage and displacement vapor losses. County-level (nonpoint) format, monthly resolution. |
| Refinery adjustments | Projection factors | ptnonipm | Not in base cases, accounts for changes in various refinery processes due to incorporation of RFS2 fuels. |

| | | | |
|---|---|---|---|
| Ethanol transport gasoline & ethanol blends | Projection factors | nonpt, ptnonipm | Not in base cases, accounts for RFS impacts on emissions from bulk plant storage, refinery to bulk terminal, and bulk terminal to pump. |
| Upstream agricultural adjustments | Projection factors | afdust, ag, nonpt, ptnonipm | Not in base cases, accounts for changes in ag burning/dust, fertilizer application/production, livestock dust/waste and pesticide application/production. |

### 4.2.1 Ethanol plants (ptnonipm)

As discussed in Section 2.4.1, for 2005 we replaced all corn ethanol plants that OTAQ had supplied from the RFS2 rule –see Section 2.1.2 in the CSAPR Final TSD- with an updated list. Additional ethanol plants cited for development in support of increased ethanol production for RFS2 are the cause for the increased number of facilities and emissions. Table 4-3 provides the summaries for the corn ethanol plants in the 2030 cases.

**Table 4-3.** 2030 corn ethanol plant emissions [tons]

| **Pollutant** | **2030** |
|---|---|
| 1,3-Butadiene | 0.0003 |
| Acrolein | 10.5 |
| Formaldehyde | 13.3 |
| Benzene | 5.7 |
| Acetaldehyde | 314.4 |
| CO | 7,023 |
| $NO_X$ | 7,396 |
| $PM_{10}$ | 10,107 |
| $PM_{2.5}$ | 3,691 |
| $SO_2$ | 9,001 |
| VOC | 10,754 |

### 4.2.2 Biodiesel plants ptnonipm)

OTAQ developed an inventory of biodiesel plants for 2030 that were sited at existing plant locations in support of producing biodiesel fuels for the RFS2 mandate. The RFS2 calls for 1.67 billion gallons per year (Bgal) of biodiesel fuel production by year 2030. Only plants with current production capacities were assumed to be operating in 2030. Total plant capacity at these existing facilities is limited to just over 1 Bgal. There was no attempt to site future year plants to account for the need to match biodiesel production needed for RFS2. Therefore, OTAQ applied scalar adjustments to each individual biodiesel plant to match the 2030 production level of 1.67 Bgal.. Once facility-level production capacities were scaled, emission factors were applied based on soybean oil feedstock. Inventories were modeled as point sources with Google Earth and web searching validating facility coordinates and correcting state-county FIPS. Table 4-4 provides the 2030 biodiesel plant emissions estimates.

**Table 4-4.** 2030 biodiesel plant emissions [tons]

| **Pollutant** | **2030** |
|---|---:|
| Acrolein | 3.56E-04 |
| Formaldehyde | 2.56E-03 |
| Benzene | 5.42E-05 |

| | |
|---|---|
| Acetaldehyde | 4.14E-04 |
| CO | 836 |
| $NO_X$ | 1,349 |
| $PM_{10}$ | 114 |
| $PM_{2.5}$ | 114 |
| $SO_2$ | 10 |
| VOC | 73 |

### 4.2.3 Portable fuel container growth and control (nonpt)

We obtained future-year VOC emissions from Portable Fuel Containers (PFCs) from inventories developed and modeled for the EPA's MSAT2 rule (EPA, 2007b). The 10 PFC SCCs are summarized below (note that the full SCC descriptions for these SCCs include "Storage and Transport; Petroleum and Petroleum Product Storage" as the beginning of the description).

- 2501011011 Residential Portable Fuel Containers: Permeation
- 2501011012 Residential Portable Fuel Containers: Evaporation
- 2501011013 Residential Portable Fuel Containers: Spillage During Transport
- 2501011014 Residential Portable Fuel Containers: Refilling at the Pump: Vapor Displacement
- 2501011015 Residential Portable Fuel Containers: Refilling at the Pump: Spillage
- 2501012011 Commercial Portable Fuel Containers: Permeation
- 2501012012 Commercial Portable Fuel Containers: Evaporation
- 2501012013 Commercial Portable Fuel Containers: Spillage During Transport
- 2501012014 Commercial Portable Fuel Containers: Refilling at the Pump: Vapor Displacement
- 2501012015 Commercial Portable Fuel Containers: Refilling at the Pump: Spillage

Additional information on the PFC inventories is available in Section 2.2.3 of the documentation for the 2002 Platform (http://www.epa.gov/ttn/chief/emch/index.html#2002).

The future-year emissions reflect projected increases in fuel consumption, state programs to reduce PFC emissions, standards promulgated in the MSAT2 rule, and impacts of the Renewable Fuel Standard (RFS) on gasoline volatility. OTAQ provided year 2030 PFC emissions that include estimated Reid Vapor Pressure (RVP) and oxygenate impacts on VOC emissions, and more importantly, large increases in ethanol emissions from RFS2. These emission estimates also include refueling from the NONROAD model for gas can vapor displacement, changes in tank permeation and diurnal emissions from evaporation. Because these PFC inventories contain ethanol and benzene, we developed a VOC E-profile that integrated ethanol and benzene, see Section 3 for more details. Emissions for 2030 are provided in Table 4-5.

**Table 4-5.** PFC emissions for 2030 [tons]

| **Pollutant** | **2030** |
|---|---|
| VOC | 146,593 |
| Benzene | 1,622 |
| Ethanol | 31,632 |

### 4.2.4 Cellulosic fuel production (nonpt)

OTAQ developed county-level inventories for cellulosic diesel and cellulosic ethanol production for 2030 to satisfy RFS2 requirements. The methodology for building cellulosic plant emissions inventories is fairly similar conceptually to that for building the biodiesel plant inventories. First, we assume that cellulosic diesel and cellulosic ethanol are produced in the same counties where current production capacity exists, based on RFS2 FRM inventories. The total county production capacity was over 16 Bgal; therefore, OTAQ applied a scalar adjustment to each county's production capacity to match the 2030 production estimate of 11.44 Bgal (6.5 Bgal diesel and 4.92Bgal ethanol): 0.715 for 2030. Once county-level cellulosic production capacities were scaled, emission factors were applied. Table 4-6 provides the year 2030 cellulosic plant emissions estimates. These emission factors were obtained from the RFS2 rule for criteria pollutants; emission factors for toxics were derived from 2005 NEI data.

**Table 4-6.** 2030 cellulosic plant emissions [tons]

| **Pollutant** | **2030** |
|---|---|
| Acrolein | 61 |
| Formaldehyde | 168 |
| Benzene | 79 |
| Acetaldehyde | 2,286 |
| CO | 124,336 |
| Ethanol | 5,530 |
| $NH_3$ | 1.6 |
| $NO_X$ | 185,745 |
| $PM_{10}$ | 21,862 |
| $PM_{2.5}$ | 10,986 |
| $SO_2$ | 14,475 |
| VOC | 15,489 |

We had no refined information on potential VOC speciation differences between cellulosic diesel and cellulosic ethanol sources. Therefore, we summed up cellulosic diesel and cellulosic ethanol sources and used the same SCC (30125010: Industrial Chemical Manufacturing, Ethanol by Fermentation production) for VOC speciation as was used for corn ethanol plants. However, these cellulosic inventories contain ethanol; therefore we developed a VOC E-profile that integrated ethanol, see Section 3 for more details.

### 4.2.5 Ethanol transport and distribution (nonpt)

OTAQ developed county-level inventories for ethanol transport and distribution for 2030 to account for losses for the processes such as truck, rail and waterways loading/unloading and intermodal transfers such as highway-to-rail, highways-to-waterways, and all other possible combinations of transfers. Emission rates were applied based on June 2008 AP-42 factors and ethanol versus gasoline vapor mass equations. These emissions are entirely evaporative and therefore limited to VOC and are summarized in Table 4-7. The leading descriptions are "Industrial Processes; Food and Agriculture; Ethanol Production" for each SCC.

**Table 4-7.** 2030 VOC losses (Emissions) due to ethanol transport and distribution [tons]

| **SCC** | **Description** | **2030** |
|---|---|---|
| 30205031 | Denatured Ethanol Storage Working Loss | 34,642 |
| 30205052 | Ethanol Loadout to Truck | 23,794 |
| 30205053 | Ethanol Loadout to Railcar | 11,991 |

### 4.2.6 Refinery adjustments (ptnonipm)

Refinery emissions were adjusted for changes in fuels due to the RFS2 mandate. These adjustments were provided by OTAQ and impact processes such as process heaters, catalytic cracking units, blowdown systems, wastewater treatment, condensers, cooling towers, flares and fugitive emissions. The impact of the RFS2-based reductions is shown in Table 4-8.

**Table 4-8.** Impact of refinery adjustments on 2030 emissions [tons]

| Pollutant | Reductions 2030 |
|---|---:|
| CO | 13,602 |
| $NO_X$ | 34,850 |
| $PM_{10}$ | 7,550 |
| $PM_{2.5}$ | 4,365 |
| $SO_2$ | 24,014 |
| VOC | 6,428 |

### 4.2.7 Ethanol transport gasoline and blends (ptnonipm, nonpt)

Emissions changes in the transport of changing fuels from the RFS2 mandate impact several processes including bulk plant storage (BPS), refinery to bulk terminal (RBT) and bulk terminal to pump (BTP). These impacts, provided by OTAQ, result in approximately 46,000 tons of VOC reductions in 2030 for these processes. See Appendix E for cross-walk between SCC and each type of petroleum transport and storage.

### 4.2.8 Upstream agricultural adjustments (afdust, ag, nonpt, ptnonipm)

Changes in domestic biofuel volumes, resulting from the RFS2 fuels mandate, impact upstream agricultural-related source categories in several emissions modeling sectors. These source categories include fertilizer application, pesticide application and livestock waste ($NH_3$ only), agricultural tilling, unloading and livestock dust (PM only) and fertilizer production mixing and blending, pesticide production and agricultural burning (all pollutants). As seen in Table 4-9, the cumulative impact of these source-specific changes is a net increase in emissions for upstream agricultural sources.

**Table 4-9.** Upstream agricultural emission increases due to RFS2 fuels in 2030 [tons]

| Pollutant | Increases 2030 |
|---|---:|
| CO | 416 |
| $NH_3$ | 61,793 |
| $NO_X$ | 500 |
| $PM_{10}$ | 59,004 |
| $PM_{2.5}$ | 8,972 |
| $SO_2$ | 95 |
| VOC | 23 |

### 4.2.9 Livestock emissions growth (ag, afdust)

Growth in ammonia ($NH_3$) and dust ($PM_{10}$ and $PM_{2.5}$) emissions from livestock in the ag, afdust and ptnonipm sectors was based on projections of growth in animal population. **Error! Reference source not found.** provides the growth factors from the 2005 base-case emissions to year 2030 scenarios for animal categories applied to the ag, afdust, and ptnonipm sectors for livestock-related SCCs.

**Table 4-10.** Growth factors from year 2005 to 2030 for animal operations

| Animal Category | 2030 |
|---|---|
| Dairy Cow | 1.0000 |
| Beef | 1.0385 |

| | |
|---|---|
| Pork | 1.1666 |
| Broilers | 1.6426 |
| Turkeys | 1.0000 |
| Layers | 1.4491 |
| Poultry Average | 1.4991 |
| Overall Average | 1.1745 |

Except for dairy cows and turkey production, the animal projection factors are derived from national-level animal population projections from the U.S. Department of Agriculture (USDA) and the Food and Agriculture Policy and Research Institute (FAPRI). For dairy cows and turkeys, we assumed that there would be no growth in emissions. This assumption was based on an analysis of historical trends in the number of such animals compared to production rates. Although productions rates have increased, the number of animals has declined. Thus, we do not believe that production forecasts provide representative estimates of the future number of cows and turkeys; therefore, we did not use these forecasts for estimating future-year emissions from these animals. In particular, the dairy cow population is projected to decrease in the future as it has for the past few decades; however, milk production will be increasing over the same period. Note that the ammonia emissions from dairies are not directly related to animal population but also nitrogen excretion. With the cow numbers going down and the production going up we suspect the excretion value will be changing, but we assumed no change because we did not have a quantitative estimate.

The inventory for livestock emissions used 2002 emissions values therefore, our projection method projected from 2002 rather than from 2005.

Appendix E in the 2002v3 platform documentation provides the animal population data and regression curves used to derive the growth factors: http://www.epa.gov/scram001/reports/Emissions%20TSD%20Vol2_Appendices_01-15-08.pdf. Appendix F in the same document provides the cross references of livestock sources in the ag, afdust and ptnonipm sectors to the relevant animal categories.

### 4.2.10 Residential wood combustion growth (nonpt)

We projected residential wood combustion (RWC) emissions based on the expected increase in the number of low-emitting wood stoves and the corresponding decrease in other types of wood stoves. As newer, cleaner woodstoves replace older, higher-polluting wood stoves, there will be an overall reduction of the emissions from these sources. The approach cited here was developed as part of a modeling exercise to estimate the expected benefits of the woodstoves change-out program (http://www.epa.gov/burnwise). Details of this approach can be found in Section 2.3.3 of the PM NAAQS Regulatory Impact Analysis (EPA, 2006).

The specific assumptions we made were:

- Fireplaces, source category code (SCC)=2104008001: increase 1%/year
- Old woodstoves, SCC=2104008002, 2104008010, or 2104008051: decrease 2%/year
- New woodstoves, SCC=2104008003, 2104008004, 2104008030, 2104008050, 2104008052 or 2104008053: increase 2%/year

For the general woodstoves and fireplaces category (SCC 2104008000) we computed a weighted average distribution based on 19.4% fireplaces, 71.6% old woodstoves, 9.1% new woodstoves using 2002v3 Platform missions for $PM_{2.5}$. These fractions are based on the fraction of emissions from these processes in the states that did not have the “general woodstoves and fireplaces” SCC in the 2002v3 NEI. This approach results in an overall decrease of 1.056% per year for this source category. Table 4-11 presents the projection factors used to project the 2005 base case (2002 emissions) for RWC.

**Table 4-11.** Projection factors for growing year 2005 residential wood combustion sources

| SCC | SCC Description | 2030 |
|---|---|---|
| 2104008000 | Total: Woodstoves and Fireplaces | 0.70 |
| 2104008001 | Fireplaces: General | 1.28 |
| 2104008070 | Outdoor Wood Burning Equipment | |
| 2104008002 | Fireplaces: Insert; non-EPA certified | 0.44 |
| 2104008010 | Woodstoves: General | |
| 2104008051 | Non-catalytic Woodstoves: Non-EPA certified | |
| 2104008003 | Fireplaces: Insert; EPA certified; non-catalytic | 1.56 |
| 2104008004 | Fireplaces: Insert; EPA certified; catalytic | |
| 2104008030 | Catalytic Woodstoves: General | |
| 2104008050 | Non-catalytic Woodstoves: EPA certified | |
| 2104008052 | Non-catalytic Woodstoves: Low Emitting | |
| 2104008053 | Non-catalytic Woodstoves: Pellet Fired | |

### 4.2.11 Gasoline Stage II growth and control (nonpt, ptnonipm)

Emissions from Stage II gasoline operations in the 2005 v4.2 platform are contained in both nonpt and ptnonipm sectors. The only SCC in the nonpt inventory used for gasoline Stage II emissions is 2501060100 (Storage and Transport; Petroleum and Petroleum Product Storage; Gasoline Service Stations; Stage II: Total). The following SIC and SCC codes are associated with gasoline Stage II emissions in the ptnonipm sector:

- SIC 5541 (Automotive Dealers & Service Stations, Gasoline Service Stations, Gasoline service stations)
- SCC 40600401 (Petroleum and Solvent Evaporation;Transportation and Marketing of Petroleum Products;Filling Vehicle Gas Tanks - Stage II;Vapor Loss w/o Controls)
- SCC 40600402 (Petroleum and Solvent Evaporation;Transportation and Marketing of Petroleum Products;Filling Vehicle Gas Tanks - Stage II;Liquid Spill Loss w/o Controls)
- SCC 40600403 (Petroleum and Solvent Evaporation;Transportation and Marketing of Petroleum Products;Filling Vehicle Gas Tanks - Stage II;Vapor Loss w/o Controls)
- SCC 40600499 (Petroleum and Solvent Evaporation;Transportation and Marketing of Petroleum Products;Filling Vehicle Gas Tanks - Stage II;Not Classified

In the LDGHG modeling, these SCCs were removed from the nonpt and ptnonipm inventories and replaced with a separate refueling inventory in the nonpt sector. This refueling inventory was generated from draft MOVES2010b, provided monthly emissions for both gasoline and diesel refueling, and was year and scenario specific. The speciation of the refueling emissions integrated ethanol as well as BAFM (EBAFM) and was speciated using E-profiles, see Section 3 for more details.

For the 2030 reference case, the MOVES refueling results account for projected fuel properties, VMT growth over time, the phase-in of onboard vapor control, and the phase-in of previously finalized fuel consumption regulations.

### 4.2.12 Aircraft growth (ptnonipm)

These 2005 point-source emissions are projected to future years by applying activity growth using data on itinerant (ITN) operations at airports. The ITN operations are defined as aircraft take-offs whereby the aircraft leaves the airport vicinity and lands at another airport, or aircraft landings whereby the aircraft has arrived from outside the airport vicinity. We used projected ITN information available from the Federal Aviation Administration's (FAA) Terminal Area Forecast (TAF) System: http://www.apo.data.faa.gov/main/taf.asp (publication date January 2010). This information is available for approximately 3,300 individual airports, for all years up to 2030. We aggregated and applied this information at the national level by summing the airport-specific (U.S. airports only) ITN operations to national totals by year and by aircraft operation, for each of the four available operation types: commercial, general, air taxi and military. We computed growth factors for each operation type by dividing future-year ITN by 2005-year ITN. We assigned factors to inventory SCCs based on the operation type.

The methods that the FAA used for developing the ITN data in the TAF are documented in: http://www.faa.gov/data_research/aviation/aerospace_forecasts/2009-2025/media/2009%20Forecast%20Doc.pdf

Table 4-12 provides the national growth factors for aircraft; all factors are applied to year 2005 emissions. For example, year 2030 commercial aircraft emissions are 50.59% higher than year 2005 emissions.

**Table 4-12.** Factors used to project 2005 base-case aircraft emissions to year 2030

| SCC | SCC Description | Projection Factor |
|---|---|---|
| 2275001000 | Military aircraft | 1.0275 |
| 2275020000 | Commercial aircraft | 1.5059 |
| 2275050000 | General aviation | 0.9916 |
| 2275060000 | Air taxi | 1.0259 |
| 27501015 | Internal Combustion Engines;Fixed Wing Aircraft L & TO Exhaust;Military;Jet Engine: JP-5 | 1.0275 |
| 27502001 | Internal Combustion Engines;Fixed Wing Aircraft L & TO Exhaust;Commercial;Piston Engine: Aviation Gas | 1.5059 |
| 27502011 | Internal Combustion Engines;Fixed Wing Aircraft L & TO Exhaust;Commercial;Jet Engine: Jet A | 1.5059 |
| 27505001 | Internal Combustion Engines;Fixed Wing Aircraft L & TO Exhaust;Civil;Piston Engine: Aviation Gas | 0.9916 |
| 27505011 | Internal Combustion Engines;Fixed Wing Aircraft L & TO Exhaust;Civil;Jet Engine: Jet A | 0.9916 |
| 27601014 | Internal Combustion Engines;Rotary Wing Aircraft L & TO Exhaust;Military;Jet Engine: JP-4 | 1.0275 |
| 27601015 | Internal Combustion Engines;Rotary Wing Aircraft L & TO Exhaust;Military;Jet Engine: JP-5 | 1.0275 |

We did not apply growth factors to any point sources with SCC 27602011 (Internal Combustion Engines; Rotary Wing Aircraft L & TO Exhaust; Commercial; Jet Engine: Jet A) because the facility names associated with these point sources appeared to represent industrial facilities rather than airports. This SCC is only in one county, Santa Barbara, California (State/County FIPS 06083).

### 4.2.13 Stationary source control programs, consent decrees & settlements, and plant closures (ptnonipm, nonpt)

We applied emissions reduction factors to the 2005 emissions for particular sources in the ptnonipm and nonpt sectors to reflect the impact of stationary-source control programs including consent decrees, settlements, and plant closures. Some of the controls described in this section were obtained from comments on the CSAPR proposal. Here we describe the contents of the controls and closures for the 2030 reference case. Detailed summaries of the impacts of the control programs are provided in Appendix D of the CSAPR TSD: ftp://ftp.epa.gov/EmisInventory/2005v4_2/transportrulefinal_eitsd_appendices_28jun2011.pdf.

Controls from the $NO_X$ SIP call were assumed to have been implemented by 2005 and captured in the 2005 base case (2005v2 point inventory). This assumption was confirmed by review of the 2005 NEI that showed reductions from Large Boiler/Turbines and Large Internal Combustion Engines in the Northeast states covered by the NOx SIP call. The future-year base controls consist of the following:

- We did not include MACT rules where compliance dates were prior to 2005, because we assumed these were already reflected in the 2005 inventory. The EPA OAQPS Sector Policies and Programs Division (SPPD) provided all controls information related to the MACT rules, and this information is as consistent as possible with the preamble emissions reduction percentages for these rules.
- Various emissions reductions from the CSAPR comments, including but not limited to: fuel switching at units, shutdowns, future-year emission limits, ozone SIP VOC controls for some sources in Virginia and Connecticut, and state and local control programs.
- Evolutionary information gathering of plant closures (i.e., emissions were zeroed out for future years) were also included where information indicated that the plant was actually closed after the 2005 base year and prior to CSAPR and LDGHG modeling that began in the fall of 2010. We also applied unit and plant closures received from the CSAPR comments. However, plants projected to close in the future (post-2010) were not removed in the future years because these projections can be inaccurate due to economic improvements. We also applied cement kiln (unit) and cement plant closures discussed later in Section 4.2.6.1. More detailed information on the overall state-level impacts of all control programs and projection datasets, including units and plants closed in the 2012 and 2014 base-case ptnonipm inventories are provided in Appendix D of the CSAPR TSD: ftp://ftp.epa.gov/EmisInventory/2005v4_2/transportrulefinal_eitsd_appendices_28jun2011.pdf. The magnitude of all unit and plant closures on the non-EGU point (ptnonipm) sector 2005 base-case emissions is shown in Table 4-13 below.

**Table 4-13.** Summary of Non-EGU Emission Reductions Applied to the 2005 Inventory due to Unit and Plant Closures

| | **CO** | **$NH_3$** | **$NO_X$** | **$PM_{10}$** | **$PM_{2.5}$** | **$SO_2$** | **VOC** |
|---|---|---|---|---|---|---|---|
| **Reductions** | 125,162 | 636 | 109,237 | 21,143 | 12,600 | 190,734 | 26,750 |

- In addition to plant closures, we included the effects of the Department of Justice Settlements and Consent Decrees on the non-EGU (ptnonipm) sector emissions. We also included estimated impacts of HAP standards per Section 112, 129 of the Clean Air Act on the non-EGU (ptnonipm) and nonpoint (nonpt) sector emissions, based on expected CAP co-benefits to sources in these sectors.
- Numerous controls have compliance dates beyond 2008; these include refinery and the Office of Compliance and Enforcement (OECA) consent decrees, Department of Justice (DOJ) settlements, as well as most national VOC MACT controls. Additional OECA consent decree information is provided in Appendix B of the Proposed Toxics Rule TSD: http://www.epa.gov/ttn/chief/emch/toxics/proposed_toxics_rule_appendices.pdf. The detailed data used are available at the website listed in Section 1.

- Refinery consent decrees controls at the facility and SCC level (collected through internal coordination on refineries by the EPA).
- Fuel sulfur fuel limits were enforceable for Maine, New Jersey and New York. These fuel limits were incremental and not applicable until after 2012.
- Criteria air pollutant (cap) reductions a cobenefit to RICE NESHAP controls, including $SO_2$ RICE cobenefit controls.
- We applied New York State Implementation Plan available controls for the 1997 8-hour Ozone standard for non-EGU point and nonpoint $NO_X$ and VOC sources based on NY State Department of Environmental Conservation February 2008 guidance. These reductions are found in Appendix J in: http://www.dec.ny.gov/docs/air_pdf/NYMASIP7final.pdf. See Section 3.2.6 in the CSAPR TSD: ftp://ftp.epa.gov/EmisInventory/2005v4_2/transportrulefinal_eitsd_28jun2011.pdf.

Most of the control programs were applied as replacement controls, which means that any existing percent reductions ("baseline control efficiency") reported in the NEI were removed prior to the addition of the percent reductions due to these control programs. Exceptions to replacement controls are "additional" controls, which ensure that the controlled emissions match desired reductions regardless of the baseline control efficiencies in the NEI. We used the "additional controls" approach for many permit limits, settlements and consent decrees where specific plant and multiple-plant-level reductions/targets were desired and at municipal waste landfills where VOC was reduced 75% via a MACT control using projection factors of 0.25.

#### 4.2.13.1 Reductions from the Portland Cement NESHAP

As indicated in Table 4-1, the Industrial Sectors Integrated Solutions (ISIS) model (EPA, 2010) was used to project the cement industry component of the ptnonipm emissions modeling sector to 2013. There were no future year estimates for year 2030, so 2013 estimates were used for the 2030 Reference case. This approach provided reductions of criteria and hazardous air pollutants, including mercury. The ISIS cement emissions were developed in support for the Portland Cement NESHAPs and the NSPS for the Portland cement manufacturing industry.

The ISIS model produced a Portland Cement NESHAP policy case of multi-pollutant emissions for individual cement kilns (emission inventory units) that were relevant for years 2013 through 2017. These ISIS-based emissions included information on new cement kilns, facility and unit-level closures, and updated policy case emissions at existing cement kilns. The units that opened or closed before 2010 were included in the projections as were the ISIS-based policy case predictions of emissions reductions and activity growth.

The ISIS model results for the future show a continuation of the recent trend in the cement sector of the replacement of lower capacity, inefficient wet and long dry kilns with bigger and more efficient preheater and precalciner kilns. Multiple regulatory requirements such as the NESHAP and NSPS currently apply to the cement industry to reduce CAP and HAP emissions. Additionally, state and local regulatory requirements might apply to individual cement facilities depending on their locations relative to ozone and $PM_{2.5}$ nonattainment areas. The ISIS model provides the emission reduction strategy that balances: 1) optimal (least cost) industry operation, 2) cost-effective controls to meet the demand for cement, and 3) emission reduction requirements over the time period of interest. Table 4-14 shows the magnitude of the ISIS-based cement industry reductions in the future-year emissions that represent 2013 (and 2030 for LDGHG), and the impact that these reductions have on total stationary non-EGU point source (ptnonipm) emissions.

**Table 4-14.** Future-year ISIS-based cement industry annual reductions (tons/yr) for the non-EGU (ptnonipm) sector

| Pollutant | Cement Industry emissions in 2005 | Decrease in cement industry emissions in 2030 vs 2005 | % decrease in ptnonipm from cement reduction |
|---|---|---|---|
| $NO_X$ | 193,000 | 56,740 | 2.4% |
| $PM_{2.5}$ | 14,400 | 7,840 | 1.8% |
| $SO_2$ | 128,400 | 106,000 | 5.0% |
| VOC | 6,900 | 5,570 | 0.4% |
| HCl | 2,900 | 2,220 | 4.5% |

### 4.2.13.2 Boiler reductions not associated with the MACT rule

The Boiler MACT ICR collected data on existing controls. We used an early version of a data base developed for that rulemaking entitled "survey_database_2008_results2.mdb" (EPA-HQ-OAR-2002-0058-0788) which is posted under the Technical Information for the Boiler MACT major source rule (http://www.epa.gov/ttn/atw/boiler/boilerpg.html). We extracted all controls that were installed after 2005, determined a percent reduction, and verified with source owners that these controls were actively in use. In many situations we learned that the controls were on site but were not in use. A summary of the plant-unit specific reductions that were verified to be actively in use are summarized in Table 4-15.

**Table 4-15.** State-level non-MACT Boiler Reductions from ICR Data Gathering

| State | Pollutant | Pre-controlled Emissions (tons) | Controlled Emissions (tons) | Reductions (tons) | Percent Reduction % |
|---|---|---|---|---|---|
| Michigan | $NO_X$ | 907 | 544 | 363 | 40 |
| North Carolina | $SO_2$ | 652 | 65 | 587 | 90 |
| Virginia | $SO_2$ | 3379 | 338 | 3041 | 90 |
| Washington | $SO_2$ | 639 | 383 | 256 | 40 |
| North Carolina | HCl | 31 | 3 | 28 | 90 |

### 4.2.13.3 RICE NESHAP

There are three rulemakings for National Emission Standards for Hazardous Air Pollutants (NESHAP) for Reciprocating Internal Combustion Engines (RICE). These rules reduce HAPs from existing and new RICE sources. In order to meet the standards, existing sources with certain types of engines will need to install controls. In addition to reducing HAPs, these controls also reduce CAPs, specifically, CO, $NO_X$, VOC, PM, and $SO_2$. In 2014 and beyond, compliance dates have passed for all three rules; thus all three rules are included in the 2030 LDGHG emissions projection.

The rules can be found at http://www.epa.gov/ttn/atw/rice/ricepg.html and are listed below:

- National Emission Standards for Hazardous Air Pollutants for Reciprocating Internal Combustion Engines; Final Rule (69 FR 33473) published 06/15/04
- National Emission Standards for Hazardous Air Pollutants for Reciprocating Internal Combustion Engines; Final Rule (FR 9648 ) published 03/03/10
- National Emission Standards for Hazardous Air Pollutants for Reciprocating Internal Combustion Engines; Final Rule (75 FR 51570) published 08/20/2010

The difference among these three rules is that they focus on different types of engines, different facility types (major for HAPs, versus area for HAPs) and different engine sizes based on horsepower (HP). In addition, they have different compliance dates. We project CAPs from the 2005 NEI RICE sources, based on the requirements of the rule for existing sources only because the inventory includes only existing sources and the current projection approach does not estimate emissions from new sources.

A complete discussion on the methodology to estimate RICE controls is provided in Appendix F in the Proposed MATS Rule TSD: http://www.epa.gov/ttn/chief/emch/toxics/proposed_toxics_rule_appendices.pdf. Impacts of the RICE controls on stationary non-EGU emissions (nonpt and ptnonipm sectors), excluding WRAP, Texas, and Oklahoma oil and gas emissions (see Section 4.2.7) are provided in Table 4-16.

**Table 4-16.** National Impact of RICE Controls on 2030 Non-EGU Projections

| | **CO** | **$NO_X$** | **$PM_{10}$** | **$PM_{2.5}$** | **$SO_2$** | **VOC** |
|---|---|---|---|---|---|---|
| **Reductions** | 116,434 | 111,749 | 1,595 | 1,368 | 21,957 | 14,669 |

#### 4.2.13.4 Fuel sulfur rules

Fuel sulfur rules that were signed (enforceable) at the time of the LDGHG emissions processing are limited to Maine, New Jersey and New York. Several other states have fuel sulfur rules that were in development but not finalized prior to CSAPR and LDGHG Rule emissions processing: http://www.ilta.org/LegislativeandRegulatory/MVNRLM/NEUSASulfur%20Rules_09.2010.pdf.

The fuel sulfur content for all home heating oil SCCs in 2005 is assumed to by 3000 part per million (ppm). Effective July 1, 2012, New York requires all heating oil sold in New York to contain no more than 15ppm of sulfur, thus reducing $SO_2$ emissions by 99.5% for post-2012 (2030) projections. These New York sulfur content reductions are further discussed here: http://switchboard.nrdc.org/blogs/rkassel/governor_paterson_signs_new_la.html.

The New Jersey year 2017 standard of 15ppm (assuming 500ppm baseline for Kersone) sulfur content yields a 96.25% $SO_2$ emissions reduction for kersone (fuel #1). The New Jersey sulfur content reductions are discussed here: http://njtoday.net/2010/09/01/nj-adopts-rule-limiting-sulfur-content-in-fuel-oil/.

The Maine fuel sulfur rule effective January 1, 2014 reduces sulfur to 15ppm, resulting in a 99.5% reduction from 3000 ppm. These Maine sulfur content reductions are discussed here: http://www.mainelegislature.org/legis/bills/bills_124th/billpdfs/SP062701.pdf.

The impact of these fuel sulfur content reductions on SO2 is shown in Table 4-17.

**Table 4-17.** Impact of Fuel Sulfur Controls on 2030 Non-EGU Projections

| **State** | **$SO_2$ Reductions** |
|---|---:|
| Maine | 18,470 |
| New Jersey | 998 |
| New York | 54,431 |
| **Total** | **73,898** |

### 4.2.14 Oil and gas projections in TX, OK, and non-California WRAP states (nonpt)

For the 2005v4.2 platform, we incorporated updated 2005 oil and gas emissions from Texas and Oklahoma. For Texas oil and gas production, we used the last available future year, year 2021, estimates from the Texas Commission of Environmental Quality (TCEQ) and used them as described in: http://www.tceq.state.tx.us/assets/public/implementation/air/am/contracts/reports/ei/5820783985FY0901-20090715-ergi-Drilling_Rig_EI.pdf.

We also received 2008 data for Oklahoma that we used as the best available data to represent 2030. We utilized the latest available future year, year 2018, Phase II WRAP oil and gas emissions data for the non-California Western Regional Air Partnership (WRAP) states to represent year 2030. RICE NESHAP reductions, which are effective by year 2014, were applied to the year 2008 Oklahoma oil and gas inventory but not applied to the 2021 TCEQ oil and gas estimates or 2018 WRAP Phase II oil and gas inventory.

For Oklahoma, we applied CO, $NO_X$, $SO_2$ and VOC emissions reductions from the RICE NESHAP, which we assumed has some applicability to this industry (see Appendix F in the Proposed Toxics Rule TSD: http://www.epa.gov/ttn/chief/emch/toxics/proposed_toxics_rule_appendices.pdf). Table 4-18 shows the 2005 and 2030 NOX and SO2 emissions including RICE reductions for Oklahoma.

**Table 4-18.** Oil and Gas $NO_X$ and $SO_2$ Emissions for 2005 and 2030 including additional reductions due to the RICE NESHAP

| | NOX | | PM2.5 | | SO2 | | VOC | |
|---|---|---|---|---|---|---|---|---|
| | **2005** | **2030** | **2005** | **2030** | **2005** | **2030** | **2005** | **2030** |
| Alaska | 836 | 453 | | | 62 | 1 | 68 | 12 |
| Arizona | 13 | 15 | | | | | 37 | 49 |
| Colorado | 32,188 | 33,517 | | | 350 | 11 | 35,500 | 43,639 |
| Montana | 10,617 | 13,880 | | | 640 | 6 | 9,187 | 14,110 |
| Nevada | 71 | 63 | | | 1 | 0 | 105 | 163 |
| New Mexico | 61,674 | 74,648 | | | 369 | 12 | 215,636 | 267,846 |
| North Dakota | 6,040 | 20,869 | | | 688 | 4 | 8,988 | 17,968 |
| Oklahoma | 39,668 | 42,402 | 1,918 | 2,231 | 1,014 | 2 | 155,908 | 163,598 |
| Oregon | 61 | 44 | | | | | 19 | 14 |
| South Dakota | 566 | 557 | | | 43 | 0 | 370 | 562 |
| Texas | 42,854 | 26,061 | 2,945 | 435 | 5,977 | 33 | 4,337 | 1,504 |
| Utah | 6,896 | 6,297 | | | 149 | 1 | 43,403 | 81,890 |
| Wyoming | 36,172 | 34,142 | | | 541 | 3 | 166,939 | 304,748 |
| **Total** | **237,656** | **252,948** | **4,862** | **2,666** | **9,834** | **73** | **640,498** | **896,104** |

## *4.3 Mobile source projections*

Mobile source monthly inventories of onroad and nonroad mobile emissions were created for 2030 using a the NMIM and MOVES2010a models. Future-year emissions reflect onroad mobile control programs including the Light-Duty Vehicle Tier 2 Rule, the Onroad Heavy-Duty Rule, and the Mobile Source Air Toxics (MSAT2) final rule. Nonroad mobile emissions reductions for these years include regulations affecting locomotives, various nonroad engines including diesel engines and various marine engine types, fuel sulfur content, and evaporative emissions.

Onroad mobile sources are comprised of several components and are discussed in the next subsection (4.3.1). Nonroad mobile emission projections are discussed in subsection 4.4. Locomotives and Class 1 and Class 2 commercial marine vessel (C1/C2 CMV) projections are discussed in subsection 4.4.2, and Class 3 (C3) CMV projected emissions are discussed in subsection 4.4.3.

### 4.3.1 Onroad mobile (on_noadj, on_moves_runpm, on_moves_startpm)

The onroad emissions for states other than California were generated with the 2010 version of the Motor Vehicle Emissions Simulator (MOVES2010a) – the same version that was used for the 2005 baseline inventory and the 2030 control case. For all three cases, the model was run with custom default inputs that accounted for the Heavy Duty Greenhouse Gas standards and allowed for the separate calculation of heavy duty emissions of different weight categories as described in the "Final Rulemaking to Establish Greenhouse Gas Emissions Standards and Fuel Efficiency Standards for Medium- and Heavy-Duty Engines and Vehicles Regulatory Impact Analysis" (http://www.epa.gov/oms/climate/documents/420r11901.pdf).

California onroad (on_noadj)

California onroad inventory: California year 2030 complete CAP/HAP onroad inventories are monthly onroad emissions and are based on March 2007 California Air Resources Board (CARB) data (Martin Johnson: mjohnson@arb.ca.gov). Like year 2005 emissions, future-year California $NH_3$ emissions are from MOVES runs for California, disaggregated to the county level using NMIM. We estimated HAP emissions by applying HAP-to-CAP ratios computed from California 2005 NEI submittal provided by EPA in 12/2007. This was done because the CARB submittal from March 2007 did not include estimates for HAPs. We retained only those HAPs that were also estimated by NMIM for nonroad mobile sources; all other HAPs were dropped.

Onroad mobile sector with no adjustment for daily temperature (on_noadj)

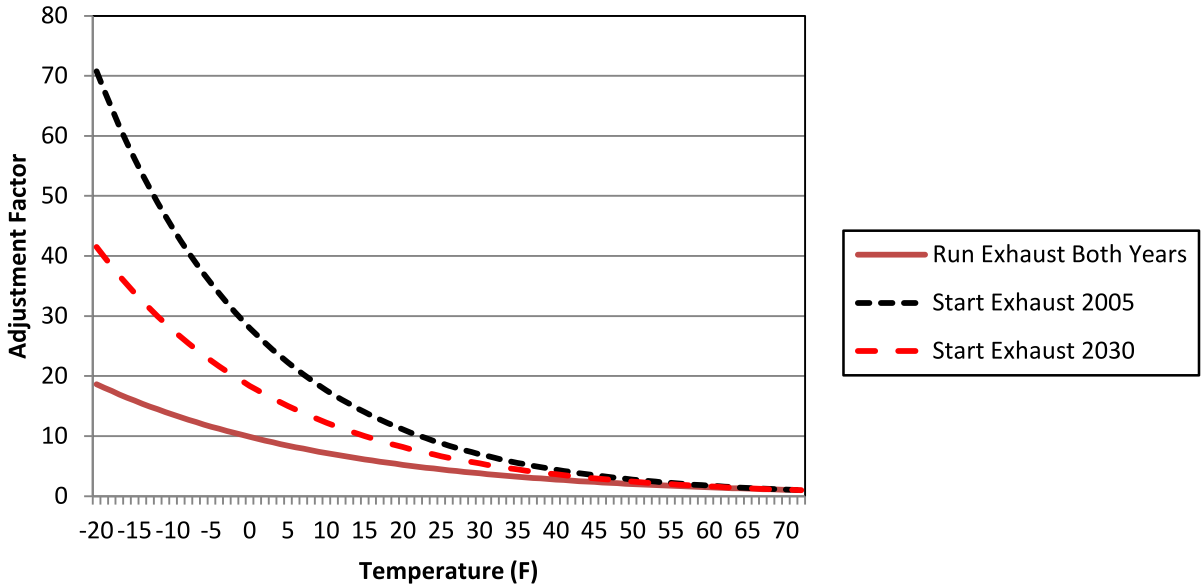
As discussed in Section 2, the MOVES2010a model was used for all vehicles, road types, and pollutants. Vehicle Miles Travelled (VMT) was projected using growth rates from the Department of Energy's AEO2011. We used MOVES2010a to create emissions by state, SCC, pollutant, emissions mode and month. We then allocated these emissions to counties using ratios based on 2030 NMIM county-level data by state, SCC, pollutant, and emissions mode.

Onroad PM gasoline running and cold start mode sectors (on_moves_startpm and on_moves_runpm)

MOVES-based cold start and running mode emissions consist of gasoline exhaust speciated PM and naphthalene. These pre-temperature-adjusted emissions at 72°F are projected to year 2030 from year 2005 inventories using the 2030-specific runs of MOVES2010a. VMT were projected using growth rates from the AEO2009. As with the on_noadj sector, the 2030 MOVES2010a data were created at the state-month level, and the 2030 NMIM results were used to disaggregate the state level results to the county level.

MOVES-based temperature adjustment factors were applied to gridded, hourly emissions using gridded, hourly meteorology. As seen in Figure 4-1, for year 2030, we used the same temperature adjustment factors as the 2005 base case for both start and running modes. However, cold start temperature adjustment factors decrease in future years, and for year 2030 processing, we updated the temperature adjustment curves for these cold start emissions. Note that running exhaust temperature adjustment factors are the same for all years. Also, it is worth noting that the running mode gasoline exhaust emissions are considerably larger than cold start mode gasoline exhaust emissions before application of the temperature adjustments.

**Figure 4-1.** MOVES exhaust temperature adjustment functions for 2005 and 2030




## *4.4 Nonroad mobile source projections (nonroad, alm_no_c3, seca_c3)*

The components of the nonroad mobile sectors are discussed in Section 2.3. Nonroad mobile emissions reductions for the LDGHG reference case includes year-specific regulations affecting locomotives, various nonroad engines including diesel engines and various marine engine types, fuel sulfur content, and evaporative emissions. This section discusses the changes due to the NONROAD/NMIM system (nonroad sector) and additional C1/C2 CMV and locomotive emissions from volume increases resulting from incorporation of larger amounts of renewable fuels in the 2030 reference case.

### 4.4.1 Emissions generated with the NONROAD model (nonroad)

OTAQ provided several runs of NMIM emissions that were blended together to create the 2030 nonroad sector emissions. We used these same nonroad emissions for both the reference and control cases. Table 4-11 shows how the various NMIM runs were combined to create the non-California nonroad mobile inventories. The first component "2002v3-based 2030 Base Case" is from the 2030 Base case in our 2002v3 platform for the SCCs listed in Table 4-11. OTAQ also provided diesel recreational marine (pleasure craft) emissions in November 2009.

**Table 4-11.** Components of 2030 HDGHG Nonroad Sector

| NMIM file | SCCs | Description of Nonroad SCCs |
|---|---|---|
| 2002v3-based 2030 Base Case | 2267x | LPG equipment |
| | 2268x | CNG equipment |
| | 2270x | Diesel engines |
| | 2285002015, 2285006015 | Railway maintenance |
| LdGhgN2030e0_nponzseg11dies.txt | 22820200x | Diesel recreational-marine |

| | | |
|---|---|---|
| LdGhgN2030e10.txt | 2260x | 2-stroke gasoline engines |
| | 2265x | 4-stroke gasoline engines |
| | 228200x, 228201x | Gasoline recreational marine |

We have not included voluntary nonroad programs in our projections such as programs encouraging either no refueling or evening refueling on Ozone Action Days and diesel retrofit programs. The national nonroad regulations are those promulgated prior to December 2009, and beginning about 1990. Recent rules include:

- “Clean Air Nonroad Diesel Final Rule - Tier 4”: (http://www.epa.gov/nonroaddiesel/2004fr.htm ), published June 29, 2004, and,
- Control of Emissions from Nonroad Large Spark-Ignition Engines, and Recreational Engines (Marine and Land-Based), November 8, 2002 (“Pentathalon Rule”).
- OTAQ’s Locomotive Marine Rule, March 2008: (http://www.epa.gov/otaq/regs/nonroad/420f08004.htm)
- OTAQ’s Small Engine Spark Ignition (“Bond”) Rule, November 2008: (http://www.epa.gov/otaq/equip-ld.htm)

All future year nonroad emissions used NMIM data that are based on AEO2009 fuels and the same NMIM county database NCD20101201Tier3. We converted emissions from monthly totals to monthly average-day values based the on number of days in each month. Only criteria and select HAPs (benzene, acetaldehyde, butadiene, acrolein, and formaldehyde) were retained when creating SMOKE one record per line (ORL) files.

California monthly nonroad emissions are year 2030 and are based on March 2007 California Air Resources Board (CARB) data (Martin Johnson: mjohnson@arb.ca.gov). NH3 emissions are from NMIM runs for California (same data as were used in 2030 from the 2002 v3 platform). We allocated refueling emissions to the gasoline equipment types based on evaporative mode VOC emissions from the 2002 v3 platform 2030 NMIM data, and the refueling emissions were computed by multiplying SCC 2505000120 emissions by 0.61, to adjust to remove double counting with Portable Fuel Container inventory for California. We estimated HAP emissions by applying HAP-to-CAP ratios computed from the California data provided for the 2005 NEI v2, collected by EPA on 12/2007. This was done because the CARB submittal from March 2007 did not include estimates for HAPs. We retained only those HAPs that are also estimated by NMIM for nonroad mobile sources; all other HAPs were dropped.

### 4.4.2 Locomotives and Class 1 & 2 commercial marine vessels (alm_no_c3)

Aircraft emissions reside in the nonEGU point inventory (ptnonipm), and the projection factors used to create year 2030 estimates, are discussed in Section 4.2. The remaining 2005 NEI emissions for locomotives and Class 1 and Class 2 commercial marine vessel (C1/C2 CMV) use year-specific projection estimates. Base future year locomotive and C1/C2 CMV emissions were calculated using projection factors that were computed based on national, annual summaries of emissions in 2005 and 2030. Some additional emissions were then factored in due to changes in fuels. These national summaries were used to create national by-pollutant, by-SCC projection factors; these factors include final locomotive-marine controls and are provided in Table 4-19. Modest additive Class I railroad and C1/C2 CMV emissions that account for RFS2 volume increases in the LDGHG future year reference scenarios were then added into the reference case due to the volume differences in corn, cellulosic and imported ethanol and cellulosic diesel fuels. These additional emissions are summarized in Table 4-20.

**Table 4-19**. Factors applied to year 2005 emissions to project locomotives and class 1 and class 2 commercial marine vessel emissions to 2030

| SCC | SCC Description | Pollutant | 2030 |
|---|---|---|---|
| 2280002X00 | Marine Vessels, Commercial;Diesel;Underway & port emissions | CO | 0.956 |
| 2280002X00 | Marine Vessels, Commercial;Diesel;Underway & port emissions | $NH_3$ | 1.285 |
| 2280002X00 | Marine Vessels, Commercial;Diesel;Underway & port emissions | $NO_X$ | 0.372 |
| 2280002X00 | Marine Vessels, Commercial;Diesel;Underway & port emissions | $PM_{10}$ | 0.350 |
| 2280002X00 | Marine Vessels, Commercial;Diesel;Underway & port emissions | $PM_{2.5}$ | 0.356 |
| 2280002X00 | Marine Vessels, Commercial;Diesel;Underway & port emissions | $SO_2$ | 0.045 |
| 2280002X00 | Marine Vessels, Commercial;Diesel;Underway & port emissions | VOC | 0.402 |
| 2285002006 | Railroad Equipment;Diesel;Line Haul Locomotives: Class I Operations | CO | 1.640 |
| 2285002006 | Railroad Equipment;Diesel;Line Haul Locomotives: Class I Operations | $NH_3$ | 1.627 |
| 2285002006 | Railroad Equipment;Diesel;Line Haul Locomotives: Class I Operations | $NO_X$ | 0.357 |
| 2285002006 | Railroad Equipment;Diesel;Line Haul Locomotives: Class I Operations | $PM_{10}$ | 0.260 |
| 2285002006 | Railroad Equipment;Diesel;Line Haul Locomotives: Class I Operations | $PM_{2.5}$ | 0.263 |
| 2285002006 | Railroad Equipment;Diesel;Line Haul Locomotives: Class I Operations | $SO_2$ | 0.006 |
| 2285002006 | Railroad Equipment;Diesel;Line Haul Locomotives: Class I Operations | VOC | 0.293 |
| 2285002007 | Railroad Equipment;Diesel;Line Haul Locomotives: Class II / III Operations | CO | 0.403 |
| 2285002007 | Railroad Equipment;Diesel;Line Haul Locomotives: Class II / III Operations | $NH_3$ | 1.627 |
| 2285002007 | Railroad Equipment;Diesel;Line Haul Locomotives: Class II / III Operations | $NO_X$ | 0.350 |
| 2285002007 | Railroad Equipment;Diesel;Line Haul Locomotives: Class II / III Operations | $PM_{10}$ | 0.272 |
| 2285002007 | Railroad Equipment;Diesel;Line Haul Locomotives: Class II / III Operations | $PM_{2.5}$ | 0.275 |
| 2285002007 | Railroad Equipment;Diesel;Line Haul Locomotives: Class II / III Operations | $SO_2$ | 0.001 |
| 2285002007 | Railroad Equipment;Diesel;Line Haul Locomotives: Class II / III Operations | VOC | 0.387 |
| 2285002008 | Railroad Equipment;Diesel;Line Haul Locomotives: Passenger Trains (Amtrak) | CO | 1.188 |
| 2285002008 | Railroad Equipment;Diesel;Line Haul Locomotives: Passenger Trains (Amtrak) | $NH_3$ | 1.627 |
| 2285002008 | Railroad Equipment;Diesel;Line Haul Locomotives: Passenger Trains (Amtrak) | $NO_X$ | 0.241 |
| 2285002008 | Railroad Equipment;Diesel;Line Haul Locomotives: Passenger Trains (Amtrak) | $PM_{10}$ | 0.148 |
| 2285002008 | Railroad Equipment;Diesel;Line Haul Locomotives: Passenger Trains (Amtrak) | $PM_{2.5}$ | 0.149 |
| 2285002008 | Railroad Equipment;Diesel;Line Haul Locomotives: Passenger Trains (Amtrak) | $SO_2$ | 0.005 |
| 2285002008 | Railroad Equipment;Diesel;Line Haul Locomotives: Passenger Trains (Amtrak) | VOC | 0.136 |
| 2285002009 | Railroad Equipment;Diesel;Line Haul Locomotives: Commuter Lines | CO | 1.172 |
| 2285002009 | Railroad Equipment;Diesel;Line Haul Locomotives: Commuter Lines | $NH_3$ | 1.627 |
| 2285002009 | Railroad Equipment;Diesel;Line Haul Locomotives: Commuter Lines | $NO_X$ | 0.237 |
| 2285002009 | Railroad Equipment;Diesel;Line Haul Locomotives: Commuter Lines | $PM_{10}$ | 0.146 |
| 2285002009 | Railroad Equipment;Diesel;Line Haul Locomotives: Commuter Lines | $PM_{2.5}$ | 0.146 |
| 2285002009 | Railroad Equipment;Diesel;Line Haul Locomotives: Commuter Lines | $SO_2$ | 0.005 |
| 2285002009 | Railroad Equipment;Diesel;Line Haul Locomotives: Commuter Lines | VOC | 0.134 |
| 2285002010 | Railroad Equipment;Diesel;Yard Locomotives | CO | 1.649 |
| 2285002010 | Railroad Equipment;Diesel;Yard Locomotives | $NH_3$ | 1.627 |
| 2285002010 | Railroad Equipment;Diesel;Yard Locomotives | $NO_X$ | 0.851 |
| 2285002010 | Railroad Equipment;Diesel;Yard Locomotives | $PM_{10}$ | 0.690 |
| 2285002010 | Railroad Equipment;Diesel;Yard Locomotives | $PM_{2.5}$ | 0.704 |
| 2285002010 | Railroad Equipment;Diesel;Yard Locomotives | $SO_2$ | 0.007 |
| 2285002010 | Railroad Equipment;Diesel;Yard Locomotives | VOC | 1.074 |

**Table 4-20.** Additional class 1 railroad and C1/C2 CMV emissions from RFS2 fuel volume changes

| Pollutant | 2030 Class 1 Rail (tons) | 2030 C1/C2 CMV (tons) |
|---|---|---|
| 1,3-Butadiene | 0.56 | 0.01 |
| Acrolein | 0.54 | 0.05 |
| Formaldehyde | 7.50 | 2.23 |
| Benzene | 0.45 | 0.30 |
| Acetaldehyde | 3.26 | 1.11 |
| CO | 1,906 | 272 |
| $NH_3$ | 5.99 | 0.95 |
| $NO_X$ | 4,298 | 642 |
| $PM_{10}$ | 86 | 21 |
| $PM_{2.5}$ | 83 | 20 |
| $SO_2$ | 4.51 | 5.99 |
| VOC | 173 | 15 |

The future-year locomotive emissions account for increased fuel consumption based on Energy Information Administration (EIA) fuel consumption projections for freight rail, and emissions reductions resulting from emissions standards from the Final Locomotive-Marine rule (EPA, 2009). This rule lowered diesel sulfur content and tightened emission standards for existing and new locomotives and marine diesel emissions to lower future-year PM, $SO_2$, and $NO_X$, and is documented at: http://www.epa.gov/otaq/regs/nonroad/420f08004.htm. Voluntary retrofits under the National Clean Diesel Campaign (http://www.epa.gov/otaq/diesel/index.htm) are not included in our projections.

We applied HAP factors for VOC HAPs by using the VOC projection factors to obtain 1,3-butadiene, acetaldehyde, acrolein, benzene, and formaldehyde.

Class 1 and 2 CMV gasoline emissions (SCC = 2280004000) were not changed for future-year processing. C1/C2 diesel emissions (SCC = 2280002100 and 2280002200) were projected based on the Final Locomotive Marine rule national-level factors provided in Table 4-19. Similar to locomotives, VOC HAPs were projected based on the VOC factor.

Delaware provided updated future-year $NO_X$, $SO_2$, and PM emission estimates for C1/C2 CMV as part of the Transport Rule comments. These updated emissions were applied to the 2030 inventory and override the C1/C2 projection factors in Table 4-19.

### 4.4.3 Class 3 commercial marine vessels (seca_c3)

The seca_c3 sector emissions data were provided by OTAQ in an ASCII raster format used since the $SO_2$ Emissions Control Area-International Marine Organization (ECA-IMO) project began in 2005. The (S)ECA Category 3 (C3) commercial marine vessel 2002 base-case emissions were projected to year 2005 for the 2005 base case and to 2030, which includes ECA-IMO controls. An overview of the ECA-IMO project 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/420f09015.htm

The resulting 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 Emission Control Areas is at: http://www.epa.gov/oms/oceanvessels.htm

These projection factors vary depending on geographic region and pollutant; where VOC HAPs are assigned the same growth rates as VOC. The projection factors used to create the 2030 seca_c3 sector emissions are provided in Table 4-21. Note that these factors are relative to 2002. Factors relative to 2005 can be computed from the 2002-2005 factors.

The geographic regions are described in the ECA Proposal technical support document: http://www.epa.gov/oms/regs/nonroad/marine/ci/420r09007-chap2.pdf. These regions extend up to 200 nautical miles offshore, though less at international boundaries. North and South Pacific regions are divided by the Oregon-Washington border, and East Coast and Gulf Coast regions are divided east-west by roughly the upper Florida Keys just southwest of Miami.

The factors to compute HAP emission are based on emissions ratios discussed in the 2005v4 documentation (ftp://ftp.epa.gov/EmisInventory/2005v4/2005_emissions_tsd_07jul2010.pdf). As with the 2005 base case, this sector uses CAP-HAP VOC integration.

**Table 4-21.** $NO_X$, $SO_2$, $PM_{2.5}$ and VOC factors to project class 3 CMV emissions for 2030

| **Region** | **$NO_X$** | **$SO_2$** | **$PM_{2.5}$** | **VOC** |
|---|---|---|---|---|
| Alaska East | 1.702 | 0.095 | 0.312 | 2.487 |
| Alaska West (AW) | 2.052 | 0.456 | 0.571 | 2.396 |
| East Coast | 1.072 | 0.123 | 0.47 | 3.464 |
| Gulf Coast | 0.688 | 0.079 | 0.303 | 2.217 |
| Hawaii East (HE) | 1.416 | 0.147 | 0.506 | 3.839 |
| Hawaii West (HW) | 2.783 | 0.733 | 0.871 | 3.842 |
| North Pacific (NP) | 0.874 | 0.098 | 0.348 | 2.528 |
| South Pacific (SP) | 1.232 | 0.166 | 0.589 | 4.225 |
| Great Lakes (GL) | 1.09 | 0.057 | 0.214 | 1.621 |
| Outside ECA | 2.427 | 0.623 | 0.745 | 3.417 |

### *4.5 Canada, Mexico, and Offshore sources (othar, othon, and othpt)*

Emissions for Canada, Mexico, and offshore sources were not projected to future years, and are therefore the same as those used in the 2005 base case. Therefore, the Mexico emissions are based on year 1999, offshore oil is based on year 2005, and Canada is based on year 2006. For both Mexico and Canada, their responsible agencies did not provide future-year emissions that were consistent with the base year emissions.

# 5 2030 Control Case

The LDGHG control case represents the future with implementation of new LDGHG standards. Similar to the 2030 base case discussed in Section 4, the control case also includes MSAT2 and HDGHG.
This section will address only those components that are different between the reference and control scenarios. VOC speciation is identical in the control and the reference cases as discussed in Section 3.

### *5.1 2030 Control Case Point and Nonpoint sources*

The point sources for the 2030 LDGHG Control Case include the same emissions as the 2030 Reference Case for the sources from Mexico, Canada, and the Gulf of Mexico (othpt). The nonpoint sources for the

2030 LDGHG Control Case include the same emissions as the 2030 Reference Case for the following nonpoint source emissions modeling sectors: area fugitive dust (afdust), agricultural ammonia (ag), average-year fires (avefire) and sources from Mexico and Canada (othar).

The LDGHG year 2030 control case includes changes to the EGU emissions (ptipm). IPM version 4.10 was run to simulate additional electricity demand from electric vehicles as detailed in the Regulatory Impact Analysis for this rule. Additional pollutant-specific adjustment factors were applied to the ptipm results to reflect the reduction in EGU emissions due to a decrease in petroleum refinery production. These adjustments are provided in Table 5-1. Table 5-2 provides total air quality inventory impacts on electrical power plants from electric and electric plug-in vehicles as well as reductions in production of electricity for refinery use.

**Table 5-1.** Adjustments to IPM Emissions to Account for Reduced Refinery Demand

| **Pollutant** | **Adjustment Factor** |
|---|---|
| CO | 0.99912 |
| NOx | 0.99892 |
| $PM_{10}$ | 0.99660 |
| $PM_{2.5}$ | 0.99871 |
| $SO_2$ | 0.99884 |
| VOC | 0.99513 |

**Table 5-2.** Total Air Quality Inventory Impacts on ptipm (Electric Power Plants from Electric and Electric Plug-in Vehicles, and Reductions in Production of Electricity for Refinery Use).

| **Pollutant** | **Tons** | **Percent of Total Ptipm Inventory** |
|---|---|---|
| $PM_{2.5}$ | --136 | 0.06 |
| $PM_{10}$ | -923 | 0.31 |
| $NO_X$ | 459 | 0.02 |
| VOC | -7 | 0.01 |
| CO | 7618 | 0.72 |
| $SO_X$ | 3131 | 0.15 |
| $NH_3$ | 541 | 1.10 |
| Acetaldehyde | 0 | 0.49 |
| Acrolein | 0 | 0 |
| Benzene | -12 | 0.24 |
| 1,3-Butadiene | 0 | 0 |
| Formaldehyde | 112 | 1.25 |

The control case also includes inventory adjustments to the following upstream processes: domestic crude production and transport losses during transport to refineries, petroleum production and refining emissions, production of energy for refinery use, combustion emissions from transport of refinery products, and gasoline transport, storage and distribution losses.[3]

[3] These upstream adjustments were supplied by OTAQ in the Excel® workbook "upstream scalars LD GHG_ram_RC.xlsx" with additional adjustments on 6/13/2012 in the workbook "Upstream_Scalars_Rerun_v6.xlsx".

To adjust inventories for domestic crude production and transport, we assumed 50% of the change in gasoline and diesel supply would come from domestic refineries, and (b) 10% of the change in crude being used by domestic refineries would be domestic crude. Using the assumption that 1.0 gallon less of gasoline equates to approximately 1.0 gallon less crude throughput, the reduction in crude extraction and transport from this rule would equal about 5% of the change in gasoline volume. Since the reduction in fuel consumption is estimated at 31.6 billion gallons for this rule, the reduction in crude production is about 1.58 billion gallons for this rule. To generate the emission inventory adjustment factors for air quality modeling these reductions were applied to the projected crude supply of 230 billion gallons to US refineries in 2030, per AEO 2011.[i] Thus, the adjustment is 0.68%. In addition, petroleum refinery emissions were reduced by 21% to account for lower gasoline production resulting from the rule.

Decreased petroleum refinery output also resulted in reduced emissions from energy feedstock production. Table 5-3 presents adjustment factors for emissions associated with residual oil production, natural gas production and coal, due to decreased petroleum refinery production. Methods used to develop these adjustments are described in the Regulatory Impact Analysis.

**Table 5-3.** Upstream Refinery Emission Impacts in Tons and Inventory Scalars

| | **Residual Oil Production** | | **Natural Gas Production** | | **Coal Production** | |
|---|---|---|---|---|---|---|
| **Pollutant** | **Impact** | **Scalar** | **Impact** | **Scalar** | **Impact** | **Scalar** |
| VOC | -51 | 0.9992 | -474 | 0.9883 | -270 | 0.9026 |
| CO | -93 | 0.9990 | -676 | 0.9758 | -97 | 0.9817 |
| $NO_x$ | -351 | 0.9943 | -2010 | 0.9583 | -551 | 0.9136 |
| $PM_{10}$ | -36 | 0.9997 | -51 | 0.9199 | -6366 | 0.7195 |
| $PM_{2.5}$ | -17 | 0.9990 | -39 | 0.9353 | -1584 | 0.7874 |
| $SO_x$ | -179 | 0.9913 | -1168 | 0.9753 | -325 | 0.8947 |

Decreased gasoline production also results in lower emissions of VOC and benzene produced by storage and transfer activities associated with distribution of gasoline. Emissions from these storage and transfer activities were partitioned into a refinery to bulk terminal component (RBT), a bulk plant storage (BPS) component, and a bulk terminal to gasoline dispensing pump (BTP) component (see Appendix C for SCCs). One set of scalars was applied to RBT/BPS emissions and another to BTP emissions. These scalars are provided in Table 5-4. The scalars for BTP emissions reflect the change in total gasoline plus ethanol volume in gasoline and gasoline/ethanol blends. However, it does not account for changes in gasoline/ethanol blends used. Impacts were assumed to be spread evenly across the U. S. Methods used to develop these scalars are described in the Regulatory Impact Analysis.

**Table 5-4.** Scalars Applied to Base Inventory (2005 Platform with RFS2 Impacts) to Obtain Reference and Control Case Gasoline Storage, Transport and Distribution Emissions

| **Process** | **Reference Case (Impacts of Medium- and Heavy-Duty Greenhouse Gas Rule)** | **Control Case (Impacts of Medium- and Heavy-Duty Greenhouse Gas Rule Plus this Rule)** |
|---|---|---|
| Refinery to Bulk Terminal/ Bulk Plant Storage | 0.9972 | 0.7944 |
| Bulk Terminal to Pump | 0.9976 | 0.8234 |

Finally, in addition to non-combustion emissions associated with storage, transport and distribution, there are combustion emissions associated with transport of gasoline by pipeline, commercial marine vessel, rail, and tanker truck. Estimates of emission impacts by transport model were developed using methods detailed in the Regulatory Impact Analysis for this rule and applied to total emissions from transport sources to develop scaling factors. Emission inventory and inventory scalars for pipelines (pumps and other equipment) are given in Table 5-5. Impacts for mobile sources are discussed in the next section.

**Table 5-5.** Gasoline Transport Pipeline Emission Impacts in Tons and Inventory Scalars

| Pollutant | Impact | Scalar |
|---|---|---|
| VOC | -287 | 0.9959 |
| CO | -1447 | 0.9864 |
| $NO_x$ | -6137 | 0.9192 |
| $PM_{10}$ | -241 | 0.9895 |
| $PM_{2.5}$ | -130 | 0.9932 |
| $SO_x$ | -1292 | 0.9890 |

Total air quality inventory impacts for the ptnonipm and nonpt sources described above are provided in Table 5-6.

**Table 5-6.** Total Air Quality Inventory Impacts on Ptnonipm and Nonpt Inventory

| Pollutant | Tons | Percent of Total Ptnonipm and Nonpt Inventory |
|---|---|---|
| $PM_{2.5}$ | -3,578 | 0.26 |
| $PM_{10}$ | -8,412 | 0.45 |
| $NO_X$ | -15,538 | 0.40 |
| VOC | -149,193 | 1.76 |
| CO | -13,004 | 0.13 |
| $SO_2$ | -14,714 | 0.55 |
| $NH_3$ | 0 | 0 |
| Acetaldehyde | -5 | 0.01 |
| Acrolein | 0 | 0 |
| Benzene | -1499 | 1.42 |
| 1,3-Butadiene | -2 | 0.04 |
| Formaldehyde | -687 | 0.19 |

## 5.2 2030 Control Case Mobile sources

The onroad mobile and nonroad mobile sources for the 2030 LDGHG Control Case include the same emissions as the 2030 Reference Case for the following emissions modeling sectors: US nonroad mobile (nonroad), C3 commercial marine (seca_c3), Canada and Mexico onroad mobile emissions (othon) and Canada and Mexico nonroad emissions (also in the othar sector with Canada and Mexico stationary sources).

The LDGHG year 2030 control case changes to the mobile sectors are limited to US locomotives and non-C3 commercial marine (alm_no_c3), the MOVES2010a-based onroad non-California (except $NH_3$) inventories (on_moves_runpm, on_moves_startpm and on_noadj sectors), and the California onroad mobile emissions.

The 2030 control case for onroad (MOVES and California based) includes a rebound effect (increased VMT due to improved fuel efficiency), and a decrease in $SO_2$ and $SO_4$ emissions due to decrease fuel usage. An adjustment factor accounting for rebound impact was calculated by running MOVES2010a at the national level with output by model year. Model-year specific rebound-related VMT changes were applied, and emissions were summed across model years and divided by the original emissions to develop pollutant-specific adjustment factor for the the exhaust, tire wear, and brake wear modes. Similarly, the SO2 and SO4 reductions were calculated by applying appropriate reductions to national emissions by model year and using these reductions to compute SCC-specific reduction ratios. These adjustment factors were applied to the 2030 reference onroad inventories (on_moves_runpm, on_moves_startpm, and on_noadj including CA). These updated inventories were then processed through SMOKE in the same manner as the reference and base cases.

The control case also includes Annual Energy Outlook (AEO) year2010-based upstream adjustments: refinery supply estimates and estimated reductions in consumption that impact the transport/distribution fuel via rail, marine vessels (c1 and c2), and heavy and medium duty trucks.[4] These adjustments impact the alm_no_c3 and onroad sectors from the 2030 reference case.

[4] These upstream adjustments to alm_no_c3 due to decreased petroleum refinery production were supplied by OTAQ on 6/13/2012 in the workbook “Upstream_Scalars_Rerun_v7.xlsx”. The adjustment to onroad including rebound, SO2/SO4 reductions, and refinery upstream impacts on medium and heavy duty truck were provide by OTAQ on 6/8/2012 in “LDGHGctl2030_adj_080612.csv”

# 6 References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# APPENDIX A

**Modified LDGHG Equations to adapt pre-speciated diesel emissions from MOVES to air quality modeling species needed for CMAQ**

As shown in equation (1) below, MOVES provides total $PM_{2.5}$, PEC and PSO4. A remainder term, *R*, makes up the difference between the two species and the total $PM_{2.5}$.

$$\text{MOVES total PM}_{2.5} = \text{PEC} + \text{PSO4} + R \tag{1}$$

The *R* term includes POM, which consists of POC and the hydrogen and oxygen atoms attached to the carbon as part of the organic matter, PNO3, soil oxides and metals (also known as “crustal” and called METAL here), ammonium, and water, and thus can be also written as:

$$R = \text{POM} + \text{PNO3} + \text{METAL} + \text{NH4} + \text{H}_2\text{0} \tag{2}$$

To correctly calculate the five $PM_{2.5}$ species needed for CMAQ, we first needed to break out the POC, PNO3, and PMFINE from *R*. Different calculations are used for light-duty diesel vehicles and heavy-duty diesel vehicles, since the speciation profiles for these are different. The speciation profiles used for these calculations are:

For both light duty diesel vehicles and heavy duty diesel vehicles, the SPECIATE 4.0 PM2.5 speciation profiles “3914” (HHDV) and “92042” (LDDV) will be used to help calculate the other species. At the time, OTAQ did not provide a justification for choosing this profile, but the fractions of metals and PNO3 are small and so presumably the choice does not matter too much as long as the smallest of those fractions is representative.

We computed the primary nitrate based on speciation profile 92011 from the SPECIATE4.1 database (Hsu et al., 2006) using equation (3) shown below.

$$\text{PNO3} = \text{PEC} \times F_{NO3} / F_{EC} \tag{3}$$

where,

$F_{EC}$ = Fraction of elemental carbon in speciation profile:
- LDDV: 57.4805% (based on profile 92042)[5]
- HDDV: 77.1241% (based on profile 3914)

$F_{NO3}$ = Fraction of nitrate in speciation profile
- LDDV: 0.1141% (based on profile 3914, intentionally inconsistent)
- HDDV: 0.1141% (based on profile 3914)

To identify which sources should get the LDDV and which should get the HDDV approach, see Table 1, below.

Since CMAQ’s PMFINE species is the sum of soil oxides, metals, ammonium, and water, we needed to calculate all of its components. First, the metals and ammonium are computed using equations (4) and (5). Equation (5) is based on stoichiometric calculations.

[5] All profile fractions provided in email from Catherine Yanca on 11/6/2009, 1:49pm in attachment “Equations for diesel MOVES speciation use in CMAQ 110609.doc”

$$\text{METAL} = \text{PEC} \times F_{metal} / F_{EC} \quad (4)$$

$$\text{NH4} = (\text{PNO3}/MW_{NO3} + 2 \times \text{PSO4}/MW_{SO4}) \times MW_{NH4} \quad (5)$$

where,

$F_{metal}$ = Fraction of metals in speciation profile (0.002663[6])
$MW_{SO4}$ = Molecular weight of sulfate (96.0576)
$MW_{NO3}$ = Molecular weight of nitrate (62.0049)
$MW_{NH4}$ = Molecular weight of ammonium (18.0383)

The final component of PMFINE is the non-carbon mass of organic carbon. To calculate the non-carbon mass, we first needed to compute organic carbon from the remainder term, *R*.

A key assumption is that POM is a factor of 1.2 greater than the mass of primary organic carbon, which is also used in the CMAQ postprocessing software at EPA.

$$\text{POM} = 1.2 \times \text{POC} \quad (6)$$

Using this assumption and assuming that the $H_20$ is negligible, the equation needed for the calculation of POC is shown in equations 7a and 7b for gasoline exhaust and diesel exhaust, respectively. As discussed in Section 2.3, for LDGHG, the NH4 component was removed for diesel exhaust only.

Gasoline Exhaust: $$\text{POC} = 5/6 \times (R - \text{METAL} - \text{NH4} - \text{PNO3}) \quad (7a)$$
Diesel Exhaust: $$\text{POC} = 5/6 \times (R - \text{METAL} - \text{PNO3}) \quad (7b)$$

See Appendix B of the 2005v4 TSD for more complete discussion on PM speciation for gasoline exhaust processes: ftp://ftp.epa.gov/EmisInventory/2005v4/2005_emissions_tsd_appendices_11may2010.pdf.

From equation (6), the non-carbon portion of the organic carbon matter is 20%, of the POC. By definition, PMFINE is the sum of the non-carbon portion of the mass, METAL and NH4. Thus, we computed PMFINE_72 using equations (8a and 8b) shown below for gasoline and diesel exhaust.

Gasoline Exhaust: $$\text{PMFINE\_72} = \text{METAL} + \text{NH4} + 0.2 \times \text{POC\_72} \quad (8a)$$
Diesel Exhaust: $$\text{PMFINE\_72} = \text{METAL} + 0.2 \times \text{POC\_72} \quad (8b)$$

Equations 7a and 8a (with NH4) will be obsolete in all subsequent MOVES post-processing; we did not have time to reprocess the gasoline exhaust emissions for LDGHG; however, the computed NH4 component in gasoline exhaust was much smaller than for diesel exhaust so this impact should be negligible.

For mobile sources, we assumed that PMC is 8.6% of the $PM_{2.5}$ mass. Equation (9) shows how we calculated it.

$$\text{PMC} = 0.086 \times (\text{PMFINE} + \text{PEC} + \text{POC} + \text{PSO4} + \text{PNO3}) \quad (9)$$

**Table A-1.** List of SCC groups for application of LDDV or HDDV approach

| **Approach** | **SCC list** |
|---|---|
| LDDV | 2230001000 through 2230060334 |
| HDDV | 2230071110 through 2230075330 |

[6] Value provided by Catherine Yanca and Joe Somers to OAQPS in email provided 11/5/2009

# APPENDIX B

**Summary of LDGHG Rule 2030 Reference Case Non-EGU Control Programs, Closures and Projections**

Lists of control, closure, projection packet datasets used to create LDGHG year 2030 Reference case inventories from the 2005 LDGHG base case are provided in Tables B-1 and B-2.

**Table B-1. Datasets used to Create LDGHG 2030 Inventories for Non-EGU Point Sources**

| Name | Type | Dataset | Version | Description |
|---|---|---|---|---|
| CLOSURES LotusNotes, ABCG, plus Timin 2016cr | Plant Closure | CLOSURES_LotusNotes_Linda_Timin_2016cr_23AUG2010 | 1 | Plant and unit closures identified through EPA review. |
| CLOSURES TR1 comments and consent decrees 2014cs | Plant Closure | CLOSURES_TR1_2014cs_01FEB2011 | 0 | Plant and unit closures through 2014 identified as a result of Transport Rule comments. |
| CLOSURES cement ISIS 2013 policy | Plant Closure | CLOSURES_cementISIS_2016cr_17AUG2010 | 1 | Cement plant and unit closures identified via the ISIS 2013 policy case. |
| closures: 2005 to 2012ck | Plant Closure | CLOSURES_2005ck_to_2012ck_CoST_format | 0 | Plant and unit closures identified 2008 or before. |
| CONTROL ADDITIONAL OECA 2005cr to 2016cr | Control | CONTROLS_additional_NEIpf4_OECA_2005cr_2016cr_29JUL2010 | 1 | Controls that implement OECA consent decrees. |
| CONTROL REPLACE DOJ 2005cr to 2016cr | Control | CONTROLS_replacement_NEIpf4_DOJ_2005cr_2016cr_02AUG2010.txt | 0 | Controls resulting from the 2002v3 DOJ Texas settlement. |
| CONTROL REPLACE HWI 2005cr to 2016cr | Control | CONTROLS_replacement_NEIpf4_HWI_2005cr_2016cr_02AUG2010.txt | 1 | Hazardous Waste Incinerator controls for CAPs and Haps carried over from 2002v31. |
| CONTROL REPLACE IndustrialBoiler nonMACT 2005cr to 2016cr | Control | CONTROLS_replacement_IndBoilers_nonMACT_by2008_20AUG2010 | 0 | Industrial boiler controls not related to application of the MACT but derived from the Boiler MACT ICR database dated 4/30/10. |
| CONTROL REPLACE LMWC 2005cr to 2016cr | Control | CONTROLS_replacement_NEIpf4_LMWC_2005cr_2016cr_02AUG2010.txt | 0 | Controls for large municipal combustors carried over from 2002v31. |
| CONTROL REPLACE MACT 2005cr to 2016cr | Control | CONTROLS_replacement_NEIpf4_MACT_2005cr_2016cr_02AUG2010.txt | 0 | MACT controls carried over from 2002v3 and updated as appropriate. |
| CONTROL REPLACE NY SIP 2005cr to 2016cr | Control | CONTROLS_replacement_NYSIP_O3_SCC_2016cr_26AUG2010 | 0 | Controls that reflect enforceable controls for NOx and VOC from the New York ozone SIP. |
| CONTROL REPLACE Refineries 2005cr to 2016cr | Control | CONTROLS_replacement_NEIpf4_refineries_2005cr_2016cr_02AUG2010.txt | 0 | Controls for refineries specified by EPA expert refinery staff. |
| CONTROL RICE 2016cr_05b | Control | CONTROLS_replacement_RICE_2016cr_21SEP2010 | 1 | Controls for 2014 and 2016 that represent three separate RICE NESHAPs |
| CONTROL RICE SO2 2014cs_05b | Control | CONTROLS_replacement_RICE_SO2_2014cs_05JAN2011 | 1 | SO2 reductions from the Ultra-low Sulfur Diesel requirement for CI engines |
| CONTROL SULF rules: ME, NY, NJ 2018 and beyond | Control | CONTROLS_SULF_rules_2018_and_beyond_03FEB2011 | 1 | SO2 reductions due to state sulfur content rules for fuel oil. |
| CONTROL St Gobain and LaFarge 2017 | Control | CONTROLS_rep_Lafarge_StGobain_2017cs_25JAN2011.txt | 0 | Controls for NOx, SO2, PM., and HCl resulting from Saint Gobain and Lafarge consent decrees |
| CONTROL TR1 Final CONTROL packet: 2021 | Control | CONTROLS_TR1_2021_09FEB2011 | 1 | Controls for TCEQ oil and gas and non-ISIS related cement controls. |
| CONTROL TR1 Final consent decrees 2019 | Control | CONTROLS_additional_TR1final_consent_decrees_2005cs_to_2019cs | 1 | Controls related to consent decrees identified during the Transport Rule comment period. |

| | | | | |
|---|---|---|---|---|
| CONTROL cement ISIS 2013 policy | Control | CONTROLS_replacement_cementISIS_2016cr_17AUG2010 | 0 | Controls for cement plants based on 2013 ISIS policy case |
| PROJECTION 2005 to 2030 ag emissions | Projection | PROJECTION_2005cs_2030_ag_09FEB2011 | 0 | Projection factors for agriculture based on animal population stats. |
| PROJECTION LMWC 2005cr to 2016cr | Projection | PROJECTION_2005cr_2016cr_LMWC_29JUL2010 | 0 | Projection factors for Solid and Liquid Municipal Waste Combustors. |
| PROJECTION TR1 comments 2005cs to 20XXcs -ptnonipm | Projection | PROJECTION_2005cs_20XX_TR1_ptnonipm_01FEB2011 | 0 | Projection factors derived from Transport Rule comments. |
| PROJECTION aircraft 2005cs to 2030 JAN2010 FAATAF | Projection | PROJECTION_2005cs_2030_aircraft_JAN2010_based_FAATAF_10FEB2011 | 0 | Projection factors for aircraft derived from the FAA Terminal Area Forecast System. |
| PROJECTION cement ISIS 2013 policy | Projection | PROJECTION_cementISIS_2016cr_17AUG2010 | 0 | Projection factors that implement the 2013 ISIS policy case for cement. |
| PROJECTION refueling 2005cs to 2030cs_LDGHG_ref | Projection | PROJECTION_2005cs_2030cs_LDGHG_ref_onroad_refueling_04FEB2011 | 0 | Projection factors for gasoline stage 2 refueling. |

**Table B-2. Datasets used to Create LDGHG 2030 Inventories for Nonpoint Sources**

| Control Program Name | Type | Dataset | Version | Description |
|---|---|---|---|---|
| CONTROL REPLACE NY SIP 2005cr to 2016cr | Control | CONTROLS_replacement_NYSIP_O3_SCC_2016cr_26AUG2010 | 0 | Controls that reflect enforceable controls for NOx and VOC from the New York ozone SIP. |
| CONTROL RICE 2016cr_05b | Control | CONTROLS_replacement_RICE_2016cr_21SEP2010 | 1 | Controls for 2014 and 2016 that represent three separate RICE NESHAPs |
| CONTROL RICE SO2 2014cs_05b | Control | CONTROLS_replacement_RICE_SO2_2014cs_05JAN2011 | 0 | SO2 reductions from the Ultra-low Sulfur Diesel requirement for CI engines |
| CONTROL SULF rules: ME, NY, NJ 2018 and beyond | Control | CONTROLS_SULF_rules_2018_and_beyond_03FEB2011 | 0 | SO2 reductions due to state sulfur content rules for fuel oil. |
| CONTROL TR1 Final CONTROL packet: 2021 | Control | CONTROLS_TR1_2021_09FEB2011 | 0 | Controls for TCEQ oil and gas and non-ISIS related cement controls. |
| PROJECTION 2005 to 2030 ag sector | Projection | PROJECTION_2005cs_2030_ag_09FEB2011 | 0 | Projection factors for agriculture based on animal population stats. |
| PROJECTION RWC and landfills 2005 to 2030 | Projection | PROJECTION_2005cs_2030cs_RWC_landfills_08FEB2011 | 0 | Projection factors for residential wood combustion and landfills. |
| PROJECTION refueling 2005cs to 2030cs_LDGHG_ref | Projection | PROJECTION_2005cs_2030cs_LDGHG_ref_onroad_refueling_04FEB2011 | 0 | Projection factors for gasoline stage 2 refueling. |

# Appendix C

## Fuel distribution SCCs in nonpt and ptnonipm

Cross-walk between SCC and portable fuel containers (PFC), bulk plant storage (BPS), refinery to bulk terminal (RBT) and bulk terminal to pump (BTP).

| scc | SCC description | Code |
|---|---|---|
| 40600100 | Petroleum and Solvent Evaporation;Transportation and Marketing of Petroleum Products;Tank Cars and Trucks;undefined | BTP |
| 40400100 | Petroleum and Solvent Evaporation;Petroleum Liquids Storage (non-Refinery);Bulk Terminals;undefined | RBT |
| 40400173 | Petroleum and Solvent Evaporation;Petroleum Liquids Storage (non-Refinery);Bulk Terminals;Gasoline RVP 7: Standing Loss - Int. Floating Roof w/ Secondary Seal | RBT |
| 2501060052 | Storage and Transport;Petroleum and Petroleum Product Storage;Gasoline Service Stations;Stage 1: Splash Filling | BTP |
| 2501060100 | Storage and Transport;Petroleum and Petroleum Product Storage;Gasoline Service Stations;Stage 2: Total | BTP |
| 2501050120 | Storage and Transport;Petroleum and Petroleum Product Storage;Bulk Terminals: All Evaporative Losses;Gasoline | RBT |
| 2501011011 | Storage and Transport;Petroleum and Petroleum Product Storage;Residential Portable Gas Cans;Permeation | PFC |
| 2505040120 | Storage and Transport;Petroleum and Petroleum Product Transport;Pipeline;Gasoline | RBT |
| 2501060201 | Storage and Transport;Petroleum and Petroleum Product Storage;Gasoline Service Stations;Underground Tank: Breathing and Emptying | BTP |
| 2501011012 | Storage and Transport;Petroleum and Petroleum Product Storage;Residential Portable Gas Cans;Evaporation (includes Diurnal losses) | PFC |
| 2501055120 | Storage and Transport;Petroleum and Petroleum Product Storage;Bulk Plants: All Evaporative Losses;Gasoline | BPS |
| 2501060053 | Storage and Transport;Petroleum and Petroleum Product Storage;Gasoline Service Stations;Stage 1: Balanced Submerged Filling | BTP |
| 2501060051 | Storage and Transport;Petroleum and Petroleum Product Storage;Gasoline Service Stations;Stage 1: Submerged Filling | BTP |
| 2501011013 | Storage and Transport;Petroleum and Petroleum Product Storage;Residential Portable Gas Cans;Spillage During Transport | PFC |
| 2505020120 | Storage and Transport;Petroleum and Petroleum Product Transport;Marine Vessel;Gasoline | RBT |
| 2501011014 | Storage and Transport;Petroleum and Petroleum Product Storage;Residential Portable Gas Cans;Refilling at the Pump - Vapor Displacement | PFC |
| 40600401 | Petroleum and Solvent Evaporation;Transportation and Marketing of Petroleum Products;Filling Vehicle Gas Tanks - Stage II;Vapor Loss w/o Controls | BTP |
| 2501011015 | Storage and Transport;Petroleum and Petroleum Product Storage;Residential Portable Gas Cans;Refilling at the Pump - Spillage | PFC |
| 2505000120 | Storage and Transport;Petroleum and Petroleum Product Transport;All Transport Types;Gasoline | RBT |
| 2501012011 | Storage and Transport;Petroleum and Petroleum Product Storage;Commercial Portable Gas Cans;Permeation | PFC |
| 2505030120 | Storage and Transport;Petroleum and Petroleum Product Transport;Truck;Gasoline | BTP |
| 40600131 | Petroleum and Solvent Evaporation;Transportation and Marketing of Petroleum Products;Tank Cars and Trucks;Gasoline: Submerged Loading (Normal Service) | BTP |
| 40400250 | Petroleum and Solvent Evaporation;Petroleum Liquids Storage (non-Refinery);Bulk Plants;Loading Racks | BPS |
| 2501012012 | Storage and Transport;Petroleum and Petroleum Product Storage;Commercial Portable Gas Cans;Evaporation (includes Diurnal losses) | PFC |

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| 40600141 | Petroleum and Solvent Evaporation;Transportation and Marketing of Petroleum Products;Tank Cars and Trucks;Gasoline: Submerged Loading (Balanced Service) | BTP |
| 2660000000 | Waste Disposal, Treatment, and Recovery;Leaking Underground Storage Tanks;Leaking Underground Storage Tanks;Total: All Storage Types | BTP |
| 2501012013 | Storage and Transport;Petroleum and Petroleum Product Storage;Commercial Portable Gas Cans;Spillage During Transport | PFC |
| 40600136 | Petroleum and Solvent Evaporation;Transportation and Marketing of Petroleum Products;Tank Cars and Trucks;Gasoline: Splash Loading (Normal Service) | BTP |
| 40600403 | Petroleum and Solvent Evaporation;Transportation and Marketing of Petroleum Products;Filling Vehicle Gas Tanks - Stage II;Vapor Loss w/o Controls | BTP |
| 40400111 | Petroleum and Solvent Evaporation;Petroleum Liquids Storage (non-Refinery);Bulk Terminals;Gasoline RVP 10: Standing Loss (67000 Bbl Capacity)-Floating Roof Tank | RBT |
| 40301151 | Petroleum and Solvent Evaporation;Petroleum Product Storage at Refineries;Floating Roof Tanks (Varying Sizes);Gasoline: Standing Loss - Internal | RBT |
| 40400150 | Petroleum and Solvent Evaporation;Petroleum Liquids Storage (non-Refinery);Bulk Terminals;Miscellaneous Losses/Leaks: Loading Racks | RBT |
| 40400153 | Petroleum and Solvent Evaporation;Petroleum Liquids Storage (non-Refinery);Bulk Terminals;Vapor Control Unit Losses | RBT |
| 40600238 | Petroleum and Solvent Evaporation;Transportation and Marketing of Petroleum Products;Marine Vessels;Gasoline: Barges Loading - Uncleaned Tanks | RBT |
| 40400179 | Petroleum and Solvent Evaporation;Petroleum Liquids Storage (non-Refinery);Bulk Terminals;Specify Liquid: Internal Floating Roof (Primary/Secondary Seal) | RBT |
| 40400116 | Petroleum and Solvent Evaporation;Petroleum Liquids Storage (non-Refinery);Bulk Terminals;Gasoline RVP 13/10/7: Withdrawal Loss (67000 Bbl Cap.) - Float Rf Tnk | RBT |
| 40400199 | Petroleum and Solvent Evaporation;Petroleum Liquids Storage (non-Refinery);Bulk Terminals;See Comment ** | RBT |
| 40400151 | Petroleum and Solvent Evaporation;Petroleum Liquids Storage (non-Refinery);Bulk Terminals;Valves, Flanges, and Pumps | RBT |
| 40600307 | Petroleum and Solvent Evaporation;Transportation and Marketing of Petroleum Products;Gasoline Retail Operations - Stage I;Underground Tank Breathing and Emptying | BTP |
| 40400160 | Petroleum and Solvent Evaporation;Petroleum Liquids Storage (non-Refinery);Bulk Terminals;Specify Liquid: Standing Loss - Internal Floating Roof w/ Primary Seal | RBT |
| 40301001 | Petroleum and Solvent Evaporation;Petroleum Product Storage at Refineries;Fixed Roof Tanks (Varying Sizes);Gasoline RVP 13: Breathing Loss (67000 Bbl. Tank Size) | RBT |
| 40400148 | Petroleum and Solvent Evaporation;Petroleum Liquids Storage (non-Refinery);Bulk Terminals;Gasoline RVP 13/10/7: Withdrawal Loss - Ext. Float Roof (Pri/Sec Seal) | RBT |
| 40301102 | Petroleum and Solvent Evaporation;Petroleum Product Storage at Refineries;Floating Roof Tanks (Varying Sizes);Gasoline RVP 10: Standing Loss (67000 Bbl. Tank Size) | RBT |
| 40301103 | Petroleum and Solvent Evaporation;Petroleum Product Storage at Refineries;Floating Roof Tanks (Varying Sizes);Gasoline RVP 7: Standing Loss (67000 Bbl. Tank Size) | RBT |
| 40688801 | Petroleum and Solvent Evaporation;Transportation and Marketing of Petroleum Products;Fugitive Emissions;Specify in Comments Field | BTP |
| 2501012014 | Storage and Transport;Petroleum and Petroleum Product Storage;Commercial Portable Gas Cans;Refilling at the Pump - Vapor Displacement | PFC |
| 40600306 | Petroleum and Solvent Evaporation;Transportation and Marketing of Petroleum Products;Gasoline Retail Operations - Stage I;Balanced Submerged Filling | BTP |
| 40600240 | Petroleum and Solvent Evaporation;Transportation and Marketing of Petroleum Products;Marine Vessels;Gasoline: Barge Loading - Average Tank Condition | RBT |
| 40600501 | Petroleum and Solvent Evaporation;Transportation and Marketing of Petroleum Products;Pipeline Petroleum Transport - General - All Products;Pipeline Leaks | RBT |
| 40600236 | Petroleum and Solvent Evaporation;Transportation and Marketing of Petroleum Products;Marine Vessels;Gasoline: Ship Loading - Uncleaned Tanks | RBT |
| 40400178 | Petroleum and Solvent Evaporation;Petroleum Liquids Storage (non-Refinery);Bulk Terminals;Gasoline RVP 13/10/7: Withdrawal Loss - Int. Float Roof (Pri/Sec Seal) | RBT |
| 40400170 | Petroleum and Solvent Evaporation;Petroleum Liquids Storage (non-Refinery);Bulk Terminals;Specify Liquid: Standing Loss - Int. Floating Roof w/ Secondary Seal | RBT |
| 40600299 | Petroleum and Solvent Evaporation;Transportation and Marketing of Petroleum Products;Marine Vessels;Not Classified ** | RBT |
| 40400108 | Petroleum and Solvent Evaporation;Petroleum Liquids Storage (non-Refinery);Bulk Terminals;Gasoline RVP 10: Working Loss (Diameter Independent) - Fixed Roof Tank | RBT |
| 40600298 | Petroleum and Solvent Evaporation;Transportation and Marketing of Petroleum Products;Marine Vessels;Not Classified ** | RBT |
| 40300201 | Petroleum and Solvent Evaporation;Petroleum Product Storage at Refineries;Deleted - Do Not Use (See 4-03-011 and 4-07);Gasoline ** | RBT |

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| 40400152 | Petroleum and Solvent Evaporation;Petroleum Liquids Storage (non-Refinery);Bulk Terminals;Vapor Collection Losses | RBT |
| 40600163 | Petroleum and Solvent Evaporation;Transportation and Marketing of Petroleum Products;Tank Cars and Trucks;Gasoline: Return with Vapor (Transit Losses) | BTP |
| 40400110 | Petroleum and Solvent Evaporation;Petroleum Liquids Storage (non-Refinery);Bulk Terminals;Gasoline RVP 13: Standing Loss (67000 Bbl Capacity)-Floating Roof Tank | RBT |
| 40688802 | Petroleum and Solvent Evaporation;Transportation and Marketing of Petroleum Products;Fugitive Emissions;Specify in Comments Field | BTP |
| 2501012015 | Storage and Transport;Petroleum and Petroleum Product Storage;Commercial Portable Gas Cans;Refilling at the Pump - Spillage | PFC |
| 40600301 | Petroleum and Solvent Evaporation;Transportation and Marketing of Petroleum Products;Gasoline Retail Operations - Stage I;Splash Filling | BTP |
| 40400162 | Petroleum and Solvent Evaporation;Petroleum Liquids Storage (non-Refinery);Bulk Terminals;Gasoline RVP 10: Standing Loss - Int. Floating Roof w/ Primary Seal | RBT |
| 40400118 | Petroleum and Solvent Evaporation;Petroleum Liquids Storage (non-Refinery);Bulk Terminals;Gasoline RVP 13: Filling Loss (10500 Bbl Cap.) - Variable Vapor Space | RBT |
| 40600232 | Petroleum and Solvent Evaporation;Transportation and Marketing of Petroleum Products;Marine Vessels;Gasoline: Ocean Barges Loading | RBT |
| 40600197 | Petroleum and Solvent Evaporation;Transportation and Marketing of Petroleum Products;Tank Cars and Trucks;Not Classified ** | BTP |
| 40400113 | Petroleum and Solvent Evaporation;Petroleum Liquids Storage (non-Refinery);Bulk Terminals;Gasoline RVP 13: Standing Loss (250000 Bbl Cap.) - Floating Roof Tank | RBT |
| 40600302 | Petroleum and Solvent Evaporation;Transportation and Marketing of Petroleum Products;Gasoline Retail Operations - Stage I;Submerged Filling w/o Controls | BTP |
| 40400251 | Petroleum and Solvent Evaporation;Petroleum Liquids Storage (non-Refinery);Bulk Plants;Valves, Flanges, and Pumps | BPS |
| 40400161 | Petroleum and Solvent Evaporation;Petroleum Liquids Storage (non-Refinery);Bulk Terminals;Gasoline RVP 13: Standing Loss - Int. Floating Roof w/ Primary Seal | RBT |
| 40400130 | Petroleum and Solvent Evaporation;Petroleum Liquids Storage (non-Refinery);Bulk Terminals;Specify Liquid: Standing Loss - External Floating Roof w/ Primary Seal | RBT |
| 40400101 | Petroleum and Solvent Evaporation;Petroleum Liquids Storage (non-Refinery);Bulk Terminals;Gasoline RVP 13: Breathing Loss (67000 Bbl Capacity) - Fixed Roof Tank | RBT |
| 40600101 | Petroleum and Solvent Evaporation;Transportation and Marketing of Petroleum Products;Tank Cars and Trucks;Gasoline: Splash Loading ** | BTP |
| 40301101 | Petroleum and Solvent Evaporation;Petroleum Product Storage at Refineries;Floating Roof Tanks (Varying Sizes);Gasoline RVP 13: Standing Loss (67000 Bbl. Tank Size) | RBT |
| 40301007 | Petroleum and Solvent Evaporation;Petroleum Product Storage at Refineries;Fixed Roof Tanks (Varying Sizes);Gasoline RVP 13: Working Loss (Tank Diameter Independent) | RBT |
| 40400140 | Petroleum and Solvent Evaporation;Petroleum Liquids Storage (non-Refinery);Bulk Terminals;Specify Liquid: Standing Loss - Ext. Float Roof Tank w/ Second'y Seal | RBT |
| 40400149 | Petroleum and Solvent Evaporation;Petroleum Liquids Storage (non-Refinery);Bulk Terminals;Specify Liquid: External Floating Roof (Primary/Secondary Seal) | RBT |
| 40400210 | Petroleum and Solvent Evaporation;Petroleum Liquids Storage (non-Refinery);Bulk Plants;Gasoline RVP 13/10/7: Withdrawal Loss (67000 Bbl Cap.) - Float Rf Tnk | BPS |
| 40400279 | Petroleum and Solvent Evaporation;Petroleum Liquids Storage (non-Refinery);Bulk Plants;Specify Liquid: Internal Floating Roof (Primary/Secondary Seal) | BPS |
| 40400171 | Petroleum and Solvent Evaporation;Petroleum Liquids Storage (non-Refinery);Bulk Terminals;Gasoline RVP 13: Standing Loss - Int. Floating Roof w/ Secondary Seal | RBT |
| 40400107 | Petroleum and Solvent Evaporation;Petroleum Liquids Storage (non-Refinery);Bulk Terminals;Gasoline RVP 13: Working Loss (Diam. Independent) - Fixed Roof Tank | RBT |
| 40400262 | Petroleum and Solvent Evaporation;Petroleum Liquids Storage (non-Refinery);Bulk Plants;Gasoline RVP 10: Standing Loss - Int. Floating Roof w/ Primary Seal | BTP |
| 40400141 | Petroleum and Solvent Evaporation;Petroleum Liquids Storage (non-Refinery);Bulk Terminals;Gasoline RVP 13: Standing Loss - Ext. Floating Roof w/ Secondary Seal | RBT |
| 40301105 | Petroleum and Solvent Evaporation;Petroleum Product Storage at Refineries;Floating Roof Tanks (Varying Sizes);Gasoline RVP 10: Standing Loss (250000 Bbl. Tank Size) | RBT |
| 40400112 | Petroleum and Solvent Evaporation;Petroleum Liquids Storage (non-Refinery);Bulk Terminals;Gasoline RVP 7: Standing Loss (67000 Bbl Capacity)- Floating Roof Tank | RBT |
| 40400203 | Petroleum and Solvent Evaporation;Petroleum Liquids Storage (non-Refinery);Bulk Plants;Gasoline RVP 7: Breathing Loss (67000 Bbl. Capacity) - Fixed Roof Tank | BPS |
| 40400114 | Petroleum and Solvent Evaporation;Petroleum Liquids Storage (non-Refinery);Bulk Terminals;Gasoline RVP 10: Standing Loss (250000 Bbl Cap.) - Floating Roof Tank | RBT |
| 40600199 | Petroleum and Solvent Evaporation;Transportation and Marketing of Petroleum Products;Tank Cars and Trucks;Not Classified ** | BTP |

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| 40400117 | Petroleum and Solvent Evaporation;Petroleum Liquids Storage (non-Refinery);Bulk Terminals;Gasoline RVP 13/10/7: Withdrawal Loss (250000 Bbl Cap.) - Float Rf Tnk | RBT |
| 2501995000 | Storage and Transport;Petroleum and Petroleum Product Storage;All Storage Types: Working Loss;Total: All Products | BTP |
| 40600239 | Petroleum and Solvent Evaporation;Transportation and Marketing of Petroleum Products;Marine Vessels;Gasoline: Tanker Ship - Ballasted Tank Condition | RBT |
| 40400205 | Petroleum and Solvent Evaporation;Petroleum Liquids Storage (non-Refinery);Bulk Plants;Gasoline RVP 10: Working Loss (67000 Bbl. Capacity) - Fixed Roof Tank | BPS |
| 40400230 | Petroleum and Solvent Evaporation;Petroleum Liquids Storage (non-Refinery);Bulk Plants;Specify Liquid: Standing Loss - External Floating Roof w/ Primary Seal | BTP |
| 40400132 | Petroleum and Solvent Evaporation;Petroleum Liquids Storage (non-Refinery);Bulk Terminals;Gasoline RVP 10: Standing Loss - Ext. Floating Roof w/ Primary Seal | RBT |
| 40600502 | Petroleum and Solvent Evaporation;Transportation and Marketing of Petroleum Products;Pipeline Petroleum Transport - General - All Products;Pipeline Venting | RBT |
| 40600237 | Petroleum and Solvent Evaporation;Transportation and Marketing of Petroleum Products;Marine Vessels;Gasoline: Ocean Barges Loading - Uncleaned Tanks | RBT |
| 40400172 | Petroleum and Solvent Evaporation;Petroleum Liquids Storage (non-Refinery);Bulk Terminals;Gasoline RVP 10: Standing Loss - Int. Floating Roof w/ Secondary Seal | RBT |
| 40600126 | Petroleum and Solvent Evaporation;Transportation and Marketing of Petroleum Products;Tank Cars and Trucks;Gasoline: Submerged Loading ** | BTP |
| 40400103 | Petroleum and Solvent Evaporation;Petroleum Liquids Storage (non-Refinery);Bulk Terminals;Gasoline RVP 7: Breathing Loss (67000 Bbl. Capacity) - Fixed Roof Tank | RBT |
| 40400201 | Petroleum and Solvent Evaporation;Petroleum Liquids Storage (non-Refinery);Bulk Plants;Gasoline RVP 13: Breathing Loss (67000 Bbl Capacity) - Fixed Roof Tank | BTP |
| 40301003 | Petroleum and Solvent Evaporation;Petroleum Product Storage at Refineries;Fixed Roof Tanks (Varying Sizes);Gasoline RVP 7: Breathing Loss (67000 Bbl. Tank Size) | RBT |
| 40400202 | Petroleum and Solvent Evaporation;Petroleum Liquids Storage (non-Refinery);Bulk Plants;Gasoline RVP 10: Breathing Loss (67000 Bbl Capacity) - Fixed Roof Tank | BTP |
| 40400261 | Petroleum and Solvent Evaporation;Petroleum Liquids Storage (non-Refinery);Bulk Plants;Gasoline RVP 13: Standing Loss - Int. Floating Roof w/ Primary Seal | BTP |
| 40400404 | Petroleum and Solvent Evaporation;Petroleum Liquids Storage (non-Refinery);Petroleum Products - Underground Tanks;Gasoline RVP 10: Working Loss | BTP |
| 40600147 | Petroleum and Solvent Evaporation;Transportation and Marketing of Petroleum Products;Tank Cars and Trucks;Gasoline: Submerged Loading (Clean Tanks) | BTP |
| 40600234 | Petroleum and Solvent Evaporation;Transportation and Marketing of Petroleum Products;Marine Vessels;Gasoline: Ship Loading - Ballasted Tank | RBT |
| 40400260 | Petroleum and Solvent Evaporation;Petroleum Liquids Storage (non-Refinery);Bulk Plants;Specify Liquid: Standing Loss - Internal Floating Roof w/ Primary Seal | RBT |
| 40600399 | Petroleum and Solvent Evaporation;Transportation and Marketing of Petroleum Products;Gasoline Retail Operations - Stage I;Not Classified ** | BTP |
| 40301202 | Petroleum and Solvent Evaporation;Petroleum Product Storage at Refineries;Variable Vapor Space;Gasoline RVP 10: Filling Loss | RBT |
| 40301002 | Petroleum and Solvent Evaporation;Petroleum Product Storage at Refineries;Fixed Roof Tanks (Varying Sizes);Gasoline RVP 10: Breathing Loss (67000 Bbl. Tank Size) | RBT |
| 40400204 | Petroleum and Solvent Evaporation;Petroleum Liquids Storage (non-Refinery);Bulk Plants;Gasoline RVP 13: Working Loss (67000 Bbl. Capacity) - Fixed Roof Tank | BPS |
| 40400240 | Petroleum and Solvent Evaporation;Petroleum Liquids Storage (non-Refinery);Bulk Plants;Specify Liquid: Standing Loss - Ext. Floating Roof w/ Secondary Seal | RBT |
| 40400402 | Petroleum and Solvent Evaporation;Petroleum Liquids Storage (non-Refinery);Petroleum Products - Underground Tanks;Gasoline RVP 13: Working Loss | BTP |
| 40400249 | Petroleum and Solvent Evaporation;Petroleum Liquids Storage (non-Refinery);Bulk Plants;Specify Liquid: External Floating Roof (Primary/Secondary Seal) | RBT |
| 40400401 | Petroleum and Solvent Evaporation;Petroleum Liquids Storage (non-Refinery);Petroleum Products - Underground Tanks;Gasoline RVP 13: Breathing Loss | BTP |
| 40600231 | Petroleum and Solvent Evaporation;Transportation and Marketing of Petroleum Products;Marine Vessels;Gasoline: Ship Loading - Cleaned and Vapor Free Tanks | RBT |
| 40400115 | Petroleum and Solvent Evaporation;Petroleum Liquids Storage (non-Refinery);Bulk Terminals;Gasoline RVP 7: Standing Loss (250000 Bbl Cap.) - Floating Roof Tank | RBT |
| 40400102 | Petroleum and Solvent Evaporation;Petroleum Liquids Storage (non-Refinery);Bulk Terminals;Gasoline RVP 10: Breathing Loss (67000 Bbl Capacity) - Fixed Roof Tank | RBT |
| 40400232 | Petroleum and Solvent Evaporation;Petroleum Liquids Storage (non-Refinery);Bulk Plants;Gasoline RVP 10: Standing Loss - Ext. Floating Roof w/ Primary Seal | BPS |
| 40400142 | Petroleum and Solvent Evaporation;Petroleum Liquids Storage (non-Refinery);Bulk Terminals;Gasoline RVP 10: Standing Loss - Ext. Floating Roof w/ Secondary Seal | RBT |

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| 40400233 | Petroleum and Solvent Evaporation;Petroleum Liquids Storage (non-Refinery);Bulk Plants;Gasoline RVP 7: Standing Loss - External Floating Roof w/ Primary Seal | BTP |
| 40400131 | Petroleum and Solvent Evaporation;Petroleum Liquids Storage (non-Refinery);Bulk Terminals;Gasoline RVP 13: Standing Loss - Ext. Floating Roof w/ Primary Seal | RBT |
| 40400109 | Petroleum and Solvent Evaporation;Petroleum Liquids Storage (non-Refinery);Bulk Terminals;Gasoline RVP 7: Working Loss (Diameter Independent) - Fixed Roof Tank | RBT |
| 40400406 | Petroleum and Solvent Evaporation;Petroleum Liquids Storage (non-Refinery);Petroleum Products - Underground Tanks;Gasoline RVP 7: Working Loss | BTP |
| 40400253 | Petroleum and Solvent Evaporation;Petroleum Liquids Storage (non-Refinery);Bulk Plants;Miscellaneous Losses/Leaks: Vapor Control Unit Losses | BPS |
| 40300302 | Petroleum and Solvent Evaporation;Petroleum Product Storage at Refineries;Deleted - Do Not Use (See 4-03-011 and 4-07);Gasoline ** | RBT |
| 40400207 | Petroleum and Solvent Evaporation;Petroleum Liquids Storage (non-Refinery);Bulk Plants;Gasoline RVP 13: Standing Loss (67000 Bbl Cap.) - Floating Roof Tank | BTP |
| 40600162 | Petroleum and Solvent Evaporation;Transportation and Marketing of Petroleum Products;Tank Cars and Trucks;Gasoline: Loaded with Fuel (Transit Losses) | BTP |
| 40600707 | Petroleum and Solvent Evaporation;Transportation and Marketing of Petroleum Products;Consumer (Corporate) Fleet Refueling - Stage I;Underground Tank Breathing and Emptying | BTP |
| 40400208 | Petroleum and Solvent Evaporation;Petroleum Liquids Storage (non-Refinery);Bulk Plants;Gasoline RVP 10: Standing Loss (67000 Bbl Cap.) - Floating Roof Tank | BPS |
| 40400403 | Petroleum and Solvent Evaporation;Petroleum Liquids Storage (non-Refinery);Petroleum Products - Underground Tanks;Gasoline RVP 10: Breathing Loss | BTP |
| 40600503 | Petroleum and Solvent Evaporation;Transportation and Marketing of Petroleum Products;Pipeline Petroleum Transport - General - All Products;Pump Station | RBT |
| 40400271 | Petroleum and Solvent Evaporation;Petroleum Liquids Storage (non-Refinery);Bulk Plants;Gasoline RVP 13: Standing Loss - Int. Floating Roof w/ Secondary Seal | BTP |
| 40600305 | Petroleum and Solvent Evaporation;Transportation and Marketing of Petroleum Products;Gasoline Retail Operations - Stage I;Unloading ** | BTP |
| 40400248 | Petroleum and Solvent Evaporation;Petroleum Liquids Storage (non-Refinery);Bulk Plants;Gasoline RVP 10/13/7: Withdrawal Loss - Ext. Float Roof (Pri/Sec Seal) | BPS |
| 40400206 | Petroleum and Solvent Evaporation;Petroleum Liquids Storage (non-Refinery);Bulk Plants;Gasoline RVP 7: Working Loss (67000 Bbl. Capacity) - Fixed Roof Tank | BTP |
| 40400104 | Petroleum and Solvent Evaporation;Petroleum Liquids Storage (non-Refinery);Bulk Terminals;Gasoline RVP 13: Breathing Loss (250000 Bbl Capacity)-Fixed Roof Tank | RBT |
| 40400105 | Petroleum and Solvent Evaporation;Petroleum Liquids Storage (non-Refinery);Bulk Terminals;Gasoline RVP 10: Breathing Loss (250000 Bbl Capacity)-Fixed Roof Tank | RBT |
| 40400278 | Petroleum and Solvent Evaporation;Petroleum Liquids Storage (non-Refinery);Bulk Plants;Gasoline RVP 10/13/7: Withdrawal Loss - Int. Float Roof (Pri/Sec Seal) | BTP |
| 40688805 | Petroleum and Solvent Evaporation;Transportation and Marketing of Petroleum Products;Fugitive Emissions;Specify in Comments Field | BTP |
| 40400106 | Petroleum and Solvent Evaporation;Petroleum Liquids Storage (non-Refinery);Bulk Terminals;Gasoline RVP 7: Breathing Loss (250000 Bbl Capacity) - Fixed Roof Tank | RBT |
| 40600144 | Petroleum and Solvent Evaporation;Transportation and Marketing of Petroleum Products;Tank Cars and Trucks;Gasoline: Splash Loading (Balanced Service) | BTP |
| 40600198 | Petroleum and Solvent Evaporation;Transportation and Marketing of Petroleum Products;Tank Cars and Trucks;Not Classified ** | BTP |
| 40600233 | Petroleum and Solvent Evaporation;Transportation and Marketing of Petroleum Products;Marine Vessels;Gasoline: Barge Loading - Cleaned and Vapor Free Tanks | BTP |
| 40600241 | Petroleum and Solvent Evaporation;Transportation and Marketing of Petroleum Products;Marine Vessels;Gasoline: Tanker Ship - Ballasting | BTP |
| 40400143 | Petroleum and Solvent Evaporation;Petroleum Liquids Storage (non-Refinery);Bulk Terminals;Gasoline RVP 7: Standing Loss - Ext. Floating Roof w/ Secondary Seal | RBT |
| 40400405 | Petroleum and Solvent Evaporation;Petroleum Liquids Storage (non-Refinery);Petroleum Products - Underground Tanks;Gasoline RVP 7: Breathing Loss | BTP |
| 40688803 | Petroleum and Solvent Evaporation;Transportation and Marketing of Petroleum Products;Fugitive Emissions;Specify in Comments Field | RBT |
| 40400270 | Petroleum and Solvent Evaporation;Petroleum Liquids Storage (non-Refinery);Bulk Plants;Specify Liquid: Standing Loss - Int. Floating Roof w/ Secondary Seal | BPS |
| 40400263 | Petroleum and Solvent Evaporation;Petroleum Liquids Storage (non-Refinery);Bulk Plants;Gasoline RVP 7: Standing Loss - Internal Floating Roof w/ Primary Seal | BTP |
| 40400231 | Petroleum and Solvent Evaporation;Petroleum Liquids Storage (non-Refinery);Bulk Plants;Gasoline RVP 13: Standing Loss - Ext. Floating Roof w/ Primary Seal | BTP |
| 40600702 | Petroleum and Solvent Evaporation;Transportation and Marketing of Petroleum Products;Consumer (Corporate) Fleet Refueling - Stage I;Submerged Filling w/o Controls | BTP |

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| 40400119 | Petroleum and Solvent Evaporation;Petroleum Liquids Storage (non-Refinery);Bulk Terminals;Gasoline RVP 10: Filling Loss (10500 Bbl Cap.) - Variable Vapor Space | RBT |
| 40400133 | Petroleum and Solvent Evaporation;Petroleum Liquids Storage (non-Refinery);Bulk Terminals;Gasoline RVP 7: Standing Loss - External Floating Roof w/ Primary Seal | RBT |
| 40400163 | Petroleum and Solvent Evaporation;Petroleum Liquids Storage (non-Refinery);Bulk Terminals;Gasoline RVP 7: Standing Loss - Internal Floating Roof w/ Primary Seal | RBT |
| 40400252 | Petroleum and Solvent Evaporation;Petroleum Liquids Storage (non-Refinery);Bulk Plants;Miscellaneous Losses/Leaks: Vapor Collection Losses | BPS |
| 40400272 | Petroleum and Solvent Evaporation;Petroleum Liquids Storage (non-Refinery);Bulk Plants;Gasoline RVP 10: Standing Loss - Int. Floating Roof w/ Secondary Seal | BPS |
| 40400241 | Petroleum and Solvent Evaporation;Petroleum Liquids Storage (non-Refinery);Bulk Plants;Gasoline RVP 13: Standing Loss - Ext. Floating Roof w/ Secondary Seal | BPS |
| 40400213 | Petroleum and Solvent Evaporation;Petroleum Liquids Storage (non-Refinery);Bulk Plants;Gasoline RVP 7: Filling Loss (10500 Bbl Cap.) - Variable Vapor Space | BTP |
| 40400211 | Petroleum and Solvent Evaporation;Petroleum Liquids Storage (non-Refinery);Bulk Plants;Gasoline RVP 13: Filling Loss (10500 Bbl Cap.) - Variable Vapor Space | BTP |
| 40301004 | Petroleum and Solvent Evaporation;Petroleum Product Storage at Refineries;Fixed Roof Tanks (Varying Sizes);Gasoline RVP 13: Breathing Loss (250000 Bbl. Tank Size) | RBT |
| 40600706 | Petroleum and Solvent Evaporation;Transportation and Marketing of Petroleum Products;Consumer (Corporate) Fleet Refueling - Stage I;Balanced Submerged Filling | BTP |
| 40600701 | Petroleum and Solvent Evaporation;Transportation and Marketing of Petroleum Products;Consumer (Corporate) Fleet Refueling - Stage I;Splash Filling | BTP |
| 40301006 | Petroleum and Solvent Evaporation;Petroleum Product Storage at Refineries;Fixed Roof Tanks (Varying Sizes);Gasoline RVP 7: Breathing Loss (250000 Bbl. Tank Size) | RBT |
| 40400212 | Petroleum and Solvent Evaporation;Petroleum Liquids Storage (non-Refinery);Bulk Plants;Gasoline RVP 10: Filling Loss (10500 Bbl Cap.) - Variable Vapor Space | BTP |
| 40301203 | Petroleum and Solvent Evaporation;Petroleum Product Storage at Refineries;Variable Vapor Space;Gasoline RVP 7: Filling Loss | RBT |
| 40600602 | Petroleum and Solvent Evaporation;Transportation and Marketing of Petroleum Products;Consumer (Corporate) Fleet Refueling - Stage II;Liquid Spill Loss w/o Controls | BTP |
| 40600504 | Petroleum and Solvent Evaporation;Transportation and Marketing of Petroleum Products;Pipeline Petroleum Transport - General - All Products;Pump Station Leaks | RBT |
| 2505020121 | Storage and Transport;Petroleum and Petroleum Product Transport;Marine Vessel;Gasoline - Barge | RBT |
| 40400120 | Petroleum and Solvent Evaporation;Petroleum Liquids Storage (non-Refinery);Bulk Terminals;Gasoline RVP 7: Filling Loss (10500 Bbl Cap.) - Variable Vapor Space | RBT |
| 40400273 | Petroleum and Solvent Evaporation;Petroleum Liquids Storage (non-Refinery);Bulk Plants;Gasoline RVP 7: Standing Loss - Int. Floating Roof w/ Secondary Seal | BPS |
| 40600235 | Petroleum and Solvent Evaporation;Transportation and Marketing of Petroleum Products;Marine Vessels;Gasoline: Ocean Barges Loading - Ballasted Tank | BTP |

[i] U. S. Energy Information Administration. Annual Energy Outlook 2011 with Projections to 2035. Report No. DOE/EIA-0383. April 2011. http://205.254.135.7/forecasts/aeo/pdf/0383(2011).pdf