Appendix I

Connecticut MOVES On-Road Modeling Documentation

MOVES (Motor Vehicle Emission Simulator) was used to calculate emissions for on-road vehicle emissions as directed in the Procedures for Emission Inventory Preparation, Volume IV: Mobile Sources[9, 10] and other guidance documents referenced in this appendix. National default values, EPA converters (http://www.epa.gov/otaq/models/moves/tools.htm) and EPA guidance conversion factor values were used for many of the input parameters. Some of the national defaults used include values such as:

< basic emission rates;
< low emission vehicle emission rate modification;
< I/M emission program rate adjustments;
< annual mileage accumulation rates; and
< diesel fractions, etc.

The MOVES model was run in inventory mode with the resulting emissions calculated for Fairfield and New Haven Counties. Separate MOVES inputs were developed for each county.

1 MOVES Inputs

1.1 Traffic Data

The Connecticut Department of Transportation (CT DOT) provided MOVES formatted Vehicle Miles Traveled (VMT) data for each county. CT DOT used their PERFORM travel demand forecasting model to develop VMT estimates. This model consists of a link-based network and trip generations, based on land use, employment, Census and car ownership data. Although the basic equations used to generate estimates have not changed, the data that drive the model are continually updated. Each update carries a series number and letter designation that represents intermediate updates. Series 29D was used for this inventory. All VMT estimates presented in this document were developed with the PERFORM model using estimates of employment, population, household characteristics, and vehicle availability data. These estimates were updated following the release of the 2005 Connecticut Department of Labor employment data. CT DOT has used a base form of this model to estimate and forecast VMT data since 1980.

The PERFORM model was used to generate VMT estimates because of its ability to estimate VMT by county with vehicle speeds included. It is also compatible with VMT tracking and analysis required under the Clean Air Act.

EPA requires the modeled VMT predictions to be consistent with data collected as part of the Highway Performance Monitoring System (HPMS) program. In the past, HPMS data were collected for each of the following 12 functional road classes/facility types listed below:

Table I.1.1-1. Old 12 HPMS Functional Road Classes

Rural	Urban
Interstate	Interstate
Other Principal Arterial	Other Freeways & Expressways
Minor Arterial	Other Principal Arterial
Major Collector	Minor Arterial
Minor Collector	Collector
Local	Local

In 2010 the Federal Highway Administration (FHWA), introduced the new 2010+ FHWA HPMS format. This new 2010+ FHWA HPMS format was needed to align ramp data to the MOVES road type since the entire Rural – Other Principal Arterial included restricted access freeways that could not be aligned to MOVES Rural restricted access road types. The FHWA identification scheme eliminated the rural/urban bifurcation and used a separate item to segregate rural, small urban and urbanized area designations. The Functional Classification Codes table below presents the new 2010+ FHWA HPMS functional classification codes.

Table I.1.1-2. The New 2010+ 14 HPMS Functional Road Classification Codes

Code	Functional Class Description	
	Rural	Urban
1	Interstate	Interstate
2	Other Freeways & Expressways	Other Freeways & Expressways
3	Other Principal Arterial	Other Principal Arterial
4	Minor Arterial	Minor Arterial
5	Major Collector	Major Collector
6	Minor Collector	Minor Collector
7	Local	Local

The differences between the old 12 HPMS functional road classes/facility types and the new 2010+ FHWA HPMS functional classification codes are the addition of the Rural - Other Freeways & Expressways and the disaggregation of the urban collector functional road class into Minor Collector and Major Collector. The CT DOT updated the EPA converter for the 16 vehicle type/12 road type to be a 16 vehicle type/14 road type to reflect the current FHWA HPMS standards. This resolved the problem of the "Other Principal Arterial" being a combination of both restricted and unrestricted access roads and allowed proper mapping of HPMS road types to MOVES road types.

Mappings used in the updated converter are presented in the table below. Road Type 12 and 30 were added with the associated road descriptions and mappings; and the associative meaning of road types 13 and 31 were modified from what is established in NMIM and the Source Classification definitions. These additions and modified meanings are contained within the converter and should not be applied to any Road Type definitions other than the updated converter. The modified or added identifiers or the associated meaning provided in the table below should not be used for anything other than understanding the mapping of 2010+ FHWA HPMS Road Types to MOVES Road Types within the updated converter.

Table I.1.1-3. New HPMS to MOVES Road Classification Mappings

DOT Created MOBILE6.2 Identifier			MOVES	
Road Type	**Area Type**	**Description (Road Description)**	**MOVES Road Type ID**	**Description (Road Description)**
11	Rural	Interstate	2	Rural restricted access
12	**Rural**	**Other Freeways and Expressways**	2	Rural restricted access
13	**Rural**	**Other Principal Arterial**	3	Rural unrestricted access
15	Rural	Minor Arterial	3	Rural unrestricted access
17	Rural	Major Collector	3	Rural unrestricted access
19	Rural	Minor Collector	3	Rural unrestricted access
21	Rural	Local	3	Rural unrestricted access
23	Urban	Interstate	4	Urban restricted access
25	Urban	Other Freeways and Expressways	4	Urban restricted access
27	Urban	Other Principal Arterial	5	Urban unrestricted access
29	Urban	Minor Arterial	5	Urban unrestricted access
30	**Urban**	**Major Collector**	5	Urban unrestricted access
31	**Urban**	**Minor Collector**	5	Urban unrestricted access
33	Urban	Local	5	Urban unrestricted access

To meet EPA's requirements, link volumes within the PERFORM model were stratified by HPMS functional class based on link location and facility type code. All highway network links in the model are individually coded for HPMS functional class. All HPMS functional classes are represented in the highway network. Intra-Zonal trips (those too short to get on the model network - less than 2% of the total VMT) are assigned an average trip length based on the size of the traffic analysis zone and were considered local road trips. The PERFORM model was adjusted in this manner to produce data for these road classifications.

CT DOT calibrated the 2009 model year VMT to 2009 HPMS VMT. These adjustments are carried throughout the forecasted years and are reflected in the 2017 and 2025 VMT estimates.

Connecticut had an average of 86.0 million VMT per day in 2009.

Validations of the PERFORM model were accomplished by comparing model output to known base data. In particular, HPMS VMT was an important basis of model validation and calibration.

A link by link assignment versus Average Daily Traffic (ADT) tabulation was made to examine expressway assignments. Graphic plots were used as a visual review of model output of the highway network, with assignments and ADTs posted on a link basis.

CT DOT also used a self-consistent equilibrium assignment process in that the state of equilibrium within the PERFORM model was determined by the closure ratio criterion. This is the ratio of the summation of the loaded network travel time to the projected summation of loaded travel time after capacity-restrained adjustment for the current iteration. The suggested default of 0.10 was retained for all assignment runs. This closure ratio was always attained at a point before the maximum number of iterations specified. The equilibrium assignment module uses volume-to-capacity ratios to adjust link speeds between iterations so that links are not over assigned.

VMT by geographic area is tabulated by four highway classifications: expressway, arterial/collector, local, and expressway ramp. Ramp VMT is estimated as a percentage of expressways' VMT based on the ratio of ramp mileage versus expressway mileage in each county. Ramp Vehicle Hour Traveled (VHT) is estimated by dividing Ramp VMT by the average speed for the appropriate road types set forth in MOBILE6.2 guidance.[8]

Connecticut used "Travel Activity by Vehicle Type and Functional System" data reported by CT DOT to the Federal Highway Authority for the HPMS program (see Table I.1.1-4a and Table I.1.1-4b). This report lists thirteen HPMS vehicle type percentages on the twelve road types outlined previously. These data don't categorize vehicle types in the same manner as MOBILE6.2.

HPMS vehicle fractions were converted to MOBILE6 vehicle fractions for input into a MOVES VMT Pre-processor by doing the following:

The HPMS vehicle count percentages were summed into light duty and heavy duty totals multiplied by the MOBILE6.2 vehicle mix for each HPMS road type. This generated a VMT fraction for each of the fourteen HPMS facility type by vehicle type for each MOBILE6.2 16 vehicle type on each road.

The thirteen vehicle groups associated with HPMS observations were summed into three groups, i.e. Light Duty Vehicle observations (LDVo), Heavy Duty Vehicles observations (HDVo) and Motorcycle observations (MCo) for each of the 14 HPMS road types. "Passenger Car" and "Other 2-Axle, 4-Tire Vehicles" vehicle count fraction observations were summed to get LDVo count fraction observations. "Motorcycle" count fraction observations were summed for count fraction observations and the remaining vehicle categories were summed for the HDVo count fraction observations group. All of the sums were done by the fourteen HPMS road types.

A Connecticut vehicle VMT fraction augmented default group totals of LDVt, HDVt and MCt per road were calculated from the augmented MOBILE6 default vehicle fractions. LDVt was a summation of VMT mix fractions for the MOBILE6.2 LDV and LDT1, LDT2, LDT3 and LDT4 vehicle classes. HDVt was a summation of the VMT mix fractions for the MOBILE6.2 HDV2B, HDV3, HDV4, HDV5, HDV6, HDV7, HDV8A and HDV8B vehicle classes. MCt was the MC

default.

EPA national default values from Table 4.1.2 (National Average Vehicle Miles Traveled Fractions by Vehicle Class Using MOBILE6.2) found in Section 4.1.4 of Reference 8 were augmented using an additional step to adjust the mix percentages. The LDV, LDT1, LDT2, LDT3, LDT4, HDV2B, HDV3, HDV4 and HDV5 vehicle class EPA national default mix values were localized using DMV registration data by age and national default mileage accumulation. This adjustment was based on the vehicle counts by vehicle class and by age from the vehicle age distribution analyses and EPA's Reference 15 annual mileage accumulation by vehicle class and by age, which was normalized to replace the existing LDV thru HDV5 values. The Connecticut fleet is comprised of more cars (LDV's) and heavier trucks than the national default and the adjustment of the national default values better aligns the MOVES VMT to the appropriate MOVES Source Types. It also better aligns the VMT apportionment to the appropriate vehicle age distribution. The localization of LDV thru HDV5 was based on the MOBILE6.2 to MOVES Source Type mapping and consideration of how the vehicles would operate within the state and be appropriately represented by local data. VMT mix calculations were normalized to the fractional value of the default values being replaced. The complete set of augmented default MOBILE6.2 VMT mix values includes a composite of original default values that were not modified from their original values (MC, HDV6, HDV7, HDBS, HDBT, HDV8A, and HDV8B) and localized default values that were modified as described in this paragraph (LDV, LDT1, LDT2, LDT3, LDT4, HDV2B, HDV3, HDV4, and HDV5).

The net result of the additional localization of the data includes an emission reduction due to a greater percentage of vehicle VMT being assigned to passenger cars (MOVES Source Type 21) and an emission increase due to a greater percentage of vehicle VMT being assigned to commercial trucks (MOVES Source Type 32). The VMT contribution from lighter trucks (MOVES Source Type 31) is reduced proportionally to the VMT contribution increases.

The preprocessing of the MOVES VMT converter HPMS input table used the methodology outlined in the MOBILE6.2 Technical Guidance[8] section 4.1.4: "Disaggregation of Local Information". Following the calculation of the complete set of augmented default VMT mix values and calculation of the VMT fraction augmented default group totals. A Connecticut specific table with MOBILE6.2 VMT mix values for each of the 14 HPMS road types was developed. This table was developed by multiplying the HPMS fractional observation count (LDVo, HDVo, MCo) times the augmented MOBILE6.2 default value divided by the MOBILE6.2 VMT fraction augmented default group totals (LDVt, HDVt and MCt) for each of the 16 MOBILE6.2 vehicle classes and each of the 14 HPMS road types. This table was formatted to obtain a Connecticut localized input table for the MOVES VMT converter. Table I.1.1-4.c presents the results of the above calculation in the form of the Connecticut MOVES converter input for fraction of VMT on HPMS Road Type by MOBILE6.2 16 Vehicle Type.

The state-specific vehicle mix data was entered into the MOBILE6 to MOVES converter for each road class, together with county level VMT (see Tables I.1.1-6a and 6b) for each of the 14 2010+ FHWA HPMS road types discussed above, the MOBILE6.2 VMT by hour data shown in Table I.1.1-7, the percent of Vehicle Hours Traveled on Ramps and the MOBILE6.2 Registration

Age Distribution so that appropriate MOVES inputs could be obtained. The CT DOT's updated EPA 16 vehicle type/14 road type converter supplied the following:

- A daily VMT value (HPMSvTypeYear) that was input to the EPA's average annual weekday vehicle miles traveled (aadvmtcalculator_hpms.xls) converter to generate annual VMT by MOVES HPMSVTypeID;
- An hourly fraction (HourVMTFraction) for each MOVES Source Type for each hour and day type (weekday and weekend);
- A road type VMT fraction (RoadTypeDistribution) which indicates the fraction VMT that a MOVES Source Type travels on each MOVES road type. The sum of all road type fractions will be a value of one for each MOVES source type and a value for road type 1 is required, but it will always be zero;
- An hourly fraction (VHT fraction aka RoadType) of the time spent on ramps relative to the total time spent on each restricted MOVES road type ramp (restricted road types are also called limited access road types);
- And a SourceTypeAgeDistribution that could be used or compared to a more accurate directly calculated age distribution obtained directly from registration data.

In addition to producing annual VMT by MOVES HPMSVTypeID mentioned above, EPA's average annual weekday vehicle miles traveled (aadvmtcalculator_hpms.xls) converter also produced the dayVMTFraction and monthVMTFraction inputs for input to the MOVES Model. In addition to inputting a daily VMT value, Connecticut entered seasonal VMT adjustments based on winter, summer and annual VMT estimates to localize monthly adjustment factors. Weekday versus weekend factors were not altered from the EPA default values provided. Tables I.1.1-8a and I.1.1-8b show the total annual VMT by MOVES HPMSVTypeID.

Variations in speed on the network are accounted for by the use of a MOBILE6 input file depicting the speed distribution of VMT (in percentage form) for freeways and arterials only. A conversion is made internally to equate CT DOT's VMT speeds to the MOBILE6 speed ranges, shown as follows: The MOBILE6 speed distributions for freeways and arterials were input to the EPA's MOBILE6 to MOVES MS Excel Average Speed Converter to obtain MOVES inputs (http://www.epa.gov/otaq/models/moves/tools/averagespeedconverter_mobile6.xls). The converter provides a mapping, an extrapolation to include extra speed bins and a conversion of the fractions assigned to each speed bin to a new vehicle hour traveled basis, rather than the previous vehicle mile travel basis previously used in MOBILE6.2. Table I.1.1-5 illustrates the MOBILE6.2 to MOVES speed bin mapping.

Table I.1.1-4a.
HPMS TRAVEL ACTIVITY PERCENTAGES BY VEHICLE TYPE AND FUNCTIONAL SYSTEM CONNECTICUT–2010

	Road Class: Rural						
VEHICLE TYPE	**Interstate**	**Other Freeway & Expressway**	**Other Principal Arterial**	**Minor Arterial**	**Major Collector**	**Minor Collector (NOTE*)**	**Local**
Motorcycle	0.00%	0.00%	2.19%	2.28%	0.93%	0.27%	0.75%
Passenger Car	74.29%	79.47%	75.35%	75.41%	80.51%	83.80%	78.62%
Light Truck	13.61%	14.11%	15.72%	17.84%	16.50%	12.74%	18.61%
Buses	0.25%	0.10%	0.11%	0.01%	0.03%	0.00%	0.02%
2-Axle, 6-Tire Single Trucks	2.72%	3.21%	1.01%	1.18%	1.17%	1.04%	1.43%
3-Axle Single Trucks	0.74%	0.60%	1.80%	1.22%	0.38%	0.78%	0.42%
4 Or More Axle Single Trucks	0.17%	0.23%	0.52%	0.27%	0.06%	0.62%	0.07%
4 Or Less Axle Trailer Trucks	1.09%	0.42%	0.91%	0.67%	0.17%	0.48%	0.06%
5-Axle Trailer Trucks	6.94%	1.86%	1.38%	1.06%	0.25%	0.18%	0.03%
6 Or More Axle Trailer Trucks	0.15%	0.03%	0.67%	0.05%	0.01%	0.09%	0.00%
5 Or Less Axle Tandem Trucks	0.03%	0.00%	0.27%	0.00%	0.00%	0.00%	0.00%
6-Axle Tandem Trucks	0.01%	0.00%	0.07%	0.00%	0.00%	0.00%	0.00%
7 Or More Tandem Trucks	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%
TOTAL	100.00%	100.03%	100.00%	99.99%	100.01%	100.00%	100.01%

* NOTE: Rural Minor Collector mixes no longer tabulated for HPMS; the mixes shown are from 1999 HPMS.

Table I.1.1-4b:
HPMS TRAVEL ACTIVITY PERCENTAGES BY VEHICLE TYPE AND FUNCTIONAL SYSTEM CONNECTICUT-2010

	Road Class: Urban						
VEHICLE TYPE	**Interstate**	**Other Freeway & Expressway**	**Other Principal Arterial**	**Minor Arterial**	**Major Collector**	**Minor Collector**	**Local**
Motorcycle	0.05%	0.11%	0.71%	0.67%	0.63%	0.67%	1.55%
Passenger Car	78.68%	82.48%	79.48%	83.01%	81.98%	82.08%	80.57%
Light Truck	12.14%	12.83%	16.17%	14.45%	15.33%	13.84%	14.87%
Buses	0.23%	0.09%	0.09%	0.10%	0.01%	0.00%	0.01%
2-Axle, 6-Tire Single Trucks	2.32%	2.08%	1.49%	1.08%	1.04%	2.31%	1.23%
3-Axle Single Trucks	0.52%	0.46%	0.64%	0.30%	0.58%	0.27%	0.91%
4 Or More Axle Single Trucks	0.14%	0.18%	0.17%	0.08%	0.07%	0.04%	0.48%
4 Or Less Axle Trailer Trucks	0.75%	0.38%	0.37%	0.13%	0.17%	0.21%	0.15%
5-Axle Trailer Trucks	4.88%	1.34%	0.73%	0.19%	0.17%	0.44%	0.18%
6 Or More Axle Trailer Trucks	0.06%	0.03%	0.03%	0.01%	0.02%	0.14%	0.04%
5 Or Less Axle Tandem Trucks	0.18%	0.02%	0.10%	0.00%	0.00%	0.00%	0.00%
6-Axle Tandem Trucks	0.06%	0.01%	0.00%	0.00%	0.00%	0.00%	0.00%
7 Or More Tandem Trucks	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%
TOTAL	100.01%	100.01%	99.98%	100.02%	100.00%	100.00%	99.99%

Table I.1.1-4.c. MOVES Converter Input for Fraction of VMT on HPMS Road Type by MOBILE6.2 16 Vehicle Type

Vehicle Type	11	12	13	15	17	19	21	23	25	27	29	30	31	33
1	0.4793	0.5103	0.4966	0.5085	0.5290	0.5264	0.5302	0.4952	0.5197	0.5215	0.5314	0.5307	0.5230	0.5204
2	0.0677	0.0721	0.0702	0.0718	0.0747	0.0744	0.0749	0.0700	0.0734	0.0737	0.0751	0.0750	0.0739	0.0735
3	0.2253	0.2398	0.2334	0.2390	0.2486	0.2474	0.2492	0.2328	0.2443	0.2451	0.2498	0.2494	0.2458	0.2446
4	0.0731	0.0778	0.0757	0.0775	0.0806	0.0802	0.0808	0.0755	0.0792	0.0795	0.0810	0.0809	0.0797	0.0793
5	0.0336	0.0358	0.0348	0.0357	0.0371	0.0369	0.0372	0.0348	0.0365	0.0366	0.0373	0.0372	0.0367	0.0365
6	0.0370	0.0196	0.0206	0.0137	0.0063	0.0098	0.0062	0.0279	0.0140	0.0111	0.0057	0.0063	0.0104	0.0092
7	0.0105	0.0056	0.0058	0.0039	0.0018	0.0028	0.0018	0.0079	0.0040	0.0031	0.0016	0.0018	0.0030	0.0026
8	0.0052	0.0028	0.0029	0.0019	0.0009	0.0014	0.0009	0.0039	0.0020	0.0016	0.0008	0.0009	0.0015	0.0013
9	0.0025	0.0013	0.0014	0.0009	0.0004	0.0007	0.0004	0.0019	0.0009	0.0007	0.0004	0.0004	0.0007	0.0006
10	0.0078	0.0042	0.0044	0.0029	0.0013	0.0021	0.0013	0.0059	0.0030	0.0024	0.0012	0.0013	0.0022	0.0019
11	0.0093	0.0049	0.0052	0.0034	0.0016	0.0024	0.0016	0.0070	0.0035	0.0028	0.0014	0.0016	0.0026	0.0023
12	0.0101	0.0054	0.0056	0.0037	0.0017	0.0027	0.0017	0.0076	0.0038	0.0030	0.0016	0.0017	0.0028	0.0025
13	0.0359	0.0191	0.0200	0.0133	0.0061	0.0095	0.0060	0.0271	0.0136	0.0108	0.0056	0.0061	0.0101	0.0089
14	0.0018	0.0010	0.0010	0.0007	0.0003	0.0005	0.0003	0.0014	0.0007	0.0005	0.0003	0.0003	0.0005	0.0004
15	0.0009	0.0005	0.0005	0.0003	0.0002	0.0002	0.0002	0.0007	0.0003	0.0003	0.0001	0.0002	0.0003	0.0002
16	0.0000	0.0000	0.0219	0.0228	0.0093	0.0027	0.0075	0.0005	0.0011	0.0071	0.0067	0.0063	0.0067	0.0155
Sum	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	0.9999	1.0001	1.0000	1.0000	1.0000

Table I.1.1-5. MOBILE6.2 to MOVES Speed Bin Mapping

MOBILE6 Speed Bins			MOVES Speed Bins		
Bin Number	Abbreviation	Description	avgSpeedBinID	avgBinSpeed	avgSpeedBinDesc
1	2.5 mph	Miles with average speed 0-2.5 mph	1	2.5	speed < 2.5mph
2	5 mph	Miles with average speed 2.5-7.5 mph	2	5	2.5mph <= speed < 7.5mph
3	10 mph	Miles with average speed 7.5-12.5 mph	3	10	7.5mph <= speed < 12.5mph
4	15 mph	Miles with average speed 12.5-17.5 mph	4	15	12.5mph <= speed < 17.5mph
5	20 mph	Miles with average speed 17.5-22.5 mph	5	20	17.5mph <= speed <22.5mph
6	25 mph	Miles with average speed 22.5-27.5 mph	6	25	22.5mph <= speed < 27.5mph
7	30 mph	Miles with average speed 27.5-32.5 mph	7	30	27.5mph <= speed < 32.5mph
8	35 mph	Miles with average speed 32.5-37.5 mph	8	35	32.5mph <= speed < 37.5mph
9	40 mph	Miles with average speed 37.5-42.5 mph	9	40	37.5mph <= speed < 42.5mph
10	45 mph	Miles with average speed 42.5-47.5 mph	10	45	42.5mph <= speed < 47.5mph
11	50 mph	Miles with average speed 47.5-52.5 mph	11	50	47.5mph <= speed < 52.5mph
12	55 mph	Miles with average speed 52.5-57.5 mph	12	55	52.5mph <= speed < 57.5mph
13	60 mph	Miles with average speed 57.5-62.5 mph	13	60	57.5mph <= speed < 62.5mph
14	65 mph	Miles with average speed >62.5 mph	14	65	62.5mph <= speed < 67.5mph
			15	70	67.5mph <= speed < 72.5mph
			16	75	72.5mph <= speed

Data used for AvgSpeedBinIDs 14, 15, and 16 are based on MOBILE6/NMIM Bin Number = 14 and the converter "Bin14-16 DefaultDist" worksheet fractions 0.5700 Speed Bin 14, 0.2900 Speed Bin 15 and 0.1400 Speed Bin 16.

Table I.1.1-6a.
Fairfield County Daily VMT Inputs for the MOBILE6 to MOVES VMT Converter

HPMS Road Type	Area Type	Description (RoadDesc)	2009 VMT (Million Miles)	2017 VMT (Million Miles)	2025 VMT (Million Miles)
11	Rural	Interstate	0.00	0.00	0.00
12	**Rural**	**Other Freeways and Expressways (1)**	0.00	0.00	0.00
13	**Rural**	**Other Principal Arterial (1)**	0.06	0.09	0.09
15	Rural	Minor Arterial	0.12	0.12	0.13
17	Rural	Major Collector	0.45	0.46	0.49
19	Rural	Minor Collector	0.08	0.08	0.09
21	Rural	Local	0.07	0.07	0.08
23	Urban	Interstate	6.39	6.69	6.95
25	Urban	Other Freeways and Expressways	3.62	3.94	4.15
27	Urban	Other Principal Arterial	2.17	2.37	2.47
29	Urban	Minor Arterial	4.09	4.28	4.55
30	**Urban**	**Major Collector (1)**	1.62	1.75	1.86
31	**Urban**	**Minor Collector (1)**	0.04	0.04	0.04
33	Urban	Local	1.71	1.83	1.94

Note 1: Road Type 12 and 30 were added with the associated road descriptions and mappings; the associative meaning of road types 13 and 31 were modified from what is established in NMIM and the Source Classification definitions. These additions and modified meanings are totally contained within the converter and should not be applied to any Road Type definitions other than the updated converter. Do not use the modified or added identifiers or the associated meaning provided in the table below for anything other than understanding the mapping of 2010+ FHWA HPMS Road Types to MOVES Road Types within the updated converter.

Table I.1.1-6b.
New Haven County Daily VMT Inputs for the MOBILE6 to MOVES VMT Converter

HPMS Road Type	Area Type	Description (RoadDesc)	2009 VMT (Million Miles)	2017 VMT (Million Miles)	2025 VMT (Million Miles)
11	Rural	Interstate	0.26	0.28	0.30
12	**Rural**	**Other Freeways and Expressways (1)**	0.00	0.00	0.00
13	**Rural**	**Other Principal Arterial (1)**	0.11	0.08	0.08
15	Rural	Minor Arterial	0.17	0.18	0.20
17	Rural	Major Collector	0.18	0.19	0.21
19	Rural	Minor Collector	0.03	0.03	0.04
21	Rural	Local	0.07	0.06	0.07
23	Urban	Interstate	7.13	7.50	7.99
25	Urban	Other Freeways and Expressways	2.98	3.18	3.32
27	Urban	Other Principal Arterial	2.50	2.72	2.85
29	Urban	Minor Arterial	3.76	4.09	4.37
30	**Urban**	**Major Collector (1)**	1.36	1.52	1.66
31	**Urban**	**Minor Collector (1)**	0.03	0.03	0.04
33	Urban	Local	1.30	1.41	1.50

Note 1: Road Types 12 and 30 were added with the associated road descriptions and mappings; the associative meaning of road types 13 and 31 were modified from what is established in NMIM and the Source Classification definitions. These additions and modified meanings are totally contained within the converter and should not be applied to any Road Type definitions other than the updated converter. Do not use the modified or added identifiers or the associated meaning provided in the table below for anything other than understanding the mapping of 2010+ FHWA HPMS Road Types to MOVES Road Types within the updated converter.

Table I.1.1-7. CT MOBILE6 Hour Input File

MOBILE6.2 Input File

VMT BY HOUR
* CTHVMT.def ... March 2010
* Based on Connecticut ATR Counts (April & October 2009)
* Fraction of all vehicle miles traveled by hour of the day.
* First hour is 6 a.m.

0.0439 0.0677 0.0662 0.0537 0.0500 0.0524
0.0556 0.0569 0.0641 0.0747 0.0791 0.0786
0.0606 0.0443 0.0352 0.0287 0.0218 0.0160
0.0094 0.0060 0.0045 0.0047 0.0073 0.0184

Table I.1.1-8a. Fairfield County Annual VMT

	2009	2017	2025
HPMSVTypeID	**HPMSBaseYearVMT**	**HPMSBaseYearVMT**	**HPMSBaseYearVMT**
10	30,407,294.31	35,823,980.13	37,853,983.75
20	3,546,597,097.10	3,896,798,411.29	4,095,948,620.93
30	3,126,918,778.06	3,419,981,441.68	3,593,797,588.98
40	8,567,567.10	8,609,354.80	8,998,019.17
50	49,694,169.52	49,881,515.88	52,119,875.92
60	143,914,700.49	144,918,020.19	151,534,056.07

Table I.1.1-8b. New Haven County Annual VMT

	2009	2017	2025
HPMSVTypeID	**HPMSBaseYearVMT**	**HPMSBaseYearVMT**	**HPMSBaseYearVMT**
10	30,407,294.31	32,721,319.19	34,821,446.94
20	3,546,597,097.10	3,802,797,003.64	4,035,023,377.49
30	3,126,918,778.06	3,350,999,095.81	3,555,591,222.48
40	8,567,567.10	9,084,303.93	9,634,093.94
50	49,694,169.52	52,633,311.25	55,804,257.70
60	143,914,700.49	152,912,659.69	162,246,079.20

1.2 Other MOVES Input Data

1.2.1 Meteorological Data:

MOVES meteorological inputs consist of temperature and humidity data for months, zones (counties) and hours included in the MOVES run specification. Temperature and to a lesser extent humidity change emission estimates, consequently assumptions used for regional conformity analyses must be consistent with those used to establish the emissions budget in the SIP as required in the transportation conformity rule, 40 CFR §93.122(a)(6).[16] MOVES meteorological inputs for the MARAMA modeling effort used the NMIM National County Database (version NCD20090531) for 2007.[6] The temperature and humidity used remained consistent with the 2007 NCD20090531 data to maintain a consistency with these prior analyses.

1.2.2 Inspection and Maintenance:

Connecticut's Inspection and Maintenance (I/M) program for motor vehicle emission testing began in 1983. The current I/M program reflects significant changes made in 1998 and 2003 in response to changes in federal and Connecticut statutory requirements. The inspection network is a decentralized system with a contractor-equipped limit of 300 stations. Cars and trucks having a gross vehicle weight rating (GVWR) of 10,000 pounds or less are subject to biennial I/M program testing. The I/M program requires all subject vehicles manufactured less than twenty-five years ago be tested for emissions, except for vehicles less than four years old. Gasoline-powered vehicles model year 1996 or newer and having a GVWR of 8,500 pounds or less receive OBDII inspections. OBDII is the current (second generation) On-Board Diagnostics electronic system that includes the most up-to-date comprehensive system monitors in vehicles starting with model year 1996. OBDII testing involves checks to ensure the OBDII system is properly operating. The emission tests for gasoline-powered vehicles having a GVWR of 8,500 pounds or less that are model year 1995 or older is a loaded-mode test (ASM2525) and a gas cap pressure test. A 1995 or older vehicle that cannot be tested on a dynamometer or any gasoline-powered vehicle having a GVWR between 8,500 pounds and 10,000 pounds receives an idle test. Light-duty (<8500 lb. GVWR) diesel-powered vehicles model year 1997 or newer receive OBD inspections. Diesel-powered vehicles receive testing for excessive exhaust smoke if they do not receive OBDII tests.

MOVES inputs reflect the characteristics and statistics of the Connecticut I/M program. I/M data for 2009 runs were obtained from the 2007 Annual Evaluation of Connecticut's Inspection/Maintenance Program[4]. I/M data for future year runs were obtained from the Revision to Connecticut's State Implementation Plan Enhanced Motor Vehicle Inspection and Maintenance Program[2]. Compliance and Waiver Rates were modified to specific values based on evaluations of test data collected from January 1, 2006 to December 31, 2007. The specific compliance and waiver rate values for each program are shown later in this write-up when the calculation of MOVES complianceFactor is detailed.

In MOVES, the I/M program is defined by the MOVES imcoverage table and includes the state, county and year IDs as well as pollutant process ID, source type ID, fuel type ID, I/M program

ID, inspection frequency, test standards ID, beginning and ending model years, and a compliance factor. It also includes a column labeled “useIMyn” which allows the user to turn off (“N”) or on (“Y”) the portion of the I/M program described in that row of the table.

The first step in the process is to eliminate all the EPA defaults, by setting the useIMyn field for each of these entries to “N”. The values are not appropriate for Connecticut and it is cleaner to upload consistent of Connecticut specific data.

All Connecticut counties use the same I/M program, thus I/M mappings and parameters will be consistent throughout the state. Table I.1.2-1 identifies the MOVES imcoverage table mapping of I/M program ID (IMProgramID), inspection frequency (inspectionFreq) and test standards ID (testStandardsID) to the MOVES imteststandards table testStandardDesc field and to the MOBILE6.2 I/M Header Comment Description.

Table I.1.2-1. I/M Input Program Mapping MOVES to MOBILE6.2

IMProgramID	inspectFreq	testStandardsID	testStandardsDesc	MOBILE6.2 I/M Header Comment Description
11	2	51	Exhaust OBD Check	Biennial OBDII I/M "tailpipe" test for post-MY1995 gasoline vehicles up to 8,500 lbs GVWR
12	2	43	Evaporative System OBD Check	Biennial OBDII evaporative "test" for post-MY1995 gasoline vehicles up to 8,500 lbs GVWR
15	2	24	ASM 2525 Final Cutpoints	Biennial ASM I/M tailpipe test for pre-96 gasoline vehicles up to 8,500 lbs GVWR
16	2	41	Evaporative Gas Cap Check	Biennial Gas Cap evaporative test for pre-96 gasoline vehicles up to 8,500 lbs GVWR
13	2	12	Two-mode, 2500 RPM/Idle Test	Biennial 2500/IDLE I/M tailpipe test for all HDGT 8,500 - 10,000 lbs GVWR
14	2	41	Evaporative Gas Cap Check	Biennial GC evaporative "test" for all HDGT 8,500 - 10,000 lbs

MOVES uses two fields in the imcoverage table to specify the beginning and ending model years affected by a particular part of the I/M program. For I/M programs without a grace period for new vehicles or an exemption period for older vehicles, this is simply the first and last model year affected by the program. Since Connecticut I/M program has a grace period and an exemption age the beginning and ending model years values change for every run year and the values are calculated from the I/M Program effective dates and/or the I/M GRACE PERIOD (4 years) and the I/M EXEMPTION AGE (25 years). For example, inputs for the 2009 analysis year would correspond to the beginning (begModelYearID) and ending (endModelYearID) model years in the table below. OBD based programs (IMProgamID 11 and 12) program start date is later that the beginning model year associated with the 25 year exemption consequently the first model year tested by the program is the first OBDII model year defined by the program while other beginning model year values that apply to older vehicles are set at the value associated with the 25 year exemption (i.e. 2009-25+1= 1985 for IMProgramID's 13, 14, 15, 16). In 2019, biennial ASM I/M tailpipe and GC evaporative test for pre-96 gasoline vehicles up to 8,500 lbs GVWR drop out of the I/M inputs due to the exemption age. As was the case for exemption age the grace period only programs with vehicle model years falling within the grace periods' influence for the selected run year are impacted by the grace period. The ending model year for the biennial ASM I/M tailpipe and GC evaporative test for pre-96 gasoline vehicles up to 8,500 lbs GVWR I/M programs are 1995 (IMProgramID 15 and 16) and is thus not impacted by the grace period. The ending model year for all other I/M programs are set based on the grace period of four years (i.e. 2009-4+1). A plus one is included in both the exemption and grace period calculations to account for the model year preceding the calendar year.

Table I.1.2-2. Connecticut Begin and End Model Years for 2009 MOVES Run

IMProgramID	begModelYearID	endModelYearID	useIMyn
11	1996	2006	Y
12	1996	2006	Y
15	1985	1995	Y
16	1985	1995	Y
13	1985	2006	Y
14	1985	2006	Y

Guidance on I/M inputs is provided in EPA's "Technical Guidance on the Use of MOVES2010 for Emission Inventory Preparation in State Implementation Plans and Transportation Conformity"[16]. This document provides specific guidance on the MOVES source types (vehicles), pollutants and processes allowed by the type of I/M program and provides specific direction on the calculation of the value to be entered in the imcoverage table complianceFactor field.

MOVES estimates emission reductions from I/M programs for hydrocarbons, NOx, and CO. For exhaust emissions, I/M programs can affect both running and start emissions. For evaporative emissions, I/M programs affect hydrocarbon emissions from fuel vapor venting and fuel leaks. The calculated imcoverage table complianceFactor field value is calculated for each I/M program and fuel type, MOVES Source type and does not vary for polProcessID assignments within the source type within the program. The table below shows the I/M program to polProcess assignments with processID, pollutantID and descriptions obtained from the emissionprocess, pollutant and pollutantprocessassoc tables provided by EPA in MOVES default database.

Table I.1.2-3. I/M Program Pollutant and Process Associations

IMProgramID	polProcessID	processID	processName	pollutantID	pollutantName
11	101	1	Running Exhaust	1	Total Gaseous Hydrocarbons
11	102	2	Start Exhaust	1	Total Gaseous Hydrocarbons
11	201	1	Running Exhaust	2	Carbon Monoxide (CO)
11	202	2	Start Exhaust	2	Carbon Monoxide (CO)
11	301	1	Running Exhaust	3	Oxides of Nitrogen
11	302	2	Start Exhaust	3	Oxides of Nitrogen
12	112	12	Evap Fuel Vapor Venting	1	Total Gaseous Hydrocarbons
12	113	13	Evap Fuel Leaks	1	Total Gaseous Hydrocarbons
15	101	1	Running Exhaust	1	Total Gaseous Hydrocarbons
15	102	2	Start Exhaust	1	Total Gaseous Hydrocarbons
15	201	1	Running Exhaust	2	Carbon Monoxide (CO)
15	202	2	Start Exhaust	2	Carbon Monoxide (CO)
15	301	1	Running Exhaust	3	Oxides of Nitrogen

Table I.1.2-3. I/M Program Pollutant and Process Associations

IMProgramID	polProcessID	processID	processName	pollutantID	pollutantName
15	302	2	Start Exhaust	3	Oxides of Nitrogen
16	112	12	Evap Fuel Vapor Venting	1	Total Gaseous Hydrocarbons
16	113	13	Evap Fuel Leaks	1	Total Gaseous Hydrocarbons
13	101	1	Running Exhaust	1	Total Gaseous Hydrocarbons
13	102	2	Start Exhaust	1	Total Gaseous Hydrocarbons
13	201	1	Running Exhaust	2	Carbon Monoxide (CO)
13	202	2	Start Exhaust	2	Carbon Monoxide (CO)
13	301	1	Running Exhaust	3	Oxides of Nitrogen
13	302	2	Start Exhaust	3	Oxides of Nitrogen
14	112	12	Evap Fuel Vapor Venting	1	Total Gaseous Hydrocarbons
14	113	13	Evap Fuel Leaks	1	Total Gaseous Hydrocarbons

MOVES currently calculates I/M program benefits only for gasoline vehicles (fuelTypeID=1 gasoline), so the inputs and this discussion are limited to gasoline vehicles only. A duplication of the fuelTypeID =1 was entered for the placeholder fuel (fuelTypeID=5) for possible future use, but this fuel type was not used in Connecticut's runs.

I/M programs are applied to vehicles by regulatory weight class; however, MOVES applies I/M benefits by source type. This leads to discrepancies between the vehicle regulatory classes covered in the actual I/M program and the vehicle regulatory classes that MOVES assumes are covered when the MOVES source type definition combines vehicles that are included in an I/M program with vehicles that are not included in an I/M program. For example, an I/M program that targets trucks less than 8501 lbs. Gross Vehicle Weight Rating (GVWR) (i.e. regulatory classes LDT1, LDT2, LDT3, and LDT4) or Heavy Duty Gas Truck I/M Programs for trucks 8,501 to 10,000 lbs GVWR (HDV2B) would include parts of two MOVES source types: passenger trucks (sourcetypeID 31) and light commercial trucks (32). However, these source types also include vehicles with GVWR less than 8,501 lbs., GVWR greater than 8500 lbs, and GVWR greater than 10,000 lbs. Only one I/M program can be applied to the source type, so either separate runs are needed and a composite complianceFactor value would need to be calculated and assigned when more than one I/M program applied to any Source Type. When an I/M program is applied to source types 31 and 32 in MOVES, all of the vehicles in these source types get I/M benefits, including the HDV3, HDV4 and HDV5 vehicles that are not subject to I/M testing. EPA guidance directs users to adjust the compliance factor (complianceFactor field

value) to account for the fraction of vehicles within a source type that are actually covered by the I/M program[16]. Regulatory Class Coverage Adjustments for each MOVES source type were extracted from EPA Technical Guidance Table A.3 Gasoline I/M Regulatory Coverage Adjustments[16] and were entered for each applicable MOBILE6.2 Regulatory Class and I/M program in the tables below. The complianceFactor and waiver rates used for 2009 were obtained from the 2007 Annual I/M Report[4] (96.7% compliance rate and waiver rates are presented in the 2009 Base Year I/M Compliance Factor Calculations table). Future year I/M program complianceFactor values were based on compliance rate (96%) and waiver rates (1.0%) specified in the I/M SIP[2]. The I/M complianceFactor doesn't comprise an adjustment to include the HDV2B I/M program and separate MOVES runs for the HDV2B program were not performed for this report. Analyses of MOVES runs for the HDV2B I/M program showed the benefit to be very low. Further, the deviation of the VMT contributions of regulatory classes within the MOVES source types 31 and 32 favor a more conservative and less complicated approach; not crediting the HDV2B I/M program would not only be less prone to error, but may also be a more accurate estimate of emissions.

Table I.1.2-4. 2009 Base Year I/M Compliance Factor Calculations

IMProgramID	sourceTypeID	MOBILE6.2 Regulatory Class Abbreviation	Regulatory Class Coverage Adjustment (%)	compliance rate	waiver rate	complianceFactor
11	21	LDV	100%	96.7	0.61	96.11013
11	31	LDT1	31%			
		LDT2	31%			
		LDT3	16%			
		LDT4	16%			
			94%	96.7	0.61	90.3435222
11	32	LDT1	29%			
		LDT2	29%			
		LDT3	15%			
		LDT4	15%			
			88%	96.7	0.61	84.5769144
12	21	LDV	100%	96.7	0.61	96.11013
12	31	LDT1	31%			
		LDT2	31%			
		LDT3	16%			
		LDT4	16%			
			94%	96.7	0.61	90.3435222
12	32	LDT1	29%			
		LDT2	29%			
		LDT3	15%			
		LDT4	15%			
			88%	96.7	0.61	84.5769144
15	21	LDV	100%	96.7	0.59	96.12947
15	31	LDT1	31%			
		LDT2	31%			
		LDT3	16%			

Table I.1.2-4. 2009 Base Year I/M Compliance Factor Calculations

IMProgramID	sourceTypeID	MOBILE6.2 Regulatory Class Abbreviation	Regulatory Class Coverage Adjustment (%)	compliance rate	waiver rate	complianceFactor
		LDT4	16%			
			94%	96.7	0.59	90.3617018
15	32	LDT1	29%			
		LDT2	29%			
		LDT3	15%			
		LDT4	15%			
			88%	96.7	0.59	84.5939336
16	21	LDV	100%	96.7	0.00	96.7
16	31	LDT1	31%			
		LDT2	31%			
		LDT3	16%			
		LDT4	16%			
			94%	96.7	0.00	90.898
16	32	LDT1	29%			
		LDT2	29%			
		LDT3	15%			
		LDT4	15%			
			88%	96.7	0.00	85.096
13	31	HDV2B	3%	96.7	0.27	2.8931673
13	32	HDV2B	5%	96.7	0.27	4.8219455
14	31	HDV2B	3%	96.7	0.00	2.901
14	32	HDV2B	5%	96.7	0.00	4.835

Table I.1.2-5. 2009 Base and Future Year Compliance Factor Results

IMProgramID	sourceTypeID	2009 complianceFactor	Future Year complianceFactor
11	21	96.11013	95.04
11	31	90.3435222	89.3376
11	32	84.5769144	83.6352
12	21	96.11013	95.04
12	31	90.3435222	89.3376
12	32	84.5769144	83.6352
15	21	96.12947	95.04
15	31	90.3617018	89.3376
15	32	84.5939336	83.6352
16	21	96.7	95.04
16	31	90.898	89.3376
16	32	85.096	83.6352
13	31	2.8931673	2.8512
13	32	4.8219455	4.752
14	31	2.901	2.8512
14	32	4.835	4.752

1.2.3 Fuel Supply and Fuel Formulation:

The federally required reformulated gasoline (RFG) program began in Connecticut in 1995, and was included in the modeling for these analyses. Connecticut had previously modeled the entire state with a single fuel input. The 2002 NMIM National County Database (NCD) used two fuel areas where Fairfield County was in one area and the remainder of Connecticut was the other fuel area. The RFG website identifies three areas for Connecticut, however only two of the areas break into county lines and have enough data to support reliable statistical analyses. The breakout of the Connecticut fuel area assignments were reviewed with the EPA RFG staff and it was determined that this two area approach was recommended for fuel similarity and statistical reasons. The Connecticut fuel data presented in the table below was developed based on a weighted average of RVP sampling in EPA's gasoline storage terminal compliance study[13] performed in 2007. The seasons identified in the table below correspond to the following months; Winter season corresponds to December, January and February; Shoulder season corresponds to March, April, October and November; and Summer corresponds to May, June, July, August and September. These seasonal definitions relate to the Summer RFG season defined on the RFG websites and a general understanding that fuel will transition to non-RFG season values before the season begins and/or after the season ends.[13] Existing MOVES default fuel formulation ID's were overwritten to input the values shown below.

Table I.1.2-6. MOVES Fuel Inputs Values

	Fairfield County			New Haven County		
Season	**Shoulder**	**Summer**	**Winter**	**Shoulder**	**Summer**	**Winter**
MOVES Parameter						
fuelFormulationID	2172	2173	1817	2180	2181	1823
fuelSubtypeID	12	12	12	12	12	12
RVP	9.59249	6.96318	11.5661	9.59249	6.95517	11.5661
sulfurLevel	32.2773	30.6072	33.9474	37.1246	39.2256	35.0237
ETOHVolume	9.85381	9.77494	9.93268	9.78217	9.74812	9.81621
MTBEVolume	0	0	0	0	0	0
ETBEVolume	0	0	0	0	0	0
TAMEVolume	0	0	0	0	0	0
aromaticContent	19.9856	20.6096	19.3615	21.515	22.9238	20.1062
olefinContent	11.951	12.7835	11.1186	10.2368	11.8922	8.58148
benzeneContent	0.68588	0.62802	0.74374	0.694624	0.61093	0.77831
e200	53.1061	47.1775	59.0346	54.712	49.0997	60.3243
e300	86.8149	85.5865	88.0434	88.6979	87.5964	89.7994
volToWtPercentOxy						
BioDieselEsterVolume	0	0	0	0	0	0
CetaneIndex	0	0	0	0	0	0
PAHContent	0	0	0	0	0	0

1.2.4 Age Distribution and Source Type Population:

The 2011 registration data were fully evaluated and assigned to MOBILE6.2 vehicle classifications and model year. The DMV year field is a two digit year. This was converted to a four digit year by adding 2000 to any two digit number less than 14 and adding 1900 to any two digit number 14 or greater. This four digit DMV year was evaluated against the year associated with the VIN digit 10 year for VIN numbers that were calculated to have a valid check digit value or were successfully decoded in the past. VIN digit 10 year values are now starting to repeat, thus even though the valid VIN digit 10 year value was considered to be reliable, it is no longer completely independent from the DMV year assignment. MOBILE6.2 assignments were generated from a Connecticut VIN decoder / Query Estimated Designation tool that allowed the query of individual VINdigits, Make, Model, Body, beginning model year, ending model year, check digit validation (true, false or all records). De la Torre Klausmeier Consulting/ERG previously generated Connecticut fleet age distribution data derived from 2005 DMV vehicle registration data and 2008 DMV vehicle registration data with the aid of a VIN decoder. These results were made available to the views provided in the decoding tool used for the analysis of the 2011 DMV registration data. After completion of the analyses of the DMV data a MOBILE62 registration age distribution was created for use in the EPA VMT converters and a MOVES specific registration age distribution file was created. Localized age distributions were applied to the MC, LDV, LDT1 thru HDV5, HDBT and HDBS Mobile 6.2 vehicle classifications only. HDV2B thru HDV5 were previously not included in the age distribution analyses and were added due to the MOVES Source Type definition for Source types 31 and 32. Moves source types 31 and 32 include LDT1 thru HDV5 vehicles. Other vehicles were addressed by the MOVES national defaults since they are subject to interstate influences. The basis for the MOBILE62 registration age file involved the inclusion of the data in the age calculation as an Age of 1 when the Model Year is 2011 or greater; inclusion of the data in the Age calculation as an age of 25 when the difference between 2011 and the Model Year is greater than 24 and inclusion in the age calculation an age of 2011 plus 1 minus the Model Year (i.e. age is 1 to 25 rather than 0 to 24), when the difference between 2011 and the Model Year is between 1 and 24. This differs from other age distribution analyses in that 2012 vehicles were not removed from the analyses as was done in earlier MOBILE 6.2 age analyses, because MOVES includes vehicle counts and it is more appropriate to include all know vehicles that have been classified. The MOVES specific analyses used a similar logic except the Model Year 2011 or later vehicles were assigned an age of zero and the difference between 2011 and the Model Year was used as the age until a maximum age of 30 years. The MOVES specific age distribution involved a translation of MOBILE62 vehicle classifications to MOVES Source Types based on mappings used in the converters and summarized in table A.1 of Reference 16.

Counts of the 2011 registration data that were evaluated and assigned to MOBILE6.2 vehicle classifications were further processed utilizing EPA mappings used in the converters, which are also summarized in table A.1 of Reference 16. A 1% factor was applied to the data in order to compensate for vehicle registrations not capable of being processed (i.e. dealer plates, state vehicles, town vehicles, transporter plates and other registration data not having adequate data to assign a model year or MOBILE6.2 classification). Population counts for all source types were based upon a complete analysis of CT-specific registration data. While a complete accounting of the in state fleet was developed, the population estimates for HPMS Vehicle Source Types 50

and 60 were increased when a VMT calculated population was greater than the population estimated from registration data to account for the influence of interstate traffic. Connecticut Specific 2009 HPMS vehicle miles travelled (VMT) from MOVES input files was used to augment vehicle counts obtained directly from the 2011 registration data. The VMT based population estimates for source types 51, 52, 53, 54, 61 and 6.2 used an approach outlined in section 3.3 of Reference 16 and a national run for all Connecticut counties to obtain a ratio of MOVES default population to VMT by source type for 2009. That ratio was multiplied by local county VMT for each source type to obtain an estimate of local population based on local VMT. As stated above the registration population data was used, when the VMT based estimate was lower that what was actually registered in the state. This accounts for inaccuracies in the VMT based method, for home-based lodging of interstate trucks and for truck populations accumulating lower than expected VMT.

Future year populations were calculated based on a ratio of CT-specific base and future year MOVES HPMS Vehicle Type VMT to obtain a growth factor for the HPMS Vehicle Type (Vtype shown in table I.1.2-7) group with an assumption of constant per vehicle mileage accumulation. Distributions of source Types within an HPMS Vtype were assumed to remain the same as established in the base year. Repeating the VMT calculation procedure with individual future national runs and local VMT projections for each projection year were not implemented, as the method was recommended by EPA guidance as a last resort and the per vehicle VMT increases projected by MOVES for source types 61 and 6.2 would be less conservative than the HPMS Vehicle Type VMT approach utilized.

Table I.1.2-7. Source Type and HPMS VType

Source Type	Source Type Description	HPMS VType	HPMS Vtype Description
51	Refuse Truck	50	Single Unit Trucks
52	Single Unit Short-haul Truck	50	Single Unit Trucks
53	Single Unit Long-haul Truck	50	Single Unit Trucks
54	Motor Home	50	Single Unit Trucks
61	Combination Short-haul Truck	60	Combination Trucks
62	Combination Long-haul Truck	60	Combination Trucks

2. Results

The Annual emission estimates presented in this section were produced by the MOVES runs that used the inputs described in this appendix.

Table I.2.1. Fairfield Annual Emissions

	Emissions (Tons)		
Pollutant Code	**2009**	**2017**	**2025**
NOX	11,888.92	5,414.05	3,573.24
PM25_PRI	404.36	237.99	192.70
SO2	84.27	71.54	66.36

Table I.2.2. New Haven Annual Emissions

	Emissions (Tons)		
Pollutant Code	**2009**	**2017**	**2025**
NOX	11,502.74	5,293.91	3,540.13
PM25_PRI	389.64	229.40	186.20
SO2	91.82	79.71	74.67

Table I.2.3. Fairfield and New Haven NOx Annual Emissions by MOVES Source Type

Pollutant Code	MOVES Source Type ID	MOVES Source Type Name	Emissions (Tons)					
			Fairfield County			New Haven County		
			2009	2017	2025	2009	2017	2025
NOX	11	Motorcycle	28.50	26.74	27.27	27.74	26.14	26.89
NOX	21	Passenger Car	3,416.14	1,592.89	1,034.29	3,307.62	1,585.62	1,046.00
NOX	31	Passenger Truck	3,897.80	1,730.27	1,151.16	3,646.61	1,640.58	1,114.23
NOX	32	Light Commercial Truck	1,725.53	846.37	581.41	1,625.54	809.42	566.89
NOX	41	Intercity Bus	28.02	10.35	4.02	27.82	10.20	3.98
NOX	42	Transit Bus	39.71	14.53	6.71	39.37	14.32	6.66
NOX	43	School Bus	30.45	12.50	8.39	33.24	13.41	9.02
NOX	51	Refuse Truck	18.92	7.53	3.73	21.83	8.68	4.34
NOX	52	Single Unit Short-haul Truck	246.40	127.56	92.14	251.37	132.22	97.96
NOX	53	Single Unit Long-haul Truck	28.03	13.80	9.96	28.28	14.20	10.52
NOX	54	Motor Home	14.92	10.27	7.74	15.44	10.69	8.24
NOX	61	Combination Short-haul Truck	878.80	307.60	145.30	947.20	330.82	157.85
NOX	62	Combination Long-haul Truck	1,535.70	713.64	501.13	1,530.69	697.60	487.53

Table I.2.4. Fairfield and New Haven PM Primary Annual Emissions by MOVES Source Type

Pollutant Code	MOVES Source Type ID	MOVES Source Type Name	Emissions (Tons)					
			Fairfield County			New Haven County		
			2009	2017	2025	2009	2017	2025
PM25_PRI	11	Motorcycle	1.87	1.79	1.90	1.76	1.70	1.81
PM25_PRI	21	Passenger Car	124.97	88.83	80.63	121.49	86.83	78.83
PM25_PRI	31	Passenger Truck	100.23	75.24	71.50	94.09	71.08	68.22
PM25_PRI	32	Light Commercial Truck	57.15	30.28	23.91	53.85	28.88	23.04
PM25_PRI	41	Intercity Bus	1.38	0.49	0.15	1.30	0.45	0.14
PM25_PRI	42	Transit Bus	1.78	0.58	0.16	1.71	0.55	0.15
PM25_PRI	43	School Bus	1.45	0.39	0.17	1.54	0.41	0.17
PM25_PRI	51	Refuse Truck	0.89	0.33	0.14	0.97	0.36	0.15
PM25_PRI	52	Single Unit Short-haul Truck	10.53	4.12	2.00	10.49	4.08	1.98
PM25_PRI	53	Single Unit Long-haul Truck	1.23	0.44	0.19	1.21	0.43	0.19
PM25_PRI	54	Motor Home	0.42	0.25	0.15	0.43	0.26	0.15
PM25_PRI	61	Combination Short-haul Truck	40.21	14.01	5.23	41.19	14.22	5.24
PM25_PRI	62	Combination Long-haul Truck	62.25	21.23	6.57	59.61	20.15	6.12

Table I.2.5. Fairfield and New Haven Sulfur Oxide Annual Emissions by MOVES Source Type

Pollutant Code	MOVES Source Type ID	MOVES Source Type Name	Emissions (Tons)					
			Fairfield County			New Haven County		
			2009	2017	2025	2009	2017	2025
SO2	11	Motorcycle	0.28	0.31	0.33	0.30	0.33	0.36
SO2	21	Passenger Car	32.21	32.24	30.35	35.58	36.08	34.30
SO2	31	Passenger Truck	29.82	27.36	24.70	32.74	30.48	27.79
SO2	32	Light Commercial Truck	10.61	8.54	7.83	11.51	9.59	8.88
SO2	41	Intercity Bus	0.10	0.02	0.02	0.10	0.02	0.02
SO2	42	Transit Bus	0.13	0.03	0.03	0.13	0.03	0.03
SO2	43	School Bus	0.13	0.03	0.03	0.14	0.04	0.04
SO2	51	Refuse Truck	0.08	0.02	0.02	0.09	0.02	0.03
SO2	52	Single Unit Short-haul Truck	1.13	0.50	0.52	1.19	0.56	0.59
SO2	53	Single Unit Long-haul Truck	0.13	0.06	0.06	0.14	0.06	0.07
SO2	54	Motor Home	0.06	0.04	0.04	0.06	0.04	0.04
SO2	61	Combination Short-haul Truck	3.85	0.96	0.98	4.11	1.02	1.06
SO2	62	Combination Long-haul Truck	5.73	1.42	1.45	5.72	1.42	1.47

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