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SURFACE AND MARITIME TRANSPORTATION

Developing Strategies for Enhancing Mobility: A National Challenge

GAO-02-775

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Abbreviations

AASHTO	American Association of State Highway and Transportation Officials
APTA	American Public Transportation Association
Corps of Engineers	U.S. Army Corps of Engineers
DOT	U.S. Department of Transportation
FHWA	Federal Highway Administration
FRA	Federal Railroad Administration
FTA	Federal Transit Administration
GARVEE	Grant Anticipation Revenue Vehicle
HOT	high occupancy toll
HOV	high occupancy vehicle
HPMS	Highway Performance Monitoring System
ISTEA	Intermodal Surface Transportation Efficiency Act of 1991
ITS	Intelligent Transportation Systems
MPO	Metropolitan Planning Organization
NAS	National Academy of Sciences
RABA	Revenue Aligned Budget Authority
RRIF	Rail Rehabilitation and Improvement Financing Program
SIB	State Infrastructure Bank
TEA-21	Transportation Equity Act for the 21st Century
TIFIA	Transportation Infrastructure Finance and Innovation Act of 1998
TRB	Transportation Research Board
WMATA	Washington Metropolitan Area Transit Authority

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United States General Accounting Office
Washington, D.C. 20548

August 30, 2002

The Honorable James Jeffords
Chairman
The Honorable Robert Smith
Ranking Minority Member
Committee on Environment and Public Works
United States Senate

The scope of the U.S. surface and maritime transportation systems—which primarily include roads, mass transit systems, railroads, and ports and waterways[1]—is vast. One of the major goals of these systems is to provide and enhance mobility, that is, the free flow of passengers and goods. Mobility provides people with access to goods, services, recreation, and jobs; provides businesses with access to materials, markets, and people; and promotes the movement of personnel and material to meet national defense needs. Among the social and economic benefits of enhanced mobility are improved economies and, for some, better quality of life and access to job opportunities. In 2000, the surface and maritime transportation systems carried 2.7 trillion miles of travel by passenger vehicles and trucks, 8.7 billion trips on public transit, 22.5 million trips on intercity passenger rail (Amtrak), and in 1998, about 13.5 billion tons of freight on all modes.

While the U.S. surface and maritime transportation systems provide many benefits, they have also generated some concerns about congestion and the burden they impose on the nation's quality of life through wasted energy, time, and money; increased pollution and threats to public safety; barriers to transportation accessibility for certain population groups; and the level of financial resources available to address transportation problems. Several key pieces of legislation that authorize funding for federal surface transportation programs will expire soon. For example, the Transportation Equity Act for the 21st Century (TEA-21)[2]—which authorizes federal funding for highways, mass transit, and a variety of other surface transportation programs—expires in fiscal year 2003 and the Amtrak

[1]In this report, we define the surface transportation system as highways, mass transit systems, and railroads; and the maritime transportation system as ports, inland waterways, and the intermodal connections leading to them. Pipelines were not part of our review.

[2]P.L. 105-178 (June 9, 1998).

Reform and Accountability Act of 1997[3] that authorizes federal appropriations for Amtrak expires at the end of fiscal year 2002. In addition, the federal funding processes and mechanisms for the maritime transportation system are currently under review by two interagency groups.[4] As the Congress considers reauthorizing surface transportation legislation, it will weigh the structure, nature, and level of federal investment it will provide in future years to enhance mobility and support other surface and maritime transportation activities.

Given the social and economic importance of the surface and maritime transportation systems and to inform the Congress in its reauthorization deliberations, you asked us to provide information on the following questions:

1. What have been the trends over the past 10 years in surface and maritime transportation expenditures made by the public sector?

2. What are the projected trends in the levels of passenger and freight travel on surface and maritime transportation modes over the next 10 years and what are the key factors that influence those trends?

3. What key challenges in maintaining and improving mobility have experts and other sources identified?

4. What are some key strategies for addressing the challenges?

In addressing the first two questions, we analyzed databases and other information obtained from the U.S. Department of Transportation (DOT) and the U.S. Army Corps of Engineers (Corps of Engineers).[5] We did not verify the accuracy of these data. In addressing the third and fourth questions, we relied upon the results of two panels of surface and maritime transportation experts that we convened in April 2002. The 22 experts were selected by the National Academy of Sciences (NAS) and its Transportation Research Board with input from us; they included a cross-section of

[3]P.L. 105-134 (Dec. 2, 1997).

[4]The two groups are the Interagency Committee on the Marine Transportation System and the Marine Transportation System National Advisory Council.

[5]The DOT data on expenditures included spending by the U.S. Coast Guard and the St. Lawrence Seaway Development Corporation for transportation.

representatives from all surface and maritime modes and from various occupations involved in transportation planning. We also reviewed reports prepared by federal agencies, academics, and industry groups to address the third and fourth questions. Appendix VI provides further information on our scope and methodology.

In this report we discuss three types of travel that have important distinctions: local passenger travel, intercity passenger travel, and freight travel. Local travel includes commuting trips to and from work, shopping trips, and other personal trips such as for school, social, or recreational purposes. The main types of vehicles and modes of transportation used for local trips include automobiles and mass transit, including city buses, commuter rail, subways, and ferries. Intercity passenger travel is different from local travel because it represents longer distances traveled, and it occurs on some different modes of transportation, primarily automobile, air service, intercity bus, and intercity rail. Freight generally moves by trucks on public roads; by barges and various cargo ships on the inland, intra-coastal, coastal, and Great Lakes waterways; by trains on rail on private right-of-way; and by airplane. The choice of mode is influenced by the type, weight, and value of goods being shipped; available modes of transportation in the region; and cost, speed, and other service requirements.

Results in Brief

During the past decade, total public sector spending (in 1999 dollars)[6] increased for public roads and transit, remained constant for waterways, and decreased for rail. Federal expenditures for public roads have substantially increased since the passage of TEA-21 in 1998—from $21.2 billion in 1998 to $26.9 billion in 2000, an increase of 26.8 percent.[7] Federal spending for transit decreased slightly between 1991 and 1999 and then increased by 21.5 percent from $4.3 billion in 1999 to $5.2 billion in 2000. Federal spending stayed constant for waterways and decreased for rail during the period from 1991 to 2000. The state and local share of total public sector expenditures stayed relatively constant during fiscal years

[6]We adjusted the expenditure data to account for inflation using separate indexes for expenditures made by the federal government or state and local governments. We used price indexes from the U.S. Bureau of Economic Analysis' National Income and Products Accounts.

[7]Throughout this report, the percentage calculations are based on amounts that have not been rounded.

1991 through 1999[8] for public roads, while modestly increasing for other modes.

Passenger and freight travel are expected to increase over the next 10 years, according to DOT projections. Passenger vehicle travel on public roads is expected to grow by 24.7 percent from 2000 to 2010. Passenger travel on transit systems is expected to increase by 17.2 percent over the same period. Amtrak has estimated that intercity passenger rail ridership will increase by 25.9 percent from 2001 to 2010. Preliminary estimates by DOT indicate that tons of freight moved on all surface and maritime modes—truck, rail, and water—are expected to increase by 43 percent from 1998 through 2010, with the largest increase expected to be in the truck sector. The key factors behind increases in passenger travel, and the modes travelers choose, are expected to be population growth, the aging of the population, and rising affluence. For freight movements, economic growth, increasing international trade, and the increasing value of cargo shipped may affect future travel levels and the modes used to move freight. However, several factors in the forecast methodologies limit their ability to capture the effects of changes in travel levels on the surface and maritime transportation systems. In particular, the key assumption underlying most of the national travel projections that we obtained is that capacity will increase as levels of travel increase; therefore, the projections are not limited by possible future constraints on capacity such as increasing congestion.

According to our expert panelists and other sources, with increasing passenger and freight travel, the surface and maritime transportation systems face a number of challenges that involve ensuring continued mobility while maintaining a balance with other social goals, such as environmental preservation. These challenges include:

- Preventing congestion from overwhelming the transportation system. Increasing travel has already been leading to increasing levels of congestion at bottlenecks and peak travel times in some areas. According to the Texas Transportation Institute,[9] the average amount of time that roadways were congested increased from about 4.5 hours per

[8]Data on state and local expenditures are only available through fiscal year 1999, while federal expenditures data are available through fiscal year 2000.

[9]David Shrank and Tim Lomax, *2002 Urban Mobility Report* (College Station, TX: Texas Transportation Institute, June 2002).

day in 1982 to about 7 hours in 2000 in 75 metropolitan areas that were studied. Freight mobility is affected by increasing congestion within specific heavily used corridors and at specific bottlenecks that tend to involve intermodal connections, such as border crossings, and road and rail connections at major seaports and within metropolitan areas. For example, one panelist said that railroads are beginning to experience more severe capacity constraints in areas where commuter and intercity passenger rail services share tracks with freight railroads.

- Ensuring access to transportation for certain underserved populations, including some elderly, poor, and rural populations that have restricted mobility. Policies and patterns of development that encourage automobile dependence and favor provision of transit services with inflexible routes and schedules—such as subway or bus—may disadvantage these groups by limiting their access to needed services and/or jobs.

- Addressing the transportation system's negative effects on the environment and communities. Increasing travel can lead to degradation of air quality and other negative externalities. Passenger and freight vehicle emissions contribute to air and water pollution, particularly in congested areas, and the accompanying noise is also a form of pollution.

There is no one solution for the mobility challenges facing the nation, and our expert panelists indicated that numerous approaches are needed to address these challenges. From these discussions, we believe that the wide range of approaches discussed can be clustered into three key strategies that may aid transportation decisionmakers at all levels of government in addressing mobility challenges. These strategies include the following:

1. Focus on the entire surface and maritime transportation system rather than on specific modes or types of travel to achieve desired mobility outcomes. This strategy involves shifting the focus of transportation agencies at the federal, state, and local level from their current emphasis on single modes to consider performance outcomes of all modes in addressing mobility challenges, as well as recognizing interactions across modes, between passenger and freight traffic, and between public and private interests. This strategy offers promise to better target the specific mobility challenges identified above.

2. Use a full range of tools to achieve desired mobility outcomes. This strategy, which calls for using various tools—such as new construction,

corrective and preventive maintenance, rehabilitation, operations and system management, and pricing—to address complex mobility challenges, offers promise to be more effective than placing emphasis on any one technique. For example, building new infrastructure can ease congestion in bottlenecks but is not always a viable solution due to cost, land, regulatory, or administrative constraints. Also, performing needed maintenance on existing transportation systems can improve the speed and reliability of passenger and freight travel, while instituting tolls or fees during peak travel times may lead people to schedule recreational trips or move freight during less congested times or by alternate routes.

3. Provide more options for financing mobility improvements and consider additional sources of revenue. This strategy—which involves providing options for targeting the financing of transportation projects to achieve desired mobility outcomes and to address transportation systems that face the greatest challenges—suggests the value of identifying more options for raising and distributing funds for surface and maritime transportation.

Background

The U.S. surface and maritime transportation systems facilitate mobility through an extensive network of infrastructure and operators, as well as through the vehicles and vessels that permit passengers and freight to move within the systems. The systems include 3.9 million miles of public roads, 121,000 miles of major private railroad networks, and 25,000 miles of commercially navigable waterways. They also include over 500 major urban public transit operators in addition to numerous private transit operators, and more than 300 ports on the coasts, Great Lakes, and inland waterways.

Maintaining the transportation system is critical to sustaining America's economic growth. Efficient mobility systems are essential facilitators of economic development—cities could not exist and global trade could not occur without systems to transport people and goods. DOT has adopted improved mobility—to "shape an accessible, affordable, reliable transportation system for all people, goods, and regions"—as one of its strategic goals. To achieve this goal, it has identified several desired outcomes, including (1) improving the physical condition of the transportation system, (2) reducing transportation time from origin to destination, (3) increasing the reliability of trip times, (4) increasing access

to transportation systems, and (5) reducing the cost of transportation services.

The relative roles, responsibilities, and revenue sources of each sector involved in surface and maritime transportation activities—including the federal government, other levels of government, and the private sector—vary across modes. For public roads, ownership is divided among federal, state, and local governments—over 77 percent of the roads are owned by local governments; 20 percent are owned by the states, including most of the Interstate Highway System; and 3 percent are owned by the federal government.[10] While the federal government owns few roads, it has played a major role in funding the nation's highways. For example, from 1954 through 2001, the federal government invested over $370 billion (in constant 2001 dollars) in the Interstate Highway System.

With the completion of the interstate system in the 1980s—and continuing with passage of the Intermodal Surface Transportation Efficiency Act of 1991 (ISTEA)[11] and its successor legislation, TEA-21, in 1998—the federal government shifted its focus toward preserving and enhancing the capacity of the system. Under the Federal Aid Highway Program, the Federal Highway Administration (FHWA) provides funds to states to construct, improve, and maintain the interstate highway system and other parts of the U.S. road network and to replace and rehabilitate bridges. TEA-21 established, among other things, a mechanism for ensuring that the level of federal highway program funds distributed to the states would be more closely linked than before to the highway user tax receipts credited to the Highway Account of the Highway Trust Fund. These user taxes include excise taxes on motor fuels (gasoline, gasohol, diesel, and special fuels) and truck-related taxes on truck tires, sales of trucks and trailers, and the use of heavy vehicles. FHWA distributes highway program funds to the states through annual apportionments according to statutory formulas that consider a variety of factors including vehicles miles traveled on the interstate system, motor fuel usage by each state's highway users, and other factors. The federal share for project funding is usually 80 percent but can vary among programs, road types, and states. State and local governments then "match" federal funds with funds from other sources, such as state or local revenues.

[10]These include roads in national forests and parks and on military and Indian reservations.

[11]P.L. 102-240 (Dec. 18, 1991).

While the federal government's primary role has been to provide capital funding for the interstate system and other highway projects, state and local governments provide the bulk of the funding for public roads in the United States and are responsible for operating and maintaining all nonfederal roads including the interstate system. The sources of state highway revenues include user charges, such as taxes on motor fuels and motor vehicles and tolls; proceeds of bond issues; General Fund appropriations; and other taxes and investment income. The sources of local highway revenues include many of the user charges and other sources used by state governments, as well as property taxes and assessments.

The U.S. transit system includes a variety of multiple-occupancy vehicle services designed to transport passengers on local and regional routes. Capital funding for transit came from the following sources in 2000: 47 percent of the total came from the federal government, 27 percent from transit agencies and other nongovernmental sources, 15 percent from local governments, and 11 percent from states. In that same year, the sources of operating funds for transit included passenger fares (36 percent of operating funds); state governments (20 percent); local governments (22 percent); other funds directly generated by transit agencies and local governments through taxes, advertising, and other sources (17 percent); and the federal government (5 percent).

The Federal Transit Administration (FTA) provides financial assistance to states and local transit operators to develop new transit systems and improve, maintain, and operate existing systems. This assistance includes (1) formula grants to provide capital and operating assistance to urbanized and nonurbanized areas and to organizations that provide specialized transit services to the elderly and disabled persons; (2) competitive capital investment grants for constructing new fixed guideway[12] systems and extensions to existing ones, modernizing fixed guideway systems, and investing in buses and bus-related facilities; (3) assistance for transit planning and research; and (4) grants to local governments and nonprofit organizations to connect low-income persons and welfare recipients to jobs and support services. Funding for federal transit programs is generally provided on an 80 percent/20 percent federal to local match basis. Federal

[12]Fixed guideway systems use and occupy a separate right-of-way for the exclusive use of public transportation services. They include fixed rail, exclusive lanes for buses and other high-occupancy vehicles, and other systems.

support for transit projects comes from the Highway Trust Fund's highway and transit accounts and from the General Fund of the U.S. Treasury.[13]

The respective roles of the public and private sector and the revenue sources vary for passenger as compared with freight railroads. With regard to passengers, the Rail Passenger Service Act of 1970 created Amtrak to provide intercity passenger rail service because existing railroads found such service unprofitable. Since its founding, Amtrak has rebuilt rail equipment and benefited from significant public investment in track and stations, especially in the Northeast corridor, which runs between Boston, Mass., and Washington, D.C. The federal government, through the Federal Railroad Administration (FRA), has provided Amtrak with $39 billion (in 2000 dollars)[14] for capital and operating expenses from 1971 through 2002. Federal payments are a significant revenue source for Amtrak's capital budget,[15] but not its operating budget. In fiscal year 2001, for example, the sources of Amtrak's capital funding were private sector debt financing (59 percent of total revenues), the federal government (36 percent), and state and local transportation agencies (5 percent). In that same year, the sources of funding for Amtrak's operating budget were passenger fares (59 percent of total revenues), other business activities and commuter railroads (34 percent), and the federal government and state governments (7 percent).[16] The role of the federal government in providing financial support to Amtrak is currently under review amid concerns about the corporation's financial viability and discussions about the future direction of federal policy toward intercity rail service.

With regard to freight, the private sector owns, operates, and provides almost all of the financing for freight railroads. Since the 1970s, the railroad industry has experienced many changes including deregulation and industry consolidation. Currently, the federal government plays a relatively small role in financing freight railroad infrastructure by offering some

[13]The General Fund contains receipts that are not earmarked by law for a specific purpose, such as almost all income tax receipts.

[14]In nominal dollars, the Congress provided Amtrak with about $25 billion from 1971 through 2002.

[15]Amtrak's capital revenues are used to acquire property, plant, and equipment.

[16]In addition, Amtrak used a portion of its federal capital funding to pay for operating expenses related to overhauling equipment.

credit assistance to state and local governments and railroads for capital improvements.

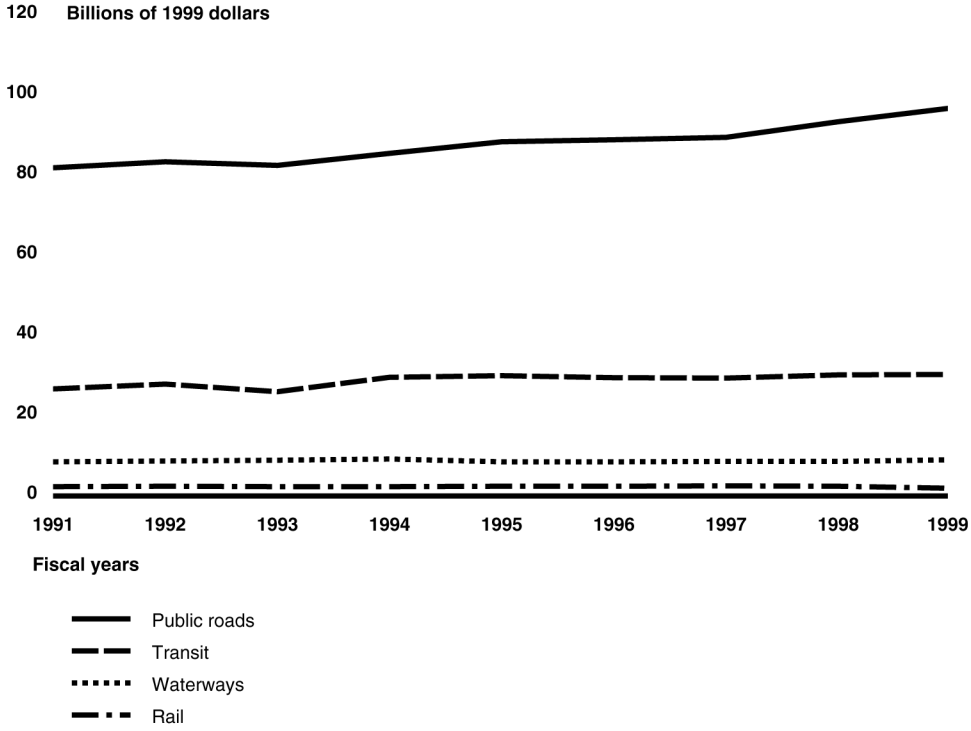
The U.S. maritime transportation system primarily consists of waterways, ports, the intermodal connections (e.g., inland rail and roadways) that permit passengers and cargo to reach marine facilities, and the vessels and vehicles that move cargo and people within the system. The maritime infrastructure is owned and operated by an aggregation of state and local agencies and private companies, with some federal funding provided by the Corps of Engineers, the U.S. Coast Guard, and DOT's Maritime Administration. The Corps of Engineers provides funding for projects to deepen or otherwise improve navigation channels, maintain existing waterways, and construct and rehabilitate inland waterway infrastructure, primarily locks and dams. Funding for channel operations and maintenance generally comes from the Harbor Maintenance Trust Fund supported by a tax on imports, domestic commodities, and other types of port usage. The costs of deepening federal channels are shared by the federal government and nonfederal entities. The Inland Waterways Trust Fund, supported by a fuel tax, funds one-half of the inland and intra-coastal capital investments. Coast Guard funding promotes (1) mobility by providing aids to navigation, icebreaking services, bridge administration, and traffic management activities; (2) security through law enforcement and border control activities; and (3) safety through programs for prevention, response, and investigation. DOT's Maritime Administration provides loan guarantees for the construction, reconstruction, or reconditioning of eligible export vessels and for shipyard modernization and improvement. It also subsidizes the operating costs of some companies that provide maritime services and provides technical assistance to state and local port authorities, terminal operators, the private maritime industry, and others on a variety of topics (e.g., port, intermodal, and advanced cargo handling technologies; environmental compliance; and planning, management, and operations of ports).

Trends in Public Expenditures for Surface and Maritime Transportation Vary by Mode

Public Sector Expenditures

Public sector spending (in 1999 dollars) has increased for public roads and transit between fiscal years 1991 and 1999, but stayed constant for waterways and decreased for rail, as shown in figure 1.

Figure 1: Total Public Sector Expenditures for Surface and Maritime Transportation by Mode, Fiscal Years 1991-1999



Source: U.S. Department of Transportation, Bureau of Transportation Statistics (2002), Government Transportation Financial Statistics (Preliminary Data), Washington, D.C.

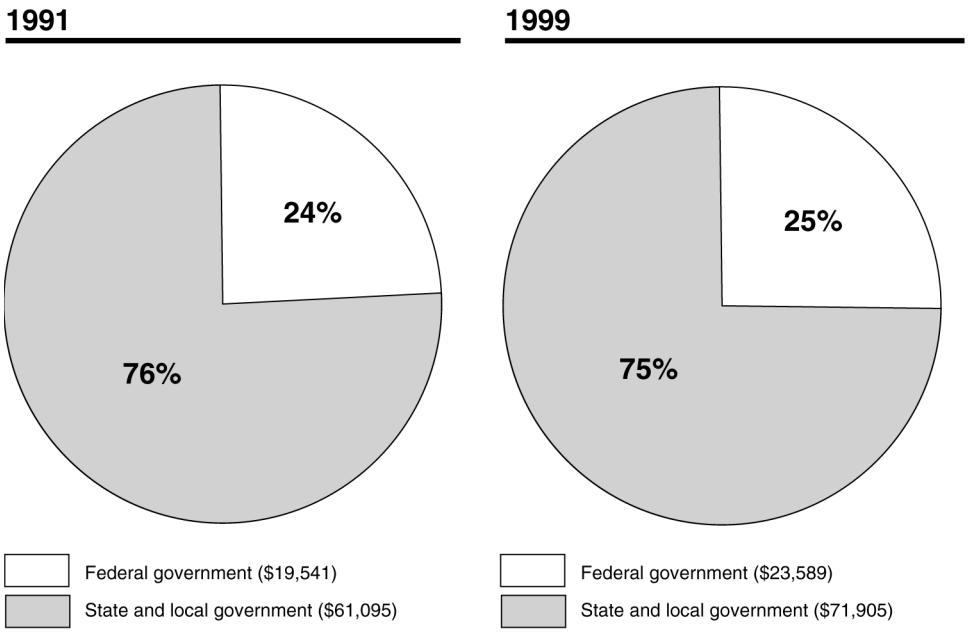
Total public sector spending for public roads increased by 18.4 percent between fiscal years 1991 and 1999,[17] from $80.6 billion to $95.5 billion (in 1999 dollars).[18] Of those totals, the relative shares contributed by the federal government and by state and local governments remained constant from 1991 to 1999, as shown in figure 2. Contributions from state and local governments' own funds—that is, independent of federal grants to state and local governments—were approximately 75 percent, with the federal government contributing the remaining 25 percent.[19]

[17]As of May 2002, state and local government expenditures were not available for fiscal years after 1999. Therefore, total public sector expenditures are only reported through fiscal year 1999. Federal expenditure data are available for fiscal year 2000, but only appropriations data are available for fiscal years 2001 and 2002.

[18]Throughout this report, the percentage calculations are based on amounts that have not been rounded.

[19]State and local governments' highway expenditures reported by the Bureau of Transportation Statistics are slightly lower than those reported in the FHWA's Highway Statistics, because data from the FHWA include outlays for activities—such as law enforcement and patrols and policing of streets and highways—not included in the Bureau of Transportation Statistics' data.

Figure 2: Federal Government and State and Local Government Shares of Expenditures on Public Roads (in millions of 1999 dollars)



Source: U.S. Department of Transportation, Bureau of Transportation Statistics (2002), Government Transportation Financial Statistics (Preliminary Data), Washington, D.C.

The increases in total public spending for roads reflect federal programmatic spending increases resulting from ISTEA in 1992 and TEA-21 in 1998, as well as increases in total state and local spending. In particular, since the passage of TEA-21, the federal government's contribution to total public expenditures on roads increased by 26.8 percent (in 1999 dollars) from $21.2 billion in fiscal year 1998 to $26.9 billion in fiscal year 2000, the latest year for which federal expenditure data are available. Although data on federal expenditures are not currently available for fiscal years after 2000, federal appropriations for fiscal years 2001 and 2002 reached $32.1 billion and $33.3 billion, respectively.[20] Federal funding increases in those years largely resulted from adjustments required by the Revenue Aligned

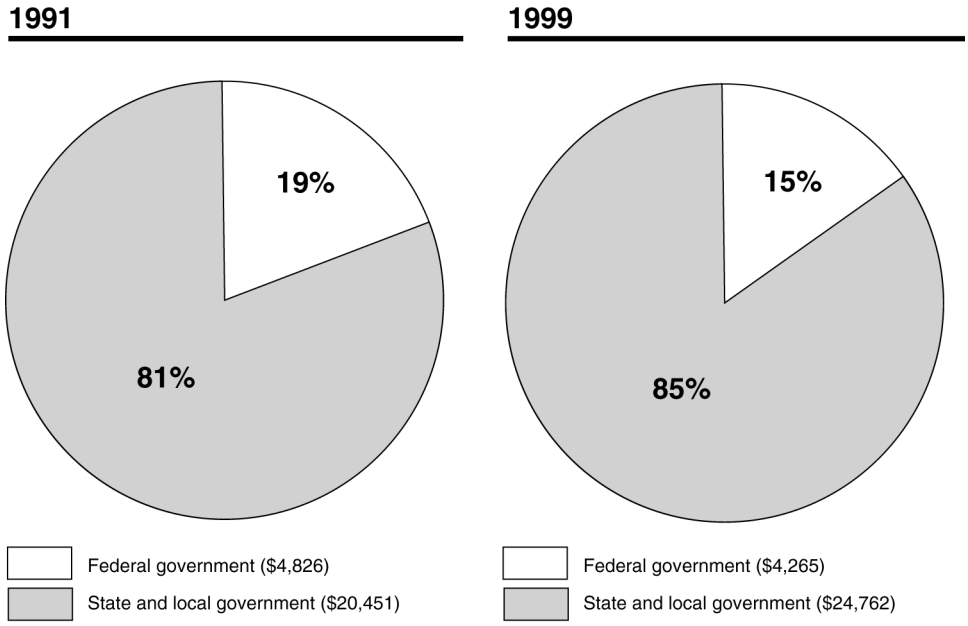
[20]Appropriations are not directly comparable to expenditures. Appropriations provide the authority to make obligations, which eventually turn into expenditures. However, those expenditures might not be made in the same fiscal year as the appropriations.

Budget Authority (RABA) provisions in TEA-21.[21] Since TEA-21, the federal government has shifted its focus toward preserving and enhancing the capacity of public roads, while state and local government expenditures have been focused on maintaining and operating public roads. Appendix I contains additional information on the levels of capital investment and maintenance spending by the public sector.

Total public spending for transit increased by 14.8 percent between fiscal years 1991 and 1999 to just over $29 billion (in 1999 dollars). This mainly reflects increases in state and local expenditures, as federal expenditures for transit actually decreased slightly over this period to $4.3 billion in 1999. In fiscal year 2000, however, federal spending on transit increased by 21.5 percent from $4.3 billion to $5.2 billion (in 1999 dollars). Although federal data on expenditures are not currently available for fiscal years after 2000, appropriations for fiscal years 2001 and 2002 reached $6.3 billion and $6.8 billion, respectively. State and local expenditures, independent of federal grants, increased to over $24 billion in 1999, accounting for over 85 percent of total public sector expenditures for transit, a share that has increased somewhat since 1991, as shown in figure 3.

[21]Under the RABA provision, the annual spending levels that are guaranteed for most federal highway programs are to be adjusted upward or downward during each fiscal year if the receipt levels in the Highway Account of the Highway Trust Fund increase or decrease from those projected in TEA-21.

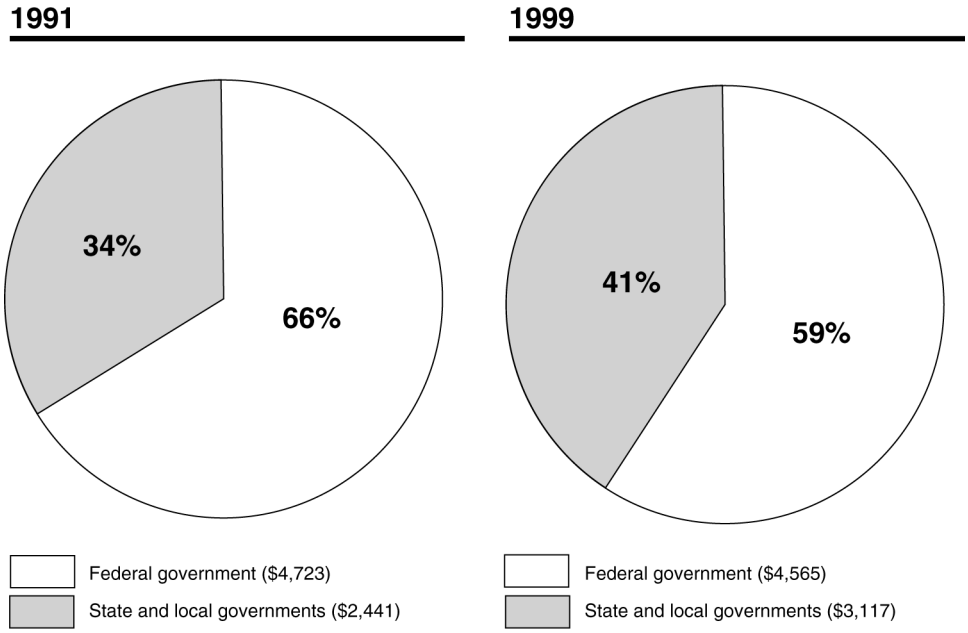
Figure 3: Federal Government and State and Local Government Shares of Expenditures on Public Transit (in millions of 1999 dollars)



Source: U.S. Department of Transportation, Bureau of Transportation Statistics (2002), Government Transportation Financial Statistics (Preliminary Data), Washington, D.C.

Public sector spending on ports and waterways has remained between $7.2 and $7.9 billion (in 1999 dollars), between fiscal years 1991 and 1999. This spending pattern reflects fairly steady levels of federal spending by the Corps of Engineers, the Coast Guard, and the Maritime Administration for water transportation expenditures. Expenditures by the Corps of Engineers and the Coast Guard comprise the bulk of federal spending for water transportation, and have remained at about $1.5 billion and $2 billion (in 1999 dollars) per year, respectively. State and local expenditures, however, increased by 27.7 percent, from $2.4 billion in fiscal year 1991 to $3.1 billion in fiscal year 1999, and accounted for about 41 percent of total public water transportation expenditures in fiscal year 1999, having grown from about 34 percent of the total in fiscal year 1991, as shown in figure 4.

Figure 4: Federal Government and State and Local Government Shares of Expenditures on Waterborne Transportation (in millions of 1999 dollars)



Source: U.S. Department of Transportation, Bureau of Transportation Statistics (2002), Government Transportation Financial Statistics (Preliminary Data), Washington, D.C.

The public sector's role in the funding of freight railroads is limited since the private sector owns, operates, and provides almost all of the financing for freight railroads. In addition, since public sector expenditures for commuter rail and subways are considered public transit expenditures, public expenditures discussed here for passenger rail are limited to funding for Amtrak. Federal support for Amtrak has fluctuated somewhat throughout the 1990s, but has dropped off substantially in recent years, with fiscal years 2001 and 2002 appropriations of $520 and $521 million, respectively. Sufficient data are not currently available to characterize trends in state and local governments' spending for intercity passenger rail.[22]

[22]However, Amtrak estimates that states will contribute $223 million to Amtrak routes and infrastructure in 2002.

Private Sector Expenditures

The private sector plays an important role in the provision of transportation services in each mode. For example, while the private sector does not invest heavily in providing roads, it purchases and operates most of the vehicles for use on publicly provided roads. For freight rail, the private sector owns and operates most of the tracks as well as the freight trains that run on the tracks. In the maritime sector, many ports on the inland waterways are privately owned, as are freight vessels and towboats. Data on private sector expenditures on a national level are limited. However, available data show that private expenditures for transportation on roads, rail, and waterways rose throughout the 1990s. According to the U.S. Bureau of Economic Analysis' Survey of Current Business,[23] individuals and businesses spent about $397 billion in 2000 for the purchase of new cars, buses, trucks, and other motor vehicles, a 57-percent increase from 1993 levels (in 2000 dollars). In addition to the purchase of vehicles, the private sector also invests in and operates toll roads and lanes; however, data on these investments are not currently available on a national level. According to the Survey of Current Business, freight railroads and other businesses spent over $11 billion for railroad infrastructure and rail cars in 2000, a 66-percent increase from 1991 (in 2000 dollars). In addition, private sector investment on ships and boats more than doubled between 1991 and 2000, to about $3.7 billion (in 2000 dollars). However, private investment in waterways also includes port facilities for loading and unloading ships and for warehousing goods. Data on these investments are also currently not available on a national level.

Passenger and Freight Travel Are Expected to Increase on All Modes

Federal projections show passenger and freight travel increasing over the next 10 years on all modes,[24] due to population growth, increasing affluence, economic growth, and other factors. Passenger vehicle travel on public roads is expected to grow by 24.7 percent from 2000 to 2010. Passenger travel on transit systems is expected to increase by 17.2 percent over the same period. Intercity passenger rail ridership is expected to

[23]Data were compiled from issues of the survey released between 1994 and 2001 (tables B-4, B-5, B-6, 5.6, and 5.8) and were adjusted for inflation using separate indexes from U.S. Bureau of Economic Analysis' National Income and Products Accounts for individual expenditures on new vehicles or business expenditures on transportation equipment. The survey data do not include overall private investment in transit systems.

[24]The projections used in this report were developed by the DOT modal administrations, the Corps of Engineers, and Amtrak. We did not verify the data used in making projections, and we do not endorse the projections as accurate.

increase by 26 percent from 2001 to 2010. Finally, preliminary estimates by DOT also indicate that tons of freight moved on all surface and maritime modes—truck, rail, and water—are expected to increase by about 43 percent from 1998 through 2010, with the largest increase expected to be in tons moved by truck.

However, several factors in the forecast methodologies limit their ability to capture the effects of changes in travel levels on the surface and maritime transportation systems as a whole (see app. II for more information about the travel forecast methodologies). For example, a key assumption underlying most of the national travel projections we obtained is that capacity will increase as levels of travel increase; that is, the projections are not limited by possible future constraints on capacity such as increasing congestion. On the other hand, if capacity does not increase, future travel levels may be lower than projected.[25] In addition, differences in travel measurements hinder direct comparisons between modes and types of travel. For example, intercity highway travel is not differentiated from local travel in FHWA's projections of travel on public roads, so projections of intercity highway travel cannot be directly compared to intercity passenger travel projections for other modes, such as rail. For freight travel, FHWA produces projections of future tonnage shipped on each mode; however, tonnage is only one measure of freight travel and does not capture important aspects of freight mobility, such as the distances over which freight moves or the value of the freight being moved.

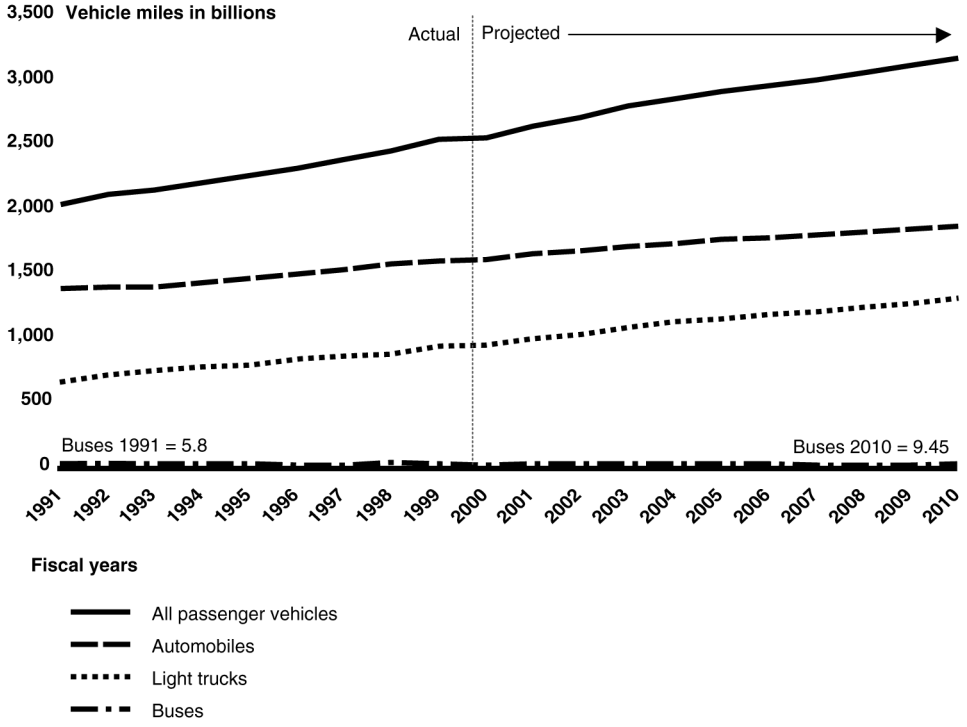
Travel on Public Roads Is Projected to Grow Fairly Steadily

As shown in figure 5, vehicle miles traveled for passenger vehicles on public roads are projected to grow fairly steadily through 2010, by 24.7 percent over the 10-year period from 2000 through 2010, with an average annual increase of 2.2 percent. This is similar to the actual average annual rate of growth from 1991 to 2000, which was 2.5 percent. At the projected rate of growth, vehicle miles traveled would reach 3.2 trillion by 2010. The

[25]Other factors also influence travel but were not always included in travel projections. For example, growth in miles driven on public roads is influenced by shifts in population to less populated residential areas, transit ridership is affected by levels of immigration, and freight travel is affected by technological innovations that improve transportation efficiency, but the influence of these factors is not taken into account. In addition, investments in additional transportation capacity can stimulate corresponding increases in travel demand. Consequently, these national travel projections need to be used carefully in evaluating how capacity improvements or other changes in one mode of transportation might affect travel across other modes and the transportation system as a whole.

20-year annual growth rate forecasts produced by individual states ranged from a low of 0.39 percent for Maine to a high of 3.43 percent for Utah.[26] (See app. II for more detailed information on state forecasts.)

Figure 5: Historical and Projected Vehicle Miles Traveled for Passenger Vehicles on Public Roads, 1991-2010



Note: Automobiles include all passenger cars plus motorcycles. Light trucks are defined as other 2-axle 4-tire vehicles (such as vans, pickup trucks, and sport utility vehicles). Buses include commercial buses, school buses, and buses owned by federal, state, or local governments.

Source: Federal Highway Administration.

In addition to passenger vehicles, trucks carrying freight contribute to the overall levels of travel on public roads. Vehicle miles traveled by freight trucks are also projected to increase by 2010, but such traffic makes up a relatively small share of total vehicle miles traveled. According to forecasts

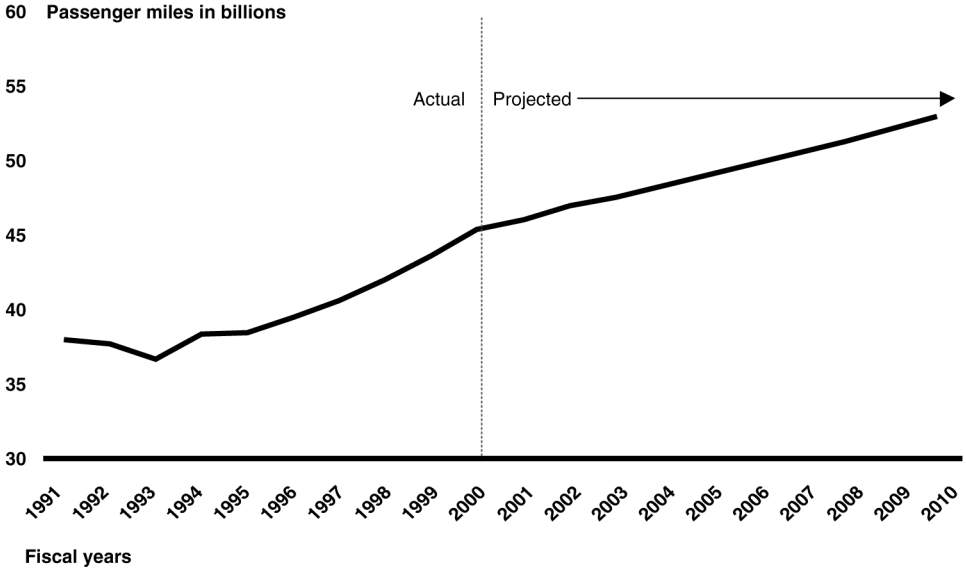
[26]FHWA provided us with forecasts for total (passenger and freight) vehicle miles traveled from individual states, the District of Columbia, and Puerto Rico (see app. II). These project future travel through 2020 rather than through 2010.

by FHWA, freight truck vehicle miles are expected to grow by 32.5 percent from 2000 to 2010, but will constitute less than 10 percent of total vehicle miles traveled nationwide in 2010. However, within certain corridors, trucks may account for a more substantial portion of total traffic. The projected average annual growth rate for truck travel is 2.9 percent for 2000 to 2010, compared to an actual average annual growth rate of 3.9 percent from 1991 to 2000. We discuss freight travel in more detail later in this report, after the discussion of passenger travel.

Transit Travel Is Projected to Increase

For transit, FTA projects that the growth in passenger miles traveled between 2000 and 2010 will average 1.6 percent annually, for a total growth of 17.2 percent. Actual growth from 1991 through 2000 averaged 2.1 percent annually. (See fig. 6.) At the projected growth rate, annual passenger miles traveled on the nation's transit systems would be approximately 52.9 billion by 2010. The transit forecast is a national weighted average and the individual forecasts upon which it is based vary widely by metropolitan area. For example, transit forecasts for specific urbanized areas range from a -0.05 percent average annual decrease in Philadelphia to a 3.56 percent average annual increase in San Diego.

Figure 6: Historical and Projected Passenger Miles Traveled on Transit, 1991-2010



Note: Types of transit included in this figure are: automated guideway (guided, fully automated vehicle), cable car, commuter rail, demand response (vehicle operating in response to calls from passengers), ferryboat, heavy rail, inclined plane (vehicle operating up and down slope on rail via a cable mechanism), light rail, bus, monorail, public trolley, and vanpool.

Sources: For 1991-2000: National Transit Database; for 2001-2010: GAO's calculations based on the Federal Transit Administration's annual growth rate projection.

Intercity Passenger Travel Is Projected to Increase

Both DOT and Amtrak project future increases in intercity passenger travel. Although automobiles dominate intercity travel, FHWA's projections of vehicle miles traveled do not separately report long-distance travel in cars on public roads. After automobiles, airplanes and intercity buses are the next most used modes and intercity passenger rail is the least used.[27] However, we do not report on air travel since it is outside the scope of this report, or on bus travel, because while FHWA projected increases in the number of miles traveled by all types of buses, we were unable to obtain specific projections of intercity ridership on buses. For intercity passenger rail, Amtrak predicts a cumulative increase in total ridership of 25.9 percent from 23.5 million passengers in 2001 to 29.6 million passengers in 2010, a contrast with the relatively flat ridership of recent years, which has remained between 20 and 23 million passengers per year (see app. II for further details about Amtrak's projections).[28]

Factors Expected to Affect Future Passenger Travel Include Population Growth, Increasing Affluence, and Improved Communications

According to FHWA, FTA, and many of our panelists, a number of factors are likely to influence not only the amount of travel that will occur in the future, but also the modes travelers choose. First, the U.S. Census Bureau predicts that the country's population will reach almost 300 million by 2010, which will result in more travelers on all modes. This population growth, and the areas in which it is expected to occur, could have a variety of effects on mode choices. In particular, the population growth that is expected in suburban areas could lead to a larger increase in travel by private vehicles than by transit because suburban areas generally have lower population densities than inner cities, and also have more dispersed

[27]In 2000, the latest year for which comparable data are available, domestic airlines carried about 657 million passengers, intercity buses carried about 359 million passengers, and Amtrak carried about 22.5 million passengers.

[28]The national Amtrak ridership statistics, however, mask some regional trends. Combined ridership in the Northeast corridor and on the West Coast has grown by about 2 million passengers since 1994, while ridership on the rest of the intercity passenger rail system has generally decreased.

travel patterns, making them harder to serve through conventional public transit. Rural areas are also expected to experience high rates of population growth and persons living there, like suburban residents, are more reliant on private vehicles and are not easily served by conventional public transit. While these demographic trends tend to decrease transit's share of total passenger travel as compared to travel by private vehicle, the overall growth in population is expected to result in absolute increases in the level of travel on transit systems as well as by private vehicle. Another important factor that could affect mode choice is that the population aged 85 and over will increase 30 percent by 2010, according to data from the Census Bureau. The aging of the population might increase the market for demand-responsive transit services[29] and improved road safety features, such as enhanced signage.

Second, DOT officials and our panelists believed that the increasing affluence of the U.S. population would play a key role in future travel, both in overall levels and in the modes travelers choose. They noted that, as income rises, people tend to take more and longer trips, private vehicle ownership tends to increase, and public transit use generally decreases. Third, communication technology could affect local and intercity travel, but the direction and extent of the effect is uncertain. For example, telecommuting and videoconferencing are becoming more common, but are not expected to significantly replace face-to-face meetings unless the technology improves substantially. Finally, changes in the price (or perceived price), condition, and reliability of one modal choice as compared to another are also likely to affect levels of travel and mode choices. For example, changes in the petroleum market that affect fuel prices, or changes in government policy that affect the cost of driving or transit prices could result in shifts between personal vehicles and transit; however, it is difficult to predict the extent to which these changes would occur. Also, if road congestion increases, there could be a shift to transit or a decrease in overall travel. See appendix III for a more detailed discussion of these factors.

[29]According to the American Public Transportation Association, demand response modes are passenger cars, vans, or buses with fewer than 25 seats operating in response to calls from passengers or their agents to the transit operator, who then dispatches a vehicle to pick up the passengers and transport them to their destinations.

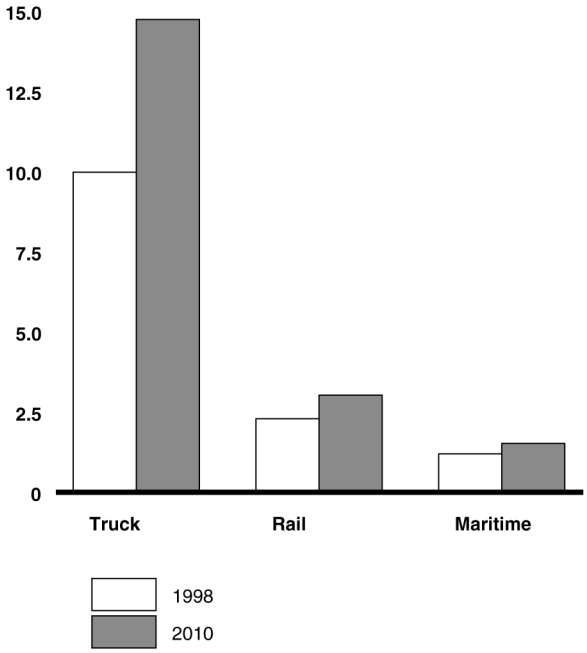
The Amount of Freight Moved Is Expected to Increase to 19.3 Billion Tons by 2010

Trucks move the majority of freight tonnage and are expected to continue moving the bulk of freight into the future. FHWA's preliminary forecasts[30] of international and domestic freight tonnage across all surface and maritime modes project that total freight moved will increase 43 percent, from 13.5 billion tons in 1998 to 19.3 billion tons in 2010. According to the forecasts, by 2010, 14.8 billion tons are projected to move by truck, a 47.6-percent increase; 3 billion tons by rail, a 31.8-percent increase; and 1.5 billion tons by water, a 26.6-percent increase, as shown in figure 7.[31] Trucks are expected to remain the dominant mode, in terms of tonnage, because production of the commodities that typically move by truck, such as manufactured goods, is expected to grow faster than the main commodities moved by rail or on water, such as coal and grain.

[30]Numerous projections of freight travel have been produced for particular modes, corridors, or commodities. For example, the Corps of Engineers has produced projections for tons moving on the inland waterways, while the *Latin America Trade and Transportation Study* contains projections of trade patterns between the United States and Latin America. For this report, we relied on projections produced by FHWA, because these are the only projections that predict national freight travel on all modes.

[31]Some freight may be moved by more than one mode before reaching its destination, such as moving by rail for one segment of the trip, then by truck to its final destination. This may result in tons being counted on more than one mode in FHWA's projections. In addition, FHWA's maritime freight projections do not include international trade of bulk products and some inland domestic bulk shipments.

Figure 7: Freight Tons (in billions) in 1998 and Projected to 2010[a] for Surface and Maritime[b] Modes



[a]These forecasts are still in draft.

[b]FHWA's maritime freight projections do not include international trade of bulk products and some inland domestic bulk shipments.

Source: Federal Highway Administration.

Tonnage is only one measure of freight travel and does not capture important aspects of freight mobility, such as the distances over which freight moves or the value of the freight being moved. Ton-miles[32] measure the amount of freight moved as well as the distance over which it moves, and historically, rail has been the dominant mode in terms of ton-miles for domestic freight. In 1998, the base year of FHWA's projections, domestic rail ton-miles totaled over 1.4 trillion, while intercity truck ton-miles totaled just over one trillion, and domestic ton-miles on the waterways totaled 672.8 billion. Air is the dominant mode in terms of value per ton according

[32]Ton-miles are calculated by multiplying the total number of tons moved by the total miles traveled.

to DOT's *Transportation Statistics Annual Report 2000*,[33] at $51,000 per ton (in 1997 dollars). However, in terms of total value, trucks are the dominant mode. According to the *Annual Report*, trucks moved nearly $5 trillion (in 1997 dollars) in domestic goods, as opposed to $320 billion by rail and less than $100 billion by inland waterway.

International freight is an increasingly important aspect of the U.S. economy. For international freight, water is the dominant mode in terms of tonnage. According to a DOT report, more than 95 percent of all overseas products and materials that enter or leave the country move through ports and waterways.[34] More specifically, containers, which generally carry manufactured commodities such as consumer goods and electrical equipment and can be easily transferred to rail or truck, dominate in terms of value, accounting for 55 percent of total imports and exports, while only accounting for 12 percent of foreign tonnage. Containers are the fastest growing segment of the maritime sector. While FHWA predicts that total maritime freight tonnage will grow by 26.6 percent, the Corps of Engineers projects that volumes of freight moving in containers will increase by nearly 70 percent by 2010. In addition, ships designed to carry containers are the fastest growing segment of the maritime shipping fleet and are also increasing in size. Although freight vessels designed to carry bulk freight (e.g., coal, grain, or oil) are the largest sector of the freight vessel fleet, the number of containerships is increasing by 8.8 percent annually, which is double the growth rate of any other type of vessel according to the Corps of Engineers. Also, most of the overall capacity of the containership fleet is now found in larger containerships, with a capacity of more than 3,000 twenty-foot containers, and ships with capacities of three times that amount are currently on order.

[33]Bureau of Transportation Statistics, *Transportation Statistics Annual Report 2000* (Washington, D.C.: U.S. Department of Transportation, 2001).

[34]*An Assessment of the U.S. Marine Transportation System* (Washington, D.C.: U.S. Department of Transportation, September 1999).

Factors Expected to Affect Freight Travel Include Increasing International Trade and Economic Growth

According to reports by the Transportation Research Board and the Bureau of Transportation Statistics,[35] increasing international trade and economic growth are expected to influence volumes of future freight travel. In addition, the increasing value of cargo shipped and changes in policies affecting certain commodities can affect overall levels of freight traffic as well as the choice of mode for that traffic. The North American Free Trade Agreement has contributed to the increases in tonnage of imports by rail (24-percent increase) and by truck (20-percent increase), from Mexico and Canada between 1996 and 2000, while expanding trade with the Pacific Rim has increased maritime traffic at west coast container ports. With increasing affluence, economic growth often results in a greater volume of goods produced and consumed, leading to more freight moved, particularly higher-value cargo. In addition, the increasing value of cargo affects the modes on which that cargo is shipped. High-value cargo, such as electronics and office equipment, tends to be shipped by air or truck, while rail and barges generally carry lower-value bulk items like coal and grains. Changes in environmental regulations and other policies also affect the amount, cost, and mode choice for moving freight. For example, a change in demand for coal due to stricter environmental controls could affect rail and water transportation, the primary modes for shipping coal. See appendix III for a more detailed discussion of the factors that influence freight travel.

[35]"Characteristics and Changes in Freight Transportation Demand: A Guidebook for Planners and Policy Analysts," prepared for the National Cooperative Highway Research Program, Project 8-30 Phase II (Washington, D.C.: Transportation Research Board, June 19, 1995). Bureau of Transportation Statistics, *Transportation Statistics Annual Report 2000* (Washington, D.C.: U.S. Department of Transportation, 2001).

Key Mobility Challenges Include Growing Congestion, Limited Access to the Transportation System for Certain Groups, and Effects on the Environment and Communities

To identify key mobility challenges and the strategies for addressing those challenges that are discussed later in this report, we relied upon the results of two panels of surface and maritime transportation experts that we convened in April 2002, as well as reports prepared by federal and other government agencies, academics, and industry groups. According to our expert panelists and other sources, with increasing passenger and freight travel, the surface and maritime transportation systems face a number of challenges that involve ensuring continued mobility while maintaining a balance with other social goals, such as environmental preservation. Ensuring continued mobility involves preventing congestion from overwhelming the transportation system and ensuring access to transportation for certain underserved populations. In particular, more travel can lead to growing congestion at bottlenecks and at peak travel times on public roads, transit systems, freight rail lines, and at freight hubs such as ports and borders where freight is transferred from one mode to another. In addition, settlement patterns and dependence on the automobile limit access to transportation systems for some elderly people and low-income households, and in rural areas where populations are expected to expand. Increasing travel levels can also negatively affect the environment and communities by increasing the levels of air, water, and noise pollution.

Congestion Is Growing at Bottlenecks and at Peak Travel Times

Many panelists explained that congestion is generally growing for passenger and freight travel and will continue to increase at localized bottlenecks (places where the capacity of the transportation system is most limited), at peak travel times, and on all surface and maritime transportation modes to some extent. However, panelists pointed out that transportation systems as a whole have excess capacity and that communities may have different views on what constitutes congestion. Residents of small cities and towns may perceive significant congestion on their streets that may be considered insignificant to residents in major metropolitan areas. In addition, because of the relative nature of congestion, its severity is difficult to determine or to measure and while one measure may be appropriate for some situations, it may be inadequate for describing others.

Congestion in Passenger Travel and on Freight Networks

For local urban travel, a study by the Texas Transportation Institute[36] showed that the amount of traffic experiencing congestion in peak travel periods doubled from 33 percent in 1982 to 66 percent in 2000 in the 75 metropolitan areas studied. In addition, the average time per day that roads were congested increased over this period, from about 4.5 hours in 1982 to about 7 hours in 2000. Increased road congestion can also affect public bus and other transit systems that operate on roads. Some transit systems are also experiencing increasing rail congestion at peak travel times. For example, the Washington Metropolitan Area Transit Authority's (WMATA) recent studies on crowding found that rail travel demand has reached and, in some cases, exceeded scheduled capacity—an average of 140 passengers per car—during the peak morning and afternoon hours. Of the more than 200 peak morning rail trips that WMATA observed over a recent 6-month period, on average, 15 percent were considered "uncomfortably crowded" (125 to 149 passengers per car) and 8 percent had "crush loads" (150 or more passengers per car).[37]

In addition to local travel, concerns have been raised about how intercity and tourist travel interacts with local traffic in metropolitan areas and in smaller towns and rural areas, and how this interaction will evolve in the future. According to a report sponsored by the World Business Council for Sustainable Development, *Mobility 2001*,[38] capacity problems for intercity travelers are generally not severe outside of large cities, except in certain heavily traveled corridors, such as the Northeast corridor, which links Washington, D.C., New York, and Boston. However, at the beginning and end of trips, intercity bus and automobile traffic contribute to and suffer from urban congestion. In addition, the study said that intercity travel may constitute a substantial proportion of total traffic passing through smaller towns and rural areas. Also, according to a GAO survey of all states, state officials are increasingly concerned about traffic volumes on interstate

[36]David Shrank and Tim Lomax, *2002 Urban Mobility Report* (College Station, TX: Texas Transportation Institute, June 2002).

[37]U.S. General Accounting Office, *Mass Transit: Many Management Successes at WMATA, but Capital Planning Could Be Enhanced*, GAO-01-744 (July 2, 2001).

[38]Massachusetts Institute of Technology and Charles River Associates, Inc., *Mobility 2001: World Mobility at the End of the Twentieth Century and Its Sustainability*, (World Business Council for Sustainable Development, August 2001).

highways in rural areas, and high levels of rural congestion are expected in 18 states within 10 years.[39]

Congestion is also expected to increase on major freight transportation networks at specific bottlenecks, particularly where intermodal connections occur, and at peak travel times, according to the panelists. They expressed concern regarding interactions between freight and passenger travel and how increases in both types of travel will affect mobility in the future. Trucks contribute to congestion in metropolitan areas where they generally move on the same roads and highways as personal vehicles, particularly during peak periods of congestion. In addition, high demand for freight, particularly freight moved on trucks, exists in metropolitan areas where overall congestion tends to be the worst.

With international trade an increasing part of the economy and with larger containerships being built, some panelists indicated that more pressure will be placed on the already congested road and rail connections to major U.S. seaports and at the border crossings with Canada and Mexico. For example, according to a DOT report,[40] more than one-half of the ports responding to a 1997 survey of port access issues identified traffic impediments on local truck routes as the major infrastructure problem.

According to one panelist from the freight rail industry, there is ample capacity on most of the freight rail network. However, railroads are beginning to experience more severe capacity constraints in particular heavily used corridors, such as the Northeast corridor, and within major metropolitan areas, especially where commuter and intercity passenger rail services share tracks with freight railroads. Capacity constraints at these bottlenecks are expected to worsen in the future. The panelist explained that congestion on some freight rail segments where the tracks are also used for passenger rail service—for which there is growing demand—reduces the ability of freight railroads to expand service on the existing tracks to meet the growing demand for freight movements on those segments.

[39]U.S. General Accounting Office, *Status of the Interstate Highway System*, GAO-02-571 (May 31, 2002).

[40]*An Assessment of the U.S. Marine Transportation System* (Washington, D.C.: U.S. Department of Transportation, September 1999).

On the inland waterways, according to two panelists from that industry, there is sufficient capacity on most of the inland waterway network, although congestion is increasing at small, aging, and increasingly unreliable locks. According to the Corps of Engineers, the number of hours that locks were unavailable due to lock failures increased in recent years, from about 35,000 hours in 1991 to 55,000 hours in 1999, occurring primarily on the upper Mississippi and Illinois rivers. In addition, according to a Corps of Engineers analysis of congestion on the inland waterways, with expected growth in freight travel, 15 locks would exceed 80 percent of their capacity by 2020, as compared to 4 that had reached that level in 1999.

Other Systemic Factors Contributing to Congestion

According to our expert panelists, while increasing passenger and freight travel contribute to increasing congestion at bottlenecks and at peak travel times, other systemic factors contribute to congestion, including barriers to building enough capacity to accommodate growing levels of travel, challenges to effectively managing and operating transportation systems, and barriers in effectively managing how, and the extent to which, transportation systems are used.

At bottlenecks and at peak travel times, there is insufficient capacity to accommodate the levels of traffic attempting to use the infrastructure. One reason for the insufficient capacity is that transportation infrastructure, which is generally publicly provided (with the major exception of freight railroads), can take a long time to plan and build, and it may not be possible to build fast enough to keep pace with increasing and shifting travel patterns. In addition, constructing new capacity is often costly and can conflict with other social goals such as environmental preservation and community maintenance. As a result, approval of projects to build new capacity, which requires environmental impact statements and community outreach, generally takes a long time, if it is obtained at all.

In addition, a number of panelists indicated that funding and planning rigidities in the public institutions responsible for providing transportation infrastructure tend to promote one mode of transportation, rather than a set of balanced transportation choices. Focus on a single mode can result in difficulties dealing effectively with congestion. For example, as suburban expressways enable community developments to grow and move farther out from city centers, jobs and goods follow these developments. This results in increasing passenger and freight travel on the expressways, and a shifting of traffic flows that may not easily be accommodated by existing transportation choices. One panelist indicated that suburban expressways are among the least reliable in terms of travel times because,

if congestion occurs, there are fewer feasible alternative routes or modes of transportation. In addition, some bottlenecks occur where modes connect, because funding is generally mode-specific, and congestion at these intermodal connections is not easily addressed. According to FHWA, public sector funding programs are generally focused on a primary mode of transportation, such as highways, or a primary purpose, such as improving air quality. This means that intermodal projects may require a broader range of funding than might be available under a single program.

Panelists also noted that the types of congestion problems that are expected to worsen in the future involve interactions between long-distance and local traffic and between passengers and freight, and existing institutions may not have the capacity or the authority to address them. For example, some local bottlenecks may hinder traffic that has regional or national significance, such as national freight flows from major coastal ports, or can affect the economies and traffic in more than one state. Current state and local planning organizations may have difficulty considering all the costs and benefits related to national or international traffic flows that affect other jurisdictions as well as their own.

The concept of capacity is broader than just the physical characteristics of the transportation network (e.g., the number of lane-miles of road). The capacity of transportation systems is also determined by how well they are managed and operated (particularly publicly owned and operated systems), and how the use of those systems is managed. Many factors related to the management and operation of transportation systems can contribute to increasing congestion. Many panelists said that congestion on highways was in part due to poor management of traffic flows on the connectors between highways and poor management in clearing roads that are blocked due to accidents, inclement weather, or construction. For example, in the 75 metropolitan areas studied by the Texas Transportation Institute, 54 percent of annual vehicle delays in 2000 were due to incidents such as breakdowns or crashes. In addition, the Oak Ridge National Laboratory reported that, nationwide, significant delays are caused by work zones on highways; poorly timed traffic signals; and snow, ice, and fog.[41]

[41]Several sources of nonrecurring delays were not considered in this study, including special events, rain, rail crossings, and toll booths. S.M. Chin, O. Franzese, D.L. Greene, H.L. Hwang, and R. Gibson, *Temporary Losses of Capacity Study and Impacts on Performance*, Report No. ORNL/TM-2002/3 (Oak Ridge, TN: Oak Ridge National Laboratory, May 2002).

In addition, according to a number of panelists, congestion on transportation systems is also in part due to inefficient pricing of the infrastructure because users—whether they are drivers on a highway or barge operators moving through a lock—do not pay the full costs they impose on the system and on other users for their use of the system. They further argued that if travelers and freight carriers had to pay a higher cost for using transportation systems during peak periods to reflect the full costs they impose, they would have an incentive to avoid or reschedule some trips and to load vehicles more fully, resulting in less congestion.

Effects of Congestion

Congestion affects travel times and the reliability of transportation systems. As discussed earlier in this report, the Texas Transportation Institute found that 66 percent of peak period travel on roadways was congested in 2000, compared to 33 percent in 1982 in the 75 metropolitan areas studied. According to the study, this means that two of every three vehicles experience congestion in their morning or evening commute. In the aggregate, congestion results in thousands of hours of delay every day, which can translate into costs such as lost productivity and increased fuel consumption. In addition, a decrease in travel reliability imposes costs on the traveler in terms of arriving late to work or for other appointments, and in raising the cost of moving goods resulting in higher prices for consumers.

Some panelists noted that congestion, in some sense, reflects full use of transportation infrastructure, and is therefore not a problem. In addition, they explained that travelers adjust to congestion and adapt their travel routes and times, as well as housing and work choices, to avoid congestion. For example, according to the *Transportation Statistics Annual Report 2000*, median commute times increased about 2 minutes between 1985 and 1999, despite increases in the percentage of people driving to work alone and the average commuting distance. For freight travel, one panelist made a similar argument, citing that transportation costs related to managing business operations have decreased as a percentage of gross national product, indicating that producers and manufacturers adjust to transportation supply, by switching modes or altering delivery schedules to avoid delays and resulting cost increases.

However, the *Mobility 2001* report describes these adaptations by individuals and businesses as economic inefficiencies that can be very costly. According to the report, increasing congestion can cause avoidance of a substantial number of trips resulting in a corresponding loss of the benefits of those trips. In addition to negative economic effects, travelers'

adaptation to congested conditions can also have a number of negative social effects on other people. For example, according to researchers from the Texas Transportation Institute, traffic cutting through neighborhoods to avoid congestion can cause community disruptions and "road rage" can be partly attributed to increasing congestion.

Certain Underserved Groups Have Limited Access to Transportation

The FHWA and FTA's 1999 *Conditions and Performance* report[42] states that significant accessibility[43] barriers persist for some elderly people and low-income households. In addition, several panelists stated that rural populations also face accessibility difficulties.

Elderly Persons

According to the *Conditions and Performance* report, the elderly have different mobility challenges than other populations because they are less likely to have drivers' licenses, have more serious health problems, and may require special services and facilities. According to 1995 data, 45 percent of women and 16 percent of men over age 75 did not have drivers' licenses, which may limit their ability to travel by car. Many of the elderly also may have difficulty using public transportation due to physical ailments. People who cannot drive themselves tend to rely on family, other caregivers, or friends to drive them, or find alternative means of transportation. As a result, according to the 1999 *Conditions and Performance* report and a 1998 report about mobility for older drivers,[44] they experience increased waiting times, uncertainty, and inconvenience, and they are required to do more advance trip planning. These factors can lead to fewer trips taken for necessary business and for recreation, as well as restrictions on times and places that health care can be obtained. Access to more flexible, demand-responsive forms of transit could enhance the mobility of the elderly, particularly in rural areas, which are difficult to

[42]Federal Highway Administration and Federal Transit Administration, *1999 Status of the Nation's Highways, Bridges, and Transit: Conditions and Performance* (Washington, D.C.: U.S. Department of Transportation, 2000).

[43]The Bureau of Transportation Statistics' *Annual Report 2000* defines accessibility as a measure of the relative ease with which people and businesses can reach a variety of locations.

[44]Jon E. Burkhardt, Arlene M. Berger, Michael Creedon, and Adam T. McGavock, *Mobility and Independence: Changes and Challenges for Older Drivers* (July 1998). This report was developed under a cooperative agreement with the U.S. Department of Health and Human Services (DHHS), under the auspices of the Joint DHHS/DOT Coordinating Council on Access and Mobility.

serve through transit systems; however, some barriers to providing these types of services exist. For example, according to one of our panelists, some paratransit[45] services are not permitted to carry able-bodied people, even if those people are on the route and are willing to pay for the service. As the elderly population increases over the next 10 years, issues pertaining to access are expected to become more prominent in society.

Low-Income Households

Lower income levels can also be a significant barrier to transportation access. The cost of purchasing, insuring, and maintaining a car is prohibitive to some households, and 26 percent of low-income households do not own a car, compared with 4 percent of other households, according to the 1999 *Conditions and Performance* report. Among all low-income households, about 8 percent of trips are made in cars that are owned by others as compared to 1 percent for other income groups. Furthermore, the same uncertainties and inconveniences apply to this group as to the elderly regarding relying on others for transportation. Transportation access is important for employment opportunities to help increase income, yet this access is not always available. This is because growth in employment opportunities tends to occur in the suburbs and outlying areas, while many low-income populations are concentrated in the inner cities or in rural areas. In case studies of access to jobs for low-income populations, FTA researchers found that transportation barriers to job access included gaps in transit service, lack of knowledge of where transit services are provided, and high transportation costs resulting from multiple transfers and long distances traveled.[46] Another problem they noted was the difficulty in coordinating certain types of work shifts with the availability of public transportation service. Without sufficient access to jobs, families face more obstacles to achieving the goal of independence from government assistance. Limited transportation access can also reduce opportunities for affordable housing and restrict choices for shopping and other services.

Rural Populations

Rural populations, which according to the 2000 Census grew by 10 percent over the last 10 years, also face access problems. Access to some form of transportation is necessary to connect rural populations to jobs and other

[45]Paratransit is a service where individuals who are unable to use the regular transit system independently (because of a physical or mental impairment) are picked up and dropped off at their destinations.

[46]Federal Transit Administration, *Access to Jobs: Planning Case Studies* (Washington, D.C.: U.S. Department of Transportation, September 2001).

amenities in city centers or, increasingly, in the suburbs. The *Mobility 2001* report states that automobiles offer greater flexibility in schedule and choice of destinations than other modes of transportation, and often also provide shorter travel times with lower out-of-pocket costs. The report also notes that conventional transit systems are best equipped to serve high levels of travel demand that is concentrated in a relatively limited area or along well-defined corridors, such as inner cities and corridors between those areas and suburbs. Trips by rural residents tend to be long due to low population densities and the relative isolation of small communities. Therefore, transportation can be a challenge to provide in rural areas, especially for persons without access to private automobiles. A report prepared for the FTA in 2001[47] found that 1 in 13 rural residents lives in a household without a personal vehicle. In addition, the elderly made 31 percent of all rural transit trips in 2000 and persons with disabilities made 23 percent. However, according to a report by the Coordinating Council on Access and Mobility,[48] while almost 60 percent of all nonmetropolitan counties had some public transportation services in 2000, many of these operations were small and offered services to limited geographic areas during limited times.

Transportation's Effects on the Environment and Communities Are a Growing Concern

While ISTEA and TEA-21 provided funds aimed at mitigating adverse effects of transportation, concerns persist about such effects on the environment and communities. As a result of the negative consequences of transportation, tradeoffs must be made between facilitating increased mobility and giving due regard to environmental and other social goals. For example, transportation vehicles are major sources of local, urban, and regional air pollution because they depend on fossil fuels to operate. Emissions from vehicles include sulfur dioxide, lead, carbon monoxide, volatile organic compounds, particulate matter, and nitrous oxides. In addition, the emission of greenhouse gases such as carbon dioxide, methane, and nitrous oxide are increasing and greenhouse gases have been linked to reduction in atmospheric ozone and climate changes. According to *Mobility 2001*, improved technologies can help reduce per-vehicle emissions, but the increasing numbers of vehicles traveling and the total

[47]Community Transportation Association of America, *Status of Rural Public Transportation-2000* (April 2001).

[48]Coordinating Council on Access and Mobility, *Planning Guidelines for Coordinated State and Local Specialized Transportation Services* (Washington, D.C.: U.S. Department of Transportation, Dec. 20, 2000).

miles traveled may offset these gains. In addition, congested conditions on highways tend to exacerbate the problem because extra fuel is consumed due to increased acceleration, deceleration, and idling. Vehicle emissions in congested areas can trigger respiratory and other illnesses, and runoff from impervious surfaces can carry lawn chemicals and other pollutants into lakes, streams, and rivers, thus threatening aquatic environments.[49]

Freight transportation also has significant environmental effects. Trucks are significant contributors to air pollution. According to the American Trucking Association, trucks were responsible for 18.5 percent of nitrous oxide emissions and 27.5 percent of other particulate emissions from mobile sources in the United States. The *Mobility 2001* report states that freight trains also contribute to emissions of hydrocarbons, carbon monoxide, and nitrous oxide, although generally at levels considerably lower than trucks. In addition, while large shipping vessels are more energy efficient than trucks or trains, they are also major sources of nitrogen, sulfur dioxide, and diesel particulate emissions. According to the International Maritime Organization, ocean shipping is responsible for 22 percent of the wastes dumped into the sea on an annual basis. Barges moving freight on the inland waterway system are among the most energy efficient forms of freight transportation, contributing relatively lower amounts of noxious emissions compared with trucks and freight trains, according to the Corps of Engineers. However, the dredging and damming required to make rivers and harbors navigable can cause significant disruption to ecosystems.

Noise pollution is another factor exacerbated by increasing levels of transportation. While FHWA, FTA, and many cities have established criteria for different land uses close to highways and rail lines to protect against physically damaging noise levels, average noise levels caused by road traffic in some areas can still have adverse consequences on people's hearing. In addition, several studies have found that residential property values decrease as average noise levels rise above a certain threshold. Freight also contributes to noise pollution. According to *Mobility 2001*, shipping is the largest source of low-frequency, underwater noise, which may have adverse effects on marine life, although these effects are not yet fully understood. These noise levels are particularly serious on highly

[49]See U.S. General Accounting Office, *Environmental Protection: Federal Incentives Could Help Promote Land Use That Protects Air and Water Quality*, GAO-02-12 (Washington, D.C.: Oct. 31, 2001).

trafficked shipping routes. In addition, dredging also contributes to noise pollution.

Growing awareness of the environmental and social costs of transportation projects is making it more difficult to pursue major transportation improvements. According to a number of panelists, the difficulty in quantifying and measuring the costs and benefits of increased mobility also hinders the ability of transportation planners to make a strong case to local decisionmakers for mobility improvements. In addition, transportation planning and funding is mode-specific and oriented toward passenger travel, which hinders transportation planners' ability to recognize systemwide and multi-modal strategies for addressing mobility needs and other social concerns.

Strategies for Addressing Mobility Challenges Include Focusing on Systemwide Outcomes, Using a Full Range of Tools, and Providing Options for Financing Surface and Maritime Transportation

The panelists presented numerous approaches for addressing the types of challenges discussed throughout this report, but they emphasized that no single strategy would be sufficient. From these discussions and our other research, we have identified three key strategies that may aid transportation decisionmakers at all levels of government in addressing mobility challenges and the institutional barriers that contribute to them. These strategies include the following:

1. Focus on the entire surface and maritime transportation system rather than on specific modes or types of travel to achieve desired mobility outcomes. A systemwide approach to transportation planning and funding, as opposed to focus on a single mode or type of travel, could improve focus on outcomes related to customer or community needs.

2. Use a full range of tools to achieve those desired outcomes. Controlling congestion and improving access will require a strategic mix of construction, corrective and preventive maintenance, rehabilitation, operations and system management, and managing system use through pricing and other techniques.

3. Provide more options for financing mobility improvements and consider additional sources of revenue. Targeting financing to transportation projects that will achieve desired mobility outcomes might require more options for raising and distributing funds for surface and maritime transportation. However, using revenue sources that are not directly tied to the use of transportation systems could allow decisionmakers to bypass transportation planning requirements

which, in turn, could limit the ability of transportation agencies to focus on and achieve desired outcomes.

Focus on the Entire Surface and Maritime Transportation System Rather Than on Specific Modes or Types of Travel to Achieve Desired Mobility Outcomes

Some panelists said that mobility should be viewed on a systemwide basis across all modes and types of travel. Addressing the types of mobility challenges discussed earlier in this report can require a scope beyond a local jurisdiction or a state line and across more than one mode or type of travel. For example, congestion challenges often occur where modes connect or should connect—such as ports or freight hubs where freight is transferred from one mode to another, or airports that passengers need to access by car, bus, or rail. These connections require coordination of more than one mode of transportation and cooperation among multiple transportation providers and planners, such as port authorities, metropolitan planning organizations (MPO),[50] and private freight railroads. Some panelists therefore advocated shifting the focus of government transportation agencies at the federal, state, and local levels to consider all modes and types of travel in addressing mobility challenges—as opposed to focusing on a specific mode or type of travel in planning and implementing mobility improvements.

Some panelists said that current transportation planning institutions, such as state transportation departments, MPOs, or Corps of Engineers regional offices, may not have sufficient expertise, or in some cases, authority to effectively identify and implement mobility improvements across modes or types of travel. They suggested that transportation planning by all entities focus more closely on regional issues and highlighted the importance of cooperation and coordination among modal agencies at the federal, state, and local level, between public and private transportation providers, and between transportation planning organizations and other government and community agencies to address transportation issues. For example, several panelists said that the Alameda Corridor in Los Angeles is a good example of successful cooperation and coordination among agencies. This corridor is designed to improve freight mobility for cargo coming into the ports of Los Angeles and Long Beach and out to the rest of the country. Planning, financing, and building this corridor required cooperation among private railroads, the local port authorities, the cities of Los Angeles and Long

[50]MPOs are organizations of city, county, state, and federal officials that provide a regional forum for transportation planning.

Beach, community groups along the entire corridor, the state of California, and the federal government.

Several panelists said that a greater understanding of the full life-cycle costs and benefits of various mobility improvements is needed to take a more systemwide approach to transportation planning and funding. The panelists said the cost-benefit frameworks that transportation agencies currently use to evaluate various transportation projects could be more comprehensive in considering a wider array of social and economic costs and benefits, recognizing transportation systems' links to each other and to other social and financial systems.

Many panelists advocated a systemwide, rather than mode-specific, approach to transportation planning and funding that could also improve focus on outcomes that users and communities desire from the transportation system. For example, one panelist described a performance oriented funding system, in which the federal government would first define certain national interests of the transportation system—such as maintaining the entire interstate highway system or identifying freight corridors of importance to the national economy—then set national performance standards for those systems that states and localities must meet. Federal funds would be distributed to those entities that are addressing national interests and meeting the established standards. Any federal funds remaining after meeting the performance standards could then be used for whatever transportation purpose the state or locality deems most appropriate to achieve state or local mobility goals. Another panelist expanded the notion of setting national performance standards to include a recognition of the interactions between transportation goals and local economic development and quality of life goals, and to allow localities to modify national performance goals given local conditions. For example, a national performance standard, such as average speeds of 45 miles per hour for highways, might be unattainable for some locations given local conditions, and might run contrary to other local goals related to economic development.

Some panelists described several other types of systems that could focus on outcomes. For example, one panelist suggested a system in which federal support would reward those states or localities that apply federal money to gain efficiencies in their transportation systems, or tie transportation projects to land use and other local policies to achieve community and environmental goals, as well as mobility goals. Another panelist described a system in which different federal matching criteria for

different types of expenditures might reflect federal priorities. For example, if infrastructure preservation became a higher national priority than building new capacity, matching requirements could be changed to a 50 percent federal share for building new physical capacity and an 80 percent federal share for preservation. Other panelists suggested that requiring state and local governments to pay for a larger share of transportation projects might provide them with incentives to invest in more cost-effective projects. If cost savings resulted, these entities might have more funds available to address other mobility challenges. Some of the panelists suggested reducing the federal match for projects in all modes to give states and localities more fiscal responsibility for projects they are planning. Other panelists also suggested that federal matching requirements should be equal for all modes to avoid creating incentives to pursue projects in one mode that might be less effective than projects in other modes.

Use a Full Range of Tools to Address Mobility Challenges

Many panelists emphasized that using a range of various tools to address mobility challenges may help control congestion and improve access. This involves a strategic mix of construction, corrective and preventive maintenance, rehabilitation, operations and system management, and managing system use through pricing or other techniques. Many of the panelists said that no one type of technique would be sufficient to address mobility challenges. Although these techniques are currently in use, panelists indicated that planners should more consistently consider a full range of techniques.

Build New Infrastructure

Building additional infrastructure is perhaps the most familiar technique for addressing congestion and improving access to surface and maritime transportation. Several panelists expressed the view that although there is a lot of unused capacity in the transportation system, certain bottlenecks and key corridors require new infrastructure. However, building new infrastructure cannot completely eliminate congestion. For example, according to the Texas Transportation Institute, it would require at least twice the level of current road expansion to keep traffic congestion levels constant, if that were the only strategy pursued. In addition, while adding lanes may be a useful tool to deal with highway congestion for states with relatively low population densities, this option may not be as useful or possible for states with relatively high population densities—particularly in urban areas, where the ability to add lanes is limited due to a shortage of available space. Furthermore, investments in additional transportation capacity can stimulate increases in travel demand, sometimes leading to

congestion and slower travel speeds on the new or improved infrastructure.

Increase Infrastructure Maintenance and Rehabilitation

Other panelists said that an emphasis on enhancing capacity from existing infrastructure through increased corrective and preventive maintenance and rehabilitation is an important supplement to, and sometimes a substitute for, building new infrastructure. In 1999, the President's Commission to Study Capital Budgeting reported that, because infrastructure maintenance requires more rapid budgetary spending than new construction and has a lower visibility, it is less likely to be funded at a sufficient level.[51] However, one panelist said that for public roads, every dollar spent on preventive maintenance when the roads are in good condition saves $4 to $5 over what would have to be spent to maintain roads in fair condition or $10 to maintain roads once they are in poor condition. Maintaining and rehabilitating transportation systems can improve the speed and reliability of passenger and freight travel, thereby optimizing capital investments.

Improve Management and Operations

Better management and operation of existing surface and maritime transportation infrastructure is another technique for enhancing mobility advocated by some panelists. Improving management and operations may allow the existing transportation system to accommodate additional travel without having to add new infrastructure. For example, the Texas Transportation Institute reported that coordinating traffic signal timing with changing traffic conditions could improve flow on congested roadways. In addition, according to an FHWA survey, better management of work zones—which includes accelerating construction activities to minimize their effects on the public, coordinating planned and ongoing construction activities, and using more durable construction materials—can reduce traffic delays caused by work zones and improve traveler satisfaction.[52] Also, according to one panelist, automating the operation of locks and dams on the inland waterways could reduce congestion at these bottlenecks. Another panelist, in an article that he authored, noted that shifting the focus of transportation planning from building capital facilities

[51]Report of the President's Commission to Study Capital Budgeting, *President's Commission to Study Capital Budgeting* (Washington, D.C.: Government Printing Office, February 1999).

[52]Federal Highway Administration, *Moving Ahead: The American Public Speaks on Roadways and Transportation in Communities*, FHWA OP-01-017 (Washington, D.C.: U.S. Department of Transportation, February 2001).

to an "operations mindset" will require a cultural shift in many transportation institutions, particularly in the public sector, so that the organizational structure, hierarchy, and rewards and incentives are all focused on improving transportation management and operations.[53] He also commented on the need to improve performance measures related to operations and management so that both the quality and the reliability of transportation services are measured.

Several panelists suggested that contracting out a greater portion of operations and maintenance activities could allow public transportation agencies to focus their attention on improving overall management and developing policies to address mobility challenges. This practice could involve outsourcing operations and maintenance to private entities through competitive bidding, as is currently done for roads in the United Kingdom. In addition, by relieving public agencies of these functions, contracting could reduce the cost of operating transportation infrastructure and improve the level of service for each dollar invested for publicly owned transportation systems, according to one panelist.

Developing comprehensive strategies for reducing congestion caused by incidents is another way to improve management and operation of surface and maritime transportation modes. According to the Texas Transportation Institute, incidents such as traffic accidents and breakdowns cause significant delays on roadways. One panelist said that some local jurisdictions are developing common protocols for handling incidents that affect more than one mode and transportation agency, such as state transportation departments and state and local law enforcement, resulting in improved communications and coordination among police, firefighters, medical personnel, and operators of transportation systems. Examples of improvements to incident management include employing roving crews to quickly move accidents and other impediments off of roads and rail and implementing technological improvements that can help barges on the inland waterways navigate locks in inclement weather, thereby reducing delays on that system.

Increase Investment in Technology

Several panelists also suggested that increasing public sector investment in technologies—known as Intelligent Transportation Systems (ITS)—that are designed to enhance the safety, efficiency, and effectiveness of the

[53]Joseph M. Sussman, "Transitions in the World of Transportation: A Systems View," *Transportation Quarterly* 56 (2002): 21-22.

transportation network, can serve as a way of increasing capacity and mobility without making major capital investments. DOT's ITS program has two major areas of emphasis: (1) deploying and integrating intelligent infrastructure and (2) testing and evaluating intelligent vehicles. ITS includes technologies that improve traffic flow by adjusting signals, facilitating traffic flow at toll plazas, alerting emergency management services to the locations of crashes, increasing the efficiency of transit fare payment systems, and other actions. Appendix IV describes the different systems that are part of DOT's ITS program.

Other technological improvements suggested by panelists included increasing information available to users of the transportation system to help people avoid congested areas and to improve customer satisfaction with the system. For example, up-to-the-minute traffic updates posted on electronic road signs or over the Internet help give drivers the information necessary to make choices about when and where to travel. It was suggested that the federal government could play a key role in facilitating the development and sharing of such innovations through training programs and research centers, such as the National Cooperative Highway Research Program, the Transit Cooperative Research Program, and possible similar programs for waterborne transportation. However, panelists cautioned that the federal government might need to deal with some barriers to investing in technology development and implementation. One panelist said that there are few incentives for agencies to take risks on new technologies. If an agency improves its efficiency, it may result in the agency receiving reduced funding rather than being able to reinvest the savings.

Use Demand Management Techniques

Finally, another approach to reducing congestion without making major capital investments is to use demand management techniques to reduce the number of vehicles traveling at the most congested times and on the most congested routes. For public roads, demand management generally means reducing the number of cars traveling on particularly congested routes toward downtown during the morning commuting period and away from downtown during the late afternoon commuting period. One panelist, in a book that he authored, said that "the most effective means of reducing

peak-hour congestion would be to persuade solo drivers to share vehicles."[54]

One type of demand management for travel on public roads is to make greater use of pricing incentives. In particular, many economists have proposed using congestion pricing that involves charging surcharges or tolls to drivers who choose to travel during peak periods when their use of the roads increases congestion. Economists generally believe that such surcharges or tolls enhance economic efficiency by making drivers take into account the external costs they impose on others in deciding when and where to drive. These costs include congestion, as well as pollution and other external effects. The goal of congestion pricing would be to charge a toll for travel during congested periods that would make the cost (including the toll) that a driver pays for such a trip equal or close to the total cost of that trip, including external costs. These surcharges could help reduce congestion by providing incentives for travelers to share rides, use transit, travel at less congested (generally off-peak) times and on less congested routes, or make other adjustments—and at the same time, generate more revenues that can be targeted to alleviating congestion in those specific corridors. According to a report issued by the Transportation Research Board, technologies that are currently used at some toll facilities to automatically charge users could also be used to electronically collect congestion surcharges without establishing additional toll booths that would cause delays.[55] Peak-period pricing also has applicability for other modes of transportation. Amtrak and some transit systems use peak-period pricing, which gives travelers incentives to make their trips at less congested times.

In addition to pricing incentives, other demand management techniques that encourage ride-sharing can be useful in reducing congestion. Ride-sharing can be encouraged by establishing carpool and vanpool staging areas, providing free or preferred parking for carpools and vanpools, subsidizing transit fares, and designating certain highway lanes as high occupancy vehicle (HOV) lanes that can only be used by vehicles with a specified number of people in them (two or more). HOV lanes can provide an incentive for sharing rides because they reduce the travel time for a

[54]Anthony Downs, *Stuck in Traffic: Coping with Peak-Hour Traffic Congestion* (The Brookings Institution: Washington, D.C.: 1992) p.64.

[55]National Research Council, Transportation Research Board, *Curbing Gridlock: Peak-Period Fees to Relieve Traffic Congestion* (Washington, D.C.: 1994).

group traveling together relative to the time required to travel alone. This incentive is likely to be particularly strong when the regular lanes are heavily congested. Several panelists also recommended use of high occupancy toll (HOT) lanes, which combine pricing techniques with the HOV concept. Experiments with HOT lanes, which allow lower occupancy vehicles or solo drivers to pay a fee to use HOV lanes during peak traffic periods, are currently taking place in California. HOT lanes can provide motorists with a choice: if they are in a hurry, they may elect to pay to have less delay and an improved level of service compared to the regular lanes. When HOT lanes run parallel to regular lanes, congestion in regular lanes may be reduced more than would be achieved by HOV lanes.

Demand management techniques on roads, particularly those involving pricing, often provoke strong political opposition. Several panelists said that instituting charges to use roads that have been available "free" is particularly unpopular because many travelers believe that they have already paid for the roads through gasoline and other taxes and should not have to pay "twice." Other concerns about congestion pricing include equity issues because of the potentially regressive nature of these charges (i.e., the surcharges constitute a larger portion of the earnings of lower income households and therefore impose a greater financial burden on them).[56] In addition, some people find the concept of restricting lanes or roads to people who pay to use them to be elitist because that approach allows people who can afford to pay the tolls to avoid congestion that others must endure. Several of the panelists suggested that tolls might become more acceptable to the public if they were applied to new roads or lanes as a demonstration project so that the tolls' effectiveness in reducing congestion and increasing commuter choices could be evaluated.

Provide Options for Financing Mobility Improvements and Consider Additional Sources of Revenue

Several panelists indicated that targeting the financing of transportation to achieving desired mobility outcomes, and addressing those segments of transportation systems that are most congested, would require more options for financing surface and maritime transportation projects than are currently available, and might also require more sources of revenue in the future.

[56]Proponents of congestion pricing, however, such as the Committee for Study of Urban Transportation Congestion Pricing of the Transportation Research Board, have noted that all income groups can benefit if there is an appropriate distribution of the revenues obtained through congestion pricing.

Increase Funding Flexibility

According to many panelists, the current system of financing surface and maritime transportation projects limits options for addressing mobility challenges. For example, several panelists said that separate funding for each mode at the federal, state, and local level can make it difficult to consider possible efficient and effective ways for enhancing mobility, and providing more flexibility in funding across modes could help address this limitation. In addition, some panelists argued that "earmarking" or designation by the Congress of federal funds for particular transportation projects bypasses traditional planning processes used to identify the highest priority projects, thus potentially limiting transportation agencies' options for addressing the most severe mobility challenges. According to one panelist, bypassing transportation planning processes can also result in logical connections or interconnections between projects being overlooked.

Expand Support for Alternative Financing Mechanisms

Several panelists acknowledged that the public sector could expand its financial support for alternative financing mechanisms to access new sources of capital and stimulate additional investment in surface and maritime transportation infrastructure. These mechanisms include both newly emerging and existing financing techniques such as providing credit assistance to state and local governments for capital projects and using tax policy to provide incentives to the private sector for investing in surface and maritime transportation infrastructure (see app. V for a description of alternative financing methods). The panelists emphasized, however, that these mechanisms currently provide only a small portion of the total funding that is needed for capital investment and are not, by themselves, a major strategy for addressing mobility challenges. Furthermore, they cautioned that some of these mechanisms, such as Grant Anticipation Revenue Vehicles,[57] could create difficulties for state and local agencies to address future transportation problems, because agencies would be reliant on future federal revenues to repay the bonds.

Consider New Revenue Sources

Many panelists stated that a possible future shortage of revenues presents a fundamental limitation to addressing mobility challenges.[58] Some panelists

[57]Grant Anticipation Revenue Vehicles allow states to pay debt financing costs with future anticipated federal highway funds.

[58]However, one panelist believed that increased spending on transportation would never alleviate congestion and that such spending increases would reduce the funds available for dealing with other problems.

said that, because of the increasing use of alternative fuels, revenues from the gas tax are expected to decrease in the future, possibly hindering the public sector's ability to finance future transportation projects. In addition, one panelist explained that MPOs are required to produce financially constrained long-range plans, and the plans in the panelist's organization indicate that future projections of revenue do not cover the rising costs of planned transportation projects.

One method of raising revenue is for counties and other regional authorities to impose sales taxes for funding transportation projects. A number of counties have already passed such taxes and more are being considered nationwide. However, several panelists expressed concerns that this method might not be the best option for addressing mobility challenges. For example, one panelist stated that moving away from transportation user charges to sales taxes that are not directly tied to the use of transportation systems weakens the ties between transportation planning and finance. Counties and other authorities may be able to bypass traditional state and metropolitan planning processes because these sales taxes provide them with their own sources of funding for transportation.

A number of panelists suggested increasing current federal fuel taxes to raise additional revenue for surface transportation projects. In contrast, other panelists argued that the federal gas tax could be reduced. They said that, under the current system, states are receiving most of the revenue raised by the federal gas tax within their state lines and therefore there is little need for the federal government to be involved in collecting this revenue, except for projects that affect more than one state or are of national significance. However, other panelists said that this might lead to a decrease in gas tax revenues available for transportation, because states may have incentives to use this revenue for purposes other than transportation or may not collect as much as is currently collected.

Given that freight tonnage moved across all modes is expected to increase by 43 percent during the period from 1998 to 2010, new or increased taxes or other fees imposed on the freight sector could also help fund mobility improvements. For example, one panelist from the rail industry suggested modeling more projects on the Alameda Corridor in Los Angeles, where private rail freight carriers pay a fee to use infrastructure built with public financing. Another way to raise revenue for funding mobility improvements would be to increase taxes on freight trucking. According to FHWA, heavy trucks (weighing over 55,000 pounds) cause a disproportionate amount of damage to the nation's highways and have not paid a corresponding share

for the cost of pavement damage they cause. This situation will only be compounded by the large expected increases in freight tonnage moved by truck over the next 10 years. The Joint Committee on Taxation estimated that raising the ceiling on the tax paid by heavy vehicles to $1,900 could generate about $100 million per year.[59]

Another revenue raising strategy includes dedicating more of the revenues from taxes on alternative fuels, such as gasohol, to the Highway Trust Fund rather than to the U.S. Treasury's General Fund, as currently happens. Finally, panelists also said that pricing strategies, mentioned earlier in this report as a tool to reduce congestion, are also possible additional sources of revenue for transportation purposes.

Agency Comments and Our Evaluation

We provided DOT, the Corps of Engineers, and Amtrak with draft copies of this report for their review and comment. We obtained oral comments from officials at DOT and the Corps of Engineers. These officials generally agreed with the report and provided technical comments that we incorporated as appropriate. In addition, officials from the Federal Railroad Administration within DOT commented that the report was timely and would be vital to the dialogue that occurs as the Congress considers the reauthorization of surface transportation legislation. Amtrak had no comments on the report.

Our work was primarily performed at the headquarters of DOT and the Corps of Engineers (see app. VI for a detailed description of our scope and methodology). We conducted our work from September 2001 through August 2002 in accordance with generally accepted government auditing standards.

As agreed with your offices, unless you publicly announce the contents of this report earlier, we plan no further distribution until 30 days after the date of this report. At that time, we will send copies of this report to the congressional committees with responsibilities for surface and maritime transportation programs; DOT officials, including the Secretary of Transportation, the administrators of the Federal Highway Administration,

[59]See U.S. General Accounting Office, *Highway Financing: Factors Affecting Highway Trust Fund Revenues*, GAO-02-667T (Washington, D.C.: May 9, 2002).

Federal Railroad Administration, Federal Transit Administration, and Maritime Administration, the Director of the Bureau of Transportation Statistics, and the Commandant of the U.S. Coast Guard; the Commander and Chief of Engineers, U.S. Army Corps of Engineers; the President of Amtrak, and the Director of the Office of Management and Budget. We will make copies available to others on request. This report will also be available on our home page at no charge at http://www.gao.gov.

If you have any questions about this report, please contact me at heckerj@gao.gov or Kate Siggerud at siggerudk@gao.gov. Alternatively, we can be reached at (202) 512-2834. GAO contacts and acknowledgments are listed in appendix VII.

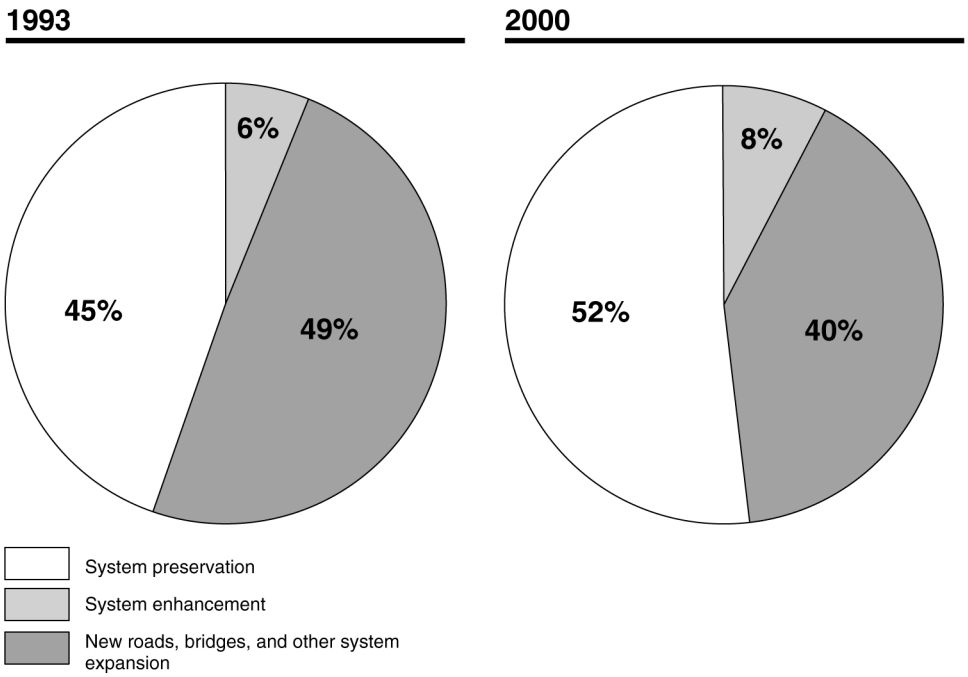
JayEtta Z. Hecker
Director
Physical Infrastructure Issues

Expenditures for Capital, Operations, and Maintenance

Comparing the proportion of public spending devoted to various purposes across modes is difficult due to differences in the level of public sector involvement and in the definition of what constitutes capital versus operations and maintenance expenses in each mode. For example, the operation of public roads is essentially a function of private citizens operating their own vehicles, while operations for mass transit includes spending for bus drivers and subway operators, among other items. In addition, maintenance expenditures can differ greatly from one mode to another in their definition and scope. For example, maintenance for a public road involves activities such as patching, filling potholes, and fixing signage, while maintenance for channels and harbors involves routine dredging of built up sediment and disposal or storage of the dredged material. Given these significant differences in scope, different modes classify and report on maintenance expenses in different ways.

For public roads, capital expenditures (which includes new construction, resurfacing, rehabilitation, restoration, and reconstruction of roads) constituted about one-half of total annual public sector expenditures over the last 10 years, with small increases in recent years. Of total capital expenditures in fiscal year 2000, 52 percent was used for system preservation, such as resurfacing and rehabilitation, while 40 percent was used for construction of new roads and bridges and other system expansions. These percentages have fluctuated somewhat throughout the 1990s. However, as shown in figure 8, the percentage of capital outlays spent on system preservation expenses increased from 45 percent to 52 percent between fiscal years 1993 and 2000, while construction of new roads and bridges and other system expansions declined from 49 percent to 40 percent over the same period.

Figure 8: Purposes for Capital Outlays for Public Roads, Fiscal Years 1993 and 2000



Source: Federal Highway Administration.

For transit, capital expenditures accounted for about 26 percent of total annual public sector expenditures in 1999. The federal government spends more heavily on capital than on operations for transit. The federal share of capital expenditures fluctuated throughout the 1990s but in fiscal year 2000 stood at about 50 percent, the same as it was in fiscal year 1991. The federal share of total operating expenses declined from about 5 percent in fiscal year 1991 to about 2 percent in fiscal year 2000.[60]

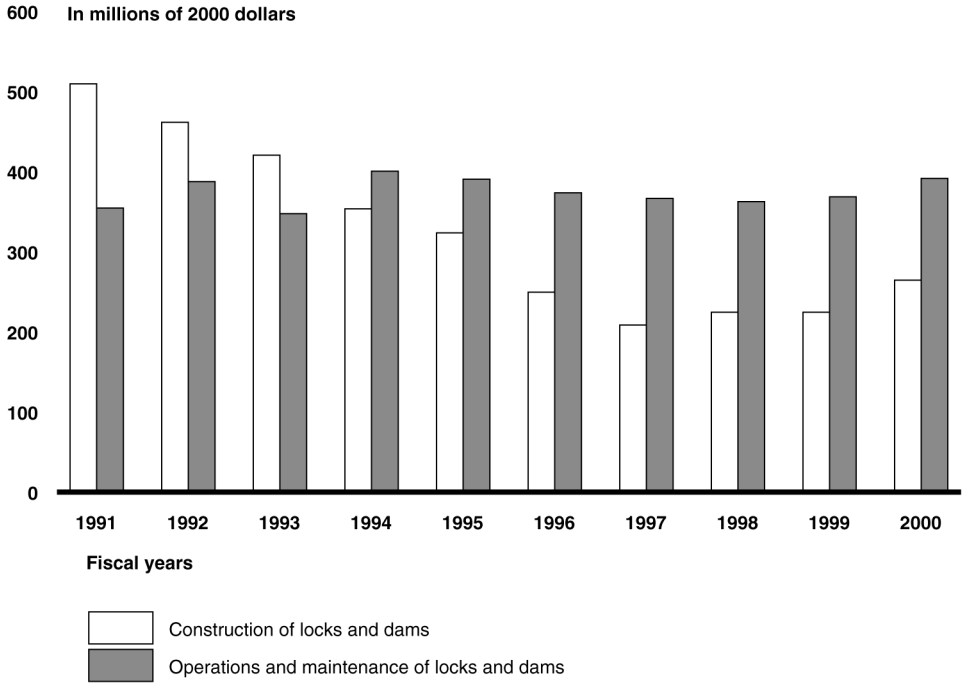
Federal government support to Amtrak for operating expenses and capital expenditures has fluctuated throughout the 1990s. Annual operating grants fluctuated between $300 and $600 million and capital grants between $300 and $500 million. In addition to these grants, the Taxpayer Relief Act of

[60]Because some capital funds from the federal Urbanized Area Formula program were used to pay for operating expenses, the 2 percent operating expense figure may be somewhat understated and the 50 percent capital expenditure figure may be somewhat overstated.

1997[61] provided Amtrak with $2.2 billion for capital and operating purposes in fiscal years 1998 and 1999. Federal support declined in fiscal years 2000 and 2001, however, with the federal government providing grants to Amtrak of $571 and $521 million, respectively.

For water transportation, spending by the U.S. Army Corps of Engineers (Corps of Engineers) for construction of locks and dams for inland waterway navigation[62] fell while expenditures for operations and maintenance remained at around $350 to $400 million, as shown in figure 9.

Figure 9: Federal Expenditures for Construction and Operations and Maintenance of Locks and Dams, Fiscal Years 1991-2000



Source: U.S. Department of Transportation, Bureau of Transportation Statistics (2002), Government Transportation Financial Statistics (Preliminary Data), Washington, D.C.

[61]P.L. 105-34 (Aug. 5, 1997).

[62]Locks and dams serve other purposes in addition to navigation, including irrigation, flood control, and recreation.

By contrast, Corps of Engineers expenditures for the construction, operations, and maintenance of federal channels and harbors have increased over the past decade. During fiscal years 1991 through 2000, construction expenditures increased from $112 million to $252 million (in 2000 dollars), while operations and maintenance expenditures increased from $631 million to $671 million (in 2000 dollars). In addition to the Corps of Engineers, the U.S. Coast Guard and the Maritime Administration also spend significant amounts for water transportation, although these agencies have limited responsibility for construction or maintenance of water transportation infrastructure.

Travel Forecast Methodologies

Demographic factors and economic growth are the primary variables influencing national travel projections for both passenger and freight travel. However, the key assumption underlying most of these travel projections is that the capacity of the transportation system is unconstrained; that is, capacity is assumed to expand as needed in order to accommodate future traffic flows.[63] As a result, national travel projections need to be used carefully in evaluating how capacity improvements or increasing congestion in one mode of transportation might affect travel across other modes and the entire transportation system.

Passenger Travel on Public Roads

Future travel growth will be influenced by demographic factors. A travel forecast study conducted for the Federal Highway Administration (FHWA) used economic and demographic variables such as per capita income and population to project a 24.7 percent national cumulative increase in vehicle miles traveled for passenger vehicles on public roads between 2000 and 2010. The study estimated that for every 1-percent increase in per capita income or population, vehicle miles traveled would increase nearly 1 percent.[64]

This forecast is unconstrained, however, in that it does not consider whether increased congestion or fiscal constraints will allow travel to grow at the rates projected. In part to deal with this limitation, FHWA uses another model to forecast a range of future vehicle miles traveled based on differing levels of investment. These projections recognize that if additional road capacity is provided, more travel is expected to occur than if the capacity additions are not provided. If congestion on a facility increases, some travelers will respond by shifting to alternate modes or routes, or will forgo some trips entirely. These projections are not available at this time but will be included in the U.S. Department of Transportation's (DOT) 2002 report to Congress entitled *Status of the Nation's Highways, Bridges, and Transit: Conditions and Performance.*

[63]The exception is the national projection of passenger miles traveled on transit, which is actually an aggregate of local projections that are capacity-constrained and may consider interactions among modes.

[64]A separate model was developed for buses, using population growth as the independent variable.

While it is clear that travelers choose between modes of travel for reasons of convenience and cost, among other things, none of the FHWA travel forecasts consider the effects of changes in levels of travel on other modes, such as transit or rail. FHWA officials said that they would like to have a data system that projects intermodal travel, but for now such a system does not exist. The models also cannot reflect the impact of major shocks on the system, such as natural disasters or the terrorist attacks of September 2001.

Passenger Travel on Transit

The Federal Transit Administration (FTA) makes national-level forecasts for growth in transit passenger miles traveled by collecting 15- to 25-year forecasts developed by metropolitan planning organizations (MPO)[65] in the 33 largest metropolitan areas in the country.[66] FTA calculates a national weighted average using the MPO forecasts and regional averages.[67] MPOs create their forecasts as part of their long-range planning process.[68] Unlike the first forecast for road travel discussed above, the 1999 *Conditions and Performance* report[69] stated that the MPO forecasts for vehicle miles traveled and passenger miles traveled incorporate the effects of actions that the MPOs are proposing to shape demand in their areas to attain air quality and other developmental goals. The MPO plans may include transit expansion, congestion pricing, parking constraints, capacity limits, and other local policy options. MPO forecasts also have to consider funding availability.

[65]MPOs are organizations of city, county, state, and federal officials that provide a regional forum for transportation planning.

[66]According to FTA, the 33 metropolitan areas account for approximately 90 percent of the nation's transit use, so they should provide a reasonable approximation of national-level forecasts.

[67]There is no forecast for New York City, so FTA substituted the average growth rate for the other major east coast cities, which is 1.32 percent.

[68]Methodologies used by the MPOs to derive their forecasts vary, although officials at FTA told us that there are two common types. One type uses a standard four-step modeling process involving data on how many trips people make, where people are going, the modal split of trips, and actual routes. The second type is econometric, in which regional forecast data on income and demographics are fed into a model to derive travel projections.

[69]Federal Highway Administration and Federal Transit Administration, *1999 Status of the Nation's Highways, Bridges, and Transit: Conditions and Performance* (Washington, D.C.: U.S. Department of Transportation, 2000).

Intercity Passenger Travel

Amtrak provided us with systemwide forecasts of ridership, which are based on assumed annual economic growth of between 1 and 1.5 percent, fare increases equal to the national inflation rate, and projected ridership increases on particular routes, including new or changing service on certain routes scheduled to come on line over the forecast period. For short-distance routes, Amtrak uses a model that estimates total travel over a route by any mode, based on economic and demographic growth. The model then estimates travel on each mode competing in the corridor based on cost and service factors in each mode. For long distance routes, Amtrak uses a different model that projects future rail ridership using variables that have been determined to influence past rail ridership, such as population, employment, travel time for rail, and level of service for rail. This model does not consider conditions on other competing modes.

Freight Travel Across Modes

In forecasting growth in national freight travel, models developed by FHWA and the U.S. Army Corps of Engineers (Corps of Engineers) use growth in trade and the economy as key factors driving freight travel. Projected growth in each particular mode is determined by growth in the production of the specific mix of commodities that historically are shipped on that mode. Therefore, any projected shift in freight movement from one mode to another is due to projected changes in the mix of commodities, or projected changes in where goods are produced and consumed.

Because current or future conditions and the capacity of the freight transportation system cannot be factored into the national forecasts, a number of factors—including growing congestion, as well as the benefits of specific projects that might relieve congestion—are not considered in the projections.[70] In addition, future trends in other factors that affect shippers' choices of freight modes—such as relative cost, time, or reliability—are not easily quantifiable and are also linked to each system's capacity and the congestion on each system. As such, these factors are not included in FHWA's or Corps of Engineers' national forecasting models.

Underlying the commodity forecasts used by FHWA and the Corps of Engineers are a number of standard macro-economic assumptions

[70]Local freight travel forecasts done by the Corps of Engineers' district offices for use in specific project feasibility studies do consider possible diversion to other alternative modes as a result of increasing congestion.

concerning primarily supply side factors, such as changes in the size of the labor force and real growth in exports due to trade liberalization. Changes in border, airport, and seaport security since September 11 may affect assumptions that are imbedded in these commodity forecasts. For example, increased delays and inspections at the border or at a port may create problems for shippers to meet just-in-time requirements, possibly resulting in a short-term shift to an alternative mode, or a limiting of trade.

Although current national freight forecasts are not capacity-constrained, FHWA is developing a "Freight Analysis Framework" to provide alternative analyses, assessing certain capacity limitations. The main impediment to developing this capability is determining capacity on each mode. There are commonly accepted measures of road capacity that are being incorporated, but rail and waterway capacity is not as easily measured.

State Forecasts of Vehicle Miles Traveled

FHWA provided us with state-level forecasts of total vehicle miles traveled on public roads from 2000 to 2010, derived from data in the Highway Performance Monitoring System (HPMS) sample data set.[71] This data set contains state-reported data on average annual daily traffic for approximately 113,000 road segments nationwide. For each sample section, HPMS includes measures of average annual daily traffic for the reporting year and estimates of future traffic for a specified forecast year, which is generally 18 to 25 years after the reporting year. It should be noted that the HPMS sample data do not include sections on any roads classified as local roads or rural minor collectors.

Because the individual HPMS segment forecasts come from the states, we do not know exactly what models were used to develop them. According to officials at FHWA, the only national guidance comes from the HPMS Field Manual, which says that future average annual daily traffic should come from a technically supportable state procedure or data from MPOs or other local sources. The manual also says that HPMS forecasts for urbanized areas should be consistent with those developed by the MPO at the functional system and urbanized area level.

[71]HPMS also includes data from the District of Columbia and Puerto Rico.

Table 1: Projected Average Annual Growth Rates for Vehicle Miles Traveled, 2000-2020

State	Rural (%)	Urban (%)	State total (%)
Alabama	2.94	3.18	3.06
Alaska	2.34	2.12	2.23
Arizona	1.60	1.42	1.48
Arkansas	2.54	2.23	2.43
California	3.09	2.25	2.42
Colorado	2.22	1.94	2.05
Connecticut	1.71	1.28	1.38
Delaware	1.33	0.86	1.05
District of Columbia	N/A	1.69	1.69
Florida	1.85	1.63	1.69
Georgia	0.60	0.86	0.75
Hawaii	1.62	1.46	1.51
Idaho	3.07	3.08	3.08
Illinois	1.17	1.36	1.30
Indiana	3.07	2.69	2.88
Iowa	1.95	2.24	2.06
Kansas	1.88	2.14	2.00
Kentucky	2.90	2.12	2.55
Louisiana	1.93	1.73	1.84
Maine	0.31	0.58	0.39
Maryland	2.82	2.56	2.64
Massachusetts	1.02	1.06	1.05
Michigan	2.22	1.63	1.86
Minnesota	2.23	2.09	2.16
Mississippi	2.77	2.71	2.75
Missouri	1.67	1.96	1.82
Montana	2.49	2.75	2.55
Nebraska	2.48	2.08	2.33
Nevada	2.16	2.08	2.11
New Hampshire	2.10	2.24	2.16
New Jersey	1.77	1.25	1.36
New Mexico	2.29	1.28	1.93
New York	1.76	1.83	1.81
North Carolina	2.68	2.64	2.66

(Continued From Previous Page)

State	Rural (%)	Urban (%)	State total (%)
North Dakota	1.76	2.31	1.90
Ohio	1.64	1.23	1.39
Oklahoma	2.21	2.32	2.26
Oregon	2.19	1.91	2.06
Pennsylvania	2.90	2.49	2.66
Rhode Island	1.28	1.09	1.12
South Carolina	2.44	2.28	2.38
South Dakota	1.47	1.48	1.47
Tennessee	2.18	2.37	2.29
Texas	2.63	2.27	2.40
Utah	3.25	3.54	3.43
Vermont	1.62	1.04	1.48
Virginia	2.60	2.01	2.27
Washington	1.80	2.03	1.96
West Virginia	2.80	2.32	2.67
Wisconsin	2.21	2.21	2.21
Wyoming	2.07	1.06	1.83
Puerto Rico	2.30	1.67	1.83
Total	**2.27**	**1.97**	**2.09**

Source: Federal Highway Administration, as reported by states in the Highway Performance Monitoring System database.

Factors Influencing Future Travel

Local and Intercity Travel

For both local and intercity passenger travel, population growth is expected to be one of the key factors driving overall travel levels. Where that growth will occur will likely have a large effect on travel patterns and mode choices. According to the U.S. Census Bureau, the U.S. population will grow to almost 300 million by 2010.[72] Although this represents a slower growth rate than in the past, it would still add approximately 18.4 million people to the 2000 population, and will likely also substantially increase the number of vehicles on public roads as well as the number of passengers on transit and intercity rail.

The Census Bureau reported that since 1990, the greatest population growth has been in the South and West. According to one panelist, these regions' metropolitan areas traditionally have lower central city densities and higher suburban densities than the Midwest and East. These areas are therefore harder to serve through transit than metropolitan areas with higher population densities, where transit can be more feasible. However, according to some transportation experts, it may not be possible to build new transit infrastructure in these areas due to environmental or other concerns. The population growth that is expected in suburban areas could lead to a larger increase in travel by private vehicles than by transit because suburban areas generally have lower population densities than inner cities, and also have more dispersed travel patterns, making them less easy to serve through conventional public transit. Although overall population growth will likely be greatest in suburban parts of metropolitan areas, high rates of growth are also predicted for rural areas. As is the case in suburbs, these rural areas are difficult to serve with anything but private automobiles because of low population densities and geographical dispersion of travel patterns, so travel by private vehicle may increase. Immigration patterns are also expected to contribute to changes in travel levels, but the extent will depend on immigration policies. For example, according to a senior researcher with the American Public Transportation Association, higher rates of immigration tend to increase transit use.

In addition to overall population growth, another demographic trend that will likely affect mode choices is the aging of the population. According to data from the U.S. Census Bureau, the number of people aged 55 and over is projected to increase 26 percent between 2001 and 2010. The most rapidly growing broad age group is expected to be the population aged 85

[72]These projections have not yet been updated with data from the 2000 Census.

and older, which is projected to increase 30 percent by 2010. According to the Federal Highway Administration and Federal Transit Administration's 1999 *Conditions and Performance* report,[73] the elderly have different mobility issues than the nonelderly because they are less likely to have drivers' licenses, have more serious health problems, and may require special services and facilities. According to a report prepared for the World Business Council for Sustainable Development (*Mobility 2001*),[74] cars driven by the elderly will constitute an increasing proportion of traffic, especially in the suburbs and rural areas, where many elderly people tend to reside. Increases in the number of older drivers can pose safety problems, in that the elderly have a higher rate of crashes per mile driven than younger drivers, and that rate rises significantly after age 85. The *Mobility 2001* report also says that the driver fatality rate of drivers over 75 years of age is higher than any other age group except teenagers. Growth of the elderly population may therefore increase the importance of providing demand-responsive transit services[75] and improving signs on public roads to make them clearer and more visible.

Along with population growth, the increasing affluence of the U.S. population is expected to play a key role in local and intercity passenger travel levels and in the modes travelers choose. The 1999 *Conditions and Performance* report states that rates of vehicle ownership are lower in low-income households, leading those households to rely more on transit systems. According to Federal Transit Administration (FTA) officials and *Mobility 2001*, transit use—particularly use of buses—generally decreases as income increases. Increasing affluence also influences intercity travel levels. The 1999 *Conditions and Performance* report says that people with high incomes take approximately 30 percent more trips than people with low incomes, and the trips tend to be longer. Long-distance travel for business and recreation increases with income. Also, as income increases,

[73]Federal Highway Administration and Federal Transit Administration, *1999 Status of the Nation's Highways, Bridges, and Transit: Conditions and Performance* (Washington, D.C.: U.S. Department of Transportation, 2000).

[74]Massachusetts Institute of Technology and Charles River Associates, Inc., *Mobility 2001: World Mobility at the End of the Twentieth Century and Its Sustainability* (World Business Council for Sustainable Development, August 2001).

[75]According to the American Public Transportation Association, demand response modes are passenger cars, vans, or buses with fewer than 25 seats operating in response to calls from passengers or their agents to the transit operator, who then dispatches a vehicle to pick up the passengers and transport them to their destinations.

travel by faster modes, such as car and air, increases, and travel by intercity bus tends to decrease.

Several participants in our surface and maritime transportation panels (see app. VI) also indicated that improvements in communication technology will likely affect the amount and mode of intercity travel, but the direction and extent of the effect is uncertain. One panelist said that there is no additional cost to communicating over greater distances, so communications will replace travel to some extent, particularly as technologies improve. However, two other panelists said that communication technology might increase travel by making the benefit of travel more certain. For example, the Internet can provide people with current and extensive information about vacation destinations, potentially increasing the desire to travel. According to *Mobility 2001*, it is unclear whether telecommunications technology will substitute for the physical transportation of people and goods. Telecommuting and teleconferencing are becoming more common, but technological improvements would have to be significant before they can substitute for actual presence at work or in face-to-face meetings. In addition, while home-based workers do not have to commute, they tend to travel approximately the same amount as traditional workers, but differ in how their travel is distributed among trip purposes.

The terrorist attacks on the United States on September 11, 2001, are expected to have some effect on passenger travel levels and choices about which mode to use, but U.S. Department of Transportation (DOT) officials and participants in the panels did not believe the long-term changes would be significant, provided that no more attacks occur. Federal Highway Administration and Federal Railroad Administration officials speculated that increased delays in air travel due to stricter security procedures might shift some travel from air to other modes, such as car or rail, although they expected this effect to be negligible in the long term unless additional incidents occur.

Finally, changes in the price (or perceived price), condition, and reliability of one modal choice as compared with another are also likely to affect levels of travel and mode choices. For example, changes in the petroleum market that affect fuel prices, or changes in government policy that affect the cost of driving or transit prices, could result in shifts between personal vehicles and transit; however, it is difficult to predict the extent to which these changes will occur. According to *Mobility 2001*, automobiles offer greater flexibility in schedule and choice of destinations than other modes

of transportation, and often also provide shorter travel times with lower out-of-pocket costs. However, if heavy and unpredictable road congestion causes large variations in automobile travel time, there could be a shift to transit or a decrease in overall travel.

Freight Travel

According to several reports by DOT and transportation research organizations, increasing international trade, economic growth, the increasing value of cargo shipped, and changes in policies affecting certain commodities are expected to influence future volumes of freight travel and the choice of mode by which freight is shipped.

Increasing international trade and national trade policies are expected to affect commodity flows, volumes, and mode choice.[76] According to the *Transportation Statistics Annual Report 2000*,[77] the globalization of businesses can shift production of goods sold in the United States to locations outside of the country, increasing total ton-miles[78] and changing the average length of haul of shipments. This shift in production could also affect freight mode choice, with more commodities being shipped by multiple modes as distances increase. According to *Mobility 2001*, truck transportation tends to be cheaper, faster, and more energy efficient than rail and barges for shipping high-value cargo. However, as distances increase, rail and intermodal transportation (linking rail and truck travel) become more cost-efficient options. Various trade policies also affect freight flows and volumes. For example, the North American Free Trade Agreement has contributed to the increased volume of trade moving on rail and highways. According to data from the Bureau of Transportation Statistics' Transborder Surface Freight Database, between 1996 and 2000, tonnage of imports by rail from Mexico and Canada increased by about 25

[76]The U.S. economy has become increasingly integrated with the global economy, as domestic and foreign companies manage worldwide production and distribution systems. For example, auto manufacturers may locate their factories and warehouses in separate countries or continents from their retail outlets. See *Characteristics and Changes in Freight Transportation Demand: A Guidebook for Planners and Policy Analysts*, prepared for the National Cooperative Highway Research Program, Project 8-30 Phase II (Washington, D.C.: Transportation Research Board, June 19, 1995).

[77]Bureau of Transportation Statistics, *Transportation Statistics Annual Report 2000* (Washington, D.C.: U.S. Department of Transportation, 2001).

[78]Ton-miles are calculated by multiplying the tons of commerce being moved by the number of miles moved.

percent, and imports by truck increased 20 percent. In the maritime sector, expanding trade with the Pacific Rim increased traffic at west coast container ports.

According to the *Transportation Statistics Annual Report 2000*, economic growth results in a greater volume of goods produced and consumed, leading to more freight moved. As the economy grows, disposable income per capita increases and individual purchasing power rises, which can cause businesses to ship more freight per capita. According to the report, freight ton-miles per capita increased more than 30 percent, from 10,600 in 1975 to 14,000 in 1999.

The increasing value of cargo and the continuing shift toward a more service-oriented economy and more time-sensitive shipments has affected the volume of freight shipments and the choice of modes on which freight is shipped. According to the *Transportation Statistics Annual Report 2000*, there is a continuing shift toward production of high-value, low-weight products, which leads to changes in freight travel levels and mode choice. For example, it takes more ton-miles to ship $1,000 worth of steel than it does to ship $1,000 worth of cell phones. High-value cargo, such as electronics and office equipment, tends to be shipped by air or truck, while rail and barges generally carry lower-value bulk items, such as coal and grain.[79] According to *Mobility 2001*, the growth of e-commerce and just-in-time inventory practices depend upon the ability to deliver goods quickly and efficiently. A report prepared for the National Cooperative Highway Research Program[80] states that the effects of just-in-time inventory practices are to increase the number of individual shipments, decrease their length of haul, and increase the importance of on-time delivery. Both reports indicate that such practices may shift some freight from slower

[79]The *Mobility 2001* report states that inland waterways can move very large shipments of grain or lumber with a minimal expenditure of energy. For example, on the lower Mississippi River, 40 or more 10-ton barges can be lashed together into a single tow for movement down the river. Rail is also cost-efficient for shipping low-value bulk commodities long distances. However, because both of these modes are slower than truck travel on highways, and are limited to fixed waterways or tracks, trucks are more often used for transporting high-value goods and for local deliveries. Ocean shipping is the dominant mode for overseas freight tonnage because extremely large ships operating with small crews can move great tonnages vast distances at minimal costs.

[80]"Characteristics and Changes in Freight Transportation Demand: A Guidebook for Planners and Policy Analysts," prepared for the National Cooperative Highway Research Program, Project 8-30 Phase II (Washington, D.C.: Transportation Research Board, June 19, 1995).

modes, such as rail, to faster modes, such as truck or air. In addition, the *Mobility 2001* report states that as the demand for specialized goods and services grows, the demand for smaller, more specialized trucks increases. Items ordered from catalogs or on-line retailers are often delivered by specialized trucks.

Policies affecting particular commodities can have a large impact on the freight industry. For example, policies concerning greenhouse gas emissions can affect the amount of coal mined and shipped. Because coal is a primary good shipped by rail and water, reduction in coal mining would have a significant effect on tonnage for those modes. Changes in the type of coal mined as a result of environmental policies—such as an increase in mining of low-sulfur coal—can also affect the regional patterns of shipments, resulting in greater ton-miles of coal shipped. Also, increasing emissions controls and clean fuel requirements may raise the cost of operating trucks and result in a shift of freight from truck to rail or barge. For example, according to *Mobility 2001*, recently released rules from the Environmental Protection Agency implementing more stringent controls for emissions from heavy-duty vehicles are predicted to increase the purchase price of a truck by $803. Other environmental regulations also affect the cost of shipping freight, as when controls on the disposal of material dredged from navigation channels increase the costs of expanding those channels. Policies regarding cargo security may also affect the flow of goods into and out of the United States. For example, several of our panelists indicated that implementing stricter security measures will increase the cost of shipping freight as companies invest in the personnel and technology required. Tighter security measures could also increase time necessary to clear cargo through Customs or other inspection stations.

Intelligent Transportation Systems

The U.S. Department of Transportation's (DOT) program of Intelligent Transportation Systems (ITS) offers technology-based systems intended to improve the safety, efficiency, and effectiveness of the surface transportation system. The ITS program applies proven and emerging technologies—drawn from computer hardware and software systems, telecommunications, navigation, and other systems—to surface transportation. DOT's ITS program has two areas of emphasis: (1) deploying and integrating intelligent infrastructure and (2) testing and evaluating intelligent vehicles. Under the first area of emphasis, the intelligent infrastructure program is composed of the family of technologies that can enhance operations in three types of infrastructure: (1) infrastructure in metropolitan areas, (2) infrastructure in rural areas, and (3) commercial vehicles. Under the ITS program, DOT provides grants to states to support ITS activities. In practice, the Congress has designated the locations and amounts of funding for ITS. DOT solicits the specific projects to be funded and ensures that those projects meet criteria established in the Transportation Equity Act for the 21st Century.

Metropolitan intelligent transportation systems focus on deployment and integration of technologies in urban and suburban geographic areas to improve mobility. These systems include:

- Arterial management systems that automate the process of adjusting signals to optimize traffic flow along arterial roadways;
- Freeway management systems that provide information to motorists and detect problems whose resolution will increase capacity and minimize congestion resulting from accidents;
- Transit management systems that enable new ways of monitoring and maintaining transit fleets to increase operational efficiencies through advanced vehicle locating devices, equipment monitoring systems, and fleet management;
- Incident management systems that enable authorities to identify and respond to vehicle crashes or breakdowns with the most appropriate and timely emergency services, thereby minimizing recovery times;
- Electronic toll collection systems that provide drivers and transportation agencies with convenient and reliable automated transactions to improve traffic flow at toll plazas and increase the operational efficiency of toll collection;

- Electronic fare payment systems that use electronic communication, data processing, and data storage techniques in the process of fare collection and in subsequent recordkeeping and funds transfer;

- Highway-rail intersection systems that coordinate traffic signal operations and train movement and notify drivers of approaching trains using in-vehicle warning systems;

- Emergency management systems that enhance coordination to ensure the nearest and most appropriate emergency service units respond to a crash;

- Regional multimodal traveler information systems that provide road and transit information to travelers to enhance the effectiveness of trip planning and en-route alternatives;

- Information management systems that provide for the archiving of data generated by ITS devices to support planning and operations; and

- Integrated systems that are designed to deliver the optimal mix of services in response to transportation system demands.

Rural Intelligent Transportation Systems are designed to deploy high potential technologies in rural environments to satisfy the needs of a diverse population of users and operators. DOT has established seven categories of rural intelligent transportation projects. They are as follows:

- Surface Transportation Weather and Winter Mobility - technologies that alert drivers to hazardous conditions and dangers, including wide-area information dissemination of site-specific safety advisories and warnings;

- Emergency Services - systems that improve emergency response to serious crashes in rural areas, including technologies that automatically mobilize the closest police, ambulances, or fire fighters in cases of collisions of other emergencies;

- Statewide/Regional Traveler Information Infrastructure – system components that provide information to travelers who are unfamiliar with the local rural area and the operators of transportation services;

- Rural Crash Prevention – technologies and systems that are directed at preventing crashes before they occur, as well as reducing crash severity;

- Rural Transit Mobility – services designed to improve the efficiency of rural transit services and their accessibility to rural residents;

- Rural Traffic Management – services designed to identify and implement multi-jurisdictional coordination, mobile facilities, and simple solutions for small communities and operations in areas where utilities may not be available; and

- Highway Operations and Maintenance – systems designed to leverage technologies that improve the ability of highway workers to maintain and operate rural roads.

The Commercial Vehicle ITS program focuses on applying technologies to improve the safety and productivity of commercial vehicles and drivers, reduce commercial vehicles' operations costs, and facilitate regulatory processes for the trucking industry and government agencies. This is primarily accomplished through the Commercial Vehicle Information Systems and Networks—a program that links existing federal, state, and motor carrier information systems so that all entities can share information and communicate with each other in a more timely and accurate manner.

The second area of emphasis in DOT's ITS program—testing and evaluating intelligent vehicles—is designed to foster improvements in the safety and mobility of vehicles. This component of the ITS program is meant to promote traffic safety by expediting the commercial availability of advanced vehicle control and safety systems in four classes of vehicles: (1) light vehicles, including passenger cars, light trucks, vans, and sport utility vehicles; (2) commercial vehicles, including heavy trucks and interstate buses; (3) transit vehicles, including all nonrail vehicles operated by transit agencies; and (4) specialty vehicles, including those used for emergency response, law enforcement, and highway maintenance.

Alternative Financing Methods

Transportation officials at all levels of government recognize that funding from traditional sources (i.e., state revenues and federal aid) does not always keep pace with demands for new, expanded, or improved surface and maritime transportation infrastructure. Accordingly, the U.S. Department of Transportation (DOT) has supported a broad spectrum of emerging or established alternative financing mechanisms that can be used to augment traditional funding sources, access new sources of capital and operating funds, and enable transportation providers to proceed with major projects sooner than they might otherwise. These mechanisms fall into several broad categories: (1) allowing states to pay debt financing costs with future anticipated federal highway funds, (2) providing federal credit assistance, and (3) establishing financing institutions at the state level. In addition, state, local, and regional governments engage in public/private partnerships to tap private sector resources for investment in transportation capital projects. The federal government helps subsidize public/private partnerships by providing them with tax exemptions.

The federal government allows states to tap into Federal-aid highway funds to repay debt-financing costs associated with highway projects through the use of Grant Anticipation Revenue Vehicles (GARVEE). Under this program, states can pledge a share of future obligations of federal highway funds toward repayment of bond-related expenses, including a portion of the principal and interest payments, insurance costs, and other costs. A project must be approved by DOT's Federal Highway Administration to be eligible for this type of assistance.

The federal government also provides credit assistance in the form of loans, loan guarantees, and lines of credit for a variety of surface and maritime transportation programs, as follows:

- Under the Transportation Infrastructure Finance and Innovation Act of 1998 (TIFIA), the federal government provides direct loans, loan guarantees, and lines of credit aimed at leveraging federal funds to attract nonfederal coinvestment in infrastructure improvements. This program is designed to provide financing for highway, mass transit, rail, airport, and intermodal projects, including expansions of multi-state highway trade corridors; major rehabilitation and replacement of transit vehicles, facilities, and equipment; border crossing infrastructure; and other investments with regional and national benefits.

- Under the Rail Rehabilitation and Improvement Financing Program (RRIF), established by the Transportation Equity Act for the 21st

Century (TEA-21) in 1998, the federal government is authorized to provide direct loans and loan guarantees for railroad capital improvements. This type of credit assistance is made available to state and local governments, government-sponsored authorities, railroads, corporations, or joint ventures that include at least one railroad. However, as of June 2002, no loans or loan guarantees had been granted under this program.

- Under Title XI of the Merchant Marine Act of 1936, known as the Federal Ship Financing Guarantees Program, the federal government provides for a full faith and credit guarantee of debt obligations issued by (1) U.S. or foreign shipowners for the purpose of financing or refinancing U.S. or eligible export vessels that are constructed, reconstructed, or reconditioned in U.S. shipyards; and (2) U.S. shipyards for the purpose of financing advanced shipbuilding technology.

A third way that the federal government helps transportation providers finance capital projects is by supporting State Infrastructure Banks (SIB). SIBs are investment funds established at the state or regional level that can make loans and provide other types of credit assistance to public and private transportation project sponsors. Under this program, the federal government allows states to use federal grants as "seed" funds to finance capital investments in highway and transit construction projects. The federal government currently supports SIBs in 39 states.

In addition to these alternative financing mechanisms directly supported by the federal government, state, local, and regional governments sometimes engage in public/private partnerships to tap private sector resources for investment in transportation capital projects. The federal government also helps subsidize public/private partnerships by providing them with tax subsidies. One such subsidy is specifically targeted towards investment in ground transportation facilities—the tax exemption for interest earned on state and local bonds that are used to finance high-speed rail facilities and government-owned docks, wharves, and other facilities. In addition, a Department of the Treasury study indicates that the rates of tax

depreciation allowed for railroads, railroad equipment, ships, and boats are likely to provide some subsidy to investors in those assets.[81]

Partnerships between state and local governments and the private sector are formed for the purpose of sharing the risks, financing costs, and benefits of transportation projects. Such partnerships can be used to minimize cost by improving project quality, maintaining risk-management, improving efficiency, spurring innovation, and accessing expertise that may not be available within the agency. These partnerships can take many forms; some examples include:

- Partnerships formed to develop, finance, build, and operate new toll roads and other roadways;
- Joint development of transit assets whereby land and facilities that are owned by transit agencies are sold or leased to private firms and the proceeds are used for capital investment in, and operations of, transit systems;
- "Turnkey" contracts for transit construction projects whereby the contractor (1) accepts a lower price for the delivered product if the project is delayed or (2) receives a higher profit if the project is delivered earlier or under budget; and
- Cross-border leases that permit foreign investors to own assets used in the United States, lease them to an American entity, and receive tax benefits under the laws of their home country. This financing mechanism offers an "up front" cost savings to transit agencies that are acquiring vehicles or other assets from a foreign firm.

[81]A subsidy is provided when the tax deductions that investors are permitted to claim for depreciation of assets are larger (in present value terms) than the amount of true economic depreciation of those assets. Although economic depreciation is difficult to estimate, the Department of the Treasury study suggests that tax depreciation exceeds economic depreciation for certain transportation assets. (See Department of the Treasury, *Report to the Congress on Depreciation Recovery Periods and Methods*, July 2000.)

Scope and Methodology

Our work covered major modes of surface and maritime transportation for passengers and freight, including public roads, public transit, railways, and ports and inland waterways. To determine trends in public expenditures for surface and maritime transportation over the past 10 years, we relied on U.S. Department of Transportation (DOT) reports and databases that document annual spending levels in each mode of transportation. We analyzed trends in total public sector and federal expenditures across modes during the 10-year period covering fiscal years 1991 through 2000, and we compared the proportion of public expenditures devoted to capital activities versus operating and maintaining the existing infrastructure during that same time period. We adjusted the expenditure data to account for inflation using separate indexes for expenditures made by the federal government and state and local governments. We used price indexes from the Department of Commerce's Bureau of Economic Analysis' National Income and Products Accounts.

To determine projected levels of freight and passenger travel over the next 10 years, we identified projections made by DOT's modal administrations, the U.S. Army Corps of Engineers, and Amtrak for the period covering calendar years 2001 through 2010. We interviewed officials responsible for the projections and reviewed available documentation to identify the methodology used in preparing the projections and the key factors driving them. We also obtained data on past levels of freight and passenger travel, covering fiscal years 1991 through 2000, from DOT's modal administrations, the U.S. Army Corps of Engineers, and Amtrak. We analyzed the factors driving the trends for three types of travel—local, intercity, and freight—that have important distinctions in the types of vehicles and modes used for the travel.

To identify mobility challenges and strategies for addressing those challenges, we primarily relied upon expert opinion, as well as a review of pertinent literature. In particular, we convened two panels of surface and maritime transportation experts to identify mobility issues and gather views about alternative strategies for addressing the issues and challenges to implementing those strategies. We contracted with the National Academy of Sciences (NAS) and its Transportation Research Board (TRB) to provide technical assistance in identifying and scheduling the two panels that were held on April 1 and 3, 2002. TRB officials selected a total of 22 panelists with input from us, including a cross-section of representatives from all surface and maritime modes and from various occupations involved in transportation planning. In keeping with NAS policy, the panelists were invited to provide their individual views and the panels were

not designed to build consensus on any of the issues discussed. We analyzed the content of all of the comments made by the panelists to identify common themes about key mobility challenges and strategies for addressing those challenges. Where applicable, we also identified the opposing points of view about the challenges and strategies.

The names and backgrounds of the panelists are as follows. We also note that two of the panelists served as moderators for the sessions, Dr. Joseph M. Sussman of the Massachusetts Institute of Technology and Dr. Damian J. Kulash of the Eno Foundation, Inc.

- Benjamin J. Allen is Interim Vice President for External Affairs and Distinguished Professor of Business at Iowa State University. Dr. Allen serves on the editorial boards of the *Transportation Journal* and *Transport Logistics*, and he is currently Chair of the Committee for the Study of Freight Capacity for the Next Century at TRB. His expertise includes transportation regulation, resource allocation, income distribution, and managerial decisionmaking and his research has been published in numerous transportation journals.

- Daniel Brand is Vice President of Charles River Associates, Inc., in Boston, Mass. Mr. Brand has served as Undersecretary of the Massachusetts Department of Transportation, Associate Professor of City Planning at Harvard University, and Senior Lecturer in the Massachusetts Institute of Technology's Civil Engineering Department. Mr. Brand edited *Urban Transportation Innovation*, coedited *Urban Travel Demand Forecasting*, and is the author of numerous monographs and articles on transportation.

- Jon E. Burkhardt is the Senior Study Director at Westat, Inc., in Rockville, Md. His expertise is in the transit needs of rural and small urban areas, in particular, the needs of the elderly population in such areas. He has directed studies on the ways in which advanced technology can aid rural public transit systems, the mobility challenges for older persons, and the economic impacts of rural public transportation.

- Sarah C. Campbell is the President of TransManagement, Inc., in Washington, D.C., where she advises transportation agencies at all levels of government, nonprofit organizations, and private foundations on transportation issues. Ms. Campbell is currently a member of the Executive Committee of the TRB. She was a founding director of the

Surface Transportation Policy Project and currently serves as chairman of its board of directors.

- Christina S. Casgar is the Executive Director of the Foundation for Intermodal Research and Education in Greenbelt, Md. Ms. Casgar's expertise is in transportation and logistics policies of federal, state, and local levels of government, particularly in issues involving port authorities. She has also worked with the TRB as an industry investigator to identify key issues and areas of research regarding the motor carrier industry.

- Anthony Downs is a Senior Fellow at the Brookings Institution. Mr. Downs's research interests are in the areas of democracy, demographics, housing, metropolitan policy, real estate, real estate finance, "smart growth," suburban sprawl, and urban policy. He is the author of *New Visions for Metropolitan America* (1994), *Stuck in Traffic: Coping with Peak-Hour Traffic Congestion* (1992), and several policy briefs published by the Brookings Institution.

- Thomas R. Hickey served until recently as the General Manager of the Port Authority Transit Corporation in Lindenwold, N.J. Mr. Hickey has 23 years of public transit experience, and he is a nationally recognized authority in the field of passenger rail operations and the design of intermodal facilities.

- Ronald F. Kirby is the Director of Transportation Planning at the Metropolitan Washington Council of Governments. Dr. Kirby is responsible for conducting long-range planning of the highway and public transportation system in the Washington, D.C., region, assessing the air quality implications of transportation plans and programs, implementing a regional ridesharing program, and participating in airport systems planning in the region. Prior to joining the Council of Governments, he conducted transportation studies for the Urban Institute and the World Bank.

- Damian J. Kulash is the President and Chief Executive Officer of the Eno Transportation Foundation, Inc., in Washington, D.C. Dr. Kulash established a series of forums at the Foundation addressing major issues affecting all transportation modes including economic returns on transportation investment, coordination of intermodal freight operations in Europe and the United States, and development of a U.S. transportation strategy that is compatible with national global climate

change objectives. He has published numerous articles in transportation journals and directed studies at the Congressional Budget Office and the TRB.

- Charles A. Lave is a Professor of Economics (Emeritus) at the University of California, Irvine where he served as Chair of the Economics Department. Dr. Lave has been a visiting scholar at the Massachusetts Institute of Technology and Harvard University, and he served on the Board of Directors of the National Bureau of Economic Research from 1991 through 1997. He has published numerous articles on transportation pricing and other topics.

- Stephen Lockwood is Vice President of Parsons Corporation, an international firm that provides transportation planning, design, construction, engineering, and project management services. Mr. Lockwood is also a consultant to the American Association of State Highway and Transportation Officials (AASHTO), the Federal Highway Administration (FHWA), and other transportation organizations. Prior to joining Parsons, he served as Associate Administrator for Policy at FHWA.

- Timothy J. Lomax is a Research Engineer at the Texas Transportation Institute at Texas A&M University. Dr. Lomax has published extensively on urban mobility issues and he developed a methodology used to assess congestion levels and costs in major cities throughout the United States. He is currently conducting research, funded by nine state transportation departments, to improve mobility measuring capabilities.

- James R. McCarville is the Executive Director of the Port of Pittsburgh Commission. He also serves as the President of the trade association, Inland Rivers' Ports and Terminals, Inc., and is a member of the Marine Transportation System National Advisory Council, a group sponsored by the U.S. Secretary of Transportation. Mr. McCarville previously served as a consultant to the governments of Brazil, Uruguay, and Mexico on matters of port organization, operational efficiency, and privatization.

- James W. McClellan is Senior Vice President for Strategic Planning at the Norfolk Southern Corporation in Norfolk, Va., where he previously held positions in corporate planning and development. Prior to joining Norfolk Southern, he served in various marketing and planning positions with the New York Central Railroad, DOT's Federal Railroad Administration, and the Association of American Railroads.

- Michael D. Meyer is a Professor in the School of Civil and Environmental Engineering at the Georgia Institute of Technology and was the Chair of the school from 1995 to 2000. He previously served as Director of Transportation Planning for the state of Massachusetts. Dr. Meyer's expertise includes transportation planning, public works economics and finance, public policy analysis, and environmental impact assessments. He has written over 120 technical articles and has authored or co-authored numerous texts on transportation planning and policy.

- William W. Millar is President of the American Public Transportation Association (APTA). Prior to joining APTA, he was executive director of the Port Authority of Allegheny County in Pittsburgh, Pa. Mr. Millar is a nationally recognized leader in public transit and has served on or as Chair of the executive committees of TRB, the Transit Development Corporation, APTA, and the Pennsylvania Association of Municipal Transportation Authorities.

- Alan E. Pisarski is an independent transportation consultant in Falls Church, Va., providing services to public and private sector clients in the United States and abroad in the areas of transport policy, travel behavior, and data analysis and development. He has served as an advisor to numerous transportation and statistics agencies and transportation trade associations. He has also conducted surface transportation reviews for AASHTO and FHWA.

- Craig E. Philip is President and Chief Executive Officer of the Ingram Barge Company in Nashville, Tenn. He has served in various professional and senior management capacities in the maritime, rail, and intermodal industries and has held adjunct faculty positions at Princeton University and Vanderbilt University. Dr. Philip serves on the Executive Committee of the American Waterways Operators Association, the Marine Transportation System National Advisory Council, and the National Academy of Sciences' Marine Board, and he is immediate past Chairman of the National Waterways Conference.

- Arlee T. Reno is a consultant with Cambridge Systematics in Washington, D.C. Mr. Reno has expertise in performance-based planning and measurement, multimodal investment analysis, urban transportation costs, alternative tax sources, and revenue forecasting for highway agencies. He has conducted reviews for the FHWA, AASHTO, and numerous state transportation agencies.

- Joseph M. Sussman is the JR East Professor in the Department of Civil and Environmental Engineering and the Engineering Systems Division at the Massachusetts Institute of Technology. Dr. Sussman is the author of *Introduction to Transportation Systems* (2000) and specializes in transportation systems and institutions, regional strategic transportation planning, intercity freight and passenger rail, intelligent transportation systems, simulation and risk assessment methods, and complex systems and he has authored numerous publications in those areas. He has served as Chair of TRB committees and as the Chairman of its Executive Committee in 1994, and he serves on the Board of Directors of ITS America and ITS Massachusetts.

- Louis S. Thompson is a Railways Advisor for the World Bank where he consults on all of the Bank's railway lending activities. Prior to joining the Bank, Mr. Thompson held a number of senior positions in DOT's Federal Railroad Administration, including Acting Associate Administrator for Policy, Associate Administrator for Passenger and Freight Services, Associate Administrator for Intercity Services, and Director of the Northeast Corridor Improvement Project. He has also served as an economics and engineering consultant.

- Martin Wachs is the Director of the Institute of Transportation Studies at the University of California, Berkeley and he holds faculty appointments in the departments of City and Regional Planning and Civil and Environmental Engineering at the university. Dr. Wachs has published extensively in the areas of transportation planning and policy, especially as related to elderly populations, fare and subsidy policies, crime in public transit, ethics, and forecasting. He currently serves as Chairman of the TRB and has served on various transportation committees for the state of California.

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