RFS2 Emissions Inventory for Air Quality Modeling Technical Support Document

United States
Environmental Protection
Agency

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Assessment and Standards Division
Office of Transportation and Air Quality

and

Emissions Inventory and Analysis Group
Office of Air Quality Planning and Standards

U.S. Environmental Protection Agency

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ACRONYMS

AEO	Annual Energy Outlook
BEIS	Biogenic Emission Inventory System
btp	Bulk plant-to-pump
CAMD	EPA's Clean Air Markets Division
CAP	Criteria Air Pollutant
CARB	California Air Resources Board
CEM	Continuous Emissions Monitoring
CMAQ	Community Multiscale Air Quality
DOE	Department of Energy
E0	0% Ethanol gasoline
E10	10% Ethanol gasoline
E85	85% Ethanol gasoline
EISA	Energy Independence and Security Act of 2007
EGU	Electric Generating Utility
FAA	Federal Aviation Administration
FIPS	Federal Information Processing Standard
HAP	Hazardous Air Pollutant
HDGV	Heavy-duty Gasoline Vehicles
IPM	Integrated Planning Model
LDGT1	Light-duty Gasoline Trucks, 0-6000 pounds gross vehicle weight
LDGT2	Light-duty Gasoline Trucks, 6000-8500 pounds gross vehicle weight
LDGV	Light-duty Gasoline Vehicles
MOBILE6	Mobile Source Emission Factor Model, version 6
MOVES	Motor Vehicle Emissions Simulator
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)
ORNL	Oak Ridge National Laboratory
MP	Multipollutant
PFC	Portable Fuel Container
rtb	Refinery-to-bulk terminal
RFS1	Renewable Fuel Standard program
RFS2	Revised annual renewable fuel standard
SMOKE	Sparse Matrix Operator Kernel Emissions
SCC	Source Category Code
TAF	Terminal Area Forecast
VOC	Volatile Organic Compound
WRAP	Western Regional Air Partnership

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1 Introduction

This document provides the details of emissions data processing done in support of the revised annual renewable fuel standard (RFS2) air quality modeling. The modeling effort had five cases and two of these cases had additional sensitivities performed to evaluate the impact of improved approaches, for a total of 7 different emissions cases. Table 1 provides of list of the emissions cases created for this modeling effort.

Table 1: List of cases run in support of RFS2 air quality modeling

Case Name	**Internal EPA Abbreviation**	**Description**
2005 model evaluation	2005ai_tox	2005 case done with year-specific data for fires and hourly electric generating utilities (EGUs), to use for model performance evaluation
2005 basecase	2005ci_tox	2005 case done with average year fires data and average year temporal allocation approach, to use for computing relative response factors with 2022 scenarios
2022 AEO case	2022ci_tox_aeo	2022 scenario representing Annual Energy Outlook (AEO) 2007 projected ethanol volume (13.2 billion gallons)
2022 RFS1 case	2022ci_tox_rfs1	2022 scenario representing the original reformulated fuel standard (RFS1) mandated ethanol volume (6.7 billion gallons)
2022 RFS1 headspace profile sensitivity case	2022ci_tox_rfs1v2_sens1	Revised RFS1 case with adjusted nonroad exhaust speciation and headspace vapor for fuel with zero percent ethanol (E0) speciation profile
2022 RFS2 case	2022ci_tox_eisa_rr	2022 scenario representing proposed ethanol volume of 34 billion gallons to meet RFS2 renewable fuel requirement
2022 RFS2 nonroad speciation sensitivity case	2022ci_tox_eisa2	Revised RFS2 case with volatile organic compound (VOC) speciation profiles all nonroad and Portable Fuel Container (PFC) emissions changed to 100% fuel with 10% ethanol (E10). Also does not include cellulosic ethanol plant emissions.

The data used in the 2005 emissions cases are often the same as those described in the 2005-based, v4 platform document (http://www.epa.gov/ttn/chief/emch/index.html#2005). The RFS2 cases use some different emissions data than the official v4 platform for two reasons: (1) the 2005 RFS2 modeling performed from December 2008 through March of 2009 was completed prior to the completion of the 2005 v4 platform and (2) the RFS2 modeling used data intended only for the rule development and not for general use. All of the documentation provided here describes what was done differently and specifically for the RFS2 effort in contrast to what is used in the v4 platform.

In RFS2, the same emission inventories were used for both the 2005 model performance case and the 2005 base case, with the exception of the fires data and EGU temporal allocation approach. These differences are documented with the v4 platform documentation as well and use the same approaches previously documented with OAQPS's 2002-based v3 platform (http://www.epa.gov/ttn/chief/emch/index.html#2002). In addition, the same biogenic emissions data as the v4 platform was used not only in the 2005 cases for

RFS2, but also in all future-year cases run for RFS2. For RFS2, the only significant data changes between the 2005 and future-year cases are emission inventories and speciation approaches.

For this effort, we have created and provided state, county, and source category code (SCC) summaries for external review for the nonpoint and mobile sectors. For point sources, we have posted the actual inventory datasets that we used for emissions modeling. The data have been provided to the EPA docket for this rule. In addition, the data can be found associated with the "RFS2 2005 and 2022 emissions data" link on the CHIEF website at http://www.epa.gov/ttn/chief/emch/index.html#2005.

In the remainder of this document, we provide a description of the approaches taken for the emissions in support of air quality modeling for RFS2. In Section 2, we describe the ancillary data and 2005 inventory differences from the v4 platform. In Section 3, we describe the speciation differences among each of the cases run for RFS2. In Section 4, we describe the 2022AEO case as compared to the 2005 base case, and in Sections 5 through 8, we describe each of the additional future-year cases in comparison to a previously described future-year case.

2 2005 Emission inventories and their preparation

The 2005 emissions modeling approach for RFS2 used much of the same data and approaches as the v4 platform. In this section, we identify the differences between the data used for RFS2 and that used for the 2005 v4 platform. Section 2.1 provides ancillary data differences that impact multiple sectors and Sections 2.2 through 2.4 provides differences for the point, area, and mobile sectors.

Table 2 below lists the platform sectors used for the RFS2 modeling platform. It also indicates which platform sectors include HAP emissions and the associated sectors from the National Emission Inventory (NEI). Subsequent sections refer to these platform sectors for identifying the emissions differences between the v4 platform and the RFS2 platform.

Table 2: Sectors Used in Emissions Modeling for the RFS2 Platform

Platform Sector	2005 NEI Sector	Description	Contains HAP emissions?
IPM sector: *ptipm*	Point	NEI EGU processes 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 records not matched to the ptipm sector.	Yes
Point source fire sector: *ptfire*	Fires	Point source fire inventory - contains wildfires and prescribed burning. Used only for the 2005 model performance case.	Yes
Average-fire sector: *avefire*	N/A	Average-year wildfire and prescribed fire emissions derived from the 2001 Platform avefire sector, county and annual resolution. Used for the 2005 base year and the future base model runs, but not for the model evaluation case.	Yes
Agricultural sector: *ag*	Nonpoint	NH3 emissions from NEI nonpoint livestock and fertilizer application.	No
Area fugitive dust sector: *afdust*	Nonpoint	PM_{10} and $PM_{2.5}$ from fugitive dust sources from the NEI nonpoint inventory.	No
Remaining nonpoint sector: *nonpt*	Nonpoint	All nonpoint sources not otherwise included in other emissions modeling sectors.	Yes
Nonroad sector: *nonroad*	Mobile: Nonroad	Nonroad emissions from National Mobile Inventory Model (NMIM) using NONROAD2005, other than for California, in which emissions submitted by the California Air Resources Board (CARB) were used. CARB data used for HAPs are annual, other data are monthly.	Yes

Platform Sector	2005 NEI Sector	Description	Contains HAP emissions?
Aircraft, locomotive, marine: *alm_no_c3*	Mobile: Nonroad	Aircraft, locomotive, commercial marine except for c3 commercial marine vessels	Yes
C3 commercial marine: *seca_c3*	Mobile: nonroad	C3 commercial marine vessels	Yes
Onroad, except gasoline PM: *on_noadj*	Mobile: onroad+	A combination of onroad mobile sources from MOBILE6, MOVES, and 2005 NEI v2 data from California. MOVES-based data used only for onroad gasoline CO, NOx, VOC, some VOC HAPs, Exhaust PM2.5, and Exhaust PM10. More details provided in the 2005 v4 platform documentation.	Yes
Onroad starting exhaust PM: *on_moves_startpm*	Mobile: onroad+	MOVES-based onroad mobile start exhaust PM and naphthalene data. More details provided in the 2005 v4 platform documentation.	Yes, naphthalene only
Onroad running exhaust PM *on_moves_runpm*	Mobile: onroad+	MOVES-based onroad mobile running exhaust PM and naphthalene data. More details provided in the 2005 v4 platform documentation.	Yes, naphthalene only
Biogenic: *biog*	N/A	Hour-specific emissions generated from the Biogenic Emission Inventory System (BEIS), version 3.13 model (includes emissions in Canada and Mexico) run with the Sparse Matrix Operator Kernel Emissions (SMOKE) modeling system.	No
Other point sources not from the NEI: *othpt*	N/A	Point sources from Canada's 2000 inventory, Mexico's 1999 inventory, and off-shore point sources from the 2001 platform	No
Other nonpoint and nonroad not from the NEI: *othar*	N/A	Canada and Mexico nonpoint and nonroad mobile inventories	No
Other onroad sources not from the NEI: *othon*	N/A	Canada and Mexico onroad mobile inventories	No
Other point mercury: *othpt_hg*	N/A	Canada point Hg	Yes, Hg only
Other nonpoint mercury: *othar_hg*	N/A	Canada nonpoint Hg	Yes, Hg only

+ Some data used for footnoted sectors are not contained in the 2005 NEI v1 or v2.

As with the 2005 v4 platform, we processed all emissions data with a custom version of the Sparse Matrix Operator Kernel Emissions (SMOKE) modeling system, version 2.5. Users seeking to replicate modeling done for this effort can use version 2.6 of SMOKE. More details about SMOKE including user documentation are available at its website (http://www.smoke-model.org).

2.1 Custom configuration for emissions modeling for RFS2

Unlike the 2005 v4 platform, the configuration for RFS2 modeling included additional hazardous air pollutants (HAPs) and used slightly older ancillary data. Both of these differences are described in this section.

Table 3 lists the additional HAP pollutants processed for the RFS2 platform, which were not included in the 2005 v4 platform. However, since using the full multipollutant HAP version of the Community Multiscale Air Quality (CMAQ) model would have taken longer than the time available for our project, we used a "lite" version of the multipollutant CMAQ that required emissions only for the species flagged in the third column of Table 3. Additional model species that will appear in model-ready data files are listed in the right two columns of the table, but we did not run these additional HAPs through CMAQ for this effort.

Table 3: Comparison of model species in 2005 v4 platform and RFS2 platform

Description	2005 v4 platform species	RFS2 platform Species in CMAQ MP lite	Additional RFS2 platform HAP Species*	Description
Carbon Monoxide	CO	CO	ACRYLONITRILE	Acrylonitrile
Nitrogen Oxide	NO	NO	BR2_C2_12	1,2 Dibromoethane
Nitrogen Dioxide	NO2	NO2	CARBONTET	Carbontet
Nitrous acid	HONO	HONO	CHCL3	Chloroform
Ammonia	NH3	NH3	CL_ETHE	Vinyl Chloride
Sulfur dioxide	SO2	SO2	CL2_C2_12	1,2 Dichloroethane
Sulfuric acid vapor	SULF	SULF	CL2_ME	Methylene Chloride
$PM_{2.5}$ Elemental carbon	PEC	PEC	CL3_ETHE	Trichloroethylene
$PM_{2.5}$ Organic carbon	POC	POC	CL4_ETHANE1122	1,1,2,2 Tetrachloroethane
$PM_{2.5}$ primary nitrate	PNO3	PNO3	CL4_ETHE	Perchloroethylene
$PM_{2.5}$ primary sulfate	PSO4	PSO4	DICHLOROBENZENE	Dichlorobenzene
$PM_{2.5}$ other	PMFINE	PMFINE	DICHLOROPROPENE	Dichloropropene
PM Coarse (PM_{10} – $PM_{2.5}$)	PMC	PMC	ETOX	Ethylene Oxide
Acetaldehyde	ALD2	ALD2	HEXAMETHY_DIIS	Hexamethylene 1,6-Diisocyanate
Higher aldehydes	ALDX	ALDX	HYDRAZINE	Hydrazine
Ethene	ETH	ETH	MAL_ANHYDRIDE	Maleic Anhydride
Ethane	ETHA	ETHA	PROPDICHLORIDE	Propdichloride
Ethanol	ETOH	ETOH	QUINOLINE	Quinoline
Formaldehyde	FORM	FORM	TOL_DIIS	2,4-Toluene Diisocyanate
Internal olefin carbon bond	IOLE	IOLE	TRIETHYLAMINE	Triethylamine
Isoprene	ISOP	ISOP	DIESEL_PEC	Diesel $PM_{2.5}$ elemental carbon
Methanol	MEOH	MEOH	DIESEL_POC	Diesel $PM_{2.5}$ organic carbon
Nonreactive VOC	NR	NR	DIESEL_PMFINE	Diesel $PM_{2.5}$ primary nitrate
Nonvolatile (from VOC mass)	NVOL	NVOL	DIESEL_PNO3	Diesel $PM_{2.5}$ primary sulfate
Terminal olefin carbon bond	OLE	OLE	DIESEL_PMC	Diesel $PM_{2.5}$ other
Parrafin carbon bond	PAR	PAR	DIESEL_PSO4	Diesel coarse PM
Toluene and other monoalkyl aromatics	TOL	TOL	BERYLLIUM_C	Coarse Beryllium
Unknown VOC	UNK	UNK	BERYLLIUM_F	Fine Beryllium
Unreactive VOC	UNR	UNR	CADMIUM_C	Coarse Cadmium
Xylene and other polyalkyl aromatics	XYL	XYL	CADMIUM_F	Fine Cadmium
Sequiterpenes	SESQ	SESQ	CHROMHEX_C	Coarse Hexavalent Chromium
Terpene	TERP	TERP	CHROMHEX_F	Fine Hexavalent Chromium
Benzene	BENZENE	BENZENE	CHROMTRI_C	Coarse Trivalent Chromium
Chlorine	CL2	CL2	CHROMTRI_F	Fine Trivalent Chromium
Hydrochloric acid	HCL	HCL	LEAD_C	Coarse Lead
Divalent gaseous mercury	HGIIGAS	HGIIGAS	LEAD_F	Fine Lead
Elemental mercury	HGNRVA	HGNRVA	MANGANESE_C	Coarse Manganese
Particulate mercury	PHGI	PHGI	MANGANESE_F	Fine Manganese
Naphthalene from the HAP inventory		NAPHTHALENE	NICKEL_C	Coarse Nickel
Acrolein from the HAP inventory		ACROLEIN	NICKEL_F	Fine Nickel
Acetaldehyde from the HAP inventory		ALD2_PRIMARY		
1,3 Butadiene from the HAP inventory		BUTADIENE13		

Description	2005 v4 platform species	RFS2 platform Species in CMAQ MP lite	Additional RFS2 platform HAP Species*	Description
Methane from the HAP inventory		CH4		
Formaldehyde from the HAP inventory		FORM_PRIMARY		
M-isomer of Xylene from the HAP inventory		MXYL		
O-isomer of Xylene from the HAP inventory		OXYL		
P-isomer of Xylene from the HAP inventory		PXYL		
Toluene from the HAP inventory		TOLU		

* These species are created by the emissions configuration, but were not modeled.

In addition to the species changes, the RFS2 platform had a few additional custom aspects in the 2005 cases. Table 4 lists the datasets used by the RFS2 platform that are different from the v4 platform, including a description of the impact of the differences. These differences stem from the 2005 v4 platform having been done after the RFS2 platform, resulting in newer inventory data used for the v4 platform. These inventory differences are described more in later sections of this document. In addition, Appendix D provides a more detailed comparison of the ancillary datasets for the 2005 v4 platform versus the RFS2 platform.

Another consideration is the speciation across the RFS2 future-year cases as compared to 2005. Section 3 provides a detailed account of these differences. Otherwise, the future-year ancillary data were largely the same as those in 2005, with no substantial differences. Are ancillary data files can be found at the 2005-based platform website (http://www.epa.gov/ttn/chief/emch/index.html#2005).

Table 4: Description of differences in ancillary data between the RFS2 2005 case and the 2005 v4 platform.

Ancillary Data Type	Difference between 2005 v4 platform and RFS2 platform
Spatial cross references	The 2005 v4 platform data are updated to support the newer (2006) Canadian inventories that were not available in time for RFS2 modeling.
Temporal cross-references	The 2005 v4 platform data are updated to support the 2006 Canadian data, additional source category codes (SCCs) found in the 2005 v2 NEI point inventory, and a revised oil and gas inventory.
Temporal profiles	The 2005 v4 platform dataset adds additional profiles from Environment Canada to support processing of the 2006 Canadian inventory.
Speciation cross-references and Speciation profiles	The RFS2 data files are configured to support the multi-pollutant (MP) version of CMAQ, whereas the 2005 v4 platform data file is configured to support only the non-MP version. Therefore, the RFS2 data files include profiles for additional HAP species, including HAP VOCs, HAP metals, chromium, and diesel PM. The 2005 v4 platform data files include profiles for passing through the pre-speciated VOCs for the 2006 Canadian inventory.
Inventory tables	The RFS2 data file is configured to support the MP version of CMAQ, whereas the 2005 v4 platform data file is configured to support only the non-MP version.
NonHAP exclusions data	The 2005 v4 platform data has been updated with new oil and gas SCCs not used for the RFS2 platform.

2.2 Point sources

The 2005 emissions from the U.S. point source sectors (ptipm and ptnonipm) used for RFS2 differ from the v4 platform primarily because the emissions are based on the 2005 NEI version 1, rather than the 2005 NEI version 2. The original emissions were created from the NEI database on June 10, 2008. These emissions were further modified, further changing the 2005 NEI version 1, as follows:

1) Inventory split into ptipm and ptnonipm sectors using the IPM indicator of the SMOKE-ready datasets
2) Applied fugitive dust transport fractions to the appropriate SCCs (see http://www.epa.gov/ttn/chief/emch/dustfractions**)**
3) Further analyzed HCl emissions for missing ptipm sector HCl sources and moved emissions originally labeled as ptnonipm to correctly be placed with their associated criteria air pollutants (CAP) emissions in the ptipm sector
4) Removed emissions of benzene, acetaldehyde, formaldehyde, methanol, to support the “no hap use” approach for the ptipm and ptnonipm sectors
5) Added an additional 47 ethanol plants based on direction from staff at the Office of Transportation and Air Quality (OTAQ). Unless otherwise note in Table 5 (a list of ethanol facilities and their emissions), we adjusted the original VOC emissions provided by a factor of 0.65 (a reduction) to offset the ethanol-heavy speciation profile (99.6% ethanol) that we had available for speciation of ethanol plants. This prevented the overstating of ethanol emissions. In addition, we multiplied all emissions by $1/(453.6 \times 2000) \times 1{,}000{,}000 = 1.1023113109$ (converting from grams/yr per million gallons to tons/yr) at the direction of OTAQ to correct the units of the emissions (from grams per million gallon per year to tons/year). These changes resulted in roughly a 10.23% increase in the emissions values initially provided by OTAQ. The list of these facilities and their emissions is available in Table 5.
6) Removed facilities that closed between 2002 and 2005, since much of the ptnonipm portion of the 2005 v1 NEI was carried forward from the 2002 v3 NEI. This change was also made in creating the v4 platform. The list of removed sources is available in the Excel® file “Closures_applied_to_2002v3_point_for_2005af.xls” provided with the 2005 v4 platform documentation.
7) Removed Minnesota airport ground support equipment (SCCs 2265008005 and 2270008005), to prevent double counting with the nonroad sector.
8) Other minor adjustments:
    - Removed exclamation marks, asterisks, and embedded double quotes in facility names, and other key text fields, changed “PM25” and “PM25-PRI” to “PM2_5”, and changed the state/county Federal Information Processing Standard (FIPS) code field for tribal records from 00000 to 88TTT, where TTT is the tribal code.
    - Removed two SCC=201002 records because this is an invalid SCC; both records had zero emissions

To implement the inventory processing, we split the 2005 ptnonipm CAP and HAP inventories into five separate datasets to facilitate replacement and projection for the 2022 scenarios. These datasets are:

1) A dataset with one ethanol plant (Chippewa) CAP and HAP emissions for which the emissions are held at 2005 values for the AEO and RFS1 cases and changed in the RFS2 case
2) A dataset with three ethanol plants’ CAP and HAP emissions that are replaced in all 2022 scenarios
3) A dataset with CAP and HAP emissions for 43 additional ethanol plants not available in the 2005 v1 NEI, which also have different emissions n all 2022 scenarios.
4) A dataset with CAP emissions from the all other nonEGU sources from the 2005 NEI v1
5) A dataset with HAP emissions from the all other nonEGU sources from the 2005 NEI v1

In addition to differences in the U.S. point sources, further differences exist from the v4 platform for the Canadian point emissions. The Mexico point emissions are identical to those documented for the 2002 v3 platform and the 2005 v4 platform. The RFS2 modeling inventories included year 2000 Canadian emissions from the 2002 v3 platform and did not include the updated 2006 Canadian emissions, because these emissions were not available in time to support the development of the model-ready emissions. There was no Canadian mercury emissions data, and so these are the same as the 2002 v3 platform. The offshore sources were different from what was used in the 2005 v4 platform because they were not updated with the new offshore inventory available in the 2005 v2 NEI. For more information on the Canadian and Mexican emissions used for this effort, please refer to the 2002 v3 platform documentation at http://www.epa.gov/ttn/chief/emch/index.html#2002.

In addition, we processed emissions for RFS2 using the 3-d emissions option for all point source sectors rather than the “inline” point source option that we used for the 2005 v4 platform. This approach has essentially no effect on the modeling results. Using the inline approach makes the CMAQ emissions data files smaller, but that option was not available in time for use on this effort.

Table 5: Emissions from ethanol plants added to 2005 v1 point inventory (tons/year)

County Name	State Name	St/Co FIPS	PLANT	CO	NO_X	VOC	SO_2	$PM_{2.5}$	PM_{10}	ACROLEIN
Swift Co	Minnesota	27151	Chippewa Valley Ethanol Co LLLP (*)	29.7	40.4	155.1	0.6	19.7	28.4	0.0001
Chippewa Co	Minnesota	27023	Granite Falls WWTP (+)	0.0	0.0	0.7	0.0	0.0	0.0	0.0000
Dodge Co	Minnesota	27039	Al-Corn Clean Fuel (+)	28.5	45.0	207.6	0.5	0.0	24.0	0.0618
Sibley Co	Minnesota	27143	Heartland Corn Products (+)	51.4	62.9	378.3	0.4	36.7	61.6	0.0000
Dawson Co	Nebraska	31047	Cornhusker Energy Lexington (CEL)	10.5	30.3	14.3	38.6	1.1	12.1	0.0557
Stevens Co	Minnesota	27149	Diversified Energy Company (DENCO), LLC	52.4	151.6	71.6	192.9	6.5	60.6	0.2783
Wichita Co	Kansas	20203	ESE Alcohol Inc.	3.1	9.1	4.3	11.6	0.4	3.6	0.0166
Sedgwick Co	Kansas	20173	Abengoa Bioenergy Corporation	52.4	151.6	71.6	192.9	5.5	60.6	0.2783
Roosevelt Co	New Mexico	35041	Abengoa Bioenergy Corporation	62.8	181.9	86.0	231.5	6.6	72.8	0.3339
Linn Co	Iowa	19113	Archer Daniels Midland (ADM)	964.7	1,338.4	418.1	1,266.3	546.7	1,248.9	2.7827
Clinton Co	Iowa	19045	Archer Daniels Midland (ADM)	733.2	1,017.2	317.7	962.4	415.5	949.2	2.1148
Platte Co	Nebraska	31141	Archer Daniels Midland (ADM)	366.6	508.6	158.9	481.2	207.8	474.6	1.0574
Lyon Co	Minnesota	27083	Archer Daniels Midland (ADM)	154.4	214.1	66.9	202.6	87.5	199.8	0.4452
Peoria Co	Illinois	17143	Archer Daniels Midland (ADM)	439.8	1,273.1	601.9	1,620.4	365.5	509.3	2.3375
Pembina Co	North Dakota	38067	Archer Daniels Midland (ADM)	52.4	151.6	71.6	192.9	43.5	60.6	0.2783
Tazewell Co	Illinois	17179	Aventine Renewable Energy, Inc. (formerl	385.9	535.4	167.2	506.5	218.7	499.6	1.1131
Monroe Co	Wisconsin	55081	Badger State Ethanol, LLC	108.9	315.3	149.0	401.2	13.4	126.1	0.5788
Des Moines Co	Iowa	19057	Big River Resources, LLC	108.9	315.3	149.0	401.2	13.4	126.1	0.5788
Washington Co	Nebraska	31177	Cargill (was PGLA-1CO)	328.0	455.1	142.1	430.5	185.9	424.6	0.9458
Christian Co	Kentucky	21047	Commonwealth Agri-Energy, LLC	41.9	121.3	57.3	154.3	5.2	48.5	0.2226
Codington Co	South Dakota	46029	Glacial Lakes Energy, LLC (GLE)	104.7	303.1	143.3	385.8	12.9	121.3	0.5567
Kossuth Co	Iowa	19109	Global Ethanol	209.4	606.3	286.6	771.6	25.8	242.5	1.1131
Riverside Co	California	06065	Golden Cheese Company of CA	10.5	30.3	14.3	38.6	1.3	12.1	0.0557
Cerro Gordo Co	Iowa	19033	Golden Grain Energy LLC	146.6	424.4	200.6	540.1	15.3	169.8	0.7793
Hardin Co	Iowa	19083	Hawkeye Renewables, LLC	115.2	333.4	157.6	424.4	14.2	133.4	0.6122
Brown Co	South Dakota	46013	Heartland Grain Fuels, LP	20.9	60.6	28.7	77.2	2.2	24.3	0.1113
Beadle Co	South Dakota	46005	Heartland Grain Fuels, LP	29.3	84.9	40.1	108.0	3.1	34.0	0.1558
Pierce Co	Nebraska	31139	Husker Ag, LLC	54.5	157.6	74.5	200.6	5.7	63.1	0.2894
Kearney Co	Nebraska	31099	KAAPA Ethanol, LLC	125.7	363.8	172.0	463.0	15.5	145.5	0.6678
Stearns Co	Minnesota	27145	Land O' Lakes / Melrose Dairy Proteins	5.4	15.8	7.5	20.1	0.7	6.3	0.0290
Crawford Co	Illinois	17033	Lincolnland Agri-Energy	58.6	169.8	80.2	216.0	7.2	67.9	0.3119

County Name	State Name	St/Co FIPS	PLANT	CO	NO_X	VOC	SO_2	$PM_{2.5}$	PM_{10}	ACROLEIN
Cherokee Co	Iowa	19035	Little Sioux Corn Processors	184.3	533.5	252.2	679.0	19.3	213.4	0.9795
Jefferson Co	Colorado	08059	Merrick & Company (Coors Brewery)	4.2	12.1	5.7	15.4	0.5	4.9	0.0223
Tazewell Co	Illinois	17179	MGP Ingredients, Inc.	188.5	545.6	257.9	694.4	23.2	218.3	1.0020
Lincoln Co	Nebraska	31111	Midwest Renewable Energy, LLC (MRE)	41.9	121.3	57.3	154.3	5.2	48.5	0.2226
Hamilton Co	Nebraska	31081	Nebraska Energy	104.7	303.1	143.3	385.8	10.9	121.3	0.5565
Roberts Co	South Dakota	46109	North Country Ethanol (NCE)	52.4	151.6	71.6	192.9	6.5	60.6	0.2783
Delaware Co	Iowa	19055	Permeate Refining	3.1	9.1	4.3	11.6	0.4	3.6	0.0166
Ida Co	Iowa	19093	Quad-County Corn Processors	56.5	163.7	77.4	208.3	7.0	65.5	0.3005
Finney Co	Kansas	20055	Reeve Agri-Energy	25.1	72.8	34.4	92.6	3.1	29.1	0.1336
Sioux Co	Iowa	19167	Siouxland Energy & Livestock Coop (SELC)	46.1	133.4	63.1	169.8	4.8	53.4	0.2449
Red Willow Co	Nebraska	31145	SW Energy, LLC.	0.2	0.6	0.3	0.8	0.0	0.2	0.0011
Loudon Co	Tennessee	47105	Tate & Lyle	254.7	353.3	110.4	334.3	144.3	329.7	0.7346
Hitchcock Co	Nebraska	31087	Trenton Agri-Products, LLC. (TAP)	83.8	242.5	114.6	308.6	10.3	97.0	0.4452
Winnebago Co	Wisconsin	55139	Utica Energy, LLC	108.9	315.3	149.0	401.2	11.4	126.1	0.5788
Gove Co	Kansas	20063	Western Plains Energy, LLC	62.8	181.9	86.0	231.5	6.6	72.8	0.3339
Mitchell Co	Georgia	13205	Wind Gap Farms (Anheuser/Miller Brewery)	0.8	2.4	1.1	3.1	0.1	1.0	0.0045
			Total	**6,074.3**	**12,610.4**	**5,923.2**	**14,417.5**	**2,537.1**	**7,456.6**	**24.0**

(*) Data taken from the 2002 NEI rather than provided by OTAQ for 2005. Units conversion not performed on this facility and no adjustment of the emissions by 0.65.

(+) Data taken from the 2005 NEI v1, rather than provided by OTAQ for 2005. Units conversion not performance on these facilities and no adjustments of the emissions data by 0.65.

2.3 2005 Nonpoint sources

The emissions from the agricultural ammonia (ag) and nonpoint fugitive dust (afdust) sectors are the same as the v4 platform, documented elsewhere. For the "other" nonpoint (nonpt) sector, the only difference from the v4 platform is that these emissions do *not* include the oil and gas extraction emissions (SCCs matching 23100XXXXX) provided by the Western Regional Air Partnership (WRAP) for the western states. These updated oil and gas extraction emissions were provided after the modeling platform development for RFS2.

For the Canadian and Mexican nonpoint sector (othar), we used the same inventories as the 2002 v3 platform, and did not yet have the updated 2006 Canadian inventory used in the v4 platform.

The 2005ci_tox_05b case uses the average fires (avefire) sector rather than the point source fires (ptfire) sector. The avefire emissions are the same as those in the 2005ci_tox_05b case mentioned above, with the exception that we added 1-3-butadiene, acrolein, and xylenes, and toluene using ratios to $PM_{2.5}$ available in the Excel® file "Wildfire HAP ratios to PM2.5 08oct2008.xls" compiled by Madeleine Strum on 10/8/2008. The factors in this Excel® file also were used to create emissions for benzene, acetaldehyde, and formaldehyde in the 2005 v4 platform and were unchanged for RFS2. References for these data are provided in the spreadsheet.

2.4 2005 Mobile sources

Mobile sources include three US onroad sectors (on_noadj, on_moves_startpm, on_moves_runpm) and two US nonroad sectors (nonroad and alm_no_c3). In addition, it includes Canadian and Mexican emissions in a separate onroad sector (othon) and nonroad/nonpoint sector (othar).

For onroad mobile, the on_noadj sector is the same as the v4 platform, with the exception of keeping additional pollutants as described in Section 2.1. The on_moves_startpm and on_moves_runpm emissions inventory data are also the same as the v4 platform, with the only additional pollutant for these sectors being naphthalene. In addition for the Motor Vehicle Emission Simulator (MOVES) sectors, the temperature adjustment calculations applied to $PM_{2.5}$ species were also applied to naphthalene, but the methods we used were the same as the v4 platform.

The nonroad emissions inventory data are the same as the v4 platform, with additional HAPs being kept for RFS2 as well. The alm_no_c3 emission sector does use different data from that of the v4 platform. Specifically, the aircraft emissions remain in this sector and are older data from that of the v4 platform. In the v4 platform, the aircraft emissions had been revised and included in the ptnonipm sector as part of the 2005 NEI v2. The airport emissions used in RFS2 were from the 2002 NEI, version 3, acquired March 27, 2007 and used in the Office of Air Quality Planning and Standards' (OAQPS's) 2002 v3.1 platform.

Additionally, the othon sector for RFS2 differs from the v4 platform because we used the older Canadian data. The data we used reflect 2000 emissions and are the same data used in the v3 and v3.1 2002-based platforms. The 2005 v4 platform uses 2006 Canadian inventory data, not available at the time that we performed RFS2 modeling.

3 VOC speciation changes that represent fuel changes

A significant detail that changes for each of the RFS2 modelingcases is the VOC speciation profiles used to split total VOC emissions into the various VOC model species needed for CMAQ. In this section, we summarize the various speciation profile information used in configuring the various cases, and we include Table 6 to provide a summary of the VOC speciation approach for each of the future-year cases.

The approaches taken in the 2005 cases below are the same as the 2005 v4 platform, but are included here for completeness. The approaches used for each of the future year cases are customized for those cases, and they include the impact of fuel changes for each of the future-year cases on emissions from the on_noadj sector, the nonroad sector, and parts of the nonpt and ptnonipm sectors. The speciation changes from fuels in the nonpt sector include changes for portable fuel containers (PFCs) and some parts of the bulk-plant-to-pump (btp) and refinery-to-bulk terminal (rbt) emissions. The speciation changes from fuels in the ptnonipm sector include the remainder of the emissions for the btp and rbt emissions. Appendices A and B provide additional details on the origin of the speciation changes based on fuel assumptions among the three future-year cases.

In Table 6 below, the VOC speciation approach gives a general indication of the approached used, but the details of the implementation are found in the ancillary data provided and in Appendices A and B. Although a sector might take the same general approach between two cases, differences may exist in the details of the approach. For example, the nonroad sector uses combinations of E0 and E10 Tier 1 profiles in the 2005 and 2022 RFS1 sensitivity cases, but different fractions of these two profiles were used for each case.

Table 6: Summary of VOC speciation profile approaches by sector across cases

Inventory type and mode	VOC speciation approach for fuels	VOC Profile Codes	2005 cases	2022 AEO	2022 RFS1	2022 RFS1 sensitivity	2022 RFS2	2022 RFS2 sensitivity
Mobile Exhaust	Tier 1 E0 and E10 combinations	8750 8751	on_noadj nonroad			nonroad		
	Tier 1 and Tier 2 E0 and E10 combinations	8750 8751 8756 8767		on_noadj nonroad	on_noadj nonroad	on_noadj		
	Tier 2 E10 and E85 combinations	8752 8757					on_noadj nonroad	on_noadj
	Tier 1 E10	8751						nonroad
Mobile Evaporative	E0 and E10 combinations	8753 8754	on_noadj nonroad					
	E0 **or** E10 (by county)	8753 8754		on_noadj nonroad				
	E0 **or** E10 **or** combinations	8753 8754			on_noadj nonroad	on_noadj nonroad		
	E10 and E85 combinations	8754 8755					on_noadj nonroad	on_noadj
	E10	8754						nonroad

Inventory type and mode	VOC speciation approach for fuels	VOC Profile Codes	2005 cases	2022 AEO	2022 RFS1	2022 RFS1 sensitivity	2022 RFS2	2022 RFS2 sensitivity
Other <u>sources:</u> nonroad refueling, PFCs, btp, rbt	E0	8737	All listed					
	E0 and E10 combination	8736 8737		All listed[+]	All listed			
	E0 (revised) and E10 combinations	8736 8737B				All listed		
	E0 (revised)	8737B					rbt	
	E10 and E85 combinations	8736 8755					PFCs btp nonroad	btp rbt
	E10	8736						PFCs nonroad

[+] A negligible fraction of E85 evaporative emissions (profile 8755, fraction 0.00075) was assumed in this combination.

Table 7 provides the purpose of the VOC speciation profile codes used in the table:

Table 7: Explanation of VOC profile codes listed in Table 6.

Exhaust		**Evaporative**		**Refueling**	
8750	Tier1 E0	8753	E0	8736	E10 headspace vapor
8751	Tier1 E10	8754	E10	8737	E0 headspace vapor
8752	E85	8755	E85	8737B	E0 headspace vapor with reduced olefins.
8756	Tier2 E0				
8757	Tier2 E10				

Appendix D summarizes the data file names used for all of the data files that are updated from the v4 platform. All ancillary data files are available on the 2005-based platform website previously referenced.

4 2022 AEO Case

The 2022 AEO case is intended to represent the emissions associated with use of the most likely volume of ethanol in the absence of the RFS2 rule and Energy Independence and Security Act of 2007 (EISA) renewable fuel requirements. For this case, the ethanol volume was projected for 2022 using the Department of Energy, Energy Information Administration in the 2007 Annual Energy Outlook (AEO) report. That year's AEO projections were used because Department of Energy (DOE) started accounting for EISA in their 2008 AEO projections. A list of inventory datasets used for this and all cases is provided in Appendix A. A list of all growth and control assumptions for this Case is provided in Appendix E. Other Sections describe the projection differences amoung the 2022 AEO, RFS1, and RFS2 cases.

4.1 2022 AEO Point sources

The point sources for the 2022 AEO case included US EGU point sources (ptipm), US nonEGU point sources (ptnonipm) and sources from Mexico, Canada, and the Gulf of Mexico (othpt and othpt_hg). The US EGU point sources for all 2022 cases use an Integrated Planning Model (IPM) run for criteria pollutants, HCl, and mercury in 2020. We used 2020 because it was the year closest to the 2022 modeling year supported by the IPM model. The code number used by EPA's Clean Air Markets Division (CAMD) to denote the run is EPA30Draft_BC_42l. While these emissions are different from those used in the v4 platform, they are consistent with the 2020 emissions used in the v3 platform. OAQPS post-processed these data in the same way as described in the 2005 v4 platform documentation for the "base case" to create daily emissions that include temporal allocation information from three years of Continuous Emissions Monitoring (CEM) data. The temporal allocation approach is the same as for the RFS2 2005 base case (2005ci_tox_05b), to eliminate artificial differences in temporal allocation between the base and future years. In addition to the IPM emissions, we held the remaining HAPs at the same values used in the 2005 cases, except mercury was removed from the original 2005 dataset (i.e., no future-year mercury data are included in the RFS2 platform).

For the Mexican and offshore point source emissions, we held the data constant with the 2005 base case. This means that the Mexican emissions were based on year 1999, since Mexico has not provided emissions projections to date. We used 2020 emissions projections for Canadian emissions, provided by Environment Canada, which are consistent with the 2000 base year. The Canadian data are the same as those used for the 2002-based v3 platform. The data used for RFS2 future years are different from our v4 platform, which was not available for this work and which used 2006 Canadian emissions provided by Environment Canada.

For the US nonEGU emissions (sector ptnonipm) there were two main pieces for the 2022 AEO ptnonipm inventories: data projected from 2005 values and data that were replaced by OTAQ-generated data in 2022. Referring to the five parts listed in Section 2.2, datasets (4) and (5) were projected from 2005 to 2022 values, datasets (2) and (3) were replaced, and dataset (1) was unchanged.

4.1.1 Part 1: Projecting 2005 to 2022 AEO for ptnonipm

We applied both control and growth factors to a subset of the 2005 ptnonipm to create 2022 AEO. We started with 2020 projection factors from the 2002 v3.1 platform for most of the RFS2 year 2022 projections. Given the uncertainty of emissions projections and the lack of any additional controls coming into effect between 2020 and 2022, we decided that using 2020 as the year for our non-EGU point and nonpoint projections would be sufficient. This approach matched the ptipm approach since IPM results were available for 2020 and not 2022. Furthermore, we did not have to adjust the factors for a 2005-base year in most cases, because most of the 2005 v1 nonEGU point emissions data were populated with 2002 emissions values.

The 2002 v3.1 platform growth and control factors had been revised from the 2002v3.0 platform projection factors that are documented in the 2002 v3 emissions modeling platform documentation (see http://www.epa.gov/ttn/chief/emch/index.html#2002)**.** These updates included Hazardous Waste Incineration adjustments and Small and Large Municipal Waste Combustor closures and adjustments. The following describes how we further modified the 2002v3.1 projection factors for the 2022 AEO case.

We used SMOKE with a "control" packet to apply control factors that implement known emissions reductions from point and nonpoint sources for national rules. For RFS2, the control packet was revised from the 2002 v3.1 factors to give key VOC HAPs the same control factors as those for VOC. The VOC HAPs (and CAS numbers) of interest for this effort were: 1,3-butadiene (CAS=106990), acrolein (CAS=107028), formaldehyde (CAS=50000), methanol (CAS=67561), benzene (CAS=71432), acetaldehyde (CAS=75070), and naphthalene (CAS=91203). The "control" packet (data file) header lists all the various components and the SAS® programs used to create it.

We also used SMOKE with a "projection" packet to apply growth adjustments, some control adjustments, and plant closures. For RFS2, the projection packet for ptnonipm consisted of several components. First, we modified the data from the 2002v3.1 platform packet to remove entries for which we had new factors for this effort, such as onroad refueling and aircraft. In addition, we added the same list of VOC HAPs to the projection factors as we had added to the control packet for the VOC-specific entries already present (e.g., landfills in nonpt sector). Next, we added the AEO-specific projection factors from several OTAQ sources, as follows:

1. Onroad refueling: We retained the same list of refueling ptnonipm and nonpt state/county FIPS codes and SCCs from the 2002 v3 emissions modeling platform. For California, we used the 2005v2 California and NMIM data and 2022 NMIM reference case VOC and VOC-HAP refueling emissions to obtain annual adjustment ratios by pollutant and county. Next, we applied an additional OTAQ-provided ethanol adjustment factor of 1.0306 to each ratio for each of the RFS2 scenarios, provided by David Brzezinski on 12/12/2008. The final formula for the projection factors was Factor 2022 = NMIM $Emis_{2022}$ * 1.0306 /NMIM $Emis_{2005}$ (note: we applied different ethanol adjustment factors to the RFS1 and RFS2 cases. These factors were applied to the refueling SCCs from the 2005 base case.

2. Year 2022 aircraft Federal Aviation Administration (FAA) takeoff and landing data from the Terminal Area Forecast (TAF) data: This activity data replaces the 2020 factors for all RFS2 2022 scenarios.

3. We applied adjustments to refinery emissions by state and SCC, using the same factor for all pollutants to represent activity adjustments (note: different adjustments were made to the RFS2 case, and no adjustments were made to the RFS1 case). The state-level adjustments and the list of SCCs affected were provided by Rich Cook on 11/25/2008 in Excel® workbook "RFS2_Refinery_Adjust.xls".

4. For gasoline distribution SCCs (both ptnonipm and nonpt SCCs), we additionally applied VOC and VOC HAP adjustments to SCCs representing emissions from bulk-plant-to-pump (btp) and refinery-to-bulk terminal (rtb) processes. These SCC-level adjustments impact VOC and VOC HAPs in both the ptnonipm and nonpt sectors. The adjustments were provided by Craig Harvey on 12/16/2008 in the Excel® workbook "2005ai_tox_SCC_50state_CAPHAP-20081216.xls". (Note: these adjustments were not applied to RFS1 and different adjustments were applied to RFS2, based on assumed changes in the ratios of E0 to E10 and E85).

We applied the control and projection factors to the ptnonipm 2005 inventory described in Section 2.2, resulting in a "2022" ptnonipm inventory. To this inventory, we added additional OTAQ-supplied inventory data as described in Step 2 below. The configuration of the processing was designed specifically to prevent inadvertent double counting of emissions.

4.1.2 Part 2: Additional OTAQ-supplied emissions data for ptnonipm

In addition to the data preparation described above, we added the following data supplied by OTAQ:

1. Ethanol plant additions: These emissions data completely replace all of the ethanol plants listed in Table 5 except the first one. OTAQ provided the emissions, stack parameters, locations and the same SCC assignments were made as described for 2005: $PM_{2.5}$ (30299999) and VOC and all other pollutants (30125010). The original VOC emissions were supplied by Rich Cook in Excel® and OAQPS further adjusted the data to correct for units conversions and to adjust VOC downward to account for too much ethanol in the speciation profile. These were the same adjustments made to the 2005 data and are described in Section 2.2. Further, we changed the original data to use the same Stack IDs for both $PM_{2.5}$ and PM_{10}, to ensure SMOKE could properly calculate PMC as PM_{10}-$PM_{2.5}$

after matching emissions sources. Lastly, we removed the benzene, formaldehyde, acetaldehyde, and methanol inventory emissions from these sources because they are “no integrate” sources for VOC HAPs (we do not use the VOC HAPs to augment speciation information for this sector), and so these model species were to be calculated from VOC speciation.

2. In addition, we retained the Chippewa plant from 2005 (the emissions at this plant were only changed for the RFS2 case).

4.2 2022 AEO Nonpoint sources

The nonpoint sources are sources aggregated to the county (or Canadian Province) and process level and included US fugitive dust sources (afdust sector), US agricultural NH3 (ag sector), US average fires (avefire sector), other US nonpoint sources (nonpt sector), and emissions for Canada and Mexico (othar and othar_hg). Of these, the nonpt sector contained the most detailed changes for the RFS2 modeling, as explained further below.

The emissions used for this case for the afdust and ag sectors are the same as those used in 2020 in the 2002-based v3 platform, previously referenced. Additionally, the avefire emissions are the same as those in the 2005ci_tox_05b case mentioned above, and were intentionally held constant between the 2005 base case and the 2022 AEO case and all other 2022 cases.

The emissions for Canada and Mexico were the same as the 2002 v3 platform referenced earlier, with one minor exception: we modified the Canada nonroad sources to remove C3 commercial marine SCC (2280003010), which was just one record in British Columbia and which prevented double-counting with the seca_c3 sector. This means that the RFS2 platform differs from the v4 platform in that older estimates of 2020 emissions were used for nonpoint sources in Canada, rather than 2006 estimates retained between the base and future years in the v4 platform. This sector includes both nonroad mobile and nonpoint sources.

The nonpt sector is comprised of several different pieces. Like the ptnonipm sector, the nonpt sector required two steps to compile the 2022 AEO inventories: data projected from 2005 values and data that are replaced by OTAQ-generated data in 2022.

4.2.1 Part 1: Projecting 2005 to 2022 AEO for nonpt

The same steps taken and described for the ptnonipm sector (Section 4.1.1) were also taken for the nonpt sector. In fact, all of the information that we added to the SMOKE projection and control packets has already been described in that section and the parts that also applied to the nonpt sector have already been identified in that section.

In addition to the documentation provided previously for ptnonipm, the 2020 projection factors for Residential Wood Combustion SCCs in this nonpt sector were not updated for 2022 because the difference would have been very small and these emissions are highly uncertain.

The refueling and gasoline distribution projection approaches described in the point source section also apply to the nonpoint sector, since those approaches affect SCCs in both sectors.

4.2.2 Part 2: Additional OTAQ-supplied emissions data for nonpt

In addition to the nonpt emissions projected from 2005 to 2022, several additional OTAQ-provided emission inventories were created to complete the emissions needed for the 2022 AEO nonpt sector:

1. Ethanol plant additions: These are conceptually the same as the ptnonipm plant additions but are for plants with unknown coordinates, and are therefore aggregated to the county-SCC level. SCC assignments determine spatial allocation using spatial surrogate ancillary data. The nonpoint ethanol plants were created from an Excel® spreadsheet provided by Craig Harvey on 11/17/2008: Corn_EtOH_Plant_Inv_2022-aeo.xls. The same VOC adjustments and SCC assignments detailed for ptnonipm were made here as well.

2. Ethanol transfer additions: These new VOC emissions account for vapor loss during transport and loading by truck and rail are assigned three SCCs (30205031, 30205052, and 30205053). Ethanol transfer emissions were provided for AEO on 12/11/2008 by Craig Harvey in an Excel® workbook called "EtOH_transport_vapor_AEO.xls".

3. Biodiesel plant additions: These new emissions are assigned SCC 2102006001 and also contain an units correction (grams/year to tons/year) of 1.102311309E-06, applied by OAQPS after receiving the data from OTAQ. These data were created from an Excel® spreadsheet provided by Craig Harvey on 11/21/2008**:** Biodsl_Plant_Inv_2022-aeo-prelim.xls. We selected the SCC 2102006001 (Stationary Source Fuel Combustion;Industrial;Natural Gas;All Boiler Types) to represent these sources in consultation with Ron Ryan. The VOC was not adjusted by 65% like it was for ethanol and cellulosic plants. OAQPS converted emissions from grams to tons.

4. Portable Fuel Containers: These MSAT-based emissions were provided by OTAQ for the year 2020 for the 2002v3 platform and are unchanged for the 2022 AEO case. We applied adjustment factors (provided by OTAQ) to the RFS1 and RFS2 cases.

4.3 Mobile sources

The mobile sources included many different approaches, depending on the modeling sector. Each of these is described in a separate subsection below.

4.3.1 US Aircraft, locomotive, and non-c3 commercial marine (alm_no_c3)

This sector has traditionally been projected from a base year (e.g., 2005) to a future year (e.g., 2022); however, so many elements of these data were developed specifically for RFS2 that we created a new program to combine all the pieces (ALM_no_C3_create_2022.sas), which includes some leftover projection steps normally done in SMOKE. This program creates three inventories in SMOKE's One Record per Line (ORL) nonroad format:

1. <u>C1 and C2 CMV</u>: Class 1 and class 2 Commercial Marine Vehicle SCCs (2280002100, 2280002200, and 2280004000) complete inventory created by OTAQ for each of the 2022 RFS2 scenarios. For this case, data were provided by Penny Carey on 12/10/2008 in Excel® file: CMV_C1C2_2022RFS2cases.xls. We applied HAP factors to VOC to obtain 1,3-butadiene, acetaldehyde, acrolein, benzene, and formaldehyde, and applied factors to PM_{10} to compute naphthalene. The remaining HAPs -metals and other non-VOC HAPs not already provided- are held at base year levels (the 2002 emissions estimates used in the 2005 basecase).

2. <u>Class 1 Locomotives</u>: This group includes the class 1 locomotives SCC (2285002006), though a very small amount of the class 2 and 3 emissions were also captured by this SCC. Emissions data were provided by OTAQ (Craig Harvey) 11/17/2008 in the data file: Class_I_II_III_locomotives_alm_2020ce_cty_scc_aeo.xls. These data included CAP emissions as well as HAP emissions for 1,3-butadiene, acetaldehyde, acrolein, benzene, formaldehyde, and

naphthalene. Tribal data (SMOKE region code=88206) from the 2005 NEI were retained. The remaining HAPs -metals and other non-VOC HAPs not provided- are held at base year levels (the 2002 emissions estimates used in the 2005 basecase).

3. Remaining alm_no_c3 emissions: These emissions are the leftover alm_no_c3 emissions after removing the data provided and computed in (1) and (2) above. These emissions are limited to aircraft and non-class 1 locomotives. For aircraft, all CAPs and VOC HAPs are projected to year 2022 using FAA TAF data. This is same approach and FAA TAF output as used for year 2020 projections in 2002v3 and 2002v3.1-based platforms, except we used 2022 activity data instead of 2020. Metals and non-VOC HAP aircraft emissions were held at base year levels (2002 emissions estimates used for 2005). We projected the other component of this file, non-class 1 locomotive emissions (SCCs=228500200##, where # = 07, 08, 09, and 10) using the final Locomotive-Marine Rule projection factors for year 2020 for CAPs and VOC HAPs. Non-VOC HAPs are also held at 2005 base year levels. For California, we applied locomotive/marine controls to diesel pleasure craft SCCs (2282020005, 2282020010) to project from 2005 to 2022.

4.3.2 Canada and Mexico onroad mobile sources (othon)

The data in this sector are the same as 2020 data released in 2002-based v3 platform, previously referenced. These are different from 2005 v4 platform because the 2006 Canadian data were not available for use in this project.

4.3.3 C3 commercial marine sources from all waters (seca_c3)

The seca_c3 sector emissions data were provided by OTAQ in an ASCII raster format used since the ECA-IMO project began in 2005. (S)ECA C3 year 2022 reference (AEO and RFS1) and control (RFS2) inventories were provided by OTAQ (Penny Carey) 11/20/2008: 2022base_redo.zip and 2022rfs2.zip. Penny Carey also provided factors to compute HAP emission (based on emissions ratios) on 2/28/2008, which OAQPS applied to either VOC or $PM_{2.5}$ to obtain HAP emissions values. Table 8 below shows these factors and whether they were applied to VOC or $PM_{2.5}$. As with the 2005 case, this sector uses CAP-HAP VOC integration. The “base” dataset is used for both AEO and RFS1 cases and different data are used for the RFS2 case.

Table 8: HAP emission ratios for generation of HAP emissions from criteria emissions for C3 commercial marine vessels.

Pollutant	Apply to	Pollutant Code	Factor
Acetaldehyde	VOC	75070	0.0002286
Benzene	VOC	71432	9.795E-06
Formaldehyde	VOC	50000	0.0015672
Benz[a]Anthracene	PM2_5	56553	5.674E-07
Benzo[a]Pyrene	PM2_5	50328	1.844E-07
Benzo[b]Fluoranthene	PM2_5	205992	1.56E-07
Benzo[k]Fluoranthene	PM2_5	207089	1.56E-07
Chrysene	PM2_5	218019	9.929E-08
Indeno[1,2,3-c,d]Pyrene	PM2_5	193395	1.418E-08
Acenaphthene	PM2_5	83329	3.404E-07
Acenaphthylene	PM2_5	208968	5.248E-07
Anthracene	PM2_5	120127	5.248E-07
Benzo[g,h,i,]Perylene	PM2_5	191242	1.277E-07

Pollutant	Apply to	Pollutant Code	Factor
Fluoranthene	PM2_5	206440	3.12E-07
Fluorene	PM2_5	86737	6.95E-07
Naphthalene	PM2_5	91203	1.987E-05
Phenanthrene	PM2_5	85018	7.943E-07
Pyrene	PM2_5	129000	5.532E-07
Beryllium	PM10	7440417	5.459E-07
Cadmium	PM10	7440439	7.642E-06
Chromium VI	PM10	18540299	2.948E-06
Chromium III	PM10	16065831	1.343E-05
Lead	PM10	7439921	3.002E-05
Manganese	PM10	7439965	5.732E-05
Nickel	PM10	7440020	0.0016377
Selenium	PM10	7782492	1.337E-05

OAQPS converted emissions to SMOKE point source ORL format allowing for emissions to be allocated to modeling layers above the surface layer. OAQPS corrected emissions for one state/county FIPS code fix in Rhode Island. All non-US emissions (i.e., in waters considered outside of US territory) are simply assigned a dummy state/county FIPS code=98001. Due the huge size of these data, the CAP emissions are in one ORL file and the HAP emissions are split into 6 separate ORL files. The emissions spatial extent includes waters off of the coasts of the US, Canada, and Mexico, as well as emissions in major waterways and the Great Lakes. The SMOKE-ready data have also been cropped from the original data provided by OTAQ to cover only the 36km CMAQ domain, which is the largest domain used for this effort.

4.3.4 US nonroad mobile sources (nonroad)

All states except California:
OTAQ provided a reference set (NMIM case "Rfs2Ref2022Nr") of NMIM emissions to be used for all 2022 RFS2 scenarios. This reference set of monthly emissions includes all 50 states plus DC and all CAPs and HAPs of interest. An AEO-specific set of NMIM monthly emissions was also provided for gasoline equipment that was used to replace gasoline equipment emissions in the reference set. All NMIM data are based on AEO2007 fuels and NMIM county database NCD20080727. We also reassigned NMIM evaporative and refueling xylene (compound XYL or CAS=EVP__1330207, RFL__1330207) into MXYL (CAS=EVP__108383, RFL__108383) and OXYL (CAS=EVP__95476, RFL__95476) using a 68% and 32% ratio to both evaporative and refueling XYL, respectively. We also split NMIM exhaust xylene (CAS=EXH__1330207) into MXYL (CAS=EXH__108383) and OXYL (CAS=EXH__95476) using a 74% and 26% ratio to XYL, respectively. We converted emissions from monthly totals to monthly average-day values based the on number of days in each month. CO_2 and all of California emissions were removed prior to creating SMOKE ORL files.

California nonroad:
California monthly nonroad emissions are year 2020 and are based on March 2007 California Air Resources Board (CARB) data (Martin Johnson: mjohnson@arb.ca.gov). NH3 emissions are from NMIM runs for California (same data as were used in 2020 from the 2002 v3 platform). We allocated refueling emissions to the gasoline equipment types based on evaporative mode VOC emissions from the v3 platform 2020 NMIM data, and the refueling emissions were computed by multiplying SCC 2505000120 emissions by 0.61, to adjust to remove double counting with Portable Fuel Container inventory for California. We estimated HAP emissions by applying HAP-to-CAP ratios computed from the California data provided for the 2005 NEI v2, collected by EPA (Laurel Driver) 12/2007. This was done because the CARB submittal from March 2007

did not include estimates for HAPs. We retained only those HAPs that are also estimated by NMIM for nonroad mobile sources; all other HAPs were dropped.

4.3.5 Onroad mobile sources (on_moves_runpm, on_moves_startpm, and on_noadj)

As in 2005, the on_moves_runpm and on_moves_startpm sectors include emissions from onroad gasoline sources for PM and naphthalene, which need temperature adjustment factors. The temperature adjustment factors were specific to 2022 (different from those used in 2005) and we used the same adjustment factors in all of the 2022 cases. The temperature adjustments have the limitation that they were based on the use of MOVES default inputs rather than county-specific inputs, because a county-specific database for input to MOVES was not available at the time this approach was needed. Further, the version of MOVES used for all runs was a preliminary version and has since changed.

Also like 2005, the on_noadj sector includes non-PM MOVES data for gasoline vehicles for some pollutants, NMIM-based data for motorcycles, diesel vehicles, and the remaining pollutants for onroad gasoline, as well as all California onroad mobile emissions. The detailed approaches described here are the same as those for 2005 (except for the NMIM and MOVES data used), but are included here for convenience.

<u>on_moves_startpm and on_moves_runpm</u>
For the on_moves_runpm and on_moves_startpm sectors, the same preprocessing as was done in 2005 was done here, but using the 2022 AEO NMIM runs to create the monthly county-to-state ratios by state and SCC and using the 2022 PM adjustment factors. The MOVES data used in this project were unique for each of the three main 2022 cases (AEO, RFS1, and RFS2), except for the adjustment factors that were the same for each case.

OTAQ supplied three input files containing state-level MOVES-based onroad gasoline emissions by month for the following pollutants:

1. Exhaust: VOC, NOX, CO, 1,3-butadiene (106990), acetaldehyde (75070), acrolein (107028), benzene (71432), and formaldehyde (50000);
2. Evaporative: Non-refueling VOC, benzene, and naphthalene (91203);
3. MOVES-speciated PM at 72 degrees: Naphthalene, and what MOVES labels as the OC, EC, and SO4 components of PM2.5 –PM25OC, PM25EC, and PM25SO4 respectively. Emissions are computed at 72F and we used SAS® and existing technical direction to convert the MOVES-based $PM_{2.5}$ species into the following SMOKE-ready pollutants:

    - NAPHTH_72: unchanged from MOVES-based file, subject to temperature adjustment below 72F.
    - PEC_72: unchanged from MOVES-based PM25EC, subject to temperature adjustment below 72F.
    - POC_72: modified MOVES-based PM25OC to remove metals, PNO3 (computed from MOVES-based PM25EC), NH4 (computed from MOVES-based PM25SO4 and PNO3), and MOVES-based PM25SO4. Subject to temperature adjustment below 72 degrees F.
    - PSO4: unchanged from MOVES-based PM25SO4, not subject to temperature adjustment.
    - PNO3: computed from MOVES-based PM25EC, not subject to temperature adjustment.
    - OTHER: sum of computed metals (fraction of MOVES-based PM25EC) and NH4 (computed from PNO3 and PSO4), not subject to temperature adjustment.

- PMFINE_72: Computed from OTHER and fraction of POC_72. Subject to temperature adjustment below 72 degrees F.
- PMC_72: Computed as fraction of sum of PMFINE_72, PEC_72, POC_72, PSO4, and PNO3. Subject to temperature adjustment below 72 degrees F.

MOVES gasoline emissions were used for light-duty gasoline vehicles (LGDV), light-duty gasoline trucks 0-6000 pounds gross vehicle weight (LDGT1), light-duty gasoline trucks 6000-8500 pounds gross vehicle weight (LDGT2), and heavy-duty gasoline trucks (HDGV). Motorcycle emissions were not available from MOVES at the time of this project and so emissions from that vehicle class came from the case-specific NMIM runs.

MOVES-based, monthly state-level emissions were first allocated to county based emissions using county-SCC specific state to county ratios that we created from the 2022 AEO NMIM run. California MOVES-based emissions are discarded; they do not replace the existing California inventories (discussed in on_noadj sector). MOVES data were provided by OTAQ (Harvey Michaels) on 01/16/2009.

In each MOVES file, “start” emissions are represented by SCCs with the SCC characters 8-9 equal to “00”: 2201001**00**0 (LDGV), 2201020**00**0 (LDGT1), 2201040**00**0 (LDGT2), and 2201070**00**0 (HDGV). These start emissions are assigned to urban and rural SCCs based on the county-level ratio of NMIM emissions from urban versus local roads. For example, LDGV start emissions (2201001000) were split into urban (2201001370) and rural (2201001350) based on the ratio of LDGV emissions from urban (2201001330) and rural (2201001210) local roads.

Finally, the set of emissions are broken into 3 sets:

1. on_moves_startpm: monthly MOVES-based “start” PM emissions subject to temperature adjustments, and PM species not subject to temperature adjustments (e.g., PNO3 and PSO4). These are limited to 8 SCCs (urban/rural and 4 vehicle types) for the following pollutants: PEC_72, POC_72, PNO3, PSO4, OTHER, PMFINE_72, PMC_72, NAPHTH_72.
2. on_moves_runpm: monthly MOVES-based “running” PM emissions subject to a different set of temperature adjustments compared to “start” emissions; similar to the on_moves_startpm sector, this sector includes all PM species, not just those subject to temperature adjustments. The same pollutants are provided as on_moves_startpm.
3. on_noadj MOVES-based emissions: The remaining monthly non-PM MOVES-based emissions that are also not subject to temperature adjustments -see inputs (1) and (2) above. These emissions are modeled in the on_noadj sector discussed below and include both start and running emissions for non-PM pollutants.

<u>on_noadj</u>

The on_noadj sector contains all US onroad mobile emissions not replaced by MOVES. There are four sources of data that are pre-processed to create three sets of monthly inventories for this sector.

1. MOVES-based non-PM: These are the monthly non-PM, non-naphthalene MOVES-based emissions discussed in item #3 in “Outputs” in the on_moves_runpm and on_moves_startpm sector discussion. In short, these are non-California, select pollutants exhaust and evaporative (non-refueling) onroad gasoline LDGV, LDGT1, LDGT2, and HDGV emissions.
2. California onroad inventory: California year 2020 complete CAP/HAP onroad inventory. California monthly onroad emissions are year 2020 and are based on March 2007 California Air Resources Board (CARB) data (Martin Johnson: mjohnson@arb.ca.gov). NH3 emissions are from NMIM runs

for California (same data as were used in 2020v3). We estimated HAP emissions by applying HAP-to-CAP ratios computed from California 2005 NEI submittal provided by EPA (Laurel Driver) 12/2007. This was done because the CARB submittal from March 2007 did not include estimates for HAPs. We retained only those HAPs that were also estimated by NMIM for nonroad mobile sources; all other HAPs were dropped.

3. Remaining onroad NMIM-based onroad inventory: The remainder of the non-California onroad inventory not replaced by MOVES. This includes monthly emissions for all onroad diesel, all motorcycles, all refueling, and onroad LDGV, LDGT1, LDGT2, and HDGV emissions for pollutants not covered by MOVES (e.g., SO2, NH3). All NMIM onroad data are based on AEO2007 fuels and NMIM county database NCD20080727.

The remainder of this section discusses the pre-processing required to create monthly ORL files for the remainder of the on_noadj sector (#3 above).

OTAQ (Harvey Michaels) provided a reference set (Rfs2Ref2022Or) 12/12/2008 of NMIM emissions to be used for all 2022 RFS2 scenarios. This reference set of monthly emissions includes all 50 states plus DC and all CAPs and HAPs of interest. An AEO-specific (Rfs2ref2022orVc11aeo) set of NMIM monthly emissions was also provided 12/15/2008 by OTAQ (Harvey Michaels) for 816 counties that Oak Ridge National Laboratory (ORNL) determined would have enhanced truck traffic for the distribution of ethanol in 2022. The only trucks affected are part5vclass=11; hence the "Vc11" designation. (These have been referred to previously as "8b trucks," but Vc11 is more accurate, since it refers to both 8a and 8b.) The adjustments were determined by annual VMT in the affected counties. We assumed that trucks made a return trip. The adjustments often average a fraction of a percent, but the largest on a county basis is about 6%. These "Vc11" emissions replaced the reference case emissions for AEO; similar "Vc11" emissions are also substituted for the RFS2 and RFS1 cases.

Similar to nonroad pre-processing, we also reassigned NMIM evaporative and refueling xylene (compound XYL or CAS=EVP__1330207, RFL__1330207) into MXYL (CAS=EVP__108383, RFL__108383) and OXYL (CAS=EVP__95476, RFL__95476) using a 68% and32% ratio to both evaporative and refueling XYL, respectively. We also split NMIM exhaust xylene (CAS=EXH__1330207) into MXYL (CAS=EXH__108383) and OXYL (CAS=EXH__95476) using a 74% and 26% ratio to XYL, respectively.

Emissions were converted from monthly to average-day based the on number of days in each month. CO_2 and all of California emissions were removed prior to creating the NMIM-only parts of the final inventory files.

We also removed refueling emissions from the raw NMIM data prior to creating the SMOKE inputs, since these emissions were included in the nonpt and ptnonipm sectors. The NMIM refueling data were used with existing 2005 refueling emissions to create projection ratios for ptnonipm and nonpt refueling, as previously described in Section 4.1.1.

5 2022 RFS1 Case

The 2022 RFS1 reference case was intended to represent the emissions associated with only the volume of ethanol required by the RFS1 rule. RFS1 required 7.5 billion gallons of renewable fuel in 2012 and later, and 6.7 billion gallons of that was considered to be ethanol. A list of inventory datasets used for this and all cases is provided in Appendix A.

5.1 2022 RFS1 Point sources

The point sources for the 2022 RFS1 Case include the same emissions as the 2022 AEO Case for the following sectors: US EGU point source (ptipm), sources from Mexico, Canada, and the Gulf of Mexico (othpt and othpt_hg).

For the nonEGU point sources (ptnonipm), some of the data are replaced for the 2022 RFS1 case. These differences from the 2022 AEO case are:

- 46 ethanol plants were revised from the 2002 AEO case with new emissions values. Only the Chippewa ethanol plant is unchanged in this case. These data were provided by Craig Harvey on 11/17/2008 in the Excel® dataset "Corn_EtOH_Plant_Inv_2022-rfs1.xls".
- Onroad refueling: We used the same overall projection approach for onroad refueling as was used in the 2022 AEO case for the ptnonipm and nonpt sectors. Instead of using the 2022 AEO NMIM run, we used the RFS1-specific NMIM run for the 2022 refueling ratio calculation, with an additional ethanol adjustment factor of 1.0153, provided by David Brzezinski on 12/12/2008. The final formula for the projection factors was Factor 2022 = Emis2022 * 1.0153 /Emis2005. We applied these factors to the refueling SCCs from the 2005 base case.

Note that we did not adjust emissions from refineries, bulk-plant-to-pump (btp), or refinery-to-bulk terminal (rtb) processes (these adjustments *were* applied in the AEO and RFS2 cases). Lastly, VOC speciation profile changes affected this sector, as described in Section 3.

5.2 2022 RFS1 Nonpoint sources

The nonpoint sources for the 2022 RFS1 Case include the same emissions as the 2022 AEO Case for the following sectors: US fugitive dust sources (afdust sector), US agricultural NH3 (ag sector), the US average fires (avefire sector), and the nonpoint emissions for Canada and Mexico (othar and othar_hg).

The 2022 RFS1 Case emissions for the "other nonpoint" sector (nonpt) emissions differed from the 2022 AEO case in the following ways:

- Revised the ethanol plant emissions. OAQPS converted these data to SMOKE input format using the same approaches as in the 2022 AEO case from an Excel® workbook provided by Craig Harvey 11/17/2008: "Corn_EtOH_Plant_Inv_2022-rfs1.xls".
- Revised the ethanol transfer emissions. OAQPS converted these data to SMOKE input format using the same approaches as in the 2022 AEO case from an Excel® workbook provided by Craig Harvey on 12/15/2008: "EtOH_transport_vapor_RFS1.xls".
- Revised biodiesel plant emissions. OAQPS converted these data to SMOKE input format using the same approaches as in the 2022 AEO case from an Excel® workbook provided by Craig Harvey on 11/25/2008: "Biodsl_Plant_Inv_2022-rfs1-prelim.xls".
- Created revised PFC emissions by applying adjustment factors by county and pollutant, based on an Excel® spreadsheet provided by Ari Kahan on 1/14/2009: "aeo_to_rfs1.xls". These adjustments reduced PFC emissions as compared to the AEO case.
- As previously mentioned for the point sources, we changed refueling emissions projections, which also affected the nonpt sector.

The gasoline distribution adjustments that affected AEO and RFS2 were not relevant to this Case. Lastly, VOC speciation profile changes affected this sector, as described in Section 3.

5.3 2022 RFS1 Mobile sources

Compared to the 2022 AEO case, the mobile source emissions included changes in all of the mobile source sectors except for the C3 commercial marine (seca_c3) and the Canada and Mexico emissions (othon).

For the aircraft, locomotive, and non-C3 commercial marine (alm_no_c3) emissions, the "remaining alm_no_c3 emissions" (item 3 in Section 4.3.1) were unchanged from the 2022 AEO case, but the C1 and C2 commercial marine emissions and the locomotive class 1 emissions both changed. Otherwise, the processing for this sector was the same as for 2005 and 2022 AEO. For the C1/C2 Commercial Marine (SCCs 2280002100, 2280002200, and 2280004000), OAQPS prepared the SMOKE-ready inventory from an Excel® worksheet provided by Penny Carey on 12/10/2008: "CMV_C1C2_2022RFS2cases.xls". OAQPS applied factors also provided by Penny Carey on 12/11/2008 to compute Benzene, Acetaldeyde, Formaldehyde, Acrolein, 1,3-butadiene, and naphthalene.

For the locomotive class 1 emissions, OAQPS create the SMOKE-ready inventory from an Excel® worksheet provided by Craig Harvey on 11/17/2008: "Class_I_II_III_locomotives_alm_2020ce_cty_scc_rfs1.xls". This CAP-only dataset was updated by Craig on 12/10/2008 to include HAP emissions of the key HAPs for RFS2.

For the nonroad sector, OAQPS made adjustments to the 2022 AEO inventory to create the RFS1 inventory. California emissions were not changed, but emissions in all other states were updated. OAQPS used data provided by OTAQ for gasoline equipment SCCs to replace those emissions from the reference case "Rfs2Ref2022Nr" mentioned in Section 4.3.4. The RFS1 case "Rfs2AqmRFS12022Nr" replaced the gasoline equipment SCCs: 2260*, 2265*, 2282005010, 2282005015, 2282010005, and 2285004015. Otherwise the steps taken were the same as described for the 2022 AEO case.

For the US onroad mobile sectors, revised NMIM data were provided by Harvey Michaels in late September 2008. OAQPS adjusted the reference case emissions "Rfs2Ref2022Or" (mentioned in Section 4.3.5) using RFS1-specific NMIM data from case "Rfs2ref2022orVc11rfs1", which contains adjusted inventories for 497 counties that ORNL determined would have enhanced truck traffic for the distribution of ethanol in 2022. The only trucks affected are part5vclass=11 (these have been referred to previously ad "8b trucks," but Vc11 is more accurate, since it refers to both 8a and 8b). The adjustments were determined by annual VMT in the affected counties. We assumed that trucks made a return trip. All county-SCC, pollutant-code, emission-type, month combinations in rfs2ref2022orVc11rfs1 replaced those combinations from the Rfs2Ref2022Or NMIM run. These changes affected the emissions in the on_noadj sector directly, and were also used in the MOVES emissions allocation step described next.

In addition to the changes in the on_noadj sector, the monthly onroad gasoline emissions were changed using a MOVES run specifically for the RFS1 scenario. We allocated the state-SCC MOVES data to county-SCC using ratios developed from the RFS1-specific NMIM county-SCC data. Other than the different data used for creating the monthly county-SCC SMOKE-ready inventories, we used the same processing steps as described for 2005 and the 2022 AEO cases.

Lastly, VOC speciation profile changes affected this sector, as described in Section 3.

6 2022 RFS1 headspace profile sensitivity case

This case made two updates: (1) revised VOC speciation for the nonroad sector from the 2022 RFS1 reference case and (2) replaced the E0 headspace vapor VOC speciation profile 8737 profile with profile 8737B. This second change affects all categories that use this E0 headspace vapor profile.

In the RFS1 Reference case, the nonroad sector used the same VOC speciation profiles as onroad mobile for the exhaust mode. Specifically for exhaust, the RFS1 Reference case used combinations of Tier 1 and Tier 2 E0 profiles, combinations of Tier 1 and Tier2 E10 profiles, or combinations of all four profiles, depending on the county. In other words, some counties got E0, some got E10, some got both E0 and E10, and the mix of Tier 1 and Tier2 onroad vehicles was considered in creating composite profiles.

Since nonroad mobile is not affected by Tier 2 standards, the improved approach that we implemented in this case used only Tier 1 E0, Tier 1 E10, or a mixture of E0 and E10, depending on the county. Table 9 below shows the different exhaust speciation profiles used for each case:

Table 9: Comparison of exhaust speciation profiles used for RFS1 headspace profile sensitivity case

RFS1 Reference exhaust VOC speciation codes for nonroad mobile	**RFS1 Sensitivity exhaust VOC speciation for nonroad mobile**
8750 (Tier 1 E0) and 8756 (Tier 2 E0) **OR** 8751 (Tier 1 E10) and 8757 (Tier 2 E10) **OR** (8750 and 8756 and 8751 and 8757) Depending on the county, using fractions of Tier 1 and Tier 2 and fractions of E10 penetration	8750 (Tier 1 E0) **OR** 8751 (Tier 1 E10) **OR** 8750 and 8751 Depending on the county, using fractions of E10 penetration

The improved exhaust speciation information was provided by Harvey Michaels on 6/11/2009 in Excel® file "Gspro_Combo_Rfs2Aqm2022Rfs1NR.zip". OAQPS further post-processed these data to reduce the size and reformatted into SMOKE-ready format.

In addition to the exhaust speciation changes, we also replaced the E0 headspace vapor VOC speciation profile 8737 profile with profile 8737B. This affects all categories that use this E0 headspace vapor profile. This headspace profile part of the sensitivity analysis was done because EPA staff noted that the headspace profiles used in the RFS1 and AEO reference case scenarios exhibited a reduction in alkene levels going from E0 to E10 that was not consistent with what one would expect as a result of increased ethanol use. In these cases, the E0 gasoline headspace profile has 13% of the VOC as alkenes and the E10 profile has an alkene content of 4%. To address this inconsistency, EPA adjusted the E0 headspace profile 8737, assuming the emissions have an alkene content of 4%, consistent with the percent alkene content of the E10 headspace profile. This adjusted profile was designated 8737B. Development of the adjusted profile is described in EPA Report No. EPA-420-D-10-001, "Hydrocarbon Composition of Gasoline Vapor Emissions from Enclosed Fuel Tanks," which is included in the docket for this rule.

This sensitivity affected emissions in the nonroad, nonpt, and ptnonipm sectors. Table 10 below shows the affected SCCs with their descriptions (the first 3 levels of the SCC descriptions). For the SCCs categorized as "Bulk plant to pump", the VOC emissions used a combination profile that consistent of 53.78% profile 8737B and 46.22% profile 8736 (E10 headspace vapor)**.** The SCCs categorized as "Refinery to bulk terminal" used the 8737B profile directly.

Table 10: SCCs affected by revised headspace profile in the 2022 RFS1 headspace profile sensitivity case.

SCC	Sector	Description	SCC Tier1	SCC Tier2	SCC Tier3
40600233	ptnonipm	Bulk plant to pump (note: for SCCs starting with 404002, all SCCs included as bulk plant to pump except for the 3 SCCs starting with 404002 listed in the refinery-to-bulk section below)	Petroleum and Solvent Evaporation	Transportation and Marketing of Petroleum Products	Marine Vessels
40600235			Petroleum and Solvent Evaporation	Transportation and Marketing of Petroleum Products	Marine Vessels
40600241			Petroleum and Solvent Evaporation	Transportation and Marketing of Petroleum Products	Marine Vessels
40688805			Petroleum and Solvent Evaporation	Transportation and Marketing of Petroleum Products	Fugitive Emissions
404002**			Petroleum and Solvent Evaporation	Petroleum Liquids Storage (non-Refinery)	Bulk Plants
404004**			Petroleum and Solvent Evaporation	Petroleum Liquids Storage (non-Refinery)	Petroleum Products - Underground Tanks
406001**			Petroleum and Solvent Evaporation	Transportation and Marketing of Petroleum Products	Tank Cars and Trucks
406003**			Petroleum and Solvent Evaporation	Transportation and Marketing of Petroleum Products	Gasoline Retail Operations - Stage I
406004**			Petroleum and Solvent Evaporation	Transportation and Marketing of Petroleum Products	Filling Vehicle Gas Tanks - Stage II
406006**			Petroleum and Solvent Evaporation	Transportation and Marketing of Petroleum Products	Consumer (Corporate) Fleet Refueling - Stage II
406007**			Petroleum and Solvent Evaporation	Transportation and Marketing of Petroleum Products	Consumer (Corporate) Fleet Refueling - Stage I
2501011***	nonpt		Storage and Transport	Petroleum and Petroleum Product Storage	Residential Portable Gas Cans
2501012***			Storage and Transport	Petroleum and Petroleum Product Storage	Commercial Portable Gas Cans
2501055***			Storage and Transport	Petroleum and Petroleum Product Storage	Bulk Plants: All Evaporative Losses
2501060***			Storage and Transport	Petroleum and Petroleum Product Storage	Gasoline Service Stations
2505030***			Storage and Transport	Petroleum and Petroleum Product Transport	Truck
2660000***			Waste Disposal, Treatment, & Recov	Leaking Underground Storage Tanks	Leaking Underground Storage Tanks
40400240	ptnonipm	Refinery to bulk terminal	Petroleum and Solvent Evaporation	Petroleum Liquids Storage (non-Refinery)	Bulk Plants
40400249			Petroleum and Solvent Evaporation	Petroleum Liquids Storage (non-Refinery)	Bulk Plants
40400260			Petroleum and Solvent Evaporation	Petroleum Liquids Storage (non-Refinery)	Bulk Plants
40600231			Petroleum and Solvent Evaporation	Transportation and Marketing of Petroleum Products	Marine Vessels
40600232			Petroleum and Solvent Evaporation	Transportation and Marketing of Petroleum Products	Marine Vessels
40600234			Petroleum and Solvent Evaporation	Transportation and Marketing of Petroleum Products	Marine Vessels
40600236			Petroleum and Solvent Evaporation	Transportation and arketing of Petroleum Products	Marine Vessels
40600237			Petroleum and Solvent Evaporation	Transportation and Marketing of Petroleum Products	Marine Vessels
40600238			Petroleum and Solvent Evaporation	Transportation and Marketing of Petroleum Products	Marine Vessels
40600239			Petroleum and Solvent Evaporation	Transportation and Marketing of Petroleum Products	Marine Vessels
40600240			Petroleum and Solvent Evaporation	Transportation and Marketing of Petroleum Products	Marine Vessels
40600298			Petroleum and Solvent Evaporation	Transportation and Marketing of Petroleum Products	Marine Vessels
40600299			Petroleum and Solvent Evaporation	Transportation and Marketing of Petroleum Products	Marine Vessels
40688803			Petroleum and Solvent Evaporation	Transportation and Marketing of Petroleum Products	Fugitive Emissions
403001**			Petroleum and Solvent Evaporation	Petroleum Product Storage at Refineries	
403002**			Petroleum and Solvent Evaporation	Petroleum Product Storage at Refineries	
403003**			Petroleum and Solvent Evaporation	Petroleum Product Storage at Refineries	
403010**			Petroleum and Solvent Evaporation	Petroleum Product Storage at Refineries	Fixed Roof Tanks (Varying Sizes)
403011**			Petroleum and Solvent Evaporation	Petroleum Product Storage at Refineries	Floating Roof Tanks (Varying Sizes)
403012**			Petroleum and Solvent Evaporation	Petroleum Product Storage at Refineries	Variable Vapor Space
404001**			Petroleum and Solvent Evaporation	Petroleum Liquids Storage (non-Refinery)	Bulk Terminals
406005**			Petroleum and Solvent Evaporation	Transportation and Marketing of Petroleum Products	Pipeline Petroleum Transpt - General - All Products
2501050***	nonpt		Storage and Transport	Petroleum and Petroleum Product Storage	Bulk Terminals: All Evaporative Losses
2505000***			Storage and Transport	Petroleum and Petroleum Product Transport	All Transport Types
2505020***			Storage and Transport	Petroleum and Petroleum Product Transport	Marine Vessel
2505040***			Storage and Transport	Petroleum and Petroleum Product Transport	Pipeline

7 2022 RFS2 Case

This case represented the emissions associated with EPA's best estimate at the time of proposal of the renewable fuel volumes that would be used to meet the EISA requirements. This included 34.14 billion gallons of ethanol and 0.81 billion gallons of biodiesel. A list of inventory datasets used for this and all cases is provided in Appendix A.

7.1 2022 RFS2 Point sources

The point sources for the 2022 RFS2 Case include the same emissions as the 2022 AEO Case for the following sectors: US EGU point source (ptipm) and sources from Mexico, Canada, and the Gulf of Mexico (othpt and othpt_hg).

For the nonEGU point sources (ptnonipm), some of the data is replaced for the 2022 RFS2 case. These differences from the 2022 AEO case are:

- 47 ethanol plants revised from the 2002 AEO case with new emissions values. The only additional plant changed in this case that was not changed in the RFS1 Case was the Chippewa ethanol plant These data were provided by Craig Harvey on 11/17/2008: in the Excel® dataset "Corn_EtOH_Plant_Inv_2022-eisa-fix.xls".
- We applied adjustments to refinery emissions by state and SCC, using the same factor for all pollutants to represent activity adjustments (note: different adjustments were made to the AEO case, and no adjustments were made to the RFS1 case). The state-level adjustments and the list of SCCs affected were provided by Rich Cook on 11/25/2008 in Excel® workbook "RFS2_Refinery_Adjust.xls".
- Onroad refueling: We used the same overall projection approach for onroad refueling as was used in the 2022 AEO case for the ptnonipm and nonpt sectors. Instead of using the 2022 AEO NMIM run, we used the RFS2-specific NMIM run for the 2022 refueling ratio calculation, with an additional ethanol adjustment factor of 1.0153, provided by David Brzezinski on 12/12/2008. The final formula for the projection factors was Factor 2022 = Emis2022 * 1.0780 /Emis2005. These factors were applied to the refueling SCCs from the 2005 base case.
- For gasoline distribution SCCs (both ptnonipm and nonpt SCCs), we additionally applied VOC and VOC HAP adjustments to SCCs representing emissions from bulk-plant-to-pump (btp) and refinery-to-bulk terminal (rtb) processes. These SCC-level adjustments only impact VOC and VOC HAPs in both the ptnonipm and nonpt sectors. The adjustments were provided by Craig Harvey on 12/16/2008 in the Excel® workbook "2005ai_tox_SCC_50state_CAPHAP-20081216.xls". (Note: these adjustments were not applied to RFS1 and different adjustments were applied to AEO, based on assumed changes in the ratios of E0 to E10 and E85)
- Upstream ag-related adjustments described below for the "ag" and "afdust" sectors also affected some ptnonipm SCCs.

Lastly, VOC speciation profile changes affected this sector, as described in Section 3. Emissions were otherwise the same as the 2022 AEO case.

7.2 2022 RFS2 Nonpoint sources

The nonpoint sources for the 2022 RFS2 Case include the same emissions as the 2022 AEO Case for the following sectors: the US average fires (avefire sector), and the nonpoint emissions for Canada and Mexico (othar and othar_hg). Changes were made to the ag, afdust, and nonpt sectors.

For the ag and afdust sectors, we adjusted emissions by SCC or SCC-pollutant combinations based on data provided by Craig Harvey on 11/7/2008 in Excel® workbook“otaq_upstream_2020cc_2020ce_2005ag_tox-cmp.xls”. These adjustments were different for the following different groups of SCCs: “Fertilizer Application”, “Pesticide Application”, “Fertilizer Production, mixing/blending”, “Pesticide Production”, “Ag Tilling/loading dust”, “Ag Burning”, “Livestock dust”, and “Livestock waste”.

The emissions for the “other nonpoint” emissions (nonpt) changed for the 2022 RFS2 Case in the following ways:

- Upstream ag-related adjustments just described for the “ag” and “afdust” sectors also affected some nonpt SCCs.
- Revised the ethanol plant emissions. OAQPS converted these data to SMOKE input format using the same approaches as in the 2022 AEO case from an Excel® workbook provided by Craig Harvey 11/17/2008: “Corn_EtOH_Plant_Inv_2022-eisa-fix.xls”.
- Revised the ethanol transfer emissions. OAQPS converted these data to SMOKE input format using the same approaches as in the 2022 AEO case from an Excel® workbook provided by Craig Harvey on 12/15/2008: “EtOH_transport_vapor_EISA.xls”.
- Revised biodiesel plant emissions. OAQPS converted these data to SMOKE input format using the same approaches as in the 2022 AEO case from an Excel® workbook provided by Craig Harvey on 11/25/2008: “Biodsl_Plant_Inv_2022-eisa-prelim.xls”.
- Added cellulosic ethanol plants. OAQPS converted emissions estimates for cellulosic ethanol plants to run in SMOKE, based on an Excel® file provided by Craig Harvey on 10/21/2009: “Cellulosic_Plant_Inv_2022-eisa-fixC-RevCell.xls”.
- Created revised portable fuel container (PFC) emissions by applying adjustment factors by county and pollutant, based on an Excel® spreadsheet provided by Ari Kahan on 1/14/2009: “aeo_to_eisa.xls”. These adjustments reduced PFC emissions as compared to the AEO case.
- As previously mentioned for the point sources in Section 7.1, we changed refueling emissions projections, which also affected the nonpt sector.
- As previously mentioned for point sources in Section 7.1, we adjusted the gasoline distribution emissions, which also affected the nonpt sector.
- Speciation changes also affected this case for the nonpt and ptnonipm sectors as noted in Section 3 by using the 8737B profile for E0 fuels for refinery to bulk (rtb) emissions sources.

Lastly, VOC speciation profile changes affected this sector, as described in Section 3.

7.3 2022 RFS2 Mobile sources

Compared to the 2022 AEO case, the mobile source emissions included changes in all of the mobile source sectors except for the Canada and Mexico emissions (othon).

For the aircraft, locomotive, and non-C3 commercial marine (alm_no_c3) emissions, the “remaining alm_no_c3 emissions” (item 3 in Section 4.3.1) were unchanged from the 2022 AEO case, but the C1 and C2 commercial marine emissions and the locomotive class I emissions both changed. Otherwise, the processing for this sector was the same as for 2005 and 2022 AEO. For the C1/C2 Commercial Marine (SCCs 2280002100, 2280002200, and 2280004000), OAQPS prepared the SMOKE-ready inventory from an Excel® worksheet provided by Penny Carey on 12/10/2008: “CMV_C1C2_2022RFS2cases.xls”. OAQPS applied factors also provided by Penny Carey on 12/11/2008 to compute benzene, acetaldehyde, formaldehyde, acrolein, 1,3-butadiene, and naphthalene. Although the process was the same, these emissions differed from those in the AEO and RFS1 cases.

For the locomotive class I emissions, OAQPS create the SMOKE-ready inventory from an Excel® worksheet provided by Craig Harvey on 11/17/2008: "Class_I_II_III_locomotives_alm_2020ce_cty_scc_eisa.xls". This CAP-only dataset was updated by Craig on 12/10/2008 to include HAP emissions of the key HAPs for RFS2.

For the C3 commercial marine sources, new inventory data were provided in the same pre-gridded formats as for 2005 and 2022 AEO by Penny Carey on 11/20/2008: "2022base_redo.zip and 2022rfs2.zip". OAQPS pre-processed these data using the same approaches described previously to create SMOKE-ready point source inventories (with each "point" representing a grid cell). Otherwise, the processing for this sector was the same as 2005 and 2022 AEO.

For the US nonroad sector, OAQPS made adjustments to the 2022 AEO inventory to create the RFS2 inventory. California emissions were not changed, but emissions in all other states were updated. OAQPS used data provided by OTAQ for gasoline equipment SCCs to replace those emissions from the reference case "Rfs2Ref2022Nr" mentioned in section 4.3.4. The RFS2 case "Rfs2AqmE102022Nr" replaced the gasoline equipment SCCs: 2260*, 2265*, 2282005010, 2282005015, 2282010005, and 2285004015. Otherwise the steps taken were the same as described for the 2022 AEO case.

For the US onroad mobile sectors, revised NMIM data were provided by Harvey Michaels in late September 2008. OAQPS adjusted the reference case emissions "Rfs2Ref2022Or" (mentioned in Section 4.3.5) using RFS2-specific NMIM data from case "Rfs2ref2022orVc11eisa", which contains adjusted inventories for 1023 counties that ORNL determined would have enhanced truck traffic for the distribution of ethanol in 2022. The only trucks affected are part5vclass=11 (these have been referred to previously ad "8b trucks," but Vc11 is more accurate, since it refers to both 8a and 8b). The adjustments were determined by annual VMT in the affected counties. We assumed that trucks made a return trip. All county-SCC, pollutant-code, emission-type, month combinations in rfs2ref2022orVc11eisa replaced those combinations in Rfs2Ref2022Or. These changes affected the emissions in the on_noadj sector directly, and were also used in the MOVES emissions allocation step described next.

In addition to the changes in the on_noadj sector, the monthly onroad gasoline emissions were changed using a MOVES run specifically for the RFS2 scenario. We allocated the state-SCC MOVES data to county-SCC using ratios developed from the RFS2-specific NMIM county-SCC data. Other than the different data used for creating the monthly county-SCC SMOKE-ready inventories, we used the same processing steps as described for 2005 and the 2022 AEO cases.

Lastly, VOC speciation profile changes affected this sector, as described in Section 3.

8 2022 RFS2 nonroad speciation sensitivity case

The purpose of this case was to test the impact of improving the nonroad speciation approach from the approach used in the 2022 RFS2 case. In the 2022 RFS2 case, the same mixtures of fuels as onroad were assumed for the nonroad exhaust and evaporative VOC emissions, and for refueling VOC speciation we assumed a mixture of 81% E10 (profile 8736) and 19% E85 (profile 8755). For this sensitivity, we revised our approach to assume 100% E10 fuel usage for nonroad mobile, which meant profile 8751 for exhaust VOC, profile 8754 for evaporative VOC, and profile 8736 for refueling VOC. Thus, this sensitivity was able to help quantify the modest magnitude of the impact of the original VOC speciation assumptions.

Given the timing of this sensitivity run, it did *not* include the revised E0 headspace vapor VOC speciation profile 8737B, but rather used the original 8737 profile that was also used in the 2022 RFS1 and 2022 AEO cases.

In addition, this sensitivity did not include the cellulosic ethanol plant emissions that were included in the 2022 RFS2 case, because we ran this sensitivity prior to adding those emissions to the RFS2 case. Since this run was compared primarily to the RFS1 case for the purposes of the nonroad mobile speciation impacts, this sensitivity was still useful for our analysis. Comparison of this case with the RFS2 case will be confounded in areas that have significant emissions from cellulosic ethanol emissions sources.

APPENDIX A

Approach for Allocating Emission Reductions and Speciating Emissions from Finished Fuel Transport and Distribution

Allocation of Emission Reductions

1) Emission Reductions were estimated for RFS2 at the National-scale as follows for each scenario by OTAQ using a spreadsheet tool. References for this spreadsheet tool are:

- EPA Docket number EPA-HQ-OAR-2005-0161-0537; Renewable Fuels Standard (RFS) 2 Production/Distribution Emission Impacts Calculation Spreadsheet - AEO Reference Case
- EPA Docket number EPA-HQ-OAR-2005-0161-0538; RFS2 Production/distribution Emission Impacts Calculation Spreadsheet - RFS1 Mandate reference case

E0 – Refinery to Bulk Terminal
E0 – Bulk Terminal to Pump
E10 – Bulk Terminal to Pump
E85 – Bulk Terminal to Pump

2) Definitions:

Refinery to Bulk Terminal = Emissions associated with pipelines and bulk terminals

Bulk Terminal to Pump = Emissions associated with bulk plants, tank trucks in transit, service station unloading, and gasoline service stations, underground tank: breathing and emptying

3) Assignment of reduction estimates to SCCs:

There are over 90 SCCs associated with finished fuel transport and distribution. In order to assign reductions to SCCs, each SCC must be identified as "refinery to bulk terminal" and "bulk terminal to pump." Table A-1 provides this mapping.

4) Allocation of emissions to fuel streams:

In order to calculate percent reduction estimates to apply to each fuel transport and distribution SCC in the NEI, emission reductions for each scenario in the categories in Step 1 must be applied to total emissions in the platform for those categories. That means total emissions from the platform must first be allocated to "refinery to bulk terminal" and "bulk terminal to pump" using the allocation in Step 3. Then "bulk terminal to pump" emissions must be assigned to E0, E10 and E85 using national fuel volumes for the scenarios. The national fuel volumes are given in Table A-1. Due to the complexity with determining differences in volumes for each fuel type across geographic areas for different SCCs, we will not account for local differences. Once the national emissions in the platform are allocated, and emission reductions from the spreadsheet tool can be used to calculate percent change estimates, and these percent change estimates applied to each SCC.

Table A-1. E0, E10 and E85 fuel volumes for RFS2 scenarios in 2022 (billions of gallons).

	Scenario		
	RFS1	**AEO**	**RFS2**
E0	77.95	16.03	0
E10	67	131	124.6
E85	0	0.1097	29.3

<u>Application of Speciation Profiles</u>

The most straightforward approach for speciating emissions is to apply the following speciation profiles:

E0 – Profile 8737: Composite profile - Non-oxygenated gasoline headspace vapor (except 8734 non-oxygenated gasoline composite profile for splash filling). For an RFS1 sensitivity case and for the RFS2 case, profile 8737B was used instead. See EPA document number EPA-420-D-10-001 "Hydrocarbon Composition of Gasoline Vapor Emissions from Enclosed Fuel Tanks" for more information about this profile.

E10 -- 8736: Composite profile - ethanol blended gasoline headspace vapor (except 8733 Composite Profile-Ethanol blended gasoline)

E85 – Profile for light-duty gasoline evaporative emissions (attached).

The E0 profile would be applied to all SCCs representing refinery to bulk terminal emissions. For the remaining SCCs, E0, E10 and E85 profiles are be weighted by national fuel sales volumes to come up with composite profiles for each control scenario.

Table A-2. Mapping of Fuel Distribution SCCs to "Refinery to Bulk Terminal" and "Bulk Terminal to Pump" Categories.

	Assignment
NONPOINT	
GASOLINE DISTRIBUTION: STAGE I	
SCCs: 2501050120 (Bulk Terminals)	Refinery to Bulk Terminal
2501055120 (Bulk Plants)	Bulk Terminal to Pump
2505030120 (Tank Trucks in Transit)	Bulk Terminal to Pump
2505040120 (Pipelines)	Refinery to Bulk Terminal
2501060051 (Gasoline Service Station Unloading: Submerged Fill)	Bulk Terminal to Pump
2501060052 (Gasoline Service Station Unloading: Splash Fill)	Bulk Terminal to Pump
2501060053 (Gasoline Service Station Unloading: Balanced Submerged Fill)	Bulk Terminal to Pump
2501060201 (Gasoline Service Stations, Underground Tank: Breathing and Emptying)	Bulk Terminal to Pump
GASOLINE DISTRIBUTION: STAGE II	
SCC: 2501060100 (Gasoline Service Stations, Stage 2: Total)	Bulk Terminal to Pump
POINT	
40400103 Bulk Terminals, Gasoline Reid vapor pressure (RVP) 7: Breathing Loss (67000 Bbl. Capacity) - Fixed R	Refinery to Bulk Terminal
40400104 Bulk Terminals, Gasoline RVP 13: Breathing Loss (250000 Bbl Capacity)-Fixed Roof Tank	Refinery to Bulk Terminal
40400105 Bulk Terminals, Gasoline RVP 10: Breathing Loss (250000 Bbl Capacity)-Fixed Roof Tank	Refinery to Bulk Terminal
40400106 Bulk Terminals, Gasoline RVP 7: Breathing Loss (250000 Bbl Capacity) - Fixed Roof Tank	Refinery to Bulk Terminal
40400107 Bulk Terminals, Gasoline RVP 13: Working Loss (Diam. Independent) - Fixed Roof Tank	Refinery to Bulk Terminal
40400108 Bulk Terminals, Gasoline RVP 10: Working Loss (Diam. Independent) - Fixed Roof Tank	Refinery to Bulk Terminal
40400109 Bulk Terminals, Gasoline RVP 7: Working Loss (Diam. Independent) - Fixed Roof Tank	Refinery to Bulk Terminal
40400110 Bulk Terminals, Gasoline RVP 13: Standing Loss (67000 Bbl Capacity)-Float. Roof Tank	Refinery to Bulk Terminal
40400111 Bulk Terminals, Gasoline RVP 10: Standing Loss (67000 Bbl Capacity)-Float. Roof Tank	Refinery to Bulk Terminal
40400112 Bulk Terminals, Gasoline RVP 7: Standing Loss (67000 Bbl Capacity)- Floating Roof Tank	Refinery to Bulk Terminal
40400113 Bulk Terminals, Gasoline RVP 13: Standing Loss (250000 Bbl Capacity) - Floating Roof Tank	Refinery to Bulk Terminal
40400114 Bulk Terminals, Gasoline RVP 10: Standing Loss (250000 Bbl Capacity) - Floating Roof Tank	Refinery to Bulk Terminal
40400115 Bulk Terminals, Gasoline RVP 7: Standing Loss (250000 Bbl Capacity) - Floating Roof Tank	Refinery to Bulk Terminal
40400116 Bulk Terminals, Gasoline RVP 13/10/7: Withdrawal Loss (67000 Bbl Capacity) - Floating Roof Tank	Refinery to Bulk Terminal
40400117 Bulk Terminals, Gasoline RVP 13/10/7: Withdrawal Loss (250000 Bbl Capacity) - Floating Roof Tank	Refinery to Bulk Terminal
40400118 Bulk Terminals, Gasoline RVP 13: Filling Loss (10500 Bbl Capacity) - Variable Vapor Space	Refinery to Bulk Terminal
40400119 Bulk Terminals, Gasoline RVP 10: Filling Loss (10500 Bbl Capacity) - Variable Vapor Space	Refinery to Bulk Terminal
40400120 Bulk Terminals, Gasoline RVP 7: Filling Loss (10500 Bbl Capacity) - Variable Vapor Space	Refinery to Bulk Terminal
40400131 Bulk Terminals, Gasoline RVP 13: Standing Loss - External Floating Roof w/ Primary Seal	Refinery to Bulk Terminal
40400132 Bulk Terminals, Gasoline RVP 10: Standing Loss - External Floating Roof w/ Primary Seal	Refinery to Bulk Terminal
40400133 Bulk Terminals, Gasoline RVP 7: Standing Loss - External Floating Roof w/ Primary Seal	Refinery to Bulk Terminal
40400141 Bulk Terminals, Gasoline RVP 13: Standing Loss - External Floating Roof w/ Secondary Seal	Refinery to Bulk Terminal
40400142 Bulk Terminals, Gasoline RVP 10: Standing Loss - External Floating Roof w/ Secondary Seal	Refinery to Bulk Terminal
40400143 Bulk Terminals, Gasoline RVP 7: Standing Loss - External Floating Roof w/ Secondary Seal	Refinery to Bulk Terminal
40400148 Bulk Terminals, Gasoline RVP 13/10/7: Withdrawal Loss - External Floating Roof (Primary/Secondary S	Refinery to Bulk Terminal
40400150 Bulk Terminals, Miscellaneous Losses/Leaks: Loading Racks	Refinery to Bulk Terminal
40400151 Bulk Terminals, Valves, Flanges, and Pumps	Refinery to Bulk Terminal
40400152 Bulk Terminals, Vapor Collection Losses	Refinery to Bulk Terminal
40400153 Bulk Terminals, Vapor Control Unit Losses	Refinery to Bulk Terminal
40400161 Bulk Terminals, Gasoline RVP 13: Standing Loss - Internal Floating Roof w/ Primary Seal	Refinery to Bulk Terminal
40400162 Bulk Terminals, Gasoline RVP 10: Standing Loss - Internal Floating Roof w/ Primary Seal	Refinery to Bulk Terminal
40400163 Bulk Terminals, Gasoline RVP 7: Standing Loss - Internal Floating Roof w/ Primary Seal	Refinery to Bulk Terminal
40400171 Bulk Terminals, Gasoline RVP 13: Standing Loss - Internal Floating Roof w/ Secondary Seal	Refinery to Bulk Terminal
40400172 Bulk Terminals, Gasoline RVP 10: Standing Loss - Internal Floating Roof w/ Secondary Seal	Refinery to Bulk Terminal
40400173 Bulk Terminals, Gasoline RVP 7: Standing Loss - Internal Floating Roof w/ Secondary Seal	Refinery to Bulk Terminal
40400178 Bulk Terminals, Gasoline RVP 13/10/7: Withdrawal Loss - Internal Float Roof (Primary/Secondary Seal)	Refinery to Bulk Terminal
SCC SCC Description	
40400201 Bulk Plants, Gasoline RVP 13: Breathing Loss (67000 Bbl Capacity) - Fixed Roof Tank	Bulk Terminal to Pump
40400202 Bulk Plants, Gasoline RVP 10: Breathing Loss (67000 Bbl Capacity) - Fixed Roof Tank	Bulk Terminal to Pump
40400203 Bulk Plants, Gasoline RVP 7: Breathing Loss (67000 Bbl. Capacity) - Fixed Roof Tank	Bulk Terminal to Pump
40400204 Bulk Plants, Gasoline RVP 13: Working Loss (67000 Bbl. Capacity) - Fixed Roof Tank	Bulk Terminal to Pump
40400205 Bulk Plants, Gasoline RVP 10: Working Loss (67000 Bbl. Capacity) - Fixed Roof Tank	Bulk Terminal to Pump
40400206 Bulk Plants, Gasoline RVP 7: Working Loss (67000 Bbl. Capacity) - Fixed Roof Tank	Bulk Terminal to Pump
40400207 Bulk Plants, Gasoline RVP 13: Standing Loss (67000 Bbl Cap.) - Floating Roof Tank	Bulk Terminal to Pump
40400208 Bulk Plants, Gasoline RVP 10: Standing Loss (67000 Bbl Cap.) - Floating Roof Tank	Bulk Terminal to Pump
40400209 Bulk Plants, Gasoline RVP 7: Standing Loss (67000 Bbl Cap.) - Floating Roof Tank	Bulk Terminal to Pump
40400210 Bulk Plants, Gasoline RVP 13/10/7: Withdrawal Loss (67000 Bbl Cap.) - Floating Roof Tank	Bulk Terminal to Pump
40400211 Bulk Plants, Gasoline RVP 13: Filling Loss (10500 Bbl Cap.) - Variable Vapor Space	Bulk Terminal to Pump
40400212 Bulk Plants, Gasoline RVP 10: Filling Loss (10500 Bbl Cap.) - Variable Vapor Space	Bulk Terminal to Pump
40400213 Bulk Plants, Gasoline RVP 7: Filling Loss (10500 Bbl Cap.) - Variable Vapor Space	Bulk Terminal to Pump
40400231 Bulk Plants, Gasoline RVP 13: Standing Loss - External Floating Roof w/ Primary Seal	Bulk Terminal to Pump
40400232 Bulk Plants, Gasoline RVP 10: Standing Loss - External Floating Roof w/ Primary Seal	Bulk Terminal to Pump
40400233 Bulk Plants, Gasoline RVP 7: Standing Loss - External Floating Roof w/ Primary Seal	Bulk Terminal to Pump
40400241 Bulk Plants, Gasoline RVP 13: Standing Loss - External Floating Roof w/ Secondary Seal	Bulk Terminal to Pump
40400242 Bulk Plants, Gasoline RVP 10: Standing Loss - External Floating Roof w/ Secondary Seal	Bulk Terminal to Pump
40400243 Bulk Plants, Gasoline RVP 7: Standing Loss - External Floating Roof w/ Secondary Seal	Bulk Terminal to Pump

APPENDIX B

IMPLEMENTATION of SPECIATION PROFILE UPDATE FOR FUTURE YEAR "bulk terminal to pump" SCCs

Speciation approach is provided in: Rich Cook's writeup (email sent 11/18/2008, file called "Transport AQ Inv.doc") along with the profiles to use via the "GSPRO_COMBO" approach and the fuels data needed to compute the linear weights to use for each profile for each future year scenario. It should be noted that the bulk terminal to pump SCCs are in both the nonpt and ptnonipm modeling sectors.

See below table for how the weights are computed from the fuels data.

All state/county FIPS codes and all months use the same speciation profile combinations based on the table from Rich Cook's writeup (email sent 11/18/2008, file called "Transport AQ Inv.doc"), as follows:

	RFS1 billions of gallons	RFS2-fraction	AEO billions of gallons	AEO-fraction	RFS2 billions of gallons	RFS2-fraction
E0	77.95	0.5378	16.03	0.1089	0	0.0000
E10	67	0.4622	131	0.8903	124.6	0.8096
E85	0		0.1097	0.0007	29.3	0.1904
Total	144.95		147.14		153.9	

E0 – Profile 8737: Composite profile - Non-oxygenated gasoline headspace vapor (except 8734 non-oxygenated gasoline composite profile for splash filling): use only headspace vapor because VOC emissions from SCCs assigned to headspace vapor in the nonpoint inventory are three times higher than the emissions from SCCs assigned to gasoline spillage (=933,818/295,259)

E10 -- 8736: Composite profile - ethanol blended gasoline headspace vapor (except 8733 Composite Profile-Ethanol blended gasoline): use only headspace vapor since approximating that more emissions assigned to headspace than spillage (as discussed above)

E85 – Profile for light-duty gasoline evaporative emissions: use pre-tier2 since it is the only evaporative E85 profile available: 8755

Steps taken to represent the approaches above in the modeling cases:

Step 1:

- Copy gsref file that is used for future year VOC to the following name: "gsref_rfs2_voc_2022"
- Change "bulk terminal to pump" sccs in the gsref file to xref to "combo"
- Change all "refinery to bulk terminal SCCs" to the E0 profile. This is profile 8737 (they are probably currently 8736). If there are any 8733 (don't think there are any), then they should be changed to 8734 (E0 profile for spillage)
- Import to Emissions Modeling Framework (data system we use to manage modeling cases)
- List of "bulk terminal to pump" and refinery to bulk terminal SCCs" provided in Appendix A.

Step 2: Make 3 new GSPRO_COMBO files

1. AEO Case:
   gspro_combo_aeo_stationary all counties/months use the following:
   $0.1089 \times$ Profile 8737 + $0.8903 \times$ Profile 8736 + $0.0007 \times$ Profile 8755

2. gspro_combo_rfs1_stationary all counties/months use the following
   $0.5378 \times$ Profile 8737 + $0.4622 \times$ Profile 8736

3. gspro_combo_eisa_stationary: all counties/months use the following
   $0.8096 \times$ Profile 8736 + $0.1904 \times$ Profile 8755

   Note: even though some stationary source SCCs use gasoline profile spillage, the ratio of nonpoint VOC emissions from SCCs assigned to the headspace speciation –to- SCCs assigned to spillage speciation is 3 (933818/295259) so we will use only headspace for E10. There are no point source SCCs assigned to spillage, so headspace is applicable to all point source sector SCCs.

Step 3: Assign the appropriate gspro_combo stationary datasets to ptnonipm and nonpt sectors in the future year cases. No need (and not possible) to concatenate with GSPRO combo from other sectors.

APPENDIX C

Inventory Data Files Used for Each RFS2 Modeling Case – SMOKE Input Inventory Datasets

In any of the following dataset names where the placeholder <mon> has been provided, this is intended to mean 12 separate files with the <mon> placeholder replaced with either jan, feb, mar, apr, may, jun, jul, aug, sep, oct, nov, or dec, each associated with a particular month of the year.

Table C-1: List of inventory data associated with RFS2 modeling cases.

Case	Sector	SMOKE input files
2005 All	ptipm	Annual: ptinv_ptipm_cap2005nei_26aug2008_v2_orl.txt ptinv_ptipm_hap2005agtox_v1_noBAFM_28aug2008_v0_orl.txt Daily: ptday_ptipm_caphap_noncem_2005ag_<mon>_ida.txt Hourly: HOUR_UNIT_2005_*.txt
	ptnonipm	ptinv_ptnonipm_xportfrac_2005cap_remainder_24nov2008_v0_orl.txt ptinv_ptnonipm_2005caphap_3ethanol_plants_delete_for_all2022_19nov2008_v0_orl.txt ptinv_ptnonipm_2005caphap_chippewa_delete_for_2022EISA_19nov2008_v0_orl.txt ptinv_ptnonipm_2005hap_noBAFM_remainder_24nov2008_v0_orl.txt ptinv_ptnonipm_caphap_ethanol_plant_additions_2005_17dec2008_v1_orl.txt
	nonpt	arinv_nonpt_pf4_cap_nopfc_08sep2008_v0_orl.txt arinv_nonpt_pf4_hap_nopfc_11sep2008_v0_orl.txt arinv_pfc_2002_caphap_27dec2007_v0_orl.txt arinv_nonpt_caphap_ethanol_plant_additions_2005_17dec2008_v0_orl.txt
	afdust	arinv_afdust_2002ad_xportfrac_26sep2007_v0_orl.txt
	ag	arinv_ag_cap2002nei_06nov2006_v0_orl.txt
	alm_no_c3	arinv_alm_no_c3_cap2002v3_30jul2008_v1_orl.txt arinv_alm_no_c3_hap2002v4_12sep2008_v0_orl.txt
	nonroad	arinv_nonroad_caps_2005v2_<mon>_revised_08sep2008_v0_orl.txt arinv_nonroad_haps_2005v2_<mon>_revised_05sep2008_v0_orl.txt arinv_nonroad_calif_caphap_2005v2_<mon>_02apr2008_v0_orl.txt
	seca_c3	ptinv_seca_c3_caps2005pf4_31jul2008_v0_orl.txt ptinv_seca_c3_haps_east2005pf4_31jul2008_v0_orl.txt ptinv_seca_c3_haps_central2005pf4_31jul2008_v0_orl.txt ptinv_seca_c3_haps_west2005pf4_31jul2008_v0_orl.txt ptinv_seca_c3_haps_NonUS_east2005pf4_09sep2008_v0_orl.txt ptinv_seca_c3_haps_NonUS_central2005pf4_09sep2008_v0_orl.txt ptinv_seca_c3_haps_NonUS_west2005pf4_09sep2008_v0_orl.txt
	on_noadj	mbinv_onroad_capshaps_2005v2_nmim_not2moves_<mon>_08sep2008_v0_orl.txt mbinv_on_noadj_moves_<mon>_14NOV08_14nov2008_v0_orl.txt mbinv_onroad_calif_caphap_2005v2_<mon>_02apr2008_v0_orl.txt
	on_moves_startpm	mbinv_onroad_moves_startpm_<mon>_20oct2008_v0_orl.txt
	on_moves_runpm	mbinv_onroad_moves_runpm_<mon>_20oct2008_v0_orl.txt
	ptfire	Master: ptinv_ptfire_2005rfs2_18nov2008_v1_orl.txt Daily: ptday_ptfire_<mon>_*2005rfs2_*_v0.orl.txt

Case	Sector	SMOKE input files
	othar	arinv_nonroad_mexico_interior1999_21dec2006_v0_ida.txt arinv_nonroad_mexico_border1999_21dec2006_v0_ida.txt arinv_nonroad_Canada_2000_inventory_11feb2008_v2_ida.txt arinv_nonpoint_Canada2000_21dec2006_v0_ida.txt arinv_nonpt_mexico_interior1999_21dec2006_v0_ida.txt arinv_nonpt_mexico_border1999_21dec2006_v0_ida.txt
	othar_hg	arinv_area_canada_hg_2000_noduplicates_23jul2008_v0_ida.txt
	othon	mbinv_onroad_Canada2000_07nov2006_v0_ida.txt mbinv_onroad_mexico_border1999_21dec2006_v0_ida.txt mbinv_onroad_mexico_interior1999_21dec2006_v0_ida.txt
	othpt	Canadian point sources from the 2002 platform are proprietary ptinv_mexico_border99_03mar2008_v1_ida.txt ptinv_mexico_interior99_05feb2007_v0_ida.txt ptinv_offshore_point_from_2001_platform_07nov2006_v0_ida.txt
	othpt_hg	Canadian point sources from the 2002 platform are proprietary
2005 “ci” case	ptipm	Annual: Same as 2005ai_tox_05b Daily: ptday_ptipm_caphap_noncem_2005ag_<mon>_ida.txt ptday_ptipm_caphap_cem_2005ci_<mon>_ida.txt
	avefire	arinv_avefire_2002ce_21dec2007_v0_ida.txt arinv_avefire_2002_hap_18nov2008_v0_orl.txt
2022 – All	ptipm	Annual/seasonal: ptinv_egu_summer_2020_pf31capsHgHCl_19feb2008_v0_orl.txt ptinv_egu_winter_2020_pf31capsHgHCl_19feb2008_v0_orl.txt ptinv_ptipm_hap2005agtox_v1_noBAFM_noHgHCL_07jan2009_v2_orl.txt Daily: ptday_ptipm_caphap_noncem_2022ci_31mar_ida.txt ptday_ptipm_caphap_noncem_2022ci_apr_ida.txt ptday_ptipm_caphap_cem_2022ci_31mar_ida.txt ptday_ptipm_caphap_cem_2022ci_apr_ida.txt ptday_ptipm_hap_cem_2005ci_31mar_ida.txt ptday_ptipm_hap_cem_2005ci_apr_ida.txt ptday_ptipm_hap_noncem_2005ag_31mar_ida.txt ptday_ptipm_hap_noncem_2005ag_apr_ida.txt
	avefire	Same as data in base case (2005ci_tox_05b)
	afdust	arinv_afdust_2020ce_02b_BASE_07apr2008_v0_orl.txt
	othar	arinv_nonroad_mexico_interior1999_21dec2006_v0_ida.txt arinv_nonroad_mexico_border1999_21dec2006_v0_ida.txt

Case	Sector	SMOKE input files
		arinv_2020nr_canada_province_17apr2008_v1_ida.txt arinv_2020as_canada_province_05oct2007_v0_ida.txt arinv_nonpt_mexico_interior1999_21dec2006_v0_ida.txt arinv_nonpt_mexico_border1999_21dec2006_v0_ida.txt
	othon	mbinv_2020ms_canada_province_05jun2007_v0_ida.txt mbinv_onroad_mexico_border1999_21dec2006_v0_ida.txt mbinv_onroad_mexico_interior1999_21dec2006_v0_ida.txt
	othpt	Canadian point sources from the 2002 platform are proprietary ptinv_mexico_border99_03mar2008_v1_ida.txt ptinv_mexico_interior99_05feb2007_v0_ida.txt ptinv_offshore_point_from_2001_platform_07nov2006_v0_ida.txt
	othar_hg and othpt_hg	Same as 2005
2022 AEO	ptnonipm	ptinv_ptnonipm_2022ci_tox_aeo_05b_AEO_06jan2009_v0_orl.txt ptinv_ptnonipm_caphap_ethanol_plant_additions_2022AEO_05jan2009_v1_orl.txt ptinv_ptnonipm_2005caphap_chippewa_delete_for_2022EISA_19nov2008_v0_orl.txt
	nonpt	arinv_nonpt_2022ci_tox_aeo_05b_AEO_29dec2008_v0_orl.txt arinv_pfc_caphap2020_02apr2008_v0_orl.txt arinv_nonpt_caphap_biodiesel_plant_additions_2022AEO_18dec2008_v0_orl.txt arinv_nonpt_caphap_ethanol_plant_additions_2022AEO_15dec2008_v0_orl.txt arinv_nonpt_voc_ethanol_transfer_additions_2022AEO_15dec2008_v0_orl.txt
	ag	arinv_ag_2020ce_02b_BASE_08apr2008_v0_orl.txt
	on_noadj	mbinv_on_noadj_MOVES_2022rfs_aeo_<mon>_21JAN2009_21jan2009_v0_orl.txt mbinv_on_noadj_rfs2_aeo_caphap2022_<mon>_12jan2009_v0_orl.txt mbinv_onroad_calif_caphap_2020v31_<mon>_17apr2008_v0_orl.txt
	on_moves_startpm	mbinv_onroad_moves_startpm_2022rfs_aeo_<mon>_18dec2008_v0_orl.txt
	on_moves_runpm	mbinv_onroad_moves_runpm_2022rfs_aeo_<mon>_18dec2008_v0_orl.txt
	seca_c3	ptinv_eca_c3_caps2022BASE_10dec2008_v0_orl.txt ptinv_eca_c3_haps_NonUS_central2022BASE_10dec2008_v0_orl.txt ptinv_eca_c3_haps_NonUS_east2022BASE_10dec2008_v0_orl.txt ptinv_eca_c3_haps_NonUS_west2022BASE_10dec2008_v0_orl.txt ptinv_eca_c3_haps_central2022BASE_10dec2008_v0_orl.txt ptinv_eca_c3_haps_east2022BASE_10dec2008_v0_orl.txt ptinv_eca_c3_haps_west2022BASE_10dec2008_v0_orl.txt

Case	Sector	SMOKE input files
	nonroad	arinv_nonroad_rfs2_aeo_caphap2022_<mon>_09jan2009_v0_orl.txt arinv_nonroad_calif_caphap_lm_2020v31_<mon>_17apr2008_v0_orl.txt
	alm_no_c3	arinv_alm_no_c3_LOCOMOTIVES_Class1_rfs2_aeo_caphap2022_14dec2008_v0_orl.txt arinv_alm_no_c3_C1C2_rfs2_aeo_caphap2022_14dec2008_v0_orl.txt arinv_alm_no_c3_AIRCRAFT_nonClass1_LOCO_rfs2_aeo_caphap2022_14dec2008_v0_orl.txt
2022 RFS1 and RFS1 sensitivity	ptnonipm	ptinv_ptnonipm_2022ci_tox_rfs1_05b_RFS1_22jan2009_v0_orl.txt ptinv_ptnonipm_caphap_ethanol_plant_additions_2022RFS1_26jan2009_v1_orl.txt ptinv_ptnonipm_2005caphap_chippewa_delete_for_2022EISA_19nov2008_v0_orl.txt
	nonpt	arinv_nonpt_2022ci_tox_rfs1_05b_RFS1_22jan2009_v0_orl.txt arinv_pfc_rfs2_rfs1_caphap2020_15jan2009_v0_orl.txt arinv_nonpt_caphap_biodiesel_plant_additions_2022RFS1_18dec2008_v0_orl.txt arinv_nonpt_caphap_ethanol_plant_additions_2022RFS1_15dec2008_v0_orl.txt arinv_nonpt_voc_ethanol_transfer_additions_2022RFS1_15dec2008_v0_orl.txt
	ag	Same as 2022 AEO
	on_noadj	mbinv_on_noadj_MOVES_2022rfs_RFS1_apr_09FEB2009_10feb2009_v0_orl.txt mbinv_on_noadj_rfs2_rfs1_caphap2022_apr_12jan2009_v0_orl.txt mbinv_onroad_calif_caphap_2020v31_apr_17apr2008_v0_orl.txt
	on_moves_startpm	mbinv_onroad_moves_startpm_2022rfs_RFS1_<mon>_09FEB2009_10feb2009_v0_orl.txt
	on_moves_runpm	mbinv_onroad_moves_runpm_2022rfs_RFS1_<mon>_09FEB2009_10feb2009_v0_orl.txt
	seca_c3	Same as 2022 AEO
	nonroad	arinv_nonroad_rfs2_rfs1_caphap2022_<mon>_09jan2009_v0_orl.txt arinv_nonroad_calif_caphap_lm_2020v31_<mon>_17apr2008_v0_orl.txt
	alm_no_c3	arinv_alm_no_c3_AIRCRAFT_nonClass1_LOCO_rfs2_all_RFS2_scenarios_ caphap2022_14dec2008_v0_orl.txt arinv_alm_no_c3_C1C2_rfs2_rfs1_caphap2022_14jan2009_v0_orl.txt arinv_alm_no_c3_LOCOMOTIVES_Class1_rfs2_rfs1_caphap2022_14jan2009_v0
2022 RFS2	ptnonipm	ptinv_ptnonipm_2022ci_tox_eisa_05b_EISA_23jan2009_v0_orl.txt ptinv_ptnonipm_caphap_ethanol_plant_additions_2022EISA_27jan2009_v2_orl.txt
	nonpt	arinv_nonpt_2022ci_tox_eisa_05b_EISA_26jan2009_v0_orl.txt arinv_nonpt_caphap_biodiesel_plant_additions_2022EISA_18dec2008_v0_orl.txt arinv_nonpt_caphap_ethanol_plant_additions_2022EISA_15dec2008_v0_orl.txt arinv_nonpt_voc_ethanol_transfer_additions_2022EISA_15dec2008_v0_orl.txt arinv_pfc_rfs2_eisa_caphap2020_15jan2009_v0_orl.txt arinv_nonpt_caphap_cellolosic_plant_additions_2022eisa_21OCT2009_orl.txt
	ag	arinv_ag_2022ci_tox_eisa_05b_EISA_27jan2009_v0_orl.txt

Case	Sector	SMOKE input files
	afdust	arinv_afdust_2022ci_tox_eisa_05b_EISA_27jan2009_v0_orl.txt
	on_noadj	mbinv_on_noadj_MOVES_2022rfs_EISA_<mon>_26FEB2009_26feb2009_v0_orl.txt mbinv_on_noadj_rfs2_eisa_caphap2022_<mon>_14jan2009_v0_orl.txt mbinv_onroad_calif_caphap_2020v31_<mon>_17apr2008_v0_orl.txt
	on_moves_startpm	mbinv_onroad_moves_startpm_2022rfs_EISA_<mon>_26FEB2009_26feb2009_v0_orl.txt
	on_moves_runpm	mbinv_onroad_moves_runpm_2022rfs_EISA_<mon>_26FEB2009_26feb2009_v0_orl.txt
	seca_c3	ptinv_eca_c3_caps2022EISA_10dec2008_v0_orl.txt ptinv_eca_c3_haps_east2022EISA_10dec2008_v0_orl.txt ptinv_eca_c3_haps_central2022EISA_10dec2008_v0_orl.txt ptinv_eca_c3_haps_west2022EISA_10dec2008_v0_orl.txt ptinv_eca_c3_haps_NonUS_east2022EISA_10dec2008_v0_orl.txt ptinv_eca_c3_haps_NonUS_central2022EISA_10dec2008_v0_orl.txt ptinv_eca_c3_haps_NonUS_west2022EISA_10dec2008_v0_orl.txt
	nonroad	arinv_nonroad_rfs2_eisa_caphap2022_<mon>_09jan2009_v0_orl.txt arinv_nonroad_calif_caphap_lm_2020v31_<mon>_17apr2008_v0_orl.txt
2022 RFS2, Sensitivity	nonpt	Same as 2022 RFS2 case, but did ***not*** include dataset: arinv_nonpt_caphap_biodiesel_plant_additions_2022EISA_18dec2008_v0_orl.txt

APPENDIX D

Ancillary Data Files Used for RFS2 2005 Case Compared to 2005 v4 Platform Data Files

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 D-1: Detailed list of ancillary data differences between RFS2 2005 and 2005 v4 platform

Description	Environment Variable	Sectors	2005 v4 platform		2005 RFS2 platform		Comment and Impact	Impact?
			Dataset	Vsn	Dataset	Vsn		
Area-source spatial cross-reference	AGREF	All sectors	amgref_us_can_mex_revised	5	amgref_us_can_allmex3	5	For v4 platform, revised for new Canadian inventory and spatial surrogates	Yes
Onroad spatial cross-reference	MGREF	All sectors	amgref_us_can_mex_revised	7	amgref_us_can_allmex3	5	For v4 platform, revised for new Canadian inventory and spatial surrogates	Yes
Area and onroad temporal profiles	ATPRO, MTPRO, PTPRO	All sectors	amptpro_2005_us_can_revised	0	amptpro_2005_us_can	1	For v4 platform, revised for new Canadian inventory and temporal profiles	Yes
Area temporal cross-reference	ATREF, PTREF	All sectors	amptref_v3_3_revised	1	amptref_v3_3	5	For v4 platform, added SCCs needed for 2005 v2 point inventory and for WRAP oil and gas inventory	Yes
Onroad temporal cross-reference	MTREF	All sectors	amptref_v3_3_revised	0	amptref_v3_3	5	For v4 platform, added SCCs needed for 2005 v2 point inventory (but not for WRAP oil and gas inventory). Superceeded by v1 of the same dataset.	Yes
Grid descriptions	GRIDDESC	All sectors	griddesc_lambertonly	24	griddesc_lambertonly	13	An older file used for RFS2 with fewer grids defined.	No
Inventory table	INVTABLE	All sectors	invtable_hapcapintegate_cb05soa_nomp	4	invtable_hapcap_cb05soa	6	RFS2 used a full toxics approach for processing the emissions and 2005 v4 platform used an approach without most toxics. Impacts only the species included in the air quality modeling.	No
Inventory table	INVTABLE	avefire, ptnonipm, ptipm	invtable_hapcapnohapuse_cb05soa_nomp	4	n/a		Approach for implementing "no HAP use" approach for these sectors was different in RFS2, but the result was the same.	No
Non-HAP Exclusions for nonpt sector	NHAP EXCLUDE	nonpt	nhapexclude_nonpt_pf4	3	nhapexclude_nonpt_pf4	0	v1 file contains updates for ethanol 8-digit SCCs with not HAPs associated with the VOC. v3 includes WRAP oil and gas SCCs since these do not have HAP VOCs either. v1 needed for future year RFS2 and v3 needed for the v4 platform.	Yes
Elevated configuration file for seca_c3 sector	PELV CONFIG	seca_c3	pelvconfig_seca_c3	0	n/a		v4 platform used inline point sources, and so PELVCONFIG file needed only in v4 platform.	Yes
Speciation profiles for INTEGRATE HAPS	GSPRO	All sectors	gspro_integratehaps_cb05_tx_pf4	1	gspro_integratehaps_cb05_tx_pf4	0	For v4 platform: Added benzene-to-benzene record: move this record from the "other HAP VOC" gspro since it is used in SOA	No
Speciation profiles for TOG	GSPRO	All sectors	gspro_tog_cb05_soa_pf4_pretier2	1	gspro_tog_nohapuse_cb05_tx_pf4_pretier2	1	Excluded ald2_primary and form_primary from v4 platform since not needed	No
Speciation profiles static	GSPRO	All sectors	gspro_static_cmaq	9	gspro_static_cmaq	7	For the v4 platform, this dataset modified to remove biogenic profiles to put them into a separate dataset.	No
Speciation profiles speciated VOC	GSPRO	othpt	gspro_speciated_voc	0	n/a		For the v4 platform, this speciation profile dataset passes through the pre-speciated VOC point source species provided by Environment Canada 2006 data.	Yes

Description	Environment Variable	Sectors	2005 v4 platform		2005 RFS2 platform		Comment and Impact	Impact?
			Dataset	Vsn	Dataset	Vsn		
Speciation profiles Canada PM	GSPRO	othpt	gspro_pm25_canada_2006_point	0	n/a		For the v4 platform, this speciation profile dataset provides the Canadia-specific $PM_{2.5}$ speciation profile recommended by Environment Canada for point sources (1% POC, 2% PEC, 12% PSO4, 85% PMFINE)	Yes
Speciagtino profiles for biogenic emissions	GSPRO	biog	gspro_biogenics	0	n/a		For the v4 platform, this dataset contains the biogenic VOC speciation profiles previously included in gspro_static_cmaq v7 for the RFS2 effort	No
Speciation profiles Other VOC HAP	GSPRO	All sectors	n/a		gspro_other_hapvoc	4	For RFS2, this dataset has the HAP VOC species that get passed through from inventory to the multipollutant inputs created for RFS2.	Yes
Speciation profiles CHROMIUM	GSPRO	All sectors	n/a		gspro_chromium	0	Chromium speciation profiles needed only for multi-polltutant approach used in RFS2	Yes
Speciation profiles DIESEL PM	GSPRO	All sectors	n/a		gspro_dieselpm	1	DIESEL_PM speciation profiles needed only for multi-pollutant approach used in RFS2.	Yes
Speciation profiles METALS	GSPRO	All sectors	n/a		gspro_hapmetals	0	HAP metal pass-through profiles needed only for multi-pollutant approach used in RFS2.	Yes
Speciation xref for PM2.5 diesel SCCs but do not produce diesel	GSREF	All sectors	gsref_no_dieselpm	1	n/a		Since the v4 platform did not create the DIESEL_PM species needed for the multipollutant version of CMAQ, the data set used for the v4 platform contains the SCC cross-references for diesel SCCs without the DIESEL_PM species. The RFS2 platform cross-references to the DIESEL_PM profiles.	Yes
Speciation xref for non-diesel PM2.5	GSREF	All sectors	gsref_pm25_pf4_nondiesel	8	gsref_pm25_pf4_nondiesel	1	For the v4 platform, this dataset includes updates for 2005 v2 point sources as well as WRAP oil and gas inventory. Note that future years of RFS2 used more current version than "v1" of this dataset, and the v8 dataset could be used for replicating RFS2 runs.	Yes
Speciation xref for VOC, not year-specific	GSREF	All sectors	gsref_voc_general	19	gsref_voc_general	9	For v4 platform, includes updates for 2005 v2 point inventory, WRAP oil and gas SCCs, changes to gasoline distribution SCCs.	Yes
Speciation xref for NONHAPVOC, not year-specific	GSREF	All sectors	gsref_nonhapvoc_general_update	3	gsref_nonhapvoc_general	0	Matches differences between "voc" files	Yes
Speciation xref for VOC, year-specific	GSREF	All sectors	gsref_voc_2005	2	gsref_voc_2002	2	The v4 platform includes gasoline distribution SCCs deemed not to be year specific (refinery to bulk terminal) and updates for 2006 Canadian point sources.	
Speciation xref for NONHAPVOC, year-specific	GSREF	All sectors	gsref_nonhapvoc_2005	1	gsref_nonhapvoc_2002	1	Matches differences between "voc" files	Yes

Description	Environment Variable	Sectors	2005 v4 platform		2005 RFS2 platform		Comment and Impact	Impact?
			Dataset	Vsn	Dataset	Vsn		
Speciation xref static NOX -- HONO for mobile sources	GSREF	All sectors	gsref_static_nox_hono_pf4	3	gsref_static_nox_hono_pf4	2	The v4 platform dataset adds four Canadian SCCs that are needed for processing the 2006 Canadian inventory.	
	GSREF	All sectors	gsref_static_integratehap_emv4	2	n/a		For the v4 platform, this speciation cross-reference dataset passes through the pre-speciated VOC point source species provided by Environment Canada 2006 data.	Yes
Speciation xref for Canada PM	GSREF	othpt	gsref_pm25_canada_2006_point	2	n/a		For the v4 platform, this speciation cross-reference dataset assigns the single Canadia-specific $PM_{2.5}$ speciation profile recommended by Environment Canada for all point sources.	Yes
Speciation xref DIESEL PM, alm_no_c3	GSREF	alm_no_c3 nonroad on_noadj	n/a		gsref_dieselpm	0	Enables creation of diesel PM species	Yes
Speciation xref NO DIESEL PM, othar	GSREF	othar	n/a		gsref_no_dieselpm	0	Prevents creation of diesel PM species in Canada	No
Speciation xref HAP chromium nonroad sectors	GSREF	alm_no_c3 nonroad seca_c3	n/a		gsref_chromium_nonroad	1	Enables creation of chromium species	Yes
Speciation xref HAP chromium on_noadj sector	GSREF	on_noadj	n/a		gsref_chromium_onroad	1	Enables creation of chromium species	Yes
Speciation xref HAP chromium stationary sectors	GSREF	nonpt ptipm ptnonipm	n/a		gsref_chromium_stationary	0	Enables creation of chromium species	Yes
Speciation xref HAP metals nonroad sectors	GSREF	alm_no_c3 nonroad seca_c3	n/a		gsref_metals_nonroad	0	Enables creation of HAP metal species	Yes
Speciation xref HAP metals stationary sector	GSREF	nonpt ptipm ptnonipm	n/a		gsref_metals_stationary	1	Enables creation of HAP metal species	Yes
Speciation xref HAP metals nonroad sectors	GSREF	nonroad	n/a		gsref_metals_nonroad	0	Enables creation of HAP metal species	Yes
Speciation xref HAP metals on_noadj sector	GSREF	on_noadj	n/a		gsref_metals_onroad	0	Enables creation of HAP metal species	Yes

APPENDIX E

Growth and Control Assumptions and Affected Pollutants for the 2022 AEO Case

For nonEGU point and stationary area sources, the "2005" inventory data used 2002 emissions. As a result, we used our 2002-based approaches for these sectors to project to 2022. Many of these controls have effective dates between 2002 and 2005, and therefore would not be applied to a true 2005 inventory value.

Table E-1: Control Strategies and Projection Assumptions in the 2022 RFS2 AEO Emissions Inventories.

Control Strategies **(Grouped by Affected Pollutants or Standard and Approach Used to Apply to the Inventory)**	**Pollutants Affected**	**Approach or Reference:**
Non-EGU Point Controls		
NO_X SIP Call (Phase II): Cement Manufacturing Large Boiler/Turbine Units Large IC Engines	NOx	1
DOJ Settlements: plant SCC controls Alcoa, TX MOTIVA, DE	NOx, SO2	2
Refinery Consent Decrees: plant/SCC controls	NOx, PM, SO2	3
Closures, pre-2007: plant control of 100% Auto plants Pulp and Paper Large Municipal Waste Combustors Small Municipal Waste Combustors Plants closed in preparation for 2005 inventory	all	4
Industrial Boiler/Process Heater plant/SCC controls for PM	PM	5
Large Municipal Waste Combustors (LMWC)	PM, Hg, and metals	6
Small Municipal Waste Combustors (SMWC)	PM, Hg, metals, NOx, SO2	6
MACT rules, national, VOC: national applied by SCC, MACT Boat Manufacturing Polymers and Resins III (Phenolic Resins) Polymers and Resins IV (Phenolic Resins) Wood Building Products Surface Coating Generic MACT II: Spandex Production, Ethylene manufacture Large Appliances Miscellaneous Organic NESHAP (MON): Alkyd Resins, Chelating Agents, Explosives, Phthalate Plasicizers, Polyester Resins, Polymerized Vinylidene Chloride Manufacturing Nutritional Yeast Oil and Natural Gas Petroleum Refineries -Catalytic Cracking, Catalytic Reforming, & Sulfur Plant Units Pesticide Active Ingredient Production Publicly Owned Treatment Works Reinforced Plastics Rubber Tire Manufacturing Asphalt Processing & Roofing Combustion Sources at Kraft, Soda, and Sulfite Paper Mills Fabric Printing, Coating and Dyeing Iron & Steel Foundries Metal: Can, Coil Metal Furniture	VOC	EPA, 2007f

Control Strategies (Grouped by Affected Pollutants or Standard and Approach Used to Apply to the Inventory)	Pollutants Affected	Approach or Reference:
Miscellaneous Metal Parts & Products Municipal Solid Waste Landfills Paper and Other Web Plastic Parts Plywood and Composite Wood Products Wet Formed Fiberglass Production Wood Building Products Surface Coating Carbon Black Production Cellulose Products Manufacturing Cyanide Chemical Manufacturing Friction Products Manufacturing Leather Finishing Operations Miscellaneous Coating Manufacturing Organic Liquids Distribution (Non-Gasoline) Refractory Products Manufacturing Sites Remediation		
Solid Waste Rules (Section 129d/111d) Hospital/Medical/Infectious Waste Incinerator Regulations	NOx, PM, SO2	EPA, 2005
MACT rules, national, PM: **Portland Cement Manufacturing** **Secondary Aluminum**	PM	7
MACT rules, plant-level, VOC: **Auto Plants**	VOC	8
MACT rules, plant-level, PM & SO_2: **Lime Manufacturing**	PM, SO2	9
MACT rules, plant-level, PM: **Taconite Ore**	PM	10
Stationary Area Assumptions		
Municipal Waste Landfills: project factor of 0.25 applied,	VOC	EPA, 2007f
Livestock Emissions Growth to year 2020	NH3	11
Residential Wood Combustion Growth and Changeouts to year 2020	all	12
Gasoline Stage II growth and control to 2022 AEO	VOC	13
Portable Fuel Container growth and control to year 2020	VOC	14
EGU Point Controls		
CAIR/CAMR/CAVR IPM Model 3.0	NOx, SO2, PM	15
Onroad Mobile and Nonroad Mobile Controls (list includes all key mobile control strategies but is not exhaustive)		
National Onroad Rules: Tier 2 Rule 2007 Onroad Heavy-Duty Rule Final Mobile Source Air Toxics Rule (MSAT2) Renewable Fuel Standard	all	
Local Onroad Programs: National Low Emission Vehicle Program (NLEV) Ozone Transport Commission (OTC) LEV Program	VOC	16

Control Strategies (Grouped by Affected Pollutants or Standard and Approach Used to Apply to the Inventory)	**Pollutants Affected**	**Approach or Reference:**
National Nonroad Controls: Clean Air Nonroad Diesel Final Rule – Tier 4 Control of Emissions from Nonroad Large-Spark Ignition Engines and Recreational Engines (Marine and Land Based): "Pentathalon Rule" Clean Bus USA Program Control of Emissions of Air Pollution from Locomotives and Marine Compression-Ignition Engines Less than 30 Liters per Cylinder Exhaust emission standards for marine spark-ignition engines and small land-based nonroad engines	all	17, 18, 19
Aircraft, Locomotives, and Commercial Marine Assumptions		
Aircraft: Itinerant (ITN) operations at airports to year 2022	all	20
Locomotives: Energy Information Administration (EIA) fuel consumption projections for freight rail Clean Air Nonroad Diesel Final Rule – Tier 4 Locomotive Emissions Final Rulemaking, December 17, 1997 Control of Emissions of Air Pollution from Locomotives and Marine	all	EPA, 2007e, 21, 18
Commercial Marine: EIA fuel consumption projections for diesel-fueled vessels OTAQ ECA C3 Base 2022 inventory for residual-fueled vessels Clean Air Nonroad Diesel Final Rule – Tier 4 Emissions Standards for Commercial Marine Diesel Engines, December 29, 1999 Tier 1 Marine Diesel Engines, February 28, 2003	all	21, (EPA, 2007e)
AEO-specific inventory adjustments		
Nonpt and ptnonipm: Gasoline distribution by SCC: bulk-plant-to-pump (btp) and refinery-to-bulk terminal (rtb) processes Ethanol plant additions	VOC all	EPA, 2010
ptnonipm: Refinery adjustments by state and SCC Ethanol plant additions	all all	EPA, 2010
nonpt: Ethanol transfer additions Biodiesel Plant additions	VOC all	EPA, 2010
C1 and C2 Commercial Marine: Complete OTAQ inventory replacement with AEO adjustments to year 2022	all	EPA, 2010
Class 1 Locomotives: Complete OTAQ inventory replacement with AEO adjustments to year 2022	all	EPA, 2010
ECA C3: Complete OTAQ inventory replacement with AEO adjustments for year 2022	all	EPA, 2010
Nonroad (not including California): AEO-specific gasoline equipment	all	EPA, 2010
Onroad (not including California): MOVES AEO-specific emissions for onroad gasoline AEO-specific Class 8a and 8B truck emissions for 816 counties determined to have enhanced truck traffic from ethanol distribution	all all	EPA, 2010

APPROACHES:

1. Used *Emission Budget Inventories* report (EPA, 1999) for list of SCCs for application of controls, and for percent reductions (except IC Engines). Used Federal Register on Response to Court decisions (Federal

Register, 2004) for IC Engine percent reductions and geographic applicability
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 Brenda Shine, EPA, OAQPS
4. Closures obtained from EPA sector leads; most verified using the world wide web.
5. Used data list of plants provided by project lead from 2001-based platform; required mapping the 2001 plants to 2002 NEI plants due to plant id changes across inventory years
6. Used data provided by Walt Stevenson, EPA, OAQPS
7. Same as used in CAIR, except added SCCs appeared to be covered by the rule: both reductions based on preamble to final rule. (Portland Cement used a weighted average across two processes)
8. Percent reductions recommended and plants to apply to reduction to were based on recommendations by rule lead engineer, and are consistent with the reference: EPA, 2007e
9. Percent reductions recommended are determined from the existing plant estimated baselines and estimated reductions as shown in the Federal Register Notice for the rule. SO2 % reduction will therefore be 6147/30,783 = 20% and PM10 and PM2.5 reductions will both be 3786/13588 = 28%
10. Same approach used in CAIR: FR notice estimates 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.
11. Except for dairy cows and turkeys (no growth), based in animal population growth estimates from USDA and Food and Agriculture Policy and Research Institute.
12. Expected benefits of woodstoves change-out program: http://www.epa.gov/woodstoves/index.html
13. VOC emission ratios of year 2022 AEO-specific from year 2005 from the National Mobile Inventory Model (NMIM) results for onroad refueling including activity growth from VMT, Stage II control programs at gasoline stations, and phase in of newer vehicles with onboard Stage II vehicle controls.
14. VOC and benzene emissions for year 2020 from year 2002 from MSAT rule (EPA, 2007c, EPA, 2007d)
15. http://www.epa.gov/airmarkets/progsregs/epa-ipm/docs/summary2006.pdf
16. Only for states submitting these inputs: http://www.epa.gov/otaq/lev-nlev.htm
17. http://www.epa.gov/nonroad-diesel/2004fr.htm
18. http://www.epa.gov/cleanschoolbus/
19. http://www.epa.gov/otaq/marinesi.htm
20. Federal Aviation Administration (FAA) Terminal Area Forecast (TAF) System, December 2007: http://www.apo.data.faa.gov/main/taf.asp
21. http://www.epa.gov/nonroad-diesel/2004fr.htm