CHAPTER TEN

Transportation

The U.S. transportation system is a vast enterprise. Transportation-related goods and services account for about one tenth of the nation's gross domestic product, and the economy relies heavily on the low-cost, highly flexible movement of goods and services. Most Americans enjoy a level of personal mobility that offers them a wide range of choices about where to live, work, shop, obtain health care, and vacation.

Yet, not all the costs of mobility are paid directly by the individuals and businesses who are the beneficiaries. Transportation has a significant impact on environmental quality in a wide variety of ways, notably in terms of air quality, land use and development, habitats and open space, and energy use.

Particularly notable is the high dependence of most American communities on the automobile as the principal means of transportation. Urban growth has often been characterized by new housing developments encroaching farther into agricultural and environmentally sensitive lands, an increasing dependence on automobiles, and the isolation of central cities and older communities.

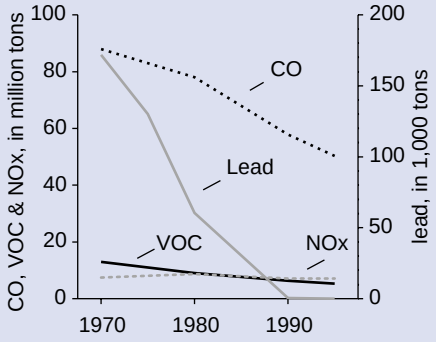
Many states have been struggling to reverse these trends. One of the most dynamic examples is Maryland's Smart Growth Initiative. The initiative was built on the Maryland Economic Growth, Resource Protection, and Planning Act of 1992, and further strengthened in 1997 with enactment of the Neighborhood Conservation and Smart Growth package of initiatives.

The centerpiece of the 1997 package is the "Smart Growth Areas" legislation. This new law limits most State spending on housing, infrastructure, economic development, and other programs to "Priority Funding Areas," areas that local governments determine are suitable for further growth. This serves to channel state funds to already developed areas and to areas selected by local governments for further growth, while restricting state funding for infrastructure or development in other rural areas. A new "Live Near Your Work" pilot program provides cash contributions to workers buying homes in certain older neighborhoods. To spur more preservation of undeveloped land, a new "Rural Legacy" program provides financial resources for the protection of farm and forest lands

and the conservation of these essential rural resources.

Such strategies could have significant long-term environmental benefits. For example, they could help build on the reductions in air pollutants from mobile sources, which to date are attributable almost entirely to technological advances that have reduced pollutant emissions, and to requirements that harmful substances be reduced or removed from fuels, or that substances be added to fuels to make them pollute less.

Figure 10.1 Pollutant Emissions by On-road Sources, 1970-1997



Source: See Part III, Tables 5.1 through 5.7.
Notes: NO_x = Nitrogen oxides. CO = Carbon monoxide. VOC = volatile organic compounds.

TRENDS

Notable reductions in air pollutant emissions and air quality concentrations have occurred since 1970, despite significant increases in population, economic and industrial activity, and vehicle miles traveled.

Over the past decade, for example, national emissions of carbon monoxide have declined from 116.1 million tons in 1988 to 87.5 million tons in 1997. More than half of total emissions are from on-road vehicles. In that category, emissions have declined from 71.1 million tons in 1988 to 50.3 million tons in 1997, despite a 25-percent increase in vehicle miles traveled over the period. NAAQS violations of CO have largely been eliminated, and CO emissions are not expected to increase.

Among other sources, the most significant increase has occurred in the category of non-road engines and vehicles, where CO emissions have increased from 15 to 17 million tons over the 1988-97 period. (Most of the 17 million tons of CO emissions from non-road engines and vehicles is from non-transportation sources, such as lawn and garden equipment and light industrial equipment.) Emissions of volatile organic compounds and lead by on-road vehicles also declined over the period, while emissions of nitrogen oxides increased slightly, continuing the trend since 1970 (Figure 10.1).

Recent data suggest a slowing of the improvements that characterized the last 25 years. Steady growth in travel coupled with increased emissions from previously unregulated off-road sources may overtake the impressive emission reductions achieved under past standards. On the whole, on-road vehicles still accounted for 58 percent of all CO emissions, 30 percent of all nitrogen oxides emissions, 27 percent of all volatile organic compounds, and 5 percent of all lead emissions in 1997.

Transportation is also a significant contributor to the nation's emissions of green-

house gases, accounting for about one third of CO_2 emissions from anthropogenic sources. In 1996, U.S. transportation-related greenhouse gas emissions grew 3.4 percent over 1995. This rate of increase is faster than the growth of energy consumption from transportation (3.2 percent) and faster than the growth of the economy (2.4 percent).

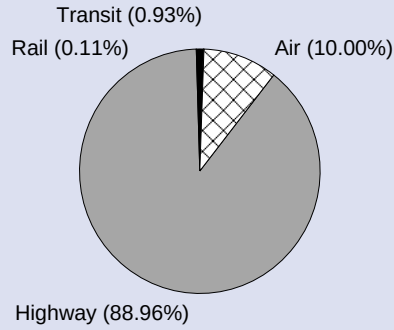
The U.S. transportation system is about 95 percent petroleum dependent, down about two percentage points from a decade ago. In 1997, transportation-driven oil demand together with declining domestic production brought about the highest levels of oil imports ever (48 percent of oil use). Transportation is the only sector of the economy that consumes significantly more petroleum today than it did in 1973, the first year of the oil price shock.

Highway vehicles continue to dominate transportation energy use. Light-duty passenger vehicles alone account for over 60 percent of all energy used in transportation.

Travel by air and on the nation's highways has increased steadily since 1960, though the upward trend for highway travel has slowed in the 1990s.

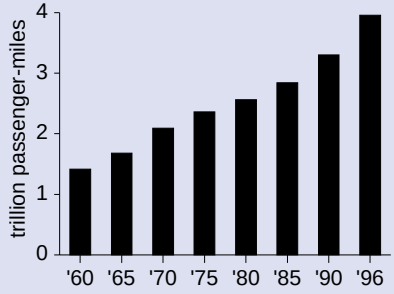
In 1996, U.S. passenger-miles totaled over 4.4 trillion, with nearly 4 trillion of the total attributable to highways and most of the remainder to air travel (Figure 10.2). Highway passenger-miles have nearly doubled since 1970 (Figure 10.3). Over the 1990-96 period, highway passenger-miles increased about 20 percent, while air passenger-miles grew about 24 percent. Travel by transit stayed about the same, while rail travel declined slightly.

Figure 10.2 U.S. Passenger-Miles by Mode, 1996



Source: See Part III, Table 10.1.
Note: Total = 4,412 billion passenger-miles.

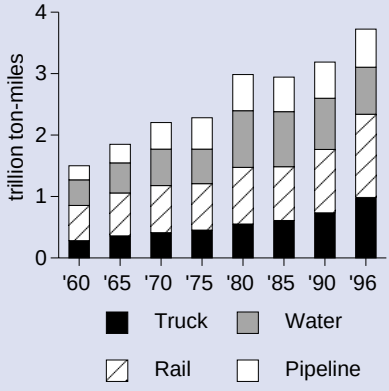
Figure 10.3 U.S. Highway Passenger-Miles, 1960-1996



Source: See Part III, Table 10.1.

Many factors contribute to the overall increase in passenger miles of travel, including increases in the U.S. population, the number of people in the labor force (especially women), and the number of people commuting to work (and the distance they travel). With an increase in disposable income, people also have more money to spend on transportation, particularly automobiles and air travel. (Passenger-miles represents the total dis-

Figure 10.4 U.S. Freight Ton-Miles by Mode, 1960-1996



Source: See Part III, Table 10.2.

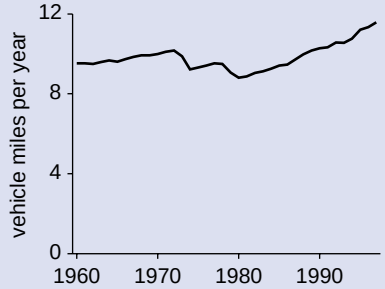
tance traveled by all passengers in passenger cars, airplanes, transit, rail and other modes; one passenger traveling one mile generates one passenger-mile). (Part III, Table 10.1)

The use of the transportation network for the movement of freight continued to grow rapidly in the 1990s (Figure 10.4). Over the 1990-96 period, ton-miles of freight hauled by intercity trucks and by rail both grew by about one third. There are several reasons for these trends other than growth in the general population and economy. These include the increasingly complex logistics of production, more international trade, technological improvements allowing more trading of perishable goods, the implementation of information technologies allowing just-in-time delivery systems, and railroad deregulation. (Ton-miles are defined as the movement of one ton of freight for a distance of one mile. Ton-miles are computed by multiplying the weight in tons of each shipment transported by the distance hauled.) (Part III, Table 10.2)

The Federal Highway Administration, in its survey of nationwide personal travel, collects data on, among other things, the number of licensed drivers per household, vehicles per household, daily vehicle trips and vehicle miles per household, average vehicle occupancy rate, average vehicle trip length, average distance to work, average annual travel per driver, and average annual personal travel.

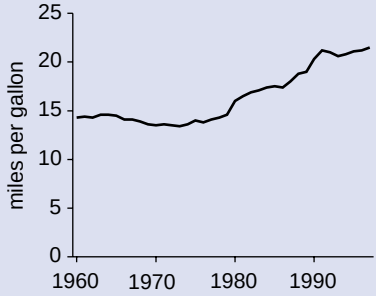
Americans generally are traveling more miles annually in their vehicles. In 1990, the average passenger car traveled 10,280 miles during the course of the year; by 1997, average vehicle-miles for passenger cars had increased to 11,575 miles. This continues a trend that began around 1980 (Figure 10.5) that has been influenced by, among other things, changes in the labor force and income as well as changes in the makeup of households and metropolitan areas. From 1970 to 1996, the number of households increased by 56 percent, partly mirroring a decline in household size. At the same

Figure 10.5 Growth in Travel in Passenger Cars, 1960-1997



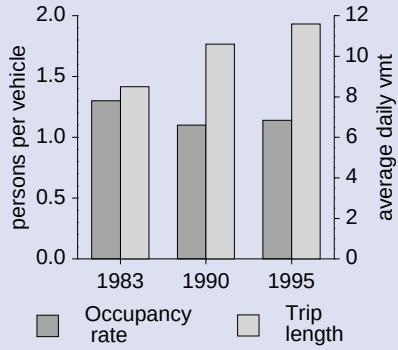
Source: See Part III, Table 10.3

Figure 10.6 U.S. Average Miles Traveled per Gallon of Fuel Consumed for Passenger Cars, 1960-1997



Source: See Part III, Table 10.3.

Figure 10.7 Profile of U.S. Passenger Vehicles Used for Commuting, 1983-1995



Source: See Part III, Table 10.4.
Notes: vmt = vehicle miles of travel.

time, the number of vehicles per household also rose. More households and vehicles translates into more trips for shopping, recreation, and taking care of children (in addition to more commuters). Changes in the locations where people live, work, and shop also increased travel and dependence on private automobiles. As metropolitan areas expanded and low-density suburbs spread into rural areas (see Part III, Table 1.4 and Table 7.2), private vehicle trips soared, as they offered more mobility and direct connections between destinations. (Vehicle-miles are estimated by calculating the number of gallons of gas sold from gasoline tax receipts and multiplying by the average number of miles per gallon for cars, buses, trucks, and other vehicles.) (Part III, Table 10.3)

Average gas mileage for passenger cars has stayed about the same in the 1990s — about 20-21 miles per gallon (mpg). Since 1960, gains are impressive. For passenger cars, fuel efficiency per vehicle has increased from 14.3 mpg in 1960 to 21.3 mpg in 1996 (Figure 10.6). From 1973 to 1996, the average fuel efficiency of new passenger cars entering the fleet increased from 14.2 mpg to 28.5 mpg. Some of the gains in car fuel efficiency were offset by a shift in the composition of private vehicle usage towards light-duty trucks and sport-utility vehicles. (Fuel consumption per vehicle is the ratio of vehicle-miles traveled to total gasoline consumption in gallons). (Part III, Table 10.3)

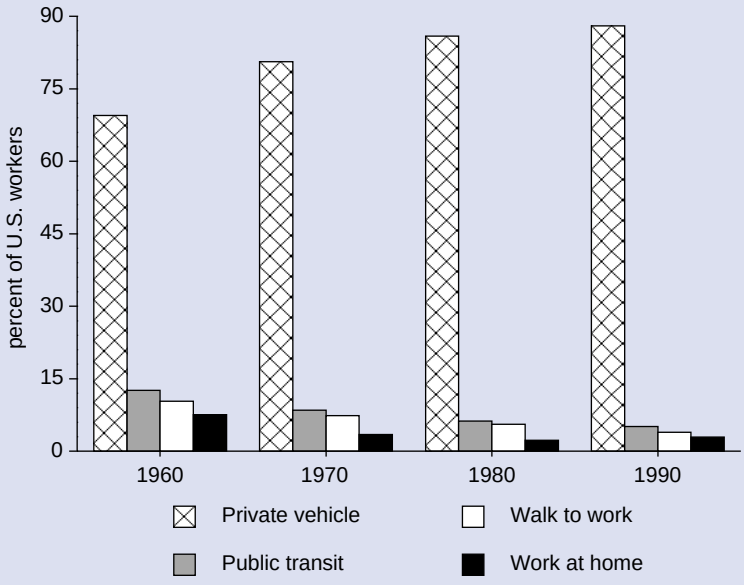
Over the period from 1983 to 1995, the average distance to work increased from 8.5 miles to 11.6 miles, or 36 percent (Figure 10.7). Over the same period, average work travel time increased 14 percent and average work trip duration increased 20 percent. These latter trends appear to contradict the reality of congested roads. The growth in suburbs around large metropolitan areas, the spreading out of peak commuting periods (because

of greater flexibility in hours of work), and the switch from carpool to single occupant vehicle trips are often cited among the reasons why people can now have a longer commute in miles with only a modest increase in travel time. (Part III, Table 10.4)

The Commerce Department's Bureau of the Census also collects data on how Americans get to work. Census data shows a dramatic rise in the use of private vehicles (Figure 10.8). In 1960, 69 percent of Americans used private vehicles to get to work, while 12 percent used public transit, 10 percent walked to work, and 7 percent worked at home. In 1990, 88 percent of working Americans were using private vehicles, while 5 percent were using public transit, 4 percent were walking, and 3 percent were working at home. (Part III, Table 10.5)

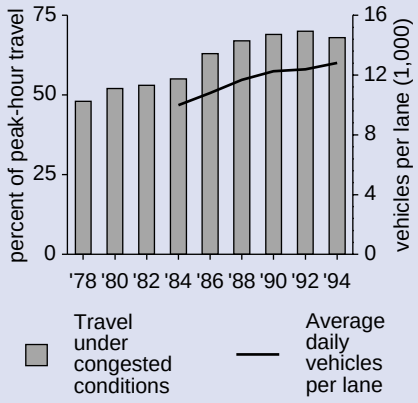
The Federal Highway Administration provides estimates of congestion on U.S. urban interstate highways. Peak hour travel under congested conditions on interstate highways increased from 41 percent of travel time in 1975 to 64 percent of travel time in 1987, and then remained stable at about 69 percent from 1988 to 1994. Meanwhile, the average daily number of vehicles per lane has continued to increase over the period (Figure 10.9). (Part III, Table 10.6) (Beginning in 1995, updated capacity (service flow) calculation procedures were instituted by DOT, making congestion data for 1995 and 1996 not comparable to previous years data.)

Figure 10.8 Journey-to-work by Mode, 1960-1990



Source: See Part III, Table 10.5.

Figure 10.9 U.S. Urban Interstate Congestion, 1978-1994



Source: See Part III, Table 10.6.
Note: See Table 10.6 for definitions of the two measures of congestion shown here.

OTHER TRANSPORTATION-RELATED TRENDS

Aircraft Noise

In the late 1960s, Congress directed the Federal Aviation Administration to begin regulating aircraft noise, establishing the first federal noise standards for new-design turbojet and transport category jet aircraft. These "Stage 2" aircraft noise standards were subsequently applied to all newly produced planes, including those of older designs.

These steps did not fully solve the problem; by 1974, FAA estimated that 7 million people were still severely affected by aircraft noise. In 1976, FAA required that all subsonic aircraft in operation meet Stage 2 requirements by January 1, 1985. In 1977, FAA implemented more stringent Stage 3 noise standards for new aircraft.

In 1990, FAA began a phased elimination of civil, subsonic aircraft over 75,000 pounds flying into or out of airports in the contiguous United States by December 31, 1999. To date, the transition to Stage 3 aircraft has remained on schedule.

In 1995, FAA estimated that 1.7 million people were exposed to day-night noise levels greater than 65 decibels, a decline of over 75 percent since 1975 even while commercial aircraft departures increased by over 75 percent.

Scrap Tire Disposition

Disposal of scrap tires has been an environmental problem for many decades; the nation annually throws away about 250 million scrap tires, many of which go to landfills, scrap tire stockpiles, or illegal dumps.

The scrap tire problem has changed quite dramatically over the past several years, largely as a result of a significant increase in their use as tire-derived fuel. From 1990 to 1996, the number of tires used as fuel increased nearly five-fold, reaching more than 150 million. Demand for scrap tires in other markets also roughly doubled during this period. These markets include ground rubber applications, such as asphalt products, new tires, bound rubber products, and athletic surfaces; civil engineering applications, such as fill material, road bed material, and aggregate; and other applications such as artificial reefs, playground equipment, and crash barriers.

With the growth of these important new markets for scrap tires, EPA and the Scrap Tire Management Council esti-

mate that the number of scrap tires stockpiled, landfilled, and dumped annually may have fallen by as much as two thirds.

ONLINE RESOURCES

The U.S. Department of Transportation's Bureau of Transportation Statistics (http://www.bts.gov/) maintains a vast quantity of data on U.S. transportation. Much of the material is available online through the bureau's National Transportation Library (http://www.bts.gov/ntl).

National Transportation Statistics (http://www.bts.gov/ntda/nts) includes numerous tables on the physical extent of the U.S. transportation system, travel and the movement of goods, energy use in transportation, and transportation-related air emissions. *National Transportation Statistics 1998* is only available online; other BTS materials are available in print form.

Transportation and the Environment

National Transportation Statistics also includes numerous tables on transportation-related energy consumption and air emissions. Air emissions estimates are compiled by Oak Ridge National Laboratory and published in the Environmental Protection Agency's *National Air Pollutant Emission Trends* reports.

Data are available describing transportation-related emissions of carbon monoxide, nitrogen oxides, nonmethane volatile organic compounds, particulate matter, sulfur dioxide, and lead. Transportation-related lead emissions, estimated at 180,000 short tons in 1970, have been nearly eliminated in the 1990s following the phaseout of lead in gasoline.

DOT's Bureau of Transportation Statistics also publishes the *Transportation Statistics Annual Report*, which includes a discussion each year on energy and environment trends pertinent to transportation. Part II of the 1996 report provided in-depth coverage of transportation's environmental impacts and trends, including international comparisons and data needs (http://www.bts.gov/programs/transtu/tsar/tsar.html).

The Federal Highway Administration's Office of Environment and Planning is online (http://www.fhwa.dot.gov/environment/). The site includes a valuable summary of environmental legislation affecting transportation.

The Center for Transportation and the Environment is a DOT-supported university research institute that focuses on research related to mitigating the effects of surface transportation on the environment (http://itre.itre.ncsu.edu/cte/).

The Transportation Action Network, or TransAct, is a joint project of the Environmental Protection Agency's Transportation Partners Program and the Surface Transportation Policy Project. TransAct (http://www.transact.org) provides information and resources about making communities more livable and helping the environment through innovative transportation projects and initiatives.

DOE's Transportation Technologies site (http://www.ott.doe.gov) is a one-stop shop for information on transportation technologies. Among other things, the

site provides information about alternative fuels, including the outlook for alternative-fuel vehicles, information sources on alternative fuels, and a glossary of key alternative fuel terms.

The Transportation Research Board is a unit of the National Research Council, which serves the National Academy of Sciences and the National Academy of Engineering. The Board's research agenda includes studies on the interaction of transportation systems with the environment. One recent report, *Transportation and a Sustainable Environment*, lays out a path toward transportation policies that are commensurate with the need for long-term environmental integrity and sustainability (http://www.nas.edu/trb).

Global Data

The World Bank (http://www.worldbank.org) provides a wealth of information about environmental issues in developing countries. *World Development Indicators*, which is available in published form or on CD-ROM, includes a table on traffic and congestion.

In the transportation area, the Bank is actively encouraging the total phase-out of leaded gasoline. The World Bank-supported Transport Air Quality Management Project for the Mexico City Metropolitan Area includes actions on vehicle emissions control technology, alternative fuels and vapor controls, travel demand management, public transport, and transport investment planning.

SELECTED RESOURCES

Highway Statistics

U.S. Department of Transportation, Federal Highway Administration, *Our Nation's Highways—Selected Facts and Figures* (FHWA, Washington, DC, 1998). (http://www.fhwa.dot.gov/ohim/onh/onh.pdf)

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—, *Highway Statistics Summary to 1995* (FHWA, Washington, DC, December 1997). (http://www.fhwa.dot.gov/ohim/Summary95/index.html)

Personal Transportation Trends

—, U.S. Department of Transportation, Federal Highway Administration, *Journey-To-Work Trends in the United States and its Major Metropolitan Areas 1960-1990* (FHWA, no date, based on decennial census data) (http://www.bts.gov/NTL/DOCS/473.html)

—, *Our Nation's Travel: 1995 NPTS Early Results Report* (FHWA, Washington, DC., 1997). (http://www-cta.ornl.gov/npts/1995/Doc/EarlyResults.shtml)

—, *Our Nation's Travel: Technical Appendix for the Early Results Report* (FHWA, Washington, DC., 1997). (http://www-cta.ornl.gov/npts/1995/Doc/TechAppx.pdf)

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U.S. Department of Transportation, Bureau of Transportation Statistics, *National Transportation Statistics 1998* (DOT, BTS, Washington, DC, 1998) (http://www.bts.gov/btsprod/nts/)

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—, *Transportation in the United States, A Review* (DOT, BTS, Washington, DC, 1997). (http://www.bts.gov/NTL/DOCS/tranrev.html)

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Transportation Energy Statistics

Davis, S.C., *Transportation Energy Databook,* (DOE, Oak Ridge National Laboratory, Center for Transportation Analysis, annual). (http://www-cta.ornl.gov/data/tedb.htm)

Other Transportation and the Environment Resources

U.S. Environmental Protection Agency, Office of Policy Planning and Evaluation, *Indicators of the Environmental Impacts of Transportation* (EPA, OPPE, Washington, DC, 1996). (http://www.epa.gov/tp/indicall.pdf)

U.S. Department of Transportation, U.S. Coast Guard, *Pollution Incidents In and Around U.S. Waters, A Spill/Release Compendium: 1969-1997* (DOT, USCG, Washington, DC, 1999). (http://www.uscg.mil/hq/g-m/nmc/response/stats/aa.htm)

CORE DATA

Table 10.1 U.S. Passenger-Miles of Travel, Five-Year Intervals, 1960-1990, and Annually, 1991-1996

Table 10.2 U.S. Ton-Miles of Freight, Five-Year Intervals, 1960-1990, and Annually, 1991-1996

Table 10.3 Average Annual U.S. Vehicle-Miles of Travel and Average Miles Traveled per Gallon of Fuel Consumed per Vehicle, 1960-1997

Table 10.4 U.S. Personal Travel per Household, Driver, and Mode, 1969, 1977, 1983, 1990, and 1995

Table 10.5 Journey-To-Work Mode for U.S. Working Population, 1960-1990

Table 10.6 Congestion on U.S. Urban Interstate Highways, Selected Years, 1975-1997