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

Growing demand for freight transportation heightens concerns about its safety, energy, 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 | 2003 | 2004[5] |
|---|---|---|---|---|---|
| **Total transportation fatalities (passenger and freight)** | **NA** | **47,347** | **(R) 44,384** | **45,132** | **NA** |
| **Highway (passenger and freight)** | **51,091** | **44,599** | **41,945** | **(R) 42,884** | **42,636** |
| Large truck occupants[1] | 1,262 | 705 | 754 | (R) 726 | 761 |
| Others killed in crashes involving large trucks | 4,709 | 4,567 | 4,528 | (R) 4,310 | 4,429 |
| Large truck occupants[1] (percent) | 2.5 | 1.6 | 1.8 | (R) 1.7 | 1.8 |
| Others killed in crashes involving large trucks (percent) | 9.2 | 10.2 | 10.8 | (R) 10.1 | 10.4 |
| **Railroad (passenger and freight)** | **1,417** | **1,297** | **937** | **(R) 865** | **899** |
| Highway-rail crossing[2] | 833 | 698 | 425 | (R) 332 | 368 |
| Railroad[2,3] | 584 | 599 | 512 | (R) 533 | 531 |
| **Waterborne (passenger and freight)** | **487** | **186** | **(R) 187** | **(R) 127** | **93** |
| Vessel-related[4] | 206 | 85 | (R) 53 | (R) 53 | 36 |
| Freight ship | 8 | 0 | 0 | 3 | 2 |
| Tank ship | 4 | 5 | 0 | 0 | 3 |
| Tug / towboat | 14 | 13 | (R) 2 | (R) 0 | 1 |
| Offshore supply | NA | 2 | (R) 3 | 0 | 0 |
| Fishing vessel | 60 | 47 | (R) 30 | (R) 18 | 14 |
| Mobile offshore drilling units | NA | 0 | 0 | (R) 2 | 0 |
| Platform | NA | 1 | 0 | 0 | 0 |
| Freight barge | NA | 0 | 0 | 0 | 1 |
| Tank barge | NA | 0 | 0 | (R) 2 | 0 |
| Miscellaneous | 56 | 11 | (R) 6 | (R) 5 | 6 |
| Not vessel-related[4] | 281 | 101 | (R) 134 | (R) 74 | 57 |
| **Pipeline** | **19** | **9** | **38** | **12** | **24** |
| Hazardous liquid pipeline | 4 | 3 | 1 | 0 | 5 |
| Gas pipeline | 15 | 6 | 37 | 12 | 19 |

**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 (482 in 2004).
[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.

Nearly 5,200 people died in crashes involving large trucks in 2004, although only 761 of those were large-truck occupants. Fatalities involving large trucks are about 12 percent of all highway fatalities, while trucks account for about 7 percent of highway vehicle miles traveled (vmt). Despite a doubling of large truck travel between 1980 and 2004, 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, Bureau of Transportation Statistics, *National Transportation Statistics 2005*, available at http://www.bts.gov/ as of September 28, 2005.

## Table 5-2. Injured Persons by Freight Transportation Mode

| | 1980 | 1990 | 2000 | 2003 | 2004[5] |
|---|---|---|---|---|---|
| **TOTAL injured persons (passenger and freight)** | **NA** | **NA** | **(R) 3,259,673** | **2,918,405** | **NA** |
| **Highway (passenger and freight)** | **NA** | **3,231,000** | **3,189,000** | **2,889,000** | **2,788,000** |
| 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 | 95,000 | 89,000 |
| Large truck occupants[1] (percent) | NA | 1.3 | 1.0 | 0.9 | 1.0 |
| Others injured in crashes involving large trucks (percent) | NA | 3.3 | 3.4 | 3.3 | 3.2 |
| **Railroad (passenger and freight)** | **62,246** | **25,143** | **11,643** | **(R) 9,157** | **8,751** |
| Highway-rail grade crossing[2] | 3,890 | 2,407 | 1,219 | (R) 1,028 | 1,071 |
| Railroad[2,3] | 58,356 | 22,736 | 10,424 | (R) 8,129 | 7,680 |
| **Waterborne (passenger and freight)** | **NA** | **NA** | **(R) 757** | **(R) 778** | **703** |
| Vessel-related[4] | 180 | 175 | (R) 150 | (R) 227 | 198 |
| Freight ship | 8 | 10 | (R) 5 | (R) 8 | 4 |
| Tank ship | 9 | 13 | 3 | (R) 1 | 7 |
| Tug / towboat | 27 | 19 | 10 | (R) 9 | 22 |
| Offshore supply | NA | 9 | 5 | (R) 5 | 5 |
| Fishing vessel | 28 | 31 | (R) 23 | (R) 22 | 36 |
| Mobile offshore drilling units | NA | 13 | 0 | (R) 15 | 0 |
| Platform | NA | 9 | (R) 0 | 0 | 0 |
| Freight barge | NA | 3 | 2 | 0 | 5 |
| Tank barge | NA | 3 | 0 | (R) 1 | 1 |
| Miscellaneous | 98 | 12 | (R) 8 | (R) 29 | 25 |
| Not related to vessel casualties[4] | NA | NA | (R) 607 | (R) 551 | 505 |
| **Pipeline** | **192** | **76** | **81** | **71** | **55** |
| Hazardous liquid pipeline | 15 | 7 | 4 | 5 | 13 |
| Gas pipeline | 177 | 69 | 77 | 66 | 42 |

**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 (5,975 in 2004) 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.
**Note:** Numbers may not add to totals due to some injuries being counted in more than one mode.

About 125,000 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, Bureau of Transportation Statistics, *National Transportation Statistics 2005*, available at http://www.bts.gov/ as of September 28, 2005.

Large trucks were involved in about 7 percent of all highway crashes in 2004. The estimated number of crashes in 2004 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 | 2003 | 2004[5] |
|---|---|---|---|---|---|
| **Highway (passenger and freight)** | **NA** | **6,471,000** | **6,394,000** | **6,328,000** | **6,181,000** |
| Large truck[1] | NA | 372,000 | 438,000 | (R) 436,000 | 416,000 |
| Large truck[1] (percent of total) | NA | 5.7 | 6.9 | (R) 6.9 | 6.7 |
| **Rail (passenger and freight)** | | | | | |
| Highway-rail grade crossing[2,3] | 10,796 | 5,715 | 3,502 | (R) 2,966 | 3,050 |
| Railroad[2,4] | 8,205 | 2,879 | 2,983 | (R) 2,991 | 3,179 |
| **Waterborne (passenger and freight)** | | | | | |
| Vessel-related | 4,624 | 3,613 | (R) 5,403 | (R) 5,163 | 4,962 |
| **Pipeline** | | | | | |
| Hazardous liquid pipeline | 246 | 180 | (R) 146 | (R) 129 | 140 |
| Gas pipeline | 1,524 | 198 | 234 | (R) 244 | 292 |

**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.
[5]Railroad data are preliminary.

**Table 5-3. Transportation Accidents by Freight Transportation Mode**
**Source:** U.S. Department of Transportation, Bureau of Transportation Statistics, *National Transportation Statistics 2005*, available at http://www.bts.gov/ as of September 28, 2005.

**Table 5-4. Hazardous Materials Transportation Incidents**

| | 1980 | 1990 | 2000 | 2003 | 2004 |
|---|---|---|---|---|---|
| **Total** | **15,719** | **8,879** | **(R) 17,557** | **(R) 15,162** | **14,740** |
| Accident-related | 486 | 297 | 390 | (R) 341 | 281 |
| **Air** | **223** | **297** | **1,419** | **(R) 751** | **995** |
| Accident-related | 0 | 0 | 1 | 0 | 0 |
| **Highway** | **14,161** | **7,296** | **(R) 15,063** | **(R) 13,599** | **12,977** |
| Accident-related | 347 | 249 | 327 | 299 | 233 |
| **Rail** | **1,271** | **1,279** | **1,058** | **(R) 802** | **753** |
| Accident-related | 134 | 48 | 62 | 42 | 48 |
| **Water[1]** | **34** | **7** | **17** | **10** | **15** |
| 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 2003, 88 percent of all incidents were highway-related. Moreover, 54 percent of injuries and 77 percent of fatalities in hazardous materials transportation occurred in highway transportation during 2004.

A very small share of hazardous material transportation incidents are the result of a vehicular crash or derailment (referred to as "accident-related"). In 2004, 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 2004, they accounted for 70 percent of all property damage.

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

| | 1999 | | 2003 | | 2004 | |
|---|---|---|---|---|---|---|
| **Safety rating** | **Number** | **Percent** | **Number** | **Percent** | **Number** | **Percent** |
| Satisfactory | 3,485 | 47.9 | (R) 5,002 | 59.9 | 4,396 | 57.7 |
| Conditional | 2,543 | 34.9 | (R) 2,345 | 28.1 | 2,308 | 30.3 |
| Unsatisfactory | 1,122 | 15.4 | (R) 754 | 9.0 | 698 | 9.2 |
| Not rated | 128 | 1.8 | (R) 243 | 2.9 | 221 | 2.9 |
| Total | 7,278 | 100.0 | (R) 8,344 | 100.0 | 7,623 | 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 July 19, 2005.

**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), March 25, 2005 data snapshot, available at http://www.fmcsa.dot.gov/ as of July 22, 2005.

The safety fitness of motor carriers has improved markedly over the past few years. In 2004, the share of motor carriers rated satisfactory was 58 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 2004, 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**

| | 2002 | | 2003 | | 2004 | |
|---|---|---|---|---|---|---|
| | Number | Percent | Number | Percent | Number | Percent |
| **All inspections** | | | | | | |
| Number of inspections | (R) 3,013,652 | 100.0 | (R) 3,012,402 | 100.0 | 3,014,907 | 100.0 |
| With no violations | (R) 830,762 | 27.6 | (R) 812,516 | 27.0 | 810,406 | 26.9 |
| With violations | (R) 2,182,890 | 72.4 | (R) 2,199,886 | 73.0 | 2,204,501 | 73.1 |
| **Driver inspections** | | | | | | |
| Number of inspections | (R) 2,956,676 | 100.0 | (R) 2,956,214 | 100.0 | 2,957,827 | 100.0 |
| With no violations | (R) 1,869,030 | 63.2 | (R) 1,881,894 | 63.7 | 1,891,067 | 63.9 |
| With violations | (R) 1,087,646 | 36.8 | (R) 1,074,320 | 36.3 | 1,066,760 | 36.1 |
| With OOS violations | (R) 212,633 | 7.2 | (R) 199,837 | 6.8 | 194,276 | 6.6 |
| **Vehicle inspections** | | | | | | |
| Number of inspections | (R) 2,172,904 | 100.0 | (R) 2,163,025 | 100.0 | 2,249,338 | 100.0 |
| With no violations | (R) 663,956 | 30.6 | (R) 674,793 | 31.2 | 697,558 | 31.0 |
| With violations | (R) 1,508,948 | 69.4 | (R) 1,488,232 | 68.8 | 1,551,780 | 69.0 |
| With OOS violations | (R) 497,613 | 22.9 | (R) 493,937 | (R) 22.8 | 524,464 | 23.3 |
| **Hazardous materials inspections** | | | | | | |
| Number of inspections | (R) 173,090 | 100.0 | (R) 181,691 | 100.0 | 178,951 | 100.0 |
| With no violations | (R) 138,939 | 80.3 | (R) 148,486 | 81.7 | 145,527 | 81.3 |
| With violations | (R) 34,151 | 19.7 | (R) 33,205 | 18.3 | 33,424 | 18.7 |
| With OOS violations | (R) 9,938 | 5.7 | (R) 9,571 | 5.3 | 9,957 | 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), March 25, 2005 data snapshot, available at www.fmcsa.dot.gov as of September 14, 2005.

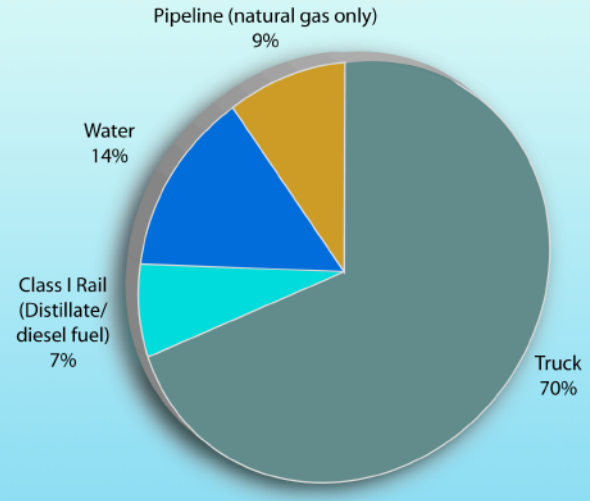
**Table 5-7. Fuel Consumption by Transportation Mode**

| | 1980 | 1990 | 2000 | 2003 |
|---|---|---|---|---|
| **Highway** | | | | |
| Gasoline, diesel and other fuels (million gallons) | 114,960 | 130,755 | 162,555 | 169,624 |
| Truck, total | 19,960 | 24,490 | 35,229 | 37,585 |
| Single-unit 2-axle 6-tire or more truck | 6,923 | 8,357 | 9,563 | 10,690 |
| Combination truck | 13,037 | 16,133 | 25,666 | 26,895 |
| Truck (percent of total) | 17.4 | 18.7 | 21.7 | 22.2 |
| **Rail, Class I (in freight service)** | | | | |
| Distillate / diesel fuel (million gallons) | 3,904 | 3,115 | 3,700 | 3,826 |
| **Water** | | | | |
| Residual fuel oil (million gallons) | 8,952 | 6,326 | 6,410 | 3,874 |
| Distillate / diesel fuel oil (million gallons) | 1,478 | 2,065 | 2,261 | 2,217 |
| Gasoline (million gallons) | 1,052 | 1,300 | 1,124 | 1,107 |
| **Pipeline** | | | | |
| Natural gas (million cubic feet) | 634,622 | 659,816 | 642,210 | 664,973 |

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 2003, the fuel consumed in highway freight transportation increased from 20 billion to 38 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 declined from 3.9 to 3.8 billion gallons.

In 2003, trucking accounted for 70 percent of freight transportation energy consumption. Water transportation accounted for 14 percent, natural gas pipelines 9 percent, and Class I rail only 7 percent.

**Figure 5-1. Energy Consumption by Freight Transportation Mode: 2003**




**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* (Washington, DC: Annual issues), table VM-1 and similar tables in earlier editions.
**Rail:** Association of American Railroads, *Railroad Facts* (Washington, DC: October 2004), 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 2003*, DOE/EIA-0131(02) (Washington, DC: January 2005), table 15 and similar tables in earlier editions.

**Figure 5-1. Energy Consumption by Freight Transportation Mode: 2003**
**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: 2004), 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 2003*, DOE/EIA-0131(03) (Washington, DC: November 2004), table 15.

Over the past two decades, miles traveled per gallon by single-unit trucks increased by nearly 30 percent. Between 1980 and 2003, the fuel consumed increased 54 percent whereas miles traveled increased by 95 percent. As a result, over these years, miles per gallon increased from 5.8 to 7.3.

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

| | 1980 | 1990 | 2000 | 2003 |
|---|---|---|---|---|
| Number registered (thousands) | 4,374 | 4,487 | 5,926 | 5,667 |
| Vehicle-miles (millions) | 39,813 | 51,901 | 70,500 | 77,562 |
| Fuel consumed (million gallons) | 6,923 | 8,357 | 9,563 | 10,690 |
| Average miles traveled per vehicle | 9,103 | 11,567 | 11,897 | 13,687 |
| Average miles traveled per gallon | 5.8 | 6.2 | 7.4 | 7.3 |
| Average fuel consumed per vehicle (gallons) | 1,583 | 1,862 | 1,614 | 1,886 |

In contrast to single-unit trucks, miles traveled per gallon by combination trucks changed very little over the past twenty years. Consequently, the gallons of fuel consumed doubled between 1980 and 2003 along with the number of miles traveled.

**Table 5-9. Combination Truck Fuel Consumption and Travel**

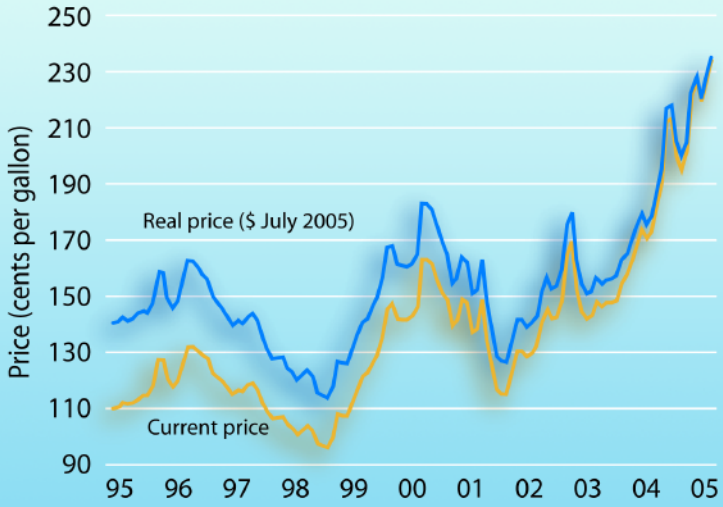
| | 1980 | 1990 | 2000 | 2003 |
|---|---|---|---|---|
| Number registered (thousands) | 1,417 | 1,709 | 2,097 | 2,245 |
| Vehicle-miles traveled (millions) | 68,678 | 94,341 | 135,020 | 138,322 |
| Fuel consumed (million gallons) | 13,037 | 16,133 | 25,666 | 26,895 |
| Average miles traveled per vehicle | 48,472 | 55,206 | 64,399 | 61,611 |
| Average miles traveled per gallon | 5.3 | 5.8 | 5.3 | 5.1 |
| Average fuel consumed per vehicle (gallons) | 9,201 | 9,441 | 12,241 | 11,980 |

Diesel prices were about 62 percent higher in July 2005 than 10 years earlier (in inflation-adjusted terms). Over that period prices bottomed out in February 1999 at just under $1.14 a gallon (in $ July 2005).

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).

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




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 more energy intense.

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 ($NO_x$).

**Table 5-10: Energy Intensities of Domestic Freight Modes**

| | 1980 | 1990 | 2000 | 2001 | 2002 |
|---|---|---|---|---|---|
| Highway (Btu per vehicle-mile) | 24,757 | 22,795 | 23,443 | 23,016 | 23,432 |
| Railroad (Class I) (Btu per freight car-mile) | 18,742 | 16,619 | 14,917 | 15,108 | 15,003 |
| Railroad (Class I) (Btu per ton-mile) | 597 | 420 | 352 | 346 | 345 |
| Water (Btu per ton-mile) | 358 | 387 | 473 | 460 | 471 |

**Key:** Btu = British thermal unit

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

FIGURE 5-2. MONTHLY DIESEL PRICES
**Source: Diesel price:** U.S. Department of Energy, Energy Information Agency, U.S. Petroleum Prices, available at www.eia.doe.gov as of September 12, 2005. **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 12, 2005.

TABLE 5-10: ENERGY INTENSITIES OF DOMESTIC FREIGHT MODES
**Source:** Oak Ridge National Laboratory, *Transportation Energy Data Book: Edition 24* (Oak Ridge,TN: 2004).

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

| | 1990 | 2000 | 2001 | 2002 | 2003 | 2004 |
|---|---|---|---|---|---|---|
| | | | Gasoline (assuming zero RFG) | | | |
| **Cars** | | | | | | |
| Exhaust HC | 2.79 | 0.97 | 0.89 | 0.81 | 0.74 | 0.61 |
| Nonexhaust HC | 1.21 | 0.92 | 0.88 | 0.84 | 0.81 | 0.77 |
| **Total HC** | **3.99** | **1.89** | **1.77** | **1.65** | **1.54** | **1.37** |
| Exhaust CO | 42.89 | 18.53 | 18.03 | 17.58 | 17.13 | 13.79 |
| Exhaust $NO_x$ | 2.70 | 1.29 | 1.25 | 1.20 | 1.14 | 1.00 |
| **Light trucks** | | | | | | |
| Exhaust HC | 3.68 | 1.45 | 1.35 | 1.24 | 1.13 | 0.96 |
| Nonexhaust HC | 1.36 | 0.97 | 0.94 | 0.89 | 0.84 | 0.80 |
| **Total HC** | **5.04** | **2.42** | **2.29** | **2.13** | **1.98** | **1.76** |
| Exhaust CO | 56.23 | 26.81 | 25.61 | 24.32 | 22.30 | 18.76 |
| Exhaust $NO_x$ | 2.62 | 1.54 | 1.53 | 1.50 | 1.45 | 1.32 |
| **Heavy trucks** | | | | | | |
| Exhaust HC | 3.66 | 1.22 | 1.09 | 0.98 | 0.82 | 0.73 |
| Nonexhaust HC | 2.74 | 1.62 | 1.54 | 1.48 | 1.41 | 1.35 |
| **Total HC** | **6.40** | **2.84** | **2.63** | **2.46** | **2.24** | **2.08** |
| Exhaust CO | 85.61 | 31.08 | 27.59 | 24.73 | 20.60 | 18.46 |
| Exhaust $NO_x$ | 7.19 | 5.26 | 5.13 | 5.01 | 4.91 | 4.62 |
| | | | Diesel | | | |
| **Cars** | | | | | | |
| Exhaust HC | 0.68 | 0.80 | 0.76 | 0.73 | 0.73 | 0.60 |
| Exhaust CO | 1.49 | 1.78 | 1.75 | 1.73 | 1.74 | 1.59 |
| Exhaust $NO_x$ | 1.83 | 1.81 | 1.72 | 1.62 | 1.54 | 1.43 |
| **Light trucks** | | | | | | |
| Exhaust HC | 1.59 | 1.02 | 0.88 | 0.96 | 0.97 | 0.98 |
| Exhaust CO | 2.67 | 1.77 | 1.54 | 1.66 | 1.68 | 1.68 |
| Exhaust $NO_x$ | 2.71 | 1.76 | 1.64 | 1.67 | 1.66 | 1.59 |
| **Heavy trucks** | | | | | | |
| Exhaust HC | 2.21 | 0.79 | 0.74 | 0.69 | 0.61 | 0.58 |
| Exhaust CO | 10.06 | 4.10 | 3.82 | 3.58 | 3.37 | 3.19 |
| Exhaust $NO_x$ | 23.34 | 18.05 | 16.68 | 15.52 | 13.92 | 12.50 |

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

Trucks are by far the largest contributor to freight emissions nationally, producing two-thirds of $NO_x$ and PM-10 from the freight sector. New U.S. Environmental Protection Agency emissions standards for trucks are expected to significantly reduce emissions, however, even with large increases in truck traffic.

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 | | | | |
|---|---|---|---|---|---|
| | 2002 | 2010 | 2020 | Percent change, 2002-2010 | Percent change, 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 | | | | |
|---|---|---|---|---|---|
| | 2002 | 2010 | 2020 | Percent change, 2002-2010 | Percent change, 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.