Chapter 3

HEAVY TRUCKS

Page

Contents

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What Types of Trucks Are in Each Truck Class?

There are eight truck classes, categorized by the gross vehicle weight rating that the vehicle is assigned when it is manufactured. The pictures below show examples of some of the different types of trucks that would be included in each class.

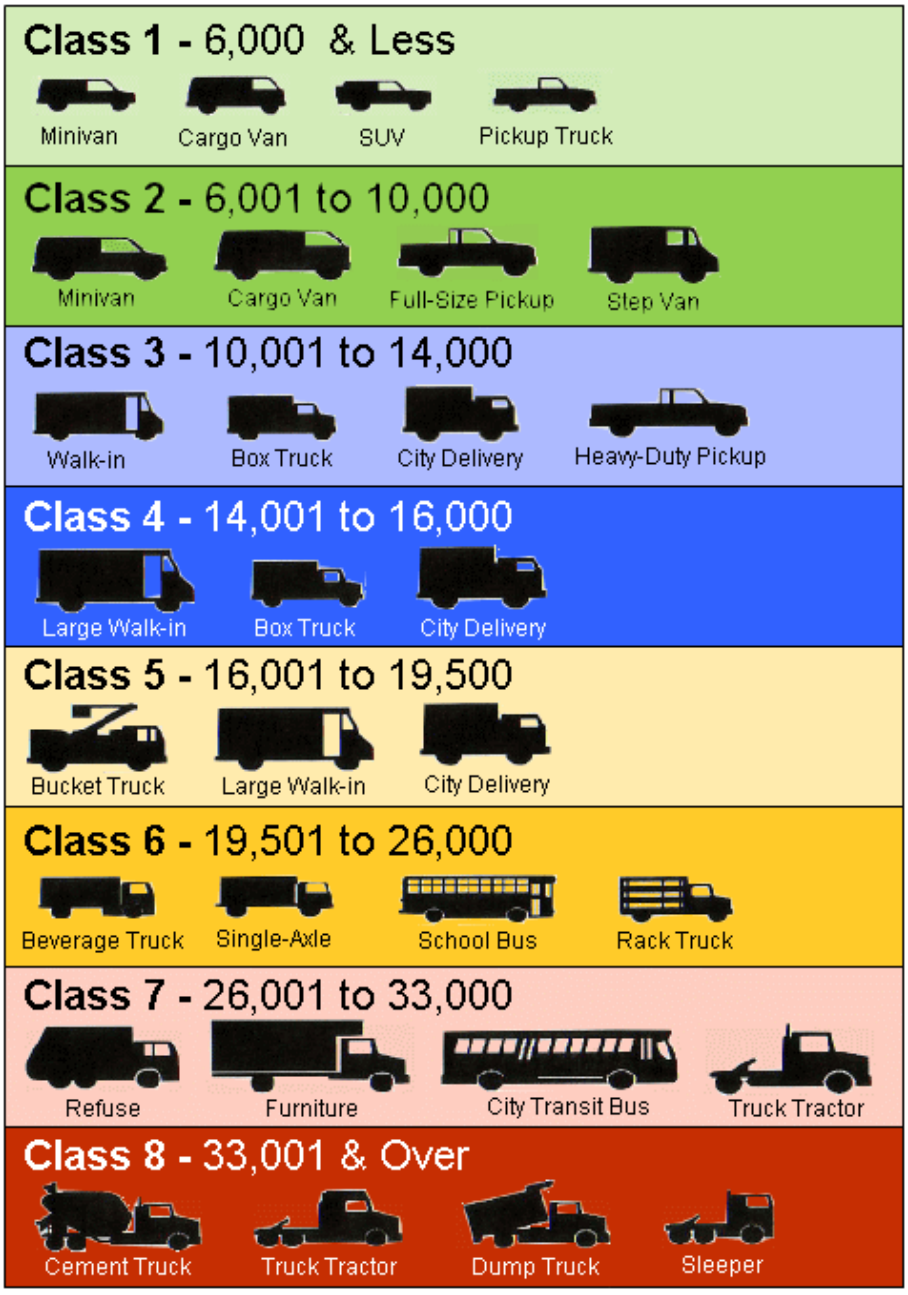

FIGURE 88. Examples of Trucks in Each Truck Class

Source:
Oak Ridge National Laboratory, Center for Transportation Analysis, Oak Ridge, TN. Weight category definitions from 49CFR565.6 (2000).

Heaviest Trucks Consume an Average of 6.5 Gallons per Thousand Ton-Miles

There are eight truck classes, categorized by the gross vehicle weight rating (GVWR) that the vehicle is assigned when it is manufactured. Cars and small pickups, vans, and sport-utility vehicles (SUVs) are shown here for comparison. Two truck classes are further subdivided into "a" and "b" designations. Class 2a and 2b are subdivided based on GVWR. Class 8a and 8b are subdivided based on the truck design (straight truck vs. combination truck).

TABLE 25. Typical Weights and Fuel Use by Truck Class

Class	Applications	Gross Weight Range (lbs.)	Empty Weight Range (lbs.)	Typical Payload Capacity Max (lbs.)	Typical Fuel Economy Range in 2007 (mpg)	Typical Fuel Consumed (gallons per thousand ton-miles)
1c	Cars *only*	3,200 - 6,000	2,400 - 5,000	250 - 1,000	25-33	69.0
1t	Minivans, Small SUVs, Small Pickups	4,000 - 6,000	3,200 - 4,500	250 - 1,500	20-25	58.8
2a	Large SUVs, Standard Pickups	6,001 - 8,500	4,500 - 6,000	250 - 2,500	20-21	38.5
2b	Large Pickups, Utility Van, Multi-Purpose, Mini-Bus, Step Van	8,501 - 10,000	5,000 - 6,300	3,700	10-15	38.5
3	Utility Van, Multi-Purpose, Mini-Bus, Step Van	10,001 - 14,000	7,650 - 8,750	5,250	8-13	33.3
4	City Delivery, Parcel Delivery, Large Walk-In, Bucket, Landscaping	14,001 - 16,000	7,650 - 8,750	7,250	7-12	23.8
5	City Delivery, Parcel Delivery, Large Walk-In, Bucket, Landscaping	16,001 - 19,500	9,500 - 10,800	8,700	6-12	25.6
6	City Delivery, School Bus, Large Walk-In, Bucket	19,501 - 26,000	11,500 - 14,500	11,500	5-12	20.4
7	City Bus, Furniture, Refrigerated, Refuse, Fuel Tanker, Dump, Tow, Concrete, Fire Engine, Tractor-Trailer	26,001 - 33,000	11,500 - 14,500	18,500	4-8	18.2
8a	Straight Trucks, e.g., Dump, Refuse, Concrete, Furniture, City Bus, Tow, Fire Engine	33,001 - 80,000	20,000 - 34,000	20,000 - 50,000	2.5-6	8.7
8b	Combination Trucks, e.g., Tractor-Trailer: Van, Refrigerated, Bulk Tanker, Flat Bed	33,001 - 80,000	23,500 - 34,000	40,000 - 54,000	4-7.5	6.5

Source:

The National Academies, *Technologies and Approaches to Reducing the Fuel Consumption of Medium- and Heavy-Duty Vehicles*, 2010. http://www.nap.edu/catalog.php?record_id=12845

United States Accounts for 61% of Medium/Heavy Truck Production in North America

Nearly 290,000 medium/heavy trucks (Classes 4-8) were produced in the United States in 2014, which is 61% of North American production. Mexico also produced a large number of trucks (37%). The top U.S. producer, Ford, made medium trucks, while the second highest producer, Freightliner, made both medium and heavy trucks. FCA produced medium trucks in Mexico only. Kenworth was the only manufacturer of medium/heavy trucks in Canada.

TABLE 26. North American Production of Medium and Heavy Trucks by Manufacturer, 2014

Manufacturer	Thousands of Trucks				U.S. Share of Total
	United States	Mexico	Canada	Total	
Ford	66.8	0.0	0.0	66.8	100%
Freightliner & Western Star	61.4	82.3	0.0	143.7	43%
Kenworth	38.2	14.3	11.9	64.4	59%
Volvo	33.8	0.2	0.0	34.0	99%
Peterbilt	32.4	0.0	0.0	32.4	100%
Mack	25.7	0.0	0.0	25.7	100%
International	19.4	39.8	0.0	59.2	33%
Hino	8.1	0.5	0.0	8.6	94%
Isuzu	3.5	0.0	0.0	3.5	100%
Blue Diamond	0.0	18.3	0.0	18.3	0%
Dina Camiones	0.0	1.1	0.0	1.1	0%
FCA	0.0	17.2	0.0	17.2	0%
MAN	0.0	1.3	0.0	1.3	0%
Total	289.3	175.0	11.9	476.2	61%

Note: Includes truck Classes 4 through 8.

Source:
Ward's Automotive Group. http://wardsauto.com

Medium and Heavy Truck Assembly Plants Are Located throughout the United States

There are seven major manufacturers of Class 7 and 8 trucks in the United States– Freightliner/Western Star, Hino, International, Kenworth, Mack, Peterbilt and Volvo. Two of those, Freightliner and International, also manufacture medium trucks (Classes 4-6), along with Isuzu. Most of the manufacturing plants are in the Eastern third of the United States. In 2015, Ford moved the production of medium trucks back to the United States from Mexico.

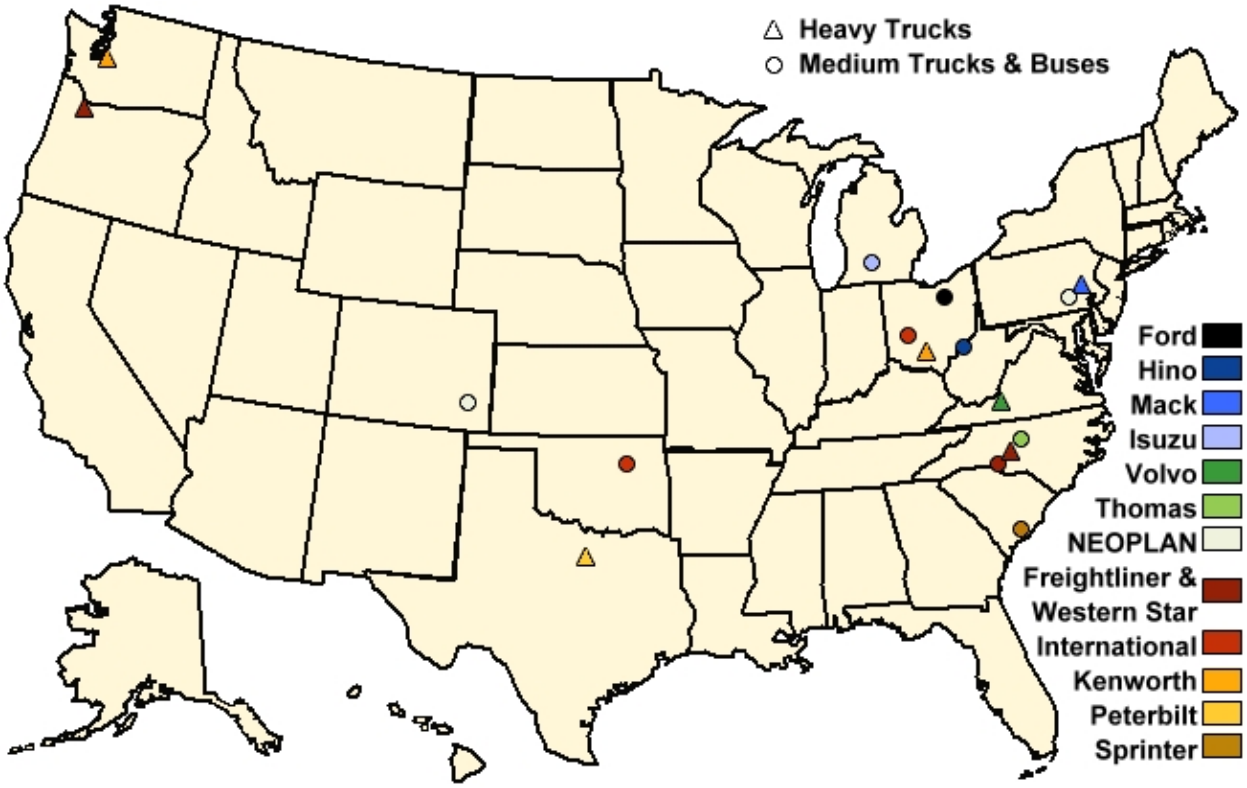

FIGURE 89. Medium and Heavy Truck Manufacturing Plants by Location, 2015

Note: Includes truck Classes 4 through 8.

Source:
Ward's Automotive Group. http://wardsauto.com

Few Medium/Heavy Trucks Are Imported

Sales of Class 4-8 trucks are overwhelmingly vehicles that are made in North America (domestic). About half of Class 4 trucks and 10% of Class 5 trucks were imported in 2015. There were no imported Class 6, 7, or 8 trucks sold. Historically the import truck market share peaked in 1987 at 7.1% and after much volatility the overall import share was 3.2% in 2015.

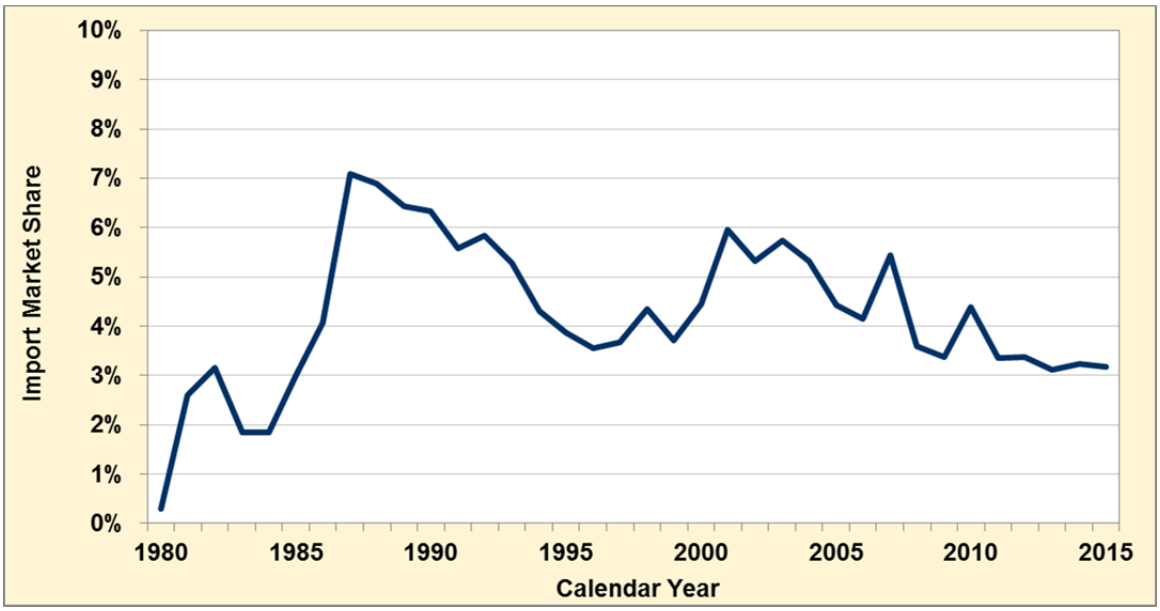

FIGURE 90. Import Share of Medium and Heavy Trucks, 1980-2015

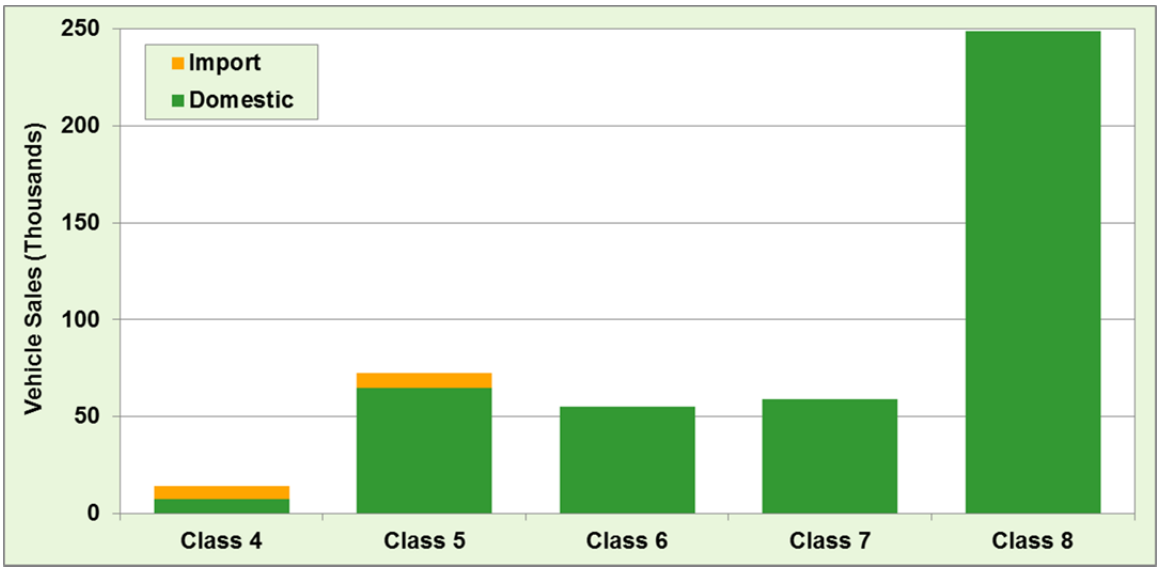

FIGURE 91. Medium and Heavy Trucks Sold by Source and Weight Class, 2015

Note: All trucks made in North America are considered domestic.

Source:
Ward's Automotive Group. http://wardsauto.com

Class 3 Truck Sales Have Increased by 45% from 2011 to 2015

The Class 3 truck market has grown each year since 2011 and reached 283,000 units by 2015. FCA, Ford, and General Motors dominate the Class 3 market.

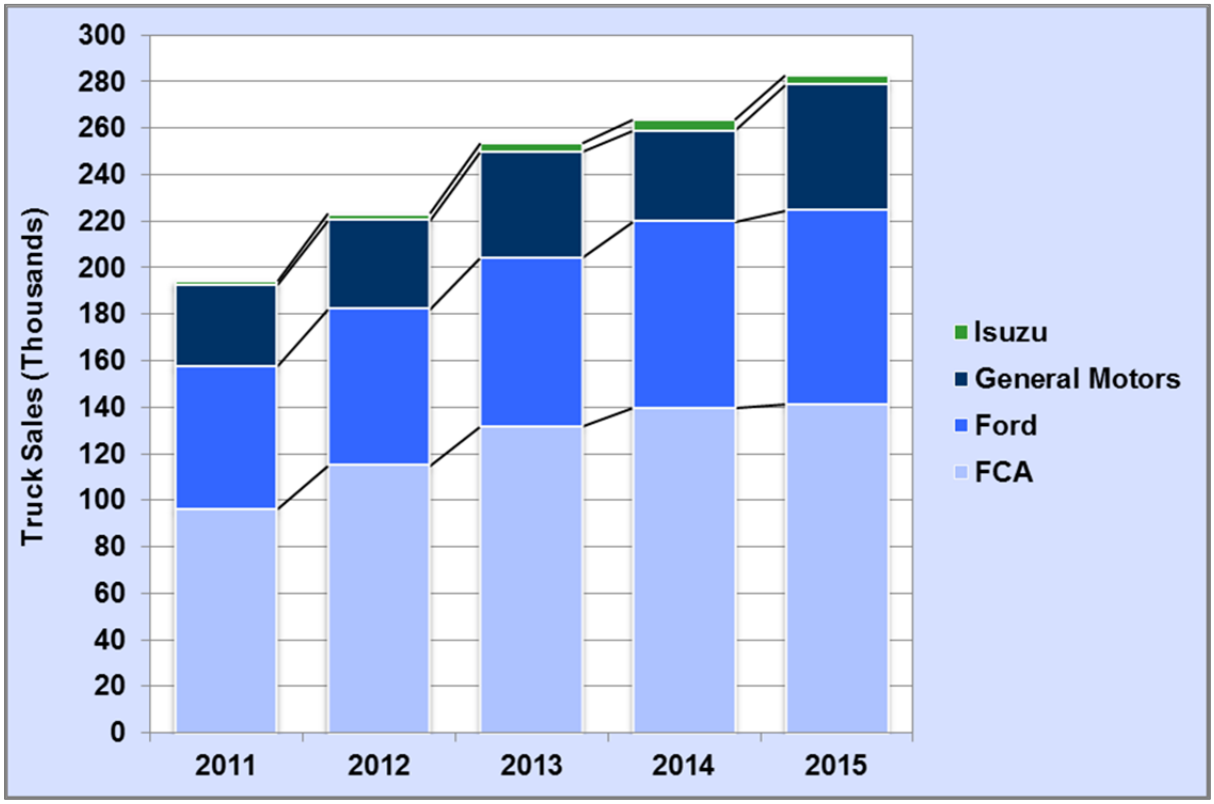

FIGURE 92. Class 3 Truck Sales by Manufacturer, 2011-2015

Note: From 2011 to 2015 Mitsubishi-Fuso sales of Class 3 trucks were between 200 and 400 units. This amount is too small to show on the figure. Also, in 2009 and 2010 International had Class 3 sales of less than 1,000 units.

Source:
Ward's Automotive Group, *Motor Vehicle Facts and Figures 2015*, Southfield, MI, 2015.
http://wardsauto.com

Class 4-7 Truck Sales Increased by 49% from 2011 to 2015

The Class 4 truck market has grown to just over 200,000 units in 2015. Many of the manufacturers doubled their sales of Class 4-7 trucks from 2011 to 2015, including Hino, FCA, and Kenworth. The only manufacturers with declining sales in this period were International and Mitsubishi-Fuso.

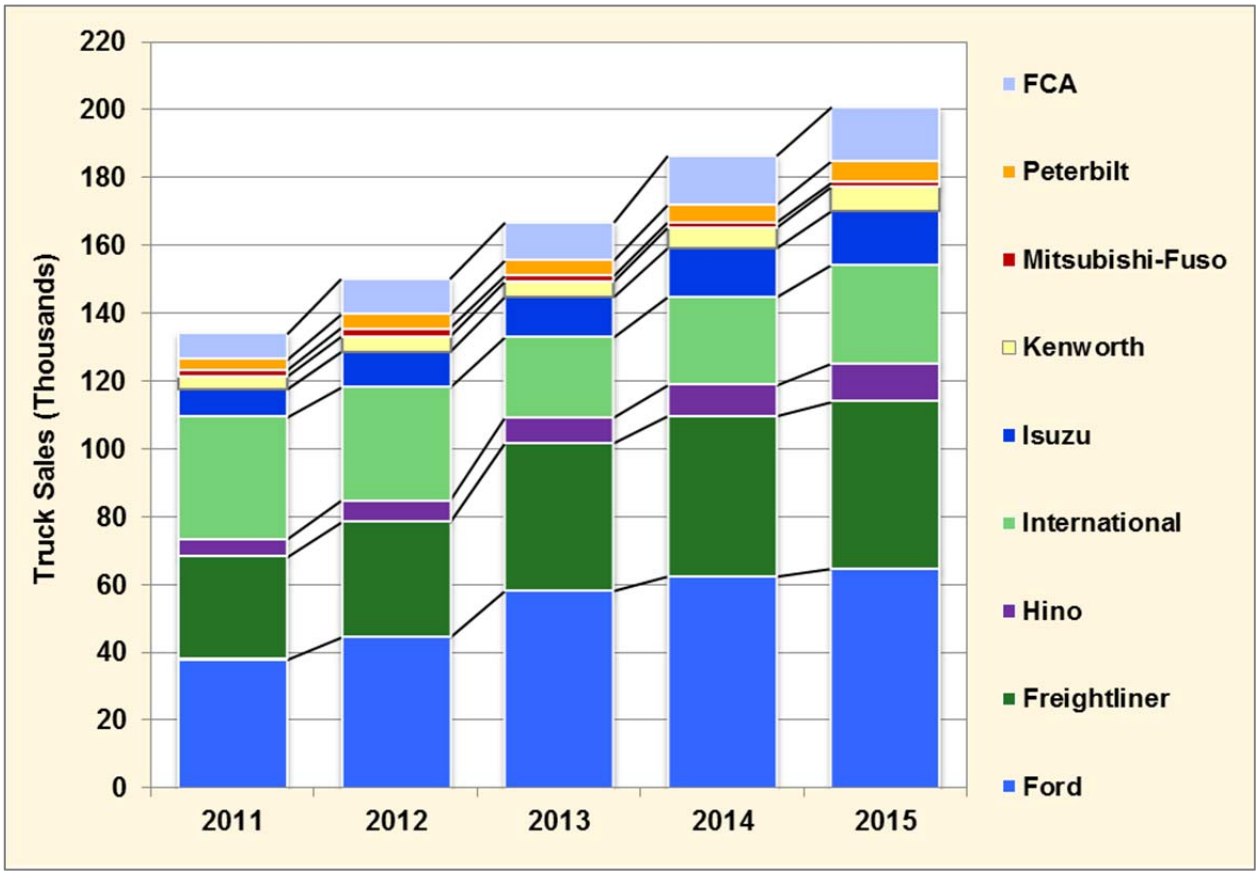

FIGURE 93. Class 4-7 Truck Sales by Manufacturer, 2011-2015

Note: From 2011 to 2013 UD trucks sold 1,000 units or less. This amount is too small to show on the figure.

Source:
Ward's Automotive Group, *Motor Vehicle Facts and Figures 2015*, Southfield, MI, 2015.
http://wardsauto.com

Class 8 Truck Sales Increased 45% from 2011 to 2015

Class 8 truck sales have grown to about 249,000 units in 2015. The market shares by manufacturer were fairly steady from 2011 to 2015, with Freightliner gaining, International losing, and all the rest staying nearly the same. The decline in Class 8 sales from 2012 to 2013 was the only decline in the five-year period.

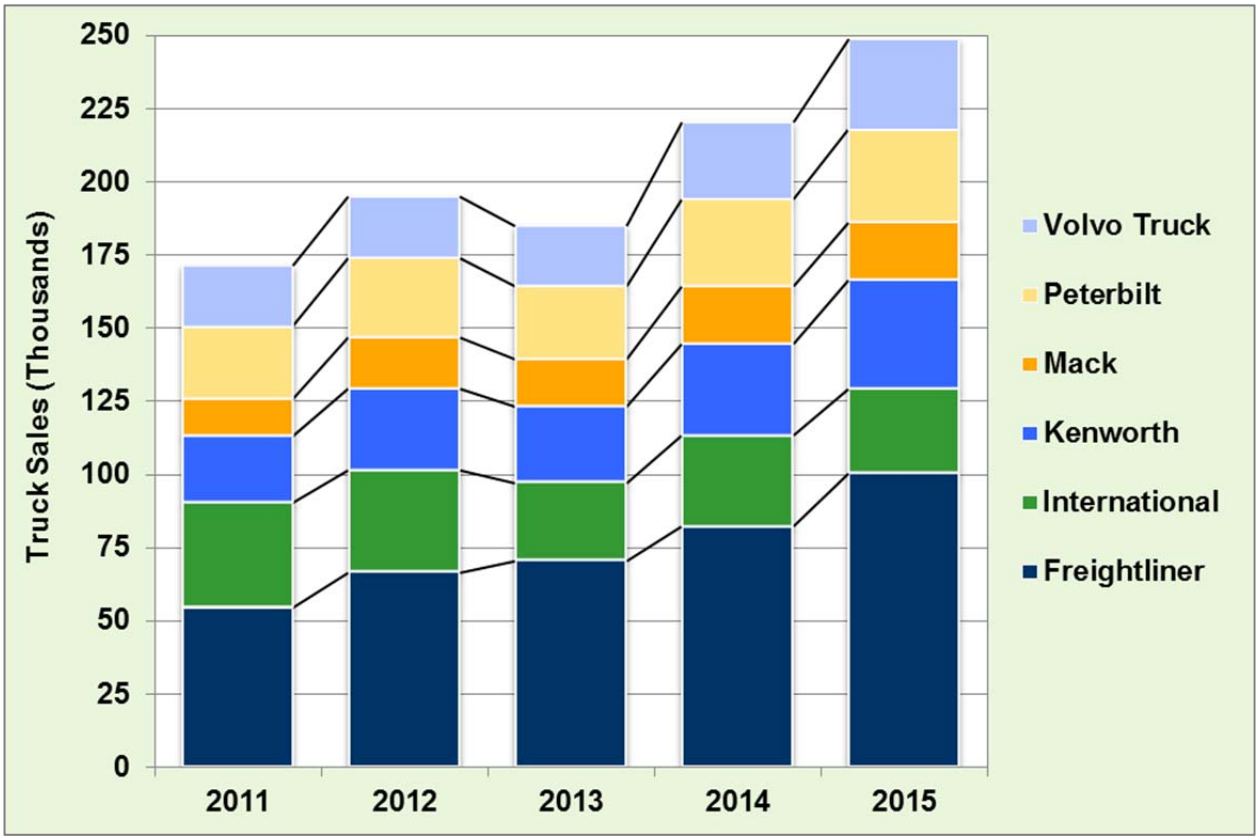

FIGURE 94. Class 8 Truck Sales by Manufacturer, 2011-2015

Note: From 2011 to 2015 sales of Class 8 trucks by "other" manufacturers were less than 100 units. This amount is too small to show on the figure.

Source:
Ward's Automotive Group, *Motor Vehicle Facts and Figures 2015*, Southfield, MI, 2015.
http://wardsauto.com

Diesel Engine Use Declines 66% for Class 4 Trucks and Increases 15% for Class 7 Trucks

Although Class 8 trucks are nearly always 100% diesel trucks, Classes 3-7 often vary in gasoline to diesel sales shares from one year to another. In 2010, when truck sales of all classes were low, Classes 4, 5, and 6 each had more than 90% diesel sales share. By 2015, the diesel share of Class 6 trucks continued to be above 90%, while Class 5 share fell to 80% and Class 4 share fell to 32%. The only class to increase diesel sales share from 2010 to 2014 was Class 7.

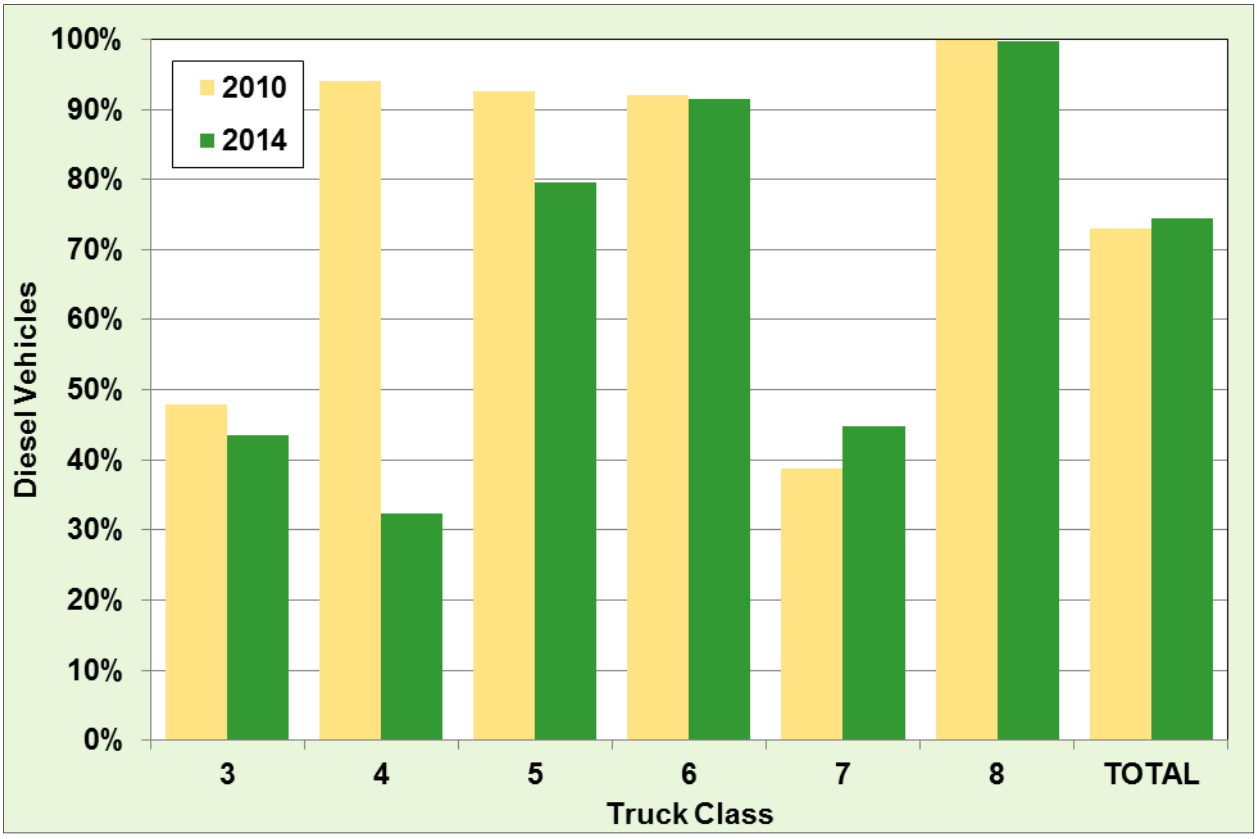

FIGURE 95. Share of Diesel Truck Sales by Class, 2010 and 2014

Note: These shares were derived using factory sales of trucks.

Source:
Ward's Automotive Group, *Motor Vehicle Facts and Figures 2015*, Southfield, MI, 2015.
http://wardsauto.com

Many Heavy Truck Manufacturers Supply Their Own Diesel Engines

Though many medium and heavy truck manufacturers also manufacture their own engines, others purchase engines from engine manufacturers. Cummins supplies diesel engines for Freightliner, International, Kenworth, Mack, Peterbilt, Volvo, and Western Star. Hino builds its own diesel engines.

TABLE 27. Diesel Engine Suppliers by Manufacturer, 2014

Make	Engine Manufacturer	Share
Freightliner	Cummins	58.5%
	Detroit Diesel	41.0%
	Mercedes Benz	0.5%
	Total	**100.0%**
Hino	Hino	100.0%
International	Cummins	31.8%
	Navistar	68.2%
	Total	**100.0%**
Kenworth	Cummins	63.2%
	PACCAR	36.8%
	Total	**100.0%**
Mack	Cummins	7.4%
	Mack	92.6%
	Total	**100.0%**
Peterbilt	Cummins	63.0%
	PACCAR	37.0%
	Total	**100.0%**
Volvo	Cummins	8.5%
	Volvo	91.5%
	Total	**100.0%**
Western Star	Cummins	17.2%
	Detroit Diesel	82.6%
	Mercedes Benz	0.2%
	Total	**100.0%**
Other	Cummins	100%

Note: International's parent company is Navistar. Kenworth's and Peterbilt's parent company is PACCAR.

Source:
Ward's Automotive Group. http://wardsauto.com

Cummins Leads Heavy Truck Diesel Engine Market

In 2010, Navistar held a 23% share of the heavy truck diesel engine market. By 2014, Navistar's share had declined to 5% and Cummins held the largest share of the market (43%).

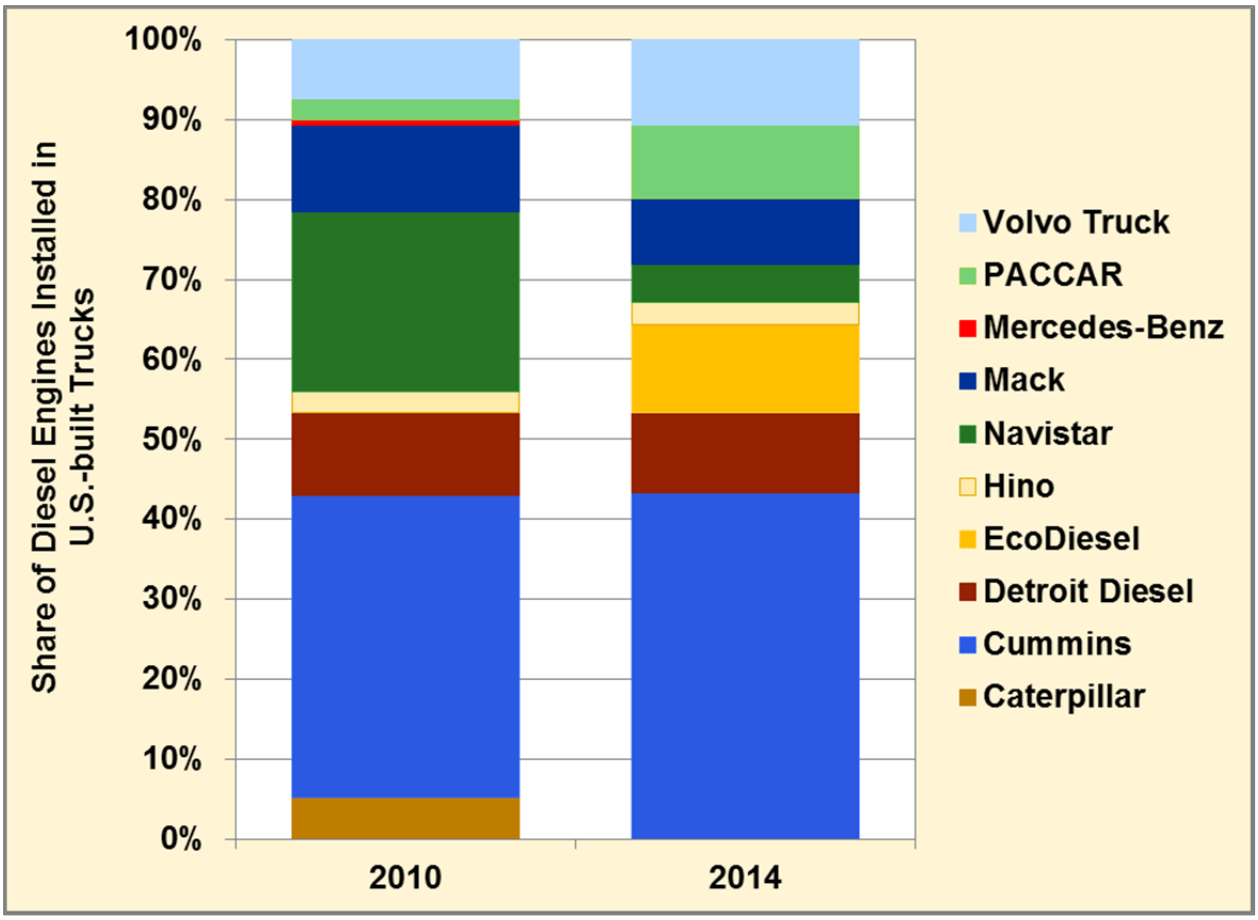

FIGURE 96. Diesel Engine Manufacturers Market Share, 2010 and 2014

Source:
Ward's Automotive Group. http://wardsauto.com

Combination Trucks Average Almost 66,000 Miles per Year

According to the latest Federal Highway Administration estimates, the average miles traveled per truck was almost 66,000 miles for a combination truck in 2014, down from over 68,000 miles in 2013. Because heavy truck duty-cycles vary, these averages have large standard deviations. Heavy single-unit trucks (above 10,000 lb and having at least six tires) were driven significantly fewer miles, because they are typically driven locally. The average fuel economy of single-unit trucks was 7.3 miles per gallon (mpg) in 2014 while the combination truck fuel economy was 5.8 mpg. The combination trucks typically have larger engines to carry heavier loads than the single-unit trucks.

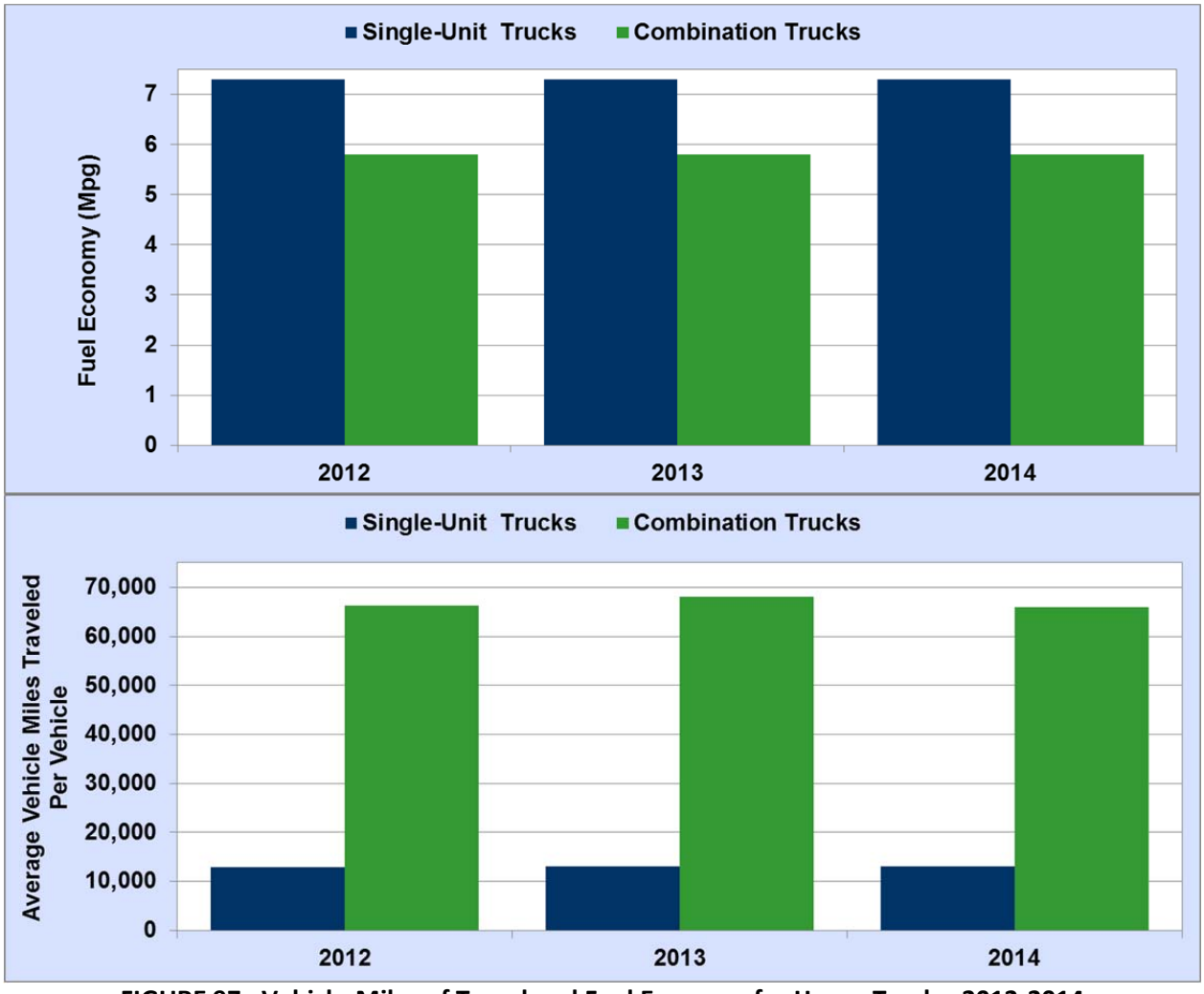

FIGURE 97. Vehicle-Miles of Travel and Fuel Economy for Heavy Trucks, 2012-2014

Note: A combination truck is a truck-tractor that is used in combination with one or more trailers. A single-unit truck is a truck on a single frame, such as a dump truck or utility truck.

Source:

U.S. Department of Transportation, Federal Highway Administration, *Highway Statistics 2014*, Table VM-1, 2016. http://www.fhwa.dot.gov/policyinformation/statistics/2014

Study Conducted of Heavy Trucks at Steady Speed on Flat Terrain

A study conducted by Oak Ridge National Laboratory outfitted Class 8 trucks with monitoring equipment which tracked the weight, speed, and fuel efficiency of the truck along with the global position of the truck. Using only data where the roadway grade was 1% to -1% grade (flat terrain) the study showed the difference in fuel efficiency for different truck weights at the speed of 65 miles per hour (mph).

TABLE 28. Fuel Efficiency of Class 8 Trucks by Vehicle Weight Range on Flat Terrain at 65 mph

Weight Range (Pounds)	Average Weight (Pounds)	Distance Traveled (Miles)	Fuel Consumed (Gallons)	Fuel Efficiency (Miles per Gallon)	Fuel Efficiency (Ton-miles per Gallon)	Average Speed (mph)
20,000-30,000	21,222	51.4	5.4	9.5	101	65.0
30,000-40,000	34,285	505.9	53.0	9.5	164	65.0
40,000-50,000	44,911	537.8	58.7	9.2	206	65.0
50,000-60,000	55,468	541.2	63.3	8.6	237	64.9
60,000-70,000	66,558	1,356.9	171.9	7.9	263	65.0
70,000-80,000	73,248	1,363.1	172.3	7.9	290	65.0

Note: Ton-miles per gallon calculated as average weight multiplied by miles per gallon.

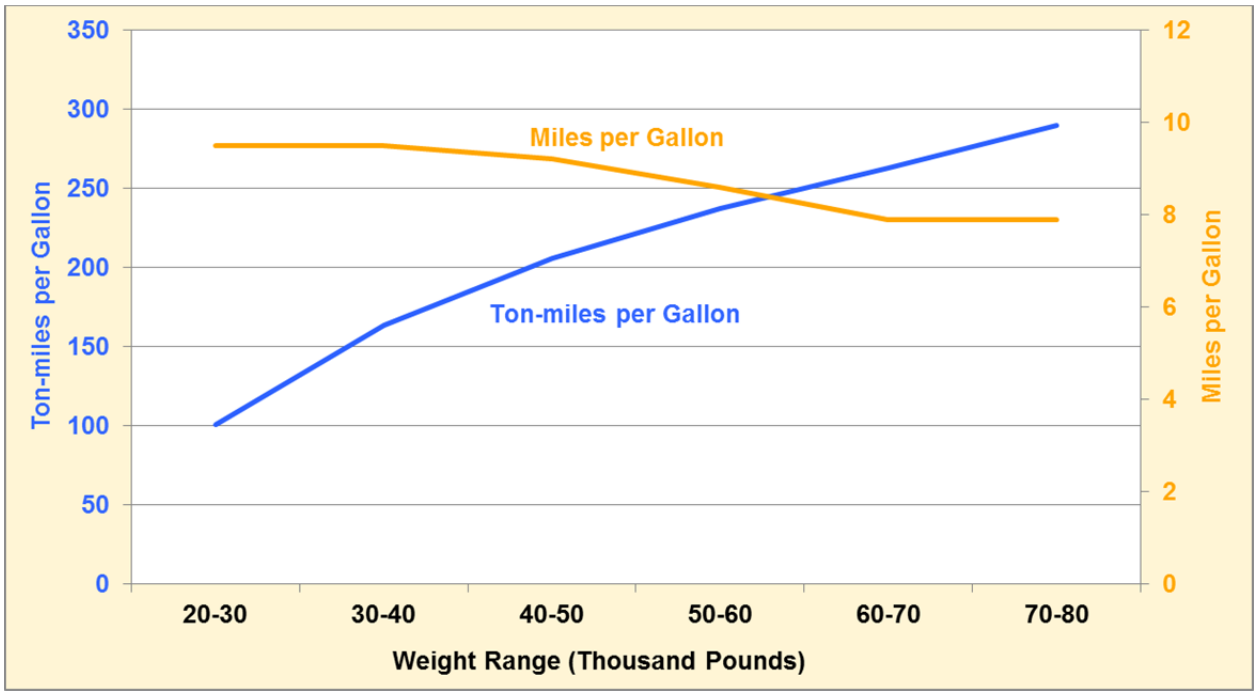

FIGURE 98. Fuel Efficiency of Class 8 Trucks by Vehicle Weight Range on Flat Terrain at 65 mph

Source:

Franzese, Oscar, *Effect of Weight and Roadway Grade on the Fuel Economy of Class-8 Freight Trucks*, Oak Ridge National Laboratory, ORNL/TM-2011/471, October 2011. http://cta.ornl.gov/cta/Publications/Reports/ORNL_TM_2011_471.pdf

Roadway Grade Affects Fuel Economy of Class 8 Trucks

A study conducted by Oak Ridge National Laboratory outfitted Class 8 trucks with monitoring equipment which tracked the weight, speed, and fuel efficiency of the truck along with the global position of the truck. The average for all trucks in the study at all speeds on flat terrain was 7.3 miles per gallon (mpg). However, the fuel economy of those same vehicles on different roadway grades was significantly different. On average, trucks on a severe downslope gained 221% of their fuel economy, while trucks on a severe upslope lost 60% of their fuel economy.

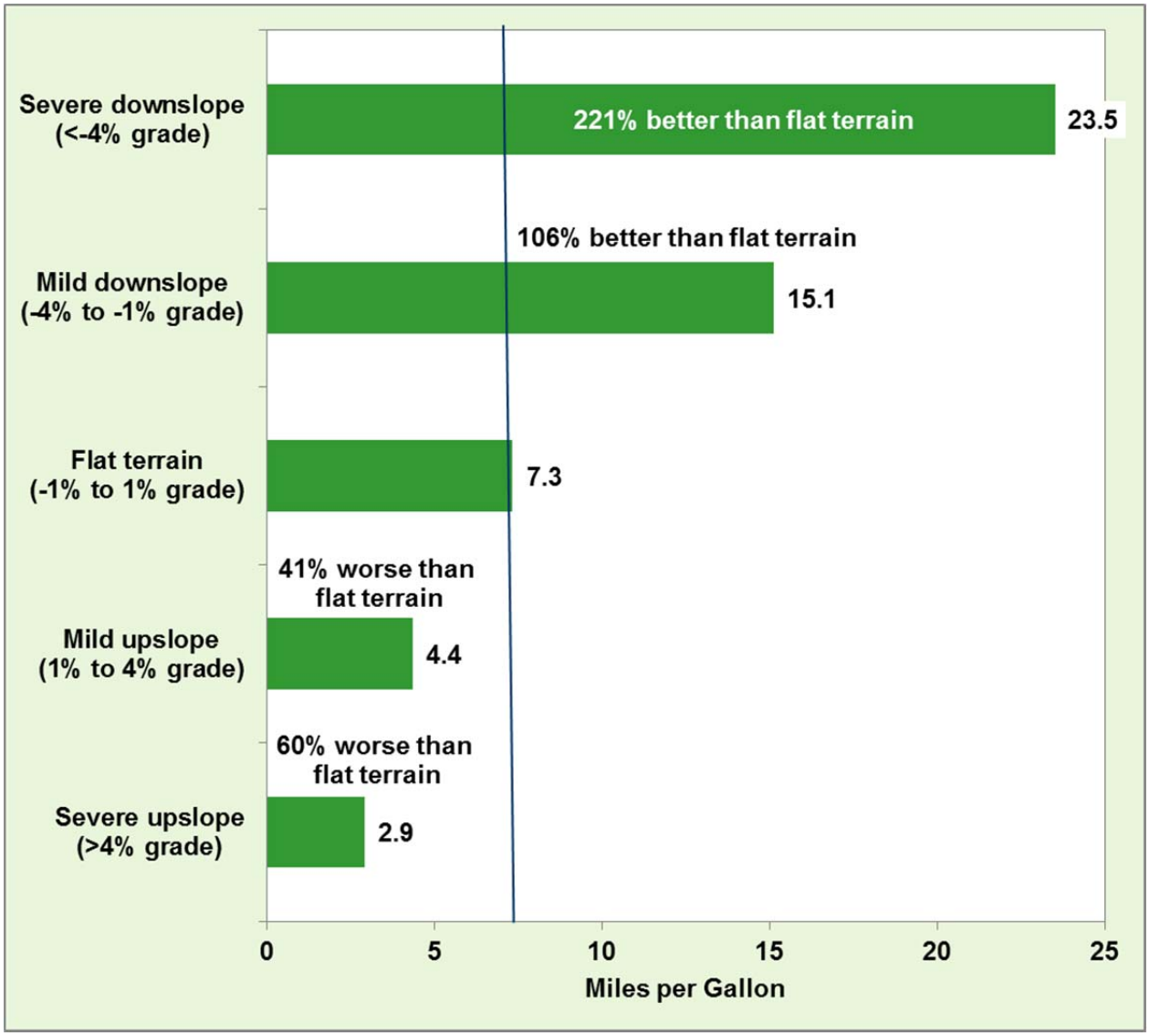

FIGURE 99. Fuel Efficiency of Class 8 Trucks by Roadway Grade

Source:

Franzese, Oscar, *Effect of Weight and Roadway Grade on the Fuel Economy of Class-8 Freight Trucks*, Oak Ridge National Laboratory, ORNL/TM-2011/471, October 2011. http://cta.ornl.gov/cta/Publications/Reports/ORNL_TM_2011_471.pdf

Idle Fuel Consumption Varies by Type of Truck

Based on a worksheet developed by Argonne National Laboratory, the idle fuel consumption rate for selected gasoline and diesel vehicles with no load (no use of accessories such as air conditioners, fans, etc.) varies widely. These data were collected from a variety of studies, thus some of the data may not be directly comparable. In general, the transit bus consumed the most fuel while idling – nearly 1 gallon per hour (gal/hr). The gasoline medium heavy truck category with a gross vehicle weight (GVW) of 19,700-26,000 lb consumed more fuel at idle than the diesel medium heavy truck category at 23,000-33,000 lb GVW. By comparison, a compact sedan using diesel or gasoline uses less than 0.2 gal/hr when idling.

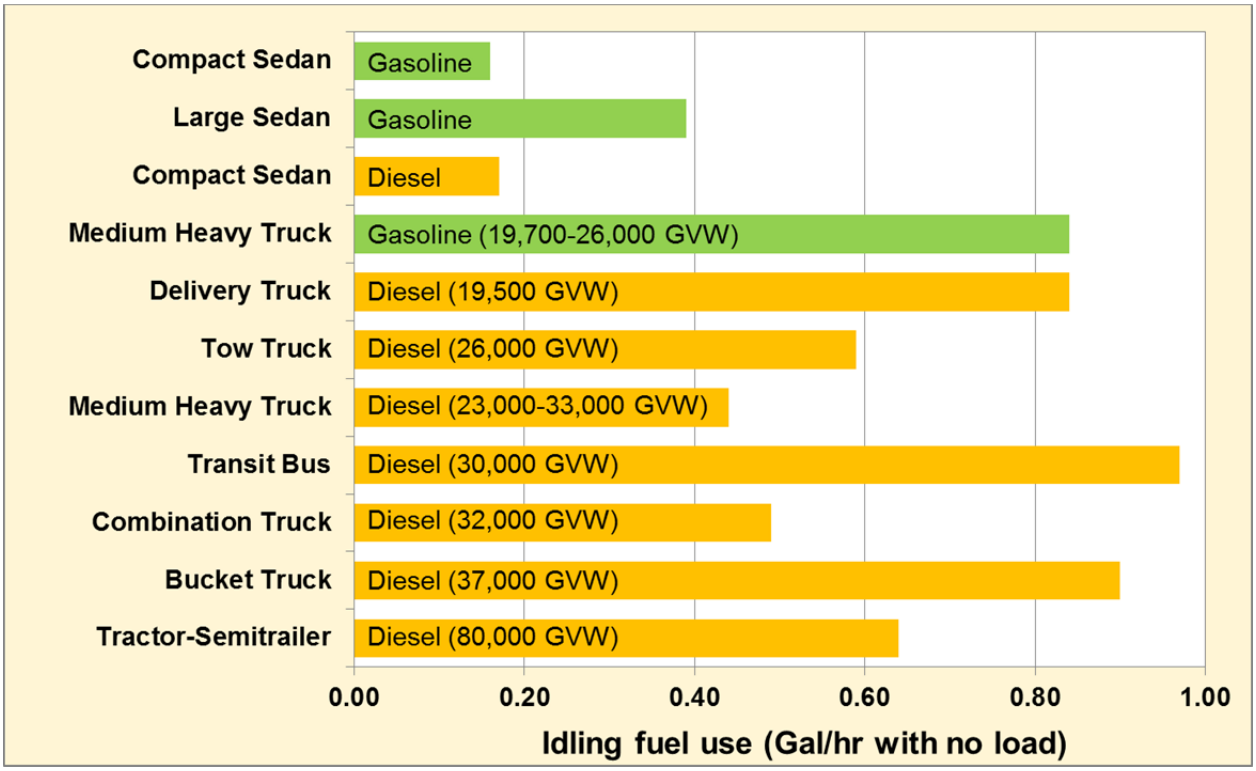

FIGURE 100. Fuel Consumption at Idle for Selected Gasoline and Diesel Vehicles

Note: The passenger car results are from a study by Argonne National Laboratory; the delivery truck results are from a study by the National Renewable Energy Laboratory; the tow truck, transit bus, combination truck and bucket truck results are from a study by Oak Ridge National Laboratory; the tractor-semitrailer results were from a study by the American Trucking Associations; both of the medium heavy truck results were from a study published in the *Journal of the Air & Waste Management Association*. For details on these results, please see the individual studies referenced by the source.

Source:
Argonne National Laboratory, Idling Reduction Savings Calculator, http://www.anl.gov/sites/anl.gov/files/idling_worksheet.pdf, accessed December 2014.

Truck Stop Electrification Reduces Idle Fuel Consumption

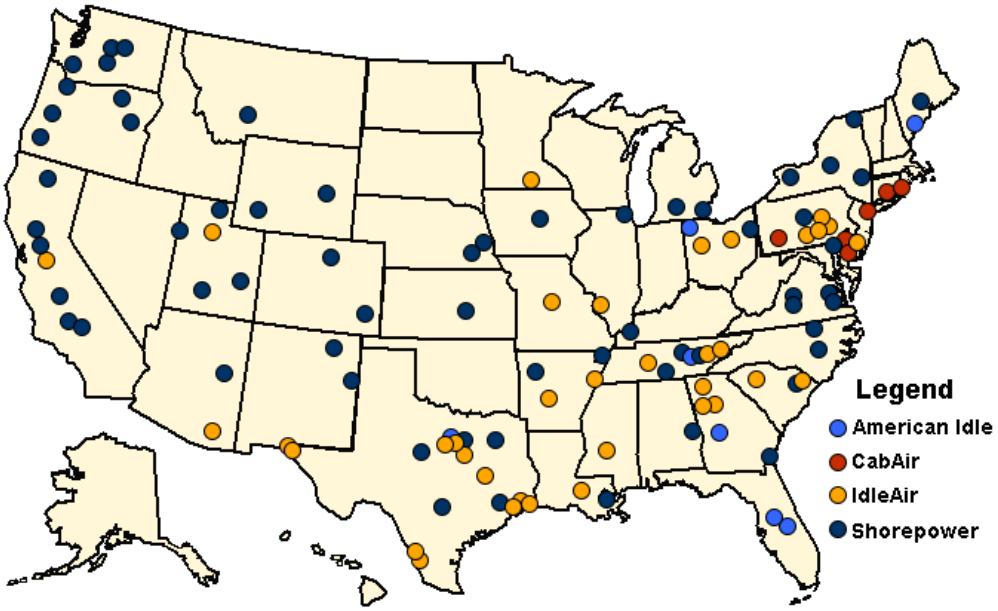

FIGURE 101. Map of Truck Stop Electrification Sites, 2016

TABLE 29. Number of Truck Stop Electrification Sites by State, 2016

State	Number of Sites	State	Number of Sites
Alabama	1	Mississippi	1
Arizona	2	Missouri	2
Arkansas	3	Montana	1
California	7	Nebraska	2
Colorado	2	New Jersey	2
Connecticut	1	New Mexico	2
Delaware	2	New York	4
Florida	2	North Carolina	2
Georgia	5	Ohio	4
Illinois	2	Oregon	5
Iowa	1	Pennsylvania	6
Kansas	1	South Carolina	3
Kentucky	1	Tennessee	7
Louisiana	2	Texas	17
Maine	2	Utah	5
Maryland	1	Virginia	4
Michigan	2	Washington	4
Minnesota	1	Wyoming	2
Total	**111**		

The U.S. Department of Transportation mandates that truckers rest for 10 hours after driving for 11 hours, during which time they often park at truck stops idling the engines to provide heating, cooling and use of electrical appliances. Electrification at truck stops allows truckers to "plug-in" vehicles to operate the necessary systems without idling the engine. There are currently 111 publicly accessible electrification sites across the nation. Some of these sites require special equipment to be installed on the truck and others do not. Presently, four companies equip electrification sites: Shorepower, CabAire, American Idle, and IdleAir.

Source:
Alternative Fuels and Advanced Vehicles Data Center. (Data through 2/12/16).
http://www.afdc.energy.gov/afdc/tse_locator

SuperTruck Project Achieves 12.2 Miles per Gallon

The U.S. Department of Energy partnered with industry to explore fuel economy improvements for class 8 trucks. In February 2015, the Daimler Trucks North America team announced that their fully-loaded class 8 truck achieved a fuel economy of 12.2 miles per gallon, which was a 100% increase in fuel economy and an 115% gain in freight efficiency in testing against a 2009 baseline truck.

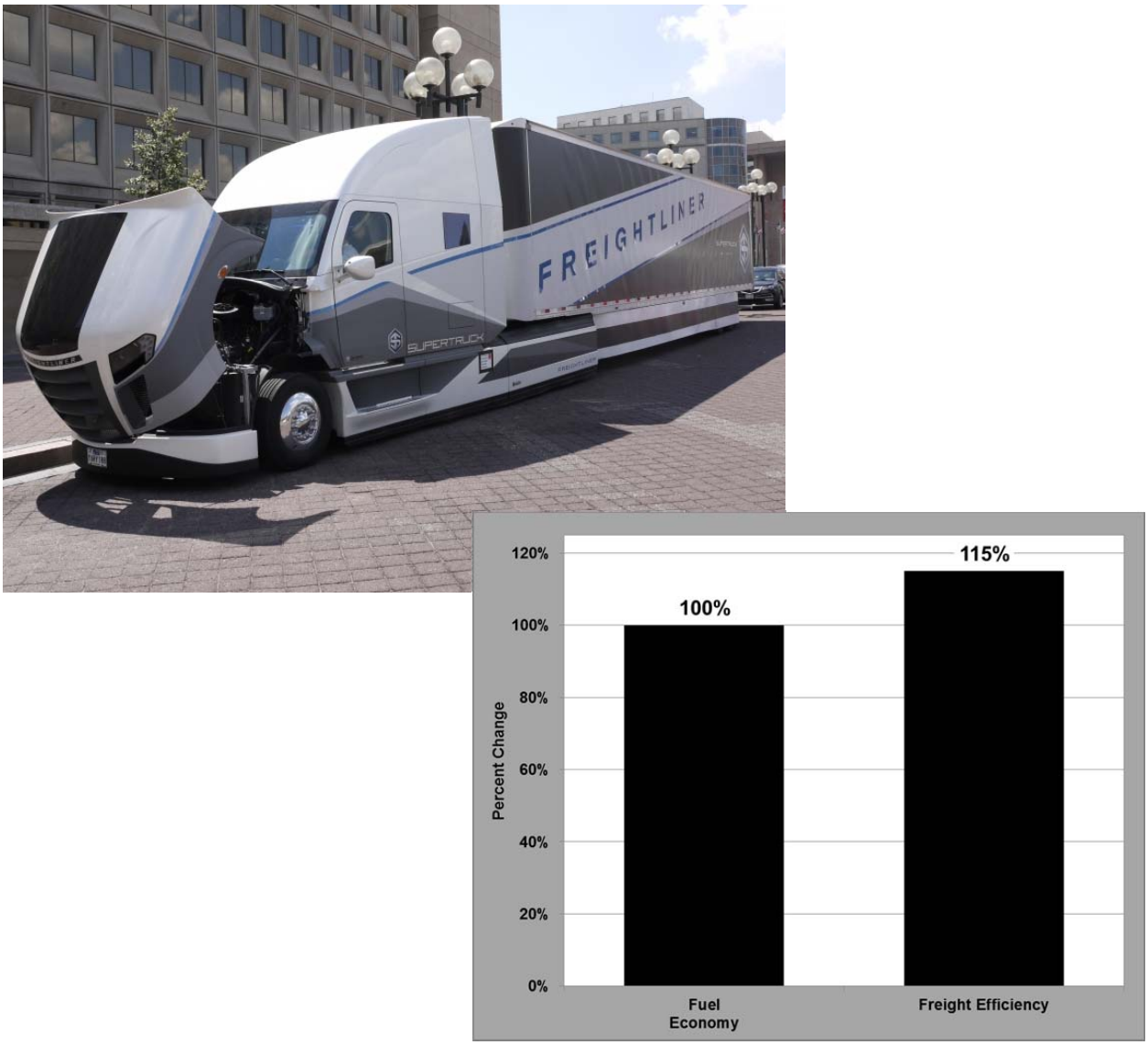

FIGURE 102. Changes in Fuel Economy and Freight Efficiency for the SuperTruck Project, February 2015

Source:

U.S. Department of Energy, "EERE Success Story—SuperTruck Initiative Partner Improves Class 8 Truck Efficiency by 115%" accessed March 10, 2016. http://energy.gov/eere/success-stories/articles/eere-success-story-supertruck-initiative-partner-improves-class-8

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