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

As freight grows to a larger share of total transportation activity, its negative aspects become a larger part of the safety, energy, and environmental consequences of transportation. Particularly in environmental matters, freight is only now being separated from the air quality and other problems of general traffic. Most of our current knowledge is in safety, with some in energy consumption. More knowledge is needed to understand and fix the problems.

Table 5-1. Transportation Fatalities by Freight Transportation Mode

	1980	1990	2000	2003[5]
Total transportation fatalities (passenger and freight)	**NA**	**47,347**	**44,333**	**NA**
Highway (passenger and freight)	**51,091**	**44,599**	**41,945**	**42,643**
Large truck occupants [1]	1,262	705	754	723
Others killed in crashes involving large trucks	4,709	4,567	4,528	4,263
Large truck occupants [1] (percent)	2.5	1.6	1.8	1.7
Others killed in crashes involving large trucks (percent)	9.2	10.2	10.8	10.0
Railroad (passenger and freight)	**1,417**	**1,297**	**937**	**856**
Highway-rail crossing [2]	833	698	425	324
Railroad [2,3]	584	599	512	532
Waterborne (passenger and freight)	**487**	**186**	**137**	**76**
Vessel-related [4]	206	85	49	28
Freight ship	8	0	0	3
Tank ship	4	5	0	0
Tug / towboat	14	13	0	8
Offshore supply	NA	2	2	0
Fishing vessel	60	47	28	15
Mobile offshore drilling units	NA	0	0	0
Platform	NA	1	0	0
Freight barge	NA	0	1	0
Tank barge	NA	0	0	0
Miscellaneous	56	11	4	2
Not vessel-related [4]	281	101	88	48
Pipeline	**19**	**9**	**38**	**12**
Hazardous liquid pipeline	4	3	1	0
Gas pipeline	15	6	37	12

Key: NA not available.
[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 are trespassers who are included under other incidents (499 in 2003).
[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. Waterborne fatalities are for 2002.
Note: Caution must be exercised in comparing fatalities across modes because significantly different definitions are used.

Nearly 5,000 people died in crashes involving large trucks in 2003, although only 723 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 VMT. Despite a rise in the amount of large truck travel, the number of fatalities involving large trucks declined 16 percent from 1980 to 2003.

TABLE 5-1. TRANSPORTATION FATALITIES BY FREIGHT TRANSPORTATION MODE
Sources: U.S. Department of Transportation, Bureau of Transportation Statistics, *National Transportation Statistics 2004* (Washington, DC: forthcoming).

Table 5-2. Injured Persons by Freight Transportation Mode

	1980	1990	2000	2003[5]
TOTAL injured persons (passenger and freight)	**NA**	**NA**	**3,240,424**	**NA**
Highway (passenger and freight)	**NA**	**3,231,000**	**3,189,000**	**2,889,000**
Large truck occupants [1]	N	42,000	31,000	27,000
Others injured in crashes involving large trucks	N	108,000	109,000	95,000
Large truck occupants [1] (percent)	N	1.3	1.0	0.9
Others injured in crashes involving large trucks (percent)	N	3.3	3.4	3.3
Railroad (passenger and freight)	**62,246**	**25,143**	**11,643**	**8,872**
Highway-rail grade crossing [2]	3,890	2,407	1,219	997
Railroad [2,3]	58,356	22,736	10,424	7,875
Waterborne (passenger and freight)	**NA**	**NA**	**697**	**676**
Vessel-related [4]	180	175	130	157
Freight ship	NA	10	4	7
Tank ship	NA	13	3	0
Tug / towboat	NA	19	10	17
Offshore supply	NA	9	5	0
Fishing vessel	NA	31	24	41
Mobile offshore drilling units	NA	13	0	0
Platform	NA	9	1	0
Freight barge	NA	3	2	0
Tank barge	NA	3	0	0
Miscellaneous	NA	12	6	9
Not related to vessel casualties [4]	NA	NA	567	519
Pipeline	**192**	**76**	**81**	**71**
Hazardous liquid pipeline	15	7	4	5
Gas pipeline	177	69	77	66

Key: NA = not available.
[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 (5,950 in 2003) involve workers on duty.
[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. Waterborne fatalities are for 2002.
Note: Numbers may not add to totals due to some injuries being counted in more than one mode.

About 120,000 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
Sources: U.S. Department of Transportation, Bureau of Transportation Statistics, *National Transportation Statistics 2004* (Washington, DC: forthcoming).

Large trucks were involved in about 7 percent of all highway crashes in 2003. The estimated number of crashes in 2003 is up about 23 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	2003[5]
Highway (passenger and freight)	**NA**	**6,471,000**	**6,394,000**	**6,328,000**
Large truck[1]	NA	372,000	438,000	457,000
Large truck[1] (percent of total)	NA	5.7	6.9	7.2
Rail (passenger and freight)				
Highway-rail grade crossing [2,3]	10,796	5,715	3,502	2,928
Railroad [2,4]	8,205	2,879	2,983	2,950
Waterborne (passenger and freight)				
Vessel-related	4,624	3,613	3,887	4,110
Pipeline				
Hazardous liquid pipeline	246	180	147	128
Gas pipeline	1,524	198	234	241

Key: NA = not available.
[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.
[5]Railroad fatalities are preliminary. Waterborne fatalities are for 2002.

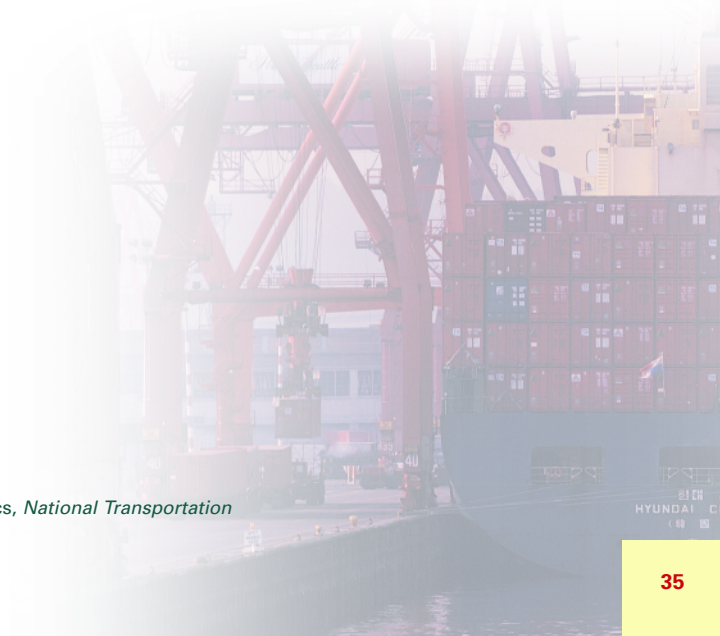


TABLE 5-3. Transportation Accidents by Freight Transportation Mode
Sources: U.S. Department of Transportation, Bureau of Transportation Statistics, *National Transportation Statistics 2004* (Washington, DC: forthcoming).

Table 5-4. Hazardous Materials Transportation Incidents

	1980	1990	2000	2003
Total	**15,719**	**8,879**	**17,556**	**15,191**
Accident-related	486	297	390	318
Air	**223**	**297**	**1,419**	**753**
Accident-related	0	0	1	0
Highway	**14,161**	**7,296**	**15,062**	**13,615**
Accident-related	347	249	327	276
Rail	**1,271**	**1,279**	**1,058**	**813**
Accident-related	134	48	62	42
Water[1]	**34**	**7**	**17**	**10**
Accident-related	2	0	0	0
Other[2]	**30**	**0**	**0**	**0**
Accident-related	3	0	0	0

[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 incidents caused by human error, package failure, and causes not elsewhere classified.

Because most hazardous materials are transported by road, most incidents related to hazardous materials transportation are on the highways. In 2003, 90 percent of all incidents were highway related. Moreover, 85 percent of injuries and all fatalities in hazardous materials transportation, a total of five, occurred in highway transportation.

A very small share of hazardous material transportation incidents are the result of vehicular accident or derailment (known as "accident-related"). In 2003, 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 2003, they accounted for nearly three quarters of all property damage.

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

	1999		2001		2003	
Safety rating	**Number**	**Percent**	**Number**	**Percent**	**Number**	**Percent**
Satisfactory	3,485	47.9	4,904	58.0	4,995	59.9
Conditional	2,543	34.9	2,524	29.9	2,346	28.1
Unsatisfactory	1,122	15.4	749	8.9	757	9.1
Not rated	128	1.8	274	3.2	242	2.9
Total	**7,278**	**100.0**	**8,451**	**100.0**	**8,340**	**100.0**

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, Research and Special Programs Administration, Office of Hazardous Materials Safety, Hazardous Materials Information System Database, available at http://hazmat.dot.gov as of July 16, 2004.

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), June 25, 2004 data snapshot, available at http://www.fmcsa.dot.gov/ as of October 2004.

The safety fitness of motor carriers has improved markedly over the past few years. In 2003, the share of motor carriers being rated satisfactory was 60 percent, up from 48 percent in 1999.

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 2002, 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		2001		2002	
	Number	Percent	Number	Percent	Number	Percent
All inspections						
Number of inspections	2,453,776	100.0	2,747,829	100.0	3,017,080	100.0
With no violations	639,593	26.1	743,577	27.1	831,974	27.6
With violations	1,814,183	73.9	2,004,252	72.9	2,185,106	72.4
Driver inspections						
Number of inspections	2,396,688	100.0	2,685,568	100.0	2,959,934	100.0
With no violations	1,459,538	60.9	1,657,098	61.7	1,871,238	63.2
With violations	937,150	39.1	1,028,470	38.3	1,088,696	36.8
With OOS violations	191,031	8.0	204,120	7.6	212,942	7.2
Vehicle inspections						
Number of inspections	1,908,300	100.0	2,073,386	100.0	2,175,558	100.0
With no violations	584,389	30.6	604,303	29.1	664,938	30.6
With violations	1,323,911	69.4	1,469,083	70.9	1,510,620	69.4
With OOS violations	452,850	23.7	484,546	23.4	498,251	22.9
Hazardous materials inspections						
Number of inspections	133,486	100.0	186,024	100.0	173,905	100.0
With no violations	101,098	75.7	148,955	80.1	139,643	80.3
With violations	32,388	24.3	37,069	19.9	34,262	19.7
With OOS violations	9,964	7.5	10,280	5.5	9,986	5.7

Key: OOS = out of service.
Note: 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.

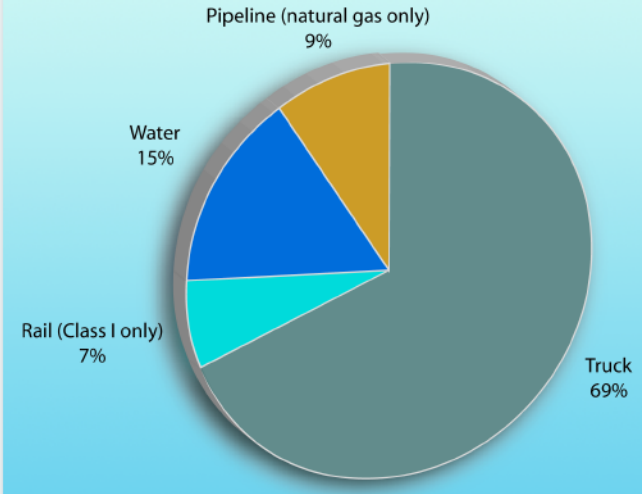
TABLE 5-6. Roadside Safety Inspection Activity Summary By Inspection Type
Source: U.S. Department of Transportation, Federal Motor Carrier Administration, Motor Carrier Management Information System (MCMIS), September 19, 2003 data snapshot, available at www.fmcsa.dot.gov as of October 2004.

Table 5-7. Fuel Consumption by Transportation Mode

	1980	1990	2000	2002
Highway				
Gasoline, diesel and other fuels (million gallons)	114,960	130,755	162,555	167,730
Truck, total	19,960	24,490	35,229	36,756
Single-unit 2-axle 6-tire or more truck	6,923	8,357	9,563	10,305
Combination truck	13,037	16,133	25,666	26,451
Truck (percent of total)	17.4	18.7	21.7	21.9
Rail, Class I (in freight service)				
Distillate / diesel fuel (million gallons)	3,904	3,115	3,700	3,730
Water				
Residual fuel oil (million gallons)	8,952	6,326	6,410	4,848
Distillate / diesel fuel oil (million gallons)	1,478	2,065	2,261	2,079
Gasoline (million gallons)	1,052	1,300	1,124	1,081
Pipeline				
Natural gas (million cubic feet)	634,622	659,816	642,210	667,027

In addition to safety concerns, freight transportation also has major implications for energy use and the environment. The number of gallons of fuel burned by commercial trucks has nearly doubled over the past twenty years, while fuel use in several other modes has declined. Between 1980 and 2002, the fuel consumed in highway freight transportation increased from 20 billion to 37 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 vehicle miles traveled (vmt). Over the same period, fuel use in Class I freight rail declined from 3.9 to 3.7 billion gallons.

Figure 5-1. Energy Consumption by Freight Transportation Mode: 2002



Note: Data do not include energy consumed by oil pipelines in their operation (crude petroleum and petroleum products) nor slurry pipelines.

TABLE 5-7. Fuel Consumption by Transportation Mode
Sources: Highway: U.S. Department of Transportation, Federal Highway Administration, *Highway Statistics* (Washington, DC: Annual issues), table VM-1and similar tables in earlier editions.
Rail: Association of American Railroads, *Railroad Facts 2003* (Washington, DC: October 2003), p. 40.
Water: U.S. Department of Energy, Energy Information Administration, *Fuel Oil and Kerosene Sales* (Washington, DC: Annual issues), tables 2, 4, and similar tables in earlier editions.
Pipeline: U.S. Department of Energy, Natural Gas Annual 2002, DOE/EIA-0131(02) (Washington, DC: January 2004), table 15 and similar tables in earlier editions.

FIGURE 5-1. Energy Consumption by Freight Transportation Mode: 2002
Sources: Truck: U.S. Department of Transportation, Federal Highway Administration, *Highway Statistics*, (Washington, DC: Annual issues). **Rail:** Association of American Railroads, *Railroad Facts* (Washington, DC: October 2002), p. 40. **Water:** U.S. Department of Energy, Energy Information Administration, *Fuel Oil and Kerosene Sales* (Washington, DC: Annual issues); U.S. Department of Transportation, Federal Highway Administration, *Highway Statistics* (Washington, DC: Annual issues), table MF-24 and similar tables in earlier editions. **Pipeline:** U.S. Department of Energy, *Natural Gas Annual 2001*, DOE/EIA-0131(01) (Washington, DC: November 2002), table 15 and similar tables in earlier editions.

In 2002, trucking accounted for 69 percent of freight transportation energy consumption. Water transportation accounted for 15 percent, natural gas pipelines 9 percent, and Class I rail only 7 percent.

Table 5-8. Single-Unit 2-Axle 6-Tire or More Truck Fuel Consumption and Travel

	1980	1990	2000	2002
Number registered (thousands)	4,374	4,487	5,926	5,651
Vehicle-miles (millions)	39,813	51,901	70,500	75,887
Fuel consumed (million gallons)	6,923	8,357	9,563	10,305
Average miles traveled per vehicle	9,103	11,567	11,897	13,430
Average miles traveled per gallon	5.8	6.2	7.4	7.4
Average fuel consumed per vehicle (gallons)	1,583	1,862	1,614	1,824

Over the past two decades, average fuel consumption of single-unit trucks increased by nearly 30 percent. Between 1980 and 2002, the fuel consumed increased 49 percent whereas miles traveled increased by 91 percent. As a result, over these years, miles per gallon increased from 5.8 to 7.4.

In contrast to single-unit trucks, the average fuel consumption of combination trucks has not changed over the past twenty years. Consequently, the gallons of fuel consumed have doubled between 1980 and 2002 along with the number of miles traveled.

Table 5-9. Combination Truck Fuel Consumption and Travel

	1980	1990	2000	2002
Number registered (thousands)	1,417	1,709	2,097	2,277
Vehicle-miles traveled (millions)	68,678	94,341	135,020	138,643
Fuel consumed (million gallons)	13,037	16,133	25,666	26,451
Average miles traveled per vehicle	48,472	55,206	64,399	60,898
Average miles traveled per gallon	5.3	5.8	5.3	5.2
Average fuel consumed per vehicle (gallons)	9,201	9,441	12,241	11,618

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* (Washington, DC: Annual issues).

TABLE 5-9. Combination Truck Fuel Consumption and Travel
Source: U.S. Department of Transportation, Federal Highway Administration, *Highway Statistics* (Washington, DC: Annual issues).

Diesel prices were about 16 percent higher in March 2004 than 10 years earlier (in inflation-adjusted terms). Over that period prices bottomed out in March 1999 at just under $1.00 a gallon (in current dollars). Except for the period July 2001 through September 2002, prices have generally been above the $1.40 mark since February 2000 (also in current dollars).

With more freight being moved and fuel consumed, air quality is affected by emissions from freight vehicles. Since 1990, emissions from heavy-duty highway vehicles per mile of operation have declined.

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

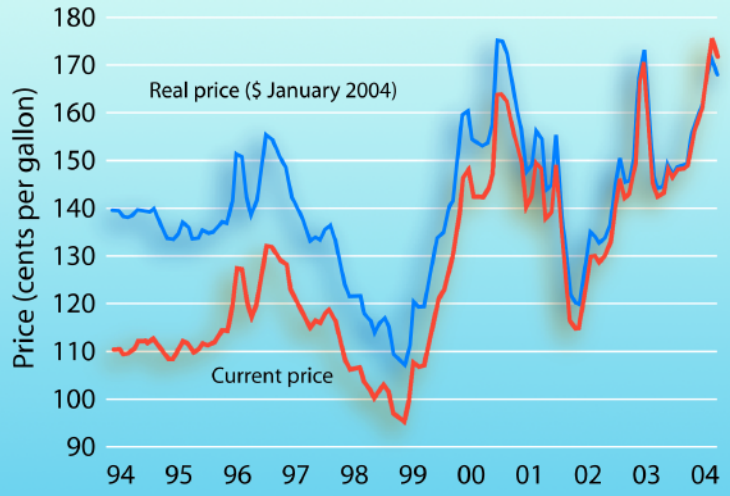


Table 5-10: Estimated National Average Vehicle Emissions Rates of Heavy-duty Vehicles (grams per mile)

	1990	1995	2000	2003
Gasoline (assuming zero RFG)				
Exhaust HC	3.66	2.16	1.22	0.82
Nonexhaust HC	2.74	2.07	1.62	1.41
Total HC	6.40	4.24	2.84	2.24
Exhaust CO	85.61	54.16	31.08	20.60
Exhaust NO_x	7.19	6.11	5.26	4.91
Diesel				
Exhaust HC	2.21	1.23	0.79	0.61
Exhaust CO	10.06	6.32	4.10	3.37
Exhaust NO_x	23.34	20.49	18.05	13.92

Key: CO = carbon monoxide; HC = hydrocarbon; NOx = nitrogen oxide; RFG = reformulated gasoline.
Notes: Heavy-duty vehicles are defined as 8,501 lbs or more gross vehicle weight rating.

FIGURE 5-2. Monthly Diesel Prices (cents per gallon)
Source: U.S. Department of Energy, Energy Information Agency, U.S. Petroleum Prices, available at www.eia.doe.gov as of July 15, 2004.

TABLE 5-10: Estimated National Average Vehicle Emissions Rates of Heavy-duty Vehicles (grams per mile)
Source: U.S. Environmental Protection Agency, National Vehicle and Fuel Emissions Laboratory.