Development of 2014 Default Onroad Activity Data

for the National Emissions Inventory version 2

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Introduction

The default 2014 National Emissions Inventory version 2 (2014NEIv2) vehicle miles traveled (VMT) activity data are developed primarily from information provided directly by the Federal Highway Administration (FHWA), along with the FHWA's published Highway Statistics 2014 and data from the U.S. Census Bureau. These data were also used in the development of the onroad activity information used in 2014 NEI version 1 (2014NEIv1). In 2014NEIv2, an additional new 2014 IHS state vehicle registration database was used. This new IHS database includes year 2014 light-duty and heavy-duty vehicle registrations from all U.S. counties for model years 1961-2015. Default VMT in units of annual millions of vehicle miles traveled were developed at the county, road type, vehicle type, and fuel type level of detail, to be used in the 2014NEIv2 in areas for which no state or local agency provided VMT data. The vehicle types used were the thirteen MOVES2014 source types (see Table 1). The road types included were the four MOVES2014 roadway types (see Table 10). The fuel types were the four onroad MOVES2014 fuel types (see Table 11). Although some updated data were available from the IHS registration database, emissions were not recomputed for Alaska, Hawaii, Puerto Rico, or the Virgin Islands as compared to 2014NEIv1.

Data used to generate EPA default data

The 2014 VMT data were developed using data supplied directly by FHWA as well as publicly available data from the 2014 version of FHWA's Highway Statistics data series, which can be found at the following Web site: http://www.fhwa.dot.gov/policyinformation/statistics/2014/.

The Highway Statistics data used in the VMT development include:

- Table VM-2, "Functional System Travel - Annual Vehicle-Miles," and
- Table VM-4, "Distribution of Annual Vehicle Distance Traveled."

The publicly available VM-2 table contains state-level summaries of 2014 miles of annual travel in each state by Highway Performance Monitoring System (HPMS) road type. VM-2 road types include interstate, other freeways/expressways, other principal arterial, minor arterial, major/minor collector, and local for both urban and rural areas. The US Department of Transportation (DOT) was able to provide HPMS VM-2 data at the county level directly to the EPA for most road types. However, not all road types were available at the county level from the US DOT. The road types not available at the county level were rural minor collector, rural local, and urban local. Additionally, county-level data were not available for any road type for the state of Massachusetts.

Table VM-4 contains state-level distribution of annual vehicle distance traveled, expressed by the percentage of vehicle miles traveled by vehicle type for both rural and urban road type groupings. These grouping fractions were applied to all counties in their respective state.

US Census population estimates were also used in developing default VMT. This included estimates of 2014 population by county. A ratio of county population to state population was developed for each county in the US to distribute state-level VM-2 VMT data to a county level where the US DOT county-level data were not available. US Census data is available from the following Web site: https://factfinder.census.gov/faces/nav/jsf/pages/index.xhtml

To assign VMT to fuel types, the fuel type information was populated into the MOVES CDBs based on the 2014 IHS vehicle population data and the VMT by fuel type was further allocated to each source type. During the VMT development process, the process of extracting the fully-specified VMT from the MOVES CDBs caused some slight changes in the fuel type distribution as compared to the original IHS fuel splits.

In 2014NEIv1, Motor Vehicle Emission Simulator version 2014a (MOVES2014a) vehicle population (VPOP) were derived from Table MV-1, "State motor-vehicle registrations" from the Federal Highway Administration's annual Highway Statistics report. These data were used by FHWA to produce the FHWA VMT estimates (e.g. MV-2) mentioned above. Also in 2014NEIv1, the EPA utilized state vehicle registration datasets for year *2011* purchased from IHS, a private company that provides automotive information services. The company maintained two databases relevant for MOVES: The National Vehicle Population Profile (NVPP®) and the Trucking Industry Profile (TIP®Net) Vehicles in Operation database. The first focused on light-duty cars and trucks, the second focused on medium and heavy-duty trucks. The IHS data can be found in CRC Report No. A-88, MOVES INPUT IMPROVEMENTS FOR THE 2011 NEI, Final Report, October 2014, found at the following Web site:

http://www.crcao.org/reports/recentstudies2014/A-88/CRC%20A88%20Final%20Report%20102114.pdf

For the 2014NEIv2, the updated IHS county vehicle registration data for 2014 were used to develop VPOP data for the year 2014, and they also impacted the 2014NEIv2 VMT development as described later in this document.

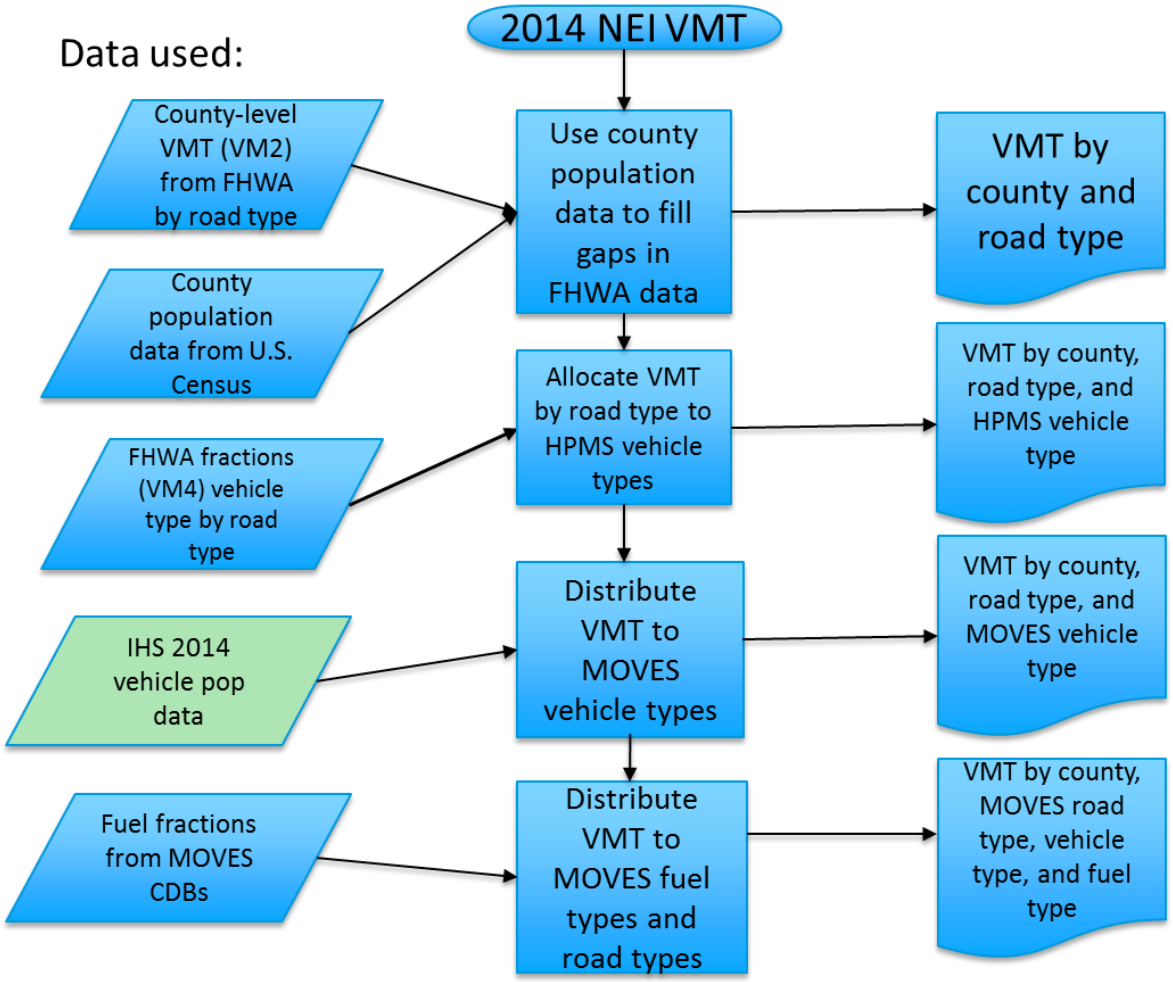
Development procedures for VMT and VPOP datasets

The procedures used in the development of the 2014 NEI default VMT are broken down into five parts (see Figure 1):

1. *Highway Statistics* VM-2 state-level VMT along with county-level human population data from US Census used to fill in gaps in FHWA VM-2 county-level data;
2. To allocate county-level VMT by HPMS road type to HPMS vehicle type the *Highway Statistics* Table VM-4 was used to develop VMT by county, HPMS road type, and HPMS vehicle type;
3. To distribute certain VMT to MOVES vehicle types the IHS year 2014 vehicle population data were used to develop VMT by county, HPMS road type, and MOVES vehicle type;
4. HPMS road types were combined to the four MOVES2014 road types to develop VMT by county, MOVES road type, MOVES vehicle type, and MOVES fuel type;
5. VMT was distributed to the MOVES fuel types by placing the IHS year 2014 vehicle population data by fuel type in the MOVES CDBs and then extracting the VMT from the CDBs to develop the final VMT by county, HPMS road type, MOVES vehicle type, and MOVES fuel type.

Each of these steps in the development of the 2014 VMT is discussed separately below.

Figure 1. Overview of 2014 NEI default VMT development



2014 County-level VMT by HPMS Road Type

Highway Performance Maintenance System (HPMS) VM-2 county-level data from the US DOT contains the majority of the road types of interest for all states except Massachusetts. VM-2 county data had most road types, however, rural minor collectors and rural and urban locals (HPMS types RminCOLL, RLOC, and ULOC) were not available. For these missing road types, the HPMS VM-2 data were used in conjunction with the Table VM-2 (state-level), Functional System Travel - Annual Vehicle-Miles (http://www.fhwa.dot.gov/policyinformation/statistics/2014/) and 2014 county-level US Census data (http://factfinder.census.gov/faces/tableservices/jsf/pages/). To fill in VMT for missing road types and for the state of Massachusetts, county- and state-level population data were used to create ratios of county population to state population. Massachusetts state-level VMT was then multiplied by the county-level ratios to develop a set of annual VMT for all counties based on population as follows:

$$state\ VMT * (county\ population) / (state\ population) = county\ VMT$$

2014 County-level VMT by HPMS Road Type and Vehicle Type

To allocate the county-level VMT by Highway Performance Maintenance System (HPMS) road type to HPMS vehicle type, the Table VM-4, Distribution of Annual Vehicle Distance Traveled (http://www.fhwa.dot.gov/policyinformation/statistics/2014/) was used to apportion county-level VMT by HPMS road type to HPMS vehicle type as follows:

HPMS vehicle type fraction X *county-level VMT=county VMT by HPMS road type and vehicle type*

2014 County-level VMT by HPMS Road Type and MOVES2014 Source Type

2014 IHS VPOP data is used to allocate VMT. For this step, HPMS vehicle types were mapped to MOVES2014 source types. This represents one of the major changes from the 2014NEIv1 to the 2014NEIv2. Note: there is a one-to-many relationship (with the exception of motorcycles) between some HPMS vehicle types and the MOVES2014 source types. The table below illustrates the mapping of the HPMS vehicle types to the MOVES2014 source types:

Table 1. MOVES2014 onroad source types

MOVES sourceType ID	MOVES Source Type Name	HPMSVTypeID	Description
11	Motorcycles	10	Motorcycles
21	Passenger Cars	25	Light-Duty Vehicles
31	Passenger Trucks	25	Light-Duty Vehicles
32	Light Commercial Trucks	25	Light-Duty Vehicles
41	Intercity Buses	40	Buses
42	Transit Buses	40	Buses
43	School Buses	40	Buses
51	Refuse Trucks	50	Single Unit Trucks
52	Single Unit Short-Haul Trucks	50	Single Unit Trucks
53	Single Unit Long-Haul Trucks	50	Single Unit Trucks
54	Motor Homes	50	Single Unit Trucks
61	Combination Short-Haul Trucks	60	Combination Trucks
62	Combination Long-Haul Trucks	60	Combination Trucks

Light Duty Vehicles

In MOVES2014, the HPMS class for light-duty vehicles (25) denotes the sum of the FHWA Table VM-4 values for long wheelbase and short wheelbase light-duty vehicles. HPMSVTypeID 25 is new for MOVES2014 and replaces HPMSVTypeID 20 (passenger cars) and 30 (other two-axle four-tire vehicles) in MOVES2010. As such, in MOVES2014 any VMT input by HPMS class for passenger cars and light-duty trucks must be entered as a combined value in the new HPMSVTypeID 25. This change in HPMS classes has come about as passenger vehicles have evolved over time with the physical characteristics of "cars" and "trucks" becoming less distinct. In response, the US DOT changed the organization of HPMS classifications and MOVES has evolved to reflect this change. In order to further refine HPMSVType 25, the EPA used data compiled from 2014 state vehicle registration data from IHS to develop county-level

fractions to break down HPMSVTypeID 25 into the three light-duty source types needed for MOVES2014 (passenger cars (21), passenger trucks (31), and light commercial trucks (32)) as follows:

HPMSVTypeID 25 VMT x *county-level IHS fraction=county VMT by HPMS road type and MOVES2014 source type*

Thus the light-duty source types are allocated in the same proportion as they were found in the county-level IHS data. Note the VMT for motorcycles did not change from 2014 NEI version 1 to version 2.

Buses (HPMSVTypeID 40)

In the 2014NEIv1, no bus registration data from IHS was available, so activity data from the 2011 NEI modeling platform was used to develop county-level fractions to break down HPMSVTypeID 40 into the three bus source types needed for MOVES2014 (intercity buses (41), transit buses (42), and school buses (43)) as follows:

HPMSVTypeID 40 VMT X *county-level fraction=county VMT by HPMS road type and MOVES2014 source type*

The VPOP for buses for 2014NEIv1 consisted of using FHWA Table MV-1, "State motor-vehicle registrations" where "Buses" were assigned to MOVES source types 41, 42, and 43.

In the 2014NEIv2, new bus VPOP was generated due to the apportionment of the 2014 IHS county registration data into the following MOVES vehicle types: intercity buses (41), transit buses (42), and school buses (43). In addition to the FHWA county VMT data and the 2014 IHS VPOP data, the following other sources were used to allocate bus VMT in the 2014NEIv2:

- State-submitted bus data by county for 2014NEI version 1
- Year 2014 county human population census data
- County area in square miles
- Various documents to determine average annual miles traveled per type of bus (e.g. Motorcoach Census: https://buses.org/assets/images/uploads/pdf/Motorcoach_Census_2014.pdf)

State-submitted data were analyzed to determine how the bus VMT splits (Intercity-Transit-School and Intercity-Transit) may vary across a country. These VMT splits were then used to distribute "Bus" VMT from the *HPMSVTypeID 40* VMT to the MOVES bus types. State-submitted data were also used to evaluate average annual miles traveled per type of bus. These VMT splits vary in urban vs. rural counties. The county human population and county area data were used to calculate the human population density for each county. Three different classifications were used while using the human population density data:

1) **Urban** (density ~ 100+ people/square-mile)
2) **Suburban** (density between 40-100 people/square-mile)
3) **Rural** (density < 40 people/square-mile)

The Intercity-Transit-School and Intercity-Transit bus percentage VMT splits in the state-submitted data were examined by population density class to understand the reasonable bounds for the VMT splits for each human population density class. This state-submitted data included bus VMT data for 1676 counties (Urban=571, Suburban=487, Rural=618). Table 2 provides the average percent VMT contribution and the general percent ranges for each bus type based in the state-submitted data.

Table 2. Intercity-Transit-School bus percentage splits based on 2014NEIv1 state-submitted data

Population Density	Variable	InterCity	Transit	School
URBAN	% of total VMT	30%	28%	42%
URBAN	% range	20-40%	25-40%	30%-70%
SUBURBAN	% of total VMT	28%	21%	51%
SUBURBAN	% range	20-40%	15-35%	40%-80%
RURAL	% of total VMT	22%	23%	55%
RURAL	% range	10-75%	0%-25%	50%-90%

Table 3 provides the average percent VMT contribution and general percent ranges between Intercity and Transit buses based on the state-submitted data.

Table 3. Intercity-Transit bus percentage splits based on 2014NEIv1 state-submitted data

Population Density	Variable	InterCity	Transit
URBAN	% of total VMT	52%	48%
URBAN	% range	20-80%	20-80%
SUBURBAN	% of total VMT	58%	42%
SUBURBAN	% range	20-80%	20-80%
RURAL	% of total VMT	49%	50%
RURAL	% range	10-100%	0%-90%

The development of EPA default bus VMT for 2014NEIv2 involved using the following assumptions and data sources:

- School buses
    - Average annual VMT for school buses varies nationally:
        - State-submitted 2014NEIv1 data indicated annual VMT for School buses can vary between 5000-59000 miles
        - Other sources (FHWA, Dept. of Transportation, others) indicated average annual VMT for school buses vary from 9000 to 20000 miles
    - EPA has high confidence in school bus registration data from the 2014 IHS database
    - There are some counties that do not have School buses registered, but a small amount of VMT was added to these counties such that the VMT for these counties did not equal zero.
        - This allows for the possibility of a school bus being registered in one county and being used in another county.
- Intercity buses
    - Average annual VMT for intercity buses varies nationally:
        - State-submitted 2014NEIv1 data indicated annual VMT for Intercity buses can vary from 35000-45000 miles
        - Other data sources (Motorcoach Census, others) indicate average annual VMT for Transit buses vary from 45000-60000 miles

    - Intercity buses use rural interstates more than School and Transit buses
    - An intercity bus may be registered in one county and be used in other counties and states.
- Transit buses
    - Average annual VMT for transit buses varies nationally:
        - State-submitted 2014NEIv1 data indicated annual VMT for transit buses can vary from 25000-35000 miles
        - Other sources (Energy.gov, others) indicate average annual VMT for Transit buses vary from 30000-55000 miles
    - There are some rural counties that do not have Transit buses registered and the resulting Transit bus VMT for these counties was set to zero
    - A transit bus may be registered in one county and used in other surrounding counties

There are major differences in the VPOP data derived from FHWA MV-1 in the 2014NEIv1 versus the new 2014 IHS VPOP registration data used in 2014NEI version 2 for buses. Table 4 summarizes on a national level the VMT and VPOP for each bus vehicle type in 2014NEIv1.

Table 4. National VPOP and VMT splits for the 2014NEIv1 bus types

Bus type	VPOP 2014NEIv1 (count)	VMT 2014NEIv1 (millions of miles)	%total VMT	%total VPOP	Calculated Annual avg VMT per bus (miles)
Intercity	83517	3646	22.70%	9.00%	43650
Transit	148880	4180	26.03%	16.04%	28077
School	695580	8236	51.28%	74.96%	11841
Total	927978	16062	100.00%	100.00%	17308

To better understand the impacts of the new 2014 IHS VPOP data an estimate of the national VMT and VPOP was calculated in Table 5 using an average annual VMT per vehicle estimate for each bus type (e.g. 55000 miles per Intercity bus).

Table 5. Estimated national bus VMT using VPOP_IHS and estimated average annual miles per bus

Bus type	VPOP_IHS(count)	Estimated Annual avg VMT per truck (miles)	Estimated VMT (millions of miles)	%total VMT	%total VPOP
Intercity	93013	55000	5116	34.25%	14.32%
Transit	31475	45000	1416	9.48%	4.84%
School	525168	16000	8403	56.26%	80.84%
Total	649656		14935	100.00%	100.00%

As shown in Tables 4 and 5, 2014 IHS VPOP vehicle count for all buses (~650,000) is about 30% lower than the 2014NEIv1 total bus count (~930,000). Other important changes in the VPOP splits are the following:

- Number of Intercity buses increased by about 11% in 2014 IHS VPOP vs. 2014NEIv1 VPOP
- Number of Transit buses decreased by about 80% in 2014 IHS VPOP vs. 2014NEIv1 VPOP

- Number of School buses decreased by about 25% in 2014 IHS VPOP vs. 2014NEIv1 VPOP

The above changes will impact the Intercity-Transit-School percentage contribution on VMT as estimated in Table 4 and Table 5. The approach outlined in this section attempted to maintain the county VMT variability contained in the FHWA county bus VMT data (used in 2014NEI v1) while using all of the above data and assumptions knowing there will be some reduction in overall bus VMT due to the lower bus count in 2014 IHS VPOP.

The following steps were taken to develop 2014NEI version bus VMT by MOVES vehicle type:

1. School bus (MOVES vehicle type 43):
    - The 2014 IHS school bus count for each county was multiplied by an average of 16000 miles per school bus.
    - This initial school bus VMT was then checked against the general ranges for school bus percentage contribution to total bus VMT (Intercity-Transit-School split) shown in Table 2 to adjust the VMT for each county. This adjustment process occurred for all population density classes to derive a final county School bus VMT
2. Intercity bus (MOVES vehicle type 41):
    - Intercity bus VMT for each county was estimated by subtracting the School bus VMT generated in step 1 above from the HPMSVTypeID 40(bus) county VMT derived from the FHWA tables.
    - An initial Intercity bus fraction for this remaining bus VMT based on the data shown in Table 3 was set
        - The initial Intercity fraction for Urban and Suburban counties was set to 0.65 (65% of the remaining VMT will be Intercity Bus VMT and 35% will be Transit Bus VMT). This fraction was estimated based on Table 3, the VPOP for Transit Buses dropped 80% and InterCity bus VPOP increased by 11% in 2014 IHS VPOP when compared to 2014NEIv1 VPOP.
        - For the Rural counties, the Intercity bus fraction was initially set based on the following formula:
            - Rural County Intercity Bus Fraction = 0.9 * (fraction of Rural Restricted VMT in county)
            - If the 2014 IHS VPOP for Transit buses = 0 for a rural county, the Intercity Bus Fraction was set to 1
        - This final Intercity Bus fraction was multiplied by the remaining FHWA VMT after School bus VMT subtraction to arrive at the Intercity bus VMT for each county
3. Transit bus VMT (42)
    - The remaining FHWA VMT after subtracting the School and Intercity bus VMT calculated in steps #1 and #2 above was divided by the number of Transit buses registered in the county from the 2014 HIS VPOP database to get the estimated annual average VMT per bus in that county
    - If the annual average VMT per bus was outside the general ranges found in state-submitted data and other transit bus information resources (Table 2), the Transit bus VMT was scaled to fall within these general ranges (25000-55000 miles annually). In almost all cases, the annual average VMT per bus was much higher than general ranges found in sources mentioned above

- There were some Rural counties that did not have Transit buses registered and the resulting Transit bus VMT for these counties was set to zero

The resulting new national VMT for buses results in about a 9% overall reduction in VMT when compared to the FHWA county bus VMT. This is due to the lower national bus VPOP used and different Intercity-Transit-School VPOP mix in the 2014 IHS VPOP.

For the VPOP for buses, the county 2014 IHS VPOP for School and Transit buses was used as is. The VPOP for Intercity buses was reapportioned because these buses may be registered in one county and may be used nationally. This reapportionment used the U.S. total number of Intercity buses from the 2014 IHS VPOP and the newly, calculated national VMT for Intercity buses to estimate annual average VMT per Intercity bus in the following formula:

Annual average VMT for Intercity bus = new Intercity bus VMT / Intercity bus VPOP

This annual average VMT for Intercity buses was found to be ~ 53065 miles. This national average was used to reallocate Intercity bus VPOP by taking the derived county Intercity Bus VMT and dividing it by national annual average of 53065 miles:

New county Intercity bus VPOP = New county Intercity VMT / 53065 miles

By using the approach, the 2014 IHS VPOP national bus count was preserved in this new county VPOP for Intercity buses. The final national VMT and VPOP data for the EPA default version 2 are show in Table 6.

Table 6. National VPOP and VMT splits for the EPA-default 2014NEIv2 bus types

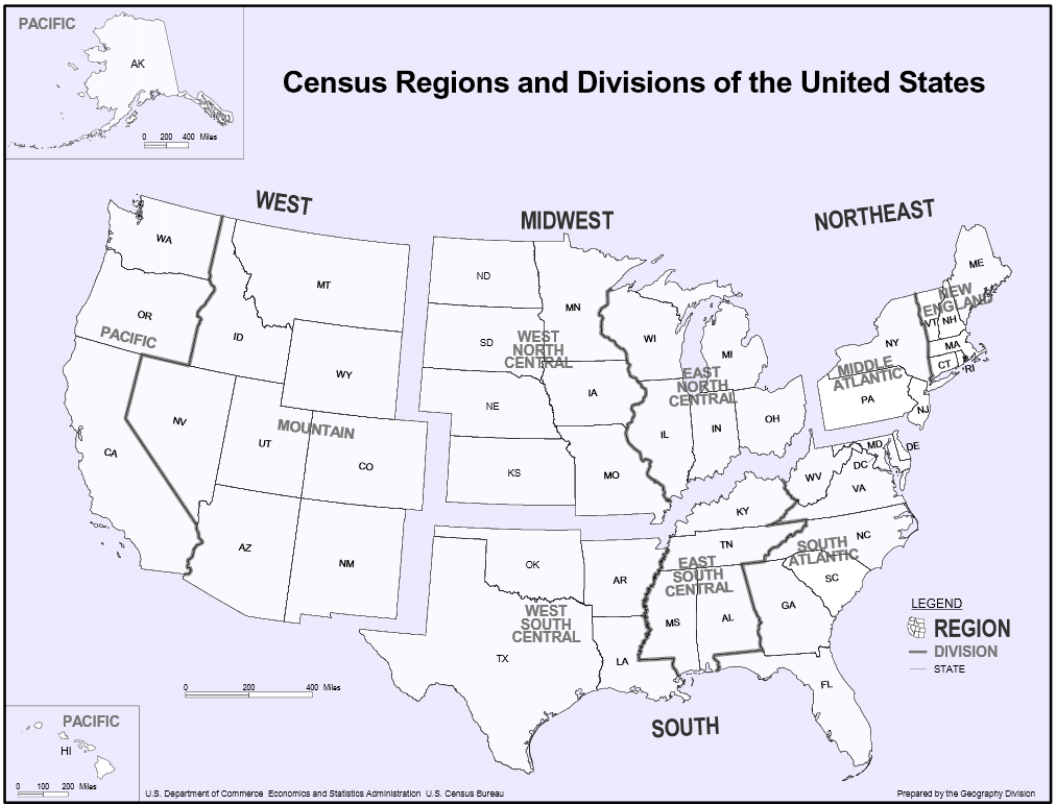
Bus type	VPOP_IHS (count)	VMT 2014NEIv2 default (millions of miles)	%total VMT	%total VPOP	Calculated Annual avg VMT per truck (miles)
Intercity	93013	4936	34.42%	14.32%	53066
Transit	31475	1412	9.85%	4.84%	44862
School	525168	7993	55.74%	80.84%	15220
Total	649656	14341	100.00%	100.00%	22075

Single-Unit Trucks (HPMSVtype 50)

In the development of VMT for the 2014NEIv1 for HPMSVType 50 (single-unit trucks), the EPA used activity data from the 2011 NEI modeling platform to develop county-level fractions to separate out the MOVES2014 refuse trucks (51) and motor homes (54) from the total HPMS single unit truck VMT. After the refuse trucks and motor homes were split out, the remainder was assumed to be the total for single unit long-haul (52) and short-haul (53) trucks. To determine long-haul vs. short-haul for single unit trucks, the EPA used VMT fractions derived from the Freight Analysis Framework (FAF), which produced unique allocations by region of the country (Figure 2), urban vs. rural, and interstate vs. non-interstate. For more information on FAF long-haul truck VMT estimates see CRC Report No. A-88, MOVES INPUT IMPROVEMENTS FOR THE 2011 NEI, Final Report, October 2014, available at:

http://www.crcao.org/reports/recentstudies2014/A-88/CRC%20A88%20Final%20Report%20102114.pdf

Figure 2. U.S. Census Regions



In the 2014NEIv2, the 2014 IHS VPOP county data were used to generate new VMT and VPOP for all single-unit truck types (51,52,53, and 54). In addition to the FHWA county VMT data used in 2014NEI version 1 and the 2014 IHS VPOP data, the following other sources were used to allocate single-unit truck VMT:

- State-submitted single-unit truck data by county for 2014NEIv1
- Year 2014 county human population census data
- Various documents to determine average annual miles traveled per type of single-unit trucks (e.g. FHWA, USDOT, https://www.afdc.energy.gov/data/10309).

The state-submitted data were used to get indications of how the single-unit truck splits (Refuse/Short-Haul/Long-Haul/Motorhome) may vary across the country. The state-submitted data were also another source used to evaluate average annual miles traveled per type of single-unit truck. Some of the findings from the state-submitted data and other data sources for single-unit VMT allocations are the following:

- Refuse trucks (51)
    - Average annual VMT for Refuse trucks does vary somewhat nationally:
        - State-submitted 2014NEIv1 data indicated annual VMT for Refuse trucks can vary between 20000-25000 miles
        - Other sources (FHWA, Dept. of Transportation, others) indicated average annual VMT for Refuse trucks vary from 20000 to 25000 miles

    - County VPOP and VMT for Refuse trucks is a function of county human population
- Single-unit short-haul trucks (52)
    - State-submitted 2014NEIv1 data indicated annual VMT for single-unit short-haul trucks can vary from 9000-15000 miles
- Single-unit long-haul trucks (53)
    - State-submitted 2014NEIv1 data indicated annual VMT for single-unit long-haul trucks can vary from 16000-20000 miles
- Motorhomes (54)
    - Average annual VMT for Motorhome trucks does vary somewhat nationally:
        - State-submitted 2014NEIv1 data indicated annual VMT for single-unit long-haul trucks can vary from 2500-5000 miles
        - Other sources (USDOT, NHTS etc.) indicated average annual VMT for Motorhomes vary from 3500 to 5000 miles
- All single-unit trucks
    - FHWA indicates annual average VMT for all single-unit trucks is about 13100 miles (Year 2014 VM-1 table)
    - The 2014 IHIS VPOP total vehicle count for all single-unit trucks (~8.2 million) is about the same as the FHWA VPOP single-unit truck count (~8.3 million according FHWA 2014 VM-1 table).

The approach for 2014NEIv2 VMT allocation results in the same FHWA total county single-unit truck VMT used in 2014NEIv1 but the allocations is based on the new 2014 IHS VPOP data. Given this approach it is important to understand that the 2014 IHS VPOP single-unit truck splits (Refuse-ShortHaul-LongHaul-Motorhome) changed significantly compared to the 2014NEIv1 and previous NEIs single-unit truck splits. Table 7 summarizes the single-unit truck VMT and VPOP for the 2014NEI version 1 (note includes state-submitted data).

Table 7. National VPOP and VMT splits for the 2014NEIv1 single-unit truck types

Single-unit truck type	VPOP 2014NEIv1 (vehicle count)	VMT 2014NEIv1 (millions of miles)	%total VMT	%total VPOP	Calculated Annual avg VMT per truck (miles)
Refuse (51)	167566	3443	3.51%	2.15%	20550
Short-Haul (52)	5933581	81795	83.26%	75.97%	13785
Long-Haul (53)	443773	10320	10.50%	5.68%	23254
Motorhomes (54)	1265816	2684	2.73%	16.21%	2121
Total	7810737	98243	100.00%	100.00%	12578

In order to estimate the impacts of the new VPOP data, national VPOP counts were generated by summing the county 2014 IHS VPOP for each single-unit truck type in Table 8. An average annual VMT per truck was also used (e.g. 24000 miles/year for a refuse truck) to get an estimated national 2014 IHS VPOP single-unit truck mix as shown in Table 8.

Table 8. Estimated national single-unit truck VMT using 2014 IHS VPOP and estimated average annual miles per truck

Single-unit truck type	2014 IHS VPOP (vehicle count)	Estimated Annual avg VMT per truck (miles)	Estimated VMT (millions of miles)	%total VMT	%total VPOP
Refuse	50361	24000	1209	1.09%	0.61%
Short-Haul	3,794,883	10000	37949	34.36%	46.00%
Long-Haul	3,701,174	18500	68472	62.00%	44.87%
Motorhomes	703160	4000	2813	2.55%	8.52%
Total	8249578		110442	100.00%	100.00%

Tables 7 and 8 indicate a significant shift of VMT and VPOP from Short-Haul trucks to Long-Haul trucks from 2014NEIv1 to the estimated vehicle mix using the new 2014 IHS VPOP and FHWA-derived county VMT datasets. Overall the total single-unit national VPOP for single-unit trucks increased by about 5% in 2014 IHS VPOP vs. 2014NEIv1 VPOP. The most significant change is that single-unit Long-Haul truck VPOP increased 730% in 2014 VPOP IHS vs. 2014NEIv1 VPOP. Other notable national VPOP changes were:

- Single-unit Short-Haul truck VPOP decreased 37% in the 2014 IHS VPOP
- Refuse trucks VPOP decreased 70% in the 2014 IHS VPOP
- Motorhomes VPOP decreased 45% in the 2014 IHS VPOP

The new estimated VMT and VPOP splits in Table 8 were used to quantify the importance of each single-unit truck type when generating actual new county VMT for 2014NEI version 2. The steps taken in developing the single-unit county VMT and VPOP are the following:

1. Refuse truck (51)
    a. The 2014 IHS county VPOP was reallocated for Refuse trucks by allocating the sum of Refuse trucks by state to the counties using year 2014 county human population data. This was done in an effort to better capture how Refuse trucks are used since Refuse trucks can be registered in one county and used in neighboring counties as well.
    b. The reallocated Refuse truck county VPOP generated in step #1a was multiplied by 24000 miles (assumed average annual miles traveled) to arrive at the final Refuse truck VMT for each county
2. Short-haul single-unit (52)
    a. An initial Short-Haul truck VMT was calculated by multiplying the county Short-Haul VMT by 10000 miles (assumed average annual miles traveled).
    b. The percentage contribution to total single-unit VMT by county was checked using this initial Short-Haul truck VMT.
    c. The data were bound based on general ranges seen in the state-submitted data for 2014NEIv1 activity data. For example, if the percentage contribution of Short-Haul VMT contribution was lower than 20% in a county, the Short-Haul VMT was adjusted so the percentage contribution equals 20%. If the percentage contribution of Short-Haul VMT contribution was greater than 75% in a county, the Short-Haul VMT was adjusted

so the percentage contribution equals 75%. These bounding steps impacted about 900 counties but resulted in the initial national Short-Haul VMT being reduced by about 5%.

3. Motorhome (54)
    a. An initial Motorhome VMT was estimated using 2014 IHS VPOP count by county and multiplying by 4000 miles (assumed average annual miles traveled)
    b. The data were bound based on general ranges seen in the state-submitted data for 2014NEIv1 activity data. For example, if the percentage contribution of Motorhome VMT to the total single-unit VMT contribution was lower than 0.5% in a county, the Motorhome VMT was adjusted so the percentage contribution equals 0.5%. If the percentage contribution of Motorhome VMT contribution was greater than 25% in a county, the Motorhome VMT was adjusted so the percentage contribution equals 25%. These bounding steps impacted about 300 counties but resulted in the initial national Motorhome VMT being reduced by about 4%.
4. Long-haul single-unit (53)
    a. The remaining county FHWA-derived VMT after subtracting out the refuse truck, short-haul single-unit truck and motorhome VMT was assumed to be the long-haul single-unit VMT
5. County VPOP reallocation for motorhomes and long-haul single-unit trucks
    a. VPOP for motorhomes (51) and long-haul single-unit trucks (53) were reapportioned because these trucks may be registered in one county and may be used nationally.
    b. Annual average VMT for each of these truck type was calculated using the following formula:
        i. Annual average VMT for truck type = new truck type VMT / truck type VPOP
        ii. This annual average VMT for Motorhomes was found to be ~ 3900 miles and about ~18600 miles for Long-Haul trucks.
    c. This national average was used to reallocate VPOP by taking the derived county truck type VMT and dividing it by national annual average from step 5b for each truck type:
        i. New county truck type VPOP = New county truck type VMT / National annual average VMT for truck type

By using the approach, the 2014 IHS VPOP truck count was preserved in this new county VPOP for each truck type. Table 9 illustrates the final national VMT and VPOP for 2014NEI version 2 after the above steps.

Table 9. Percentage VPOP and VMT splits for the EPA-default 2014NEIv2 single-unit truck types

Single-unit truck type	2014 IHS VPOP (2014NEIv2) (count)	VMT 2014NEIv2 default (millions of miles)	%total VMT	%total VPOP	Annual avg VMT per truck (miles)
Refuse	50361	1209	1.09%	0.61%	24000
Short-Haul	3,794,883	37592	34.05%	46.00%	9906
Long-Haul	3,701,174	68861	62.37%	44.87%	18605
Motorhomes	703160	2742	2.48%	8.52%	3900
Total	8249578	110404	100.00%	100.00%	13383

Combination Trucks (HPMSVtype 60)

In the development of VMT for the 2014NEI version 1 for HPMSVType 60 (combination trucks), to determine long-haul (62) vs. short-haul (61) for combination trucks, the EPA used VMT fractions derived from the Freight Analysis Framework (FAF), which produced unique allocations by region of the country (Figure 2), urban vs. rural, and interstate vs. non-interstate. This was the same information used for single-unit trucks mentioned earlier in this document.

In the 2014NEIv2, the 2014 IHS VPOP county data were used to generate new VPOP for all combination truck types (61 and 62). The total county VMT for combination trucks was assumed to be unchanged from the EPA default 2014NEI version 1. Since it was assumed that all combination trucks can be used outside of the county where they are registered, the following steps were taken to reapportion the VPOP for the short-haul and long-haul trucks. The annual average VMT for each of these truck type was calculated using the following formula:

Annual average VMT for truck type = new truck type VMT / truck type VPOP

This annual average VMT for short-haul trucks (61) was found to be ~ 57000 miles and for the long-haul trucks to be about ~68000 miles. This national average was used to reallocate VPOP by taking the derived county truck type VMT and dividing it by national annual average for each truck type:

New county truck type VPOP = New county truck type VMT / National annual avg. VMT for truck type

2014 County-level VMT by MOVES2014 Road Type, Source Type, and Fuel Type

To assign VMT from the FHWA functional types to the MOVES2014 road types, VMT was combined by the following table:

Table 10. MOVES2014 road types

roadTypeID	Description	FHWA Functional Types
2	Rural Interstate	Rural Interstate
3	Rural Unrestricted Access	Rural Principal Arterial, Minor Arterial, Major Collector, Minor Collector & Local
4	Urban Restricted Access	Urban Interstate & Urban Freeway/Expressway
5	Urban Unrestricted Access	Urban Principal Arterial, Minor Arterial, Collector & Local

The four MOVES road types (2-5) are thus aggregations of FHWA functional types.

2014 County-level VMT by HPMS Road Type, MOVES2014 Source Type and Fuel Type

To assign VMT to fuel type, the EPA used fuel fraction data from year 2014 IHS vehicle population databases for each MOVES source type. These data were placed into the MOVES CDBs and then the fully disaggregated data by fuel type, source type, and road type were extracted from the CDBs. The following table summarizes the fuel types available for onroad vehicles in MOVES:

Table 11. MOVES2014 fuel types

fuelTypeID	Description
1	Gasoline
2	Diesel Fuel
3	Compressed Natural Gas (CNG)
5	Ethanol (E-85) Capable

Hoteling Hours Development Procedures for Long-Haul Trucks

An analogous approach was used to develop hoteling hours for the long-haul trucks as was used for 2014NEIv. Default hoteling hours for the 2014 estimates based on VMT from 2014NEIv2 were derived as follows:

2014 hours = (2014 long-haul comb restricted (urban+rural) VMT) * (2014 National hoteling hours / 2014 National long haul comb. restricted (urban+rural) VMT)

The method starts by calculating a national rate of hoteling hours per mile of travel by long-haul combination trucks for both rural and urban restricted roads using a national MOVES2014a run. This rate is applied to the restricted access VMT (both urban and rural) in each county to calculate the total hotelling hours. The hours of extended idle versus auxiliary power unit (APU) use are calculated using the fraction calculated from the results of the national MOVES2014a run.

The final 2014NEIv2 activity data including state-submitted data are available from: ftp://newftp.epa.gov/Air/nei/2014/doc/2014v2_supportingdata/onroad/2014v2_onroad_activity_final.zip

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