V. SAFETY, ENERGY, AND ENVIRONMENTAL IMPLICATIONS OF FREIGHT TRANSPORTATION

Growing demand for freight transportation heightens concerns about its safety, energy consumption, and environmental impacts. While safety in all freight modes continues to be monitored actively, the environmental implications of freight transportation only recently have been considered separately from passenger travel. At the same time, the availability of energy consumption data has declined with the discontinuation of the Vehicle Inventory and Use Survey.

Table 5-1. Fatalities by Freight Transportation Mode: 1980-2010

	1980	1990	2000	2009	2010
Total transportation fatalities (passenger and freight)	**NA**	**47,350**	**44,384**	**(P) 35,929**	**U**
Highway (passenger and freight)	**51,091**	**44,599**	**41,945**	**33,808**	**U**
Large truck occupants[1]	1,262	705	754	503	U
Others killed in crashes involving large trucks	4,709	4,567	4,528	(R) 2,551	U
Large truck occupants[1] (percent)	2.5	1.6	1.8	1.5	U
Others killed in crashes involving large trucks (percent)	9.2	10.2	10.8	7.5	U
Railroad (passenger and freight)	**1,417**	**1,297**	**937**	**(R) 695**	**737**
Highway-rail crossing[2]	833	698	425	(R) 247	261
Railroad[2,3]	584	599	512	(R) 448	476
Waterborne (passenger and freight)	**487**	**186**	**111**	**185**	**160**
Vessel-related[4]	206	85	42	54	28
Freight ship	8	0	0	1	1
Tank ship	4	5	0	1	0
Tug/towboat	14	13	1	3	0
Offshore supply	NA	2	0	0	0
Fishing vessel	60	47	26	25	14
Mobile offshore drilling units	NA	0	0	1	0
Platform	NA	1	0	0	0
Freight barge	NA	0	0	0	0
Tank barge	NA	0	0	0	0
Miscellaneous[5]	56	11	15	23	13
Not vessel-related[4]	281	101	69	131	132
Pipeline	**19**	**9**	**38**	**(R) 13**	**22**
Hazardous liquid pipeline	4	3	1	4	1
Gas pipeline	15	6	37	(R) 9	21

Key: NA = not available; R = revised; P = preliminary; U = unavailable at date of publication.
[1]Large trucks are defined as trucks over the 10,000 pound gross vehicle weight rating, including single-unit trucks and truck tractors.
[2]Includes Amtrak.
[3]Includes train accidents and other incidents. Most fatalities involve trespassers who are included under other incidents (442 in 2010).
[4]Vessel-related casualties include those involving damage to vessels such as collisions or groundings. Fatalities not related to vessel casualties include deaths from falling overboard or from accidents involving onboard equipment.
[5]Includes industrial vessel, passenger (inspected), passenger (uninspected), recreational, research vessel, unclassified, and unknown data.
Notes: Caution must be exercised in comparing fatalities across modes because significantly different definitions are used. Numbers may not add to toals because some fatalities are counted in more than one mode.

Table 5-1. Fatalities by Freight Transportation Mode: 1980-2010
Sources: Total: U.S. Department of Transportation, Research and Innovative Technology Administration, Bureau of Transportation Statistics, *National Transportation Statistics*, available at www.bts.gov as of August 29, 2011. **Highway:** 1980, 1990, and 2000: U.S. Department of Transportation, National Highway Transportation Safety Administration, National Center for Statistics and Analysis, *Traffic Safety Facts, Large Trucks* (annual issues). 2008- 2009: U.S. Department of Transportation, National Highway Transportation Safety Administration, National Center for Statistics and Analysis, *Traffic Safety Facts - Highlights* (August 2010). **Railroad:** U.S. Department of Transportation, Federal Railroad Administration, Office of Safety Analysis, available at http://safetydata.fra.dot.gov/officeofsafety/default.asp as of August 29, 2011. **Waterborne:** U.S. Department of Homeland Security, U.S. Coast Guard, Data Administration Division, personal communication, September 6, 2011. **Pipeline:** U.S. Department of Transportation, Pipeline and Hazardous Materials Safety Administration, Pipeline Safety Program, Pipeline Library, available at http://primis.phmsa.dot.gov/comm/PipelineLibrary.htm as of August 28, 2011.

While the amount of freight transportation activity has increased in recent decades, the number of fatalities has declined or remained stable in each mode, with the exception of waterborne casualties that are not vessel related. Trucks accounted for approximately 9 percent of all highway fatalities in 2009. The vast majority of fatalities involve passenger travel on highways.

The highway mode accounted for almost all of the injuries in freight transportation, but the number of injuries has dropped substantially since 2000.

Table 5-2. Injured Persons by Freight Transportation Mode: 1980-2010

	1980	1990	2000	2009	2010
Total injured persons (passenger and freight)	**NA**	**NA**	**3,259,673**	**NA**	**U**
Highway (passenger and freight)	**NA**	**3,230,666**	**3,188,750**	**2,217,000**	**U**
Large truck occupants[1]	NA	41,822	30,832	17,000	U
Others injured in crashes involving large trucks	NA	108,000	109,000	56,000	U
Large truck occupants[1] (percent)	NA	1.3	1.0	0.8	U
Others injured in crashes involving large trucks (percent)	NA	3.3	3.4	2.5	U
Railroad (passenger and freight)	**62,246**	**25,143**	**11,643**	**(R) 7,968**	**8,221**
Highway-rail grade crossing[2]	3,550	2,407	1,219	(R) 741	845
Railroad[2,3]	58,696	22,736	10,424	(R) 7,227	7,376
Waterborne (passenger and freight)	**NA**	**NA**	**665**	**722**	**509**
Vessel-related[4]	180	175	151	186	135
Freight ship	8	10	5	8	17
Tank ship	9	13	3	4	0
Tug/towboat	27	19	18	39	0
Offshore supply	NA	9	6	0	3
Fishing vessel	28	31	21	35	15
Mobile offshore drilling units	NA	13	0	1	10
Platform	NA	9	0	0	0
Freight barge	NA	3	2	0	0
Tank barge	NA	3	0	1	0
Miscellaneous[5]	98	12	96	98	90
Not related to vessel casualties[4]	NA	NA	514	536	374
Pipeline	**192**	**76**	**81**	**(R) 65**	**107**
Hazardous liquid pipeline	15	7	4	4	4
Gas pipeline	177	69	77	(R) 61	103

Key: NA = not available; R = revised; U = unavailable at date of publication.
[1]Large trucks are defined as trucks over the 10,000 pound gross vehicle weight rating, including single-unit trucks and truck tractors.
[2]Includes Amtrak.
[3]Includes train accidents and other incidents. Most injuries involve workers on duty and are included under other incidents (4,183 in 2010).
[4]Vessel-related injuries include those involving damage to vessels, such as collisions or groundings. Injuries not related to vessel casualties include those from falls overboard or from accidents involving onboard equipment.
[5]Includes industrial vessel, oil recovery, passenger (inspected), passenger (uninspected), recreational, research vessel, unclassified, and unknown data.
Note: Numbers may not add to totals because some injuries are counted in more than one mode.

Table 5-2. Injured Persons by Freight Transportation Mode: 1980-2010
Sources: Total: U.S. Department of Transportation, Research and Innovative Technology Administration, Bureau of Transportation Statistics, National Transportation Statistics, available at www.bts.gov as of August 29, 2011. **Highway:** 1980, 1990, and 2000: U.S. Department of Transportation, National Highway Transportation Safety Administration, National Center for Statistics and Analysis, *Traffic Safety Facts, Large Trucks* (annual issues). 2008- 2009: U.S. Department of Transportation, National Highway Transportation Safety Administration, National Center for Statistics and Analysis, *Traffic Safety Facts - Highlights* (August 2010). **Railroad:** U.S. Department of Transportation, Federal Railroad Administration, Office of Safety Analysis, available at http://safetydata.fra.dot.gov/officeofsafety/default.asp as of August 29, 2011. **Waterborne:** U.S. Department of Homeland Security, U.S. Coast Guard, Data Administration Division, personal communication, September 6, 2011. **Pipeline:** U.S. Department of Transportation, Pipeline and Hazardous Materials Safety Administration, Pipeline Safety Program, Pipeline Library, available at http://primis.phmsa.dot.gov/comm/PipelineLibrary.htm as of August 28, 2011.

Table 5-3. Accidents by Freight Transportation Mode: 1980-2010

	1980	1990	2000	2009	2010
Highway (passenger and freight)	**NA**	**6,471,000**	**6,394,000**	**5,505,000**	**U**
Large truck[1]	NA	371,801	437,861	296,000	U
Large truck[1] (percent of total)	NA	5.7	6.8	5.4	U
Rail (passenger and freight)					
Highway-rail grade crossing[2,3]	10,612	5,715	3,502	(R) 1,926	2,013
Railroad[2,4]	8,205	2,879	2,983	(R) 1,902	1,884
Waterborne (passenger and freight)					
Vessel-related	4,624	3,613	5,403	5,475	5,434
Pipeline					
Hazardous liquid pipeline	246	180	135	(R) 106	120
Gas pipeline	1,524	198	290	(R) 271	256

Key: NA = not available; R = revised; U = unavailable at date of publication.
[1]Large trucks are defined as trucks over the 10,000 pound gross vehicle weight rating, including single-unit trucks and truck tractors.
[2]Includes Amtrak.
[3]Includes both accidents and incidents. Most highway-rail grade crossing accidents are also counted under highway.
[4]Train accidents only.

The number of crashes and other freight transportation accidents has declined in all modes except water over that last 20 years, despite an increase in freight transportation activity.

Because most hazardous materials are transported by truck, most incidents related to the movement of hazardous materials occur on highways or in truck terminals. A very small share of hazardous materials transportation incidents are the result of a

Table 5-4. Hazardous Materials Transportation Incidents: 1980-2010

	1980	1990	2000	2009	2010
Total	**15,719**	**8,879**	**17,557**	**(R) 14,819**	**14,783**
Accident-related	486	297	394	(R) 290	353
Air	**223**	**297**	**1,419**	**(R) 1,356**	**1,293**
Accident-related	0	0	3	2	2
Highway	**14,161**	**7,296**	**15,063**	**(R) 12,730**	**12,635**
Accident-related	347	249	329	(R) 251	313
Rail	**1,271**	**1,279**	**1,058**	**(R) 643**	**750**
Accident-related	134	48	62	37	37
Water[1]	**34**	**7**	**17**	**(R) 90**	**105**
Accident-related	2	0	0	0	1
Other[2]	**30**	**0**	**0**	**NA**	**NA**
Accident-related	3	0	0	NA	NA

Key: NA = not available; R = revised.
[1]Water category includes only packaged (nonbulk) marine. Non-packaged (bulk) marine hazardous materials incidents are reported to the U.S. Coast Guard and are not included.
[2]Other category includes freight forwarders and modes not otherwise specified.
Notes: Hazardous materials transportation incidents required to be reported are defined in the Code of Federal Regulations (CFR), 49 CFR 171.15, 171.16 (Form F 5800.1). Hazardous materials deaths and injuries are caused by the hazardous material in commerce. Accident related means vehicular accident or derailment. Each modal total also includes fatalities caused by human error, package failure, and causes not elsewhere classified. As of 2005, the "Other" data is no longer included in the hazardous materials information system report.

Table 5-3. Accidents by Freight Transportation Mode: 1980-2010
Sources: Highway: 1980, 1990, and 2000: U.S. Department of Transportation, National Highway Transportation Safety Administration, National Center for Statistics and Analysis, *Traffic Safety facts, Large Trucks* (annual issues). 2009: U.S. Department of Transportation, National Highway Transportation Safety Administration, National Center for Statistics and Analysis, *Traffic Safety Facts - Highlights* (August 2010). **Railroad:** U.S. Department of Transportation, Federal Railroad Administration, Office of Safety Analysis, available at http://safetydata.fra.dot.gov/officeofsafety/default.asp as of August 20, 2011. **Waterborne:** U.S. Department of Homeland Security, U.S. Coast Guard, Data Administration Division, personal communication, September 6, 2011. **Pipeline:** U.S. Department of Transportation, Pipeline and Hazardous Materials Safety Administration, Pipeline Safety Program, Pipeline Library, available at http://primis.phmsa.dot.gov/comm/PipelineLibrary.htm as of August 28, 2011.

Table 5-4. Hazardous Materials Transportation Incidents: 1980-2010
Source: U.S. Department of Transportation, Pipeline and Hazardous Materials Safety Administration, Office of Hazardous Materials Safety, Hazardous Materials Information System Database, available at www.phmsa.dot.gov/hazmat/library/data-stats as of August 21, 2011.

vehicular crash or derailment (referred to as "accident related"). Approximately two percent of incidents were accident related in 2010, but they accounted for 85 percent of all property damage. Most incidents occur because of human error or package failure, particularly during loading and unloading.

Table 5-5. Commercial Motor Carrier Compliance Review Activity by Safety Rating: 2000-2010

	2000		2009		2010	
Safety rating	**Number**	**Percent**	**Number**	**Percent**	**Number**	**Percent**
Satisfactory	5,309	51.1	(R) 6,916	(R) 68.5	6,046	67.6
Conditional	3,354	32.3	(R) 2,731	(R) 27.1	2,506	28.0
Unsatisfactory	1,481	14.3	(R) 293	(R) 2.9	198	2.2
Not rated	245	2.4	152	1.5	190	2.1
Total	**10,389**	**100.0**	**(R) 10,092**	**100.0**	**8,940**	**100.0**

Key: R = revised.
Notes: A compliance review is an on-site examination of a motor carrier's records and operations to determine whether the carrier meets the Federal Motor Carrier Safety Administration's safety fitness standard. This entails having adequate safety management controls in place to ensure acceptable compliance with applicable safety requirements to reduce the risk associated with: alcohol and controlled substance testing violations; commercial driver's license standard violations; inadequate levels of financial responsibility; the use of unqualified drivers; improper use and driving of motor vehicles; unsafe vehicles operating on the highways; failure to maintain crash registers and copies of crash reports; the use of fatigued drivers; inadequate inspection, repair, and maintenance of vehicles; transportation of hazardous materials; driving and parking rule violations; violation of hazardous materials regulations; and motor vehicle crashes and hazardous materials incidents. Percents may not add to totals due to rounding. Numbers and percents may not add to totals due to rounding.

The safety fitness of motor carriers has improved markedly over the past few years. In 2010, the share of motor carriers rated satisfactory was nearly 68 percent, up from 51 percent in 2000.

Less than one-fourth of all roadside inspections of commercial vehicles result in the vehicle being taken out of service (OOS) for a serious violation. A much lower percentage of driver and hazardous materials inspections results in OOS orders. In 2009, about five percent of driver inspections and four percent of hazardous materials inspections result in an OOS order.

Fuel consumption is a major concern for environmental and other reasons. The number of gallons of fuel burned by commercial trucks decreased by nearly five percent from 2007 to 2009. This is due, in part, to increases in fuel costs, a slight decrease in the number of trucks on the road, and improved energy efficiency. Fuel use in Class I freight railroads declined from 4.1 billion gallons in 2007 to 3.2 billion gallons in 2009.

Table 5-5. Commercial Motor Carrier Compliance Review Activity by Safety Rating: 2000-2010
Source: U.S. Department of Transportation, Federal Motor Carrier Administration, Motor Carrier Management Information System (MCMIS), Compliance Review Activity by Safety Rating for Calendar Years, available at www.fmcsa.dot.gov as of August 28, 2011.

Table 5-6. Roadside Safety Inspection Activity Summary By Inspection Type: 2000-2010

	2000		2008		2009		2010	
	Number	Percent	Number	Percent	Number	Percent	Number	Percent
All inspections								
Number of inspections	2,453,776	100.0	3,317,187	100.0	3,530,382	100.0	3,569,373	100.0
With no violations	639,593	26.1	1,041,262	31.4	1,176,351	33.3	1,225,324	34.3
With violations	1,814,183	73.9	2,275,925	68.6	2,354,031	66.7	2,344,049	65.7
Driver inspections								
Number of inspections	2,396,688	100.0	3,176,813	100.0	3,429,882	100.0	3,470,871	100.0
With no violations	1,459,538	60.9	2,012,241	63.3	2,100,760	61.2	2,316,960	66.8
With violations	937,150	39.1	1,164,572	36.7	1,329,122	38.8	1,153,911	33.2
With OOS violations	191,031	8.0	204,542	6.4	196,625	5.7	183,350	5.3
Vehicle inspections								
Number of inspections	1,908,300	100.0	2,278,230	100.0	2,349,072	100.0	2,413,094	100.0
With no violations	584,389	30.6	746,362	33.6	779,891	33.2	834,551	34.6
With violations	1,323,911	69.4	1,513,868	66.5	1,569,181	66.8	1,578,543	65.4
With OOS violations	452,850	23.7	509,800	22.4	506,878	21.6	480,416	19.9
Hazardous materials inspections								
Number of inspections	133,486	100.0	192,516	100.0	222,587	100.0	211,154	100.0
With no violations	101,098	75.7	159,799	83.0	153,219	68.8	180,522	85.5
With violations	32,388	24.3	32,717	17.0	69,368	31.2	30,632	14.5
With OOS violations	9,964	7.5	9,648	5.0	10,323	4.6	9,210	4.4

Key: OOS = out of service.
Notes: A roadside inspection is an examination of individual commercial motor vehicles and drivers to determine if they are in compliance with the Federal Motor Carrier Safety Regulations and/or Hazardous Materials Regulations. Serious violations result in the issuance of driver or vehicle OOS orders. These violations must be corrected before the driver or vehicle can return to service. Moving violations also may be recorded in conjunction with a roadside inspection.

Table 5-7. Fuel Consumption by Transportation Mode: 2007-2009

	2007	2008	2009
Highway[1]			
Gasoline, diesel and other fuels (million gallons)	176,203	170,765	168,140
Truck, total	47,219	47,704	44,472
Single-unit 2-axle 6-tire or more truck	16,314	17,144	16,342
Combination truck	30,904	30,561	28,130
Truck (percent of total)	26.8	27.9	26.4
Rail, Class I (in freight service)			
Distillate / diesel fuel (million gallons)	4,062	3,886	3,192
Water			
Residual fuel oil (million gallons)	6,327	5,066	4,543
Distillate / diesel fuel oil (million gallons)	1,924	1,187	1,266
Gasoline (million gallons)	1,222	1,136	1,130
Pipeline			
Natural gas (million cubic feet)	621,364	(R) 647,956	598,216

Key: R = revised.
[1]Based on a new methodology, FHWA revised its annual vehicle miles travelled, number of vehicles, and fuel economy data beginning with 2007. Information on the new methodology is available at www.fhwa.dot.gov/policyinformation/statistics.cfm. Data in this table should not be compared to those in previous editions of Freight Facts and Figures.

Table 5-6. Roadside Safety Inspection Activity Summary By Inspection Type: 2000-2010
Source: U.S. Department of Transportation, Federal Motor Carrier Administration, Motor Carrier Management Information System (MCMIS), Roadside Inspection Activity Summary for Calendar Years, special tabulation, October 3, 2011.

Table 5-7. Fuel Consumption by Transportation Mode: 2007-2009
Sources: Highway: U.S. Department of Transportation, Federal Highway Administration, *Highway Statistics* (Washington, DC: annual issues), table VM-1, available at www.fhwa.dot.gov/policyinformation/statistics/2009/ as of October 5, 2011. **Rail:** Association of American Railroads, *Railroad Facts* (Washington, DC: annual issues), p. 40. **Water:** U.S. Department of Energy, Energy Information Administration, *Fuel Oil and Kerosene Sales 2009* (Washington, DC: 2010), tables 2, 4, and similar tables in earlier editions. **Pipeline:** U.S. Department of Energy, *Natural Gas Annual 2009* (Washington, DC: December 2010), table 15 and similar tables in earlier editions.

Table 5-8. Energy Consumption by Selected Freight Transportation Mode: 2007-2009 (trillions of BTUs)

	2007	2008	2009
Truck	6,326	6,382	5,944
Class I Rail	563	539	443
Water	1,367	1,065	997
Pipeline (natural gas only)	642	668	617

Notes: Based on a new methodology, FHWA revised its annual vehicle miles travelled, number of vehicles, and fuel economy data beginning with 2007. Information on the new methodology is available at www.fhwa.dot.gov/policyinformation/statistics.cfm. Data in this figure should not be compared to those in previous editions of *Freight Facts and Figures*. Data do not include energy consumed by oil pipelines (crude petroleum and petroleum products) or coal slurry/water slurry pipelines.

In 2009, trucking accounted for nearly three-fourths of freight transportation energy consumption followed by water, a distant second.

Miles per gallon by single-unit trucks (based on total travel and fuel consumption) have been stable in recent years. In 2009, single-unit trucks consumed 802 million fewer gallons than the previous year.

Table 5-9. Single-Unit Truck Fuel Consumption and Travel: 2007-2009

	2007	2008	2009
Number registered (thousands)	8,117	8,288	8,356
Vehicle miles (millions)	119,979	126,855	120,163
Fuel consumed (million gallons)	16,314	17,144	16,342
Average miles traveled per vehicle	14,782	15,306	14,380
Average miles traveled per gallon	7.4	7.4	7.4
Average fuel consumed per vehicle (gallons)	2,010	2,068	1,956

Notes: Based on a new methodology, FHWA revised its annual vehicle miles travelled, number of vehicles, and fuel economy data beginning with 2007. Information on the new methodology is available at www.fhwa.dot.gov/policyinformation/statistics.cfm. Data in this table should not be compared to those in previous editions of *Freight Facts and Figures*.

Table 5-8. Share of Energy Consumption by Freight Transportation Mode: 2009
Sources: Highway: Sources: Highway: U.S. Department of Transportation, Federal Highway Administration, Highway Statistics (Washington, DC: annual issues), table VM-1. Rail: Association of American Railroads, Railroad Facts (Washington, DC: annual issues), p. 40. Water: U.S. Department of Energy, Energy Information Administration, Fuel Oil and Kerosene Sales 2009 (Washington, DC: 2010), tables 2, 4, and similar tables in earlier editions; U.S. Department of Transportation, Federal Highway Administration, Highway Statistics (Washington, DC: annual issues), table MF-24, available at www.fhwa.dot.gov/policyinformation/statistics/2009/ as of September 20, 2011. Pipeline: U.S. Department of Energy, Natural Gas Annual 2009, (Washington, DC: December 2010), table 15 and similar tables in earlier editions.

Table 5-9. Single-Unit Truck Fuel Consumption and Travel: 2007-2009
Source: U.S. Department of Transportation, Federal Highway Administration, *Highway Statistics* (Washington, DC: annual issues), table VM-1. available at www.fhwa.dot.gov/policyinformation/statistics/2009/ as of October 5, 2011.

Miles per gallon by combination trucks (based on total travel and fuel consumption) remained the same between 2007 and 2009. During the same period, vehicle miles traveled by combination trucks declined by 16.4 billion (nearly 9 percent).

Table 5-10. Combination Truck Fuel Consumption and Travel: 2007-2009

	2007	2008	2009
Number registered (thousands)	2,635	2,585	2,617
Vehicle miles traveled (millions)	184,199	183,826	167,842
Fuel consumed (million gallons)	30,904	30,561	28,130
Average miles traveled per vehicle	69,896	71,106	64,132
Average miles traveled per gallon	6.0	6.0	6.0
Average fuel consumed per vehicle (gallons)	11,727	11,821	10,748

Notes: Based on a new methodology, FHWA revised its annual vehicle miles travelled, number of vehicles, and fuel economy data beginning with 2007. Information on the new methodology is available at www.fhwa.dot.gov/policyinformation/statistics.cfm. Data in this table should not be compared to those in previous editions of *Freight Facts and Figures*.

Table 5-11. Energy Intensities of Selected Domestic Freight Transportation Modes: 2007-2009

	2007	2008	2009
Highway[1] (Btu per vehicle mile)	(R) 21,238	(R) 21,008	21,127
Railroad (Class I) (Btu per freight car mile)	14,846	14,573	13,907
Railroad (Class I) (Btu per ton mile)	320	305	291

Key: Btu = British thermal unit; R = revised.
[1]Based on a new methodology, FHWA revised its annual vehicle miles travelled, number of vehicles, and fuel economy data beginning with 2007. Energy intensity data is based on FHWA fuel use methodology. Information on the new methodology is available at www.fhwa.dot.gov/policyinformation/statistics.cfm. Data in this table should not be compared to those in previous editions of *Freight Facts and Figures*.

Energy intensity is the amount of energy used in producing a given level of output or activity, in this case vehicle miles and ton miles. In recent years, the energy intensity of trucking has remained stable, while rail has improved slightly.

Table 5-10. Combination Truck Fuel Consumption and Travel: 2007-2009
Source: U.S. Department of Transportation, Federal Highway Administration, *Highway Statistics* (Washington, DC: annual issues), table VM-1. available at www.fhwa.dot.gov/policyinformation/statistics/2009/ as of October 5, 2011.

Table 5-11. Energy Intensities of Domestic Freight Transportation Modes: 2007-2009
Source: Oak Ridge National Laboratory, *Transportation Energy Data Book: Edition 30* (Oak Ridge, TN: annual issues), table 2.15, available at http://cta.ornl.gov/data/index.shtml as of August 19, 2011.

Table 5-12. Estimated National Average Vehicle Emissions Rates of Heavy-Duty and Light-Duty Vehicles: 2000- 2010 (grams per mile)

	2000	2005	2009	2010
Gasoline				
Cars				
Exhaust HC	0.88	0.49	0.33	0.29
Nonexhaust HC	0.61	0.38	0.25	0.22
Total HC	1.49	0.87	0.57	0.51
Exhaust CO	15.21	8.44	5.63	5.17
Exhaust NO_x	1.98	1.24	0.85	0.77
Light trucks				
Exhaust HC	1.31	0.98	0.79	0.74
Nonexhaust HC	0.63	0.44	0.35	0.33
Total HC	1.94	1.43	1.14	1.08
Exhaust CO	23.44	16.08	12.48	11.77
Exhaust NO_x	2.85	2.04	1.66	1.59
Heavy trucks				
Exhaust HC	2.75	1.87	1.38	1.30
Nonexhaust HC	1.22	0.94	0.81	0.76
Total HC	3.96	2.81	2.19	2.06
Exhaust CO	62.89	47.27	37.26	35.27
Exhaust NO_x	5.84	4.50	3.67	3.56
Diesel				
Cars				
Exhaust HC	0.26	0.16	0.08	0.08
Exhaust CO	1.14	0.57	0.45	0.54
Exhaust NO_x	1.36	1.96	1.38	1.23
Light trucks				
Exhaust HC	0.65	0.66	0.63	0.60
Exhaust CO	3.51	3.74	3.53	3.40
Exhaust NO_x	6.04	5.83	4.96	4.62
Heavy trucks				
Exhaust HC	1.06	1.10	0.94	0.92
Exhaust CO	4.59	4.64	3.72	3.57
Exhaust NO_x	23.20	16.84	12.15	10.97

Key: CO = carbon monoxide; HC = hydrocarbon; NO_x = nitrogen oxides.
Notes: This table is based on MOVES, the latest U.S. Environmental Protection Agency's (EPA) highway vehicle emissions factor model. Tables in previous editions of *Freight Facts and Figures* were based on the MOBILE6 model. Thus, the data in this table should not be compared to those in previous editions. Data are for July of each year.

Air quality is affected by freight vehicle emissions. Compared with gasoline-fueled cars and trucks, diesel-fueled heavy trucks emit small amounts of carbon monoxide (CO) but large amounts of nitrogen oxides (NO_x). However, since 2000 heavy-duty truck emissions of NO_x have declined by 50 percent.

Table 5-12. Estimated National Average Vehicle Emissions Rates of Heavy-Duty and Light-Duty Vehicles: 2000- 2010
Source: U.S. Environmental Protection Agency, National Vehicle and Fuel Emissions Laboratory, personal communication, September 19, 2011.

Most PM-10 emissions come from agricultural fields, wildfires, and fugitive dust. Consequently, freight transportation is a minor factor when considering total PM-10 emissions.

Table 5-13. Freight Nitrogen Oxides (NO_x) and Particulate Matter (PM-10) Emissions by Freight Transportation Mode: 2002

Mode	NO_x Emissions: Tons (thousands)	NO_x Emissions: Percent	NO_x Emissions: As a percent of: All mobile sources	NO_x Emissions: As a percent of: All sources	PM-10 Emissions: Tons (thousands)	PM-10 Emissions: Percent	PM-10 Emissions: As a percent of: All mobile sources	PM-10 Emissions: As a percent of: All sources
Heavy-duty vehicles	3,782.0	66.8	33.0	17.9	120.0	64.7	23.3	0.5
Freight railroads	857.2	15.1	7.5	4.1	21.3	11.5	4.1	0.1
Marine vessels	1,011.0	17.9	8.8	4.8	44.0	23.7	8.5	0.2
Air freight	8.2	0.1	0.1	0.0	0.3	0.2	0.1	0.0
Total	**5,658.4**	**100.0**	**49.4**	**26.8**	**185.6**	**100.0**	**36.0**	**0.8**

Note: Numbers and percents may not add to totals due to rounding.

Trucks are by far the largest contributor to freight emissions nationally, producing two-thirds of NO_x from the freight sector. However, as noted earlier, freight emissions of NO_x have declined significantly since the U.S. Environmental Protection Agency required the use of ultra low sulfur diesel (ULSD) fuel in heavy-duty trucks and other diesel-powered highway vehicles beginning in 2006.

Table 5-14. Current and Projected Nitrogen Oxides (NO_x) Emissions by Freight Transportation Mode: 2002 and 2020

	Tons (thousands)		Percent change, 2002 to 2020
	2002	2020	
Heavy-duty trucks	3,782.0	662.6	-82.5
Freight rail	857.2	486.4	43.3
Commercial marine	1,011.0	938.6	-7.2
Air freight	8.2	12.4	51.2
Total freight	**5,658.4**	**2,100.0**	**-62.9**

Note: Numbers and percents may not add to totals due to rounding.

Table 5-13. Freight Nitrogen Oxides (NO_x) and Particulate Matter (PM-10) Emissions by Freight Transportation Mode: 2002
Source: U.S. Department of Transportation, Federal Highway Administration, *Assessing the Effects of Freight Movement on Air Quality at the National and Regional Level, Final Report* (Washington, DC: 2005), available at www.fhwa.dot.gov/environment/freightaq/ as of August, 22, 2011.

Table 5-14. Current and Projected Nitrogen Oxides (NO_x) Emissions by Freight Transportation Mode: 2002 and 2020
Source: U.S. Department of Transportation, Federal Highway Administration, *Assessing the Effects of Freight Movement on Air Quality at the National and Regional Level, Final Report* (Washington, DC: 2005), available at www.fhwa.dot.gov/environment/freightaq/ as of August 22, 2011.

Table 5-15. Current and Projected Particulate Matter (PM-10) Emissions by Freight Transportation Mode: 2002 and 2020

	Tons (thousands)		Percent change, 2002 to 2020
	2002	2020	
Heavy-duty trucks	120.0	34.8	-71.0
Freight rail	21.3	13.0	-39.0
Commercial marine	44.0	44.1	0.2
Air freight	0.3	0.3	-10.0
Total freight	**185.6**	**92.1**	**-50.4**

Trucks produced two-thirds of PM-10 emissions from the freight sector. Freight-related PM-10 emissions are forecast to decline by 50 percent from 2002 to 2020, primarily from a reduction in heavy-duty truck emissions. The required use of ULSD fuel in heavy-duty trucks and other diesel-powered highway vehicles has helped to reduce PM emissions and enabled the use of advanced pollution control technologies to meet emissions standards.

In addition to CO, NO_x, and particulate matter emissions, the transportation sector releases large quantities of greenhouse gases (GHGs), such as carbon dioxide (CO_2), methane, nitrous oxide, and hydrofluorocarbons. Transportation is responsible for about 27 percent of all greenhouse gases emitted in the United States and nearly 7 percent of all greenhouse gases emitted globally.[1] When emissions from electricity generation are allocated among end-use sectors (on the basis of each sector's share of electricity consumption), the industrial sector produces the largest amount of GHG emissions, followed closely by transportation.

[1]Intergovernmental Panel on Climate Change, Climate Change 2007: Synthesis Report (Geneva, Switzerland: 2008).

Table 5-15. Current and Projected Particulate Matter (PM-10) Emissions by Freight Transportation Mode: 2002 and 2020
Source: U.S. Department of Transportation, Federal Highway Administration, *Assessing the Effects of Freight Movement on Air Quality at the National and Regional Level, Final Report* (Washington, DC: 2005), available at www.fhwa.dot.gov/environment/freightaq/ as of August, 22, 2011.

From 1990 to 2009, transportation GHG emissions rose by 17 percent. However, transportation sector emissions decreased by 4 percent from 2008 to 2009, likely the result of the economic downturn and higher fuel prices, which led to a decrease in vehicle travel and fuel consumption.

Table 5-16. U.S. Greenhouse Gas Emissions by Economic End-Use Sector: 1990-2009 (electricity-related emissions distributed among sectors)[1] (millions of metric tonnes of CO_2 equivalent)

Sector	1990	1995	2000	(R)2005	(R)2008	2009
Industry[2]	(R)2,238.3	2,228.0	(R)2314.4	2,162.5	2,146.5	1,910.9
Transportation[3]	1,548.2	1,698.3	1,935.8	2,022.2	1,895.5	1,816.9
Commercial	(R)947.7	1,000.2	(R)1,135.8	1,205.1	1,224.5	1,184.9
Residential	(R)953.8	1,024.5	(R)1,162.2	1,242.9	1,215.1	1,158.9
Agriculture	(R)460.0	497.1	(R)518.4	522.7	531.1	516.0
U.S. Territories[4]	33.7	40.7	(R)46.0	58.2	48.4	45.5
Total	**(R)6,181.8**	**6,488.8**	**(R)7,112.7**	**7,213.5**	**7,061.1**	**6,633.2**

Key: CO_2 = carbon dioxide; R = revised.

[1]Emissions from electricity generation are allocated to each economic end-use sector on the basis of each sector's share of aggregate electricity consumption. This method assumes each sector consumes electricity that is generated from the national average mix of fuels according to their carbon intensity.

[2]Industry includes manufacturing, construction, and mining. Six manufacturing industries--petroleum refinieries, chemicals, primary metals, paper, food, and nonmetallic mineral products--represent the vast majority of energy use and thus GHG emissions in the industrial sector.

[3]Includes emissions from military aircraft (14.3 million metric tonnes in 2009) and "other" transportation, primarily lubricants (8.5 million metric tonnes in 2009). Emissions from international bunker fuels are not included.

[4]Electricity-related emissions were not distributed to U.S. Territories.

Notes: Greenhouse gas (GHG) emissions include CO_2, methane, nitrous oxide, hydrofluorocarbons, perfluorocarbons, and sulfur hexafluoride. CO_2 equivalent is computed by multiplying the weight of the gas being measured by its estimated Global Warming Potential (GWP). The Intergovernmental Panel on Climate Change developed the GWP concept to compare the ability of one GHG to trap heat in the atmosphere to another gas. Carbon comprises 12/44 of CO_2 by weight. Numbers may not add to totals due to rounding.

Table 5-16. U.S. Greenhouse Gas Emissions by Economic End-Use Sector: 1990-2009

Source: U.S. Environmental Protection Agency, *Inventory of U.S. Greenhouse Gas Emissions and Sinks: 1990-2009*, EPA 430-R-11-005 (Washington, DC: April 15, 2011), table ES-8, available at http://epa.gov/climatechange/emissions/usinventoryreport.html as of August 10, 2011.

CO_2 accounts for nearly all of the transportation sector's GHG emissions, primarily from the combustion of fossil fuels. Almost all of the energy consumed by the sector is petroleum-based and includes motor gasoline, diesel fuel, jet fuel, and residual oil. Gasoline-fueled passenger cars and light-duty trucks are responsible for about 65 percent of transportation sector CO_2 emissions while the combustion of diesel fuel in heavy-duty trucks and jet fuel in aircraft produced much of the rest.

Table 5-17. U.S. Transportation Sector CO_2 Emissions from Fossil Fuel Combustion by Fuel Type: 1990-2009 (millions of metric tonnes of CO_2 equivalent)

Fuel	1990	1995	2000	2005	2008	2009
Petroleum	**(R)1,449.9**	**(R)1,569.8**	**1,773.9**	**(R)1863.5**	**(R)1,753.1**	1,683.4
Motor gasoline	(R)983.7	(R)1,041.8	(R)1,135.0	(R)1187.8	(R)1,130.3	1,125.7
Distillate fuel oil	262.9	324.2	402.5	458.1	(R)443.5	402.5
Jet fuel	176.2	170.9	199.8	(R)194.2	(R)155.1	138.8
Residual fuel[1]	22.6	29.1	33.3	19.3	(R)19.9	12.0
Aviation gasoline	3.1	2.7	2.5	2.4	2.0	1.8
Liquefied petroleum gas	(R)1.4	(R)1.1	0.7	(R)1.7	(R)2.4	2.5
Natural Gas	**36.0**	**38.4**	**35.6**	**33.1**	**(R)36.8**	**36.3**
Transportation Total[2]	**(R)1,485.9**	**(R)1,608.2**	**1,809.5**	**(R)1,896.6**	**(R)1789.9**	**1,719.7**
U.S. Total[2]	**(R)4,738.4**	**(R)5,031.5**	**(R)5,594.8**	**(R)5,753.2**	**(R)5565.9**	**5,209.0**
Transportation Sector as % of Total	**31.4**	**32.0**	**(R)32.3**	**(R)33.0**	**32.0**	**33.0**

Key: CO_2 = carbon dioxide; R = revised.
[1]Fluctuations in emissions estimates reflect data collection problems.
[2]Electricity-related emissions are not included in the transportation sector and U.S. totals.
Note: CO_2 equivalent is computed by multiplying the weight of the gas being measured by its estimated Global Warming Potential (GWP). The Intergovernmental Panel on Climate Change developed the GWP concept to compare the ability of one GHG to trap heat in the atmosphere to another gas. Carbon comprises 12/44 of CO_2 by weight. Numbers may not add to totals due to rounding. Electricity-related emissions are not included in this table.

Table 5-17. U.S. Transportation Sector CO2 Emissions from Fossil Fuel Combustion by Fuel Type: 1990-2009
Source: U.S. Environmental Protection Agency, *Inventory of U.S. Greenhouse Gas Emissions and Sinks: 1990-2009*, EPA 430-R-11-005 (Washington, DC: April 15, 2011), Annex 2, tables A-11, A-12, A-15, A-20, A-25, and A-30, available at http://epa.gov/climatechange/emissions/usinventoryreport.html as of August 10, 2011.

Table 5-18. U.S. Greenhouse Gas Emissions from Domestic Freight Transportation: 1990-2009 (millions of metric tonnes of CO_2 equivalent)

Mode	1990	1995	2000	2005	2008	2009	Percent change, 1990 to 2009
Trucking	231.1	(R)277.8	(R)354.5	(R)408.4	(R)403.1	365.6	58.2
Freight Rail	34.5	39.1	42.8	46.7	(R)44.5	37.2	7.8
Ships and Other Boats[1]	30.6	42.2	48.3	27.9	(R)22.6	13.5	-55.9
Pipelines[2]	36.1	(R)38.2	35.2	(R)32.2	(R)35.7	35.2	-2.5
Commercial Aircraft	23.7	24.8	29.6	26.0	18.0	16.4	-30.8
Freight Total	**356.0**	**422.1**	**510.5**	**(R)541.1**	**(R)523.7**	**467.9**	**31.4**
Passenger Total	**(R)1,145.7**	**(R)1,241.0**	**1,391.8**	**(R)1,452.5**	**(R)1,345.8**	**1,326.1**	**15.7**
Transportation Total[3]	**1,548.2**	**1,698.3**	**1,935.8**	**(R)2,022.2**	**(R)1,895.5**	**1,816.9**	**17.4**
Freight as % of Transportation Total	**23.0**	**24.9**	**26.4**	**26.8**	**27.6**	**25.8**	**12.2**

Key: CO_2 = carbon dioxide; R = revised.
[1]Fluctuations in emissions estimates reflect data collection problems.
[2]Includes only CO_2 emissions from natural gas used to power pipelines.
[3]Includes greenhouse gas emissions from military aircraft (14.3 million metric tonnes); "other" transportation, primarily lubricants (8.5 million metric tonnes); and electricity-related emissions. Emissions from international bunker fuels are not included.
Notes: U.S. Environmental Protection Agency (EPA) used U.S. Department of Energy fuel consumption data to allocate freight and passenger rail emissions. EPA used U.S. Department of Transportation, Research and Innovative Technology Administration, Bureau of Transportation Statistics data on freight shipped by commercial aircraft and the total number of passengers enplaned to split commercial aircraft emissions. Each passenger was estimated to weigh an average of 150 pounds and luggage was estimated to weigh 50 pounds. Previous Inventories included commercial aircraft emissions under passenger travel. CO2 equivalent is computed by multiplying the weight of the gas being measured by its estimated Global Warming Potential (GWP). The Intergovernmental Panel on Climate Change developed the GWP concept to compare the ability of one GHG to trap heat in the atmosphere to another gas. Carbon comprises 12/44 of CO2 by weight. Numbers may not add to totals due to rounding.

Since 1990, the rate of growth of GHG emissions from freight sources has been twice as fast as that for passenger travel (31.4 percent vs. 15.7 percent). Trucking accounted for the lion's share of freight emissions followed by freight rail, a distant second.

Table 5-18. U.S. Greenhouse Gas Emissions from Domestic Freight Transportation: 1990-2009
Source: U.S. Environmental Protection Agency, *Inventory of U.S. Greenhouse Gas Emissions and Sinks: 1990-2009*, EPA 430-R-11-005 (Washington, DC: April 15, 2011), table ES-8 and Annex 3, tables A-111 and A-112, available at www.epa.gov/climatechange/emissions/usinventoryreport.html as of August 10, 2011.

Between 1990 and 2009, medium- and heavy-duty truck emissions rose by more than 58 percent, the largest percentage increase of any major transportation mode. An increase in truck freight movement is largely responsible for the rise in emissions.

Table 5-19. Medium- and Heavy-Duty Truck Greenhouse Gas Emissions: 1990-2009 (millions of metric tonnes of CO_2 equivalent)

	1990	1995	2000	2005	2008	2009
Carbon dioxide (CO_2)	230.1	274.8	345.8	396.0	(R)390.4	353.1
Methane	0.2	0.2	0.1	0.1	0.1	0.1
Nitrous Oxide	0.8	1.0	1.2	1.1	1.0	0.8
Hydrofluorocarbons	<0.05	1.7	7.4	11.1	11.6	11.6
Total Truck (R)	**231.1**	**277.7**	**(R)354.6**	**(R)408.4**	**(R)403.1**	**365.5**
Total U.S. Transportation[1]	**(R)1,548.3**	**1,698.3**	**1,935.8**	**(R)2,022.2**	**(R)1,895.5**	**1,816.90**
Total U.S.[1]	**(R)6,181.8**	**6,488.8**	**(R)7,112.7**	**(R)7,213.5**	**(R)7,061.1**	**6,633.20**
Truck share of transportation total (percent)	**14.9**	**16.5**	**18.3**	**20.2**	**(R)21.3**	**20.1**
Truck share of U.S. total (percent)	**(R)3.7**	**4.3**	**5.0**	**5.7**	**(R)5.7**	**5.6**

Key: CO_2 = carbon dioxide; R = revised.
[1]Transportation and U.S. totals include greenhouse gas emissions from military aircraft (14.3 million metric tonnes in 2009); "other" transportation, primarily lubricants (8.5 million metric tonnes in 2009); and electricity-related emissions. Emissions from international bunker fuels are not included.
Notes: CO_2 equivalent is computed by multiplying the weight of the gas being measured by its estimated Global Warming Potential (GWP). The Intergovernmental Panel on Climate Change developed the GWP concept to compare the ability of one GHG to trap heat in the atmosphere to another gas. Carbon comprises 12/44 of CO_2 by weight. Medium- and heavy-duty trucks weigh 8,501 pounds and above. Numbers may not add to totals due to rounding.

Table 5-19. Medium- and Heavy-Duty Truck Greenhouse Gas Emissions: 1990-2009
Source: U.S. Environmental Protection Agency, *Inventory of U.S. Greenhouse Gas Emissions and Sinks: 1990-2009*, EPA 430-R-11-005 (Washington, DC: April 15, 2011), tables 2-15 and ES-8, available at http://epa.gov/climatechange/emissions/usinventoryreport.html as of August 10, 2011.