

# Logistics Partner 2.0.13 Tool: Technical Documentation 2013 Data Year - United States Version





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Transportation and Climate Division  
Office of Transportation and Air Quality  
U.S. Environmental Protection Agency



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# SmartWay 2.0.13

## Logistics Tool Technical Documentation

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#### 1.0 Overview

The SmartWay Logistics Tool is intended to help logistics companies estimate and assess their carbon, PM, and NOx emission performance levels as well as their total emissions associated with goods movement in the U.S. freight rail, barge and trucking sectors<sup>1</sup>.

The new SmartWay truck and barge carrier emissions performance data that EPA has included in the tool, along with publically available Class I rail CO<sub>2</sub> data, will allow logistics companies to generate more accurate emissions performance estimates and mass emissions inventories. The tool will allow logistics companies to track their freight-related emissions performance from year to year, and also help optimize their emissions performance by allowing them to better estimate the emissions impact of individual carriers.

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<sup>1</sup> While this tool is primarily focused on freight movements in the U.S. rail, barge and trucking freight sectors, our long-term vision is to provide users with tools to help them evaluate the emissions performance associated with other transport modes including ocean-going marine and air.

## 2.0 Tool Inputs and Calculations

After logistics companies enter their company and contact information, they provide basic information about each company they operate, including name, SCAC, MCN, and US DOT Number. Logistics companies then identify each carrier that they use for each logistics business unit. Next, users proceed to input activity data for each carrier specified.

### Emission Inventory and Performance Metric Calculations

After inputting the required mileage and/or ton-mile information for each carrier used, the tool will calculate the associated total mass emissions (i.e., an emissions inventory) based on the mileage-related activity data entered, as well as various emission performance metrics (e.g., composite grams/mile and grams/ton-mile – see below) . The tool offers two options for calculating mass emissions, based on either the annual mileage or ton-mileage data that logistics companies enter for each carrier. We encourage logistics companies to select the unit of activity data that is most appropriate for characterizing each carrier type (e.g., use grams per mile for TL and grams per ton-mile for LTL and rail.)

The emissions inventory for each carrier/mode combination displayed on the **Emissions Summary**, **Carrier Performance**, and **Ranking Category Details** screens is calculated by multiplying the appropriate unit of activity data (i.e., truck or barge miles, railcar-miles, or ton-miles) by the corresponding carrier emissions performance data. To calculate composite, business unit-wide emissions performance metrics on the **Carrier Performance** screen (i.e., overall g/mile and g/ton-mile performance), the tool weights the emissions performance of each of the logistics business unit's carriers by the percentage of the business unit's overall freight activity that the carrier moves. An example composite performance calculation is provided below.

**Table 1. Example Compositing Calculation**

|           | <u>CO<sub>2</sub> g/mi</u> | <u>Mi/yr</u>                   | <u>Weighting Factor</u> | <u>Weighted CO<sub>2</sub> g/mi</u> |
|-----------|----------------------------|--------------------------------|-------------------------|-------------------------------------|
| Carrier 1 | 1,700                      | 2,000,000                      | 0.667                   | 1,134 (0.667 x 1,700)               |
| Carrier 2 | 1,500                      | 1,000,000                      | 0.333                   | 500 (0.333 x 1,500)                 |
|           |                            |                                |                         |                                     |
|           |                            | <b>Weighted composite g/mi</b> |                         | <b>1,633 (1,134 + 500)</b>          |

This compositing process proceeds in an identical fashion for ton-miles.

***Note that the composite emissions performance values are the numbers that will be used to place logistics partners into performance bins within the logistics ranking category.***

## Ton-Mile Calculation

*Correctly calculating Ton-Miles is critically important for the accurate determination of your carbon foot-print. You can calculate your business unit's ton-miles as follows.*

Determine the ton-miles hauled per year attributable to each carrier. A ton-mile is one ton moving one mile. **DO NOT ESTIMATE TON-MILES BY SIMPLY MULTIPLYING TOTAL MILES BY TOTAL TONS** - this calculation effectively assumes your entire tonnage is transported on **EACH AND EVERY** truck, railcar, or barge, and will clearly overstate your ton-miles.

Many companies track their ton-miles and can report them directly without further calculation. For example, logistics company systems are typically set up to associate a payload with the mileage traveled on each trip by carrier, and are then summed at the end of the year. If such information is not available, there are two ways to calculate ton-miles:

1) Companies can determine their average payload per carrier, multiply the average payload by the total miles per carrier, and sum the results for all carriers for the reporting year; or

2) Set Ton-miles per carrier = 
$$\frac{(\text{total miles per carrier} \times \text{total tons per carrier})}{\text{total \# of trips per carrier}}$$

NOTE: Empty miles are not included in the ton-mile calculation, but the fuel used to move those empty miles are included in the overall g/ton-mile calculations.

To check your estimate, divide ton-miles by miles. The result is your fleet-average payload. If this number is not reasonable, please check your calculations.

## Carrier Emissions Performance Data

The current SmartWay program provides CO<sub>2</sub>, NO<sub>x</sub> and PM gram per mile and gram per ton-mile emission factors for truck, barge and rail freight transport providers. These data are provided in the SmartWayCarrierData2013.xls file, which should be downloaded to the user's computer using the appropriate button on the tool's Home page. Performance data for Truck, barge and Multi-modal partners correspond to data submittals for the 2013 calendar year, while current Logistics partner performance corresponds to submittals for 2012. Performance for Rail companies are modal averages, based on publicly available R-1 data. Performance values for non-SmartWay truck, multi-modal and logistics partners are based on the lowest performing SmartWay partner fleets, with the exception of non-SmartWay barge carriers – SmartWay does not

have performance estimates for non-SmartWay barge carriers at this time.<sup>2</sup> **For this reason the Logistics Tool cannot calculate carbon footprints for this portion of your carrier fleet at this time.** SmartWay plans to incorporate emission factors for non-SmartWay barge carriers, as well as for ocean-going marine and air transport providers as a whole, and gram per volume-mile emission factors for all modes, in the near future.

### Truck Carrier Performance

Truck carrier performance data utilized by the Logistics Tool is based on 2013 Truck Partner Tool submittals. Performance data includes g/mile and g/ton-mile for each truck carrier by ranking category, with a top ranking indicating top 20 percent performance for a given pollutant/bin category. Note that g/mile and g/ton-mile values represent midpoints for the appropriate ranking category, rather than exact performance levels for a given carrier. Truck ranking categories include:

- TL Dry Van
- LTL Dry Van
- Refrigerated
- Flatbed
- Tanker
- Dray
- Heavy/Bulk
- Package
- Auto Carrier
- Moving
- Specialized
- Mixed
- Expedited

The following provides an overview of the truck carrier ranking process used to estimate the carrier-specific performance bins.

### *Truck Performance Ranking*

In the SmartWay Truck Tool, data is collected at the individual company fleet level. Fleets are characterized by A.) business type: for-hire or private, B.) operational type: truckload/expedited, less than truckload, dray, package delivery, or expedited, and C.) equipment type: dry van, refrigerated van, flatbed, tanker, heavy/bulk, chassis (container), auto carrier, moving, utility, or specialized (e.g., hopper, livestock, other). The possible categories are shown below.

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<sup>2</sup> All rail carriers are assumed to have the same industry modal average performance levels in the Logistics Tool, regardless of the partnership status.

| For-Hire  |         |        |         |        |         |            |              |        |             |
|-----------|---------|--------|---------|--------|---------|------------|--------------|--------|-------------|
|           | Dry Van | Reefer | Flatbed | Tanker | Chassis | Heavy/Bulk | Auto Carrier | Moving | Specialized |
| TL        |         |        |         |        |         |            |              |        |             |
| LTL       |         |        |         |        |         |            |              |        |             |
| PD        |         |        |         |        |         |            |              |        |             |
| Expedited |         |        |         |        |         |            |              |        |             |
| Dray      |         |        |         |        |         |            |              |        |             |

| Private   |         |        |         |        |         |            |              |        |             |
|-----------|---------|--------|---------|--------|---------|------------|--------------|--------|-------------|
|           | Dry Van | Reefer | Flatbed | Tanker | Chassis | Heavy/Bulk | Auto Carrier | Moving | Specialized |
| TL        |         |        |         |        |         |            |              |        |             |
| LTL       |         |        |         |        |         |            |              |        |             |
| PD        |         |        |         |        |         |            |              |        |             |
| Expedited |         |        |         |        |         |            |              |        |             |
| Dray      |         |        |         |        |         |            |              |        |             |

For-hire and private fleets are combined in SmartWay ranking categories. There are relatively few private fleets compared to for-hire fleets. Because owners of private fleets generally hire their own fleets exclusively, it was determined that ranking for-hire and private fleets together would not be detrimental to for-hire fleets, and the simplicity of one for-hire and private category outweighed the benefits of listing fleets separately. Ranking for-hire and private separately would have doubled the number of categories. Fleets can thus be categorized as shown below.

| For Hire / Private |         |        |         |        |         |            |              |        |             |
|--------------------|---------|--------|---------|--------|---------|------------|--------------|--------|-------------|
|                    | Dry Van | Reefer | Flatbed | Tanker | Chassis | Heavy/Bulk | Auto Carrier | Moving | Specialized |
| TL                 |         |        |         |        |         |            |              |        |             |
| LTL                |         |        |         |        |         |            |              |        |             |
| PD                 |         |        |         |        |         |            |              |        |             |
| Expedited          |         |        |         |        |         |            |              |        |             |
| Dray               |         |        |         |        |         |            |              |        |             |

To be categorized in a particular category, a fleet must have at least 75% of its operations by mileage in a single category, otherwise it is classified as a “Mixed” fleet. Fleets could be mixed via their operational or equipment type. Fleets are generally

segregated by their operational type, but some mixing does occur via equipment type, especially with smaller carriers that do not differentiate their fleet. Fleets that do not have 75% of their operations in a specific category are placed in the Mixed category.

Individual fleets were then placed into categories. The following graphic illustrates the population of the various categories. The darker the shade of the intersection, the higher the number of fleets in that category.

|           | Dry Van | Reefer | Flatbed | Tanker | Chassis | Heavy/Bulk | Auto Carrier | Moving | Specialized | Mixed |
|-----------|---------|--------|---------|--------|---------|------------|--------------|--------|-------------|-------|
| TL        |         |        |         |        |         |            |              |        |             |       |
| LTL       |         |        |         |        |         |            |              |        |             |       |
| PD        |         |        |         |        |         |            |              |        |             |       |
| Expedited |         |        |         |        |         |            |              |        |             |       |
| Dray      |         |        |         |        |         |            |              |        |             |       |
| Mixed     |         |        |         |        |         |            |              |        |             |       |

SmartWay then looked at combining categories that exhibited similar characteristics for simplification purposes. One prerequisite was that there needed to be a minimum number of fleets in each category. SmartWay determined that a category needed a minimum of 25 fleets to be created. It was also determined that dry van and chassis (intermodal container) functioned primarily as dry van transport, so these categories were combined. While most refrigerated carriers were truckload, a few less than truckload refrigerated fleets exist, so these two categories were combined. A similar situation was identified with flatbed, and flatbed truckload and less than truckload were combined. Although no less than truckload tanker fleets were identified, tanker truckload and less than truckload were combined into one category so that no intersections would be left undefined. Similar aggregations were made for the remaining, less common body types including heavy/bulk, auto carrier, moving and specialized. All dray was collapsed into one category, and package delivery was restricted to dry van body types. Any fleet that had mixed operation and/or mixed equipment was placed into a single mixed category. This produces the final bin categories illustrated below.

#### For-Hire and Private

|           | Dry Van/Chassis | Reefer | Flatbed | Tanker | Heavy/Bulk | Auto Carrier | Moving | Utility | Specialized | Mixed |
|-----------|-----------------|--------|---------|--------|------------|--------------|--------|---------|-------------|-------|
| TL        |                 |        |         |        |            |              |        |         |             |       |
| LTL       |                 |        |         |        |            |              |        |         |             |       |
| PD        |                 |        |         |        |            |              |        |         |             |       |
| Expedited |                 |        |         |        |            |              |        |         |             |       |
| Dray      |                 |        |         |        |            |              |        |         |             |       |
| Mixed     |                 |        |         |        |            |              |        |         |             |       |

It is possible that SmartWay will expand these categories based on in-use experience or as a result of further data analysis, and/or requests from industry.

Companies *within a category* have been ranked from lowest emission factor (best) to highest emission factor (worst) for each of the following metrics: CO<sub>2</sub> g/mile, CO<sub>2</sub> g/ton-mile, NOx g/mile, NOx g/ton-mile, PM10 g/mile and PM10 g/ton-mile. Companies within a category were then separated into 5 groups (rankings) such that an equal number of companies were in each. Each ranking category thus represents a range of emission factors. This range, and associated cutpoints (transition points from one ranking category to the next) were then modified so that each bin had an equal range, and the new ranking category cutpoints remained as close to the originals as possible. The new

range cutpoint is displayed as a number with significant digits appropriate to emission factors in that category. The midpoint of the range is used as the emission factor for all companies in a ranking category.

It would be simpler and more straightforward to use company-specific emission factors, however the trucking industry expressed concern with revealing exact data that could be used to back-calculate mile per gallon numbers. The above described methodology prevents a determination of an exact mpg figure, while at the same time attributing an emission factor much more exact than a modal default number. Given the large number of trucking companies, and thus opportunity for companies to be very close to each other in performance (for example 0.001 g/mile of CO<sub>2</sub>), SmartWay believes it is acceptable and appropriate to break truck fleets into 5 performance rankings. The table below illustrates the ranking results for the For Hire/Private Truckload/Expedited Dry Van/Container category, using 2010 truck partner data.

**Table 2. Example Binning Results for One Ranking Category (2010 Data)**

| For-Hire/Private Truckload/Expedited Dry Van/Container CO <sub>2</sub> g/mile |        |                    |                    |                    |                         |                        |
|-------------------------------------------------------------------------------|--------|--------------------|--------------------|--------------------|-------------------------|------------------------|
| Rank                                                                          | Fleets | Grams Per Mile Min | Grams Per Mile Max | Grams Per Mile Avg | Grams Per Mile Midpoint | Grams Per Mile Std Dev |
| 1                                                                             | 159    | 602                | 1,600              | 1,503              | 1,550                   | 141                    |
| 2                                                                             | 241    | 1,601              | 1,699              | 1,654              | 1,650                   | 28                     |
| 3                                                                             | 204    | 1,700              | 1,799              | 1,746              | 1,750                   | 28                     |
| 4                                                                             | 139    | 1,800              | 1,899              | 1,853              | 1,850                   | 28                     |
| 5                                                                             | 55     | 1,900              | 3,701              | 2,064              | 2,801                   | 302                    |

Similar tables were developed for all categories. The midpoint of each ranking category is the data that a logistics company will download into their SmartWay Logistics Tool to represent the emission performance of a specific carrier fleet that is in the associated rank category. Once the categories and ranks have been established, the carrier fleets of any new companies joining SmartWay will fall into one of the predefined categories/ranks. SmartWay expects to update the category/ranks structure approximately every three years.

Performance estimates for Non-SmartWay truck carriers were calculated based on the lowest performing truck partners. Since no data exists specifically for non-SmartWay fleets, SmartWay believes the prudent approach is to assign conservative emission factors to non-SmartWay companies. Also, this policy makes it likely that any company joining SmartWay will see better emission factors displayed than the non-SmartWay default emission factors.

The Non-SmartWay performance metrics were calculated by taking the standard performance rank range delta (min/max) for each ranking category, and using the delta to calculate a non-SmartWay carrier midpoint for each category. This midpoint was the midpoint for Rank 5 plus the standard range delta. For example, if the Rank 5 midpoint

was 10.5 and the Ranking Categories standard delta was 1, then the non-SmartWay midpoint was calculated to be 11.5. Once the non-SmartWay midpoints for each pollutant were calculated for all Ranking Categories, the worst performance value was selected to be the midpoint for the non-SmartWay Truck carriers. This approach does not require the shipper to identify the appropriate ranking category for their Non-SmartWay carrier(s), which they may not know.

As discussed in the **Logistics Tool Data Entry and Troubleshooting Guide**, depending upon the type of data available for a given carrier, the user may input ton-miles or miles, and rely on carrier data to back-calculate the other value. For example, providing ton-miles and average payload allows the tool to estimate total miles, by dividing the former by the latter. Alternatively, freight density and cargo volume utilization information can also be used to estimate average payloads. For this reason, average payload and volume information are provided for each carrier in the SmartWayCarrierData2013.xls file.<sup>3</sup> For Non-SmartWay truck carriers, the values for average payload (18.7 tons) and average volume (3,260 cubic feet) were derived from the average values for all Truck Partners (2011 data), weighted by miles.

### Logistics and Multi-modal Carrier Performance

Logistic and multi-modal carriers have their own performance bins based on the carrier tool submittals for the most recent available calendar year (2012 for logistics, and 2013 for multi-modal). The Logistics Tool modifies the Bin 5 values for each of these ranking categories (logistics and multi-modal) to estimate non-SmartWay carrier performance in the same way as was done for non-SmartWay Truck carriers (i.e., adding the standard range delta value to the Rank 5 midpoints).

### Barge Carrier Performance

Barge carriers have agreed to have their actual emissions results made public, hence, barge performance values used in the Logistics are carrier-specific. , The gram per mile performance values for barge carriers correspond to individual barge miles travelled, rather than miles travelled by a string of barges or the associated tug.

### Rail Carrier Performance

Rail carrier performance data are collected and displayed in the Logistics Tool at the industry average level derived from Class 1 rail company data. Gram per ton-mile factors were determined by dividing total fuel use by total ton-miles and multiplied by a rail diesel CO<sub>2</sub> factor (10,084 g CO<sub>2</sub>/gal diesel fuel), from publicly available data submitted in the 2010 railroad R-1 reports to the Department of Transportation. 2010 R-

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<sup>3</sup> The Logistics Tool also calculates average payload and average volume for each logistics fleet defined by the user, weighting truck and rail carrier payloads and volumes by the miles assigned on the Tool Activity screen. The resulting average payload and volume figures will be included in subsequent updates to the SmartWay Carrier file for use by Shippers and Logistics companies.

1 data was also used to obtain total railcar-miles per year for all Class 1 carriers, in order to estimate gram per railcar-mile factors. Industry average values are currently assumed for all rail carriers in the carrier data file. Specific rail companies may have an opportunity to provide company-specific data in the future. The R-1 data and corresponding CO<sub>2</sub> performance data are presented in Table 3 below.

**Table 3. Rail Carrier Performance Metric Calculation Inputs and Results (2010 R-1 Data)**

| <b>Rail Company</b>                 | <b>Gal/Yr<br/>(‘000)Sch.<br/>750 Line 4</b> | <b>Freight Ton-<br/>Mi/Yr (‘000)<br/>Sch .755 line<br/>110</b> | <b>Railcar-Mi/Yr<br/>(‘000) Sch.<br/>755 sum of<br/>lines 30, 46,<br/>64 &amp; 82</b> | <b>g CO<sub>2</sub>/railcar-<br/>mile</b> | <b>g CO<sub>2</sub>/short<br/>ton-mile</b> |
|-------------------------------------|---------------------------------------------|----------------------------------------------------------------|---------------------------------------------------------------------------------------|-------------------------------------------|--------------------------------------------|
| BNSF Railway                        | 1,295,147                                   | 646,549,059                                                    | 11,230,994                                                                            | 1,163                                     | 20.20                                      |
| CSX Transportation                  | 490,050                                     | 230,507,431                                                    | 4,720,293                                                                             | 1,047                                     | 21.44                                      |
| Grand Trunk                         | 88,290                                      | 50,586,328                                                     | 1,206,818                                                                             | 738                                       | 17.60                                      |
| Kansas City Southern                | 62,354                                      | 31,025,588                                                     | 609,929                                                                               | 1,031                                     | 20.76                                      |
| Norfolk Southern*                   | 440,159                                     | 183,104,320                                                    | 4,081,893                                                                             | 1,087                                     | 24.24                                      |
| Soo Line                            | 65,530                                      | 33,473,544                                                     | 771,033                                                                               | 857                                       | 19.74                                      |
| Union Pacific                       | 1,063,201                                   | 525,297,747                                                    | 10,336,081                                                                            | 1,037                                     | 20.41                                      |
| <b>Total – Industry<br/>Average</b> | <b>3,504,731</b>                            | <b>1,700,544,017</b>                                           | <b>32,957,041</b>                                                                     | <b>1,072</b>                              | <b>20.78</b>                               |

\* and combined subsidiaries

NO<sub>x</sub> and PM emission factors for rail carriers are based on industry averages. The freight rail gNO<sub>x</sub>/ton-mile and gPM<sub>2.5</sub>/ton-mile factors were developed with 2010 inventory data from Tables 3-82 and 3-83, respectively, in EPA’s 2008 Regulatory Impact Analysis for a locomotive diesel engine rule. This inventory data represents 2010 emission projections for all U.S. rail except for passenger and commuter rail (i.e., large line-haul, large switch, and small railroads), which EPA determined would very closely align with the freight rail sector. This emissions inventory data was divided by the 2007 R-1 ton-mile data.

EPA developed the industry average freight rail g/mile factors by using 2008 railcar mileage data from lines 15 through 81 of R-1 forms that Class I railroad companies submitted to the Surface Transportation Board. The railcar miles were then converted into “truck-equivalent” railcar miles by estimating the average volume capacity of Class I railcars and dividing that by an average freight truck volume capacity. This results in a very crude estimate that does not take into consideration the utilized volume of railcars or the comparative freight truck, but EPA determined that this was the best available data and method to estimate modal average truck-equivalent railcar miles.

To estimate the industry average volume capacity of Class I railcars, the railcar miles reported by each company for each railcar type in their respective 2008 R-1 reports (lines 15-81) were multiplied by the volume-per-railcar assumptions in Table 7 below to obtain total Class I TEU-miles. EPA then divided the total railcar TEU-miles by the total

railcar miles to estimate the industry average railcar volume capacity. EPA then divided this average railcar volume capacity (3.92) by the average freight truck volume capacity (2.78 TEUs) to develop the conversion factor - 1.41 railcar-miles-to-truck-miles.

EPA developed the NO<sub>x</sub> and PM inventories using the average 2010 locomotive gPM10/gal and gNO<sub>x</sub>/gal factors from Tables 5 and 6, respectively, in EPA's 2009 *Technical Highlights: Emissions Factors for Locomotives*. To calculate gPM2.5/gal, we assumed 95% of PM10 is PM2.5, which we determined was a good approximation of the share of overall PM10 emissions represented by particulate matter that is 2.5 micrometers in diameter or smaller.

Table 4 presents the industry-average freight rail NO<sub>x</sub> and PM emissions factors in the tool and Table 5 presents the key underlying data.

**Table 4. Illustrative U.S. Freight Rail Industry Average Factors**

|                            | NO <sub>x</sub> | PM2.5  |
|----------------------------|-----------------|--------|
| gram/short ton-mile        | 0.4270          | 0.0120 |
| gram/truck-equivalent mile | 13.19           | 0.3569 |
| gram/TEU-mile              | 4.745           | 0.1284 |

**Table 5. Underlying Emissions Inventories and Activity Data for Illustrative U.S. Freight Rail Industry Average Factors**

|                                                    |                      |
|----------------------------------------------------|----------------------|
| short ton-miles                                    | 1,819,633,000,000    |
| Class I-only railcar miles (total)                 | 34,611,843,000       |
| <i>50' and Larger Box Plain + Box Equipped</i>     | <i>2,223,402,000</i> |
| <i>40' Box Plain</i>                               | <i>22,000</i>        |
| <i>Flat TOFC/COFC, General, and Other</i>          | <i>5,057,466,000</i> |
| <i>Flat Multi Level</i>                            | <i>1,725,998,000</i> |
| <i>Gondola Plain and Equipped</i>                  | <i>7,893,684,000</i> |
| <i>Refrigerated Mechanical and Non-Mechanical</i>  | <i>495,311,000</i>   |
| <i>Open Top Hopper General and Special Service</i> | <i>5,913,012,000</i> |
| <i>Covered Hopper</i>                              | <i>7,210,656,000</i> |
| <i>Tank under 22,000 gallons</i>                   | <i>1,295,482,000</i> |
| <i>Tank 22,000 gallons and over</i>                | <i>2,394,565,000</i> |
| <i>All Other Car Types</i>                         | <i>402,245,000</i>   |

Average payload per loaded railcar were calculated for all Class 1 carriers by dividing the value for annual ton-miles hauled by an estimate for loaded railcar-miles, based on 2008 R-1 data. The calculation uses the Total Revenue and Non-Revenue Ton-Miles as listed In the R-1 Report on line 114 of schedule 755 divided by the Total loaded Railcar-Miles (the sum of lines 30 and 64 of schedule 755) along with the factor for fuel gallons consumed for loaded freight that is created based on the percentage of loaded freight to total freight multiplied by the total diesel fuel value listed on schedule 750 Line 4. The following table summarizes the estimated average payload per railcar, by carrier.

**Table 6. Rail Carrier Average Payload**

| <b>Carrier</b>          | <b>Avg Payload/Loaded Railcar (tons)</b> |
|-------------------------|------------------------------------------|
| BNSF Railway            | 108                                      |
| CSX Transportation      | 85                                       |
| Grand Trunk             | 80                                       |
| Kansas City Southern    | 91                                       |
| Norfolk Southern        | 76                                       |
| Soo Line                | 77                                       |
| Union Pacific           | 91                                       |
| <b>Industry Average</b> | <b>93</b>                                |

Average railcar volumes were calculated for all carriers by first estimating an average volume for each major railcar type listed in the R-1 forms (schedule 755, lines 15-81). The assumptions used to estimate these volumes are provided in Table 8 below. The railcar-miles reported for each railcar type were multiplied by these average volumes to estimate annual cubic foot-miles travelled by car type for each company and for the industry average. The distribution of cubic foot-miles across car types was used as the weighting factor to estimate a single average railcar volume for each company. These values and the resulting volume estimates are presented in Table 7 below.

Average railcar volumes were calculated for each carrier by first estimating an average volume for each major railcar type listed in the R-1 forms (schedule 755, lines 15-81). The assumptions used to estimate these volumes are provided in Table 7 below. The railcar-miles reported for each railcar type were multiplied by these average volumes to estimate annual cubic foot-miles travelled by car type for each rail company. The distribution of cubic foot-miles across car types was used as the weighting factor to estimate a single average railcar volume for each company. These values and the resulting volume estimates are presented in Table 8 below.

**Table 7. Railcar Volume Assumptions and Sources**

| Railcar Type                                                                                                         | Cubic Feet | Source/Method<br><b>Key:</b> Norfolk Southern Railroad (NS) <sup>4</sup> , Union Pacific Railroad (UP) <sup>5</sup> , Burlington Northern Santa Fe Railroad (BNSF) <sup>6</sup> , CSX Transportation Railroad (CSX) <sup>7</sup> , World Trade Press Guide to Railcars (GTRC) <sup>8</sup> , Chicago Rail Car Leasing (CRCL) <sup>9</sup> , Union Tank Car Company (UTCC) <sup>10</sup> , U.S. Department of Agriculture (USDA) <sup>11</sup>                                                                                                                                                         |
|----------------------------------------------------------------------------------------------------------------------|------------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Boxcar 50 ft and longer including equipped boxcars                                                                   | 7,177      | Based on the average of the following boxcar types:<br><u>50ft</u> assumed to be 5694 [reflecting the average of 5355 (NS), 5431 (UP), 5238 (CSX), 6175 (BNSF), 6269 (GTRC)].<br><u>60ft</u> assumed to be 6,648 [reflecting the average of 6618 (NS), 6389 (UP), 6085 (CSX), 7500 (BNSF)].<br><u>50ft high cube</u> assumed to be 6,304 [reflecting the average of 6339 (NS) and 6269 (CSX)].<br><u>60 ft high cube</u> assumed to be 6917 [reflecting the average of 7499 (NS) , 6646 (CSX), and 6607 (GTRC)].<br><u>86ft</u> assumed to be 9999 (NS).<br><u>Autoparts</u> assumed to be 7499 (NS). |
| Boxcar 40ft                                                                                                          | 4,555      | Based on estimate of 50ft boxcar volume described above. Assumed 40ft length would result in 20% reduction in volume.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                 |
| Flat car – all types except for multi-level                                                                          | 6,395      | Based on the average of the following flat car types:<br><u>60ft</u> assumed to be 6739 (BNSF).<br><u>89ft</u> assumed to be 9372(BNSF).<br><u>Coil</u> assumed to be 3387(NS).<br><u>Covered coil</u> assumed to be 5294 [reflecting the average of 8328 (NS) and 2260 (BNSF)].<br><u>Centerbeam</u> assumed to be 6546 [reflecting the average of 5857 (UP) and 7236 (BNSF)].<br><u>Bulkhead</u> assumed to be 7030 (BNSF).                                                                                                                                                                         |
| Multi-level flat car                                                                                                 | 13,625     | Based on the average of the following multi-level flat car types:<br><u>Unilevel</u> (that carry very large cargo, such as vehicles/tractors) assumed to be 12183 (NS).<br><u>Bi-level</u> assumed to be 14381(NS).<br><u>Tri-level</u> assumed to be 14313 (based on average of 15287 (NS) and 13339 (BNSF)).                                                                                                                                                                                                                                                                                        |
| Flat Car – all types- including multi-level [not used in analysis, except for estimating volume of “All Other Cars”] | 7,428      | Based on the average volumes of the flatcar types described above including multi-level as a single flat car type.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                    |
| Gondola – all types Including equipped                                                                               | 5,190      | Based on the average of the following gondola car types:<br><u>52-53ft</u> assumed to be 2626 [based on average of 2665 (NS), 2743 (CSX), 2400 (BNSF), and 2697(CRCL)].<br><u>60-66ft</u> assumed to be 3372 [based on average of 3281 (NS), 3242 (CSX),                                                                                                                                                                                                                                                                                                                                              |

<sup>4</sup> [http://www.nscorp.com/nscportal/nscorp/Customers/Equipment\\_Guide](http://www.nscorp.com/nscportal/nscorp/Customers/Equipment_Guide)

<sup>5</sup> <http://www.uprr.com/customers/equip-resources/cartypes/index.shtml>

<sup>6</sup> <http://www.bnsf.com/customers/how-can-i-ship/individual-railcar/#%23subtabs-3>

<sup>7</sup> [http://www.csx.com/index.cfm/customers/equipment/railroad-equipment/#boxcar\\_specs](http://www.csx.com/index.cfm/customers/equipment/railroad-equipment/#boxcar_specs)

<sup>8</sup> [http://www.worldtraderef.com/WTR\\_site/Rail\\_Cars/Guide\\_to\\_rail\\_Cars.asp](http://www.worldtraderef.com/WTR_site/Rail_Cars/Guide_to_rail_Cars.asp)

<sup>9</sup> <http://www.crdx.com/railcar.html>

<sup>10</sup> [http://www.utlx.com/bdd\\_tank.html](http://www.utlx.com/bdd_tank.html)

<sup>11</sup> U.S. Department of Agriculture (USDA), 1992, *Weights, Measures, and Conversion Factors for Agricultural Commodities and Their Products*, Agricultural Handbook Number 697, Economic Research Service, Washington, DC. Available at: <http://www.ers.usda.gov/publications/ah697/ah697.pdf>

| Railcar Type                              | Cubic Feet | Source/Method<br><b>Key:</b> Norfolk Southern Railroad (NS) <sup>4</sup> , Union Pacific Railroad (UP) <sup>5</sup> , Burlington Northern Santa Fe Railroad (BNSF) <sup>6</sup> , CSX Transportation Railroad (CSX) <sup>7</sup> , World Trade Press Guide to Railcars (GTRC) <sup>8</sup> , Chicago Rail Car Leasing (CRCL) <sup>9</sup> , Union Tank Car Company (UTCC) <sup>10</sup> , U.S. Department of Agriculture (USDA) <sup>11</sup>                                                                                                                                                                                                           |
|-------------------------------------------|------------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
|                                           |            | 3350 (BNSF), CRCL-3670, and 3366 (GTRC)].<br><u>Municipal Waste</u> assumed to be 7999 (NS).<br><u>Woodchip</u> assumed to be 7781 [based on average of 7862 (NS) and 7700 (CRCL)].<br><u>Coal</u> assumed to be 4170 [based on average of 3785 (NS) and 4556 (BNSF)].                                                                                                                                                                                                                                                                                                                                                                                  |
| Refrigerated - Mechanical /non-Mechanical | 6,202      | Based on the average of the following refrigerated car types:<br><u>48-72ft</u> assumed to be 6963 [based on average of 6043 (UP) and 7883 (BNSF)].<br><u>50ft</u> assumed to be 5167 (GTRC).<br><u>40-90 ft</u> assumed to be 6476 [based on average of 6952 (UP) and 6000 (BNSF)].                                                                                                                                                                                                                                                                                                                                                                    |
| Open Top Hopper                           | 4,220      | Based on the average of the following open top hopper car types:<br><u>42ft</u> assumed to be 3000 (UP).<br><u>54ft</u> assumed to be 3700 (UP).<br><u>60ft</u> assumed to be 5188 [based on average of 5125 (UP) and 5250 (GTRC)].<br><u>45ft+</u> assumed to be 4105 [based on average of 4500 (UP) and 3710 (BNSF)].<br><u>Woodchip</u> assumed to be 7075 [based on average of 7525 (NS), 5999 (UP), and 7700 (CRCL)].<br><u>Small Aggregate</u> assumed to be 2252 [based on average of 2150 (NS), 2106 (BNSF), and 2500 (CRCL)].                                                                                                                  |
| Covered Hopper                            | 4,188      | Based on the average of the following covered top hopper car types:<br><u>45ft</u> assumed to be 5250 (GTRC).<br><u>Aggregate</u> assumed to be 2575 [based on average of 2150 (NS) and 3000 (CRCL)].<br><u>Small Cube Gravel</u> assumed to be 2939 [based on average of 2655 (NS), 3100 (CSX), and 3063 (BNSF)].<br><u>Med-Large Cube Ores and Sand</u> assumed to be 4169 [based on average of 3750 (NS) and 4589 (BNSF)].<br><u>Jumbo</u> assumed to be 5147 [based on average of 4875 (NS), 4462 (CSX), 5175 (BNSF), and 6075 (CRCL)].<br><u>Pressure Differential (flour)</u> assumed to be 5050 [based on average of 5124 (NS) and 4975 (CRCL)]. |
| Tank Cars under 22,000 gallons            | 2,314      | Assumes 1 gallon=0.1337 cubic foot (USDA).<br>Based on small tank car average volume of 17304 gallons, which is the average of the following currently manufactured tank car volume design capacities of 13470, 13710, 15100, 15960, 16410, 17300, 19900, 20000, 20590, and 20610 gallons (GTRC).                                                                                                                                                                                                                                                                                                                                                       |
| Tank Cars over 22,000 gallons             | 3,857      | Assumes 1 gallon=0.1337 (USDA).<br>Based on large tank car volume of 28851 gallons, which is the average of the following currently manufactured tank car volume design capacities of 23470, 25790, 27200, 28700, 30000, 33000, and 33800 gallons (GTRC).                                                                                                                                                                                                                                                                                                                                                                                               |
| All Other Cars                            | 5,014      | Based on average volume presented above for each of the nine railcar types (all flatcars are represented by the line item that includes multi-level flatcars - 7428).                                                                                                                                                                                                                                                                                                                                                                                                                                                                                   |

**Table 8. Rail Carrier Average Volume Determination**

| <b>Freight Car Types (R1 - Schedule 755)</b> | <b>Avg. Cu Ft.</b> | <b>BNSF</b>                |                          |
|----------------------------------------------|--------------------|----------------------------|--------------------------|
|                                              |                    | <b>Railcar Miles (x1K)</b> | <b>Cu Ft Miles (x1K)</b> |
| Box-Plain 40-Foot                            | 4,555              | 1                          | 4,555                    |
| Box-Plain 50-Foot & Longer                   | 7,177              | 9,338                      | 67,018,826               |
| Box-Equipped                                 | 7,177              | 147,226                    | 1,056,641,002            |
| Gondola-Plain                                | 5,190              | 379,762                    | 1,970,964,780            |
| Gondola-Equipped                             | 5,190              | 75,894                     | 393,889,860              |
| Hopper-Covered                               | 4,188              | 758,442                    | 3,176,355,096            |
| Hopper-Open Top-General Service              | 4,220              | 65,077                     | 274,624,940              |
| Hopper-Open Top-Special Service              | 4,220              | 137,449                    | 580,034,780              |
| Refrigerator-Mechanical                      | 6,202              | 19,272                     | 119,524,944              |
| Refrigerator-Non-Mechanical                  | 6,202              | 32,910                     | 204,107,820              |
| Flat-TOFC/COFC                               | 6,395              | 520,521                    | 3,328,731,795            |
| Flat-Multi-Level                             | 13,625             | 38,624                     | 526,252,000              |
| Flat-General Service                         | 6,395              | 357                        | 2,283,015                |
| Flat-All Other                               | 6,395              | 71,826                     | 459,327,270              |
| All Other Car Types-Total                    | 5,772              | 20,146                     | 116,282,712              |
| <b>Average Railcar Cubic Feet</b>            |                    |                            | <b>5,811</b>             |

|                                              | <b>CSX</b>          |                   |
|----------------------------------------------|---------------------|-------------------|
| <b>Freight Car Types (R1 - Schedule 755)</b> | Railcar Miles (x1K) | Cu Ft Miles (x1K) |
| Box-Plain 40-Foot                            | -                   | -                 |
| Box-Plain 50-Foot & Longer                   | 6,987               | 50,145,699        |
| Box-Equipped                                 | 144,631             | 1,038,016,687     |
| Gondola-Plain                                | 137,256             | 712,358,640       |
| Gondola-Equipped                             | 64,532              | 334,921,080       |
| Hopper-Covered                               | 153,315             | 642,083,220       |
| Hopper-Open Top-General Service              | 78,412              | 330,898,640       |
| Hopper-Open Top-Special Service              | 35,451              | 149,603,220       |
| Refrigerator-Mechanical                      | 17,117              | 106,159,634       |
| Refrigerator-Non-Mechanical                  | 11,923              | 73,946,446        |
| Flat-TOFC/COFC                               | 125,828             | 804,670,060       |
| Flat-Multi-Level                             | 29,956              | 408,150,500       |
| Flat-General Service                         | 162                 | 1,035,990         |
| Flat-All Other                               | 31,913              | 204,083,635       |
| All Other Car Types-Total                    | 19,861              | 114,637,692       |
| <b>Average Railcar Cubic Feet</b>            |                     | <b>6,389</b>      |

|                                              | <b>Grand Trunk</b>  |                   |
|----------------------------------------------|---------------------|-------------------|
| <b>Freight Car Types (R1 - Schedule 755)</b> | Railcar Miles (x1K) | Cu Ft Miles (x1K) |
| Box-Plain 40-Foot                            | 0                   | -                 |
| Box-Plain 50-Foot & Longer                   | 2,119               | 15,208,063        |
| Box-Equipped                                 | 66,110              | 474,471,470       |
| Gondola-Plain                                | 6,467               | 33,563,730        |
| Gondola-Equipped                             | 19,201              | 99,653,190        |
| Hopper-Covered                               | 44,239              | 185,272,932       |
| Hopper-Open Top-General Service              | 9,114               | 38,461,080        |
| Hopper-Open Top-Special Service              | 32,621              | 137,660,620       |
| Refrigerator-Mechanical                      | 312                 | 1,935,024         |
| Refrigerator-Non-Mechanical                  | 205                 | 1,271,410         |
| Flat-TOFC/COFC                               | 2,779               | 17,771,705        |
| Flat-Multi-Level                             | 4,831               | 65,822,375        |
| Flat-General Service                         | 20                  | 127,900           |
| Flat-All Other                               | 31,744              | 203,002,880       |
| All Other Car Types-Total                    | 4,755               | 27,445,860        |
| <b>Average Railcar Cubic Feet</b>            |                     | <b>6,309</b>      |

|                                              | <b>Kansas City Southern</b> |                   |
|----------------------------------------------|-----------------------------|-------------------|
| <b>Freight Car Types (R1 - Schedule 755)</b> | Railcar Miles (x1K)         | Cu Ft Miles (x1K) |
| Box-Plain 40-Foot                            | 0                           | -                 |
| Box-Plain 50-Foot & Longer                   | 3,383                       | 24,279,791        |
| Box-Equipped                                 | 39,792                      | 285,587,184       |
| Gondola-Plain                                | 16,628                      | 86,299,320        |
| Gondola-Equipped                             | 11,150                      | 57,868,500        |
| Hopper-Covered                               | 50,346                      | 210,849,048       |
| Hopper-Open Top-General Service              | 626                         | 2,641,720         |
| Hopper-Open Top-Special Service              | 943                         | 3,979,460         |
| Refrigerator-Mechanical                      | 21                          | 130,242           |
| Refrigerator-Non-Mechanical                  | 52                          | 322,504           |
| Flat-TOFC/COFC                               | 10,736                      | 68,656,720        |
| Flat-Multi-Level                             | 629                         | 8,570,125         |
| Flat-General Service                         | 12                          | 76,740            |
| Flat-All Other                               | 2,321                       | 14,842,795        |
| All Other Car Types-Total                    | 247                         | 1,425,684         |
| <b>Average Railcar Cubic Feet</b>            |                             | <b>5,938</b>      |

|                                              | <b>Norfolk Southern</b> |                   |
|----------------------------------------------|-------------------------|-------------------|
| <b>Freight Car Types (R1 - Schedule 755)</b> | Railcar Miles (x1K)     | Cu Ft Miles (x1K) |
| Box-Plain 40-Foot                            | 0                       | -                 |
| Box-Plain 50-Foot & Longer                   | 7,622                   | 54,703,094        |
| Box-Equipped                                 | 136,745                 | 981,418,865       |
| Gondola-Plain                                | 193,214                 | 1,002,780,660     |
| Gondola-Equipped                             | 111,320                 | 577,750,800       |
| Hopper-Covered                               | 116,848                 | 489,359,424       |
| Hopper-Open Top-General Service              | 84,557                  | 356,830,540       |
| Hopper-Open Top-Special Service              | 30,078                  | 126,929,160       |
| Refrigerator-Mechanical                      | 3,512                   | 21,781,424        |
| Refrigerator-Non-Mechanical                  | 5,392                   | 33,441,184        |
| Flat-TOFC/COFC                               | 114,928                 | 734,964,560       |
| Flat-Multi-Level                             | 20,349                  | 277,255,125       |
| Flat-General Service                         | 145                     | 927,275           |
| Flat-All Other                               | 24,563                  | 157,080,385       |
| All Other Car Types-Total                    | 212,408                 | 1,226,018,976     |
| <b>Average Railcar Cubic Feet</b>            |                         | <b>6,065</b>      |

|                                              | <b>Soo Line</b>     |                   |
|----------------------------------------------|---------------------|-------------------|
| <b>Freight Car Types (R1 - Schedule 755)</b> | Railcar Miles (x1K) | Cu Ft Miles (x1K) |
| Box-Plain 40-Foot                            | 0                   | -                 |
| Box-Plain 50-Foot & Longer                   | 725                 | 5,203,325         |
| Box-Equipped                                 | 17,972              | 128,985,044       |
| Gondola-Plain                                | 1,203               | 6,243,570         |
| Gondola-Equipped                             | 8,856               | 45,962,640        |
| Hopper-Covered                               | 94,146              | 394,283,448       |
| Hopper-Open Top-General Service              | 3,077               | 12,984,940        |
| Hopper-Open Top-Special Service              | 20                  | 84,400            |
| Refrigerator-Mechanical                      | 159                 | 986,118           |
| Refrigerator-Non-Mechanical                  | 742                 | 4,601,884         |
| Flat-TOFC/COFC                               | 11,178              | 71,483,310        |
| Flat-Multi-Level                             | 2,973               | 40,507,125        |
| Flat-General Service                         | 12                  | 76,740            |
| Flat-All Other                               | 10,068              | 64,384,860        |
| All Other Car Types-Total                    | 428                 | 2,470,416         |
| <b>Average Railcar Cubic Feet</b>            |                     | <b>5,667</b>      |

|                                              | <b>Union Pacific</b> |                   |
|----------------------------------------------|----------------------|-------------------|
| <b>Freight Car Types (R1 - Schedule 755)</b> | Railcar Miles (x1K)  | Cu Ft Miles (x1K) |
| Box-Plain 40-Foot                            | 0                    | -                 |
| Box-Plain 50-Foot & Longer                   | 12,311               | 88,356,047        |
| Box-Equipped                                 | 238,241              | 1,709,855,657     |
| Gondola-Plain                                | 206,370              | 1,071,060,300     |
| Gondola-Equipped                             | 91,775               | 476,312,250       |
| Hopper-Covered                               | 370,929              | 1,553,450,652     |
| Hopper-Open Top-General Service              | 188,027              | 793,473,940       |
| Hopper-Open Top-Special Service              | 104,969              | 442,969,180       |
| Refrigerator-Mechanical                      | 82,874               | 513,984,548       |
| Refrigerator-Non-Mechanical                  | 27,009               | 167,509,818       |
| Flat-TOFC/COFC                               | 1,026,251            | 6,562,875,145     |
| Flat-Multi-Level                             | 46,889               | 638,862,625       |
| Flat-General Service                         | 350                  | 2,238,250         |
| Flat-All Other                               | 72,371               | 462,812,545       |
| All Other Car Types-Total                    | 16,769               | 96,790,668        |
| <b>Average Railcar Cubic Feet</b>            |                      | <b>6,248</b>      |

| <b>Freight Car Types (R1 - Schedule 755)</b> | <b>Total (for Industry Average)</b> |                   |
|----------------------------------------------|-------------------------------------|-------------------|
|                                              | Railcar Miles (x1K)                 | Cu Ft Miles (x1K) |
| Box-Plain 40-Foot                            | 1                                   | 4,555             |
| Box-Plain 50-Foot & Longer                   | 42,485                              | 304,914,845       |
| Box-Equipped                                 | 790,717                             | 5,674,975,909     |
| Gondola-Plain                                | 940,900                             | 4,883,271,000     |
| Gondola-Equipped                             | 382,728                             | 1,986,358,320     |
| Hopper-Covered                               | 1,588,265                           | 6,651,653,820     |
| Hopper-Open Top-General Service              | 428,890                             | 1,809,915,800     |
| Hopper-Open Top-Special Service              | 341,531                             | 1,441,260,820     |
| Refrigerator-Mechanical                      | 123,267                             | 764,501,934       |
| Refrigerator-Non-Mechanical                  | 78,233                              | 485,201,066       |
| Flat-TOFC/COFC                               | 1,812,221                           | 11,589,153,295    |
| Flat-Multi-Level                             | 144,251                             | 1,965,419,875     |
| Flat-General Service                         | 1,058                               | 6,765,910         |
| Flat-All Other                               | 244,806                             | 1,565,534,370     |
| All Other Car Types-Total                    | 274,614                             | 1,585,072,008     |
| <b>Average Railcar Cubic Feet</b>            |                                     | <b>6,091</b>      |

## **% SmartWay Value**

The **% SmartWay** screen tracks the portion of goods that shippers move with SmartWay Partners (expressed as a percentage between 0 and 100). You may select either ton-miles or total miles as the basis for determining your % SmartWay Value. Note that the tool will automatically populate the % SmartWay screen with any carrier activity data entered in the Activity Data screen. In addition, the metric selected for the first business unit (miles or ton-miles) will be chosen as the basis for your other business units as well, so that a company-level % SmartWay Value can be calculated.

To see your company-level % SmartWay Value, calculated across all business units, go to the % SmartWay Report in the Reports Menu via the Home page.

### 3.0 Data Validation

The Logistics Tool also contains data validation checks designed to identify missing and potentially erroneous data. At this time the only validation involves payload checks and total ton-mile checks, on the Activity Data screen.

#### **Payload Validation**

Payload validation cutpoints were set with the intention of identifying those payloads that are somewhat outside typical industry values (yellow flag warnings) and those that are far outside industry averages (red flag warnings). The payload check only applies to Data Availability selections 2, 3, 5, and 6, where payloads are either entered by the user, or calculated based on other inputs. Checks are applied at the carrier (row) level. Both direct payload inputs and indirect payload (derived from density and load % calculators) must be checked, using the same criteria for each. If Data Availability Options 3 or 6 are used, the following equation is used to calculate inferred payload:

Payload (tons) = (density/2000) x carrier average volume x (average load percent/100)

Payload checks are specific to the truck ranking category, which is available for each carrier from the Carrier Data File. For Truck carriers, the payload checks are consistent with the Class 8b payload checks currently in the Truck Tool, and are shown below in Table 9. (See the **Truck Tool Technical Documentation** for additional information.) Note that Ranges 1 and 5 are colored red, and require explanations before proceeding. Ranges 2 and 4 are colored yellow, and explanations are optional.

**Table 9. Truck Carrier Payload Validation Ranges**

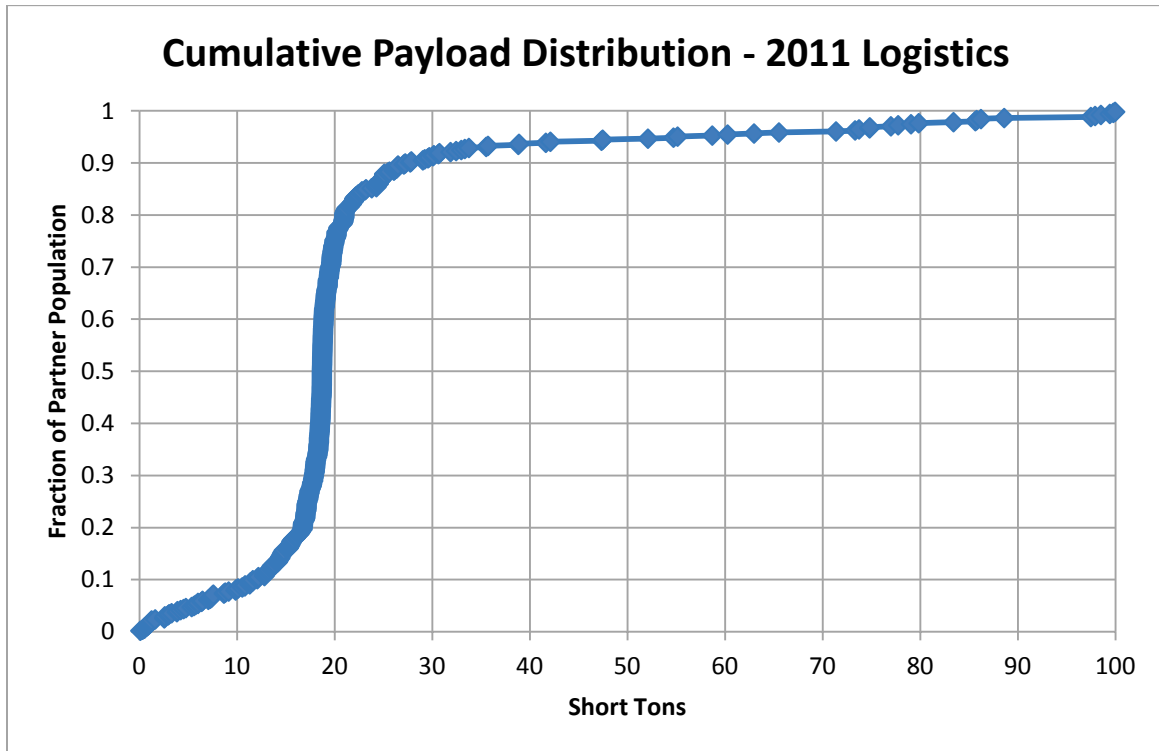
| <b>Truck Bin Category</b>                                            | <b>Range<br/>1 Low</b> | <b>Range<br/>1 High<br/>/ 2 Low</b> | <b>Range<br/>2 High<br/>/ 3 Low</b> | <b>Range<br/>3 High<br/>/ 4 Low</b> | <b>Range<br/>4 High<br/>/ 5 Low</b> | <b>Range<br/>5 High<br/>(Max)</b> |
|----------------------------------------------------------------------|------------------------|-------------------------------------|-------------------------------------|-------------------------------------|-------------------------------------|-----------------------------------|
| LTL Dry Van (from Dry Van Single - LTL-Moving-Package) <sup>12</sup> | 0.0                    | 0.0                                 | 11.0                                | 19.1 <sup>13</sup>                  | 23.2                                | 83.7                              |
| Package (from Dry Van Single - LTL-Moving-Package)                   | 0.0                    | 0.0                                 | 11.0                                | 19.1                                | 23.2                                | 83.7                              |
| TL Dry Van (from Dry Van Single - other bins)                        | 0.0                    | 10.5                                | 14.5                                | 22.4                                | 26.4                                | 150.0                             |
| Refrigerated                                                         | 0.0                    | 14.5                                | 17.3                                | 22.9                                | 25.7                                | 82.5                              |
| Flatbed                                                              | 0.0                    | 14.0                                | 18.3                                | 26.7                                | 31.0                                | 99.9                              |
| Tanker                                                               | 0.0                    | 19.1                                | 22.0                                | 27.8                                | 30.7                                | 103.8                             |
| Moving (from Dry Van Single – LTL-Moving-Package)                    | 0.0                    | 6.9                                 | 11.0                                | 19.1                                | 23.2                                | 83.7                              |
| Specialized (from Specialty - Other bins)                            | 0.0                    | 20.2                                | 22.9                                | 28.3                                | 31.1                                | 111.0                             |
| Dray (from Chassis)                                                  | 0.0                    | 11.2                                | 16.5                                | 27.1                                | 32.4                                | 73.5                              |
| Auto Carrier                                                         | 0.0                    | 5.7                                 | 11.0                                | 21.4                                | 26.6                                | 73.5                              |
| Heavy-Bulk                                                           | 0.0                    | 2.7                                 | 16.5                                | 44.0                                | 57.8                                | 120.0                             |
| Utility (from Specialty – Other bins)                                | 0.0                    | 20.2                                | 22.9                                | 28.3                                | 31.1                                | 111.0                             |
| Mixed (from Other - Heavy-Flatbed-Mixed bins)                        | 0.0                    | 14.7                                | 21.1                                | 33.8                                | 40.1                                | 99.3                              |
| Expedited (from Dry Van Single - other bins)                         | 0.0                    | 10.5                                | 14.5                                | 22.4                                | 26.4                                | 150.0                             |

Logistic carrier payload validations are based on 2011 Logistics Partner data, and use simple cutoffs from the cumulative payload distribution shown in Figure 1 below.

<sup>12</sup> Since LTL and package shipments can be very small, no lower-bound “red/yellow” ranges are designated for LTL and package carrier payloads.

<sup>13</sup> A further assessment of reasonable upper bound LTL payloads is planned for 2015.

**Figure 1. Logistics Partner Payload Distribution**



As can be seen in the figure, the payload distribution is highly non-normal, so use of validation cutoffs based on standard deviation is not appropriate. However, rough inflection points appear at approximately 10%, 20%, 80%, and 90%. As such, these values were used to specify the following payload validation cutoffs for logistics carriers.

- Range 1 Red: 0 – 12.0 tons
- Range 2 Yellow: 12.0 – 16.7 tons
- Range 3: 16.7 – 21.0 tons
- Range 4 Yellow: 21.0 – 27.2 tons
- Range 5 Red: 27.2 – 150 tons (150 absolute max)

Validation levels for rail and multi-modal carriers are summarized below. The upper bound cutpoints for multi-modal payloads are based on a qualitative review of 2011 multi-modal carrier tool submittals. The upper bound cutpoints for rail payloads are based on the distribution of average values estimated for Class 1 carriers (see Table 6 above).

- Average multi-modal payloads less than 9.4 tons (error – red)
- Average multi-modal payloads greater than 95 tons (error – red)
- Average railcar payloads less than 9.4 tons or greater than 125 tons (error – red)
- Average multi-modal payloads between 9.4 and 15.5 tons (warning – yellow)

- Average multi-modal payloads between 60 and 95 tons (warning – yellow)

In addition, the absolute upper bound for rail and multi-modal carriers have both been set at 200 tons.

Finally, any payload value less than or equal to zero will be flagged as an error and must be changed.

### **Ton-Mile Validation**

2011 Logistics Partner data was evaluated to establish absolute upper bounds for ton-mile inputs. The ton-mile validation applies at the carrier (row) and total fleet (summation of rows) level, with the same values applied to both. The maximum allowable ton-mile value was set to twice the observed maximum value in the 2011 data set: 209,207,446,000 ton-miles.