1 Introduction

2 Overview

3 Point Sources

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5 Nonroad Equipment – Diesel, Gasoline and Other

Although "nonroad" is used to refer to all transportation sources that are not on-highway, this section addresses nonroad equipment other than locomotives, aircraft, or commercial marine vessels. Locomotive emissions from railyards and aircraft and associated ground support equipment are described in Section 3. Section 4 includes descriptions of the nonpoint portion of locomotives and the commercial marine vessel emissions.

5.1 Sector Description

This section deals specifically with emissions processes calculated by the EPA's NONROAD2008 model [ref 1] and the family of off-road models used by California [ref 2]. They include nonroad engines and equipment, such as lawn and garden equipment, construction equipment, engines used in recreational activities, portable industrial, commercial, and agricultural engines. Nonroad equipment emissions are included in every state, the District of Columbia, Puerto Rico, and the Virgin Islands.

Nonroad mobile source emissions are generated by a diverse collection of equipment from lawn mowers to locomotive support. NONROAD estimates emissions from nonroad mobile sources using a variety of fuel types as shown in Table 5-1.

Table 5-1: MOVES-NONROAD equipment and fuel types

Equipment Types	**Fuel Types**
Recreational Construction Industrial Lawn and Garden Agriculture Commercial Logging Airport Ground Support Equipment (GSE) (excludes aircraft)* Underground Mining Oilfield** Pleasure Craft (recreational marine) (excludes commercial marine vessels) Railroad (excludes locomotives)	Compressed Natural Gas (CNG) Diesel Gasoline Liquified Petroleum Gas (LPG)

*Although NONROAD2008 estimates GSE, the results are not used in the NEI. NEI GSE estimates are instead calculated via the Federal Aviation Administration's Emission and Dispersion Modeling System (EDMS).

**Although NONROAD2008 estimates oil field equipment, the results are not used in the NEI, because they are duplicative of results from EPA's Oil and Gas Tool used in nonpoint source calculations.

5.2 MOVES-NONROAD

NONROAD2008, the latest public release of EPA's NONROAD Model, estimates daily emissions for total hydrocarbons (THC), nitrogen oxides (NOx), carbon monoxide (CO), carbon dioxide (CO_2), particulate matter 10 microns and less (PM_{10}), and sulfur dioxide (SO_2), as well as calculating fuel consumption. MOVES2014a (version 20151201) [ref 4] uses ratios from some of these emissions to calculate emissions for particular matter 2.5 microns and less ($PM_{2.5}$), methane, ammonia (NH_3), 4 more aggregate hydrocarbon groups (NMHC, NMOG, TOG, and VOC), 14 hazardous air pollutants (HAPs), 17 dioxin/furan congeners, 32 polycyclic aromatic hydrocarbons, and 6 metals. For a complete list of these pollutants, see Table 5-2. All of the input and activity data required to run MOVES-NONROAD are contained within the Motor Vehicle Emissions Simulator (MOVES) default database, which is distributed with the model. State- and county-specific data can be used by creating a supplemental database known as a county database (CDB) and specifying it in the MOVES run specification (runspec). State, local and tribal (S/L/T) agencies can update the data within the CDBs to produce emissions estimates that accurately reflect local conditions and equipment usage. MOVES first uses the data in the CDBs and fills in any missing data from the MOVES default database.

MOVES-NONROAD is the new way of running NONROAD2008. Nonroad emissions for previous NEIs have been produced by running NONROAD2008 for all U.S. counties using the National Mobile Inventory Model (NMIM) [ref 4]. Now superseded by MOVES, NMIM was the EPA's consolidated mobile emissions estimation system that allowed the EPA to produce nonroad mobile emissions in a consistent and automated way for the entire country. NMIM was basically a user interface for NONROAD2008. It took data from the NMIM County Database (NCD) and used it to write input files for NONROAD2008 (called "opt" files), executed NONROAD2008, picked up the output, and put it into a MySQL database. It also generated additional pollutant estimates as ratios to those produced by NONROAD. As part of the EPA's continuing efforts to upgrade the NONROAD model, it was moved from NMIM into MOVES2014. Although MOVES is primarily a user interface for NONROAD, just as NMIM was, data are now stored in standard MySQL tables, the same as for the onroad sources, which are much easier to access and update than the original NONROAD ASCII files. The transfer to MOVES was tested by verifying that the NONROAD model and MOVES2014 produced identical results for the species produced by stand-alone NONROAD (THC, CO, CO_2, NOx, SO_2, PM_{10}, and fuel consumption). MOVES-NONROAD also includes improved estimation of HAPs, which are creating by post-processing NONROAD2008 output. MOVES2014-NONROAD produced THC, NOx, PM_{10}, $PM_{2.5}$, CO, SO_2, NH_3, CO_2, and fuel consumption. MOVES2014a added the ability to calculate all of the species mentioned above and listed in Table 5-2. At the same time, it based these calculations on much newer and better data than had been used in NMIM [refs 5,6].

Table 5-2: Pollutants produced by MOVES-NONROAD for 2014 NEI

Pollutant ID	Pollutant Name	Pollutant ID	Pollutant Name
1	Total Gaseous Hydrocarbons	83	Phenanthrene particle
2	Carbon Monoxide (CO)	84	Pyrene particle
3	Oxides of Nitrogen (NOx)	86	Total Organic Gases
5	Methane (CH_4)	87	Volatile Organic Compounds

Pollutant ID	Pollutant Name	Pollutant ID	Pollutant Name
20	Benzene	88	NonHAPTOG
21	Ethanol	90	Atmospheric CO_2
22	MTBE	99	Brake Specific Fuel Consumption (BSFC)
23	Naphthalene particle	100	Primary Exhaust PM_{10} - Total
24	1,3-Butadiene	110	Primary Exhaust $PM_{2.5}$ - Total
25	Formaldehyde	130	1,2,3,7,8,9-Hexachlorodibenzo-p-Dioxin
26	Acetaldehyde	131	Octachlorodibenzo-p-dioxin
27	Acrolein	132	1,2,3,4,6,7,8-Heptachlorodibenzo-p-Dioxin
30	Ammonia (NH_3)	133	Octachlorodibenzofuran
31	Sulfur Dioxide (SO_2)	134	1,2,3,4,7,8-Hexachlorodibenzo-p-Dioxin
40	2,2,4-Trimethylpentane	135	1,2,3,7,8-Pentachlorodibenzo-p-Dioxin
41	Ethyl Benzene	136	2,3,7,8-Tetrachlorodibenzofuran
42	Hexane	137	1,2,3,4,7,8,9-Heptachlorodibenzofuran
43	Propionaldehyde	138	2,3,4,7,8-Pentachlorodibenzofuran
44	Styrene	139	1,2,3,7,8-Pentachlorodibenzofuran
45	Toluene	140	1,2,3,6,7,8-Hexachlorodibenzofuran
46	Xylene	141	1,2,3,6,7,8-Hexachlorodibenzo-p-Dioxin
60	Mercury Elemental Gaseous	142	2,3,7,8-Tetrachlorodibenzo-p-Dioxin
61	Mercury Divalent Gaseous	143	2,3,4,6,7,8-Hexachlorodibenzofuran
62	Mercury Particulate	144	1,2,3,4,6,7,8-Heptachlorodibenzofuran
63	Arsenic Compounds	145	1,2,3,4,7,8-Hexachlorodibenzofuran
65	Chromium 6+	146	1,2,3,7,8,9-Hexachlorodibenzofuran
66	Manganese Compounds	168	Dibenzo(a,h)anthracene gas
67	Nickel Compounds	169	Fluoranthene gas
68	Dibenzo(a,h)anthracene particle	170	Acenaphthene gas
69	Fluoranthene particle	171	Acenaphthylene gas
70	Acenaphthene particle	172	Anthracene gas
71	Acenaphthylene particle	173	Benz(a)anthracene gas
72	Anthracene particle	174	Benzo(a)pyrene gas
73	Benz(a)anthracene particle	175	Benzo(b)fluoranthene gas
74	Benzo(a)pyrene particle	176	Benzo(g,h,i)perylene gas
75	Benzo(b)fluoranthene particle	177	Benzo(k)fluoranthene gas
76	Benzo(g,h,i)perylene particle	178	Chrysene gas
77	Benzo(k)fluoranthene particle	181	Fluorene gas
78	Chrysene particle	182	Indeno(1,2,3,c,d)pyrene gas
79	Non-Methane Hydrocarbons	183	Phenanthrene gas
80	Non-Methane Organic Gases	184	Pyrene gas
81	Fluorene particle	185	Naphthalene gas
82	Indeno(1,2,3,c,d)pyrene particle		

5.3 Changes for 2014NEIv2

Three states provided v2 updates to their nonroad inputs: Delaware Department of Natural Resources and Environmental Control, Georgia Department of Natural Resources and North Carolina Department of Air Quality (NCDAQ). See Section 5.5 below for additional details.

5.4 Default MOVES code and database

The nonroad runs were executed using MOVES2014a, the most current publically-released version of MOVES available at the time. The code version for this release is moves20151201. A modification was made to one Java class (ApplicationRunner) to allow MOVES to run NONROAD2008 on a Linux distributed processing system. This change had no effect on the modeling output and will be included in all future versions of MOVES. The code with the change is referred to as moves20151201a. The default database is movesdb20151201, the same one released publically with MOVES2014a. When NONROAD2008 was incorporated into MOVES, the default data built into NONROAD2008 was converted to MySQL tables and included in movesdb20151201.

5.5 Additional Data: NONROAD County Databases (CDBs)

MOVES uses county databases (CDBs) to provide detailed local information for developing nonroad emissions. The EPA encouraged S/L/T agencies to submit MOVES-NONROAD CDBs to the Emission Inventory System (EIS) for the 2014 NEI. To facilitate the transition from NMIM to MOVES for 2014 v1, the EPA also accepted NONROAD inputs in the old format of the NCD. The NCD inputs were converted to CDBs in MOVES format. Data not provided in CDBs is automatically supplied from the MOVES default database. As is also true for MOVES onroad runs, even if an agency submitted fuel or meteorological data, the EPA's values for these data parameters were used. The fuels were those in the MOVES default database for MOVES2014a, movesdb20151201 (see also Section 6.8.2.3). The meteorological data were provided by OAQPS and were derived from a Weather Research and Forecasting Model (WRF) version 3.8 [ref 7] run.

Table 5-3 shows the selection hierarchy for the nonroad data category. The MOVES default database for MOVES2014a (movesdb20151201) and state-submitted inputs in CDBs were used to run MOVES-NONROAD to produce emissions for all states other than California. California-submitted emissions were used.

Table 5-3: Selection hierarchy for the Nonroad Mobile data category

Priority	Dataset	Notes
1	S/L/T-supplied emissions	Several tribes submitted NONROAD emissions. California used their own model, OFFROAD. (Texas ran NONROAD2008 using their data. These data are present in EIS, but were not selected for the 2014NEI. Texas also supplied NCD inputs which were converted and used in MOVESNONROAD)
2	S/L/T-supplied input data from 2014 NEI process	
3	S/L/T-supplied input data from previous NEIs	
4	Movesdb20151201	All data from Movesdb20151201

The EPA asked S/L/T agencies to provide model inputs (CDBs or NCDs) instead of emissions for 2014. However, some agencies also submitted nonroad emissions. Table 5-4 shows the S/L/T agencies that submitted nonroad

emissions and/or activity data for the 2014 NEI via the EIS Gateway. The NCDs all went into the database NCD20160513_nei2014v1, which was used to run NMIM to compare with the MOVES-NONROAD runs. Most of the state- and county-specific data in this NCD was converted to CDBs for the MOVES run. The NCD20160513_nei2014v1 database also contained data which had been submitted by S/L/Ts previously, primarily for the 2011 NEI. This S/L/T data were also converted to CDBs for the MOVES-NONROAD runs. Table 5-4 shows all the states for which either v1 CDBs were submitted or created from the NCD20160513_nei2014v1 database. The latter includes those submitted for 2014 and those submitted in earlier NEI processes.

If a CDB was supplied as part of the 2014 NEI process, earlier data from NCD20160513_nei2014v1 that was converted to CDBs was not used. States for which one or more CDBs were created from NCD20160513_nei2014v1 and for which NONROAD files were included are listed in Table 5-5. Only Texas submitted valid NCD data for 2014. Florida submitted a nonroad NCD, but it contained only onroad data. Several allocation files were submitted for Pima County (Arizona) that assigned all of the state's activity to that county, so it was not used. The user-supplied allocation files incorrectly have set the state total surrogates the same as Pima. Since equipment activity and population was not supplied with the Pima submission, the result is that the whole state population is assigned to Pima County. Our solution to this problem was to use the MOVES results for Arizona without rerunning. Although there is probably some good information in the Pima submission, timing prohibited its use. Their submission is for 2014, whereas the default data that was included was for 2002, so changing state totals to match 2002 would not be correct and therefore it was not used**.**

Table 5-4: Nonroad Mobile S/L/T submissions for the 2014 NEI**

Agency Organization	**State**
2014 Nonroad Emissions	
California Air Resources Board	CA
Coeur d'Alene Tribe	ID
Kootenai Tribe of Idaho	ID
Metro Public Health of Nashville/Davidson County	TN
Nez Perce Tribe	ID
Northern Cheyenne Tribe	MT
Shoshone-Bannock Tribes of the Fort Hall Reservation of Idaho	ID
Texas Commission on Environmental Quality	TX
2014 Nonroad CDB	
Illinois Environmental Protection Agency	IL
New York State Department of Environmental Conservation	NY
North Carolina Department of Environment and Natural Resources	NC
Washington State Department of Ecology	WA
Washoe County Health District	NV
2014 Nonroad NCD*	
Texas Commission on Environmental Quality	TX

* Florida submitted a Nonroad NCD, but it contained only onroad data. Several allocation files were submitted for Pima County that assigned all of the state's activity to that county, so it was not used.

**California and tribal emissions submittals are included in the 2014v2 NEI. All other state/counties used MOVES estimates from EPA model runs, with submitted input.

Table 5-5: States for which one or more CDBs were created from NCD20160513_nei2014v1 and for which NONROAD files were included

Name	FIPS	Pop	Act	Alo*	Grw	Sea
Colorado	08			1		
Connecticut	09	X				
Delaware	10	X		17		
Georgia	13			10		
Illinois	17	X	X	2	X	X
Indiana	18	X	X	2	X	X
Iowa	19		X	2		X
Maryland	24	X				
Michigan	26	X	X	2	X	X
Minnesota	27		X	3	X	X
Nevada	32			10		
New Hampshire	33	X				
New Jersey	34	X				
New York	36			1		
North Carolina	37					X
Ohio	39	X	X	2	X	X
Rhode Island	44	X				
Texas	48	X	X	19	X	X
Washington	53			2		
Wisconsin	55	X	X	2	X	X

* "Alo" is allocation of equipment population from state to county, based on one of 19 possible surrogates. The number in the "Alo" column is the number of files, one for each surrogate. "Act" is activity in hours per year. "Pop" is equipment population. "Grw" is growth of population from a number of base years. MOVES will use the correct surrogate and closest base year. "Sea" (seasonality) is temporal allocation of activity to different seasons. In MOVES, this allocation is by month and state. "FIPS" is the 2-digit Federal Information Processing Standard state code.

The 320 submitted CDBs used for the v1 MOVES-NONROAD run are collected together in NonroadCDBs.zip in the NRSupplementalData folder. CDBs were used only for states/counties that submitted CDBs or NCDs, including submissions prior to 2014. The rest were run using the MOVES default database, which does not require CDBs. A list of all 3,224 U.S. counties and their corresponding CDBs, if any, is available in nonroad_counties_nei2014v1_FinalList.xlsx. The contents of the NRSupplementalData folder are listed in Table 5-6 and are all available at: ftp://newftp.epa.gov/Air/nei/2014/doc/2014v2_supportingdata/nonroad.

Three state agencies submitted data for use in MOVES-NONROAD for 2014 v2. The Delaware Department of Natural Resources and Environmental Control provided a CDB for each county (3 total) that contained local population data for pleasure craft vessels. The Georgia Department of Natural Resources provided a single CDB, applicable to all 159 counties in the state, with local data on growth factors for several nonroad equipment sectors. The North Carolina Department of Air Quality (NCDAQ) provided a spreadsheet of growth factors based on local data for the construction and agriculture equipment subsectors. EPA's contractor ERG created a statewide CDB for North Carolina and imported the growth factors provided by NCDAQ. ERG performed QA on the v2 submitted data by performing MOVES runs for each state with default information (baseline) and the

CDBs (comparison case) to check that the various tables were updated and that equipment populations changed according to expectation from the states' submittal documentation.

Table 5-6: Contents of the Nonroad Mobile supplemental folder

	File or Folder	Description
1	2014v1_NonroadCDBs.zip	Submitted CDBs used to run MOVES-NONROAD.
2	NonroadCDBs_2014v2_DE_GA_NC_20170824.zip	Submitted CDBs used to run MOVES-NONROAD updated for 2014v2
2	2014v1_nonroad_counties_nei2014v1_FinalList.xlsx	List of all counties and their CDBs.
3	2014v1_zonemonthhour2014.zip	Zonemonthhour table (meteorology data).
4	2014v1_NonroadRunspecs.zip 2014v2_Nonroad_Runspecs_DE_GA_NC.zip	Runspecs for all counties.
5	2014v1_NmimToMovesConversion.zip	Folder containing two subfolders corresponding to the two steps of the NMIM to MOVES conversion.
6	2014v1_NCD20160513_nei2014v1_nrextfiles.zip	The NONROAD files from the external files folder of NCD20160513_nei2014v1.
7	2014v1_postprocess_nrnei_20160523.jar	Post-processing scripts for MOVES runs.
8	2014v1_EICtoEPA_SCCmapping.xlsx	File mapping California emission inventory codes (EICs) to EPA SCCs.

5.6 Conversion of NMIM NCDs to MOVES CDBs

Conversion from NMIM NCDs to MOVES CDBs was done in two steps. First, the data packets in the NCD ASCII files were converted into intermediate MySQL tables with the same column headings. Second, the resulting MySQL tables were converted into MOVES tables and stored in the correct CDB.

The state- and county-specific custom data files that NONROAD2008 uses are text files that are stored in a folder called ExternalFiles within the NCD. It is these text files that the S/L/T agencies submit. The files are activity (hours per year by SCC and horsepower category), allocation files (allocation of equipment population from state to county level), growth, population, and seasonality (how equipment usage varies with season). These data files may be found in the NCD20160513_nei2014v1_nrextfiles folder in the online NRSupplementalData folder. All the NRSupplemental data and scripts are listed in Table 5-6. The NR external files contain one or more "packets" of data. Table 5-7 shows the data files and the packets they contain. These packets were converted by a Python program (ProcessNRTxtFiles.py) into Intermediate MySQL tables, as shown in Table 5-8.

Table 5-7: Conversion of NONROAD data files to MOVES tables

NR data file	NONROAD data file packet	Intermediate MySQL tables	MOVES tables
Pop	Population	Population*	nrbaseyearequippopulation
Act	Activity	Activity*	nrsourceusetype
Alo	Indicators	Allocation*	nrstatesurrogate
Grw	Indicators Growth Scrappage Alternate scrappage	Growthindicators Growth* Growthscrappage Growthaltscrappage	Nrgrowthindex
Sea	Regions Monthly Daily	Region Monthlyadjfactors* Dailyadjfactors*	 nrmonthallocation nrdayallocation

*These are the intermediate MySQL tables that were converted into MOVES tables by the scripts listed in Table 5-8.

Table 5-8: MySQL scripts to convert intermediate to MOVES tables

Script	Comment
GenerateMovesNr_activity.sql	If pop is provided
GenerateMovesNR_activity_nopop.sql	If pop is not provided
GenerateMovesNr_allocation.sql	
GenerateMovesNr_dailyadjfactors.sql	
GenerateMovesNr_growth.sql	Converts only the "Growth" packet
GenerateMovesNr_monthlyadjfactors.sql	
GenerateMovesNr_population.sql	

The intention was to convert all intermediate tables to MOVES tables, but time and resource limitations restricted us to the most important tables. Only Texas submitted NCDs for 2014.

5.7 MOVES runs

In the online NRSupplementalData folder, the Excel® file nonroad_counties_nei2014v1_FinalList.xlsx lists all 3,224 counties and their corresponding CDBs. If no CDB was listed for a county, that county was run with the MOVES default database for MOVES2014a (movesdb20151201). The NRSupplemental Data is listed in Table 5-6.

There were 16 unique state CDBs and 304 unique county CDBs from five states. We constructed the MOVES runspecs so that if a state CDB existed, it was included first, followed by a county CDB. There was only one county with both state and county CDBs. There were 16+304 = 320 CDBs used in the full MOVES-NONROAD run. The CDBs that were used are in nei2014v1_CDBs in the online NRSupplementatalData folder

MOVES was run for each county, using two runspecs: one for diesel equipment, which included horsepower output, and one for all other fuels without horsepower output. All the runspecs are in the NonroadRunspecs folder in the online NRSupplementatalData folder. The MOVES-NONROAD runs were checked for completeness and absence of error messages in the run logs. The output was post-processed to consolidate each county into a single database and to produce SMOKE-ready output. The scripts that performed these processes are in postprocess_nrnei_20160523.jar in the online NRSupplementatalData folder. The MOVES runs created monthly inventories for every U.S. county and post-processing was also done on these monthly outputs.

The following additional steps were taken on the monthly MOVES nonroad outputs to prepare data for loading into EIS:

1. The gas and particle components of PAHs (e.g., Chrysene, Fluorene) were combined.
2. The individual mercury species were combined into total mercury (i.e., pollutant 7439976).
3. Modes for exhaust and evaporative were removed from pollutant names and separated out into the emis_type data field in flat file 2010 files that were then loaded into EIS.
4. Pollutants produced by MOVES but not accepted in the NEI were removed (e.g., ethanol, NONHAPTOG, and total hydrocarbons).
5. Five speciated $PM_{2.5}$ species were added based on speciation profiles (i.e., elemental carbon, organic carbon, nitrate, sulfate and other $PM_{2.5}$). See Section 2.2.5.
6. DIESEL-PM10 and DIESEL-PM25 were added by copying the PM_{10} and $PM_{2.5}$ pollutants (respectively) as DIESEL-PM pollutants for all diesel SCCs. See Section 2.2.5.
7. Airport ground support equipment emissions were removed.
8. Oil and gas field equipment emissions were removed.

9. Bedford City, Virginia emissions were combined with Bedford County, Virginia emissions.
10. Incorporated California-submitted nonroad emissions.

5.8 NMIM Runs

For comparison purposes, NMIM was run using the NCD20160513_nei2014v1 database. We checked to ensure that no error messages were created during the runs for each geographical area. Furthermore, NMIM generates the same number of output records for each RunID-FIPSCountyID-FIPSStateID-Year-Month combination. Therefore, we confirmed that each output table included the correct number of records for this combination of fields. As with the MOVES runs, the NMIM runs were post-processed to produce monthly inventories for every U.S. county in SMOKE-ready format.

5.9 Quality Assurance: Comparison with NMIM

For the 2014NEIv1, we compared the MOVES-NONROAD results to the NMIM results. SO_2 was valuable as a comparison species because nearly zero differences in results were expected if activity inputs were the same. Thirty-nine states showed SO_2 differences less than 0.01 percent. Table 5-9 shows the fourteen states that had SO_2 differences greater than 0.01 percent.

Table 5-9: States with absolute percent difference (MOVES-NMIM) > 0.01% for SO_2 exhaust*

State FIPS Code	State	MOVES - NMIM % diff	2014 CDB	NCD
36	New York	-29.743%	X	
4	Arizona	-29.684%		
53	Washington	-24.787%	X	
37	North Carolina	-10.399%	X	
17	Illinois	-9.956%	X	
39	Ohio	7.696%		grw
2	Alaska	6.248%		
27	Minnesota	5.819%		grw
55	Wisconsin	5.145%		grw
26	Michigan	1.637%		grw
24	Maryland	1.376%		pop
48	Texas	-0.040%		grw
18	Indiana	-0.039%		grw
33	New Hampshire	-0.019%		pop

* Sorted in order of decreasing absolute difference

We investigated the reasons behind the larger observed SO_2 differences. The large differences for states that submitted CDBs (-10 percent to -30 percent, in Illinois, New York, North Carolina, and Washington) are attributed to those submittals. Submitted CDBs were expected to contain different data than NCD20160513_nei2014v1. Some states with differences of 2 percent to 8 percent (Michigan, Minnesota, Ohio, and Wisconsin) are attributed to NCD growth files that were only partially converted to CDBs. There are four data packets in the NONROAD growth file. Due to resource limitations, a conversion script was written for only one of them (see Section 5.6). The region packet in the seasonality file did not require conversion because in

MOVES, every state has its own seasonality, as defined in the nrmonthallocation table. The growth packets that were not converted for 2014NEIv1 will be converted for the 2014NEIv2.

A NCD for Pima County, Arizona, was submitted, which was used to produce the NMIM results. However, this NCD included allocation files with Pima County allocation surrogates set equal to the state total. The result was that all of the state's emissions were assigned to Pima county, while reasonable allocations were assigned to other counties. Because of this error, the MOVES run was performed without using data from the submittal. As a result, the differences between the MOVES-NONROAD and NMIM-based runs were nearly 30 percent.

In Alaska, between 2007 and 2008, three counties were eliminated and five new ones formed. The eliminated county FIPS codes were 02201, 02232, and 02280. The newly formed county FIPS codes were 02105, 02195, 02230, 02195, and 02198. The NMIM counties were correct, but produced zero emissions for the five new counties. Therefore, MOVES was 6 percent higher. The 24 Alaska counties for which NMIM produced SO_2 emissions agreed exactly with MOVES.

Comparing MOVES and NMIM for states with good agreement in SO_2 (Table 5-10) demonstrates differences due to effects other than activity. Differences in VOC and HAPs were expected since they are both post-processed from THC, and MOVES uses newer emission factor data than NMIM [ref 8]. The HAPs generally increased dramatically, which is reflected in the overall increase shown in the table (the sum of 52 species). NOx increased slightly and CO decreased slightly due to a change in the conversion factor of ethanol volume percent to oxygen weight percent from 0.3448 in NMIM [ref 9] to 0.3653 in MOVES. The direction and small size of these changes was expected. Overall, the changes in criteria air pollutants (CAPs) are small, and provide confidence that the transfer of NONROAD2008 from NMIM to MOVES was successful. We have examined the large changes in HAPs individually and confirmed that these changes agree with our updates.

In addition to the comparison of NMIM and MOVES, county plots of NOx, SO_2, and VOC for of 2014 MOVES were compared and reviewed, along with comparison plots and spreadsheets of 2014 NMIM versus 2011NEIv2. County plots of MOVES nonroad activity hours and population along with plots of NOx emissions per unit activity by nonroad category (agriculture, industrial, lawn and garden, etc) were also developed and reviewed.

Table 5-10: Comparison of NMIM to MOVES-NONROAD*

Pollutant Code	Pollutant Name	Percent Difference
CO	CO	-1.28%
CO2	CO2	0.98%
NH3	NH3	0.00%
NOX	NOx	0.34%
PM10-PRI	PM10-PRI	0.00%
PM25-PRI	PM25-PRI	0.00%
SO2	SO_2	0.00%
VOC	VOC	-1.68%
200	Mercury Elemental Gaseous	23.64%
201	Mercury Divalent Gaseous	14.58%
202	Mercury Particulate	2.02%
50000	Formaldehyde	103.17%
50328	Benzo(a)pyrene	1122.47%
53703	Dibenzo(a,h)anthracene	1383.69%
56553	Benz(a)anthracene	612.21%
71432	Benzene	26.70%

Pollutant Code	Pollutant Name	Percent Difference
75070	Acetaldehyde	63.19%
83329	Acenaphthene	675.35%
85018	Phenanthrene	702.97%
86737	Fluorene	494.41%
91203	Naphthalene	300.49%
100414	Ethyl Benzene	61.64%
100425	Styrene	182.84%
106990	1,3-Butadiene	61.39%
107028	Acrolein	306.56%
108883	Toluene	32.78%
110543	Hexane	31.90%
120127	Anthracene	419.28%
123386	Propionaldehyde	49.94%
129000	Pyrene	269.93%
191242	Benzo(g,h,i)perylene	841.48%
193395	Indeno(1,2,3,c,d)pyrene	1065.88%
205992	Benzo(b)fluoranthene	928.25%
206440	Fluoranthene	273.50%
207089	Benzo(k)fluoranthene	989.73%
208968	Acenaphthylene	574.35%
218019	Chrysene	777.29%
540841	2,2,4-Trimethylpentane	149.54%
1330207	Xylene	5.59%
1746016	2,3,7,8-Tetrachlorodibenzo-p-Dioxin	-96.58%
3268879	Octachlorodibenzo-p-dioxin	-100.00%
7439965	Manganese Compounds	-0.13%
7440020	Nickel Compounds	-4.50%
7440382	Arsenic Compounds	-84.51%
18540299	Chromium 6+	-97.18%
19408743	1,2,3,7,8,9-Hexachlorodibenzo-p-Dioxin	-99.93%
35822469	1,2,3,4,6,7,8-Heptachlorodibenzo-p-Dioxin	-99.99%
39001020	Octachlorodibenzofuran	-100.00%
39227286	1,2,3,4,7,8-Hexachlorodibenzo-p-Dioxin	-99.88%
40321764	1,2,3,7,8-Pentachlorodibenzo-p-Dioxin	-98.45%
51207319	2,3,7,8-Tetrachlorodibenzofuran	-99.01%
55673897	1,2,3,4,7,8,9-Heptachlorodibenzofuran	-99.98%
57117314	2,3,4,7,8-Pentachlorodibenzofuran	-98.72%
57117416	1,2,3,7,8-Pentachlorodibenzofuran	-99.76%
57117449	1,2,3,6,7,8-Hexachlorodibenzofuran	-99.67%
57653857	1,2,3,6,7,8-Hexachlorodibenzo-p-Dioxin	-99.31%
60851345	2,3,4,6,7,8-Hexachlorodibenzofuran	-99.81%
67562394	1,2,3,4,6,7,8-Heptachlorodibenzofuran	-99.94%

Pollutant Code	Pollutant Name	Percent Difference
70648269	1,2,3,4,7,8-Hexachlorodibenzofuran	-99.83%
72918219	1,2,3,7,8,9-Hexachlorodibenzofuran	-99.77%

* Differences from the 39 states for which SO_2 was within 0.01%. Positive values mean MOVES is larger.

5.10 Use of California Submitted Emissions

California submitted nonroad emissions for EPA's use in the NEI, and we used these emissions directly. Prior to preparing the emissions for submission, the California Air Resources Board (CARB) updated the mapping of their EICs to EPA's detailed SCCs used for emissions modeling that include the off network, on-network, and brake and tire wear categories. CARB provided their HAP and CAP emissions by county using these more detailed SCCs. The updated version of the mapping is posted with the supplemental data in the Excel file 2014v1_EICtoEPA_SCCmapping.xlsx. In addition, CO_2 data were added to the California data based on EPA estimates, because CO_2 emissions were not provided in the submission. We also speciated CARB total $PM_{2.5}$ and PM_{10} using the same approach as for other states (see Section 5.7) and copied the $PM_{2.5}$ and PM_{10} to DIESEL-PM "pollutants" for all diesel SCCs.

5.11 References for nonroad mobile

1. NONROAD2008, its documentation and technical reports can be found here: https://www.epa.gov/moves/nonroad-model-nonroad-engines-equipment-and-vehicles.
2. CARB's group of models for off-road equipment may be linked to from this site: https://www.arb.ca.gov/msei/categories.htm.
3. MOVES2014a, its default database, documentation and technical reports can be found here: https://www.epa.gov/moves/moves2014a-latest-version-motor-vehicle-emission-simulator-moves.
4. NMIM, its documentation and tech reports can be found here: https://www.epa.gov/moves/national-mobile-inventory-model-nmim.
5. Speciation Profiles and Toxic Emission Factors for Nonroad Engines, EPA-420-R-15-019, November 2015 (https://nepis.epa.gov/Exe/ZyPDF.cgi?Dockey=P100NOC7.pdf).
6. Lawrence Reichle, Rich Cook, Catherine Yanca, and Darrell Sonntag. Development of Organic Gas Exhaust Speciation Profiles for Nonroad Spark Ignition and Compression Ignition Engines and Equipment. 2015. *Journal of the Air and Waste Management Association*, 65: 1185-1193.
7. Detailed information on The Weather Research & Forecasting Model (WRF) may be found here: http://www.wrf-model.org/index.php and here: Skamarock, W.C., et al., National Center for Atmospheric Research, Mesoscale and Microscale Meteorology Division, Boulder CO, June 2008, NCAR/TN-475+STR, A Description of the Advanced Research WRF Version 3, http://www2.mmm.ucar.edu/wrf/users/docs/arw_v3.pdf.
8. Speciation of Total Organic Gas and Particulate Matter Emissions from On-road Vehicles in MOVES2014 (PDF) (75 pp, 1.2MB, EPA-420-R-15-022, November 2015). This document is available at https://nepis.epa.gov/Exe/ZyPDF.cgi?Dockey=P100NOJG.pdf.

9. *EPA's National Inventory Model (NMIM), A Consolidated Emissions Modeling System for MOBILE6 and NONROAD,* EPA420-R-05-024, December 2005. This document is available at https://nepis.epa.gov/Exe/ZyPDF.cgi?Dockey=P10023FZ.pdf.

6 Mobile Onroad – All Vehicles and Refueling

6.1 Sector description

Onroad mobile sources include emissions from motorized vehicles that are normally operated on public roadways. This includes passenger cars, motorcycles, minivans, sport-utility vehicles, light-duty trucks, heavy-duty trucks, and buses. The sector includes emissions generated from parking areas as well as emissions while the vehicles are moving. The sector also includes "hoteling" emissions, which refers to the time spent idling in a diesel long-haul combination truck during federally-mandated rest periods of long-haul trips.

The 2014 NEI is comprised of emission estimates calculated based on the MOVES model run with S/L/T-submitted activity data when provided, except for California and tribes, for which the NEI includes submitted emissions.

6.2 Important Changes in V2

The EPA made several substantial improvements in default data for v2 that include new 2014 vehicle populations and fleet characteristics, as well as new default vehicle speed distributions and relative hourly and day type VMT distributions at the local level from the CRC A-100 study [ref 1]. In addition, other changes in v2 included new CDB submittals (526 databases) and minor changes to the representative county groups based on the new 2014 age distribution data. Also new for v2, age distributions for representative county CDBs now reflect a population-weighted average of the member county age distributions. The major changes in default data are described in detail below, and the CDBs and representative county groups are discussed in Sections 6.5 and 6.8.2.1, respectively.

6.2.1 New 2014 Vehicle Populations and Fleet Characteristics

Version 2 uses updated 2014 vehicle populations, source type age distributions, and fuel type fractions created from data purchased from IHS Markit (IHS). Under contract with EPA, ERG purchased the mid-year 2014 vehicle registration database from IHS, which contains a county-level summary of all registered vehicles in the US. IHS retrieves its information from each state DMV, compiles it in-house, decodes the vehicle identification numbers (VINs), and assigns each record a MOVES source type code. The database IHS provided did not include VINs or identify individual vehicles, but rather provided a summary count of the population in each county by parameters including make, model, model year, gross vehicle weight (GVW) class, and other fields. In total, there were over 44 million records in the IHS database that identified 277 million vehicles registered in the US as of July 1, 2014. ERG analyzed and made minor changes to the database, then wrote a program to calculate county-level age distributions and fuel type fractions, to populate the MOVES CDB tables `SourceTypeAgeDistribution` and `AVFT` (i.e., Alternative Vehicle and Fuel Technologies), respectively [ref 2].

EPA used the IHS vehicle population data to create EPA default vehicle population data to be used for areas of the country for which source type populations were not provided in 2014 CDB submittals. In areas for which vehicle population data was provided, EPA still reapportioned the relative populations of cars vs. light-duty trucks (while retaining the magnitude of the light-duty vehicles from the submittals) using the county-specific information from the IHS data. In this way, car and light trucks are treated more consistently from state to state than in previous NEIs.

6.2.2 New Vehicle Speeds and VMT Distributions

The Coordinating Research Council sponsored the A-100 project to develop improved, local inputs of vehicle speeds and VMT distributions for use in MOVES and SMOKE based on vehicle telematics data. The CRC A-100 study concluded several interesting findings, including higher speeds for heavy trucks than light and medium vehicles in peak hours clear differences in speed profiles and VMT patterns across vehicle category and city. A sensitivity case study conducted as part of the CRC work showed an emissions impact of up to 9%, 5% and 14% in VOC, NOX, and PM2.5 respectively, for an annual average day with MOVES Inventory Mode. The emissions sensitivity showed much larger changes at the hourly level. Previous NEIs have used nationwide averages for these inputs in many counties, and v2 uses the MOVES-formatted tables `AvgSpeedDistribution,` `HourVMTFraction,` and `DayVMTFraction` in all CDBs except for New York, because they specifically requested that their submittal data be used instead of data from vehicle telematics. Several states reviewed the CRC A-100 data products specific to their counties and requested that EPA use the new data over their local data. In addition to updating CDBs, v2 also incorporates SMOKE input files based on the CRC A-100 hourly speeds and diurnal and weekly VMT temporal profiles.

6.3 Sources of data and selection hierarchy

The EPA calculated the onroad emissions for 2014 for all states using the most recently released version of MOVES, MOVES2014a (code version: 20151201, database version: movesdb20161117). The sources of MOVES input data vary by area, representing a mix of local data, past NEI data, and some MOVES defaults. More state and local agencies than ever before have submitted local input data for MOVES. The S/L/T agencies that submitted data for 2014 are listed below in Section 6.10. The EPA used programs within the Sparse Matrix Operator Kernel Emissions (SMOKE) modeling system that integrate with MOVES to generate the emission inventories in the lower 48 states for each hour of the year. These emissions are summed over all hours and across road types to develop the emissions for the NEI. For areas outside the continental U.S. (Alaska, Hawaii, Virgin Islands, and Puerto Rico), the EPA ran MOVES in *Inventory Mode* (rather than with SMOKE-MOVES) to directly estimate emissions[1]. For the state of California, the EPA used onroad emissions provided by California based on the EMFAC model.

As in past NEIs, the data selection hierarchy for 2014 favored local input data over default information. For areas that did not submit a MOVES CDB for this NEI, the EPA projected the corresponding CDB from the most recent version (2011 v2) from year 2011 to 2014. In all projected CDBs, the EPA updated the older 2011 vehicle miles travelled (VMT), population, and hoteling activity with new activity specific to 2014, described in Section 6.8.4.

6.4 California-submitted onroad emissions

California is the only state agency for which an onroad *emissions* submittal was used in the 2014 NEI v1 and these emissions are unchanged in v2. California uses their own emission model, EMFAC, which uses EICs instead of SCCs. The EPA and California worked together to develop a code mapping to better match EMFAC's EICs to EPA MOVES' detailed set of SCCs that distinguish between off-network and on-network and brake and tire wear emissions. This detail is needed for modeling but not for the NEI, because the NEI uses simplified/more aggregated SCCs than used in modeling. This code mapping is provided in "2014v1_EICtoEPA_SCCmapping.xlxs." California provided their CAP and HAP emissions by county using EPA SCCs after applying the mapping. The California-submitted emissions data provided CAPs (including NH_3), HAPs and methane, but did not include CO_2.

[1] More information on the Inventory Mode for MOVES2014a is available in the MOVES2014a User Guide.

Therefore, the 2014 NEI includes MOVES-based CO_2 estimates for California. There was one vehicle/fuel type combination included in the CARB data, gas intercity buses (first 6 digits of the SCC = 220141), that did not match to an SCC generated using MOVES, so we mapped it to gasoline single unit short-haul trucks (220152).

CARB estimates onroad refueling emissions outside of the EMFAC model; they provided these to the EPA, and we assigned them to the onroad refueling SCC 2201000062 (Mobile Sources**;** Highway Vehicles - Gasoline; Refueling; Total Spillage and Displacement). The two EIC codes mapped to this SCC are: EIC 33037811000000 (Petroleum Marketing / Vehicle Refueling – Vapor Displacement Losses / Gasoline (Unspecified)) and EIC 33038011000000 (Petroleum Marketing / Vehicle Refueling – Spillage / Gasoline (Unspecified)).

6.5 Agency-submitted MOVES inputs

Many state and local agencies provided county-level MOVES inputs in the form of CDBs. This established format requirement enables the EPA to more efficiently scan for errors and manage input datasets. The EPA screened all submitted data using several quality assurance scripts that analyze the individual tables in each CDB to look for missing or unrealistic data values.

6.5.1 Overview of MOVES input submissions

State and local agencies prepare complete sets of MOVES input data in the form of one CDB per county. One way agencies can ensure a correctly-formatted CDB is to use the MOVES graphical user interface (GUI) county data manger (CDM) importer. With a proper template created for a single county, a larger set of counties (e.g., statewide) can be updated systematically with county-specific information if the preparer has well-organized county data and familiarity with MySQL queries. However, there is no requirement of MySQL experience to prepare the NEI submittal because the user can instead rely on the CDM to help build the individual CDBs one at a time. Table 6-1 lists each table in a CDB and describes its content or purpose. Note that several of the tables are optional, which means that they may be left blank without consequence to a MOVES run's completeness of results. If an optional CDB table is populated, the data override MOVES internal calculations and produce a different result that may better represent local conditions.

Table 6-1: MOVES2014a CDB tables

Table Name	**Description of Content**
Auditlog	Information about the creation of the database
Avft	Fuel type fractions
avgspeeddistribution	Average speed distributions
County	Description of the county
Countyyear	Description of the Stage 2 refueling control program
Dayvmtfraction	Fractions to distribute VMT between day types
Fuelformulation	Fuel properties
Fuelsupply	Fuel differences by month of year
fuelusagefraction	Fraction of the time that E85 vs. gasoline is used in flex-fuel engine vehicles
hotellingactivitydistribution	***Optional table*** – fraction of hoteling hours in which the power source is the main engine, diesel APU, electric APU, or engine-off
Hotellinghours	***Optional table*** – total hoteling hours
hourvmtfraction	Fractions to distribute VMT across hours in a day

Table Name	Description of Content
hpmsvtypeday	VMT input by HPMS vehicle group, month, and day type (1 of 4 options)
hpmsvtypeyear	VMT input by HPMS vehicle group, as annual total (2 of 4 options)
imcoverage	Description of the inspection and maintenance program
importstartsopmodedistribution	***Optional table*** – engine soak distributions
monthvmtfraction	Fractions to distribute VMT across 12 months of the year
roadtype	***Optional table*** – fraction of highway driving time spent on ramps
roadtypedistribution	Fractions to distribute VMT across the road types
sourcetypeagedistribution	Distribution of vehicle population by age
sourcetypedayvmt	VMT input by source use type, month, and day type (3 of 4 options)
sourcetypeyear	Vehicle populations
sourcetypeyearvmt	VMT input by source use type, as annual total (4 of 4 options)
starts	***Optional table*** – starts activity, replacing the MOVES-generated starts table
startshourfraction	***Optional table*** – fractions to distribute starts across hours in a day
startsmonthadjust	***Optional table*** – fractions to vary the vehicle starts by month of year
startsperday	***Optional table*** – total number of starts in a day
startssourcetypefraction	***Optional table*** – fractions to distribute starts among MOVES source types
state	Description of the state
year	Year of the database
zone	Allocations of starts, extended idle and vehicle hours parked to the county
zonemonthhour	Temperature and relative humidity values
zoneroadtype	Allocation of source hours operating to the county
emissionratebyage	Implementation of California standards [not normally part of a CDB but included for NEI because state-specific data is applicable]

S/L/T agencies submitted a total of 1,815 CDBs for the 2014 v1 and they submitted one new CDB and updated 525 of the v1 submittals, for a total of 1,816 CDBs for use in v2. Previously for the 2011 NEI, the number of submitted CDBs totaled 1,363 and 1,426 in v1 and v2, respectively. Agencies submitting data through the EIS, provided completed CDBs (i.e., each required table populated), along with documentation and a submission checklist indicating which of the CDB tables contained local data. Table 6-2 summarizes these submission checklists, showing the number of counties within each submittal for which the information was local data, as opposed to a default. Empty slots in the table indicate that the state or county did not provide local data for that particular CDB table. The grand totals of counties across all states show that VMT and population (found in the 'HPMSVtypeYear' and 'SourceTypeYear' tables, respectively) were the most commonly provided local data types.

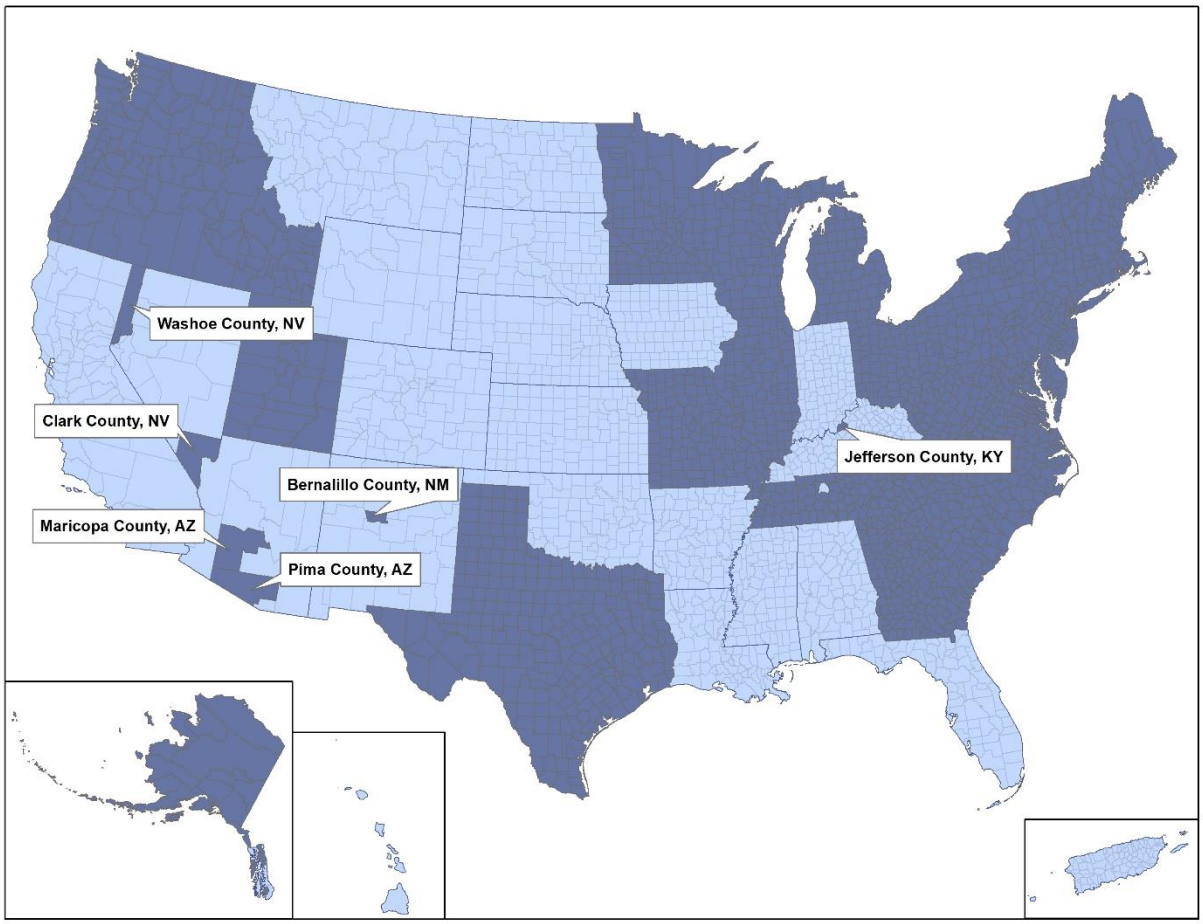
Figure 6-1 shows the geographic coverage of CDB submissions where the state or local agency submitted data that was used for at least one table (dark blue). The light blue areas are counties for which the CDBs were developed by EPA based on the 2011 v2 NEI.

Table 6-2: Number of counties with submitted data, by state and key MOVES CDB table

State/County	avft	avgspeeddistribution	countyyear	dayvmtfraction	emissionratebyage	fuelformulation	fuelsupply	fuelusagefraction	hotellingactivitydistribution	hotellinghours	hourvmtfraction	hpmsvtypeyear	imcoverage	Monthvmtfraction	onroadretrofit	roadtype	roadtypedistribution	sourcetypeagedistribution	sourcetypedayvmt	sourcetypeyear	starts	startsperday
Alaska	29											29	1				29	29		29		
Arizona (Maricopa)	1	1	1	1		1	1				1	1	1	1			1	1		1		
Arizona (Pima)	1	1		1							1	1	1	1			1	1		1		
Connecticut	8	8	8	8	8	8	8	8	8	8	8	8	8	8			8	8		8		
Delaware	3		3		3	3	3	3	3	3		3			3						3	3
District of Columbia		1		1							1	1	1	1			1	1		1		
Georgia		24	13	159							24	159	13	159			159	159		159		20
Idaho	44	44		44				44			44	44	2	44			44	44		44		
Illinois		102	10	102		10	10	10			10	102	11	102			102	102		102		
Kentucky (Jefferson)	1	1										1	1				1	1		1		
Maine		16		16		16	16	16			16	16	1	16			16	16		16		
Maryland	24	24	24	24	24	24	24	24			24	24	24	24			24	24		24		
Massachusetts	14	14		14	14	14	14	14	14	14	14	14		14	14					14	14	14
Michigan	7	83		83		7	7	7			83	83	83	83			83	83		83		
Minnesota		87		87							87	87		87			87	87		87		
Missouri	11											115	5					115		115		
Nevada (Clark)											1	1	1	1			1	1		1		
Nevada (Washoe)		1		1		1	1	1			1		1				1	1	1			
New Hampshire			10									10					10	10		10		
New Jersey	21	21	21	21		21	21	21	21	21	21	21	21	21	21		21	21		21		
New Mexico												1						1		1		
New York	62	62	62	62		62	62	62	62	62	62	62	62	62			62	62		62		
North Carolina		20				1	1				20	100	48				100	100		100		

State/County	avft	avgspeeddistribution	countyyear	dayvmtfraction	emissionratebyage	fuelformulation	fuelsupply	fuelusagefraction	hotellingactivitydistribution	hotellinghours	hourvmtfraction	hpmsvtypeyear	imcoverage	Monthvmtfraction	onroadretrofit	roadtype	roadtypedistribution	sourcetypeagedistribution	sourcetypedayvmt	sourcetypeyear	starts	startsperday
Ohio	88	88	88	88		1	1	88			88	88	14	88			88	88		88		
Oregon			36				36			36		36	6					36		36		
Pennsylvania		67		67	67	67	67	67			67	67	67	67			67	67		67		
Rhode Island				5							5	5	5	5			5	5		5		
South Carolina												46					46			46		
Tennessee	1	1		1	1	1	1	1	1	1	1	1	1	1	1		1	1		1	1	1
Tennessee (Knox)		1		1							1	1		1			1	1		1		
Tennessee (Memphis)	1			1							1	1		1			1	1		1		
Tennessee				91							91	91		91			91	91		91		
Texas	25	254	25	254		25	25		25	25	25	254	25	254		25	254	254		254	25	
Utah	29	29										29	29			29	29	29		29		
Vermont	14											14	14	14				14		14		
Virginia			17				13					134	10	134			134	134		134		
Washington	1			39			1	1			39	39	5	39			39	39		39		
West Virginia												55		55			55	55		55		
Wisconsin		72	9								7	72	7				72	72		72		
Total	**70**	**100**	**64**	**106**	**11**	**56**	**73**	**44**	**36**	**39**	**95**	**181**	**68**	**126**	**39**	**28**	**161**	**175**	**1**	**181**	**27**	**38**

Figure 6-1: Counties for which agencies submitted local data for at least 1 CDB table



6.5.2 QA checks on MOVES CDB Tables

The EPA used two separate quality assurance scripts to scan submitted CDBs and flag potential data errors. The scripts report the potential errors by compiling a list into a summary quality assurance database table. The list of potential errors includes the CDB name, table name, a numeric error code, and in some cases the suspect data value or sum of values that caused the script to flag the particular table. EPA reviewed all of the potential errors, identified which ones needed to be addressed, and then coordinated with the responsible state/local agency to clarify whether the data were correct or needed revision.

The first quality assurance script is one that the EPA updates for each version of the NEI for which states are asked to submit CDBs through the EIS. This script was designed to catch errors that would cause MOVES to fail during a run. The second script was designed to catch unreasonable data values that wouldn't necessarily cause MOVES to fail, but could cause it to produce unreasonable model outputs. Examples of suspected unreasonable values include (a) a mix of vehicle type population or VMT that shows more heavy-duty (HD) vehicles or VMT than shown for light-duty (LD), (b) age distributions that are skewed to older vehicles rather than newer, or (c) atypical VMT temporal patterns such as higher VMT in winter than summer or higher VMT overnight than during daytime.

Nearly 90 percent of the submitted 1,815 CDBs in v1 required at least one update due to missing or incorrect data, incorrect table formatting, or excess data (more than required), which was removed prior to use. The missing or incorrect data included the following problems:

- Missing age distributions for some HD source types (most commonly buses)
- Age distribution for some source types not summing to 1 (e.g., 0.93 or 3.5)
- Negative values in the Hoteling Activity Distribution table
- Missing weekend (day type 2) activity across one or more CDB tables: VMT (via the `SourceTypeDayVMT` table), average speed distributions, hourly VMT fractions, and/or starts per day
- Completely empty or missing source types in the Hour, Day, or Month VMT fractions
- Old inspection and maintenance (I/M) programs included as active, but known to have previously ended
- Incorrect year (e.g., 2013, but should be 2014) in the population table
- Fleet mix too large for HD vehicles (e.g., combination truck population 100 times larger than that of passenger cars)
- All freeways in a state have zero ramps

Nearly 50 percent of the new submitted 526 CDBs for v2 required a correction in order for MOVES to be able to use the database. The following problems were addressed:

- Wrong year listed in one or more tables
- Duplicate entries in the HPMSVtypeYear table
- IMCoverage table covered gasoline but not flex-fuel vehicles
- RoadType table structure not compatible with MOVES2014a
- Expected VMT tables required for MOVES2014a (SourceTypeDayVMT, SourceTypeYearVMT, and HPMSVtypeDay) were missing

The EPA resolved each of the above data problems by coordinating with state/local agencies individually. In some cases, the agency preferred to submit a corrected CDB, which the EPA contractor reviewed again to verify the intended correction. In other cases, the agency provided the EPA with instructions for a "spot correction" to a table or simply accepted the EPA's proposed update. ERG also corrected formatting problems with the database tables. In some cases, tables had missing data fields and/or table keys; the missing fields did not house important content, but their presence is required for MOVES2014a to run. One state's table formatting problems were so widespread that we rebuilt the states' databases using a template MOVES CDB and filled them with the content from the submittal. We also removed the following unnecessary, excess data content from several tables in several states' submissions:

- 2011 entries for vehicle population, age distribution, and year tables (presumably carried over from 2011 NEI, presented in addition to 2014 data).
- Invalid input road types in the `roadType` CDB table including road types 6, 7, 8, 9 (associated with separating ramps from freeways) and 100 (associated with the MOVES nonroad model) generated by the County Data Manager template.

6.6 Tribal Emissions Submittals

Tribal onroad emissions were submitted and used in the 2014 NEI v1 and these emissions are unchanged in v2. The submitting tribal agencies are listed in Table 6-3.

Table 6-3: Tribes that Submitted Onroad Mobile Emissions Estimates for the 2014NEI

Coeur dAlene Tribe
Kootenai Tribe of Idaho
Morongo Band of Cahuilla Mission Indians of the Morongo Reservation, California
Nez Perce Tribe
Northern Cheyenne Tribe
Shoshone-Bannock Tribes of the Fort Hall Reservation of Idaho

6.7 EPA default MOVES inputs

6.7.1 Sources of default data by MOVES CDB table

The EPA used 2014 v1 CDBs for counties where agencies did not submit them for v2. The EPA developed new 2014 estimates of VMT, vehicle population, and hoteling at the county- and SCC-level for use in the subsequent SMOKE-MOVES processing step. In the CDBs, we used these v2 activity estimates for 2014 to overwrite any default data. States and counties with CDBs that included 2014 EPA-generated activity and projected CDBs are those indicated by light blue shading in Figure 6-1. Table 6-4 below lists the sources of default information by MOVES CDB table. The spreadsheet 2014NEIV2_Plans_for_CDB_Input_Data_07072017b.xls provides specific information about where state-supplied data were used versus default data. Additional detail on processing steps in the IHS data to create `AVFT` and `SourceTypeAgeDistribution` is provided below Table 6-4.

Table 6-4: Source of defaults for key data tables in MOVES CDBs

CDB Table	**Default content for 2014 NEI v2**
avft	2014 IHS data
avgspeeddistribution	CRC A-100 study
dayvmtfraction	CRC A-100 study
fuelformulation	Based on EPA estimates for each county from 2014 refinery data
fuelsupply	Based on EPA estimates for each county from 2014 refinery data
fuelusagefraction	MOVES2014a default E85 usage
hotellingactivitydistribution	MOVES2014a default APU vs. Main Engine fractions
hotellinghours	2014 EPA estimates of hoteling based on 2014 VMT
hourvmtfraction	CRC A-100 study
hpmsvtypeday	Empty by default
hpmsvtypeyear	Empty by default
imcoverage	2014 NEI v1
importstartsopmodedistribution	Empty by default
monthvmtfraction	2014 NEI v1
roadtype	2014 NEI v1

CDB Table	Default content for 2014 NEI v2
roadtypedistribution	EPA estimates based on FHWA
sourcetypeagedistribution	2014 IHS data
sourcetypedayvmt	Empty by default
sourcetypeyear	2014 IHS data, with EPA modification
sourcetypeyearvmt	2014 EPA estimates of VMT based on FHWA data and 2014 IHS data
starts	Empty by default
startshourfraction	Empty by default
startsmonthadjust	Empty by default
startsperday	Empty by default
startssourcetypefraction	Empty by default
zonemonthhour	2014 meteorology data averaged by county
emissionratebyage	The `emissionratebyage` tables for some counties were populated using appropriate data described in the guidance for states adopting California emission standards

Preparation of `AVFT` and `SourceTypeAgeDistribution` CDB Tables

As mentioned above in Section 6.2.1, national vehicle population data from IHS were used to derive updated `SourceTypeAgeDistribution` and the alternative vehicle fuel type `AVFT` tables in the CDBs. The IHS data provided county-specific vehicle counts by source type, fuel type, and model year. From these data, two sets of `SourceTypeAgeDistribution` and `AVFT` tables were generated: one set with unique distributions calculated independently for each county, and another set with distributions population-weighted over the v2 representative county groups. The grouped tables were used in the representative CDBs seeded for running MOVES in emission factor mode. The individual county tables were used in the full set of CDBs that are unseeded and appropriate for running MOVES in inventory mode. Both sets of age distribution tables are provided in .csv form with the 2014NEIv2 onroad supporting data (see Table 6-7). More discussion on database seeding can be found in Sections 6.8.6 and 6.8.7

The IHS data did not contain vehicle counts for every possible source type and county combination, so some gap filling was necessary. Data for *sourceTypeID* 41 (Intercity Bus) were not reliably distinguishable from *sourceTypeID* 42 (Transit Bus) in the IHS data, so we used a county-specific bus age distribution to represent these two bus types for each county. Similarly, source types 52 and 53 (single unit trucks) could not be distinguished, nor could source types 61 and 62. We also calculated national averages for the long-haul source types 53 (Single Unit Long-haul Truck) and 62 (Combination Unit Long-haul Truck) because these vehicles tend to operate regionally or nationally rather than in their county of registration. Missing *countyID/sourceTypeID* combinations were filled using national averages for the *sourceTypeID*. In summary, the following averaging for age distribution was performed:

- Source type 53 (single unit long-haul) and 62 (combination long-haul) age distributions use the IHS national average

- All other source types (11,21,31,32,41,42,43,51,52,54,61) are population-weighted averaged over rep county group
- Source type 41 and 42 have the same age distribution for any given area (because IHS could not reliably distinguish between Intercity vs. Transit Buses)
- Some county groups had missing age distribution for a source type due to no registered vehicles. This happened only for Refuse Trucks (51) and non-school buses (41/42). Where there were no registered vehicles in a county group, the IHS national average age distribution for the source type was used.

The MOVES `AVFT` table defines the fraction of vehicles of a specific fuel type (e.g., gasoline, diesel ethanol-85, electric) for a given source type and model year; the *fuelEngFraction* sums to one for each unique *sourceTypeID/modelYearID* combination. The `AVFT` table fuel type fractions for each county were calculated in a similar manner to the `SourceTypeAgeDistribution` table: the population for each unique *sourceTypeID, modelYearID*, *fuelTypeID*, and *engTechID* combination was divided by the total population for that source type and model year. While light-duty electric vehicles are included in the AVFT table, heavy-duty electric vehicles were not because those combinations are not allowable in MOVES. In addition, any heavy duty E85 and CNG fractions were re-mapped to gasoline vehicles.

For MOVES compatibility, the `AVFT` distributions for certain source type IDs (Intercity Bus and Combination Unit Long-haul Truck) were set to 100% diesel even though other fuel types were present in the IHS data.

EPA's preference was to use the IHS-derived age distributions everywhere unless state agencies opted out. Four states preferred to use their submitted data for the `SourceTypeAgeDistribution` and/or `AVFT` tables submitted for the NEI. Georgia, New Jersey, New York and Ohio CDBs retained the submitted `SourceTypeAgeDistribution` tables and New York retained its submitted `AVFT` tables. The only change to these four states' data was to population-weight the distributions over v2 county groups.

After the `AVFT` tables were created as described above, a final gap filling step was performed to ensure that each existing *sourceTypeID* and *modelYearID* combination with data had listed all allowable *fuelTypeIDs* for MOVES (populated with zeros, rather than missing from the table), which prevents the model from supplementing a CDB `AVFT` distribution that already summed to 1 with model default values. Both the grouped and county-specific age distribution tables are provided in .csv form with the 2014NEIv2 onroad supporting data (see Table 6-7).

6.7.2 Default California emission standards

The EPA populated an alternative MOVES database table 'EmissionRateByAge' in the CDBs for some counties in the states that have adopted emission standards from California's Low Emission Vehicle (LEV) program. Table 6-5 shows which states adopted the California standards and the year the program began in each state. We developed these tables to be consistent with the EPA guidance for LEV modeling provided on the EPA web site [ref 3].

Table 6-5: States adopting California LEV standards and start year

FIPS State ID	State Name	LEV Program Start Year
06	California	1994
09	Connecticut	2008
10	Delaware	2014
23	Maine	2001
24	Maryland	2011
25	Massachusetts	1995
34	New Jersey	2009
36	New York	1996
41	Oregon	2009
42	Pennsylvania	2008
44	Rhode Island	2008
50	Vermont	2000
53	Washington	2009

6.8 Calculation of EPA Emissions

6.8.1 EPA-developed onroad emissions data for the continental U.S.

For the 2014 NEI, the EPA estimated emissions for every county. For the continental U.S., the EPA used county-specific inputs and programs that integrate inputs and outputs for the MOVES model with the SMOKE modeling system (i.e., SMOKE-MOVES) to take advantage of the gridded hourly temperature information available from meteorology modeling used for air quality modeling. This set of programs was developed by the EPA and also is used by states and regional planning organizations to compute onroad mobile source emissions for regional air quality modeling. SMOKE-MOVES requires emission rate "lookup" tables generated by MOVES that differentiate emissions by process (running, start, vapor venting, etc.), vehicle type, road type, temperature, speed, hour of day, etc.

To generate the MOVES emission rates for counties in each state across the U.S., the EPA used an automated process to run MOVES to produce emission factors by temperature and speed for a set of "representative counties," to which every other county could be mapped, as detailed below. Using the calculated MOVES emission rates, SMOKE selected appropriate emissions rates for each county, hourly temperature, SCC, and speed bin and multiplied the emission rate by activity (VMT, vehicle population, or hoteling hours) to produce emissions. These calculations were done for every county, grid cell, and hour in the continental U.S. and aggregated by county and SCC for use in the 2014 NEI. The MOVES "RunSpec" files (that provide MOVES input data for each representative county) are provided in the supplementary materials (see Table 6-7 for access information).

The EPA used a different approach for states and territories outside the lower 48 states. For Alaska, the EPA ran MOVES in Inventory Mode, during which MOVES computes the emissions instead of emission rates, for every county and month, using county-specific inputs and meteorological data. For Hawaii, Puerto Rico and the Virgin Islands, MOVES was run in Inventory Mode for the months of January and

August, with the months of May through September using the August emissions and the other months using January emissions. More information is provided Section 6.8.10.

SMOKE-MOVES tools are incorporated into recent versions of SMOKE and can be used with different versions of the MOVES model. For the 2014 NEI, the EPA used the latest publically released version: MOVES2014a (version 20151201) [ref 4]. Creating the NEI onroad mobile source emissions with SMOKE-MOVES requires numerous steps, as described in the sections below:

- Determine which counties will be used to represent other counties in the MOVES runs (see Section 6.8.2.1)
- Determine which months will be used to represent other month's fuel characteristics (see Section 6.8.2.2)
- Create MOVES inputs needed only for the MOVES runs (see Section 6.6). For example, MOVES requires county-specific information on age distributions and inspection-maintenance programs for each of the representative counties.
- Create inputs needed both by MOVES and by SMOKE, including a list of temperatures and activity data (see Section 6.8.4)
- Run MOVES to create emission factor tables (see Section 6.8.8)
- Run SMOKE to apply the emission factors to activity data to calculate emissions (see Section 6.8.9)
- Aggregate the results at the county-SCC level for the NEI, summaries, and quality assurance (see Section 6.8.11)

Some things to note about the 2014 NEI that are different from the **2011 NEI v2** are:

- Manganese/7439965 now includes the brake and tire contribution, whereas in 2011 NEI v2, manganese did not include brake and tire contributions.
- Gasoline with 85 percent ethanol (E85) was tracked as a separate fuel in the 2014 NEI v1, while in the 2011 NEI v2, it was combined with regular gasoline.
- Five speciated $PM_{2.5}$ species were added based on speciation profiles (i.e., elemental carbon, organic carbon, nitrate, sulfate and other $PM_{2.5}$). See Section 2.2.5.
- DIESEL-PM10 and DIESEL-PM25 were added by copying the PM_{10} and $PM_{2.5}$ pollutants (respectively) as DIESEL-PM pollutants for all diesel SCCs. See Section 2.2.5.
- Brake and tire PM was tracked separately from exhaust processes, although all non-refueling processes were combined into broader SCCs prior to loading into EIS.
- For Colorado, refueling emissions were removed from all counties for which Colorado reported refueling in the point source data category.

6.8.2 Representative counties and fuel months

6.8.2.1 *Representative counties*

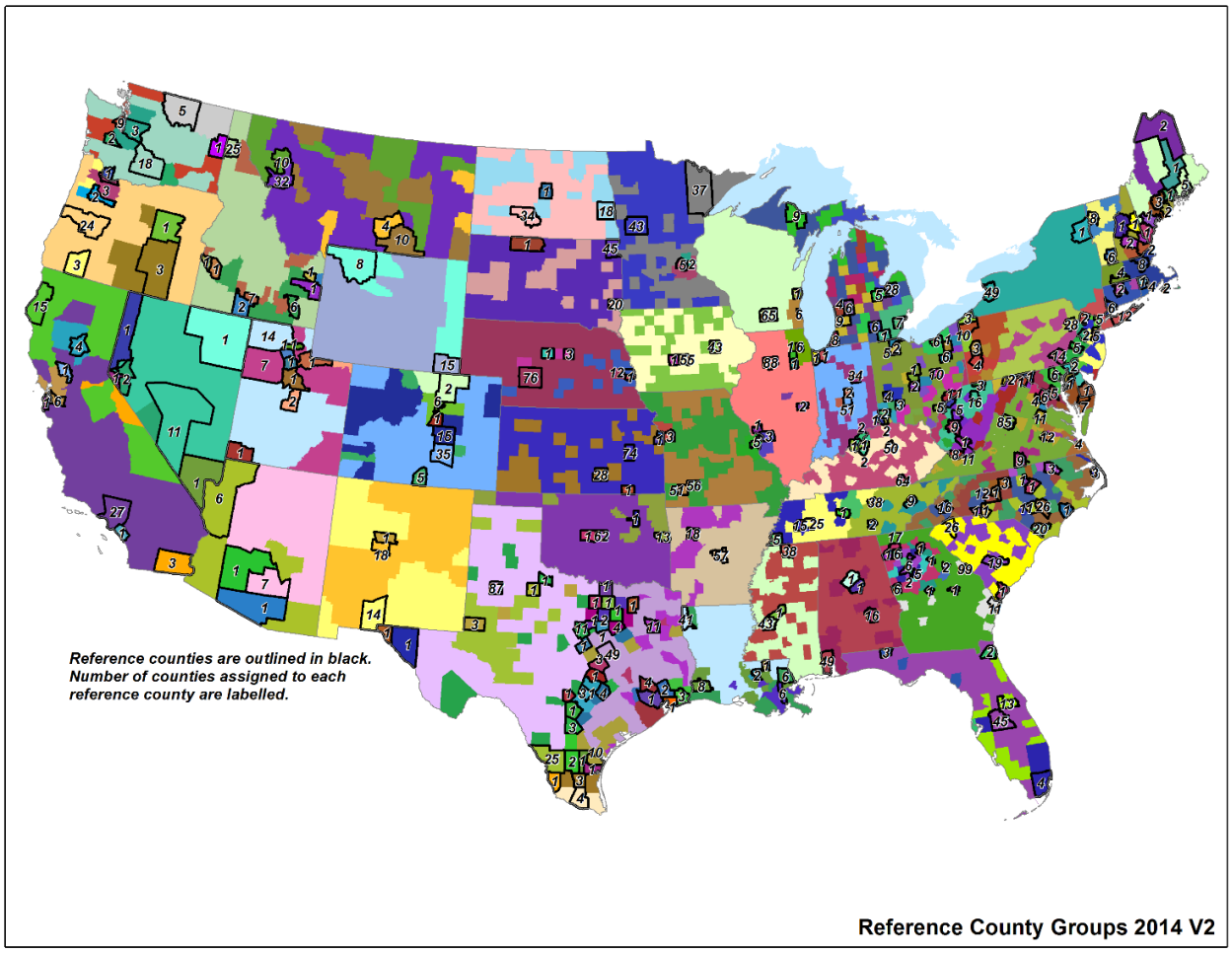
Although the EPA develops a CDB for each county in the nation, only a subset of these were run with MOVES based on an assumption that most of the important emissions-determining differences among counties can be accounted for by assigning counties to groups with similar properties such as fleet age, a shared I/M program, and shared fuel controls (e.g., low RVP for summer gasoline). The county used to

provide emission rates to other counties is called the "representative county." This approach of running MOVES for representative counties reduces computation time by reducing the number of MOVES runs to generate a nationwide inventory. The MCXREF file listed in Table 6-6 provides the mapping of each county to its representative county. Usually the same MCXREF file is used for all MOVES processes. However, the emission factors for hoteling Ramsey County, Minnesota were discovered to be zero late in the process of creating 2014NEIv2. To address this issue, Anoka and Ramsey County, MN were mapped to use hoteling emission factors from Hennepin County, MN. This additional MCXREF file is listed in Table 6-6 and was only used for hoteling emissions processes.

In the SMOKE-MOVES framework, temperature- and speed-specific data from the emission factor lookup tables generated for the representative counties are multiplied with the county-level activity data for all counties within the corresponding county group. The activity data specific to individual counties in the inventory includes VMT, vehicle population, hoteling hours, and hourly speeds.

The EPA used the 2014 age distributions derived from IHS data to re-evaluate the v1 representative county groups and as a result, added 12 new representative counties for v2. In general, we desired to keep the county groups as similar as possible between v1 and v2. However, we also wanted to ensure that the introduction of new vehicle age data would be reflected in the representative county emission factors appropriately. In some cases, we split v1 county groups when the average age of light-duty vehicles in particular counties was significantly newer or older than vehicle age the rest of the counties in the group. We performed the analysis by first calculating the average age of light duty (LD) vehicles in each county, where LD included the three source types passenger car, passenger truck, and light commercial truck. The average age was then assigned a bin number 1 through 6 according to the following six ranges of 0-7 years old, 7-9, 9-11, 11-13, 13-15, and more than 15 years old. Next, we examined the spread of age bins within the existing v1 county groups. For counties whose age bin became a non-neighboring bin (at least 2 bins away) from the v1 age bin of the group, we moved the county out. For example, if a representative county group was age bin 3 in v1, and the new data resulted in LD average ages of bin 3-6, then bin 3 and 4 were left in the v1 group, and 5 and 6 formed a new county group. Figure 6-2 displays a map of the representative counties by state and their corresponding county groups. The MCXREF file listed in Table 6-7 provides the mapping of each specific county to its representative county.

Figure 6-2: Representative county groups for the 2014 NEI



6.8.2.2 *Fuel Months*

A "fuel month" indicates when a particular set of fuel properties should be used in a MOVES simulation. Similar to the representative county, the fuel month reduces the computational time of MOVES by using a single month to represent a set of months during which a specific fuel has been used in a representative county. Because there are winter fuels and summer fuels, the EPA used January to represent October through April and July to represent May through September. For example, if the grams/mile exhaust emission rates in January are identical to February's rates for a given representative county, and temperature (as well as other factors), then we use a single fuel month to represent January and February. In other words, only one of the months needs to be modeled through MOVES to obtain the necessary emission factors. The hour-specific VMT, temperature and other factors for February are still used to calculate emissions in February, but the emission factors themselves do not need to be created, since one month can sufficiently represent the other month. The fuel months used for each representative county are provided in the MFMREF file in the supplementary materials (see Table 6-7 for access information).

6.8.2.3 *Fuels*

Although state/local-submitted CDBs may have included information about fuel properties, this fuel information was replaced for the MOVES runs for the 2014 NEI v2 using fuel properties developed for a set of fuel regions that was generated by the EPA in July, 2017 for 2014 NEI v2 (moves201x_2014fuels). The EPA developed these data using a combination of purchased fuel survey data, proprietary fuel refinery information and known federal and local regulatory constraints. Our past analyses of state/local-submitted fuel information has led us to conclude that our replacement of the data is more accurate and the best way to treat all parts of the country consistently with respect to fuel use and the fuel impacts on emission rates. The updated fuel information used for the 2014 NEI v2 for calendar year 2014 will be reflected in future versions of the MOVES model.

The steps used to determine the fuel properties in each fuel region are as follows:

1. Fuel properties from proprietary refinery certification data were compiled on a regional basis (based on typical pipeline delivery areas).
2. Properties within a region for finished fuel batches (e.g., no conventional blendstock for oxygenate blending (CBOB), reformulated blendstock for oxygenate blending (RBOB) or oxygen backout (OBO) fuel batches) produced in 2010, excluding reformulated gasoline (RFG), were averaged to generate non-ethanol conventional gasoline fuel properties within that region, for a given month.
3. RFG fuel properties were based on RFG fuel compliance survey data, and oxygenate levels were assumed to be 10 percent ethanol (E10, no MTBE).
4. Refinery modeling results generated for the Renewable Fuel Standard were used to adjust the regional conventional gasoline fuel properties to account for ethanol blending up to E10, for a given month.
5. Additional adjustments to fuel properties were performed on individual counties within a region, based on refinery modeling, for known local regulatory constraints such as low-RVP or oxygenate level mandates.
6. Appropriate E10 and conventional gasoline fuel market shares were calculated on a regional basis for the level of ethanol produced in 2014, after ethanol required for RFG compliance was taken into account.
7. Gasoline fuel properties and ethanol market shares were applied to each county regionally and accounting for known local regulatory constraints.
8. Diesel properties were assumed to be 15 parts per million nationally with no significant biodiesel penetration.

The regional fuel supply database used for the 2014 NEI v2 is an external MOVES database called moves201x_2014fuels available for download with the modeling platform (see Section 6.10). A detailed description of the development of the default national fuel supply is provided in the documentation for the MOVES model and on the MOVES Technical Reports webpage [ref 5].

6.8.3 Temperature and humidity

Ambient temperature can have a large impact on emissions. Low temperatures are associated with high start emissions for many pollutants. High temperatures and high relative humidity are associated with

greater running emissions due to the increase in the heat index and resulting higher engine load for air conditioning. High temperatures also are associated with higher evaporative emissions.

The 12-km gridded meteorological input data for the entire year of 2014 covering the continental U.S. were derived from simulations of version 3.4 of the Weather Research and Forecasting Model (WRF), Advanced Research WRF core [ref 6]. The WRF Model is a mesoscale numerical weather prediction system developed for both operational forecasting and atmospheric research applications. The Meteorology-Chemistry Interface Processor (MCIP) [ref 7] was used as the software for maintaining dynamic consistency between the meteorological model, the emissions model, and air quality chemistry model.

The EPA applied the SMOKE program Met4moves [ref 8] to the gridded, hourly meteorological data (output from MCIP version 4.3) to generate a list of the maximum temperature ranges, average relative humidity, and temperature profiles that are needed for MOVES to create the emission-factor lookup tables. "Temperature profiles" are arrays of 24 temperatures that describe how temperatures change over a day, and they are used by MOVES to estimate vapor venting emissions. The hourly gridded meteorological data (output from MCIP) was also used directly by SMOKE (see Section 6.8.9).

The temperature lists were organized based on the representative counties and fuel months as described in Section 6.8.2. Temperatures were analyzed for all of the counties that are mapped to the representative counties, i.e., for the county groups, and for all the months that were mapped to the fuel months. The EPA used Met4moves to determine the minimum and maximum temperatures in a county group for the January fuel month and for the July fuel month, and the minimum and maximum temperatures for each hour of the day. Met4moves also generated temperature profiles using the minimum and maximum temperatures and 10 °F intervals. In addition to the meteorological data, the representative counties and the fuel months, Met4moves uses spatial surrogates to determine which grid cells from the meteorological data have roads and uses the WRF temperature and relative humidity data from those areas. For example, if a county had a mountainous area with no roads, the grid cells with no roads would be excluded from the meteorological processing. We updated the spatial surrogates used for the 2014 NEI from those used in the 2011 NEI with 2014 activity such as link-based VMT with the goal of better characterizing the spatial variability of the onroad mobile source emissions. The use of these new spatial surrogates required updates to the cross reference of surrogate assignments by vehicle type and process.

To account for changes in relative humidity, there is a pairing of relative humidity to temperature bins. Met4moves calculated an average relative humidity for the county group for all grid cells that make up that temperature bin. In other words, for all grid cells and hours within a single temperature bin and county group, it extracts and averages the corresponding relative humidity. Met4moves repeats this calculation for each temperature bin and county group, and finally repeats the whole process for each fuel month. When the emission factors are applied by SMOKE, the appropriate temperature bin and fuel month specific relative humidity was used for all runs of the county group. The EPA used a 5 °F temperature bin size for RatePerDistance (RPD), RatePerVehicle (RPV), and RatePerHour (RPH).

Met4moves can be run in daily or monthly mode for producing SMOKE input. In monthly mode, the temperature range is determined by looking at the range of temperatures over the whole month for that specific grid cell. Therefore, there is one temperature range per grid cell per month. While in daily mode, the temperature range is determined by evaluating the range of temperatures in that grid cell for

each day. The output for the daily mode is one temperature range per grid cell per day and is a more detailed approach for modeling the vapor venting RatePerProfile (RPP) based emissions. The EPA ran Met4moves in daily mode for the 2014 NEI.

The resulting temperatures for the representative counties are provided in the supplementary materials (see Table 6-7 for access information). The gridded, hourly temperature data used are publicly available only upon request and with provision of a disk media to copy these very large datasets (contact info.chief@epa.gov).

6.8.4 VMT, vehicle population, speed, and hoteling activity data

The activity data used to compute onroad mobile source emissions for the 2014 NEI uses EPA defaults where state/local agencies did not provide their own data. These default (but county-specific) data were derived from Federal Highway Administration Data (FHWA) information including the published *Highway Statistics 2014* [ref 9], along with county-level VMT data allocated to vehicle type, fuel type, and road type. Some additional data sources were also used. The development of the default data is described in detail in 2014v2_Default_Onroad_Activity_Data_Documentation.pdf, which is provided with the supporting data in Table 6-7.

As discussed above, SMOKE combines the MOVES emission factors for each representative county with county-specific VMT, population, and hoteling data to compute the emissions for each individual county. These activity data are provided to SMOKE in a flat file format, and the source of the data varies according to area of the country and depending on whether the state/local agency submitted data for the 2014 NEI.

For the counties for which an agency submitted a CDB (the dark blue areas shown previously in Figure 6-1), the EPA ran scripts to extract the agency-submitted data from the CDBs and reformat it into the flat file text file format that can be input to SMOKE (i.e., FF10). For the non-submitting areas of the U.S. (light blue areas in Figure 6-1), the EPA VMT, population, and hoteling were used. The 2014 v2 default speeds are from the CRC A-100 study. The CDBs use a distribution of speeds specific to hour, vehicle and road type, and weekday/weekend day types. SMOKE uses these same data but the 16 speed bin distributions are averaged into an hourly speed, by SCC, county, and weekday/weekend days.

The FF10 creation scripts that read submitted CDBs are described separately by activity type below, followed by discussion on how the EPA created the default 2014 activity data for VMT, population, speed, and hoteling for non-submitting areas.

6.8.4.1 *VMT FF10 file creation*

As of 2014 v2, the FF10-generation scripts read VMT from the MOVES CDB table `sourceTypeYearVMT,` which contains 2014 annual VMT organized by MOVES source type. The scripts disaggregate the source type VMT into fuel type, model year, and road type using a combination of other CDB tables as well as some MOVES default tables. First, the annual VMT is divided into model year using the CDB table with age distribution and the MOVES default database table containing relative annual mileage accumulation by age (`SourceTypeAge`). The scripts use these tables to create travel fractions for each source type and model year that sums to one (1) by source type.

Next, the VMT is further divided into fuel type categories of gasoline, diesel, CNG, E85, and electric vehicles – preferentially by using submitted MOVES CDB tables `AVFT` to determine the split of engine-fuel types by model year and `FuelUsageFraction` to determine the percent of flex-fuel engines that actually use E85. Flex-fuel engines refer to those capable of operating on either E85 or conventional gasoline, the percentage of which could be a function of local availability of the alternative fuel. Because the AVFT and FuelUsageFraction tables are optional tables in a MOVES CDB, they were not always populated in a submitted database. In cases where data werenot provided, the FF10-generation scripts automatically default to MOVES national distributions of fuel types and/or E85 availability, using the `SampleVehiclePopulation` and `FuelUsageFraction` tables of the model default database to fill the missing data. It is worth noting that several states do not have any VMT (or vehicle population) associated with flex-fuel vehicles because they submitted data indicating either no flex-fuel vehicle population or zero E85 fuel supply in the CDB tables. States without E85 in the 2014 v2 NEI include Connecticut, New Jersey, and New York. In the past 2011 NEI, all counties had some E85 vehicles because the FF10 script read only MOVES national data, rather than CDB fuel split and E85 availability information.

Finally, the FF10-generation scripts read the CDB table `RoadTypeDistribution` to further split VMT (by fuel type) into the four MOVES road types (urban and rural, restricted and unrestricted access). The scripts aggregate VMT across model years to the SCC level (i.e., MOVES source type, fuel type, and road type) and reports annual and monthly VMT (using the `MonthVMTFraction` CDB table) for each SCC in each county into a consolidated list.

6.8.4.2 *Population FF10 file creation*

The FF10-generation script that creates the SMOKE vehicle population (i.e., VPOP) data operates similarly to the VMT script just described, except that the calculations do not use travel fractions to disaggregate population by model year. First, the script reads the CDB `SourceTypeYear` table, which contains 2014 population by MOVES source type and divides it into model years based on the submitted CDB `SourceTypeAgeDistribution` table. For each vehicle model year, the scripts apportion vehicle populations to fuel types using the submitted CDB tables `AVFT' and `FuelUsageFraction,' or, if no data were provided, uses the national default corresponding data tables described in Section 6.8.4.1.

The FF10 scripts then aggregate population from the model year level back up to the SCC level (MOVES source type and fuel type, and the road type 1). As with the VMT by SCC, there is no E85 vehicle population in Connecticut, New Jersey, or New York due to agency-submitted data describing the local E85 supply as zero.

6.8.4.3 *Speed FF10 file creation*

SMOKE uses speed data for all counties to lookup the appropriate VMT-based emission factors by speed bin and SCC. The FF10 "SPEED" input for SMOKE is one of two speed-related inputs; the other, described below, contains hourly speeds by SCC and county, separately for weekdays and weekends. The FF10 speed file for SMOKE contains a single daily average speed by SCC and county as an annual average and for each of the 12 months.

The FF10-generation scripts read the CDB table `avgSpeedDistribution,' which contains the fraction of VMT by 16 speed bins for each source type, day type (weekday/weekend), and hour. The scripts calculate a weighted-average to arrive at the average day values.

6.8.4.4 *Speed Profile creation*

The speed profile (SPDPRO) input for SMOKE is optional and supersedes the FF10 SPEED input. The FF10 SPEED file contains average speed data by county and SCC with no time variation, while the SPDPRO contains average speed data by county, SCC, hour, and weekday/weekend. The FF10 SPEED file is read by the SMOKE program Smkinven, and the SPDPRO is read by the Movesmrg program. The values in the FF10 SPEED file are only used by SMOKE-MOVES if a SPDPRO entry is not available. However, regardless of whether or not you have a SPDPRO, SMOKE-MOVES requires that you have an FF10 SPEED file. SMOKE uses speed data for all counties in order to lookup the appropriate VMT-based emission factors by speed bin and SCC. The scripts read the same MOVES CDB tables as used when creating the FF10 SPEED file, though instead of aggregating to a daily average, the scripts preserve the hourly detail. The scripts compile SPDPRO data listing one average speed per hour of day by SCC and county for weekday/weekend day types

6.8.4.5 *Hoteling FF10 file creation.*

Hoteling activity refers to the time spent idling in a diesel long-haul combination truck during federally-mandated rest periods of long-haul trips. Drivers may spend these rest periods with the main engine on, a smaller auxiliary power unit (APU) engine on, plugged into an electric source if available, or simply leave the engine off. MOVES and the NEI track the emissions from hoteling using the main engine idling versus those from APUs separately. SMOKE reads each type of hoteling hours by SCC and matches them to the appropriate MOVES emission factor from the `RatePerHour' lookup table.

Because the 2014 NEI is the first to use the 2014a version of MOVES, it is the first NEI to have the option for agencies to directly provide MOVES with the number of hotelling hours (via the 'hotellingHours' table) and the percent of trucks by model year that use APUs (the 'hotellingActivityDistribution' table). These CDB tables are optional. When they are present, the FF10-generation scripts read them and translate them into the FF10 formats for SMOKE. If they are empty, the FF10-generation scripts calculate the hoteling consistently with the methodology used internally to MOVES when these tables are empty. Thus, the scripts multiply the VMT for diesel-fueled long-haul combination truck VMT on restricted access roads (urban and rural together) and with the national average rate of hoteling, which in year 2014 is estimated by EPA to be 0.027337 hours per mile. The scripts use the MOVES default fractions of APU usage, which in MOVES2014a is zero percent APU usage through model year 2009, and 30 percent APU usage in model years 2010 and later. The remaining hoteling hours are assumed to occur with the main engine on.

For the 2014NEIv2, an adjustment to hoteling was made to address concerns raised by stakeholders about hoteling hours being artificially concentrated in areas with large amounts of combination truck VMT, but which were not necessarily areas that trucks stopped to take long rest breaks. This is particularly an issue in heavily-traveled urban areas. The hoteling hours per county were compared to the number of truck stop spaces identified in the Shapefile on which the surrogate that spatially allocates hoteling emissions to grid cells is based. This Shapefile was created collaboratively with states during the development of the 2011 NEI. In the analysis, for each county, the maximum number of hoteling hours per year that could be supported by the number of specified parking spaces was computed using the formula:

*max hours / year = number of spaces * 24 hours / day * 365 days / year*

This assumes that all spaces are filled at all hours of the day. The maximum number of hours was subtracted from the number of hours assigned to that county to determine if the county was over-allocated with hoteling hours as compared to the known spots. For counties with at least 2 million over-allocated hours, a manual review of truck stop spaces was conducted using Google Earth. In cases where evidence of additional spaces was found, the number of spaces was adjusted and a factor was computed so that when that factor was multiplied by hours, the max hours per year matched those available with the adjusted number of spaces (i.e., hoteling hours were no longer over-allocated to the county). For the remaining over-allocated counties, no analysis was performed and a factor to adjust the hoteling hours down to match the max hours per year for each county was computed and applied, although it was assumed that any county can support a minimum of 105,120 hoteling hours (i.e., 12 spaces' worth). No adjustments to hoteling hours were made in counties for which hoteling hours were substantially under-allocated as compared to the number of available spots. Ideally, hoteling hours would be properly allocated to counties by someone familiar with traffic patterns in the local area. The spreadsheet used to compare the hoteling hours with available spaces is listed in Table 6-7, along with a separate spreadsheet that estimates the reductions to hoteling emissions for key pollutants.

6.8.5 Public release of the NEI county databases

Two sets of 2014 v2 CDBs are available for download: (1) seeded CDBs, which have been altered to produce emission rates for all sources, roads and processes, and (2) unseeded CDBs intended to be used with MOVES Inventory Calculation. The unseeded CDBs are available for all U.S. counties, but that the seeded CDBs are only available for the representative counties. See Table 6-7 for access details.

6.8.6 Seeded CDBs

The seeded county databases can be used with MOVES to generate emission factor lookup tables for SMOKE-MOVES. In order to create them for SMOKE-MOVES modeling, the EPA performed a "seeding" step, whereby values of zero (0) were updated to a small value of 1e-15. This seeding ensures that the lookup tables will be fully populated regardless of whether the representative county itself had activity for all of the categories covered. Seeding is necessary because counties mapping to the representative county may require an emission factor that would otherwise be missing.

6.8.7 Unseeded CDBs

In contrast to the seeded CDBs, the unseeded CDBs do not have any seeding performed on them. This set of CDBs is true to the local conditions. The unseeded CDBs merge the databases that were agency-submitted with the default CDBs that were carried over from 2014 v1 with updates based on IHS and CRC study data. The unseeded CDB tables `SourceTypeYearVMT,` `SourceTypeYear,` `HotellingHours,` and `HotellingActivityDistribution` are consistent with the SMOKE-ready files of 2014 VMT, population, and hoteling.

The CDBs created by EPA (i.e., ones for which there was no submittal by S/L/T agencies) include the 2014 default VMT in the 'SourceTypeYearVMT' tables rather than the 'HPMSVtypeYear' tables (used in the past EPA defaults), which are now empty. The 2014 default hoteling information is included in the CDB tables 'HotellingHours' and 'HotellingActivityDistribution.' As in the past NEI, the 2014 EPA-default vehicle populations are included in the 'SourceTypeYear' tables in the non-submitted CDBs.

6.8.8 Run MOVES to create emission factors

The EPA ran MOVES for each representative county using January fuels and July fuels for the range of temperatures spanned by the represented county group and set of months associated with each fuel set (January and July). A runspec generator script created a series of runspecs (MOVES jobs) based on the outputs from Met4moves temperature information for all months of the year. Specifically, the script used a 5-degree temperature bin with the minimum and maximum temperature ranges from Met4moves and used the idealized diurnal profiles from Met4moves to generate a series of MOVES runs that captured the full range of temperatures for the county group for the months assigned to each fuel. The MOVES runs resulted in four emission factors tables for each representative county and fuel month: rate per distance (RPD), rate per vehicle (RPV), rate per hour (RPH), and rate per profile (RPP). After the MOVES runs were completed, the post-processor script Moves2smk converted the MySQL tables into EF files that can be read by SMOKE. For more details, see the SMOKE documentation [ref 10].

6.8.9 Run SMOKE to create emissions

To prepare the NEI emissions, the EPA first generated emissions at an hourly resolution using more detailed SCCs than are found in the NEI (i.e., by road type and aggregate processes). The SMOKE-MOVES program Movesmrg performs this function by combining activity data, meteorological data, and emission factors to produce gridded, hourly emissions. The EPA ran Movesmrg for each of the four sets of emission factor tables (RPD, RPV, RPH, and RPP). During the Movesmrg run, the program used the hourly, gridded temperature (for RPD, RPV, and RPH) or daily, gridded temperature profile (for RPP) to select the proper emissions rates and compute emissions. These calculations were done for all counties and SCCs in the SMOKE inputs, covering the continental U.S.

The emissions processes in RPD modeling the driving emissions. This includes the following modes (i.e., processes): vehicle exhaust, evaporation, evaporative permeation, refueling, brake wear, and tire wear. For RPD, the activity data is monthly VMT, monthly speed (i.e., SMOKE variable of SPEED), and hourly speed profiles for weekday versus weekend (i.e., SPDPRO in SMOKE). The SMOKE program Temporal takes temporal profiles specific to vehicle type and road type and distributes the monthly VMT to day of the week and hour. Movesmrg reads the speed data for that county and SCC and the temperature from the gridded hourly (MCIP) data and uses these values to look-up the appropriate emission factors (EFs) from the representative county's EF table. It then multiplies this EF by temporalized and gridded VMT for that SCC to calculate the emissions for that grid cell and hour. This is repeated for each pollutant and SCC in that grid cell. The diurnal and weekly VMT temporal profiles were updated for the 2014 NEI v2 based on the CRC A-100 study.

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

The emissions processes in RPH model the parked emissions for combination long-haul trucks (source type 62) that are hoteling. This includes the following modes: extended idle and APUs. For RPH, the activity data is monthly hoteling hours. The SMOKE program Temporal takes a temporal profile and

distributes the monthly hoteling hours to day of the week and hour. Movesmrg reads the temperature from the gridded hourly (MCIP) data and uses these values to look-up the appropriate emission factors from the representative county's EF table. It then multiplies this EF by temporalized and gridded HOTELING hours for that SCC to calculate the emissions for that grid cell and hour. This is repeated for each pollutant and SCC in that grid cell.

The emission processes in RPP model the parked emissions for vehicles that are key-off. This includes the mode vehicle evaporative (fuel vapor venting). For RPP, the activity data is VPOP. Movesmrg reads the gridded diurnal temperature range (Met4moves' output for SMOKE). It uses this temperature range to determine a similar idealized diurnal profile from the EF table using the temperature min and max, SCC, and hour of the day. It then multiplies this EF by the gridded VPOP for that SCC to calculate the emissions for that grid cell and hour. This repeats for each pollutant and SCC in that grid cell.

The result of the Movesmrg processing is hourly data as well as daily reports for each of the four processing streams (RPD, RPV, RPH, and RPP). The results include emissions for every county in the continental U.S.

6.8.10 Onroad mobile emissions data for Alaska, Hawaii, Puerto Rico, and the Virgin Islands

Since the meteorological data used by the EPA for running SMOKE-MOVES covers only the continental U.S., the EPA used the MOVES Inventory Mode to create emissions for Alaska, Hawaii, Puerto Rico and the Virgin Islands. These runs used the average monthly hourly temperatures and humidity values derived from the National Climatic Data Center temperature and humidity data for calendar year 2014. The emissions generated by the Inventory Mode MOVES runs characterized all pollutants, including a full set of metals and dioxins.

These emission inventory estimates were not derived using the same SMOKE-MOVES process used for the other counties. Instead, each county was run independently using the Inventory Mode of the MOVES2014a model. This approach directly calculates the inventory in each county using the inputs provided in each of the county databases. For Hawaii, Puerto Rico, and the Virgin Islands, MOVES was run for only January and July due to the relatively modest temperature variation over the year for these islands. All other months were mapped to those months to create an annual estimate of the emissions. Due to the greater meteorological variation in Alaska, MOVES was run for every month of the year.

The MOVES inputs used to compute for these emissions are:

- The MOVES CDM databases,
- The run specifications used to run MOVES, and
- The MySQL database containing the tables that describe the temperatures and relative humidity values used for these states and territories.

These inputs are provided in the supplementary materials (see Table 6-7 for access information).

6.8.11 Post-processing to create annual inventory

For the purposes of the NEI, the EPA needed emissions data by county, SCC and pollutant. The EPA ran SMOKE-MOVES at a more detailed level including road type and emission processes (e.g. extended idle) and summed over road types and processes to create the more aggregate NEI SCCs. The EPA developed

and used a set of scripts to combine the emissions from the four sets of reports and from all days to create the annual inventory.

The onroad emissions for Alaska, Hawaii, Puerto Rico and the Virgin Islands, which the EPA generated via MOVES in Inventory Mode were appended to the onroad inventory generated from SMOKE-MOVES to create the final emissions. These estimates are the same in v1 and v2. This complete inventory was loaded into the EIS dataset "2014_EPA_MOVES "as the EPA estimates for the onroad sector.

Five speciated $PM_{2.5}$ species were added based on speciation profiles (i.e., elemental carbon, organic carbon, nitrate, sulfate and other $PM_{2.5}$). DIESEL-PM10 and DIESEL-PM25 were also added by copying the PM_{10} and $PM_{2.5}$ pollutants (respectively) as DIESEL-PM pollutants for all diesel SCCs. See Section 2.2.5 for more details.

6.9 Summary of quality assurance methods

The EPA performed a series of checks and comparisons against both the inputs and the resulting emissions to quality assure the onroad inventory. These checks are in addition to the ones described on the underlying CDBs. The following is a list of the more significant checks that were performed:

- The 2014NEIv2 emissions were compared to the 2014NEIv1 and 2011 emissions to make sure that all SCCs, counties, and pollutants were covered and as a general quality assurance of the emissions.
- Comparisons of 2014 and 2011 emissions were done using spreadsheets that compared emissions from the two years using (a) groupings at the first 6 digits of the SCC (fuel + MOVES source type) and (b) grouping by light-duty and heavy-duty.
- Maps of county-level NOx, $PM_{2.5}$ and VOC were prepared for each fuel + MOVES source type combination, total light-duty, total heavy-duty, that included maps of the difference between 2014 v2 emissions versus 2014NEIv1 and 2011NEIv2.

The maps and spreadsheets helped to identify areas with suspect activity data or emission factors, and the EPA followed up on any suspect areas to investigate further and resolve problems if any were found.

6.10 Supporting data

Onroad 2014 emissions were computed by EPA estimates based primarily on input data submitted by state and local agencies and secondarily using EPA-developed input data, except for the state of California. Table 6-6 provides the submittal history of these county databases. The onroad scripts and data files used in the calculations are listed in Table 6-7. The files and datasets listed in Table 6-7 are all available at: ftp://newftp.epa.gov/Air/nei/2014/doc/2014v2_supportingdata/onroad

Table 6-6: Agency submittal history for Onroad Mobile inputs and emissions

Agency Organization	Onroad CDB Submission Date (MM/DD/YYYY)	Onroad Emissions Submission Date (MM/DD/YYYY)	Notes
Alaska Department of Environmental Conservation	V1: 01/14/2016		
Chattanooga Air Pollution Control Bureau	V2: 05/10/2017		
City of Albuquerque (New Mexico) Environmental Health Department	V1: 01/14/2016		
Clark County Department of Air Quality	V1: 01/22/2016		
Coeur d'Alene Tribe*		V1: 01/07/2016	
Connecticut Bureau of Air Management	V1: 01/14/2016		
Department of Energy and Environment (Washington D.C.)	V1: 12/17/2015		
Delaware Department of Natural Resources	V1: 01/15/2016		
Georgia Department of Natural Resources	V1: 12/21/2015 and 05/17/2016 V2: 05/10/2017		
Idaho Department of Environmental Quality	V1: 12/17/2015		
Illinois EPA	V1: 12/01/2015		
Knox County (Tennessee) Department of Air Quality Management	V1: 12/29/2015		
Kootenai Tribe of Idaho*		V1: 01/07/2016	
Louisville (Kentucky) Metro Air Pollution Control District	V1: 06/03/2015		
Maine Department of Environmental Protection	V1: 01/26/2016 V2: 05/05/2017		
Maricopa County (Arizona) Air Quality Department	V1: 12/07/2015		
Maryland Department of the Environment	V1: 01/07/2016		

Agency Organization	Onroad CDB Submission Date (MM/DD/YYYY)	Onroad Emissions Submission Date (MM/DD/YYYY)	Notes
Massachusetts Department of Environmental Protection	V1: 11/23/2015		
Memphis and Shelby County Health Department – Pollution Control	V2: 05/16/2017		
Metro Public Health of Nashville/Davidson County		V1: 01/15/2016	Agency sent VPOP and VMT via email on 6/7/2016.
Michigan Department of Environmental Quality	V1: 01/13/2016		
Minnesota Pollution Control Agency	V1: 12/17/2015 and 04/08/2016		
Missouri Department of Natural Resources	V1: 03/07/2016 and 06/08/2016		
Morongo Band of Cahuilla Mission Indians of the Morongo Reservation, California*		V1: 12/14/2015	
New Hampshire Department of Environmental Services	V1: 12/18/2015 and04/15/2016		
New Jersey Department of Environment Protection	V1: 01/14/2016		
New York Department of Environmental Conservation	V1: 03/14/2016		
Nez Perce Tribe*	V1: 01/07/2016		
North Carolina DEQ, Division of Air Quality	V1: 01/14/2016		
Northern Cheyenne Tribe		V1: 12/01/2015	
Ohio EPA	V1: 01/12/2016 and 03/18/2016		
Oregon Department of Environmental Quality	V1: 01/13/2016		
Pennsylvania Department of Environmental Protection	V1: n03/04/2016		
Pima Association of Governments (Tuscon, Arizona)	V1: 01/27/2016		EPA imported the submittal into MySQL tables and renamed the database (to match the NEI naming

Agency Organization	Onroad CDB Submission Date (MM/DD/YYYY)	Onroad Emissions Submission Date (MM/DD/YYYY)	Notes
			convention) and removed the empty non-CDB tables.
Rhode Island Department of Environmental Management	V1: 02/11/2016		
Shoshone-Bannock Tribes of the Fort Hall Reservation of Idaho*		V1: 01/07/2016	
South Carolina Department of Health and Environmental Control	V1: 12/01/2015		
Tennessee Department of Environment and Conservation	V1: 12/15/2015 V2: 05/17/2017		
Texas Commission on Environmental Quality	V1: 01/28/2016	V1: 01/07/2016	Texas emissions are available in EIS, but Texas' inputs are reflected in EPAMOVES results and in the NEI.
Utah Division of Air Quality	V1: 12/01/2016 and 04/01/2016		
Vermont Department of Environmental Conservation	V1: 01/15/2016 V2: 05/19/2017		
Virginia Department of Environmental Quality	V1: 12/21/2015 V2: 05/16/2017		
Washington State Department of Ecology	V1: 12/01/2015 V2: 04/12/2017		
Washoe County (Nevada) Health District, Air Quality Management Division	V1: 01/11/2016 and 05/13/2016	V1: 05/13/2016	
West Virginia Division of Air Quality	V1: 12/16/2015		
Wisconsin Department of Natural Resources	V1: 01/15/2016 V2: 05/16/2017		

* Tribal emissions data submitted to EIS were inadvertently not included in the 2014v1 NEI but will be in version 2 Tribal territory emissions are not calculated by EPA, because they are not in the county databases.

Table 6-7: Onroad Mobile data file references for the 2014 NEI

	File Name	Description
1	2014NEIv2_default_onroad_activity_approach_022118.pdf	Describes method used for EPA default VMT, VPOP, and hoteling hours data used in counties for which data were not submitted by S/L/T agencies.
2	Folder *CDBs_for_all_counties* contains 2014v2CDBs_stXX.zip where XX is the two-digit state FIPS code	"*Unseeded*" CDBs for all counties in the U.S. archived separately by state. These may not produce fully populated emission rates tables across all categories without "seeding". Activity data and age distributions are specific to each county and not aggregated.
3	2014NEIv2_repCounty_CDBs_seeded_26sep17.zip	"*Seeded*" CDBs for representative counties in the continental U.S. used to develop 2014NEIv2. These should produce fully populated rates tables because values of zero in the MOVES input tables have been updated to small numbers (1e-15). It only includes the approximately 300 rep. counties and does not include AK, HI, VI, or PR. Age distributions are vehicle-population-weighted across all represented counties.
4	2014v2_onroad_activity_final.zip	All three data types are in FF10 format for SMOKE and are a combination of EPA estimates, agency submittals, and corrections: 1. Vehicle population by county and SCC covering every county in the U.S., 2. VMT annual and monthly by county and SCC covering every county in the U.S., and 3. Hoteling hours annual and monthly by county covering every county in the U.S. including hours of extended idle and hours of auxiliary power units for combination long-haul trucks only.
5	2014v2_RepCounty_Runspecs.zip	The MOVES2014a run specifications (runspecs) for the representative counties for running MOVES in emissions rate mode (used for SMOKE-MOVES).
6	2014NEIv2_RepCounty_Temperatures.zip 2014v2_RepCounty_Temperatures_MOVES_zmh.zip	The temperature and relative humidity bins for running MOVES to create the full range of emissions factors necessary to run SMOKE-MOVES and the ZMH files used to run MOVES. Generated by running the SMOKE Met4moves program.
7	MFMREF_2014v2_10jul2017_v0.txt	Fuels cross reference (MFMREF) is a table that maps representative fuel months to calendar months for each representative county. The MFMREF file is an input to SMOKE.

	File Name	Description
8	2014v1_AKHIPRVI_Runspecs.zip	The MOVES2014 run specifications (runspecs) for all counties in Alaska, Hawaii, Puerto Rico and the Virgin Islands. These are for running MOVES in Inventory Mode.
9	MCXREF_2014v2_10jul2017_v0.txt MCXREF_2014v2_10jan2018_nf_v2_for_MN.txt	County cross reference file (MCXREF) is a table that shows every US county along with the representative county used as its surrogate. The MCXREF is an input to SMOKE. A special version is used to compute hoteling emissions in Minnesota to correct an issue with hoteling emission factors.
10	2014NEIv2_speed_spdpro.zip	These data are in FF10 format for SMOKE and are a combination of EPA estimates, agency submittals, and corrections: 1. Average speed in miles per hour, annual and monthly values, by county and SCC covering every county in the U.S. and 2. Weekend and weekday hourly speed profiles (SPDPRO) in miles per hour, by county and SCC covering every county in the U.S.
11	2014v1_CDB_QA_Checks_MOVES2014a_v1 2014v1_QA_Checks_v8_2December2015.sql	Scripts designed to catch errors that would cause MOVES to fail during a run and to identify unreasonable data values.
12	generateFF10_from_CDBs.zip populateCDBs_from_FF10.zip	FF10 generation scripts read CDB tables and produce SMOKE-formatted activity input files for use in SMOKE-MOVES. The SMOKE files include VMT, vehicle population, hoteling hours, speed, and SPDPRO. Populate CDBs from FF10 scripts read SMOKE-formatted activity files: VMT, vehicle population, and hoteling hours, and update the MOVES CDB tables SourceTypeYearVMT, SourceTypeYear, HotellingHours, and HotellingActivityDistribution.
13	2014v2_EICtoEPA_SCCmapping.xlxs	Maps California EMFAC codes to MOVES SCCs
14	2014NEIV2_Plans_for_CDB_Input_Data_07072017b.xlsx	Spreadsheet that shows how state-submitted and default data were merged together to prepare 2014NEIv2.
15	2014NEI_v2_Representative_Counties_List_20170620_for_documentation.xlsx	Spreadsheet of representative county characteristics.

	File Name	Description
16	2014v2_hoteling_by_county_versus_truck_stop_parking_102817.xlsx	Spreadsheet documenting computation of adjustment factors applied to hoteling hours where there were more hours assigned than the available truck stop parking spaces could support.
17	2014v2_onroad_RPH_reduced_hotelling_comparison.xlsx	Spreadsheet that estimates the change in emissions due to the reduction in hoteling hours.
18	2014v2_avft_grouped_csvs.zip 2014v2_agedist_grouped_csvs.zip	Grouped AVFT and age distribution .csv files used to compute emission factors for representative counties and to create the CDBs in 2014NEIv2_repCounty_CDBs_seeded_26sep17.zip
19	2014v2_avft_individual_csvs.zip 2014v2_agedist_individual_csvs.zip	County-specific AVFT and age distribution .csv files appropriate for inventory modeling of specific counties and used to create the CDBs in the folder *CDBs_for_all_counties*

6.11 References for onroad mobile

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