United States Environmental Protection Agency

Emissions Modeling for the Final Mercury and Air Toxics Standards Technical Support Document

EPA-454/R-11-011
December 2011

Emissions Modeling for the Final Mercury and Air Toxics Standards Technical Support Document

By:
Alison Eyth
Rich Mason
Alexis Zubrow

U.S. Environmental Protection Agency
Office of Air and Radiation
Office of Air Quality Planning and Standards
Air Quality Assessment Division

TABLE OF CONTENTS

LIST OF TABLES

LIST OF APPENDICES

ACRONYMS

AEO	Annual Energy Outlook
BEIS	Biogenic Emission Inventory System
bps	Buly plant storage
btp	Bulk plant terminal-to-pump
C3	Category 3 (commercial marine vessels)
CAP	Criteria Air Pollutant
CMAQ	Community Multiscale Air Quality
CSAPR	Cross-State Air Pollution (formerly Transport) Rule
E0	0% Ethanol gasoline (by volume)
E10	10% Ethanol gasoline
E15	15% Ethanol gasoline
EGU	Electric Generating Utility
EISA	Energy Independence and Security Act of 2007
EPAct	Energy Policy Act of 2005
FAA	Federal Aviation Administration
FIPS	Federal Information Processing Standard
HAP	Hazardous Air Pollutant
HDGHG	Heavy Duty Greenhouse Gas
HONO	HNO2, nitrous acid
IPM	Integrated Planning Model
LDGHG	Light Duty Greenhouse Gas
MOBILE6	Mobile Source Emission Factor Model, version 6
MOVES	Motor Vehicle Emissions Simulator
MY	Model Year
NEEDS	National Electric Energy Database System
NEI	National Emission Inventory
NMIM	National Mobile Inventory Model
OAQPS	EPA's Office of Air Quality Planning and Standards
ORL	One Record per Line (a SMOKE input format)
MP	Multipollutant
NO	Nitric oxide
NO2	Nitrogen dioxide
NOX	Nitrogen oxides
PFC	Portable Fuel Container
PEC	Elemental carbon component of PM2.5
PMFINE	Leftover "Other", or "crustal" component of PM2.5
PNO3	Particulate nitrate component of PM2.5
PSO4	Particulate sulfate component of PM2.5
POC	Organic carbon component of PM2.5
rbt	Refinery-to-bulk terminal
RFS2	Revised annual renewable fuel standard (mandate)
SMOKE	Sparse Matrix Operator Kernel Emissions
SCC	Source Category Code
TAF	Terminal Area Forecast
TSD	Technical Support Document
VOC	Volatile Organic Compound
WRAP	Western Regional Air Partnership

1 Introduction to the Modeling Platform

This Technical Support Document (TSD) describes the development of the emissions inventories used as inputs to the air quality modeling that the U.S. Environmental Protection Agency (EPA) performed to assess the impact of the Mercury and Air Toxics Standards (MATS). This document provides the details of emissions modeling done to support the development of the Regulatory Impact Assessment (RIA) for the MATS. The emissions processing described herein and the corresponding air quality modeling were used to develop benefit-per-ton scaling factors for the benefits calculation as described in the RIA. More information on this approach can be found in Appendix 5C of the RIA and in the Air Quality Modeling Technical Support Document (TSD). The emissions inventories were using the Sparse Matrix Operator Kernel Emissions (SMOKE) modeling system version 2.7 processed into the form required by the Community Multi-scale Air Quality (CMAQ) model. CMAQ simulates the numerous physical and chemical processes involved in the formation, transport, and destruction of ozone, particulate matter and air toxics.

As part of the analysis for this rulemaking, the modeling system was used to calculate daily and annual $PM_{2.5}$ concentrations, 8-hr maximum ozone and visibility impairment. Model predictions of $PM_{2.5}$ and ozone are used in a relative sense to estimate scenario-specific, future-year design values of $PM_{2.5}$ and ozone. These are combined with monitoring data to estimate population-level exposures to changes in ambient concentrations for use in estimating health and welfare effects. In this document, we provide an overview of (1) the emissions components of the modeling platform, (2) the development of the 2005 base year emissions, (3) the development of the future year baseline emissions, and (4) the development of the future year control case emissions.

A modeling platform is the collection of the inputs to an air quality model, including the settings and data used for the model, including emissions data, meteorology, initial conditions, and boundary conditions. The 2005-based air quality modeling platform used for the proposed utility NESHAP RIA includes 2005 base year emissions and 2005 meteorology for modeling ozone and $PM_{2.5}$ with CMAQ. In support of this rule, EPA modeled the air quality in the Eastern and the Western United States using two separate model runs, each with a horizontal grid resolution of 12 km x 12 km. These 12 km modeling domains were "nested" within a modeling domain covering the remainder of the lower 48 states and surrounding areas using a grid resolution of 36 x 36 km. The results from the 36-km modeling were used to provide incoming "boundary" for the 12km grids. Additional details on the non-emissions portion of the 2005v4.3 modeling platform used for the RIA are described in the air quality modeling TSD.

The 2005-based air quality modeling platform used in support of the RIA is version 4.3 and is referred to as the 2005v4.3 platform. It is an update to the 2005-based platform, version 4.1 (i.e., 2005v4.1) used for the proposal modeling and for the appropriate and necessary finding. The Technical Support Document "Preparation of Emissions Inventories for the Version 4.1, 2005-based Platform" provides information on the platform used for the proposed version of this rule and for the appropriate and necessary finding. The 2005v4.3 platform builds upon the 2005-based platform, version 4.2, which was the version of the platform used for the final Cross-State Air Pollution Rule and incorporated changes made in response to public comments on the proposed version of that rule.

Table 1-1 provides a high-level summary of the three emissions cases that were modeled in support of the final rule RIA. The form of the fuel used for mobile sources is a key discriminator between the cases. Therefore, the mobile source emissions are described with respect to the impacts of the Energy Independence and Security Act of 2007 (EISA) and the Energy Policy Act of 2005 (EPAct) on mobile source fuels.

Table 1-1. List of cases run in support of the MATS air quality modeling for the RIA

Case Name	Internal EPA Abbreviation	Description
2005 base case	2005ct	2005 calendar year case / scenarios that uses an average year temporal allocation approach for Electrical Generating Units (EGUs), a pre-EISA/EPAct fuel supply for mobile sources, and average year fires data. Air quality outputs from this case are used to compute relative response factors with the 2017 future year reference case scenarios.
2017 reference case	2017ct_ref	2017 future year baseline scenario with EGU emissions that represent the implementation of the Cross-State Air Pollution Rule (CSAPR) and mobile sources representing the implementation of the EISA/EPAct fuel supply (RFS2 Rule) along with average year fire data.
2017 control case	2017ct_ref_mats	2017 "control" or remedy case scenario with EGU emissions that represent the implementation of both CSAPR and MATS, and mobile sources representing implementation of the EISA/EPAct fuel supply (RFS2), along with average year fire data.

In the remainder of this document, we provide a description of the approaches taken for the emissions in support of air quality modeling for the MATS. In Section 2, we describe the 2005v4.3 platform custom configurations, ancillary data and 2005 inventory differences from the v4.2 platform. In Section 3, we describe the speciation differences among each of the cases run. In Section 4, we describe the 2017 Reference (i.e., future year baseline) case as compared to the 2005 base case. Appendix A provides a comparison of the ancillary datasets and parameters used for the various MATS emissions cases, and Appendix B compares the emissions inventory and other input data files used for each of the MATS cases.

2 2005 Emission Inventories and Their Preparation

As mentioned previously, the 2005 emissions modeling approach for MATS used much of the same data and approaches as the 2005v4.2 platform. In this section, we identify the differences between the data used for the MATS 2005v4.3 platform and that used for the 2005v4.2 platform. Section 2.1 provides ancillary data differences that impact multiple sectors. Section 2.2 discusses the new approach used for emissions preprocessing and processing for all onroad mobile sources. Section 2.3 discusses the updated nonroad mobile components. Sections 2.2 and 2.65 provide differences for the nonpoint and nonpoint (area) inventories, respectively.

The data used in the 2005 emissions case is often the same as those described in the Final Cross-State Air Pollution Rule TSD, also known as the CAP-BAFM 2005-based Version 4.2 Platform (i.e., 2005v4.2). However, some different emissions data are used for this rulemaking. All of the documentation provided here describes what was done differently and specifically for the MATS in contrast to what was done for the 2005v4.2 platform.

In MATS, we used a 2005 base case approach for the year 2005 emissions scenario. This approach is very similar to that CSAPR Final Rule (formerly known as the "Transport Rule"). A base case approach uses average year fires and EGU temporal profiles from three years of EGU data. We use a base case approach because we want to reduce year-specific variability in some components of the inventory. For example, large fires vary in location and day of the year each year, and EGU shutdowns and high use on high energy demand days also vary by year. By using a base case approach, these two aspects of the inventory are maintained into the future year modeling and therefore do not introduce potentially spurious year-specific artifacts into the air quality modeling estimates. For MATS, the same biogenic emissions data as the 2005v4.2 platform was used for the 2005 case, and also for both future-year cases. The only significant data changes between the 2005 and the 2017 future-year MATS case are the emission inventories and speciation approaches.

Table 2-1 below lists the platform sectors used for the MATS modeling platform. It also indicates which platform sectors include HAP emissions and the associated sectors from the National Emission Inventory (NEI). Subsequent subsections refer to these platform sectors to identify the emissions differences between the 2005v4.2 platform and the MATS 2005v4.3-based platform.

Table 2-1. Sectors used in emissions modeling for the final MATS 2005v4.3 platform

Platform Sector	2005 NEI Sector	Description	Contains HAP emissions?
IPM sector: *ptipm*	Point	NEI EGU units at facilities mapped to the IPM model using the National Electric Energy Database System (NEEDS) database.	Yes
Non-IPM sector: *ptnonipm*	Point+	All NEI point source units not matched to the ptipm sector, including airports.	Yes
Average-fire sector: *avefire*	N/A	Average-year wildfire and prescribed fire emissions, county and annual resolution.	Yes
Agricultural sector: *ag*	Nonpoint	Ammonia (NH_3) emissions from NEI nonpoint livestock and fertilizer application.	No
Area fugitive dust sector: *afdust*	Nonpoint	PM_{10} and $PM_{2.5}$ emissions from fugitive dust sources in the NEI nonpoint inventory.	No
Remaining nonpoint sector: *nonpt*	Nonpoint+	All U.S. nonpoint (i.e. inventoried at the county-level) sources not otherwise included in other emissions modeling sectors.	Yes
Nonroad sector: *nonroad*	Mobile: Nonroad	Monthly nonroad emissions from the NONROAD model version NR08b and National Mobile Inventory Model (NMIM) software version NMIM20090504b and NMIM and Meteorology database version NCD20101201Tier3. Nonroad version is equivalent to NONROAD2008a used in 2005v4.2 for future year 2017.	Yes
C1 & C2 CMV and locomotives: *alm_no_c3*	Mobile: Nonroad	Primarily 2002 NEI non-rail maintenance locomotives, and category 1 and category 2 commercial marine vessel (CMV) emissions sources, county and annual resolution. Aircraft emissions are no longer in this sector and are now included in the Non-EGU sector (as point sources); also, category 3 CMV emissions are no longer in this sector and are now contained in the seca_c3 sector.	Yes
C3 commercial marine: *seca_c3*	Mobile: nonroad	Annual point source-formatted, year 2005 category 3 (C3) CMV emissions, developed for the rule called "Control of Emissions from New Marine Compression-Ignition Engines at or Above 30 Liters per Cylinder", usually described as the Emissions Control Area (ECA) study (http://www.epa.gov/otaq/oceanvessels.htm). Utilized final projections from 2002, developed for the C3 ECA Proposal to the International Maritime Organization (EPA-420-F-10-041, August 2010).	Yes
Onroad Mobile: *onroad*	Mobile: onroad+	Motor Vehicle Emissions Simulator (MOVES) emission factors created to account for hourly-based meteorology dependencies at a select number of representative counties. Includes local input information such as fuels, temperatures, vehicle fleet, speed distributions and controls. Emission factors are combined with activity data and gridded temperature via SMOKE to produce gridded emissions. These emissions are discussed extensively in Section 2.2.	Yes

Platform Sector	2005 NEI Sector	Description	Contains HAP emissions?
Biogenic: *biog*	N/A	Hour-specific, grid cell-specific emissions generated from the BEIS3.14 model, including emissions in Canada and Mexico. Unchanged from the 2005v4 platform, and the same data are used for all future year scenarios.	No
Other point sources not from the NEI: *othpt*	N/A	Point sources from Canada's 2006 inventory and Mexico's Phase III 1999 inventory, annual resolution. Also includes annual U.S. offshore oil 2005v2 NEI point source emissions. Unchanged from the 2005v4 platform, and the same data are used for all future year scenarios.	No
Other nonpoint and nonroad not from the NEI: *othar*	N/A	Annual year 2006 Canada (province resolution) and year 1999 Mexico Phase III (municipio resolution) nonpoint and nonroad mobile inventories. Unchanged from the 2005v4 platform, and the same data is used for all future year scenarios.	No
Other onroad sources not from the NEI: *othon*	N/A	Year 2006 Canada (province resolution) and year 1999 Mexico Phase III (municipio resolution) onroad mobile inventories, annual resolution. Unchanged from the 2005v4 platform, and the same data is used for all future year scenarios.	No

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

2.1 Custom configuration for emissions modeling for MATS

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

Table 2-2 lists the additional HAP pollutants processed for the MATS 2005v4.3 platform, which were not included in the 2005v4.2 platform. A "lite" version of the multi-pollutant CMAQ (Version 4.7) was used that required emissions only for the species listed in the footnote of Table 2-2. In addition to the model species differences, the MATS platform had a few additional custom aspects in the 2005 cases. Table 2-3 lists the datasets used by the 2005v4.3 platform that are different from the 2005v4.2 platform.

Another consideration is the speciation across the MATS future-year cases as compared to 2005. Section 3 provides a detailed account of these differences. The future-year ancillary data were largely the same as those in 2005, with no substantial differences for most modeling sectors. The exception to this is onroad mobile, which in MATS processing, required several new ancillary input files to support the SMOKE to MOVES modules; these are discussed in detail in Section 2.4. All other ancillary data files not required for SMOKE to MOVES processing can otherwise be found at the 2005-based platform website.

Table 2-2. Model species produced by SMOKE for CB05 with SOA for the MATS platform

Inventory Pollutant	Model Species	Model species description
CL2	CL2	Atomic gas-phase chlorine
HCl	HCL	Hydrogen Chloride (hydrochloric acid) gas
CO	CO	Carbon monoxide
NO_X	NO	Nitrogen oxide
	NO2	Nitrogen dioxide
	HONO	Nitrous acid
SO_2	SO2	Sulfur dioxide
	SULF	Sulfuric acid vapor
NH_3	NH3	Ammonia
VOC	ACROLEIN*	Acrolein from the HAP inventory
	ALD2	Acetaldehyde from VOC speciation
	ALD_PRIMARY*	Acetaldehyde from the HAP inventory
	ALDX	Propionaldehyde and higher aldehydes
	BENZENE	Benzene (not part of CB05)
	BUTADIENE13*	1,3-butadiene from the HAP inventory
	ETH	Ethene
	ETHA	Ethane
	ETOH	Ethanol, from select inventories provided by OTAQ
	FORM	Formaldehyde
	FORM_PRIMARY*	Formaldehyde from the HAP inventory
	IOLE	Internal olefin carbon bond (R-C=C-R)
	ISOP	Isoprene
	MEOH	Methanol
	OLE	Terminal olefin carbon bond (R-C=C)
	PAR	Paraffin carbon bond
	TOL	Toluene and other monoalkyl aromatics
	XYL	Xylene and other polyalkyl aromatics
Various additional VOC species from the biogenics model which do not map to the above model species	SESQ	Sesquiterpenes
	TERP	Terpenes
PM_{10}	PMC	Coarse PM > 2.5 microns and ≤ 10 microns
$PM_{2.5}$	PEC	Particulate elemental carbon ≤ 2.5 microns
	PNO3	Particulate nitrate ≤ 2.5 microns
	POC	Particulate organic carbon (carbon only) ≤ 2.5 microns
	PSO4	Particulate Sulfate ≤ 2.5 microns
	PMFINE	Other particulate matter ≤ 2.5 microns
Sea-salt species (non – anthropogenic emissions)	PCL	Particulate chloride
	PNA	Particulate sodium

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

Table 2-3. Description of differences in ancillary data (unrelated to SMOKE to MOVES) between the MATS 2005 case and the 2005v4.2 platform

Ancillary Data Type	Difference between 2005v4.2 platform and MATS platform
Speciation cross-references and Speciation profiles	The MATS 2005v4.3 data files are configured to support the multi-pollutant (MP) version of CMAQ, whereas the 2005v4.2 platform data file is configured to support only the non-MP version. Therefore, the MATS data files include profiles for additional VOC HAP species.
Speciation VOC to TOG conversion profiles	Added MATS-specific VOC to TOG and nonHAP VOC to nonHAP TOG assignments
SCC Descriptions	Added onroad diesel SCCs representing start and idle modes (223007X000)
Inventory tables	The MATS data file was updated to support SMOKE to MOVES pollutants and modes, the MP "lite" version of CMAQ, and, to accept inventory Ethanol (ETOH). The 2005v4.2 platform data file is configured to support only the non-MP version.

2.2 Onroad mobile sources (onroad)

For each scenario, emissions from cars, trucks and motorcycles were estimated by using the EPA's Motor Vehicle Emission Simulator (MOVES) to create emission factors that were then input to the Sparse Matrix Operator Kernel Emissions system (SMOKE). The SMOKE-MOVES Integration Tools combined the county and temperature-specific emission factors with the activity data to compute the actual emissions. In brief, our approach was to use the met4moves program to identify a set of temperatures that needed emission rates. For each scenario, we then ran MOVES repeatedly to produce emission rates by temperature, Source Classification Code (SCC), speed bin, and representing county. The moves2smk tool then reformatted the MOVES rates and selected the appropriate rates for each county and month. Movesmrg then multiplies the emission rates by county VMT or vehicle population, applies speciation profiles to develop inventories for pollutants not included in MOVES and temporally and spatially allocates emissions to individual grid cells for CMAQ input.

2.2.1 MOVES

For MATS, EPA used a version of the MOVES 2010a model that was enhanced for the proposed Tier 3 rule. This model included updated information on how fuel parameters impact vehicle emissions and updates on our understanding of evaporative emissions. It also included some minor updates to emission rates and some changes designed to make the model run more efficiently. All updates are described in detail in a memorandum to the docket (U.S. EPA 2012, Memorandum to Docket: Updates to MOVES for the Tier 3 NPRM). The following sections describe inputs to the MOVES model that were specific to this analysis.

The gridded meteorological input data for the entire year of 2005 were derived from simulations of the Pennsylvania State University / National Center for Atmospheric Research Mesoscale Model (MM5), a limited-area, nonhydrostatic, terrain-following system that solves for the full set of physical and thermodynamic equations which govern atmospheric motions. The Meteorology-Chemistry Interface Processor (MCIP) version 3.4 was used as the software for maintaining dynamic consistency between the meteorological model and chemistry mechanisms. The hourly gridded meteorological data was post-processed by met4moves to create maximum temperature ranges, average relative humidity, and a series of diurnal temperature profiles. MOVES was run for each temperature bin and diurnal profile. See Sections 2.2.4.1 and 2.2.4.3 for details.

Vehicle population data is a required input for MOVES when modeling on a county basis. Using the technical guidance provided to states by EPA, the contractor generated appropriate estimates for vehicle populations for use in the MOVES databases using the county specific VMT and national average ratios of vehicle populations versus vehicle VMT from the MOVES application. This method is described in Section 3.3 of the document, "Technical Guidance on the Use of MOVES2010 for Emission Inventory Preparation in State Implementation Plans and Transportation Conformity" (EPA-420-B-10-023, April 2010).

The county inputs used for the rule were derived from the inputs used for the 2005 National Emissions Inventory (NEI). This inventory covers the 50 United States (U.S.), Washington DC, Puerto Rico and U.S. Virgin Islands. The NEI was created by the EPA's Emission Inventory and Analysis Group (EIAG) in Research Triangle Park, North Carolina, in cooperation with the Office of Transportation and Air Quality (OTAQ) in Ann Arbor, Michigan.

OTAQ has developed a consolidated modeling system known as the National Mobile Inventory Model (NMIM) for calculation of emissions from onroad highway mobile source and nonroad mobile sources. NMIM documentation. NMIM includes a county-level database with the important input parameters specific to each county. The data in the NMIM county database (NCD) are used to develop MOBILE6.2 and NONROAD model input files within NMIM. The basis for the 2005 default vehicle miles traveled (VMT) is data supplied by the Federal Highway Administration (FHWA), as well as publicly available data from FHWA's Highway Statistics series. Details of how the NCD was developed are documented for the NEI "Documentation for the 2005 Mobile National Emissions Inventory, Version 2 (December 2008)". For the onroad portion of the inventory estimates for the rule, including all base and control scenarios, the current EPA highway mobile source emission model (MOVES) was used. This required conversion of the NCD database parameters to a format consistent with MOVES. A contractor was given the assignment (TranSystems, Contract No. EP-D-06-001, WA 4-65) to convert the NCD database to MOVES formatted input databases. This was accomplished with the assistance of converters designed for this purpose.

All of the county specific onroad data available in the NCD was converted to MOVES format for use at the county scale consistent with the databases created using the MOVES County Data Manager (CDM), except for the information regarding fuel properties. The fuel properties were updated using more recent information and methods specifically for this rule and described elsewhere in this document. Any table entries in the NCD that contained national average default information from the MOBILE6 model were replaced with the more recent national average default information used by MOVES.

2.2.2 Representing counties

Although EPA compiles county specific databases for all counties in the nation, many of the states can provide little or no county specific information for most counties. Rather than explicitly model every county in the nation (there are over 3,000 counties), we have performed detailed modeling for some counties and less detailed estimates for the other counties. This has been accomplished in this rule using a concept called "representing counties".

In this approach, we group counties that have similar properties and therefore would have similar emission rates. Then, we explicitly model only one county in the group (the "representing" county) to determine the rates. These representative rates are then used, in combination with county specific activity and meteorology data to generate emissions estimates for all of the counties in the group. This approach dramatically reduces the number of modeling runs required to generate inventories and still takes into account differences between counties.

As described in Section 2.2.4, in order to generate onroad mobile emissions, MOVES was run in conjunction with the EPA SMOKE model to generate "grid" level inventories for use in air quality modeling. SMOKE uses emission rates (not inventories) to generate inventory estimates within each grid. Since SMOKE handles the differences in the fleet mix, temperatures, speeds and VMT versus location and time, MOVES can be run in the "emission rate" mode. As a result, when counties are grouped, they can be grouped independently of fleet mix, speeds and temperature. This greatly increases the number of counties that can be in each grouping, since temperature is a factor that varies among the counties[1]. For this analysis, we grouped counties with similar fuel, emission standards, altitude, and inspection and maintenance (I/M) programs.

The information used to group the counties was derived from the NMIM inputs used for the 2005 NEI onroad and nonroad mobile sectors. For the onroad portion of the inventory estimates for the rule, including all base and control scenarios, the current EPA highway mobile source emission model (MOVES) was used. This required conversion of the NCD database parameters to a format consistent with MOVES.

The NCD also does not contain county specific information regarding vehicle populations and there are no default values. Vehicle population data is a required input for MOVES when modeling on a county basis. Using the technical guidance provided to states by EPA, the contractor generated appropriate estimates for vehicle populations for use in the MOVES databases using the county specific VMT and national average ratios of vehicle populations versus vehicle VMT from the MOVES application. This method is described in Section 3.3 of the document, "Technical Guidance on the Use of MOVES2010 for Emission Inventory Preparation in State Implementation Plans and Transportation Conformity" (EPA-420-B-10-023, April 2010).

The grouping of counties uses a tree algorithm, which is conceptually simple. In the tree algorithm, all counties are assigned to various categories. Then by grouping counties within the same categories, you get groups of counties that have the similar parameters. Counties were sorted into their Petroleum Administration for Defense Districts (PADDs). PADD 1 is divided into three sub-PADD groupings and each sub-group is treated as a separate PADD (1a, 1b and 1c). Each state belongs to a PADD and all counties in any state are within the same PADD. Table 2-4 below shows the PADDs and the states within each PADD.

Table 2-4. Allocation of states to the Petroleum Administration for Defense Districts

PADD	State FIPS	State Name	Abbreviation
1a	09	CONNECTICUT	CT
1a	23	MAINE	ME
1a	25	MASSACHUSETTS	MA
1a	33	NEW HAMPSHIRE	NH
1a	44	RHODE ISLAND	RI
1a	50	VERMONT	VT
1b	10	DELAWARE	DE
1b	11	DISTRICT OF COLUMBIA	DC
1b	24	MARYLAND	MD
1b	34	NEW JERSEY	NJ
1b	36	NEW YORK	NY
1b	42	PENNSYLVANIA	PA
1c	12	FLORIDA	FL
1c	13	GEORGIA	GA
1c	37	NORTH CAROLINA	NC
1c	45	SOUTH CAROLINA	SC
1c	51	VIRGINIA	VA

[1] This differs from the calculation of nonroad inventories where temperature was considered in the choice of representing county.

PADD	State FIPS	State Name	Abbreviation
1c	54	WEST VIRGINIA	WV
1c	72	PUERTO RICO	PR
1c	78	VIRGIN ISLANDS	VI
2	17	ILLINOIS	IL
2	18	INDIANA	IN
2	19	IOWA	IA
2	20	KANSAS	KS
2	21	KENTUCKY	KY
2	26	MICHIGAN	MI
2	27	MINNESOTA	MN
2	29	MISSOURI	MO
2	31	NEBRASKA	NE
2	38	NORTH DAKOTA	ND
2	39	OHIO	OH
2	40	OKLAHOMA	OK
2	46	SOUTH DAKOTA	SD
2	47	TENNESSEE	TN
2	55	WISCONSIN	WI
3	01	ALABAMA	AL
3	05	ARKANSAS	AR
3	22	LOUISIANA	LA
3	28	MISSISSIPPI	MS
3	35	NEW MEXICO	NM
3	48	TEXAS	TX
4	08	COLORADO	CO
4	16	IDAHO	ID
4	30	MONTANA	MT
4	49	UTAH	UT
4	56	WYOMING	WY
5	02	ALASKA	AK
5	04	ARIZONA	AZ
5	06	CALIFORNIA	CA
5	15	HAWAII	HI
5	32	NEVADA	NV
5	41	OREGON	OR
5	53	WASHINGTON	WA

The counties in each PADD were sorted into fuel groups using the January fuel properties and the July fuel properties. The fuel supply and fuel formulation data were taken from the 2005 fuels developed for the rule. The fuel parameters used for grouping and the ranges of values used for the bins are described in Table 2-5.

Table 2-5. Gasoline parameter categories

Gasoline Parameter	Category ID	Minimum Value (>=)	Maximum Value (<)
Reid Vapor Pressure (psi)	1	0	7.3
	2	7.3	8.2
	3	8.2	9.2
	4	9.2	100

Gasoline Parameter	Category ID	Minimum Value (>=)	Maximum Value (<)
Sulfur (ppm)	1	0	50
	2	50	100
	3	100	110
	4	110	1000
Ethanol (volume percent)	1	0	3
	2	3	8
	3	8	100
Benzene (volume percent)	1	0	1
	2	1	1.5
	3	1.5	2
	4	2	10

Some states have adopted California highway vehicle emission standards or plan to adopt them. Since the emission rates in these states will be different than in neighboring states, they must be modeled separately. Also, because the implementation of California standards varies between these states, each state with California standards must be modeled independently from the other states with California standards as well. Each state with California standards will be treated separately when choosing representing counties. Table 2-6 shows the states with California emission standards.

Table 2-6. States adopting California emission standards

State ID	State Name	Abbreviation	CA Program Begins
06	California	CA	1994
25	Massachusetts	MA	1995
36	New York	NY	1996
50	Vermont	VT	2000
23	Maine	ME	2001
09	Connecticut	CT	2008
42	Pennsylvania	PA	2008
44	Rhode Island	RI	2008
41	Oregon	OR	2009
53	Washington	WA	2009
34	New Jersey	NJ	2009
24	Maryland	MD	2011
10	Delaware	DE	2014
35	New Mexico	NM	2016

The counties in each PADD-fuel group were sorted into groups with and without I/M vehicle inspection programs. I/M programs were determined using the 2005 calendar year entries in the IMCoverage table of the MOVES database. The I/M category is the state in which the county resides. All I/M programs within a state were considered as a single program, even though each county may be administered separately and have a different program design.

Altitude was also added as its own category. Altitude is a field in the County table of the MOVESDB20101006 database. Counties are either high (H) or low (L) altitude based on the criteria set forth by EPA certification procedures (4,000 feet above sea level). The result is a set of county groups with similar fuel, emission standards, altitude and I/M program. Then the county in with the highest VMT in each group is chosen as the representing county. The categories are summarized below in Table 2-7.

Table 2-7. Summary of county grouping characteristics for representative counties

County Grouping Characteristic	Description
PADD	Petroleum Administration for Defense Districts (PADDs). PADD 1 is divided into three sub-PADD groupings and each sub-group is treated as a separate PADD (1a, 1b and 1c). Each state belongs to a PADD and all counties in any state are within the same PADD.
Fuel Parameters	Average gasoline fuel properties for January and July 2005, including RVP, sulfur level, ethanol fraction and percent benzene.
Emission Standards.	Some states have adopted California highway vehicle emission standards or plan to adopt them. Since implementation of the standards varies, each state with California standards is treated separately.
Inspection/Maintenance Programs	Counties were grouped within a state according to whether or not they had an I/M program. All I/M programs within a state were considered as a single program, even though each county may be administered separately and have a different program design.
Altitude	Counties are either high or low altitude based on the criteria set forth by EPA certification procedures (4,000 feet above sea level).

Using these criteria, a set of 106 counties were selected to represent the nation. Of these, only 103 were needed to model the 48 states included in the air quality analysis inventory. If MOVES runs were performed for all U.S. counties and months, there would be 3141 counties (excluding AK and HI) times 12 months = 37,692 county-months. The MOVES runs for each representative county and fuel month were performed independently of one another on different computer processors each accessing a MySQL database specific to that run.

2.2.3 SMOKE-MOVES inputs

Both MOVES and SMOKE require meteorological data. The program met4moves takes gridded hourly meteorological data, the representative counties, and the representative fuel months and produces separate meteorological products for MOVES and SMOKE. Met4moves uses the representative counties and fuel months to determine the full range of meteorology in that county group. For each representative county and fuel month, it determines all the grid cells that fall within the corresponding counties in that county group for the number of months that correspond to the fuel month[2]. The temperature range is then determined by looking at the minimum and maximum temperature across all these grid cells for all hours in that time period. Relative humidity is calculated by taking an average over these same grid cells.

For rate-per-profile (RPP), SMOKE-MOVES uses the change in temperature over the day, the diurnal profile, instead of the temperature at the hour of processing. Met4moves create a series of diurnal profiles based on the extent of the temperature range and the size of the temperature bins. For MOVES, these diurnal profiles will span the full range of temperatures for that representative county and fuel month. For SMOKE processing of RPP, met4moves creates a minimum and maximum temperature range for each county in the

[2] Spatial surrogates are used in determining which grid cells to pull in calculating the various meteorological statistics. These spatial surrogates both map counties to grid cells. The spatial surrogates further limit the grid cells by determining whether some of the grid cells should not be included in the calculation of temperature range. For example, if some of the county has no roads or population, e.g. high mountains, then there is no reason to include it in the temperature range for onroad emissions.

domain. Note that these temperature ranges are county specific, not based on the representative county or county group. Met4moves can be run in daily or monthly mode for producing SMOKE input. In monthly mode, the temperature range is determined by looking at the range of temperatures over the whole month for that specific county. Therefore, there is one temperature range per county per month. While in daily mode, the temperature range is determined by evaluating the range of temperatures in that county for that day. The output for the daily mode is one temperature range per county per day. Typically, the SMOKE input produced in monthly mode will have larger temperature ranges for each county than when it is run in daily mode. For the MATS runs, met4moves was run in daily mode.

In addition to the lookup tables of emission rates produced by MOVES, SMOKE requires county VMT, population, and average speed by road type to calculate the necessary emissions for air quality modeling. VMT by county and Source Classification Code (SCC) was developed using MOVES2010a and the National County Database. The National County Database (NCD20101201) has our most recent estimates of 2005 VMT and our best estimates of allocation of VMT from national to the county level. Accordingly, for the 2005 base year, our estimates of VMT by county and SCC were taken directly from the NCD.

The average speeds provided to SMOKE for each county were derived from the default national average speed distributions found in the default MOVES2010a database AvgSpeedDistribution table. These average speeds are the average speeds developed for the previous EPA highway vehicle emission factor model, MOBILE6. The same speed data was used for the base and future year cases.

In MOVES, there is a distribution of average speeds for each hour of the day for each road type. The average speeds in these distributions were used to calculate an overall average speed for each hour of the day. These hourly average speeds were weighted together using the default national average hourly vehicle miles traveled (VMT) distribution found in the MOVES default database HourlyVMTFraction table, to calculate an average speed for each road type. This average speed by road type was provided to SMOKE for each county.

2.2.4 Generating emission factors for SMOKE

After representative counties and fuel months were chosen, the met4moves script was executed to produce the set of MOVES RunSpecs and meteorology tables that would ultimately generate a set of SMOKE lookup tables encompassing the full range of temperatures for all the counties and months in each group. OTAQ also provided VMT, population, and average speed tables for every county.

The onroad model-ready emissions were produced by running SMOKE-MOVES using 103 representative counties and two fuel months. SMOKE-MOVES is a series of scripts and programs that 1) produce meteorological data for MOVES (Met4Moves), 2) construct a set of MOVES RunSpecs that produce lookup tables by temperature and average speed (runspec_generator), 3) process the MOVES lookup tables into a SMOKE-ready format (moves2smkEF), and 4) runs SMOKE. The way that OTAQ used SMOKE-MOVES differs somewhat from the way that SMOKE-MOVES was initially designed to be run. The full sequence of events was the following:

1) OAQPS ran met4moves for a nation-wide 12 km grid. This generated the temperatures needed for the emission factor lookup tables and an average humidity for each county and month. The inputs to met4moves are the hourly gridded temperature and humidity generated by the meteorological model used for CMAQ along with the list of representative counties and fuel months. For each representative county and fuel-month, met4moves queries all the grid cells in all the represented county-months to find the full range of temperatures and profiles needed and averages the relative

humidity.

2) OTAQ ran the runSpec_generator Perl script, (runspec_generator_v0.3_04Nov2010.plx). The inputs to this process include the representative county list, fuel month list, temperature bin size (=10 degrees here), and the outputs from met4moves. The runspec_generator script produced MOVES run-specifications that control how the MOVES run is configured, along zonemonthhour tables in CSV format. Specifications were generated for the three types of MOVES processes: rate-per-distance (RPD), rate-per-profile (RPP), and rate-per-vehicle (RPV). Run specifications were generated as needed to simulate the range of conditions reflected in the meteorological inputs. For RPD and RPV, a series of run specifications were created for each representative county, one for each temperature bin covering the temperature ranges provided by the met4moves output. For RPP, a second series of run specifications were created for each representative county, one for each diurnal profile provided by the met4moves output. The input data specific to each county were loaded into databases called "scaleinputdatabases", and the zonemonthhour tables were also loaded into databases.

3) OTAQ ran a tool to read the county databases, the zonemonthhour databases, other user-supplied databases, and the run specifications. The tool implemented LEV programs into the specifications as appropriate and also modified the pollutant-process associations in the run specifications to meet the needs of MATS. The tool then packaged the information into a form that could be used by the compute server.

4) OTAQ issued the command to kick off the required MOVES runs for each county and fuel month on the compute server.

5) Once the MOVES runs were complete, OTAQ ran the moves2smkEF postprocessor to reformat the MySQL tables into the emission factor tables in CSV format that is readable by the SMOKE movesmrg program. The postprocessor also performed additional calculations to support SMOKE processing of CMAQ ready model emissions: speciating HONO from NO and NO_2, speciating the AE5 PM species (PEC, POC, PNO3, PSO4, PMFINE, and PMC for break and tire wear), and aggregating the detailed MOVES modes into 5 broader modes (exhaust, evaporative, permeation, break wear, and tire wear)[3]

6) OAQPS downloaded the emission factors from the server and executed SMOKE programs to produce gridded, hourly, speciated emissions for CMAQ. See the next section for details.

2.2.5 Running SMOKE for onroad mobile

Running SMOKE using emission factors (EF) from MOVES required the development of a new set of functionality. The central SMOKE program that performs this new analysis is movesmrg which takes activity data, meteorological data, and the EF to produce gridded emissions. SMOKE is run independently for each of the three processes: rate-per-distance (RPD), rate-per-vehicle (RPV) and rate-per-profile (RPP).

The emissions process RPD is for modeling the on-network emissions. This includes the following modes: vehicle exhaust, evaporation, permeation, break wear, and tire wear. For RPD, the activity data is monthly VMT, monthly speed (SPEED), and hourly speed profiles for weekday versus weekend (SPDPRO)[4]. The

[3] The moves2smk postprocessor also corrects the extended idle emissions for RPV by merging in data from a separate national extended idle run and replaces missing EF from RPD due to missing SCCroadtypes in some reference counties.

[4] If the SPDPRO is available, the hourly speed takes precedence over the average speed in the SPEED inventory. Due to an oversight, SPDPRO was not used in the base and future-years modeling. A later sensitivity was run including the SPDPRO input

SMOKE program temporal takes vehicle and roadtype specific temporal profiles and distributes the monthly VMT to day of the week and hour. Movesmrg reads the speed data for that county and SCC and the temperature from the gridded hourly data and uses these values to look-up the appropriate EF from the representative county's EF table. It then multiplies this EF by temporalized VMT to calculate the emissions for that grid cell and hour. This is repeated for each pollutant and SCC in that grid cell.

The emission process RPV is for modeling the off-network emissions. This includes the following modes: vehicle exhaust, evaporative, and permeation (????). For RPV, the activity data is vehicle population (VPOP). Movesmrg reads the temperature from the gridded hourly data and uses the temperature plus SCC and the hour of the day to look up the appropriate EF from the representative county's EF table. It then multiplies this EF by the VPOP for that SCC and FIPS to calculate the emissions for that grid cell and hour. This repeats for each pollutant and SCC in that grid cell.

The emission process RPP is for modeling the off-network emissions for parked vehicles. This includes the mode vehicle evaporative (fuel vapor venting). For RPP, the activity data is VPOP. Movesmrg reads the county based diurnal temperature range from met4moves output for SMOKE. It uses this temperature range to determine the most similar idealized diurnal profile from the EF table using the temperature min and max, SCC, and hour of the day. It then multiplies this EF by the VPOP for that SCC and FIPS to calculate the emissions for that grid cell and hour. This repeats for each pollutant and SCC within the county. For more details on processing RPD, RPV, and RPP in SMOKE.

MOVES was run for a series of representative counties and fuel months. For each representative county and fuel month, three EF tables were created: RPD, RPV, and RPP. SMOKE was run so that for each model day it would read in a single EF table (based on the appropriate fuel month), process all the counties that are part of the county group (i.e. are represented by that representative county), then read the next representative county EF table, etc. After all days in the model year were looped over, SMOKE has generated a separate set of daily intermediate files for each of the emissions processes (RPD, RPV, and RPP). Post-processing scripts were developed to integrate the process specific intermediate files into model-ready intermediate files for the onroad sector. These files were on national 12km domain, to support the CMAQ runs they were further processed to create an aggregated 36km sector specific model-ready file and 2 12km domains (12EUS1 and 12WUS1).

2.3 Nonroad mobile sources (nonroad, alm_no_c3, seca_c3)

The nonroad sectors include a wide-range of mobile emission sources ranging from locomotives, marine vessels, construction and farming equipment to hand-held lawn tools. As discussed in Section 5, nonroad upstream impacts also impact the post-EPAct/EISA/RFS2/reference case (anti-backsliding) reflecting increased ethanol production resulting in fuel volume increases for locomotives and C1/C2 CMV emissions.

2.3.1 Emissions generated with the NONROAD model (nonroad)

Most nonroad emissions are were estimated using the EPA's NONROAD model, as run by the EPA's NMIM. NONROAD is EPA's model for calculating emissions from nonroad equipment, except for aircraft, locomotives, and commercial marine vessels. The NONROAD Model and extensive documentation is available. NMIM is a program that references a national database of county-month data, writes county-month input files for NONROAD based on that data, runs NONROAD once for every county and month requested by the user, and collects the results in an output database. Rather than running every county, NMIM is designed to run NONROAD for "representative counties" and to use individual county activity to develop national inventories. Inputs for NMIM runs were stored in the NMIM County Database (NCD).

---

for the base year which found that the use of hourly speed slightly increased the emissions for most pollutants (e.g. nationally NO_x showed a 0.8% increase, VOC showed a 1% increase, and $PM_{2.5}$ showed a 3% increase).

The NCD version is NCD20101201Tier3. This NCD is based on NCD20101201, which is the version of the NCD that includes all updates from the 2008 National Emission Inventory process.

In particular, for this analysis, we made updates to the underlying fuel supply for the post EISA/EPAct reference case. The NCD20101201Tier3 contained special versions of countyyearmonth, gasoline, and diesel, which were copied into the standard versions of these tables in order to run the model. The fuels in NCD2010201Tier3 were developed from the fuels used for onroad vehicles, as described in Section 2.2.1.

Similarly, a special countymonthhour table that contained 2005 meteorology was copied into the standard countymonthhour table. The use of the countymonthhour table for meteorology was selected by the RunSpec setting useYearlyWeatherDataSelected="false." We also made a minor change for snowmobiles: the SCC toxics table in the NMIM County Database (NCD) was updated to correct 1,3-butadiene exhaust emissions for 2-stroke snowmobiles (SCC 2260001020), as shown in Table 2-8 below. This correction addressed an issue identified in air quality modeling for the RFS2 rule, where unexpected increases in ambient concentrations were observed in rural areas during winter due to snowmobile emissions. The increases were based on data from only three engines, which showed unusually high1,3-butadiene emissions with 10% ethanol (Eth oxygenate). Other data suggests that this increase is highly unlikely to be representative of the in-use fleet as a whole; thus results were corrected to those in the "NCD20101201Tier3" column. In Table 2-but, Base Gasoline represents cases where the fuel type is not Eth, MTBE or RFG. Eth gas is used where the fuel contains ethanol which is greater than or equal to 5% by volume or Ethyl Tertiary Butyl Ether (ETBE) is greater than or equal to 5% by volume. MTBE gas is used where the fuel contains MTBE which is greater than or equal to 12% by volume or Tertiary Amine Methyl Ether (TAME) is greater than or equal to 13% by volume. Finally, RFG gas is used where the fuel is RFG and where the fuel contains oxygenate greater than 5% by volume and where the fuel contains MTBE which is less than 12% by volume or TAME is less than 13% by volume.

Table 2-8. Updated 1,3-butadiene to VOC ratio for 2-stroke snowmobiles for NMIM's gasoline categories

Fuel Type	NCD20101201	NCD20101201Tier3
Base Gasoline	0.0012	0.0012
Ethyl Tertiary Butyl Ether (Eth) Gas	0.00732	0.0012
Methyl ertiary Butyl Ether (MTBE) Gas	0.0012	0.0012
Reformulated Gasoline (RFG) Gas	0.0012	0.0012

In addition, a special countymap table was developed to use representing counties in the NMIM runs. The algorithm for producing representing counties for NMIM was identical to that used for MOVES except that ten degree temperature bins were added to the criteria. The result was 293 representing counties. Finally, NMIM does not estimate ethanol emissions, so the inventory for this pollutant was from the chemical speciation that is obtained by post-processing using SMOKE

2.3.1.1 Representing counties for NONROAD

"Representing counties" is a way of saving NMIM run time by grouping together similar counties and generating emission factors by running the NONROAD Model for only one of those counties and then using those emission factors for all the counties in the group. For this analysis, 293 county groups were developed. The counties in each group were in the same state, had similar fuels in both summer and winter, and had similar I/M programs. Since there are winter fuels and summer fuels, January was chosen as the fuel-month to represent the seven months October through April, and July was chosen to represent the five months May-September. The total number of county-months for which NMIM runs needed to be performed was thus 293 times 12 months = 3,516 county-months for each scenario-year. If NMIM runs were performed for all U.S. counties and months, there would be 3141 counties (excluding AK and HI) times 12 months = 37,692 county-months. Representing counties were chosen for NONROAD-Model NMIM runs by grouping counties based on the characteristics listed in Table 2-9.

Table 2-9. Criteria for grouping representative counties for nonroad mobile analysis

Characteristic	**Grouping Criteria**
Petroleum Administration for Defense District (PADD)	All counties in a group must be in the same PADD.
Gasoline parameters	Fuel bins were created for RVP, sulfur, benzene, and ethanol. All counties in each group had all of these fuel properties in the same bins for all twelve months.
Inspection/Maintenance Programs	Counties with I/M programs were grouped with other counties with I/M programs in the same state.
Altitude	All counties in the group must be in the same altitude category (high or low).
Temperatures	All counties in the group must have similar temperatures, as detailed below.

Nonroad inventories are not calculated on a grid basis, as the highway mobile sources were, so when running NMIM for nonroad emissions, the representing counties must also account for temperatures. The temperatures are taken from the 2005 calendar year values in the CountyYearMonthHour table of the NCD20100602 NMIM database. As shown in Table 2-10, ten degree Fahrenheit (F) bins were created for min and max temperatures for each month. All counties in each group had all min and max temperatures for all twelve months in the same bins. The lowest interval includes all temperatures below -10 degrees F. The highest interval includes all temperatures above 100 degrees F.

Table 2-10. NONROAD model temperature (F) categories

Temperature Bin	Minimum Temperature (>=)	Maximum Temperature (<)
1	-20	-10
2	-10	0
3	0	10
4	10	20
5	20	30
6	30	40
7	40	50
8	50	60
9	60	70
10	70	80
11	80	90
12	90	100
13	100	200

Once counties were grouped, the representing county was chosen as the one with the highest VMT. The same set of 293 county groups and representing counties was used for all years and scenarios.

2.3.1.2 Fuel inputs for NONROAD runs

For the nonroad mobile portion of the inventory estimate for the rule, the NMIM county database (NCD) developed for the 2005 NEI, with one exception of the county-specific fuel properties, was used to calculate nonroad emissions. Fuels were developed for MOVES (onroad mobile) for the MATS Rule (see Section 2.2) and were converted to NMIM fuels. Practically, this means converting the fuelsupply and fuelformulation tables from MOVES into the countyyearmonth, gasoline, and diesel tables in the NCD. In 2005, onroad and nonroad gasoline formulations are assumed to be identical.

While MOVES allows for multiple gasoline fuels, each with a market share, for a single county-month. The market shares always sum to one. The NCD allows only one fuel per county month, but, for each of the four oxygenates (ETOH, MTBE, TAME, and ETBE), the NCD has columns for both volume percent and market share. The sum of these market shares is less than or equal to one. If less than one, the remainder of the market is non-oxygenated (conventional) gasoline. When there are multiple MOVES gasoline fuels for a single county-month, non-oxygenate MOVES fuel properties are multiplied by market share and summed to produce the fuel property in the gasoline table. Individual non-ethanol oxygenates and California ethanol occur in only one fuel per county-month in MOVES, so the volume and market share are transferred to the appropriate columns for that oxygenate in NMIM. In states other than California, for multiple ethanol volumes with volume percents less than 10, the product of market share and volume percent is averaged and then divided by 10, resulting in a market share of E10.

2.3.1.3 NMIM runs

Table 2-11 shows the NMIM runs that were performed to generate the NONROAD Model county-month results for both national inventories and air quality modeling inventories.

Table 2-11. NONROAD NMIM runs

Case	Year	Run Name
Base	2005	Tier3Base2005Nr
Reference	2017	Tier3Ref2017e10Nr

MOVES fuels were used for future year cases and converted to NMIM format. However, for 2017, EPA assumed that nonroad equipment would use only E10. The details of the fuel's conversion from MOVES to NMIM was discussed above. Table 2-12 describes the components in the NONROAD/NMIM system common to all MATS modeling scenarios.

Table 2-12. Summary of NONROAD modeling components

Model	Version	Description
NONROAD	NR08b	This is identical to the official NONROAD2008, except it was modified to allow modeling of emissions on E15 fuels. The existing fuel effects algorithm was retained.
NMIM Code	NMIM20090504b	This is the same as the official NMIM2008a software, except the NONROAD model was updated to NRO8b.
NMIM Database	NCD20101201Tier3	This is based on NCD20101201, which was developed for the 2008 NEI. It was adapted to model the desired scenarios.
Meteorology	NCD20101201Tier3	Historical data for calendar year 2005 from the National Climatic Data Center. County temperatures were determined by weighting nearby temperature stations by their distance from the population-based centroid of each county.

2.3.2 Locomotives and commercial marine vessels (alm_no_c3, seca_c3)

The year 2005 emissions from these sources used for this rule are the same as they were for the Final Rulemaking: Greenhouse Gas Emissions Standards and Fuel Efficiency Standards for Medium- and Heavy-Duty Engines and Vehicles signed on August 9, 2011, and the Final Cross-State Air Pollution (CSAPR) Rule. The procedures for calculating emissions from locomotives and C1/C2 commercial marine were developed for the Locomotive Marine Rule (2008) and are detailed in the RIA "Final Rule: Control of Emissions of Air Pollution from Locomotives and Marine Compression-Ignition Engines Less Than 30 Liters per Cylinder", published May 6, 2008 and republished June 30, 2008. The procedures used for calculating C3 commercial marine emissions are those developed in the recent C3 "Final Rule: Control of Emissions from New Marine Compression-Ignition Engines at or Above 30 Liters per Cylinder", published April 30, 2010.

2.4 2005 point sources (ptipm and ptnonipm sectors)

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 but are unchanged for MATS modeling. Discussion of the seca_c3 and othpt sector emissions can be found in the Final CSAPR TSD referenced in Section 2.3.2.

After removing offshore oil platforms (othpt sector), 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).

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

2.4.1 Ethanol plants (ptnonipm)

We replaced all ethanol plants that OTAQ had supplied from the RFS2 rule –see Section 2.1.2 in the CSAPR Final TSD- with those recently compiled for the 2005 case for MATS. These plants represent a "Low Ethanol" scenario needed to produce only 4 billion gallons of ethanol, essentially a scenario without a future year RFS2 mandate (or MATS). All ethanol plants were assigned or corrected (after quality assurance analyses) coordinates based on analysis using searches of company web sites and Google Earth verification for many sites. Emissions were calculated based on plant design capacity and emission factors based on fuel type (e.g., coal, natural gas). Finally, because benzene, acetaldehyde and formaldehyde (BAF) emissions were directly computed for these sources, unlike the rest of the ptnonipm sector, we treated these ethanol plants as VOC integrate sources. A summary of the ethanol plant emissions used in the 2005 scenario is provided in Table 2-13.

Table 2-13. 2005 ethanol plant emissions

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

2.5 2005 nonpoint sources (afdust, ag, avefire, nonpt)

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

2.5.1 Portable fuel containers

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

Ethanol_2005 = Ethanol_2017reference * (VOC_2005 / VOC_2017reference)

2.5.2 Onroad refueling

As mentioned in Section 2.2, NEI-based onroad refueling emissions were replaced with estimates from the revised version of EPA's Motor Vehicle Emissions Simulator (MOVES2010a) at the county level for all twelve months. This section describes how the emission inventories for refueling from on-road vehicles in calendar years 2005 and 2017 for MATS reference and control cases were generated for air quality modeling. The refueling inventory includes emissions from spillage loss and displacement vapor loss. For this analysis, the refueling emissions were estimated using the revised version of EPA's Motor Vehicle Emissions Simulator (MOVES2010a) at the county level for all twelve months.

In an effort to reduce MOVES runtime, the "representing counties" approach was used instead of running every single county in the lower 48 states. As described in Section 2.2 for onroad counties, we selected representing counties by grouping counties based on Petroleum Administration for Defense Districts (PADD), fuel parameters, usage of California emission standards, Inspection/Maintenance programs, and altitude. One additional parameter included in developing the representing counties for refueling was temperature.

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

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

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

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

2.6 Other sources (biogenics, othpt, othar, and othon)

All emissions from Canada, Mexico, and Offshore Drilling platforms (othpt, othar, and othon), and all non-anthropogenic inventories (biogenics and ocean chlorine) are unchanged from the 2005v4.2 (used for the Final CSAPR and HDGHG FRM) emissions modeling platform. The same emissions are used for all MATS scenarios and years.

2.7 Emissions summaries for 2005 base case

Once developed, the emissions inventories were processed to provide the hourly, gridded emissions for the model-species needed by CMAQ. Table 2-14 provides summaries of the 2005 U.S. emissions inventories modeled for this rule by sector. Table 2-15 and Table 2-16 provide state-level summaries of SO_2, and $PM_{2.5}$ by sector. Note that the nonroad columns include emissions from traditional nonroad sources that are found "on-land", along with commercial marine sources. The nonpoint columns include area fugitive dust, agriculture, and other nonpoint emissions.

Table 2-14. 2005 U.S. emissions (tons/year) by sector

Emissions Sector	NO_X	SO_2	$PM_{2.5}$	PM_{10}	NH_3	CO	VOC
Agriculture					3,251,990		
Area fugitive Dust			1,030,391	8,858,992			
Average fires	189,428	49,094	684,035	796,229	36,777	8,554,551	1,958,992
Commercial marine Category 3 (US)	130,164	97,485	10,673	11,628		11,862	4,570
EGU	3,729,161	10,380,883	496,877	602,236	21,995	603,788	41,089
Locomotive/ marine	1,922,723	153,068	56,666	59,342	773	270,007	67,690
Non-EGU Point	2,213,471	2,030,759	433,346	647,873	158,342	3,201,418	1,279,308
Nonpoint	1,696,902	1,216,362	1,079,906	1,349,639	133,962	7,410,946	7,560,061
Nonroad	2,031,527	196,277	201,406	210,767	1,971	20,742,873	2,806,422
Onroad	8,235,002	168,480	301,073	369,911	144,409	41,117,658	3,267,931
US TOTAL	**20,148,378**	**14,292,410**	**4,294,373**	**12,906,616**	**3,750,218**	**81,913,104**	**16,986,064**

Table 2-15. 2005 base year SO_2 emissions (tons/year) for states by sector

State	EGU	NonEGU	Nonpoint	Nonroad	Onroad	Fires	Total
Alabama	460,123	66,373	52,325	5,622	3,554	983	588,980
Arizona	52,733	23,966	2,571	6,151	3,622	2,888	91,931
Arkansas	66,384	13,039	27,260	5,678	1,918	728	115,008
California	601	33,097	77,672	40,222	4,526	6,735	162,852
Colorado	64,174	1,550	6,810	4,897	2,948	1,719	82,098
Connecticut	10,356	1,831	18,455	2,557	1,337	4	34,540
Delaware	32,378	34,859	1,030	2,657	486	6	71,416
District of Columbia	1,082	686	1,559	414	205	0	3,947
Florida	417,321	57,429	70,490	31,190	12,388	7,018	595,836
Georgia	616,063	52,827	56,829	9,224	6,939	2,010	743,893
Idaho	0	17,151	2,915	2,304	902	3,845	27,117
Illinois	330,382	131,357	5,395	19,305	6,881	20	493,339
Indiana	878,979	86,337	59,775	9,437	4,641	24	1,039,194
Iowa	130,264	41,010	19,832	8,838	2,036	25	202,004
Kansas	136,520	12,926	36,381	8,035	1,978	103	195,943
Kentucky	502,731	25,808	34,229	6,943	3,240	364	573,315
Louisiana	109,875	165,705	2,378	25,451	2,902	892	307,202
Maine	3,887	18,512	9,969	1,625	963	150	35,106
Maryland	283,205	34,988	40,864	9,353	3,016	32	371,458
Massachusetts	84,234	19,620	25,261	6,524	2,669	93	138,402
Michigan	349,877	76,510	42,066	14,626	8,253	91	491,423
Minnesota	101,678	24,603	14,747	10,409	2,934	631	155,002
Mississippi	75,047	29,892	6,796	5,930	2,590	1,051	121,306
Missouri	284,384	78,308	44,573	10,464	4,901	186	422,816
Montana	19,715	11,056	2,600	3,813	874	1,422	39,480

State	EGU	NonEGU	Nonpoint	Nonroad	Onroad	Fires	Total
Nebraska	74,955	7,910	7,659	9,199	1,510	105	101,337
Nevada	53,363	2,253	12,477	2,880	656	1,346	72,975
New Hampshire	51,445	3,155	7,408	789	746	38	63,580
New Jersey	57,044	7,639	10,726	13,321	3,038	61	91,830
New Mexico	30,628	7,831	3,193	3,541	1,801	3,450	50,445
New York	180,847	58,426	125,158	15,666	6,258	113	386,468
North Carolina	512,231	59,433	22,020	8,766	6,287	696	609,433
North Dakota	137,371	9,582	6,455	5,986	533	66	159,994
Ohio	1,116,095	115,155	19,810	15,425	7,336	22	1,273,843
Oklahoma	110,081	40,482	8,556	5,015	3,039	469	167,642
Oregon	12,304	9,825	9,845	5,697	1,790	4,896	44,357
Pennsylvania	1,002,203	83,375	68,349	11,999	6,266	32	1,172,224
Rhode Island	176	2,743	3,365	816	254	1	7,354
South Carolina	218,781	31,495	13,489	7,719	3,589	646	275,719
South Dakota	12,215	1,702	10,347	3,412	623	498	28,797
Tennessee	266,148	65,693	32,714	6,288	5,538	277	376,659
Texas	534,949	223,625	115,192	34,944	16,592	1,178	926,480
Tribal	3	1,511	0	0	0	0	1,515
Utah	34,813	9,132	3,577	2,439	1,890	1,934	53,784
Vermont	9	902	5,385	385	342	49	7,073
Virginia	220,287	69,401	32,923	10,095	4,600	399	337,705
Washington	3,409	24,211	7,254	18,810	3,343	407	57,433
West Virginia	469,456	46,710	14,589	2,133	1,378	215	534,481
Wisconsin	180,200	66,807	6,369	7,163	3,647	70	264,256
Wyoming	89,874	22,321	6,721	2,674	721	1,106	123,417
Total	10,380,883	2,030,759	1,216,362	446,831	168,480	49,094	14,292,410

Table 2-16. 2005 base year $PM_{2.5}$ emissions (tons/year) for states by sector

State	EGU	NonEGU	Nonpoint	Nonroad	Onroad	Fires	Total
Alabama	23,366	19,498	35,555	4,142	5,775	13,938	102,273
Arizona	7,418	3,940	21,402	4,486	6,920	37,151	81,316
Arkansas	1,688	10,820	34,744	3,803	3,102	10,315	64,472
California	347	21,517	94,200	22,815	26,501	97,302	262,682
Colorado	4,342	7,116	25,340	3,960	4,377	24,054	69,189
Connecticut	562	224	11,460	1,740	2,544	56	16,586
Delaware	2,169	1,810	1,590	818	922	87	7,397
District of Columbia	17	172	589	277	367	0	1,421
Florida	24,217	25,193	52,955	15,035	16,241	99,484	233,125
Georgia	28,057	12,666	63,133	6,504	12,449	24,082	146,892
Idaho	0	2,072	41,492	2,140	1,402	52,808	99,914
Illinois	16,585	15,155	74,045	12,880	12,574	277	131,516
Indiana	34,439	14,124	74,443	6,515	7,585	344	137,450
Iowa	8,898	6,439	54,312	6,969	3,468	349	80,436
Kansas	5,549	7,387	138,437	5,719	3,109	1,468	161,669
Kentucky	19,830	10,453	31,245	4,762	5,566	5,155	77,010
Louisiana	5,599	32,201	28,164	9,440	4,288	12,647	92,339
Maine	52	3,783	15,037	1,363	1,759	2,127	24,120
Maryland	15,417	6,768	23,323	3,410	5,504	531	54,952
Massachusetts	3,110	2,245	31,116	3,293	5,913	1,324	47,001
Michigan	11,022	12,926	47,722	8,561	13,006	1,283	94,520

State	EGU	NonEGU	Nonpoint	Nonroad	Onroad	Fires	Total
Minnesota	3,262	10,538	73,990	8,541	6,842	8,943	112,116
Mississippi	2,029	10,602	34,217	4,133	4,195	14,897	70,074
Missouri	6,471	6,966	76,419	7,230	7,665	2,636	107,388
Montana	2,398	2,729	30,096	2,654	1,347	17,311	56,536
Nebraska	1,246	2,340	45,661	5,848	2,620	1,483	59,198
Nevada	3,341	4,095	9,920	2,212	1,290	19,018	39,876
New Hampshire	2,586	568	13,316	907	1,512	534	19,423
New Jersey	4,625	2,588	13,623	5,042	5,963	865	32,707
New Mexico	5,583	1,460	50,698	1,959	2,861	48,662	111,224
New York	9,648	4,994	48,540	8,607	11,139	1,601	84,529
North Carolina	16,967	12,665	49,551	6,272	8,939	9,870	104,264
North Dakota	6,397	598	41,504	4,552	976	934	54,962
Ohio	53,572	12,847	52,348	9,847	11,785	316	140,715
Oklahoma	1,411	6,246	90,047	3,765	4,559	6,644	112,672
Oregon	412	8,852	58,145	3,741	3,375	65,350	139,874
Pennsylvania	55,547	16,263	44,607	7,565	11,058	454	135,494
Rhode Island	10	256	1,289	394	577	14	2,540
South Carolina	14,455	4,779	26,598	3,491	5,061	9,163	63,548
South Dakota	390	2,982	33,678	2,910	1,056	7,062	48,079
Tennessee	12,856	21,912	32,563	5,072	8,514	3,934	84,851
Texas	21,464	37,563	194,036	21,361	29,859	21,578	325,861
Tribal	0	1,569	0	0	0	0	1,569
Utah	5,055	3,595	14,761	1,627	2,703	27,412	55,153
Vermont	37	337	6,943	479	605	696	9,098
Virginia	12,357	11,455	38,140	5,968	6,661	5,659	80,241
Washington	2,396	4,618	45,599	6,697	6,721	4,487	70,519
West Virginia	26,377	5,154	14,778	1,702	1,930	3,050	52,991
Wisconsin	5,233	7,967	37,277	6,083	6,783	994	64,337
Wyoming	8,068	10,298	31,645	1,455	1,103	15,686	68,254
Total	496,877	433,346	2,110,298	268,745	301,073	684,035	4,294,373

3 VOC Speciation Changes that Represent Fuel Changes

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

A major change between the 2005v4.2 platform and the MATS base and future modeling is the integration of ethanol for key sectors and specific inventories. In the previous platform, the inventories for specific sources had benzene, acetaldehyde, formaldehyde and/or methanol (BAFM). These emissions would be integrated, namely their emissions would come from the inventory not from speciating VOC. To prevent double counting, BAFM would be removed from VOC, leaving the remainder (NONHAPVOC) to be speciated to other components (i.e. non-BAFM species). See section 3.1.2.1 of the 2005v4 platform for more details. In the MATS modeling, if ethanol was present in the inventories, it would also be integrated. To differentiate when a source was integrating BAFM versus EBAFM (ethanol in addition to BAFM), the speciation profiles is referred to as an "E-profile", for example pre-Tier 2 vehicles E10 gasoline exhaust speciation profile 8751 versus 8751E. For the onroad sector, ethanol is integrated for all emissions from gasoline vehicles. For the nonpt sector, ethanol is integrated for refueling and portable fuel containers (PFCs). In the future-year case, the nonpt sector includes a cellulosic corn ethanol and biodiesel inventory (SCC 30125010) in which ethanol is integrated. For fuel distribution operations associated with the bulk-plant-to-pump (btp) distribution, ethanol is speciated from VOC because the nonpoint inventories do not include ethanol specifically.

The onroad sector has some additional changes to VOC speciation. Instead of speciating VOC, SMOKE-MOVES uses TOG instead of VOC. Therefore, SMOKE does not need to convert VOC to TOG before creating NONHAPTOG and performing additional speciation. A second change in VOC speciation is the differentiation of a new mode. In previous platforms, onroad mobile emissions were divided into exhaust and evaporative modes. For the MATS base and future years, gasoline vehicle's evaporative mode is further divided into permeation specific emissions and evaporative. Similar to evaporative and exhaust profiles, these profiles change between the base and future year cases. Additional updates include headspace vapor speciation utilizes a combination of the E10 headspace vapor profile and E0 headspace vapor profile as opposed to using solely E0 for 2005[5], and a new Heavy Duty Diesel vehicle exhaust mode profile for pre-2007 model year (MY) vehicles that replaces an older 2004-vintage medium-duty diesel profile. See Table 3-1 for more details.

The VOC speciation approach is customized to account for the impact of fuel changes in the future year case. These changes affect the onroad sector, the nonroad sector, and parts of the nonpt and ptnonipm sectors. These fuel changes and vehicle changes are implemented by using different VOC profiles and combination of profiles between the base and future cases. The speciation changes from fuels in the nonpt sector are for refueling, portable fuel containers (PFCs), and fuel distribution operations associated with the bulk-plant-to-pump (btp) distribution. The speciation changes from fuels in the ptnonipm sector include btp distribution operations inventoried as point sources[6]. Refinery to bulk terminal (rbt) fuel distribution speciation does not change across the modeling cases because this is considered upstream from the introduction of ethanol into the fuel[7]. Mapping of fuel distribution SCCs to btp and rbt emissions categories can be found in Appendix A of the revised annual Renewable Fuel Standard (RFS2) Emissions Inventory for Air Quality Modeling Technical Support Document (EPA Report No. 420-R-10-005, January 2010.

Table 3-1 summarizes the different profiles utilized for the fuel-related sources in each of the sectors for 2005 and the future year cases. A comparison of the 2005v4.2 platform with the MATS 2005 case is also included. Appendix A lists ancillary input data set names used for MATS emissions.

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

[6] VOC speciation is customized by using different speciation profiles in the base versus future year cases. For some sources related to the mobile sector and fuel distribution, a combination of profiles are specified by county, month and mode (e.g. exhaust, evaporative, permeation). SMOKE calculates a resultant profile by calculating the fraction of each profile by month, county, and mode. The GSPRO_COMBO ancillary file controls this feature in SMOKE. The GSPRO_COMBO file represents the county specific mixture of fuels, for example the mixture of E10 and E0. For the nonpt sector, a further complication in developing the GSPRO_COMBO is differentiating the sources that integrate ethanol (i.e. use E-profiles) and those that do not integrate ethanol. By using the mode for refueling (RFL__VOC) and PFC (EVP__VOC), these ethanol integrated sectors can be differentiated from btp (VOC).

[7] We also identified bulk plant storage (bps) as an upstream source that is pre-addition of ethanol and uses the same speciation profile as rbt.

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

Category	2005v4.2		2005 MATS		2017 MATS reference	
Onroad Gasoline						
Exhaust	COMBO		COMBO		COMBO	
	8750	Pre-Tier 2 E0 exhaust	8750E	Pre-Tier 2 E0 exhaust	8751E	Pre-Tier 2 E10 exhaust
	8751	Pre-Tier 2 E10 exhaust	8751E	Pre-Tier 2 E10 exhaust	8757E	Tier 2 E10 Exhaust
					8758E	Tier 2 E15 Exhaust
Evaporative	COMBO		COMBO (All evap except permeation)		COMBO (All evap except permeation)	
	8753	E0 Evap	8753E	E0 Evap	8754E	E10 Evap
	8754	E10 Evap	8754E	E10 Evap	8872E	E15 Evap
			COMBO (Permeation evap)		COMBO (Permeation evap)	
			8766E	E0 evap perm	8769E	E10 evap perm
			8769E	E10 evap perm	8770E	E15 evap perm
Refueling	8762	E0 Headspace composite	COMBO		COMBO	
			8869E	E0 Headspace	8870E	E10 Headspace
			8870E	E10 Headspace	8871E	E15 Headspace
Onroad Diesel						
Exhaust	4674	2004 MDD exhaust	8774	Pre-2007 MY HDD exhaust	877T3	Pre & Post 2007 MY HDD exhaust
					Weighted 8774 and 8775 profiles	
Evaporative	4547	Diesel Headspace	4547	Diesel Headspace	4547	Diesel Headspace
Refuel	4547	Diesel Headspace	4547	Diesel Headspace	4547	Diesel Headspace
Nonroad Gasoline						
Exhaust	COMBO		COMBO		8751	Pre-Tier 2 E10 exhaust
	8750	Pre-Tier 2 E0 exhaust	8750	Pre-Tier 2 E0 exhaust		
	8751	Pre-Tier 2 E10 exhaust	8751	Pre-Tier 2 E10 exhaust		
Evaporative	COMBO		COMBO		8754	E10 Evap
	8753	E0 evap	8753	E0 evap		
	8754	E10 evap	8754	E10 evap		
Refueling	8762	E0 Headspace composite	COMBO		8870	E10 Headspace
			8869	E0 Headspace		
			8870	E10 Headspace		

<table>
<tr><th>Category</th><th colspan="2">2005v4.2</th><th colspan="2">2005 MATS</th><th colspan="2">2017 MATS reference</th></tr>
<tr><td>Nonroad Diesel</td><td colspan="6"></td></tr>
<tr><td>Exhaust</td><td>4674</td><td>2004 MDD exhaust</td><td>8774</td><td>Pre-2007 MY HDD exhaust</td><td>8774</td><td>Pre-2007 MY HDD exhaust</td></tr>
<tr><td>Evaporative</td><td>4547</td><td>Diesel Headspace</td><td>4547</td><td>Diesel Headspace</td><td>4547</td><td>Diesel Headspace</td></tr>
<tr><td>Refueling</td><td>4547</td><td>Diesel Headspace</td><td>4547</td><td>Diesel Headspace</td><td>4547</td><td>Diesel Headspace</td></tr>
<tr><td rowspan="3">PFC</td><td rowspan="3">8762</td><td rowspan="3">E0 Headspace composite</td><td colspan="2">COMBO</td><td rowspan="3">8870E</td><td rowspan="3">E10 Headspace</td></tr>
<tr><td>8869E</td><td>E0 Headspace</td></tr>
<tr><td>8870E</td><td>E10 Headspace</td></tr>
<tr><td rowspan="2">Aircraft</td><td rowspan="2">5565</td><td rowspan="2">Aircraft Exhaust</td><td>5565*</td><td>Aircraft Exhaust</td><td>5565*</td><td>Aircraft Exhaust</td></tr>
<tr><td colspan="2">* Updated version in SPECIATE 4.3</td><td colspan="2">* Updated version in SPECIATE 4.3</td></tr>
<tr><td>Locomotives</td><td>4674</td><td>2004 MDD exhaust</td><td>8774</td><td>Pre-2007 MY HDD exhaust</td><td>8774</td><td>Pre-2007 MY HDD exhaust</td></tr>
<tr><td>Marine</td><td>2480</td><td>Ship Channel Downwind</td><td>2480</td><td>Ship Channel Downwind</td><td>2480</td><td>Ship Channel Downwind</td></tr>
<tr><td rowspan="3">BTP</td><td rowspan="3">8762</td><td rowspan="3">E0 Headspace composite</td><td colspan="2">COMBO</td><td colspan="2">COMBO</td></tr>
<tr><td>8869</td><td>E0 Headspace</td><td>8870</td><td>E10 Headspace</td></tr>
<tr><td>8870</td><td>E10 Headspace</td><td>8871</td><td>E15 Headspace</td></tr>
<tr><td>RBT/BPS</td><td>8762</td><td>E0 Headspace composite</td><td>8869</td><td>E0 Headspace</td><td>8869</td><td>E0 Headspace</td></tr>
<tr><td rowspan="4">Ethanol Plants</td><td rowspan="4">1188</td><td rowspan="4">fermentation process</td><td rowspan="4">8776</td><td rowspan="4">Ethanol Fuel Prod</td><td>8776</td><td>Ethanol Fuel Prod[a]</td></tr>
<tr><td>8776E</td><td>Ethanol Fuel Prod[b]</td></tr>
<tr><td colspan="2">[a] corn ethanol and biodiesel ptnonipm</td></tr>
<tr><td colspan="2">[b] cellulosic ethanol & cellulosic diesel nonpt</td></tr>
</table>

4 2017 Reference Case

The 2017 reference case represents the future, including the implementation of emissions impacts of the fuel volumes mandated by the 2005 EPAct and 2007 EISA and finalized in the RFS2 program. The reference case includes MSAT2 and LDGHG but does not include HDGHG impacts. The 2017 reference case assumes 21.6 billion gallons of renewable fuels (24 billion ethanol-equivalent gallons due to volume increases of ethanol), with 17.8 billion gallons of E10 and E15, 1.5 billion gallons of biodiesel, 0.2 billion gallons of renewable diesel, and 2.2 billion gallons of cellulosic diesel. The fuel changes required upstream emissions estimates and adjustments in addition to the downstream changes to onroad and nonroad mobile source emissions. For nonroad mobile sources, onroad mobile including refueling sources, OTAQ-generated emissions were provided to reflect the reference case fuels.

The 2017 reference case uses many of the same growth and control assumptions as those for the Final Cross-State Air Pollution Rule (CSAPR), because other than onroad mobile, nonroad mobile, onroad refueling, PFC, and ethanol plant sources, both MATS and CSAPR use the same 2005v4.2-based emissions inventories. There are some differences between the 2012 and 2014 base case projections in CSAPR and the 2017 reference case for MATS:

1) 2017 includes some additional controls that were promulgated after 2014, (e.g., post-2014 consent decrees and fuel sulfur rules in a couple of states).
2) Growth factors for several sources are year-specific; so while the methodology is the same as CSAPR, the future year emissions estimates differ (e.g., oil and gas in a couple states, residential wood combustion).
3) Onroad refueling uses year and scenario-specific (i.e., reference) MOVES emissions for all MATS modeling, rather than NEI emissions.
4) There is a new dataset of ethanol plants that replace a limited set of NEI ethanol plants in 2005v4.2-based CSAPR 2012 and 2014 projections. These MATS reference case emissions are the same for the 2005 and 2017 base case.
5) Minor errors identified after CSAPR modeling was complete were fixed (e.g, we include agricultural dust projections for the couple of states that provided point source farms).

The remainder of Section 4 is very similar to Section 4 in the CSAPR emissions modeling TSD, but with the updates described above.

The future case projection methodologies vary by sector. For EGU emissions (ptipm sector), the emissions reflect state rules and federal consent decrees through December 1, 2010. For onroad mobile sources, all national measures for which data were available at the time of modeling have been included. The future case scenarios 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 NO_X and VOC reductions associated with the New York, Virginia, and Connecticut State Implementation Plans (SIP), which were added as part of the comments received from the CSAPR and a larger effort to start including more local control information on stationary non-EGU sources; this is described further in Section 4.2. The following bullets summarize the projection methods used for sources in the various sectors, while additional details and data sources are given in Table 4-1.

- IPM sector (ptipm): Unit-specific estimates from IPM, version 4.10.
- Non-IPM sector (ptnonipm): Projection factors and percent reductions reflect CSAPR (Transport Rule) comments and emission reductions due to control programs, plant closures, consent decrees and settlements, and 1997 and 2001 ozone State Implementation Plans in NY, CT, and VA. We also used projection approaches for point-source livestock, and aircraft that are consistent with projections used for the sectors that contain the bulk of these emissions. Terminal area forecast (TAF) data aggregated to the national level were used for aircraft to account for projected changes in landing/takeoff activity. Year-specific speciation was applied to some portions of this sector and was discussed in Section 3.
- Average fires sector (avefire): No growth or control.
- Agricultural sector (ag): Projection factors for livestock estimates based on expected changes in animal population from 2005 Department of Agriculture data; no growth or control for NH_3 emissions from fertilizer application.
- Area fugitive dust sector (afdust): Projection factors for dust categories related to livestock estimates based on expected changes in animal population; no growth or control for other categories in this sector.
- Remaining Nonpoint sector (nonpt): Projection factors that implement CSAPR 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 and include ethanol emissions. Gasoline stage II onroad refueling emissions obtained directly from MOVES. Oil and gas projection estimates are provided for the non-California Western Regional Air Partnership (WRAP) states as well as Oklahoma and Texas. Year-specific speciation was applied to some portions of this sector and was discussed in Section 3.
- Nonroad mobile sector (nonroad): Same version of the NONROAD2008a, including same set of 293 county groups and representing counties as the 2005 base case. Future-year equipment population estimates and control programs (final locomotive-marine and small spark ignition) to 2017 are included. The only differences between the MATS future case runs are the fuels used, specifically, the ratio of E10 and E15 fuels. Year-specific speciation was applied to some portions of this sector and is discussed in Section 3.
- 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 CSAPR Proposal 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 2017, incorporating CSAPR Proposal comments and controls based on Emissions Control Area (ECA) and International Marine Organization (IMO) global NO_X and SO_2 controls.
- Onroad mobile sector uses a version MOVES developed for the Tier 3 Proposal that incorporates new car and light truck greenhouse gas emissions standards (LDGHG) affecting model years 2012 and later (published May 7, 2010). These emissions also include RFS2 fuels. 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. This sector includes all non-refueling onroad mobile emissions (exhaust, evaporative, brake wear and tire wear modes). SMOKE-MOVES was used in a similar configuration as the 2005 base case to apportion MOVES emissions factors into hourly gridded temperature-adjusted 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 2017 reference-case emissions from the 2005v4.2 base-case inventories. These future year base case projections and controls are also included in the MATS reference and control cases. All Mexico, Canada, and offshore oil emissions are unchanged in all future cases from those in the 2005 base case.

Lists of the control, closures, projection packets (datasets) used to create the MATS 2017 future case inventories from the 2005 MATS base case are provided in Appendix C.

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 MATS 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 2017 reference case emissions inventories from the 2005 base case

Control Strategies and/or growth assumptions (grouped by affected pollutants or standard and approach used to apply to the inventory)	**Pollutants affected**	**Approach/ Reference**
Non-EGU Point (ptnonipm sector) projection approaches		
MACT rules, national, VOC: national applied by SCC, MACT Boat Manufacturing 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	NOx, PM, SO_2	3
Hazardous Waste Combustion	PM	4
Municipal Waste Combustor Reductions –plant level	PM	5
Hospital/Medical/Infectious Waste Incinerator Regulations	NO_X, PM, SO_2	EPA, 2005
Large Municipal Waste Combustors – growth applied to specific plants	All (including Hg)	5
MACT rules, plant-level, VOC: Auto Plants	VOC	6
MACT rules, plant-level, PM & SO_2: Lime Manufacturing	PM, SO_2	7
MACT rules, plant-level, PM: Taconite Ore	PM	8
Livestock Emissions Growth from year 2002 to year 2017 (some farms in the point inventory)	NH_3, PM	9
NESHAP: Portland Cement (09/09/10) – plant level based on **Industrial Sector Integrated Solutions (ISIS)** policy emissions in 2013. The ISIS results are from the ISIS-Cement model runs for the NESHAP and NSPS analysis of July 28, 2010 and include closures.	Hg, NO_X, SO2, PM, HCl	10; EPA, 2010
New York ozone SIP controls	VOC, NO_X, HAP VOC	11
Additional plant and unit closures provided by state, regional, and the EPA agencies and additional consent decrees. Includes updates from CSAPR comments.	All	12
Emission reductions resulting from controls put on specific boiler units (not due to MACT) after 2005, identified through analysis of the control data gathered from the	NO_X, SO_2, HCl	Section 4.2.13.2

Information Collection Request (ICR) from the Industrial/Commercial/Institutional Boiler NESHAP.		
Reciprocating Internal Combustion Engines (RICE) NESHAP	NO_X, CO, PM, SO_2	13
Ethanol plants that account for increased ethanol production due to RFS2 mandate	All	14
State fuel sulfur content rules for fuel oil –*effective only in Maine, New Jersey, and New York*	SO_2	15
Nonpoint (nonpt sector) projection approaches		
Municipal Waste Landfills: projection factor of 0.25 applied	All	EPA, 2007a
Livestock Emissions Growth from year 2002 to 2017	NH_3, PM	9
New York, Connecticut, and Virginia ozone SIP controls	VOC	11, 16
RICE NESHAP	NO_X, CO, VOC, PM, SO_2	13
State fuel sulfur content rules for fuel oil –*effective only in Maine, New Jersey, and New York*	SO_2	15
Residential Wood Combustion Growth and Change-outs from year 2005 to 2017	All	17
Gasoline and diesel fuel Stage II refueling via MOVES2010a month-specific inventories for 2017 with assumed RFS2 and LDGHG fuels	VOC, Benzene, Ethanol	18
Portable Fuel Container Mobile Source Air Toxics Rule 2 (MSAT2) inventory growth and control from year 2005 to 2017	VOC	19
Use Phase II WRAP 2018 Oil and Gas	VOC, SO_2, NO_X, CO	Section 4.2.14
Use 2008 Oklahoma and Texas Oil and Gas, and apply year 2017 projections for TX, and RICE NESHAP controls to Oklahoma emissions.	VOC, SO_2, NO_X, CO, PM	Section 4.2.14

APPROACHES/REFERENCES- Non-EGU Stationary Sources:

1. Appendix B in the MATS Proposal TSD
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 4.2.10.
10. Data files for the cement sector provided by Elineth Torres, the EPA-SPPD, from the analysis done for the Cement NESHAP: The ISIS documentation and analysis for the cement NESHAP/NSPS is in the docket of that rulemaking- docket # EPA-HQ-OAR-2002-005. The Cement NESHAP is in the Federal Register: September 9, 2010 (Volume 75, Number 174, Page 54969-55066
11. New York NO_X and VOC reductions obtained from Appendix J in NY Department of Environmental Conservation Implementation Plan for Ozone (February 2008)
12. Appendix D of Cross-State Air Pollution Rule
13. Appendix F in the Proposed (Mercury and Air) Toxics Rule TSD
14. The 2008 data used came from Illinois' submittal of 2008 emissions to the NEI.

15. Based on available, enforceable state sulfur rules as of November, 2010: ILTA, Maine Legislature, NRDC, Green blogs NY Times,
16. VOC reductions in Connecticut and Virginia obtained from CSAPR comments.
17. Growth and Decline in woodstove types based on industry trade group data, See Section 4.2.11.
18. MOVES (2010a) results for onroad refueling including activity growth from VMT, Stage II control programs at gasoline stations, and phase in of newer vehicles with onboard Stage II vehicle controls.
19. VOC, benzene, and ethanol emissions for 2017 based on MSAT2 rule and ethanol fuel assumptions (EPA, 2007b)

Onroad mobile and nonroad mobile controls (list includes all key mobile control strategies but is not exhaustive)		
National Onroad Rules: 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 Light Duty Greenhouse Gas Rule: May, 2010 Corporate Average Fuel Economy standards for 2008-2011	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 Locomotive and marine rule (May 6, 2008) Marine SI rule (October 4, 1996) Nonroad large SI and recreational engine rule (November 8, 2002) Nonroad SI rule (October 8, 2008) Phase 1 nonroad SI rule (July 3, 1995) Tier 1 nonroad diesel rule (June 17, 2004)	all	3,4,5
Aircraft (emissions are in the nonEGU point inventory)**:** Itinerant (ITN) operations at airports to 2017	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 Locomotive rule: April 16, 2008 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 CSAPR comments.* EIA fuel consumption projections for diesel-fueled vessels Clean Air Nonroad Diesel Final Rule – Tier 4 Emissions Standards for Commercial Marine Diesel Engines, December 29, 1999 Locomotive and marine rule (May 6, 2008) Tier 1 Marine Diesel Engines, February 28, 2003	all	7, 3; EPA, 2009

APPROACHES/REFERENCES – Mobile Sources

1. Vehicles and Engines
2. Only for states submitting these inputs: Transportation, Air Pollution, and Climate Change
3. Non Road Diesel
4. Clean School Bus
5. Marines

6. Federal Aviation Administration (FAA) Terminal Area Forecast (TAF) System, January 2010
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 using version 4.10 Final 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 Final reflects federal and state rules and binding, enforceable consent decrees through December of 2010. The 2017 IPM emissions reflect the CSAPR as finalized in July 2011. The reference case, also known as the future year baseline, emissions do not reflect the final Mercury and Air Toxics (MATS) rule, but the control case emissions do reflect the rule. Neither case reflects the Boiler MACT regulatory assumptions.

Version 4.10 Final reflects state rules and consent decrees through December 1, 2010, information obtained from the 2010 Information Collection Request (ICR), and information from comments received on the IPM-related Notice of Data Availability (NODA) published on September 1, 2010. Notably, IPM 4.1 Final included the addition of over 20 GW of existing Activated Carbon Injection (ACI) for coal-fired EGUs reported to EPA via the ICR. Additional unit-level updates that identified existing pollution controls (such as scrubbers) were also made based on the ICR and on comments from the IPM NODA. Units with SO2 or NOX 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. The IPM run for the reference case modeled with CMAQ assumed that 100% of the HCl found in the coal was emitted into the atmosphere. However, in the final IPM results for the rule, neutralization of 75% of the available HCl was included based on recent findings.

Further details on the reference case EGU emissions inventory used for this rule can be found in the IPM v.4.10 Documentation, available at http://www.epa.gov/airmarkets/progsregs/epa-ipm/transport.html. The reference case modeled in IPM for this rule includes estimates of emissions reductions that will result from the Cross-State Air Pollution Rule. However, reductions from the Boiler MACT rule were not represented this modeling because the rule was stayed at the time the modeling was performed. A complete list of state regulations, NSR settlements, and state settlements included in the IPM modeling is given in Appendices 3-2, 3-3, and 3-4 beginning on p. 68 of http://www.epa.gov/airmarkets/progsregs/epa-ipm/CSAPR/docs/DocSuppv410_FTransport.pdf. For the 2017 reference case EGU emissions, the IPM outputs for 2020, which are also representative of the year 2017, were used. These emissions were very similar to the year 2015 emissions output from the same IPM modeling case.

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

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

To project U.S. stationary sources other than the ptipm sector, we applied growth factors and/or controls to certain categories within the ptnonipm, nonpt, ag and afdust platform sectors. This subsection provides details on the data and projection methods used for these sectors. The MATS future year scenarios also required obtaining and preprocessing numerous other inputs that we received directly from OTAQ.

In estimating future-year emissions, we assumed that emissions growth does not track with economic growth for many stationary non-IPM sources. This “no-growth” assumption is based on an examination of historical emissions and economic data. More details on the rationale for this approach can be found in Appendix D of the Regulatory Impact Assessment for the PM NAAQS rule (EPA, 2006).

The starting point for projecting the 2005 MATS emissions was to use similar emission projection methodologies as used for the 2005v4.2 platform for the Final CSAPR, which incorporated responses to public comments on the modeling inventories. The 2012 and 2014 projection factors developed for the CSAPR were updated to reflect year 2017.

Year-specific projection factors for years 2017 were created. Growth factors (and control factors) are provided in the following sections where feasible. However, some sectors used growth or control factors that varied geographically and their contents could not be provided in the following sections (e.g., gasoline distribution varies by state and pollutant and has hundreds of records).

Table 4-2 lists the stationary non-EGU inputs and projection factors that were applied to account for the year 2017 RFS2 mandate impacts on emissions to the reference case. These inputs are discussed in more detail in Section 4.2.1 through Section 4.2.9. All other stationary non-EGU projections, controls and plant closure information not related to the RFS2 impacts are discussed in Section 4.2.10 through Section 4.2.13. All stationary non-EGU emissions in the 2017 reference case are unchanged in the 2017 control case (see Section 5); therefore, we will simply note that these emissions are “year 2017” rather than the more cumbersome “year 2017 reference case”.

Table 4-2. MATS reference case mobile source-related projection methods

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

4.2.1 Ethanol plants (ptnonipm)

As discussed in Section 2.4.1, we replaced all corn ethanol plants that OTAQ had supplied from the RFS2 rule –see Section 2.1.2 in the CSAPR Final TSD- with those recently compiled for 2005 and a year 2017 without the RFS2 mandate (not separately modeled for this rule). Additional ethanol plants cited for development in support of increased ethanol production for RFS2 are the cause for the increased number of facilities and emissions in the reference case. Table 4-3 provides the summaries for the corn ethanol plants in the 2017 reference case.

Table 4-3. 2017 reference case corn ethanol plant emissions

Pollutant	Tons
1,3-Butadiene	0.0011
Acrolein	41.7
Formaldehyde	45.2
Benzene	20.3

Acetaldehyde	643.2
CO	14,847
NO_X	20,035
PM_{10}	21,639
$PM_{2.5}$	6,825
SO_2	11,299
VOC	35,459

4.2.2 Biodiesel plants (ptnonipm)

OTAQ developed an inventory of existing biodiesel plants for 2017 that were sited at existing plant locations in support of producing biodiesel fuels for the RFS2 mandate. The RFS2 calls for 1.45 billion gallons per year (Bgal) of biodiesel fuel production by year 2017. Only plants with current production capacities were assumed to be operating in 2017. Total plant capacity at these existing facilities is limited to just over 1 Bgal. There was no attempt to site future year plants to account for the need to match biodiesel production needed for RFS2. Therefore, OTAQ applied a scalar adjustment (of 1.41) to each individual biodiesel plant to match the 2017 production target of 1.45 Bgal. Once facility-level production capacities were scaled, emission factors were applied based on an assumed natural gas combustion process. Inventories were modeled as point sources with Google Earth and web searching validating facility coordinates and correcting state-county FIPS. Table 4-4 provides the 2017 biodiesel plant emissions estimates.

Table 4-4. 2017 biodiesel plant emissions

Pollutant	Tons
Acrolein	3.09E-04
Formaldehyde	2.23E-03
Benzene	4.71E-05
Acetaldehyde	3.59E-04
CO	726
NO_X	1,171
PM_{10}	99
$PM_{2.5}$	99
SO_2	9
VOC	64

4.2.3 Portable fuel containers (nonpt)

OTAQ provided year 2017 PFC emissions that include estimated Reid Vapor Pressure (RVP) and oxygenate impacts on VOC emissions, and more importantly, large increases in ethanol emissions from RFS2. These emission estimates also include refueling from the NONROAD model for gas can vapor displacement, changes in tank permeation and diurnal emissions from evaporation. Because these PFC inventories contain ethanol, we developed a VOC E-profile that integrated ethanol, see Section 3 for more details. Emissions for 2017 are provided in Table 4-5.

Table 4-5. PFC emissions for 2017

Pollutant	Tons
VOC	123,186
Benzene	1,368
Ethanol	11,565

4.2.4 Cellulosic fuel production (nonpt)

OTAQ developed county-level inventories for cellulosic diesel and cellulosic ethanol production for 2017 to satisfy RFS2 production. The methodology for building cellulosic plant emissions inventories is fairly similar conceptually to that for building the biodiesel plant inventories. First, we assume that cellulosic diesel and cellulosic ethanol are produced in the same counties where current production capacity exists, based on RFS2 FRM inventories. Total county production capacities was over 16 Bgal; therefore, OTAQ applied a scalar adjustment (of 0.246) to each counties production capacity to match the 2017 production target of 3.93 Bgal (2.2 Bgal diesel and 1.69Bgal ethanol). Once county-level cellulosic production capacities were scaled down to match the 2017 target, emission factors were applied based on an assumed natural gas combustion process. Table 4-6 provides the year 2017 cellulosic plant emissions estimates.

Table 4-6. 2017 cellulosic plant emissions

Pollutant	Tons
Acrolein	21
Formaldehyde	58
Benzene	27
Acetaldehyde	786
CO	42,839
Ethanol	1,875
NH_3	0.5
NO_X	64,062
PM_{10}	7,533
$PM_{2.5}$	3,796
SO_2	4,973
VOC	5,336

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

4.2.5 Ethanol transport and distribution (nonpt)

OTAQ developed county-level inventories for ethanol transport and distribution for 2017 to account for losses for the processes such as truck, rail and waterways loading/unloading and intermodal transfers such as highway-to-rail, highways-to-waterways, and all other possible combinations of transfers. Emission rates were applied based on June 2008 AP-42 factors and ethanol versus gasoline vapor mass equations. These emissions are entirely evaporative and therefore limited to VOC and are summarized in Table 4-7. The leading descriptions are "Industrial Processes; Food and Agriculture; Ethanol Production" for each SCC.

Table 4-7. VOC losses (Emissions) due to ethanol transport and distribution

SCC	Description	Tons
30205031	Denatured Ethanol Storage Working Loss	27,763
30205052	Ethanol Loadout to Truck	19,069
30205053	Ethanol Loadout to Railcar	9,610

4.2.6 Onroad refueling (nonpt)

As discussed in Section 2.5.2, the refueling inventory includes gasoline and diesel fuel emissions from spillage loss and displacement vapor loss. For this analysis, the refueling emissions were estimated using the revised version of EPA's Motor Vehicle Emissions Simulator (MOVES2010a) at the county level for all twelve months. The same set of representative counties and temperatures were used for all MATS scenarios. VMT, fleet age distribution and speed distribution were developed for 2017. Because these refueling inventories contain ethanol, we developed a VOC E-profile that integrated ethanol, see Section 3 for more details. A summary of the 2017 onroad mobile refueling emissions is provided in Table 4-8.

Table 4-8. Onroad gasoline and diesel refueling emissions

Fuel Type	Pollutant	Tons
Gasoline	VOC	63,759
Diesel	VOC	12,962
Gasoline	Benzene	161
Gasoline	Ethanol	8,735

4.2.7 Refinery adjustments (ptnonipm)

Refinery emissions were adjusted for changes in fuels due to the RFS2 mandate. These adjustments were provided by OTAQ and impact processes such as process heaters, catalytic cracking units, blowdown systems, wastewater treatment, condensers, cooling towers, flares and fugitive emissions. The impact of the RFS2-based reductions is shown in Table 4-9.

Table 4-9. Impact of refinery adjustments on 2017 emissions

Pollutant	Reductions (tons)
CO	12,674
NO_X	20,183
PM_{10}	4,367
$PM_{2.5}$	2,525
SO_2	13,846
VOC	3,693

4.2.8 Ethanol transport gasoline and blends (ptnonipm, nonpt)

Emissions changes in the transport of changing fuels from the RFS2 mandate impact several processes including bulk plant storage (BPS), refinery to bulk terminal (RBT) and bulk terminal to pump (BTP). These impacts, provided by OTAQ, result in approximately 15,000 tons of VOC reductions in 2017 for these processes.

4.2.9 Upstream agricultural adjustments (afdust, ag, nonpt, ptnonipm)

Changes in domestic biofuel volumes, resulting from the RFS2 fuels mandate, impact upstream agricultural-related source categories in several emissions modeling sectors. These source categories include fertilizer application, pesticide application and livestock waste (NH_3 only), agricultural tilling, unloading and livestock dust (PM only) and fertilizer production mixing and blending, pesticide production and agricultural burning (all pollutants). As seen in Table 4-10, the cumulative impact of these source-specific changes is a net increase in emissions for upstream agricultural sources.

Table 4-10. Upstream agricultural emission increases due to RFS2 fuels in 2017

Pollutant	Increases (tons)
CO	302
NH_3	45,272
NO_X	363
PM_{10}	42,934
$PM_{2.5}$	6,500
SO_2	69
VOC	16

4.2.10 Livestock emissions growth (ag, afdust)

Growth in ammonia (NH_3) and dust (PM_{10} and $PM_{2.5}$) emissions from livestock in the ag, afdust and ptnonipm sectors was based on projections of growth in animal population. Table 4-11 provides the growth factors from the 2005 base-case emissions to all MATS year 2017 scenarios for animal categories applied to the ag, afdust, and ptnonipm sectors for livestock-related SCCs.

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 4-11.

Table 4-11. Growth factors from year 2005 to 2017 for animal operations

Animal Category	Projection Factor
Dairy Cow	1.0000
Beef	1.0206
Pork	1.0893
Broilers	1.3442
Turkeys	1.0000
Layers	1.2406
Poultry Average	1.2674
Overall Average	1.0935

4.2.11 Residential wood combustion growth (nonpt)

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

The specific assumptions we made were:

- Fireplaces, source category code (SCC)=2104008001: increase 1%/year
- Old woodstoves, SCC=2104008002, 2104008010, or 2104008051: decrease 2%/year

- New woodstoves, SCC=2104008003, 2104008004, 2104008030, 2104008050, 2104008052 or 2104008053: increase 2%/year

For the general woodstoves and fireplaces category (SCC 2104008000) we computed a weighted average distribution based on 19.4% fireplaces, 71.6% old woodstoves, 9.1% new woodstoves using 2002v3 Platform missions for $PM_{2.5}$. These fractions are based on the fraction of emissions from these processes in the states that did not have the "general woodstoves and fireplaces" SCC in the 2002v3 NEI. This approach results in an overall decrease of 1.056% per year for this source category.

We discovered an interpolation error in the year 2017 projection factors for RWC after air quality modeling. Table 4-12 presents the projection factors used to project the 2005 base case (2002 emissions) for RWC, including these 2017 errors. Table 4-13shows the national impact (tons) of the 2017 projection factor error.

Table 4-12. Projection factors for growing year 2005 residential wood combustion sources

SCC	SCC Description	Erroneous 2017 Factor	Correct 2017 Factor
2104008000	Total: Woodstoves and Fireplaces	0.45	0.84
2104008001	Fireplaces: General	0.65	1.15
2104008070	Outdoor Wood Burning Equipment		
2104008002	Fireplaces: Insert; non-EPA certified	0.36	0.70
2104008010	Woodstoves: General		
2104008051	Non-catalytic Woodstoves: Non-EPA certified		
2104008003	Fireplaces: Insert; EPA certified; non-catalytic	0.74	1.30
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		

Table 4-13. Impact of year 2017 projection factor error on residential wood combustion estimates

Pollutant	2005 Emissions	Erroneous 2017 Emissions	Erroneous 2017 Reductions	Correct 2017 Emissions	Correct 2017 Reductions
NO_X	38,292	18,023	20,270	33,545	4,747
$PM_{2.5}$	381,362	174,769	206,593	326,706	54,656
SO_2	5,302	2,529	2,773	4,697	605
VOC	569,950	242,126	327,824	450,990	118,959

4.2.12 Aircraft growth (ptnonipm)

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

The methods that the FAA used for developing the ITN data in the TAF.

Table 4-14 provides the national growth factors for aircraft; all factors are applied to year 2005 emissions. For example, year 2017 commercial aircraft emissions are 12.88% higher than year 2005 emissions. The same aircraft factors were used for each of the year-specific scenarios: low-ethanol, reference and control.

Table 4-14. Factors used to project 2005 base-case aircraft emissions to 2017

SCC	SCC Description	Projection Factor
2275001000	Military aircraft	1.0229
2275020000	Commercial aircraft	1.1288
2275050000	General aviation	0.8918
2275060000	Air taxi	0.8620
27501015	Internal Combustion Engines;Fixed Wing Aircraft L & TO Exhaust;Military;Jet Engine: JP-5	1.0229
27502001	Internal Combustion Engines;Fixed Wing Aircraft L & TO Exhaust;Commercial;Piston Engine: Aviation Gas	1.1288
27502011	Internal Combustion Engines;Fixed Wing Aircraft L & TO Exhaust;Commercial;Jet Engine: Jet A	1.1288
27505001	Internal Combustion Engines;Fixed Wing Aircraft L & TO Exhaust;Civil;Piston Engine: Aviation Gas	0.8918
27505011	Internal Combustion Engines;Fixed Wing Aircraft L & TO Exhaust;Civil;Jet Engine: Jet A	0.8918
27601014	Internal Combustion Engines;Rotary Wing Aircraft L & TO Exhaust;Military;Jet Engine: JP-4	1.0229
27601015	Internal Combustion Engines;Rotary Wing Aircraft L & TO Exhaust;Military;Jet Engine: JP-5	1.0229

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, signed July 2011, was not adopted as an EPA (or U.S.) rule prior to MATS modeling; therefore, the effects of this rule were not included in the future-year emissions projections.

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

We applied emissions reduction factors to the 2005 emissions for particular sources in the ptnonipm and nonpt sectors to reflect the impact of stationary-source control programs including consent decrees, settlements, and plant closures. Some of the controls described in this section were obtained from comments on the CSAPR proposal. Detailed summaries of the impacts of the control programs are provided in Appendix D of the CSAPR TSD.

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 NO_X SIP call. The future-year base controls consist of the following:

- We did not include MACT rules where compliance dates were prior to 2005, because we assumed these were already reflected in the 2005 inventory. The EPA OAQPS Sector Policies and Programs Division (SPPD) provided all controls information related to the MACT rules, and this information is as consistent as possible with the preamble emissions reduction percentages for these rules.
- Various emissions reductions from the CSAPR comments, including but not limited to: fuel switching at units, shutdowns, future-year emission limits, ozone SIP VOC controls for some sources in Virginia and Connecticut, and state and local control programs.
- Evolutionary information gathering of plant closures (i.e., emissions were zeroed out for future years) were also included where information indicated that the plant was actually closed after the 2005 base year and prior to CSAPR and MATS modeling that began in the spring of 2011. We also applied unit and plant closures received from the CSAPR comments. However, plants projected to close in the future (post-2010) were not removed in the future years because these projections can be inaccurate due to economic improvements. We also applied cement kiln (unit) and cement plant closures discussed later in Section 4.2.6.1. More detailed information on the overall state-level impacts of all control programs and projection datasets, including units and plants closed in the 2017 reference case ptnonipm inventories are provided in Appendix D of the Final CSAPR TSD. The magnitude of all unit and plant closures on the non-EGU point (ptnonipm) sector 2005 base-case emissions is shown in Table 4-15 below. These same reductions are seen in all MATS future year scenarios.

Table 4-15. Summary of non-EGU emission reductions applied to the 2005 inventory due to unit and plant closures

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

- In addition to plant closures, we included the effects of the Department of Justice Settlements and Consent Decrees on the non-EGU (ptnonipm) sector emissions. We also included estimated impacts of HAP standards per Section 112, 129 of the Clean Air Act on the non-EGU (ptnonipm) and nonpoint (nonpt) sector emissions, based on expected CAP co-benefits to sources in these sectors.
- Numerous controls have compliance dates beyond 2008; these include refinery and the Office of Compliance and Enforcement (OECA) consent decrees, Department of Justice (DOJ) settlements, as well as most national VOC MACT controls. Additional OECA consent decree information is provided in Appendix B of the Proposed Toxics Rule TSD. The detailed data used are available at the website listed in Section 1.
- Refinery consent decrees controls at the facility and SCC level (collected through internal coordination on refineries by the EPA).
- Fuel sulfur fuel limits were enforceable for Maine, New Jersey and New York.
- Criteria air pollutant (cap) reductions a cobenefit to RICE NESHAP controls, including SO_2 RICE cobenefit controls.
- We applied New York State Implementation Plan available controls for the 1997 8-hour Ozone standard for non-EGU point and nonpoint NO_X and VOC sources based on NY State Department of

Environmental Conservation February 2008 guidance. These reductions are found in Appendix J. Section 3.2.6 in the CSAPR TSD.

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

4.2.13.1 Reductions from the Portland Cement NESHAP (ptnonipm)

As indicated in Table 4-1, the Industrial Sectors Integrated Solutions (ISIS) model (EPA, 2010) was used to project the cement industry component of the ptnonipm emissions modeling sector to 2013. There were no future year estimates for 2017, so 2013 estimates were used for all future year MATS modeling scenarios. This approach provided reductions of criteria and hazardous air pollutants, including mercury. The ISIS cement emissions were developed in support for the Portland Cement NESHAPs and the NSPS for the Portland cement manufacturing industry.

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

The ISIS model results for the future show a continuation of the recent trend in the cement sector of the replacement of lower capacity, inefficient wet and long dry kilns with bigger and more efficient preheater and precalciner kilns. Multiple regulatory requirements such as the NESHAP and NSPS currently apply to the cement industry to reduce CAP and HAP emissions. Additionally, state and local regulatory requirements might apply to individual cement facilities depending on their locations relative to ozone and $PM_{2.5}$ nonattainment areas. The ISIS model provides the emission reduction strategy that balances: 1) optimal (least cost) industry operation, 2) cost-effective controls to meet the demand for cement, and 3) emission reduction requirements over the time period of interest. Table 4-16 shows the magnitude of the ISIS-based cement industry reductions in the future-year emissions that represent 2013 (and 2017 for MATS), and the impact that these reductions have on total stationary non-EGU point source (ptnonipm) emissions.

Table 4-16. Future-year ISIS-based cement industry annual reductions (tons/yr) for the non-EGU (ptnonipm) sector

Pollutant	Cement Industry emissions in 2005 (tons)	Reductions in 2017 (tons)	Percent Reduction %
NO_X	193,000	56,740	2.4%
$PM_{2.5}$	14,400	7,840	1.8%
SO_2	128,400	106,000	5.0%
VOC	6,900	5,570	0.4%
HCl	2,900	2,220	4.5%

4.2.13.2 Boiler reductions not associated with the MACT rule (ptnonipm)

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 non-EGU stationary (ptnonipm) 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 4-17. All reductions are promulgated by the present day, and therefore these reductions are the same for all MATS future year scenarios.

Table 4-17. State-level non-MACT boiler reductions from ICR data gathering

State	Pollutant	Pre-controlled Emissions (tons)	Controlled Emissions (tons)	Reductions in 2017 (tons)	Percent Reduction %
Michigan	NO_X	907	544	363	40
North Carolina	SO_2	652	65	587	90
Virginia	SO_2	3379	338	3041	90
Washington	SO_2	639	383	256	40
North Carolina	HCl	31	3	28	90

4.2.13.3 RICE NESHAP (ptnonipm and nonpt)

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 2017 reference case emissions projection.

The rules are listed below:

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

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

A complete discussion on the methodology to estimate RICE controls is provided in Appendix F in the Proposed MATS Rule TSD. 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 4-18. These reductions are promulgated before year 2017, and therefore these reductions are the same for all MATS future year scenarios.

Table 4-18. National impact of RICE controls on non-EGU projections

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

4.2.13.4 Fuel sulfur rules (ptnonipm and nonpt)

Fuel sulfur rules that were signed (enforceable) at the time of the emissions processing are limited to Maine, New Jersey and New York. Several other states have fuel sulfur rules that were in development but not finalized prior to the final CSAPR and proposed MATS emissions processing available at ILTA.

The fuel sulfur content for all home heating oil SCCs in 2005 is assumed to by 3000 part per million (ppm). Effective July 1, 2012, New York requires all heating oil sold in New York to contain no more than 15ppm of sulfur, thus reducing SO_2 emissions by 99.5% for post-2012 projections. These New York sulfur content reductions are further discussed on NRDC.

The New Jersey year 2017 standard of 15ppm (assuming 500ppm baseline for Kerosene) sulfur content yields a 96.25% SO_2 emissions reduction for kerosene (fuel #1). The New Jersey sulfur content reductions.

For MATS year 2017 projections, the Maine fuel sulfur rule, effective in year 2016, reduces sulfur to50 ppm from 3,000 ppm in 2005, resulting in a 98.3% reduction for the 2017 scenario. The impact of these fuel sulfur content reductions on SO_2 is shown in Table 4-19. These year-specific reductions are the same for all MATS scenarios: low-ethanol, reference and control.

Table 4-19. Impact of fuel sulfur (SO_2) controls on 2017 non-EGU projections

State	**Reductions (tons)**
Maine	8,323
New Jersey	998
New York	54,431
Total	**63,751**

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

For the 2005v4.2 platform, we incorporated updated 2005 oil and gas emissions from Texas and Oklahoma. For Texas oil and gas production, we used year 2017 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 2017. We utilized the latest available future year, year 2018, Phase II WRAP oil and gas emissions data for the non-

California Western Regional Air Partnership (WRAP) states to represent 2017. RICE NESHAP reductions, discussed earlier in this section, which are effective by year 2014, were applied to the year 2008 Oklahoma oil and gas inventory but not applied to the 2017 TCEQ oil and gas estimates or 2018 WRAP Phase II oil and gas inventory.

For Oklahoma, we applied CO, NO_X, SO_2 and VOC emissions reductions from the RICE NESHAP, which we assumed has some applicability to this industry (Appendix F in the Proposed Toxics Rule TSD). All these year-specific oil and gas projection estimates are the same for all MATS scenarios: low-ethanol, reference and control. Table 4-20 shows the 2005 and 2017 NO_X and SO_2 emissions including RICE reductions for Oklahoma.

Table 4-20. Oil and gas NO_X and SO_2 emissions for 2005 and 2017 including additional reductions due to the RICE NESHAP

	NO_X		**$PM_{2.5}$**		**SO_2**		**VOC**	
	2005	**2017**	**2005**	**2017**	**2005**	**2017**	**2005**	**2017**
Alaska	836	453			62	1	68	12
Arizona	13	15					37	49
Colorado	32,188	33,517			350	11	35,500	43,639
Montana	10,617	13,880			640	6	9,187	14,110
Nevada	71	63			1	0	105	163
New Mexico	61,674	74,648			369	12	215,636	267,846
North Dakota	6,040	20,869			688	4	8,988	17,968
Oklahoma	39,668	42,402	1,918	2,231	1,014	2	155,908	163,598
Oregon	61	44					19	14
South Dakota	566	557			43	0	370	562
Texas	42,854	34,772	2,945	1,085	5,977	36	4,337	2,800
Utah	6,896	6,297			149	1	43,403	81,890
Wyoming	36,172	34,142			541	3	166,939	304,748
Total	**237,656**	**261,659**	**4,862**	**3,316**	**9,834**	**76**	**640,498**	**897,400**

4.3 Onroad mobile source projections (onroad)

The same version of MOVES and SMOKE-MOVES Integration Tool was used to create all MATS onroad emission scenarios. Section 2.2 describes these components in support of year 2005 processing. This section will only address the differences related to creating and processing year 2017 reference case emissions. Speciation changes for all scenarios are discussed in Section 3.

Inputs for temperatures (Section 2.2.1), the representative counties and fuel months (Section 2.2.2), the overall parallel processing procedures (Section 2.2.3), speed data (Section 2.2.4), and SMOKE-MOVES configurations (Section 2.2.4) were previously discussed and were the same for all MATS scenarios. However, year-specific MOVES inputs were obtained for fuels and California LEV standards, and SMOKE inputs of VMT and vehicle populations were year-specific and are described below.

For the 2017 VMT inventory, MOVES2010a was run with default inputs to generate total national VMT by SCC. But, because MOVES uses a static (1999) default allocation of VMT to county, MOVES was not used for these allocations. Instead, the 2017 county VMT was created by interpolating between the NCD VMT values for 2015 and those for 2020 and computing the NCD fraction for each county, then multiplying these fractions by the MOVES VMT. The VMT was also adjusted to account for increased onroad transportation of ethanol fuels and the resulting increase in travel by large tanker trucks.

Vehicle populations by county and SCC were developed similarly to the VMT, using MOVES to generate national totals for each year and using the NCD to allocate to county. However, the NCD does not include population estimates, so we used MOVES to generate the 2005 national population and we assumed that, for each calendar year (2005 and 2017) and for each SCC, the allocation of national vehicle population to county was proportional to the allocation of VMT (summed across road types).

The MOVES 2017 emissions used for MATS reflect onroad mobile control programs including the Light-Duty Vehicle Tier 2 Rule and the Mobile Source Air Toxics (MSAT2) final rule.

4.3.1 California LEV

The list of States which have implemented programs to require the sale of vehicles in their state certified for sale in California began with the information stored in the modeling inputs used for the 2008 National Emission Inventory (NEI) stored in the National Mobile Inventory Model (NMIM) County database. This information was reviewed and updated by states during the process of developing the national inventory for calendar year 2008. This information was supplemented with information from a "Dear Manufacturer" letter, "Sales of California-certified 2008-2010 Model Year Vehicles (Cross-Border Sales Policy)" (October 29,2007) produced by the Compliance and Innovative Strategies Division of the US Environmental Protection Agency which describes the areas that have recently implemented a California standards program. This information was used to generate emission rate table inputs for the MOVES model for each of these areas using the guidance provided in the document, "Instructions for Using LEV and NLEV Inputs for MOVES" (EPA-420-B-10-003, January 2010) provided to States with the MOVES model. For calendar year 2017, areas that had implemented California standards would still have these programs in place in calendar year 2017. More information on the states that have implemented California LEV standards.

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

The components of the nonroad mobile sectors are discussed in Section 2.3. Nonroad mobile emissions reductions for MATS include year-specific regulations affecting locomotives, various nonroad engines including diesel engines and various marine engine types, fuel sulfur content, and evaporative emissions. This section discusses the changes due to the NONROAD/NMIM system (nonroad sector) and additional C1/C2 CMV and locomotive emissions from volume increases resulting from incorporation of larger amounts in renewable fuels in the 2017 reference case.

4.4.1 Emissions generated with the NONROAD model (nonroad)

As discussed in Section 2.3.1, most nonroad emissions are were estimated using the EPA's NONROAD model, as run by the EPA's consolidated modeling system known as the National Mobile Inventory Model (NMIM). NONROAD is EPA's model for calculating emissions from nonroad equipment, except for aircraft, locomotives, and commercial marine vessels. Like the onroad emissions, the NONROAD/NMIM system 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.

The same temperatures and representative counties were used for all NONROAD model-generated MATS scenarios. For 2017, E10 and E15 are available in every county, but nonroad equipment is assumed to burn only E10. To generate the NMIM fuels, the E10 fuel was copied from MOVES to NMIM, and the E10 oxygenate was assigned a market share of 1. Highway diesel fuel sulfur levels are copied directly from MOVES to NMIM. Nonroad diesel fuel sulfur levels are retained from NMIM.

Section 2.3.1.3 provides a cross-walk of the nonroad mobile NMIM emission scenarios used in MATS; as previously discussed, the only difference between these scenarios are the 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. For year 2017, EPA assumed that nonroad equipment would use only E10. Although the NONROAD Model estimates changes in VOC production from E15, NMIM calculates toxics as if the fuel were E10. Emission estimates for ethanol come from speciation of VOC in the SMOKE model. These ethanol adjustments for nonroad engines running on E15 came from the EPAct Phase 1 data.

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

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

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

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

Aircraft emissions reside in the nonEGU point inventory (ptnonipm), and the projection factors used to create year 2017 estimates, are discussed in Section 4.2. The remaining 2005 NEI emissions for locomotives and Class 1 and Class 2 commercial marine vessel (C1/C2 CMV) use year-specific projection estimates. Base future year locomotive and C1/C2 CMV emissions were calculated using projection factors that were computed based on national, annual summaries of emissions in 2002 and 2017. Some additional emissions were then factored in due to changes in fuels. These national summaries were used to create national by-pollutant, by-SCC projection factors; these factors include final locomotive-marine controls and are provided in Table 4-21. Modest additive Class I railroad and C1/C2 CMV emissions that account for RFS2 volume increases in the MATS reference scenario were then added into the reference case due to the volume differences in corn, cellulosic and imported ethanol and cellulosic diesel fuels. These additional emissions are summarized in Table 4-22.

Table 4-21. Factors applied to year 2005 emissions to project locomotives and class 1 and class 2 commercial marine vessel emissions to 2017

SCC	SCC Description	Pollutant	Projection Factor
2280002X00	Marine Vessels, Commercial;Diesel;Underway & port emissions	CO	0.938
2280002X00	Marine Vessels, Commercial;Diesel;Underway & port emissions	NH_3	1.144
2280002X00	Marine Vessels, Commercial;Diesel;Underway & port emissions	NO_X	0.700
2280002X00	Marine Vessels, Commercial;Diesel;Underway & port emissions	PM_{10}	0.642
2280002X00	Marine Vessels, Commercial;Diesel;Underway & port emissions	$PM_{2.5}$	0.653
2280002X00	Marine Vessels, Commercial;Diesel;Underway & port emissions	SO_2	0.087
2280002X00	Marine Vessels, Commercial;Diesel;Underway & port emissions	VOC	0.786
2285002006	Railroad Equipment;Diesel;Line Haul Locomotives: Class I Operations	CO	1.334

SCC	SCC Description	Pollutant	Projection Factor
2285002006	Railroad Equipment;Diesel;Line Haul Locomotives: Class I Operations	NH_3	1.325
2285002006	Railroad Equipment;Diesel;Line Haul Locomotives: Class I Operations	NO_X	0.627
2285002006	Railroad Equipment;Diesel;Line Haul Locomotives: Class I Operations	PM_{10}	0.578
2285002006	Railroad Equipment;Diesel;Line Haul Locomotives: Class I Operations	$PM_{2.5}$	0.586
2285002006	Railroad Equipment;Diesel;Line Haul Locomotives: Class I Operations	SO_2	0.005
2285002006	Railroad Equipment;Diesel;Line Haul Locomotives: Class I Operations	VOC	0.589
2285002007	Railroad Equipment;Diesel;Line Haul Locomotives: Class II / III Operations	CO	0.328
2285002007	Railroad Equipment;Diesel;Line Haul Locomotives: Class II / III Operations	NH_3	1.325
2285002007	Railroad Equipment;Diesel;Line Haul Locomotives: Class II / III Operations	NO_X	0.352
2285002007	Railroad Equipment;Diesel;Line Haul Locomotives: Class II / III Operations	PM_{10}	0.286
2285002007	Railroad Equipment;Diesel;Line Haul Locomotives: Class II / III Operations	$PM_{2.5}$	0.288
2285002007	Railroad Equipment;Diesel;Line Haul Locomotives: Class II / III Operations	SO_2	0.001
2285002007	Railroad Equipment;Diesel;Line Haul Locomotives: Class II / III Operations	VOC	0.315
2285002008	Railroad Equipment;Diesel;Line Haul Locomotives: Passenger Trains (Amtrak)	CO	1.071
2285002008	Railroad Equipment;Diesel;Line Haul Locomotives: Passenger Trains (Amtrak)	NH_3	1.325
2285002008	Railroad Equipment;Diesel;Line Haul Locomotives: Passenger Trains (Amtrak)	NO_X	0.496
2285002008	Railroad Equipment;Diesel;Line Haul Locomotives: Passenger Trains (Amtrak)	PM_{10}	0.461
2285002008	Railroad Equipment;Diesel;Line Haul Locomotives: Passenger Trains (Amtrak)	$PM_{2.5}$	0.463
2285002008	Railroad Equipment;Diesel;Line Haul Locomotives: Passenger Trains (Amtrak)	SO_2	0.005
2285002008	Railroad Equipment;Diesel;Line Haul Locomotives: Passenger Trains (Amtrak)	VOC	0.475
2285002009	Railroad Equipment;Diesel;Line Haul Locomotives: Commuter Lines	CO	1.057
2285002009	Railroad Equipment;Diesel;Line Haul Locomotives: Commuter Lines	NH_3	1.325
2285002009	Railroad Equipment;Diesel;Line Haul Locomotives: Commuter Lines	NO_X	0.489
2285002009	Railroad Equipment;Diesel;Line Haul Locomotives: Commuter Lines	PM_{10}	0.455
2285002009	Railroad Equipment;Diesel;Line Haul Locomotives: Commuter Lines	$PM_{2.5}$	0.455
2285002009	Railroad Equipment;Diesel;Line Haul Locomotives: Commuter Lines	SO_2	0.005
2285002009	Railroad Equipment;Diesel;Line Haul Locomotives: Commuter Lines	VOC	0.469
2285002010	Railroad Equipment;Diesel;Yard Locomotives	CO	1.341
2285002010	Railroad Equipment;Diesel;Yard Locomotives	NH_3	1.325
2285002010	Railroad Equipment;Diesel;Yard Locomotives	NO_X	1.128
2285002010	Railroad Equipment;Diesel;Yard Locomotives	PM_{10}	0.914
2285002010	Railroad Equipment;Diesel;Yard Locomotives	$PM_{2.5}$	0.934
2285002010	Railroad Equipment;Diesel;Yard Locomotives	SO_2	0.006
2285002010	Railroad Equipment;Diesel;Yard Locomotives	VOC	1.509

Table 4-22. Additional class 1 railroad and C1/C2 CMV emissions from RFS2 fuel volume changes

Pollutant	2017 Class 1 Rail (tons)	2017 C1/C2 CMV (tons)
1,3-Butadiene	0.83	0.01
Acrolein	0.80	0.08
Formaldehyde	11.12	3.21
Benzene	0.66	0.44
Acetaldehyde	4.83	1.59
CO	1,250	197
NH_3	3.93	0.62
NO_X	5,731	890
PM_{10}	141	29
$PM_{2.5}$	136	27
SO_2	2.96	3.96
VOC	257	21

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. 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-. 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 2017 inventory and override the C1/C2 projection factors in Table 4-.

4.4.3 Class 3 commercial marine vessels (seca_c3)

The seca_c3 sector emissions data were provided by OTAQ in an ASCII raster format used since the SO_2 Emissions Control Area-International Marine Organization (ECA-IMO) project began in 2005. The (S)ECA Category 3 (C3) commercial marine vessel 2002 base-case emissions were projected to year 2005 for the 2005 base case and to 2017, which includes ECA-IMO controls. An overview of the ECA-IMO project and future-year goals for reduction of NO_X, SO_2, and PM C3 emissions.

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 2017 seca_c3 sector emissions are provided in Table 4-23. 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.

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 4-23. NO_X, SO_2, and $PM_{2.5}$ factors to project class 3 CMV emissions for 2017

Region	NO_X	SO_2	$PM_{2.5}$	VOC
Alaska East	1.409	0.062	0.203	1.631
Alaska West	1.469	1.571	1.571	1.571
East Coast	1.435	0.070	0.264	1.955
Gulf Coast	1.120	0.055	0.207	1.529
Hawaii East	1.539	0.078	0.268	2.036
Hawaii West	1.725	2.037	2.035	2.037
North Pacific	1.240	0.064	0.222	1.644
South Pacific	1.573	0.084	0.293	2.114
Great Lakes	1.106	0.046	0.171	1.302
Outside ECA	1.585	1.891	1.891	1.891

4.5 Canada, Mexico, and offshore sources (othar, othon, and othpt)

Emissions for Canada, Mexico, and offshore sources were not projected to future years, and are therefore the same as those used in the 2005 base case for all MATS scenarios. 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.

4.6 Reference case emission summaries

Table 4-24 shows a summary of the 2005 and modeled reference case emissions for the lower 48 states. Table 4-25 and Table 4-26 provide summaries of SO_2 and $PM_{2.5}$ in the 2017 baseline for each sector by state. Table 4-27shows the future year baseline EGU emissions by state for all criteria air pollutants.

Table 4-24. Summary of modeled base case SO_2 and $PM_{2.5}$ annual emissions (tons/year) for 48 states by sector

Source Sector SO_2 Emissions	**2005**	**2017**
EGU Point	10,380,883	3,281,364
Non-EGU Point	2,030,759	1,534,991
Nonpoint	1,216,362	1,125,985
Nonroad	446,831	15,759
On-road	168,480	29,288
Average Fire	49,094	49,094
Total SO_2, All Sources	**14,292,410**	**6,036,480**
Source Sector $PM_{2.5}$ Emissions	**2005**	**2017**
EGU Point	496,877	276,430
Non-EGU Point	433,346	411,437
Nonpoint	2,110,298	1,912,757
Nonroad	268,745	150,221
On-road	301,073	129,416
Average Fire	684,035	684,035
Total $PM_{2.5}$, All Sources	**4,294,373**	**3,564,296**

Table 4-25. Reference case SO_2 emissions (tons/year) for states by sector

State	EGU	NonEGU	Nonpoint	Nonroad	Onroad	Fires	Total
Alabama	186,084	63,053	52,341	146	569	983	303,177
Arizona	36,996	24,191	2,467	59	724	2,888	67,324
Arkansas	92,804	12,160	26,801	123	314	728	132,929
California	5,346	21,046	67,846	3,311	2,087	6,735	106,370
Colorado	74,255	1,415	6,210	50	532	1,719	84,181
Connecticut	3,581	1,833	18,149	100	311	4	23,978
Delaware	2,835	4,770	1,018	500	91	6	9,220
District of Columbia	5	686	1,505	3	38	0	2,237
Florida	117,702	49,082	70,073	1,255	2,111	7,018	247,241
Georgia	96,712	44,248	55,946	192	1,158	2,010	200,266
Idaho	182	17,133	2,894	23	162	3,845	24,240
Illinois	118,217	81,683	5,650	295	1,107	20	206,971
Indiana	200,969	73,930	59,771	150	760	24	335,604
Iowa	85,178	22,865	19,929	86	324	25	128,407
Kansas	45,740	10,288	36,140	57	294	103	92,622
Kentucky	116,927	23,530	33,852	215	463	364	175,350
Louisiana	142,447	129,730	2,669	1,449	447	892	277,634
Maine	2,564	14,285	2,007	72	149	150	19,226
Maryland	29,786	33,562	40,642	494	593	32	105,110
Massachusetts	15,133	17,077	24,907	266	565	93	58,041
Michigan	163,168	48,697	42,185	448	995	91	255,584
Minnesota	52,380	24,742	14,635	220	558	631	93,164
Mississippi	34,865	24,284	6,635	208	396	1,051	67,440
Missouri	178,143	33,757	44,680	191	722	186	257,679
Montana	24,018	7,212	1,875	25	106	1,422	34,657
Nebraska	70,910	6,885	7,899	58	202	105	86,058
Nevada	14,140	2,132	12,028	27	200	1,346	29,873
New Hampshire	6,719	2,471	7,284	21	137	38	16,671
New Jersey	9,042	6,700	9,528	686	757	61	26,774
New Mexico	10,211	7,813	2,719	26	262	3,450	24,480
New York	14,653	45,222	71,060	659	1,466	113	133,173
North Carolina	71,113	58,517	21,713	197	890	696	153,125
North Dakota	105,344	9,915	5,559	36	71	66	120,991
Ohio	180,935	93,600	19,777	373	1,093	22	295,799
Oklahoma	141,433	27,873	7,731	49	501	469	178,056
Oregon	13,211	9,790	9,508	218	361	4,896	37,985
Pennsylvania	126,316	64,697	67,650	427	1,060	32	260,183
Rhode Island	0	2,745	3,338	33	85	1	6,202
South Carolina	103,694	28,536	13,310	294	500	646	146,980
South Dakota	29,711	1,655	10,301	23	86	498	42,273
Tennessee	33,080	59,145	32,624	154	757	277	126,037
Texas	249,748	129,667	108,633	1,146	2,483	1,178	492,855
Tribal	0	676	0	0	0	0	676
Utah	34,912	6,599	3,365	27	291	1,934	47,128
Vermont	264	902	5,283	8	129	49	6,634
Virginia	51,004	50,387	32,439	275	849	399	135,353
Washington	5,569	19,780	6,885	881	633	407	34,156
West Virginia	84,344	32,458	14,322	64	178	215	131,582
Wisconsin	50,777	61,080	6,260	122	633	70	118,941

State	EGU	NonEGU	Nonpoint	Nonroad	Onroad	Fires	Total
Wyoming	48,198	20,491	5,944	18	87	1,106	75,844
Total	3,281,364	1,534,991	1,125,985	15,759	29,288	49,094	6,036,480

Table 4-26. Reference case $PM_{2.5}$ emissions (tons/year) for states by sector

State	EGU	NonEGU	Nonpoint	Nonroad	Onroad	Fires	Total
Alabama	13,154	17,052	33,235	2,403	2,217	13,938	81,999
Arizona	3,889	3,809	20,214	2,674	2,762	37,151	70,498
Arkansas	2,838	10,527	33,486	2,042	1,242	10,315	60,450
California	475	20,693	73,607	14,875	13,492	97,302	220,443
Colorado	3,845	7,037	19,868	2,350	2,387	24,054	59,540
Connecticut	400	222	6,838	1,038	1,414	56	9,968
Delaware	434	772	1,207	383	375	87	3,259
District of Columbia	1	172	536	139	154	0	1,002
Florida	12,723	24,620	50,472	8,100	7,652	99,484	203,050
Georgia	13,445	12,105	59,412	3,803	4,863	24,082	117,711
Idaho	36	2,076	40,288	1,186	714	52,808	97,108
Illinois	8,587	13,471	70,775	6,885	4,926	277	104,922
Indiana	22,354	13,570	72,501	3,491	3,380	344	115,640
Iowa	4,298	7,000	51,684	3,348	1,519	349	68,198
Kansas	3,199	6,895	136,633	2,872	1,268	1,468	152,335
Kentucky	12,078	10,353	26,811	2,717	2,059	5,155	59,173
Louisiana	3,093	30,865	27,082	5,107	1,673	12,647	80,467
Maine	355	3,543	8,213	881	750	2,127	15,869
Maryland	3,969	6,382	18,960	1,975	2,492	531	34,310
Massachusetts	1,465	2,123	23,729	1,914	2,590	1,324	33,145
Michigan	8,102	11,688	43,055	4,696	4,949	1,283	73,773
Minnesota	2,598	9,867	68,121	4,483	2,882	8,943	96,893
Mississippi	2,201	10,492	31,474	2,337	1,525	14,897	62,926
Missouri	7,061	6,384	69,722	3,954	3,059	2,636	92,816
Montana	3,870	2,562	28,479	1,332	492	17,311	54,048
Nebraska	2,358	2,834	44,904	2,967	919	1,483	55,465
Nevada	2,505	4,032	9,351	1,319	857	19,018	37,083
New Hampshire	1,130	464	8,981	576	663	534	12,348
New Jersey	2,452	2,520	8,559	2,929	3,244	865	20,569
New Mexico	3,153	1,442	49,789	1,148	1,103	48,662	105,298
New York	2,331	4,859	44,334	5,032	6,723	1,601	64,879
North Carolina	9,983	12,656	43,398	3,583	3,521	9,870	83,011
North Dakota	5,870	795	40,802	2,126	383	934	50,910
Ohio	18,920	12,353	47,811	5,302	5,013	316	89,715
Oklahoma	3,530	5,695	88,862	2,029	2,006	6,644	108,767
Oregon	381	8,869	39,503	2,148	1,627	65,350	117,877
Pennsylvania	16,727	14,874	38,523	4,582	4,854	454	80,014
Rhode Island	4	256	1,070	222	383	14	1,949
South Carolina	9,997	4,527	23,430	1,932	1,929	9,163	50,978
South Dakota	737	2,399	32,697	1,339	416	7,062	44,650
Tennessee	5,053	21,553	28,449	2,939	3,057	3,934	64,985
Texas	21,677	34,648	187,604	11,901	9,289	21,578	286,698
Tribal	1	1,568	0	0	0	0	1,569
Utah	4,524	3,530	13,978	963	1,318	27,412	51,724

State	EGU	NonEGU	Nonpoint	Nonroad	Onroad	Fires	Total
Vermont	67	336	4,930	307	653	696	6,989
Virginia	4,529	10,165	32,254	3,507	3,446	5,659	59,561
Washington	1,444	4,421	35,706	3,328	2,874	4,487	52,259
West Virginia	13,602	4,281	12,951	1,048	762	3,050	35,695
Wisconsin	5,323	7,853	27,656	3,161	3,148	994	48,135
Wyoming	5,662	10,225	30,812	850	392	15,686	63,626
Total	276,430	411,437	1,912,757	150,221	129,416	684,035	3,564,296

Table 4-27. Future year baseline EGU CAP emissions (tons/year) by state

State	CO	NO_X	VOC	SO_2	NH_3	PM_{10}	$PM_{2.5}$
Alabama	27,024	64,064	1,524	186,084	1,472	16,686	13,154
Arizona	16,797	36,971	825	36,996	1,163	5,038	3,889
Arkansas	9,925	36,297	658	92,804	560	3,507	2,838
California	45,388	20,910	1,031	5,346	2,519	580	475
Colorado	9,006	50,879	636	74,255	398	4,605	3,845
Connecticut	9,180	2,738	139	3,581	313	431	400
Delaware	4,256	2,452	132	2,835	119	580	434
District of Columbia	67	11	2	5	3	1	1
Florida	72,915	83,174	2,253	117,702	3,997	19,098	12,723
Georgia	16,537	43,778	1,293	96,712	903	18,668	13,445
Idaho	1,532	613	41	182	57	38	36
Illinois	51,862	56,128	3,091	118,217	1,437	9,926	8,587
Indiana	30,587	106,881	2,295	200,969	1,317	33,816	22,354
Iowa	8,316	42,698	791	85,178	452	5,735	4,298
Kansas	5,066	25,163	683	45,740	305	3,996	3,199
Kentucky	37,287	71,259	1,604	116,927	928	16,279	12,078
Louisiana	32,626	33,509	852	142,447	1,427	3,677	3,093
Maine	12,789	6,121	306	2,564	269	366	355
Maryland	13,446	17,933	533	29,786	301	5,322	3,969
Massachusetts	7,128	7,991	279	15,133	395	1,915	1,465
Michigan	25,856	66,846	1,497	163,168	874	11,056	8,102
Minnesota	9,365	36,867	746	52,380	460	3,034	2,598
Mississippi	9,704	27,319	440	34,865	469	3,113	2,201
Missouri	16,499	52,464	1,714	178,143	740	9,093	7,061
Montana	5,266	20,946	338	24,018	198	6,117	3,870
Nebraska	4,691	28,898	542	70,910	292	2,948	2,358
Nevada	9,677	15,627	438	14,140	953	3,095	2,505
New Hampshire	5,667	4,908	206	6,719	207	1,234	1,130
New Jersey	25,831	11,178	823	9,042	747	2,948	2,452
New Mexico	9,079	65,189	574	10,211	570	3,833	3,153
New York	19,731	21,172	731	14,653	1,076	3,248	2,331
North Carolina	17,367	44,141	1,076	71,113	654	13,368	9,983
North Dakota	7,437	53,778	867	105,344	383	6,757	5,870
Ohio	33,481	93,150	2,005	180,935	1,317	25,688	18,920
Oklahoma	26,165	47,454	957	141,433	1,073	4,457	3,530
Oregon	5,905	10,828	203	13,211	381	446	381
Pennsylvania	38,767	123,501	2,023	126,316	1,522	22,117	16,727
Rhode Island	1,748	456	44	0	136	7	4
South Carolina	10,305	37,516	726	103,694	515	14,469	9,997

State	CO	NO_X	VOC	SO_2	NH_3	PM_{10}	$PM_{2.5}$
South Dakota	742	14,293	129	29,711	48	764	737
Tennessee	10,693	16,982	862	33,080	406	6,313	5,053
Texas	78,317	145,182	4,975	249,748	5,304	31,404	21,677
Tribal	601	73	15	0	47	2	1
Utah	5,632	67,476	526	34,912	279	5,843	4,524
Vermont	1,868	458	52	264	25	69	67
Virginia	30,205	39,408	821	51,004	1,115	5,404	4,529
Washington	7,183	14,284	326	5,569	346	1,706	1,444
West Virginia	15,496	54,247	1,320	84,344	658	18,415	13,602
Wisconsin	19,247	35,179	1,137	50,777	649	6,503	5,323
Wyoming	9,087	71,380	970	48,198	481	7,385	5,662
TOTAL	873,344	1,930,769	46,050	3,281,364	40,259	371,101	276,430

* Emission estimates apply to all fossil Electric Generating Units, including those with capacity < 25MW

5 MATS Control Case

For the future year control case (i.e., policy case) air quality modeling, the emissions for all sectors were unchanged from the base case modeling except for those from EGUs. The IPM model was used to prepare the future year policy case for EGU emissions. The air quality modeling for MATS relied on EGU emission projections from an interim IPM platform based on the Cross-state Air Pollution Rule version 4.10_FTransport, and was subsequently updated during the rulemaking process. The updates made include: updated assumptions regarding the removal of HCl by alkaline fly ash in subbituminous and lignite coals; an update to the fuel-based mercury emission factor for petroleum coke, which was corrected based on re-examination of the 1999 ICR data; updated capital cost for new nuclear capacity and nuclear life extension costs; corrected variable operating and maintenance cost (VOM) for ACI retrofits; adjusted coal rank availability for some units, consistent with EIA From 923 (2008); updated state rules in Washington and Colorado; and numerous unit-level revisions based on comments received through the notice and comment process. Additional details on the version of IPM used to develop the control case are available in Chapter 3.

The changes in EGU SO_2, and $PM_{2.5}$ emissions as a result of the policy case for the lower 48 states are summarized in Table 5-1. Table 5-2 shows the CAP emissions for the modeled MATS control case by State. State-specific difference summaries of EGU SO_2 and $PM_{2.5}$ for the sum of the lower 48 states are shown in Table 5-3 and Table 5-4 respectively.

Table 5-1. Summary of emissions changes for the MATS AQ modeling in the lower 48 states

Future Year EGU Emissions	**SO_2**	**$PM_{2.5}$**
Base Case EGU Emissions (tons)	3,281,364	276,430
Control Case EGU Emissions (tons)	1,866,247	223,320
Reductions to Base Case in Control case (tons)	1,415,117	53,110
Percentage Reduction of Base EGU Emissions	43%	19%
Total Man-made Emissions*		
Total Base Case Emissions (tons)	6,036,480	3,564,296
Total Control Case Emissions (tons)	4,621,363	3,511,186
Percentage Reduction of All Man-made Emissions	23%	1%
* In this table, man-made emissions includes average fires.		

Table 5-2. EGU emissions totals for the Modeled MATS control case in the lower 48 states

State	**CO**	**NO_X**	**VOC**	**SO_2**	**NH_3**	**PM_{10}**	**$PM_{2.5}$**
Alabama	20,873	61,863	1,313	68,517	1,235	9,734	7,844
Arizona	13,238	34,804	749	23,459	921	4,264	3,494
Arkansas	9,036	35,788	642	35,112	490	1,696	1,593
California	56,360	27,159	1,307	5,041	2,548	1,057	942
Colorado	8,219	44,409	582	19,564	358	3,492	2,859
Connecticut	8,017	2,800	136	1,400	313	439	412
Delaware	1,312	2,527	67	4,160	93	3,056	1,455
District of Columbia							
Florida	66,378	61,676	2,055	64,791	3,482	16,434	11,377
Georgia	14,217	41,006	1,197	78,197	790	11,165	9,742
Idaho	1,523	609	41	182	56	38	36

State	CO	NO_X	VOC	SO_2	NH_3	PM_{10}	$PM_{2.5}$
Illinois	24,365	50,655	2,353	103,867	1,050	7,309	6,588
Indiana	17,061	102,045	1,872	156,781	1,110	29,683	20,388
Iowa	7,340	41,247	747	48,030	410	3,318	2,947
Kansas	4,683	22,136	623	22,767	282	2,504	2,263
Kentucky	25,911	70,126	1,476	125,430	882	12,544	10,635
Louisiana	28,171	31,655	767	30,509	1,261	2,003	1,899
Maine	10,992	5,683	302	1,372	267	342	331
Maryland	4,283	16,554	400	18,091	211	3,851	3,143
Massachusetts	5,408	7,211	226	5,033	344	1,702	1,267
Michigan	18,792	60,982	1,215	82,834	718	8,261	6,893
Minnesota	8,699	34,942	709	33,214	430	3,332	2,936
Mississippi	8,782	20,749	410	15,975	397	1,949	1,720
Missouri	12,249	52,755	1,605	95,965	686	5,216	4,809
Montana	2,223	19,758	264	6,399	133	2,637	1,727
Nebraska	4,493	28,180	533	34,631	277	2,152	1,828
Nevada	7,178	14,382	336	6,372	725	2,626	2,073
New Hampshire	6,781	4,862	232	2,102	232	1,336	1,264
New Jersey	8,350	7,699	315	6,404	546	2,020	1,583
New Mexico	7,987	64,922	545	9,984	554	2,961	2,750
New York	18,725	20,863	699	28,174	1,086	3,123	2,350
North Carolina	15,195	35,309	1,033	59,551	602	8,885	7,988
North Dakota	7,266	53,267	858	23,889	371	5,940	5,051
Ohio	29,956	85,565	1,852	139,208	1,229	19,599	15,823
Oklahoma	26,687	44,725	892	44,602	970	2,293	2,056
Oregon	6,002	9,671	198	3,565	379	241	233
Pennsylvania	24,865	104,906	1,645	93,606	1,349	17,330	14,080
Rhode Island	1,721	443	43	0	134	7	4
South Carolina	9,826	37,849	725	40,901	459	9,627	6,963
South Dakota	641	14,290	117	2,483	41	260	245
Tennessee	5,551	16,931	723	42,666	334	6,721	5,272
Texas	71,475	138,086	4,444	105,958	4,774	25,359	17,601
Tribal	266	32	7	0	21	1	1
Utah	4,003	65,286	474	17,007	241	4,755	3,896
Vermont	1,868	458	52	264	25	69	67
Virginia	26,778	37,255	707	33,704	748	5,306	4,506
Washington	6,334	3,834	179	854	254	183	176
West Virginia	13,923	47,836	1,263	66,857	632	14,321	11,572
Wisconsin	16,124	32,865	1,012	28,322	578	4,725	3,969
Wyoming	7,516	71,135	932	28,456	467	5,946	4,671
TOTAL	707,640	1,789,790	40,875	1,866,247	35,493	281,811	223,320

Table 5-3. State-specific changes in annual EGU SO_2 for the lower 48 states

State	Future year baseline SO_2 (tons)	Future Year Policy Case SO_2 (tons)	EGU SO_2 reduction (tons)	EGU SO_2 reduction (%)
Alabama	186,084	68,517	117,568	63%
Arizona	36,996	23,459	13,537	37%
Arkansas	92,804	35,112	57,692	62%
California	5,346	5,041	305	6%
Colorado	74,255	19,564	54,690	74%

Connecticut	3,581	1,400	2,181	61%
Delaware	2,835	4,160	-1,324	-47%
District of Columbia	5	0	5	100%
Florida	117,702	64,791	52,911	45%
Georgia	96,712	78,197	18,515	19%
Idaho	182	182	0	0%
Illinois	118,217	103,867	14,350	12%
Indiana	200,969	156,781	44,189	22%
Iowa	85,178	48,030	37,148	44%
Kansas	45,740	22,767	22,973	50%
Kentucky	116,927	125,430	-8,503	-7%
Louisiana	142,447	30,509	111,938	79%
Maine	2,564	1,372	1,191	46%
Maryland	29,786	18,091	11,695	39%
Massachusetts	15,133	5,033	10,100	67%
Michigan	163,168	82,834	80,334	49%
Minnesota	52,380	33,214	19,165	37%
Mississippi	34,865	15,975	18,890	54%
Missouri	178,143	95,965	82,177	46%
Montana	24,018	6,399	17,618	73%
Nebraska	70,910	34,631	36,279	51%
Nevada	14,140	6,372	7,768	55%
New Hampshire	6,719	2,102	4,618	69%
New Jersey	9,042	6,404	2,638	29%
New Mexico	10,211	9,984	228	2%
New York	14,653	28,174	-13,521	-92%
North Carolina	71,113	59,551	11,562	16%
North Dakota	105,344	23,889	81,455	77%
Ohio	180,935	139,208	41,727	23%
Oklahoma	141,433	44,602	96,831	68%
Oregon	13,211	3,565	9,646	73%
Pennsylvania	126,316	93,606	32,710	26%
Rhode Island	0	0	0	N/A
South Carolina	103,694	40,901	62,793	61%
South Dakota	29,711	2,483	27,228	92%
Tennessee	33,080	42,666	-9,586	-29%
Texas	249,748	105,958	143,790	58%
Tribal	0	0	0	N/A
Utah	34,912	17,007	17,905	51%
Vermont	264	264	0	0%
Virginia	51,004	33,704	17,300	34%
Washington	5,569	854	4,716	85%
West Virginia	84,344	66,857	17,488	21%
Wisconsin	50,777	28,322	22,454	44%
Wyoming	48,198	28,456	19,742	41%
TOTAL	**3,281,364**	**1,866,247**	**1,415,117**	

Table 5-4. State-specific changes in annual EGU $PM_{2.5}$ for the lower 48 states

State	Future year baseline PM2.5 (tons)	Future Year Policy Case $PM_{2.5}$ (tons)	EGU $PM_{2.5}$ reduction (tons)	EGU $PM_{2.5}$ reduction (%)
Alabama	13,154	7,844	5,310	40%
Arizona	3,889	3,494	395	10%
Arkansas	2,838	1,593	1,246	44%
California	475	942	-467	-98%
Colorado	3,845	2,859	985	26%
Connecticut	400	412	-12	-3%
Delaware	434	1,455	-1,021	-235%
District of Columbia	1	0	1	100%
Florida	12,723	11,377	1,346	11%
Georgia	13,445	9,742	3,703	28%
Idaho	36	36	0	0%
Illinois	8,587	6,588	2,000	23%
Indiana	22,354	20,388	1,966	9%
Iowa	4,298	2,947	1,351	31%
Kansas	3,199	2,263	936	29%
Kentucky	12,078	10,635	1,443	12%
Louisiana	3,093	1,899	1,193	39%
Maine	355	331	24	7%
Maryland	3,969	3,143	826	21%
Massachusetts	1,465	1,267	198	14%
Michigan	8,102	6,893	1,210	15%
Minnesota	2,598	2,936	-339	-13%
Mississippi	2,201	1,720	481	22%
Missouri	7,061	4,809	2,252	32%
Montana	3,870	1,727	2,143	55%
Nebraska	2,358	1,828	530	22%
Nevada	2,505	2,073	432	17%
New Hampshire	1,130	1,264	-134	-12%
New Jersey	2,452	1,583	868	35%
New Mexico	3,153	2,750	403	13%
New York	2,331	2,350	-19	-1%
North Carolina	9,983	7,988	1,995	20%
North Dakota	5,870	5,051	819	14%
Ohio	18,920	15,823	3,097	16%
Oklahoma	3,530	2,056	1,474	42%
Oregon	381	233	148	39%
Pennsylvania	16,727	14,080	2,646	16%
Rhode Island	4	4	0	2%
South Carolina	9,997	6,963	3,033	30%
South Dakota	737	245	492	67%
Tennessee	5,053	5,272	-219	-4%
Texas	21,677	17,601	4,077	19%
Tribal	1	1	1	56%
Utah	4,524	3,896	627	14%

State	Future year baseline PM2.5 (tons)	Future Year Policy Case $PM_{2.5}$ (tons)	EGU $PM_{2.5}$ reduction (tons)	EGU $PM_{2.5}$ reduction (%)
Vermont	67	67	0	0%
Virginia	4,529	4,506	24	1%
Washington	1,444	176	1,268	88%
West Virginia	13,602	11,572	2,031	15%
Wisconsin	5,323	3,969	1,354	25%
Wyoming	5,662	4,671	991	17%
TOTAL	**276,430**	**223,320**	**53,110**	

6 References

EPA, 2005. Clean Air Interstate Rule Emissions Inventory Technical Support Document, U.S. Environmental Protection Agency, Office of Air Quality Planning and Standards, March 2005.

EPA, 2006. Regulatory Impact Analyses, 2006 National Ambient Air Quality Standards for Particle Pollution. U.S. Environmental Protection Agency, Office of Air Quality Planning and Standards, October, 2006. Docket # EPA-HQ-OAR-2001-0017, # EPAHQ-OAR-2006-0834.

EPA, 2007a. Guidance for Estimating VOC and NOx Emission Changes from MACT Rules, U.S. Environmental Protection Agency Office of Air Quality Planning and Standards, Air Quality Policy Division, Research Triangle Park, NC 27711, EPA-457/B-07-001, May 2007.

EPA. 2007b. National Scale Modeling for the Final Mobile Source Air Toxics Rule, Office of Air Quality Planning and Standards, Emissions Analysis and Monitoring Division, Research Triangle Park, NC 27711, EPA 454/R-07-002, February 2007.

EPA, 2009. Regulatory Impact Analysis: Control of Emissions of Air Pollution from Locomotive Engines and Marine Compression Ignition Engines Less than 30 Liters Per Cylinder. U.S. Environmental Protection Agency Office of Transportation and Air Quality, Assessment and Standards Division, Ann Arbor, MI 48105, EPA420-R-08-001a, May 2009.

EPA, 2010. Technical Support Document: The Industrial Sectors Integrated Solutions (ISIS) Model and the Analysis for the National Emission Standards for Hazardous Air Pollutants and New Source Performance Standards for the Portland Cement Manufacturing Industry, U.S. Environmental Protection Agency, Sectors Policies and Program Division and Air Pollution Prevention and Control Division, Research Triangle Park, NC 27711, August 2010.

APPENDIX A

Ancillary Datasets and Parameters Used for Each MATS Modeling Case

The ancillary data files used for the MATS cases are shown in Table A-1. The Input name column gives a brief designator for the dataset. The Environment Variable column gives the name of the environment variable that is used by SMOKE to specify the input. The Sector column specifies the modeling sector for the dataset. The remaining columns show the data set name and version used in the 2005 base case and 2017 reference case.

To match the Datasets and Versions listed in this table to actual data files, combine the Dataset name and the version number in the following pattern: <Dataset Name>_<Date>_<Version number>.txt, where <Date> is the last date of change for that version and will have a unique value for the combination of Dataset Name and Version number.

Table A-2 shows the parameters used for the MATS modeling cases. The columns are the same as in Table A-1 except that the Program is not shown. Many of the parameters apply to all programs, or all programs for the specified processing sector. The values for the control case are not shown, but they are the same as those used for the 2017 reference case.

Table A-1. List of ancillary data sets associated with the MATS modeling cases.

Input Name	Environment Variable	Program	Sector	2005 Base Case	2017 Reference Case
Area-to-point data	ARTOPNT	smkinven		artopnt_2002detroit [v0]	artopnt_2002detroit [v0]
BEIS3 emission factors	B3FAC	Tmpbeis3	beis	beis3_efac_v3.14 [v0]	beis3_efac_v3.14 [v0]
Biogenic gridding surrogate for reports 12EUS1	BGPRO	Smkmerge	beis	bgpro_12EUS1 (/garnet/oaqps) [v0]	bgpro_12EUS1 (/garnet/oaqps) [v0]
Biogenic gridding surrogate for reports 36US1	BGPRO	Smkmerge	beis	bgpro_36US1 (/garnet/oaqps) [v0]	bgpro_36US1 (/garnet/oaqps) [v0]
Biogenic land use, file A, 12EUS1	BELD3_A	Normbeis3	beis	LANDA_EUS12_279X240 (/garnet/oaqps) [v0]	LANDA_EUS12_279X240 (/garnet/oaqps) [v0]
Biogenic land use, file A, 36US1	BELD3_A	Normbeis3	beis	LANDA_US36_148X112 (/garnet/oaqps) [v0]	LANDA_US36_148X112 (/garnet/oaqps) [v0]
Biogenic land use, file B, 12EUS1	BELD3_B	Normbeis3	beis	LANDB_EUS12_279X240 (/garnet/oaqps) [v0]	LANDB_EUS12_279X240 (/garnet/oaqps) [v0]
Biogenic land use, file B, 36US1	BELD3_B	Normbeis3	beis	LANDB_US36_148X112 (/garnet/oaqps) [v0]	LANDB_US36_148X112 (/garnet/oaqps) [v0]
Biogenic land use, totals, 12EUS1	BELD3_TOT	Normbeis3	beis	LAND_TOTALS_EUS12_279X240 (/garnet/oaqps) [v0]	LAND_TOTALS_EUS12_279X240 (/garnet/oaqps) [v0]
Biogenic land use, totals, 36US1	BELD3_TOT	Normbeis3	beis	LAND_TOTALS_US36_148X112 (/garnet/oaqps) [v0]	LAND_TOTALS_US36_148X112 (/garnet/oaqps) [v0]

Bioseasons file 12EUS1	BIOSEASON	Tmpbeis3	beis	bioseason.cmaq.2005b_12km (/garnet/oaqps) [v0]	bioseason.cmaq.2005b_12km (/garnet/oaqps) [v0]
Bioseasons file 36US1 mcip v3.4 beta4 b	BIOSEASON	Tmpbeis3	beis	bioseason.cmaq.2005b_36km (/garnet/oaqps) [v0]	bioseason.cmaq.2005b_36km (/garnet/oaqps) [v0]
CEM annually summed data	CEMSUM	smkinven	ptipm	cemsum_ptipm_2005 (/orchid/share) [v0]	cemsum_ptipm_2005 (/garnet/oaqps) [v0]
Combination profiles	GSPRO_COMBO	Spcmat		gspro_combo_2005 [v6]	gspro_combo_2005 [v6]
Combination profiles - nonpt	GSPRO_COMBO	Spcmat	nonpt	gspro_combo_tier3_2005_base_nonpt_v2 [v2]	gspro_combo_tier3_2017_ref_nonpt [v1]
Combination profiles - nonroad	GSPRO_COMBO	Spcmat	nonroad	gspro_combo_tier3_2005_base_nonroad_v2 [v0]	
Combination profiles – onroad	GSPRO_COMBO	Spcmat	onroad	gspro_combo_tier3_2005_base_onroad_v2 [v0]	gspro_combo_tier3_2017_ref_onroad [v2]
Combination profiles - ptnonipm (same as nonpt)	GSPRO_COMBO	Spcmat	ptnonipm	gspro_combo_tier3_2005_base_nonpt_v2 [v2]	gspro_combo_tier3_2005_base_nonpt_v2 [v2]
Country, State, County Information	COSTCY	smkinven		costcy_for_2002 [v5]	costcy_for_2002 [v5]
Elevation Configuration File for Point Sources	PELVCONFIG	Laypoint		pelvconfig_inline_allpts [v1]	pelvconfig_inline_allpts [v1]
Elevation Configuration File for seca_c3 sector	PELVCONFIG	Laypoint	seca_c3	pelvconfig_seca_c3 [v1]	pelvconfig_seca_c3 [v1]

Grid Description List	GRIDDESC	Grdmat		griddesc_lambertonly [v39]	griddesc_lambertonly [v39]
Gridding surrogates CAN-MEX 12km	SRGPRO	Grdmat	othon	Canada_12km_revised (/garnet/oaqps) [v0]	Canada_12km_revised (/garnet/oaqps) [v0]
Gridding surrogates CAN-MEX 12km	SRGPRO	Grdmat	othar	Canada_12km_revised (/garnet/oaqps) [v0]	Canada_12km_revised (/garnet/oaqps) [v0]
Gridding surrogates CAN-MEX 36km	SRGPRO	Grdmat	othar	Canada_36km_revised (/garnet/oaqps) [v0]	Canada_36km_revised (/garnet/oaqps) [v0]
Gridding surrogates CAN-MEX 36km	SRGPRO	Grdmat	othon	Canada_36km_revised (/garnet/oaqps) [v0]	Canada_36km_revised (/garnet/oaqps) [v0]
Gridding surrogates USA 12km	SRGPRO	Grdmat		USA-CAN-MEX_12km (/garnet/oaqps) [v0]	USA-CAN-MEX_12km (/garnet/oaqps) [v0]
Gridding surrogates USA 36km	SRGPRO	Grdmat		USA-CAN-MEX_36km (/garnet/oaqps) [v0]	USA-CAN-MEX_36km (/garnet/oaqps) [v0]
GSCNV - pollutant to pollutant conversions	GSCNV	Spcmat		gscnv_cb05_soa [v2]	gscnv_cb05_soa [v3]
GSPRO speciated MOVES PM	GSPROTMP_L	Spcmat		gspro_speciated_pm [v3]	gspro_speciated_pm [v3]
GSREF speciated PM	GSREFTMP_L	Spcmat		gsref_speciated_pm [v2]	gsref_speciated_pm [v2]
Holidays table	HOLIDAYS	Temporal		holidays [v0]	holidays [v0]

Inventory Table - HAPCAP EBAFM integration CMAQ-lite v4.7 N1e HDGHG	INVTABLE	smkinven	onroad	invtable_hapcap_cb05soa [v13]	invtable_hapcap_cb05soa [v13]
Inventory Table - HAPCAP EBAFM integration CMAQ-lite v4.7 N1e HDGHG	INVTABLE	smkinven	nonpt	invtable_hapcap_cb05soa [v13]	invtable_hapcap_cb05soa [v13]
Inventory Table - HAPCAP integration CMAQ-lite v4.7 N1e HDGHG	INVTABLE	smkinven		invtable_hapcap_cb05soa [v12]	invtable_hapcap_cb05soa [v12]
Inventory Table -no-BAFM CMAQ-lite v4.7 N1e HDGHG	INVTABLE	smkinven	avefire	invtable_hapcap_cb05_no_bafm [v3]	invtable_hapcap_cb05_no_bafm [v3]
Inventory Table -no-BAFM CMAQ-lite v4.7 N1e HDGHG	INVTABLE	smkinven	ptipm	invtable_hapcap_cb05_no_bafm [v3]	invtable_hapcap_cb05_no_bafm [v3]
List of sectors for mrggrid	SECTORLIST	Mrggrid		sectorlist_2005ct_05b [v3]	sectorlist_2017ct_ref_05b [v1]
List of sectors for mrggrid	SECTORLIST	Mrggrid		sectorlist_2005ct_05b [v2]	sectorlist_2017ct_ref_05b [v0]
List of sectors for mrggrid	SECTORLIST	Mrggrid		sectorlist_2005ct_05b [v1]	sectorlist_2017ct_ref_05b [v0]
MACT Description	MACTDESC	Smkreport		mactdesc_2002v3 [v1]	mactdesc_2002v3 [v1]
Meteorology temperature profiles	METMOVES	movesmrg	onroad	SMOKE_DAILY_12MERGEUS1_2005 [v0]	SMOKE_DAILY_12MERGEUS1_2005 [v0]
Mobile codes file default	MCODES	smkinven		mcodes [v1]	mcodes [v1]
MOVES county cross-reference	MCXREF	movesmrg	onroad	MCXREF_tier3 [v0]	MCXREF_tier3 [v0]
MOVES Emission Factor Table list	MRCLIST	movesmrg	onroad	mrclist_RPV_05jul2011_2005ct_05b [v0]	mrclist_RPV_01jul2011_2017ct_ref_05b [v0]

MOVES Emission Factor Table list	MRCLIST	movesmrg	onroad	mrclist_RPD_20may2011_2005ct_05b [v0]	mrclist_RPD_10jun2011_2017ct_ref_05b [v0]
MOVES Emission Factor Table list	MRCLIST	movesmrg	onroad	mrclist_RPP_20may2011_2005ct_05b [v0]	mrclist_RPP_10jun2011_2017ct_ref_05b [v0]
MOVES Emission Factor Tables	EFTABLES	movesmrg	onroad	EFtables_20110520_Tier3Base2005 [v0]	EFtables_20110610_Tier3Ref2017 [v0]
MOVES Emission Factor Tables	EFTABLES	movesmrg	onroad	EFtables_20110705_Tier3Base2005_RPVfix [v0]	EFtables_20110701_Tier3Ref2017_RPVfix [v0]
MOVES processes and pollutants	MEPROC	movesmrg	onroad	meproc_RPP_mplite [v0]	meproc_RPP_mplite [v0]
MOVES processes and pollutants	MEPROC	movesmrg	onroad	meproc_RPV_mplite [v1]	meproc_RPV_mplite [v1]
MOVES processes and pollutants	MEPROC	movesmrg	onroad	meproc_RPD_mplite [v2]	meproc_RPD_mplite [v2]
MOVES reference county fuel month	MFMREF	movesmrg	onroad	MFMREF_tier3 [v0]	MFMREF_tier3 [v0]
NAICS descriptions	NAICSDESC	Smkreport		naicsdesc [v0]	naicsdesc [v0]
NHAPEXCLUDE alm_no_c3	NHAPEXCLUDE	smkinven	alm_no_c3	nhapexclude_alm_no_c3_pf4 [v1]	nhapexclude_alm_no_c3_pf4 [v1]
NHAPEXCLUDE avefire	NHAPEXCLUDE	smkinven	avefire	nhapexclude_everything [v0]	nhapexclude_everything [v0]
NHAPEXCLUDE nonpt	NHAPEXCLUDE	smkinven	nonpt	nhapexclude_nonpt_pf4_addpesticides [v3]	nhapexclude_nonpt_pf4_addpesticides [v3]

NHAPEXCLUDE NONROAD	NHAPEXCL UDE	smkinven	nonroad	nhapexclude_nonroad_pf4 [v0]	nhapexclude_nonroad_pf4 [v0]
NHAPEXCLUDE ptnonipm	NHAPEXCL UDE	smkinven	ptnonipm	nhapexclude_ptnonipm_include_30 125010 [v0]	nhapexclude_ptnonipm_include_30 125010 [v0]
NHAPEXCLUDE seca_c3	NHAPEXCL UDE	smkinven	seca_c3	nhapexclude_nothing [v0]	nhapexclude_nothing [v0]
nonpoint & nonroad surrogate xref	AGREF	Grdmat		amgref_us_can_mex_revised [v11]	amgref_us_can_mex_revised [v13]
onroad surrogate xref default	MGREF	Grdmat		amgref_us_can_mex_revised [v11]	amgref_us_can_mex_revised [v13]
ORIS Description	ORISDESC	smkinven		orisdesc [v0]	orisdesc [v0]
SCC descriptions	SCCDESC	smkinven		sccdesc_pf31 [v12]	sccdesc_pf31 [v12]
SIC descriptions	SICDESC	Smkreport		sic_desc [v0]	sic_desc [v0]
Smkmerge representative dates files	MRGDATE_ FILES	Run script		merge_dates_2005 (/garnet/oaqps) [v0]	merge_dates_2005 (/garnet/oaqps) [v0]
Speciation profiles additional for SMOKE-MOVES	GSPROTMP_ O	Spcmat	onroad	gspro_new_for_smoke-moves [v0]	gspro_new_for_smoke-moves [v0]
Speciation profiles Canada PM	GSPROTMP_ J	Spcmat	othpt	gspro_pm25_canada_2006_point [v0]	gspro_pm25_canada_2006_point [v0]
Speciation profiles for biogenics	GSPROTMP_ K	Spcmat	beis	gspro_biogenics [v1]	gspro_biogenics [v1]

Speciation profiles for HG	GSPROTMP_ H	Spcmat		gspro_hg [v2]	gspro_hg [v2]
Speciation profiles for INTEGRATE HAPS	GSPROTMP_ F	Spcmat		gspro_integratehaps_cb05_tx_pf4 [v1]	gspro_integratehaps_cb05_tx_pf4 [v1]
Speciation profiles for NONHAPTOG	GSPROTMP_ E	Spcmat		gspro_nonhaptog_cb05 [v3]	gspro_nonhaptog_cb05 [v3]
Speciation profiles for NONHAPTOG w/ETOH integration	GSPROTMP_ E	Spcmat	onroad	gspro_nonhaptog_cb05_eprofiles [v0]	gspro_nonhaptog_cb05_eprofiles [v0]
Speciation profiles for NONHAPTOG w/ETOH integration	GSPROTMP_ E	Spcmat	nonpt	gspro_nonhaptog_cb05_eprofiles [v0]	gspro_nonhaptog_cb05_eprofiles [v0]
Speciation profiles for NOX	GSPROTMP_ G	Spcmat		gspro_nox_hono_pf4 [v0]	gspro_nox_hono_pf4 [v0]
Speciation profiles for PM2.5	GSPROTMP_ C	Spcmat		gspro_pm25 [v2]	gspro_pm25 [v2]
Speciation profiles for SO2-SULF	GSPROTMP_ B	Spcmat		gspro_sulf [v1]	gspro_sulf [v1]
Speciation profiles for TOG	GSPROTMP_ D	Spcmat		gspro_tog_cb05_soa [v3]	gspro_tog_cb05_soa [v3]
Speciation profiles Other VOC HAP	GSPROTMP_ M	Spcmat		gspro_other_hapvoc_no_benz-benz [v0]	gspro_other_hapvoc_no_benz-benz [v0]
Speciation profiles speciated VOC	GSPROTMP_ I	Spcmat		gspro_speciated_voc [v0]	gspro_speciated_voc [v0]

Speciation profiles static	GSPROTMP_A	Spcmat		gspro_static_cmaq [v12]	gspro_static_cmaq [v12]
Speciation xref CAP static	GSREFTMP_A	Spcmat		gsref_static_cap_pf4 [v1]	gsref_static_cap_pf4 [v1]
Speciation xref for Canada PM	GSREFTMP_N	Spcmat	othpt	gsref_pm25_canada_2006_point [v3]	gsref_pm25_canada_2006_point [v3]
Speciation xref for Integrate-HAPs static	GSREFTMP_J	Spcmat		gsref_static_integratehap_emv4 [v2]	gsref_static_integratehap_emv4 [v2]
Speciation xref for NONHAPVOC, not year-specific	GSREFTMP_H	Spcmat	nonpt		gsref_nonhapvoc_general_hdghg [v3]
Speciation xref for NONHAPVOC, not year-specific	GSREFTMP_H	Spcmat		gsref_nonhapvoc_general_hdghg [v2]	gsref_nonhapvoc_general_hdghg [v2]
Speciation xref for NONHAPVOC, year-specific	GSREFTMP_I	Spcmat		gsref_nonhapvoc_2005_hdghg [v2]	gsref_nonhapvoc_2017_ref_tier3 [v1]
Speciation xref for NONHAPVOC, year-specific	GSREFTMP_I	Spcmat	nonpt		gsref_nonhapvoc_2017_ref_tier3 [v2]
Speciation xref for PM2.5 diesel SCCs but do not produce diesel	GSREFTMP_D	Spcmat		gsref_no_dieselpm [v3]	gsref_no_dieselpm [v3]
Speciation xref for PM2.5 non-diesel SCCs	GSREFTMP_E	Spcmat		gsref_pm25_pf4_nondiesel [v14]	gsref_pm25_pf4_nondiesel [v14]
Speciation xref for SMOKE-MOVES not TOG	GSREFTMP_P	Spcmat	onroad	gsref_new_for_smoke-moves_otherthantog [v0]	gsref_new_for_smoke-moves_otherthantog [v0]

Speciation xref for SMOKE-MOVES TOG	GSREFTMP_O	Spcmat	onroad	gsref_new_for_smoke-moves_tog [v1]	gsref_2017_for_smoke_moves_tog [v1]
Speciation xref for SO2-SULF	GSREFTMP_B	Spcmat		gsref_sulf [v0]	gsref_sulf [v0]
Speciation xref for speciated VOC	GSREFTMP_M	Spcmat	onroad	gsref_speciated_voc [v2]	gsref_speciated_voc [v2]
Speciation xref for speciated VOC	GSREFTMP_M	Spcmat	othpt	gsref_speciated_voc [v2]	gsref_speciated_voc [v2]
Speciation xref for VOC, not year-specific	GSREFTMP_F	Spcmat		gsref_voc_general_hdghg [v3]	gsref_voc_general_hdghg [v3]
Speciation xref for VOC, year-specific	GSREFTMP_G	Spcmat		gsref_voc_2005_hdghg [v4]	gsref_voc_2017_ref_tier3 [v3]
Speciation xref HG	GSREFTMP_K	Spcmat		gsref_hg [v8]	gsref_hg [v8]
Speciation xref static NOX -- HONO for mobile sources	GSREFTMP_C	Spcmat		gsref_static_nox_hono_pf4 [v6]	gsref_static_nox_hono_pf4 [v6]
Stack replacement	PSTK	smkinven		pstk [v0]	pstk [v0]
surrogate descriptions (works for all grids)	SRGDESC	Grdmat	othon	srgdesc_36km_revised [v1]	srgdesc_36km_revised [v1]
surrogate descriptions (works for all grids)	SRGDESC	Grdmat		srgdesc_12km [v2]	srgdesc_12km [v2]
surrogate descriptions (works for all grids)	SRGDESC	Grdmat	othar	srgdesc_36km_revised [v1]	srgdesc_36km_revised [v1]
Temporal profiles, all nonpoint and nonroad	ATPRO	Temporal		amptpro_2005_us_can_revised [v2]	amptpro_2005_us_can_revised [v2]
Temporal profiles, all point	PTPRO	Temporal		amptpro_2005_us_can_revised [v2]	amptpro_2005_us_can_revised [v2]
Temporal profiles, onroad default	MTPRO	Temporal		amptpro_2005_us_can_revised [v2]	amptpro_2005_us_can_revised [v2]
Temporal xref, all nonpoint and nonroad	ATREF	Temporal		amptref_v3_3_revised [v12]	amptref_v3_3_revised [v12]
Temporal xref, onroad mobile default	MTREF	Temporal		amptref_v3_3_revised [v12]	amptref_v3_3_revised [v12]
Temporal xref, othpt	PTREF	Temporal	othpt	ptref_othpt [v4]	ptref_othpt [v4]
Temporal xref, point default	PTREF	Temporal		amptref_v3_3_revised [v12]	amptref_v3_3_revised [v12]
Temporal xref, ptipm only	PTREF	Temporal	Ptipm	ptref_ptipm_us [v0]	ptref_ptipm_us [v0]

Table A-2. Parameters used in the MATS cases

Parameter Name	Environment Variable	Sector	2005 Base Case	2017 Reference Case
All months across all sectors	ALL_MONTHS		1 2 3 4 5 6 7 8 9 10 11 12	1 2 3 4 5 6 7 8 9 10 11 12
BEIS3 version	BEIS3_VERSION	beis	3.14	3.14
Biogenics land area surrogate	AREA_SURROGATE_NUM	beis	340	340
Biogenics speciation profile code	BIOG_SPRO	beis	B10C5	B10C5
Check for duplicate sources	RAW_DUP_CHECK	ptfire	N	N
Check for duplicate sources	RAW_DUP_CHECK	ptnonipm	N	N
Check for duplicate sources	RAW_DUP_CHECK	ptipm	N	N
Check for duplicate sources	RAW_DUP_CHECK		Y	Y
Check for duplicate sources	RAW_DUP_CHECK	alm_no_c3		N
Check for duplicate sources	RAW_DUP_CHECK	nonpt		N
Check for duplicate sources	RAW_DUP_CHECK	othon	N	N
Check for duplicate sources	RAW_DUP_CHECK	othpt	N	N
Check for duplicate sources	RAW_DUP_CHECK	othar	N	N
Check stack parameters for missing	CHECK_STACKS_YN	ptfire	N	N

Convective rainfall variable for Pleim-Xiu	RC_VAR	beis	RC	RC
Count of underscores for Daily data prefix	NAMEBREAK_DAILY	ptipm	9	10
Custom merge output	SMKMERGE_CUSTOM_ OUTPUT		Y	Y
Custom merge output - MOVES	MOVESMRG_CUSTOM_ OUTPUT	onroad	Y	Y
Default surrogate code	SMK_DEFAULT_SRGID		100	100
Default surrogate code	SMK_DEFAULT_SRGID	afdust	340	340
Don't need spinup for most sectors	SPINUP_DURATION	ptipm		0
Don't need spinup for most sectors	SPINUP_DURATION	nonpt	0	0
Don't need spinup for most sectors	SPINUP_DURATION	ptipm		
Don't need spinup for most sectors	SPINUP_DURATION	ptnonipm	0	0
Don't need spinup for most sectors	SPINUP_DURATION	nonroad	0	0
Don't need spinup for most sectors	SPINUP_DURATION	othpt	0	0
Don't need spinup for most sectors	SPINUP_DURATION	seca_c3		
Don't need spinup for most sectors	SPINUP_DURATION	seca_c3		0
Don't speciate zero emission SCCs	NO_SPC_ZERO_EMIS	ptnonipm	Y	Y

Don't speciate zero emission SCCs	NO_SPC_ZERO_EMIS	nonpt	Y	Y
Don't use day-specific emission	DAY_SPECIFIC_YN	ptipm	N	N
Don't use pollutant conversion	POLLUTANT_CONVERSI ON	onroad	N	N
EGU daily type	EGU_TYPE		model_performance	model_performance
EMF queue options	EMF_QUEUE_OPTIONS		#NAME?	#NAME?
Emission rate model	SMK_EF_MODEL	onroad	MOVES	MOVES
Fill annual values	FILL_ANNUAL	nonroad	Y	Y
Fill annual values	FILL_ANNUAL		N	N
Fill annual values	FILL_ANNUAL	nonpt	Y	Y
Fire-specific plume rise calculations	FIRE_PLUME_YN	ptfire	Y	Y
Formula for Smkinven	SMKINVEN_FORMULA		PMC=PM10-PM2_5	PMC=PM10-PM2_5
Formula for Smkinven	SMKINVEN_FORMULA	ag		
Formula for Smkinven	SMKINVEN_FORMULA	nonroad	EXH__PMC=EXH__PM10-EXH__PM2_5	EXH__PMC=EXH__PM10-EXH__PM2_5
Formula for Smkinven	SMKINVEN_FORMULA	onroad		
Include market penetration	MRG_MARKETPEN_YN		N	N

I/O API Sphere type	IOAPI_ISPH		19	19
Laypoint uses Elevpoint to set sources for plume rise calc	SMK_SPECELEV_YN		Y	Y
Match full SCCs	FULLSCC_ONLY		Y	Y
Maximum errors printed	SMK_MAXERROR		10000	10000
Maximum warnings printed	SMK_MAXWARNING		10	10
MCIP name abbreviation	MCIPNAME		MCIP_v3.4beta4	MCIP_v3.4beta4
Merge by day	MRG_BYDAY	ptnonipm	P	P
Merge by day	MRG_BYDAY	seca_c3	P	P
Merge by day	MRG_BYDAY	othpt	P	P
Merge type	M_TYPE		Mwdss	mwdss
Merge type	M_TYPE	ptipm	All	all
Merge type	M_TYPE	ptnonipm	Mwdss	mwdss
Merge type	M_TYPE	ptfire	All	all
Merge type	M_TYPE	avefire	Aveday	aveday
Merge type	M_TYPE	ag	Aveday	aveday

Merge type	M_TYPE	afdust	Week	week
Merge type	M_TYPE	onroad	All	all
Merge type	M_TYPE	nonptfire	Aveday	aveday
Merge type	M_TYPE	othpt	Mwdss	mwdss
Merge type	M_TYPE	othon	Week	week
Merge type	M_TYPE	seca_c3	Aveday	aveday
Merge type	M_TYPE	beis	All	all
Model output format	OUTPUT_FORMAT		$EMF_AQM	$EMF_AQM
Nonhap Type	NONHAP_TYPE	nonpt	VOC	VOC
Nonhap Type	NONHAP_TYPE	ptnonipm	VOC	VOC
Nonhap Type	NONHAP_TYPE	avefire	VOC	VOC
Nonhap Type	NONHAP_TYPE	nonroad	VOC	VOC
Nonhap Type	NONHAP_TYPE	onroad	TOG	TOG
Nonhap Type	NONHAP_TYPE	alm_no_c3	VOC	VOC
Nonhap Type	NONHAP_TYPE	seca_c3	VOC	VOC
Number of emissions layers	SMK_EMLAYS		10	10

Ocean Chlorine filename extension	EXT	mrggrid	.ncf	.ncf
Output county biogenic totals	BIO_COUNTY_SUMS	beis	Y	Y
Output county/SCC totals	MRG_REPSRC_YN	onroad	Y	Y
Output county totals	MRG_REPCNY_YN		N	N
Output county totals	MRG_REPCNY_YN		Y	
Output county totals	MRG_REPCNY_YN	onroad	Y	Y
Output SCC totals	MRG_REPSCC_YN	onroad	Y	Y
Output state biogenic totals	BIO_STATE_SUMS	beis	Y	Y
Output state totals	MRG_REPSTA_YN		Y	Y
Output state totals	MRG_REPSTA_YN		N	
Output state totals	MRG_REPSTA_YN	onroad	N	N
Output time zone	OUTZONE		0	0
Platform name	PLATFORM		v4.3	v4.3
Pleim-Xiu land surface used?	PX_VERSION	beis	Y	Y
Plume-in-grid method	SMK_PING_METHOD		0	0
Pressure variable name	PRES_VAR	beis	PRSFC	PRSFC

PTDAY file name case	DAILY_CASE	ptipm	2005ck	2005ck
Radiation/cloud variable name	RAD_VAR	beis	RGRND	RGRND
Renormalize temporal profiles	RENORM_TPROF		Y	Y
Report default profiles used	REPORT_DEFAULTS		Y	Y
Run holidays	RUN_HOLIDAYS	ag	N	N
Run holidays	RUN_HOLIDAYS	avefire	N	N
Run holidays	RUN_HOLIDAYS		Y	Y
Run holidays	RUN_HOLIDAYS	seca_c3	N	N
Run holidays	RUN_HOLIDAYS	alm_no_c3	N	N
Run holidays	RUN_HOLIDAYS	othon	N	N
Run holidays	RUN_HOLIDAYS	othpt	N	N
Run holidays	RUN_HOLIDAYS	othar	N	N
Run holidays	RUN_HOLIDAYS	nonptfire	N	N
Run holidays	RUN_HOLIDAYS	afdust	Y	Y
Run in inline mode	INLINE_MODE		Both	both
Run in inline mode SECA_C3	INLINE_MODE	seca_c3	Only	only

Run script for Smkmerge annual totals	RUN_PYTHON_ANNUAL		Y	Y
Smkmerge reports units	MRG_TOTOUT_UNIT		tons/dy	
SMOKE-MOVES processing mode	MOVES_TYPE	onroad	RPD	RPD
SMOKE-MOVES processing mode	MOVES_TYPE	onroad	RPP	RPP
SMOKE-MOVES processing mode	MOVES_TYPE	onroad	RPV	RPV
Soil moisture variable for Pleim-Xiu	SOIM1_VAR	beis	SOIM1	SOIM1
Soil temperature variable for Pleim-Xiu	SOILT_VAR	beis	SOIT1	SOIT1
Soil type variable for Pleim-Xiu	ISLTYP_VAR	beis	SLTYP	SLTYP
Sort inventory EVs by letter	SORT_LIST_EVS	othpt	Y	Y
Sort inventory EVs by letter	SORT_LIST_EVS	avefire	Y	Y
Sort inventory EVs by letter	SORT_LIST_EVS	ptipm	Y	Y
Speciation type name	SPC		$EMF_SPC	$EMF_SPC
Spinup Duration	SPINUP_DURATION		10	10
Spinup Duration	SPINUP_DURATION		3	3
Temperature variable name	TMPR_VAR	beis	TEMP2	TEMP2
Temperature variable name - MOVES	TVARNAME	onroad	TEMP2	TEMP2

Temporal type	L_TYPE		Mwdss	mwdss
Temporal type	L_TYPE	ptipm	All	all
Temporal type	L_TYPE	ptfire	All	all
Temporal type	L_TYPE	avefire	Aveday	aveday
Temporal type	L_TYPE	ag	Aveday	aveday
Temporal type	L_TYPE	afdust	Week	week
Temporal type	L_TYPE	onroad	All	all
Temporal type	L_TYPE	nonptfire	Aveday	aveday
Temporal type	L_TYPE	othon	Week	week
Temporal type	L_TYPE	seca_c3	Aveday	aveday
Temporal type	L_TYPE	beis	All	all
Use area-to-point	SMK_ARTOPNT_YN	alm_no_c3	Y	Y
Use area-to-point	SMK_ARTOPNT_YN	nonpt	Y	Y
Use area-to-point	SMK_ARTOPNT_YN	nonroad	Y	Y
Use average day emissions	SMK_AVEDAY_YN		N	N
Use day-specific emission	DAY_SPECIFIC_YN	ptipm	Y	Y

Use day-specific emission	DAY_SPECIFIC_YN	ptfire	Y	Y
Use hourly plume rise data	HOURLY_FIRE_YN	ptfire	Y	Y
Use NHAPEXCLUDE file	SMK_PROCESS_HAPS	alm_no_c3	PARTIAL	PARTIAL
Use NHAPEXCLUDE file	SMK_PROCESS_HAPS	seca_c3	ALL	ALL
Use NHAPEXCLUDE file	SMK_PROCESS_HAPS	onroad	ALL	ALL
Use NHAPEXCLUDE file	SMK_PROCESS_HAPS	nonroad	PARTIAL	PARTIAL
Use NHAPEXCLUDE file	SMK_PROCESS_HAPS	avefire	NONE	NONE
Use NHAPEXCLUDE file	SMK_PROCESS_HAPS	ptnonipm	PARTIAL	PARTIAL
Use NHAPEXCLUDE file	SMK_PROCESS_HAPS	nonpt	PARTIAL	PARTIAL
Use pollutant conversion	POLLUTANT_CONVERSION		Y	Y
Western hemisphere?	WEST_HSPHERE		Y	Y
Write zero emissions	WRITE_ANN_ZERO	ptfire	Y	Y
Write zero emissions	WRITE_ANN_ZERO	ptipm	Y	Y
Zip merged model-ready files	GZIP_OUTPUTS	mrggrid	Y	Y
Base Year			2005	2005
Downstream Model			CMAQ v4.7 N5c	CMAQ v4.7 N5c
End Date & Time			12/31/2005 23:59	12/31/2005 23:59
Future Year			0	2017
Last Modified Date			13:57.7	22:39.1
Meteorological Year			2005	2005
Model			SMOKE	SMOKE
Modeling Region			National	National
# of emission layers			14	14
# of met layers			14	14
Speciation			cmaq_cb05_tx	cmaq_cb05_tx
Start Date			1/1/2005 0:00	1/1/2005 0:00
Version			2.7	2.7

APPENDIX B

Inventory Data Files Used for Each MATS Modeling Case – SMOKE Input Inventory Datasets

The emissions inventory data files used for the MATS cases are shown in Table B-1. The Input name column gives a brief designator for the inventory. The Sector column specifies the modeling sector for the inventory. The remaining columns show the data set name and version used in the 2005 base case and 2017 reference cases. The datasets used for the 2017 control case are identical to the 2017 reference case, except for the following replacements:

- Inventory ptipm CAP used PTINV_EPA410FINAL_BC_226_summer_2015_01SEP2011_ORL [v0],
- Inventory ptipm daily data (CEM sources) used ptday_ptipm_cem_2017ct_ref_mats_05b [v0], and
- Inventory ptipm daily data (nonCEM sources) used ptday_ptipm_noncem_2017ct_ref_mats_05b [v0].

To match the Datasets and Versions listed in this table to actual data files, combine the Dataset name and the version number in the following pattern: <Dataset Name>_<Date>_<Version number>.txt, where <Date> is the last date of change for that version and will have a unique value for the combination of Dataset Name and Version number.

Table B-1. List of inventory data sets associated with the MATS modeling cases.

Input name	**Sector**	**2005 Base Case**	**2017 Reference Case**
Inventory afdust CAP	afdust	afdust_2002ad_xportfrac [v0]	afdust_2017ct_ref [v0]
Inventory ag CAP	Ag	ag_cap2002nei [v0]	ag_cap2017ct_ref [v0]
Inventory alm_no_c3 CAP	alm_no_c3	lm_no_c3_cap2002v3 [v1]	lm_no_c3_cap2017ct_lowE [v0]
Inventory alm_no_c3 HAP	alm_no_c3	lm_no_c3_hap2002v4 [v0]	lm_no_c3_hap2017ct_lowE [v0]
Inventory avefire CAP	avefire	avefire_2002ce [v0]	avefire_2002ce [v0]
Inventory avefire HAP	avefire	avefire_2002_hap [v0]	avefire_2002_hap [v0]
Inventory C1/C2 additional CAP/HAP	alm_no_c3		c1c2_additional_2017ct_ref_caphap_25jul2011 [v0]
Inventory fire list	ptfire	ptfire_2005ag_tox [v0]	ptfire_2005ag_tox [v0]
Inventory nonpt CAP and HAP (PFC only)	nonpt	pfc_2002_caphap_wETOH [v1]	pfc_2017_ref_caphap_23aug2011 [v0]
Inventory nonpt CAP/HAP Cellulosic Biodiesel plants for Tier3	nonpt		cellulosic_ETOH_Biodiesel_2017ct_ref_caphap_29jul2011 [v0]
Inventory nonpt CAP/HAP Ethanol Transport for Tier3	nonpt		Ethanol_transport_vapor_2017ct_ref_caphap_25jul2011 [v0]
Inventory nonpt CAP (no PFC, no refueling)	nonpt	nonpt_pf4_cap_nopfc [v6]	nonpt_pf4_cap_nopfc_2017ct_ref [v0]
Inventory nonpt CAP: TX and OK Oil and Gas	nonpt	nonpt_cap_2005_TCEQ_Oklahoma_OilGas [v0]	nonpt_cap_2017ct_lowE_TCEQ_Oklahoma_OilGas [v0]

Inventory nonpt CAP: WRAP Oil and Gas	nonpt	nonpt_cap_2005_WRAP_OilGas [v0]	nonpt_cap_2018PhaseII_WRAP_OilGas [v0]
Inventory nonpt HAP (no PFC, no refueling)	nonpt	nonpt_pf4_hap_nopfc_nobafmpesticidesplus [v4]	nonpt_pf4_hap_nopfc_nobafmpesticidesplus_2017ct_ref [v0]
Inventory nonpt Refueling from MOVES, April	nonpt	rfl_moves_wETOH_2005ct_apr_18may2011 [v0]	rfl_moves_wETOH_2017ct_ref_apr_27jul2011 [v0]
Inventory nonpt Refueling from MOVES, August	nonpt	rfl_moves_wETOH_2005ct_aug_18may2011 [v0]	rfl_moves_wETOH_2017ct_ref_aug_27jul2011 [v0]
Inventory nonpt Refueling from MOVES, December	nonpt	rfl_moves_wETOH_2005ct_dec_18may2011 [v0]	rfl_moves_wETOH_2017ct_ref_dec_27jul2011 [v0]
Inventory nonpt Refueling from MOVES, February	nonpt	rfl_moves_wETOH_2005ct_feb_18may2011 [v0]	rfl_moves_wETOH_2017ct_ref_feb_27jul2011 [v0]
Inventory nonpt Refueling from MOVES, January	nonpt	rfl_moves_wETOH_2005ct_jan_18may2011 [v0]	rfl_moves_wETOH_2017ct_ref_jan_27jul2011 [v0]
Inventory nonpt Refueling from MOVES, July	nonpt	rfl_moves_wETOH_2005ct_jul_18may2011 [v0]	rfl_moves_wETOH_2017ct_ref_jul_27jul2011 [v0]
Inventory nonpt Refueling from MOVES, June	nonpt	rfl_moves_wETOH_2005ct_jun_18may2011 [v0]	rfl_moves_wETOH_2017ct_ref_jun_27jul2011 [v0]
Inventory nonpt Refueling from MOVES, March	nonpt	rfl_moves_wETOH_2005ct_mar_18may2011 [v0]	rfl_moves_wETOH_2017ct_ref_mar_27jul2011 [v0]
Inventory nonpt Refueling from MOVES, May	nonpt	rfl_moves_wETOH_2005ct_may_18may2011 [v0]	rfl_moves_wETOH_2017ct_ref_may_27jul2011 [v0]
Inventory nonpt Refueling from MOVES, November	nonpt	rfl_moves_wETOH_2005ct_nov_18may2011 [v0]	rfl_moves_wETOH_2017ct_ref_nov_27jul2011 [v0]
Inventory nonpt Refueling from MOVES, October	nonpt	rfl_moves_wETOH_2005ct_oct_18may2011 [v0]	rfl_moves_wETOH_2017ct_ref_oct_27jul2011 [v0]
Inventory nonpt Refueling from MOVES, September	nonpt	rfl_moves_wETOH_2005ct_sep_18may2011 [v0]	rfl_moves_wETOH_2017ct_ref_sep_27jul2011 [v0]
Inventory nonroad cap+CMAQ-lite HAPs US, incl Calif April	nonroad	nonroad_cmaq_lite_2005ct_apr_19may2011 [v0]	nonroad_cmaq_lite_2017ct_ref_apr_20jul2011 [v0]
Inventory nonroad cap+CMAQ-lite HAPs US, incl Calif August	nonroad	nonroad_cmaq_lite_2005ct_aug_19may2011 [v0]	nonroad_cmaq_lite_2017ct_ref_aug_20jul2011 [v0]
Inventory nonroad cap+CMAQ-lite HAPs US, incl Calif December	nonroad	nonroad_cmaq_lite_2005ct_dec_19may2011 [v0]	nonroad_cmaq_lite_2017ct_ref_dec_20jul2011 [v0]
Inventory nonroad cap+CMAQ-lite HAPs US, incl Calif February	nonroad	nonroad_cmaq_lite_2005ct_feb_19may2011 [v0]	nonroad_cmaq_lite_2017ct_ref_feb_20jul2011 [v0]
Inventory nonroad cap+CMAQ-lite HAPs US, incl Calif January	nonroad	nonroad_cmaq_lite_2005ct_jan_19may2011 [v0]	nonroad_cmaq_lite_2017ct_ref_jan_20jul2011 [v0]
Inventory nonroad cap+CMAQ-lite HAPs US, incl Calif July	nonroad	nonroad_cmaq_lite_2005ct_jul_19may2011 [v0]	nonroad_cmaq_lite_2017ct_ref_jul_20jul2011 [v0]
Inventory nonroad cap+CMAQ-lite HAPs US, incl Calif June	nonroad	nonroad_cmaq_lite_2005ct_jun_19may2011 [v0]	nonroad_cmaq_lite_2017ct_ref_jun_20jul2011 [v0]
Inventory nonroad cap+CMAQ-lite HAPs US, incl Calif March	nonroad	nonroad_cmaq_lite_2005ct_mar_19may2011 [v0]	nonroad_cmaq_lite_2017ct_ref_mar_20jul2011 [v0]

Inventory nonroad cap+CMAQ-lite HAPs US, incl Calif May	nonroad	nonroad_cmaq_lite_2005ct_may_19may2011 [v0]	nonroad_cmaq_lite_2017ct_ref_may_20jul2011 [v0]
Inventory nonroad cap+CMAQ-lite HAPs US, incl Calif November	nonroad	nonroad_cmaq_lite_2005ct_nov_19may2011 [v0]	nonroad_cmaq_lite_2017ct_ref_nov_20jul2011 [v0]
Inventory nonroad cap+CMAQ-lite HAPs US, incl Calif October	nonroad	nonroad_cmaq_lite_2005ct_oct_19may2011 [v0]	nonroad_cmaq_lite_2017ct_ref_oct_20jul2011 [v0]
Inventory nonroad cap+CMAQ-lite HAPs US, incl Calif September	nonroad	nonroad_cmaq_lite_2005ct_sep_19may2011 [v0]	nonroad_cmaq_lite_2017ct_ref_sep_20jul2011 [v0]
Inventory onroad RPD	onroad	VMT_tier3_2005 [v0]	VMT_tier3_2017_ref_cntl [v3]
Inventory onroad RPD	onroad	VMT_tier3_2005 [v0]	VMT_tier3_2017_ref_cntl [v3]
Inventory onroad RPD	onroad	VMT_tier3_2005 [v0]	VMT_tier3_2017_ref_cntl [v3]
Inventory onroad RPD	onroad	SPEED_tier3 [v0]	SPEED_tier3 [v0]
Inventory onroad RPD	onroad	VMT_tier3_2005 [v0]	VMT_tier3_2017_ref_cntl [v3]
Inventory onroad RPP	onroad	VPOP_tier3_2005 [v0]	VPOP_tier3_2017 [v0]
Inventory onroad RPV	onroad	VPOP_tier3_2005 [v0]	VPOP_tier3_2017 [v0]
Inventory othar nonpoint CAP Mexico border states	othar	nonpt mexico border1999 [v0]	nonpt mexico border1999 [v0]
Inventory othar nonpoint CAP Mexico interior states	othar	nonpt mexico interior1999 [v0]	nonpt mexico interior1999 [v0]
Inventory othar nonroad CAP Mexico border states	othar	nonroad mexico border1999 [v0]	nonroad mexico border1999 [v0]
Inventory othar nonroad CAP Mexico interior states	othar	nonroad mexico interior1999 [v0]	nonroad mexico interior1999 [v0]
Inventory othon CAP Mexico border states	othon	onroad mexico border1999 [v0]	onroad mexico border1999 [v0]
Inventory othon CAP Mexico interior states	othon	onroad mexico interior1999 [v0]	onroad mexico interior1999 [v0]
Inventory othon CAP onroad Canada	othon	canada_onroad_cap_2006 [v0]	canada_onroad_cap_2006 [v0]
Inventory othpt CAP Mexico border states	othpt	mexico_border99 [v1]	mexico_border99 [v1]
Inventory othpt CAP Mexico interior states	othpt	mexico_interior99 [v0]	mexico_interior99 [v0]
Inventory othpt CAP offshore	othpt	ptnonipm_offshore_oil_cap2005v2_20nov2008 [v0]	ptnonipm_offshore_oil_cap2005v2_20nov2008 [v0]
Inventory ptipm CAP	ptipm	ptipm_2005cs_cap_27dec2010.txt [v1]	
Inventory ptipm CAP	ptipm		PTINV_EPA410FINAL_BC_58_summer_2020_21MAY2011_ORL [v0]
Inventory ptipm CAP	ptipm		
Inventory ptipm daily data (CEM sources)	ptipm	ptday_ptipm_caphap_cem_2005cs_05b (/garnet/oaqps) [v0]	ptday_ptipm_caphap_cem_2017ct_05b [v0]
Inventory ptipm daily data (nonCEM sources)	ptipm	ptday_ptipm_caphap_noncem_2005cs_05b (/garnet/oaqps) [v0]	ptday_ptipm_caphap_noncem_2017ct_05b [v0]

Inventory ptipm HAP	ptipm	ptipm_2005cs_hap_27dec2010.txt [v0]	
Inventory ptnonipm CAP	ptnonipm	ptnonipm_xportfrac_cap2005v2_2005cs_orl [v7]	ptnonipm_xportfrac_cap2017ct_ref [v0]
Inventory ptnonipm CAPHAP biodiesel plant additions forTier3	ptnonipm		biodiesel_plants_2017ct_ref_caphap_29jul2011 [v0]
Inventory ptnonipm CAPHAP ethanol plant additions forTier3	ptnonipm	ethanol_plants_2005ct_2017ct_lowE_caphap [v0]	ethanol_plants_2017ct_ref_caphap_19jul2011 [v0]
Inventory ptnonipm cement capHg	ptnonipm		ptnonipm_capHG_cementISIS_2016cr_16AUG2010 [v0]
Inventory ptnonipm HAP	ptnonipm	ptnonipm_hap2005v2_2005cs_orl [v6]	ptnonipm_hap2017ct_ref [v0]
Inventory rail additional CAP/HAP for Tier3 ref/ctl	alm_no_c3		rail_additional_2017ct_ref_caphap_26jul2011 [v0]
Inventory seca_c3 BAF HAPs Canada	seca_c3	eca_imo_CANADA_SCC_fix_vochaps_2005_09DEC2010 [v0]	eca_imo_CANADA_SCC_fix_vochaps_2017 [v0]
Inventory seca_c3 BAF HAPs US includes EEZ and offshore FIPS	seca_c3	eca_imo_fixFIPS_US_andSCC_fix_vochaps_2005_09DEC2010 [v0]	eca_imo_fixFIPS_US_andSCC_fix_vochaps_2017 [v0]
Inventory seca_c3 CAP Canada	seca_c3	eca_imo_CANADA_SCC_fix_caps_2005_09DEC2010 [v0]	eca_imo_CANADA_SCC_fix_caps_2017 [v0]
Inventory seca_c3 CAP US + EEZ + Offshore non-Canada	seca_c3	eca_imo_fixFIPS_US_wDE_andSCC_fix_caps_2005_09DEC2010 [v0]	eca_imo_fixFIPS_US_wDE_andSCC_fix_caps_2017 [v0]
ORL Nonpoint Inventory - Afdust Canada 2006	othar	canada_afdust_xportfrac_cap_2006 [v0]	canada_afdust_xportfrac_cap_2006 [v0]
ORL Nonpoint Inventory - Ag Canada 2006	othar	canada_ag_cap_2006 [v0]	canada_ag_cap_2006 [v0]
ORL Nonpoint Inventory - Aircraft Canada 2006	othar	canada_aircraft_cap_2006 [v0]	canada_aircraft_cap_2006 [v0]
ORL Nonpoint Inventory - Commercial Marine Canada 2006	othar	canada_marine_cap_2006 [v0]	canada_marine_cap_2006 [v0]
ORL Nonpoint Inventory - Nonroad Canada 2006	othar	canada_offroad_cap_2006 [v0]	canada_offroad_cap_2006 [v0]
ORL Nonpoint Inventory - Oarea Canada 2006	othar	canada_oarea_cap_2006 [v3]	canada_oarea_cap_2006 [v3]
ORL Nonpoint Inventory - Rail Canada 2006	othar	canada_rail_cap_2006 [v0]	canada_rail_cap_2006 [v0]
ORL Point Inventory - Point 2006	othpt	canada_point_2006_orl [v2]	canada_point_2006_orl [v2]
ORL Point Inventory - Point CB5 2006	othpt	canada_point_cb5_2006_orl [v0]	canada_point_cb5_2006_orl [v0]
ORL Point Inventory - Upstream Oil & Gas 2006	othpt	canada_point_uog_2006_orl [v0]	canada_point_uog_2006_orl [v0]

Appendix C

Summary of MATS Rule 2017 Base Case Non-EGU Control Programs, Closures and Projections

Lists of control, closure and projection packet datasets used to create MATS year 2017 base case inventories from the 2005 MATS base case are provided in Tables C-1 and C-2.

Table C-1. Datasets used to create MATS 2017 reference case inventories for non-EGU point sources

Name	Type	Dataset	Version	Description
CLOSURES LotusNotes, ABCG, plus Timin 2016cr	Plant Closure	CLOSURES_LotusNotes_Linda_Timin_2016cr_23AUG2010	1	Plant and unit closures identified through EPA review.
CLOSURES TR1 comments and consent decrees 2014cs	Plant Closure	CLOSURES_TR1_2014cs_01FEB2011	0	Plant and unit closures through 2014 identified as a result of Transport Rule comments.
CLOSURES cement ISIS 2013 policy	Plant Closure	CLOSURES_cementISIS_2016cr_17AUG2010	1	Cement plant and unit closures identified via the ISIS 2013 policy case.
closures: 2005 to 2012ck	Plant Closure	CLOSURES_2005ck_to_2012ck_CoST_formatt	0	Plant and unit closures identified 2008 or before.
CONTROL ADDITIONAL OECA 2005cr to 2016cr	Control	CONTROLS_additional_NEIpf4_OECA_2005cr_2016cr_29JUL2010	1	Controls that implement OECA consent decrees.
CONTROL REPLACE DOJ 2005cr to 2016cr	Control	CONTROLS_replacement_NEIpf4_DOJ_2005cr_2016cr_02AUG2010.txt	0	Controls resulting from the 2002v3 DOJ Texas settlement.
CONTROL REPLACE HWI 2005cr to 2016cr	Control	CONTROLS_replacement_NEIpf4_HWI_2005cr_2016cr_02AUG2010.txt	1	Hazardous Waste Incinerator controls for CAPs and Haps carried over from 2002v31.
CONTROL REPLACE IndustrialBoiler nonMACT 2005cr to 2016cr	Control	CONTROLS_replacement_IndBoilers_nonMACT_by2008_20AUG2010	0	Industrial boiler controls not related to application of the MACT but derived from the Boiler MACT ICR database dated 4/30/10.
CONTROL REPLACE LMWC 2005cr to 2016cr	Control	CONTROLS_replacement_NEIpf4_LMWC_2005cr_2016cr_02AUG2010.txt	0	Controls for large municipal combustors carried over from 2002v31.
CONTROL REPLACE MACT 2005cr to 2016cr	Control	CONTROLS_replacement_NEIpf4_MACT_2005cr_2016cr_02AUG2010.txt	0	MACT controls carried over from 2002v3 and updated as appropriate.
CONTROL REPLACE NY SIP 2005cr to 2016cr	Control	CONTROLS_replacement_NYSIP_O3_SCC_2016cr_26AUG2010	0	Controls that reflect enforceable controls for NOx and VOC from the New York ozone SIP.
CONTROL REPLACE Refineries 2005cr to 2016cr	Control	CONTROLS_replacement_NEIpf4_refineries_2005cr_2016cr_02AUG2010.txt	1	Controls for refineries specified by EPA expert refinery staff.
CONTROL RICE 2016cr_05b	Control	CONTROLS_replacement_RICE_2016cr_21SEP2010	1	Controls for 2014 and 2016 that represent three separate RICE NESHAPs
CONTROL RICE SO2 2014cs_05b	Control	CONTROLS_replacement_RICE_SO2_2014cs_05JAN2011	1	SO_2 reductions from the Ultra-low Sulfur Diesel requirement for CI engines

CONTROL SULF rules: ME, NY, NJ 2017 ONLY	Control	CONTROLS_SULF_rules_2017only_03FEB2011	0	SO_2 reductions due to state sulfur content rules for fuel oil.
CONTROL St Gobain and LaFarge 2017	Control	CONTROLS_rep_Lafarge_StGobain_2017cs_25JAN2011.txt	0	Controls for NO_X, SO_2, PM., and HCl resulting from Saint Gobain and Lafarge consent decrees
CONTROL TR1 Final CONTROL packet: 2017	Control	CONTROLS_TR1_2017	0	Controls for TCEQ oil and gas and non-ISIS related cement controls.
CONTROL TR1 Final consent decrees 20XX	Control	CONTROLS_additional_TR1final_consent_decrees_2005cs_to_20XXcs.csv	0	Controls related to consent decrees identified during the Transport Rule comment period.
CONTROL cement ISIS 2013 policy	Control	CONTROLS_replacement_cementISIS_2016cr_17AUG2010	0	Controls for cement plants based on 2013 ISIS policy case
PROJECTION 2005 to 2017 ag emissions	Projection	PROJECTION_2005_2017_ag	0	Projection factors for agriculture based on animal population stats.
PROJECTION LMWC 2005cr to 2016cr	Projection	PROJECTION_2005cr_2016cr_LMWC_29JUL2010	0	Projection factors for Solid and Liquid Municipal Waste Combustors.
PROJECTION TR1 comments 2005cs to 20XXcs -ptnonipm	Projection	PROJECTION_2005cs_20XX_TR1_ptnonipm_01FEB2011	0	Projection factors derived from Transport Rule comments.
PROJECTION aircraft 2005 to 2017 JAN2010 FAATAF	Projection	PROJECTION aircraft 2005 to 2017 JAN2010 FAATAF	0	Projection factors for aircraft derived from the FAA Terminal Area Forecast System.
PROJECTION cement ISIS 2013 policy	Projection	PROJECTION_cementISIS_2016cr_17AUG2010	0	Projection factors that implement the 2013 ISIS policy case for cement.
PROJECTION RWC and landfills 2005 to 2017 BAD	Projection	PROJECTION_2005_2017_RWC_landfills_BAD	0	Projection factors for residential wood combustion
PROJECTION Tier3 Proposal 2017 low-E to 2017 REF transport BPS BTP RBT	Projection	PROJECTION_2017ct_REF_Tier3prop_transport_scalars_28jul2011	0	Projection factors for transport of renewable fuel blends from bulk plant to storage, refinery to bulk terminal and bulk terminal to pump
PROJECTION Tier3 Proposal 2017 low-E to 2017 REF-CTL ag	Projection	PROJECTION_2017ct_REF_Tier3prop_ag_scalars_26jul2011	0	Projection factors accounting for changes in biofuel volumes on upstream agricultural sources
PROJECTION Tier3 Proposal 2017 low-E to 2017 REF-CTL refineries	Projection	PROJECTION_2017ct_REF_Tier3prop_refinery_scalars_26jul2011	0	Projection factors accounting for refinery process changes from renewable fuels

Table C-2. Datasets used to create MATS 2017 reference case inventories for nonpoint sources

Control Program Name	**Type**	**Dataset**	**Version**	**Description**
CONTROL REPLACE NY SIP 2005cr to 2016cr	Control	CONTROLS_replacement_NYSIP_O3_SCC_2016cr_26AUG2010	0	Controls that reflect enforceable controls for NOx and VOC from the New York ozone SIP.
CONTROL RICE 2016cr_05b	Control	CONTROLS_replacement_RICE_2016cr_21SEP2010	1	Controls for 2014 and 2016 that represent three separate RICE NESHAPs
CONTROL RICE SO2 2014cs_05b	Control	CONTROLS_replacement_RICE_SO2_2014cs_05JAN2011	1	SO_2 reductions from the Ultra-low Sulfur Diesel requirement for CI engines
CONTROL SULF rules: ME, NY, NJ 2017 ONLY	Control	CONTROLS_SULF_rules_2017only_03FEB2011	0	SO_2 reductions due to state sulfur content rules for fuel oil.
CONTROL TR1 Final CONTROL packet: 2017	Control	CONTROLS_TR1_2017	0	Controls for TCEQ oil and gas and non-ISIS related cement controls.

PROJECTION 2005 to 2017ag sector	Projection	PROJECTION_2005_2017_ag	0	Projection factors for agriculture based on animal population stats.
PROJECTION RWC and landfills 2005 to 2017 BAD	Projection	PROJECTION_2005_2017_RWC_landfills_BAD	0	Projection factors for residential wood combustion and landfills.
PROJECTION aircraft 2005 to 2017 JAN2010 FAATAF	Projection	PROJECTION aircraft 2005 to 2017 JAN2010 FAATAF	0	Projection factors for aircraft derived from the FAA Terminal Area Forecast System.
PROJECTION Tier3 Proposal 2017 low-E to 2017 REF transport BPS BTP RBT	Projection	PROJECTION_2017ct_REF_Tier3prop_transport_scalars_28jul2011	0	Projection factors for transport of renewable fuel blends from bulk plant to storage, refinery to bulk terminal and bulk terminal to pump
PROJECTION Tier3 Proposal 2017 low-E to 2017 REF-CTL ag	Projection	PROJECTION_2017ct_REF_Tier3prop_ag_scalars_26jul2011	0	Projection factors accounting for changes in biofuel volumes on upstream agricultural sources
PROJECTION Tier3 Proposal 2017 low-E to 2017 REF-CTL refineries	Projection	PROJECTION_2017ct_REF_Tier3prop_refinery_scalars_26jul2011	0	Projection factors accounting for refinery process changes from renewable fuels

United States Environmental Protection Agency	Office of Air Quality Planning and Standards Air Quality Assessment Division Research Triangle Park, NC	Publication No. EPA-454/R-11-011 December, 2011