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 availablity of energy consumption data has declined with the demise of the Vehicle Inventory and Use Survey, and the environmental implications of freight transportation are being considered separately from passenger travel only recently.

TABLE 5-1. FATALITIES BY FREIGHT TRANSPORTATION MODE: 1980-2006

	1980	1990	2000	2005	2006
Total transportation fatalities (passenger and freight)	**NA**	**(R) 47,350**	**44,384**	**NA**	**NA**
Highway (passenger and freight)	**51,091**	**44,599**	**41,945**	**(R) 43,510**	**(P) 42,642**
Large truck occupants[1]	1,262	705	754	(R) 804	805
Others killed in crashes involving large trucks	4,709	4,567	4,528	(R) 4,409	NA
Large truck occupants[1] (percent)	2.5	1.6	1.8	(R) 1.9	NA
Others killed in crashes involving large trucks (percent)	9.2	10.2	10.8	(R) 10.1	NA
Railroad (passenger and freight)	**1,417**	**1,297**	**937**	**(R) 885**	**915**
Highway-rail crossing[2]	833	698	425	(R) 358	368
Railroad[2,3]	584	599	512	(R) 528	553
Waterborne (passenger and freight)	**487**	**186**	**(R) 111**	**(R) 80**	**(R) 87**
Vessel-related[4]	206	85	(R) 42	(R) 45	48
Freight ship	8	0	0	(R) 2	1
Tank ship	4	5	0	(R) 0	0
Tug / towboat	14	13	(R) 1	(R) 10	6
Offshore supply	NA	2	(R) 0	(R) 0	0
Fishing vessel	60	47	(R) 26	(R) 16	19
Mobile offshore drilling units	NA	0	0	(R) 0	1
Platform	NA	1	0	(R) 0	0
Freight barge	NA	0	0	(R) 1	2
Tank barge	NA	0	0	(R) 0	0
Miscellaneous	56	11	(R) 15	(R) 16	19
Not vessel-related[4]	281	101	(R) 69	(R) 35	39
Pipeline	**19**	**9**	**38**	**(R) 16**	19
Hazardous liquid pipeline	4	3	1	2	0
Gas pipeline	15	6	37	(R) 14	19

Key: NA = not available; R = revised; P = preliminary.
[1]Large trucks are defined as trucks over 10,000 pounds 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 (467 in 2005).
[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]Railroad fatalities are preliminary.
Note: Caution must be exercised in comparing fatalities across modes because significantly different definitions are used.

While the amount of freight transportation activity has increased in recent decades, the number of fatalities has declined or remained stable in each mode. Most fatalities involve people who are not in the freight business, such as trespassers on freight railroads.

TABLE 5-1. FATALITIES BY FREIGHT TRANSPORTATION MODE: 1980-2006
Sources: Total and Pipeline: U.S. Department of Transportation, Research and Innovative Technology Administration, Bureau of Transportation Statistics, *National Transportation Statistics 2007*, available at http://www.bts.gov/ as of August 2, 2007. **Highway:** National Center for Transportation Analysis, National Highway Transit Safety Administration, *Traffic Safety Facts, Large Trucks* (annual issues). 2006: National Center for Transportation Analysis, National Highway Transit Safety Administration, *Traffic Safety Facts* (July 2007). **Highway-Rail Grade Crossings:** U.S. Department of Transportation, Federal Railroad Administration, Office of Safety Analysis, http://safetydata.fra.dot.gov/officeofsafety/default.asp as of August 17, 2007. **Waterborne:** U.S. Department of Homeland Security, U.S. Coast Guard, Data Administration Division, personal communication, August 17, 2007.

Highways and railroads account for almost all of the people injured by freight transportation, and the number of those injuries has dropped substantially over the last quarter century.

TABLE 5-2. INJURED PERSONS BY FREIGHT TRANSPORTATION MODE: 1980-2006

	1980	1990	2000	2005	2006
TOTAL injured persons (passenger and freight)	**NA**	**NA**	**3,259,673**	**NA**	**NA**
Highway (passenger and freight)	**NA**	**(R) 3,230,666**	**(R) 3,188,750**	**2,699,000**	**(P) 2,575,000**
Large truck occupants[1]	NA	(R) 41,822	(R) 30,832	27,000	23,000
Others injured in crashes involving large trucks	NA	108,000	109,000	86,000	NA
Large truck occupants[1] (percent)	NA	(R) 1.3	(R) 1.0	(R) 1.0	NA
Others injured in crashes involving large trucks (percent)	NA	3.3	3.4	3.2	NA
Railroad (passenger and freight)	**62,246**	**25,143**	**11,643**	**(R) 9,231**	**7,880**
Highway-rail grade crossing[2]	(R) 3,550	2,407	1,219	(R) 1,020	1,021
Railroad[2,3]	(R) 58,696	22,736	10,424	(R) 8,219	6,881
Waterborne (passenger and freight)	**NA**	**NA**	**(R) 665**	**(R) 644**	**771**
Vessel-related[4]	180	175	(R) 151	(R) 140	177
Freight ship	8	10	5	(R) 12	19
Tank ship	9	13	3	(R) 3	2
Tug / towboat	27	19	(R) 18	(R) 20	22
Offshore supply	NA	9	(R) 6	(R) 1	6
Fishing vessel	28	31	(R) 21	(R) 29	33
Mobile offshore drilling units	NA	13	0	(R) 2	2
Platform	NA	9	0	(R) 1	0
Freight barge	NA	3	2	(R) 0	0
Tank barge	NA	3	0	(R) 1	0
Miscellaneous	98	12	(R) 96	(R) 71	93
Not related to vessel casualties[4]	NA	NA	(R) 514	(R) 504	594
Pipeline	**192**	**76**	**81**	**(R) 47**	**31**
Hazardous liquid pipeline	15	7	4	2	2
Gas pipeline	177	69	77	(R) 45	29

Key: NA = not available; R = revised; P = preliminary.
[1]Large trucks are defined as trucks over 10,000 pounds 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 (5,543 in 2005).
[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]Railroad injuries are preliminary.
Note: Numbers may not add to totals due to some injuries being counted in more than one mode.

TABLE 5-2. INJURED PERSONS BY FREIGHT TRANSPORTATION MODE: 1980-2006
Sources: Total and Pipeline: U.S. Department of Transportation, Research and Innovative Technology Administration, Bureau of Transportation Statistics, *National Transportation Statistics 2007*, available at http://www.bts.gov/ as of August 2, 2007. **Highway:** National Center for Transportation Analysis, National Highway Transit Safety Administration, *Traffic Safety Facts, Large Trucks* (annual issues). 2006: National Center for Transportation Analysis, National Highway Transit Safety Administration, *Traffic Safety Facts* (July 2007). **Highway-Rail Grade Crossings:** U.S. Department of Transportation, Federal Railroad Administration, Office of Safety Analysis, http://safetydata.fra.dot.gov/officeofsafety/default.asp as of August 17, 2007. **Waterborne:** U.S. Department of Homeland Security, U.S. Coast Guard, Data Administration Division, personal communication, August 17, 2007.

Table 5-3. Accidents by Freight Transportation Mode: 1980-2006

	1980	1990	2000	2005	2006
Highway (passenger and freight)	**NA**	**6,471,000**	**6,394,000**	**6,159,000**	**NA**
Large truck[1]	NA	(R) 371,801	(R) 437,861	442,000	NA
Large truck[1] (percent of total)	NA	(R) 5.7	(R) 6.8	7.2	NA
Rail (passenger and freight)					
Highway-rail grade crossing[2,3]	(R) 10,612	5,715	3,502	(R) 3,053	2,920
Railroad[2,4]	8,205	2,879	2,983	(R) 3,242	2,876
Waterborne (passenger and freight)					
Vessel-related	4,624	3,613	(R) 13,546	(R) 4,977	5,400
Pipeline					
Hazardous liquid pipeline	246	180	146	(R) 137	108
Gas pipeline	1,524	198	234	(R) 352	274

Key: NA = not available; R = revised.
[1]Large trucks are defined as trucks over 10,000 pounds 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 accidents in freight transportation has declined in all modes over the last quarter century in spite of the increase in freight activity.

Because most hazardous materials are transported by truck, most incidents related to 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 vehicular crash or derailment (referred to as

Table 5-4. Hazardous Materials Transportation Incidents: 1980-2006

	1980	1990	2000	2005	2006
Total	**15,719**	**8,879**	**17,557**	**(R) 15,917**	**20,228**
Accident-related	486	297	394	(R) 379	340
Air	**223**	**297**	**1,419**	**(R) 1,654**	**2,409**
Accident-related	0	0	3	(R) 9	7
Highway	**14,161**	**7,296**	**15,063**	**(R) 13,450**	**17,051**
Accident-related	347	249	329	(R) 319	290
Rail	**1,271**	**1,279**	**1,058**	**(R) 744**	**700**
Accident-related	134	48	62	(R) 51	43
Water[1]	**34**	**7**	**17**	**(R) 69**	**68**
Accident-related	2	0	0	0	0
Other[2]	**30**	**0**	**0**	**NA**	**NA**
Accident-related	3	0	0	NA	NA

Key: R = revised; NA = not available.
[1]Water category only includes 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 category is no longer included in the hazardous materials information system report.

Table 5-3. Accidents by Freight Transportation Mode: 1980-2006
Sources: Highway: National Center for Transportation Analysis, National Highway Transit Safety Administration, *Traffic Safety Facts, Large Trucks* (annual issues). 2006: National Center for Transportation Analysis, National Highway Transit Safety Administration, *Traffic Safety Facts* (July 2007). **Highway-Rail Grade Crossings:** U.S. Department of Transportation, Federal Railroad Administration, Office of Safety Analysis, http://safetydata.fra.dot.gov/officeofsafety/default.asp as of August 17, 2007. **Waterborne:** U.S. Department of Homeland Security, U.S. Coast Guard, Data Administration Division, personal communication, August 17, 2007. **Pipeline:** U.S. Department of Transportation, Research and Innovative Technology Administration, Bureau of Transportation Statistics, National Transportation Statistics 2007, available at http://www.bts.gov/ as of August 2, 2007.

Table 5-4. Hazardous Materials Transportation Incidents: 1980-2006
Source: U.S. Department of Transportation, Pipeline and Hazardous Materials Safety Administration, Office of Hazardous Materials Safety, Hazardous Materials Information System Database, available at http://hazmat.dot.gov as of June 4, 2007.

"accident-related"). In 2006, less than 2 percent of incidents were accident-related. Most incidents occur because of human error or package failure, particularly during loading and unloading. While less than 2 percent of incidents were accident-related in 2006, they accounted for nearly 84 percent of all property damage.

TABLE 5-5. COMMERCIAL MOTOR CARRIER COMPLIANCE REVIEW ACTIVITY BY SAFETY RATING: 2000-2006

	2000		2004		2005		2006	
Safety rating	**Number**	**Percent**	**Number**	**Percent**	**Number**	**Percent**	**Number**	**Percent**
Satisfactory	5,309	51.1	(R) 4,432	57.9	(R) 5,258	64.8	6,833	66.0
Conditional	3,354	32.3	(R) 2,302	30.1	(R) 2,116	26.1	2,614	25.3
Unsatisfactory	1,481	14.3	(R) 701	9.2	(R) 529	6.5	659	6.4
Not rated	245	2.4	(R) 216	2.8	(R) 211	2.6	247	2.4
Total	**10,389**	**100.0**	**(R) 7,651**	**100.0**	**(R) 8,114**	**100.0**	**10,353**	**100.0**

Key: R = revised.
Note: 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; motor vehicle crashes and hazardous materials incidents.

The safety fitness of motor carriers has improved markedly over the past few years. In 2006, the share of motor carriers rated satisfactory was 66 percent, up from 51 percent in 2000.

Less than one-quarter of 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 2006, only 7 percent of driver inspections and about 5 percent of hazardous materials inspections resulted in an OOS order.

The number of gallons of fuel burned by commercial trucks increased significantly over the past 25 years while fuel use in the water and pipeline modes declined. Between 1980 and 2005, the fuel consumed in highway freight transportation increased from 20 billion to 33 billion gallons annually. This is due to a substantial increase in the number of trucks on the road, an increase in the average number of miles traveled per truck,

TABLE 5-5. COMMERCIAL MOTOR CARRIER COMPLIANCE REVIEW ACTIVITY BY SAFETY RATING: 2000-2006
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 http://www.fmcsa.dot.gov/ as of June 4, 2007.

Table 5-6. Roadside Safety Inspection Activity Summary by Inspection Type: 2000-2006

	2000		2004		2005		2006	
	Number	Percent	Number	Percent	Number	Percent	Number	Percent
All inspections								
Number of inspections	2,453,776	100.0	(R) 3,019,504	100.0	(R) 3,026,094	100.0	3,193,397	100.0
With no violations	639,593	26.1	(R) 810,870	26.9	(R) 821,869	27.2	897,020	28.1
With violations	1,814,183	73.9	(R) 2,208,634	73.1	(R) 2,204,225	72.8	2,296,377	71.9
Driver inspections								
Number of inspections	2,396,688	100.0	(R) 2,962,312	100.0	(R) 2,964,492	100.0	3,056,743	100.0
With no violations	1,459,538	60.9	(R) 1,893,227	63.9	(R) 1,882,527	63.5	1,931,724	63.2
With violations	937,150	39.1	(R) 1,069,085	36.1	(R) 1,081,965	36.5	1,125,019	36.8
With OOS violations	191,031	8.0	(R) 197,347	6.7	(R) 195,832	6.6	216,783	7.1
Vehicle inspections								
Number of inspections	1,908,300	100.0	(R) 2,253,217	100.0	(R) 2,201,740	100.0	2,317,877	100.0
With no violations	584,389	30.6	(R) 698,495	31.0	(R) 688,617	31.3	759,653	32.8
With violations	1,323,911	69.4	(R) 1,554,722	69.0	(R) 1,513,123	68.7	1,558,224	67.2
With OOS violations	452,850	23.7	(R) 531,933	23.6	(R) 514,314	23.4	532,685	23.0
Hazardous materials inspections								
Number of inspections	133,486	100.0	(R) 179,234	100.0	(R) 180,891	100.0	183,925	100.0
With no violations	101,098	75.7	(R) 145,787	81.3	(R) 147,602	81.6	150,068	81.6
With violations	32,388	24.3	(R) 33,447	18.7	(R) 33,289	18.4	33,857	18.4
With OOS violations	9,964	7.5	(R) 9,955	5.6	(R) 9,871	5.5	9,795	5.3

Key: OOS = out of service; R = revised.
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 out of service (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: 1980-2005

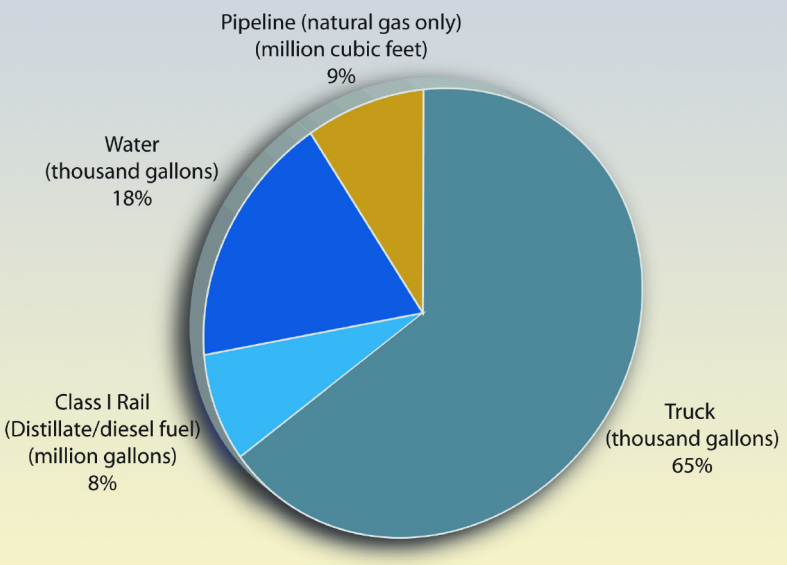
	1980	1990	2000	2004	2005
Highway					
Gasoline, diesel and other fuels (million gallons)	114,960	130,755	162,555	(R) 173,531	174,287
Truck, total	19,960	24,490	35,229	(R) 33,150	33,453
Single-unit 2-axle 6-tire or more truck	6,923	8,357	9,563	(R) 8,959	9,042
Combination truck	13,037	16,133	25,666	(R) 24,191	24,411
Truck (percent of total)	17.4	18.7	21.7	(R) 19.1	19.2
Rail, Class I (in freight service)					
Distillate / diesel fuel (million gallons)	3,904	3,115	3,700	4,059	4,098
Water					
Residual fuel oil (million gallons)	8,952	6,326	6,410	4,690	5,179
Distillate / diesel fuel oil (million gallons)	1,478	2,065	2,261	2,140	2,006
Gasoline (million gallons)	1,052	1,300	1,124	(R) 1,033	1,261
Pipeline					
Natural gas (million cubic feet)	634,622	659,816	642,210	(R) 566,187	584,779

Key: R = revised.

Table 5-6. Roadside Safety Inspection Activity Summary by Inspection Type: 2000-2006
Source: U.S. Department of Transportation, Federal Motor Carrier Administration, Motor Carrier Management Information System (MCMIS), Roadside Inspection Activity Summary for Calendar Years, available at www.fmcsa.dot.gov as of June 4, 2007.

Table 5-7. Fuel Consumption by Transportation Mode: 1980-2005
Sources: Highway: U.S. Department of Transportation, Federal Highway Administration, *Highway Statistics 2005* (Washington, DC: 2005), table VM-1 and similar tables in earlier editions. **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 2005* (Washington, DC: 2005), tables 2, 4, and similar tables in earlier editions. **Pipeline:** U.S. Department of Energy, *Natural Gas Annual 2005*, DOE/EIA-0131(04) (Washington, DC: December 2005), table 15 and similar tables in earlier editions.

Figure 5-1. Energy Consumption by Freight Transportation Mode: 2005



Note: Data do not include energy consumed by oil pipelines (crude petroleum and petroleum products) nor coal slurry/water slurry pipelines.

and a doubling of truck-miles traveled. Over the same period, fuel use in Class I freight railroads increased slightly from 3.9 billion gallons to 4.1 billion gallons.

In 2005, trucking accounted for 65 percent of freight transportation energy consumption. Water transportation accounted for 18 percent, natural gas pipelines for 9 percent, and Class I railroads for 8 percent.

Over the past two decades, miles per gallon by single-unit trucks (based on total travel and fuel consumption) increased by more than 50 percent. Between 1980 and 2005, the fuel consumed increased 31 percent whereas miles traveled nearly doubled, indicating that miles per gallon increased from 5.8 to 8.8.

Table 5-8. Single-Unit Truck Fuel Consumption and Travel: 1980-2005

	1980	1990	2000	2004	2005
Number registered (thousands)	4,374	4,487	5,926	6,161	6,395
Vehicle-miles (millions)	39,813	51,901	70,500	(R) 78,441	79,174
Fuel consumed (million gallons)	6,923	8,357	9,563	(R) 8,959	9,042
Average miles traveled per vehicle	9,103	11,567	11,897	(R) 12,732	12,380
Average miles traveled per gallon	5.8	6.2	7.4	8.8	8.8
Average fuel consumed per vehicle (gallons)	1,583	1,862	1,614	(R) 1,454	1,414

Key: R = revised.

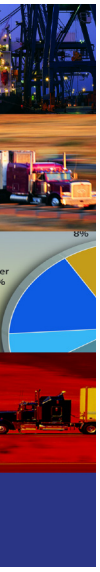


Figure 5-1. Energy Consumption by Freight Transportation Mode: 2005
Sources: Truck: U.S. Department of Transportation, Federal Highway Administration, *Highway Statistics*, (Washington, DC: annual issues), table VM-1. **Rail:** Association of American Railroads, *Railroad Facts* (Washington, DC: 2006), p. 40. **Water:** U.S. Department of Energy, Energy Information Administration, *Fuel Oil and Kerosene Sales* (Washington, DC: annual issues), tables 2 and 4; U.S. Department of Transportation, Federal Highway Administration, *Highway Statistics* (Washington, DC: annual issues), table MF-24. **Pipeline:** U.S. Department of Energy, *Natural Gas Annual 2005*, DOE/EIA-0131(04) (Washington, DC: December 2006), table 15.

Table 5-8. Single-Unit Truck Fuel Consumption and Travel: 1980-2005
Source: U.S. Department of Transportation, Federal Highway Administration, *Highway Statistics 2005* (Washington, DC: 2005), table VM-1 and similar tables in earlier editions.

In contrast to single-unit trucks, miles per gallon by combination trucks (based on total travel and fuel consumption) increased by only 11 percent over the past 25 years. Consequently, the gallons of fuel consumed increased by nearly 87 percent, and miles traveled more than doubled between 1980 and 2005.

TABLE 5-9. COMBINATION-TRUCK FUEL CONSUMPTION AND TRAVEL: 1980-2005

	1980	1990	2000	2004	2005
Number registered (thousands)	1,417	1,709	2,097	2,010	2,087
Vehicle-miles traveled (millions)	68,678	94,341	135,020	(R) 142,370	143,662
Fuel consumed (million gallons)	13,037	16,133	25,666	(R) 24,191	24,411
Average miles traveled per vehicle	48,472	55,206	64,399	(R) 70,819	68,845
Average miles traveled per gallon	5.3	5.8	5.3	5.9	5.9
Average fuel consumed per vehicle (gallons)	9,201	9,441	12,241	(R) 12,033	11,698

Key: R = revised.

Diesel prices were about 80 percent higher in June 2007 than 10 years earlier (in inflation-adjusted terms). Over that period prices bottomed out in February 1999 at $1.21 a gallon (in $ July 2007).

FIGURE 5-2. MONTHLY DIESEL PRICES: 1997-2007 (CENTS PER GALLON)

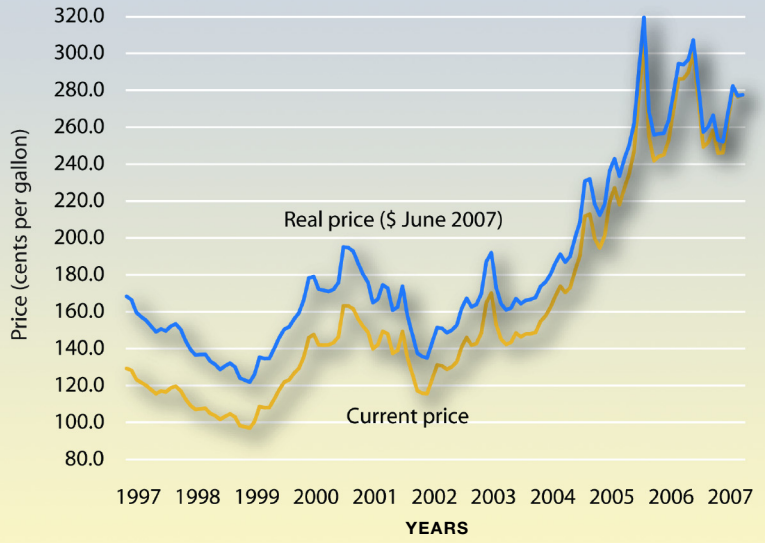


TABLE 5-9. COMBINATION-TRUCK FUEL CONSUMPTION AND TRAVEL: 1980-2005
Source: U.S. Department of Transportation, Federal Highway Administration, *Highway Statistics 2005* (Washington, DC: 2005), table VM-1 and similar tables in earlier editions.

FIGURE 5-2. MONTHLY DIESEL PRICES: 1997-2007 (CENTS PER GALLON)
Sources: Diesel price: U.S. Department of Energy, Energy Information Agency, U.S. Petroleum Prices, available at www.eia.doe.gov as of August 6, 2007. **Consumer price index:** U.S. Department of Labor, Bureau of Labor Statistics, Consumer Price Index – All Urban Consumers, Monthly, available at www.bls.gov as of August 6, 2007.

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. Since 1980 the energy intensity of both trucking and freight rail has improved. However, over the same period, domestic freight water transportation, measured by Btu per ton-mile, has become less energy efficient.

TABLE 5-10. ENERGY INTENSITIES OF DOMESTIC FREIGHT TRANSPORTATION MODES: 1980-2005

	1980	1990	2000	2004	2005
Highway (Btu per vehicle-mile)	24,757	22,795	23,448	20,540	20,539
Railroad (Class I) (Btu per freight car-mile)	18,742	16,619	14,917	15,274	15,152
Railroad (Class I) (Btu per ton-mile)	597	420	352	341	337
Domestic Water (Btu per ton-mile)	358	387	473	510	514

Key: Btu = British thermal unit.

TABLE 5-10. ENERGY INTENSITIES OF DOMESTIC FREIGHT TRANSPORTATION MODES: 1980-2005
Source: Oak Ridge National Laboratory, *Transportation Energy Data Book: Edition 25* (Oak Ridge, TN: 2007).

Air quality is affected by emissions from freight vehicles. 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).

Freight transportation is a major source of NO_x emissions accounting for 27 percent of all NO_x emissions in the United States and one-half of emissions from mobile sources. Freight transportation also accounts for about one-third of emissions of particulate matter 10 microns in diameter (PM-10) from mobile sources. Most PM-10, however, comes from agricultural fields, wildfires, and fugitive dust. Consequently, freight transportation is a minor factor when considering total PM-10 emissions.

Table 5-11. Estimated National Average Vehicle Emissions Rates of Heavy-Duty and Light-Duty Vehicles: 1990-2005 (Grams per Mile)

	1990	2000	2005	2006
Gasoline (assuming zero RFG)				
Cars				
Exhaust HC	2.79	0.97	0.52	0.46
Nonexhaust HC	1.21	0.92	0.72	0.68
Total HC	3.99	1.89	1.25	1.13
Exhaust CO	42.89	18.53	12.57	10.87
Exhaust NO_x	2.70	1.29	0.92	0.79
Light trucks				
Exhaust HC	3.68	1.45	0.78	0.69
Nonexhaust HC	1.36	0.97	0.76	0.71
Total HC	5.04	2.42	1.54	1.40
Exhaust CO	56.23	26.81	16.23	14.33
Exhaust NO_x	2.62	1.54	1.21	1.09
Heavy trucks				
Exhaust HC	3.66	1.22	0.64	0.53
Nonexhaust HC	2.74	1.62	1.24	1.14
Total HC	6.40	2.84	1.88	1.67
Exhaust CO	85.61	31.08	16.73	14.51
Exhaust NO_x	7.19	5.26	4.28	3.73
Diesel				
Cars				
Exhaust HC	0.68	0.80	0.58	0.48
Exhaust CO	1.49	1.78	1.57	1.41
Exhaust NO_x	1.83	1.81	1.32	1.11
Light trucks				
Exhaust HC	1.59	1.02	0.80	0.79
Exhaust CO	2.67	1.77	1.37	1.34
Exhaust NO_x	2.71	1.76	1.37	1.30
Heavy trucks				
Exhaust HC	2.21	0.79	0.54	0.51
Exhaust CO	10.06	4.10	3.05	2.90
Exhaust NO_x	23.34	18.05	11.45	10.55

Key: CO = carbon monoxide; HC = hydrocarbon; NO_x = nitrogen oxides; RFG = reformulated gasoline.

Table 5-12. Nitrogen Oxides (NO_x) and Particulate Matter (PM-10) Emissions by Freight Transportation Mode: 2002

	NO_x Emissions				PM-10 Emissions			
			As percent of:				As percent of:	
Mode	Tons	Percent	All mobile sources	All sources	Tons	Percent	All mobile sources	All sources
Heavy-duty vehicles	3,782,000	66.8	33.0	17.9	120,000	64.7	23.3	0.5
Freight railroads	857,200	15.1	7.5	4.1	21,300	11.5	4.1	0.1
Marine vessels	1,011,000	17.9	8.8	4.8	44,000	23.7	8.5	0.2
Air freight	8,200	0.1	0.1	0.0	300	0.2	0.1	0.0
Total	5,658,400	100.0	49.4	26.8	185,600	100.0	36.0	0.8

Table 5-11. Estimated National Average Vehicle Emissions Rates of Heavy-Duty and Light-Duty Vehicles: 1990-2005 (Grams per Mile)
Source: U.S. Environmental Protection Agency, National Vehicle and Fuel Emissions Laboratory, personal communication, August 8, 2007.

Table 5-12. 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*, April 2005, located at: http://www.fhwa.dot.gov/environment/freightaq/.

Table 5-13. Current and Future Nitrogen Oxides (NO_x) Emissions by Freight Transportation Mode: 2002, 2010, 2020

	Tons			Percent change, 2002-2010	Percent change, 2002-2020
	2002	2010	2020		
Heavy-duty trucks	3,782,000	2,186,900	662,600	-42	-82
Freight rail	857,200	563,200	486,400	-34	-43
Commercial marine	1,011,000	987,200	938,600	-2	-7
Air freight	8,200	10,000	12,400	22	51
Freight total	5,658,400	3,747,299	2,099,999	-34	-63

Freight emissions of NO_X are forecast to decline by almost two-thirds over the next two decades. Trucks are by far the largest contributor to freight emissions nationally, producing two-thirds of NO_X from the freight sector. The U.S. Environmental Protection Agency passed new rules requiring the use of ultra low sulfur diesel (ULSD) fuel in heavy-duty trucks and other diesel-powered highway vehicles beginning in June 2006. ULSD will reduce emissions of NO_X and enable the use of advanced pollution control technologies to meet 2007 emissions standards.

Freight emissions of PM-10 are forecast to decline by one-half over the next two decades. As in the case of NO_X, trucks are by far the largest contributor to freight emissions nationally, producing two-thirds PM-10 from the freight sector. New rules requiring the use of ultra low sulfur diesel (ULSD) fuel in heavy-duty trucks and other diesel-powered highway vehicles will reduce emissions of PM and enable the use of advanced pollution control technologies to meet 2007 emissions standards.

Table 5-14. Current and Future Particulate Matter (PM-10) Emissions by Freight Transportation Mode: 2002, 2010, 2020

	Tons			Percent change, 2002-2010	Percent change, 2002-2020
	2002	2010	2020		
Heavy-duty trucks	120,000	65,380	34,760	-46	-71
Freight rail	21,300	(R) 15,730	(R) 12,990	(R) -26	(R) -39
Commercial marine	44,000	(R) 42,930	(R) 44,080	(R) -2	(R) 0
Air freight	300	290	270	-3	-10
Freight total	185,600	124,329	(R) 92,099	(R) -33	(R) -50

Key: R = revised.

Table 5-13. Current and Future Nitrogen Oxides (NOx) Emissions by Freight Transportation Mode: 2002, 2010, 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*, April 2005, available at: http://www.fhwa.dot.gov/environment/freightaq/.

Table 5-14. Current and Future Particulate Matter (PM-10) Emissions by Freight Transportation Mode: 2002, 2010, 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*, April 2005, located at: http://www.fhwa.dot.gov/environment/freightaq/.