SmartWay Transport Partnership
U.S. Environmental Protection Agency

SmartWay 2.0.11 Truck Tool – Technical Documentation:

United States Version

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Transportation and Climate Division
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1.0 Overview

This document provides detailed background information on the data sources, calculation methods, and assumptions used within the new SmartWay Truck Tool, version 2.0.11. The SmartWay Truck Tool utilizes the most up-to-date emission factors, in combination with detailed vehicle activity data, to estimate emissions and associated performance metrics. While the primary purpose of earlier versions of the truck carrier tool (FLEET) was to help fleets estimate the likely fuel and emission reduction benefits of specific advanced technologies (e.g., through the adoption of certified aerodynamic retrofits) relative to a pre-control baseline, the primary purpose of the new tool is to help fleets calculate actual pollutant emissions for specific truck types and applications and track their emissions performance over time. Shippers can, in turn, use the data that truck carriers report using these tools to develop more advanced emissions inventories associated with their freight activity and to track their emissions performance over time.

The new tool allows the user to evaluate fleet performance in terms of different mass-based performance metrics for CO_2, NOx, and PM (PM_{10} and $PM_{2.5}$), including:[1]

- Grams per mile
- Grams per average payload ton-mile
- Grams per thousand cubic foot-miles
- Grams per thousand utilized cubic foot-miles

The tool can also generate estimates of emissions associated with the total miles, loaded miles, and revenue miles traveled by a fleet. Fleet performance can then be assessed at the truck-class and/or fuel-type level, or on an aggregated basis across all classes and fuels.

[1] At this time the Truck Tool does not calculate performance metrics for specialty fleets that track their activity in terms of hours of use rather than miles traveled or freight hauled (e.g., refuse haulers and utility fleets). Future modifications may be made to the current tool to accommodate such fleets.

The tool also collects extensive information on fleet operations and truck body types, allowing detailed segmentation of Partner fleets for more appropriate, equitable comparisons. For example, fleets that cube-out with low payloads (e.g., those hauling potato chips) will be able to compare themselves to similar fleets on a simple grams per mile basis, rather than a mix of fleets that includes fleets that routinely weigh-out. Similarly, fleets that operate in primarily short-haul, urban environments at relatively low average speeds will have fundamentally different emission rates and constraints than long-haul fleets operating at highway speeds. By collecting detailed information on fleet operations (short vs. long, TL vs. LTL, urban vs. highway, etc), as well as truck class (2b through 8b) and body type (dry van, reefer, flatbeds, etc.), individual fleets can compare their performance to other, similar fleets, which can help them to better manage their emissions performance.

2.0 Data Inputs and Sources

The SmartWay Truck Tool user provides most vehicle characteristic, operational, and activity data needed for emissions performance estimation (see Section 3 for more information). The tool calculates emissions by multiplying fleet activity data with EPA-approved emission rate factors that are stored in look-up tables within the tool.

The tool contains different types of emission rate factors for different pollutants. CO_2 factors are expressed in grams of CO_2 *per gallon of fuel*.[2] NOx and PM factors are expressed in *grams of pollutant per mile traveled* for operating emissions, and in *grams per hour* for idle emissions. In general, CO_2 factors are independent of the truck types, classes, and operational practices in a fleet. NOx and PM factors, however, vary depending upon a number of parameters, including:

- Truck class
- Engine model year/emission certification standard
- Vehicle speed
- Vehicle driving pattern (referred to as "drive cycle")

In addition, PM emissions will also vary with the application of PM control retrofits, including diesel oxidation catalysts (DOC), closed crankcase ventilation (CCV), and diesel particulate filters ("PM traps" or flow-through filters). In the tool, PM control retrofits are assumed to have the same impact on operating and idle emission factors.[3]

2.1 CO_2 Factors

EPA populated the SmartWay Tuck Tool with CO_2 factors that are based on fuel consumption. These factors and their sources and are summarized below in Table 1.

[2] At this time other greenhouse gases such as methane (CH_4) and nitrous oxide (N_2O) are not included in the current Truck Tool.
[3] Future versions of the tool may account for differences in retrofit effectiveness for running versus idle emissions.

Table 1. CO_2 Factors by Fuel Type*

	g/gal	Source[4]
Gasoline	8,887	(i)
Diesel	10,180	(ii)
Biodiesel (B100)	9,460	(iii)
Ethanol (E100)	5,764	(iv)
CNG	7,030	(v)
LNG	4,394	(vi)
LPG	5,790	(vii)

* 100% combustion (oxidation) assumed

Note that the tool calculates tailpipe emissions from biofuel blends (gasoline/ethanol, diesel/biodiesel) by applying separate emission factors to the user-specified volume of each blend component. The tool then adds the emissions from each blend component together to determine total CO_2 emissions. Therefore emission factors for specific blend ratios are not needed for CO_2.

Within the tool, users may provide their CNG fuel use estimates in terms of gasoline-equivalent gallons (on a Btu basis), or in standard cubic feet (scf). If CNG consumption is expressed in scf, the tool applies a fuel factor expressed in grams per scf (57.8), based on 983 Btu/scf and 58,819 g CO_2/mmBtu.[5]

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[4] i) Final Rule on Light-Duty Vehicle Greenhouse Gas Emissions Standards and Corporate Average Fuel Economy Standards (75 FR 25324, May 7, 2010). The gasoline factor used in this rule was sourced from the California Air Resources Board and is based on measurement of carbon from a gasoline test fuel (indolene).
ii) Fuel economy calculations in 40 C.F.R 600.113 available at http://edocket.access.gpo.gov/cfr_2004/julqtr/pdf/40cfr600.113-93.pdf.
iii) Tables IV.A.3-2 and 3-3 in A Comprehensive Analysis of Biodiesel Impacts on Exhaust Emissions, available at http://www.epa.gov/oms/models/analysis/biodsl/p02001.pdf
iv) Final Rule on Mandatory Reporting of Greenhouse Gases (70 FR 56260, October 30, 2009). Full source documentation is available on pp. 31-32 in the Technical Support Document, *Petroleum Products and Natural Gas Liquids: Definitions, Emission Factors, Methods and Assumptions*, available at www.epa.gov/climatechange/emissions/downloads09/documents/SubpartMMProductDefinitions.pdf.
v) Calculations of Lifecycle Greenhouse Gas Emissions for the 2005 Gasoline and Diesel Baselines in the Notice of Availability of Expert Peer Review Record supporting the proposed revisions to the Renewable Fuel Standard Program (74 FR 41359) available in Docket EPA-HQ-OAR-2005-0161-0925.1 (Spreadsheet "Emission Factors").
vi) Assuming 74,720 Btu/gal lower heating value (http://www.afdc.energy.gov/afdc/fuels/properties.html), and 0.059 g/Btu (from CNG calculation, source vi).
vii) Table C-1 in the Final Rule on Mandatory Reporting of Greenhouse Gases (70 FR 56260, October 30, 2009). Full source documentation is available in Table A-39 and pg. A-60 of the *Inventory of U.S. Greenhouse Gas Emissions and Sinks: 1990 – 2007* available at http://epa.gov/climatechange/emissions/downloads/US_GHG_Inv_Annexes_1990-2007.pdf

[5] See footnote 4, v.

2.2 NOx and PM Factors

The SmartWay Truck Tool contains NOx, PM_{10} and $PM_{2.5}$ emission factor outputs for on-road operation from EPA's MOVES2010a model for gasoline, diesel, and E10 for all heavy truck classes (2b – 8b) under national default temperature and fuel conditions, for model years 1987 through 2012, for the 2012 calendar year (see Appendix A for a full list of factors).[6] The emission factors are broken out by general drive cycle type (urban or highway), and average speed range, as discussed below.

Idle emission factors for NOx and PM were developed separately by model year, truck class, and fuel type (diesel and gasoline). MOVES2010a does not currently provide idle factors in terms of grams per hour, so we ran MOVES2010a using the Project Level scale with a single link and with an average speed of zero. We performed runs for typical winter and summer conditions and took the average of outputs from those runs obtain g/hr factors. The resulting idle factors are presented in Appendix B.[7]

This section describes the process we followed to select the on-road emission factors from MOVES2010a for use in the Truck Tool. Emission factors in grams per mile were developed for gasoline, E10,[8] and diesel fuel types for all MOVES source types that correspond to MOBILE6 heavy duty vehicle classes, 2b-8b inclusive. The MOVES source types modeled are shown in the table below. Of these, note school buses, refuse trucks and motor homes represent only a small fraction of total activity.

Table 2. MOVES Source Types Associated with Class 2b – 8b Vehicles

Source Type ID	Source Type Name
31	Passenger Truck
32	Light Commercial Truck
43	School Bus
51	Refuse Truck
52	Single Unit Short-haul Truck

[6] Due to an inconsistency in the future year gasoline specification file within MOVES2010a, gasoline and E10 tailpipe emission factors were not modeled for calendar year 2012. In these instances the MOVES outputs for the 2011 calendar year were used instead, with the 2012 model year emissions rates set equal to the 2011 model year values.

[7] The idle factors correspond to short-term idling. Factors for long-term extended idling will be higher (at least for late model engines), since engine operation temperatures and loads at idle are generally not high enough to activate late-model emission controls such as SCR and EGR. Adjustment factors to account for the difference between short and long-term idling may be applied in the future, utilizing the reported differences between long and short-term hours on the Activity Information page in the SmartWay Truck Tool.

[8] E15 can be modeled as well, if the required fuel specifications are provided.

Source Type ID	Source Type Name
53	Single Unit Long-haul Truck
54	Motor Home
61	Combination Short-haul Truck
62	Combination Long-haul Truck

Separate factors were developed for "Urban" and "Highway/Rural" roadway types. These factors were apportioned according to MOVES operating mode groups, which correspond to speed ranges of 0-25 mph, 25-50 mph, and 50+ mph.

Emission factors calculated by the model, output by MOVES source type, were then converted to a MOBILE6 vehicle class basis. In this way, the Truck Tool can select appropriate emission factors for use by:

- weight class
- model year
- road type (urban vs. highway/rural)
- speed distribution

The following describes the methodology for the emission factor calculation.

Calculation of MOVES emission factors by operating mode

In calculating emission factors, the primary goal is to disaggregate factors by the percentage of time a given type of vehicle spends operating at certain speeds. The ranges of speeds analyzed include 0-25 mph, 25-50 mph, and greater than 50 mph. These speed ranges correspond to MOVES operating modes #11-16, 21-29, and 30-40 inclusive, where each operating mode is defined by both the speed of the vehicle and its vehicle specific power (VSP). First, for a given source type and model year, the fraction of emissions attributable to each range of speed was determined. Emissions for a vehicle can be expressed in Equation 1:

Equation 1

$$E` = A_1E_1` + A_2E_2` + A_3E_3` + A_IE_I + A_BE_B$$

Where:

E` = uncorrected[9] mass emissions calculated based on operating mode and emissions contribution by speed bin

[9] Subsequent adjustment factors are presented in Equation 3 below.

$A_{1\text{-}3}$ = the sum of activity fractions (in seconds) over speed range n. (A_I and A_B represent the activity associated with the individual operating modes for idling and braking, respectively.)

$E_{1\text{-}3}$` = the weighted average emissions over a given speed range n. (E_I and E_B represent the emissions associated with the individual operating modes for idling and braking, respectively.)

The following figure shows a range of emissions and activity fractions for an example source type and model year. The operating mode (or VSP bin) are shown on the x-axis. The dashed red line presents the fraction of vehicle activity associated with a given operating mode, while the black circles present average HC emissions for each operating mode.

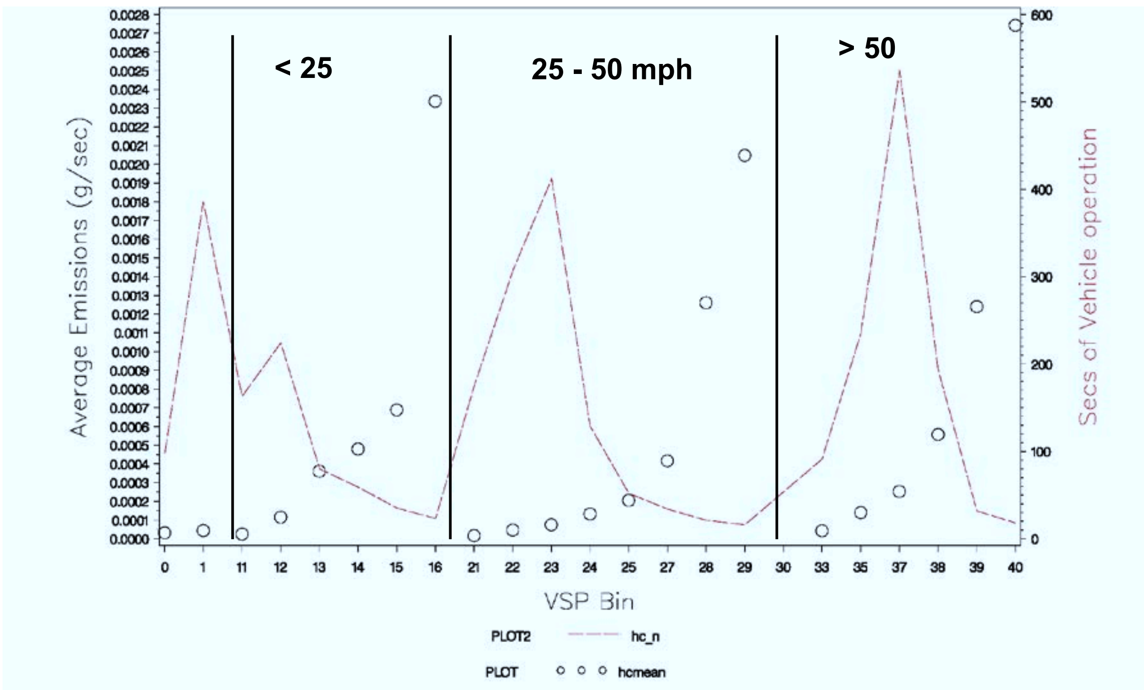


Figure 1. Example Emissions and Activity Fractions by Operating Mode

For our purposes, A_n from Equation 1 is obtained by retaining the “opmodedistribution” table from the Operating Mode Distribution Generator (OMDG), which is created during a MOVES run. This table contains operating mode fractions by source type, roadway type, and pollutant/process. The sum of the operating mode fractions in each speed bin constitutes A_n.

E_n` is derived from data obtained from the default MOVES “emissionratebyage” table. This table contains emission rates by pollutant process, operating mode, and age group for a wide variety of *sourcebinIDs*. For this analysis, a MySQL query was used to select *sourcebinIDs* corresponding to the source type, fuel type, and calendar year of interest, and limited our rate selection to the 4-5 year age group. The emissions obtained here were then converted to a source type basis (from their current *sourcebinID* basis); this was done by retaining the "sourcebindistribution" table from the Source Bin Distribution Generator (SBDG), which is created during each MOVES run, and weighting the activity fractions for each source type and model year combination in this table with the data from the "emissionratebyage" table described above. Having finished this mapping, an emission rate is generated, by source type and model year, for each operating mode (corresponding to the circles in the figure above). Since E_n` for each speed range represents the average emissions of the range weighted by the activity in that range, the weighted average emissions can be calculated from the 0-25 mph speed bin, $E_1$`, as follows in Equation 2:

Equation 2

$$E_1` = \frac{R_{11}T_{11} + R_{12}T_{12} + R_{13}T_{13} + R_{14}T_{14} + R_{15}T_{15} + R_{16}T_{16}}{\sum_{11}^{16} R_n}$$

Where:

R_n = The activity fraction for operating mode n, obtained from the OMDG table
T_n = The emissions for operating mode n.

Other speed bins will use different operating modes in their calculations; the equation above is merely an example illustrating the calculation method for the first speed bin. Having calculated an appropriate E_n` for each speed range for a given source type and model year, Equation 1 can be used, along with the appropriate activity fraction, to arrive at a total uncorrected emissions value. In and of itself, this emission factor has little value in estimating emissions. However, it can be used along with the modeled emission factor for a particular source type and model year to arrive at an overall adjustment factor, as shown in Equation 3:

Equation 3

$$Z = \frac{E}{E`}$$

Where:

E = The modeled emission, obtained from MOVES outputs, for an individual source type and model year

E`= The uncorrected emissions for an individual source type and model year, calculated using operating mode distributions and emission factors from the “emissionratebyage” table

This overall adjustment factor, in turn, can be applied to each individual emissions component, E_n`, as shown in Equation 4:

Equation 4

$$E_n = ZE_n`$$

The adjusted emissions, E_n, are subsequently used to calculate a total, corrected emission factor for a given source type and model year combination, as described by Equation 5:

Equation 5

$$E = A_1E_1 + A_2E_2 + A_3E_3 + A_IE_I + A_BE_B$$

In this way, a representative emission factor is calculated by operating mode/speed group. This will allow the Truck Tool to adjust the default operating mode percentages (A_n) to more accurately represent a user-provided speed profile for the vehicles they are evaluating. Default operating mode percentages may also be used, as calculated above.

Conversion of emission factors from source type to weight class basis

Ultimately, emission factor lookup tables are required for use in the Truck Tool by weight class, fuel type, and model year. However, modeled output from MOVES is aggregated by source type. Therefore a post-processing tool was developed to convert vehicle emission factors from source types to weight class based on internal MOVES tables. The conversion methodology used in this tool is described below.

First, the adjusted emissions and activity output from MOVES are combined, *by pollutantID*, by joining the “movesoutput” and “movesactivityoutput” tables by calendar year, source type, fuel type and model year. The sourcetype and model year for each record are combined in a new field, *sourcetypemodelyearID*.

Next, the emissions and activity output from the first step are combined with the MOVES “sizeweightfraction” table by joining on the *sourcetypemodelyearID*. The “sizeweightfraction” table contains, for a given combination of source type and model year, the fraction of vehicles apportioned across *weightclassID*. Given the *weightclassID*, the portion of emissions and activity attributable to a given range of vehicle weights is determined, and subsequently, those weights (along with fuel type) are mapped back to MOBILE6 vehicle classes, which are based on GVWR. (This is achieved with a separate lookup table, “M6VehType”, which is derived from Appendix B, Table 3 of the EPA’s MOBILE6.2 User’s Guide.) For each calendar year, *sourcetypemodelyearID* and *pollutantID*, the sizeweightfraction is multiplied by the emissions (in grams) and activity (in miles) to obtain *EmissionFrac* and *ActivityFrac*, respectively.

Finally, the *EmissionFrac* and *ActivityFrac* calculated above are summed by *yearID*, *pollutantID*, *fueltypeID*, and MOBILE6 vehicle type (e.g., HDDV8b). This provides total emissions and activity independent of the MOVES source type or vehicle model year. Finally, the aggregated emissions are divided by the activity to arrive at g/mi emission factors, presented in Appendix A.

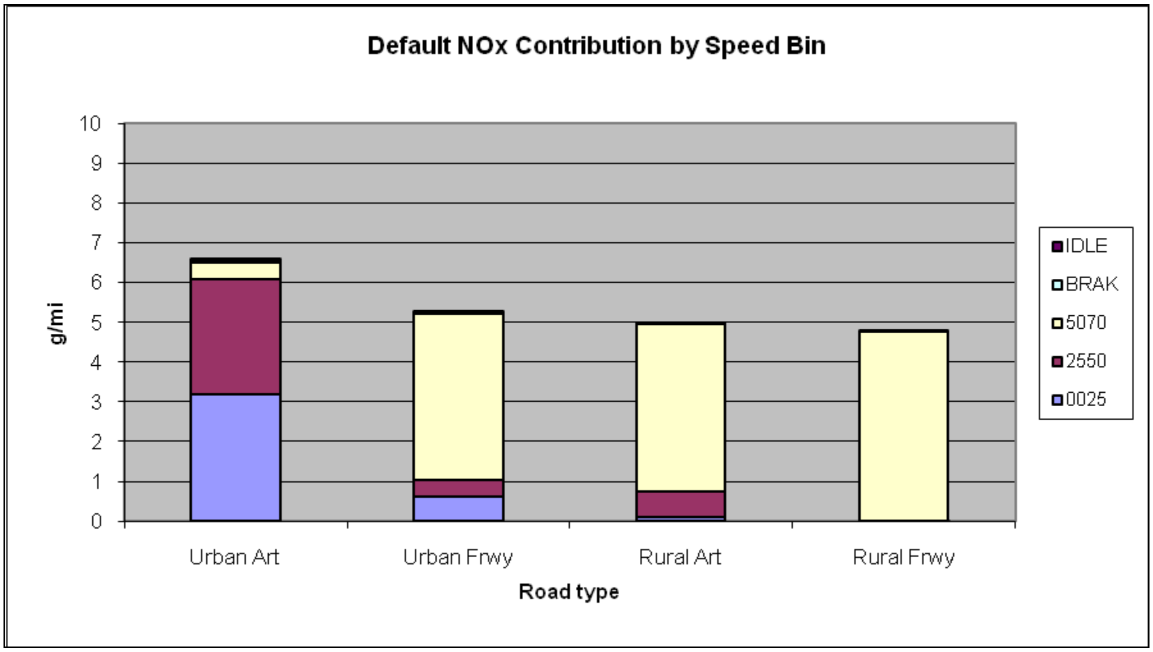
Modeling E10 Emission Rates

In a MOVES run that uses nationwide defaults for fuel supply, the model includes many thousands of fuel formulations on a by-county basis in its calculations. In addition to diesel fuels, many counties in the model defaults are characterized by varying market shares of gasoline and E10. This intertwining of fuel mixtures by market share can make isolation of nationwide E10-based and gasoline-based emission factors from the model somewhat difficult.

In order to isolate E10 emission factors, an external database tool was used to alter the MOVES “*fuelsupply”* table for two scenarios: one in which market shares for E10 and gasoline fuels were set to 1 and 0, respectively, and the inverse case, in which market shares for E10 and gasoline fuels were set to 0 and 1. Importing the updated “*fuelsupply”* tables using external MySQL scripts, separate E10 and gasoline MOVES runs were then performed using the newly updated information.

Sensitivity Analysis Results

The relative emissions impact of different speed regimes were evaluated for four road types – urban arterial, urban freeway, rural arterial, and rural freeway. To simplify the sensitivity analysis, MOVES outputs were generated for diesel long-haul combination trucks, model year 2008, run for the 2011 calendar year, using national average defaults (e.g., fuel specifications, temperatures, etc). The results of the analysis are shown for NOx and $PM_{2.5}$ below.



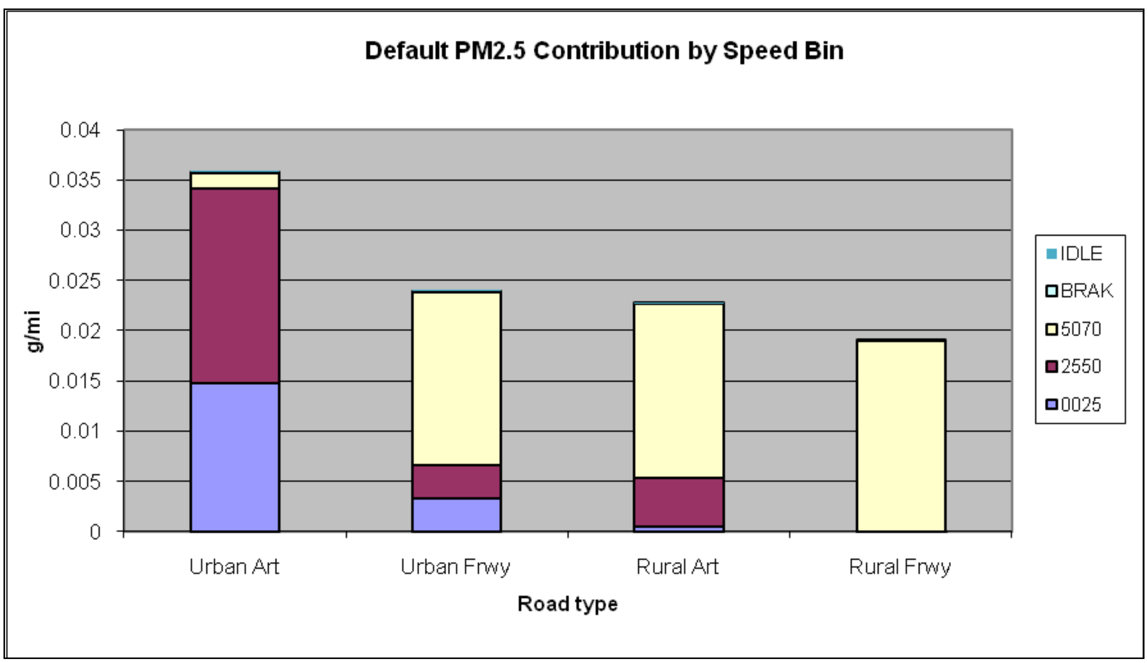


Figure 2. Default NOx and $PM_{2.5}$ Emission Contribution by Speed Bin

As shown in the above charts, the emissions for urban freeways, rural arterials, and rural freeways are all heavily dominated by high speed (50 – 70 mph) operation.[10] In addition, actual emission levels are relatively insensitive to road type across these three types. However, speed distribution appears to have a significant bearing on emissions for urban arterial operation. Accordingly, the recommendation for Truck Tool application was to develop fully disaggregated emission factor look up tables (retaining all four road types), and then weight urban freeway, rural arterial, and rural freeway road type operations in order to aggregate emission lookup tables within the SmartWay tool to reflect "urban" (i.e., urban arterial) and "other" road types. In addition, under this approach users can choose default speed distributions for these selections, or specify the percent of operation by major speed range (0 – 25, 25 – 50, 50 – 70). Given the relative insensitivity to speed for the "other" category, specifying speed distributions would only be permitted for urban arterial operation.

Under this approach, the user is given the follow input options:

- Specify % Highway/Rural ("other") operation fraction
- Specify % urban operation distribution by speed bin, or select "default speed distribution"

Data entry is handled through the addition of a popup screen for non-default data entry (see Truck Tool User Guide for details).

2.3 Alternative Fuels

NOx and PM emission factors are not available from MOVES2010a for certain alternative fuels, including biodiesel, E85, natural gas, and LPG. Accordingly, EPA used adjustment factors from a number of sources described below to estimate NOx and PM factors for these other fuels.

NOx and PM emission factors for biodiesel were based on the findings from an EPA study, A Comprehensive Analysis of Biodiesel Impacts on Exhaust Emissions (EPA420-P-02-001, October 2002). This study developed regression equations to predict the percentage change in NOx and PM emission rates relative to conventional diesel fuel, as a function of biodiesel blend percentage, expressed in the following form:

Equation 6

$$\% \text{ change in emissions} = \{\exp[a \times (\text{vol\% biodiesel})] - 1\} \times 100\%$$

Where:

[10] This finding is consistent with the 2008 SmartWay partner data submissions, wherein 87% of Partners selected the 50+ mph category as the most representative of their non-urban operations.

a = 0.0009794 for NOx, and
a = -0.006384 for PM

Using Equation 6, adjustment factors were developed for biodiesel blends based on the percentage of the biofuel component,[11] and then these adjustment factors were applied to the appropriate conventional diesel emission factors in Appendix A (see Section 2.2 for the sources of conventional diesel emission factors). Note that the fleet-average blend value is assumed to be the same for all truck classes, since the biofuel consumption data is not collected at the truck class level. (This assumption holds for ethanol consumption data inputs as well.)

For gasoline-ethanol blends, the SmartWay Truck Tool only accepts fuel consumption estimates for E10 and E85 since, unlike biodiesel where the biofuel fraction can vary significantly, ethanol is generally blended with gasoline at two discrete levels: 10% (E10) and 85% (E85). As discussed in Section 2.2 above, NOx and PM factors for E10 were output directly from MOVES2010a. Given the lack of heavy-duty E85 test data, adjustment factors for E85 were based on emissions estimates for light-duty vehicles cited by the US DOE Alternative Fuels and Advanced Vehicles Data Center.[12] These estimates come from a technical paper published in the Journal of Air & Waste Management.[13] Relative to conventional gas vehicles, the authors of this paper estimate that vehicles running on E85 provide an **average NOx reduction of 54%** (based on 73 vehicle tests), and an **average PM reduction of 34%** (based on 3 vehicle tests). These adjustment factors are applied to the appropriate gasoline engine emission factors in Appendix A to develop emission factors for E85.

If the consumption level of E10 is unknown, the Truck Tool user may also specify national average default blend levels for ethanol. National totals for gasoline use for 2009 were obtained from the Energy Information Administration's (EIA) Annual Energy Outlook Reference Case for 2010, Table 46 (Transportation Sector Energy Use by Fuel Type within a Mode). Summing the energy use values for light-duty gasoline vehicles, commercial light trucks, and freight trucks from the table yields an estimate of 16,234 TBtu (15,605 + 322 + 306) for 2009. National fuel ethanol consumption estimates for 2009 were also obtained from the EIA, totaling 894 TBtu (see Table 10.3, consumption minus denaturant in http://www.eia.doe.gov/aer/txt/ptb1003.html). Assuming 114,100 Btu/gallon of gasoline, and 76,100 Btu/gallon of E100,[14] **ethanol is estimated to constitute 7.7% of gasoline fuel consumption in the U.S., on a volumetric basis**.[15]

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[11] Biodiesel blend percentage is calculated by dividing B100-equivalent gallons by total fuel gallons at the fleet level – see the Truck Tool User Guide for details regarding biodiesel use inputs.
[12] See http://www.afdc.energy.gov/afdc/vehicles/emissions_e85.html, last validated December 22, 2011.
[13] http://www.afdc.energy.gov/afdc/pdfs/technical_paper_feb09.pdf
[14] https://www.afdc.energy.gov/afdc/prep/popups/gges.html, last verified 12-22-11.
[15] 16,234 TBtu gasoline x 10^{12} Btu/TBtu / 114,100 Btu/gal = 1.42 x 10^{11} gallons of gasoline;

Emission adjustment factors were used for gaseous fuels (LPG, CNG and LNG) that were cited by the Alternative Fuels and Advanced Vehicles Data Center, Table 2: NREL/UWV Field Tests of Natural Gas Vehicle Emissions.[16]. These factors were developed by the National Renewable Energy Lab and University of West Virginia based on field studies on natural gas vehicles. For this assessment, it was assumed that CNG and LNG emissions were identical. In addition, it was also assumed LPG vehicle emissions would be equal to natural gas vehicle emissions.[17] To be conservative, the smallest emission reduction estimates were selected from Table 2 (**86% for PM and 17% for NOx**) relative to comparable diesel vehicles. These adjustment factors are then applied to the diesel emission factors in Appendix A for to develop emission factors for these fuels.

The same adjustment factors are applied for all model years in the Truck Tool because model year-specific emissions data do not appear to be available at this time. Note, however, that the emissions from the combustion of alternative fuels may be different for older trucks (with minimal emission controls) and newer trucks (with extensive control systems in place) due to vehicle emission standards.

2.4 PM Control Effectiveness

The Truck Tool applies adjustment factors to the PM emission factors in Appendix A and B for any pre-2007 diesel truck for which Partners have installed a specific retrofit control device. The following adjustment factors were obtained from EPA OTAQ (presented as a % reduction in emissions; see Section 3.2 below for details):

- Diesel oxidation catalyst (DOC) – 25%
- Closed crankcase ventilation (CCV) – 5%
- Diesel particulate filter (DPF) – 90%

The tool applies these adjustment factors to pre-2007 PM operating and idle emission estimates. The tool also allows for situations where CCVs are applied in combination with either DOCs or DPFs. In such a case, the reduction effectiveness is calculated additively. For example, if pre-control operating

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894 TBtu E100 x 10^{12} Btu/TBtu / 76,100 Btu/gal = 0.118 x 10^{11} gallons of E100;
0.118 / (1.42 + 0.118) = 7.7%. Note this methodology disregards the relatively small volumes of ethanol consumed as E85.

[16] http://www.afdc.energy.gov/afdc/vehicles/emissions_natural_gas.html, last validated 12-22-11.

[17] The PM and NOx estimates cited by this source for LPG vehicles were actually slightly lower than for natural gas vehicles - http://www.afdc.energy.gov/afdc/vehicles/emissions_propane.html. However, based on engineering judgment it was assumed that LPG PM and NOx emissions would be similar to comparable CNG vehicles.

emissions were 1.0 g/mile for a diesel truck, and a CCV and DPF were applied, the resulting emission rate would be:

Equation 7

1.0 x [1 – (0.25 + 0.05)] = 0.07 g/mile, post-control

However, the Truck Tool assumes that DOC and DPF application are mutually exclusive.

3.0 Emission and Activity Estimation

The emission rates and adjustment factors discussed above are combined with appropriate activity data (provided by the Partners) to calculate mass emissions at the fleet and/or division level for CO_2, NOx and PM, as described below.

3.1 CO_2

CO_2 is calculated within the Truck Tool utilizing emission factors expressed in *grams per gallon of fuel*, as discussed in Section 2.1 above. The general equation for calculating CO_2 emissions using reported fuel consumption values is

Equation 8

$$E_{CO2} = ((F - B) \times EF_F) + (B \times EF_B)$$

Where:

E_{CO2} = grams CO_2 per year
F = Fossil Fuel (Gallons per year)
B = Biofuel (Gallons per year)
EF_F = Fossil Fuel Emissions Factor (g/gal based on fuel type)
EF_B = Biofuel Emissions Factor (g/gal based on biofuel type)

3.2 NOx and PM

Unlike CO_2 emissions which only vary with fuel type, NOx and PM emission rates also vary substantially depending upon model year and/or emission certification level, vehicle class, drive cycle, speed, and operation mode (running or idle). For this reason, EPA developed lookup tables in the Truck Tool with emission factors that correspond to user-supplied inputs regarding their fleet activity. The NOx and PM emission rates expressed in *grams per mile* were combined with the appropriate mileage metric (i.e., total miles) in order to estimate mass emissions. The general equation for calculating NOx emissions is as follows:

Equation 9

$$E_{NOx} = (M_C \times ((GPM_H \times HDC) + (GPM_{U1} \times UDC_1) + (GPM_{U2} \times UDC_2) + (GPM_{U3} \times UDC_3) + (GPM_{U4} \times UDC_4))) \times T_{CY} / T_{CT}) + (GPH_I \times H_I \times T_{CY})$$

Where:

E_{NOx} = grams NOx per year for a given truck class
M_C = Miles driven for Truck Class C per year
GPM_H = Grams/mi (by truck class & engine yr) for Highway/Rural Driving
HDC = Highway drive cycle % (% of miles under highway/rural driving)
$GPM_{U1/2/3/4}$ = Grams/mi (by truck class & engine yr) for Urban Driving by mode (1 = 0 – 25 mph; 2 = 25 – 50 mph; 3 = 50+ mph; 4 = deceleration)
$UDC_{1/2/3/4}$ = Urban drive cycle % (% of miles under urban driving conditions, by mode (1,2,3,4))

T_{CY} = Number of trucks for a given Class/Year combination
T_{CT} = Number of trucks total for a given Class
GPH_I = Grams per hour (by truck class & engine year) for Idling
H_I = Hours of Idling per year (average per truck per year by class)

PM emissions for non-diesel vehicles are calculated using an equation identical to that for NOx, utilizing PM emission factors. PM emission for diesel vehicles may be adjusted for PM control effectiveness, as shown below.

Equation 10

$$E_{PM} = (((M_C \times ((GPM_H \times HDC) + (GPM_{U1} \times UDC_1) + (GPM_{U2} \times UDC_2) + (GPM_{U3} \times UDC_3) + (GPM_{U4} \times UDC_4))) \times T_{CY} / T_{CT}) + (GPH_I \times H_I \times T_{CY})) \times (1 - ((0.25 \times T_{DOC} / T_{CT}) + (0.05 \times T_{CCV} / T_{CT}) + (0.9 \times T_{DPF} / T_{CT})))$$

Where:

E_{PM} = grams PM per year for a given truck class
T_{DOC} = Number of trucks using Diesel Oxidation Catalysts by class
T_{CCV} = Number of trucks using Closed Crankcase Ventilation by class
T_{DPF} = Number of trucks using Diesel Particulate Filters by class
0.25 = Effectiveness of DOCs (25%) at reducing particulate matter
0.05 = Effectiveness of CCVs (5%) at reducing particulate matter
0.9 = Effectiveness of DPFs (90%) at reducing particulate matter

Note the above calculation methodology assumes that the same highway/urban drive cycle fractions apply across all model years of a given truck class. Similarly, the method assumes that estimated idle hours apply equally to all model years of a given truck class.

The above methodology also utilizes estimates for the fraction of miles traveled associated with different road types and speed categories, as shown in the equations above. The Truck Tool user must provide an estimate of the percent of total miles associated with highway/rural driving for each truck class. The user may also provide percentages for the miles spent driving in urban conditions (e.g., unrestricted access, surface roads in well-traveled urban areas), for different speed categories (0 – 25 / 25 – 50 / 50+ mph). This information may be obtained from analysis of truck ECM or possibly GPS data. If urban speed distribution data is not available, the user may select to use default distributions, obtained from the MOVES model. The default speed distributions for urban operation (as defined in Section 2.2 above) varies with vehicle class and model year. However, the variation over model years is very slight (typically with a range of 1 to 2 percent for the largest speed category), the percentages were averaged over all model years for a given speed category/vehicle type combination for use within the Truck Tool.

Table 3 presents the resulting default urban speed distributions by speed category for each truck class, for both diesel and gasoline vehicles. Note that the Truck Tool utilizes the diesel default speed distributions for LPG, LNG, and CNG.

Vehicle Class	**Speed Group**	**Percent by Class**
Diesels		
HDDV2b	0 - 25	35%
	25 - 50	38%
	50+	13%
	Deceleration	15%
HDDV3	0 - 25	41%
	25 - 50	36%
	50+	12%
	Deceleration	11%
HDDV4	0 - 25	42%
	25 - 50	35%
	50+	12%
	Deceleration	11%
HDDV5	0 - 25	42%
	25 - 50	35%
	50+	12%
	Deceleration	11%
HDDV6	0 - 25	42%
	25 - 50	35%
	50+	12%
	Deceleration	10%
HDDV7	0 - 25	42%
	25 - 50	35%
	50+	12%
	Deceleration	10%
HDDV8a	0 - 25	44%
	25 - 50	35%
	50+	12%
	Deceleration	9%
HDDV8b	0 - 25	45%
	25 - 50	34%
	50+	12%
	Deceleration	8%

Vehicle Class	**Speed Group**	**Percent by Class**
Gasoline		
HDGV2b	0 - 25	43%
	25 - 50	31%
	50+	10%
	Deceleration	15%
HDGV3	0 - 25	45%
	25 - 50	34%
	50+	11%
	Deceleration	11%
HDGV4	0 - 25	45%
	25 - 50	34%
	50+	11%
	Deceleration	10%
HDGV5	0 - 25	46%
	25 - 50	33%
	50+	10%
	Deceleration	11%
HDGV6	0 - 25	46%
	25 - 50	33%
	50+	10%
	Deceleration	11%
HDGV7	0 - 25	45%
	25 - 50	32%
	50+	10%
	Deceleration	14%
HDGV8a	0 - 25	45%
	25 - 50	34%
	50+	11%
	Deceleration	10%
HDGV8b	0 - 25	43%
	25 - 50	31%
	50+	10%
	Deceleration	15%

Table 3. Default Speed Category Distributions by Vehicle Class for Urban

Operation (MOVES2010a basis)[18]

As seen in the above table, the MOVES model assumes that some fraction of vehicle operation is associated with "deceleration" events, evaluated independently from other operation due to their unique emission rate patterns.[19] However, it is assumed that most Truck Tool users will not know their fleet's deceleration fraction. As such, the Truck Tool will adjust any values input by the user to include a deceleration fraction based on MOVES model percentages. If the user selects the default urban speed distributions, the Truck Tool will adjust the urban values from Table 3 to account for the percentage of miles specified for Highway/Rural operation as well. The following provides an illustrative example for calculating PM emissions for diesels given a specific set of road type / speed category distributions. NOx emission calculations will follow the same procedure.

User specifies 1 Class 8b diesel, model year 2011, traveling 100,000 mi/yr.

User specifies the following Road type/speed category distributions:

40% highway/rural
30% 0-25 mph
20% 25-50 mph
10% 50+ mph

For highway/rural operation, the lookup value from MOVES is 0.0195 g/mi for PM2.5

For urban operation, the lookup values are as follows:

0-25:	0.031 g/mi
25-50:	0.052 g/mi
50+:	0.012 g/mi
deceleration:	0.002 g/mi

Now the urban speed distribution percentage inputs must to account for deceleration, as follows:

0-25: 30% x sum of default percentages for the three speed bins (but excluding default deceleration fraction) = 30% x (45% + 34% + 12%) = 27.5%

25-50: 20% x sum of default percentages (45% + 34% + 12%) = 18.3%

50+: 10% x sum of default percentages (45% + 34% + 12%) = 9.2%

deceleration: the remaining percentage, which equals 100% - 40% (highway) - 27.5% - 18.3% - 9.2% = 5.1%

Now apply these percentage weights to the total mileage, and then multiply by the corresponding emission factors to obtain mass, as follows:

Highway/rural component: 0.40 x 100,000 x 0.0195 = 780 grams
0-25 urban component: 0.275 x 100,000 x 0.031 = 826 grams
25 - 50 urban component: 0.183 x 100,000 x 0.052 = 952 grams
50+ urban component: 0.092 x 100,000 x 0.012 = 110 grams
Deceleration urban component: 0.51 x 100,000 x 0.002 = 10 grams

Therefore total = 2,678 grams of PM2.5 (This value will then be summed with any other model year/vehicle class combinations and converted to short tons.)

As discussed in Section 2.3, the Truck Tool assumes that B100-equivalent biodiesel volumes are distributed proportionately across all diesel vehicle classes. For example, if a fleet uses 100 B-100 equivalent gallons of biodiesel, and 1,000 gallons of fuel total, the tool assumes that B10 (100 / 1,000 = 10) is the blend used by each truck class. Accordingly, emission rate adjustment factors are calculated for B10 using Equation 6, and applied to the diesel emission factors for each vehicle class.

Emission calculations for ethanol blends follow a different methodology, however, applying discrete emission factors for gasoline and E10 from MOVES (and adjusted gasoline emission factors for E85) with the specific fuel volume estimates provided by the user. The following provides an example illustrating how the miles of travel are apportioned across different blend volumes, in order to estimate mass emissions.

User specifies 1,000 gallons of fuel total, and 10,000 miles of travel total

User inputs:
100 gallons of E10
100 gallons of E85

Therefore there are 800 gallons of pure gasoline (1,000 – 100 - 100)

Apportion the 10,000 miles of travel across the different blend levels using gasoline-gallon equivalent (gge) factors (from https://www.afdc.energy.gov/afdc/prep/popups/gges.html) as follows:

100 gallons of E10 is equivalent to 100/1.05 = 95 gallons of gasoline*
100 gallons of E85 is equivalent to 100/1.39 = 72 gallons of gasoline

Therefore there are 800 + 95 + 72 = 967 gasoline equivalent gallons of fuel, total.

Applying the energy-equivalent fuel volume ratios to the 10,000 miles of total travel:

gasoline (E0) miles = 10,000 x 800/967 = 8,273 miles
E10 miles = 10,000 x 95/967 = 982 miles
E85 miles = 10,000 x 72/967 = 745 miles

Finally, multiplying these mileage values by the appropriate E0 and E10 gram/mile emission factors from MOVES results in the desired mass emission estimates. Similarly, multiplying the E85 miles by the E85 emission factors (adjusted from E0 factors as discussed in Section 2.3, provides mass emissions associated with E85.

* E10 gge factor developed from linear interpolation of E100 and gasoline Btu/gallon values

In addition, if national default ethanol blend levels are specified for gasoline fuel use, the Truck Tool assumes that *all* ethanol consumed is in an E10 blend. For example, assuming 1,000 gallons of gasoline are specified by the user, there would be 770 gallons of E10 (1,000 x .077 – see Section 2.3), and 230 (1,000 - 770) gallons of gasoline. Mass emissions would then be calculated for the gasoline and E10 components of the fuel as in the above example, apportioning total miles across gasoline and E10 in order to apply the appropriate g/mi factors.

Finally, note that the PM factors output by the MOVES model for use in the Truck Tool are expressed in terms of $PM_{2.5}$. The MOVES model assumes a fixed ratio of PM_{10} / $PM_{2.5}$ for a given fuel type, as summarized below:

- Gasoline – 1.086
- Diesel – 1.031
- CNG – 1.000

These factors were applied directly to the $PM_{2.5}$ emission factors to obtain mass emission and performance metrics for PM_{10} within the Truck Tool. In addition, it was assumed that LNG and LPG had PM ratios equivalent to the CNG value (1.00). Ethanol was assumed to have a ratio equal to that for gasoline, while the ratio for biodiesel was assumed to equal that for diesel.

3.3 Activity Calculations

The Truck Tool requires users to provide specific activity information on fuel consumption, miles traveled, payload, capacity volume, and capacity volume utilization at the vehicle class level for the emissions performance assessment (see Section 4.0 below). While the user may provide direct data inputs for any or all of these activity parameters, the Truck Tool also allows the user to select default values for payload and volume determination, in the absence of fleet-specific information. (Direct inputs for payload are highly preferred over the use of calculator defaults.) The data sources and assumptions used to develop these default values are discussed below.

<u>Default Payload Distributions</u>

Average payloads can vary widely among fleets, even within a given vehicle class, depending upon commodity type and body/trailer type. (While the Truck Tool does collect commodity information, this information is not used in determining payloads.) However, common body types were identified within each vehicle class, along with associated payload distributions, using data from the US Census Bureau's 2002 Vehicle Inventory Use Survey (VIUS).[20] The VIUS collected self-reported data from thousands of truck operators involved in freight movement across the U.S. In order to identify common body and trailer types at the vehicle class level, the following filters were first applied to the full VIUS dataset.

- BUSINESS = 1 (for-hire transportation or warehousing), or 2 (vehicle leasing and rental). This filter thereby excluded non-freight vehicles such as utilities, construction, and agriculture;
- FUEL = 1 (Gasoline), or 2 (Diesel). Alternative fuel vehicles such as CNG and LPG were excluded;
- P_EMPTY <> 100. That is, vehicles operating empty 100% of the time were excluded;
- TRUCK_SORTER <>1 – excludes light-duty vehicle body types;
- VIUS_GVW >2 – gross vehicle weight rating > 8,500 lbs;
- BODYTYPE <> 5 (armored), 7 (concrete mixer), 8 (concrete pumper), 9 (crane), 11 (dump), 15 (utility service), 16 (other service), 17 (street sweeper), 20 (wrecker), 21 (trash/garbage/recycling), 22 (vacuum);
- TRAILERTYPE <> 4 (dump), 8 (mobile home toter), 13 (trailer-mounted equipment).

After applying these screens, 14,540 records remained in the VIUS dataset for further analysis. Each of these records corresponded to survey responses from individual fleets of varying sizes, truck classes, and services. These records were then sorted by vehicle class according to the VIUS_GVW field to identify major body types within each class, and the corresponding payload averages and standard deviations. Average payload from VIUS was assumed to equal WEIGHTAVG – WEIGHTEMPTY.

Body types constituting approximately 5 percent or more of the total VIUS class-level vehicle count were included in the Truck Tool Payload Calculator, as described in Part 3 of the Truck Tool User Guide.[21] In addition, the payload averages and ranges for "Other" body type categories were set equal to the class-level values within the VIUS (i.e., averaged across all body types). Table 4 presents the payload averages, standard deviations, minimum and maximum values for common body types by vehicle class.[22] Note that the average values and standard deviations presented below are not weighted by fleet size.

[20] See http://www.census.gov/svsd/www/vius/2002.html.
[21] Trailer types representing less than 5 percent of the Class 8b category are also presented in the tool, due to the relatively large vehicle populations within this class.
[22] Given the lack of data on non-diesel heavy-duty vehicles, payload ranges are assumed to apply to all fuel types.

Table 4. Average Payload and Standard Deviation (short tons) for Common Body Types, by Vehicle Class (VIUS 2002 basis – diesel and gasoline)

Body/trailer type	Average payload (tons)	Std Deviation	Max	Min	Vehicle Count (N)	% of Vehicle Class
Class 2b						
flatbed/stake/platform	1.3	0.4	2.0	0.8	756	7%
step/walk-in	1.2	0.4	2.3	0.3	5,591	52%
van (basic enclosed)	1.1	0.7	2.9	0.0	3,897	36%
All (other)	1.2	0.6	2.9	0.0	10,794	
Class 3						
step/walk-in	2.1	0.5	3.8	0.4	39,555	60%
van (basic enclosed)	1.8	0.8	4.5	0.0	20,490	31%
All (other)	1.9	0.7	4.5	0.0	65,544	
Class 4						
flatbed/stake/platform	2.1	0.9	3.4	0.3	3,502	10%
step/walk-in	3.1	0.8	5.2	0.2	12,554	37%
van (basic enclosed)	2.7	0.8	5.0	0.2	15,385	45%
All (other)	2.8	0.8	5.2	0.2	34,025	
Class 5						
step/walk-in	4.1	0.9	5.4	0.3	14,058	41%
van (basic enclosed)	3.2	1.2	6.5	0.0	17,595	51%
All (other)	3.4	1.3	6.5	0.0	34,670	
Class 6						
flatbed/stake/platform	4.5	1.9	8.8	0.5	6,986	6%
reefer	5.0	1.5	8.5	0.8	7,301	6%
step/walk-in	5.3	1.1	8.5	0.5	27,711	23%
van (basic enclosed)	4.7	1.5	10.0	0.5	74,600	61%
All (other)	4.9	1.5	10.0	0.4	121,747	
Class 7 - straight trucks						
beverage	8.2	3.1	14.1	0.5	2,617	8%
flatbed/stake/platform	5.5	3.2	12.0	0.0	2,762	8%
reefer	7.1	1.9	10.6	4.5	4,203	13%
tank (fluid)	6.8	2.3	10.0	0.0	3,272	10%
van (basic enclosed)	5.9	2.2	11.0	1.0	18,278	55%
All (other)	6.3	2.4	14.1	0.0	33,250	
Class 7 - combination trucks						
flatbed/stake/platform	5.2	0.4	6.0	5.0	869	13%
reefer	3.6	1.0	4.5	2.5	484	7%
van (basic enclosed)	5.0	1.6	7.8	0.0	4,948	75%

Body/trailer type	Average payload (tons)	Std Deviation	Max	Min	Vehicle Count (N)	% of Vehicle Class
All (other)	5.0	1.6	7.8	0.0	6,585	
Class 8a - straight trucks						
flatbed/stake/platform	9.1	4.9	25.5	1.0	4,070	28%
tank (fluid)	12.9	3.6	22.0	4.0	3,668	25%
van (basic enclosed)	9.7	4.6	24.5	1.0	5,390	37%
All (other)	10.9	4.7	25.5	1.0	14,526	
Class 8a - combination trucks						
beverage	12.3	4.4	18.5	1.0	4,994	5%
flatbed/stake/platform	9.9	4.3	21.2	1.4	8,139	8%
van (basic enclosed)	10.6	4.0	21.5	0.3	79,757	76%
All (other)	10.5	4.1	21.5	0.3	104,842	
Class 8b - combination trucks						
flatbed	23.9	4.0	60.0	10.5	64,385	12%
reefer	22.2	2.9	32.3	6.0	67,028	12%
tanker	26.0	4.7	49.5	15.4	42,100	8%
Dry van (single trailer)	19.5	6.7	40.4	0.5	313,057	57%
Dry van (double trailer)	20.6	5.8	41.3	7.5	10,468	2%
Dry van (triple trailer)	27.1	3.2	31.8	24.5	283	0%
specialty	24.5	5.0	52.5	8.3	43,047	8%
Chassis (container)	22.2	4.3	32.5	2.0	8,398	2%
All (other)	21.6	6.1	60.0	0.5	548,767	

The values above serve as the basis for the default payload ranges provided in the Truck Tool payload calculator. For most vehicle class/body type combinations,[23] five default ranges are offered for Partner selection:

- Range 1: from 0 tons to (Average payload – 2 x standard deviation);
- Range 2: from (Average payload – 2 x standard deviation) to (Average payload – 1 x standard deviation);
- Range 3: from (Average payload – 1 x standard deviation) to (Average payload + 1 x standard deviation);
- Range 4: from (Average payload + 1 x standard deviation) to (Average payload + 2 x standard deviation); and,
- Range 5: from (Average payload + 2 x standard deviation) to VIUS Maximum observed value.

[23] In a few instances, the maximum VIUS value for a particular vehicle class/body type combination was less than the Range 4 minimum value. In these cases the Payload Calculator indicates Range 5 as "N/A".

Once a particular range is selected, the payload calculator estimates the midpoint of the range in order to estimate class level average payloads. The estimated midpoint payload values for each body type are weighted by one of the four allocation methods specified by the user in the payload calculator: # miles, # trips, % operation, and # vehicles by body type. The weighted sum is then used as the class level average payload, which in turn is used directly in determining grams per ton-mile performance metrics for the fleet.

Payload data based on bills of lading and entered directly into the payload calculator are validated using the same VIUS data described above, corresponding to the "Other" body types in the calculators.

Default Capacity Volumes

The Truck Tool also provides a volume calculator to estimate the cubic feet associated with the common straight truck body types (classes 2b through 7) identified using the VIUS dataset, as well as typical trailer, container, carrier, and tanker sizes, for combination trucks (classes 8a and b).[24] Capacity volumes in cubic feet are relatively easy to estimate for many combination trucks. Per unit interior volume defaults are assumed for standard dry vans - no high cubes, reefers, etc.), and containers. Trailer calculations assume an 8' x 9' cross-section, and the exterior length less 1/2 foot. 20 and 40 foot container dimensions are referenced in many places, such as http://www.mussonfreight.com/containers/containers.html.[25] Table 5 summarizes the default volumes assumed for a number of standard trailers, containers, tankers, and bulk carriers.

Table 5. Default Average Cubic Feet (Class 8a – 8b trucks)

Type	Size	Cubic Feet
Trailers	28ft	1,980
	40ft	2,844
	42ft	2,988
	45ft	3,204
	48ft	3,420
	53ft	3,780
	57ft	4,068
	28x28	3,960
	40x28	4,824
	40x40	5,688
	48x48	6,840

[24] Default capacity volumes for Class 7 combination vehicles were not available from the literature search, and were set equal to the average volume for Class 8 combination trucks in the 2010 SmartWay database.
[25] 53 foot containers are assumed to have interior dimensions of 52' 5" x 7' 8" x 7' 10"

Type	Size	Cubic Feet
	28x28x28	5,940
Containers	20ft	1,159
	40ft	2,347
	53ft	3,148
Tankers	Small (3,000 gal)	401
	Medium (5,250 gal)	702
	Large (7,500 gal)	1,003
Bulk Carriers	Small (22’x8’10.25’)	1,804
	Medium (32’x8’x11’)	2,816
	Large (42’x8.5’x11.5’)	4,106

Cargo volume capacity data is often not readily available for straight trucks, however. Such trucks are highly variable in their configuration and when volume estimates are found, the data often do not permit cross-referencing with vehicle class. Most highway infrastructure and operating agencies, including enforcement, are concerned about weight (e.g., pavement and structure damage), but not cubic capacity. The operating agencies are also concerned about maximum dimensions, of length, height and width (for, respectively, turning radii, vertical clearance, and lane width) but the shape of the box and its relation to the truck superstructure, not these maximums, dictates cubic capacity. Little public research on the cubic capacity of the box has been done, and thus little information is published.

Available information was compiled as it relates to cargo *volume* capacity for the common straight truck body types identified in the VIUS. (Following a SAS analysis on the VIUS Microdata, grouping body type versus cubic cargo capacity, it was determined that none of the 246 variables in VIUS included cubic capacity information.)

Without a comprehensive data source, such as the VIUS, other strategies needed to be employed to develop examples, or ranges, of volume capacity for the various body type/truck class combinations of interest. A literature review and vendor interviews were performed to determine appropriate values for cargo volume capacity. The first step in the literature review involved preparing a list of vendors responsible for designing, manufacturing, or operating all the different truck types identified.

Cubic capacity is also dependent upon a variety of factors and is not uniform for even the same make and model, as many truck manufactures will design to specifications based on a client’s unique needs for their cargo. For example, a client may request a manufacturer to design a truck interior to best accommodate the delivery of a certain size of parcel, and install shelving or otherwise compartmentalize to that end. Consideration was given to these factors during the review.

The literature review encompassed Internet searches of vendors of the truck types described above. Sources explored included truck manufacturers, dealers, and fleet lessors of vehicles such as Budget/U-haul/Enterprise/Ryder/E-Dart). Additionally, validation searches were performed on websites outlining current truck sales to help identify the appropriate size/class of the vehicles and applicable specifications. The following information was collected from these searches for over 40 different vehicles currently available on the market:

- Length, width, height of the cargo hold
- Reported cargo space (cubic feet)
- Gross Vehicle Weight
- Payload
- Manufacturer
- Make/Model
- Reference website

Outreach to key stakeholders in the commercial vehicle industry was also performed to further validate the information collected from the literature and resource review. Contact was made with representatives from Volvo Trucks North America; the American Transportation Research Institute (ATRI); the Commercial Vehicle Safety Alliance (CVSA); the Truck Manufacturers Association (TMA); Federal Highway Administration (FHWA) Truck Size and Weight; and a wide variety of trucking manufactures and other vendors.

The results of this review are provided in Table 6 below for straight trucks, class 2b through 7. In those instances where multiple vehicle models were identified for a given body type/vehicle class combination, simple averages were calculated across models.[26] Consistent with the Payload Calculator methodology, the value for "Other" body types was set equal to the average across all body types identified for a given truck class.

[26] Ideally in the future capacity estimates would be weighted by model sales data or other sources of information related to the relative frequency of the different vehicle makes and models.

Table 6. Estimated Capacity Volumes (cubic feet) for Common Straight Truck Body Types, by Vehicle Class

Body/trailer type	Average Capacity Volume (Cubic Feet)
Class 2b	
flatbed/stake/platform	336
step/walk-in	314
van (basic enclosed)	340
Other	330
Class 3	
step/walk-in	547
van (basic enclosed)	450
Other	599
Class 4	
flatbed/stake/platform	448
step/walk-in	700
van (basic enclosed)	808
Other	830
Class 5	
step/walk-in	670
van (basic enclosed)	1,515
Other	1,233
Class 6	
flatbed/stake/platform	672
reefer	1,521
step/walk-in	1,496
van (basic enclosed)	1,380
Other	1,267
Class 7	
beverage	1,505*
flatbed/stake/platform	728
reefer	1,774
tank (fluid)	267
van (basic enclosed)	1,552
Other	1,505

*Set equal to “Other” due to lack of data

Once a default capacity volume is selected, the volume calculator weights the volume estimates for each body type by one of the four allocation methods: #

miles, # trips, % operation, and # vehicles by body type. The weighted sum is then used as the class level average capacity volume, which in turn is used directly in determining grams per volume-mile performance metrics for the fleet.

A list of websites utilized in the literature review is provided below.

Truck manufacturers:
www.gmc.com
www.chevrolet.com
www.ford.com
www.freightlinersprinterusa.com
www.silvercrowncoach.com

Fleet operators:
www.uhaul.com
www.pensketruckrental.com
www.budgettruck.com
www.hendersonrentals.co.nz
www.hackneybeverage.com
www.hackneyusa.com
www.fedex.com
www.grummanolson.com

Other sources:
www.usedtruckdepot.com
www.usedtrucks.ryder.com
www.truckingauctions.com
www.truckpaper.com
www.motortrend.com
files.harc.edu/Projects/Transportation/FedExReportTask3.pdf

The detailed findings of this review are presented in Appendix D.

3.4 Data Validation

The SmartWay Truck Tool has a number of standard logical, range and value checks that must be passed before Partners can submit their data to EPA. Many of these checks simply confirm the presence of required data (e.g., total miles for each truck class selected), or the accuracy of logical relationships (e.g., revenue miles < = total miles). The list of these basic checks is provided below. Partners will not be able to finalize their fleet files until all associated errors have been resolved.

Table 7. Basic Range and Logical Checks – Conditions Resulting in Error or Warning Messages

Fleet Characterization	User must include a Partner Name.
Fleet Characterization	SCACs must be between 2 and 4 characters in length, and at least one character must be a letter. Multiple SCACs must be separated by commas.
Fleet Characterization	MCNs must be between 6 and 7 digits.
Fleet Characterization	User must select a Fleet Type.
Fleet Characterization	User must indicate operational control over at least 95% of the fleet. (If partner does not have at least 95% operational control, Truck Tool may not be used for the fleet.)
Fleet Characterization	User must include a Fleet Contact name for each fleet.
Fleet Characterization	The Operation Category totals must add up to 100%.
Fleet Characterization	The Body Type totals must add up to 100%.
General Information	User must designate the Short-haul vs. Long-haul split.
General Information	User must select at least one fuel type.
General Information	User must designate the percentage of truckloads that utilize 100% of available cargo capacity.
General Information	User must indicate the commodities that are carried by each fleet.
General Information	If participating in the Port Dray Program, user must indicate the number of trucks equipped with APUs and SmartWay tires. (If none of the trucks in the fleet are equipped with these, a zero must be entered into the field.)
General Information	If participating in the Port Dray Program, the number of trucks equipped with APUs or SmartWay tires cannot exceed the number of trucks in the fleet.
Activity Information	All fields are required, so no field can be left blank. (If appropriate, a zero can be placed in certain fields.)
Activity Information	For all numeric fields except Empty Miles and Idle Hours, the value must be greater than zero.
Activity Information	For Revenue Miles, the amount cannot exceed the number of Total Miles Driven.
Activity Information	For Revenue Miles, amounts that are less than 50% of Total Miles Driven must be explained.
Activity Information	For Revenue Miles, if the Data Source Detail "Equal to total miles" is selected, the amount must equal the Total Miles Driven.
Activity Information	For Revenue Miles, if the Data Source Detail "Total miles less empty miles" is selected, the amount must equal the Total Miles Driven minus Empty Miles Driven.
Activity Information	For Empty Miles, the amount must be less than the number of Total Miles.

Activity Information	For Empty Miles, amounts that are more than 50% of Total Miles Driven must be explained.
Activity Information	For Empty Miles, if the Data Source Detail "Total miles less revenue miles " is selected, the amount must equal the Total Miles Driven minus Revenue Miles Driven.
Activity Information	On the Biofuel Blend Worksheet, the total gallons of biofuel cannot exceed the amount entered for Total Fuel on the Activity Information screen.
Activity Information	For each row of data, user must specify a Data Source.
Activity Information	For Capacity Utilization, the value cannot exceed 100%.
Activity Information	For Capacity Utilization, the value must be less than 100% if user indicated that the fleet is 100% Less-Than-Truckload (LTL). (By definition, LTL fleets cannot have 100% capacity utilization.)
Activity Information	For Capacity Utilization, values less than the expected minimum value of 45% must be explained.
Activity Information	For Idle Hours, the value cannot exceed 8,760.
Activity Information	For Idle Hours, values significantly outside the expected range (260 - 2,100) must be explained.
Activity Information	Total Miles per Truck cannot exceed 500,000.
Activity Information	Total Miles per Truck outside the expected range (12,000 to 125,000 for class 2-7, or 12,000 to 125,000 for class 8) must be explained.
Activity Information	MPG must be greater than zero.
Activity Information	MPG that is significantly outside the expected range for the given truck class (based on a lookup table) must be explained.
Model Year & Class	Total truck count for each fleet cannot be zero.
Model Year & Class	Total truck counts for each selected truck class (those with a check mark) cannot be zero.
PM Reduction	The number of trucks using any particular PM reduction strategy cannot be greater than the number of trucks for the given class and model year.
PM Reduction	The sum of the trucks using either DOC or Particulate Matter Traps cannot be greater than the number of trucks for the given class and model year.
PM Reduction	If participating in the Port Dray Program, the sum of the trucks using either DOC/CCV, Flow Through Filters, or Particulate Matter Traps cannot be greater than the number of trucks for the given class and model year.
PM Reduction	If user indicates that the company uses PM reduction equipment, there must be at least one truck included on the PM Reduction sub-tab.
Payload & Volume Calculators	User must provide a Data Source for the information entered on the calculators.
Payload & Volume Calculators	The sum of the total miles or total trucks entered in the calculator must equal the number entered on the Activity Information screen.
Payload & Volume Calculators	The calculated average cannot be equal to zero.

Payload & Volume Calculators	For percentages, the total must equal 100%.
Payload & Volume Calculators	For each body type for which some information has been entered, all of the visible field must be completed (including the explanation field).
Payload & Volume Calculators	Zero is not a valid value for any payload or volume.
Payload & Volume Calculators	Values that are significantly outside the expected range for the given body type and class must be explained.
Payload & Volume Calculators	The body types indicated in the Volume Calculator must agree with those used in the Payload Calculator.
Payload & Volume Calculators	If "# of Vehicles in this class" is selected for both the Payload and Volume calculators for a given truck class, the number of trucks entered into each calculator must agree.
Payload & Volume Calculators	If "# of miles in this class" is selected for both the Payload and Volume calculators for a given truck class, the number of miles entered into each calculator must agree.
Payload & Volume Calculators	If "# of Trips done by this class" is selected for both the Payload and Volume calculators for a given truck class, the number of trips entered into each calculator must agree.

Also note that there is an implicit validation check on all numeric fields because the system will not accept any non-numeric characters (including minus signs) within these fields.

Additional, rigorous validity checks of key data inputs are also needed to ensure the overall quality of the performance metrics calculated by the Truck Tool. Validity checks serve three purposes to this end. First, unusually high or low values can be identified and flagged for the user's attention before finalizing inputs. For example, a user may misplace a decimal, inadvertently add an extra zero, or utilize the wrong units (e.g. reporting pounds instead of tons for payload) upon data entry. By comparing these data entries to reliable industry averages and distributions, these values can be flagged allowing users to quickly correct such errors.

Second, under certain circumstances Partners may operate their fleets under atypical conditions, resulting in extreme (outlier) data values. For example, permitted heavy-haul operations may routinely exceed industry-average payload values by 10 or more tons. By flagging such data entries Partners have the opportunity to provide additional information regarding their unique operating conditions through use of the Truck Tool comment fields.

Finally, independent criteria can be established to ensure that data inputs are never allowed to exceed certain physically-constrained absolute limits. For example, a truck cannot exceed roughly 500,000 miles per year, even with dual drivers and minimal maintenance time, simply due to the available hours per year and highway speed limits. Data values above these absolute maximum levels are not allowed by the Truck Tool, and users are required to modify the associated inputs before proceeding.

Several parameters were identified for detailed validity checks of data inputs. The data sources and validation rules associated with each of these parameters is discussed below.

<u>Annual Miles per Truck</u>
Appendix C presents a number of parameter distributions compiled from draft SmartWay partner submissions of their 2008 fleet files, including annual miles per truck by vehicle class.[27] As seen in the histograms, the class 2b through class 7 distributions are highly skewed toward relatively low mileage rates. On the other hand, the class 8b mileage data appears to resemble a normal distribution centered at approximately 100,000 miles per year. (Class 8a vehicles present a much less "organized" distribution, with substantial spread over a very large range of values.) As such, it was decided to implement a 2-tiered warning system, applying the following rules:

- For class 2b through 7 vehicles, raise a warning flag if annual mileage is > 125,000 miles per year;
- For class 8a/b vehicles, flag if mileage is > 200,000 miles per year;
- For all classes, do not allow mileage values greater than 500,000 miles per year.

Finally, a lower-bound value of 12,000 miles per year per truck was instituted across all vehicle classes as warning requiring text explanation.

<u>Revenue and Empty Miles</u>
In addition to the logical relation checks (e.g., revenue miles are less than or equal to total miles – see Table 7), additional validation cutoffs were developed. Based on the 2010 Truck Partner data very distinct low population "tails" were identified in the revenue and empty mile distributions. Specifically, revenue miles were less than 50% of total miles for only 105 fleets out of 5,821. Similarly, empty miles were greater than 50% of total miles for only 60 fleets out of 5,821. In addition, both the revenue and empty mile distributions featured significant "spikes" at the 50% of total miles mark. Accordingly, validation checks were set at the 50% mark (below for revenue miles, above for empty miles) in order to flag potential outliers.

[27] Note that this data was collected before implementing rigorous validation routines. As such it may contain inaccurate/erroneous data points. However, the data provides a reasonable "first cut" at establishing warning levels for Partners to confirm or modify their data inputs.

Average Miles per Gallon

The distribution of diesel mpg values for SmartWay partners (based on draft 2008 data) is shown in Appendix C by vehicle class. The mpg values for class 6 and larger vehicles appear to be roughly normally distributed, while the distributions for the smaller vehicles do not appear to follow a clear pattern.[28] In order to remove potentially erroneous values from the data, the top and bottom 5% of mpg values were dropped from the distributions, and averages and standard deviations were calculated for the remaining data. This process preferentially removed high end values from the original distributions, thereby lowering both sample averages and standard deviations. The resulting values are presented in Table 8. These values were used to develop five ranges for validation of class-level mpg estimates based on standard deviations, similar to the ranges developed for average payload described above.

Average Payload

As summarized in Table 4 above, the VIUS data was used to develop default payload ranges for different common body types, by truck class. Ranges are centered around the average payload value, with boundaries at one and two times the standard deviation of the payload distribution. While the tool will flag any payload input more than one standard deviation from the average value, and requires an explanation for such values, the tool will allow any non-zero payload to be entered.

Average Capacity Volume

As discussed in Section 3.3, data regarding straight truck capacity volumes was extremely limited. As such, it was not possible to develop distributional estimates for this parameter. Accordingly, a simple validation criteria was implemented, applying a "yellow flag" to data entries differing from the default value for a given body type by +/- 25%, and a "red flag" to values greater than 50%.[29]

% Capacity Volume

A "yellow" warning is initiated for capacity volumes less than 45%, and a "red" warning for capacity volumes less than 25%.

Average Annual Idle Hours per Truck

A "red" warning is initiated for average idle hours less than 50 or greater than 2,900, while a "yellow" warning is initiated for hours between 50 and 260, or between 2,100 and 2,900.

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[28] The smaller vehicle class distributions also have substantially smaller sample sizes, increasing their associated uncertainty.

[29] For this parameter "red flag" warnings simply note that the associated value is far from the typical value for that body type/class (also referred to as Level 1 warnings on the Truck Tool Out of Range Report), while "yellow flag" warnings note that the value is somewhat larger/smaller than anticipated (Level 2 warning in the Out of Range Report). Explanations are not requested for yellow flag warnings.

Table 8. SmartWay Partner Average MPG, Standard Deviation, and Validation Ranges for Diesel Vehicles (2008 Data Submittal)

			Range									
			1		2		3		4		5	
Class	Avg	Std dev	min	max	min	max	min	max	min	max	min	max*
2b	11.68	4.01	> 0.00	3.66	3.66	7.67	7.67	15.69	15.69	19.70	19.70	--
3	9.11	3.63	> 0.00	1.85	1.85	5.48	5.48	12.74	12.74	16.37	16.37	--
4	10.04	2.53	> 0.00	4.98	4.98	7.51	7.51	12.57	12.57	15.10	15.10	--
5	8.13	2.72	> 0.00	2.69	2.69	5.41	5.41	10.85	10.85	13.57	13.57	--
6	7.59	1.38	> 0.00	4.83	4.83	6.21	6.21	8.97	8.97	10.35	10.35	--
7	7.37	1.57	> 0.00	4.23	4.23	5.80	5.80	8.94	8.94	10.51	10.51	--
8a	5.98	0.69	> 0.00	4.60	4.60	5.29	5.29	6.67	6.67	7.36	7.36	--
8b	5.86	0.51	> 0.00	4.84	4.84	5.35	5.35	6.37	6.37	6.88	6.88	--

*No maximum value – allows for inclusion of hybrid and other high-efficiency technologies, with proper explanatory text provided.

Non-Diesel MPG Validation

The 2008 data submissions from SmartWay partners did not include enough information on non-diesel trucks in order to develop a robust distribution of mpg values for validation purposes. Accordingly, engineering judgment was used to adjust the diesel mpg values for other fuel types, accounting for general, relative vehicle and/or fuel efficiency differences. First, a ratio was developed for adjusting diesel mpg values to comparable gasoline mpg values, based upon simulated modeling performed by Argonne National Laboratory.[30] The Argonne data for gas and diesel trucks was based on PSAT simulations of a typical pickup in the class 2b or class 3 range. The fuel consumption was reported for the same truck equipped with both gasoline and diesel engines over the various EPA emissions and fuel economy driving cycles. Using this data, a combined fuel economy was calculated using the method from EPA's pre-2008 combined 2-cycle fuel economy using the FTP and Highway cycles as given in 40 CFR Part 600. This method uses a weighted harmonic average of the two values, with the FTP weighted at 55% and the Highway weighted at 45%.

The difference in the calculated combined fuel economies for the gas- and diesel-powered model results showed that the diesel had a 25.9% greater fuel economy than gasoline. These results are a direct volumetric comparison rather than in terms of gasoline-equivalent gallons. As such, the diesel mpg ranges shown in Table 8 above were divided by 1.259 to obtain comparable mpg ranges for gasoline vehicles. Since CNG vehicle fuel consumption is reported in terms of gasoline-equivalent gallons, the mpg validation ranges for CNG vehicles were set equal to those for comparable gasoline vehicles.

Validation ranges for LPG and LNG vehicles were developed from the gasoline ranges, dividing the gasoline values by the appropriate gasoline gallon-equivalent factor for these fuels (1.35 for LPG and 1.52 for LNG),[31] thereby adjusting mpg values for volumetric energy density.

[30] Delorme, A. et. al., *Impact of Advanced Technologies on Medium-Duty Trucks Fuel Efficiency*, Argonne National Laboratory, 2010-01-1929.

[31] https://www.afdc.energy.gov/afdc/prep/popups/gges.html

4.0 Performance Metrics

The Truck Tool allows the user to calculate their emissions performance using a number of different metrics, at different levels of aggregation. Available performance metrics include:

- Grams per mile
- Grams per Payload Ton-Mile
- Grams per Thousand Cubic Foot-Miles
- Grams per Thousand Utilized Cubic Foot-Miles

The Internal Metrics report within the Truck Tool presents the results of 36 calculations (4 x 4 x 3 = 48), which represent the following four calculations for each of the three pollutants (CO_2, NOx, PM_{10} and $PM_{2.5}$) and for each of three different mileage types (total, payload, and loaded). Note that all capitalized fields represent fields in the user interface:

1. **g/mile: ∑E / M**
   where E = Emissions, M = Miles Driven
2. **g/avg payload ton-mile: ∑E / (M × AP)**
   where E = Emissions, M = Miles Driven, AP = Average Payload
3. **g/avg cubic foot volume: ∑E / (M × ACV)**
   where E = Emissions, M = Miles Driven, ACV = Average Capacity Volume
4. **g/avg utilized cubic foot: ∑E / (M × ACV) / CU**
   where E = Emissions, M = Miles Driven, ACV = Average Capacity Volume, CU = % Cube Utilization

For all four calculations:

Emissions = grams of pollutant (as specified above)
Miles Driven = Total Miles, Payload Miles, or Loaded Miles (Total Miles minus Empty Miles)

As shown in the equations above, summations are performed for the different metrics. Each of the metrics is automatically aggregated across model years (for NOx and PM) for all reporting purposes. Additional aggregation may be reported across truck classes, fuel types, divisions, and at the company level, as specified by the user.

4.1 Upcoming Functionality

Future versions of the Truck Tool will contain additional functionality to allow Partners to track their performance from year to year, as well as to compare their performance with other Partners.

5.0 Port Dray Program Inputs and Calculations

Those fleets with 75% or more of their operation in the Dray Operation Type category are eligible to participate in SmartWay's Port Drayage Program. This voluntary program recognizes Partners for reducing diesel emissions from port drayage trucks. Participating partners must provide information on their drayage fleet's model year distribution, use of PM control equipment, auxiliary power units (APUs), SmartWay tires, and LNG trucks in order to obtain an Environmental Performance Rating for the program.

The following summarizes the calculations used in the Truck Tool to calculate Port Dray Program Environmental Performance Rating.

Baseline CO_2 Emissions from Average Dray Truck Fleet

To calculate baseline CO_2 emissions from the average dray truck fleet, the total number of trucks within a single model year group, as supplied by the user, is multiplied by an average model year distribution factor, as seen in Table 9.

Table 1. Average Model Year Distribution Factors by Model Year Group

Model Year Group	Average Model Year Distribution Factor
Pre-1988	0.061
1988 – 1993	0.190
1994 – 2002	0.632
2003 – 2006	0.083
2007 – 2009	0.033
Post 2009	0.000

Then, the fuel consumption is calculated by dividing the average miles per truck, also supplied by the user, by an assumed 5.47 miles per gallon.[32] This calculated fuel consumption is then multiplied by the CO_2 emission factor of 0.01015. CO_2 emissions across all model year groups are summed to obtain the total baseline CO_2 emissions.

Untreated and Controlled CO_2 Emissions

To calculate CO_2 emissions from untreated trucks (e.g., without PM retrofits), as well as trucks with diesel oxidation catalysts (DOCs), closed crankcase

[32] This and other calculation elements used to derive the Dray Program Environmental Performance Score are completely independent of the performance metric calculations in other portions of the Truck Tool. For example, the truck fleet gram per mile and gram per ton-mile performance metrics are calculated using the fleet's actual fuel efficiency, not the 5.47 value used for the Dray Program calculations.

ventilation (CCVs), flow through filters, and diesel particulate filters in the fleet, the fuel consumption is calculated by dividing the average miles per truck, supplied by the user, by the assumed value of 5.47 miles per gallon. This calculated fuel consumption is then multiplied by the CO_2 emission factor of 0.01015. CO_2 emissions across all model year bins are summed to obtain the total untreated plus controlled vehicle CO_2 emissions.

Baseline PM Emissions from Average Dray Truck Fleet

To calculate baseline PM emissions from the average dray truck fleet, the total number of trucks within a single model year group, as supplied by the user, is multiplied by an average model year distribution factor, as shown in Table 9. The resulting value is then multiplied by the average miles per truck, as supplied by the user, as well as the specified PM emission factor, as shown in Table 10. PM emissions across all model year bins are summed to obtain the total baseline PM emissions.

Table 10. PM Emission Factors by Model Year Group

Model Year Group	PM Emission Factor
Pre '88	3.428E-06
88-'93	2.535E-06
94-'02	1.157E-06
03-'06	6.834E-07
07-'09	9.921E-08
post 2009	7.716E-08

PM Emissions from Untreated Trucks

To calculate PM emissions from untreated trucks, the total number of untreated trucks within a single model year bin, as supplied by the user, is multiplied by the average miles per truck, also supplied by the user, as well as an appropriate PM emission factor, as shown in Table 10. PM emissions across all model year groups are summed to obtain the total PM emissions from untreated trucks within the fleet.

PM Emissions from Controlled Trucks

To calculate PM emissions from controlled trucks, the total number of controlled trucks within a single model year group, as supplied by the user, is multiplied by the average miles per truck, also supplied by the user, as well as an appropriate PM emission factor, as shown in Table 10. This value is then multiplied by a control factor, as shown in Table 11. PM emissions across all model year groups are summed to obtain the total PM emissions from untreated trucks within the fleet.

Table 11. PM Control Factors by Control Type

Control Type	PM Control Factor
DOC & CCVs	70%
Flow Through Filter	50%
Diesel Particulate	10%

Baseline NO_x Emissions from Average Dray Truck Fleet

To calculate baseline NO_x emissions from the average dray truck fleet, the total number of trucks within a single model year group, as supplied by the user, is multiplied by an average model year distribution factor, as seen in Table 9. The resulting value is then multiplied by the average miles per truck, as supplied by the user, as well as an appropriate NO_x emission factor, as shown in Table 12. NO_x emissions across all model year groups are summed to obtain the total baseline NO_x emissions.

Table 12. NO_x Emission Factors by Model Year Group

Model Year Group	PM Emission Factor
Pre '88	2.65E-05
88-'93	2.51E-05
94-'02	2.38E-05
03-'06	1.68E-05
07-'09	1.01E-05
post 2009	3E-06

NO_x Emissions from Untreated and Controlled Trucks

To calculate NO_x emissions from untreated trucks, the total number of untreated trucks within a single model year group, as supplied by the user, is multiplied by the average miles per truck, also supplied by the user, as well as an appropriate NO_x emission factor, as seen in Table 12. NO_x emissions across all model year groups are summed to obtain the total NO_x emissions from untreated trucks within the fleet.

Reductions in CO_2 Emissions from Auxiliary Power Units (APUs), SmartWay Approved Tires, and LNG Vehicles

The user-supplied number of vehicles with each control is divided by the total number of trucks in the fleet and multiplied by a control factor, as shown in Table 13.

Table 13. Control Strategy Control Factors

Control Type	PM Control Factor
APUs	11%
SmartWay Tires	2%
LNG	21%

The reductions are then summed across all control types and multiplied by the sum of CO_2 emissions for untreated trucks, and trucks with DOCs & CCVs, flow through filters, and diesel particulate traps installed. This value is then multiplied by -1 to indicate a reduction in emissions.

Reductions in PM Emissions from Auxiliary Power Units (APUs)

The user-supplied number of trucks with APUs installed is divided by the total number of trucks in the fleet and multiplied by a control factor of 8%. The reductions are then multiplied by the sum of PM emissions for untreated trucks, and trucks with DOCs & CCVs, flow through filters, and diesel particulate traps installed. This value is then multiplied by -1 to indicate a reduction in emissions.

Reductions in NO_x Emissions from Auxiliary Power Units (APUs) and SmartWay Tires

The user-supplied number of trucks with APUs and SmartWay Tires installed is divided by the total number of trucks in the fleet and multiplied by a control factor of 11% and 2% for APUs and SmartWay tires, respectively. The reductions are then multiplied by the sum of NO_x emissions for untreated trucks, and trucks with DOCs & CCVs, flow through filters, and diesel particulate traps installed. This value is then multiplied by -1 to indicate a reduction in emissions.

Total Fleet Emissions

The total fleet emissions are calculated by subtracting the reductions that were calculated for each pollutant from the sum of the emissions, by pollutant, for untreated trucks and trucks equipped with DOCs & CCVs, flow through filters, and diesel particulate traps.

Change in Emissions from Baseline

Total fleet emissions are subtracted from the baseline emissions for each pollutant to determine the change in emissions from baseline.

Percent Change in Emissions

The change in emissions from baseline is divided by the baseline emissions, by pollutant.

Fleet Composite Score and Environmental Performance Rating

The fleet composite score determines the dray fleet's Environmental Performance Rating, which is used by shippers to assess their status in the Port Dray Program. The fleet composite score is determined by the formula:

$$\left[\frac{CO2\ \%\ Change\ in\ Emissions}{40} + \frac{NOX\ \%\ Change\ in\ Emissions}{80} + \frac{PM\ \%\ Change\ in\ Emissions}{80}\right] * -100$$

The Environmental Performance Rating is assigned based on the value of the fleet composite score, as shown in Table 14.

Table 14. Environmental Performance Rating Assignments

Fleet Composite Score	Environmental Performance Rating
≤0.05	No Rating
>0.05 and ≤0.499	Average
>0.499 and ≤1.00	Good
>1.00 and ≤1.8	Very Good
>1.8	Outstanding

Appendix E shows a detailed breakdown of all equations in EPA's Drayage Calculator, which is used as the basis of the drayage calculations within the SmartWay Truck Tool.

Appendix A: MOVES2010a NOx/$PM_{2.5}$ Emission Factors (g/mi)

Year & Class	Diesel NOx Decel	Diesel NOx 0 to 25	Diesel NOx 25 to 50	Diesel NOx 50 +	Diesel NOx Highway	Diesel PM 2.5 Decel	Diesel PM 2.5 0 to 25	Diesel PM 2.5 25 to 50	Diesel PM 2.5 50 +	Diesel PM 2.5 Highway
1987-2b	2.642	29.260	40.441	9.854	16.545	0.066	1.534	2.468	0.849	1.200
1987-3	2.641	29.301	40.532	9.912	16.609	0.066	1.539	2.473	0.851	1.203
1987-4	2.646	29.264	40.787	9.927	17.485	0.061	1.345	2.038	0.693	1.015
1987-5	2.635	29.501	41.049	10.211	17.140	0.065	1.518	2.399	0.823	1.174
1987-6	2.583	31.738	45.322	12.755	22.423	0.071	1.836	2.717	0.927	1.457
1987-7	2.439	37.330	56.680	19.430	31.999	0.086	2.532	3.305	1.110	1.882
1987-8a	2.322	40.928	64.530	24.070	36.168	0.099	3.004	3.772	1.262	2.093
1987-8b	2.221	44.184	71.869	28.178	39.257	0.112	3.460	4.218	1.410	2.274
1988-2b	2.156	21.847	27.128	7.288	12.595	0.086	1.033	1.385	0.335	0.642
1988-3	2.619	30.182	42.195	10.902	18.984	0.066	1.173	1.532	0.418	0.733
1988-4	2.645	29.223	40.600	9.852	17.193	0.060	1.197	1.545	0.437	0.746
1988-5	2.594	31.309	44.460	12.217	21.752	0.068	1.243	1.574	0.428	0.771
1988-6	2.579	31.933	45.691	12.924	22.949	0.071	1.256	1.586	0.427	0.779
1988-7	2.522	34.214	50.303	15.652	27.269	0.077	1.370	1.656	0.438	0.830
1988-8a	2.363	39.722	62.063	22.488	34.924	0.098	1.621	1.834	0.466	0.917
1988-8b	2.207	44.835	73.611	28.908	39.944	0.124	1.866	2.021	0.500	0.978
1989-2b	2.318	28.029	37.456	11.360	21.485	0.084	1.242	1.539	0.387	0.765
1989-3	2.579	28.311	38.436	9.422	15.976	0.066	1.142	1.504	0.412	0.709
1989-4	2.645	29.210	40.562	9.834	17.158	0.060	1.210	1.550	0.441	0.752
1989-5	2.610	30.602	43.039	11.383	20.150	0.065	1.230	1.562	0.431	0.761
1989-6	2.566	32.477	46.755	13.551	24.120	0.071	1.310	1.613	0.436	0.803
1989-7	2.570	32.365	46.623	13.399	23.889	0.072	1.304	1.615	0.438	0.802
1989-8a	2.408	38.358	59.062	20.690	33.334	0.091	1.583	1.797	0.462	0.906
1989-8b	2.200	45.012	74.008	29.147	40.077	0.122	1.892	2.027	0.499	0.983
1990-2b	2.018	14.957	18.846	5.616	8.869	0.099	1.040	1.419	0.308	0.634
1990-3	2.062	19.687	25.726	7.022	12.114	0.084	1.147	1.507	0.376	0.707
1990-4	2.041	22.499	31.032	7.482	12.750	0.061	1.181	1.530	0.432	0.731
1990-5	2.030	22.989	32.020	8.061	14.055	0.062	1.217	1.551	0.436	0.752
1990-6	1.967	25.657	37.245	11.138	19.741	0.072	1.372	1.640	0.442	0.828
1990-7	1.962	25.827	37.598	11.369	20.028	0.072	1.383	1.647	0.443	0.832
1990-8a	1.788	31.899	50.633	18.880	28.332	0.098	1.764	1.891	0.473	0.955
1990-8b	1.672	35.466	58.824	23.467	31.508	0.117	2.008	2.053	0.496	1.007
1991-2b	1.708	12.618	15.934	4.803	7.601	0.231	0.678	0.684	0.138	0.377
1991-3	1.867	20.777	29.249	7.107	11.934	0.060	1.096	0.823	0.218	0.454
1991-4	1.762	25.180	38.109	12.253	21.193	0.083	1.468	1.061	0.341	0.753
1991-5	1.800	17.146	22.502	6.111	10.432	0.164	0.911	0.756	0.167	0.420
1991-6	1.811	23.247	34.228	9.956	17.756	0.073	1.305	0.959	0.289	0.645
1991-7	1.748	25.572	39.071	12.802	21.746	0.085	1.500	1.085	0.351	0.770
1991-8a	1.596	30.305	49.665	18.882	27.374	0.118	1.902	1.382	0.508	0.962
1991-8b	1.521	32.742	55.468	21.949	29.495	0.143	2.116	1.558	0.612	1.044
1992-2b	1.659	11.160	14.168	4.430	6.792	0.238	0.594	0.653	0.132	0.363
1992-3	1.803	18.332	24.394	6.235	10.575	0.124	0.957	0.792	0.215	0.450
1992-4	1.871	20.655	28.975	6.933	11.743	0.063	1.074	0.849	0.248	0.475

Year & Class	Diesel NOx Decel	Diesel NOx 0 to 25	Diesel NOx 25 to 50	Diesel NOx 50 +	Diesel NOx Highway	Diesel PM 2.5 Decel	Diesel PM 2.5 0 to 25	Diesel PM 2.5 25 to 50	Diesel PM 2.5 50 +	Diesel PM 2.5 Highway
1992-5	1.869	20.757	29.337	7.105	12.275	0.060	1.080	0.826	0.221	0.462
1992-6	1.814	23.077	33.803	9.755	17.457	0.073	1.281	0.966	0.301	0.644
1992-7	1.778	24.540	36.902	11.505	20.218	0.080	1.406	1.036	0.331	0.724
1992-8a	1.600	30.569	50.350	19.038	27.706	0.123	1.929	1.412	0.531	0.980
1992-8b	1.520	32.862	55.802	22.075	29.614	0.143	2.129	1.558	0.607	1.043
1993-2b	1.750	14.084	17.788	5.118	8.337	0.215	0.748	0.715	0.154	0.396
1993-3	1.827	19.455	26.435	6.549	11.138	0.092	1.015	0.790	0.210	0.443
1993-4	1.859	21.591	30.718	7.914	14.098	0.065	1.153	0.871	0.250	0.532
1993-5	1.876	20.804	29.257	7.059	12.021	0.060	1.085	0.823	0.221	0.456
1993-6	1.828	22.891	33.385	9.469	17.005	0.071	1.260	0.938	0.283	0.621
1993-7	1.803	23.876	35.472	10.644	18.821	0.076	1.345	0.998	0.314	0.683
1993-8a	1.606	30.584	50.316	19.027	27.684	0.121	1.919	1.401	0.523	0.975
1993-8b	1.528	33.023	56.125	22.168	29.747	0.142	2.134	1.553	0.601	1.043
1994-2b	1.700	12.840	16.168	4.813	7.685	0.168	1.412	1.031	0.194	0.521
1994-3	1.776	12.890	16.315	4.898	7.725	0.177	1.454	1.068	0.200	0.530
1994-4	1.878	20.693	28.960	6.892	11.715	0.098	1.618	1.249	0.267	0.623
1994-5	1.876	20.826	29.351	7.098	12.166	0.097	1.672	1.268	0.269	0.642
1994-6	1.846	22.107	31.846	8.575	15.260	0.107	1.738	1.333	0.286	0.711
1994-7	1.789	24.469	36.709	11.326	19.926	0.129	1.876	1.484	0.323	0.824
1994-8a	1.604	30.687	50.535	19.148	27.772	0.201	2.268	1.921	0.429	1.018
1994-8b	1.536	32.833	55.679	21.895	29.613	0.238	2.406	2.108	0.477	1.067
1995-2b	1.677	10.479	13.470	4.330	6.441	0.174	1.330	0.966	0.173	0.473
1995-3	1.838	19.511	26.564	6.624	11.215	0.113	1.589	1.207	0.254	0.608
1995-4	1.830	19.874	27.185	7.131	12.674	0.119	1.624	1.232	0.260	0.644
1995-5	1.851	21.989	31.634	8.425	15.111	0.106	1.745	1.334	0.285	0.710
1995-6	1.820	23.207	34.032	9.855	17.561	0.117	1.789	1.397	0.302	0.763
1995-7	1.779	24.823	37.426	11.784	20.476	0.132	1.889	1.504	0.328	0.834
1995-8a	1.593	31.053	51.452	19.603	28.145	0.212	2.260	1.971	0.445	1.028
1995-8b	1.536	32.875	55.817	21.932	29.670	0.243	2.384	2.130	0.485	1.070
1996-2b	1.678	12.215	15.335	4.672	7.350	0.163	1.371	0.990	0.184	0.496
1996-3	1.852	19.727	26.724	6.675	11.281	0.111	1.606	1.216	0.256	0.612
1996-4	1.862	21.934	31.107	8.222	14.680	0.105	1.718	1.315	0.282	0.696
1996-5	1.826	21.361	29.904	8.368	15.206	0.117	1.753	1.308	0.276	0.712
1996-6	1.822	23.669	34.758	10.242	18.316	0.122	1.827	1.437	0.312	0.789
1996-7	1.775	25.314	38.104	12.298	21.068	0.133	1.940	1.519	0.330	0.850
1996-8a	1.608	30.966	50.779	19.340	27.967	0.204	2.284	1.935	0.433	1.026
1996-8b	1.543	33.058	55.730	22.005	29.721	0.235	2.439	2.106	0.474	1.073
1997-2b	1.527	8.912	11.602	3.871	5.565	0.163	1.201	0.863	0.151	0.425
1997-3	1.731	18.720	24.742	6.947	12.729	0.126	1.595	1.173	0.245	0.638
1997-4	1.886	20.751	28.766	6.863	11.674	0.097	1.663	1.256	0.268	0.628
1997-5	1.873	21.445	30.289	7.705	13.767	0.100	1.756	1.311	0.278	0.686
1997-6	1.840	22.792	32.807	9.226	16.632	0.113	1.782	1.379	0.298	0.744
1997-7	1.808	24.108	35.543	10.783	19.144	0.127	1.852	1.468	0.321	0.805

Year & Class	Diesel NOx Decel	Diesel NOx 0 to 25	Diesel NOx 25 to 50	Diesel NOx 50 +	Diesel NOx Highway	Diesel PM 2.5 Decel	Diesel PM 2.5 0 to 25	Diesel PM 2.5 25 to 50	Diesel PM 2.5 50 +	Diesel PM 2.5 Highway
1997-8a	1.613	30.972	50.746	19.276	27.963	0.216	2.228	1.983	0.451	1.026
1997-8b	1.546	32.939	55.414	21.854	29.611	0.248	2.348	2.146	0.492	1.068
1998-2b	1.463	8.835	11.211	3.889	5.609	0.200	0.410	0.389	0.115	0.258
1998-3	2.179	17.784	24.142	7.214	10.721	0.116	0.590	0.671	0.233	0.348
1998-4	2.245	18.305	25.209	7.461	11.011	0.107	0.600	0.694	0.242	0.353
1998-5	2.246	18.330	25.323	7.514	11.217	0.107	0.593	0.679	0.242	0.351
1998-6	2.244	18.338	25.297	7.520	11.110	0.108	0.600	0.692	0.242	0.353
1998-7	2.206	19.549	27.595	9.067	14.350	0.114	0.686	0.742	0.251	0.405
1998-8a	1.962	25.792	40.449	17.527	24.142	0.165	1.171	1.087	0.309	0.586
1998-8b	1.832	28.575	46.717	21.484	26.719	0.196	1.393	1.254	0.340	0.636
1999-2b	1.295	6.672	8.795	3.243	4.263	0.202	0.383	0.360	0.104	0.243
1999-3	1.223	10.823	12.620	4.717	6.466	0.127	0.563	0.612	0.221	0.335
1999-4	1.204	11.447	13.458	5.006	6.789	0.107	0.590	0.667	0.244	0.348
1999-5	1.203	11.481	13.511	5.035	6.823	0.108	0.592	0.669	0.244	0.349
1999-6	1.193	11.796	14.013	5.357	7.693	0.110	0.616	0.679	0.247	0.367
1999-7	1.189	12.963	15.699	6.263	9.576	0.115	0.689	0.730	0.254	0.407
1999-8a	1.144	21.310	28.873	13.285	18.207	0.173	1.238	1.137	0.319	0.603
1999-8b	1.132	23.943	33.438	15.642	19.909	0.200	1.422	1.283	0.346	0.646
2000-2b	1.225	6.287	8.335	3.088	4.047	0.190	0.362	0.339	0.098	0.231
2000-3	1.215	10.784	12.548	4.687	6.443	0.126	0.560	0.608	0.218	0.333
2000-4	1.207	11.556	13.614	5.065	6.866	0.108	0.595	0.674	0.244	0.350
2000-5	1.207	11.614	13.706	5.117	6.926	0.108	0.598	0.677	0.244	0.351
2000-6	1.198	11.643	13.794	5.215	7.302	0.109	0.605	0.675	0.245	0.359
2000-7	1.194	13.321	16.221	6.490	10.085	0.117	0.713	0.752	0.257	0.422
2000-8a	1.154	20.345	27.212	12.404	17.517	0.165	1.174	1.089	0.311	0.588
2000-8b	1.139	23.868	33.270	15.539	19.906	0.200	1.420	1.287	0.346	0.649
2001-2b	1.213	5.897	8.030	2.963	3.824	0.191	0.344	0.322	0.091	0.221
2001-3	1.200	10.764	12.519	4.699	6.444	0.123	0.561	0.607	0.221	0.333
2001-4	1.200	11.400	13.400	4.994	6.768	0.107	0.589	0.663	0.244	0.348
2001-5	1.200	11.429	13.444	5.019	6.796	0.108	0.591	0.665	0.244	0.348
2001-6	1.192	11.916	14.198	5.452	7.956	0.111	0.627	0.685	0.249	0.374
2001-7	1.191	12.479	14.985	5.885	8.852	0.113	0.661	0.709	0.252	0.393
2001-8a	1.154	21.146	28.571	13.086	18.167	0.173	1.233	1.137	0.321	0.607
2001-8b	1.138	23.816	33.172	15.505	19.860	0.199	1.415	1.281	0.345	0.647
2002-2b	1.258	6.305	8.434	3.105	4.051	0.197	0.364	0.342	0.097	0.233
2002-3	1.228	10.805	12.574	4.678	6.454	0.130	0.560	0.608	0.213	0.333
2002-4	1.217	11.665	13.743	5.071	6.895	0.108	0.597	0.684	0.242	0.351
2002-5	1.217	11.665	13.743	5.071	6.895	0.108	0.597	0.684	0.242	0.351
2002-6	1.208	11.761	13.932	5.224	7.315	0.108	0.607	0.685	0.244	0.359
2002-7	1.205	12.896	15.571	6.079	9.316	0.115	0.681	0.735	0.252	0.404
2002-8a	1.160	19.650	26.118	11.757	16.955	0.159	1.125	1.052	0.304	0.574
2002-8b	1.127	23.542	32.766	15.298	19.629	0.195	1.391	1.252	0.340	0.636
2003-2b	2.435	6.227	9.628	3.345	4.197	0.168	0.324	0.304	0.088	0.207

Year & Class	Diesel NOx Decel	Diesel NOx 0 to 25	Diesel NOx 25 to 50	Diesel NOx 50 +	Diesel NOx Highway	Diesel PM 2.5 Decel	Diesel PM 2.5 0 to 25	Diesel PM 2.5 25 to 50	Diesel PM 2.5 50 +	Diesel PM 2.5 Highway
2003-3	1.988	9.231	10.576	4.057	5.233	0.112	0.511	0.560	0.197	0.303
2003-4	1.872	9.690	10.787	4.199	5.385	0.097	0.539	0.617	0.219	0.317
2003-5	1.872	9.690	10.787	4.199	5.385	0.097	0.539	0.617	0.219	0.317
2003-6	1.863	9.776	10.920	4.270	5.554	0.098	0.547	0.617	0.220	0.323
2003-7	1.845	10.175	11.408	4.483	6.135	0.103	0.606	0.657	0.227	0.359
2003-8a	1.674	12.870	15.000	6.095	8.669	0.141	0.991	0.931	0.272	0.511
2003-8b	1.536	14.636	17.573	7.233	9.647	0.176	1.251	1.126	0.306	0.573
2004-2b	2.435	6.232	9.624	3.341	4.195	0.158	0.305	0.290	0.085	0.193
2004-3	1.990	9.222	10.573	4.054	5.230	0.110	0.508	0.556	0.196	0.301
2004-4	1.872	9.691	10.789	4.200	5.386	0.097	0.539	0.617	0.219	0.317
2004-5	1.872	9.691	10.789	4.200	5.386	0.097	0.539	0.617	0.219	0.317
2004-6	1.863	9.786	10.930	4.275	5.566	0.098	0.548	0.618	0.220	0.324
2004-7	1.843	10.215	11.458	4.505	6.188	0.103	0.611	0.661	0.227	0.363
2004-8a	1.667	12.968	15.138	6.158	8.733	0.142	1.005	0.942	0.273	0.515
2004-8b	1.533	14.657	17.604	7.247	9.656	0.176	1.253	1.128	0.307	0.573
2005-2b	2.440	6.170	9.619	3.337	4.180	0.158	0.300	0.286	0.083	0.190
2005-3	1.997	9.195	10.563	4.047	5.222	0.111	0.506	0.553	0.195	0.300
2005-4	1.872	9.691	10.790	4.200	5.387	0.097	0.539	0.617	0.219	0.317
2005-5	1.872	9.691	10.790	4.200	5.387	0.097	0.539	0.617	0.219	0.317
2005-6	1.863	9.788	10.932	4.275	5.567	0.098	0.549	0.619	0.220	0.324
2005-7	1.843	10.218	11.461	4.507	6.191	0.103	0.612	0.662	0.227	0.363
2005-8a	1.666	12.971	15.142	6.161	8.734	0.142	1.005	0.942	0.273	0.515
2005-8b	1.533	14.655	17.601	7.247	9.655	0.176	1.253	1.128	0.306	0.573
2006-2b	1.936	5.172	7.427	2.499	3.270	0.158	0.297	0.282	0.081	0.188
2006-3	1.887	9.079	10.160	3.911	5.109	0.110	0.507	0.554	0.196	0.300
2006-4	1.872	9.692	10.791	4.201	5.387	0.097	0.539	0.617	0.219	0.317
2006-5	1.872	9.692	10.791	4.201	5.387	0.097	0.539	0.617	0.219	0.317
2006-6	1.863	9.801	10.947	4.282	5.586	0.098	0.550	0.620	0.221	0.325
2006-7	1.840	10.275	11.533	4.539	6.267	0.104	0.620	0.667	0.228	0.367
2006-8a	1.656	13.099	15.323	6.243	8.815	0.145	1.023	0.955	0.276	0.520
2006-8b	1.530	14.681	17.640	7.266	9.666	0.176	1.256	1.130	0.307	0.574
2007-2b	0.902	2.416	3.456	1.168	1.535	0.007	0.015	0.020	0.010	0.011
2007-3	0.929	4.522	5.037	1.944	2.543	0.004	0.024	0.030	0.013	0.015
2007-4	0.936	4.846	5.396	2.101	2.694	0.004	0.025	0.032	0.013	0.016
2007-5	0.936	4.846	5.396	2.101	2.694	0.004	0.025	0.032	0.013	0.016
2007-6	0.933	4.880	5.448	2.129	2.760	0.004	0.025	0.032	0.013	0.016
2007-7	0.926	5.030	5.631	2.209	2.984	0.004	0.027	0.035	0.014	0.018
2007-8a	0.851	6.243	7.231	2.927	4.201	0.003	0.040	0.061	0.017	0.027
2007-8b	0.772	7.262	8.700	3.580	4.797	0.003	0.051	0.085	0.020	0.031
2008-2b	0.904	2.552	3.532	1.208	1.601	0.007	0.016	0.020	0.010	0.011
2008-3	0.931	4.606	5.127	1.984	2.583	0.004	0.024	0.030	0.013	0.015
2008-4	0.936	4.847	5.397	2.101	2.694	0.004	0.025	0.032	0.013	0.016
2008-5	0.936	4.847	5.397	2.101	2.694	0.004	0.025	0.032	0.013	0.016

Year & Class	Diesel NOx Decel	Diesel NOx 0 to 25	Diesel NOx 25 to 50	Diesel NOx 50 +	Diesel NOx Highway	Diesel PM 2.5 Decel	Diesel PM 2.5 0 to 25	Diesel PM 2.5 25 to 50	Diesel PM 2.5 50 +	Diesel PM 2.5 Highway
2008-6	0.933	4.880	5.448	2.128	2.759	0.004	0.025	0.032	0.013	0.016
2008-7	0.926	5.027	5.627	2.206	2.978	0.004	0.027	0.035	0.014	0.018
2008-8a	0.852	6.227	7.209	2.918	4.189	0.003	0.040	0.061	0.017	0.027
2008-8b	0.773	7.256	8.691	3.576	4.794	0.003	0.051	0.085	0.020	0.031
2009-2b	0.867	2.562	3.447	1.192	1.593	0.004	0.009	0.011	0.006	0.006
2009-3	0.927	4.640	5.154	1.998	2.597	0.003	0.015	0.019	0.008	0.009
2009-4	0.936	4.847	5.397	2.101	2.695	0.002	0.015	0.020	0.008	0.010
2009-5	0.936	4.847	5.397	2.101	2.695	0.002	0.015	0.020	0.008	0.010
2009-6	0.933	4.881	5.448	2.128	2.759	0.002	0.016	0.020	0.008	0.010
2009-7	0.926	5.026	5.625	2.206	2.976	0.002	0.017	0.022	0.008	0.011
2009-8a	0.853	6.221	7.200	2.914	4.184	0.002	0.025	0.038	0.011	0.017
2009-8b	0.773	7.252	8.686	3.574	4.792	0.002	0.032	0.054	0.013	0.020
2010-2b	0.228	0.640	0.911	0.315	0.408	0.004	0.009	0.011	0.006	0.006
2010-3	0.210	1.020	1.146	0.441	0.572	0.003	0.015	0.018	0.008	0.009
2010-4	0.206	1.066	1.187	0.461	0.591	0.002	0.015	0.019	0.008	0.009
2010-5	0.206	1.066	1.187	0.461	0.591	0.002	0.015	0.019	0.008	0.009
2010-6	0.205	1.073	1.197	0.466	0.606	0.002	0.015	0.020	0.008	0.010
2010-7	0.204	1.111	1.243	0.486	0.660	0.002	0.016	0.021	0.008	0.011
2010-8a	0.193	1.424	1.647	0.666	0.967	0.002	0.024	0.037	0.010	0.016
2010-8b	0.181	1.702	2.037	0.838	1.127	0.002	0.031	0.053	0.012	0.020
2011-2b	0.228	0.645	0.913	0.316	0.411	0.004	0.009	0.011	0.006	0.006
2011-3	0.210	1.023	1.148	0.442	0.573	0.003	0.015	0.018	0.008	0.009
2011-4	0.206	1.066	1.187	0.461	0.592	0.002	0.015	0.019	0.008	0.009
2011-5	0.206	1.066	1.187	0.461	0.592	0.002	0.015	0.019	0.008	0.009
2011-6	0.205	1.073	1.197	0.466	0.605	0.002	0.015	0.020	0.008	0.010
2011-7	0.204	1.110	1.242	0.485	0.659	0.002	0.016	0.021	0.008	0.011
2011-8a	0.194	1.419	1.640	0.663	0.963	0.002	0.024	0.037	0.010	0.016
2011-8b	0.181	1.699	2.034	0.837	1.126	0.002	0.031	0.052	0.012	0.020
2012-2b	0.228	0.654	0.918	0.318	0.415	0.004	0.009	0.011	0.006	0.006
2012-3	0.209	1.027	1.152	0.444	0.575	0.003	0.015	0.018	0.008	0.009
2012-4	0.206	1.067	1.187	0.461	0.592	0.002	0.015	0.019	0.008	0.009
2012-5	0.206	1.067	1.187	0.461	0.592	0.002	0.015	0.019	0.008	0.009
2012-6	0.205	1.073	1.197	0.466	0.605	0.002	0.015	0.020	0.008	0.010
2012-7	0.205	1.110	1.241	0.485	0.658	0.002	0.016	0.021	0.008	0.011
2012-8a	0.194	1.417	1.637	0.662	0.962	0.002	0.024	0.037	0.010	0.016
2012-8b	0.181	1.698	2.032	0.836	1.125	0.002	0.031	0.052	0.012	0.020

Year & Class	Gasoline NOx Decel	Gasoline NOx 0 to 25	Gasoline NOx 25 to 50	Gasoline NOx 50 +	Gasoline NOx Highway	Gasoline PM 2.5 Decel	Gasoline PM 2.5 0 to 25	Gasoline PM 2.5 25 to 50	Gasoline PM 2.5 50 +	Gasoline PM 2.5 Highway
1987-2b	0.246	3.747	7.567	3.777	4.362	0.006	0.050	0.082	0.054	0.055
1987-3	0.287	7.266	11.018	6.138	7.094	0.007	0.061	0.040	0.062	0.054

Year & Class	Gasoline NOx Decel	Gasoline NOx 0 to 25	Gasoline NOx 25 to 50	Gasoline NOx 50 +	Gasoline NOx Highway	Gasoline PM 2.5 Decel	Gasoline PM 2.5 0 to 25	Gasoline PM 2.5 25 to 50	Gasoline PM 2.5 50 +	Gasoline PM 2.5 Highway
1987-4	0.285	7.078	11.096	6.173	7.171	0.007	0.061	0.040	0.062	0.055
1987-5	0.294	7.944	11.102	6.154	7.271	0.006	0.062	0.042	0.061	0.054
1987-6	0.297	7.949	11.039	6.121	7.200	0.006	0.061	0.041	0.060	0.053
1987-7	0.307	7.809	10.733	5.973	6.848	0.006	0.060	0.039	0.060	0.052
1987-8a	0.311	10.016	12.287	6.583	8.431	0.006	0.063	0.052	0.058	0.055
1987-8b	0.311	10.016	12.287	6.583	8.431	0.006	0.063	0.052	0.058	0.055
1988-2b	0.246	3.747	7.567	3.777	4.362	0.006	0.050	0.082	0.054	0.055
1988-3	0.287	7.266	11.018	6.138	7.094	0.007	0.061	0.040	0.062	0.054
1988-4	0.285	7.078	11.096	6.173	7.171	0.007	0.061	0.040	0.062	0.055
1988-5	0.294	7.944	11.102	6.154	7.271	0.006	0.062	0.042	0.061	0.054
1988-6	0.297	7.949	11.039	6.121	7.200	0.006	0.061	0.041	0.060	0.053
1988-7	0.307	7.809	10.733	5.973	6.848	0.006	0.060	0.039	0.060	0.052
1988-8a	0.311	10.016	12.287	6.583	8.431	0.006	0.063	0.052	0.058	0.055
1988-8b	0.311	10.016	12.287	6.583	8.431	0.006	0.063	0.052	0.058	0.055
1989-2b	0.246	3.905	7.670	3.858	4.479	0.006	0.050	0.081	0.054	0.055
1989-3	0.286	7.113	10.950	6.116	6.992	0.007	0.061	0.039	0.062	0.054
1989-4	0.285	6.991	11.039	6.151	7.087	0.007	0.061	0.039	0.062	0.054
1989-5	0.302	7.576	10.668	5.968	6.744	0.006	0.060	0.038	0.060	0.052
1989-6	0.295	7.441	10.733	6.015	6.784	0.006	0.061	0.039	0.061	0.053
1989-7	0.300	7.538	10.686	5.981	6.755	0.006	0.060	0.038	0.060	0.052
1989-8a	0.424	11.067	7.912	1.733	6.217	0.006	0.041	0.016	0.010	0.044
1989-8b	0.424	11.067	7.912	1.733	6.217	0.006	0.041	0.016	0.010	0.044
1990-2b	0.154	4.121	7.535	3.214	4.050	0.002	0.016	0.070	0.054	0.054
1990-3	0.150	5.337	7.730	3.370	4.453	0.002	0.013	0.019	0.039	0.035
1990-4	0.149	5.247	7.797	3.395	4.529	0.002	0.014	0.019	0.039	0.036
1990-5	0.154	5.539	7.609	3.319	4.336	0.002	0.013	0.019	0.038	0.034
1990-6	0.155	5.567	7.600	3.313	4.332	0.002	0.013	0.019	0.038	0.034
1990-7	0.163	5.783	7.529	3.262	4.308	0.002	0.013	0.019	0.037	0.033
1990-8a	0.232	8.568	6.042	1.025	4.151	0.002	0.008	0.010	0.006	0.028
1990-8b	0.232	8.568	6.042	1.025	4.151	0.002	0.008	0.010	0.006	0.028
1991-2b	0.158	3.719	7.457	3.157	3.931	0.006	0.069	0.046	0.021	0.032
1991-3	0.150	5.338	7.770	3.379	4.474	0.006	0.075	0.019	0.017	0.028
1991-4	0.149	5.295	7.788	3.388	4.497	0.006	0.074	0.019	0.017	0.029
1991-5	0.151	5.438	7.727	3.358	4.417	0.006	0.075	0.019	0.017	0.028
1991-6	0.153	5.542	7.682	3.336	4.359	0.006	0.075	0.019	0.017	0.028
1991-7	0.152	5.522	7.689	3.340	4.361	0.006	0.075	0.019	0.017	0.028
1991-8a	0.163	5.816	7.588	3.271	4.324	0.006	0.075	0.019	0.017	0.027
1991-8b	0.163	5.816	7.588	3.271	4.324	0.006	0.075	0.019	0.017	0.027
1992-2b	0.139	3.406	6.793	2.888	3.608	0.005	0.052	0.035	0.016	0.024
1992-3	0.149	5.270	7.797	3.392	4.512	0.004	0.056	0.015	0.013	0.022
1992-4	0.149	5.240	7.813	3.399	4.538	0.004	0.056	0.015	0.013	0.022
1992-5	0.148	5.334	7.762	3.379	4.457	0.004	0.057	0.015	0.013	0.022
1992-6	0.149	5.452	7.702	3.353	4.368	0.004	0.057	0.015	0.013	0.021

Year & Class	Gasoline NOx Decel	Gasoline NOx 0 to 25	Gasoline NOx 25 to 50	Gasoline NOx 50 +	Gasoline NOx Highway	Gasoline PM 2.5 Decel	Gasoline PM 2.5 0 to 25	Gasoline PM 2.5 25 to 50	Gasoline PM 2.5 50 +	Gasoline PM 2.5 Highway
1992-7	0.149	5.444	7.705	3.355	4.370	0.004	0.057	0.015	0.013	0.021
1992-8a	0.149	5.464	7.699	3.350	4.367	0.004	0.057	0.015	0.013	0.021
1992-8b	0.149	5.464	7.699	3.350	4.367	0.004	0.057	0.015	0.013	0.021
1993-2b	0.140	3.714	6.874	2.937	3.721	0.005	0.053	0.033	0.016	0.024
1993-3	0.150	5.316	7.739	3.375	4.464	0.004	0.056	0.015	0.013	0.022
1993-4	0.149	5.262	7.780	3.389	4.509	0.004	0.056	0.015	0.013	0.022
1993-5	0.154	5.435	7.704	3.350	4.444	0.004	0.056	0.015	0.013	0.021
1993-6	0.153	5.518	7.609	3.322	4.336	0.004	0.057	0.014	0.013	0.021
1993-7	0.160	5.686	7.555	3.284	4.317	0.004	0.057	0.014	0.013	0.021
1993-8a	0.163	5.767	7.529	3.265	4.308	0.005	0.057	0.014	0.013	0.021
1993-8b	0.163	5.767	7.529	3.265	4.308	0.005	0.057	0.014	0.013	0.021
1994-2b	0.116	3.251	6.347	2.761	3.400	0.003	0.012	0.039	0.068	0.039
1994-3	0.146	5.232	7.587	3.311	4.366	0.003	0.011	0.042	0.115	0.056
1994-4	0.146	5.166	7.643	3.330	4.429	0.003	0.011	0.043	0.115	0.056
1994-5	0.148	5.207	7.633	3.322	4.425	0.003	0.011	0.042	0.114	0.056
1994-6	0.148	5.361	7.494	3.276	4.267	0.003	0.011	0.042	0.115	0.056
1994-7	0.156	5.558	7.432	3.232	4.244	0.003	0.011	0.041	0.113	0.054
1994-8a	0.227	8.415	5.934	1.006	4.077	0.004	0.014	0.021	0.025	0.040
1994-8b	0.227	8.415	5.934	1.006	4.077	0.004	0.014	0.021	0.025	0.040
1995-2b	0.115	3.273	6.367	2.770	3.415	0.003	0.015	0.035	0.019	0.025
1995-3	0.146	5.262	7.594	3.309	4.356	0.003	0.017	0.012	0.017	0.019
1995-4	0.146	5.194	7.640	3.326	4.418	0.003	0.017	0.012	0.017	0.019
1995-5	0.147	5.232	7.621	3.317	4.396	0.003	0.017	0.012	0.017	0.019
1995-6	0.152	5.473	7.498	3.261	4.265	0.003	0.017	0.012	0.016	0.018
1995-7	0.151	5.445	7.507	3.267	4.269	0.003	0.017	0.012	0.017	0.019
1995-8a	0.227	8.415	5.934	1.006	4.077	0.003	0.015	0.006	0.003	0.015
1995-8b	0.227	8.415	5.934	1.006	4.077	0.003	0.015	0.006	0.003	0.015
1996-2b	0.099	1.972	3.775	1.918	2.085	0.003	0.011	0.043	0.008	0.019
1996-3	0.146	5.224	7.612	3.317	4.382	0.003	0.013	0.015	0.008	0.015
1996-4	0.146	5.168	7.651	3.331	4.433	0.003	0.013	0.015	0.008	0.015
1996-5	0.146	5.178	7.648	3.329	4.431	0.003	0.013	0.015	0.008	0.015
1996-6	0.147	5.345	7.531	3.287	4.280	0.003	0.013	0.015	0.008	0.015
1996-7	0.150	5.415	7.509	3.272	4.270	0.003	0.012	0.015	0.008	0.014
1996-8a	0.227	8.415	5.934	1.006	4.077	0.003	0.009	0.008	0.001	0.012
1996-8b	0.227	8.415	5.934	1.006	4.077	0.003	0.009	0.008	0.001	0.012
1997-2b	0.096	1.629	3.244	1.526	1.802	0.001	0.007	0.028	0.017	0.018
1997-3	0.146	5.228	7.555	3.305	4.345	0.001	0.007	0.010	0.022	0.015
1997-4	0.146	5.141	7.655	3.335	4.449	0.001	0.007	0.010	0.022	0.016
1997-5	0.146	5.171	7.622	3.325	4.415	0.001	0.007	0.010	0.022	0.016
1997-6	0.147	5.321	7.469	3.276	4.260	0.001	0.007	0.010	0.022	0.015
1997-7	0.150	5.372	7.454	3.265	4.254	0.001	0.007	0.010	0.022	0.015
1997-8a	0.227	8.415	5.934	1.006	4.077	0.001	0.004	0.004	0.003	0.012
1997-8b	0.227	8.415	5.934	1.006	4.077	0.001	0.004	0.004	0.003	0.012

Year & Class	Gasoline NOx Decel	Gasoline NOx 0 to 25	Gasoline NOx 25 to 50	Gasoline NOx 50 +	Gasoline NOx Highway	Gasoline PM 2.5 Decel	Gasoline PM 2.5 0 to 25	Gasoline PM 2.5 25 to 50	Gasoline PM 2.5 50 +	Gasoline PM 2.5 Highway
1998-2b	0.128	1.318	3.079	1.589	1.681	0.001	0.008	0.026	0.010	0.014
1998-3	0.291	3.186	4.932	3.040	3.128	0.002	0.006	0.011	0.009	0.011
1998-4	0.290	3.124	4.956	3.054	3.157	0.002	0.006	0.011	0.009	0.011
1998-5	0.291	3.185	4.932	3.040	3.128	0.002	0.006	0.011	0.009	0.011
1998-6	0.292	3.224	4.914	3.029	3.108	0.002	0.006	0.011	0.009	0.011
1998-7	0.294	3.238	4.903	3.021	3.098	0.002	0.006	0.011	0.009	0.010
1998-8a	0.404	4.413	3.394	0.769	2.718	0.002	0.005	0.005	0.002	0.008
1998-8b	0.404	4.413	3.394	0.769	2.718	0.002	0.005	0.005	0.002	0.008
1999-2b	0.135	1.332	3.117	1.609	1.698	0.000	0.004	0.025	0.005	0.014
1999-3	0.290	3.204	4.927	3.038	3.120	0.000	0.003	0.005	0.002	0.009
1999-4	0.290	3.180	4.936	3.043	3.132	0.000	0.003	0.005	0.002	0.009
1999-5	0.290	3.173	4.938	3.043	3.135	0.000	0.003	0.005	0.002	0.009
1999-6	0.291	3.175	4.937	3.042	3.133	0.000	0.003	0.005	0.002	0.009
1999-7	0.291	3.221	4.917	3.031	3.110	0.000	0.003	0.005	0.002	0.009
1999-8a	0.292	3.224	4.915	3.030	3.109	0.000	0.003	0.005	0.002	0.009
1999-8b	0.292	3.224	4.915	3.030	3.109	0.000	0.003	0.005	0.002	0.009
2000-2b	0.130	1.298	3.082	1.584	1.669	0.000	0.003	0.023	0.006	0.014
2000-3	0.290	3.205	4.928	3.037	3.120	0.000	0.002	0.004	0.004	0.008
2000-4	0.290	3.183	4.936	3.042	3.131	0.000	0.002	0.004	0.004	0.008
2000-5	0.290	3.176	4.938	3.043	3.133	0.001	0.002	0.004	0.004	0.008
2000-6	0.291	3.178	4.936	3.042	3.132	0.001	0.002	0.004	0.004	0.008
2000-7	0.291	3.221	4.918	3.031	3.111	0.001	0.002	0.004	0.004	0.008
2000-8a	0.291	3.224	4.917	3.030	3.110	0.001	0.002	0.004	0.004	0.008
2000-8b	0.291	3.224	4.917	3.030	3.110	0.001	0.002	0.004	0.004	0.008
2001-2b	0.094	1.003	2.196	1.217	1.315	0.000	0.004	0.023	0.006	0.013
2001-3	0.304	3.368	5.176	3.190	3.277	0.000	0.001	0.006	0.014	0.012
2001-4	0.304	3.346	5.184	3.194	3.287	0.000	0.001	0.006	0.014	0.012
2001-5	0.305	3.339	5.185	3.195	3.290	0.000	0.001	0.006	0.014	0.012
2001-6	0.305	3.341	5.184	3.194	3.288	0.000	0.001	0.006	0.014	0.012
2001-7	0.306	3.383	5.167	3.184	3.268	0.000	0.001	0.006	0.014	0.012
2001-8a	0.306	3.385	5.165	3.183	3.267	0.000	0.001	0.006	0.014	0.012
2001-8b	0.306	3.385	5.165	3.183	3.267	0.000	0.001	0.006	0.014	0.012
2002-2b	0.078	0.875	1.909	1.059	1.146	0.001	0.006	0.015	0.005	0.008
2002-3	0.304	3.369	5.176	3.190	3.277	0.001	0.004	0.007	0.003	0.005
2002-4	0.304	3.349	5.183	3.194	3.286	0.001	0.004	0.007	0.003	0.005
2002-5	0.305	3.342	5.185	3.195	3.289	0.001	0.004	0.007	0.003	0.005
2002-6	0.305	3.344	5.183	3.193	3.287	0.001	0.004	0.007	0.003	0.005
2002-7	0.305	3.383	5.168	3.184	3.269	0.001	0.004	0.007	0.003	0.005
2002-8a	0.306	3.385	5.166	3.183	3.267	0.001	0.004	0.007	0.003	0.005
2002-8b	0.306	3.385	5.166	3.183	3.267	0.001	0.004	0.007	0.003	0.005
2003-2b	0.081	0.930	2.014	1.116	1.208	0.000	0.004	0.017	0.004	0.009
2003-3	0.304	3.370	5.177	3.190	3.277	0.000	0.003	0.003	0.004	0.006
2003-4	0.304	3.352	5.184	3.194	3.286	0.000	0.003	0.003	0.004	0.006

Year & Class	Gasoline NOx Decel	Gasoline NOx 0 to 25	Gasoline NOx 25 to 50	Gasoline NOx 50 +	Gasoline NOx Highway	Gasoline PM 2.5 Decel	Gasoline PM 2.5 0 to 25	Gasoline PM 2.5 25 to 50	Gasoline PM 2.5 50 +	Gasoline PM 2.5 Highway
2003-5	0.305	3.345	5.185	3.194	3.288	0.000	0.003	0.003	0.004	0.006
2003-6	0.305	3.347	5.183	3.193	3.286	0.000	0.003	0.003	0.004	0.006
2003-7	0.305	3.383	5.169	3.185	3.270	0.000	0.003	0.003	0.004	0.006
2003-8a	0.306	3.385	5.168	3.184	3.268	0.000	0.003	0.003	0.004	0.006
2003-8b	0.306	3.385	5.168	3.184	3.268	0.000	0.003	0.003	0.004	0.006
2004-2b	0.063	0.695	1.256	0.724	0.821	0.001	0.005	0.014	0.006	0.007
2004-3	0.296	3.276	5.032	3.100	3.185	0.001	0.005	0.006	0.005	0.006
2004-4	0.296	3.260	5.038	3.103	3.192	0.001	0.005	0.006	0.005	0.006
2004-5	0.296	3.254	5.039	3.104	3.194	0.001	0.005	0.006	0.005	0.006
2004-6	0.296	3.256	5.037	3.103	3.193	0.001	0.005	0.006	0.005	0.006
2004-7	0.297	3.288	5.025	3.096	3.178	0.001	0.005	0.006	0.005	0.006
2004-8a	0.297	3.289	5.024	3.095	3.177	0.001	0.005	0.006	0.005	0.006
2004-8b	0.297	3.289	5.024	3.095	3.177	0.001	0.005	0.006	0.005	0.006
2005-2b	0.055	0.522	1.006	0.574	0.638	0.001	0.005	0.014	0.006	0.007
2005-3	0.296	3.277	5.032	3.100	3.185	0.001	0.005	0.006	0.005	0.006
2005-4	0.296	3.262	5.038	3.103	3.192	0.001	0.005	0.006	0.005	0.006
2005-5	0.296	3.257	5.039	3.103	3.194	0.001	0.005	0.006	0.005	0.006
2005-6	0.296	3.258	5.037	3.103	3.192	0.001	0.005	0.006	0.005	0.006
2005-7	0.296	3.288	5.026	3.096	3.179	0.001	0.005	0.006	0.005	0.006
2005-8a	0.297	3.289	5.025	3.095	3.178	0.001	0.005	0.006	0.005	0.006
2005-8b	0.297	3.289	5.025	3.095	3.178	0.001	0.005	0.006	0.005	0.006
2006-2b	0.042	0.392	0.707	0.413	0.466	0.001	0.004	0.012	0.005	0.007
2006-3	0.240	2.657	4.079	2.512	2.532	0.001	0.004	0.005	0.005	0.005
2006-4	0.240	2.647	4.083	2.515	2.539	0.001	0.004	0.005	0.005	0.005
2006-5	0.240	2.643	4.084	2.515	2.541	0.001	0.004	0.005	0.005	0.005
2006-6	0.240	2.644	4.083	2.515	2.541	0.001	0.004	0.005	0.005	0.005
2006-7	0.240	2.665	4.075	2.509	2.528	0.001	0.004	0.005	0.005	0.005
2006-8a	0.240	2.666	4.074	2.509	2.528	0.001	0.004	0.005	0.005	0.005
2006-8b	0.240	2.666	4.074	2.509	2.528	0.001	0.004	0.005	0.005	0.005
2007-2b	0.041	0.394	0.691	0.408	0.465	0.001	0.004	0.012	0.005	0.007
2007-3	0.237	2.632	4.040	2.488	2.508	0.001	0.004	0.005	0.005	0.005
2007-4	0.237	2.622	4.044	2.490	2.513	0.001	0.004	0.005	0.005	0.005
2007-5	0.237	2.619	4.044	2.490	2.516	0.001	0.004	0.005	0.005	0.005
2007-6	0.238	2.620	4.043	2.490	2.515	0.001	0.004	0.005	0.005	0.005
2007-7	0.238	2.639	4.036	2.485	2.504	0.001	0.004	0.005	0.005	0.005
2007-8a	0.238	2.640	4.035	2.484	2.503	0.001	0.004	0.005	0.005	0.005
2007-8b	0.238	2.640	4.035	2.484	2.503	0.001	0.004	0.005	0.005	0.005
2008-2b	0.043	0.478	0.732	0.449	0.525	0.000	0.003	0.008	0.003	0.004
2008-3	0.237	2.633	4.040	2.488	2.508	0.001	0.003	0.003	0.003	0.003
2008-4	0.237	2.624	4.044	2.490	2.513	0.001	0.003	0.003	0.003	0.003
2008-5	0.237	2.621	4.044	2.490	2.515	0.001	0.003	0.003	0.003	0.003
2008-6	0.238	2.622	4.043	2.489	2.514	0.001	0.003	0.003	0.003	0.003
2008-7	0.238	2.639	4.037	2.485	2.504	0.001	0.003	0.003	0.003	0.003

Year & Class	Gasoline NOx Decel	Gasoline NOx 0 to 25	Gasoline NOx 25 to 50	Gasoline NOx 50 +	Gasoline NOx Highway	Gasoline PM 2.5 Decel	Gasoline PM 2.5 0 to 25	Gasoline PM 2.5 25 to 50	Gasoline PM 2.5 50 +	Gasoline PM 2.5 Highway
2008-8a	0.238	2.640	4.036	2.485	2.504	0.001	0.003	0.003	0.003	0.003
2008-8b	0.238	2.640	4.036	2.485	2.504	0.001	0.003	0.003	0.003	0.003
2009-2b	0.046	0.537	0.791	0.490	0.580	0.000	0.003	0.008	0.003	0.004
2009-3	0.237	2.634	4.041	2.488	2.508	0.001	0.003	0.003	0.003	0.003
2009-4	0.237	2.626	4.044	2.489	2.512	0.001	0.003	0.003	0.003	0.003
2009-5	0.237	2.623	4.044	2.490	2.514	0.001	0.003	0.003	0.003	0.003
2009-6	0.238	2.623	4.043	2.489	2.514	0.001	0.003	0.003	0.003	0.003
2009-7	0.238	2.639	4.038	2.485	2.505	0.001	0.003	0.003	0.003	0.003
2009-8a	0.238	2.640	4.037	2.485	2.504	0.001	0.003	0.003	0.003	0.003
2009-8b	0.238	2.640	4.037	2.485	2.504	0.001	0.003	0.003	0.003	0.003
2010-2b	0.042	0.459	0.707	0.434	0.506	0.000	0.003	0.008	0.003	0.004
2010-3	0.237	2.634	4.042	2.488	2.508	0.001	0.003	0.003	0.003	0.003
2010-4	0.237	2.627	4.044	2.489	2.512	0.001	0.003	0.003	0.003	0.003
2010-5	0.237	2.624	4.045	2.490	2.514	0.001	0.003	0.003	0.003	0.003
2010-6	0.237	2.625	4.044	2.489	2.513	0.001	0.003	0.003	0.003	0.003
2010-7	0.238	2.639	4.039	2.486	2.505	0.001	0.003	0.003	0.003	0.003
2010-8a	0.238	2.640	4.038	2.485	2.505	0.001	0.003	0.003	0.003	0.003
2010-8b	0.238	2.640	4.038	2.485	2.505	0.001	0.003	0.003	0.003	0.003
2011-2b	0.043	0.478	0.726	0.447	0.524	0.000	0.003	0.008	0.003	0.004
2011-3	0.237	2.635	4.042	2.488	2.508	0.001	0.003	0.003	0.003	0.003
2011-4	0.237	2.628	4.044	2.489	2.512	0.001	0.003	0.003	0.003	0.003
2011-5	0.237	2.626	4.045	2.489	2.513	0.001	0.003	0.003	0.003	0.003
2011-6	0.237	2.626	4.044	2.489	2.513	0.001	0.003	0.003	0.003	0.003
2011-7	0.237	2.639	4.040	2.486	2.505	0.001	0.003	0.003	0.003	0.003
2011-8a	0.238	2.640	4.039	2.486	2.505	0.001	0.003	0.003	0.003	0.003
2011-8b	0.238	2.640	4.039	2.486	2.505	0.001	0.003	0.003	0.003	0.003
2012-2b	0.043	0.478	0.726	0.447	0.524	0.000	0.003	0.008	0.003	0.004
2012-3	0.237	2.635	4.042	2.488	2.508	0.001	0.003	0.003	0.003	0.003
2012-4	0.237	2.628	4.044	2.489	2.512	0.001	0.003	0.003	0.003	0.003
2012-5	0.237	2.626	4.045	2.489	2.513	0.001	0.003	0.003	0.003	0.003
2012-6	0.237	2.626	4.044	2.489	2.513	0.001	0.003	0.003	0.003	0.003
2012-7	0.237	2.639	4.040	2.486	2.505	0.001	0.003	0.003	0.003	0.003
2012-8a	0.238	2.640	4.039	2.486	2.505	0.001	0.003	0.003	0.003	0.003
2012-8b	0.238	2.640	4.039	2.486	2.505	0.001	0.003	0.003	0.003	0.003

Note – highlighted cells are set equal to the row above (MOVES does not provide consistent outputs for Class 8b gasoline vehicles; therefore 8bs are set equal to 8as).

Year & Class	E10 NOx Decel	E10 NOx 0 to 25	E10 NOx 25 to 50	E10 NOx 50 +	E10 NOx Highway	E10 PM 2.5 Decel	E10 PM 2.5 0 to 25	E10 PM 2.5 25 to 50	E10 PM 2.5 50 +	E10 PM 2.5 Highway
1987-2b	0.268	4.087	8.254	4.120	4.758	0.006	0.050	0.082	0.054	0.055

Year & Class	E10 NOx Decel	E10 NOx 0 to 25	E10 NOx 25 to 50	E10 NOx 50 +	E10 NOx Highway	E10 PM 2.5 Decel	E10 PM 2.5 0 to 25	E10 PM 2.5 25 to 50	E10 PM 2.5 50 +	E10 PM 2.5 Highway
1987-3	0.313	7.925	12.018	6.695	7.737	0.007	0.062	0.040	0.062	0.054
1987-4	0.310	7.720	12.102	6.733	7.821	0.007	0.062	0.040	0.062	0.055
1987-5	0.321	8.665	12.109	6.712	7.931	0.006	0.062	0.042	0.061	0.054
1987-6	0.324	8.670	12.041	6.676	7.853	0.006	0.062	0.041	0.061	0.053
1987-7	0.334	8.518	11.706	6.515	7.469	0.006	0.060	0.039	0.060	0.052
1987-8a	0.340	10.924	13.402	7.180	9.196	0.006	0.063	0.052	0.058	0.055
1987-8b	0.340	10.924	13.402	7.180	9.196	0.006	0.063	0.052	0.058	0.055
1988-2b	0.268	4.087	8.254	4.120	4.758	0.006	0.050	0.082	0.054	0.055
1988-3	0.313	7.925	12.018	6.695	7.737	0.007	0.062	0.040	0.062	0.054
1988-4	0.310	7.720	12.102	6.733	7.821	0.007	0.062	0.040	0.062	0.055
1988-5	0.321	8.665	12.109	6.712	7.931	0.006	0.062	0.042	0.061	0.054
1988-6	0.324	8.670	12.041	6.676	7.853	0.006	0.062	0.041	0.061	0.053
1988-7	0.334	8.518	11.706	6.515	7.469	0.006	0.060	0.039	0.060	0.052
1988-8a	0.340	10.924	13.402	7.180	9.196	0.006	0.063	0.052	0.058	0.055
1988-8b	0.340	10.924	13.402	7.180	9.196	0.006	0.063	0.052	0.058	0.055
1989-2b	0.268	4.259	8.366	4.208	4.885	0.006	0.051	0.081	0.055	0.055
1989-3	0.312	7.758	11.943	6.671	7.627	0.007	0.062	0.039	0.062	0.054
1989-4	0.311	7.625	12.040	6.709	7.730	0.007	0.062	0.040	0.062	0.055
1989-5	0.329	8.263	11.636	6.509	7.356	0.006	0.060	0.038	0.061	0.052
1989-6	0.321	8.116	11.707	6.561	7.400	0.007	0.061	0.039	0.061	0.053
1989-7	0.327	8.222	11.656	6.524	7.368	0.006	0.061	0.039	0.061	0.052
1989-8a	0.462	12.071	8.630	1.890	6.781	0.006	0.042	0.016	0.010	0.044
1989-8b	0.462	12.071	8.630	1.890	6.781	0.006	0.042	0.016	0.010	0.044
1990-2b	0.168	4.495	8.218	3.506	4.418	0.002	0.016	0.071	0.054	0.054
1990-3	0.163	5.821	8.431	3.676	4.857	0.002	0.014	0.019	0.039	0.035
1990-4	0.163	5.723	8.505	3.703	4.940	0.002	0.014	0.019	0.039	0.036
1990-5	0.168	6.041	8.299	3.620	4.729	0.002	0.013	0.019	0.038	0.034
1990-6	0.169	6.072	8.289	3.613	4.726	0.002	0.013	0.019	0.038	0.034
1990-7	0.178	6.308	8.212	3.558	4.699	0.002	0.013	0.019	0.037	0.033
1990-8a	0.253	9.346	6.590	1.118	4.528	0.002	0.008	0.010	0.006	0.028
1990-8b	0.253	9.346	6.590	1.118	4.528	0.002	0.008	0.010	0.006	0.028
1991-2b	0.172	4.057	8.134	3.444	4.287	0.006	0.069	0.046	0.021	0.032
1991-3	0.163	5.823	8.475	3.685	4.879	0.006	0.075	0.019	0.017	0.029
1991-4	0.162	5.776	8.495	3.695	4.905	0.006	0.075	0.020	0.017	0.029
1991-5	0.165	5.932	8.428	3.662	4.818	0.006	0.075	0.019	0.017	0.028
1991-6	0.166	6.045	8.379	3.638	4.754	0.006	0.076	0.019	0.017	0.028
1991-7	0.165	6.023	8.386	3.643	4.757	0.006	0.076	0.019	0.017	0.028
1991-8a	0.178	6.344	8.277	3.568	4.716	0.006	0.075	0.019	0.017	0.027
1991-8b	0.178	6.344	8.277	3.568	4.716	0.006	0.075	0.019	0.017	0.027
1992-2b	0.152	3.715	7.409	3.150	3.935	0.005	0.052	0.035	0.016	0.025
1992-3	0.162	5.748	8.504	3.700	4.921	0.004	0.057	0.015	0.013	0.022
1992-4	0.162	5.715	8.522	3.707	4.949	0.004	0.056	0.015	0.013	0.022
1992-5	0.162	5.818	8.467	3.685	4.861	0.004	0.057	0.015	0.013	0.022

Year & Class	E10 NOx Decel	E10 NOx 0 to 25	E10 NOx 25 to 50	E10 NOx 50 +	E10 NOx Highway	E10 PM 2.5 Decel	E10 PM 2.5 0 to 25	E10 PM 2.5 25 to 50	E10 PM 2.5 50 +	E10 PM 2.5 Highway
1992-6	0.162	5.947	8.401	3.657	4.765	0.004	0.058	0.015	0.013	0.021
1992-7	0.162	5.938	8.404	3.659	4.766	0.004	0.058	0.015	0.013	0.021
1992-8a	0.163	5.960	8.397	3.654	4.763	0.004	0.058	0.015	0.013	0.021
1992-8b	0.163	5.960	8.397	3.654	4.763	0.004	0.058	0.015	0.013	0.021
1993-2b	0.153	4.051	7.498	3.204	4.058	0.005	0.053	0.033	0.016	0.024
1993-3	0.163	5.799	8.441	3.681	4.869	0.004	0.057	0.015	0.013	0.022
1993-4	0.162	5.739	8.486	3.697	4.918	0.004	0.056	0.015	0.013	0.022
1993-5	0.168	5.928	8.403	3.654	4.848	0.004	0.057	0.015	0.013	0.021
1993-6	0.167	6.019	8.299	3.623	4.730	0.004	0.057	0.015	0.013	0.021
1993-7	0.174	6.202	8.241	3.582	4.709	0.004	0.057	0.014	0.013	0.021
1993-8a	0.178	6.290	8.212	3.561	4.699	0.005	0.057	0.014	0.013	0.021
1993-8b	0.178	6.290	8.212	3.561	4.699	0.005	0.057	0.014	0.013	0.021
1994-2b	0.126	3.546	6.923	3.012	3.709	0.003	0.012	0.039	0.069	0.039
1994-3	0.160	5.707	8.275	3.611	4.762	0.003	0.011	0.042	0.115	0.056
1994-4	0.159	5.634	8.336	3.632	4.831	0.003	0.011	0.043	0.115	0.056
1994-5	0.161	5.680	8.325	3.623	4.826	0.003	0.011	0.043	0.115	0.056
1994-6	0.162	5.847	8.174	3.573	4.655	0.003	0.011	0.042	0.115	0.056
1994-7	0.170	6.063	8.106	3.526	4.629	0.003	0.012	0.041	0.113	0.054
1994-8a	0.248	9.179	6.472	1.098	4.447	0.004	0.014	0.021	0.025	0.040
1994-8b	0.248	9.179	6.472	1.098	4.447	0.004	0.014	0.021	0.025	0.040
1995-2b	0.125	3.570	6.944	3.022	3.724	0.003	0.015	0.035	0.019	0.025
1995-3	0.160	5.739	8.283	3.609	4.752	0.003	0.017	0.012	0.017	0.019
1995-4	0.160	5.665	8.333	3.628	4.819	0.003	0.017	0.012	0.017	0.019
1995-5	0.161	5.706	8.312	3.618	4.795	0.003	0.017	0.012	0.017	0.019
1995-6	0.166	5.970	8.178	3.557	4.652	0.003	0.017	0.012	0.017	0.019
1995-7	0.164	5.939	8.188	3.563	4.656	0.003	0.017	0.012	0.017	0.019
1995-8a	0.248	9.179	6.472	1.098	4.447	0.003	0.015	0.006	0.003	0.015
1995-8b	0.248	9.179	6.472	1.098	4.447	0.003	0.015	0.006	0.003	0.015
1996-2b	0.108	2.150	4.118	2.092	2.275	0.003	0.011	0.043	0.008	0.019
1996-3	0.159	5.698	8.302	3.618	4.779	0.003	0.013	0.015	0.008	0.015
1996-4	0.159	5.636	8.345	3.634	4.835	0.003	0.013	0.015	0.008	0.015
1996-5	0.160	5.648	8.342	3.631	4.834	0.003	0.013	0.015	0.008	0.015
1996-6	0.160	5.830	8.214	3.585	4.668	0.003	0.013	0.015	0.008	0.015
1996-7	0.163	5.906	8.190	3.569	4.658	0.003	0.013	0.015	0.008	0.014
1996-8a	0.248	9.179	6.472	1.098	4.447	0.003	0.009	0.008	0.001	0.012
1996-8b	0.248	9.179	6.472	1.098	4.447	0.003	0.009	0.008	0.001	0.012
1997-2b	0.105	1.776	3.538	1.665	1.966	0.001	0.007	0.028	0.017	0.018
1997-3	0.160	5.702	8.241	3.605	4.739	0.001	0.007	0.010	0.022	0.015
1997-4	0.159	5.607	8.350	3.638	4.853	0.001	0.007	0.010	0.022	0.016
1997-5	0.159	5.640	8.314	3.626	4.815	0.001	0.007	0.010	0.022	0.016
1997-6	0.161	5.804	8.147	3.573	4.647	0.001	0.007	0.010	0.022	0.015
1997-7	0.163	5.859	8.130	3.561	4.640	0.001	0.007	0.010	0.022	0.015
1997-8a	0.248	9.179	6.472	1.098	4.447	0.001	0.004	0.004	0.003	0.012

Year & Class	E10 NOx Decel	E10 NOx 0 to 25	E10 NOx 25 to 50	E10 NOx 50 +	E10 NOx Highway	E10 PM 2.5 Decel	E10 PM 2.5 0 to 25	E10 PM 2.5 25 to 50	E10 PM 2.5 50 +	E10 PM 2.5 Highway
1997-8b	0.248	9.179	6.472	1.098	4.447	0.001	0.004	0.004	0.003	0.012
1998-2b	0.139	1.437	3.358	1.733	1.833	0.001	0.008	0.026	0.010	0.014
1998-3	0.317	3.475	5.379	3.316	3.411	0.002	0.006	0.011	0.009	0.011
1998-4	0.317	3.407	5.406	3.331	3.444	0.002	0.006	0.011	0.009	0.011
1998-5	0.317	3.474	5.379	3.316	3.411	0.002	0.006	0.011	0.009	0.011
1998-6	0.318	3.516	5.360	3.304	3.390	0.002	0.006	0.011	0.009	0.011
1998-7	0.321	3.532	5.347	3.296	3.379	0.002	0.006	0.011	0.009	0.011
1998-8a	0.441	4.814	3.702	0.839	2.964	0.002	0.005	0.005	0.002	0.008
1998-8b	0.441	4.814	3.702	0.839	2.964	0.002	0.005	0.005	0.002	0.008
1999-2b	0.147	1.453	3.400	1.755	1.852	0.000	0.004	0.025	0.005	0.014
1999-3	0.316	3.495	5.374	3.313	3.404	0.000	0.003	0.005	0.002	0.009
1999-4	0.316	3.469	5.384	3.319	3.416	0.000	0.003	0.005	0.002	0.009
1999-5	0.317	3.461	5.386	3.320	3.419	0.000	0.003	0.005	0.002	0.009
1999-6	0.317	3.463	5.384	3.318	3.417	0.000	0.003	0.005	0.002	0.009
1999-7	0.318	3.514	5.363	3.306	3.393	0.000	0.003	0.005	0.002	0.009
1999-8a	0.318	3.516	5.361	3.305	3.391	0.000	0.003	0.005	0.002	0.009
1999-8b	0.318	3.516	5.361	3.305	3.391	0.000	0.003	0.005	0.002	0.009
2000-2b	0.142	1.416	3.361	1.728	1.820	0.000	0.003	0.023	0.006	0.014
2000-3	0.316	3.496	5.375	3.313	3.404	0.001	0.002	0.004	0.004	0.008
2000-4	0.316	3.472	5.384	3.318	3.415	0.001	0.002	0.004	0.004	0.008
2000-5	0.317	3.464	5.386	3.319	3.418	0.001	0.002	0.004	0.004	0.008
2000-6	0.317	3.466	5.384	3.318	3.416	0.001	0.002	0.004	0.004	0.008
2000-7	0.317	3.513	5.365	3.307	3.393	0.001	0.002	0.004	0.004	0.008
2000-8a	0.318	3.516	5.363	3.305	3.392	0.001	0.002	0.004	0.004	0.008
2000-8b	0.318	3.516	5.363	3.305	3.392	0.001	0.002	0.004	0.004	0.008
2001-2b	0.102	1.094	2.395	1.327	1.435	0.000	0.004	0.023	0.006	0.013
2001-3	0.332	3.673	5.645	3.479	3.574	0.000	0.001	0.006	0.014	0.012
2001-4	0.332	3.650	5.654	3.484	3.585	0.000	0.001	0.006	0.014	0.012
2001-5	0.332	3.642	5.656	3.485	3.588	0.000	0.001	0.006	0.014	0.012
2001-6	0.333	3.644	5.654	3.484	3.586	0.000	0.001	0.006	0.014	0.012
2001-7	0.333	3.690	5.636	3.473	3.565	0.000	0.001	0.006	0.014	0.012
2001-8a	0.334	3.692	5.634	3.472	3.563	0.000	0.001	0.006	0.014	0.012
2001-8b	0.334	3.692	5.634	3.472	3.563	0.000	0.001	0.006	0.014	0.012
2002-2b	0.085	0.955	2.082	1.155	1.250	0.001	0.006	0.015	0.005	0.008
2002-3	0.332	3.674	5.646	3.479	3.574	0.001	0.004	0.007	0.003	0.005
2002-4	0.332	3.653	5.654	3.484	3.584	0.001	0.004	0.007	0.003	0.005
2002-5	0.332	3.645	5.655	3.484	3.587	0.001	0.004	0.007	0.003	0.005
2002-6	0.333	3.647	5.653	3.483	3.585	0.001	0.004	0.007	0.003	0.005
2002-7	0.333	3.690	5.637	3.473	3.565	0.001	0.004	0.007	0.003	0.005
2002-8a	0.333	3.692	5.635	3.472	3.564	0.001	0.004	0.007	0.003	0.005
2002-8b	0.333	3.692	5.635	3.472	3.564	0.001	0.004	0.007	0.003	0.005
2003-2b	0.088	1.014	2.196	1.217	1.317	0.000	0.004	0.017	0.004	0.009
2003-3	0.332	3.676	5.646	3.479	3.574	0.000	0.003	0.003	0.004	0.006

Year & Class	E10 NOx Decel	E10 NOx 0 to 25	E10 NOx 25 to 50	E10 NOx 50 +	E10 NOx Highway	E10 PM 2.5 Decel	E10 PM 2.5 0 to 25	E10 PM 2.5 25 to 50	E10 PM 2.5 50 +	E10 PM 2.5 Highway
2003-4	0.332	3.656	5.654	3.483	3.584	0.000	0.003	0.003	0.004	0.006
2003-5	0.332	3.648	5.655	3.484	3.586	0.000	0.003	0.003	0.004	0.006
2003-6	0.333	3.650	5.653	3.483	3.585	0.000	0.003	0.003	0.004	0.006
2003-7	0.333	3.690	5.638	3.474	3.566	0.000	0.003	0.003	0.004	0.006
2003-8a	0.333	3.692	5.637	3.472	3.565	0.000	0.003	0.003	0.004	0.006
2003-8b	0.333	3.692	5.637	3.472	3.565	0.000	0.003	0.003	0.004	0.006
2004-2b	0.064	0.698	1.263	0.728	0.825	0.001	0.005	0.014	0.006	0.007
2004-3	0.297	3.292	5.056	3.115	3.200	0.001	0.005	0.006	0.005	0.006
2004-4	0.297	3.276	5.062	3.118	3.208	0.001	0.005	0.006	0.005	0.006
2004-5	0.297	3.270	5.063	3.119	3.210	0.001	0.005	0.006	0.005	0.006
2004-6	0.298	3.271	5.061	3.118	3.208	0.001	0.005	0.006	0.005	0.006
2004-7	0.298	3.304	5.049	3.110	3.194	0.001	0.005	0.006	0.005	0.006
2004-8a	0.298	3.305	5.048	3.110	3.192	0.001	0.005	0.006	0.005	0.006
2004-8b	0.298	3.305	5.048	3.110	3.192	0.001	0.005	0.006	0.005	0.006
2005-2b	0.055	0.525	1.011	0.576	0.641	0.001	0.005	0.014	0.006	0.007
2005-3	0.297	3.293	5.057	3.115	3.200	0.001	0.005	0.006	0.005	0.006
2005-4	0.297	3.278	5.062	3.118	3.207	0.001	0.005	0.006	0.005	0.006
2005-5	0.297	3.273	5.063	3.118	3.209	0.001	0.005	0.006	0.005	0.006
2005-6	0.298	3.274	5.062	3.118	3.208	0.001	0.005	0.006	0.005	0.006
2005-7	0.298	3.304	5.051	3.111	3.194	0.001	0.005	0.006	0.005	0.006
2005-8a	0.298	3.305	5.049	3.110	3.193	0.001	0.005	0.006	0.005	0.006
2005-8b	0.298	3.305	5.049	3.110	3.193	0.001	0.005	0.006	0.005	0.006
2006-2b	0.042	0.394	0.710	0.415	0.468	0.001	0.004	0.013	0.005	0.007
2006-3	0.241	2.670	4.099	2.524	2.545	0.001	0.004	0.005	0.005	0.005
2006-4	0.241	2.659	4.103	2.527	2.551	0.001	0.004	0.005	0.005	0.005
2006-5	0.241	2.655	4.104	2.527	2.554	0.001	0.004	0.005	0.005	0.005
2006-6	0.241	2.656	4.103	2.527	2.553	0.001	0.004	0.005	0.005	0.005
2006-7	0.241	2.678	4.095	2.521	2.540	0.001	0.004	0.005	0.005	0.005
2006-8a	0.241	2.679	4.094	2.521	2.540	0.001	0.004	0.005	0.005	0.005
2006-8b	0.241	2.679	4.094	2.521	2.540	0.001	0.004	0.005	0.005	0.005
2007-2b	0.042	0.396	0.694	0.410	0.467	0.001	0.004	0.012	0.005	0.007
2007-3	0.238	2.645	4.059	2.500	2.520	0.001	0.004	0.005	0.005	0.005
2007-4	0.238	2.635	4.063	2.502	2.526	0.001	0.004	0.005	0.005	0.005
2007-5	0.239	2.631	4.064	2.502	2.528	0.001	0.004	0.005	0.005	0.005
2007-6	0.239	2.632	4.063	2.502	2.527	0.001	0.004	0.005	0.005	0.005
2007-7	0.239	2.652	4.056	2.497	2.516	0.001	0.004	0.005	0.005	0.005
2007-8a	0.239	2.653	4.055	2.496	2.515	0.001	0.004	0.005	0.005	0.005
2007-8b	0.239	2.653	4.055	2.496	2.515	0.001	0.004	0.005	0.005	0.005
2008-2b	0.043	0.481	0.736	0.451	0.527	0.000	0.003	0.008	0.003	0.004
2008-3	0.238	2.646	4.060	2.500	2.520	0.001	0.003	0.003	0.003	0.003
2008-4	0.238	2.637	4.063	2.502	2.525	0.001	0.003	0.003	0.003	0.003
2008-5	0.239	2.633	4.064	2.502	2.527	0.001	0.003	0.003	0.003	0.003
2008-6	0.239	2.634	4.063	2.501	2.526	0.001	0.003	0.003	0.003	0.003

Year & Class	E10 NOx Decel	E10 NOx 0 to 25	E10 NOx 25 to 50	E10 NOx 50 +	E10 NOx Highway	E10 PM 2.5 Decel	E10 PM 2.5 0 to 25	E10 PM 2.5 25 to 50	E10 PM 2.5 50 +	E10 PM 2.5 Highway
2008-7	0.239	2.652	4.056	2.497	2.516	0.001	0.003	0.003	0.003	0.003
2008-8a	0.239	2.652	4.056	2.497	2.516	0.001	0.003	0.003	0.003	0.003
2008-8b	0.239	2.652	4.056	2.497	2.516	0.001	0.003	0.003	0.003	0.003
2009-2b	0.047	0.540	0.794	0.493	0.583	0.000	0.003	0.008	0.003	0.004
2009-3	0.238	2.646	4.060	2.500	2.520	0.001	0.003	0.003	0.003	0.003
2009-4	0.238	2.638	4.063	2.501	2.524	0.001	0.003	0.003	0.003	0.003
2009-5	0.238	2.635	4.064	2.502	2.526	0.001	0.003	0.003	0.003	0.003
2009-6	0.239	2.636	4.063	2.501	2.526	0.001	0.003	0.003	0.003	0.003
2009-7	0.239	2.652	4.057	2.497	2.517	0.001	0.003	0.003	0.003	0.003
2009-8a	0.239	2.653	4.057	2.497	2.516	0.001	0.003	0.003	0.003	0.003
2009-8b	0.239	2.653	4.057	2.497	2.516	0.001	0.003	0.003	0.003	0.003
2010-2b	0.043	0.462	0.710	0.436	0.508	0.000	0.003	0.008	0.003	0.004
2010-3	0.238	2.647	4.061	2.500	2.520	0.001	0.003	0.003	0.003	0.003
2010-4	0.238	2.640	4.064	2.501	2.524	0.001	0.003	0.003	0.003	0.003
2010-5	0.238	2.637	4.064	2.502	2.526	0.001	0.003	0.003	0.003	0.003
2010-6	0.239	2.638	4.063	2.501	2.525	0.001	0.003	0.003	0.003	0.003
2010-7	0.239	2.652	4.058	2.498	2.517	0.001	0.003	0.003	0.003	0.003
2010-8a	0.239	2.653	4.058	2.497	2.517	0.001	0.003	0.003	0.003	0.003
2010-8b	0.239	2.653	4.058	2.497	2.517	0.001	0.003	0.003	0.003	0.003
2011-2b	0.044	0.481	0.730	0.449	0.526	0.000	0.003	0.008	0.003	0.004
2011-3	0.238	2.648	4.062	2.500	2.520	0.001	0.003	0.003	0.003	0.003
2011-4	0.238	2.641	4.064	2.501	2.524	0.001	0.003	0.003	0.003	0.003
2011-5	0.238	2.638	4.064	2.501	2.525	0.001	0.003	0.003	0.003	0.003
2011-6	0.239	2.639	4.064	2.501	2.525	0.001	0.003	0.003	0.003	0.003
2011-7	0.239	2.652	4.059	2.498	2.517	0.001	0.003	0.003	0.003	0.003
2011-8a	0.239	2.653	4.059	2.498	2.517	0.001	0.003	0.003	0.003	0.003
2011-8b	0.239	2.653	4.059	2.498	2.517	0.001	0.003	0.003	0.003	0.003
2012-2b	0.044	0.481	0.730	0.449	0.526	0.000	0.003	0.008	0.003	0.004
2012-3	0.238	2.648	4.062	2.500	2.520	0.001	0.003	0.003	0.003	0.003
2012-4	0.238	2.641	4.064	2.501	2.524	0.001	0.003	0.003	0.003	0.003
2012-5	0.238	2.638	4.064	2.501	2.525	0.001	0.003	0.003	0.003	0.003
2012-6	0.239	2.639	4.064	2.501	2.525	0.001	0.003	0.003	0.003	0.003
2012-7	0.239	2.652	4.059	2.498	2.517	0.001	0.003	0.003	0.003	0.003
2012-8a	0.239	2.653	4.059	2.498	2.517	0.001	0.003	0.003	0.003	0.003
2012-8b	0.239	2.653	4.059	2.498	2.517	0.001	0.003	0.003	0.003	0.003

Note – highlighted cells are set equal to the row above (MOVES does not provide consistent outputs for Class 8b gasoline vehicles; therefore 8bs are set equal to 8as).

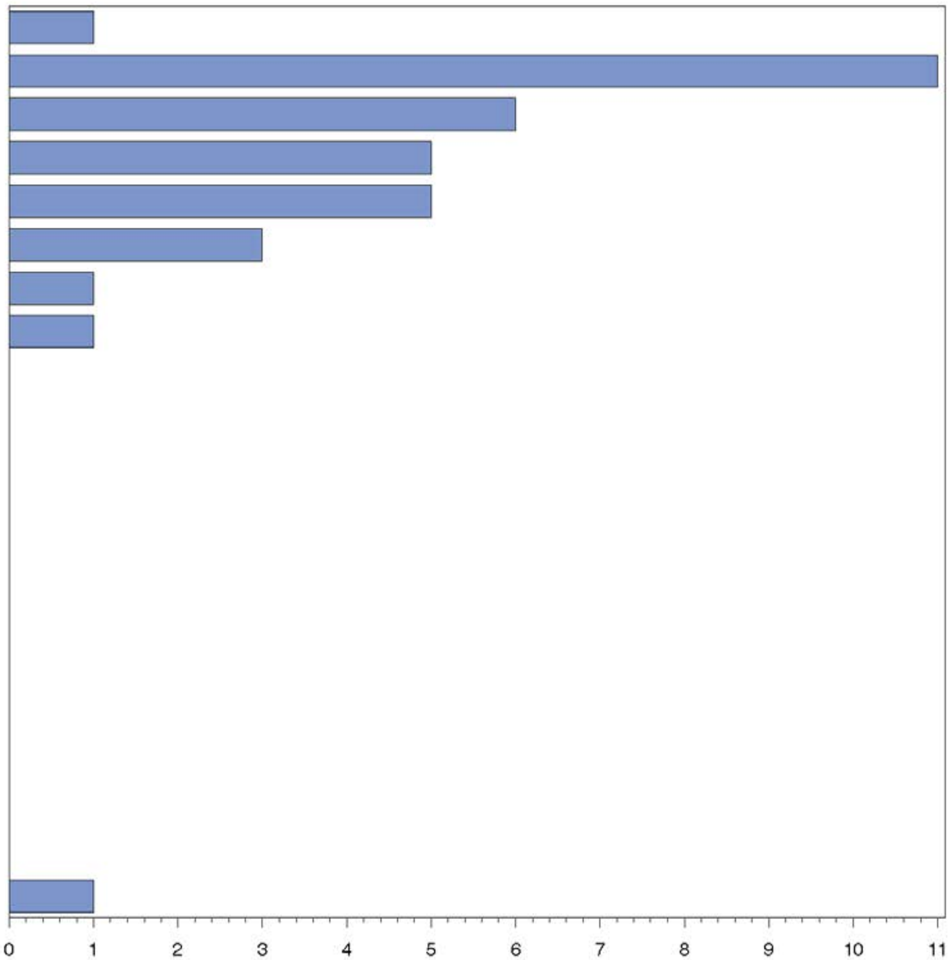
Appendix B – NOx and PM Idle Factors – g/hr
(MOVES2010a, 2012 Calendar Year, ULSD)

SW Idle factors (g/hr) from MOVES2010a				*Source: David Brz, OTAQ, 12-21-11*		
average of Jan and July factors						
			Truck Class			
Month	**Pollutant**	**Model Year**	**HDGV**	**LHDDV**	**MHDDV**	**HHDDV**
Annual Av	NOX	1987	14.05	142.96	192.01	192.01
Annual Av	NOX	1988	14.07	131.91	192.01	192.01
Annual Av	NOX	1989	14.10	146.29	192.01	192.01
Annual Av	NOX	1990	7.10	178.06	148.28	148.28
Annual Av	NOX	1991	7.12	143.79	139.42	139.42
Annual Av	NOX	1992	7.18	140.10	139.42	139.42
Annual Av	NOX	1993	7.17	151.56	139.42	139.42
Annual Av	NOX	1994	7.30	151.33	139.42	139.42
Annual Av	NOX	1995	7.30	148.59	139.42	139.42
Annual Av	NOX	1996	7.05	147.89	139.42	139.42
Annual Av	NOX	1997	6.85	129.61	139.42	139.42
Annual Av	NOX	1998	13.49	129.00	117.07	117.07
Annual Av	NOX	1999	13.57	121.78	114.27	144.37
Annual Av	NOX	2000	13.43	120.79	115.83	144.37
Annual Av	NOX	2001	13.13	108.09	112.07	146.83
Annual Av	NOX	2002	13.06	117.06	114.66	144.02
Annual Av	NOX	2003	12.73	74.26	48.98	54.70
Annual Av	NOX	2004	12.52	74.26	48.99	54.72
Annual Av	NOX	2005	12.46	74.54	48.95	54.70
Annual Av	NOX	2006	12.57	54.31	49.01	54.75
Annual Av	NOX	2007	6.86	25.14	24.51	27.39
Annual Av	NOX	2008	6.90	25.15	24.50	27.39
Annual Av	NOX	2009	6.91	24.03	24.47	27.37
Annual Av	NOX	2010	7.16	6.48	5.42	6.42
Annual Av	NOX	2011	7.28	6.48	5.42	6.42
Annual Av	NOX	2012	7.09	6.48	5.42	6.42
Annual Av	Total PM10	1987	0.33	4.38	4.34	4.34
Annual Av	Total PM10	1988	1.02	4.41	4.34	4.34
Annual Av	Total PM10	1989	1.02	4.39	4.34	4.34
Annual Av	Total PM10	1990	0.32	4.37	4.34	4.34
Annual Av	Total PM10	1991	0.36	4.11	4.34	4.34
Annual Av	Total PM10	1992	0.36	3.95	4.34	4.34
Annual Av	Total PM10	1993	0.27	4.19	4.34	4.34
Annual Av	Total PM10	1994	0.09	7.29	7.13	6.83
Annual Av	Total PM10	1995	0.10	6.66	7.14	6.81
Annual Av	Total PM10	1996	0.24	6.58	7.16	6.83
Annual Av	Total PM10	1997	0.26	5.80	7.17	6.76
Annual Av	Total PM10	1998	0.11	6.57	6.78	6.48
Annual Av	Total PM10	1999	0.06	6.23	6.88	6.48

SW Idle factors (g/hr) from MOVES2010a				*Source: David Brz, OTAQ, 12-21-11*		
average of Jan and July factors						
			Truck Class			
Month	**Pollutant**	**Model Year**	**HDGV**	**LHDDV**	**MHDDV**	**HHDDV**
Annual Av	Total PM10	2000	0.02	6.14	6.86	6.48
Annual Av	Total PM10	2001	0.02	5.54	6.91	6.45
Annual Av	Total PM10	2002	0.10	5.97	6.88	6.48
Annual Av	Total PM10	2003	0.05	5.14	6.22	5.87
Annual Av	Total PM10	2004	0.11	4.74	6.22	5.86
Annual Av	Total PM10	2005	0.10	4.73	6.22	5.86
Annual Av	Total PM10	2006	0.10	4.72	6.22	5.86
Annual Av	Total PM10	2007	0.09	0.35	0.30	0.31
Annual Av	Total PM10	2008	0.09	0.35	0.30	0.31
Annual Av	Total PM10	2009	0.06	0.18	0.18	0.19
Annual Av	Total PM10	2010	0.06	0.18	0.18	0.19
Annual Av	Total PM10	2011	0.06	0.18	0.18	0.19
Annual Av	Total PM10	2012	0.06	0.18	0.18	0.19
Truck Class Definitions						
HDGV	gasoline trucks - all classes					
LHDDV	diesel classes 2b - 5					
MHDDV	diesel classes 6 and 7					
HHDDV	diesel classes 8a and 8b					

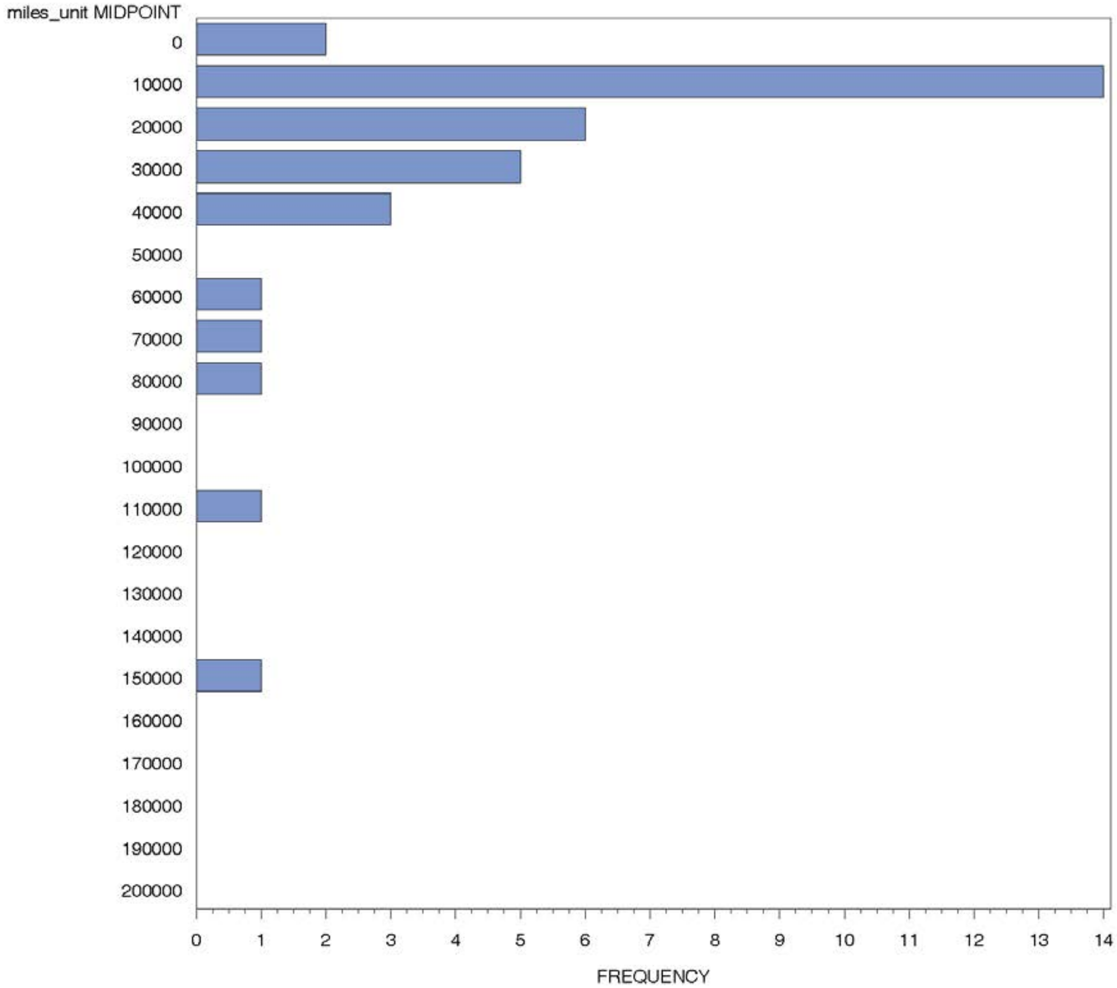
Appendix C – SmartWay Fleet Activity Distributions by Vehicle Class

Calendar Year 2008 Diesel smart way vehicles
truck_class=2B



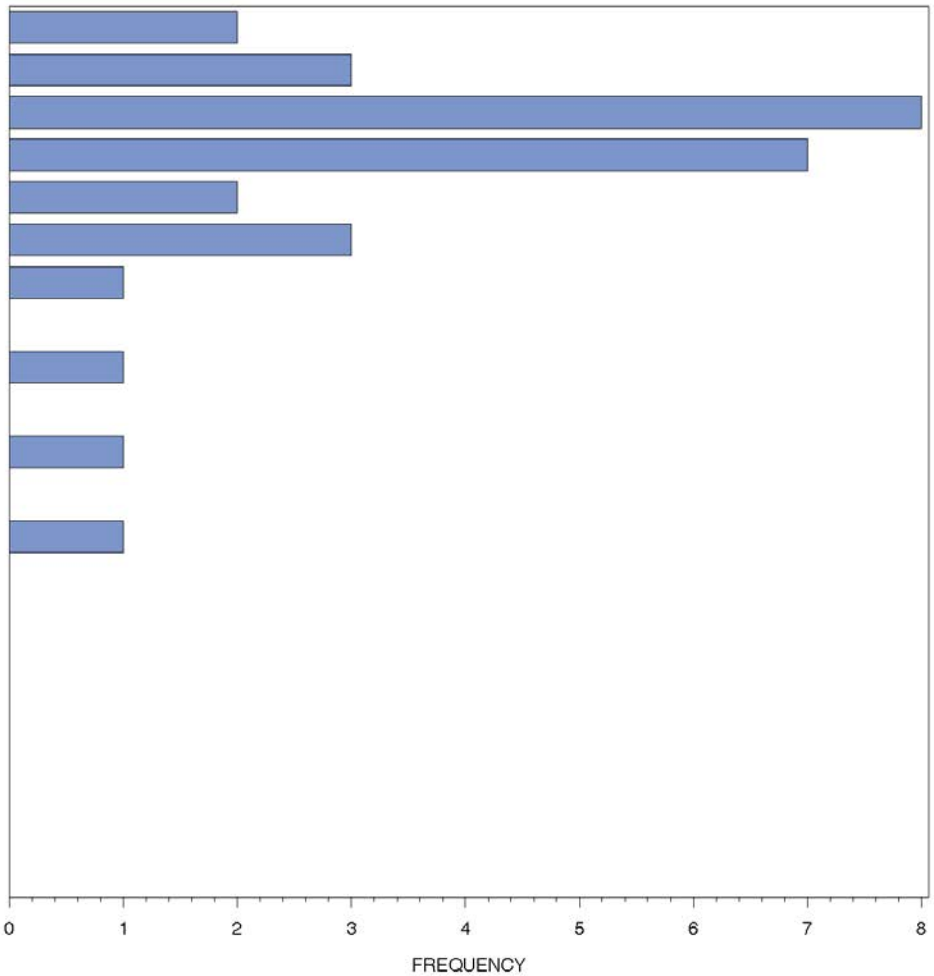
miles_unit MIDPOINT	FREQ.	CUM. FREQ.	PCT.	CUM. PCT.
0	1	1	2.94	2.94
10000	11	12	32.35	35.29
20000	6	18	17.65	52.94
30000	5	23	14.71	67.65
40000	5	28	14.71	82.35
50000	3	31	8.82	91.18
60000	1	32	2.94	94.12
70000	1	33	2.94	97.06
80000	0	33	0.00	97.06
90000	0	33	0.00	97.06
100000	0	33	0.00	97.06
110000	0	33	0.00	97.06
120000	0	33	0.00	97.06
130000	0	33	0.00	97.06
140000	0	33	0.00	97.06
150000	0	33	0.00	97.06
160000	0	33	0.00	97.06
170000	0	33	0.00	97.06
180000	0	33	0.00	97.06
190000	0	33	0.00	97.06
200000	1	34	2.94	100.00

Calendar Year 2008 Diesel smart way vehicles
truck_class=3



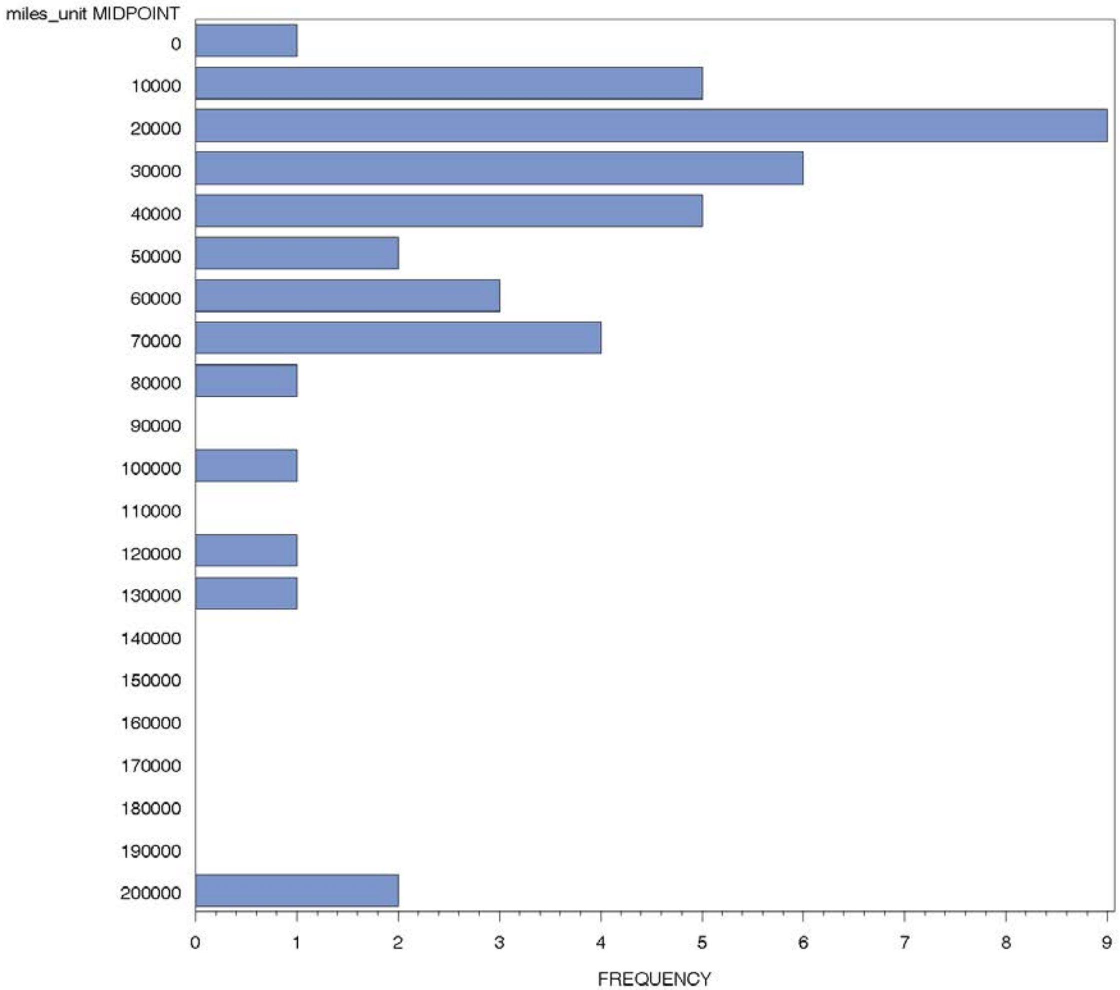
miles_unit MIDPOINT	FREQ.	CUM. FREQ.	PCT.	CUM. PCT.
0	2	2	5.71	5.71
10000	14	16	40.00	45.71
20000	6	22	17.14	62.86
30000	5	27	14.29	77.14
40000	3	30	8.57	85.71
50000	0	30	0.00	85.71
60000	1	31	2.86	88.57
70000	1	32	2.86	91.43
80000	1	33	2.86	94.29
90000	0	33	0.00	94.29
100000	0	33	0.00	94.29
110000	1	34	2.86	97.14
120000	0	34	0.00	97.14
130000	0	34	0.00	97.14
140000	0	34	0.00	97.14
150000	1	35	2.86	100.00
160000	0	35	0.00	100.00
170000	0	35	0.00	100.00
180000	0	35	0.00	100.00
190000	0	35	0.00	100.00
200000	0	35	0.00	100.00

Calendar Year 2008 Diesel smart way vehicles
truck_class=4



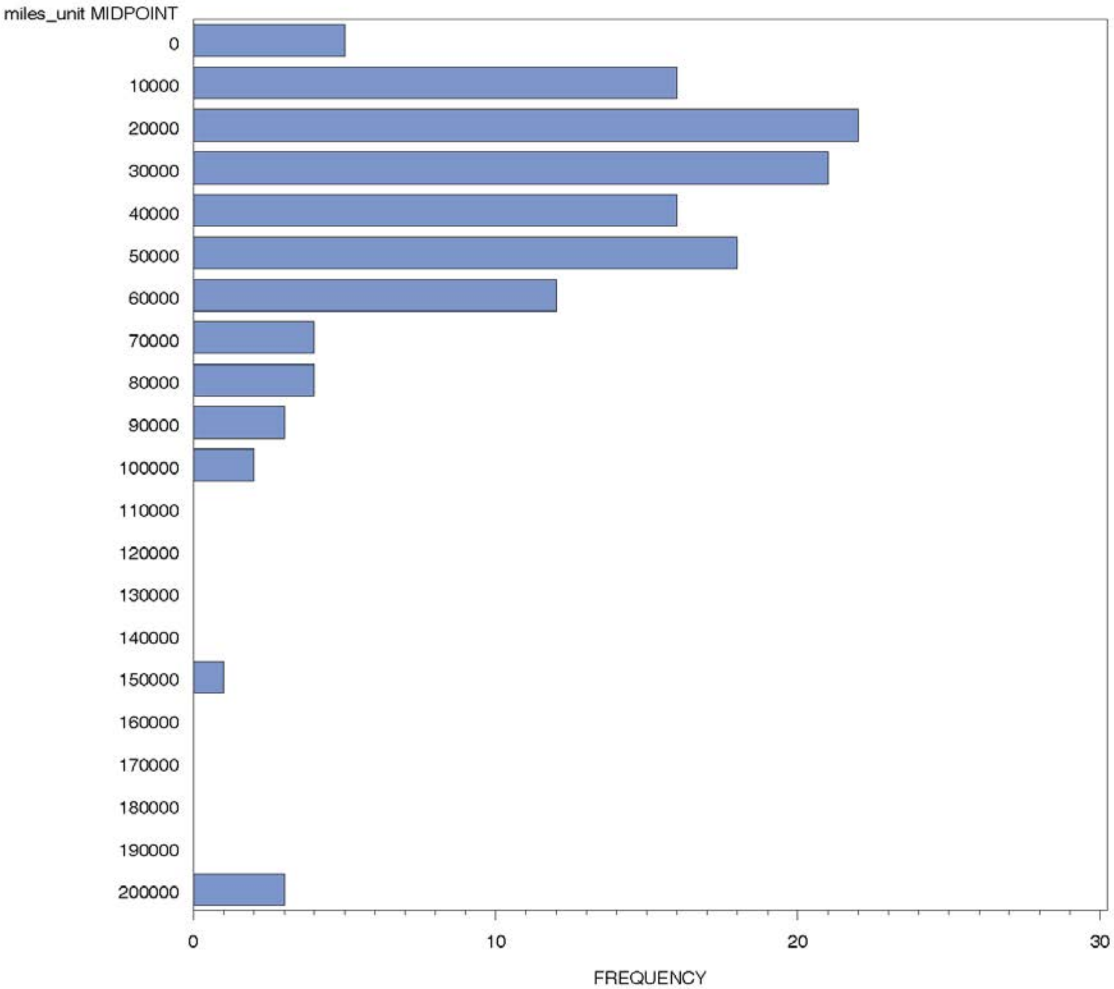
miles_unit MIDPOINT	FREQ.	CUM. FREQ.	PCT.	CUM. PCT.
0	2	2	6.90	6.90
10000	3	5	10.34	17.24
20000	8	13	27.59	44.83
30000	7	20	24.14	68.97
40000	2	22	6.90	75.86
50000	3	25	10.34	86.21
60000	1	26	3.45	89.66
70000	0	26	0.00	89.66
80000	1	27	3.45	93.10
90000	0	27	0.00	93.10
100000	1	28	3.45	96.55
110000	0	28	0.00	96.55
120000	1	29	3.45	100.00
130000	0	29	0.00	100.00
140000	0	29	0.00	100.00
150000	0	29	0.00	100.00
160000	0	29	0.00	100.00
170000	0	29	0.00	100.00
180000	0	29	0.00	100.00
190000	0	29	0.00	100.00
200000	0	29	0.00	100.00

Calendar Year 2008 Diesel smart way vehicles
truck_class=5



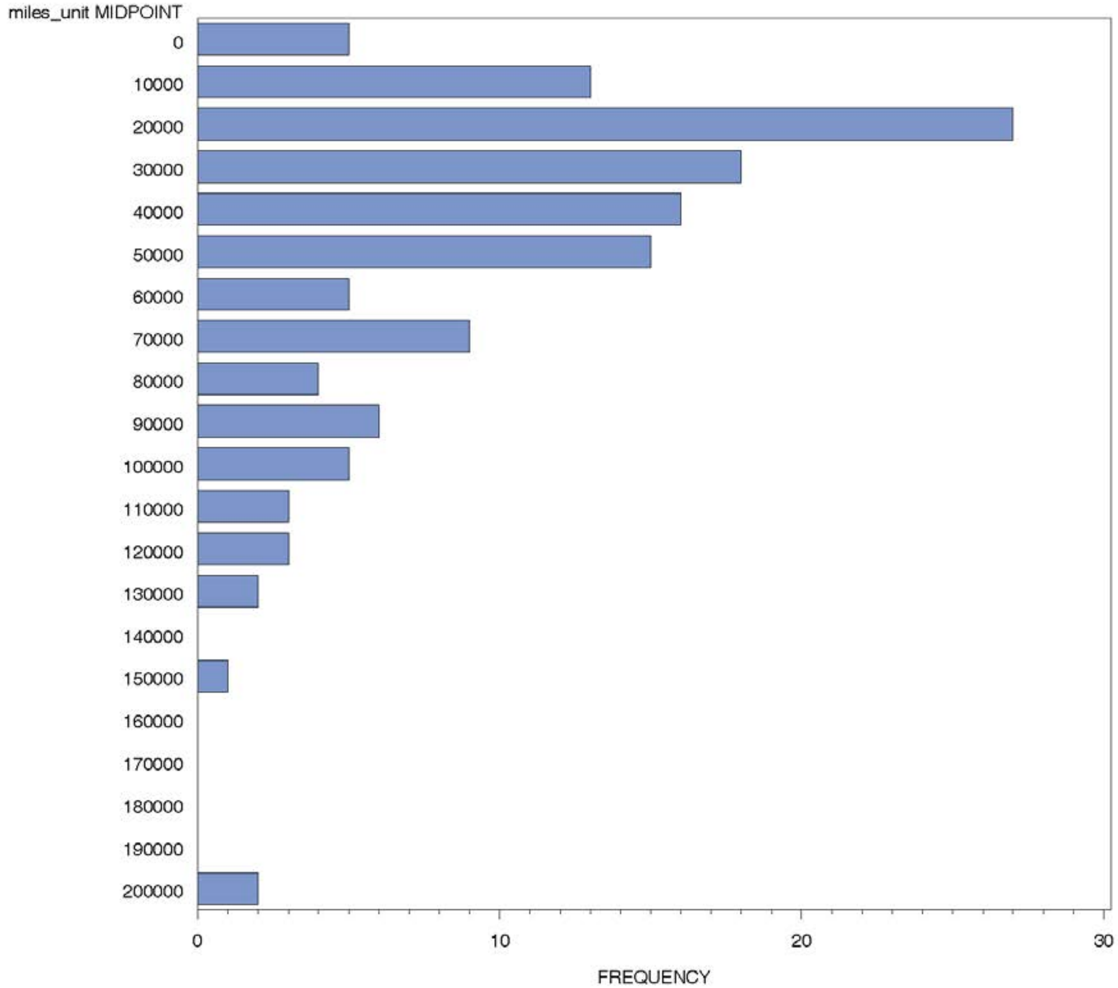
miles_unit MIDPOINT	FREQ.	CUM. FREQ.	PCT.	CUM. PCT.
0	1	1	2.44	2.44
10000	5	6	12.20	14.63
20000	9	15	21.95	36.59
30000	6	21	14.63	51.22
40000	5	26	12.20	63.41
50000	2	28	4.88	68.29
60000	3	31	7.32	75.61
70000	4	35	9.76	85.37
80000	1	36	2.44	87.80
90000	0	36	0.00	87.80
100000	1	37	2.44	90.24
110000	0	37	0.00	90.24
120000	1	38	2.44	92.68
130000	1	39	2.44	95.12
140000	0	39	0.00	95.12
150000	0	39	0.00	95.12
160000	0	39	0.00	95.12
170000	0	39	0.00	95.12
180000	0	39	0.00	95.12
190000	0	39	0.00	95.12
200000	2	41	4.88	100.00

Calendar Year 2008 Diesel smart way vehicles
truck_class=6



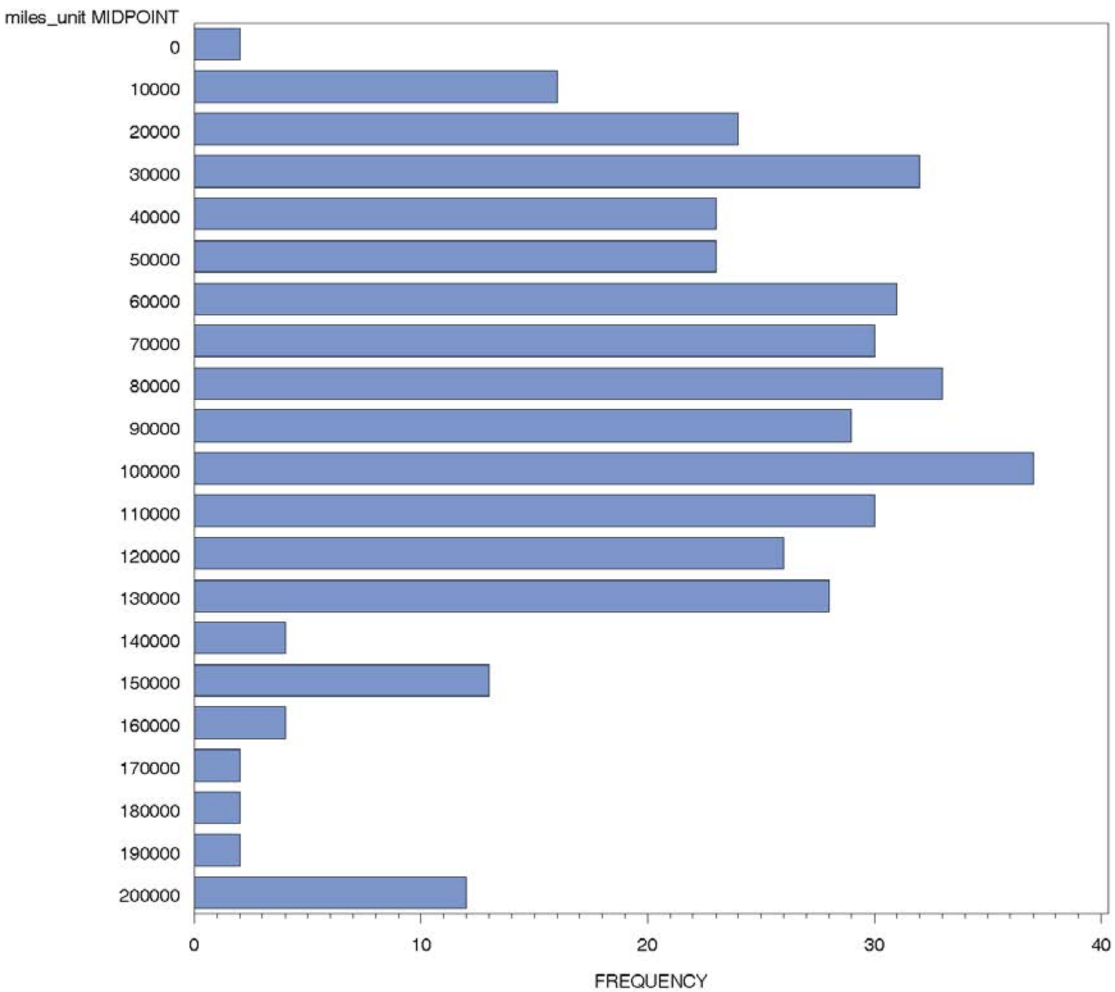
miles_unit MIDPOINT	FREQ.	CUM. FREQ.	PCT.	CUM. PCT.
0	5	5	3.94	3.94
10000	16	21	12.60	16.54
20000	22	43	17.32	33.86
30000	21	64	16.54	50.39
40000	16	80	12.60	62.99
50000	18	98	14.17	77.17
60000	12	110	9.45	86.61
70000	4	114	3.15	89.76
80000	4	118	3.15	92.91
90000	3	121	2.36	95.28
100000	2	123	1.57	96.85
110000	0	123	0.00	96.85
120000	0	123	0.00	96.85
130000	0	123	0.00	96.85
140000	0	123	0.00	96.85
150000	1	124	0.79	97.64
160000	0	124	0.00	97.64
170000	0	124	0.00	97.64
180000	0	124	0.00	97.64
190000	0	124	0.00	97.64
200000	3	127	2.36	100.00

Calendar Year 2008 Diesel smart way vehicles
truck_class=7



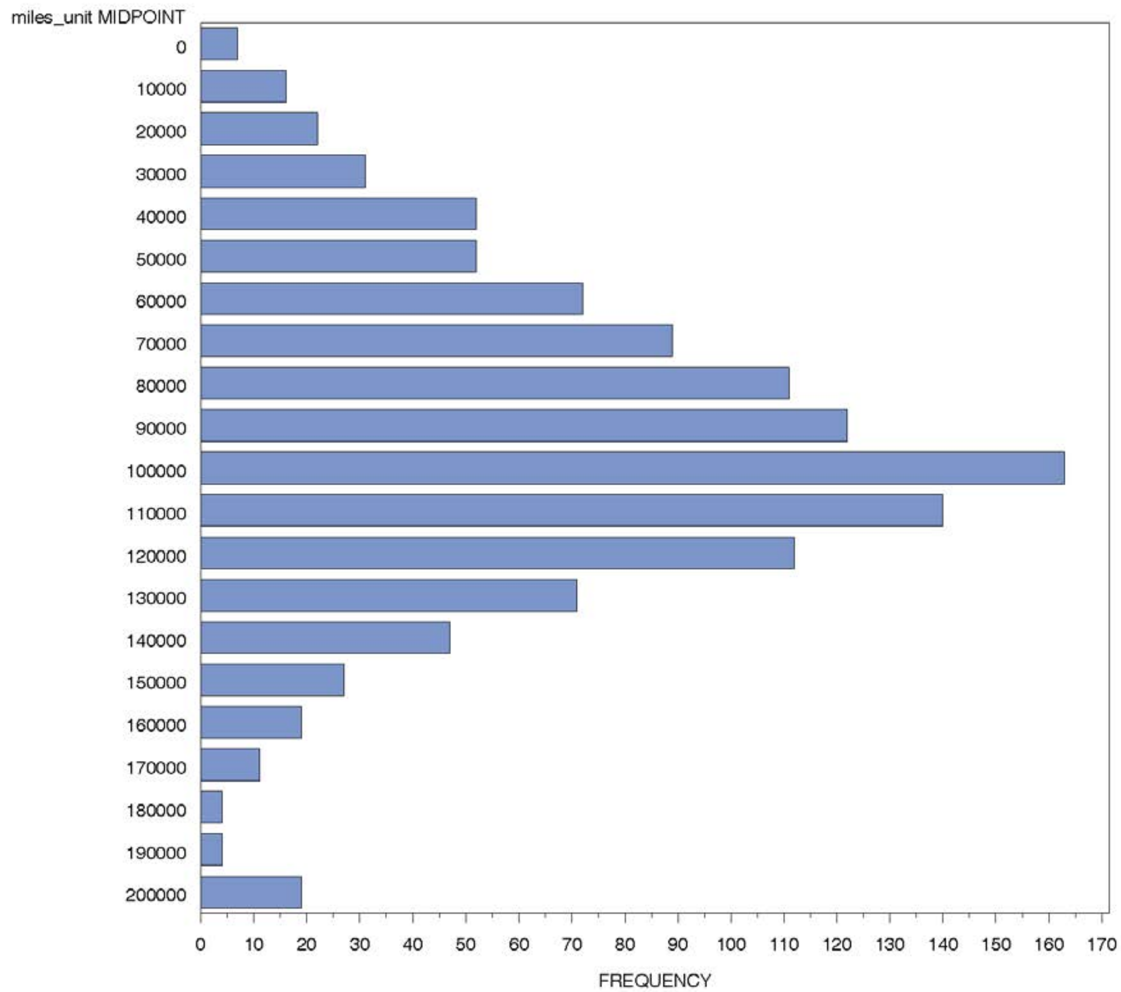
miles_unit MIDPOINT	FREQ.	CUM. FREQ.	PCT.	CUM. PCT.
0	5	5	3.73	3.73
10000	13	18	9.70	13.43
20000	27	45	20.15	33.58
30000	18	63	13.43	47.01
40000	16	79	11.94	58.96
50000	15	94	11.19	70.15
60000	5	99	3.73	73.88
70000	9	108	6.72	80.60
80000	4	112	2.99	83.58
90000	6	118	4.48	88.06
100000	5	123	3.73	91.79
110000	3	126	2.24	94.03
120000	3	129	2.24	96.27
130000	2	131	1.49	97.76
140000	0	131	0.00	97.76
150000	1	132	0.75	98.51
160000	0	132	0.00	98.51
170000	0	132	0.00	98.51
180000	0	132	0.00	98.51
190000	0	132	0.00	98.51
200000	2	134	1.49	100.00

Calendar Year 2008 Diesel smart way vehicles
truck_class=8A



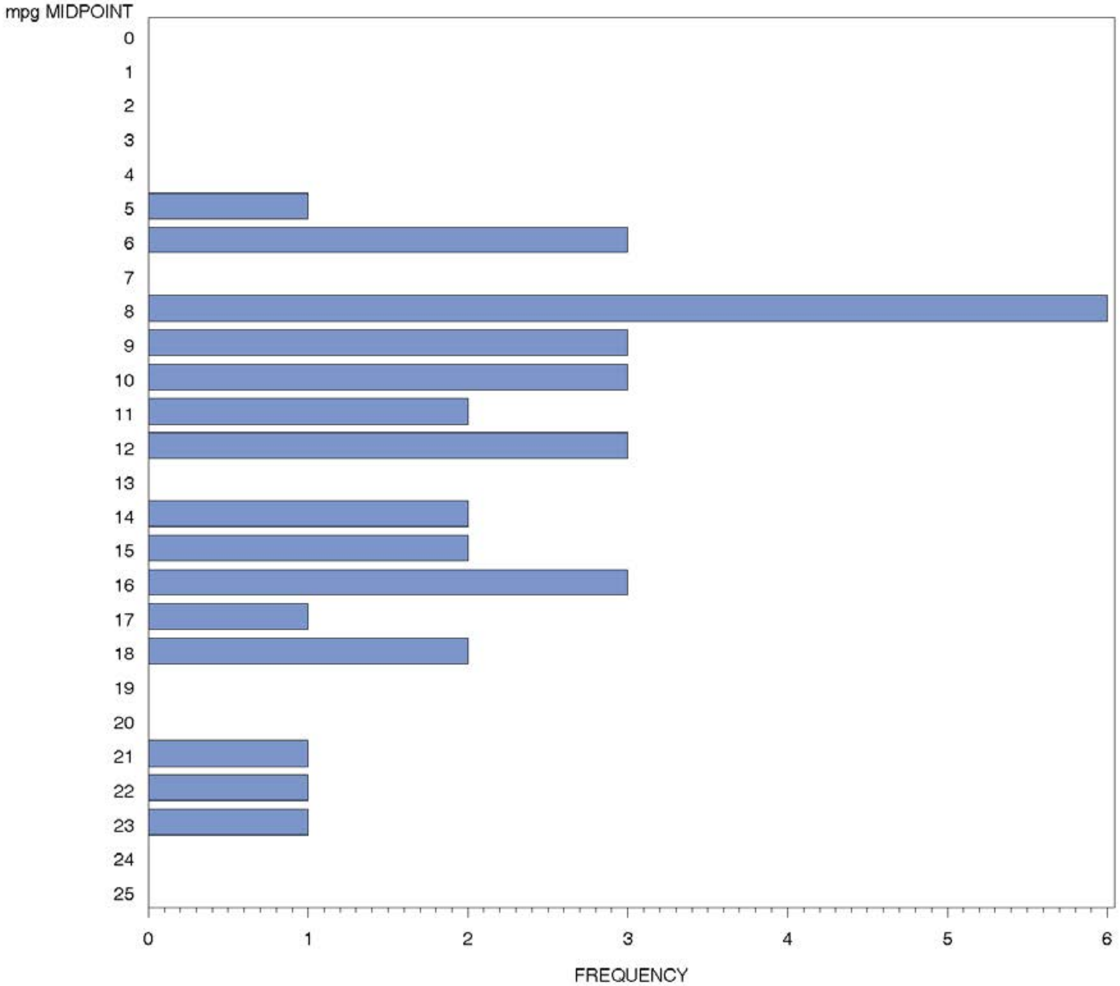
miles_unit MIDPOINT	FREQ.	CUM. FREQ.	PCT.	CUM. PCT.
0	2	2	0.50	0.50
10000	16	18	3.97	4.47
20000	24	42	5.96	10.42
30000	32	74	7.94	18.36
40000	23	97	5.71	24.07
50000	23	120	5.71	29.78
60000	31	151	7.69	37.47
70000	30	181	7.44	44.91
80000	33	214	8.19	53.10
90000	29	243	7.20	60.30
100000	37	280	9.18	69.48
110000	30	310	7.44	76.92
120000	26	336	6.45	83.37
130000	28	364	6.95	90.32
140000	4	368	0.99	91.32
150000	13	381	3.23	94.54
160000	4	385	0.99	95.53
170000	2	387	0.50	96.03
180000	2	389	0.50	96.53
190000	2	391	0.50	97.02
200000	12	403	2.98	100.00

Calendar Year 2008 Diesel smart way vehicles
truck_class=8B



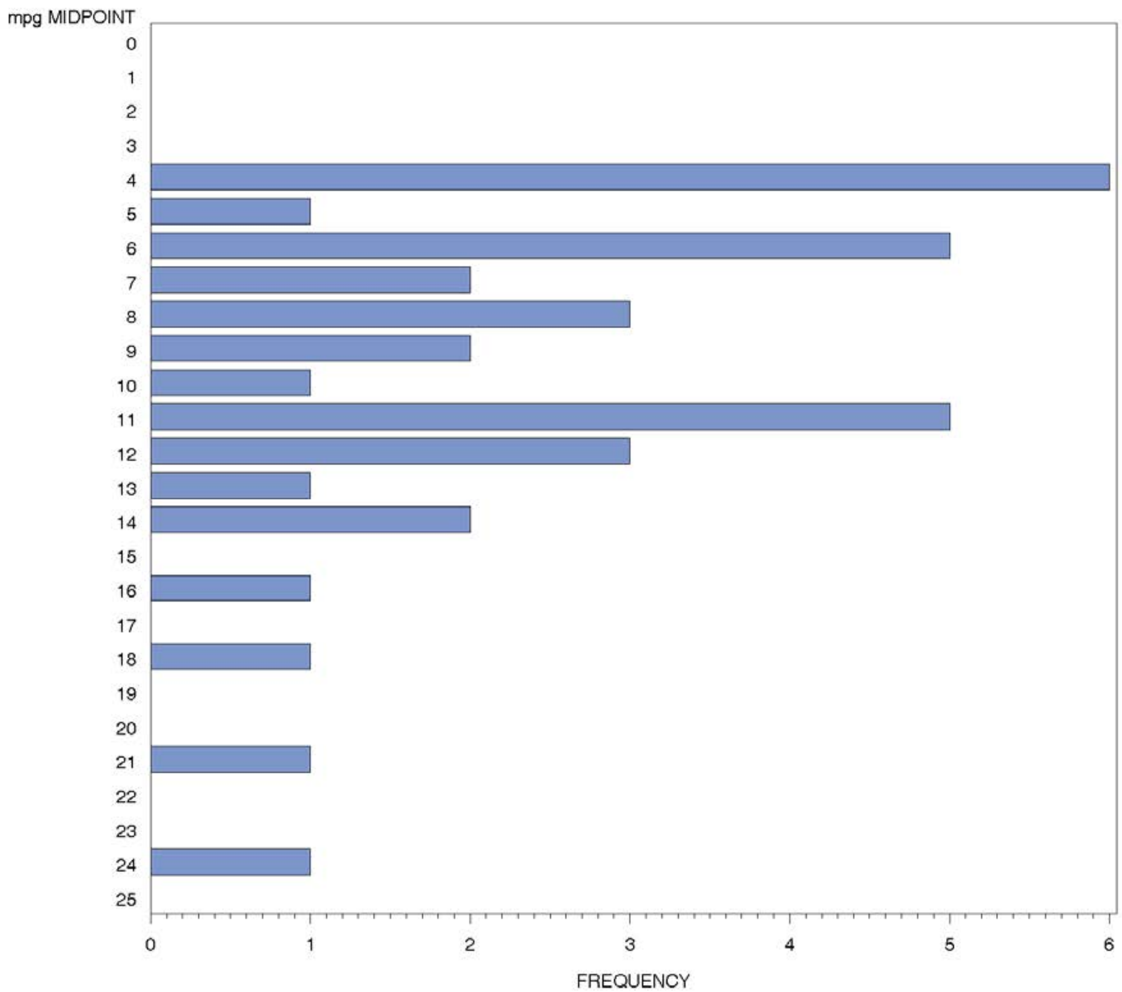
miles_unit MIDPOINT	FREQ.	CUM. FREQ.	PCT.	CUM. PCT.
0	7	7	0.59	0.59
10000	16	23	1.34	1.93
20000	22	45	1.85	3.78
30000	31	76	2.60	6.38
40000	52	128	4.37	10.75
50000	52	180	4.37	15.11
60000	72	252	6.05	21.16
70000	89	341	7.47	28.63
80000	111	452	9.32	37.95
90000	122	574	10.24	48.19
100000	163	737	13.69	61.88
110000	140	877	11.75	73.64
120000	112	989	9.40	83.04
130000	71	1060	5.96	89.00
140000	47	1107	3.95	92.95
150000	27	1134	2.27	95.21
160000	19	1153	1.60	96.81
170000	11	1164	0.92	97.73
180000	4	1168	0.34	98.07
190000	4	1172	0.34	98.40
200000	19	1191	1.60	100.00

Calendar Year 2008 Diesel smart way vehicles
truck_class=2B



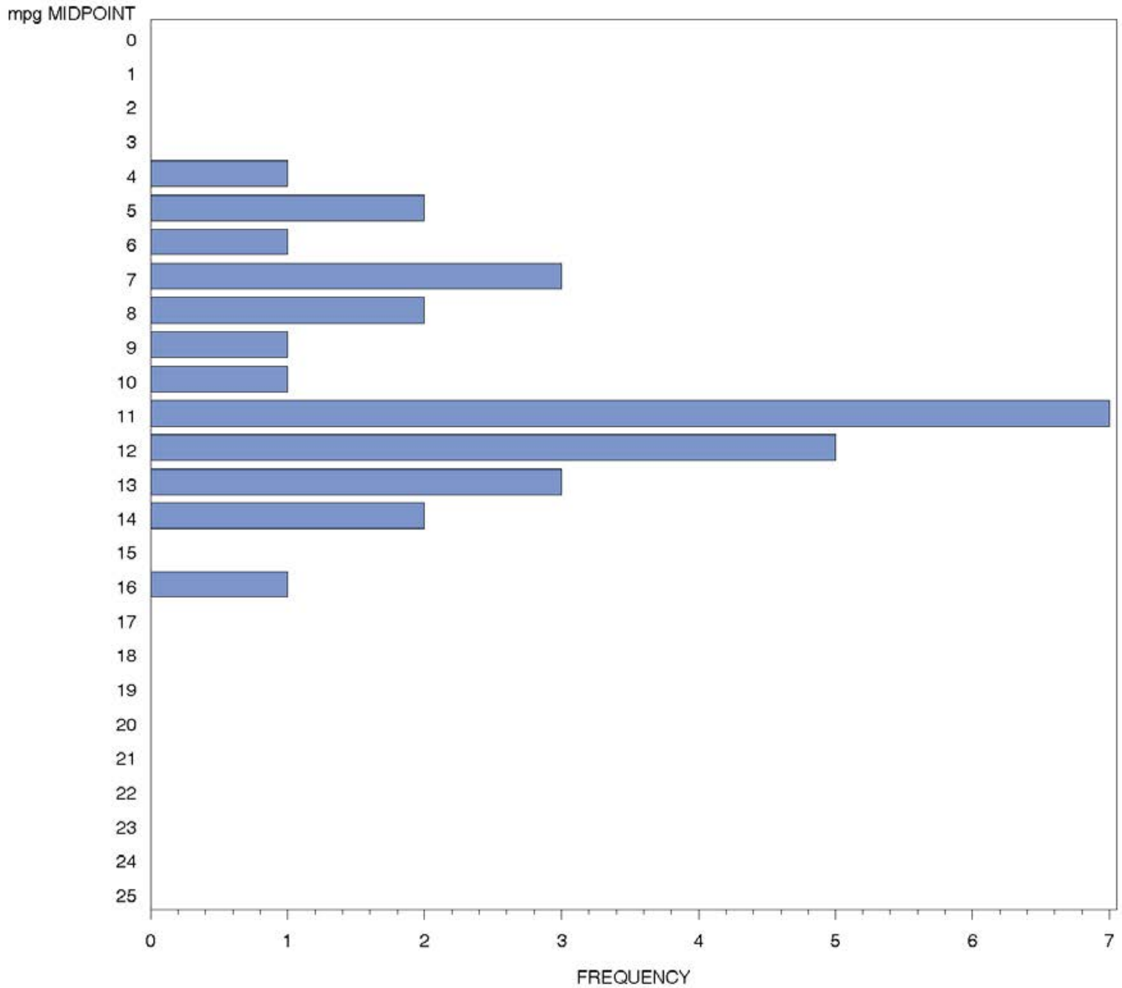
mpg MIDPOINT	FREQ.	CUM. FREQ.	PCT.	CUM. PCT.
0	0	0	0.00	0.00
1	0	0	0.00	0.00
2	0	0	0.00	0.00
3	0	0	0.00	0.00
4	0	0	0.00	0.00
5	1	1	2.94	2.94
6	3	4	8.82	11.76
7	0	4	0.00	11.76
8	6	10	17.65	29.41
9	3	13	8.82	38.24
10	3	16	8.82	47.06
11	2	18	5.88	52.94
12	3	21	8.82	61.76
13	0	21	0.00	61.76
14	2	23	5.88	67.65
15	2	25	5.88	73.53
16	3	28	8.82	82.35
17	1	29	2.94	85.29
18	2	31	5.88	91.18
19	0	31	0.00	91.18
20	0	31	0.00	91.18
21	1	32	2.94	94.12
22	1	33	2.94	97.06
23	1	34	2.94	100.00
24	0	34	0.00	100.00
25	0	34	0.00	100.00

Calendar Year 2008 Diesel smart way vehicles
truck_class=3



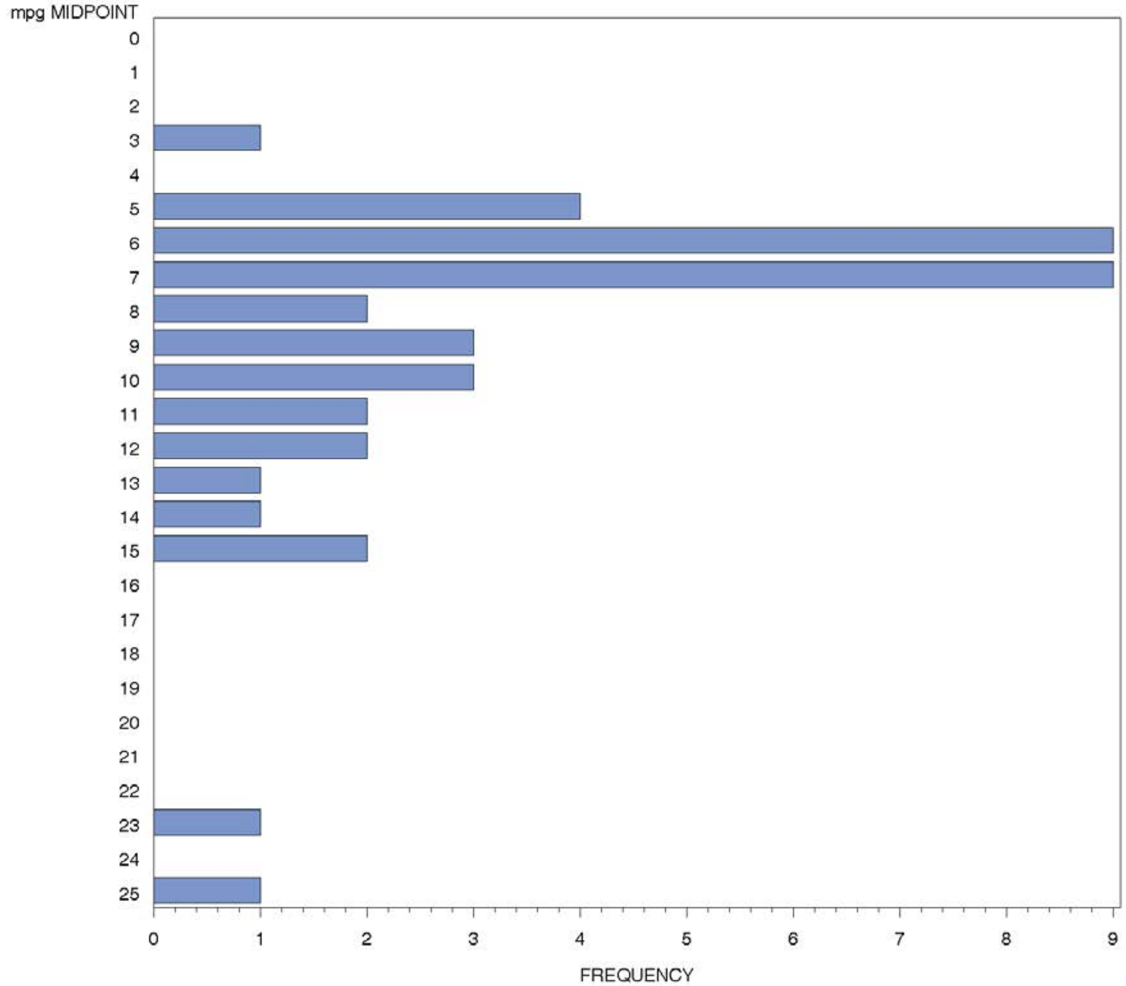
mpg MIDPOINT	FREQ.	CUM. FREQ.	PCT.	CUM. PCT.
0	0	0	0.00	0.00
1	0	0	0.00	0.00
2	0	0	0.00	0.00
3	0	0	0.00	0.00
4	6	6	17.14	17.14
5	1	7	2.86	20.00
6	5	12	14.29	34.29
7	2	14	5.71	40.00
8	3	17	8.57	48.57
9	2	19	5.71	54.29
10	1	20	2.86	57.14
11	5	25	14.29	71.43
12	3	28	8.57	80.00
13	1	29	2.86	82.86
14	2	31	5.71	88.57
15	0	31	0.00	88.57
16	1	32	2.86	91.43
17	0	32	0.00	91.43
18	1	33	2.86	94.29
19	0	33	0.00	94.29
20	0	33	0.00	94.29
21	1	34	2.86	97.14
22	0	34	0.00	97.14
23	0	34	0.00	97.14
24	1	35	2.86	100.00
25	0	35	0.00	100.00

Calendar Year 2008 Diesel smart way vehicles
truck_class=4



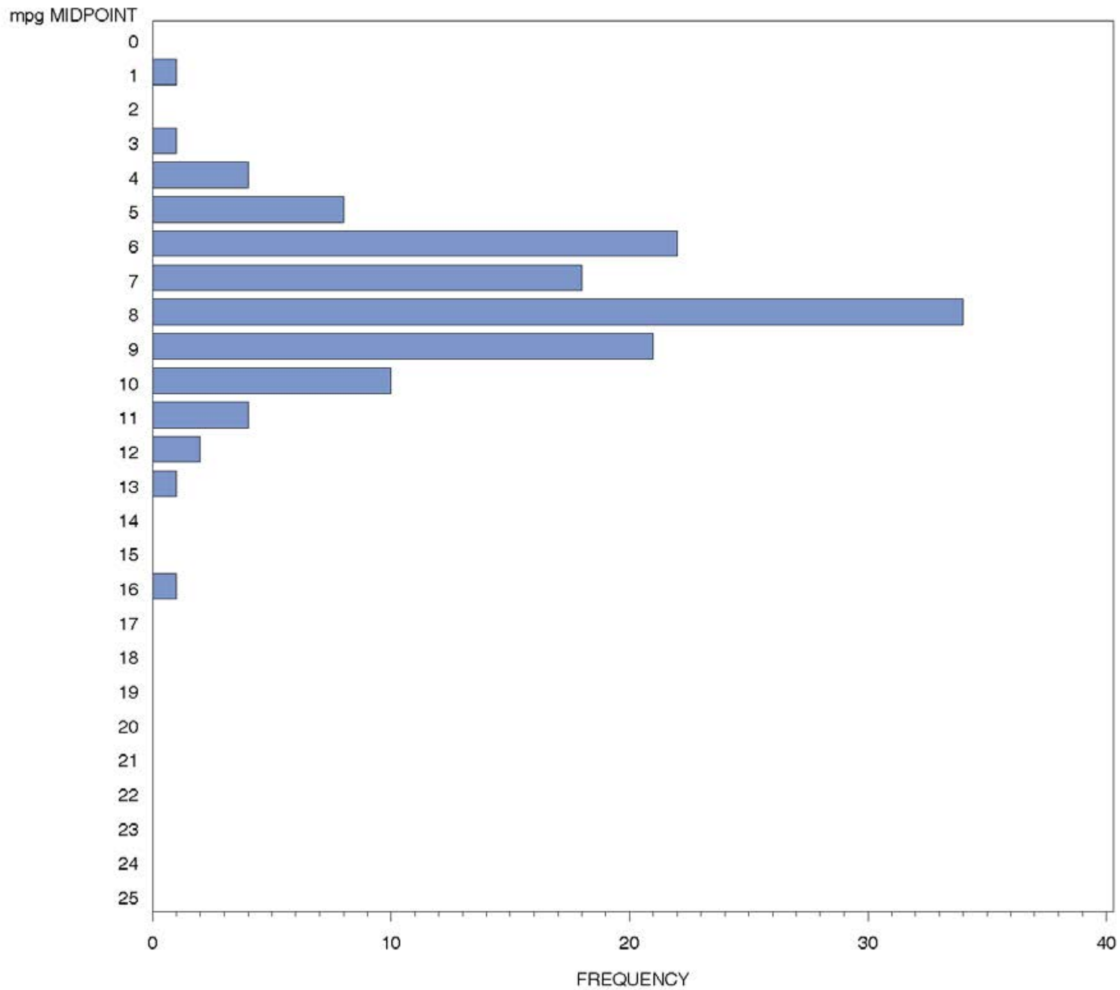
mpg MIDPOINT	FREQ.	CUM. FREQ.	PCT.	CUM. PCT.
0	0	0	0.00	0.00
1	0	0	0.00	0.00
2	0	0	0.00	0.00
3	0	0	0.00	0.00
4	1	1	3.45	3.45
5	2	3	6.90	10.34
6	1	4	3.45	13.79
7	3	7	10.34	24.14
8	2	9	6.90	31.03
9	1	10	3.45	34.48
10	1	11	3.45	37.93
11	7	18	24.14	62.07
12	5	23	17.24	79.31
13	3	26	10.34	89.66
14	2	28	6.90	96.55
15	0	28	0.00	96.55
16	1	29	3.45	100.00
17	0	29	0.00	100.00
18	0	29	0.00	100.00
19	0	29	0.00	100.00
20	0	29	0.00	100.00
21	0	29	0.00	100.00
22	0	29	0.00	100.00
23	0	29	0.00	100.00
24	0	29	0.00	100.00
25	0	29	0.00	100.00

Calendar Year 2008 Diesel smart way vehicles
truck_class=5



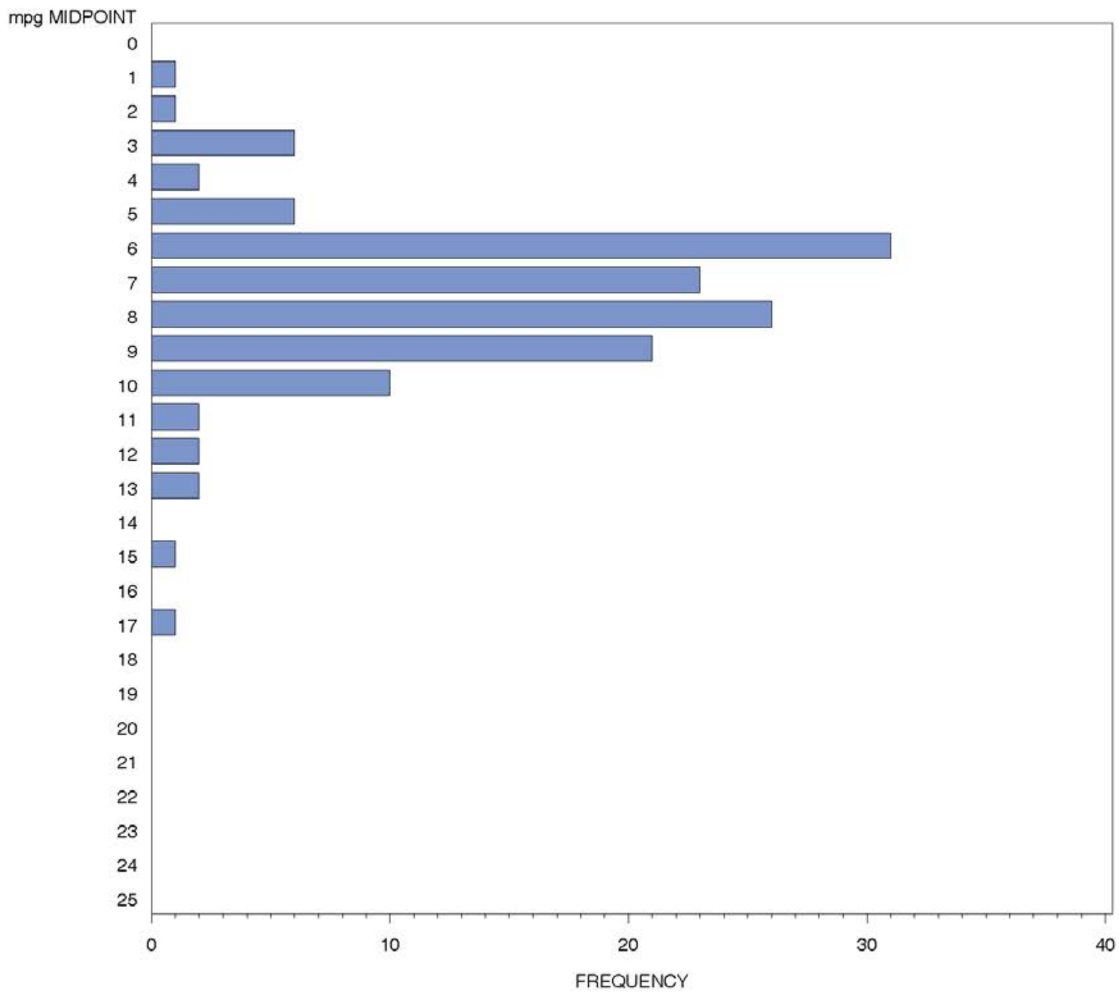
mpg MIDPOINT	FREQ.	CUM. FREQ.	PCT.	CUM. PCT.
0	0	0	0.00	0.00
1	0	0	0.00	0.00
2	0	0	0.00	0.00
3	1	1	2.44	2.44
4	0	1	0.00	2.44
5	4	5	9.76	12.20
6	9	14	21.95	34.15
7	9	23	21.95	56.10
8	2	25	4.88	60.98
9	3	28	7.32	68.29
10	3	31	7.32	75.61
11	2	33	4.88	80.49
12	2	35	4.88	85.37
13	1	36	2.44	87.80
14	1	37	2.44	90.24
15	2	39	4.88	95.12
16	0	39	0.00	95.12
17	0	39	0.00	95.12
18	0	39	0.00	95.12
19	0	39	0.00	95.12
20	0	39	0.00	95.12
21	0	39	0.00	95.12
22	0	39	0.00	95.12
23	1	40	2.44	97.56
24	0	40	0.00	97.56
25	1	41	2.44	100.00

Calendar Year 2008 Diesel smart way vehicles
truck_class=6



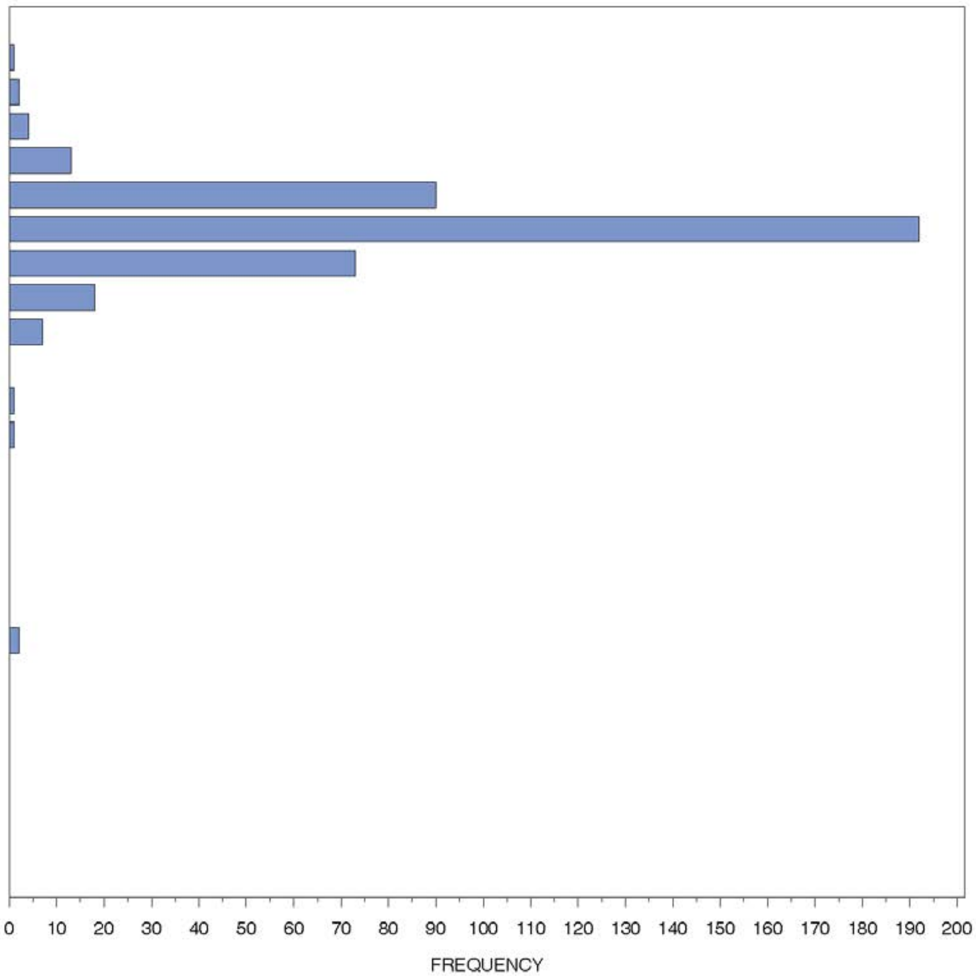
mpg MIDPOINT	FREQ.	CUM. FREQ.	PCT.	CUM. PCT.
0	0	0	0.00	0.00
1	1	1	0.79	0.79
2	0	1	0.00	0.79
3	1	2	0.79	1.57
4	4	6	3.15	4.72
5	8	14	6.30	11.02
6	22	36	17.32	28.35
7	18	54	14.17	42.52
8	34	88	26.77	69.29
9	21	109	16.54	85.83
10	10	119	7.87	93.70
11	4	123	3.15	96.85
12	2	125	1.57	98.43
13	1	126	0.79	99.21
14	0	126	0.00	99.21
15	0	126	0.00	99.21
16	1	127	0.79	100.00
17	0	127	0.00	100.00
18	0	127	0.00	100.00
19	0	127	0.00	100.00
20	0	127	0.00	100.00
21	0	127	0.00	100.00
22	0	127	0.00	100.00
23	0	127	0.00	100.00
24	0	127	0.00	100.00
25	0	127	0.00	100.00

Calendar Year 2008 Diesel smart way vehicles
truck_class=7



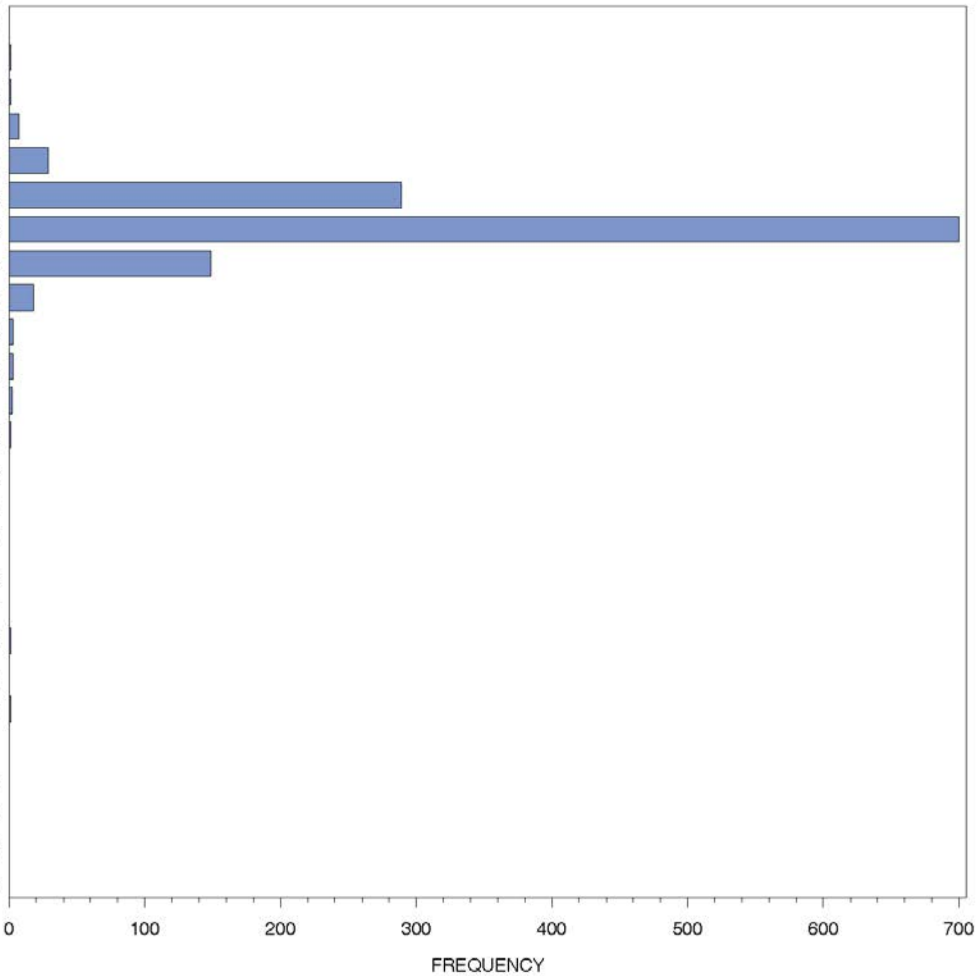
mpg MIDPOINT	FREQ.	CUM. FREQ.	PCT.	CUM. PCT.
0	0	0	0.00	0.00
1	1	1	0.74	0.74
2	1	2	0.74	1.48
3	6	8	4.44	5.93
4	2	10	1.48	7.41
5	6	16	4.44	11.85
6	31	47	22.96	34.81
7	23	70	17.04	51.85
8	26	96	19.26	71.11
9	21	117	15.56	86.67
10	10	127	7.41	94.07
11	2	129	1.48	95.56
12	2	131	1.48	97.04
13	2	133	1.48	98.52
14	0	133	0.00	98.52
15	1	134	0.74	99.26
16	0	134	0.00	99.26
17	1	135	0.74	100.00
18	0	135	0.00	100.00
19	0	135	0.00	100.00
20	0	135	0.00	100.00
21	0	135	0.00	100.00
22	0	135	0.00	100.00
23	0	135	0.00	100.00
24	0	135	0.00	100.00
25	0	135	0.00	100.00

Calendar Year 2008 Diesel smart way vehicles
truck_class=8A



mpg MIDPOINT	FREQ.	CUM. FREQ.	PCT.	CUM. PCT.
0	0	0	0.00	0.00
1	1	1	0.25	0.25
2	2	3	0.50	0.74
3	4	7	0.99	1.73
4	13	20	3.22	4.95
5	90	110	22.28	27.23
6	192	302	47.52	74.75
7	73	375	18.07	92.82
8	18	393	4.46	97.28
9	7	400	1.73	99.01
10	0	400	0.00	99.01
11	1	401	0.25	99.26
12	1	402	0.25	99.50
13	0	402	0.00	99.50
14	0	402	0.00	99.50
15	0	402	0.00	99.50
16	0	402	0.00	99.50
17	0	402	0.00	99.50
18	2	404	0.50	100.00
19	0	404	0.00	100.00
20	0	404	0.00	100.00
21	0	404	0.00	100.00
22	0	404	0.00	100.00
23	0	404	0.00	100.00
24	0	404	0.00	100.00
25	0	404	0.00	100.00

Calendar Year 2008 Diesel smart way vehicles
truck_class=8B



mpg MIDPOINT	FREQ.	CUM. FREQ.	PCT.	CUM. PCT.
0	0	0	0.00	0.00
1	1	1	0.08	0.08
2	1	2	0.08	0.17
3	7	9	0.58	0.75
4	29	38	2.41	3.15
5	289	327	23.98	27.14
6	700	1027	58.09	85.23
7	149	1176	12.37	97.59
8	18	1194	1.49	99.09
9	3	1197	0.25	99.34
10	3	1200	0.25	99.59
11	2	1202	0.17	99.75
12	1	1203	0.08	99.83
13	0	1203	0.00	99.83
14	0	1203	0.00	99.83
15	0	1203	0.00	99.83
16	0	1203	0.00	99.83
17	0	1203	0.00	99.83
18	1	1204	0.08	99.92
19	0	1204	0.00	99.92
20	1	1205	0.08	100.00
21	0	1205	0.00	100.00
22	0	1205	0.00	100.00
23	0	1205	0.00	100.00
24	0	1205	0.00	100.00
25	0	1205	0.00	100.00

Appendix D
Cargo Volume Literature Review Summary

Class	Application	Body Type	VIUS Category	Manuf	Model	Cargo Space (cubic feet)	Unit	Max Payload	GVW	Notes or Comments	URL
2b	Full Size Pick-up	Pick-up		Chevy	Silverado 2500HD		Cu. Ft	3,644	9,200		http://www.chevrolet.com/vehicles/2010/silverado2500hd/features.do
2b	Full Size Pick-up	Pick-up		Ford	F250		Cu. Ft	2,900	9,400		http://www.fordf150.net/specs/05sd_specs.pdf
2b	Step Van	Budget Cargo Van	step/walk-in	Ford		309	Cu. Ft	3,116	8,600		http://www.budgettruck.com/Moving-Trucks.aspx
2b	Step Van	Step Van	step/walk-in	Freightliner-Sprinter	2500 Standard Roof	318	Cu. Ft	3,469	8,550		http://www.freightlinersprinterusa.com/vehicles/cargo-van/models/specifications.php
2b	Utility Van	Utility/ cargo van	van (basic enclosed)	Ford	E350	237	Cu. Ft	4,239	9,500		http://www.motortrend.com/cars/2008/ford/e_350/specifications/index.html
2b	Utility Van	Uhaul 10' Truck	van (basic enclosed)	GMC		402	Cu. Ft	2,810	8,600		http://www.uhaul.com/Reservations/EquipmentDetail.aspx?model=EL
2b	Utility Van	Budget 10' Moving Truck	van (basic enclosed)			380	Cu. Ft	3,100	8,600		http://www.budgettruck.com/Moving-Trucks.aspx
2b	Stake Truck	Stake/ platform	flatbed/stake/ platform	Supreme		336	Cu. Ft				
3	Pickup	Pick-up		GMC	Sierra 3500		Cu. Ft	4,566	10,700		http://www.gmc.com/sierra/3500/specsStandard.jsp
3	Step Van	Step Van	step/walk-in	Freightliner-Sprinter	3500 Standard Roof	547	Cu. Ft	4,845	11,030		http://www.freightlinersprinterusa.com/vehicles/cargo-van/models/3500-high-roof-170-wb-6-specs.php
3	Conventional Van	Penske 12' Cargo Van	van (basic enclosed)			450	Cu. Ft	2,600			http://www.pensketruckrental.com/commercial-truck-rentals/moving-vans/12-ft.html
3	City Delivery	Budget 16' Moving Truck				800	Cu. Ft	3,400	11,500		http://www.budgettruck.com/Moving-Trucks.aspx
4	Conventiona	Uhaul 14'		Ford		733	Cu. Ft	6,190	14,050		http://www.uhaul.com/Reservations/Eq

Class	Application	Body Type	VIUS Category	Manuf	Model	Cargo Space (cubic feet)	Unit	Max Payload	GVW	Notes or Comments	URL
	l Van	Truck									uipmentDetail.aspx?model=EL
4	Conventional Van	Uhaul 17' Truck		Ford		865	Cu. Ft	5,930	14,050		http://www.uhaul.com/Reservations/EquipmentDetail.aspx?model=EL
4	Conventional Van	Penske 16' Economy Van				826	Cu. Ft	4,300	15,000		http://www.pensketruckrental.com/commercial-truck-rentals/moving-cargo-vans/16-ft.html
4	City Delivery	Penske 16' Cargo Van				1,536	Cu. Ft	5,100			http://www.pensketruckrental.com/commercial-truck-rentals/moving-cargo-vans/16-ft.html
4	Large Walk-In	Walk-in			W700 Step Van	700	Cu. Ft	5,720	16,000		http://files.harc.edu/Projects/Transportation/FedExReportTask3.pdf
4	Large Walk-In	Walk-in		Eaton Hybrid	W700 Step Van	700	Cu. Ft	5,390	16,000		http://files.harc.edu/Projects/Transportation/FedExReportTask3.pdf
4	UPS	Walk-in		Grumman							http://www.grummanolson.com/index2.htm
4	Stake Truck	Stake/platform	flatbed/stake/platform	GMC	W4500	448	Cu. Ft		14,500		http://www.usedtrucksdepot.com/browse_listdetails.php?manf=GMC&scate=Stake+Truck&catname=Medium+Duty+Trucks&main_id=208
5	Bucket Truck	Bucket truck					Cu. Ft				
5	City Delivery	Uhaul 24' Truck	van (basic enclosed)			1,418	Cu. Ft	6,500	18,000		http://www.uhaul.com/Reservations/EquipmentDetail.aspx?model=EL
5	City Delivery	Uhaul 26' Truck	van (basic enclosed)			1,611	Cu. Ft	7,400	18,000		http://www.uhaul.com/Reservations/EquipmentDetail.aspx?model=EL
5	Large Walk-In	Large Walk-in	step/walk-in			670	Cu. Ft		16,000		http://news.van.fedex.com/node/7379
6	Beverage	Beverage		Hackney	6-Bay 52" Performer	588/case capacity = 531 @ 120z cans	Cu. Ft/cases cans	11,601	21,150		http://www.hackneybeverage.com/bodycad5.htm
6	Single Axle	Budget	van (basic			1,380	Cu. Ft	12,000	25,500		http://www.budgettruck.com/Moving-

Class	Application	Body Type	VIUS Category	Manuf	Model	Cargo Space (cubic feet)	Unit	Max Payload	GVW	Notes or Comments	URL
	Van	24' Truck	enclosed)								Trucks.aspx
6	Stake Truck	24' Stake Truck	flatbed/stake/platform	International/ Supreme	24'	672	Cu. Ft		25,900		http://www.usedtrucks.ryder.com/Vehicle/VehicleSearch.aspx?VehicleTypeId=1&VehicleGroupId=5
6	Refrigerated /Reefer	24' Kold King Refrigerated	reefer	Supreme	24'	1,521	Cu. Ft				http://www.silvercrowncoach.com/supreme.php?page=product&body=refrigerated&product=21&section=specs
6	Landscape Van	Vanscaper Landscape Van	step/walk-in	Supreme	22'	1,496	Cu. Ft			Note: typical step/walk-ins do not reach this size. This is a speciality vehicle	http://www.silvercrowncoach.com/supreme.php?page=product&body=landscaping&product=30
7	Refuse	Refuse Truck					Cu. Ft				
7	Furniture	Furniture Truck				2,013	Cu. Ft				http://www.hendersonrentals.co.nz/?t=38
7	Beverage	Beverage (delivery body)		Hackney	Hackney 10-Bay-48" Aluminum	1251/ case capacity = 1,100 12 oz cans	Cu. Ft/case cans	23,700	37,733		http://hackneyusa.com/
7	Stake Truck	flatbed/stake/platform	flatbed/stake/platform	Supreme	SH20096	728			33,000		http://www.usedtrucks.ryder.com/Vehicle/VehicleSearch.aspx?VehicleTypeId=1&VehicleGroupId=5
7	Refrigerated /Reefer	28' Kold King Refrigerated	reefer	Supreme	28'	1,774	Cu. Ft				http://www.silvercrowncoach.com/supreme.php?page=product&body=refrigerated&product=21&section=specs
7	Tanker Truck	tank (fluid)	tank (fluid)	Ford	F750 XL	267	Cu. Ft	2,000-4000 GAL	26,000		http://www.truckingauctions.com/browse_listdetails.php?scate=Water%20Tank%20Truck&manf=GMC&catname=H

Class	Application	Body Type	VIUS Category	Manuf	Model	Cargo Space (cubic feet)	Unit	Max Payload	GVW	Notes or Comments	URL
											eavy%20Duty%20Trucks
7	Single Axle Van	Freightliner Truck	van (basic enclosed)	Freightliner Business Class (24')	Business Class M2 112	1,552			33,000	Note: front axle lbs 12,000/rear axle 21,000 lbs (each add'l axle approx 12,000 lbs)	http://www.truckpaper.com/listingsdetail/detail.aspx?OHID=2379362

Appendix E
EPA Drayage Calculator Equations

Drayage Fleet Score and Emission Reductions for Generic Port													
Company Name	California Cartage Express												
Year 2008	Pre-1988	1988-1993	1994-2002	2003-2006	2007-2009	Post 2009	Total Trucks	CO_2 *Grams*	CO2 *Short tons*	PM *Short tons*	NOx *Short tons*	SmartWay SIF Score	Environmental Performance
Baseline Emissions From Average Dray Truck Fleet							1		**111**	**0.1**	**1.4**		
Untreated	1	0	0	0			1		**111**	**0.2**	**1.6**		
DOC & CCVS							0		**0**	**0.0**	**0.0**		
Flow Through Filter							0		**0**	**0.0**	**0.0**		
Diesel Particulate Filter/LNG			0	0	0	0	0		**0**	**0.0**	**0.0**		
Total Trucks Equipped with:	APUs	0	SW Tires		**0**	LNG	0		**0**	**0.0**	**0.0**		
2008 Total Fleet Emissions									**111**	**0.2**	**1.6**		
Change in Emissions from Baseline									**0.0**	**0.1**	**0.2**		
% Change in Emissions									**0%**	**131%**	**14%**		
Avg. Miles Per Truck	**60000**		Fuel Consumed (gal)			**10000**							
SmartWay FLEET Score and Environmental Performance for:							2008					No Rating	No Rating

I. CO_2 Short Tons

<u>A. CO_2 (Short tons) – Baseline Emissions From Average Dray Truck Fleet</u>

$$A_{CO2} = \mathbf{(((BaselineEmissionsFromAverageDrayTruckFleet_{Pre1988} + BaselineEmissionsFromAverageDrayTruckFleet_{1988to1993} + BaselineEmissionsFromAverageDrayTruckFleet_{1994to2002})} * \mathrm{AvgMilesPerTruck}/\mathbf{5.47)} + \mathbf{((BaselineEmissionsFromAverageDrayTruckFleet_{2003to2006} + BaselineEmissionsFromAverageDrayTruckFleet_{2007to2009} + BaselineEmissionsFromAverageDrayTruckFleet_{Post2009})} * \mathrm{AvgMilesPerTruck}\ /\mathbf{5.47))} * \mathbf{0.01015}$$

NOTE: AvgMilesPerTruck =60000

B. CO_2 (Short tons) – Untreated

B_{CO2} = (((**Untreated**$_{Pre1988}$ + **Untreated**$_{1988to1993}$ + **Untreated**$_{1994to2002}$**)** * AvgMilesPerTruck **/5.47)** + **((Untreated**$_{2003to2006}$ + **Untreated**$_{2007to2009}$ + **Untreated**$_{Post2009}$ **)** * AvgMilesPerTruck **/5.47))** * **0.01015**

NOTE: AvgMilesPerTruck =60000

C. CO_2 (Short tons) – DOCs & CCVs

C_{CO2} = **(((DOCs&CCVs**$_{Pre1988}$ + **DOCs&CCVs**$_{1988to1993}$ + **DOCs&CCVs**$_{1994to2002}$**)** * AvgMilesPerTruck **/5.47)** + **((DOCs&CCVs**$_{2003to2006}$ + **DOCs&CCVs**$_{2007to2009}$ + **DOCs&CCVs**$_{Post2009}$**)** * AvgMilesPerTruck **/5.47))** * **0.01015**

NOTE: AvgMilesPerTruck =60000

D. CO_2 (Short tons) – Flow Through Filter

D_{CO2} = **(((FlowThroughFilter**$_{Pre1988}$ + **FlowThroughFilter**$_{1988to1993}$ + **FlowThroughFilter**$_{1994to2002}$**)** * AvgMilesPerTruck **/5.47)** + **((FlowThroughFilter**$_{2003to2006}$ + **FlowThroughFilter**$_{2007to2009}$ + **FlowThroughFilter**$_{Post2009}$**)** * AvgMilesPerTruck **/5.47))** * **0.01015**

NOTE: AvgMilesPerTruck =60000

E. CO_2 (Short tons) – Diesel Particulate

E_{CO2} = **(((DieselParticulate**$_{Pre1988}$ + **DieselParticulate**$_{1988to1993}$ + **DieselParticulate**$_{1994to2002}$**)** * AvgMilesPerTruck **/5.47)** + **((DieselParticulate**$_{2003to2006}$ + **DieselParticulate**$_{2007to2009}$ + **DieselParticulate**$_{Post2009}$**)** * AvgMilesPerTruck **/5.47))** * **0.01015**

NOTE: AvgMilesPerTruck =60000

F. CO_2 (Short tons) – Total Trucks Equipped with APU/SWTires/LNG

F_{CO2} = **((TotalTruckEquipped**$_{APU}$/BaselineEmissionsFromAverageDrayTruckFleet$_{TotalTrucks}$ * **0.11)** + **(TotalTruckEquipped**$_{SWTires}$ / BaselineEmissionsFromAverageDrayTruckFleet$_{TotalTrucks}$ * **0.02)** + **(TotalTruckEquipped**$_{LNG}$ / BaselineEmissionsFromAverageDrayTruckFleet$_{TotalTrucks}$ * **0.21))** * **(**B_{CO2} + C_{CO2} + D_{CO2} + E_{CO2}**)** * **-1**

Where

BaselineEmissionsFromAverageDrayTruckFleet$_{TotalTrucks}$ = **BaselineEmissionsFromAverageDrayTruckFleet**$_{Pre1988}$ + **BaselineEmissionsFromAverageDrayTruckFleet**$_{1988to1993}$ +

$BaselineEmissionsFromAverageDrayTruckFleet_{1994to2002}$ +
$BaselineEmissionsFromAverageDrayTruckFleet_{2003to2006}$ +
$BaselineEmissionsFromAverageDrayTruckFleet_{2007to2009}$ + **$BaselineEmissionsFromAverageDrayTruckFleet_{Post2009}$**

B_{CO2} = **CO_2 (Short tons) – Untreated**
C_{CO2} = **CO_2 (Short tons) – DOCs & CCVs**
D_{CO2} = **CO_2 (Short tons) – Flow Through Filter**
E_{CO2} = **CO_2 (Short tons) – Diesel Particulate**

<u>G. CO_2 (Short tons) – Total Fleet Emissions</u>

$G_{CO2} = B_{CO2} + C_{CO2} + D_{CO2} + E_{CO2} + F_{CO2}$

Where

B_{CO2} = **CO_2 (Short tons) – Untreated**
C_{CO2} = **CO_2 (Short tons) – DOCs & CCVs**
D_{CO2} = **CO_2 (Short tons) – Flow Through Filter**
E_{CO2} = **CO_2 (Short tons) – Diesel Particulate**
F_{CO2} = **CO_2 (Short tons) – CO2 (Short tons) – Total Trucks Equipped with APU/SWTires/LNG**

<u>H. CO_2 (Short tons) – Change in Emissions from Baseline</u>

$H_{CO2} = G_{CO2} - A_{CO2}$

Where

G_{CO2} = **CO_2 (Short tons) – Total Fleet Emissions**
A_{CO2} = **CO_2 (Short tons) – Baseline Emissions From Average Dray Truck Fleet**

<u>I. CO_2 (Short tons) – Percent Change in Emissions from Baseline</u>

$I_{CO2} = (G_{CO2} - A_{CO2}) / A_{CO2}$

Where

G_{CO2} = **CO_2 (Short tons) – Total Fleet Emissions**
A_{CO2} = **CO_2 (Short tons) – Baseline Emissions From Average Dray Truck Fleet**

<u>J. CO_2 (Short tons) – SmartWay Fleet Score and Environmental Performance</u>

$J_{CO2} = (I_{CO2} / 40) * -100$

Where

I_{CO2} = **CO_2 (Short tons) – Percent Change in Emissions from Baseline**

II. PM Short Tons

A. PM (Short tons) – Baseline Emissions From Average Dray Truck Fleet

A_{PM} = **(((BaselineEmissionsFromAverageDrayTruckFleet$_{Pre1988}$** * PMGramsPerMile$_{Pre1988}$ * **1.10E-06)** + **(BaselineEmissionsFromAverageDrayTruckFleet$_{1988to1993}$** * PMGramsPerMile$_{1988to1993}$ * **1.10E-06)** + **(BaselineEmissionsFromAverageDrayTruckFleet$_{1994to2002}$** * PMGramsPerMile$_{1994to2002}$ * **1.10E-06)** + **(BaselineEmissionsFromAverageDrayTruckFleet$_{2003to2006}$** * PMGramsPerMile$_{2003to2006}$ * **1.10E-06)** + **(BaselineEmissionsFromAverageDrayTruckFleet$_{2007to2009}$** * PMGramsPerMile$_{Pre1988}$ * **1.10E-06)** + **(BaselineEmissionsFromAverageDrayTruckFleet$_{Post2009}$** * PMGramsPerMile$_{Pre1988}$ * **1.10E-06))** * AvgMilesPerTruck**)**

NOTE: AvgMilesPerTruck =60000

Where

PMGramsPerMile$_{Pre1988}$ = **3.11**

B. PM (Short tons) – Untreated

B_{PM} = **(((Untreated$_{Pre1988}$** * PMGramsPerMile$_{Pre1988}$ * **1.10E-06)** + **(Untreated$_{1988to1993}$** * PMGramsPerMile$_{1988to1993}$ * **1.10E-06)** + **(Untreated$_{1994to2002}$** * PMGramsPerMile$_{1994to2002}$ * **1.10E-06)** + **(Untreated$_{2003to2006}$** * PMGramsPerMile$_{2003to2006}$ * **1.10E-06)** + **(Untreated$_{2007to2009}$** * PMGramsPerMile$_{Pre1988}$ * **1.10E-06)** + **(Untreated$_{Post2009}$** * PMGramsPerMile$_{Pre1988}$ * **1.10E-06))** * AvgMilesPerTruck**)**

NOTE: AvgMilesPerTruck =60000

C. PM (Short tons) – DOCs & CCVs

C_{PM} = **(((DOCs&CCVs$_{Pre1988}$** * PMGramsPerMile$_{Pre1988}$ * **1.10E-06* 0.7)** + **(DOCs&CCVs$_{1988to1993}$** * PMGramsPerMile$_{1988to1993}$ * **1.10E-06 * 0.7)** + **(DOCs&CCVs$_{1994to2002}$** * PMGramsPerMile$_{1994to2002}$ * **1.10E-06 * 0.7)** + **(DOCs&CCVs$_{2003to2006}$** * PMGramsPerMile$_{2003to2006}$ * **1.10E-06 * 0.7)** + **(DOCs&CCVs$_{2007to2009}$** * PMGramsPerMile$_{Pre1988}$ * **1.10E-06 * 0.7)** + **(DOCs&CCVs$_{Post2009}$** * PMGramsPerMile$_{Pre1988}$ * **1.10E-06 * 0.7))** * AvgMilesPerTruck**)**

NOTE: AvgMilesPerTruck =60000

D. PM (Short tons) – Flow Through Filter

D_{PM} = **(((FlowThroughFilter$_{Pre1988}$** * PMGramsPerMile$_{Pre1988}$ * **1.10E-06* 0.5) + (FlowThroughFilter$_{1988to1993}$** * PMGramsPerMile$_{1988to1993}$ * **1.10E-06** * **0.5) + (FlowThroughFilter$_{1994to2002}$** * PMGramsPerMile$_{1994to2002}$ * **1.10E-06** * **0.5) + (FlowThroughFilter$_{2003to2006}$** * PMGramsPerMile$_{2003to2006}$ * **1.10E-06** * **0.5) + (FlowThroughFilter$_{2007to2009}$** * PMGramsPerMile$_{Pre1988}$ * **1.10E-06** * **0.5) + (FlowThroughFilter$_{Post2009}$** * PMGramsPerMile$_{Pre1988}$ * **1.10E-06** * **0.5))** * AvgMilesPerTruck**)**

NOTE: AvgMilesPerTruck =60000

E. PM (Short tons) – Diesel Particulate

E_{PM} = **(((DieselParticulate$_{Pre1988}$** * PMGramsPerMile$_{Pre1988}$ * **1.10E-06* 0.1) + (DieselParticulate$_{1988to1993}$** * PMGramsPerMile$_{1988to1993}$ * **1.10E-06** * **0.1) + (DieselParticulate$_{1994to2002}$** * PMGramsPerMile$_{1994to2002}$ * **1.10E-06** * **0.1) + (DieselParticulate$_{2003to2006}$** * PMGramsPerMile$_{2003to2006}$ * **1.10E-06** * **0.1) + (DieselParticulate$_{2007to2009}$** * PMGramsPerMile$_{Pre1988}$ * **1.10E-06) + (DieselParticulate$_{Post2009}$** * PMGramsPerMile$_{Pre1988}$ * **1.10E-06))** * AvgMilesPerTruck**)**

NOTE: AvgMilesPerTruck =60000

F. PM (Short tons) – Total Trucks Equipped with APU/SWTires/LNG

F_{PM} = **((TotalTruckEquipped$_{APU}$**/BaselineEmissionsFromAverageDrayTruckFleet$_{TotalTrucks}$ * **0.08)** * **(**B_{PM} + C_{PM} + D_{PM} + E_{PM}**)** * **-1)**

Where

BaselineEmissionsFromAverageDrayTruckFleet$_{TotalTrucks}$ = **BaselineEmissionsFromAverageDrayTruckFleet$_{Pre1988}$** + **BaselineEmissionsFromAverageDrayTruckFleet$_{1988to1993}$** + **BaselineEmissionsFromAverageDrayTruckFleet$_{1994to2002}$** + **BaselineEmissionsFromAverageDrayTruckFleet$_{2003to2006}$** + **BaselineEmissionsFromAverageDrayTruckFleet$_{2007to2009}$** + **BaselineEmissionsFromAverageDrayTruckFleet$_{Post2009}$**

B_{PM} = **PM (Short tons) – Untreated**

C_{PM} = **PM (Short tons) – DOCs & CCVs**

D_{PM} = **PM (Short tons) – Flow Through Filter**

E_{PM} = **PM (Short tons) – Diesel Particulate**

G. PM (Short tons) – Total Fleet Emissions

$G_{PM} = B_{PM} + C_{PM} + D_{PM} + E_{PM} + F_{PM}$

Where

B_{PM} = **PM (Short tons) – Untreated**
C_{PM} = **PM (Short tons) – DOCs & CCVs**
D_{PM} = **PM (Short tons) – Flow Through Filter**
E_{PM} = **PM (Short tons) – Diesel Particulate**
F_{PM} = **PM (Short tons) – Total Trucks Equipped with APU/SWTires/LNG**

H. PM (Short tons) – Change in Emissions from Baseline

$H_{PM} = G_{PM} - A_{PM}$

Where

G_{PM} = **PM (Short tons) – Total Fleet Emissions**
A_{PM} = **PM (Short tons) – Baseline Emissions From Average Dray Truck Fleet**

I. PM (Short tons) – Percent Change in Emissions from Baseline

$I_{PM} = (G_{PM} - A_{PM}) / A_{PM}$

Where

G_{PM} = **PM (Short tons) – Total Fleet Emissions**
A_{PM} = **PM (Short tons) – Baseline Emissions From Average Dray Truck Fleet**

J. PM (Short tons) – SmartWay Fleet Score and Environmental Performance

$J_{PM} = (I_{PM} / 80) * -100$

Where

I_{PM} = **PM (Short tons) – Percent Change in Emissions from Baseline**

III. NO_X Short Tons

A. NO_X (Short tons) – Baseline Emissions From Average Dray Truck Fleet

A_{NOX} = **(((BaselineEmissionsFromAverageDrayTruckFleet$_{Pre1988}$** * PMGramsPerMile$_{Pre1988}$ * **1.10E-06) +**
(BaselineEmissionsFromAverageDrayTruckFleet$_{1988to1993}$ * PMGramsPerMile$_{1988to1993}$ * **1.10E-06) +**

(BaselineEmissionsFromAverageDrayTruckFleet$_{1994to2002}$ * PMGramsPerMile$_{1994to2002}$ * 1.10E-06) +
(BaselineEmissionsFromAverageDrayTruckFleet$_{2003to2006}$ * PMGramsPerMile$_{2003to2006}$ * 1.10E-06) +
(BaselineEmissionsFromAverageDrayTruckFleet$_{2007to2009}$ * PMGramsPerMile$_{Pre1988}$ * 1.10E-06) +
(BaselineEmissionsFromAverageDrayTruckFleet$_{Post2009}$ * PMGramsPerMile$_{Pre1988}$ * 1.10E-06)) * AvgMilesPerTruck)

NOTE: AvgMilesPerTruck =60000

B. NO_X (Short tons) – Untreated

B_{NOX} = (((Untreated$_{Pre1988}$ * PMGramsPerMile$_{Pre1988}$ * 1.10E-06) + (Untreated$_{1988to1993}$ * PMGramsPerMile$_{1988to1993}$ * 1.10E-06) + (Untreated$_{1994to2002}$ * PMGramsPerMile$_{1994to2002}$ * 1.10E-06) + (Untreated$_{2003to2006}$ * PMGramsPerMile$_{2003to2006}$ * 1.10E-06) + (Untreated$_{2007to2009}$ * PMGramsPerMile$_{Pre1988}$ * 1.10E-06) + (Untreated$_{Post2009}$ * PMGramsPerMile$_{Pre1988}$ * 1.10E-06)) * AvgMilesPerTruck)

NOTE: AvgMilesPerTruck =60000

C. NO_X (Short tons) – DOCs & CCVs

C_{NOX} = (((DOCs&CCVs$_{Pre1988}$ * PMGramsPerMile$_{Pre1988}$ * 1.10E-06) + (DOCs&CCVs$_{1988to1993}$ * PMGramsPerMile$_{1988to1993}$ * 1.10E-06) + (DOCs&CCVs$_{1994to2002}$ * PMGramsPerMile$_{1994to2002}$ * 1.10E-06) + (DOCs&CCVs$_{2003to2006}$ * PMGramsPerMile$_{2003to2006}$ * 1.10E-06) + (DOCs&CCVs$_{2007to2009}$ * PMGramsPerMile$_{Pre1988}$ * 1.10E-06) + (DOCs&CCVs$_{Post2009}$ * PMGramsPerMile$_{Pre1988}$ * 1.10E-06)) * AvgMilesPerTruck)

NOTE: AvgMilesPerTruck =60000

D. NO_X (Short tons) – Flow Through Filter

D_{NOX} = (((FlowThroughFilter$_{Pre1988}$ * PMGramsPerMile$_{Pre1988}$ * 1.10E-06) + (FlowThroughFilter$_{1988to1993}$ * PMGramsPerMile$_{1988to1993}$ * 1.10E-06) + (FlowThroughFilter$_{1994to2002}$ * PMGramsPerMile$_{1994to2002}$ * 1.10E-06) + (FlowThroughFilter$_{2003to2006}$ * PMGramsPerMile$_{2003to2006}$ * 1.10E-06) + (FlowThroughFilter$_{2007to2009}$ * PMGramsPerMile$_{Pre1988}$ * 1.10E-06) + (FlowThroughFilter$_{Post2009}$ * PMGramsPerMile$_{Pre1988}$ * 1.10E-06)) * AvgMilesPerTruck)

NOTE: AvgMilesPerTruck =60000

E. NO_X (Short tons) – Diesel Particulate

E_{NOX} = (((**DieselParticulate**$_{Pre1988}$ * PMGramsPerMile$_{Pre1988}$ * **1.10E-06) + (DieselParticulate**$_{1988to1993}$ * PMGramsPerMile$_{1988to1993}$ * **1.10E-06) + (DieselParticulate**$_{1994to2002}$ * PMGramsPerMile$_{1994to2002}$ * **1.10E-06) + (DieselParticulate**$_{2003to2006}$ * PMGramsPerMile$_{2003to2006}$ * **1.10E-06) + (DieselParticulate**$_{2007to2009}$ * PMGramsPerMile$_{Pre1988}$ * **1.10E-06) + (DieselParticulate**$_{Post2009}$ * PMGramsPerMile$_{Pre1988}$ * **1.10E-06)) *** AvgMilesPerTruck**)**

NOTE: AvgMilesPerTruck =60000

F. NO_X (Short tons) – Total Trucks Equipped with APU/SWTires/LNG

F_{NOX} = **((TotalTruckEquipped**$_{APU}$/BaselineEmissionsFromAverageDrayTruckFleet$_{TotalTrucks}$ * **0.11)** + **(TotalTruckEquipped**$_{SWTires}$ / BaselineEmissionsFromAverageDrayTruckFleet$_{TotalTrucks}$ * **0.02)** * **(**B_{NOX} + C_{NOX} + D_{NOX} + E_{NOX}**)** * **-1**

Where

BaselineEmissionsFromAverageDrayTruckFleet$_{TotalTrucks}$ = **BaselineEmissionsFromAverageDrayTruckFleet**$_{Pre1988}$ + **BaselineEmissionsFromAverageDrayTruckFleet**$_{1988to1993}$ + **BaselineEmissionsFromAverageDrayTruckFleet**$_{1994to2002}$ + **BaselineEmissionsFromAverageDrayTruckFleet**$_{2003to2006}$ + **BaselineEmissionsFromAverageDrayTruckFleet**$_{2007to2009}$ + **BaselineEmissionsFromAverageDrayTruckFleet**$_{Post2009}$

B_{NOX} = **NO_X (Short tons) – Untreated**

C_{NOX} = **NO_X (Short tons) – DOCs & CCVs**

D_{NOX} = **NO_X (Short tons) – Flow Through Filter**

E_{NOX} = **NO_X (Short tons) – Diesel Particulate**

G. NO_X (Short tons) – Total Fleet Emissions

G_{NOX} = B_{NOX} + C_{NOX} + D_{NOX} + E_{NOX} + F_{NOX}

Where

B_{NOX} = **NO_X (Short tons) – Untreated**

C_{NOX} = **NO_X (Short tons) – DOCs & CCVs**

D_{NOX} = **NO_X (Short tons) – Flow Through Filter**

E_{NOX} = **NO_X (Short tons) – Diesel Particulate**

F_{NOX} = **NO_X (Short tons) – Total Trucks Equipped with APU/SWTires/LNG**

H. NO_X (Short tons) – Change in Emissions from Baseline

$H_{NOX} = G_{NOX} - A_{NOX}$

Where

G_{NOX} = **NO_X (Short tons) – Total Fleet Emissions**

A_{NOX} = **NO_X (Short tons) – Baseline Emissions From Average Dray Truck Fleet**

I. NO_X (Short tons) – Percent Change in Emissions from Baseline

$I_{NOX} = (G_{NOX} - A_{NOX}) / A_{NOX}$

Where

G_{NOX} = **NO_X (Short tons) – Total Fleet Emissions**

A_{NOX} = **NO_X (Short tons) – Baseline Emissions From Average Dray Truck Fleet**

J. NO_X (Short tons) – SmartWay Fleet Score and Environmental Performance

$J_{NOX} = (I_{NOX} / 80) * -100$

Where

I_{NOX} = **NO_X (Short tons) – Percent Change in Emissions from Baseline**

IV. SmartWay SIF Score and Environmental Performance

A. Score Calculation

$A_{SCORE} = I_{CO2} + I_{PM} + I_{NOX}$

Where

I_{CO2} = **CO_2 (Short tons) – Percent Change in Emissions from Baseline**

I_{PM} = **PM (Short tons) – Percent Change in Emissions from Baseline**

I_{NOX} = **NO_X (Short tons) – Percent Change in Emissions from Baseline**

B. SmartWay SIF Ranking

B_{rank} = **If $A_{SCORE} < 0.498$, then “No Rating”**

B_{rank} = **If $A_{SCORE} > 0.499$ and $A_{SCORE} \leq 1$, then “0.75”**

B_{rank} = **If $A_{SCORE} > 1$ and $A_{SCORE} \leq 1.8$, then “1.00”**

B_{rank} = **If** A_{SCORE} **>1.8, then "1.25"**

Where

A_{SCORE} = **Score Calculation**

C. Environmental Performance

$C_{EnvPerf}$ = **If** A_{SCORE} **≤0.05, then "No Rating"**

$C_{EnvPerf}$ = **If** A_{SCORE} **> 0.05 and** A_{SCORE} **≤ 0.499, then "Average"**

$C_{EnvPerf}$ = **If** A_{SCORE} **> 0.499 and** A_{SCORE} **≤ 1, then "Good"**

$C_{EnvPerf}$ = **If** A_{SCORE} **> 1 and** A_{SCORE} **≤ 1.8, then "Very Good"**

$C_{EnvPerf}$ = **If** A_{SCORE} **>1.8, then "Outstanding"**

Where

A_{SCORE} = **Score Calculation**