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

Growing demand for freight transportation heightens concerns about its safety, energy consumption, and environmental consequences. Most of our current knowledge is in safety, with some in energy consumption. More information is needed to understand and fix freight-related environmental issues.

TABLE 5-1. TRANSPORTATION FATALITIES BY FREIGHT TRANSPORTATION MODE

	1980	1990	2000	2004	2005
Total transportation fatalities (passenger and freight)	**NA**	**47,347**	**44,384**	**(R) 45,005**	**NA**
Highway (passenger and freight)	**51,091**	**44,599**	**41,945**	**(R) 42,836**	**44,443**
Large truck occupants[1]	1,262	705	754	(R) 766	803
Others killed in crashes involving large trucks	4,709	4,567	4,528	(R) 4,469	4,409
Large truck occupants[1] (percent)	2.5	1.6	1.8	1.8	1.8
Others killed in crashes involving large trucks (percent)	9.2	10.2	10.8	10.4	10.3
Railroad (passenger and freight)	**1,417**	**1,297**	**937**	**(R) 896**	**892**
Highway-rail crossing[2]	833	698	425	(R) 370	357
Railroad[2,3]	584	599	512	(R) 526	535
Waterborne (passenger and freight)	**487**	**186**	**187**	**93**	**U**
Vessel-related[4]	206	85	53	36	U
Freight ship	8	0	0	2	U
Tank ship	4	5	0	3	U
Tug / towboat	14	13	2	1	U
Offshore supply	NA	2	3	0	U
Fishing vessel	60	47	30	14	U
Mobile offshore drilling units	NA	0	0	0	U
Platform	NA	1	0	0	U
Freight barge	NA	0	0	1	U
Tank barge	NA	0	0	0	U
Miscellaneous	56	11	6	6	U
Not vessel-related[4]	281	101	134	57	U
Pipeline	**19**	**9**	**38**	**(R) 23**	**19**
Hazardous liquid pipeline	4	3	1	5	2
Gas pipeline	15	6	37	(R) 18	17

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 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.

About 5,200 people died in crashes involving large trucks in 2005, although only 803 of those were large-truck occupants. Fatalities involving large trucks are about 12 percent of all highway fatalities, while trucks account for about 8 percent of highway vehicle-miles traveled (vmt). Despite a doubling of large truck travel between 1980 and 2005, the number of fatalities involving large trucks declined 13 percent over this period.

TABLE 5-1. TRANSPORTATION FATALITIES BY FREIGHT TRANSPORTATION MODE
Source: U.S. Department of Transportation, Research and Innovative Technology Administration, Bureau of Transportation Statistics, *National Transportation Statistics 2006*, available at http://www.bts.gov/ as of September 15, 2006

Table 5-2. Injured Persons by Freight Transportation Mode

	1980	1990	2000	2004	2005
TOTAL injured persons (passenger and freight)	**NA**	**NA**	**3,259,673**	**2,818,446**	**NA**
Highway (passenger and freight)	**NA**	**3,231,000**	**3,189,000**	**2,788,000**	**2,699,000**
Large truck occupants[1]	NA	42,000	31,000	27,000	27,000
Others injured in crashes involving large trucks	NA	108,000	109,000	89,000	86,000
Large truck occupants[1] (percent)	NA	1.3	1.0	1.0	1.0
Others injured in crashes involving large trucks (percent)	NA	3.3	3.4	3.2	3.2
Railroad (passenger and freight)	**62,246**	**25,143**	**11,643**	**(R) 9,088**	**9,105**
Highway-rail grade crossing[2]	3,890	2,407	1,219	(R) 1,088	989
Railroad[2,3]	58,356	22,736	10,424	(R) 8,000	8,116
Waterborne (passenger and freight)	**NA**	**NA**	**757**	**703**	**U**
Vessel-related[4]	180	175	150	198	U
Freight ship	8	10	5	4	U
Tank ship	9	13	3	7	U
Tug / towboat	27	19	10	22	U
Offshore supply	NA	9	5	5	U
Fishing vessel	28	31	23	36	U
Mobile offshore drilling units	NA	13	0	0	U
Platform	NA	9	0	0	U
Freight barge	NA	3	2	5	U
Tank barge	NA	3	0	1	U
Miscellaneous	98	12	8	25	U
Not related to vessel casualties[4]	NA	NA	607	505	U
Pipeline	**192**	**76**	**81**	**(R) 60**	**49**
Hazardous liquid pipeline	15	7	4	(R) 16	2
Gas pipeline	177	69	77	(R) 44	47

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 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.

About 113,000 people are injured each year in freight transportation. Like fatalities, most injuries involve trucks. Yet, these injuries account for less than 5 percent of the total number of people injured on the highway each year. Approximately, 10 percent of injures are the result of non-highway related incidents, mostly railroading. Since 1980, railroading has become much safer with a drop in injuries of more than 80 percent.

Table 5-2. Injured Persons by Freight Transportation Mode
Source: U.S. Department of Transportation, Research and Innovative Technology Administration, Bureau of Transportation Statistics, *National Transportation Statistics 2006*, available at http://www.bts.gov/ as of September 15, 2006.

Large trucks were involved in about 7 percent of all highway crashes in 2005. The estimated number of crashes in 2005 is up by about 12 percent since 1990, a good deal less than the roughly 50 percent increase in truck-miles driven over the same period.

Table 5-3. Transportation Accidents by Freight Transportation Mode

	1980	1990	2000	2004	2005
Highway (passenger and freight)	**NA**	**6,471,000**	**6,394,000**	**6,181,000**	**6,159,000**
Large truck[1]	NA	372,000	438,000	416,000	442,000
Large truck[1] (percent of total)	NA	5.7	6.9	6.7	7.2
Rail (passenger and freight)					
Highway-rail grade crossing[2,3]	10,796	5,715	3,502	(R) 3,074	3,040
Railroad[2,4]	8,205	2,879	2,983	(R) 3,367	3,187
Waterborne (passenger and freight)					
Vessel-related	4,624	3,613	5,403	4,962	NA
Pipeline					
Hazardous liquid pipeline	246	180	146	(R) 142	136
Gas pipeline	1,524	198	234	(R) 297	353

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.

Table 5-3. Transportation Accidents by Freight Transportation Mode
Source: U.S. Department of Transportation, Research and Innovative Technology Administration, Bureau of Transportation Statistics, *National Transportation Statistics 2006*, available at http://www.bts.gov/ as of September 15, 2006.

Table 5-4. Hazardous Materials Transportation Incidents

	1980	1990	2000	2004	2005
Total	**15,719**	**8,879**	**17,557**	**(R) 14,879**	**14,624**
Accident-related	486	297	(R) 394	(R) 329	315
Air	**223**	**297**	**1,419**	**995**	**1,505**
Accident-related	0	0	(R) 3	0	7
Highway	**14,161**	**7,296**	**15,063**	**(R) 13,097**	**12,359**
Accident-related	347	249	(R) 329	(R) 282	263
Rail	**1,271**	**1,279**	**1,058**	**(R) 771**	**693**
Accident-related	134	48	62	(R) 47	45
Water[1]	**34**	**7**	**17**	**(R) 16**	**67**
Accident-related	2	0	0	0	0
Other[2]	**30**	**0**	**0**	**0**	**0**
Accident-related	3	0	0	0	0

Key: R = revised.
[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.

Because most hazardous materials are transported by truck, most incidents related to hazardous materials transportation are on the highways. In 2005, 85 percent of all incidents were highway-related. Moreover, 71 percent of fatalities in hazardous materials transportation occurred in highway transportation during 2005.

A very small share of hazardous material transportation incidents are the result of a vehicular crash or derailment (referred to as "accident-related"). In 2005, only 2 percent of incidents were accident-related. Most incidents occur because of human error or package failure, particularly during loading and unloading. While only 2 percent of incidents were accident-related in 2005, they accounted for nearly 80 percent of all property damage.

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

	2000		2004		2005	
Safety rating	**Number**	**Percent**	**Number**	**Percent**	**Number**	**Percent**
Satisfactory	5,309	51.1	(R) 4,424	57.8	5,098	64.3
Conditional	3,354	32.3	(R) 2,307	30.2	1,699	21.4
Unsatisfactory	1,481	14.3	(R) 702	9.2	441	5.6
Not rated	245	2.4	(R) 218	2.8	692	8.7
Total	**10,389**	**100.0**	**(R) 7,651**	**100.0**	**7,930**	**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.

Table 5-4. Hazardous Materials Transportation Incidents
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 May 24, 2006.

Table 5-5. Commercial Motor Carrier Compliance Review Activity by Safety Rating
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 May 4, 2006.

The safety fitness of motor carriers has improved markedly over the past few years. In 2005, the share of motor carriers rated satisfactory was 64 percent, up from 51 percent in 2000.

Almost a 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 result in OOS orders. In 2005, only 7 percent of driver inspections and 6 percent of hazardous materials inspections resulted in an OOS order.

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

	2000		2003		2004		2005	
	Number	Percent	Number	Percent	Number	Percent	Number	Percent
All inspections								
Number of inspections	2,453,776	100.0	(R) 3,013,872	100	(R) 3,019,262	100.0	2,867,124	100.0
With no violations	639,593	26.1	(R) 812,783	27.0	(R) 810,814	26.9	772,850	27.0
With violations	1,814,183	73.9	(R) 2,201,089	73.0	(R) 2,208,448	73.1	2,094,274	73.0
Driver inspections								
Number of inspections	2,396,688	100.0	(R) 2,957,646	100.0	(R) 2,962,085	100.0	2,808,360	100.0
With no violations	1,459,538	60.9	(R) 1,883,071	63.7	(R) 1,893,106	63.9	1,782,300	63.5
With violations	937,150	39.1	(R) 1,074,575	36.3	(R) 1,068,979	36.1	1,026,060	36.5
With OOS violations	191,031	8.0	(R) 200,256	6.8	(R) 197,338	6.7	184,609	6.6
Vehicle inspections								
Number of inspections	1,908,300	100.0	(R) 2,164,847	100.0	(R) 2,252,986	100.0	2,093,394	100.0
With no violations	584,389	30.6	(R) 675,167	31.2	(R) 698,396	31.0	649,658	31.0
With violations	1,323,911	69.4	(R) 1,489,680	68.8	(R) 1,554,590	69.0	1,443,736	69.0
With OOS violations	452,850	23.7	(R) 495,621	22.9	(R) 531,927	23.6	489,754	23.4
Hazardous materials inspections								
Number of inspections	133,486	100.0	(R) 181,592	100.0	(R) 179,213	100.0	170,962	100.0
With no violations	101,098	75.7	(R) 148,409	81.7	(R) 145,763	81.3	139,191	81.4
With violations	32,388	24.3	(R) 33,183	18.3	(R) 33,450	18.7	31,771	18.6
With OOS violations	9,964	7.5	(R) 9,575	5.3	9,957	5.6	9,496	5.6

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 5-6. Roadside Safety Inspection Activity Summary By Inspection Type
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 May 4, 2006.

Table 5-7. Fuel Consumption by Transportation Mode

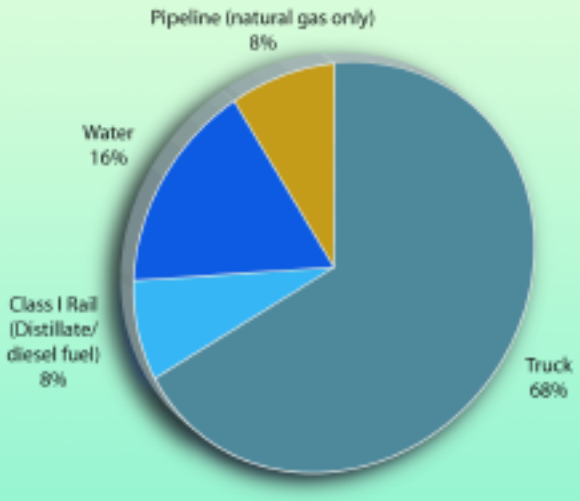
	1980	1990	2000	2003	2004
Highway					
Gasoline, diesel and other fuels (million gallons)	114,960	130,755	162,555	(R) 170,069	173,750
Truck, total	19,960	24,490	35,229	(R) 32,696	33,968
Single-unit 2-axle 6-tire or more truck	6,923	8,357	9,563	(R) 8,880	9,263
Combination truck	13,037	16,133	25,666	(R) 23,815	24,705
Truck (percent of total)	17.4	18.7	21.7	(R) 19.2	19.6
Rail, Class I (in freight service)					
Distillate / diesel fuel (million gallons)	3,904	3,115	3,700	3,826	4,059
Water					
Residual fuel oil (million gallons)	8,952	6,326	6,410	3,874	4,690
Distillate / diesel fuel oil (million gallons)	1,478	2,065	2,261	2,217	2,140
Gasoline (million gallons)	1,052	1,300	1,124	1,107	1,005
Pipeline					
Natural gas (million cubic feet)	634,622	659,816	642,210	(R) 591,492	571,853

Key: R = revised.

The number of gallons of fuel burned by commercial trucks nearly doubled over the past twenty years, while fuel use in several other modes declined. Between 1980 and 2004, the fuel consumed in highway freight transportation increased from 20 billion to 34 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, and a doubling of truck vmt. Over the same period, fuel use in Class I freight rail increased marginally from 3.9 to 4.1 billion gallons.

In 2004, trucking accounted for 68 percent of freight transportation energy consumption. Water transportation accounted for 16 percent, natural gas pipelines for 8 percent, and Class I rail for 8 percent.

Figure 5-1. Energy Consumption by Freight Transportation Mode: 2004



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

Table 5-7. Fuel Consumption by Transportation Mode
Sources: Highway: U.S. Department of Transportation, Federal Highway Administration, *Highway Statistics 2004* (Washington, DC: 2005), table VM-1 and similar tables in earlier editions.
Rail: Association of American Railroads, *Railroad Facts* (Washington, DC: November 2005), p. 40.
Water: U.S. Department of Energy, Energy Information Administration, *Fuel Oil and Kerosene Sales 2004* (Washington, DC: 2005), tables 2, 4, and similar tables in earlier editions.
Pipeline: U.S. Department of Energy, *Natural Gas Annual 2004*, 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: 2004
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: 2005), 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 2004*, DOE/EIA-0131(04) (Washington, DC: December 2005), table 15.

Over the past two decades, miles traveled per gallon by single-unit trucks increased by more than 50 percent. Between 1980 and 2004, the fuel consumed increased 34 percent whereas miles traveled increased by 104 percent. As a result, over these years, miles per gallon increased from 5.8 to 8.8.

TABLE 5-8. SINGLE-UNIT 2-AXLE 6-TIRE OR MORE TRUCK FUEL CONSUMPTION AND TRAVEL

	1980	1990	2000	2003	2004
Number registered (thousands)	4,374	4,487	5,926	(R) 5,849	6,161
Vehicle-miles (millions)	39,813	51,901	70,500	(R) 77,757	81,107
Fuel consumed (million gallons)	6,923	8,357	9,563	(R) 8,880	9,263
Average miles traveled per vehicle	9,103	11,567	11,897	(R) 13,295	13,164
Average miles traveled per gallon	5.8	6.2	7.4	(R) 8.8	8.8
Average fuel consumed per vehicle (gallons)	1,583	1,862	1,614	(R) 1,518	1,503

Key: R = revised

In contrast to single-unit trucks, miles traveled per gallon by combination trucks increased by only 12 percent over the past twenty years. Consequently, the gallons of fuel consumed increased by nearly 90 percent between 1980 and 2004 along with a doubling of miles traveled.

TABLE 5-9. COMBINATION TRUCK FUEL CONSUMPTION AND TRAVEL

	1980	1990	2000	2003	2004
Number registered (thousands)	1,417	1,709	2,097	(R) 1,908	2,010
Vehicle-miles traveled (millions)	68,678	94,341	135,020	(R) 140,160	145,398
Fuel consumed (million gallons)	13,037	16,133	25,666	(R) 23,815	24,705
Average miles traveled per vehicle	48,472	55,206	64,399	(R) 73,445	72,325
Average miles traveled per gallon	5.3	5.8	5.3	(R) 5.9	5.9
Average fuel consumed per vehicle (gallons)	9,201	9,441	12,241	(R) 12,479	12,289

Key: R = revised.
Note: 1 mile = 1.61 kilometers; 1 gallon = 3.8 liters.

TABLE 5-8. SINGLE-UNIT 2-AXLE 6-TIRE OR MORE TRUCK FUEL CONSUMPTION AND TRAVEL
Source: U.S. Department of Transportation, Federal Highway Administration, *Highway Statistics 2004* (Washington, DC: 2005), table VM-1 and similar tables in earlier editions.

TABLE 5-9. COMBINATION TRUCK FUEL CONSUMPTION AND TRAVEL
Source: U.S. Department of Transportation, Federal Highway Administration, *Highway Statistics 2004* (Washington, DC: 2005), table VM-1 and similar tables in earlier editions.

Figure 5-2. Monthly Diesel Prices (cents per gallon)

Diesel prices were about 93 percent higher in July 2006 than 10 years earlier (in inflation-adjusted terms). Over that period prices bottomed out in February 1999 at $1.18 a gallon (in $ July 2006).

Energy intensity is the amount of energy used in producing a given level of output or activity, in this case transportation. Since 1980 the energy intensity of both trucking and freight rail have 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 Modes

	1980	1990	2000	2002	2003
Highway (Btu per vehicle-mile)	24,757	22,795	(R) 23,448	(R) 23,461	23,461
Railroad (Class I) (Btu per freight car-mile)	18,742	16,619	14,917	15,003	15,016
Railroad (Class I) (Btu per ton-mile)	597	420	352	345	344
Water (Btu per ton-mile)	358	387	473	(R) 470	417

Key: Btu = British thermal unit; R = revised.

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 U.S. NO_x emissions and 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

Figure 5-2. Monthly Diesel Prices
Sources: Diesel price: U.S. Department of Energy, Energy Information Agency, U.S. Petroleum Prices, available at www.eia.doe.gov as of September 5, 2006. **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 September 5, 2006.

Table 5-10: Energy Intensities of Domestic Freight Modes
Source: Oak Ridge National Laboratory, *Transportation Energy Data Book: Edition 25* (Oak Ridge, TN: 2006).

Table 5-11: Estimated National Average Vehicle Emissions Rates of Heavy-duty and Light-duty Vehicles (grams per mile)

	1990	2000	2002	2004	2005
Gasoline (assuming zero RFG)					
Cars					
Exhaust HC	2.79	0.97	0.81	0.61	0.52
Nonexhaust HC	1.21	0.92	0.84	0.77	0.72
Total HC	3.99	1.89	1.65	1.37	1.25
Exhaust CO	42.89	18.53	17.58	13.79	12.57
Exhaust NO_x	2.70	1.29	1.20	1.00	0.92
Light trucks					
Exhaust HC	3.68	1.45	1.24	0.96	0.78
Nonexhaust HC	1.36	0.97	0.89	0.80	0.76
Total HC	5.04	2.42	2.13	1.76	1.54
Exhaust CO	56.23	26.81	24.32	18.76	16.23
Exhaust NO_x	2.62	1.54	1.50	1.32	1.21
Heavy trucks					
Exhaust HC	3.66	1.22	0.98	0.73	0.64
Nonexhaust HC	2.74	1.62	1.48	1.35	1.24
Total HC	6.40	2.84	2.46	2.08	1.88
Exhaust CO	85.61	31.08	24.73	18.46	16.73
Exhaust NO_x	7.19	5.26	5.01	4.62	4.28
Diesel					
Cars					
Exhaust HC	0.68	0.80	0.73	0.60	0.58
Exhaust CO	1.49	1.78	1.73	1.59	1.57
Exhaust NO_x	1.83	1.81	1.62	1.43	1.32
Light trucks					
Exhaust HC	1.59	1.02	0.96	0.98	0.80
Exhaust CO	2.67	1.77	1.66	1.68	1.37
Exhaust NO_x	2.71	1.76	1.67	1.59	1.37
Heavy trucks					
Exhaust HC	2.21	0.79	0.69	0.58	0.54
Exhaust CO	10.06	4.10	3.58	3.19	3.05
Exhaust NO_x	23.34	18.05	15.52	12.50	11.45

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

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

Trucks are by far the largest contributor to freight emissions nationally, producing two-thirds of NO_x and PM-10 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 PM and enable the use of advanced pollution control technologies to meet 2007 emissions standards.

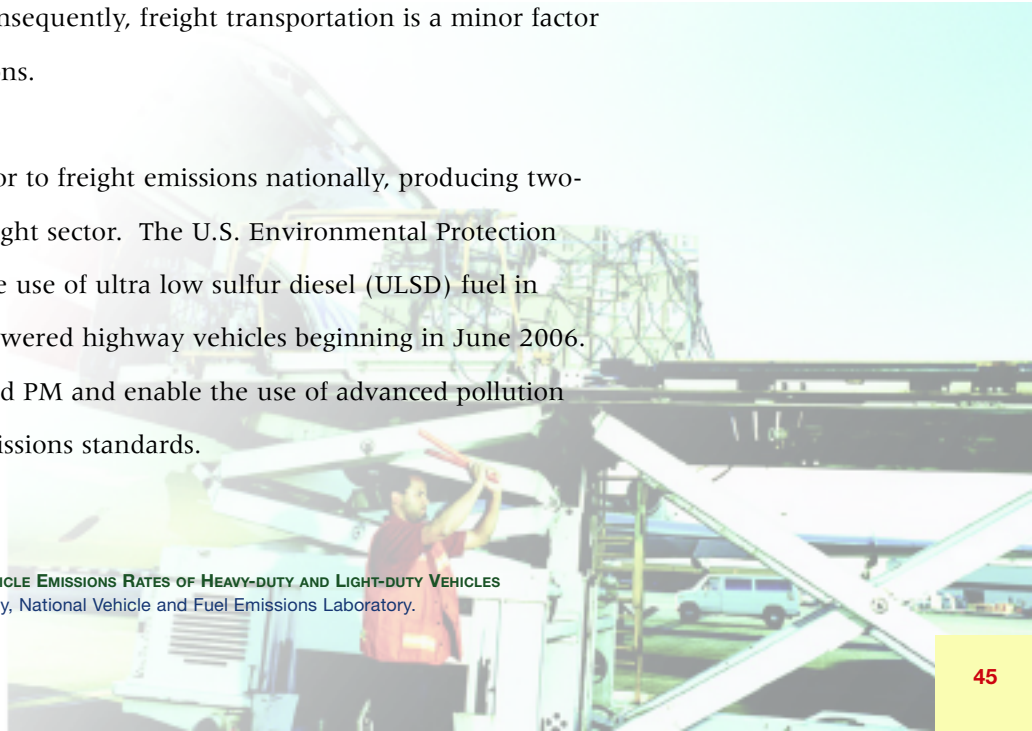


Table 5-11: Estimated National Average Vehicle Emissions Rates of Heavy-duty and Light-duty Vehicles
Source: U.S. Environmental Protection Agency, National Vehicle and Fuel Emissions Laboratory.

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 5-13: Current and Future Nitrogen Oxides (NO_x) Emissions by Freight Transportation Mode

	Tons			Percent change,	Percent change,
	2002	2010	2020	2002-2010	2002-2020
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

Table 5-14: Current and Future Particulate Matter (PM-10) Emissions by Freight Transportation Mode

	Tons			Percent change,	Percent change,
	2002	2010	2020	2002-2010	2002-2020
Heavy-duty trucks	120,000	65,380	34,760	-46	-71
Freight rail	21,300	17,890	15,360	-16	-28
Commercial marine	44,000	45,330	46,960	3	7
Air freight	300	290	270	-3	-10
Freight total	185,600	128,889	97,349	-31	-48

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, *Impacts of Freight Movement on Air Quality*, prepared by ICF Consulting, January 26, 2005, based on U.S. Environmental Protection Agency, National Emissions Inventory.

Table 5-13: Current and Future Nitrogen Oxides (NO_x) Emissions by Freight Transportation Mode
Source: U.S. Department of Transportation, Federal Highway Administration, *Impacts of Freight Movement on Air Quality*, prepared by ICF Consulting, January 26, 2005, based on U.S. Environmental Protection Agency, National Emissions Inventory.

Table 5-14: Current and Future Particulate Matter (PM-10) Emissions by Freight Transportation Mode
Source: U.S. Department of Transportation, Federal Highway Administration, Impacts of Freight Movement on Air Quality, prepared by ICF Consulting, January 26, 2005, based on U.S. Environmental Protection Agency, National Emissions Inventory.