Emissions Inventory Final Rule Technical Support Document

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Emissions Inventory Final Rule Technical Support Document

U.S. Environmental Protection Agency
Office of Air Quality Planning and Standards
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Acronyms

BAFM	Benzene, Acetaldehyde, Formaldehyde and Methanol
BEIS	Biogenic Emissions Inventory System
C3	Category 3 (commercial marine vessels)
CAIR	Clean Air Interstate Rule
CAMD	The EPA's Clean Air Markets Division
CAM_X	Comprehensive Air Quality Model with Extensions
CAP	Criteria Air Pollutant
CARB	California Air Resources Board
CEM	Continuous Emissions Monitoring
CHIEF	Clearinghouse for Inventories and Emissions Factors
Cl	Chlorine
CMAQ	Community Multiscale Air Quality
CMV	Commercial marine vessel
CO	Carbon monoxide
EGU	Electric generating units
EPA	Environmental Protection Agency
EMFAC	Emission Factor (California's onroad mobile model)
EEZ	Exclusive Economic Zone
FAA	Federal Aviation Administration
FCCS	Fuel Characteristic Classification System
FIPS	Federal Information Processing Standards
HAP	Hazardous Air Pollutant
HCl	Hydrochloric acid
Hg	Mercury
HGNRVA	Natural recycled, volcanic and anthropogenic Hg
HMS	Hazard Mapping System
ICI	Industrial/Commercial/Institutional (boilers and process heaters)
ICR	Information Collection Request
IMO	International Marine Organization
IPM	Integrated Planning Model
ITN	Itinerant
MACT	Maximum Achievable Control Technology
MMS	Minerals Management Service (now known as the Bureau of Energy Management, Regulation and Enforcement (BOEMRE)
MOBILE	OTAQ's model for estimation of onroad mobile emissions factors
MOVES	Motor Vehicle Emissions Simulator -- OTAQ's model for estimation of onroad mobile emissions – replaces the use of the MOBILE model
MSAT2	Mobile Source Air Toxics Rule
NEEDS	National Electric Energy Database System
NEI	National Emission Inventory
NESHAP	National Emission Standards for Hazardous Air Pollutants
NH_3	Ammonia
nm	nautical mile
NMIM	National Mobile Inventory Model
NOAA	National Oceanic and Atmospheric Administration
NODA	Notice of Data Availability
NONROAD	OTAQ's model for estimation of nonroad mobile emissions
NO_X	Nitrogen oxides
OAQPS	The EPA's Office of Air Quality Planning and Standards

OTAQ	The EPA's Office of Transportation and Air Quality
ORD	The EPA's Office of Research and Development
ORL	One Record per Line
PF	Projection Factor, can account for growth and/or controls
PFC	Portable Fuel Container
$PM_{2.5}$	Particulate matter less than or equal to 2.5 microns
PM_{10}	Particulate matter less than or equal to 10 microns
ppm	Parts per million
RIA	Regulatory Impact Analysis
RRF	Relative Response Factor
RWC	Residential Wood Combustion
RPO	Regional Planning Organization
SCC	Source Classification Code
SMARTFIRE	Satellite Mapping Automated Reanalysis Tool for Fire Incident Reconciliation
SMOKE	Sparse Matrix Operator Kernel Emissions
SO_2	Sulfur dioxide
SOA	Secondary Organic Aerosol
SPPD	Sector Policies and Programs Division
TAF	Terminal Area Forecast
TCEQ	Texas Commission on Environmental Quality
TSD	Technical support document
VOC	Volatile organic compounds
VMT	Vehicle miles traveled
WRAP	Western Regional Air Partnership

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1 Introduction

This technical support document (TSD) provides the details of emissions data processing done in support of the Environmental Protection Agency's (EPA) final rulemaking effort for the Federal Transport Rule (hereafter referred to as Transport Rule). The Transport Rule air quality modeling results were evaluated with respect to the 1997 annual and 2006 24-hour National Ambient Air Quality Standards (NAAQS) for particulate matter less than 2.5 microns ($PM_{2.5}$), as well as the 1997 8-hour ozone NAAQS.

The emissions and modeling effort for Transport Rule consists of four 'complete' emissions cases: 2005 base case, 2012 base case, 2014 base case, and 2014 remedy (i.e., "control") case. Table 1-1 provides more information on these emissions cases. The purpose of 2005 base case is to provide a 2005 case that is consistent with the methods used in the future-year base cases and remedy case. For regulatory applications, this case is used with the outputs from the 2012 base case in the relative response factor (RRF) calculations to identify future nonattainment and maintenance. For more information on the use of RRFs, please see the Air Quality Modeling Final Rule TSD. The outputs of the 2014 remedy case were compared to the outputs from the 2014 base case to quantify the benefits of the rule. Not listed in Table 1-1 are source apportionment runs that were based on the 2012 base case and used to quantify the contributions of emissions in upwind states to the annual average 24-hour $PM_{2.5}$ and 8-hour ozone concentrations in other states in 2012. For more information on the benefits of this rulemaking, please see the Regulatory Impact Assessment for the Transport Rule NFR.

Table 1-1. List of cases run in support of the Final Transport Rule air quality modeling

Case Name	**Internal EPA Abbreviation**	**Description**
2005 base case	2005cs	2005 case created using average-year fires data and an average-year temporal allocation approach for Electrical Generating Units (EGUs); used for computing relative response factors with 2012 and 2014 scenarios.
2005 evaluation case	2005as	2005 case created for air quality model performance evaluation that uses actual 2005 and 2005 continuous emissions monitoring (CEM) data for EGUs.
2012 base case	2012cs	2012 "baseline" scenario, representing the best estimate for the future year without implementation of EGU remedy controls.
2014 base case	2014cs	2014 "baseline" scenario, representing the best estimate for the future year without implementation of EGU remedy controls.
2014 Remedy case	2014cs_tr1remedy	2014 EGU remedy or "control" scenario to address significant contribution for the 1997 ozone and annual PM standards, and 2006 daily PM standard.

The air quality modeling platform consists of all the emissions inventories and input ancillary files, along with the meteorological, initial condition, and boundary condition files needed to run the air quality model. The platform for this rule uses all Criteria Air Pollutants (CAPs) and the following select Hazardous Air Pollutants (HAPs): chlorine (CL2), hydrochloric acid or hydrogen chloride (HCl) and benzene, acetaldehyde, formaldehyde and methanol. The latter four are also denoted 'BAFM'. The Final Transport Rule modeling platform is called the "CAP-BAFM 2005-Based Platform, Version 4.2" platform (we will use the shortened name "2005v4.2" in this documentation).

The data used in the 2005 emissions base case are an updated version of the 2005-based air quality modeling platform that was used for the Transport Rule Proposal (2005v4). This TSD describes the emissions inventory and emissions modeling for the 2005v4.2 version of the platform used for the Final Transport Rule and focuses on the changes made since the 2005v4 platform. The 2005v4 platform is documented at the emissions modeling clearinghouse website under the section entitled "2005-Based Modeling Platform" and the subsection entitled "CAP-BAFM 2005-Based Platform Version 4 (do not use for Mercury)". It should be noted that this 2005v4.2 platform includes all non-mercury (Hg) updates reflected in the 2005v4.1 platform, which is under the section entitled "CAP-Hg-BAFM 2005-Based Platform Version 4.1 (use for Mercury)".

The 2005v4.2 platform includes both the evolutionary platform changes between 2005v4 and 2005v4.2, as well as implementation of inventory changes resulting from the incorporation of comments on the Transport Rule Proposal. For details on the emissions inventory-related comments received on the Transport Rule NPR and the EPA's responses to those, see the document "Emissions Inventories Response to Comments for the Transport Rule NFR". This document is in the Transport Rule docket (EPA-HQ-OAR-2009-0491) and is posted on the emissions modeling clearinghouse website listed above. For simplicity, this TSD refers to the cumulative changes in both the 2005v4.1 and 2005v4.2 platforms, thus any comparisons made in this document will be against data in the 2005v4 platform used in the Transport Rule Proposal. For more information on the emissions inventories used for the Transport Rule Proposal, see the document "Federal Transport Rule Emissions Inventory for Air Quality Modeling Technical Support Document", available in the Transport Rule docket and on the emissions modeling clearinghouse website specified above.

The underlying 2005 inventories used are most significantly defined by: 1) for point sources: the 2005 National Emission Inventory (NEI) version 2, and 2) for onroad mobile sources: the Motor Vehicle Emissions Simulator with database corrections for diesel toxics (MOVES2010). This document describes the approach and data used to produce the emission inputs to the air quality model used in the 2005v4.2 platform for the 2005 and future-year scenarios.

Emissions preparation for the 2005v4.2 platform supports both the Community Multiscale Air Quality (CMAQ) model and the Comprehensive Air Quality Model, with extensions (CAM_X). Both models support modeling ozone (O_3), and particulate matter (PM), and require hourly and gridded emissions of chemical species from the following inventory pollutants: carbon monoxide (CO), nitrogen oxides (NO_X), volatile organic compounds (VOC), sulfur dioxide (SO_2), ammonia (NH_3), particulate matter less than or equal to 10 microns (PM_{10}), and individual component species for particulate matter less than or equal to 2.5 microns ($PM_{2.5}$). In addition, the CMAQ Carbon Bond 05 (CB05) chemical mechanism with chlorine chemistry, which is part of the "base" version of CMAQ, allows explicit treatment of BAFM and includes HAP emissions of HCl and CL2. In the platform, BAFM emissions come from either the NEI values for benzene, formaldehyde, acetaldehyde and methanol (BAFM) or via speciation of NEI VOC into the component species. For the Transport Rule air quality modeling, only the CAM_X model was used.

The creation of emission inputs for the 2005v4.2 platform included:

(1) modifying the emission inventories used for the 2005v4 base case,
(2) updating the emissions modeling ancillary files used by the emissions modeling tools, and
(3) applying the emissions modeling tools.

The primary emissions modeling tool used to create the air quality model-ready emissions was the Sparse Matrix Operator Kernel Emissions (SMOKE) modeling system. We used SMOKE version 2.6 to create emissions files for a 36-km national grid, and a 12-km Eastern grid for the 2005 base case (also known as the "2005cs_05b" case).

The 2005v4.2 platform includes a base case for 2005 (2005cs) and a traditional model evaluation case (2005as). The evaluation case is identical to the base case except that it uses 2005-specific fire emissions and 2005 hour-specific continuous emission monitoring (CEM) data for electric generating units (EGUs). The 2005 base case in the 2005v4.2 platform includes an "average year" scenario for fires and an illustrative (rather than year-specific) temporal allocation approach for EGUs to allocate annual 2005 emissions to days and hours. This approach to temporal allocation of emissions was used for all base and control cases modeled to provide temporal consistency between the years. It is intended to be a conceivable representation of temporal allocation of the emissions without tying the approach to a single year. For example, each year has different days and different locations with large fires, unplanned EGU shutdowns, and periods of high electricity demand. By using a base-case approach such as the one used on 2005v4.2, the temporal and spatial aspects of the inventory for these sources are maintained into the future-year modeling. This avoids potentially spurious year-specific artifacts in the air quality modeling estimates. The 2005v4.2 platform biogenic emissions data is the same as the 2005v4 platform and was held constant between the 2005 case and all future-year cases.

The 2005v4.2 platform was developed using the concepts, tools and emissions modeling data from the EPA's 2005v4 platform, documented by: main document, appendices to the main document, and future year.

The future-year inventories, ancillary files, and detailed projection data used for this modeling are available in the Transport Rule docket at EPA-HQ-OAR-2009-0491 as part of the Final Transport Rulemaking. Since the data are large, the data files themselves are not posted with online access through the docket. A more convenient access location is the 2005 platform section of the EPA Emissions Modeling Clearinghouse. The Final Transport Rule data files are provided as a subheading under this main link.

In the remainder of this document, we provide a description of the approaches taken for the emissions modeling in support of air quality modeling for the Transport Rule. In Section 2, we review the 2005 base-case inventory (2005cs_05b) and provide high–level emissions summaries. Section 3 describes the emissions modeling and the ancillary files used with the emission inventories. In Section 4, we describe the development of the future year 2012 (2012cs_05b) and 2014 (2014cs_05b) base cases. The 2012 Source Tagging scenarios are described in Section 5. The 2014 EGU Transport Rule Remedy (Control) case (2014cs_tr1remedy_05b) is discussed in Section 6. In Section 7 we provide data summaries comparing the modeling cases, followed by the technical references for this document. Appendices A through D provide additional details about specific technical methods. Some additional emission summaries are also provided in the Final Transport Rule Regulatory Impact Analysis, Chapter 3.

2 2005 Emission Inventories and Approaches

This section describes the 2005 emissions data created for input to SMOKE that is part of the 2005v4.2 platform. As with the 2005v4 platform, the primary basis for the 2005 stationary source emission inputs is the 2005 National Emission Inventory (NEI), version 2, which includes emissions of CO, NO_X, VOC, SO_2, NH_3, PM_{10}, $PM_{2.5}$ and hazardous air pollutants (HAPs). The HAPs we used from this inventory are mercury, chlorine (CL2), hydrogen chloride (HCl), benzene, acetaldehyde, formaldehyde, and methanol. We began with the same SMOKE-formatted inventory inputs as the 2005v4 platform (the EPA case name: 2005ck_05b) and made the changes described below.

Documentation for the 2005 NEI, and for inventories outside of the United States, which include Canada and Mexico, we used the latest available base-year inventories as discussed in Section 2.6. The 2005 NEI includes five sectors: nonpoint (formerly called "stationary area") sources, point sources, nonroad mobile sources, onroad mobile sources, and fires. Because the 2005v4.2 platform includes only a base case as opposed to a model evaluation case, the day-specific wildfire and prescribed burning data from the 2005 NEI was not used; rather an average fire inventory is used for both base and future years. In addition to the NEI data, biogenic emissions and emissions from the Canadian and Mexican inventories are included in the 2005v4.2 platform. Some inventories are augmented with other emissions data as explained below.

For the purposes of preparing the air quality model-ready emissions, we split the 2005 emissions inventory into "platform" sectors in the same way as was done in the 2005v4 platform. The significance of an emissions modeling or "platform" sector is that the data is run through all of the SMOKE programs except the final merge (Mrggrid) independently from the other sectors. The final merge program then combines the sector-specific gridded, speciated and hourly emissions together to create CMAQ-ready emission inputs. These inputs are then converted into emissions that can be used by CAM_X, as was needed for the Transport Rule modeling.

Table 2-1 presents the sectors in the 2005 platform. The sector abbreviations are provided in italics; these abbreviations are used in the SMOKE modeling scripts and inventory file names, and throughout the remainder of this document. Table 2-1 does not describe in specific detail the updates in the 2005v4.2 platform from those in the 2005v4 platform. The specific updates to the 2005v4.2 platform as compared to the 2005v4 platform are highlighted in Table 2-2 and discussed in detail later in this section.

Table 2-1. Platform sectors used in emissions modeling for the 2005 platform, version 4.2

Platform Sector: ***short name***	**2005 NEI Sector**	**Description and resolution of the data input to SMOKE**
EGU (also called the IPM sector): ***ptipm***	Point	2005v2 NEI point source EGUs mapped to the Integrated Planning Model (IPM) model using the National Electric Energy Database System (NEEDS) 2006 version 4.10. Day-specific emissions created for input into SMOKE. Includes updates from Transport Rule comments and evolutionary improvements from 2005v4.
Non-EGU (also called the non-IPM sector): ***ptnonipm***	Point	All 2005v2 NEI point source records not matched to the ptipm sector. Includes all aircraft emissions and point source fugitive dust emissions for which county-specific PM transportable fractions were applied. Annual resolution. Includes updates from Transport Rule comments and evolutionary improvements from 2005v4.
Average-fire: ***avefire***	Not applicable	Average-year wildfire and prescribed fire emissions, unchanged from the 2005v4 platform; county and annual resolution.

Platform Sector: ***short name***	**2005 NEI Sector**	**Description and resolution of the data input to SMOKE**
Agricultural: ***ag***	Nonpoint	NH_3 emissions from NEI nonpoint livestock and fertilizer application, county and annual resolution. Unchanged from the 2005v4 platform.
Area fugitive dust: ***afdust***	Nonpoint	PM_{10} and $PM_{2.5}$ from fugitive dust sources from the NEI nonpoint inventory after application of county-specific PM transportable fractions. Includes building construction, road construction, paved roads, unpaved roads, agricultural dust), county and annual resolution. Unchanged from the 2005v4 platform.
Remaining nonpoint: ***nonpt***	Nonpoint	Primarily 2002 NEI nonpoint sources not otherwise included in other SMOKE sectors; county and annual resolution. Also includes updated Residential Wood Combustion emissions, year 2005 non-California WRAP oil and gas Phase II inventory, year 2005 Texas and Oklahoma oil and gas inventories, and updates resulting from Transport Rule comments.
Nonroad: ***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.
locomotive, and non-C3 commercial 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 included in the Non-EGU sector (as point sources) and category 3 CMV emissions are contained in the seca_c3 sector. Includes updates resulting from Transport Rule comments.
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. Utilized final projections from 2002, developed for the C3 ECA Proposal to the International Maritime Organization (EPA-420-F-10-041, August 2010). Includes updates resulting from Transport Rule comments.
Onroad California, NMIM-based, and MOVES sources not subject to temperature adjustments: ***on_noadj***	Mobile: onroad	Three, monthly, county-level components: 1) California onroad, created using annual emissions for all pollutants, submitted by CARB for the 2005v2 NEI. NH_3 (not submitted by CARB) from MOVES2010. 2) Onroad gasoline and diesel vehicle emissions from MOVES2010 not subject to temperature adjustments: exhaust CO, NO_X, VOC, NH3, benzene, formaldehyde, acetaldehyde, 1,3-butadiene, acrolein, naphthalene, brake and tire wear PM, and evaporative VOC, benzene, and naphthalene. 3) Onroad emissions for Hg from NMIM using MOBILE6.2, other than for California.

Platform Sector: *short name*	2005 NEI Sector	Description and resolution of the data input to SMOKE
Onroad cold-start gasoline exhaust mode vehicle from MOVES subject to temperature adjustments: *on_moves_startpm*	Mobile: onroad	Monthly, county-level MOVES2010-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).
Onroad running gasoline exhaust mode vehicle from MOVES subject to temperature adjustments: *on_moves_runpm*	Mobile: onroad	Monthly, county-level draft MOVES2010-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).
Biogenic: *biog*	Not applicable	Hour-specific, grid cell-specific emissions generated from the BEIS3.14 model, including emissions in Canada and Mexico. Unchanged from the 2005v4 platform.
Other point sources not from the NEI: *othpt*	Not applicable	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.
Other nonpoint and nonroad not from the NEI: *othar*	Not applicable	Annual year 2006 Canada (province resolution) and year 1999 Mexico Phase III (municipio resolution) nonpoint and nonroad mobile inventories. Unchanged from the 2005v4 platform.
Other onroad sources not from the NEI: *othon*	Not applicable	Year 2006 Canada (province resolution) and year 1999 Mexico Phase III (municipio resolution) onroad mobile inventories, annual resolution. Unchanged from the 2005v4 platform.

The emission inventories in SMOKE input format for the 2005 base case are available at the 2005v4.2 website (see the end of Section 1). The "readme" file provided indicates the particular zipped files associated with each platform sector.

Before discussing the specific components of the 2005v4.2 emissions platform, we provide in Table 2-2 a summary of the significant differences between the 2005v4 emissions platform and the 2005v4.2 platform. The sectors that did not change between 2005v4.2 and 2005v4 are not included in the table and are the following: average fire, agriculture, area fugitive dust, biogenic sources, and "other" (i.e. non-US) point, nonpoint, nonroad, and onroad sources.

Table 2-2. Summary of significant changes between v4 and v4.2 platforms by sector

Platform Sector	Summary of Significant Inventory Differences from V4 to V4.2
IPM sector: *ptipm*	1) Added or changed ORIS Boiler IDs to some units with missing or incorrect values, and for a subset of these, recomputed annual emissions of NO_X, SO_2 or both using 2005 CEM data. Only replaced emissions if 2005 CEM data were confirmed to be for the entire year (since some CEMs only run for the summer season). A facility-level summary of these changes is provided in Appendix A, Table A-1 of the 2005v4.1 TSD. 2) Moved several stacks and units from the ptnonipm sector, assigning ORIS facility and boiler codes and matching stack parameters to those provided in the future-year IPM emissions. These edits ensure future-year EGUs are not double counted and that base year and future-year stack parameters are similar. Affected plants are listed in Appendix A, Table A-1. 3) Deleted several units from the inventory that were found to be either double counts or closed. Affected plants are listed in Appendix A, Table A-2.
Non-IPM sector: *ptnonipm*	1) Revised 2005 emissions to remove duplicates, improve estimates from ethanol plants, and reflect new emissions and controls information collected from industry and a state through the Boiler MACT Information Collection Request (ICR). 2) Moved several stacks and units from the ptnonipm sector to the ptipm sector (Appendix A, Table A-1). This edit prevents double counting of EGU emissions in the future years. 3) Deleted several units from the inventory that were found to be either double counts or closed. Affected plants are listed in Appendix A, Table A-2. 4) Revised emissions in several states using improved information obtained from Transport Rule comments.
Remaining nonpoint sector: *nonpt*	1) Added: year 2005 oil and gas data for Texas and Oklahoma provided by these states. Replaced previous Oklahoma oil and gas emissions from this sector (SCC 2310000000). No removals for Texas since the new oil and gas emissions only cover oil rig emissions that are in the nonroad sector. The nonroad sector emissions were not removed because they were very small compared to the newer Texas oil and gas emissions added to this sector and the possibility of double counting was not able to be confirmed by the EPA. 2) Changed pesticide category to "no-integrate," thereby using VOC speciation (rather than the HAP emissions) to compute the BAFM emissions. 3) Incorporation of Transport Rule comments including: i) replacing Delaware fuel combustion, residential wood burning, and open burning, ii) removing South Carolina residual oil emissions from industrial boilers, iii) replacing Nebraska industrial fuel combustion emissions. State level changes that include these impacts are shown in Appendix A, Table A-3.
Nonroad sector: *nonroad*	Added PM to 7 California counties which were found to be 0 in the 2005v4 platform. Data used came from an earlier version of the 2005 inventory provided by CARB, which had the same PM values as the 2005v2 NEI other than in the missing counties, for which nonzero PM values were provided.
locomotive, and non-C3 commercial marine: *alm_no_c3*	Updated diesel fuel commercial marine vessel emissions in Delaware per Transport Rule comments. The impacts of these changes are shown in Appendix A, Table A-3.
C3 commercial marine: *seca_c3*	1) Revised 2005 emissions reflect the final projections from 2002 developed for the category 3 commercial marine vessel Emissions Control Area (ECA)

Platform Sector	Summary of Significant Inventory Differences from V4 to V4.2
	Proposal to the International Maritime Organization (EPA-420-F-10-041, August 2010). 2) Projected Canada as part of the ECA rather than an "outside the ECA" region, using region-specific growth rates. For example, British Columbia emissions were projected the same as "North Pacific" growth and control used in Washington. Therefore the v4.2 seca_c3 inventories contain Canadian province codes. 3) Updated Delaware emissions per Transport Rule comments. 4) Redefined the spatial extent of state boundaries off-shore from up to 200 nautical miles to under 10 miles based on Mineral Management Service (MMS) state-federal water boundaries data. This item did not change emissions, but it drastically reduces areas that are assigned to states.
Onroad California, NMIM-based, and MOVES sources not subject to temperature adjustments: ***on_noadj***	1) For all states except California: All pollutants and modes (exhaust, tire and brake wear) from all vehicle types are now from MOVES2010. In the 2005v4 platform, only exhaust mode onroad gasoline vehicles, other than motorcycles, were included from MOVES in this sector and the rest had been from MOBILE6. 2) For California: Replaced NMIM-based NH_3 with MOVES2010 emissions for California because California does not provide NH_3 in its onroad inventory. For the 2005v4 platform, we used NH_3 from NMIM but since MOVES generates all criteria pollutants, we now use MOVES.
Onroad cold-start gasoline exhaust mode vehicle from MOVES subject to temperature adjustments: ***on_moves_startpm***	For the 2005v4.2 platform, this sector uses MOVES2010 based emissions for all exhaust mode onroad gasoline vehicle types including motorcycles. In the v4 version, motorcycle exhaust mode PM emissions relied on NMIM and were therefore in the on_noadj sector, and other exhaust mode gasoline vehicle PM emissions used the draft version of MOVES. As with v4, these PM and naphthalene cold start mode emissions are subject to grid cell and hourly temperature adjustments.
Onroad running gasoline exhaust mode vehicle from MOVES subject to temperature adjustments: ***on_moves_runpm***	Same change as "***on_moves_startpm***"

Annual emission summaries for 2005v4.2, with comparisons to 2005v4 CAPs emissions by emissions modeling sector are provided in Table 2-3. VOC totals are before BAFM speciation (i.e., they are inventory VOC emissions, and not the sum of VOC emissions after BAFM speciation.

The emission inventories for input to SMOKE for the 2005 base case are available at the 2005v4 website (see the end of Section 1) under the link "Data Files" (see the "2005emis" directory). The inventories "readme" file indicates the particular zipped files associated with each platform sector.

Table 2-3. 2005 Emissions by Sector: VOC, NO_X, CO, SO_2, NH_3, PM_{10}, $PM_{2.5}$

Sector short name	2005 VOC [tons/yr]		2005 NOX [tons/yr]		2005 CO [tons/yr]		2005 SO2 [tons/yr]		2005 NH3 [tons/yr]		2005 PM10 [tons/yr]		2005 PM2_5 [tons/yr]	
	V4.2	**V4**	**V4.2**	**V4**	**V4.2**	**V4**	**V4.2**	**V4**	**V4.2**	**V4**	**V4.2**	**V4**	**V4.2**	**V4**
afdust											8,858,992	same	1,030,391	same
ag									3,251,990	same				
alm_no_c3	67,690	same	1,922,723	1,924,925	270,007	same	153,068	154,016	773	same	59,342	59,366	56,666	56,687
seca_c3 (US component)	4,580	22,367	130,164	642,088	11,862	53,746	97.485	417,312			11,628	53,580	10,673	49,294
seca_c3 (non-US component)	62,132	18,241	1,801,699	526,760	146,027	42,959	1,085,894	319,200			146,312	43,014	134,604	39,574
nonpt	7,530,578	7,474,512	1,696,902	1,683,490	7,410,946	7,376,314	1,216,362	1,252,645	133,962	134,080	1,349,639	1,349,685	1,079,906	1,076,954
nonroad	2,691,844	same	2,115,408	same	19,502,718	same	197,341	same	1,972	same	211,807	209,100	201,138	198,734
on_noadj	3,949,362	3,123,642	9,142,274	7,203,876	43,356,130	41,647,066	177,977	144,216	156,528	295,203	308,497	170,554	236,927	115,991
on_moves _runpm											54,071	46,430	49,789	42,753
on_moves_ startpm											22,729	23,607	20,929	21,738
ptipm	41,089	40,950	3,729,161	3,728,190	603,788	601,564	10,380,883	10,381,411	21,995	21,684	602,236	615,095	496,877	508,903
ptnonipm	1,309,895	1,310,085	2,226,250	2,247,228	3,214,833	3,222,221	2,082,159	2,117,649	158,524	159,003	646,373	653,957	433,381	442,656
avefire	1,958,992	same	189,428	same	8,554,551	same	49,094	same	36,777	same	796,229	same	684,035	same
Canada othar[1]	1,281,095	same	734,587	same	3,789,362	same	95,086	same	546,034	same	1,666,188	same	432,402	same
Canada othon	270,872	same	524,837	same	4,403,745	same	5,309	same	21,312	same	14,665	same	10,395	same
Canada othpt	447,313	same	857,977	same	1,270,438	same	1,664,040	same	21,268	same	117,669	same	68,689	same
Mexico othar	586,842	same	249,045	same	644,733	same	101,047	same	486,484	same	143,816	same	92,861	same
Mexico othon	183,429	same	147,419	same	1,455,121	same	8,270	same	2,547	same	6,955	same	6,372	same
Mexico othpt	113,044	same	258,510	same	88,957	same	980,359	same	0	same	125,385	same	88,132	same
offshore othpt	51,240	same	82,581	same	89,812	same	1,961	same	0	same	839	same	837	same

1. Canada provided 2006 fires, but we did not use them in the 2005 platform (for neither v4.2 nor v4)

The remainder of Section 2 provides details about the data contained in each of the 2005 platform sectors. Different levels of detail are provided for different sectors depending on the availability of reference information for the data, the degree of changes or manipulation of the data needed for preparing it for input to SMOKE, and whether the 2005v4.2 platform emissions changed appreciably since the previously-documented 2005v4 platform.

2.1 2005 NEI point sources (ptipm and ptnonipm)

Point sources are sources of emissions for which specific geographic coordinates (e.g., latitude/longitude) are specified, as in the case of an individual facility. A facility may have multiple emission points, which 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 that are discussed in Section 2.6 .

After removing offshore oil platforms (othpt sector), we created two platform sectors from the remaining 2005v2 NEI point sources for input 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. 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 3.1.2.1).

The ptnonipm emissions were provided to SMOKE as annual emissions. The ptipm emissions for the base case were input to SMOKE as daily emissions.

Documentation for the development of the 2005 point source NEI v2. A summary of this documentation describes these data as follows:

1. Electric generating unit (EGU) emissions are obtained from emissions/heat input from the EPA's Acid Rain Program for Continuous Emissions Monitoring System (CEMS) reporting. The following approach applied to units in the 2002 NEI that matched to 2005 CEMS units. For pollutants covered by the CEMS, the 2005 CEMS data were used. For CEMS units with pollutants not covered by CEMS (e.g., VOC, $PM_{2.5}$, HCl) unit-specific ratios of 2005 to 2002 heat input were applied to 2002v3 NEI emissions to obtain 2005 estimates.

2. Non-EGU stationary source development for the 2005 NEI focused on improving the following sectors:

a. HAP data received from States and industry to support the MACT program, including the recent Risk and Technology Review rulemaking
b. 2005 State, local, and tribal data submitted to the EPA under the Consolidated Emissions Reporting Rule (CERR)
c. HAP data from Toxic Release Inventory (TRI) for missing facilities and pollutants
d. Off-shore platform data from Mineral Management Services (MMS)

The changes made to the 2005v2 NEI point inventory prior to modeling 2005v4 are as follows:

- The tribal data, which do not use state/county Federal Information Processing Standards (FIPS) codes in the NEI, but rather use the tribal code, were assigned a state/county FIPS code of 88XXX, where XXX is the 3-digit tribal code in the NEI. We made this change because SMOKE requires the 5-digit state/county FIPS code.
- Stack parameters were defaulted for some point sources when modeling in SMOKE. SMOKE uses an ancillary file, called the PSTK file that provides default stack parameters by SCC code to either gap fill stack parameters if they are missing in the NEI, or to correct stack parameters if they are outside the ranges specified in SMOKE as acceptable values. The SMOKE PSTK file is contained in the ancillary file directory of the 2005v4 website (see the end of Section 1).
- We applied a transport fraction to all SCCs that we identified as PM fugitive dust, to prevent the overestimation of fugitive dust impacts in the grid modeling as described in Section 2.2.1.

There are several changes made to the ptipm and ptnonipm sectors for the 2005v4.2 platform that were briefly discussed in Table 2-2. One of these changes involved reassigning stacks, units and facilities from the ptnonipm sector to the ptipm sector because it was determined that these sources were reflected in the future-year IPM data. By moving these sources from ptnonipm to ptipm, we prevent their being double counted in future-year emissions processing. These changes and other updates in the ptipm and ptnonipm sectors for 2005v4.2 are discussed in the following sections.

2.1.1 IPM sector (ptipm)

The ptipm sector contains emissions from EGUs in the 2005v2 NEI point inventory that we were able match to the units found in the NEEDS database. While we originally used version 3.02 of NEEDS to split out the ptipm sector for v4 of the platform, there were no changes to the mapping when we moved to NEEDs version 4.10. The IPM model provides future-year emission inventories for the universe of EGUs contained in the NEEDS database. As described below, this matching was done (1) to provide consistency between the 2005 EGU sources and future-year EGU emissions for sources which are forecasted by IPM and (2) to avoid double counting in projecting point source emissions.

The 2005v4 platform document provides additional details on how the 2005 NEI point source inventory was split into the ptipm and ptnonipm sectors.

Creation of temporally resolved emissions for the ptipm sector

Another reason we separated the ptipm sources from the other sources was due to the difference in the temporal resolution of the data input to SMOKE. For the base-case 2005 run, the ptipm sector uses daily emissions input into SMOKE. The daily emissions are computed from the annual emissions. First, we allocate annual emissions to each month (this process occurs outside of SMOKE). To do this, we created state-specific, three-year averages of 2004-2006 CEM data. These average annual-to-month factors were assigned to sources by state. To allocate the monthly emissions to each day, we used the 2005 CEM data to compute state-specific month-to-day factors, averaged across all units in each state. The resulting daily emissions were input into SMOKE. The daily-to-hourly allocation was performed with SMOKE using diurnal profiles. The development of these diurnal ptipm-specific profiles, which are considered ancillary data for SMOKE, is described in Section 3.2.3.

Ptipm updates from the 2005v4 platform used in creating the 2005v4.2 platform

- We started with the same ptipm/ptnonipm split as was used for the v4 platform; however, we changed some emissions values based on updates we made to some ORIS identifiers in the ptipm file. For a subset of the units for which we added or changed ORIS identifiers, we recomputed annual emissions for SO_2, NO_X or both using the CEMS data available at the EPA's data and maps website.[2] Facility-level impacts of these changes are provided in Appendix A, Table A-1 of the 2005v4.1 TSD.
- Several sources in the 2005v4 ptnonipm inventory were found to be EGU emissions that were either found in the future-year IPM inventories or determined to have closed between 2005 and the future years. If these emissions were retained in the ptnonipm sector, then future-year projections would either double-count these EGU emissions, or incorrectly not close these units; in both cases, future-year EGU emissions were inflated in the 2005v4 platform. Therefore, we reassigned these known EGU emissions to the ptipm sector. In situations where emissions were moved from ptnonipm to ptipm and these sources were not closed in the future (they were in the future-year IPM inventories), facility, and unit identifier codes were changed to match IPM codes, and more importantly, ORIS facility and boiler identifier codes were also changed to match IPM codes and hence, the CEMS data base. Facilities and units that were moved from the ptnonipm to ptipm sector for 2005v4.2 are provided in Appendix A, Table A-1.
- Several units and facilities in the 2005v4 ptipm inventory were found to be either double counts or were determined to have closed prior to 2005. In most cases, these deletions were for closures at facilities reported in the 2002 NEI that were not updated in the 2005 NEI as closed. These changes are detailed in Appendix A, Table A-2.

[2] http://camddataandmaps.epa.gov/gdm/index.cfm?fuseaction=emissions.wizard

2.1.2 Non-IPM sector (ptnonipm)

The non-IPM (ptnonipm) sector contains all 2005v2 NEI point sources that we did not include in the IPM (ptipm) sector.[3] The ptnonipm sector contains fugitive dust PM emissions from vehicular traffic on paved or unpaved roads at industrial facilities or coal handling at coal mines.[4] Prior to input to SMOKE, we reduced the fugitive dust PM emissions to estimate the emissions that remain aloft by applying county-specific fugitive dust transportable fraction factors. This is discussed further in Section 2.2.1.

For some geographic areas, some of the sources in the ptnonipm sector belong to source categories that are contained in other sectors. This occurs in the inventory when states, tribes or local programs report certain inventory emissions as point sources because they have specific geographic coordinates for these sources. They may use point source SCCs (8-digit) or non-point, onroad or nonroad (10-digit) SCCs. In the 2005 NEI, examples of these types of sources include: aircraft emissions in all states, waste disposal emissions in several states, firefighting training in New Mexico, several industrial processes and solvent utilization sources in North Carolina and Tennessee, livestock (i.e., animal husbandry) in primarily Kansas and Minnesota, and petroleum product working losses.

The modifications between the published 2005v2 NEI and the 2005v4 ptnonipm inventory we used for modeling are summarized here:

Ptnonipm changes from the original 2005v2 inventory for the v4 platform development

- Removed duplicate annual records. We did not delete some apparent duplicates because they were in fact covering different parts of the year (i.e., the emissions in the inventory file were sub-annual).
- Removed a source with a state/county FIPS code of 30777; the “777” county FIPS represents portable facilities that move across counties, but, is not currently a valid state/county FIPS code in the SMOKE ancillary file “COSTCY”. This Montana FIPS code was located in northern Wyoming and contained very small emissions.
- Dropped sources with coordinates located well into the oceans or lakes.
- Fixed the coordinates for several larger sources that had a state/county FIPS code mismatch with their inventory coordinates greater than 10 km and emissions greater than 10 tons per year of either NO_X, VOC, SO_2, or 5 tons/yr of $PM_{2.5}$. These corrections were limited to a small number of plants in Arizona, Indiana, Kentucky, Ohio, and Virginia.

In addition to the ptnonipm inventory updates implemented in the 2005v4 platform, we applied the following updates in the 2005v4.2 ptnonipm sector:

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[3] Except for the offshore oil and day-specific point source fire emissions data which are included in separate sectors, as discussed in sections 2.6 and 2.3.1, respectively.

[4] Point source fugitive dust emissions, which represent a very small amount of PM, were treated the same way in the 2002 platform but were treated as a separate sector in the 2001 Platform.

Ptnonipm updates from 2005v4 platform used in creating the 2005v4.2 platform

- As discussed in Section 2.1.1, several sources in the 2005v4 ptnonipm inventory were found to be EGU emissions that were either found in the future-year IPM inventories or determined to have closed between 2005 and the future years. Therefore, we reassigned these known EGU emissions to the ptipm sector; these are provided in Appendix A, Table A-1.
- Several units and facilities in the 2005v4 ptnonipm inventory were found to be either double counts or were determined to have closed prior to 2005. In most cases, these deletions were for closures at facilities reported in the 2002 NEI that were not updated in the 2005 NEI as closed.
- Evolutionary inventory updates and updates from the Transport Rule comments were applied to several facilities. A list of all facilities with updated or deleted ptnonipm emissions between 2005v4 and 2005v4.2 is provided in Appendix A. One of the most significant evolutionary updates was incorporating the PM condensable portion of emissions to the Clarion Steel Plant in Allegheny County Pennsylvania (PLANTID=4200300032), where by-product Coke Manufacturing, quenching PM condensable emissions were augmented, increasing total plant-level $PM_{2.5}$ emissions from under 500 annual tons in the 2005v4 platform to approximately 2,000 annual tons in the 2005v4.2 platform.
- We added the North Dakota ADM facility (FIPS code = 38067) that was in the 2005v1 NEI but was missing from the 2005v2 NEI and was not determined to have shut down. The 2002-based emissions were added to the ptnonipm file, since 2005 data were not available.
- We added an inventory of 2005 ethanol plants using plant names and data provided by the EPA's Office of Transportation and Air Quality for use in a previous modeling effort (Renewable Fuel Standards 2), which included these with the 2005v1 inventory. The list below includes only the ethanol plants that were used in the previous modeling effort but were missing from the 2005v2 NEI.

State/County FIPS code	Plant Name	CO (tons/yr)	NOX (tons/yr)	PM10 (tons/yr)	PM2.5 (tons/yr)	SO2 (tons/yr)	VOC (tons/yr)
06065	Golden Cheese Company of CA	10	30	12	1	39	14
13205	Wind Gap Farms (Anheuser/Miller Brewery)	1	2	1	0	3	1
19033	Golden Grain Energy LLC	147	424	170	15	540	201
19035	Little Sioux Corn Processors	184	534	213	19	679	252
19055	Permeate Refining	3	9	4	0	12	4
19057	Big River Resources, LLC	109	315	126	13	401	149
19083	Hawkeye Renewables, LLC	115	333	133	14	424	158
19093	Quad-County Corn Processors	57	164	65	7	208	77
19167	Siouxland Energy & Livestock Coop (SELC)	209	606	243	26	772	287
21047	Commonwealth Agri-Energy, LLC	46	133	53	5	170	63
31047	Cornhusker Energy Lexington (CEL)	25	73	29	3	93	34
31145	SW Energy, LLC.	42	121	49	5	154	57
35041	Abengoa Bioenergy Corporation	10	30	12	1	39	14
46005	Heartland Grain Fuels, LP	0	1	0	0	1	0

46109	North Country Ethanol (NCE)	63	182	73	7	231	86
19109	Global Ethanol	29	85	34	3	108	40
20055	Reeve Agri-Energy	52	152	61	6	193	72
	TOTAL TONS	1,104	3,195	1,278	127	4,066	1,510

2.2 2005 nonpoint sources (afdust, ag, nonpt)

The 2005v2 NEI typically used the same values for nonpoint emissions as were found in the 2002 NEI. This modeling platform took a similar approach, with a couple of notable exceptions discussed in Section 2.2.3. We created several sectors from the 2002 nonpoint NEI. We removed the nonpoint tribal-submitted emissions to prevent possible double counting with the county-level emissions. Because the tribal nonpoint emissions are small, we do not anticipate these omissions having an impact on the results at the 36-km and 12-km scales used for this modeling. The documentation for the nonpoint sector of the 2005 NEI.

In the rest of this section, we describe in more detail each of the platform sectors into which we separated the 2005 nonpoint NEI, and the changes we made to these data. We will refer to the 2002 platform documentation for sectors that did not change.

2.2.1 Area fugitive dust sector (afdust)

The emissions for this sector are unchanged from the 2005v4 platform, and the documentation is repeated here for convenience. However, we changed the temporal allocation of the emissions to account for day-of-week variation. In particular, we used updated dust profiles that are consistent with the activity related to non-dust profiles for similar processes. The processes and profiles updated are provided in Pouliot, et. al., 2010. In previous modeling, all days within the same month had the same emissions.

The area-source fugitive dust (afdust) sector contains PM_{10} and $PM_{2.5}$ emission estimates for 2002 NEI nonpoint SCCs identified by the EPA staff as dust sources. This sector is separated from other nonpoint sectors to make it easier to apply a “transport fraction,” which reduces emissions to reflect observed diminished transport from these sources at the scale of our modeling. Application of the transport fraction prevents the overestimation of fugitive dust impacts in the grid modeling as compared to ambient samples. Categories included in this sector are paved roads, unpaved roads and airstrips, construction (residential, industrial, road and total), agriculture production and all of the mining 10-digit SCCs beginning with the digits “2325.” It does not include fugitive dust from grain elevators because these are elevated point sources.

We created the afdust sector from the 2002 NEI based on SCCs and pollutant codes (i.e., PM_{10} and $PM_{2.5}$) that are considered “fugitive”. A complete list of all possible fugitive dust SCCs (including both 8-digit point source SCCs and 10-digit nonpoint SCCs). However, not all of the SCCs in this file are present in the 2002 NEI. The SCCs included in the 2002 NEI that comprise the 2005 (and 2002) platform afdust sector (which are a subset of the SCCs in the web link) are provided in Table 2-4.

Table 2-4. SCCs in the afdust platform sector

SCC	SCC Description
2275085000	Mobile Sources;Aircraft;Unpaved Airstrips;Total
2294000000	Mobile Sources;Paved Roads;All Paved Roads;Total: Fugitives
2296000000	Mobile Sources;Unpaved Roads;All Unpaved Roads;Total: Fugitives
2296005000	Mobile Sources;Unpaved Roads;Public Unpaved Roads;Total: Fugitives
2296010000	Mobile Sources;Unpaved Roads;Industrial Unpaved Roads;Total: Fugitives
2311000000	Industrial Processes;Construction: SIC 15 - 17;All Processes;Total
2311010000	Industrial Processes;Construction: SIC 15 - 17;Residential;Total
2311010040	Industrial Processes;Construction: SIC 15 - 17;Residential;Ground Excavations
2311010070	Industrial Processes;Construction: SIC 15 - 17;Residential;Vehicle Traffic
2311020000	Industrial Processes;Construction: SIC 15 - 17;Industrial/Commercial/Institutional;Total
2311020040	Industrial Processes;Construction: SIC 15 - 17;Industrial/Commercial/Institutional;Ground Excavations
2311030000	Industrial Processes;Construction: SIC 15 - 17;Road Construction;Total
2325000000	Industrial Processes;Mining and Quarrying: SIC 14;All Processes;Total
2801000000	Miscellaneous Area Sources;Agriculture Production - Crops;Agriculture - Crops;Total
2801000002	Miscellaneous Area Sources;Agriculture Production - Crops;Agriculture - Crops;Planting
2801000003	Miscellaneous Area Sources;Agriculture Production - Crops;Agriculture - Crops;Tilling
2801000005	Miscellaneous Area Sources;Agriculture Production - Crops;Agriculture - Crops;Harvesting
2801000007	Miscellaneous Area Sources;Agriculture Production - Crops;Agriculture - Crops;Loading
2805000000	Miscellaneous Area Sources;Agriculture Production - Livestock;Agriculture - Livestock;Total
2805001000	Miscellaneous Area Sources;Agriculture Production - Livestock;Beef cattle - finishing operations on feedlots (drylots);Dust Kicked-up by Hooves (use 28-05-020, -001, -002, or -003 for Waste

Our approach was to apply the transportable fractions by county such that all afdust SCCs in the same county receive the same factor. The approach used to calculate the county-specific transportable fractions is based on land use data. As this paper mentions, a limitation of the transportable fraction approach is the lack of monthly variability, which would be expected due to seasonal changes in vegetative cover. Further, the variability due to soil moisture, precipitation, and wind speeds is not accounted for by the methodology. Here is an electronic version of the county-level transport fractions.

The 2002 platform documentation describes an error in which the transportable fraction application for $PM_{2.5}$ was not applied. This error was fixed for the 2005v4.2 platform, and 2005 $PM_{2.5}$ afdust emissions are therefore correctly about 43% less than those in the 2002 platform.

2.2.2 Agricultural ammonia sector (ag)

This sector is unchanged from the 2005v4 platform; the documentation is repeated here for completeness.

The agricultural NH_3 "ag" sector is comprised of livestock and agricultural fertilizer application emissions from the nonpoint sector of the 2002 NEI. This sector is unchanged in the 2005 platform. The rest of this section documentation is therefore very similar to that in the 2002 documentation.

In building this sector we extracted livestock and fertilizer emissions based on the SCC. The livestock SCCs are listed in Table 2-5, and the fertilizer SCCs are listed in Table 2-6.

Table 2-5. Livestock SCCs extracted from the 2002 NEI to create the ag sector

SCC	SCC Description*
2805000000	Agriculture - Livestock;Total
2805001100	Beef cattle - finishing operations on feedlots (drylots);Confinement
2805001200	Beef cattle - finishing operations on feedlots (drylots);Manure handling and storage
2805001300	Beef cattle - finishing operations on feedlots (drylots);Land application of manure
2805002000	Beef cattle production composite;Not Elsewhere Classified
2805003100	Beef cattle - finishing operations on pasture/range;Confinement
2805007100	Poultry production - layers with dry manure management systems;Confinement
2805007300	Poultry production - layers with dry manure management systems;Land application of manure
2805008100	Poultry production - layers with wet manure management systems;Confinement
2805008200	Poultry production - layers with wet manure management systems;Manure handling and storage
2805008300	Poultry production - layers with wet manure management systems;Land application of manure
2805009100	Poultry production - broilers;Confinement
2805009200	Poultry production - broilers;Manure handling and storage
2805009300	Poultry production - broilers;Land application of manure
2805010100	Poultry production - turkeys;Confinement
2805010200	Poultry production - turkeys;Manure handling and storage
2805010300	Poultry production - turkeys;Land application of manure
2805018000	Dairy cattle composite;Not Elsewhere Classified
2805019100	Dairy cattle - flush dairy;Confinement
2805019200	Dairy cattle - flush dairy;Manure handling and storage
2805019300	Dairy cattle - flush dairy;Land application of manure
2805020001	Cattle and Calves Waste Emissions;Milk Cows
2805020002	Cattle and Calves Waste Emissions;Beef Cows
2805020003	Cattle and Calves Waste Emissions;Heifers and Heifer Calves
2805020004	Cattle and Calves Waste Emissions;Steers, Steer Calves, Bulls, and Bull Calves
2805021100	Dairy cattle - scrape dairy;Confinement
2805021200	Dairy cattle - scrape dairy;Manure handling and storage
2805021300	Dairy cattle - scrape dairy;Land application of manure
2805022100	Dairy cattle - deep pit dairy;Confinement
2805022200	Dairy cattle - deep pit dairy;Manure handling and storage
2805022300	Dairy cattle - deep pit dairy;Land application of manure
2805023100	Dairy cattle - drylot/pasture dairy;Confinement
2805023200	Dairy cattle - drylot/pasture dairy;Manure handling and storage
2805023300	Dairy cattle - drylot/pasture dairy;Land application of manure
2805025000	Swine production composite;Not Elsewhere Classified (see also 28-05-039, -047, -053)
2805030000	Poultry Waste Emissions;Not Elsewhere Classified (see also 28-05-007, -008, -009)
2805030001	Poultry Waste Emissions;Pullet Chicks and Pullets less than 13 weeks old
2805030002	Poultry Waste Emissions;Pullets 13 weeks old and older but less than 20 weeks old
2805030003	Poultry Waste Emissions;Layers
2805030004	Poultry Waste Emissions;Broilers
2805030007	Poultry Waste Emissions;Ducks
2805030008	Poultry Waste Emissions;Geese
2805030009	Poultry Waste Emissions;Turkeys
2805035000	Horses and Ponies Waste Emissions;Not Elsewhere Classified
2805039100	Swine production - operations with lagoons (unspecified animal age);Confinement
2805039200	Swine production - operations with lagoons (unspecified animal age);Manure handling and storage
2805039300	Swine production - operations with lagoons (unspecified animal age);Land application of manure

SCC	SCC Description*
2805040000	Sheep and Lambs Waste Emissions;Total
2805045000	Goats Waste Emissions;Not Elsewhere Classified
2805045002	Goats Waste Emissions;Angora Goats
2805045003	Goats Waste Emissions;Milk Goats
2805047100	Swine production - deep-pit house operations (unspecified animal age);Confinement
2805047300	Swine production - deep-pit house operations (unspecified animal age);Land application of manure
2805053100	Swine production - outdoor operations (unspecified animal age);Confinement

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

The "ag" sector includes all of the NH_3 emissions from fertilizer from the NEI. However, the "ag" sector does not include all of the livestock ammonia emissions, as there are also significant NH_3 emissions from livestock in the point source inventory that we retained from the 2002 NEI. Note that in these cases, emissions were not also in the nonpoint inventory for counties for which they were in the point source inventory; therefore no double counting occurred. Most of the point source livestock NH_3 emissions were reported by the states of Kansas and Minnesota. For these two states, farms with animal operations were provided as point sources using the following SCCs[5]:

- 30202001: Industrial Processes; Food and Agriculture; Beef Cattle Feedlots; Feedlots General
- 30202101: Industrial Processes; Food and Agriculture; Eggs and Poultry Production; Manure Handling: Dry
- 30203099: Industrial Processes; Food and Agriculture; Dairy Products; Other Not Classified

There are also livestock NH_3 emissions in the point source inventory with SCCs of 39999999 (Industrial Processes; Miscellaneous Manufacturing Industries; Miscellaneous Industrial Processes; Other Not Classified) and 30288801 (Industrial Processes; Food and Agriculture; Fugitive Emissions; Specify in Comments Field). We identified these sources as livestock NH_3 point sources based on their facility name. The reason why we needed to identify livestock NH_3 in the ptnonipm sector was to properly implement the emission projection techniques for livestock sources, which cover all livestock sources, not only those in the ag sector, but also those in the ptnonipm sector.

[5] These point source emissions are also identified by the segment ID, which is one of the following: "SWINE", "CATTLE", "DAIRY", or "PLTRY".

Table 2-6. Fertilizer SCCs extracted from the 2002 NEI for inclusion in the "ag" sector

2002 SCC	2002 SCC Description*
2801700001	Anhydrous Ammonia
2801700002	Aqueous Ammonia
2801700003	Nitrogen Solutions
2801700004	Urea
2801700005	Ammonium Nitrate
2801700006	Ammonium Sulfate
2801700007	Ammonium Thiosulfate
2801700010	N-P-K (multi-grade nutrient fertilizers)
2801700011	Calcium Ammonium Nitrate
2801700012	Potassium Nitrate
2801700013	Diammonium Phosphate
2801700014	Monoammonium Phosphate
2801700015	Liquid Ammonium Polyphosphate
2801700099	Miscellaneous Fertilizers

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

2.2.3 Other nonpoint sources (nonpt)

Nonpoint sources that were not subdivided into the afdust, ag, or avefire sectors were assigned to the "nonpt" sector.

The 2002 platform documentation describes the creation of the 2002 nonpt sector in great detail, but the rest of this section will simply document what has changed for the 2005v4.2 platform. Below is a list of changes made from the 2002 platform both for the v4 platform and for the v4.2 platform. Details on the changes to 2002 for the version 4 platform are in the v4 documentation.

Updates to the nonpt sector from 2002 platform made for creation of the nonpt sector of the 2005v4 platform

- The 2005 platform replaces 2002v3 NEI non-California Western Regional Air Partnership (WRAP) oil and gas emissions (SCCs beginning with "23100") with WRAP year 2005 Phase II oil and gas emissions.
- Residential wood combustion (RWC) emissions were replaced with data for Oregon and New York. This update is consistent with the 2005v2 NEI.
- RWC VOC emissions were recalculated for all states except California to reflect an updated emissions factor for VOC from RWC sources. This update is consistent with the 2005v2 NEI.
- We utilized benzene, formaldehyde, acetaldehyde and methanol (BAFM) emissions from sources that met the HAP-CAP integration criteria discussed in Section 3.1.2.1 (i.e., the "integrate" sources). We removed BAFM from sources that did not meet the integration criteria (i.e., the "no-integrate" sources) so that BAFM would not be double counted with the BAFM generated via speciation of VOC.

Updates from 2005v4 platform used in creating the 2005v4.2 platform

- We changed the integration status for pesticide emissions from using the "integrate" case to using the "no-integrate" case. The main reason is that there were significant benzene emissions from this category in the NEI that was considered incorrect. The NEI benzene came from solvent utilization data (Fredonia) for "other markets" for the year 1998. Since benzene no longer allowed in pesticides, we chose to eliminate the use of these HAP data and use a VOC speciation profile that did not include benzene emissions to be more consistent with the changed regulations.
- We replaced Delaware fuel combustion (all industrial, commercial, and residential), residential wood combustion, and open burning with revised state estimates for NOX, SO2, and PM. The impact of this inventory change is shown in Appendix A, Table A-3.
- We removed South Carolina residual oil emissions from industrial boilers. We determined that these nonpoint emissions were a double count from those in the point inventory. Removing these emissions is consistent with the preliminary 2008 NEI data submittal. The impact of this inventory change is shown in Appendix A, Table A-3.
- We replaced Nebraska industrial fuel combustion emissions with 2005 Central Regional Air Planning Association (CENRAP) dataset, version G. The impact of this inventory change is shown in Appendix A, Table A-3.
- We added oil and gas emissions for Texas and replaced oil and gas emissions with updated 2005 data from Oklahoma.

TCEQ Oil and Gas Emissions

The Texas Commission on Environmental Quality (TCEQ) provided 2005 oil and gas emissions which we added to the nonpt sector. The emissions were for a single SCC: 2310000220 Industrial Processes; Oil and Gas Exploration and Production; All Processes; Drill Rigs. The TCEQ indicated that these should replace emissions in the nonroad inventory from the NONROAD model (drill rigs: SCC=2270010010). Because the nonroad emissions are significantly less than the updated nonpt emissions, we did not remove the nonroad emissions. Both the TCEQ and related nonroad emissions from the 2005 NEI are summarized in Table 2-7.

Table 2-7. Additional TCEQ oil and gas emissions added to the 2005v2 NEI

Pollutant	TCEQ Emissions 2005, added to nonpt (tons/yr)	NEI 2005 Emissions (nonroad inventory), not subtracted (tons/yr)
CO	15,878	1,396
NH_3		3
NO_X	42,854	4,704
PM_{10}	3,036	275
$PM_{2.5}$	2,945	267
SO_2	5,977	573
VOC	4,337	340

Oklahoma Oil and Gas Emissions

The state of Oklahoma provided and emissions replacement for their 2005 oil and gas sector emissions. These data added emissions for the SCCs shown in Table 2-8.

Table 2-8. SCCs provided with Oklahoma oil and gas sector emissions

SCC	SCC Description
31000103	Crude Oil Production;Wells: Rod Pumps*
31000122	Crude Oil Production;Drilling and Well Completion*
31000203	Natural Gas Production;Compressors*
31000215	Natural Gas Production;Flares Combusting Gases >1000 BTU/scf*
31000222	Natural Gas Production;Drilling and Well Completion*
31000227	Gas Production;Glycol Dehydrator Reboiler Still Stack*
31000228	Natural Gas Production;Glycol Dehydrator Reboiler Burner*
31000403	Industrial Processes;Oil and Gas Production;Process Heaters;Crude Oil
31000404	Industrial Processes;Oil and Gas Production;Process Heaters;Natural Gas
31088811	Industrial Processes;Oil and Gas Production;Fugitive Emissions;Fugitive Emissions

* These SCC descriptions start with the preface "Industrial Processes;Oil and Gas Production"

In addition, this update removed emissions for SCC 2310000000, which is "Industrial Processes;Oil and Gas Production: SIC 13;All Processes;Total: All Processes."

The resultant Oklahoma emissions are shown below in Table 2-9. Note that Oklahoma instructed that PM_{10} emissions were size $PM_{2.5}$, and therefore no coarse PM (PMC) was generated and PM_{10} is the same as PM2.5

Table 2-9. Changes to Oklahoma oil and gas emissions

Pollutant	2005 Oklahoma Oil and gas emissions 2005, removed from nonpt (tons/yr)	2005 Oklahoma Oil and gas emissions, added to nonpt (tons/yr)
CO	11,251	32,821
VOC	104,193	155,908
NO_X	66,480	39,668
SO_2	0	1,014
$PM_{10} = PM_{2.5}$	0	1,918

2.3 Fires (avefire)

The purpose of the avefire sector is to represent emissions for a typical year's fires for use in projection year inventories, since the location and degree of future-year fires are not known. This approach keeps the fires information constant between the 2005 base case and future-year cases to eliminate large and uncertain differences between those cases that would be caused by changing the fires. Using an average of multiple years of data reduces the possibility that a single-year's high or low fire activity would unduly affect future-year model-predicted concentrations.

The avefire sector contains wildfire and prescribed burning emissions. It excludes agricultural burning and other open burning sources, which are included in the nonpt sector. Generally, their year-to-year impacts are not as variable as wildfires and non-agricultural prescribed/managed burns.

We use this sector for the 2005 base case, and all future-year cases. Emissions are annual and county-level. The same emissions are used in the v4 and v4.2 versions of the 2005-based platform. Refer to the 2005v4 platform documentation for more information.

2.4 Biogenic sources (biog)

This sector is unchanged from the 2005v4 platform; the documentation is repeated here for completeness.

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.

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.

2.5 2005 mobile sources (on_noadj, on_moves_runpm, on_moves_startpm, nonroad, alm_no_c3, seca_c3)

For the 2005 platform, as indicated in Table 2-2, we separated the 2005 onroad emissions into three sectors: (1) “on_moves_startpm”; (2) “on_moves_runpm”; and (3) “on_noadj”. The on_moves_startpm and on_moves_runpm sectors are processed separately because these sectors contain gasoline exhaust PM emissions that are subject to mode-specific (start versus running) hourly temperature adjustments during SMOKE processing. All pollutants and sources in the on_noadj sector are not subject to hourly temperature adjustments. The aircraft, locomotive, and commercial marine emissions are divided into two nonroad sectors: “alm_no_c3” and “seca_c3”, and as previously mentioned, the aircraft emissions are in the non-EGU (ptnonipm) point inventory. The seca_c3 emissions are treated as point emissions with an elevated release component while all other nonroad emissions are treated as county-specific low-level emissions.

The onroad emissions were primarily based on the publicly released 12/21/2009 version of the Motor Vehicle Emissions Simulator (MOVES2010). MOVES was run with a state/month aggregation using county-average fuels for each state, state/month-average temperatures, and national default vehicle age distributions. 2005 Vehicle Miles Travelled (VMT), consistent with the 2005v2 NEI, were used.

The major changes between v4.2 and v4 versions of the 2005-based platform are that (1) we used a publicly released version of MOVES (MOVES2010), rather than a draft version of MOVES; (2) we used the MOVES emissions for all vehicle types and modes (as opposed to non-motorcycle gasoline exhaust vehicles only); (3) MOVES2010 emissions cover all criteria pollutants and criteria pollutant precursors (as opposed to draft MOVES that covered only exhaust mode $PM_{2.5}$, VOC, NO_X and CO); and (4) we used NH_3 from MOVES for California (as opposed to NH_3 from NMIM) since California-supplied emissions in the 2005v2 NEI do not include NH_3. It should also be noted that the exhaust $PM_{2.5}$ from diesel vehicles, which had previously come from NMIM but in v4.2 comes from MOVES, are not impacted by cold temperatures. In addition, PM brake wear and tire wear mode emissions are now provided in MOVES in v4.2; these emissions for both gasoline and diesel vehicles are also not impacted by cold temperatures.

Table 2-10 lists the data source for all pollutants, vehicle types, and modes (e.g., exhaust, evaporative, brake and tire wear) for all pollutants in the 2005v4 and 2005v4.2 emissions modeling platform. Naphthalene, 1-3-butadiene, and acrolein are also provided by MOVES2010 but were not included in our 2005v4.2 platform.

Table 2-10. Data sources for onroad mobile sources in the 2005v4 and 2005v4.2 platforms[1]

Pollutants/vehicles/modes	2005v4	2005v4.2
$PM_{2.5}$; gasoline exhaust, partially speciated[2]	Draft MOVES	MOVES2010
$PM_{2.5}$; diesel exhaust, partially speciated[2]	NMIM	MOVES2010
$PM_{2.5}$, brake and tirewear, unspeciated	NMIM	MOVES2010
VOC, Benzene (except refueling); gasoline	Draft MOVES	MOVES2010
VOC, Benzene (except refueling); diesel	NMIM	MOVES2010
CO, NO_X, SO_2, NH_3, Acetaldehyde, Formaldehyde; gasoline	Draft MOVES	MOVES2010
CO, NO_X, SO_2, NH_3, Acetaldehyde, Formaldehyde; diesel	NMIM	MOVES2010

[1] For California, 2005v4 and 2005v4.2 use draft MOVES and MOVES2010 (respectively) only for NH_3.
[2] Exhaust mode $PM_{2.5}$ species from MOVES consist of: PEC, PSO_4 and the difference between $PM_{2.5}$ and PEC (named as "PM25OC"). Procedures to produce the species needed are provided in Appendix D of the 2005v4.1 TSD. Diesel partially speciated emissions are not impacted by cold temperatures and do not need to be adjusted by gridded temperature as do the gasoline exhaust particulate emissions. Brake wear and tire wear $PM_{2.5}$ emissions were not pre-speciated.

Similar to the v4 platform, we used the MOVES data to create emissions by state and month (and SCC) and then allocated to counties based on 2005 NMIM-based county-level data. The reason for using the state resolution was due to (a) run time issues that made a county run for the entire nation infeasible in the timeframe required and (b) incomplete efforts to create a national database of county-specific inputs to MOVES. For 2005v4.2, no pollutants are obtained from the 2005 NMIM runs.

The 2005v2 NEI does not contain the MOVES data that we use for the 2005 platform. Instead, it contains onroad and nonroad mobile emissions that we generated using NMIM (EPA, 2005a) for all of the U.S. except for California.[6] The NMIM data was used only to allocate California-submitted data to road types, to allocate the state-month-SCC MOVES data to counties, and for some of the nonroad mobile sources. NMIM relies on calculations from the MOBILE6 and NONROAD2005 models as described below, and in the NEI documentation. Inputs to NMIM are posted with the 2005 Emission Inventory.

NMIM creates the onroad and nonroad emissions on a month-specific basis that accounts for temperature, fuel types, and other variables that vary by month. Inventory documentation for the 2005v2 NEI onroad and nonroad sectors is also posted with other 2005 NEI documentation.

The residual fuel commercial marine vessel (CMV), also referred to as Category 3 (C3) from the 2002 platform were replaced with a set of approximately 4-km resolution point source format emissions; these were modeled separately as point sources in the "seca_c3" sector for the 2005 platform. They were updated for v4.2 by using revised 2005 emissions from the category 3 commercial marine vessel sector to reflect the final projections from 2002 developed for the category 3 commercial marine Emissions Control Area (ECA) Proposal to the International Maritime Organization (EPA-420-F-10-041, August 2010). Unlike for the v4 platform, we projected Canada as part of the ECA, using region-specific growth rates; thus the v4.2 seca_c3 inventories contain Canadian province codes for near shore emissions.

The nonroad sector, based on NMIM did not change for the v4.2 platform other than for California, for which missing $PM_{2.5}$ emissions for 7 counties was discovered. We corrected these $PM_{2.5}$ emissions by using an earlier version of the 2005 submittal which California had provided values for the 7 counties.

The mobile sectors are compiled at a county and SCC resolution, with the exception of the seca_c3 sector that uses point sources to map the pre-gridded data to the modeling domain. Similar to v4, in v4.2, tribal data from the alm_no_c3 sector have been dropped because we do not have spatial surrogate data, and the emissions are small; these data were removed from the SMOKE input inventories for 2005.

Most mobile sectors use the HAP portion on the inventory to provide benzene, acetaldehyde, formaldehyde and/or methanol to the modeling inputs through HAP VOC "integration", as described in Section 3.1.2.1. A few categories of nonroad sources (CNG and LPG-fueled equipment) do not have the BAFM pollutants in the inventory and therefore utilize the "no-

[6] Although OTAQ generated emissions using NMIM for California, these were not used in the 2005 NEI version 2, but rather were replaced by state-submitted emissions. Since California did not submit NH_3, values from MOVES were used.

integrate”, “no-hap-use” case, which means VOC from these sources is speciated to provide BAFM.

2.5.1 Onroad gasoline exhaust cold-start mode PM (on_moves_startpm)

This sector contains MOVES2010 emissions for PM and naphthalene[7] for non-California onroad gasoline cold-start exhaust. These emissions (and the on_moves_runpm sector discussed in the next section) are processed separately from the remainder of the onroad mobile emissions because they are subject to hourly temperature adjustments, and these temperature adjustments are different for cold-start and running exhaust modes.

Temperature adjustments were applied to account for the strong sensitivity of PM and naphthalene exhaust emissions to temperatures below 72ºF. Because it was not feasible to run MOVES directly for all of the gridded, hourly temperatures needed for modeling, we created emissions of PM and naphthalene exhaust at 72ºF and applied temperature adjustments after the emissions were spatially and temporally allocated. The $PM_{2.5}$ (and naphthalene) adjustment factors were different for starting and running exhaust because these two processes respond differently to temperature as shown in Figure 2-1 which shows how these emissions increase with colder temperatures. The temperature adjustment factor in this figure is defined in terms of primary elemental carbon (PEC) as follows:

PEC = Adjustment Factor x PEC_72

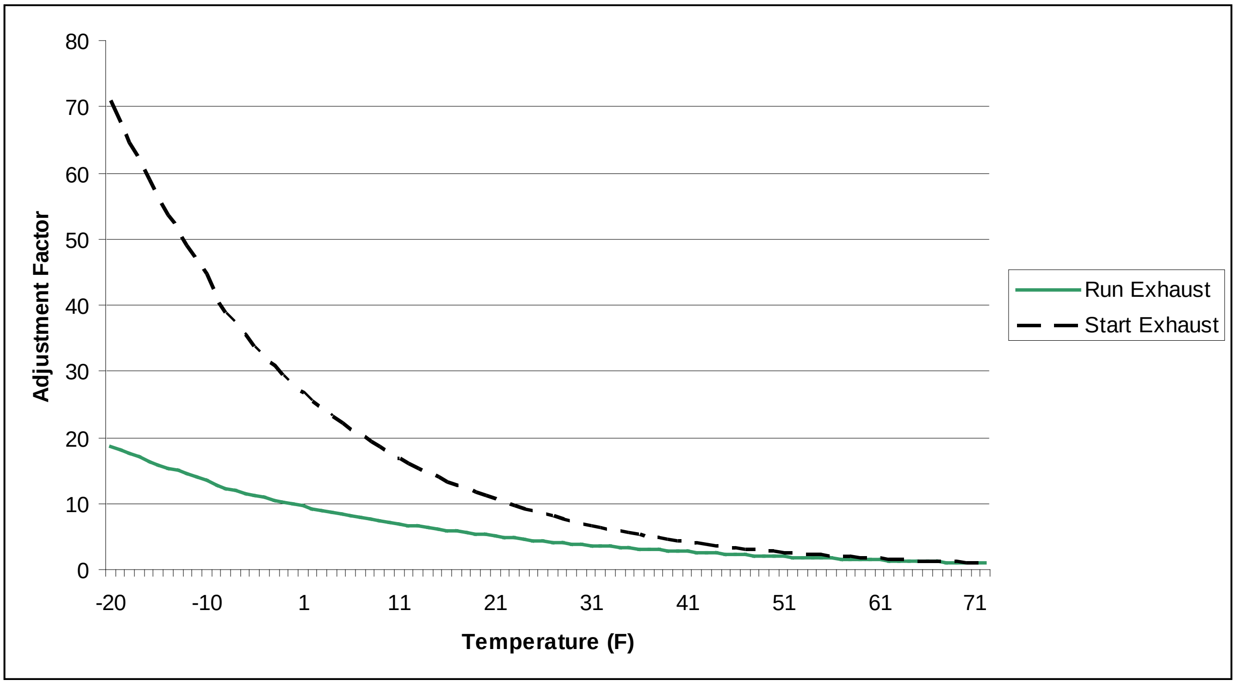
Where:
PEC = PEC at Temperatures below 72ºF
PEC_72 = PEC at 72ºF or higher

As seen in the figure, start exhaust emissions increase more than running exhaust emissions as temperatures decrease from 72ºF.

Figure 2-1 also shows that the actual adjustments are different for start exhaust and running exhaust emissions. The method for applying these adjustments was the same for both start and running exhaust sectors: They were applied to SMOKE gridded, hourly intermediate files, based upon the gridded hourly temperature data (these same data are also input to the air quality model). One result of this approach is that inventory summaries based on the raw SMOKE inputs for the on_moves_startpm and on_moves_runpm sectors will not be valid because they will not include the temperature adjustments. As a result, the post-processing for temperature adjustments included computing the emissions totals at state, county, and month resolution to use for summaries.

[7] Naphthalene is not used in the 2005v4 CAP-BAFM platform, but it is contained in the MOVES emissions.

Figure 2-1. MOVES exhaust temperature adjustment functions.



The MOVES output data required pre-processing to develop county-level monthly ORL files for input to SMOKE. As stated earlier, the resolution of the MOVES data was state-SCC totals, and the state level data were allocated to county level prior to input into SMOKE. An additional pre-processing step was for the exhaust $PM_{2.5}$, for which emissions from MOVES were partially speciated. To retain the speciated elemental carbon and sulfate emissions from MOVES, the speciation step that is usually done in SMOKE was performed prior to SMOKE, and it was modified to allow the temperature adjustments to be applied to only the species affected by temperature as described in the list below. Finally, because the start exhaust emissions were broken out separately from running exhaust emissions, they were assigned to new SCCs (urban and rural parking areas) that allowed for the appropriate spatial and temporal profiles to be applied in SMOKE.

A list of the procedures performed to prepare the MOVES data for input into SMOKE is provided here.

i. We allocated state-level emissions to counties using state-county emission ratios by SCC, pollutant, month, and emissions mode (e.g., evaporative, exhaust, brake wear, and tire wear) for each month. The ratios were computed using NMIM 2005 data (same data included in the 2005v2 NEI).

ii. We assigned these start exhaust emissions to urban and rural SCCs based on the county-level ratio of emissions from urban versus rural local roads from the NMIM onroad gasoline exhaust mode data. For example, we split light duty gasoline vehicle (LDGV) start emissions in the state-total MOVES data (assigned SCC 2201001000) into urban (2201001370) and rural (2201001350) based on the ratio of LDGV urban (2201001330) and rural (2201001210) local roads.

iii. We converted MOVES-based $PM_{2.5}$ species at 72ºF to SMOKE-ready PM species. The SMOKE-ready species are listed below and the speciation technique used to obtain the SMOKE-ready species is further discussed in Appendix D of the 2005v4.1 TSD.

- NAPHTH_72: unchanged from MOVES-based file, subject to temperature adjustment below 72ºF.
- PEC_72: unchanged from MOVES-based PM25EC, subject to temperature adjustment below 72ºF.
- POC_72: modified MOVES-based PM25OC to remove metals, PNO3 (computed from MOVES-based PM25EC), NH_4 (computed from MOVES-based PM25SO4 and PNO3) and MOVES-based PM25SO4. Subject to temperature adjustment below 72ºF.
- PSO4: unchanged from MOVES-based PM25SO4, not subject to temperature adjustment.
- PNO3: computed from MOVES-based PM25EC, not subject to temperature adjustment.
- OTHER: sum of computed metals (fraction of MOVES-based PM25EC) and NH_4 (computed from PNO3 and PSO4), not subject to temperature adjustment.
- PMFINE_72: Computed from OTHER and fraction of POC_72. Subject to temperature adjustment below 72 ºF.
- PMC_72: Computed as fraction of sum of PMFINE_72, PEC_72, POC_72, PSO4, and PNO3. Subject to temperature adjustment below 72 ºF.

The total MOVES PM emissions are conserved during allocation from states to counties, and from the generic total “start” SCCs to the two new parking SCCs that end in “350” and “370”. PEC and PSO4 components of $PM_{2.5}$ emissions are also conserved as they are simply renamed from the MOVES species “PM25EC” and “PM25SO4”. However, as seen above, POC, PNO3, and PMFINE components involve multiplying the MOVES PM species by components of an onroad gasoline exhaust speciation profile described in Appendix D of the 2005v4.1 TSD.

2.5.2 Onroad gasoline exhaust running mode PM (on_moves_runpm)

This sector is identical to the on_moves_startpm sector discussed in Section 2.5.1, but, contains running exhaust emissions instead of cold-start exhaust emissions. The same pollutants are in this sector, and allocation from the MOVES state-level to county-level inventory is a simple match by SCC and month to NMIM state-county ratios. The only reason this sector is separated from on_moves_startpm is because the temperature adjustments are less extreme for these running emissions at colder temperatures when compared to the curve for cold-start emissions (Figure 2-1).

2.5.3 Onroad mobile with no adjustments for daily temperature (on_noadj)

This sector consists of the bulk of the onroad mobile emissions, which are not covered by the on_moves_startpm and on_moves_runpm sectors. These emissions did not receive any temperature adjustments in our processing. There are four sources of data that are pre-processed to create two sets of monthly inventories for this sector.

1. MOVES-based onroad gasoline and diesel: These are the MOVES-based emissions monthly (not including gasoline exhaust mode PM and naphthalene) consisting of the following:

    a. Gasoline Exhaust: VOC, NO_X, CO, SO_2, NH_3, 1,3-butadiene (106990), acetaldehyde (75070), acrolein (107028), benzene (71432), formaldehyde (50000), and brake and tire wear $PM_{2.5}$;

    b. Diesel Exhaust: Partially-speciated $PM_{2.5}$ (that were fully speciated prior to input into SMOKE (via Appendix D of the 2005v4.1 TSD), VOC, NO_X, CO, SO_2, NH_3, 1,3-butadiene (106990), acetaldehyde (75070), acrolein (107028), benzene (71432), formaldehyde (50000), and brake and tire wear $PM_{2.5}$. Because diesel exhaust PM does not require the same intermediate temperature adjustments as gasoline exhaust PM, diesel exhaust PM can therefore be processed with the remaining onroad mobile emissions.

    c. Evaporative: Non-refueling VOC, benzene, and naphthalene (91203).

    For the pollutants listed, these non-California MOVES emissions encompass the same sources as the on_moves_startpm and on_moves_runpm sectors: light duty gasoline vehicles, light duty gasoline trucks (1 & 2), and heavy duty gasoline vehicles, but they do not require the same intermediate temperature adjustments and can therefore be processed with the remaining onroad mobile emissions. These emissions contain both running and parking sources and they are pre-processed from state-level to county-level much like the on_moves_startpm and on_moves_runpm sectors already discussed. The preprocessing for the non-PM emissions did not require species calculations because the raw MOVES emissions translated directly to SMOKE inventory species.

2. California onroad inventory: California 2005v2 NEI complete CAP/HAP onroad inventory. California monthly onroad emissions are year 2005 and are based on September 2007 California Air Resources Board (CARB) data from Chris Nguyen. NH_3 emissions are from MOVES2010 runs for California. We retained only those HAPs that are also estimated by NMIM for onroad mobile sources; all other HAPs provided by California were dropped. The California onroad inventory does not use the SCCs for Heavy Duty Diesel Vehicles (HDDV) class 6 & 7 (2230073XXX) emissions. California does not specify road types, so we used NMIM-based California ratios to break out vehicle emissions to the match the more detailed NMIM level.

2.5.4 Nonroad mobile sources: NMIM-based (nonroad)

This sector includes monthly exhaust, evaporative and refueling emissions from nonroad engines (not including commercial marine, aircraft, and locomotives) that are derived from NMIM for all states except California, which were corrected due to an inadvertent omission of $PM_{2.5}$ from seven counties. Thus, except for seven counties in California, emissions from this sector did not change between the v4 and v4.2 platform versions, and we repeat the documentation here for completeness.

NMIM relied on the version of the NONROAD2005 model (NR05c-BondBase) used for the marine spark ignited (SI) and small SI engine final rule, published May 2009 (EPA, 2008). For 2005, the NONROAD2005 model (NR05c-BondBase) 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 future years. As with the onroad emissions, NMIM provides nonroad emissions for VOC by three emission modes: exhaust, evaporative and refueling. Unlike the onroad sector, refueling emissions nonroad sources are not dropped from processing for this sector.

The EPA/OTAQ ran NMIM to create county-SCC emissions for the 2005v2 NEI nonroad mobile CAP/HAP inventory, and similar to on_noadj, we removed California NMIM emissions that were submitted separately by California. Emissions were converted from monthly totals to monthly average-day based on the number of days in each month. Similar to onroad NMIM emissions, the EPA default inputs were replaced by state inputs where provided. The NMIM inventory documentation describes this and all other details of the NMIM nonroad emissions development.

California nonroad

California monthly nonroad emissions are year 2005 and are based on September 2007 California Air Resources Board (CARB) data from Chris Nguyen, other than for the $PM_{2.5}$ missing from 7 counties, which used the March 2007 version. In addition, NH_3 emissions are from NMIM runs for California because these were not included in the California NEI submittal. HAP emissions were estimated by applying HAP-to-CAP ratios computed from California data provided in the 2005v2 NEI submittal. We retained only those HAPs that are also estimated by NMIM for nonroad mobile sources; all other HAPs were dropped.

The CARB-based nonroad data did not have mode-specific data for VOC (exhaust, evaporative, and refueling). To address this inconsistency with other states, we split the annual total California data into monthly, mode-specific nonroad emissions for California using the NMIM results. Details on this process are documented separately (Strum, 2007). Nonroad refueling emissions for California were computed as Gasoline Transport (SCC=2505000120) emissions multiplied by a factor of 0.46 (to avoid double counting with portable fuel container (PFC) emissions in the nonpt sector) and were allocated to the gasoline equipment types based on ratios of evaporative-mode VOC. The factor of 0.46 was computed by dividing the NMIM-derived California refueling for 2005 by the sum of portable fuel container emissions and NMIM-derived refueling for 2005.

2.5.5 Nonroad mobile sources: locomotive and non-C3 commercial marine (alm_no_c3)

The alm_no_c3 sector contains CAP and HAP emissions from locomotive and commercial marine vessel (CMV) sources, except for category 3/residual-fuel (C3) CMV and railway maintenance. In modeling platforms prior to the 2005v4 platform, this sector also contained aircraft emissions. Point-source airports were included in the non-EGU point sector (ptnonipm) through the 2005v2 NEI point source inventory. The C3 CMV emissions are in the seca_c3 sector. We note that the “a” in the “alm_no_c3” sector name is now misleading because aircraft are no longer in this sector. With the exception of revised Delaware CMV emissions from the Transport Rule comments, this sector is unchanged from the v4 platform.

The remaining emissions in the alm_no_c3 sector are year 2002 emissions unchanged from the 2002 platform; we repeat the 2005v4 documentation for completeness. The SCCs in the alm_no_c3 sector are listed in Table 2-11.

Table 2-11. SCCs in the 2005 alm_no_c3 inventory compared to the 2002 platform alm sector

SCC	Action	SCC Description
2275000000	Emissions removed and replaced by aircraft in ptnonipm sector for 2005 platform	Mobile Sources; Aircraft: All Aircraft Types and Operations: Total
2275001000	Emissions removed and replaced by aircraft in ptnonipm sector for 2005 platform	Mobile Sources; Aircraft: Military Aircraft: Total
2275020000	Emissions removed and replaced by aircraft in ptnonipm sector for 2005 platform	Mobile Sources; Aircraft: Commercial Aircraft: Total: All Types
2275050000	Emissions removed and replaced by aircraft in ptnonipm sector for 2005 platform	Mobile Sources; Aircraft: General Aviation: Total
2275060000	Emissions removed and replaced by aircraft in ptnonipm sector for 2005 platform	Mobile Sources; Aircraft: Air Taxi: Total
2280002100	Retained from 2002 platform	Mobile Sources;Marine Vessels, Commercial;Diesel;Port emissions
2280002200	Retained from 2002 platform	Mobile Sources;Marine Vessels, Commercial;Diesel;Underway emissions
2280003100	Emissions removed and replaced by seca_c3 inventories for 2005 platform	Mobile Sources;Marine Vessels, Commercial;Residual;Port emissions
2280003200	Emissions removed and replaced by seca_c3 inventories for 2005 platform	Mobile Sources;Marine Vessels, Commercial;Residual;Underway emissions
2280004000	Retained from 2002 platform	Mobile Sources;Marine Vessels, Commercial;Gasoline;Total, All Vessel Types
2285002006	Retained from 2002 platform	Mobile Sources;Railroad Equipment;Diesel;Line Haul Locomotives: Class I Operations
2285002007	Retained from 2002 platform	Mobile Sources;Railroad Equipment;Diesel;Line Haul Locomotives: Class II / III Operations
2285002008	Retained from 2002 platform	Mobile Sources;Railroad Equipment;Diesel;Line Haul Locomotives: Passenger Trains (Amtrak)
2285002009	Retained from 2002 platform	Mobile Sources;Railroad Equipment;Diesel;Line Haul Locomotives: Commuter Lines
2285002010	Retained from 2002 platform	Mobile Sources;Railroad Equipment;Diesel;Yard Locomotives

The documentation of the 2002 NEI for the category 1 and 2 (C1/C2) commercial marine and locomotive emissions.

For modeling purposes, the following additional changes were made to the NEI data for the 2005v4 platform:

- For the 2005v4 platform, we removed C3 CMV SCCs (residual fuel) and aircraft SCCs.
- Removed railway maintenance emissions (SCCs 2285002015, 2285004015, and 2285006015) because these are included in the nonroad NMIM monthly inventories. This change was made for the 2002 platform and is retained here in the 2005 platform.
- For the purpose of CAP-HAP VOC integration as discussed in Section 3.1.2.1, we removed benzene, formaldehyde, and acetaldehyde for all sources that we did not integrate these HAPs with VOC. As discussed in Section 3.1.2.1, sources are considered no-integrate when the source of data between VOC and VOC HAPs is inconsistent or VOC analysis of VOC and VOC HAPs indicates the source is not integrated. Although our CAP-HAP integration approach also required the removal of methanol for no-integrate sources, the only sources in this sector that included methanol were in California, where we used the integrate approach for all sources and therefore did not need to remove it.

The 2002 platform documentation goes into greater detail on the locomotives and C1/C2 CMV emissions in this sector.

2.5.6 Nonroad mobile sources: C3 commercial marine (seca_c3)

The raw seca_c3 sector emissions data were developed in an ASCII raster format used since the Emissions Control Area-International Marine Organization (ECA-IMO) project began in 2005, then known as the Sulfur Emissions Control Area (SECA). These emissions consist of large marine diesel engines (at or above 30 liters/cylinder) that until very recently, were allowed to meet relatively modest emission requirements, often burning residual fuel. The emissions in this sector are comprised of primarily foreign-flagged ocean-going vessels, referred to as Category 3 (C3) CMV ships. The seca_c3 (ECA) inventory includes these ships in several intra-port modes (cruising, hoteling, reduced speed zone, maneuvering, and idling) and underway mode and includes near-port auxiliary engines. An overview of the ECA-IMO project and future-year goals for reduction of NO_X, SO_2, and PM C3 emissions.

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.

The raw ECA inventory started as a set of ASCII raster datasets at approximately 4-km resolution that we converted to SMOKE point-source ORL input format.

In summary, this paper describes how the ASCII raster dataset was converted to latitude-longitude, mapped to state/county FIPS codes that extend up to 200 nautical miles (nm) from the coast, assigned stack parameters, and how the monthly ASCII raster dataset emissions were used to create monthly temporal profiles. Counties in 2005v4 were assigned as extending up to 200nm from the coast because of this was the distance to the edge of the Exclusive Economic Zone (EEZ), a distance that would be used to define the outer limits of ECA-IMO controls for these vessels.

The base year ECA inventory is 2002 and consists of these CAPs: PM_{10}, CO, CO_2, NH_3, NO_X, SO_X (assumed to be SO_2), and Hydrocarbons (assumed to be VOC). The EPA developed regional growth (activity-based) factors that we applied to create the v4 platform 2005 inventory from the 2002 data.

We computed HAPs directly from the CAP inventory and the calculations are therefore consistent; therefore, the entire seca_c3 sector utilizes CAP-HAP VOC integration to use the VOC HAP species directly, rather than VOC speciation profiles.

For the v4.2 platform, we chose only to include some HAPs in the seca_c3 sector: benzene, formaldehyde, and acetaldehyde. We projected these HAPs using the same VOC factors as used in 2005v4:

Benzene	= VOC * 9.795E-06
Acetaldehyde	= VOC * 2.286E-04
Formaldehyde	= VOC * 1.5672E-03

We converted the emissions to SMOKE point source ORL format, allowing for the emissions to be allocated to modeling layers above the surface layer. We also corrected FIPS code assignments for one county in Rhode Island. All non-US emissions (i.e., in waters considered outside of the 200nm EEZ, and hence out of the U.S. and Canadian ECA-IMO controllable domain) are simply assigned a dummy state/county FIPS code=98001. The SMOKE-ready data have also been cropped from the original ECA-IMO data to cover only the 36-km air quality model domain, which is the largest domain used for this effort.

Seca_c3 updates from 2005v4 platform used in creating 2005v4.2 platform

There are several updates to the seca_c3 emissions from 2005v4 to 2005v4.2:

1) Delaware provided updated county total emissions in the Transport Rule comments. There are several other changes that impact Delaware state total emissions discussed below.
2) Region-specific and pollutant-specific growth factors were updated for the v4.2 platform as compared to the v4 platform to be consistent with the final projections from 2002, developed for the C3 ECA Proposal to the International Maritime Organization (EPA-420-F-10-041, August 2010). The exception to this is Delaware, where county totals were modified to match those provided in Transport Rule comments. The updated factors that we used to project from 2002 to 2005 are presented in Table 2-12. These updated 2002 to 2005 projection factors for 2005v.2 are approximately 1% higher for all pollutants nationally.

Table 2-12. Adjustment factors to update the 2005 seca_c3 sector emissions for the v4.2 platform.

	2005 Adjustments Relative to 2002					
Region	**NO_X**	**PM_{10}**	**$PM_{2.5}$**	**VOC (HC)**	**CO**	**SO2**
East Coast (EC)[1]	1.10524	1.15242	1.15383	1.15256	1.15238	1.15244
Gulf Coast (GC)	1.04056	1.08521	1.08269	1.08467	1.08536	1.08530
North Pacific (NP)	1.07254	1.11354	1.09817	1.11358	1.11318	1.11339
South Pacific (SP)	1.12539	1.17416	1.17257	1.17055	1.17012	1.17565
Great Lakes (GL)	1.04397	1.06264	1.06241	1.06341	1.06280	1.06251
Outside ECA	1.08654	1.13186	1.13186	1.13186	1.13186	1.13186

1 –Delaware emissions were provided for 2005 from Transport Rule comments.

3) In addition to the updated values, near-shore Canadian emissions are now assigned to regions whereas previously Canadian sources used the "Outside ECA" factors. Canada uses North Pacific, Great Lakes and East Coast depending on where the emissions are. For example, near-shore emissions around Vancouver British Columbia are projected from 2002 using North Pacific (NP) factors rather than "Outside ECA" factors.

4) One of the most significant comments from the Transport Rule Proposal was the assignment in 2005v4 of state boundaries that extended to the 200nm EEZ distance offshore. This had potentially unrealistic impacts on source apportionment modeling (see Section 5) because large emissions from shipping lanes far from shore were attributable to states whose coastlines were up to 200nm away. For 2005v4.2, we obtained state-federal water boundaries data from the Mineral Management Service (MMS) that extended only 3 to 10 miles off shore. It is important to note that the emission values did not change as a result of this update, only the state to which those emissions from 3 to 200 miles offshore were assigned. We retained separate dummy "FIPS" for these offshore emissions to ensure that they were projected to future years based on the appropriate regional-based factors in Table 2-12.

5) The 2005v4 ECA-based C3 inventory did not delineate between ports and underway (or other C3 modes such as hoteling, maneuvering, reduced-speed zone, and idling) emissions; therefore, we assigned these emissions to the broad ("total") SCC for C3 CMV (2280003000). For 2005v4.2, we used a U.S. ports spatial surrogate dataset to simply map the seca_c3 emissions ports or underway SCCs. This had no effect on temporal allocation or speciation compared to existing profiles for underway and port C3 emissions (2280003100 and 2280003200).

The net impact of all the 2005v4.2 changes to U.S. total NO_X, SO_2, and $PM_{2.5}$ seca_c3 emissions are shown in Table 2-13. Again, with the exceptions of NO_X, $PM_{2.5}$, and most notably, SO_2 in Delaware, approximately 99% of these differences are solely attributable to reclassification of U.S. states to the 3-10 mile MMS boundaries in 2005v4.2 rather than the 200nm EEZ boundaries in 2005v4.

Table 2-13. Contiguous U.S. C3 CMV emissions in the 2005v4 and 2005v4.2 platforms

Pollutant	2005v4	2005v4.2
NO_X	642,000	130,000
$PM_{2.5}$	49,000	11,000
SO_2	417,000	97,000

2.6 Emissions from Canada, Mexico and offshore drilling platforms (othpt, othar, othon)

These sectors are unchanged from the 2005v4 platform; the documentation is included here for completeness. 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. All "oth" emissions are CAP-only inventories. Mexico's emissions are unchanged from the 2002 platform with one exception –one stack diameter was updated (recomputed from stack velocity and flowrate) in the Mexico border states point inventory.

For Canada we updated the emissions from the 2002 platform, migrating the data from year 2000 inventories to year 2006 inventories for the 2005 platform. We migrated to these 2006 Canadian emissions despite not receiving future-year emissions, as we were advised by Canada that the improvement in the 2006 inventory over the 2000 inventory was more significant than the undesirable effect of retaining these 2006 emissions for all future-year modeling. We applied several modifications to the 2006 Canadian inventories:

i. We did not include wildfires, or prescribed burning because Canada does not include these inventory data in their modeling.
ii. We did not include in-flight aircraft emissions because we do not include these for the U.S., and we do not have an appropriate approach to include in our modeling.
iii. We applied a 75% reduction ("transport fraction") to PM for the road dust, agricultural, and construction emissions in the Canadian "afdust" inventory. This approach is more simplistic than the county-specific approach used for the U.S., but a comparable approach was not available for Canada.
iv. We did not include speciated VOC emissions from the ADOM chemical mechanism.
v. Residual fuel CMV (C3) SCCs (22800030X0) were removed because these emissions are included in the seca_c3 sector, which covers not only emissions close to Canada but also emissions far at sea. Canada was involved in the inventory development of the seca_c3 sector emissions.
vi. Wind erosion (SCC=2730100000) and cigarette smoke (SCC=2810060000) emissions were removed from the nonpoint (nonpt) inventory; these emissions are also absent from our U.S. inventory.

vii. Quebec $PM_{2.5}$ emissions (2,000 tons/yr) were removed for one SCC (2305070000) for Industrial Processes, Mineral Processes, Gypsum, Plaster Products due to corrupt fields after conversion to SMOKE input format. This error should be corrected in a future inventory.

viii. Excessively high CO emissions were removed from Babine Forest Products Ltd (British Columbia SMOKE plantid='5188') in the point inventory. This change was made at our discretion because the value of the emissions was impossibly large.

ix. The county part of the state/county FIPS code field in the SMOKE inputs were modified in the point inventory from "000" to "001" to enable matching to existing temporal profiles.

For Mexico we continued to use emissions for 1999 (Eastern Research Group Inc., 2006) which were 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).

Table 2-14 summarizes the data in the "oth" sectors and indicates where these emissions have been updated from the 2002 platform.

Table 2-14. Summary of the othpt, othar, and othon sectors changes from the 2002 platform

Sector	**Components**	**Changes from 2002 platform**
othpt	Mexico, 1999, point	None
	Canada, 2006, point	Uses emissions from 2006 National Pollutant Release Inventory (NPRI), 3 components: 1) upstream oil and gas sector emissions for all CAPs except VOC; 2) VOC sources pre-speciated to CB05 speciation except for benzene; 3) Remaining point source emissions.
	Offshore, 2005, point	Uses emissions from 2005 v2 point inventory
othar	Mexico, 1999, nonpoint	None
	Mexico, 1999, nonroad	None
	Canada, 2006, nonpoint	Uses 2006 Canadian aircraft (landing and take-offs only), agricultural NH_3, fugitive dust, and remaining nonpoint inventories.
	Canada, 2006, nonroad	Uses 2006 Canadian nonroad mobile, non-C3 marine, and locomotives inventories.
othon	Mexico, 1999, onroad	None

Sector	Components	Changes from 2002 platform
	Canada, 2006, onroad	Uses 2006 Canadian onroad inventory. Emissions are given at vehicle type resolution only (i.e., does not include road types).

2.7 SMOKE-ready non-anthropogenic inventories for chlorine

For the ocean chlorine, we used the same data as in the CAP and HAP 2002-based platform.

3 Emissions Modeling Summary

Both the CMAQ and CAM_X models require hourly emissions of specific gas and particle species for the horizontal and vertical grid cells contained within the modeled region (i.e., modeling domain). To provide emissions in the form and format required by the model, it is necessary to "pre-process" the "raw" emissions (i.e., emissions input to SMOKE) for the sectors described above in Section 2. In brief, the process of emissions modeling transforms the emissions inventories from their original temporal resolution, pollutant resolution, and spatial resolution into the resolution hourly, speciated, gridded resolution required by the air quality model.

As seen in Section 2, the temporal resolution of the emissions inventories input to SMOKE for the 2005 platform varies across sectors, and may be hourly, monthly, or annual total emissions. The spatial resolution, which also can be different for different sectors, may be individual point sources or county totals (province totals for Canada, municipio totals for Mexico). The pre-processing steps involving temporal allocation, spatial allocation, pollutant speciation, and vertical allocation of point sources are referred to as emissions modeling. This section provides some basic information about the tools and data files used for emissions modeling as part of the 2005 platform. Since we devoted Section 2 to describing the emissions inventories, we have limited the descriptions of data in this section to the ancillary data SMOKE uses to perform the emissions modeling steps. Note that all SMOKE inputs for the 2005v4.2 platform emissions are available at the 2005v4.2 website (see the end of Section 1).

We used SMOKE version 2.6 to pre-process the raw emissions to create the emissions inputs for CMAQ and then converted those to inputs suitable for CAM_X. The emissions processing steps and ancillary data for v4.2 were very similar to those done for v4. A summary of the revisions is as follows:

- We updated the ancillary files to handle additional MOVES SCCs related to parking area emissions and to make some changes to the temporal and spatial approaches that were originally assigned to parking area SCCs.
- We changed speciation profiles for headspace vapor (VOC).
- We changed the $PM_{2.5}$ speciation profile for category 3 commercial marine vessels burning residual oil.
- We updated the list of state-county names to include "dummy" seca_c3 FIPS for emissions outside of U.S. MMS-base state boundaries but within the 200nm EEZ (see section 2.5.6). These dummy FIPS were used for internal projections of regional offshore emissions in the ECA-IMO control area that extended up to 200nm offshore.
- We used an updated county-to-cell spatial surrogate for U.S. oil and gas emissions.
- We changed the temporal allocation approach to use: 1) profiles that vary by day of week and to use new temporal profiles for the afdust sector, 2) CENRAP-based state-specific agricultural burning profiles that vary monthly for the nonpt sector, and 3) residential natural gas combustion and commercial propane and kerosene combustion from uniform monthly to a profile that varies for the nonpt sector.

We also utilized the feature in SMOKE (updated in version 2.5) to create combination speciation profiles that could vary by state/county FIPS code and by month; we used this approach for some mobile sources as described in Section 3.1.2. For sectors that have plume rise, we used the in-line emissions capability of the air quality model to create source-based emissions files, rather than created the much larger 3-dimensional files. The air quality model-ready emissions were first created in a form appropriate for CMAQ and were then converted to a form usable by CAM_X using a FORTRAN convertor called 'inline2camx'. This program generates the gridded surface level 2-dimensional emissions and elevated point source files necessary for CAM_X, and it also renames certain emissions species to the names needed by CAM_X. Emissions totals by specie for the entire model domain are output as reports that are then compared to reports generated by SMOKE to ensure mass is not lost or gained during this conversion process.

3.1 Key emissions modeling settings

Each sector is processed separately through SMOKE, until the final merge program (Mrggrid) is run to combine the model-ready, sector-specific emissions across sectors. The SMOKE settings in the run scripts and the data in the SMOKE ancillary files control the approaches used for the individual SMOKE programs for each sector. Table 3-1 summarizes the major processing steps of each platform sector. The "Spatial" column shows the spatial approach: "point" indicates that SMOKE maps the source from a point location (i.e., latitude and longitude) to a grid cell; "surrogates" indicates that some or all of the sources use spatial surrogates to allocate county emissions to grid cells; and "area-to-point" indicates that some of the sources use the SMOKE area-to-point feature to grid the emissions (further described in Section3.2.1.2). The "Speciation" column indicates that all sectors use the SMOKE speciation step, though biogenics speciation is done within BEIS3 and not as a separate SMOKE step. The "Inventory resolution" column shows the inventory temporal resolution from which SMOKE needs to calculate hourly emissions.

Finally, the "plume rise" column indicates the sectors for which the "in-line" approach is used. These sectors are the only ones which will have emissions in aloft layers, based on plume rise. The term "in-line" means that the plume rise calculations are done inside of the air quality model instead of being computed by SMOKE. The height of the plume rise determines the model layer into which the emissions are placed. For the 2005v4 and 2005v4.2 platforms, we did not have SMOKE compute the vertical plume rise. Instead, this was done in the air quality model using the stack data and the hourly air quality model inputs found in the SMOKE output files for each model-ready sector. The seca_c3 sector is the only sector with only "in-line" emissions, meaning that all of the entire emissions occur in aloft layers and there are no emissions in the two-dimensional, layer-1 files created by SMOKE.

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

Platform sector	Spatial	Speciation	Inventory resolution	Plume rise
ptipm	Point	Yes	daily & hourly	in-line
ptnonipm	Point	Yes	annual	in-line
othpt	Point	Yes	annual	in-line

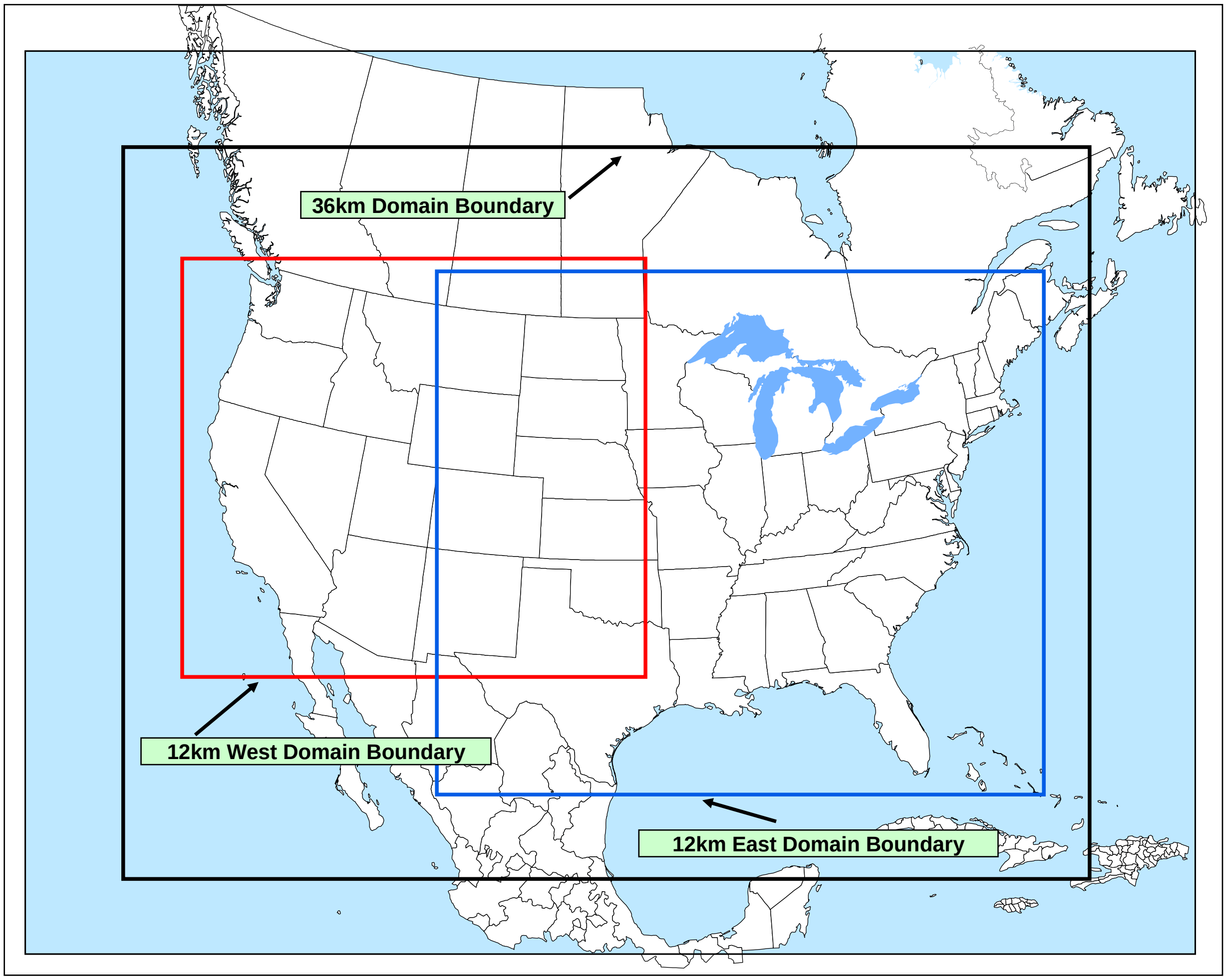
Platform sector	Spatial	Speciation	Inventory resolution	Plume rise
nonroad	surrogates & area-to-point	Yes	monthly	
othar	Surrogates	Yes	annual	
seca_c3	Point	Yes	annual	in-line
alm_no_c3	surrogates & area-to-point	Yes	annual	
on_noadj	Surrogates	Yes	monthly	
on_noadj	Surrogates	Yes	monthly	
on_moves_startpm	Surrogates	Yes	monthly	
on_moves_runpm	Surrogates	Yes	monthly	
othon	surrogates	Yes	annual	
nonpt	surrogates & area-to-point	Yes	annual	
ag	surrogates	Yes	annual	
afdust	surrogates	Yes	annual	
biog	pre-gridded landuse	in BEIS3.14	hourly	
avefire	surrogates	Yes	annual	

In addition to the above settings, we used the PELVCONFIG file, which can be optionally used to group sources so that they would be treated as a single stack by SMOKE when computing plume rise. For the 2005v4.2 platform we chose to have no grouping, which is a difference the 2005v4 platform. We changed this because grouping done for "in-line" processing will not give identical results as "offline" (i.e., processing whereby SMOKE creates 3-dimensional files). The only way to get the same results between in-line and offline is to choose to have no grouping.

3.1.1 Spatial configuration

For the 2005v4.2 platform in support of the Transport Rule, we ran SMOKE followed by CAM_X for the 36-km CONtinental United States "CONUS" modeling domain and the eastern US 12-km modeling domain (EUS) shown in Figure 3-1. Figure 3-1 also shows the 12-km western domain (WUS), but this domain was not used for Transport Rule modeling. Note that these domains were also used in the 2005v4 and 2002 platforms.

Figure 3-1. Air quality modeling domains



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

Table 3-2. Descriptions of the 2005-based platform grids

Common Name	Grid Cell Size	Description (see Figure 3-1)	Grid name	Parameters listed in SMOKE grid description (GRIDDESC) file: projection name, xorig, yorig, xcell, ycell, ncols, nrows, nthik
US 36 km or CONUS-36	36 km	Entire conterminous US plus some of Mexico/Canada	US36KM_148X112	'LAM_40N97W', -2736.D3, -2088.D3, 36.D3, 36.D3, 148, 112, 1
Big East 12 km	12 km	Goes west to Colorado, covers some Mexico/Canada	EUS12_279X240	'LAM_40N97W', -1008.D3 , -1620.D3, 12.D3, 12.D3, 279, 240, 1
West 12 km	12 km	Goes east to Oklahoma, covers some of Mexico/Canada	US12_213X192	'LAM_40N97W', -2412.D3 , -972.D3, 12.D3, 12.D3, 213, 192, 1

Section 3.2.1 provides the details on the spatial surrogates and area-to-point data used to accomplish spatial allocation with SMOKE.

3.1.2 Chemical speciation configuration

The emissions modeling step for chemical speciation creates "model species" needed by the air quality model for a specific chemical mechanism. These model species are either individual chemical compounds or groups of species, called "model species." The chemical mechanism used for the 2005 platform is the CB05 mechanism (Yarwood, 2005). The same base chemical mechanism is used with CMAQ and CAM_X, but the implementation differs slightly between the two models. For details of the chemical mechanism as it is implemented in CAM_X 5.2. The specific versions of CMAQ and CAMx used in applications of this platform include secondary organic aerosol (SOA) and HONO enhancements.

From the perspective of emissions preparation, the CB05 mechanism is the same as was used in the 2002 platform except that additional input model species are needed to support the nitrous acid (HONO) chemistry enhancements and additional input model species are needed to support SOA. Table 3-3 lists the model species produced by SMOKE for use in CMAQ and CAM_X; the only three input species that were not in the CAP 2002-Based platform are nitrous acid (HONO), BENZENE and sesquiterpenes (SESQ). It should be noted that the BENZENE model species is not part of CB05 in that the concentrations of BENZENE do not provide any feedback into the chemical reactions (i.e., it is not "inside" the chemical mechanism). Rather, benzene is used as a reactive tracer and as such is impacted by the CB05 chemistry. BENZENE, along with several reactive CBO5 species (such as TOL and XYL) plays a role in SOA formation.

Table 3-3. Model species produced by SMOKE for CB05 with SOA for CMAQ4.7 and CAM_X*

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	ALD2	Acetaldehyde
	ALDX	Propionaldehyde and higher aldehydes
	BENZENE	Benzene (not part of CB05)
	ETH	Ethene
	ETHA	Ethane
	ETOH	Ethanol
	FORM	Formaldehyde
	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

*The same species names are used for the CAM_X model with exceptions as follows:
1. CL2 is not used in CAM_X
2. CAM_X particulate sodium is NA (in CMAQ it is PNA)
3. CAM_X uses different names for species that are both in CBO5 and SOA for the following: TOLA=TOL, XYLA=XYL, ISP=ISOP, TRP=TERP. They are duplicate species in CAM_X that are used in the SOA chemistry. CMAQ uses the same names in CB05 and SOA for these species.
4. CAM_X uses a different name for sesquiterpenes: CMAQ SESQ = CAM_X SQT
5. CAM_X uses particulate species uses different names for organic carbon, coarse particulate matter and other particulate mass as follows: CMAQ POC = CAM_X POA, CMAQ PMC = CAM_X CPRM, and CMAQ PMFINE= CAM_X FPRM

The approach for speciating $PM_{2.5}$ emissions in v4.2 is the same as v4 except that in addition to the on_moves_startpm and on_moves_runpm sectors, exhaust PM from diesel is provided to SMOKE as speciated emissions. Thus, the only PM species requiring speciation in SMOKE from the onroad sector are the brake and tirewear PM2.5. Canada point sources have an SCC of 3999999999 and all use the Speciation profile '92037' which is the "Industry Manufacturing Avge profile." While this had not changed between v4 and v4.2, the documentation for v4 incorrectly stated that the Canadian point inventory (othpt sector) was pre-speciated. The Canadian point source inventory is pre-speciated for VOC but not for $PM_{2.5}$. One other difference in $PM_{2.5}$ speciation is that we used a new profile ('92200') called "simplified profile - Marine Vessel – Main Boiler - Heavy Fuel Oil – Simplified." At the time that this profile was used, we anticipated its release with SPECIATE4.3.

The approach for speciating VOC emissions from non-biogenic sources is the same for the v4.2 platform as for the v4 platform, though there are some differences in the data files used. The approach is that:

1. For some sources, HAP emissions are used in the speciation process to allow integration of VOC and HAP emissions in the NEI. This has the result of modifying the speciation profiles based on the HAP emission estimates which are presumed to be more accurate than the speciated VOC results for the HAPs; and,
2. For some mobile sources, "combination" profiles are specified by county and month and emission mode (e.g., exhaust, evaporative). SMOKE computes the resultant profile using the fraction of each specific profile assigned by county, month and emission mode. A new feature and new profile file in SMOKE (the GSPRO_COMBO file) allowed the use of this approach for the 2005v4 platform, and its use continues here.

The VOC speciation data files are different because we added another part of the nonpt sector to exclude from HAP VOC integration: the category of pesticide application. Additionally, the v4.2 platform used a new headspace profile representative of E0 gasoline, profile code 8762: "Gasoline Headspace Vapor using 0% Ethanol - Composite Profile". This profile is part of SPECIATE4.3 and was used in place of the SPECIATE4.0 profile 8737 (Composite Profile - Non-oxygenated Gasoline Headspace Vapor), which was used in the v4 platform. The new headspace profile was used for the same sources as was the previous headspace profile: year 2005 refueling and other ambient temperature evaporative gasoline processes (portable fuel containers and any evaporation of gasoline associated with gasoline storage and distribution sources).

The below subsections provide a further description of the HAP/CAP integration and use of combination profiles. Section 3.2.2 provides the details about the data files used to accomplish these speciation processing steps.

3.1.2.1 The combination of HAP BAFM (benzene, acetaldehyde, formaldehyde and methanol) and VOC for VOC speciation

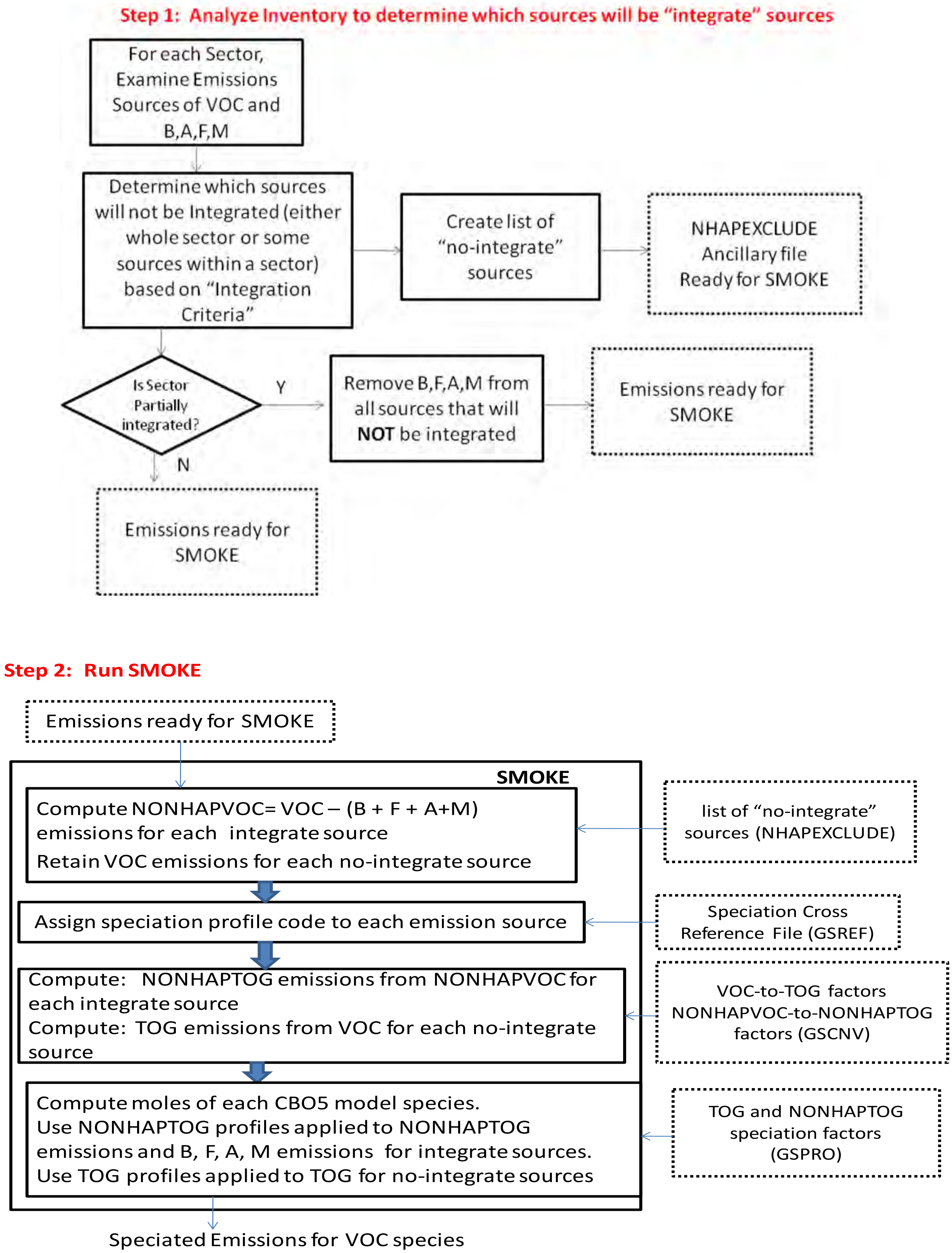
The VOC speciation approach for the 2005v4.2 platform differed from the 2002 platform in that we included, for some of the U.S. platform sectors, HAP emissions from the NEI in the speciation process. That is, instead of speciating VOC to generate all of the species listed in Table 3-3 as we did for the 2002 platform, we integrated emissions of the 4 HAPs, benzene, acetaldehyde, formaldehyde and methanol (BAFM) from the NEI with the NEI VOC. The integration process (described in more detail below) combines the BAFM HAPs with the VOC in a way that does not double count emissions and uses the BAFM directly in the speciation process. We believe that generally, the HAP emissions from the NEI are more representative of emissions of these compounds than their generation via VOC speciation.

We chose these HAPs because, with the exception of BENZENE, they are the only explicit VOC HAPs in the base version of CMAQ 4.7 (CAPs only with chlorine chemistry) model. By "explicit VOC HAPs," we mean model species that participate in the modeled chemistry using the CB05 chemical mechanism. We denote the use of these HAP emission estimates along with VOC as "HAP-CAP integration". BENZENE was chosen because it was added as a model species in the base version of CMAQ 4.7, and there was a desire to keep its emissions consistent between multi-pollutant and base versions of CMAQ.

The integration of HAP VOC with VOC is a feature available in SMOKE for all inventory formats other than PTDAY (the format used for the ptfire sector). SMOKE allows the user to specify the particular HAPs to integrate and the particular sources to integrate. The particular HAPs to integrate are specified in the INVTABLE file, and the particular sources to integrate are based on the NHAPEXCLUDE file (which actually provides the sources that are *excluded* from integration[8]). For the "integrate" sources, SMOKE subtracts the "integrate" HAPs from the VOC (at the source level) to compute emissions for the new pollutant "NONHAPVOC." The user provides NONHAPVOC-to-NONHAPTOG factors and NONHAPTOG speciation profiles. SMOKE computes NONHAPTOG and then applies the speciation profiles to allocate the NONHAPTOG to the other air quality model VOC species not including the integrated HAPs. This process is illustrated in Figure 3-2. Note that we did not need to remove BAFM from no-integrate sources in a sector where all sources are no-integrate because this is accomplished by through use of a SMOKE ancillary "INVTABLE" which essentially drops all BAFM in that sector.

[8] In SMOKE version 2.6 the options to specify sources for integration are expanded so that a user can specify the particular sources to include or exclude from integration, and there are settings to include or exclude all sources within a sector. We did not take advantage of this new flexibility in processing v4.2 emissions or v4 emissions, but the user will now have the ability for easier inclusion of specific sources to get the same result.

Figure 3-2. Process of integrating BAFM with VOC for use in VOC Speciation



We considered CAP-HAP integration for all sectors and developed "integration criteria" for some of those. Table 3-4 summarizes the integration approach for each platform sector used in Step 1 of Figure 3-2.

Table 3-4. Integration status of benzene, acetaldehyde, formaldehyde and methanol (BAFM) for each platform sector

Platform Sector	**Approach for Integrating NEI emissions of Benzene (B), Acetaldehyde (A), Formaldehyde (F) and Methanol (M)**
ptipm	No integration because emissions of BAFM are relatively small for this sector
ptnonipm	No integration because emissions of BAFM are relatively small for this sector and it is not expected that criteria for integration would be met by a significant number of sources
avefire	No integration
ag	N/A – sector contains no VOC
afdust	N/A – sector contains no VOC
nonpt	Partial integration; details provided below table
nonroad	For other than California: Partial integration – did not integrate CNG or LPG sources (SCC beginning with 2268 or 2267) because NMIM computed only VOC and not any HAPs for these SCCs. For California: Full integration
alm_no_c3	Partial integration; details provided below table
seca_c3	Full integration
onroad	Full integration
biog	N/A – sector contains no inventory pollutant "VOC"; but rather specific VOC species
othpt	No integration – not the NEI
othar	No integration – not the NEI
othon	No integration – not the NEI

For the nonpt sector, we used the following integration criteria to determine the sources to integrate (Step 1):

1. Any source for which BAFM emissions were from the 1996 NEI were not integrated (data source code contains a "96").

2. Any source for which the sum of BAFM is greater than the VOC was not integrated, since this clearly identifies sources for which there is an inconsistency between VOC and VOC HAPs. This includes some cases in which VOC for a source is zero.

3. For certain source categories (those that comprised 80% of the VOC emissions), we chose to integrate sources in the category per the criteria specified in the first column in Table 3-5. For most of these source categories, we allow sources to be integrated if they had the minimum combination of BAFM specified in the first column. For a few source categories, we designated all sources as "no-integrate". The one change we made from Table 3-5 for the v4.2 platform is highlighted: we changed pesticides application to "no-integrate."

4. For source categories not covered in Table 3-5 (i.e., that do not comprise the top 80% of VOC emissions), then as long as the source has emissions of one of the BFAM pollutants, then it can be integrated.

Table 3-5. Source-category specific criteria for integrating nonpt SCCs for categories comprising 80% of the nonpoint VOC emissions

minimum HAP(s) needed	SCC Tier 3	SCC Tier 3 Description	Comments
BFA	2104008000	Stationary Source Fuel Combustion;Residential;Wood	
B	2501060000	Storage and Transport;Petroleum and Petroleum Product Storage;Gasoline Service Stations	
BM	2440000000	Solvent Utilization;Miscellaneous Industrial;All Processes	Speciation profile: 3144 has no benzene but most records have it and they're from the EPA (and Calif)
FAM	2401001000	Solvent Utilization;Surface Coating;Architectural Coatings	
B	2310001000	Industrial Processes;Oil and Gas Production: SIC 13;All Processes : On-shore	
M	2460000000	Solvent Utilization;Miscellaneous Non-industrial: Consumer and Commercial;All Processes	
B	2501011000	Storage and Transport;Petroleum and Petroleum Product Storage;Residential Portable Gas Cans	
M	2425000000	Solvent Utilization;Graphic Arts;All Processes	
M	2465000000	Solvent Utilization;Miscellaneous Non-industrial: Consumer;All Products/Processes	3144 is profile, and it does have methanol (but no BFA).
BFA	2801500000	Miscellaneous Area Sources;Agriculture Production - Crops;Agricultural Field Burning - whole field set on fire	8746 is speciation profile and has BFA
M	2440020000	Solvent Utilization;Miscellaneous Industrial;Adhesive (Industrial) Application	3142 is speciation profile which has methanol (.32%) and 0 form (and no acetald, benz)
B	2501050000	Storage and Transport;Petroleum and Petroleum Product Storage;Bulk Terminals: All Evaporative Losses	
B	2310000000	Industrial Processes;Oil and Gas Production: SIC 13;All Processes	
M	2465400000	Solvent Utilization;Miscellaneous Non-industrial: Consumer;Automotive Aftermarket Products	8520 is speciation profile which doesn't have benz but does have methanol. OR is only state with benzene which is negligible
No-integrate (change from v4 platform)	2461850000	Solvent Utilization;Miscellaneous Non-industrial: Commercial;Pesticide Application: Agricultural	Profile has no benzene. Inventory benzene came from solvent utilization data (Fredonia) for "other markets" for the year 1998. Since benzene no longer allowed in pesticides, use of a no-benzene profile would give more accurate results. Note that this is a change from the v4 platform, where this sector was "integrate."
BFA	2630020000	Waste Disposal, Treatment, and Recovery;Wastewater Treatment;Public Owned	profile BFA 2002 (wastewater treatment plants). No methanol in profile. No methanol mentioned in POTW National Emissions Standards for Hazardous Air Pollutants (NESHAP). Acetaldehyde and Formaldehyde were in profile but not NESHAP. Methanol in NEI documentation.
no-integrate	2461021000	Solvent Utilization;Miscellaneous Non-industrial: Commercial;Cutback Asphalt	profile 1007 has none of these HAP. Only Minnesota has a tiny amount.
no-integrate	2401005000	Solvent Utilization;Surface Coating;Auto Refinishing: SIC 7532	Only NY has benzene. Spec. profile is 2402 and has none of these HAP. Documentation for NEI does not estimate this HAP.
use Integrate case	2301030000	Industrial Processes;Chemical Manufacturing: SIC 28;Process Emissions from Pharmaceutical Manuf (NAPAP cat. 106)	profile 2462 - has nearly 8% benzene. Will create a LOT of benzene with "no HAP use" case.

minimum HAP(s) needed	SCC Tier 3	SCC Tier 3 Description	Comments
M	2460200000	Solvent Utilization;Miscellaneous Non-industrial: Consumer and Commercial;All Household Products	profile is 3146 contains only nonzero methanol.
any 1 HAP	2415000000	Solvent Utilization;Degreasing;All Processes/All Industries	profile 8745 (non-legacy but composite made up of a bunch of E-rated profiles)has M, B.
M	2401002000	Solvent Utilization;Surface Coating;Architectural Coatings - Solvent-based	profile 3139 has only M
no-integrate	2401020000	Solvent Utilization;Surface Coating;Wood Furniture: SIC 25	profile 2405 has no HAP
B	2505040000	Storage and Transport;Petroleum and Petroleum Product Transport;Pipeline	
any 1 HAP	2610030000	Waste Disposal, Treatment, and Recovery;Open Burning;Residential	profile 0121 is old and has only hexane.
any 1 HAP	2610000000	Waste Disposal, Treatment, and Recovery;Open Burning;All Categories	profile 0121 is old and has only hexane.
FAM	2401003000	Solvent Utilization;Surface Coating;Architectural Coatings - Water-based	profile 3140 has FAM
M	2460100000	Solvent Utilization;Miscellaneous Non-industrial: Consumer and Commercial;All Personal Care Products	profile (3247, nonlegacy based on CARB 1997 survey) has no M or B. However, Freedonia was used for M.
M	2465200000	Solvent Utilization;Miscellaneous Non-industrial: Consumer;Household Products	
M	2415300000	Solvent Utilization;Degreasing;All Industries: Cold Cleaning	profile 8745 (non-legacy but composite made up of a bunch of E-rated profiles)has M, B.
any 1 HAP	2401040000	Solvent Utilization;Surface Coating;Metal Cans: SIC 341	profile 2408 has none. - no HAPs in NEI so this SCC will not have any integrated sources
any 1 HAP	2401050000	Solvent Utilization;Surface Coating;Miscellaneous Finished Metals: SIC 34 - (341 + 3498)	SPEC PROFILE 3127 has none - no HAPs in NEI so this SCC will not have any integrated sources
any 1 HAP	2401200000	Solvent Utilization;Surface Coating;Other Special Purpose Coatings	profile 3138 has methanol. Not legacy. 0.11% aerosol coatings.
B	2461800000	Solvent Utilization;Miscellaneous Non-industrial: Commercial;Pesticide Application: All Processes	3001 is speciation profile (not legacy) "D" rating 2004. Calif. Testing for speciation profile from 2000. Has NO benzene! Benzene came from solvent utilization data (Fredonia) for "other markets" for the year 1998.
M	2460800000	Solvent Utilization;Miscellaneous Non-industrial: Consumer and Commercial;All FIFRA Related Products	3145 has M only and just a 0.01%

For the alm_no_c3 sector, the integration criteria were (1) that the source had to have at least one of the 4 HAPs and (2) that the sum of BAFM could not exceed the VOC emissions. The criteria for this sector were less complex than the nonpt sector because it has much fewer source categories.

We used the SMOKE feature to compute speciation profiles from mixtures of other profiles in user-specified proportions. The combinations are specified in the GSPRO_COMBO ancillary file by pollutant (including pollutant mode, e.g., EXH__VOC), state and county (i.e., state/county FIPS code) and time period (i.e., month).

We used this feature for onroad and nonroad mobile and gasoline-related related stationary sources whereby the emission sources use fuels with varying ethanol content, and therefore the speciation profiles require different combinations of gasoline, E10 an E85 profiles. Since the ethanol content varies spatially (e.g., by state or county), temporally (e.g., by month) and by modeling year (future years have more ethanol) the feature allows combinations to be specified at various levels for different years.

3.1.3 Temporal processing configuration

Table 3-6 summarizes the temporal aspect of the emissions processing configuration. It compares the key approaches we used for temporal processing across the sectors. We control the temporal aspect of SMOKE processing through (a) the scripts L_TYPE (temporal type) and M_TYPE (merge type) settings and (b) the ancillary data files described in Section 3.2.3. The one change made from the v4 to the v4.2 platform is the treatment of the afdust sector. In the v4 platform we used “aveday” settings and no use of holidays such that every day in a specific month had the same emissions. In the v4.2 platform, we used “week” settings and holidays and used profiles which were day-of-week dependent for some categories, such as road dust and tilling, where non-uniform profiles were being used for other pollutants associated with these processes.

Table 3-6. Temporal settings used for the platform sectors in SMOKE, v4.2 platform

Platform sector short name (see Table 2-1)	Inventory resolution	Monthly profiles used?	Daily temporal approach [1,2]	Merge processing approach [1,3]	Process Holidays as separate days?
ptipm	daily & hourly		all	all	yes
ptnonipm	annual	yes	mwdss	all	yes
othpt	annual	yes	mwdss	all	
nonroad	monthly		mwdss	mwdss	yes
othar	annual	yes	mwdss	mwdss	
alm_no_c3	annual	yes	mwdss	mwdss	
seca_c3	annual	yes	mwdss	mwdss	
on_noadj	monthly		week	week	yes
on_moves_startpm	monthly		week	week	yes
on_moves_runpm	monthly		week	week	yes
othon	annual	yes	week	week	
nonpt	annual	yes	mwdss	mwdss	yes
ag	annual	yes	aveday	aveday	
afdust	annual	yes	week	week	yes
biog	hourly		n/a	n/a	
avefire	annual	yes	aveday	aveday	

[1] **Definitions for processing resolution:**
all = hourly emissions computed for every day of the year, inventory is already daily
week = hourly emissions computed for all days in one "representative" week, representing all weeks for each month, which means emissions have day-of-week variation, but not week-to-week variation within the month
mwdss= hourly emissions for one representative Monday, representative weekday, representative Saturday and representative Sunday for each month, which means emissions have variation between Mondays, other weekdays, Saturdays and Sundays within the month, but not week-to-week variation within the month. Also Tuesdays, Wednesdays and Thursdays are treated the same.
aveday = hourly emissions computed for one representative day of each month, which means emissions for all days of each month are the same.

[2] **Daily temporal approach** refers to the temporal approach for getting daily emissions from the inventory using the Temporal program. The values given are the values of the L_TYPE setting.

[3] **Merge processing approach** refers to the days used to represent other days in the month for the merge step. If not "all", then the SMOKE merge step just run for representative days, which could include holidays as indicated by the rightmost column. The values given are the values of the M_TYPE setting.

In addition to the resolution, temporal processing includes a ramp-up period for several days prior to January 1, 2005, which is intended to mitigate the effects of initial condition concentrations. The same procedures were used for all grids, but with different ramp-up periods for each grid:

- 36 km: 10 days (Dec 22 - Dec 31)
- 12 km (East): 3 days (Dec 29 - Dec 31)

For most sectors, our approach used the emissions from December 2005 to fill in surrogate emissions for the end of December 2004. In particular, we used December 2005 emissions (representative days) for December 2004. For biogenic emissions, we processed December 2004 emissions using 2004 meteorology.

3.2 Emissions modeling ancillary files

In this section we summarize the ancillary data that SMOKE used to perform spatial allocation, chemical speciation, and temporal allocation for the 2005v4.2 platform. The ancillary data files, particularly the cross-reference files, provide the specific inventory resolution at which spatial, speciation, and temporal factors are applied. For the 2005v4.2 platform, we generally applied spatial factors by country/SCC, speciation factors by pollutant/SCC or (for combination profiles) state/county FIPS code and month, and temporal factors by some combination of country, state, county, SCC, and pollutant.

For the v4.2 platform, we updated the 2005v4 ancillary files in a few major areas:

1. We used new data for spatially allocating oil and gas emission sources
2. We assigned spatial, temporal and speciation profiles to parking area emissions for additional vehicle types (new data from MOVES2010) and updated previous assignments for some vehicle types (summarized in Table 3-14 and Table 3-155).
3. We updated the headspace VOC speciation profile we used for refueling.
4. We used a new profile for speciating $PM_{2.5}$ from C3 marine emissions.

3.2.1 Spatial allocation data

As described in Section 3.1.1, we performed spatial allocation for a national 36-km domain, and an Eastern 12-km domain**.** To do this, SMOKE used national 36-km and 12-km spatial surrogates and a SMOKE area-to-point data file. For the U.S. and Mexico, we used the same spatial surrogates as were used for the 2002v3 platform. For Canada we used a set of Canadian surrogates provided by Environment Canada. The spatial data files we used can be obtained from the files listed below; these are available from the 2002v3CAP (for US and Mexico) and the 2005v4 CAP-BAFM (for Canada) platform websites listed at the end of Section 1. The oil and natural gas surrogate files are posted at the 2005v4.1 website. For the v4.2 platform, all of the relevant surrogate files can be found in a single consolidated zip file: **gridding_surrogates_2005v4_2.zip**. This zip file contains the following information:

- U.S. and Mexican surrogate files at 36-km spatial resolution
- U.S. and Mexican surrogate files for surrogate files at 12 km spatial resolution
- Canadian surrogate files at 36-km spatial resolution
- Canadian surrogate files at 12-km spatial resolution
- Updated oil and gas surrogate files at 36-km and 12-km spatial resolutions for the new oil and gas surrogate (US) developed for the v4.1 platform

Additional information related to spatial allocation is found in this file:

- **ancillary_2005v4_2_smokeformat.zip:** contains spatial related data included are the grid description (GRIDDESC), surrogate description (SRGDESC), surrogate cross reference file (AGREF), and area-to-point (ARTOPNT) file. This data is provided on the 2005v4.2 website under "2005 Emissions Data Files".

The U.S., Mexican, and Canadian 12-km surrogates cover the entire CONUS domain, though they are used directly as inputs for the two separate Eastern and Western Domains shown in Figure 3-1. The SMOKE model windowed the Eastern and Western grids while it created these emissions. The remainder of this subsection provides further detail on the origin of the data used for the spatial surrogates and the area-to-point data.

3.2.1.1 Surrogates for U.S. emissions

There are 67 spatial surrogates available for spatially allocating U.S. county-level emissions to the 36-km and 12-km grid cells used by the air quality model; 66 are the same as for the v4 platform, and one new surrogate, "Oil & Gas Wells, IHS Energy, Inc. and USGS" was added for v4.2 which is discussed below. As described in Section 3.2.1.2, an area-to-point approach overrides the use of surrogates for some sources. Table 3-7 lists the codes and descriptions of the surrogates.

Table 3-7. U.S. Surrogates available for the 2005v4.2 platform.

Code	Surrogate Description	Code	Surrogate Description
N/A	Area-to-point approach (see 3.3.1.2)	515	Commercial plus Institutional Land
100	Population	520	Commercial plus Industrial plus Institutional
110	Housing	525	Golf Courses + Institutional +Industrial + Commercial
120	Urban Population	527	Single Family Residential
130	Rural Population	530	Residential - High Density
137	Housing Change	535	Residential + Commercial + Industrial + Institutional + Government
140	Housing Change and Population	540	Retail Trade
150	Residential Heating - Natural Gas	545	Personal Repair
160	Residential Heating - Wood	550	Retail Trade plus Personal Repair
165	0.5 Residential Heating - Wood plus 0.5 Low Intensity Residential	555	Professional/Technical plus General Government
170	Residential Heating - Distillate Oil	560	Hospital
180	Residential Heating - Coal	565	Medical Office/Clinic
190	Residential Heating - LP Gas	570	Heavy and High Tech Industrial
200	Urban Primary Road Miles	575	Light and High Tech Industrial
210	Rural Primary Road Miles	580	Food, Drug, Chemical Industrial
220	Urban Secondary Road Miles	585	Metals and Minerals Industrial
230	Rural Secondary Road Miles	590	Heavy Industrial
240	Total Road Miles	595	Light Industrial
250	Urban Primary plus Rural Primary	596	Industrial plus Institutional plus Hospitals
255	0.75 Total Roadway Miles plus 0.25 Population	600	Gas Stations
260	Total Railroad Miles	650	Refineries and Tank Farms
270	Class 1 Railroad Miles	675	Refineries and Tank Farms and Gas Stations
280	Class 2 and 3 Railroad Miles	680	Oil & Gas Wells, IHS Energy, Inc. and USGS
300	Low Intensity Residential	700	Airport Areas
310	Total Agriculture	710	Airport Points
312	Orchards/Vineyards	720	Military Airports
320	Forest Land	800	Marine Ports

Code	Surrogate Description	Code	Surrogate Description
330	Strip Mines/Quarries	807	Navigable Waterway Miles
340	Land	810	Navigable Waterway Activity
350	Water	850	Golf Courses
400	Rural Land Area	860	Mines
500	Commercial Land	870	Wastewater Treatment Facilities
505	Industrial Land	880	Drycleaners
510	Commercial plus Industrial	890	Commercial Timber

We did not use all of the available surrogates to spatially allocate sources in the v4.2 platform; that is, some surrogates in Table 3-7 were not assigned to any SCCs.

The creation of surrogates and shapefiles for the U.S. via the Surrogate Tool was discussed in the 2002v3 platform documentation and is not repeated here. This same tool was used for the new surrogate 680, "Oil & Gas Wells, IHS Energy, Inc. and USGS"

The new surrogate "Oil & Gas Wells, IHS Energy, Inc. and USGS" was developed for oil and gas SCCs, which had previously (in the v4 platform) used surrogate 585. The data reflect data through 10/1/2005. The underlying data for this surrogate is a grid of one-quarter square mile cells containing an attribute to indicate whether the wells within the cell are predominantly oil-producing, gas-producing, both oil- and gas-producing, or the wells are dry, or their production status is unknown. The well information was initially retrieved from IHS Inc.'s PI/Dwights PLUS Well Data on CD-ROM, which is a proprietary commercial database containing information for most oil and gas wells in the U.S. Cells were developed as a graphic solution to overcome the problem of displaying proprietary well data. No proprietary data are displayed or included in the cell maps and oil and gas quarter mile cell maps.

The spatial cross-reference file was also updated to assign onroad off-network (parking area) emissions from the MOVES2010 model, new to the 2005v4 platform, were allocated as shown in Table 3-8.

Table 3-8. Surrogate assignments to new mobile categories in the 2005v4 platform

SCC & Description	Surrogate
2201001350 Light Duty Gas Vehicles- parking areas rural 2201002350 Light Duty Gas Trucks 1&2- parking areas rural 2201004350 Light Duty Gas Trucks 3&4- parking areas rural	Rural population (same as rural local roads), code= 130
2201001370 Light Duty Gas Vehicles- parking areas urban 2201002370 Light Duty Gas Trucks 1&2- parking areas urban 2201004370 Light Duty Gas Trucks 3&4- parking areas urban	Urban population (same as urban local roads), code =120
2201070350 Heavy Duty Gasoline Vehicles 2B through 8B & Buses (HDGV)- parking areas rural 2201070370 Heavy Duty Gasoline Vehicles 2B through 8B & Buses (HDGV)- parking areas urban	Commercial plus Industrial plus Institutional, code = 520

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

There are numerous airport-related emission sources in the 2005 NEI, such as aircraft, airport ground support equipment, and jet refueling. Unlike the 2002v3 platform in which most of these emissions were contained in sectors with county-level resolution – alm (aircraft), nonroad (airport ground support) and nonpt (jet refueling), the 2005 platform includes the aircraft emissions as point sources. As shown in Table 2-1, aircraft emissions are part of the ptnonipm sector, since the 2005v2 inventory included them as point sources.

Thus, for the 2005 platform, we used the SMOKE “area-to-point” approach for only airport ground support equipment (nonroad sector), and jet refueling (nonpt sector). The approach is described in detail in the 2002 platform documentation.

We used nearly the same ARTOPNT file to implement the area-to-point approach as was used for the CAP and HAP-2002-Based platform. This was slightly updated from the CAP-only 2002 platform by further allocating the Detroit-area airports into multiple sets of geographic coordinates to support finer scale modeling that was done under a different project. We chose to retain the updated file for the 2005 platform. This approach is the same in the v4.2 and v4 platforms.

3.2.1.3 Surrogates for Canada and Mexico emission inventories

We used an updated set of surrogates for Canada to spatially allocate the 2006 Canadian emissions for the 2005v4 platform. The updated set completely replaced the 2002v3 platform surrogates for allocating the 2006 province-level Canadian emissions.

The updated surrogate data provided in the 2005v4 zip files and described in Table 3-9 came from Environment Canada. They provided the surrogates and cross references; the surrogates they provided were outputs from the Surrogate Tool (previously referenced). Per Environment Canada, the surrogates are based on 2001 Canadian census data. We changed the cross-references that Canada originally provided as follows: all assignments to surrogate '978' (manufacturing industries) were changed to '906' (manufacturing services), and all assignments to '985' (construction and mining) and ‘984’ (construction industries) were changed to '907' (construction services) because the surrogate fractions in 984, 978 and 985 did not sum to 1. We also changed codes for surrogates other than population that did not begin with the digit “9”. The same surrogates were used for the 12-km domains as were used for the 36-km domain.

Table 3-9. Canadian Spatial Surrogates for 2005-based platform Canadian Emissions (v4.2 unchanged from v4)

Surrogate description	Filename of 2005 Platform Surrogate	Surrogate description	Filename of 2005 Platform Surrogate
Population	CA_100_NOFILL.txt	asphalt	CA_951_NOFILL.txt
Total dwelling	CA_901_NOFILL.txt	cement	CA_952_NOFILL.txt
Agriculture and Forestry and Fishing	CA_902_NOFILL.txt	chemical	CA_953_NOFILL.txt
Waste Management Service	CA_903_NOFILL.txt	commfuelcomb	CA_954_NOFILL.txt

Surrogate description	**Filename of 2005 Platform Surrogate**	**Surrogate description**	**Filename of 2005 Platform Surrogate**
Upstream Oil and Gas (UOG)	CA_904_NOFILL.txt	downstream_petroleum	CA_955_NOFILL.txt
Mining and Oil and Gas services	CA_905_NOFILL.txt	egu	CA_956_NOFILL.txt
Manufacturing services	CA_906_NOFILL.txt	grain	CA_957_NOFILL.txt
Construction services	CA_907_NOFILL.txt	manufacturing	CA_958_NOFILL.txt
Transportation of Passengers and goods	CA_908_NOFILL.txt	mining	CA_959_NOFILL.txt
Electric and Gas and Water utilities	CA_909_NOFILL.txt	oilgas_distibution	CA_960_NOFILL.txt
Wholesaling Merchandise services	CA_910_NOFILL.txt	smelting	CA_961_NOFILL.txt
Retailing Merchandise services	CA_911_NOFILL.txt	waste	CA_962_NOFILL.txt
Government Services	CA_915_NOFILL.txt	wood	CA_963_NOFILL.txt
All Sales	CA_920_NOFILL.txt	asphalt industries	CA_971_NOFILL.txt
Intersection of AGRFORFISH and MANUFACT	CA_921_NOFILL.txt	cement industries	CA_972_FILL.txt
Intersection of Forest and Housing	CA_922_NOFILL.txt	chemical industries	CA_973_FILL.txt
Intersection of MININGOILG and MANUFACT	CA_923_NOFILL.txt	commercial fuel combustion	CA_974_FILL.txt
Intersection of UTILITIES and DWELLING	CA_924_NOFILL.txt	downstream petroleum industries	CA_975_FILL.txt
Intersection of CONSTRUCTION and DWELLING	CA_925_NOFILL.txt	Electric utilities	CA_976_FILL.txt
Intersection of PUBADMIN and DWELLING	CA_926_NOFILL.txt	grain industries	CA_977_FILL.txt
Commercial Marine Vessels	CA_928_NOFILL.txt	manufacturing industries[1]	CA_978_FILL.txt
HIGHJET	CA_929_NOFILL.txt	mining industries	CA_979_FILL.txt
LOWMEDJET	CA_930_NOFILL.txt	smelting industries	CA_981_FILL.txt
OTHERJET	CA_931_NOFILL.txt	waste management	CA_982_NOFILL.txt
CANRAIL	CA_932_NOFILL.txt	construction industries[1]	CA_984_NOFILL.txt
LDGV	CA_934_NOFILL.txt	construction and mining[1]	CA_985_NOFILL.txt
PAVED ROADS	CA_941_NOFILL.txt	TOTALBEEF[2]	CA_986_NOFILL.txt [2]
UNPAVED ROADS	CA_942_NOFILL.txt	TOTALPOUL[2]	CA_987_NOFILL.txt[2]
Oil Sands	CA_950_NOFILL.txt	TOTALSWIN[2]	CA_988_NOFILL.txt[2]
		TOTALFERT[2]	CA_989_NOFILL.txt[2]

1: Not used because fractions did not sum to 1;
2: Surrogates 986, 987, 988 and 989 were originally numbered by Canada as 611, 615, 620 and 65, respectively. We changed the numbers so that all Canadian surrogates would begin with "9".

The Mexican emissions and single surrogate (population) are the same in the v4.2 platform as were used in the 2005v4 and 2002 platforms.

3.2.2 Chemical speciation ancillary files

The following data files, provided at the 2005v4.2 website (see the end of Section 1), contain the SMOKE inputs used for chemical speciation of the inventory species to the air quality model species. SMOKE environment variable names, used in the file names, are shown using capital letters in parentheses:

- **ancillary_2005v4_2_smokeformat.zip:** inventory table (INVTABLE), NONHAPVOC emissions calculation exclusions file (NHAPEXCLUDE), speciation cross references (GSREF), speciation VOC-to-TOG conversion factors (GSCNV), speciation profiles (GSPRO), and combined, monthly speciation profiles (GSPRO_COMBO).
- **ancillary_2005v4_2_futureyear_smokeformat.zip:** speciation-related files associated with the future-year speciation changes.

The following subsections explain these SMOKE input files.

3.2.2.1 INVABLE and NHAPEXCLUDE

The INVTABLE and NHAPEXCLUDE SMOKE input files have a critical function in the VOC speciation process for emissions modeling cases utilizing HAP-CAP integration, as is done for the 2005v4.2 platform.

We prepared two different INVTABLE files to use with different sectors of the platform. For sectors in which we chose no integration across the entire sector (see Table 3-5), we created a "no HAP use" INVTABLE that set the "KEEP" flag to "N" for BAFM pollutants. Thus, any BAFM pollutants in the inventory input into SMOKE would be dropped. This approach both avoids double-counting of these species and assumes that the VOC speciation is the best available approach for these species for the sectors using the approach. The second INVTABLE, used for sectors in which one or more sources are integrated, causes SMOKE to keep the BAFM pollutants and indicates that they are to be integrated with VOC (by setting the "VOC or TOG component" field to "V" for all four HAP pollutants.

We also prepared sector-specific NHAPEXCLUDE files that provide the specific sources that are excluded from integration (see Table 3-5).

3.2.2.2 GSPRO, GSPRO_COMBO, GSREF and GSCNV

For VOC speciation, we generated the following SMOKE-ready profiles for the CB05 chemical mechanism using the Speciation Tool (Eyth, 2006):

- TOG-to-model species (used only for no-integrate sources)
- NONHAPTOG-to-model species (used only for the integrate sources)
- TOG-to-BENZENE (used only for no-integrate sources)

We added speciation profile entries that simply map NEI emissions of benzene, acetaldehyde, formaldehyde and methanol to the model species BENZENE, ALD2, FORM and METHANOL, respectively. These profiles were used only for the integrate sources. Note that we process the integrate and no-integrate sources using the same GSREF and GSPRO files. Thus, to avoid double counting of these HAP species, we removed BAFM pollutants for all no-integrate sources in the inventory. If the entire sector was no-integrate, then we were able to remove these in SMOKE (by using “N” in the INVTABLE) but if a sector was partially integrated, then we needed to remove these HAPS from the actual inventory input to SMOKE, but only for the no HAP use, no-integrate sources.

In addition to the speciation profiles, the Speciation Tool generates the SMOKE-ready speciation conversion files (GSCNV). We generated two of these: one containing profile-specific VOC-to-TOG conversion factors and the other containing profile-specific NONHAPVOC-to-NONHAPTOG conversion factors.

The TOG and $PM_{2.5}$ speciation factors that are the basis of the chemical speciation approach were developed from the SPECIATE4.2 database which is the EPA's repository of TOG and PM speciation profiles of air pollution sources. However, a few of the profiles we used in the v4.2 platform will be published in SPECIATE4.3 after the release of this documentation.

The SPECIATE database development and maintenance is a collaboration involving the EPA’s ORD, OTAQ, and the EPA’s Office of Air Quality Planning and Standards (OAQPS), and Environment Canada (EPA, 2006a). The SPECIATE database contains speciation profiles for TOG, speciated into individual chemical compounds, VOC-to-TOG conversion factors associated with the TOG profiles, and speciation profiles for $PM_{2.5}$. The database also contains the $PM_{2.5}$ speciated into both individual chemical compounds (e.g., zinc, potassium, manganese, lead), and into the “simplified” $PM_{2.5}$ components used in the air quality model. These simplified components are:

- PSO4 : primary particulate sulfate
- PNO3: primary particulate nitrate
- PEC: primary particulate elemental carbon
- POC: primary particulate organic carbon
- PMFINE: other primary particulate, less than 2.5 micrograms in diameter

As discussed earlier, for the v4.2 platform we updated the $PM_{2.5}$ profile used for category 3 marine vessels burning residual oil to use the profile: Marine Vessel - Main Engine - Heavy Fuel Oil which will be published in SPECIATE4.3. This profile was compiled from data published in Emission Measurements from a Crude Oil Tanker at Sea, Environ. Sci. Technol. 2008, 42, 7098–7103. Previously the Draft Residual Oil Combustion – Simplified (92072) was used. The SCCs affected were:

2280003000	Mobile Sources;Marine Vessels, Commercial;Residual;Total, All Vessel Types
2280003010	Mobile Sources;Marine Vessels, Commercial;Residual;Ocean-going Vessels
2280003100	Mobile Sources;Marine Vessels, Commercial;Residual;Port emissions
2280003200	Mobile Sources;Marine Vessels, Commercial;Residual;Underway emissions

The difference between the two profiles is provided in Table 3-10, and shows that the new profile produces much more organic carbon and less elemental carbon, sulfate, and other $PM_{2.5}$.

Table 3-10. Differences between two profiles used for commercial marine residual oil

Pollutant	Species	Split factors new c3 profile 92200 used for v4.2	Split factors residual oil combustion 92072, used for v4
PM2_5	PEC	0.005	0.01
PM2_5	PMFINE	0.5022	0.54
PM2_5	PNO3	0	0
PM2_5	POC	0.1125	0.01
PM2_5	PSO4	0.3803	0.44

We also updated the bituminous coal profile, 92095, which we had previously used for only a single nonpoint SCC (2101002000) with the sub-bituminous profile 92084, which was used for all other coal combustion SCCs. We replaced profile 92095 with 92084 for consistency. Table 3-11 shows the differences are shown below, though these are quite small and represent only a minor change to the SMOKE results:

Table 3-11. Differences between two profiles used for coal combustion

Pollutant	Species	Split factors sub-bituminous 92084	Split factors bituminous 92095
PM2_5	PEC	0.0188	0.01696
PM2_5	PMFINE	0.8266	0.827928
PM2_5	PNO3	0.0016	0.00208
PM2_5	POC	0.0263	0.026307
PM2_5	PSO4	0.1267	0.126725

We made other updates to profile assignments for the SCCs shown in Table 3-12 below as compared to the 2002 platform. These updates were kept for the v4.2 platform.

Table 3-12: $PM_{2.5}$ speciation profile updates assignments for the v4 platform

SCC	New Profile Code	Pollutant	Profile Name
39900501	92025	PM2_5	Distillate Oil Combustion Source Type: Distillate Oil Combustion
49090021	92025	PM2_5	Distillate Oil Combustion Source Type: Distillate Oil Combustion
30890002	92072	PM2_5	Residential Oil Combustion Source Type: Residential Oil Combustion
10100912	92091	PM2_5	Wood Fired Boiler Source Type: Wood/Bark Combustion
10102018	92057	PM2_5	PM/SO2 controlled lignite combustion: Waste Coal Combustion
50410563	92082	PM2_5	Solid Waste Combustion Source Type: Solid Waste Combustion
10100692	92048	PM2_5	Natural Gas Combustion Source Type: Natural Gas Combustion
50100511	92086	PM2_5	Tire Burning Source Type: Tire Burning
50100512	92082	PM2_5	Solid Waste Combustion: Solid Waste Combustion
2810040000	92035	PM2_5	HDDV Source Type: Aircraft Engines

Key changes to the TOG profiles for the v4.2 platform from the 2005v4 platform are as follows:

- Used new headspace profiles for E0 (no ethanol gasoline) and E10 (10% ethanol gasoline), which will be published in SPECIATE4.3. Profile 8762 is Gasoline Headspace Vapor using 0% Ethanol - Composite Profile and Profile 8763 is Gasoline Headspace Vapor using 10% Ethanol - Composite Profile. In 2005, only the E0 profile is used. This was an oversight since we could have used the same combinations of profiles of E0 exhaust E10 exhaust (which are also the same combinations of E10 evaporative and E10 evaporative) that we used for 2005. We did, however use consistent combinations (E0/E10) in future-year modeling for the headspace profiles as the evaporative and exhaust combinations.
- Added the fuel-specific VOC profiles for the new parking area SCCs generated due to the fact that MOVES2010 was used for all vehicle types in the v4.2 platform. A summary of the assignments of all profiles (speciation, temporal and spatial surrogates) is provided in Table 3-14 for gasoline vehicles and Table 3-155 for diesel vehicles.

Table 3-13 provides a summary of the 2005 speciation approach for mobile and other fuel-related sources. It shows the updated profiles that form the 2005 combinations. The headspace profile, 8762 is a new profile for the v4.2 platform, and, is used for other nonroad refueling and other fuel-related stationary source emission categories in 2005.

Table 3-13. Summary of VOC speciation profile approach by sector for 2005

Inventory type and mode	VOC speciation approach for fuels	VOC Profile Codes	2005 sectors
Mobile onroad and nonroad Exhaust	E0 and E10 combinations (excludes Tier 2)	8750 8751	on_noadj nonroad
Mobile onroad and nonroad Evaporative	E0 and E10 combinations	8753 8754	on_noadj nonroad
Mobile nonroad Refueling Stationary (no mode assigned to VOC): Portable Fuel Containers, bulk plant -to-pump, refinery-to-bulk terminal	E0	8762	Nonroad nonpt

In future years, different profile combinations and a different headspace profile is used, due to the influx of greater quantities of ethanol in fuels. Changes to the above profiles for future-year scenarios will be discussed in more detail in the documentation of future-year emissions development for the rule or application of interest. In summary, we utilized additional profiles in the combinations that is appropriate. The profiles we added were Tier 2 profiles for E0 and E10 and an E10 headspace profile.

Speciation profiles for use with BEIS are not included in SPECIATE. The 2005 platform uses BEIS3.14, which includes a new species (SESQ) that was not in BEIS3.13 (the version used for the 2002 platform). Thus we added this species (it is mapped to the model species SESQT) to the set of profiles that we had been using in the 2002 platform. The profile code associated with BEIS3.14 profiles for use with CB05 uses the same as in the 2002 platform: "B10C5."

3.2.3 Temporal allocation ancillary files

The emissions modeling step for temporal allocation creates the 2005 hourly emission inputs for the air quality model by adjusting the emissions from the inventory resolution (annual, monthly, daily or hourly) that are input into SMOKE. The temporal resolution of each of the platform sectors prior to their input into SMOKE is included in the sector descriptions from Table 2-1 and repeated in the discussion of temporal settings in Table 3-6.

The monthly, weekly, and diurnal temporal profiles and associated cross references used to create the 2005 hourly emissions inputs for the air quality model were generally based on the temporal allocation data used for the 2002v3 platform. For the v4 and v4.2 platforms, we added new profile assignments for SCCs in the 2005 inventory that were not in the 2002 inventory, and we updated the profiles used for ptipm sources without CEM data to represent the year 2005.

The following data file, provided at the 2005v4 website (see the end of Section 1), contains the files used for temporal allocation of the inventory emissions. SMOKE environmental variable names, used in the file names, are shown in capital letters in parentheses:

- **ancillary_2005v4_2_smokeformat.zip:** includes temporal cross reference files used across all inventory sectors (ATREF, MTREF, and PTREF) and for ptipm sector (used for electric generating units) for the evaluation case (PTREF) and, temporal profiles (ATPRO, MTPRO, and PTPRO)

The starting point for our temporal profiles was the 2002 platform. The remainder of this section discusses the development of the new temporal profiles or profile assignments used in the 2005v4 platform.

<u>Canadian emissions</u>

The profiles assignments for the Canadian 2006 inventory were provided by Environment Canada along with the inventory. They provided profile assignments that rely on the existing set of temporal profiles in the 2002 platform. For point sources, they provided profile assignments by PLANTID.

<u>WRAP Oil and Gas Inventory Profiles</u>

The WRAP 2005 oil and gas inventory SCCs utilized uniform monthly and day of week profiles (codes 262 and 7, respectively) and an hourly profile (code 26) that put emissions in every hour, but, weighted towards the day light hours.

Diurnal Profiles for Electric Generating Units (ptipm)

We updated the state-specific and pollutant-specific diurnal profiles for use in allocating the day-specific emissions for non-CEM sources in the ptipm sector. We used the 2005 CEM data to create state-specific, day-to-hour factors, averaged over the whole year and all units in each state. We calculated the diurnal factors using CEM SO_2 and NO_X emissions and heat input. We computed SO_2 and NO_X-specific factors from the CEM data for these pollutants. All other pollutants used factors created from the hourly heat input data. We assigned the resulting profiles by state and pollutant.

Area Fugitive Dust Profiles (afdust)

The monthly and day of week temporal profiles for several fugitive dust sources were changed from uniform in the v4 platform (code 262 and 7 respectively) to a summer peak/winter minimum (monthly code 22) and weekend minimum (code 18) in the v4.2 platform. These sources include fugitive dust from industrial unpaved roads and construction, residential and industrial/commercial/institutional construction, road construction, mining and quarrying, and agricultural production (planting, tilling, harvesting, and loading).

Diurnal weekday and weekend temporal profiles were changed from a simple bell curve profile (code 26) for all categories in v4 to a more dynamic profile with a morning and afternoon peak (code 2013) for paved and unpaved road dust in v4.2. Diurnal temporal profiles were changed to a zero nighttime, daytime plateau profile (code 27) for all agricultural production sources in v4.2.

Agricultural Burning Profiles in CENRAP States (nonpt)

The uniform monthly, day of week, and diurnal profiles (codes 262, 7, and 24 respectively) in the v4 platform for all agricultural burning emissions were modified in the v4.2 platform to state-specific monthly, day of week, and diurnally-varying profiles for these CENRAP region states: Arkansas, Iowa, Kansas, Louisiana, Minnesota, North Dakota, Nebraska, Oklahoma, and Texas.

Residential and Commercial/Institutional Natural Gas, LPG, and Kerosene Combustion (nonpt)

Uniform monthly (code 262) profiles in platform v4 for residential and commercial/institutional liquified petroleum gas (LPG), natural gas, and kerosene sources were changed to monthly varying with a strong winter peak in platform v4.2.

Onroad Parking Area Profiles

The SCCs and descriptions, along with the assignments chosen are shown in Table 3-14 (gasoline vehicles) and Table 3-155 (diesel vehicles). Figure 3-3 and Figure 3-4 show the diurnal profiles referred to in the tables.

Figure 3-3. Diurnal Profiles based on road type (use local for “start”) and whether the road is urban versus rural

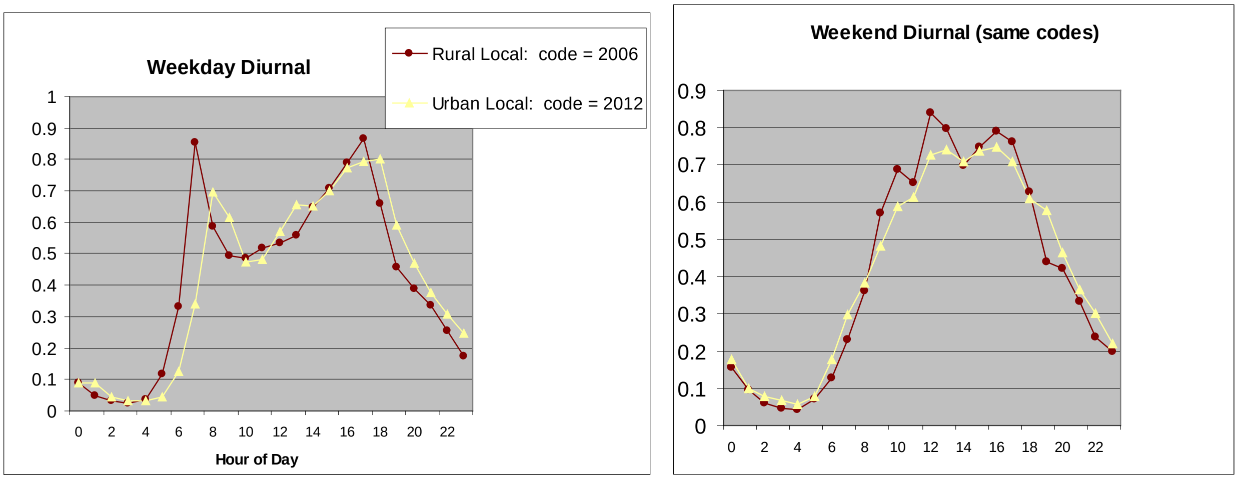


Figure 3-4. Diurnal temporal profile for HDDV 2B through 8B at Parking areas

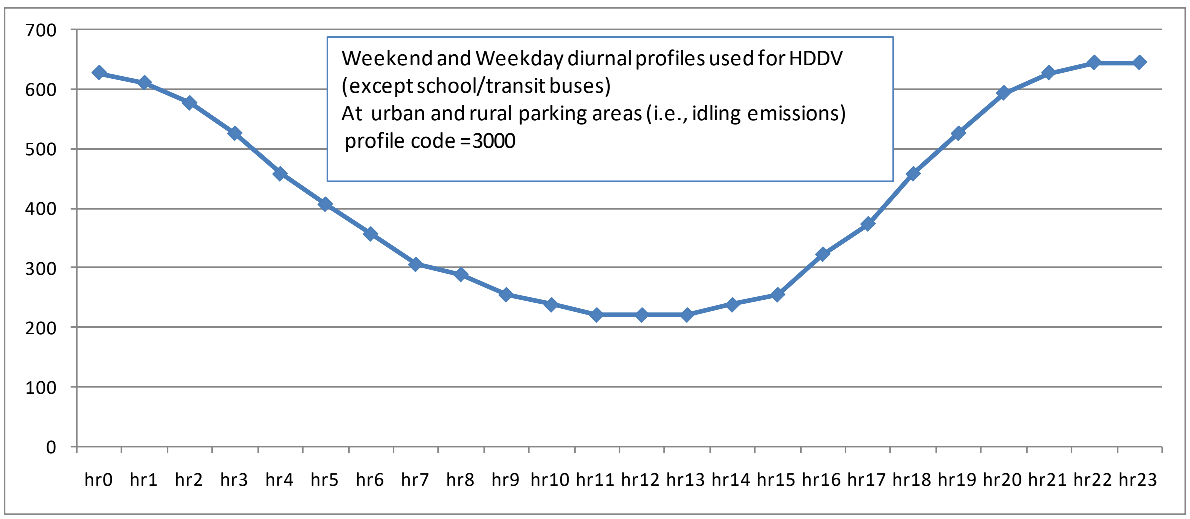


Table 3-14. Summary of spatial surrogates, temporal profiles, and speciation profiles used by gasoline vehicle types for the onroad parking area-related SCCs.

GASOLINE VEHICLE TYPES					
SCC&Description	**Surrogate**	**Temporal Profile: Monthly Variation**	**Temporal Profile: Day of Week Variation**	**Temporal Profile: Diurnal variation**	**Speciation Profile**
2201001350 Light Duty Gas Vehicles- parking areas **rural** 2201020350 Light Duty Gas Trucks 1&2- parking areas **rural** 2201040350 Light Duty Gas Trucks 3&4- parking areas **rural** 2201080370 Motorcycles (MC) - parking areas **rural**	Rural Population (same as rural local roads) 130	Not applicable – inventory contains monthly emissions	RURAL LD values are: Mon –Fri 12.1% 12.1% 12.1% 12.1% 18.3% Sat/Sun: 15.3% 18.3% Weekly_code (for SMOKE) =20021	Use same as profile as **rural local roads (Rdtype=210)**. Code = 2006 (see Figure 3-3, reddish curve)	Use same speciation profiles as what is used for LD GAS vehicles on the other roadway types. * i.e.: **EVP__VOC:** COMBO of 8753 (Gasoline Vehicle - Evaporative emission - Reformulated gasoline) & 8754 (Gasoline Vehicle - Evaporative emission - E10 ethanol gasoline) Note that these are the combinations used in 2005. In some cases, future-year profiles may also include 8755 (Gasoline Vehicle - Evaporative emission - E85) **EXH__VOC:** COMBO of 8750&8751 These combinations are used in 2005. In some cases, future-year profiles may also include combinations of 8752 (E85) , 8756 (tier 2 exhaust, E0), 8757 (tier 2 exhaust, E10) EXH__PM2.5 not needed because OTAQ supplies pre-speciated emissions BRK_PM2.5 and TIR_PM2.5 use same as other roadways (92009 and 92087, respectively)
2201001370 Light Duty Gas Vehicles- parking areas **urban** 2201020370 Light Duty Gas Trucks 1&2- parking areas **urban** 2201040370 Light Duty Gas Trucks 3&4- parking areas **urban**	Urban Population (same as urban local roads) 120	Not applicable – inventory contains monthly emissions	URBAN LD values are: Mon-Fri 14.8% 14.8% 14.8% 14.8% 16.0% Sat Sun 13.4% and 11.6% Weekly_code (for SMOKE) =20031	Use same as profile as **urban local roads**. **(Rdtype=330)**. Code = 2012 (see Figure 3-3, yellow curve)	Same as above

GASOLINE VEHICLE TYPES					
SCC&Description	**Surrogate**	**Temporal Profile: Monthly Variation**	**Temporal Profile: Day of Week Variation**	**Temporal Profile: Diurnal variation**	**Speciation Profile**
2201080370 Motorcycles (MC) - parking areas **rural**					
2201070350 Heavy Duty Gasoline Vehicles 2B through 8B & Buses (HDGV)- parking areas **rural**	Commercial plus Industrial plus Institutional (code = 520)	Not applicable – inventory contains monthly emissions	RURAL HD values are: Mon-Fri 16.8% 16.8% 16.8% 16.8% 15.9% Sat Sun 8.8% and 8.8% Weekly_code (for SMOKE) =20022	Use same as profile **rural local roads**. Code = 2006 (see Figure 3-3, reddish curve)	Same as above
2201070370 Heavy Duty Gasoline Vehicles 2B through 8B & Buses (HDGV)- parking areas **urban**	Same as above	Not applicable – inventory contains monthly emissions	URBAN HD values are: Mon-Fri 17.7% 17.7% 17.7% 17.7% 17.7% Sat Sun 7% and 5% Weekly_code (for SMOKE) =20032	Use same as profile on **urban local roads**. Code = 2012 (see Figure 3-3, yellow curve)	Same as above

Table 3-15. Summary of spatial surrogates, temporal profiles, and speciation profiles used by diesel vehicle types for the onroad parking area-related SCCs from MOVES2010.

DIESEL VEHICLE TYPES					
SCC&Description	**Surrogate**	**Temporal Profile: Monthly Variation**	**Temporal Profile: Day of Week Variation**	**Temporal Profile: Diurnal variation**	**Speciation Profile**
2230001350 Light Duty Diesel Vehicles (LDDV)- parking areas **rural** 2230060350 Light Duty Diesel Trucks 1 through 4 (M6) (LDDT))- parking areas **rural**	Rural Population (same as rural local roads) 130	Not applicable – inventory contains monthly emissions	RURAL LD values are: Mon –Fri 12.1% 12.1% 12.1% 12.1% 18.3% Sat/Sun: 15.3% 18.3% Weekly_code (for SMOKE) =20021 Rationale: choose same weekend/weekday variation for all Light Duty Vehicles on all rural road types	Use same as profile as **rural local roads (Rdtype=210)**. Code = 2006 (see Figure 3-3, reddish curve) Rationale: choose same diurnal profile for all vehicles (except HDDV 2B to 8B) for all rural parking areas (which is the profile used for rural local roads)	Use same speciation profiles as what is used for LD DIESEL vehicles, irrespective of road type. i.e.: **EVP__VOC:** ZERO emissions (placeholder profile is required by SMOKE: 4547 (Gasoline Headspace Vapor - Circle K Diesel - adjusted for oxygenates) **EXH__VOC:** 4674 (Diesel Exhaust - Medium Duty Trucks) PM2.5 : ZERO emissions →not needed since OTAQ supplies pre-speciated emissions. Placeholder profile is required by SMOKE: 92042 (LDDV Exhaust – Simplified) BRK_PM2.5 and TIR_PM2.5 use same as other roadways (92009 and 92087, respectively)
2230001370 Light Duty Diesel Vehicles (LDDV)- parking areas **urban** 2230060370 Light Duty Diesel Trucks 1 through 4 (M6) (LDDT))- parking areas **urban**	URBAN Population (same as urban local roads) 120	Not applicable – inventory contains monthly emissions	URBAN LD values are: Mon-Fri 14.8% 14.8% 14.8% 14.8% 16.0% Sat Sun 13.4% and 11.6% Weekly_code (for SMOKE) =20031 Rationale: choose same weekend/weekday variation for all Light Duty Vehicles on urban road types	Use same as profile as **urban local roads**. **(Rdtype=330)**. Code = 2012 (see Figure 3-3, yellow curve Rationale: choose same diurnal profile for all vehicles (except HDDV 2B to 8B) for all rural parking areas (which is the profile used for rural local roads)	Same as above

DIESEL VEHICLE TYPES					
SCC&Description	**Surrogate**	**Temporal Profile: Monthly Variation**	**Temporal Profile: Day of Week Variation**	**Temporal Profile: Diurnal variation**	**Speciation Profile**
2230071350 Heavy Duty Diesel Vehicles (HDDV) Class 2B-parking areas rural 2230072350 Heavy Duty Diesel Vehicles (HDDV) Class 3, 4, & 5-parking areas rural 2230073350 Heavy Duty Diesel Vehicles (HDDV) Class 6 & 7-parking areas rural 2230074350 Heavy Duty Diesel Vehicles (HDDV) Class 8A & 8B-parking areas rural	Rural primary roads code=210 Rationale: most idling will occur at truckstops	Not applicable – inventory contains monthly emissions	RURAL HD values are: Mon-Fri 16.8% 16.8% 16.8% 16.8% 15.9% Sat Sun 8.8% and 8.8% Weekly_code (for SMOKE) =20022	Construct new profile CODE=3000 which is low at daytime and high at night-time (11pm to 2am) See Figure 3-4	Use same speciation profiles as what is used for HD DIESEL vehicles, irrespective of road type. i.e.: **EVP__VOC:** ZERO emissions (placeholder profile is required by SMOKE: 4547 (Gasoline Headspace Vapor - Circle K Diesel - adjusted for oxygenates) **EXH__VOC:** 4674 (Diesel Exhaust - Medium Duty Trucks) PM2.5: ZERO emissions →not needed since OTAQ supplies pre-speciated emissions. Placeholder profile is required by SMOKE: 92035 (HDDV Exhaust – Simplified) BRK_PM2.5 and TIR_PM2.5 use same as other roadways (92009 and 92087, respectively)
2230071370 Heavy Duty Diesel Vehicles (HDDV) Class 2B-parking areas urban 2230072370 Heavy Duty Diesel Vehicles (HDDV) Class 3, 4, & 5-parking areas urban 2230073370 Heavy Duty Diesel Vehicles (HDDV) Class 6 & 7-parking areas urban 2230074370 Heavy Duty Diesel Vehicles (HDDV) Class 8A & 8B-parking areas urban	URBAN primary roads code=200 Rationale: most idling will occur at truckstops	Not applicable – inventory contains monthly emissions	URBAN LD values are: Mon-Fri 14.8% 14.8% 14.8% 14.8% 16.0% Sat Sun 13.4% and 11.6% Weekly_code (for SMOKE) =20031	Construct new profile CODE=3000 which is low at daytime and high at night-time (11pm to 2am) See Figure 3-4	Same as above

DIESEL VEHICLE TYPES					
SCC&Description	**Surrogate**	**Temporal Profile: Monthly Variation**	**Temporal Profile: Day of Week Variation**	**Temporal Profile: Diurnal variation**	**Speciation Profile**
2230075350 Heavy Duty Diesel Buses (School & Transit) - parking areas **rural**	Rural Population (same as rural local roads) 130	Not applicable – inventory contains monthly emissions	USE URBAN LD values: Mon-Fri 14.8% 14.8% 14.8% 14.8% 16.0% Sat Sun 13.4% and 11.6% Weekly_code (for SMOKE) =20031 Rationale: these vehicles follow profile of LD vehicles better than HD; day of week variation should more closely follow urban (higher weekday than weekend)	Use same as profile as **rural local roads (Rdtype=210)**. Code = 2006 (see Figure 3-3, reddish curve) Rationale: choose same diurnal profile for all vehicles (except HDDV 2B to 8B) for all rural parking areas (which is the profile used for rural local roads)	Same as above
2230075370 Heavy Duty Diesel Buses (School & Transit) - parking areas **urban**	URBAN Population (same as urban local roads) 120	Not applicable – inventory contains monthly emissions	USE URBAN LD values: Mon-Fri 14.8% 14.8% 14.8% 14.8% 16.0% Sat Sun 13.4% and 11.6% Weekly_code (for SMOKE) =20031	Use same as profile as **urban local roads**. **(Rdtype=330)**. Code = 2012 (see Figure 3-3, yellow curve Rationale: choose same diurnal profile for all vehicles (except HDDV 2B to 8B) for all rural parking areas (which is the profile used for rural local roads)	Same as above

4 Development of 2012 and 2014 Base-Case Emissions

This section describes the methods we used for developing the 2012 and 2014 future-year base-case emissions. The year 2012 source apportionment scenarios and the 2014 EGU remedy (i.e., "control") case are discussed in Sections 5 and 6, respectively. The ancillary input data in the future-year scenarios are very similar to those used in the 2005 base case except for the speciation profiles used for gasoline-related sources, which change in the future to account for increased ethanol usage in gasoline. Table B-1 of Appendix B is a table of differences between these ancillary input data between the 2005 base case and these future-year scenarios. Appendix B also provides the values for the main parameters used in the emissions modeling cases in Table B-2. The specific speciation profile changes are discussed in Sections 4.2.8 and 4.3.5. A list of inventory datasets used for this and all cases is provided in Appendix C.

The future base-case projection methodologies vary by sector. The 2012 and 2014 base cases represent 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 Transport Rule Proposal 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.
- Non-IPM sector (ptnonipm): Projection factors and percent reductions reflect 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 is discussed in Section 4.2.8.
- 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 WRAP states as well as Oklahoma and Texas. Year-specific speciation was applied to some portions of this sector and is discussed in Section 4.2.8.
- 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 years 2012 and 2015 and using national level inputs. Year 2014 emissions were created by interpolating 2012 and 2015 emissions. 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 2012 and 2014 (interpolated) 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 2012 and 2014, 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): MOVES2010 run (state-month) for 2012 and 2014 with results disaggregated to the county level in proportion to NMIM 2012 and NMIM 2015 emissions estimates. Temperature impacts at the monthly average resolution. California-specific data provided by the state of California, except NH_3 which was obtained from MOVES2010. VOC speciation uses different future-year values to take into account both the increase in ethanol use, and the existence of Tier 2 vehicles that use a different speciation profile. 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 MOVES2010 year 2012 and 2014 future-year state-month estimates for PM and naphthalene, apportioned to the county level using NMIM 2012 and NMIM 2015 state-county ratios matched to vehicle and road types. 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 MOVES2010 future-year 2012 and 2014 state-month estimates for PM and naphthalene, apportioned to the county level using NMIM 2012 and NMIM 2015 state-county ratios of local urban and rural roads by vehicle type. 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 nonroad/nonpoint (othar): 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 2012 and 2014 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. Emission summaries by sector for 2005 and future years are provided in Section 7. Note that mercury (Hg) is listed in the pollutant's column; however, we did not include Hg in our v4.2 modeling. Note that a few controls are not fully promulgated by 2012 but are by 2014. For example the Maximum Achievable Control Technology (MACT) rule "Boat Manufacturing" has a compliance date in year 2013; therefore the VOC control associated with this MACT rule is not reflected in the 2012 base case but is reflected in the 2014 base and control cases.

Lists of the control, closures, projection packets (datasets) used to create Transport Rule 2012 and 2014 future year base-case scenario inventories from the 2005 base case are provided in Appendix D. Additional summaries on the emissions changes resulting from these various control programs that were too large to include in this section can be found in Appendix D, and the following files are provided with the Transport Rule final emissions data. TransportRuleFinal_2012_Projection_info.xlsx and TransportRuleFinal_2014_Projection_info.xlsx.

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 Transport 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 2012 and 2014 base-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 carried forward from the Proposed Transport Rule		
MACT rules, national, VOC: national applied by SCC, MACT Boat Manufacturing *(promulgated in year 2013, thus not reflected in the 2012 base case)* Wood Building Products Surface Coating Generic MACT II: Spandex Production, Ethylene manufacture Large Appliances Miscellaneous Organic NESHAP (MON): Alkyd Resins, Chelating Agents, Explosives, Phthalate Plasticizers, Polyester Resins, Polymerized Vinylidene Chloride Reinforced Plastics Asphalt Processing & Roofing Iron & Steel Foundries Metal: Can, Coil Metal Furniture Miscellaneous Metal Parts & Products Municipal Solid Waste Landfills Paper and Other Web Plastic Parts Plywood and Composite Wood Products Carbon Black Production Cyanide Chemical Manufacturing Friction Products Manufacturing Leather Finishing Operations Miscellaneous Coating Manufacturing Organic Liquids Distribution (Non-Gasoline) Refractory Products Manufacturing 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: Alcoa, TX Premcor (formerly Motiva), DE	All	2
Refinery Consent Decrees: plant/SCC controls *(a few of these controls are promulgated in year 2013, and thus are not reflected in the 2012 base case)*	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, 2005b
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
Additional projections used in the final Transport Rule modeling for non-EGU point sources (ptnonipm sector)		
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. *(promulgated in year 2013, thus only known closures and new units*	Hg, NO_X, SO2, PM, HCl	13; EPA, 2010

through year 2009 were included for year 2012 –ISIS-based future-year projections included only for 2014)		
New York ozone SIP controls	VOC, NO_X, HAP VOC	14
Additional plant and unit closures provided by state, regional, and the EPA agencies and additional consent decrees. Includes updates from Transport Rule comments.	All	Appendix D
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 Information Collection Request (ICR) from the Industrial/Commercial/Institutional Boiler NESHAP.	NO_X, SO_2, HCl	Section 4.2.6
Reciprocating Internal Combustion Engines (RICE) NESHAP: *(SO2 controls for RICE are not effective until after 2012, but are applied in 2014)*	NO_X, CO, PM, SO_2	15
Replaced 2005 with 2008 emissions for Corn Products International, Cook County, Illinois, due to the shutdown of 3 boilers and addition of a new boiler (subject to Prevention of Significant Deterioration and Requirements). Agency Identifier: 031012ABI (ILEPA)	All	16
State fuel sulfur content rules for fuel oil –*effective only in Maine and New York in 2014*	SO_2	17
Nonpoint (nonpt sector) projection approaches carried forward from the Proposed Transport Rule		
Municipal Waste Landfills: projection factor of 0.25 applied	All	EPA, 2007a
Livestock Emissions Growth from year 2002 to year 2012 and 2014	NH3, PM	9
Residential Wood Combustion Growth and Change-outs from year 2005 to year 2012 and 2014	All	10
Gasoline Stage II growth and control from year 2005 to year 2012 and 2014	VOC	11
Portable Fuel Container Mobile Source Air Toxics Rule 2 (MSAT2) inventory growth and control from year 2005 to year 2012 and 2014	VOC	12
Additional projections used in the final Transport Rule modeling for Nonpoint sources (nonpt sector)		
RICE NESHAP: *(SO2 controls for RICE are not effective until after 2012, but are applied in 2014)*	NO_X, CO, VOC, PM, SO_2	15
Use Phase II WRAP 2005 Oil and Gas, but apply year 2012- and year 2014-specific RICE controls to these emissions	VOC, SO_2, NO_X, CO	Section 3.2.7
Use 2008 Oklahoma and Texas Oil and Gas, and, apply year 2012- and year 2014-specific RICE controls to these emissions.	VOC, SO_2, NO_X, CO, PM	Section 3.2.7
New York, Connecticut, and Virginia ozone SIP controls	VOC	14, 18
State fuel sulfur content rules for fuel oil –*effective only in Maine and New York in 2014*	SO_2	17

APPROACHES/REFERENCES- Stationary Sources:

1. Appendix B in the Proposed Toxics Rule TSD
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.
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 3.2.1.

10. Growth and Decline in woodstove types based on industry trade group data, See Section.
11. VOC emission ratios of year 2016 (linear interpolation between 2015 and 2020) -specific from year 2005 from the National Mobile Inventory Model (NMIM) 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.
12. VOC and benzene emissions for year 2016 (linear interpolation between 2015 and 2020) from year 2002 from MSAT2 rule (EPA, 2007b)
13. 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
14. New York NO_X and VOC reductions obtained from Appendix J in NY Department of Environmental Conservation Implementation Plan for Ozone (February 2008). Located in Section 3.2.6.
15. Appendix F in the Proposed Toxics Rule TSD
16. The 2008 data used came from Illinois' submittal of 2008 emissions to the NEI.
17. Based on available, enforceable state sulfur rules as of November, 2010: ILTA; An Act To Improve Maine's Air Quality and Reduce Regional Haze at Acadia National Park and Other Federally Designated Class I Areas, NRDC, New York Times.
18. VOC reductions in Connecticut and Virginia obtained from Transport Rule comments.

Onroad mobile and nonroad mobile controls (list includes all key mobile control strategies but is not exhaustive)[a]		
National Onroad Rules: Tier 2 Rule: Signature date February, 2000 2007 Onroad Heavy-Duty Rule: February, 2009 Final Mobile Source Air Toxics Rule (MSAT2): February, 2007 Renewable Fuel Standard: March, 2010	all	1
Local Onroad Programs: National Low Emission Vehicle Program (NLEV): March, 1998 Ozone Transport Commission (OTC) LEV Program: January,1995	VOC	2
National Nonroad Controls: Clean Air Nonroad Diesel Final Rule – Tier 4: June, 2004 Control of Emissions from Nonroad Large-Spark Ignition Engines and Recreational Engines (Marine and Land Based): "Pentathalon Rule": November, 2002 Clean Bus USA Program: October, 2007 Control of Emissions of Air Pollution from Locomotives and Marine Compression-Ignition Engines Less than 30 Liters per Cylinder: October, 2008	all	3,4,5
Aircraft: Itinerant (ITN) operations at airports to year 2012 and year 2014	all	6
Locomotives: Energy Information Administration (EIA) fuel consumption projections for freight rail Clean Air Nonroad Diesel Final Rule – Tier 4: June 2004 Locomotive Emissions Final Rulemaking, December 17, 1997 Control of Emissions of Air Pollution from Locomotives and Marine: May 2008	all	EPA, 2009; 3; 4; 5
Commercial Marine: Category 3 marine diesel engines Clean Air Act and International Maritime Organization standards (April, 30, 2010) –*also includes Transport Rule comments.* EIA fuel consumption projections for diesel-fueled vessels OTAQ ECA C3 Base 2020 inventory for residual-fueled vessels Clean Air Nonroad Diesel Final Rule – Tier 4 Emissions Standards for Commercial Marine Diesel Engines, December 29, 1999 Tier 1 Marine Diesel Engines, February 28, 2003	all	7, 3; EPA, 2009
a. These control programs are the same as were used in the Proposed Transport Rule except for the C3 marine standards of April 2010, which are included in the Toxics Rule but were not included in the Proposed Transport Rule.		

APPROACHES/REFERENCES – Mobile Sources

1. Vehicles and Engines
2. Only for states submitting these inputs: Transportation, Air Pollution, and Climate Change
3. Regulations for Emissions from Vehicles and Engines
4. Clean School Bus http://www.epa.gov/cleanschoolbus/
5. Office of Transportation and Air Quality Contacts
6. Federal Aviation Administration (FAA) Terminal Area Forecast (TAF) System, December 2008:
7. International Standards to Reduce Emissions from marine Diesel Engines and Their Fuels

4.1 Stationary source projections: EGU sector (ptipm)

The future-year data for the ptipm sector used in the air quality modeling were created by version 4.10 (v4.10) of the Integrated Planning Model (IPM). 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. 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.

Updates to IPM 4.10 (with respect to the version released in the IPM NODA version) include 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. Note that the Transport Rule future-year base cases do not include the Toxics Rule, which was proposed on March 16, 2011. In addition, the Boiler MACT was not represented in the final Transport Rule modeling because the rule was not final at the time the modeling was performed.

IPM is run in 5 year increments beyond year 2015. IPM results were generated for 2012 and 2015. The IPM 2015 results are valid for representing 2014, 2015, and 2016. As explained in the Transport Rule IPM TSD, additional steps were taken to ensure that the results were valid for use in a 2014, 2015 (or 2016) model run.

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 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. While we are working toward improving the projection approach in future emissions platforms, we are still using the no-growth assumption for the 2005, v4.2 platform. 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, 2006b).

The starting point was the emission projections done for the 2005v4 platform for the Proposed Transport Rule. The 2012 and 2014 projection factors developed for the Transport Rule Proposal were updated for these 2012 and 2014 baseline projections. Several additional National Emission Standards for Hazardous Air Pollutants (NESHAPs) were promulgated since emission projections were done for the Proposed Transport Rule, and these were included for the 2012 and 2014 base cases. Also included in the 2012 and 2014 base cases are numerous future-year projection data from the Transport Rule comments; these data are described in the following sections.

Year-specific projection factors for years 2012 and 2014 were used for creating the 2012 and 2014 base cases 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 county and pollutant and has thousands of records). If the growth or control factors for a sector are not provided in a table in this document, they are available as a "projection" or "control" packet for input to SMOKE on the v4.2 platform website (see the end of Section).

4.2.1 Livestock emissions growth (ag, afdust)

Growth in ammonia (NH_3) and dust (PM_{10} and $PM_{2.5}$) emissions from livestock in the ag and afdust and ptnonipm sectors was based on projections of growth in animal population. While there are a very small amount of livestock emissions in the ptnonipm sector as compared to the ag sector, the livestock growth projection packet was inadvertently not applied to the ptnonipm that sector. This results in an underestimate of NH_3 in the ptnonipm sector of roughly 1,160 tons in 2012 and 1,390 tons in 2014 (primarily in Kansas and Minnesota for which the NH_3 were reported at specific farms in the point source inventory), and for $PM_{2.5}$ the ptnonipm sector underestimates are 3 tons in both 2012 and 2014. These omissions are expected to have a negligible impact on the air quality PM and ozone results and these omissions were made in both the future base case and Transport Rule policy case.

Table 4-2 provides the growth factors from the 2005 base-case emissions to 2012 and 2014 for animal categories applied to the ag and afdust sectors for livestock-related SCCs. For example, year 2014 beef emissions are 1.7% larger than the 2005 base-case emissions. 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. Appendix F in the same document provides the cross references of livestock sources in the ag, afdust and ptnonipm sectors to the animal categories in Table 4-2.

Table 4-2. Growth factors from year 2005 to future years for Animal Operations

Animal Category	Projection Factors	
	2012	**2014**
Dairy Cow	1.000	1.000
Beef	1.014	1.017
Pork	1.060	1.071
Broilers	1.230	1.275
Turkeys	1.000	1.000
Layers	1.160	1.193
Poultry Average	1.178	1.214
Overall Average	1.0623	1.075

4.2.2 Residential wood combustion growth (nonpt)

We projected residential wood combustion 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. Details of this approach can be found in Section 2.3.3 of the PM NAAQS Regulatory Impact Analysis (EPA, 2006b).

The specific assumptions we made were:

- Fireplaces, 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 (these emissions have not been updated for the 2005v4 platform used for the Transport Rule Proposal 2005v4) emissions 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 4-3 presents the projection factors used to project the 2005 base case (2002 emissions) for residential wood combustion.

Table 4-3. Projection Factors for growing year 2005 Residential Wood Combustion Sources

SCC	SCC Description	Projection Factors	
		2012	2014
2104008000	Total: Woodstoves and Fireplaces	0.8944	0.8733
2104008001	Fireplaces: General	1.10	1.12
2104008070	Outdoor Wood Burning Equipment		
2104008002	Fireplaces: Insert; non-EPA certified	0.80	0.76
2104008010	Woodstoves: General		
2104008051	Non-catalytic Woodstoves: Non-EPA certified		
2104008003	Fireplaces: Insert; EPA certified; non-catalytic	1.20	1.24
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		

4.2.3 Gasoline Stage II growth and control (nonpt, ptnonipm)

Emissions from Stage II gasoline operations in the 2005 base case 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

We used a consistent approach across nonpt and ptnonipm to project these gasoline stage II emissions. The approach involved computing state-level VOC-specific projection factors from the state-level MOVES2010-based results for onroad refueling, using ratios of future–year 2012 and 2014 refueling emissions to 2005 base-case emissions. The approach accounts for three elements of refueling growth and control: (1) activity growth (due to VMT growth as input into MOVES2010), (2) emissions reductions from Stage II control programs at gasoline stations, and (3) emissions reductions resulting from the phase-in over time of newer vehicles with onboard Stage II vehicle controls. We assumed that all areas with Stage II controls in 2005 continue to have Stage II controls in 2012 and 2014. This approach is an update from the 2005v4 platform projections in the Proposed Transport Rule; in that platform, NMIM refueling projections were used instead of MOVES2010.

We computed VOC, benzene and naphthalene projection factors at a county-specific, annual resolution as shown below; note that naphthalene, while provided by MOVES2010, is not used in the Transport Rule:

$PF\_VOC_{[state,\ future\ year]} = VOC\_RFL_{[state,\ future\ year]}/VOC\_RFL_{[state,\ 2005]}$,
$PF\_BENZENE_{[state,\ future\ year]} = BENZENE\_RFL_{[state,\ future\ year]}/ BENZENE\ \_RFL_{[state,\ 2005]}$, and
$PF\_NAPHTHALENE_{[state,\ future\ year]} = PF\_VOC_{[state,\ future\ year]}$

where VOC_RFL is the VOC refueling emissions for onroad sources from MOVES2010, and
BENZENE_RFL is the BENZENE refueling emissions for onroad sources from MOVES2010

We applied these projection factors to both nonpt and ptnonipm sector gasoline stage II sources.

Chemical speciation uses certain VOC HAPs for some sources, specifically, benzene, acetaldehyde, formaldehyde, and methanol (BAFM). The VOC HAPs are used for sources that have consistent VOC and VOC HAPs using various criteria as described in the Section3.1.2.1, and these sources are called "integrated" sources. The nonpoint gasoline stage II emissions are an integrated source, and so the VOC HAPs are also projected based on ratios of future-year and base-year VOC. The only two VOC HAPs emitted from refueling are benzene and naphthalene, and both of these were projected consistently with VOC. However, naphthalene was not used in the chemical speciation (it is not B,A,F or M) and was therefore not used for this effort. Benzene was used as part of the speciation for the nonpt sector gasoline stage II sources. The ptnonipm is a "no-integrate" sector, so ptnonipm gasoline stage II sources did not use the projected benzene as part of the speciation, but rather used VOC speciation to estimate benzene.

4.2.4 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, 2007a). 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.

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. Future-year emissions for PFCs were available for 2010, 2015, 2020, and 2030. In creating the inventories for 2012 and 2014, we linearly interpolated year 2010 and year 2015 inventories. Benzene and other VOC HAP future-year PFC emissions were also included in the interpolation. Benzene was used in VOC speciation for the air quality model through the modification of VOC speciation profiles calculations (no other BAFM HAPs are emitted from PFCs).

4.2.5 Aircraft growth (ptnonipm)

As with the 2005v4 platform, aircraft emissions are contained in the ptnonipm inventory. 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 (publication date December 2008). This information is available for approximately 3,300 individual airports, for all years up to 2025. 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, 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.

Table 4-4 provides the national growth factors for aircraft; all factors are applied to year 2005 emissions. For example, year 2012 commercial aircraft emissions are 1.9% higher than year 2005 emissions.

Table 4-4. Factors used to project 2005 base-case aircraft emissions to future years

		Projection Factor	
SCC	**SCC Description**	**2012**	**2014**
2275001000	Military aircraft	0.967	0.968
2275020000	Commercial aircraft	1.019	1.066
2275050000	General aviation	0.962	0.977
2275060000	Air taxi	0.872	0.897
27501015	Internal Combustion Engines;Fixed Wing Aircraft L & TO Exhaust;Military;Jet Engine: JP-5	0.967	0.968
27502001	Internal Combustion Engines;Fixed Wing Aircraft L & TO Exhaust;Commercial;Piston Engine: Aviation Gas	1.019	1.066
27502011	Internal Combustion Engines;Fixed Wing Aircraft L & TO Exhaust;Commercial;Jet Engine: Jet A	1.019	1.066
27505001	Internal Combustion Engines;Fixed Wing Aircraft L & TO Exhaust;Civil;Piston Engine: Aviation Gas	0.962	0.977
27505011	Internal Combustion Engines;Fixed Wing Aircraft L & TO Exhaust;Civil;Jet Engine: Jet A	0.962	0.977
27601014	Internal Combustion Engines;Rotary Wing Aircraft L & TO Exhaust;Military;Jet Engine: JP-4	0.967	0.968
27601015	Internal Combustion Engines;Rotary Wing Aircraft L & TO Exhaust;Military;Jet Engine: JP-5	0.967	0.968

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).

None of our aircraft emission projections account for any control programs. We considered the NO_X standard adopted by the International Civil Aviation Organization's (ICAO) Committee on Aviation Environmental Protection (CAEP) in February 2004, which is expected to reduce NO_X by approximately 2% in 2015 and 3% in 2020. However, this rule has not yet been adopted as an EPA (or U.S.) rule; therefore, the effects of this rule were not included in the future-year emissions projections.

4.2.6 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 Transport Rule proposal. Here we describe the contents of the controls and closures for the 2012 and 2014 base cases. Detailed summaries of the impacts of the control programs are provided in Appendix D.

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 Transport Rule 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 Transport Rule modeling that began in the fall of 2010. We also applied unit and plant closures received from the Transport Rule 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. The magnitude of all unit and plant closures on the non-EGU point (ptnonipm) sector 2005 base-case emissions is shown in Table 4-5 below.

Table 4-5. Summary of Non-EGU Emission Reductions Applied to the 2005 Inventory due to Unit and Plant Closures

State	CO (tons)	NH_3 (tons)	NO_X (tons)	PM_{10} (tons)	$PM_{2.5}$ (tons)	SO_2 (tons)	VOC (tons)
Alabama	10,680	6	4,104	2,543	2,257	1,912	870
Arizona	509	0	1,524	161	65	7	28
Arkansas	1,110	0	3,994	401	129	920	271
California	2,684	0	6,675	1,121	444	1,161	23
Delaware	93	6	1,495	350	326	5,409	391

State	CO (tons)	NH_3 (tons)	NO_X (tons)	PM_{10} (tons)	$PM_{2.5}$ (tons)	SO_2 (tons)	VOC (tons)
Florida	4,136	230	7,869	1,049	577	8,547	246
Georgia	7,435	21	2,678	1,187	765	2,688	2,295
Idaho	625	6	461	14	6	17	1
Illinois	10,175	0	11,605	1,996	1,267	23,830	716
Indiana	1,058	0	4,794	486	207	8,468	157
Iowa	461	0	1,939	230	48	4,787	15
Kansas	989	4	1,624	84	48	329	52
Louisiana	3,035	127	1,878	521	337	4,114	4,061
Maine	256	13	1,906	467	212	3,767	310
Maryland	107	22	1,634	168	83	1,137	6
Massachusetts	45	7	518	114	68	1,909	55
Michigan	7,995	73	10,900	2,274	1,076	14,598	2,083
Mississippi	0	0	69	5	5	96	
Missouri	17	4	23	2	2	0	310
Nevada	204	0	2,817	212	74	175	66
New Hampshire	109	0	287	113	103	681	291
New Jersey	9	0	31	24	24	0	996
New York	5	1	48	16	11	217	14
North Carolina	12	1	94	25	17	379	7
Ohio	340		4,238	610	299	7,128	69
Oklahoma	103	4	1,757	531	184	1,498	17
Pennsylvania	1,415	4	6,117	1,293	683	6,852	116
South Carolina	1,666	4	2,115	441	266	1,052	302
Tennessee	106	0	2,229	242	146	5,407	9,065
Texas	5,395	20	9,664	1,264	642	9,216	507
Virginia	3,161	1	3,737	1,355	1,029	11,102	2,188
West Virginia	59,321	55	5,257	1,244	830	13,410	783
Wisconsin	479	28	1,953	436	297	7,672	349
Grand Total	123,735	637	106,034	20,979	12,527	148,485	26,660

- 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. The detailed data used are available at the website listed in Section 1. Several of these consent decrees and national NESHAP rules such as RICE and cement have compliance dates that are between 2012 and 2014; therefore, there are several differences in controls applied to the 2012 and 2014 base cases.

- 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 in 2014 (not 2012) for Maine and New York. These fuel limits were incremental and not applicable until after 2012. Because we only apply controls that are applicable before July 1, 2014, more stringent sulfur fuel controls and additional states with controls in later years were not applied.
- Criteria air pollutant (cap) reductions a cobenefit to RICE NESHAP controls. SO_2 RICE cobenefit controls are not applied in 2012.
- 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.
- 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, located in Section 3.2.6.

4.2.6.1 2014 base-case 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 2014. 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 2012 base case. The ISIS-based policy case predictions of emissions reductions and activity growth were only included in the 2014 base case and not in the 2012 base case.

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 4-6 shows the magnitude of the ISIS-based cement industry reductions in the future-year emissions that represent 2014, and the impact that these reductions have on total stationary non-EGU point source (ptnonipm) emissions.

Table 4-6. 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 2014 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%

4.2.6.2 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. 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 4-7.

Table 4-7. 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

4.2.6.3 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 emissions projection. In 2012 only the earliest rule's compliance date has passed so only one rule is included.

The rules 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 year 2012 and year 2014 RICE controls is provided in Appendix F in the Proposed Toxics Rule TSD. 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 4-8.

Table 4-8. National Impact of RICE Controls on 2012 and 2014 Non-EGU Projections

Pollutant	2012 Reductions	2014 Reductions
CO	18,987	124,516
NOX	30,250	123,662
PM2.5	0	1,368
PM10	0	1,595
SO2	0	23,368
VOC	1,069	15,934

4.2.6.4 Fuel sulfur rules

Fuel sulfur rules that were signed and implemented by June 30, 2014 are limited to Maine and New York. No fuel sulfur rule reductions were available in other states and compliance dates for 2012. As standard practice we have used June 30th as the cut-off date for all control programs to be included in a calendar year. For example, a control program with a compliance (effective) date of June 30, 2012 would be included in the 2012 projected emissions; however, a control program effective July 1, 2012 would not be included in 2012 projections. Several other states have fuel sulfur rules that were in development but not finalized prior to Transport Rule emissions processing.

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 2014 projections (and no reduction for 2012). These New York sulfur content reductions are further discussed at NRDC.

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The Maine fuel sulfur rule effective January 1, 2014 reduces sulfur to 500ppm, resulting in an 83.33% reduction from 3000 ppm. These Maine sulfur content reductions.

Further reductions in NY, ME, and other states effective after June 30, 2014 are not included. The impact of these fuel sulfur content reductions on SO2 is shown in Table 4-9.

Table 4-9. Impact of Fuel Sulfur Controls on 2014 Non-EGU Projections

State	SO_2 Reductions
Maine	7,053
New York	54,431

4.2.7 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 2012 and 2014 estimates from the Texas Commission of Environmental Quality (TCEQ).

We also received 2008 data for Oklahoma that we used as the best available data to represent 2012 and 2014. As with the 2005 v4 platform, the v4.2 platform utilizes the Phase II WRAP oil and gas emissions data for the non-California Western Regional Air Partnership (WRAP) states for 2005. WRAP 2018 Phase II emissions were also available but determined to be inappropriate for use in 2012 and 2014. Consequently, we started with the base year emissions for Oklahoma and the WRAP states and applied these additional reductions related to the RICE NESHAP.

For Oklahoma and WRAP oil and gas emissions, we applied CO, NO_X, and VOC emissions reductions from the Stationary Reciprocating Internal Combustion Engine (RICE) NESHAP, which we assumed has some applicability to this industry (Appendix F in the Proposed Toxics Rule TSD). SO_2 reductions associated with the RICE NESHAP were also included for these same data for the year 2014 projection. Table 4-10 shows the 2005, 2012, and 2014 NOX and SO2 emissions including RICE reductions for Oklahoma and the WRAP states.

Table 4-10. Oil and Gas NO_X and SO_2 Emissions for 2005, 2012, and 2014 including additional reductions due to the RICE NESHAP

	NOX (tons)			SO2 (tons)		
State	**2005**	**2012**	**2014**	**2005**	**2012**	**2014**
Alaska	836	811	732	62	62	31
Arizona	13	12	12			
Colorado	32,188	31,806	30,625	350	350	176
Montana	10,617	10,456	9,957	640	640	321
Nevada	71	69	62	1	1	0
New Mexico	61,674	60,317	56,119	369	369	188
North Dakota	6,040	5,861	5,306	688	688	355
Oklahoma	39,668	44,362	42,402	1,014	2	2
Oregon	61	60	55			
South Dakota	566	550	502	43	43	21
Texas	42,854	46,251	39,462	5,977	43	38
Utah	6,896	6,777	6,409	149	149	75
Wyoming	36,172	35,505	33,442	541	541	272
Grand Total	**237,656**	**242,837**	**225,085**	**9,834**	**2,888**	**1,479**

4.2.8 Future-year VOC Speciation for gasoline-related sources (ptnonipm, nonpt)

To account for the future projected increase in the ethanol content of fuels, we used different future-year VOC speciation for certain gasoline-related emission sources. Such sources include gasoline stage II (refueling vehicles), portable fuel containers (PFCs), and finished fuel storage and transport-related sources related to bulk terminals (where the ethanol may be mixed) and downstream to the pump. We identified this last group of sources as "btp" (from bulk terminals to pumps). While most of these sources are in the nonpt sector, there are also some in the ptnonipm sector. In the 2005 base year, we used zero percent ethanol (E0) fuel profiles. For the 2012 and 2014 profiles, we used combinations of E0 and ten percent ethanol (E10) fuel profiles. The fuel type fraction was developed based on the Department of Energy Annual Energy Outlook (AEO) 2007 projections of ethanol fuels for the year 2022. In the AEO 2007 data, the proportions of E0 and E10 fuels are the same for 2012 and years beyond (even though the quantities of the two fuels change over these years). The national level proportions were allocated to counties across the country using fuel modeling at the EPA Office of Transportation and Air Quality. All gasoline stage II and "btp" sources used the same combination of E0 and E10 headspace profiles as were used for exhaust and evaporative profiles.

4.3 Mobile source projections

Mobile source monthly inventories of onroad and nonroad mobile emissions were created for 2012 and 2014 using a combination of the NMIM and MOVES2010 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 reductions to locomotives, various nonroad engines including diesel engines and various marine engine types, fuel sulfur content, and evaporative emissions standards.

Onroad mobile sources are comprised of several components and are discussed in the next subsection (4.3.1). Monthly nonroad mobile emission projections are discussed in subsection 4.3.2. Locomotives and Class 1 and Class 2 commercial marine vessel (C1/C2 CMV) projections are discussed in subsection 4.3.3, and Class 3 (C3) CMV projected emissions are discussed in subsection 4.3.4.

4.3.1 Onroad mobile (on_noadj, on_moves_runpm, on_moves_startpm)

The onroad emissions were primarily based on the 2010 version of the Motor Vehicle Emissions Simulator (MOVES2010) – the same version as was used for 2005. The same MOVES-based $PM_{2.5}$ temperature adjustment factors were applied as were used in 2005 for running mode emissions; however, cold start emissions used year-specific temperature adjustment factors. The temperature adjustments have the minor limitation that they were based on the use of MOVES national default inputs rather than county-specific inputs. This was because a county-specific database for input to MOVES was not available at the time this approach was needed. However, the $PM_{2.5}$ temperature adjustments are fairly insensitive to the county-specific inputs, which is why this is only a minor limitation.

<u>California onroad</u> (on_noadj)

Like year 2005 emissions, future-year California NH_3 emissions are from MOVES runs for California, disaggregated to the county level using NMIM. For all other pollutants, we did not use MOVES to generate future-year onroad emissions for California, because the 2005 base year emissions were provided by CARB's Emission Factors mobile model (EMFAC), outputs of which CARB submitted for the 2005 NEI. For California, we chose an approach that would maintain consistency between the 2005 and 2012 and 2014 emissions. This approach involved computing projection factors from a consistent set of future and 2005-year data provided by CARB based on the EMFAC2007 model. For 2012 emissions, we generated projection factors by dividing the EMFAC2007-based emissions for 2012 (linearly interpolated between year 2009 and year 2014) by the EMFAC2007-based emissions for 2005. These EMFAC-based emissions were provided in March 2007. California does not specify road types, so we first used NMIM California ratios to break out vehicle emissions to the match the more detailed NMIM level before projecting to 2012.

HAP emissions were computed as 2005v2-based HAP-CAP ratios applied to 2012 and 2014 CAP emissions at the pollutant and Level 3 SCC (first 7 characters). HAPs were scaled to either of three pollutants: exhaust $PM_{2.5}$ (e.g., metals), exhaust VOC (e.g., exhaust mode VOC HAPs such as acetaldehyde and formaldehyde), or evaporative VOC (e.g., evaporative mode VOC HAPs such as benzene).

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

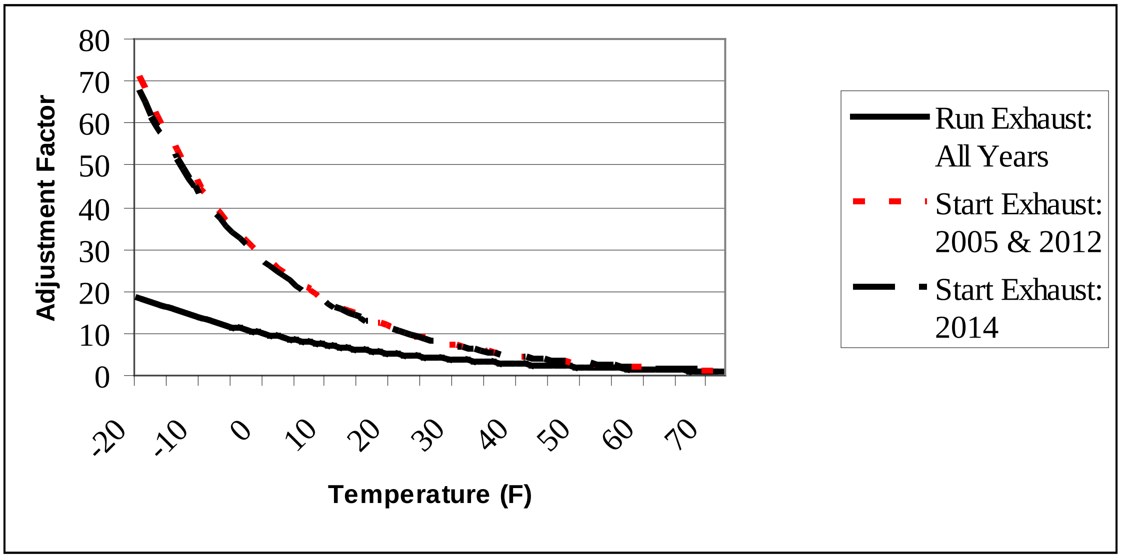
As discussed in Section 2, the MOVES2010 model was used for all vehicles, road types, and pollutants. Vehicle Miles Travelled (VMT) were projected using growth rates from the Department of Energy's AEO2009. We used MOVES2010 to create emissions by state, SCC, pollutant, emissions mode and month. We then allocated these emissions to counties using ratios based on 2012 and 2015 NMIM county-level data by state, SCC, pollutant, and emissions mode. 2014 NMIM data were not available for this effort, but the 2015 NMIM can reasonably be expected to be sufficient for 2014 state-county allocations for this purpose. While the EPA intends to replace this approach with a county-specific implementation of MOVES for use in future regulatory actions, this approach was the best approach available at the time of this modeling.

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 years 2012 and 2014 from year 2005 inventories using the 2012- and 2014-specific runs of MOVES2010. VMT were projected using growth rates from the AEO2009. As with the on_noadj sector, the 2012 and 2014 MOVES2010 data were created at the state-month level, and the 2012 and 2015 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 2012, 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 slightly in future years, and for year 2014 processing, we updated the temperature adjustment curves for these cold start emissions. These have little impact, reducing cold-start mode temperature-adjusted PM and naphthalene by under 4% for temperatures down to 0 °F. Note that running exhaust temperature adjustment factors are the same for all years. Also, these running mode exhaust mode emissions are considerably larger than cold start mode emissions.

Figure 4-1. MOVES exhaust temperature adjustment functions for 2005, 2012, and 2014



4.3.2 Nonroad mobile (nonroad)

This sector includes monthly exhaust, evaporative and refueling emissions from nonroad engines (not including commercial marine, aircraft, and locomotives) derived from NMIM for all states except California. Like the onroad emissions, NMIM provides nonroad emissions for VOC by three emission modes: exhaust, evaporative and refueling. Unlike the onroad sector, nonroad refueling emissions for nonroad sources are not included in the nonpoint (nonpt) sector and so are retained in this sector.

With the exception of California, U.S. emissions for the nonroad sector (defined as the equipment types covered by NMIM) were created using a consistent NMIM-based approach as was used for 2005, but projected for 2012 and 2015. The 2012 and 2015 NMIM runs utilized the NR05d-Bond-final version of NONROAD (which is equivalent to NONROAD2008a). Similar to the onroad mobile NMIM inventories, year 2014 NMIM emissions were created by interpolating year 2012 and year 2015 NMIM inventories. These future-year emissions account for increases in activity (based on NONROAD model default growth estimates of future-year equipment population) and changes in fuels and engines that reflect implementation of national regulations and local control programs that impact each year differently due to engine turnover.

The national regulations incorporated in the modeling 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
- OTAQ's Small Engine Spark Ignition ("Bond") Rule

We have not included voluntary programs such as programs encouraging either no refueling or evening refueling on Ozone Action Days and diesel retrofit programs. NMIM version 20071009, with county database NCD20070912, and NONROAD model version NONROAD2008a was used to create NMIM inventories for 2012 and 2015.

California nonroad emissions

Similar to onroad mobile, NMIM was not used to generate future-year nonroad emissions for California, other than for NH_3. We used NMIM for California future nonroad NH_3 emissions because CARB did not provide these data for any nonroad vehicle types. As we did for onroad emissions, we chose a projection approach that would maintain consistency between the base year and future-year emissions for nonroad emissions in California.

California year 2014 nonroad CAP emissions are similar to those used in the 2002v3 projected inventory. However, similar to onroad mobile, California nonroad HAPs were computed as ratios to select CAPs using 2005 NMIM CAP-HAP ratios.

California year 2012 nonroad CAP emissions were computed by linearly interpolating year 2009 and 2014 inventories. And 2012 HAP emissions were also computed using the same 2005-based CAP-HAP ratios used to create 2014 HAP emissions.

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

Future locomotive and Class 1 and Class 2 commercial marine vessel (CMV) emissions were calculated using projection factors that were computed based on national, annual summaries of locomotive emissions in 2002 and future years. 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 4-11.

Table 4-11. Factors applied to year 2005 emissions to project locomotives and Class 1 and Class 2 Commercial Marine Vessel Emissions

			Projection Factor	
SCC	**SCC Description**	**Pollutant**	**2012**	**2014**
2280002X00	Marine Vessels, Commercial;Diesel;Underway & port emissions	CO	0.972	0.968
2280002X00	Marine Vessels, Commercial;Diesel;Underway & port emissions	NH_3	1.094	1.114
2280002X00	Marine Vessels, Commercial;Diesel;Underway & port emissions	NO_X	0.851	0.792
2280002X00	Marine Vessels, Commercial;Diesel;Underway & port emissions	PM_{10}	0.875	0.762
2280002X00	Marine Vessels, Commercial;Diesel;Underway & port emissions	$PM_{2.5}$	0.890	0.775
2280002X00	Marine Vessels, Commercial;Diesel;Underway & port emissions	SO_2	0.531	0.278
2280002X00	Marine Vessels, Commercial;Diesel;Underway & port emissions	VOC	0.951	0.897
2285002006	Railroad Equipment;Diesel;Line Haul Locomotives: Class I Operations	CO	1.232	1.272
2285002006	Railroad Equipment;Diesel;Line Haul Locomotives: Class I Operations	NH_3	1.223	1.262
2285002006	Railroad Equipment;Diesel;Line Haul Locomotives: Class I Operations	NO_X	0.732	0.711
2285002006	Railroad Equipment;Diesel;Line Haul Locomotives: Class I Operations	PM_{10}	0.768	0.696
2285002006	Railroad Equipment;Diesel;Line Haul Locomotives: Class I Operations	$PM_{2.5}$	0.778	0.705
2285002006	Railroad Equipment;Diesel;Line Haul Locomotives: Class I Operations	SO_2	0.166	0.005
2285002006	Railroad Equipment;Diesel;Line Haul Locomotives: Class I Operations	VOC	0.839	0.748
2285002007	Railroad Equipment;Diesel;Line Haul Locomotives: Class II / III Operations	CO	0.303	0.313
2285002007	Railroad Equipment;Diesel;Line Haul Locomotives: Class II / III Operations	NH_3	1.223	1.262
2285002007	Railroad Equipment;Diesel;Line Haul Locomotives: Class II / III Operations	NO_X	0.339	0.350
2285002007	Railroad Equipment;Diesel;Line Haul Locomotives: Class II / III Operations	PM_{10}	0.283	0.286
2285002007	Railroad Equipment;Diesel;Line Haul Locomotives: Class II / III Operations	$PM_{2.5}$	0.286	0.288
2285002007	Railroad Equipment;Diesel;Line Haul Locomotives: Class II / III Operations	SO_2	0.038	0.001
2285002007	Railroad Equipment;Diesel;Line Haul Locomotives: Class II / III Operations	VOC	0.291	0.300
2285002008	Railroad Equipment;Diesel;Line Haul Locomotives: Passenger Trains (Amtrak)	CO	1.030	1.046
2285002008	Railroad Equipment;Diesel;Line Haul Locomotives: Passenger Trains (Amtrak)	NH_3	1.223	1.262
2285002008	Railroad Equipment;Diesel;Line Haul Locomotives: Passenger Trains (Amtrak)	NO_X	0.667	0.598
2285002008	Railroad Equipment;Diesel;Line Haul Locomotives: Passenger Trains (Amtrak)	PM_{10}	0.660	0.576
2285002008	Railroad Equipment;Diesel;Line Haul Locomotives: Passenger Trains (Amtrak)	$PM_{2.5}$	0.662	0.578

SCC	SCC Description	Pollutant	Projection Factor	
			2012	2014
2285002008	Railroad Equipment;Diesel;Line Haul Locomotives: Passenger Trains (Amtrak)	SO_2	0.156	0.005
2285002008	Railroad Equipment;Diesel;Line Haul Locomotives: Passenger Trains (Amtrak)	VOC	0.738	0.633
2285002009	Railroad Equipment;Diesel;Line Haul Locomotives: Commuter Lines	CO	1.015	1.032
2285002009	Railroad Equipment;Diesel;Line Haul Locomotives: Commuter Lines	NH_3	1.223	1.262
2285002009	Railroad Equipment;Diesel;Line Haul Locomotives: Commuter Lines	NO_X	0.658	0.590
2285002009	Railroad Equipment;Diesel;Line Haul Locomotives: Commuter Lines	PM_{10}	0.650	0.568
2285002009	Railroad Equipment;Diesel;Line Haul Locomotives: Commuter Lines	$PM_{2.5}$	0.651	0.568
2285002009	Railroad Equipment;Diesel;Line Haul Locomotives: Commuter Lines	SO_2	0.155	0.005
2285002009	Railroad Equipment;Diesel;Line Haul Locomotives: Commuter Lines	VOC	0.728	0.625
2285002010	Railroad Equipment;Diesel;Yard Locomotives	CO	1.239	1.279
2285002010	Railroad Equipment;Diesel;Yard Locomotives	NH_3	1.223	1.262
2285002010	Railroad Equipment;Diesel;Yard Locomotives	NO_X	1.133	1.127
2285002010	Railroad Equipment;Diesel;Yard Locomotives	PM_{10}	0.942	0.919
2285002010	Railroad Equipment;Diesel;Yard Locomotives	$PM_{2.5}$	0.962	0.938
2285002010	Railroad Equipment;Diesel;Yard Locomotives	SO_2	0.183	0.005
2285002010	Railroad Equipment;Diesel;Yard Locomotives	VOC	1.548	1.526

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. Voluntary retrofits under the National Clean Diesel Campaign 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 4-11. 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 2012 and 2014 inventories and override the C1/C2 projection factors in Table 4-11.

4.3.4 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 years 2012 and 2014 for the future base cases. Both future base cases include 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.

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.

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 2012 and 2014 seca_c3 sector emissions are provided in Table 4-12. 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. 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.

Delaware provided updated future-year NO_X, SO_2, and PM emission estimates for the C3 CMV as part of the Transport Rule comments. These updated emissions were applied to the 2012 and 2014 inventories and override the C3 projection factors in Table 4-12**.**

The factors to compute HAP emission are based on emissions ratios discussed in the 2005v4 documentation. As with the 2005 base case, this sector uses CAP-HAP VOC integration.

Table 4-12. NO_X, SO_2, and $PM_{2.5}$ Factors to Project Class 3 Commercial Marine Vessel emissions to 2012 and 2014

	NO_X		**SO_2**		**$PM_{2.5}$**	
	2012	**2014**	**2012**	**2014**	**2012**	**2014**
Alaska East	1.26234	1.32620	0.52912	0.56462	0.52433	0.55951
Alaska West	1.28461	1.35119	1.33532	1.42491	1.33555	1.42515
East Coast	1.33102	1.39686	0.55987	0.61140	0.51862	0.56635
Gulf Coast	1.12285	1.14364	0.47456	0.50248	0.43526	0.46087
Hawaii East	1.37239	1.45513	0.61127	0.67392	0.54920	0.60550
Hawaii West	1.45767	1.54847	1.59605	1.75964	1.59408	1.75748
North Pacific	1.19916	1.23653	0.54159	0.57792	0.47330	0.50506
South Pacific	1.40836	1.49931	0.64318	0.71344	0.54825	0.60797
Great Lakes	1.08304	1.10302	0.42239	0.43687	0.39684	0.41045
Outside ECA	1.37211	1.44085	1.52102	1.65818	1.52102	1.65818

4.3.5 Future-year VOC Speciation (on_noadj, nonroad)

We used speciation profiles for VOC in the nonroad and on_noadj sectors that account for the increase in ethanol content of fuels in future years. The same future-year profiles were used for 2012 and 2014. The combination profiles use proportions of E0 and E10 expected in the future based on AEO 2007 projections of E10 and E0 fuel use. The proportions of E0 and E10 are the same for 2012 and years beyond (even though the quantities of the two fuels change over these years). The national proportions were allocated to counties across the country using the same fuel modeling done for the stationary source gasoline speciation, as discussed in Section 4.2.8.

The speciation of onroad exhaust VOC additionally accounts for a portion of the vehicle fleet meeting Tier 2 standards; different exhaust profiles are available for pre-Tier 2 versus Tier 2 vehicles. Thus for exhaust VOC, a combination of pre-Tier 2 E0, pre-Tier 2 E10, Tier 2 E0 and Tier 2 E10 profiles are used. Figure 4-2 shows the Tier 2 fraction of Light Duty Vehicles for different future years in terms of different metrics. For previous modeling applications, we based the fraction on the population of vehicles. However, since these vehicles emit a smaller portion of VOC, a more appropriate metric for use in weighting the speciation profiles is the fraction of exhaust total hydrocarbons (THC) which is used in the 2012 case described here.

The fraction of Tier 2 emissions used here for 2012 is 0.182. We erroneously used this same fraction for 2014; the correct fraction of Tier 2 emissions for 2014 should have been 0.261.

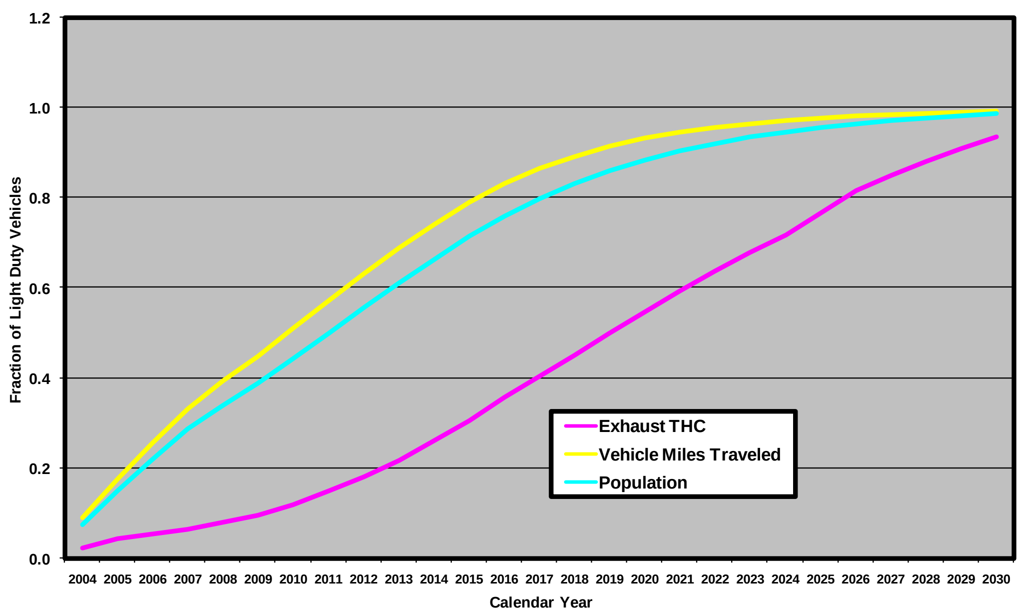
Table 4-13 summarizes the profiles combined for the source categories and VOC emission modes used.

Table 4-13. Future-year Profiles for Mobile Source Related Sources

Sector	Type of profile	Profile Codes Combined for the Future-year Speciation
Stationary	headspace	**8762**: Composite Profile - Gasoline Headspace Vapor using 0% Ethanol **8763**: Composite Profile - Gasoline Headspace Vapor using 10% Ethanol
Nonroad exhaust	Pre-Tier 2 vehicle exhaust	**8750**: Gasoline Exhaust - Reformulated gasoline **8751**: Gasoline Exhaust - E10 ethanol gasoline
Onroad and Nonroad evap*	Evaporative	**8753**: Gasoline Vehicle - Evaporative emission - Reformulated gasoline **8754**: Gasoline Vehicle - Evaporative emission - E10 ethanol gasoline
Nonroad refueling	headspace	Same as Stationary
Onroad exhaust	Pre-Tier 2 vehicle exhaust and Tier 2 vehicle exhaust	**8750**: Gasoline Exhaust - Reformulated gasoline **8751**: Gasoline Exhaust - E10 ethanol gasoline **8756**: Composite Profile - Gasoline Exhaust - Tier 2 light-duty vehicles using 0% Ethanol **8757**: Composite Profile - Gasoline Exhaust - Tier 2 light-duty vehicles using 10% Ethanol

- E0 and E10 combinations are based on AEO2007 projections of E0 and E10 fuel
- Tier 2 and pre-Tier 2 combinations are based on the 2012 contribution of Tier 2 exhaust emissions

Figure 4-2. Tier 2 Fraction of Light Duty Vehicles



4.4 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 Source Apportionment

The EPA prepared special emissions inputs for the CAM_X model to allow CAM_X to be used for source apportionment modeling. Source apportionment modeling was used to quantify the impact of emissions in specific upwind states on projected downwind nonattainment and maintenance receptors for both $PM_{2.5}$ and 8-hour ozone. To prepare these emissions, the EPA prepared special tagging input files called GSTAG files for the SMOKE speciation processor.

The tagging input files and custom SMOKE scripts implemented tagging by state of all source emissions except for biogenic and wildfire emissions for all ozone and $PM_{2.5}$ precursors. Separate tagging runs were done for ozone and $PM_{2.5}$ precursors. Biogenic and wildfire emissions were not tagged by state because they are generally considered not feasible for emissions controls, but these were tagged as "other sources" and their contributions could be tracked in total without association with individual states. Prescribed burning and agricultural burning *were* included in the tagged emissions. The states the EPA analyzed using source apportionment for ozone and for $PM_{2.5}$ are: Alabama, Arkansas, Connecticut, Delaware, Florida, Georgia, Illinois, Indiana, Iowa, Kansas, Kentucky, Louisiana, Maine, Maryland, Massachusetts, Michigan, Minnesota, Mississippi, Missouri, Nebraska, New Hampshire, New Jersey, New York, North Carolina, North Dakota, Ohio, Oklahoma, Pennsylvania, Rhode Island, South Carolina, South Dakota, Tennessee, Texas, Vermont, Virginia, West Virginia, Washington D.C., and Wisconsin. There were also several other states that are only partially contained within the 12 km modeling domain (i.e., Colorado, Montana, New Mexico, and Wyoming). However, the EPA did not individually track the emissions or assess the contribution from emissions in these states

6 Remedy Case

The 2014 Remedy Case for the Transport Rule represents the implementation of SO_2, annual NO_X, and ozone-season NO_X emission reductions to address upwind state emissions that contribute significantly to nonattainment in, or, interfere with maintenance by downwind states with respect to the existing ozone and $PM_{2.5}$ NAAQS standards in the eastern U.S. The final Transport Rule requires SO_2 and/or NO_X reductions from EGUs in 27 states starting in 2012. For the remedy case modeling, the emissions for all sectors were unchanged from the base-case modeling except for those from EGUs (the ptipm sector). The EPA used the IPM model to project the 2014 remedy case EGU emissions. The changes in EGU SO_2 and NO_X emissions as a result of the control case for the lower 48 states are summarized in Section 7. Section 7 also provides state-specific summaries of EGU NO_X and SO_2 for the lower 48 states. Additional details on the changes that resulted from the remedy case are provided in the Transport Rule Final Regulatory Impact Analysis (RIA), Chapter 7 (Cost, Economic, and Energy Impacts), which describes the modeling conducted to estimate the cost, economic, and energy impacts to the power sector.

The 23 states covered by the annual SO_2 and NO_X reduction requirements for the annual and/or 24-hour $PM_{2.5}$ standards in the remedy case are colored in blue and green in Figure 6-1. Figure 6-2 distinguishes between the "Group 1" states (in red) and the "Group 2" states (in orange); the Group 1 states are subject to a second, more stringent phase of SO_2 reductions starting in 2014 (sections VI and VII of the preamble to the final Transport Rule discuss the SO_2 groups in detail). All states covered for the annual and/or 24-hour $PM_{2.5}$ standards are in one annual NO_X tier with uniform stringency beginning in 2012. Table 6-1 shows the groups in which each state is included, including whether the state is included in the Eastern modeling domain. Section 7 provides annual SO_2 and NO_X summaries for these selected groups/tiers of states.

The 20 states required to make ozone-season NO_X reductions to address the 8-hour ozone standard in the final Transport Rule are shown in green and yellow in Figure 6-1. In these states, ozone-season NO_X reductions begin with the 2012 ozone season. As discussed in section III of the preamble, the EPA issued a supplemental proposal to provide the opportunity for public comment on inclusion of six additional states in the Transport Rule ozone-season program: Iowa, Kansas, Michigan, Missouri, Oklahoma, and Wisconsin. These six states are also shown in green or yellow in Figure 6-1. Section 7 provides ozone-season NO_X emissions summaries for the states required in the final Transport Rule to make ozone-season NO_X reductions and the six additional states addressed in the supplemental proposal. Figure 6-1 shows for each of the contiguous 48 states the components of the rule they fall under, and whether they are included in the Eastern modeling domain. Tribal land emissions are not associated with particular states; those few tribal emissions in the eastern domain are very small and are not associated with existing units covered by the Transport Rule.

The emissions, cost, air quality, and benefits analyses done for the Transport Rule are from a modeling scenario that requires annual SO_2 and NO_x reductions in the 23 states covered for the $PM_{2.5}$ standards, and ozone season NO_X requirements in the 20 states covered for the ozone standard and the six states addressed by the supplemental proposal (26 states total) as shown in Figure 6-1.

Figure 6-1. States Covered by the Final Transport Rule

(Figure 6-1 includes six states--IA, KS, MI, MO, OK, and WI--not covered for ozone-season requirements in the final rule, for which the EPA issued a supplemental proposal to require ozone-season reductions.)

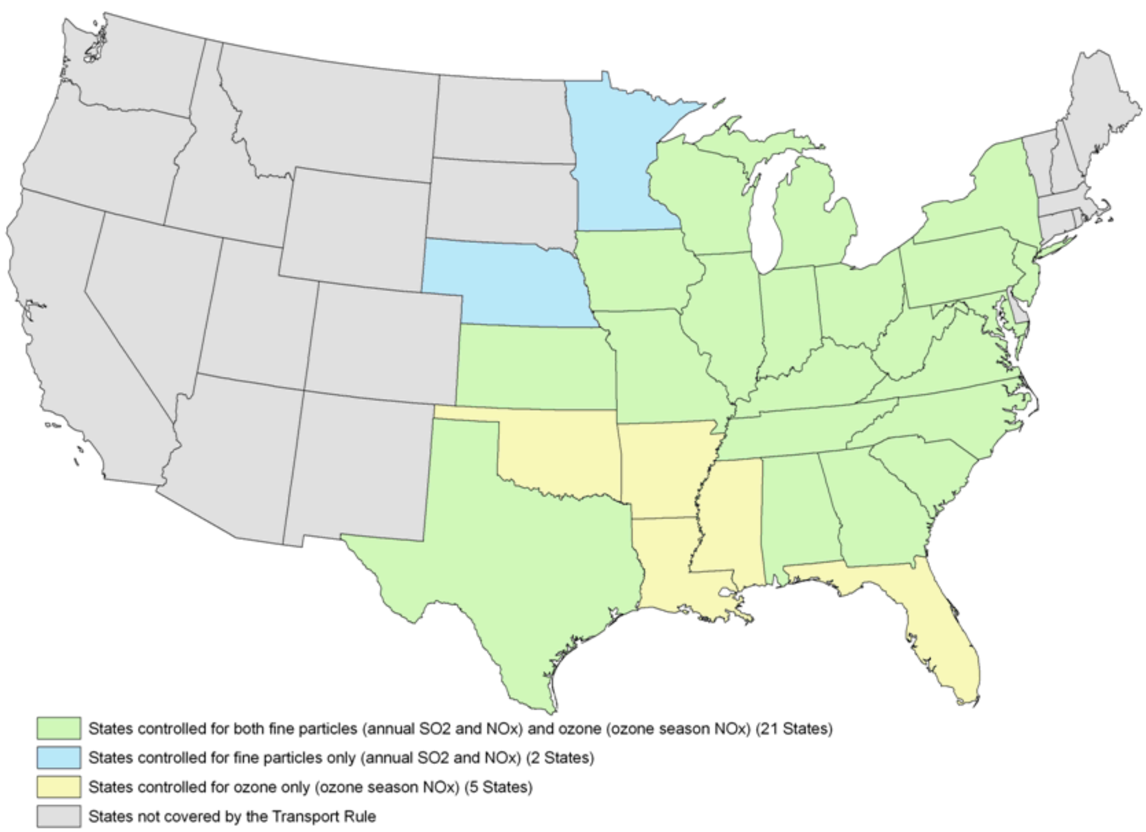


Figure 6-2. Group 1 and Group 2 States Covered by the Annual PM Component of the Final Transport Rule

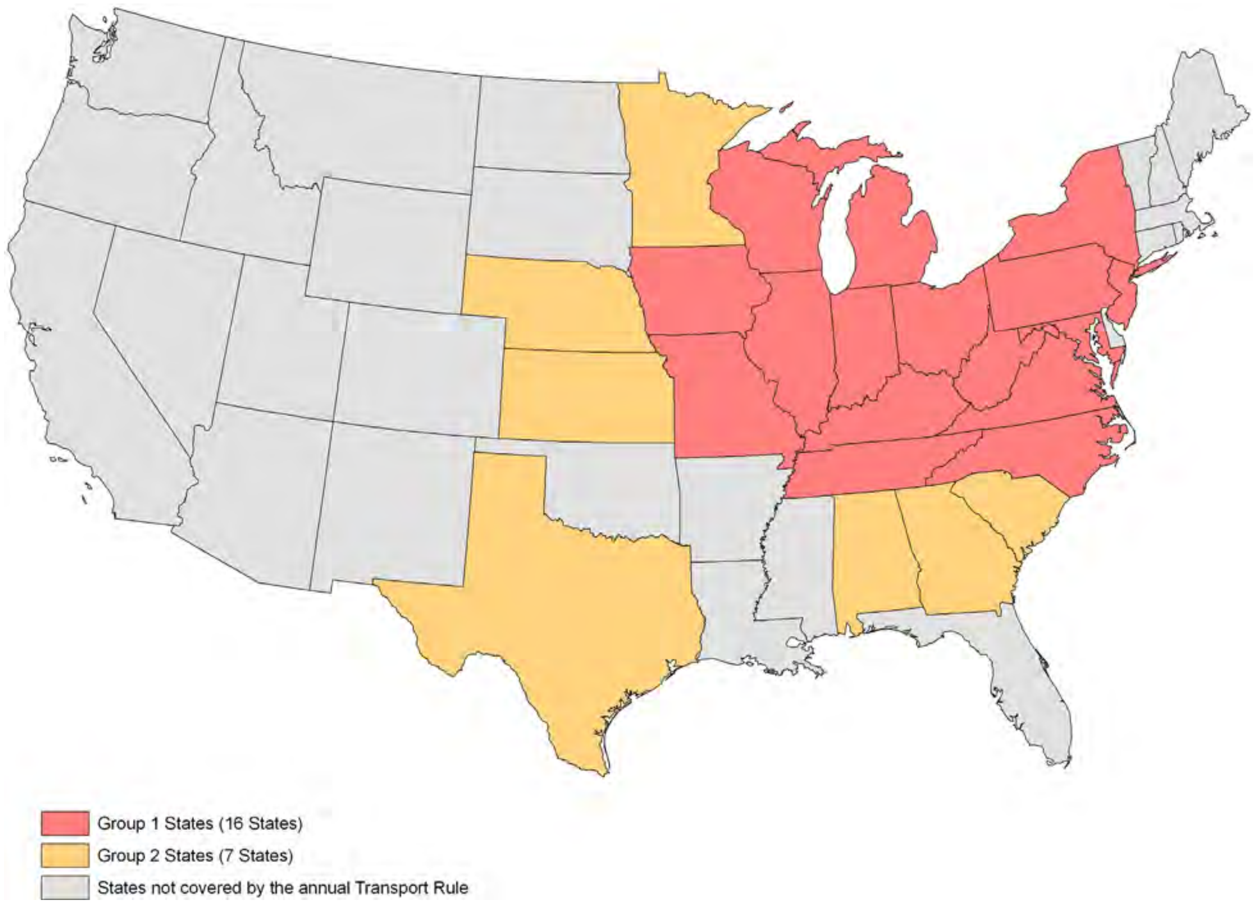


Table 6-1. Transport Rule Status of States

State	State	EPA Region	Covered for $PM_{2.5}$ – Group 1 SO_2	Covered for $PM_{2.5}$ – Group 2 SO_2	Covered for Ozone in Transport Rule	Covered for Ozone in Supplemental Proposal	Total State Coverage	In Eastern Domain	Western State
ALABAMA	AL	4	0	1	1	0	1	1	0
ARIZONA	AZ	9	0	0	0	0	0	0	1
ARKANSAS	AR	6	0	0	1	0	1	1	0
CALIFORNIA	CA	9	0	0	0	0	0	0	1
COLORADO	CO	8	0	0	0	0	0	0	1
CONNECTICUT	CT	1	0	0	0	0	0	1	0
DELAWARE	DE	3	0	0	0	0	0	1	0
DISTRICT OF COLUMBIA	DC	3	0	0	0	0	0	1	0
FLORIDA	FL	4	0	0	1	0	1	1	0
GEORGIA	GA	4	0	1	1	0	1	1	0
IDAHO	ID	10	0	0	0	0	0	0	1

State	State	EPA Region	Covered for $PM_{2.5}$ – Group 1 SO_2	Covered for $PM_{2.5}$ – Group 2 SO_2	Covered for Ozone in Transport Rule	Covered for Ozone in Supplemental Proposal	Total State Coverage	In Eastern Domain	Wester n State
ILLINOIS	IL	5	1	0	1	0	1	1	0
INDIANA	IN	5	1	0	1	0	1	1	0
IOWA	IA	7	1	0	0	1	1	1	0
KANSAS	KS	7	0	1	0	1	1	1	0
KENTUCKY	KY	4	1	0	1	0	1	1	0
LOUISIANA	LA	6	0	0	1	0	1	1	0
MAINE	ME	1	0	0	0	0	0	1	0
MARYLAND	MD	3	1	0	1	0	1	1	0
MASSACHUSETTS	MA	1	0	0	0	0	0	1	0
MICHIGAN	MI	5	1	0	0	1	1	1	0
MINNESOTA	MN	5	0	1	0	0	1	1	0
MISSISSIPPI	MS	4	0	0	1	0	1	1	0
MISSOURI	MO	7	1	0	0	1	1	1	0
MONTANA	MT	8	0	0	0	0	0	0	1
NEBRASKA	NE	7	0	1	0	0	1	1	0
NEVADA	NV	9	0	0	0	0	0	0	1
NEW HAMPSHIRE	NH	1	0	0	0	0	0	1	0
NEW JERSEY	NJ	2	1	0	1	0	1	1	0
NEW MEXICO	NM	6	0	0	0	0	0	0	1
NEW YORK	NY	2	1	0	1	0	1	1	0
NORTH CAROLINA	NC	4	1	0	1	0	1	1	0
NORTH DAKOTA	ND	8	0	0	0	0	0	1	0
OHIO	OH	5	1	0	1	0	1	1	0
OKLAHOMA	OK	6	0	0	0	1	1	1	0
OREGON	OR	10	0	0	0	0	0	0	1
PENNSYLVANIA	PA	3	1	0	1	0	1	1	0
RHODE ISLAND	RI	1	0	0	0	0	0	1	0
SOUTH CAROLINA	SC	4	0	1	1	0	1	1	0
SOUTH DAKOTA	SD	8	0	0	0	0	0	1	0
TENNESSEE	TN	4	1	0	1	0	1	1	0
TEXAS	TX	6	0	1	1	0	1	1	0
TRIBAL			0	0	0	0	0	1	0
UTAH	UT	8	0	0	0	0	0	0	1
VERMONT	VT	1	0	0	0	0	0	1	0
VIRGINIA	VA	3	1	0	1	0	1	1	0
WASHINGTON	WA	10	0	0	0	0	0	0	1
WEST VIRGINIA	WV	3	1	0	1	0	1	1	0
WISCONSIN	WI	5	1	0	0	1	1	1	0
WYOMING	WY	8	0	0	0	0	0	0	1

State	State	EPA Region	Covered for $PM_{2.5}$ – Group 1 SO_2	Covered for $PM_{2.5}$ – Group 2 SO_2	Covered for Ozone in Transport Rule	Covered for Ozone in Supplemental Proposal	Total State Coverage	In Eastern Domain	Western State
TOTAL COUNT			16	7	26	6	28	39	11

7 Emission Summaries

The following tables summarize emissions differences between the 2005 base case, 2012 base case, 2014 base case, and 2014 EGU control case at various levels of geographic, temporal, and emission sector resolution.

Table 7-1 and

Table 7-2 provide NO_X and SO_2 emissions, respectively (including average fire emissions and excluding biogenic emissions) by state for the 2005 base case, 2012 base case, 2014 base case, and 2014 EGU control cases, as well as differences and percent differences between these cases. Note that the average fire emissions are the same for all emissions cases. Table 7-3 and Table 7-4 provide EGU sector (ptipm) NO_X and SO_2 emissions (respectively) by state for the 2005 base case, 2012 base case, 2014 base case, and 2014 EGU control cases, as well as differences and percent differences between these cases.

Table 7-5 and Table 7-6 provide NO_X and SO_2 emissions, respectively (including average fire emissions and excluding biogenic emissions) for the "group 1" states, "group 2" states, and cumulative totals for all states included in the Transport Rule for PM. See Figure 6-2 for a map of the group 1 and group 2 states. Emissions are provided for the 2005 base case, 2012 base case, 2014 base case, and 2014 EGU remedy cases, as well as differences and percent differences between these cases. We also provide summaries for all "Eastern Modeling Domain" states and "All Western States". The western states are defined as Arizona, California, Colorado, Idaho, Montana, Nevada, New Mexico, Oregon, Utah, Washington, and Wyoming. States in the eastern modeling domain are defined as the rest of the contiguous (lower 48 states) U.S. plus the District of Columbia.

Table 7-7 and Table 7-8 provide EGU sector only (ptipm) NO_X and SO_2 emissions (respectively) for the "group 1" states, "group 2" states, and cumulative totals for all states included in the Transport Rule for PM. See Figure 6-2 for a map of the group 1 and group 2 states. Emissions are provided for the 2005 base case, 2012 base case, 2014 base case, and 2014 EGU remedy case, as well as differences and percent differences between these cases. Summaries for the eastern modeling domain states and western states are also provided.

Table 7-9 provides summer (defined as May through September) EGU and Total Anthropogenic NO_X for the states that the Transport Rule covers for ozone. See Figure 6-2 for a map of these states. Emissions are provided for the 2005 base case, 2012 base case, 2014 base case, and 2014 EGU control ("remedy") cases, as well as differences and percent differences between these cases.

Additional information and pollutants are provided in the accompanying workbook: TransportRuleFinal_EmissionsSummaries.xls.

Table 7-1. State-level Total NO_X Emissions for each Transport Rule Modeling Case in 48 States and Washington, D.C.

State	2005 Base	2012 Base	2014 Base	2014 Remedy	2012 Base minus 2005 Base		2014 Base minus 2012 Base		2014 Remedy minus 2014 Base	
					Difference	% Diff.	Difference	% Diff	Difference	% Diff.
Alabama	484,282	343,206	321,975	315,155	-141,076	-29.1%	-21,231	-6.2%	-6,820	-2.1%
Arizona	400,774	274,608	248,574	248,570	-126,166	-31.5%	-26,034	-9.5%	-4	0.0%
Arkansas	264,979	205,673	193,670	194,964	-59,306	-22.4%	-12,002	-5.8%	1,293	0.7%
California	1,333,571	1,030,864	942,254	942,157	-302,706	-22.7%	-88,610	-8.6%	-97	0.0%
Colorado	334,635	253,291	237,296	237,246	-81,344	-24.3%	-15,995	-6.3%	-50	0.0%
Connecticut	129,736	88,660	80,787	80,793	-41,076	-31.7%	-7,873	-8.9%	6	0.0%
Delaware	58,486	35,549	31,729	31,744	-22,936	-39.2%	-3,820	-10.7%	15	0.0%
District of Columbia	16,802	11,040	9,773	9,773	-5,762	-34.3%	-1,267	-11.5%	0	0.0%
Florida	1,056,174	683,733	638,227	616,154	-372,441	-35.3%	-45,506	-6.7%	-22,073	-3.5%
Georgia	662,673	456,393	403,691	395,764	-206,280	-31.1%	-52,702	-11.5%	-7,927	-2.0%
Idaho	122,228	105,888	101,710	101,710	-16,340	-13.4%	-4,178	-3.9%	0	0.0%
Illinois	865,139	583,602	546,467	540,361	-281,537	-32.5%	-37,135	-6.4%	-6,107	-1.1%
Indiana	673,669	455,325	431,342	424,250	-218,344	-32.4%	-23,983	-5.3%	-7,092	-1.6%
Iowa	331,034	238,425	223,390	217,221	-92,608	-28.0%	-15,036	-6.3%	-6,169	-2.8%
Kansas	387,554	271,578	248,692	240,384	-115,976	-29.9%	-22,886	-8.4%	-8,308	-3.3%
Kentucky	482,262	318,048	294,262	286,806	-164,214	-34.1%	-23,786	-7.5%	-7,456	-2.5%
Louisiana	626,542	494,774	466,089	466,098	-131,768	-21.0%	-28,686	-5.8%	9	0.0%
Maine	86,094	66,633	61,657	61,657	-19,461	-22.6%	-4,975	-7.5%	0	0.0%
Maryland	312,230	197,441	181,909	181,533	-114,789	-36.8%	-15,533	-7.9%	-375	-0.2%
Massachusetts	283,638	189,620	175,275	175,316	-94,018	-33.1%	-14,345	-7.6%	41	0.0%
Michigan	718,454	481,684	449,343	442,544	-236,770	-33.0%	-32,341	-6.7%	-6,798	-1.5%
Minnesota	506,905	364,052	345,483	338,438	-142,853	-28.2%	-18,568	-5.1%	-7,045	-2.0%
Mississippi	324,595	232,009	216,438	216,224	-92,587	-28.5%	-15,571	-6.7%	-214	-0.1%
Missouri	563,356	374,298	357,846	352,631	-189,059	-33.6%	-16,451	-4.4%	-5,216	-1.5%
Montana	149,429	97,575	92,723	92,627	-51,854	-34.7%	-4,852	-5.0%	-96	-0.1%
Nebraska	263,714	197,887	186,408	169,571	-65,827	-25.0%	-11,479	-5.8%	-16,836	-9.0%
Nevada	151,905	86,487	81,041	81,017	-65,418	-43.1%	-5,446	-6.3%	-24	0.0%
New Hampshire	73,325	50,415	47,637	47,482	-22,910	-31.2%	-2,778	-5.5%	-156	-0.3%

State	2005 Base	2012 Base	2014 Base	2014 Remedy	2012 Base minus 2005 Base		2014 Base minus 2012 Base		2014 Remedy minus 2014 Base	
					Difference	% Diff.	Difference	% Diff	Difference	% Diff.
New Jersey	341,376	230,816	210,127	209,841	-110,559	-32.4%	-20,690	-9.0%	-286	-0.1%
New Mexico	343,139	281,341	264,414	264,502	-61,798	-18.0%	-16,926	-6.0%	88	0.0%
New York	688,109	491,308	459,087	457,927	-196,800	-28.6%	-32,221	-6.6%	-1,160	-0.3%
North Carolina	554,183	352,649	321,544	317,230	-201,534	-36.4%	-31,106	-8.8%	-4,314	-1.3%
North Dakota	182,289	133,332	127,125	127,127	-48,956	-26.9%	-6,207	-4.7%	2	0.0%
Ohio	906,327	560,718	522,450	508,054	-345,609	-38.1%	-38,268	-6.8%	-14,396	-2.8%
Oklahoma	434,284	344,447	328,683	305,859	-89,837	-20.7%	-15,764	-4.6%	-22,823	-6.9%
Oregon	240,218	189,886	179,324	179,371	-50,332	-21.0%	-10,563	-5.6%	48	0.0%
Pennsylvania	781,647	565,051	529,673	514,563	-216,596	-27.7%	-35,378	-6.3%	-15,110	-2.9%
Rhode Island	28,381	20,756	18,808	18,808	-7,625	-26.9%	-1,948	-9.4%	0	0.0%
South Carolina	314,276	216,883	204,389	202,118	-97,393	-31.0%	-12,494	-5.8%	-2,271	-1.1%
South Dakota	91,336	70,618	65,498	65,500	-20,717	-22.7%	-5,121	-7.3%	3	0.0%
Tennessee	527,027	338,047	302,103	293,339	-188,980	-35.9%	-35,944	-10.6%	-8,764	-2.9%
Texas	2,006,916	1,501,170	1,372,735	1,368,612	-505,746	-25.2%	-128,435	-8.6%	-4,123	-0.3%
Tribal	13,400	13,304	13,137	13,137	-96	-0.7%	-167	-1.3%	0	0.0%
Utah	216,810	179,535	170,840	170,840	-37,275	-17.2%	-8,696	-4.8%	0	0.0%
Vermont	25,696	23,142	22,824	22,824	-2,554	-9.9%	-318	-1.4%	0	0.0%
Virginia	488,263	359,907	334,720	333,985	-128,355	-26.3%	-25,187	-7.0%	-735	-0.2%
Washington	357,674	268,870	249,322	249,322	-88,804	-24.8%	-19,548	-7.3%	0	0.0%
West Virginia	308,655	172,143	166,094	155,245	-136,512	-44.2%	-6,049	-3.5%	-10,849	-6.5%
Wisconsin	401,226	279,465	262,201	254,989	-121,760	-30.3%	-17,264	-6.2%	-7,212	-2.8%
Wyoming	236,894	191,051	183,726	184,297	-45,843	-19.4%	-7,325	-3.8%	571	0.3%
Grand Total	**21,152,309**	**14,973,199**	**13,924,510**	**13,725,678**	**-6,179,110**	**-29.2%**	**-1,048,689**	**-7.0%**	**-198,832**	**-1.4%**

Table 7-2. State-level Total SO_2 Emissions for each Transport Rule Modeling Case in 48 States and Washington, D.C.

State	2005 Base	2012 Base	2014 Base	2014 Remedy	2012 Base minus 2005 Base		2014 Base minus 2012 Base		2014 Remedy minus 2014 Base	
					Difference	% Diff.	Difference	% Diff.	Difference	% Diff.
Alabama	589,408	574,045	534,700	290,925	-15,363	-2.6%	-39,345	-6.9%	-243,775	-45.6%
Arizona	92,231	65,046	65,792	65,792	-27,185	-29.5%	746	1.1%	0	0.0%
Arkansas	115,087	129,337	139,599	146,873	14,250	12.4%	10,262	7.9%	7,274	5.2%
California	164,217	136,846	119,268	119,268	-27,371	-16.7%	-17,579	-12.8%	0	0.0%
Colorado	82,213	63,748	72,227	83,980	-18,465	-22.5%	8,479	13.3%	11,753	16.3%
Connecticut	34,576	24,455	24,618	24,727	-10,121	-29.3%	163	0.7%	109	0.4%
Delaware	71,449	10,703	9,311	9,311	-60,746	-85.0%	-1,392	-13.0%	0	0.0%
District of Columbia	3,961	2,289	2,230	2,230	-1,672	-42.2%	-59	-2.6%	0	0.0%
Florida	596,729	247,550	280,233	284,700	-349,179	-58.5%	32,683	13.2%	4,468	1.6%
Georgia	744,119	511,422	274,332	197,251	-232,697	-31.3%	-237,090	-46.4%	-77,080	-28.1%
Idaho	27,166	24,326	24,248	24,248	-2,840	-10.5%	-79	-0.3%	0	0.0%
Illinois	518,531	608,867	260,031	251,073	90,336	17.4%	-348,835	-57.3%	-8,959	-3.4%
Indiana	1,040,947	929,162	863,923	331,182	-111,785	-10.7%	-65,239	-7.0%	-532,740	-61.7%
Iowa	225,451	206,314	198,747	149,491	-19,136	-8.5%	-7,567	-3.7%	-49,256	-24.8%
Kansas	196,515	116,861	117,050	92,971	-79,654	-40.5%	189	0.2%	-24,078	-20.6%
Kentucky	573,604	580,849	547,085	176,007	7,244	1.3%	-33,764	-5.8%	-371,078	-67.8%
Louisiana	307,340	249,655	261,579	282,552	-57,685	-18.8%	11,924	4.8%	20,973	8.0%
Maine	35,129	27,598	20,642	20,642	-7,531	-21.4%	-6,956	-25.2%	0	0.0%
Maryland	371,166	128,360	120,089	107,531	-242,806	-65.4%	-8,271	-6.4%	-12,558	-10.5%
Massachusetts	138,551	53,866	57,914	57,913	-84,686	-61.1%	4,049	7.5%	-1	0.0%
Michigan	492,106	362,718	364,035	257,233	-129,388	-26.3%	1,317	0.4%	-106,802	-29.3%
Minnesota	155,736	109,940	112,099	90,784	-45,796	-29.4%	2,158	2.0%	-21,315	-19.0%
Mississippi	121,397	63,330	64,156	65,293	-58,066	-47.8%	825	1.3%	1,137	1.8%
Missouri	423,253	483,607	511,664	308,275	60,354	14.3%	28,057	5.8%	-203,388	-39.8%
Montana	39,518	25,621	26,678	34,058	-13,897	-35.2%	1,057	4.1%	7,379	27.7%
Nebraska	100,026	87,120	85,799	84,065	-12,906	-12.9%	-1,321	-1.5%	-1,734	-2.0%
Nevada	73,018	29,694	30,112	30,112	-43,325	-59.3%	418	1.4%	0	0.0%

State	2005 Base	2012 Base	2014 Base	2014 Remedy	2012 Base minus 2005 Base		2014 Base minus 2012 Base		2014 Remedy minus 2014 Base	
					Difference	% Diff.	Difference	% Diff.	Difference	% Diff.
New Hampshire	63,614	13,401	16,391	16,680	-50,213	-78.9%	2,990	22.3%	289	1.8%
New Jersey	91,898	49,252	61,455	28,841	-42,646	-46.4%	12,203	24.8%	-32,614	-53.1%
New Mexico	50,755	25,254	26,507	28,575	-25,501	-50.2%	1,253	5.0%	2,068	7.8%
New York	386,707	232,727	163,302	135,575	-153,980	-39.8%	-69,425	-29.8%	-27,727	-17.0%
North Carolina	609,652	231,489	208,652	151,982	-378,163	-62.0%	-22,837	-9.9%	-56,670	-27.2%
North Dakota	160,082	118,490	119,385	119,375	-41,592	-26.0%	895	0.8%	-9	0.0%
Ohio	1,274,427	999,536	966,938	294,714	-274,890	-21.6%	-32,598	-3.3%	-672,224	-69.5%
Oklahoma	167,918	178,504	175,459	175,550	10,586	6.3%	-3,045	-1.7%	91	0.1%
Oregon	44,438	36,494	37,175	37,175	-7,945	-17.9%	681	1.9%	0	0.0%
Pennsylvania	1,172,555	638,071	645,278	261,173	-534,483	-45.6%	7,207	1.1%	-384,105	-59.5%
Rhode Island	7,366	6,391	6,385	6,385	-975	-13.2%	-6	-0.1%	0	0.0%
South Carolina	275,871	231,565	258,231	145,737	-44,306	-16.1%	26,666	11.5%	-112,494	-43.6%
South Dakota	29,083	42,688	42,453	42,453	13,605	46.8%	-235	-0.6%	0	0.0%
Tennessee	378,676	419,588	378,878	159,131	40,912	10.8%	-40,710	-9.7%	-219,747	-58.0%
Texas	927,857	712,582	704,311	517,627	-215,275	-23.2%	-8,271	-1.2%	-186,685	-26.5%
Tribal	1,515	1,510	677	677	-4	-0.3%	-833	-55.2%	0	0.0%
Utah	53,893	46,929	45,947	46,417	-6,965	-12.9%	-981	-2.1%	469	1.0%
Vermont	7,078	6,631	6,614	6,614	-446	-6.3%	-18	-0.3%	0	0.0%
Virginia	337,752	181,472	162,611	136,499	-156,280	-46.3%	-18,861	-10.4%	-26,112	-16.1%
Washington	57,580	38,581	38,062	38,062	-18,999	-33.0%	-519	-1.3%	0	0.0%
West Virginia	534,392	585,385	546,702	132,539	50,993	9.5%	-38,683	-6.6%	-414,163	-75.8%
Wisconsin	264,315	204,473	198,795	118,394	-59,842	-22.6%	-5,678	-2.8%	-80,401	-40.4%
Wyoming	123,503	74,547	80,419	87,133	-48,956	-39.6%	5,872	7.9%	6,714	8.3%
Grand Total	**14,354,370**	**10,928,889**	**10,078,786**	**6,275,795**	**-3,425,481**	**-23.9%**	**-850,103**	**-7.8%**	**-3,802,991**	**-37.7%**

Table 7-3. State-level Electric Generating Unit Sector NO_X Emissions for each Transport Rule Modeling Case in 48 States and Washington, D.C.

State	2005 Base	2012 Base	2014 Base	2014 Remedy	2012 Base minus 2005 Base		2014 Base minus 2012 Base		2014 Remedy minus 2014 Base	
					Difference	% Diff.	Difference	% Diff.	Difference	% Diff.
Alabama	133,051	83,037	76,012	69,192	-50,014	-37.6%	-7,025	-8.5%	-6,820	-9.0%
Arizona	79,776	40,365	35,616	35,613	-39,412	-49.4%	-4,748	-11.8%	-4	0.0%
Arkansas	35,407	33,540	36,347	37,640	-1,867	-5.3%	2,807	8.4%	1,293	3.6%
California	6,925	25,101	26,874	26,776	18,176	262.5%	1,773	7.1%	-97	-0.4%
Colorado	73,909	48,464	49,381	49,331	-25,445	-34.4%	917	1.9%	-50	-0.1%
Connecticut	6,865	2,603	2,854	2,860	-4,262	-62.1%	251	9.7%	6	0.2%
Delaware	11,917	2,639	1,701	1,717	-9,278	-77.9%	-937	-35.5%	15	0.9%
District of Columbia	492	0	0	0	-492	-100.0%	0		0	
Florida	217,282	91,072	100,581	78,508	-126,210	-58.1%	9,509	10.4%	-22,073	-21.9%
Georgia	111,281	67,682	49,411	41,484	-43,599	-39.2%	-18,271	-27.0%	-7,927	-16.0%
Idaho	19	608	608	608	589	3062.5%	0	0.0%	0	0.0%
Illinois	127,940	52,481	55,269	49,162	-75,459	-59.0%	2,788	5.3%	-6,107	-11.0%
Indiana	213,588	120,593	117,832	110,740	-92,995	-43.5%	-2,761	-2.3%	-7,092	-6.0%
Iowa	72,806	46,105	48,400	42,231	-26,701	-36.7%	2,295	5.0%	-6,169	-12.7%
Kansas	90,220	37,240	32,637	24,328	-52,981	-58.7%	-4,603	-12.4%	-8,308	-25.5%
Kentucky	164,783	88,195	83,544	76,088	-76,588	-46.5%	-4,651	-5.3%	-7,456	-8.9%
Louisiana	64,987	30,453	31,573	31,582	-34,534	-53.1%	1,120	3.7%	9	0.0%
Maine	1,100	4,864	5,402	5,402	3,764	342.2%	538	11.1%	0	0.0%
Maryland	62,574	16,706	17,566	17,190	-45,868	-73.3%	860	5.1%	-375	-2.1%
Massachusetts	25,134	4,954	6,992	7,033	-20,181	-80.3%	2,038	41.1%	41	0.6%
Michigan	120,026	63,266	67,705	60,907	-56,761	-47.3%	4,440	7.0%	-6,798	-10.0%
Minnesota	84,304	39,400	41,474	34,429	-44,904	-53.3%	2,074	5.3%	-7,045	-17.0%
Mississippi	45,166	23,655	26,294	26,080	-21,510	-47.6%	2,639	11.2%	-214	-0.8%
Missouri	127,431	55,633	57,318	52,103	-71,798	-56.3%	1,685	3.0%	-5,216	-9.1%
Montana	39,858	18,302	19,399	19,303	-21,555	-54.1%	1,096	6.0%	-96	-0.5%
Nebraska	52,426	44,496	45,047	28,211	-7,930	-15.1%	551	1.2%	-16,836	-37.4%

State	2005 Base	2012 Base	2014 Base	2014 Remedy	2012 Base minus 2005 Base		2014 Base minus 2012 Base		2014 Remedy minus 2014 Base	
					Difference	% Diff.	Difference	% Diff.	Difference	% Diff.
Nevada	47,297	13,294	14,074	14,050	-34,003	-71.9%	780	5.9%	-24	-0.2%
New Hampshire	8,827	4,068	5,126	4,971	-4,759	-53.9%	1,059	26.0%	-156	-3.0%
New Jersey	30,142	7,534	8,006	7,720	-22,608	-75.0%	472	6.3%	-286	-3.6%
New Mexico	75,483	64,264	64,745	64,833	-11,220	-14.9%	481	0.7%	88	0.1%
New York	63,315	20,909	21,689	20,528	-42,406	-67.0%	779	3.7%	-1,160	-5.4%
North Carolina	111,576	54,463	49,322	45,008	-57,113	-51.2%	-5,141	-9.4%	-4,314	-8.7%
North Dakota	76,381	52,968	53,265	53,267	-23,414	-30.7%	297	0.6%	2	0.0%
Ohio	258,944	103,192	104,149	89,753	-155,751	-60.1%	957	0.9%	-14,396	-13.8%
Oklahoma	86,204	66,365	66,966	44,143	-19,839	-23.0%	601	0.9%	-22,823	-34.1%
Oregon	9,383	8,875	9,584	9,632	-508	-5.4%	709	8.0%	48	0.5%
Pennsylvania	176,891	130,738	134,092	118,981	-46,153	-26.1%	3,354	2.6%	-15,110	-11.3%
Rhode Island	545	449	442	442	-96	-17.6%	-7	-1.6%	0	0.0%
South Carolina	52,657	35,395	39,018	36,747	-17,262	-32.8%	3,623	10.2%	-2,271	-5.8%
South Dakota	15,650	14,269	14,270	14,273	-1,381	-8.8%	1	0.0%	3	0.0%
Tennessee	102,934	37,694	29,276	20,512	-65,240	-63.4%	-8,418	-22.3%	-8,764	-29.9%
Texas	176,170	137,128	142,087	137,964	-39,043	-22.2%	4,960	3.6%	-4,123	-2.9%
Tribal	78	32	11	11	-46	-58.6%	-21	-64.9%	0	0.0%
Utah	65,261	67,429	67,434	67,434	2,168	3.3%	5	0.0%	0	0.0%
Vermont	297	379	455	455	82	27.6%	76	20.2%	0	0.0%
Virginia	62,793	38,820	40,469	39,734	-23,973	-38.2%	1,649	4.2%	-735	-1.8%
Washington	17,634	12,565	13,322	13,322	-5,069	-28.7%	757	6.0%	0	0.0%
West Virginia	159,947	62,434	64,824	53,975	-97,513	-61.0%	2,390	3.8%	-10,849	-16.7%
Wisconsin	72,170	40,062	40,750	33,537	-32,108	-44.5%	687	1.7%	-7,212	-17.7%
Wyoming	89,315	69,911	70,207	70,778	-19,404	-21.7%	296	0.4%	571	0.8%
Grand Total	**3,729,161**	**2,084,689**	**2,089,422**	**1,890,590**	**-1,644,472**	**-44.1%**	**4,733**	**0.2%**	**-198,832**	**-9.5%**

Table 7-4. State-level Electric Generating Unit Sector SO_2 Emissions for each Transport Rule Modeling Case in 48 States and Washington, D.C.

State	2005 Base	2012 Base	2014 Base	2014 Remedy	2012 Base minus 2005 Base		2014 Base minus 2012 Base		2014 Remedy minus 2014 Base	
					Difference	% Diff.	Difference	% Diff.	Difference	% Diff.
Alabama	460,123	455,825	417,340	173,566	-4,298	-0.9%	-38,485	-8.4%	-243,775	-58.4%
Arizona	52,733	34,734	35,601	35,601	-17,999	-34.1%	867	2.5%	0	0.0%
Arkansas	66,384	87,241	99,411	106,685	20,857	31.4%	12,170	13.9%	7,274	7.3%
California	601	6,763	7,350	7,350	6,162	1025.3%	587	8.7%	0	0.0%
Colorado	64,174	52,963	62,105	73,858	-11,211	-17.5%	9,143	17.3%	11,753	18.9%
Connecticut	10,356	3,355	3,774	3,883	-7,001	-67.6%	419	12.5%	109	2.9%
Delaware	32,378	3,641	2,172	2,172	-28,738	-88.8%	-1,468	-40.3%	0	0.0%
District of Columbia	1,082	0	0	0	-1,082	-100.0%	0		0	
Florida	417,321	110,687	143,601	148,069	-306,634	-73.5%	32,914	29.7%	4,468	3.1%
Georgia	616,063	406,279	170,288	93,208	-209,784	-34.1%	-235,991	-58.1%	-77,080	-45.3%
Idaho	0	182	182	182	182	106823.2%	0	0.0%	0	0.0%
Illinois	330,382	489,140	141,606	132,647	158,758	48.1%	-347,534	-71.0%	-8,959	-6.3%
Indiana	878,979	789,116	727,786	195,046	-89,863	-10.2%	-61,330	-7.8%	-532,740	-73.2%
Iowa	130,264	127,102	133,083	83,827	-3,162	-2.4%	5,981	4.7%	-49,256	-37.0%
Kansas	136,520	68,541	69,819	45,740	-67,978	-49.8%	1,277	1.9%	-24,078	-34.5%
Kentucky	502,731	520,546	488,005	116,927	17,815	3.5%	-32,541	-6.3%	-371,078	-76.0%
Louisiana	109,875	103,835	118,230	139,204	-6,040	-5.5%	14,395	13.9%	20,973	17.7%
Maine	3,887	2,203	2,355	2,355	-1,684	-43.3%	152	6.9%	0	0.0%
Maryland	283,205	49,942	42,926	30,368	-233,263	-82.4%	-7,016	-14.0%	-12,558	-29.3%
Massachusetts	84,234	8,581	13,364	13,363	-75,653	-89.8%	4,783	55.7%	-1	0.0%
Michigan	349,877	255,038	269,434	162,632	-94,840	-27.1%	14,396	5.6%	-106,802	-39.6%
Minnesota	101,678	67,816	70,937	49,622	-33,862	-33.3%	3,121	4.6%	-21,315	-30.0%
Mississippi	75,047	29,336	30,972	32,109	-45,711	-60.9%	1,636	5.6%	1,137	3.7%
Missouri	284,384	383,313	390,287	186,899	98,930	34.8%	6,973	1.8%	-203,388	-52.1%
Montana	19,715	13,641	15,447	22,826	-6,074	-30.8%	1,806	13.2%	7,379	47.8%
Nebraska	74,955	71,904	73,073	71,339	-3,050	-4.1%	1,169	1.6%	-1,734	-2.4%

State	2005 Base	2012 Base	2014 Base	2014 Remedy	2012 Base minus 2005 Base		2014 Base minus 2012 Base		2014 Remedy minus 2014 Base	
					Difference	% Diff.	Difference	% Diff.	Difference	% Diff.
Nevada	53,363	13,486	14,416	14,416	-39,876	-74.7%	930	6.9%	0	0.0%
New Hampshire	51,445	3,332	6,453	6,742	-48,113	-93.5%	3,121	93.7%	289	4.5%
New Jersey	57,044	26,346	38,856	6,243	-30,698	-53.8%	12,511	47.5%	-32,614	-83.9%
New Mexico	30,628	9,895	11,857	13,926	-20,734	-67.7%	1,963	19.8%	2,068	17.4%
New York	180,847	56,461	42,887	15,160	-124,386	-68.8%	-13,574	-24.0%	-27,727	-64.7%
North Carolina	512,231	148,606	126,048	69,377	-363,625	-71.0%	-22,558	-15.2%	-56,670	-45.0%
North Dakota	137,371	101,946	103,633	103,624	-35,425	-25.8%	1,688	1.7%	-9	0.0%
Ohio	1,116,095	882,559	851,199	178,975	-233,536	-20.9%	-31,359	-3.6%	-672,224	-79.0%
Oklahoma	110,081	135,972	137,981	138,072	25,891	23.5%	2,009	1.5%	91	0.1%
Oregon	12,304	10,197	11,336	11,336	-2,107	-17.1%	1,139	11.2%	0	0.0%
Pennsylvania	1,002,203	495,463	509,649	125,545	-506,740	-50.6%	14,186	2.9%	-384,105	-75.4%
Rhode Island	176	0	0	0	-176	-100.0%	0	#DIV/0!	0	
South Carolina	218,781	186,355	213,281	100,788	-32,426	-14.8%	26,927	14.4%	-112,494	-52.7%
South Dakota	12,215	29,711	29,711	29,711	17,495	143.2%	0	0.0%	0	0.0%
Tennessee	266,148	324,377	284,468	64,721	58,229	21.9%	-39,909	-12.3%	-219,747	-77.2%
Texas	534,949	446,006	453,332	266,648	-88,944	-16.6%	7,326	1.6%	-186,685	-41.2%
Tribal	3	0	0	0	-3	-100.0%	0	#DIV/0!	0	
Utah	34,813	33,828	33,498	33,968	-985	-2.8%	-330	-1.0%	469	1.4%
Vermont	9	219	263	263	209	2218.6%	44	20.2%	0	0.0%
Virginia	220,287	92,468	77,256	51,144	-127,819	-58.0%	-15,212	-16.5%	-26,112	-33.8%
Washington	3,409	3,225	3,430	3,430	-183	-5.4%	205	6.3%	0	0.0%
West Virginia	469,456	536,695	498,507	84,344	67,239	14.3%	-38,188	-7.1%	-414,163	-83.1%
Wisconsin	180,200	135,827	130,538	50,137	-44,373	-24.6%	-5,290	-3.9%	-80,401	-61.6%
Wyoming	89,874	45,112	51,817	58,530	-44,762	-49.8%	6,705	14.9%	6,714	13.0%
Grand Total	**10,380,883**	**7,859,810**	**7,159,569**	**3,356,577**	**-2,521,072**	**-24.3%**	**-700,242**	**-8.9%**	**-3,802,991**	**-53.1%**

Table 7-5. Group 1 and Group 2 States NO_X Total Emissions for each Transport Rule Modeling Case

	2005 Base Year	2012 Base Case	2014 Base Case	2014 Remedy	2014 Remedy - 2012 Base Case	Percent Change: 2014 Remedy vs 2012 Base Case	2014 Remedy - 2014 Base Case	Percent Change: 2014 Remedy vs 2014 Base Case
Annual Total NO_X Emissions for States in Group 1	8,942,956	5,998,929	5,592,557	5,490,517	-508,412	-8.5%	-102,039	-1.8%
Annual Total NO_X Emissions for States in Group 2	4,626,321	3,351,169	3,083,373	3,030,042	-321,127	-9.6%	-53,331	-1.7%
Annual Total NO_X for all States included for PM	13,569,277	9,350,098	8,675,929	8,520,559	-829,539	-8.9%	-155,370	-1.8%
Annual Total NO_X Emissions for All States Fully within the Eastern Modeling Domain	17,265,033	12,013,803	11,173,286	10,974,018	-1,039,784	-8.7%	-199,268	-1.8%
Annual Total NO_X Emissions for All Western States	3,887,276	2,959,396	2,751,224	2,751,659	-207,737	-7.0%	435	0.0%
Total NO_X	21,152,309	14,973,199	13,924,510	13,725,678	-1,247,521	-8.3%	-198,832	-1.4%

Table 7-6. Group 1 and Group 2 States SO_2 Total Emissions for each Transport Rule Modeling Case

	2005 Base Year	2012 Base Case	2014 Base Case	2014 Remedy	2014 Remedy - 2012 Base Case	Percent Change: 2014 Remedy vs 2012 Base Case	2014 Remedy - 2014 Base Case	Percent Change: 2014 Remedy vs 2014 Base Case
Annual Total SO2 Emissions for States in Group 1	8,695,431	6,841,869	6,198,185	2,999,641	-3,842,228	-56.2%	-3,198,544	-51.6%
Annual Total SO2 Emissions for States in Group 2	2,989,533	2,343,536	2,086,522	1,419,361	-924,175	-39.4%	-667,161	-32.0%
Annual Total SO2 for all States included for PM	11,684,964	9,185,405	8,284,707	4,419,002	-4,766,403	-51.9%	-3,865,705	-46.7%
Annual Total SO2 Emissions for All States Fully within the Eastern Modeling Domain	13,545,837	10,361,804	9,512,351	5,680,977	-4,680,826	-45.2%	-3,831,374	-40.3%
Annual Total SO2 Emissions for All Western States	808,533	567,085	566,435	594,818	27,733	4.9%	28,383	5.0%
Total SO2	14,354,370	10,928,889	10,078,786	6,275,795	-4,653,094	-42.6%	-3,802,991	-37.7%

Table 7-7. Group 1 and Group 2 States NO_X EGU Sector Emissions for each Transport Rule Modeling Case

	2005 Base Year	2012 Base Case	2014 Base Case	2014 Remedy	2014 Remedy - 2012 Base Case	Percent Change: 2014 Remedy vs 2012 Base Case	2014 Remedy - 2014 Base Case	Percent Change: 2014 Remedy vs 2014 Base Case
Annual EGU NO_X Emissions for States in Group 1	1,927,858	938,824	940,211	838,171	-100,653	-10.7%	-102,039	-10.9%
Annual EGU NO_X Emissions for States in Group 2	700,110	444,377	425,686	372,355	-72,022	-16.2%	-53,331	-12.5%
Annual EGU NO_X for all States included for PM	2,627,967	1,383,201	1,365,897	1,210,527	-172,674	-12.5%	-155,370	-11.4%
Annual EGU NO_X Emissions for All States Fully within the Eastern Modeling Domain	3,224,300	1,715,510	1,718,178	1,518,910	-196,600	-11.5%	-199,268	-11.6%
Annual EGU NO_X Emissions for All Western States	504,861	369,180	371,244	371,680	2,500	0.7%	435	0.1%
Total EGU NO_X	3,729,161	2,084,689	2,089,422	1,890,590	-194,099	-9.3%	-198,832	-9.5%

Table 7-8. Group 1 and Group 2 States SO_2 EGU Sector Emissions for each Transport Rule Modeling Case

	2005 Base Year	2012 Base Case	2014 Base Case	2014 Remedy	2014 Remedy - 2012 Base Case	Percent Change: 2014 Remedy vs 2012 Base Case	2014 Remedy - 2014 Base Case	Percent Change: 2014 Remedy vs 2014 Base Case
Annual EGU SO2 Emissions for States in Group 1	6,764,335	5,313,000	4,752,537	1,553,993	-3,759,007	-70.8%	-3,198,544	-67.3%
Annual EGU SO2 Emissions for States in Group 2	2,143,069	1,702,727	1,468,071	800,910	-901,816	-53.0%	-667,161	-45.4%
Annual EGU SO2 for all States included for PM	8,907,403	7,015,726	6,220,608	2,354,903	-4,660,823	-66.4%	-3,865,705	-62.1%
Annual EGU SO2 Emissions for All States Fully within the Eastern Modeling Domain	10,019,270	7,635,785	6,912,529	3,081,155	-4,554,630	-59.6%	-3,831,374	-55.4%
Annual EGU SO2 Emissions for All Western States	361,613	224,026	247,039	275,422	51,397	22.9%	28,383	11.5%
EGU SO2	10,380,883	7,859,810	7,159,569	3,356,577	-4,503,233	-57.3%	-3,802,991	-53.1%

Table 7-9. 26-State Total and Electric Generating Unit Sector Summer NO_X Emissions for each Transport Rule Modeling Case

	2005 Base Year	2012 Base Case	2014 Base Case	2014 Remedy	2014 Remedy - 2012 Base Case	Percent Change: 2014 Remedy vs 2012 Base Case	2014 Remedy - 2014 Base Case	Percent Change: 2014 Remedy vs 2014 Base Case
Summer EGU NO_x Emissions for States Included for Ozone	1,001,600	671,939	668,513	593,833	-78,106	-11.6%	-74,680	-11.2%
Summer Total NO_x Emissions for States Included for Ozone	6,153,473	4,455,600	4,128,792	4,054,111	-401,489	-9.0%	-74,680	-1.8%

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