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Testimony

Statement of
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Current and Future Investment in Infrastructure

before the
Committee on the Budget and the
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Chairman Spratt, Chairman Oberstar, Representative Ryan, Representative Mica, and Members of the Committees, thank you for inviting me to testify today on the challenges the nation faces in maintaining and upgrading its infrastructure. Growing congestion on the nation's transportation networks, high-profile events such as the tragic collapse of the I-35 bridge in Minneapolis last year, and concerns that the nation is underinvesting in its physical infrastructure raise important policy questions for the Congress.

"Infrastructure" is notoriously difficult to define because it can encompass such a wide array of physical assets. Today's testimony adopts a relatively broad definition; in this testimony, infrastructure includes transportation, utilities, and some other public facilities. Our nation currently invests more than $400 billion per year in infrastructure defined this way, and about $60 billion of that amount—primarily for highways and other transportation networks—is financed by the federal government each year.

The Congress would face several challenges if it sought to enhance the quality of the nation's infrastructure—among them determining what kinds of projects the nation requires; how those projects should be funded and by whom; and how to provide an environment that fosters private development, where that is an appropriate approach.

My testimony draws on past work done by the Congressional Budget Office (CBO) and others, and it sets the stage for more detailed analysis to identify economically justifiable infrastructure spending and appropriate funding mechanisms. The testimony makes the following key points:

- Estimates from the Federal Highway Administration (FHWA) and other sources indicate that additional spending of up to tens of billions of dollars each year on transportation infrastructure projects could be justified. Some of that spending would simply maintain the current performance of existing infrastructure; other projects would improve performance to the extent that the economic benefits exceeded the costs (although some projects would have net benefits that were smaller than those that could be obtained from spending on items besides infrastructure).

- In general, additional government spending for nontransportation infrastructure appears more difficult to justify. In some instances, the interaction of private producers and consumers in the marketplace determines an appropriate level of spending on infrastructure. In other instances, the case for a government role might be strong, but the case for specific additional spending either is not well documented or is difficult to justify from an economic perspective.

- Although the rationale for some additional spending is probably strong, the economic returns on specific projects vary widely. The evidence suggests that a relatively large share of net benefits would come from a relatively small share of projects. Accordingly, even if the Congress were to increase spending, it would be important to identify which projects provided the largest potential benefit from limited budgetary resources.

- Some of the demand for additional spending on infrastructure could be met by providing incentives to use existing infrastructure more efficiently and by devoting current budgetary resources to their highest valued uses. For example, the Department of Transportation has reported that the demand for new spending on highways could be reduced by as much as $20 billion annually if congestion pricing were implemented to encourage efficient use of existing infrastructure.

- The question of whether projects are economically justifiable is distinct from determining who should pay for them. There is a strong economic rationale for charging beneficiaries for the costs of infrastructure. For example, it can be more efficient to impose taxes and fees on identifiable groups of users, such as drivers, than to rely on general revenues to fund an infrastructure project. Similarly, for projects whose benefits are mostly local or regional, state or local funding can be more efficient than federal funding.

- A special-purpose entity, such as a federally chartered infrastructure bank, could provide funding for infrastructure outside of the annual appropriation process but would not be a source of "free money": Any reduction in the federal shares of project costs (obtained by reducing grant sizes or by shifting from grants to loans or loan guarantees with smaller subsidy costs) would require greater shares to be borne by project users, state or local taxpayers, or both.

Current Spending on Infrastructure

Under any definition, "infrastructure investment" encompasses spending on a variety of projects. For present purposes, it is useful to distinguish transportation, which receives the bulk of federal support, from other types of infrastructure, such as utilities. Both types of assets promote other economic activities: An adequate road, for example, facilitates the transport of goods from one place to another and thereby promotes economic activity; utilities that provide such services as electricity, telecommunications, and waste disposal are also essential to modern economies. (Appendix A describes spending on research and development and on education. Those categories form the basis for supporting intellectual and human capital, respectively, and can provide benefits that are similar to those generated by infrastructure spending.)

The most recent comprehensive data, for 2004, indicate that total capital spending from all sources on transportation, utilities, and selected other public facilities—specifically, prisons, schools, and facilities related to water and other natural resources, such as dams—was more than $400 billion in 2004 (see Table 1).[1] The federal government financed about $60 billion (including federal grants to state and local governments), or roughly 15 percent of the total.[2] State and local governments (net of the federal grants) funded 42 percent of the investment, and the private sector provided the balance. Those funding shares have changed over time and vary greatly from one infrastructure category to another.

Federal spending on infrastructure is dominated by transportation, which accounted for nearly three-quarters of the roughly $60 billion total federal investment in infrastructure in 2004. Highways alone accounted for nearly half of the total. Spending by state and local governments that year was primarily for schools, highways, and water systems. Together, those categories accounted for about $135 billion in state and local government spending, which is about 80 percent of the $170 billion spent on infrastructure by state and local governments.

In contrast, private-sector investment in infrastructure is dominated by spending on energy and telecommunications, which in 2004 represented nearly 80 percent of the sector's total infrastructure spending of about $175 billion. Private entities provide most of the nation's electricity and telecommunications services (typically, under federal or state regulation) and account for nearly all capital spending on those utilities.

To examine trends in infrastructure spending, CBO has compiled data on public spending on transportation, water resources, and drinking water and wastewater systems, which together account for the majority of the federal investment in infrastructure. From 1956 to 2004, public spending on infrastructure capital grew by 1.7 percent annually (after adjustment for inflation; see Figure 1, top panel). Since 1987, real annual spending has grown more rapidly, rising by 2.1 percent a year. As a share of gross domestic product (GDP), however, public spending on capital infrastructure has been relatively constant for the past several decades (see Figure 1, bottom panel).

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1. The data in Table 1 include capital spending on infrastructure but exclude spending to maintain that infrastructure. The distinction can be somewhat arbitrary—some forms of maintenance extend the useful life of an asset and thus can have long-term benefits in much the same way new infrastructure can—and can vary from category to category. That variation affects the comparability of the rows in the table.

2. The federal government also funds investments in infrastructure through "tax expenditures," which represent the cost of tax receipts that are forgone because of the exclusion of interest on tax-exempt municipal bonds from personal and corporate gross income and certain other tax preferences. In 2006, tax expenditures for transportation, water resources, and water supply and wastewater treatment systems totaled about $8 billion.

Table 1.

Capital Spending on Infrastructure in 2004, by Category

(Billions of 2004 dollars)

	Public		Total		
	Federal	State and Local	Public	Private	Total
			Transportation Infrastructure		
Highways	30.2 [a]	36.5 [a]	66.7	n.a.	66.7
Mass Transit[b]	7.6 [a]	8.0 [a]	15.5	0 [c]	15.5
Freight Railroads	0 [a]	0 [a]	0	6.4 [c]	6.4
Passenger Railroads	0.7 [d]	0 [a]	0.7	0 [c]	0.7
Aviation	5.6 [a]	6.8 [a]	12.4	2.0 [c]	14.4
Water Transportation[e]	0.7 [a]	1.7 [a]	2.4	0.1 [c]	2.5
Total Transportation	44.7	53.0	97.7	8.5 [c]	106.2
			Other Infrastructure		
Drinking Water and Wastewater	2.6 [a]	25.4 [a]	28.0	n.a.	28.0
Energy[f]	1.7 [g]	7.7 [h]	9.4	69.0 [i,j]	78.4
Telecommunications[k]	3.9 [l]	n.a. [h]	3.9	68.6 [i]	72.5
Pollution Control and Waste Disposal[m]	0.8 [i]	1.8 [j]	2.6	3.6 [k]	6.2
Postal Facilities	0.9 [g]	0 [j]	0.9	0	0.9
Prisons	0.3 [g]	2.6 [j]	2.9	n.a.	2.9
Schools[n]	0.4 [g]	75.5 [j]	75.9	23.8 [k]	99.7
Water and Other Natural Resources[o]	7.1 [a]	4.3 [j]	11.3	n.a.	11.3
Total Utilities and Other	17.6	117.2	134.9	165.0	299.9
Total	**62.4**	**170.2**	**232.6**	**173.5**	**406.1**

Continued

Highways and roads have been the largest category of federal capital spending for decades (see Figure 2). In 2007, the federal government spent approximately $32 billion (in 2006 dollars) on highways and roads, $8.5 billion on mass transit, $5.8 billion on aviation, and $3.5 billion on water resources. Over time, the relative shares have fluctuated. The growth in highway spending in the late 1950s was associated with the development of the Interstate Highway System. Spending on water systems increased sharply in the 1970s, after passage of the Clean Water Act; more recently, the combined share of aviation, mass transit, and rail has increased significantly.

Potential for Additional Investment in Infrastructure

Growing delays in air travel and surface transportation, bottlenecks in transmitting electricity, and inadequate school facilities all suggest that some targeted additional infrastructure spending could be economically justifiable. CBO's review of

Table 1. **Continued**

Capital Spending on Infrastructure in 2004, by Category

Source: Congressional Budget Office.

Note: n.a. = not available.

a. See Congressional Budget Office, *Trends in Public Spending on Transportation and Water Infrastructure, 1956 to 2004* (August 2007), Supplemental Tables.

b. Includes subways, bus transportation, and commuter rail.

c. Department of Commerce, Bureau of Economic Analysis, National Economic Accounts, Fixed Asset Tables, Table 3.7ES, Historical-Cost Investment in Private Fixed Assets by Industry, www.bea.gov/national/FA2004/TableView.asp?SelectedTable=53&FirstYear=2001&LastYear=2006&Freq=Year. Private spending for transportation equipment is primarily for vehicles, which can be used anywhere in the system and therefore is not considered part of infrastructure spending.

d. See *Amtrak Strategic Plan, FY 2004–2008* (April 25, 2003), p. 7, www.amtrak.com/pdf/strategic.pdf. Data represent infrastructure and fleet/facilities.

e. Includes inland waterways, harbors, and port facilities.

f. Includes electricity generation, transmission, and distribution; natural gas transmission and distribution; and oil pipelines.

g. CBO analysis of data reported in *Budget of the United States Government, Fiscal Year 2006: Analytical Perspectives,* 2006, Table 6.2.

h. Census Bureau, *Annual Survey of State and Local Government Finances and Census of Governments, 2006, 2007,* www.census.gov/govs/www/estimate.html.

i. Department of Commerce, Bureau of Economic Analysis, National Economic Account, Fixed Asset Tables, Table 3.7ES (includes equipment).

j. Includes a small amount of private spending on drinking water and wastewater treatment systems.

k. Includes wired and wireless telecommunications, Internet service providers, fiber-optic networks, and broadcasting.

l. CBO analysis of data provided by Universal Service Administrative Company.

m. Includes disposal of hazardous waste and solid waste.

n. Includes primary, secondary, higher, vocational, and special education.

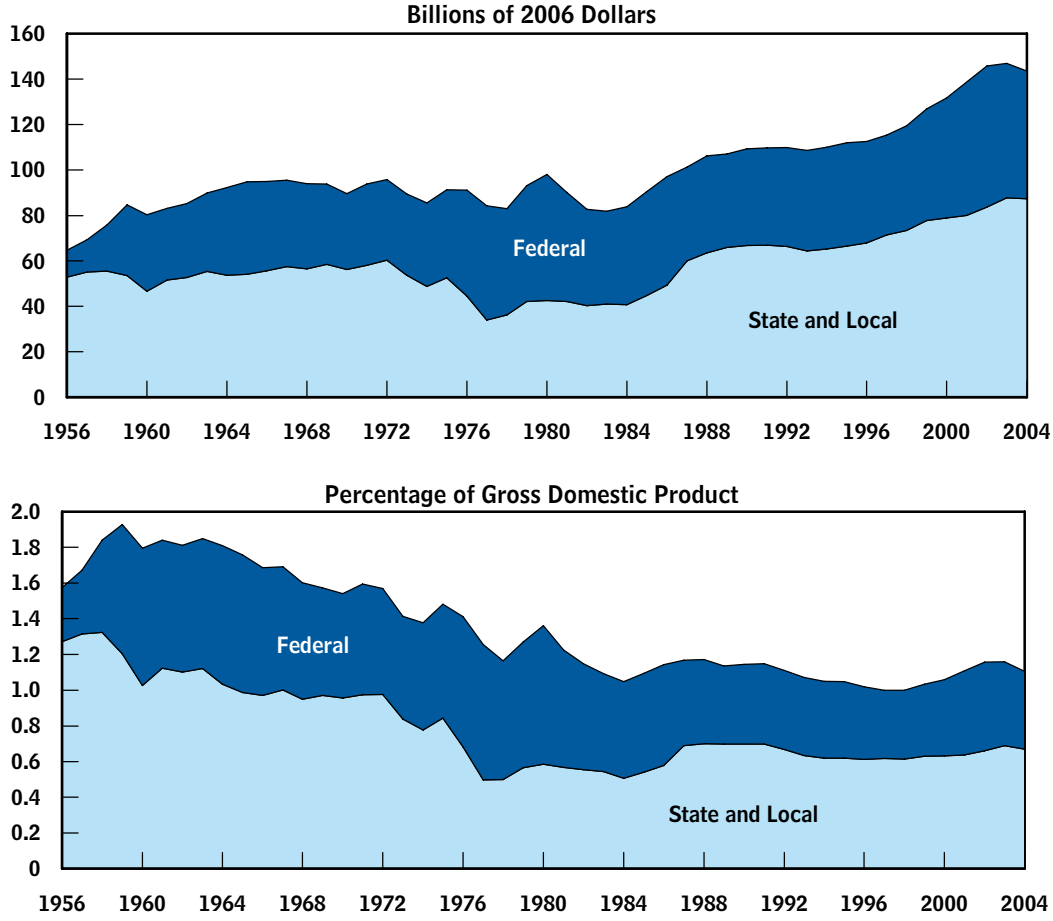
o. Includes conservation, dams, and flood control.

the evidence suggests that tens of billions of dollars of additional infrastructure spending each year could be justified on an economic basis. The need for such spending, however, could be substantially reduced by user fees that encourage more efficient use of infrastructure.

Estimates of requirements for additional infrastructure are available from a variety of sources that often define "need" differently. Some analyses seek to quantify the spending required to maintain the current performance of an asset or to provide improvement that is considered desirable according to certain engineering or public health standards (such as standards for the smoothness of pavement or allowable concentrations of a contaminant in drinking water). Other analyses attempt,

Figure 1.

Public Capital Spending on Transportation and Water Infrastructure, 1956 to 2004



Source: Congressional Budget Office.

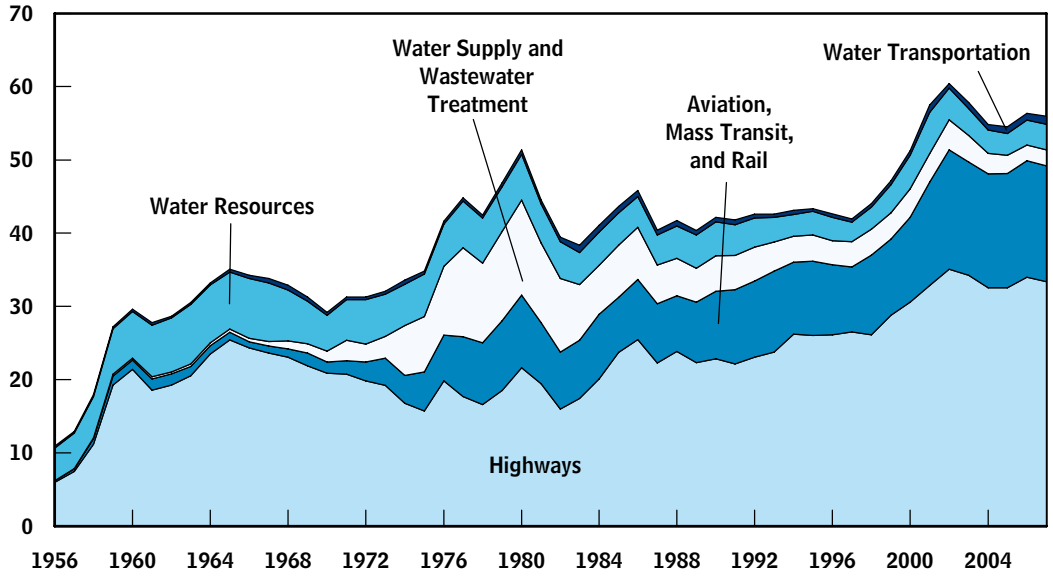
Note: Includes spending on highways, mass transit, rail, aviation, water transportation, water resources, and water supply and wastewater treatment systems.

through evaluation of private and social benefits and opportunity costs, to estimate the maximum investment that could be justified on economic grounds. The discussion below provides more detail for transportation than for other types of infrastructure because federal investment is concentrated in transportation and because more information is available on those estimates. However, the general issues raised about the transportation estimates apply to utilities and other types of infrastructure as well.

Figure 2.

Federal Capital Spending on Transportation and Water Infrastructure, 1956 to 2007

(Billions of 2006 dollars)



Source: Congressional Budget Office.

Transportation

Although capital spending on transportation infrastructure already exceeds $100 billion annually, studies from the FHWA, the Federal Aviation Administration (FAA), and elsewhere suggest that it would cost roughly $20 billion more per year to keep transportation services at current levels. Those studies also suggest that substantially more than $20 billion in additional capital spending on transportation would be justified on economic grounds if well targeted (because such spending would generate benefits whose value would exceed its cost).

Table 2 provides data on current public and private spending (reproducing the totals from Table 1) and estimates from various sources of the annual spending that would maintain each category of infrastructure at its current service level, given expected growth in demand (see the column "Spending to Maintain Current Levels of Service"). The table also provides estimates of the maximum annual investment that might be justified on economic grounds—investments whose

Table 2.

Annual Spending on U.S. Transportation Infrastructure

(Billions of 2004 dollars)

	Current Spending (Total Column, Table 1)	Spending to Maintain Current Levels of Service[a]	Economically Justifiable Investment[b]	Other
Highways[c]	66.7	78.8 [d]	131.7 [d]	*
Mass Transit[c,e]	15.5	15.8 [d]	21.8 [d]	*
Freight Railroads[c]	6.4 [f]	10.7 [g]	12.3 [g]	*
Passenger Railroads[c]	0.7	0.5 [h]	n.a.	2.1 [i]
Aviation[c]	14.4	17.9 [j]	18.9 [j]	*
Water Transportation[c,k]	2.5	2.7 [l]	n.a.	7.9 [m]
Total Transportation	**106.2**	**126.5**	**184.8**	

Source: Congressional Budget Office.

Notes: n.a. = not available; * = not applicable.

a. Given expected growth in demand.

b. Based on estimates from other sources of investments for which private and social benefits at least equal economic costs.

c. Excludes private investment in transportation equipment (primarily vehicles).

d. Department of Transportation, Federal Highway Administration (FHWA), *2006 Status of the Nation's Highways, Bridges, and Transit: Conditions and Performance* (updated March 15, 2007), Chapter 7, www.fhwa.dot.gov/policy/2006cpr/. The study contains specific estimates of the "cost to maintain" and "cost to improve" based on models of highway and mass transit infrastructure. FHWA derived the "cost to improve" estimates through analyses that compared total costs of various types of projects with their discounted future public and private benefits. Other recent studies (such as that by the National Surface Transportation Policy and Revenue Study Commission, *Transportation for Tomorrow* [December 2007], www.transportationfor tomorrow.org/final_report/) contain larger estimates for investments. However, those estimates assume substantial service improvements or include investments that may not pass a benefit–cost test.

e. Includes subways, bus transportation, and commuter rail.

f. A substantial amount of current capital spending is being used to increase railroad capacity. See "New Era Dawns for Rail Building," *Wall Street Journal,* February 13, 2008, p. A1.

g. *Transportation for Tomorrow,* Exhibit 4-16, provides estimates of additional freight rail investment required to accommodate expected traffic growth and to improve service. The estimate of "investment to maintain" reflects widespread improvements in infrastructure performance that are thought to be needed to maintain rail's share of the freight market.

Continued

h. Statement of Mark R. Dayton, Senior Economist, Department of Transportation, Office of Inspector General, before the Subcommittee on Transportation, Treasury, the Judiciary, Housing and Urban Development, and Related Agencies, Committee on Appropriations, U.S. Senate, *Intercity Passenger Rail and Amtrak* (March 16, 2006), p. 2. The *Amtrak Strategic Plan, FY 2004–2008* (April 25, 2003), p. 7, www.amtrak.com/pdf/strategic.pdf, presents a slightly higher average of $669 million (in 2007 dollars) per year over five years for infrastructure and fleet/facilities.

i. Estimate by David Gunn, then-president of Amtrak, quoted in "Gunn: Amtrak Needs Up to $2 Billion Yearly to Repair Tracks and Bridges," *AASHTO Journal,* vol. 103, no. 4 (January 23, 2003), p. 5. Gunn was speaking of capital requirements for all Amtrak service at that time. Other sources, such as *Transportation for Tomorrow,* Exhibit 4-17, report a much higher estimate, $7.4 billion (in 2007 dollars), for a substantial expansion of intercity passenger service. Concerns about the long-term economic viability of Amtrak service outside the Northeast corridor, and the economic viability of a substantial expansion of intercity passenger service, prevent CBO from concluding that such investments would be economically justifiable. See Congressional Budget Office, *The Past and Future of U.S. Passenger Rail Service* (September 2003).

j. Federal capital spending on airports: Federal Aviation Administration, *National Plan of Integrated Airport Systems (NPIAS), 2007–2011* (2006), p. v, www.faa.gov/airports_airtraffic/airports/planning_capacity/npias/reports/media/2007/npias_2007_narrative.pdf. State and local capital spending on airports, net of Airport Improvement Program grants: CBO analysis of data from the Census Bureau, *Annual Survey of State and Local Government Finances and Census of Governments, 2006, 2007,* www.census.gov/govs/www/estimate.html. Air traffic control: Federal Aviation Administration, *Capital Investment Plan for Fiscal Years 2009–2013* (2008), Appendix C, p. 4, www.faa.gov/about/office_org/headquarters_offices/ato/service_units/operations/sysengsaf/cip/. "Air traffic control" includes $4.082 billion for the Next Generation Air Traffic System (NGATS) over five years.

   Other estimates of NGATS are $1 billion or more per year higher. See statement of David A. Dobbs, Assistant Inspector General for Aviation and Special Program Audits, Department of Transportation, *Perspectives on the Progress and Actions Needed to Address the Next Generation Air Transportation System,* before the Subcommittee on Aviation, Committee on Commerce, Science and Transportation, U.S. Senate (July 25, 2006), p. 11. Private investment to implement NGATS is estimated to be roughly equal to public investment. See Federal Aviation Administration, Joint Planning and Development Office, *Business Case for the Next Generation Air Transportation System* (August 24, 2007), p. 15, www.jpdo.gov/library.asp.

k. Includes inland waterways, harbors, and port facilities.

l. Inland waterways and harbors: Department of the Army, Office of the Assistant Secretary of the Army (Civil Works), *Civil Works Budget for the U.S. Army Corps of Engineers, Fiscal Year 2009* (February 2008), pp. 3 and 4. Port facilities: Department of Transportation, U.S. Maritime Administration, *U.S. Public Port Development Expenditure Report* (July 2007), Table 7, www.marad.dot.gov/Publications/ports.htm.

m. Inland waterways and harbors: Department of the Army, Army Corps of Engineers, "Database of Internal Analysis of Approved and Ongoing Construction for Inland Waterways and Harbors." Port facilities: *U.S. Public Port Development Expenditure Report,* Table 7. Concerns about the quality of the Corps' benefit–cost analyses prevent CBO from accepting its estimate as economically justifiable. (See General Accounting Office, *U.S. Infrastructure: Agencies' Approaches to Developing Investment Estimates Vary,* GAO-01-835 [July 2001], p. 36.)

private and social benefits would be at least equal to their economic costs (see the column "Economically Justifiable Investment").[3]

Highways constitute by far the largest category of current spending on transportation infrastructure, and they dominate the estimates of investment required to maintain current performance. FHWA estimates that, without a significant change in the way highways are paid for, it would cost $79 billion per year to maintain performance—$12 billion more than total current spending. The next largest category is aviation, which has seen burgeoning demand for air travel and a commensurate growth in congestion. According to estimates from the FAA and other sources, annual investment of $18 billion, about $4 billion above current annual spending for airports and air traffic control, would be necessary to maintain performance under current pricing policies. Freight railroads also would require annual investment of about $4 billion more than is currently spent. (Some current spending on freight rail is for projects that will expand service by boosting capacity on major routes.[4])

For mass transit and water transportation, the best estimate of investment to maintain current services is only slightly above the current amount; and for passenger rail, it is below current spending. The latter fact could be the result of differences among sources in the definitions of capital spending and maintenance, or it could indicate that some efforts to maintain performance are simply inefficient—that is, they cost more than is necessary. The figures for freight and passenger rail illustrate an important general point: Not all current investment is effective in maintaining, or even is intended to maintain, the performance of the existing infrastructure. Likewise, future increases in investment might or might not be targeted to that purpose.

Similar distinctions apply to the estimates of spending that might be justified on economic grounds. In most instances, those estimates are for amounts well above

3. Because the estimates in Table 2 were derived from a variety of sources using different methodologies and periods, it is difficult to compare modes. The table does not present estimates of economically justifiable investments for passenger rail or water transportation. David Gunn, then-president of Amtrak, was quoted providing an estimate for passenger rail in "Gunn: Amtrak Needs Up to $2 Billion Yearly to Repair Tracks and Bridges," *AASHTO Journal*, American Association of State Highway and Transportation Officials, vol. 103, no. 4 (January 24, 2003), p. 5; the National Surface Transportation Policy and Revenue Study Commission, *Transportation for Tomorrow* (December 2007), www.transportationfortomorrow.org/final_report, also presented figures. The Army Corps of Engineers and the Maritime Administration have developed estimates for water transportation. However, concerns about the quality of the analyses prevent CBO from placing confidence in the estimates. See the notes to Table 2 and Congressional Budget Office, *The Past and Future of U.S. Passenger Rail Service* (September 2003) and General Accounting Office, *U.S. Infrastructure: Agencies' Approaches to Developing Investment Estimates Vary*, GAO-01-835 (July 2001), p. 36.

4. See Daniel Machalaba, "New Era Dawns for Rail Building," *Wall Street Journal*, February 13, 2008, p. A1.

current spending or the estimate of investment required to maintain current services. The estimates, however, are approximations because they are based on analyses of broad samples of generic projects and not detailed analyses of individual projects. Moreover, the estimates do not justify increases of those amounts in infrastructure spending unless such spending is carefully targeted to economically efficient projects. Otherwise, the spending would not generate the same benefits as the estimates suggest—and indeed it could produce costs that exceed the benefits.

A related point is that, even within a group of economically justifiable projects, the benefits from some would greatly exceed their costs while the benefits from others would just barely do so (and might not exceed the benefits available from other types of federal or private spending). Carefully ranking and funding projects to implement those with the highest net benefits would yield a disproportionate share of the total possible benefits at a fraction of the total spending that is potentially economically justifiable. For example, according to a detailed analysis that the FHWA provided to CBO, over the next five years, investments required to maintain current levels of highway service would represent 58 percent of the total spending for all economically justifiable investments for highways, but they would provide 83 percent of the net benefits.

Table 2 on page 8 provides information about the potential for additional spending, but it provides no information about who should pay. The "benefits principle" suggests that federal taxpayers are often the least efficient source of financial support for an infrastructure investment—after the direct beneficiaries of the investment and local or state taxpayers. From the standpoint of economic efficiency, the ideal is to charge users of infrastructure according to the marginal costs of their use. For example, people who use water can be charged for the costs of acquiring, storing, treating, and distributing the water they consume.

One characteristic of many infrastructure services, however, is that some costs are not associated with anyone's marginal use. For example, to the extent that water pipes deteriorate with time, independent of the volume of water flowing through them, investments in pipes cannot be financed solely through marginal-cost pricing. Telecommunications networks provide a similar example: Until a network begins to experience congestion effects, the marginal cost of another phone call is essentially zero. In such cases, the most efficient solution might be a two-part tariff, which includes an access charge (for example, a monthly fee) as well as use charges. Although two-part tariffs pose the risk of discouraging some uses that would be cost-efficient, they demonstrate the willingness of users to pay for the services that are made possible by an infrastructure investment, and thus they provide an indication of that investment's efficiency. (Indeed, the term "infrastructure demand" should arguably be reserved for desires that are supported by beneficiaries' willingness to pay.)

Although it is generally desirable from an economic efficiency perspective, charging the beneficiaries of infrastructure investments is not always feasible,

even when the benefits of such investments would exceed their costs. In some cases, the key problems are technical, such as the limitations of 20th-century methods for collecting highway tolls. In other cases, the difficulty arises because the benefits are widely distributed and preventing nonpayers from receiving the benefits is difficult or impossible, as in the case of a dam that provides flood control services. In those instances, taxpayer funding can be the most efficient solution, if the projects to be funded are chosen on the basis of benefit–cost analyses.

Even under taxpayer funding, a version of the benefits principle still applies: The more closely the group being taxed matches the set of beneficiaries, the more efficient the investment decisions are likely to be. In particular, if the benefits of a project are concentrated locally or regionally, state or local governments spending their own money are likely to be in a better position to make efficient choices, weighing benefits against costs, than the federal government would be. For example, partial taxpayer support for a mass transit system could be economically efficient, to the extent that the system benefits nonriders by reducing congestion on area roads. However, decisions about the amount to invest might be less efficient if the taxes being collected come from areas that extend beyond the region served by the system.

Conversely, the case for support from federal taxpayers is strongest for investments with benefits that accrue to broad geographic areas or to the nation as a whole and are not restricted to a class of users that can be charged more directly. Infrastructure with such widespread benefits arguably includes the Interstate Highway System and wastewater treatment plants for communities whose water eventually flows into a major resource such as the Chesapeake Bay or the Gulf of Mexico. Even when federal support for a given type of infrastructure is justified in principle, implementation problems might make it undesirable in practice. If the federal government decides to channel additional infrastructure funds through state governments, some of those funds ultimately might not finance additional infrastructure; instead, federal funding might merely substitute for state and local government funding, with little or no effect on the total. The Government Accountability Office (GAO) has confirmed earlier analyses showing that federal grants to state and local governments do not always serve their intended purposes. In its analysis of increases in federal highway grants between 1982 and 2002, GAO reported that states offset roughly half of the increases by reducing their own funding, and that "the rate of substitution increased during the 1990s."[5]

A final and crucial point regarding Table 2 on page 8: The estimates generally assume that the economic and policy environment remains unchanged. In

5. See Government Accountability Office, *Federal-Aid Highways: Trends, Effects on State Spending, and Options for Future Program Design*, GAO-04-802 (August 2004), summary page. Another factor that undermines the efficiency case for federal funding is the formulaic approach commonly used to divide federal resources among the states, which can be an obstacle to funding for the projects with the best benefit–cost ratios.

particular, the estimate for highways assumes no expansion in the use of congestion pricing—that is, tolls that are higher during peak times and lower during off-peak times.[6] However, the FHWA estimates that widespread implementation of congestion pricing would reduce the investment needed to maintain the highway system by more than one-fourth, or about $20 billion annually. Thus, the estimate of the investment to maintain current services would decline from nearly $80 billion to slightly less than $60 billion per year, which is less than the current spending of $66.7 billion.[7] Similarly, congestion pricing would reduce the amount of highway investment that would be economically justifiable by almost 16 percent, to roughly $110 billion per year.

Utilities and Other Types of Infrastructure

Most energy and telecommunications systems are privately owned and operated, and their funding comes from sales to consumers. Current capital spending on energy-related infrastructure exceeds $75 billion annually—about 90 percent of it in private investment. Estimates prepared for the Edison Electric Institute indicate that electric utilities would need to invest an annual average of $28 billion for generation, $12 billion for transmission, and $34 billion for distribution of electricity to maintain current levels of service, given expected growth in demand.[8] To justify such investment to shareholders and regulatory authorities, businesses typically conduct thorough financial analyses before undertaking large investments. Comparable figures for electricity generation, oil pipelines, and natural gas distribution are not readily available. The Department of Energy's Energy Information Administration arrived at an estimate of $2.6 billion per year for economically justifiable investment in the natural gas transmission network.[9]

Systems for wastewater and drinking water are dominated by the public sector. The nation spends about $26 billion per year on those systems, and CBO has previously estimated that investment from 2000 to 2019 would need to average between $29.7 billion and $47.2 billion annually (converted to 2004 dollars) to maintain current service standards and allow some modest improvements to meet

6. Other policy changes, such as the implementation of a carbon tax or a cap-and-trade system for carbon dioxide emissions, also could affect the amount of spending that could be justified on economic grounds.

7. See Federal Highway Administration, *2006 Status of the Nation's Highways, Bridges, and Transit: Conditions and Performance* (updated March 15, 2007), p. 10-6.

8. See Brattle Group, "Transforming America's Power Industry: The Investment Challenge—Preliminary Findings" (presented at the Edison Foundation Conference, "Keeping the Lights On—Our National Challenge," New York, April 21, 2008).

9. See Department of Energy, Energy Information Administration, *Natural Gas 1998: Issues and Trends*, p. 126. (The estimate given here was converted to 2004 dollars by CBO to be consistent with Table 2.) A more recent but less well documented estimate appears in J. Alex Tarquinio, "There's a Light at the End of the Energy Pipelines," *New York Times*, February 26, 2006.

current or future regulations imposed by the Environmental Protection Agency (a somewhat different standard than that presented in Table 2 on page 8).[10]

The available estimates for investment in other categories of infrastructure included in Table 1 on page 4—pollution control and waste disposal facilities, postal facilities, prisons, schools, and water and other natural resources—are limited. Two estimates are available for schools: Survey data from the National Center for Education Statistics indicate that a one-time investment of $142 billion beyond current amounts would be necessary to bring school facilities into a good state of repair; the National Education Association has estimated that a one-time investment of $360 billion beyond current spending would be necessary to "modernize" schools (both figures are in 2004 dollars).[11] However, neither estimate makes any allowance for the opportunity cost of the capital invested or specifies the period over which the investment would be made.

The Association of State Dam Safety Officials has estimated that maintaining non-federal dams in their current condition would cost $0.8 billion per year and that $3.2 billion (in 2004) in annual spending is economically justifiable.[12] CBO has no information on the methods by which those estimates were produced. Other available estimates for public facilities include the Environmental Protection Agency's $8.3 billion per year for cleaning up waste sites and the Postal Service's $2.9 billion for capital spending from 2007 to 2016.[13]

Conversely, for one category of public facility not covered in Table 1—federal buildings—the government could reduce total investment and operating costs by changing the way it acquires, manages, and disposes of property. Agencies could construct more federal facilities rather than enter into more costly long-term leases of private facilities; better manage unused, underused, and inefficient buildings; and maximize proceeds from the disposal of federal property (see Box 1).

10. See Congressional Budget Office, *Future Investment in Drinking Water and Wastewater Infrastructure* (November 2002).

11. See Department of Education, National Center for Education Statistics, *Condition of America's Public School Facilities: 1999*, NCES 2000-32 (June 2000), p. iv; and National Education Association, *Modernizing Our Schools: What Will It Cost?* (April 2000), p. 1.

12. See Association of State Dam Safety Officials, *The Cost of Rehabilitating Our Nation's Dams, 2002*, as cited in American Society of Civil Engineers, *Report Card for America's Infrastructure, 2005*, www.asce.org/reportcard/2005/index2005.cfm.

13. For the former, see Environmental Protection Agency, Office of Solid Waste and Emergency Response, *Cleaning Up the Nation's Waste Sites: Markets and Technology Trends, 2004 Edition*, EPA 542-R-04-015 (September 2004), pp. viii; the latter is based on data the Postal Service provided to CBO.

Economic Returns on Public Spending for Infrastructure

Another approach that sheds light on the appropriateness of additional spending on infrastructure reaches broadly similar conclusions. In particular, spending on infrastructure benefits the economy by reducing the cost of private business transactions; over the past 20 years, economists have attempted to measure those benefits and have obtained a wide range of estimates. The literature supports two conclusions: First, public spending on infrastructure often produces positive economic returns, and second, there is significant variation—both in the average returns and in the range of returns among projects—that depends on several factors. Second, the research suggests that the returns on the initial phase of a system of public investments, such as the creation of the Interstate Highway System, can be large but that the economic payoff declines as the system grows.

Federal spending on infrastructure increases the stock of publicly owned capital and, in that sense, represents an investment in the future productivity of the private sector. The economic payoff from public spending on infrastructure depends on the usefulness of the investments themselves and the extent to which the spending "crowds out"—or reduces the funding available for—investment in private capital. The early research on infrastructure spending identified substantial returns on that investment. One prominent study from the late 1980s concluded that, from 1949 to 1985, a 1 percent increase in the stock of "core infrastructure" (transportation, water supply and wastewater treatment, and electrical and natural gas facilities) was associated with a 0.24 percent increase in the level of national output.[14] Because annual national output was roughly four times the estimated value of the stock of core infrastructure, that result suggested that public capital enhanced the economy's ability to produce goods and services to the extent that $1 spent on infrastructure could generate close to $1 of output within roughly a year. An implication of such findings was that a substantial part of the productivity slump of the 1970s and 1980s was the result of a shortfall of investment in infrastructure.

Estimates of such large returns, however, have been persuasively challenged by subsequent researchers. For example, some of those estimates have been found to be overly sensitive to minor changes in the data from which they were derived (as

14. Most of the issues considered in the 1990s were raised by David Alan Aschauer, "Is Public Expenditure Productive?" *Journal of Monetary Economics,* vol. 23, no. 2 (March 1989), pp. 177–200, and discussed in a large number of papers reviewed by Alicia H. Munnell, "Policy Watch: Infrastructure Investment and Economic Growth," *Journal of Economic Perspectives,* vol. 6, no. 4 (Autumn 1992), pp. 189–198, and Edward M. Gramlich, "Infrastructure Investment: A Review Essay," *Journal of Economic Literature,* vol. 32, no. 3 (September 1994), pp. 1176–1196. See also Congressional Budget Office, *The Economic Effects of Federal Spending on Infrastructure and Other Investments* (June 1998); and Jeffrey P. Cohen and Catherine J. Morrison Paul, "Public Infrastructure Investment, Interstate Spatial Spillovers, and Manufacturing Costs," *Review of Economics and Statistics,* vol. 86, no. 2 (May 2004), pp. 551–559. There is variation in the definitions of public capital and the periods covered by those papers.

Box 1.

Management of Federal Buildings and Facilities

The General Services Administration (GSA) reports that the federal government owns about 1.2 million structures, which together have an estimated replacement value of more than $1.5 trillion. The list includes standard office buildings, hospitals, courthouses, dams, and utility systems. GSA's list also includes specialized research and industrial facilities—60 percent of which are controlled by the Department of Defense.

GSA reports that about 10 percent of all government facilities are either underused or empty and that there is no information on the market value of those facilities. GSA notes that each year federal agencies destroy thousands of unused and surplus structures because they have little or no market value and demolition can reduce operating costs. Some of the structures do not meet current building and safety codes and might also pose environmental hazards.

Federal agencies that seek to dispose of unneeded facilities must follow legislatively prescribed procedures for property disposition. In particular, before they can be sold at auction, facilities must first be screened for use by other federal, state, or local agencies or evaluated for use by organizations that serve the homeless. Transfers of federal property to nonfederal entities are called public benefit conveyances and typically are executed for $1. Many federal civilian agencies that control real property are authorized to spend any proceeds from the disposal of surplus property; in some cases they also have the option of leasing unneeded assets and either spending the rental income or, more commonly, receiving services such as building improvements or construction of new facilities. In most years, net receipts to the Treasury from the sale of surplus civilian properties are relatively small, generally less than $50 million. The Base Realignment

Continued

occurs if the time period or the sectors of the economy covered by the analysis are changed only slightly). Follow-up research has identified other weaknesses in methodology and, after attempting to correct for them, has in some cases resulted in a different conclusion about the economic returns on public spending for infrastructure. For example, the size of the stock of public capital and the level of economic output can vary together over time for reasons unrelated to a causal link between them. One study that attempted to control for that spurious correlation

Box 1. Continued

Management of Federal Buildings and Facilities

and Closure (BRAC) process—by which the Department of Defense identifies opportunities to relocate military organizations, consolidate facilities, and eliminate excess infrastructure to reduce annual costs for operating, sustaining, repairing, and modernizing defense facilities—has generated about $1 billion in receipts since 1990, but the process has not been designed to maximize receipts.[1]

To improve the management of federal facilities and maximize proceeds from the sale of surplus properties, the Congress could consider creating incentives for the quick identification and disposal of unneeded facilities. Resources also would be necessary to pay for identifying and marketing those facilities that have a value in the private sector, and laws related to public conveyances would need to be amended.

Reforms to the process that agencies follow when making property acquisition decisions also could yield long-term budget savings. According to the Government Accountability Office, in many cases it is less expensive for the government to build new facilities for its own long-term use than it is to lease property from private landlords.[2]

1. According to estimates from the Department of Defense, the up-front costs of the first four rounds of BRAC were recouped in one-time savings from canceled construction and restoration projects, and annual net savings of about $6.5 billion in operations costs are now being realized. CBO has not verified those estimates. The fifth round of BRAC, which began in 2005, is years away from producing net savings.

2. See Government Accountability Office, *Federal Real Property: Strategy Needed to Address Agencies' Long-standing Reliance on Costly Leasing*, GAO-08-197 (January 2008).

identified no positive association of public capital with economic performance.[15] Even the direction of causality is open to question: For example, it could be that states that are more productive and more prosperous choose to spend more on

15. See Charles R. Hulten and Robert M. Schwab, "Public Capital Formation and the Growth Process in Developing Countries," *National Tax Journal*, vol. 44, no. 1, part 1 (December 1991), pp. 121–134. A criticism of efforts that focus on year-to-year changes is that they can mask long-term relationships between accumulated stocks of public capital and subsequent economic performance when additions to the stock of public capital could influence economic activity for years after they occur.

infrastructure and not that spending more on infrastructure makes states more productive or prosperous. One study concludes that, once such state-specific characteristics are recognized, public capital plays no role in the differences among states' economic performance.[16]

However, recent surveys that involve the United Sates and other nations show positive returns from investment in public capital. One study from 2007 concludes that the recent literature reflects more consensus about the "growth-enhancing effect of public capital" than existed before. Similarly, a study sponsored by the Organisation for Economic Co-operation and Development reports a "positive effect of infrastructure."[17] The implications of those findings for public spending on infrastructure in the United States, though, are unclear because much of the newer research supporting those favorable assessments analyzed circumstances that might not be relevant in this country. The studies range from analyses of national and regional spending on infrastructure within various countries in Europe, South America, and Asia to investigations of economic returns on infrastructure spending in a large sample of countries at different stages of development. Moreover, some important results cited by those surveys rely on a broader concept that includes public investment in basic telecommunications, for example, and in other areas that in the United States are privately owned and funded.[18]

All together, recent research indicates that the returns on investment in public capital in the United States are positive but below earlier estimates. One 2006 study concludes that a dollar of capital or maintenance spending for highways and roads in 1996 reduced annual congestion costs to drivers by $0.11 that year.[19] Total benefits over time would be greater; whether they would be large enough to

16. See Douglas Holtz-Eakin, "Public-Sector Capital and the Productivity Puzzle," *Review of Economics and Statistics*, vol. 76, no. 1 (February 1994), pp. 12–21.

17. For a comprehensive overview of the relevant economic literature with brief descriptions of individual papers and their results, see Ward Romp and Jakob de Haan, "Public Capital and Economic Growth: A Critical Survey," *Perspektiven der Wirtschaftspolitik*, vol. 8, special issue no. 1 (April 2007), pp. 6–52. See also Vincent Ribeyrol, "Impact of Infrastructure on the Economy: Review of the Literature" (paper presented at the Organisation for Economic Co-operation and Development's conference on Global Infrastructure Needs: Prospects and Implications for Public and Private Actors, Paris, June 3, 2005).

18. See Lars-Hendrik Röller and Leonard Waverman, "Telecommunications Infrastructure and Economic Development: A Simultaneous Approach," *American Economic Review*, vol. 91, no. 4 (September 2001), pp. 909–923; and António Afonso and Miguel St. Aubyn, "Macroeconomic Rates of Return of Public and Private Investment: Crowding-In and Crowding-Out Effects," European Central Bank Working Paper 864 (Frankfurt, February 2008).

19. Congestion costs reflect both the amount of gasoline consumed and the value of the time that motorists lose to traffic delays. See Clifford M. Winston and Ashley Langer, "The Effect of Government Highway Spending on Road Users' Congestion Costs," *Journal of Urban Economics*, vol. 60, no. 3 (November 2006), pp. 463–483.

justify the costs would depend on the opportunity cost of the spending and the rate at which the highway construction or improvements deteriorate.

Consistent with such findings, other economic research points out that the payoff from investments in public infrastructure, such as highways, falls off significantly after the initial impact on economic activity. For example, according to data spanning 1953 to 1989, construction of the Interstate Highway System in the United States made vehicle-intensive industries in particular more productive; however, the capital spending that took place after completion of that system in 1973 appears not to have had an effect on differences in those industries' productivity.[20] The evidence thus suggests that the positive returns on investments in infrastructure depend on the type of infrastructure and the amount of infrastructure already in place.

Options for Meeting Demand for Infrastructure Services

Broadly speaking, the federal government can take four basic approaches—separately or together—to contribute to meeting the growing demand for services associated with the nation's infrastructure: It can increase spending, improve the cost-effectiveness of tax expenditures, reduce the cost of providing infrastructure, and promote reductions in demand for services to an economically efficient level.

Increase Federal Spending

If the Congress were to decide that there is justification for building additional infrastructure, it could choose to increase federal spending (although such increases might not translate dollar for dollar into increased total spending if state governments or other funders decided in response to redirect some of their own spending away from infrastructure). Increases in federal support for infrastructure could come from any combination of increased receipts, reduced spending elsewhere, and higher deficits. However, most such funding currently comes either from dedicated receipts or through tax expenditures.

Most of the federal government's programs for surface transportation are financed through the Highway Trust Fund (see Appendix B). About 90 percent of total revenues credited to the trust fund come from two taxes on motor fuels. The tax of 18.4 cents per gallon on gasoline and gasoline–ethanol blends currently accounts for about two-thirds of the trust fund's total revenues. The levy of 24.3 cents per

20. See John Fernald, "Roads to Prosperity? Assessing the Link Between Public Capital and Prosperity," *American Economic Review,* vol. 89, no. 3 (June 1999), pp. 619–638.

gallon on diesel fuel accounts for about one-quarter more.[21] Both tax rates have been unchanged since 1993. In 2007, receipts to the Highway Trust Fund from those taxes totaled about $38.8 billion.

The trust fund's taxes are scheduled to expire in 2011. If they are reauthorized at current levels, CBO projects that, over the coming decade, revenues credited to the trust fund will rise at an average annual rate of about 2 percent. However, they will decline as a share of GDP (which CBO expects to rise at an average annual rate of 4.4 percent during the same period), from 0.28 percent of GDP in 2007 to 0.20 percent of GDP in 2018. The main reason for that relative decline is that fuel tax collections depend on the quantity of fuel consumed rather than on the price of gasoline. Moreover, the purchasing power of fuel taxes has eroded since 1993. On the basis of a price index produced by the Bureau of Economic Analysis to analyze spending by state and local governments, CBO estimates that a current gasoline tax would need to be about 30 cents per gallon to match 1993 purchasing power.

CBO projects that, even before the current taxes expire, the trust fund's highway account will be depleted because revenues are not keeping pace with the outlays that have increased under the latest two authorization acts (see Appendix B). To avoid that result, spending must be reduced or the revenues going into the trust fund must be increased.

On the basis of information supplied by the Joint Committee on Taxation (JCT), CBO estimates that a 1 cent increase in gasoline and diesel taxes would raise about $1.8 billion per year for the trust fund over the next 10 years and that a 10 cent increase would raise about $18 billion annually.[22] The National Surface Transportation Policy and Revenue Study Commission recommended that the Congress raise fuel taxes between 25 cents and 40 cents per gallon, by 2012, to help finance infrastructure investments. Using information from JCT, CBO estimates that an increase of 25 cents per gallon would generate $44 billion per year for the trust fund; an increase of 40 cents would generate $70 billion annually.

Current law requires states to provide matching funds—generally about 20 percent of a project's costs—on most highway projects that they undertake using federal money. If that matching requirement was retained, an increase of roughly 6.5 cents per gallon in gasoline and diesel taxes would bring in enough revenue to meet

21. The Omnibus Budget Reconciliation Act of 1993 increased the gasoline tax by 4.3 cents; the added receipts initially were not deposited into the trust fund but went into the general fund of the Treasury. A share of one-tenth of a cent per gallon goes to the Leaking Underground Storage Tank Trust Fund.

22. Because excise taxes reduce the tax base of income and payroll taxes, higher excise taxes would lead to reductions in income and payroll tax revenues. The estimates cited here do not reflect those reductions. Those reductions would amount to an estimated 25 percent of the estimated increase in excise tax receipts.

FHWA's estimate of the amount necessary to maintain service at current levels.[23] A 6.5 cent increase would boost revenue by about $11.6 billion annually. Currently, 87 percent of that total, or about $10.1 billion, would be deposited into the trust fund's highway account. The remaining $1.5 billion would go to the mass transit account. (The increase in mass transit revenue could allow spending to exceed FHWA's estimated cost of maintaining performance, although not its estimate of economically justifiable investment.) Those figures assume that states would not substitute the increased federal funding for their own funds and that they would be willing and able to support the increase with the 20 percent match. Without the state match, the required increase in gasoline and diesel taxes would be about 8 cents per gallon.

Improve the Cost-Effectiveness of Tax Expenditures

The federal government could substantially increase the efficiency with which it subsidizes debt financing of state and local spending by replacing federal tax exemptions on income from municipal bonds with carefully designed tax-credit bonds.

According to JCT, tax-exempt bonds will cost the federal government an average of $31.2 billion per year between 2007 and 2011. However, the savings that state and local entities receive will be considerably less, and the difference will accrue to investors in higher-income tax brackets who receive greater tax savings through those exemptions than would be necessary for them to purchase such bonds. For 2006 and 2007, the observed yield spreads between high-grade municipal bonds and corporate bonds suggest that the marginal tax rates of the "market-clearing" municipal bond buyers—those who purchase the last units of the bond issues—averaged 21 percent.[24] That figure implies that all bonds issued in those years that are held by taxpayers whose marginal rates are above 21 percent cost the federal government more in forgone tax revenues than they save the issuers in reduced interest costs.

A relatively new debt instrument, the tax-credit bond, has gained some favor as a way to finance public expenditures. Tax-credit bonds allow bond purchasers to receive credits against federal income tax liability instead of all or some of the cash interest that is typically paid on the borrowing the bonds represent. Current-law tax-credit bonds are designed to provide investors with a credit that is the

23. Based on its analysis of the trust fund's revenues and outlays, CBO estimates that closing the gap between them in 2008 through higher fuel taxes would require an increase of about 2 cents per gallon. That amount would grow over time.

24. For more information on the tax treatment of municipal bonds and the benefit to bond issuers, see Joint Committee on Taxation, *Present Law and Background Relating to State and Local Government Bonds*, JCX-14-06 (March 14, 2006). Table 1 of that report (p. 6) shows interest rates on corporate and high-grade municipal bonds and the resulting implied tax rate of the market-clearing municipal bond buyers for 1986 through 2005. CBO used the same method and data sources to derive estimates for 2006 and 2007.

equal of 100 percent of the interest that would otherwise be paid on the bonds. With a 100 percent credit, the federal government bears virtually all of the cost of borrowing in the form of forgone revenues. That structure provides a subsidy to issuers of such bonds that is deeper than the subsidy provided to issuers of tax-exempt bonds (which is limited to the difference between tax-exempt and taxable interest rates). However, bonds with a partial tax credit could be designed to deliver a subsidy to state and local governments that is equivalent to the subsidy provided by current-law, tax-exempt bonds, or any other desired level of subsidy. For a given subsidy, the federal cost is lower for tax-credit bonds than for tax-exempt bonds because the revenues forgone by the federal government through tax-credit bonds reduce state and local borrowing costs, dollar for dollar, rather than partially accruing to investors in high marginal tax brackets.

To illustrate, assume that the inefficiency associated with current tax-exempt financing is between 10 percent and 20 percent, so that 80 percent to 90 percent of the federal tax expenditures actually translates into lower borrowing costs for states and localities. Then, if the outstanding stock of tax-exempt debt during the 2007–2011 period instead took the form of tax-credit bonds designed to deliver the same amount of federal subsidy, the federal government would save between $3 billion and $6 billion per year. (However, the savings would not be recognized in the federal budget; for budgetary purposes, the tax expenditures are not classified as federal spending.)

Reduce the Cost of Providing Infrastructure

In addition to using tax expenditures more efficiently, the federal government also could encourage efficiency by lowering the costs of supplying infrastructure services. One way to accomplish that is to encourage funding of high-value projects through more systematic use of rigorous analysis, and conversely, to minimize funding of potentially low-value projects—for example, by careful scrutiny of projects initiated by the Congress, which represent significant portions of federal investments in infrastructure. The Department of Transportation estimated that $5.7 billion, or about 15 percent of the $36.6 billion appropriated to FHWA programs in fiscal year 2006, was earmarked, as was $2.4 billion of the $8.6 billion (28 percent) in funding for Federal Transit Administration programs.[25] In some cases, earmarks might be used to improve efficiency, compensating for the rigidity of the formula that allocates funds to the states or for problems with the process or criteria for project selection by state or local governments. In other cases, policymakers earmark projects on the basis of criteria for fairness or equity, or other

25. The estimates are based GAO's definition of an earmark as a Congressional directive in legislation to a federal agency to spend a specific amount of its budget for a specific entity, project, or service. Other estimates of earmarks were $408 million for FAA programs and $56 million for all other transportation programs. See Government Accountability Office, Office of the General Counsel, *Principles of Federal Appropriations Law,* 3rd edition, vol. 2 (February 2006); and Department of Transportation, *Review of Congressional Earmarks Within Department of Transportation Programs,* AV-2007-066 (September 7, 2007).

noneconomic goals, although doing so raises the total cost of providing any given set of infrastructure services.

More generally, the federal government can encourage the use of "asset management" to maximize the benefit from existing and future infrastructure. Asset management relies on monitoring the condition of equipment and the performance of systems and analyzing the discounted costs of different investment and maintenance strategies. For existing infrastructure, the key issue is making efficient choices about maintenance and replacement. In constructing new infrastructure, asset management involves evaluating total life-cycle costs—both the initial capital costs and the subsequent costs for operation, maintenance, and disposal—to ensure not only that projects are prioritized appropriately, but also that they are built cost-effectively.[26]

The principles of asset management apply to all types of infrastructure, although specific applications differ. In the case of highways, asset management can involve making a larger initial investment in thicker pavement, which could provide a more-than-proportional increase in pavement life. It also might involve shortening the period between pavement overlays, which could reduce the fuel and maintenance costs of highway users.

The potential for managing assets efficiently in the case of wastewater and drinking water systems has increased with the advent of sophisticated analytical tools that can optimize the design of pipe networks (in some cases, identifying links that can be abandoned rather than replaced) and that can be used to evaluate the trade-offs involved in maintaining or replacing equipment. Asset management has been shown to produce significant payoffs in extending the life of equipment, eliminating redundant systems, reducing the cost of operations and maintenance by as much as 40 percent, and improving systems' reliability by roughly 70 percent.[27]

Promote Reductions in Demand

Finally, the government could reduce the demand for additional infrastructure by implementing fees and charges that raise the cost to users of existing infrastructure. One factor that can contribute to the high cost of infrastructure services is that users often are not asked to pay the full marginal cost of the services they use.

A classic case is the excessive crowding of a highway for which users pay no congestion charge. In economic terms, society would be better served by reducing demand for travel on such a highway during the hours when traffic is heaviest instead of investing to increase the road's capacity to accommodate traffic. One

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26. Another approach the federal government could take to reduce the cost of meeting demands for infrastructure (in addition to promoting more use of asset management) would be to conduct or support research and development in cost-saving technology.

27. See Congressional Budget Office, *Future Investment in Drinking Water and Wastewater Infrastructure* (November 2002).

way to reduce that inefficient demand is to impose congestion pricing—that is, to charge tolls that are higher during peak times of the day and lower during off-peak hours. Besides dampening demand for the highway during the most congested periods—some motorists would alter their travel plans and use the road when it is less crowded, find alternative routes, or switch to public transit—congestion pricing also helps to signal the places where additional investment in road capacity is warranted. FHWA has estimated that widespread use of congestion pricing would reduce by about $20 billion per year both the investment required to maintain services in their current condition and the total economically justifiable investment.

Congestion pricing is in use in the New York City area, for example, where, since March 2001, the Port Authority of New York and New Jersey has charged more for vehicles to cross the Hudson River during peak hours than during off-peak hours. The crossing's six bridges and tunnels carry about 350,000 vehicles in each direction every day. Initially, drivers who paid with cash were charged a $6 toll, regardless of the hour of the day; drivers who used the E-ZPass electronic toll collection system paid $5 during peak hours and $4 during off-peak hours—a 20 percent discount for off-peak E-ZPass users. After the program took effect, traffic in the morning peak period declined by 7 percent from May 2000 to May 2001, and evening peak traffic declined by 4 percent (overall traffic volume remained the same).[28] Six percent of trucking carriers shifted their operations to off-peak hours.[29] Tolls from the Port Authority's facilities raised $750 million in 2006, more than covering their operating and capital expenses.[30] Those funds are used exclusively to build, operate, and maintain transportation facilities in the New York–New Jersey area.[31] Tolls on the crossings went up March 2, 2008. The cash charge is now $8; E-ZPass rates are $8 during peak hours and $6 during off-peak hours.

Similar pricing systems have been adopted for more than half a dozen bridges, tunnels, and highways in the United States. In Orange County, California, express toll lanes built in a 10-mile section of the median strip of State Route 91 give motorists a choice between driving in toll-free lanes and driving in new lanes on which tolls are charged according to time of day. More than a dozen similar

28. See Mark F. Muriello and Danny Jiji, *The Value Pricing Toll Program at the Port Authority of New York & New Jersey: Revenue for Transportation Investment and Incentives for Traffic Management* (New York: Port Authority of New York and New Jersey, September 30, 2003), http://knowledge.fhwa.dot.gov/cops/hcx.nsf/384aefcefc48229e85256a71004b24e0/f28934ff571ff3c685256db10063e81b?OpenDocument.

29. See José Holguín-Veras, Kaan Ozbay, and Allison de Cerreño, *Evaluation Study of Port Authority of New York and New Jersey's Time of Day Pricing Initiative, Final Report* (March 2005), p. 7.

30. See Port Authority of New York and New Jersey, *Annual Report* (2006), p. 92.

31. See José Holguín-Veras, Kaan Ozbay, and Allison de Cerreño, *Evaluation Study of Port Authority of New York and New Jersey's Time of Day Pricing Initiative,* p. 7.

highway capacity expansions are either in operation, under construction, or in planning. On Interstate 15 in San Diego, drivers of single-occupant vehicles may pay a toll to use high-occupancy vehicle (HOV) lanes. At least a half a dozen existing HOV lanes have been converted or soon will be converted to "high-occupancy toll" (HOT) lanes.

The concept of marginal-cost pricing extends beyond congestion, however. To maximize efficiency, users would be charged for all of the incremental costs they impose on the system. For example, the incremental damage imposed by trucks on highways does not depend on a vehicle's total weight but rather on its weight per axle.[32] Because that fact is not reflected in the current taxes on truck ownership and use, there are wide disparities in the degree to which different types of trucks pay the cost of the highway damage that is associated with their use. For example, researchers have estimated that the taxes paid for a five-axle tractor–semitrailer with a gross vehicle weight of 55,000 pounds on rural interstate highways are about 20 percent more than the marginal cost of use. In contrast, the taxes paid by a vehicle with the same configuration and a gross weight of 80,000 pounds represent only one-third of the marginal costs on rural interstate highways. Marginal costs on urban interstate highways, which are more expensive to repair, or on lighter-duty roads, which incur more damage, are even higher. Instituting charges that are tied to axle weight and to the number of miles traveled by a truck could reduce the need for spending on highways by inducing motor freight carriers to reconfigure their vehicles or shippers to switch from trucks to rail. If the charges also varied by the type of road, some carriers might adjust their routes to travel on more durable roads.[33]

Financing Infrastructure Through a Special-Purpose Entity

Through the years, the Congress has considered proposals to charter banks, corporations, or other special-purpose entities to help finance investment in infrastructure outside of the annual appropriation process. Two issues in the makeup of such entities—which could be designed in a variety of ways—are particularly important: first, the entity's relationship to the federal government and the extent to which it relies on federal funding rather than on income from its own operations; second, the types of financing tools that the entity is authorized to use to support infrastructure investment.

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32. See Congressional Budget Office, *Paying for Highways, Airways, and Waterways: How Can Users Be Charged?* (May 1992).

33. See Kenneth A. Small, Clifford Winston, and Carol A. Evans, *Road Work: A New Highway Pricing and Investment Policy* (Washington, D.C.: Brookings Institution, 1989), as cited in Congressional Budget Office, *Paying for Highways, Airways, and Waterways,* p. 19.

Although special-purpose entities can be designed to allow a given level of federal spending to support a greater volume of infrastructure projects, they are not sources of "free money." To the extent that such an entity would reduce the federal share of projects' costs, it would do so by increasing the shares borne by the projects' users, state or local taxpayers, or both. Relying more heavily on user fees to fund infrastructure might improve economic efficiency if doing so encouraged better selection, operation, and maintenance of projects. However, an infrastructure entity that issued its own debt would incur higher interest and issuance costs than the Treasury does and could expose the federal government to the risk of default on such debt. Moreover, some entities might be designed primarily as special conduits for federal funds, removing the spending from the oversight of the regular appropriation process but not drawing on larger shares of funding from state and local taxpayers or infrastructure users.

If the Congress wishes to increase the extent to which federally supported infrastructure projects draw their funding from user fees, it need not create a special entity to do so. Under authority provided by the Transportation Infrastructure Finance and Innovation Act (TIFIA) of 1998 (Public Law 105-178, sections 1501–1504), the Department of Transportation provides assistance to public or private surface transportation projects that have dedicated revenues for repayment. As of February 2008, the department reported that it had provided $4.3 billion in assistance under TIFIA, supporting $17.2 billion in total project investments.[34] Federal support for infrastructure investment that draws on user fees occurs through other vehicles as well, such as the state revolving funds for water supply and wastewater treatment systems that are capitalized with grants made by the Environmental Protection Agency; the Airport Improvement Program, which provides grants for the development or improvement of airports that are significant to national air transportation; and tax expenditures on revenue bonds, which are issued by states and localities to finance construction of toll roads, utilities, and other user-supported infrastructure.

Options in Designing a Special-Purpose Entity

A special-purpose entity could be designed as an independent federal agency or corporation, as a government-sponsored enterprise (GSE), as a fully independent corporation owned by the private sector or by state government, and perhaps in other ways as well. One trade-off to be considered in designing such an entity is between federal control and budgetary status: The more authority the Congress or the Administration has over project selection, fund-raising, and other management choices of an entity, the more likely the entity is to be considered part of the federal budget. Conversely, the activities of an entity that is essentially independent of federal control would not be recorded in the budget, but such an entity would be subject to little if any control over its operations. For example, the Tennessee

34. See Department of Transportation, *TIFIA Credit Program Overview* (updated February 2008), http://tifia.fhwa.dot.gov/tifia_bkgrnd_slides_080211.pdf.

Valley Authority (TVA) is supported by its sales of electricity, receives no federal appropriations, and can issue its own debt instruments. But ultimately, it is under federal control—all nine of TVA's directors are nominated by the President and confirmed by the Senate—and its activities are recorded in the budget. Other federal corporations or "independent" agencies could be designed not to be self-supporting but to serve primarily or exclusively as conduits for federal funds.

GSEs are privately owned—although they are more constrained than are most private businesses by their charters and by federal regulation and oversight—and have only a minority of federally appointed directors, if any. For example, 5 of 18 directors each on the boards of Fannie Mae and Freddie Mac are federal appointees (those positions currently are vacant).

GSEs and fully independent private entities are alike in that they typically sustain their operations from business income. GSEs are distinguished from other chartered private entities by investors' perception of an implicit federal guarantee of GSEs' debt obligations; that perception arises in part from various legal characteristics that they tend to share. For example, a GSE's corporate earnings may be exempt from state and local income taxes, and its securities, like Treasury debt, may be exempt from Securities and Exchange Commission registration or eligible to be held in unlimited amounts by federally regulated banks and thrifts.[35]

The National Cooperative Bank is one example of a fully independent corporation. It was established as a federal agency in 1978 and then was converted to private, cooperative ownership in 1981. The legislation that privatized the bank provided start-up funding in a long-term subordinated loan at a below-market interest rate.[36]

A corporation owned by state governments could be similar to an independent private corporation in several ways, such as its independence from federal control. However, it might differ from most private corporations in having more access to federal funds to support its operations.

In addition to the governance structure, another issue in the design of an infrastructure bank or corporation is the set of financing tools available to it, perhaps including direct subsidies, loans, loan guarantees, lines of credit, bond insurance and reinsurance, debt or equity purchases, issuance of bonds on behalf of a supported project, insurance for project development costs, or technical assistance on project development or financing. Because the degree of support the entity can provide to projects depends on its availability of funds, any direct subsidies are likely to be

35. See Congressional Budget Office, *Controlling the Risks of Government-Sponsored Enterprises* (April 1991), pp. 6–8.

36. That approach to support investment in infrastructure is discussed in Congressional Budget Office, *An Analysis of the Report of the Commission to Promote Investment in America's Infrastructure* (February 1994).

small unless the entity receives continuing federal appropriations or has some other source of external support.

Comparing Special-Purpose Entities and Other Methods for Financing Infrastructure

Infrastructure banks, corporations, or other special entities can be compared with other vehicles for federal support—annual appropriations, direct spending authority, and tax expenditures—in terms of the associated budgetary cost and economic efficiency.

The budgetary cost of federal support for infrastructure investment depends on two factors: the share of project costs drawn from nonfederal funds—such as user fees and state and local tax revenues—and the federal cost per dollar of effective project aid. Some proposals for infrastructure entities call for nonfederal shares that are much higher than is common under current appropriated programs (for example, the 20 percent typically required for projects supported through the Highway Trust Fund), and such entities would therefore stretch federal dollars further. However, because Treasury securities are highly liquid and free of default risk, any given federal share of project costs could be provided at lower budgetary cost through a program funded by appropriations or direct spending, such as TIFIA, rather than through a special entity. TVA's bonds, for example, typically pay 30 to 40 basis points more than comparable Treasury securities (a basis point is one one-hundredth of a percentage point). The interest rates on bonds and other debt instruments from GSEs are higher than are those from independent agencies, and those paid by fully private corporations are higher still. Because of their comparatively smaller offerings, special entities also would face higher costs than the Treasury does in issuing bonds.

Economic efficiency focuses on the use of real resources, and so the source of investment funds matters less than the way the funds are used.[37] In that light, the important questions to ask about any given funding vehicle involve whether it tends to select the most cost-beneficial projects for support and whether it promotes efficient operations, maintenance, and use. To the extent that an infrastructure bank or corporation funds projects that are supported by user fees, rather than by tax dollars, it is possible that inefficient demands would be reduced and that market discipline would improve project selection and management. (See the discussion of public–private partnerships below.) Again, however, the federal government already supports projects that rely on user fees through various spending programs and through tax expenditures, and policymakers could choose to increase such support without establishing a special entity.

37. Funding mechanisms matter for efficiency to the extent that some have lower "transaction costs" than others—that is, they use fewer resources to verify project quality, issue the bonds, and the like. Essentially, the interest payments themselves are transfers that do not consume real resources.

Current Proposals

Three proposals in the current Congress illustrate the options for structuring an infrastructure investment entity: the National Infrastructure Bank Act of 2007 (S. 1926 and H.R. 3401); the National Infrastructure Development Act of 2007 (H.R. 3896); and the Build America Bonds Act of 2007 (S. 2021). (The European Investment Bank, described in Box 2, is an example of such an entity outside the United States.)

The National Infrastructure Bank (NIB) would be an independent federal entity with a five-member board of directors appointed by the President and confirmed by the Senate. The bank would evaluate and finance infrastructure projects "of substantial regional and national significance" with a potential federal investment of at least $75 million per project. The NIB would serve as a conduit for federal funding. It would be authorized to issue $60 billion in bonds—the proceeds of which could be used to finance direct subsidies, loans, and loan guarantees—but the Treasury would pay the interest on the bonds. Because the bonds would carry the full faith and credit of the United States, the Treasury also would have ultimate responsibility for paying the principal in the event that the bank's own funds (for example, from repayments of project loans the bank had made) were insufficient.

The National Infrastructure Development Act would create a National Infrastructure Development Corporation (NIDC) and a subsidiary National Infrastructure Investment Corporation (NIIC). Initially, both would be federal corporations, but the bill would give the NIDC five years to develop a plan to convert both entities to GSEs. The NIDC would be capitalized with up to $9 billion in appropriations authorized over three years. Thereafter, it would be self-financed through business income, presumably through fees on users of infrastructure, and (once converted to a GSE) through the sale of public stock. The NIDC would be authorized to make senior and subordinated loans and to buy debt and equity securities issued by others to fund infrastructure projects; the NIIC would be authorized to insure and reinsure debt instruments and loans, insure leases, and issue letters of credit.

The Build America Bonds Act would grant consent and recognition to a transportation finance corporation established by two or more state infrastructure banks. The corporation would be under the control of the participating states, but it would be authorized to issue up to $50 billion in bonds providing federal tax credits in lieu of interest. The rate of the credits would be set so as to equal the average yield of long-term corporate debt obligations at the time the bonds were issued.

Public–Private Partnerships

Some advocates of increased spending on infrastructure suggest that greater use of public–private partnerships (PPPs) would facilitate such increases. (A PPP is an institutional arrangement in which a private entity assumes some level of risk

Box 2.

The European Investment Bank

The European Investment Bank (EIB), a major lender for projects in the European Union (EU), was established under the terms of the 1957 Treaty of Rome (the founding contract for the European Economic Community, the forerunner of the EU). The EIB is the European Union's long-term lending institution, financing an array of projects that contribute to economic policy objectives in the energy, infrastructure, and industrial sectors. The nonprofit bank raises funds through bond issues and other debt instruments; it makes loans to public and private enterprises.

Each of the EU's 27 member states owns a proportional share of the bank and provides a proportional share of its total capital—currently 164 billion euros (equivalent to $255 billion as this was written). A country's share is set by its relative gross domestic product within the EU at the time of its accession, and each member provides 5 percent of that share and agrees to make the rest available to the EIB as deemed necessary to cover the cost of loan defaults. The EIB's board of governors consists of ministers (usually the finance ministers) from all of the EU member states; its board of directors has a representative from each member state. The governors supervise the bank's operations, defining lending policies, deciding on capital increases, and approving the balance sheet. The directors manage the bank's lending and borrowing operations.

Mainly, the EIB provides low-interest loans to finance the capital projects of public- and private-sector enterprises. Borrowers include large corporations and countries and small enterprises and municipalities. More than 85 percent of the 45.8 billion euros (roughly $70 billion) lent in 2006 went to organizations located within the EU. Lending to borrowers outside the European Union supports the EU's development and cooperation policies. External projects have promoted the enlargement of the EU toward southern and eastern Europe, supported nearby countries in the Mediterranean and Eurasia, assisted development in Africa, and aided the EU's programs in Asia and Latin America.

Repayment periods for EIB loans range from four years to two decades, and borrowers may use the loans to finance up to 50 percent of the total cost of a project. To be eligible, projects must contribute to the EU's economic policy objectives. Included on the list are projects that support small and medium-sized enterprises; develop transportation, energy, and telecommunications infrastructure; protect, remediate, or ameliorate the rural or urban landscape; develop human capital through health care or

Continued

The European Investment Bank

projects; and support industry and manufacturing. Eligible projects must be economically, financially, technically, and environmentally sound. Projects that can demonstrate compliance with those criteria are subjected to detailed appraisals by EIB's project teams, which consist of economists, engineers, and loan contact officers. All approved projects are monitored by the EIB for the lifetime of the loan.

As a nonprofit, policy-driven bank, the EIB can provide loans to its clients at relatively low interest rates. The rates are determined by three factors: the bank's cost of funds (that is, the interest rate the EIB pays to borrow in capital markets), which is fully passed along to the borrower; a markup to cover administrative costs; and an additional risk-related charge for certain projects. Those rates are attractive to the EIB's borrowers because of the bank's AAA credit rating, which is a function of the quality of its investments; the high amount of capital available through the reserve fund provided by the member states; and its size.

The EIB also offers technical assistance and loan guarantees to its clients. Its specialist economists and engineers help assess and advise borrowers with their projects. The assistance often is provided during project formulation and preparation and focuses on regulatory issues, questions of feasibility, and challenges in project management. The aid helps streamline the loan application process.

For some clients of the EIB, loan guarantees are more cost-effective than loans. The EIB provides the largest loan guarantee program for the Trans-European Networks (TENs), the infrastructure networks for transportation, energy, and telecommunications that cover the entire EU. The EIB program provides a guarantee against revenue risk for a short period after the construction of a TENs project.

The EIB is part of the EIB Group, which was established in 2000 to coordinate the activities of the EIB with the European Investment Fund (EIF), which itself was chartered to promote development of small and medium-sized enterprises in Europe's rapidly expanding new-technologies sector. The EIF finances venture capital funds that invest in projects that contribute to the EU's economic policy objectives. The EIB is the EIF's majority shareholder with 61 percent of the fund's shares; the European Commission controls 30 percent, and the 26 European banks and financial institutions control the remaining 9 percent.

beyond that traditionally associated with supplying its services to a government agency.) In the infrastructure arena, such partnerships appear to be most common for projects that lend themselves to private operation: roads, rail, and water supply and wastewater treatment. A private entity could control access to and charge for the use of a toll road or a drinking water system, for example, but it would be harder to charge users to recoup costs given the more diffuse benefits from a dam or flood control project.

Public–private partnerships can take a variety of forms that differ in the amount of risk assumed by the private entity. For example, private entities bidding on long-term contracts to supply services, such as maintaining public roads or operating water supply facilities, would face relatively modest risks concerning their ability to deliver services at the agreed-upon price over the length of the contract.[38] In other cases, however, the private entity could have almost complete responsibility for the project and accept a variety of risks, including uncertainties about construction, the cost of financing, and the demand for the infrastructure that it provided. In some public–private partnerships for highway and road construction, for example, the private entity could raise most or all of the funds and also would be responsible for design, construction, operation, and maintenance. That entity would recoup its investment through user fees.[39]

A recent report by the Government Accountability Office provides examples of PPPs for highway infrastructure in the United States, and it illustrates the use of both private management and private financing.[40] Two of the four partnerships reviewed involve long-term lease concessions of existing toll roads: Chicago has entered into a 99-year lease with a private entity. That business paid the city $1.83 billion in consideration of the right to operate, maintain, and collect the tolls on the Chicago Skyway. Similarly, Indiana received $3.85 billion for a 75-year lease on the Indiana Toll Road. The other two cases involve plans for new toll roads. The winning bid for the first segment of the Trans-Texas Corridor (a projected 4,000-mile network of roads, railways, and utility rights-of-way) included $6 billion in capital investment for a new toll road between Dallas and San Antonio and $1.2 billion in concession payments to the state for the right to

38. An extensive treatment of public–private partnerships in transportation can be found in Department of Transportation, *Report to Congress on Public–Private Partnerships* (December 2004), www.fhwa.dot.gov/reports/pppdec2004/index.htm.

39. The risk to the private entity of not recouping its investment often is mitigated by advantageous financing available through government sponsorship of the project and through terms that grant the private entity exclusive rights to provide the services in question.

40. See Government Accountability Office, *Highway Public–Private Partnerships: More Rigorous Up-front Analysis Could Better Secure Potential Benefits and Protect the Public Interest,* GAO-08-44 (February 2008).

operate the facility for 50 years.[41] And in Oregon, three projects have been studied under an agreement between the state and a private group to determine suitability for PPPs that would combine design services, financing, construction, and operation. Two of the three projects have been found to have insufficient toll revenue potential, but the third is moving forward to the environmental assessment phase.

PPPs have been used in many other cases to obtain private-sector financing of new toll roads, including the Dulles Greenway in Virginia and the State Route 91 and State Route 125 toll roads in California. PPPs also have been used to finance transit projects, such as the Hudson–Bergen Light Rail system in New Jersey, and freight railroad projects, including the Alameda Corridor in Los Angeles.

The potential advantages and disadvantages of PPPs include the possible reductions in investment requirements that would come with more efficient management (including cost-based pricing) and the potential increases in the costs of financing, respectively. Whether the use of private management in PPPs would help to reduce total spending on infrastructure depends on the extent to which savings from improved asset management exceed the costs of using the private services. To maximize profits, a private partner might reduce life-cycle costs through higher construction standards, more frequent maintenance, or investments in cost-saving technology. Efficiencies also could result if a private entity charged prices that were more closely aligned with costs, thereby reducing inefficient demands for services and thus perceived investment needs. However, if there is insufficient competition, public oversight could be needed to guard against the risk that the private entity might use monopoly power to raise prices excessively.

CBO's recent analysis of spending on transportation and water infrastructure reported that PPPs do not yet account for a significant share of nationwide spending in those categories. According to a regularly cited survey, the cumulative project costs of such partnerships in the United States that had been funded or completed by October 2006 totaled a bit over $48 billion (in nominal dollars).[42] In contrast, nominal capital spending on those types of infrastructure by the federal government and by states and localities totaled $1.6 trillion between 1985 and 2004 (averaging $80 billion annually). Other studies have come to a similar conclusion regarding highway and transit projects.[43]

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41. Public opposition to the Trans-Texas Corridor and other PPPs resulted in the Texas Legislature's enacting a two-year moratorium on future highway PPPs (other than regional projects in the Dallas area). The moratorium will expire on September 1, 2009.

42. That figure is based on data from the 2006 International Major Projects Survey, which accompanied *Public Works Financing*, vol. 209 (October 2006). The data have important limitations: For the purposes of this analysis in particular, they do not distinguish between the public- and private-sector components of such projects. More generally, the data were not collected to provide an exhaustive inventory of public–private partnerships and, as a result, they probably understate their extent.

43. See General Accounting Office, *Highways and Transit: Private Sector Sponsorship of and Investment in Major Projects Has Been Limited*, GAO-04-419 (March 2004).

Proposals for Capital Budgeting

Questions about the adequacy of current investment in infrastructure are sometimes accompanied by questions about whether capital spending should be treated differently in the federal budget. Capital budgeting would involve distinguishing certain investments from other expenditures in the budget. Under many proposals for capital budgeting, the full cost of those investments would not be counted at the time of purchase; rather, it would be apportioned over the expected life of the resulting assets. Spreading the cost into the future, however, would deviate from current budgetary treatment, which generally requires funding for the full cost of a project up front and records expenditures when cash is disbursed.

The federal budget is a statement of the government's expenditures and revenues for a given fiscal year. That statement is designed to serve many purposes: It provides a mechanism for making decisions to allocate resources to serve national objectives, provides constraints and direction for agencies' management of fiscal resources, gives the Treasury information needed for its management of cash resources and the public debt, and provides businesses and individuals with the information they need to assess the government's stewardship of the public's money and resources.

Proponents of capital budgeting often assert that the current budgetary treatment of capital investment creates a bias against capital spending and that additional spending would benefit the economy through future increases in productivity. Even if a change in budgetary treatment would increase federal capital spending, the degree to which such increased spending benefited the economy would depend on how well the additional funds were targeted and the extent to which they were offset by reduced spending by others.

Moving to a budget that is more reliant on accrual-based accounting could increase complexity, diminish transparency, and make the federal budget process more sensitive to small changes in assumed parameters, such as depreciation rates. (Indeed, other nations have considered adopting capital budgets, but generally decided against it for those same reasons.) Adopting an accrual approach to only one aspect of the budget could raise concerns about whether the budgeting system would provide a fair basis for allocating the government's resources among competing priorities. In addition, providing special treatment to certain areas of the budget, such as capital spending, could make the process more prone to manipulation. For example, arriving at a definition of "capital" for budgeting purposes could be a significant challenge.

More limited reform of the current process might still accomplish the goal of focusing on capital investment but be simpler to implement. One approach would be to create a category for capital spending as part of a restoration of the statutory budget enforcement procedures that expired in 2002. Such a category within overall discretionary spending limits could help highlight important policy goals. By carving out separate limits for certain programs, however, lawmakers would forgo flexibility to meet other needs. Another alternative might be to attribute a portion of the cost of assets each year to the programs that use them. Requiring users to pay the costs might improve incentives for agencies to sell assets that were no longer appropriate to their needs.

Appendix A:
Spending for Research and Development and for Education

Total public and private spending on research and development (R&D) is currently about 2.6 percent of gross domestic product (GDP) (see Figure A-1).[1] In fiscal year 2007, the federal government's budget authority for the conduct of R&D totaled $135 billion, slightly less than 1 percent of GDP. The government spent an additional $3.6 billion for acquisition and construction of R&D facilities and equipment.

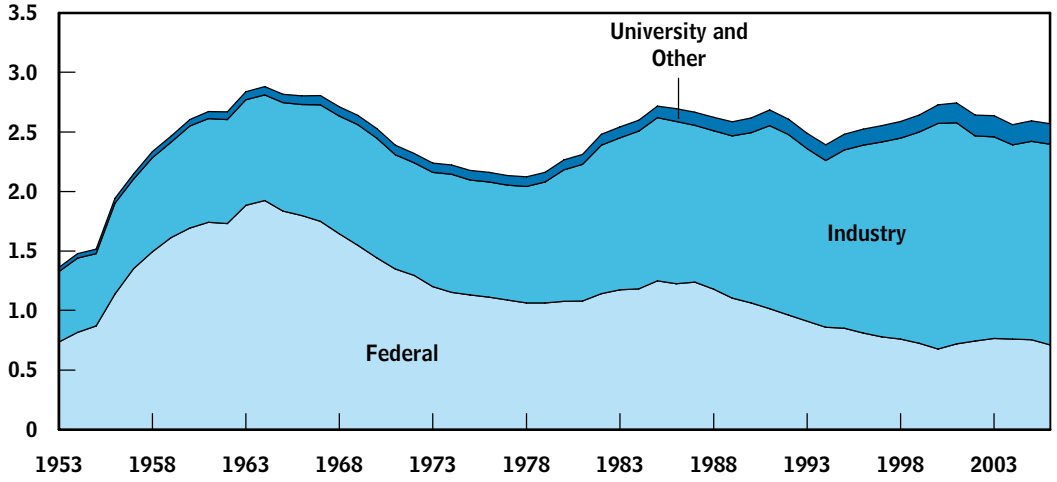
About $78 billion of the $135 billion went to the Department of Defense, and 92 percent of that spending was for developing programs and systems that support national defense. Conversely, 84 percent of the rest of the federal government's spending of $57 billion went to basic and applied research. During the past 20 years, federal funding has typically represented between 40 percent and 50 percent of all research funding nationwide. Except in the case of the Department of Defense and other agencies where R&D is linked to an explicit mission, economists generally view federal funding of research more favorably than development; even though research might not be conducted with a specific commercial purpose in mind, the knowledge it produces has large potential for wider use, both by other researchers and in later commercial endeavors. Still, economic returns are difficult to measure because the resulting progress can be difficult to discern and the economic payoff might take years or even decades to become clear.

The life sciences account for more than half of federal spending on research. Although some observers have attributed high rates of return to research in the life sciences, others state that there are benefits to supporting a wide range of scientific fields because researchers reach across disciplines for new ideas and tools. In the past decade, as more than 40 percent of federal research funding has gone to university researchers, federal laboratories have seen their share fall to near 20 percent, and federally funded R&D centers have received about 15 percent. Industry and nonprofits account for the rest. Besides supporting increases in knowledge, federal funding of academic research also contributes to the education

1. See Congressional Budget Office, *Federal Support for Research and Development* (June 2007).

Figure A-1.

U.S. R&D Spending as a Percentage of GDP, 1953 to 2006



Sources: Congressional Budget Office and National Science Foundation.

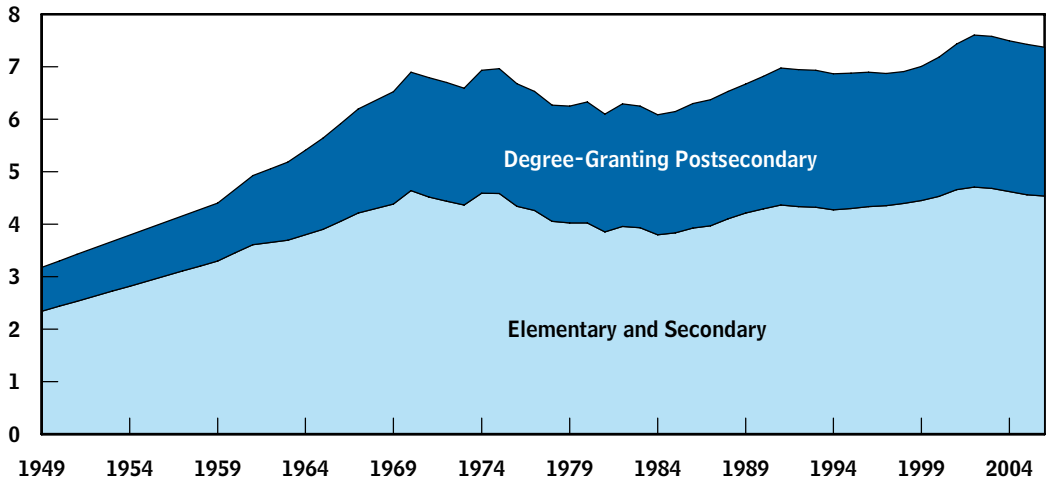
Note: R&D = research and development; GDP = gross domestic product.

of the next generation of researchers: In 2005, more than 55,000 science and engineering graduate students received financial support through federally funded research assistantships.

The United States spends more than 7 percent of its GDP on elementary, secondary, and postsecondary education (see Figure A-2). State and local governments provide about 75 percent of the funding, mostly for elementary and secondary education. The federal government pays about 12 percent, about two-thirds of which goes to elementary and secondary schools, primarily in the form of grants distributed by states. The rest is mostly for student financial aid for postsecondary education. The remaining 13 percent of the funds come from families and other private sources. Families often pay part of the cost of the higher education of their children, and some families pay tuition to private elementary and secondary schools.

Figure A-2.

Expenditures by Educational Institutions as a Percentage of GDP, 1949 to 2005



Sources: Congressional Budget Office and Department of Education.

Note: GDP = gross domestic product.

On average, the private rate of return on investment in education is estimated to be about 10 percent. In addition, as with other forms of capital, investment in education can produce benefits for the larger economy and for society that exceed those to the individual student. Although the spillover benefits of education are most easily documented in developing countries, some economists believe that even in developed countries, increasing the educational attainment of the population fosters productivity growth—for example, by increasing the body of knowledge that makes up modern science, technology, and management. To the extent they exist, such effects could provide an economic rationale for investments in education. Research has suggested significant social returns on investment in high-quality early-childhood education, in the form of fewer retentions in grade, higher achievement, less involvement in criminal activity, and lower rates of participation in welfare programs.[2]

2. See James J. Heckman and Dimitriy V. Masterov, *The Productivity Argument for Investing in Young Children*, Working Paper 13016 (Cambridge, Mass.: National Bureau of Economic Research, April 2007); and Art Rolnick and Rob Grunewald, *Early Childhood Development: Economic Development with a High Public Return*, Federal Reserve Bank of Minneapolis (December 2003).

Appendix B: Overview of the Highway Trust Fund

The Highway Trust Fund is the source of funding for most of the federal government's surface transportation programs (certain transit programs receive appropriations from the Treasury's general fund), and the programs are administered by the Federal Highway Administration (FHWA) and the Federal Transit Administration.[1]

The Highway Trust Fund is an accounting mechanism in the federal budget that comprises two separate accounts, one for highways and one for mass transit. It records specific cash inflows (revenues from certain excise taxes on motor fuels and trucks) and cash outflows (spending on designated highway and mass transit programs). By far, the largest component of the trust fund is the Federal-Aid Highway program.

Spending from the trust fund is not automatically triggered by tax revenues credited to it. Authorization acts provide budget authority for highway programs, mostly in the form of contract authority (the authority to incur obligations in advance of appropriations). Annual spending is largely controlled by limits on the amount of contract authority that can be obligated in a particular year.

Such obligation limitations are customarily set in annual appropriation acts. The most recent authorization law governing spending from the trust fund, called SAFETEA-LU, the Safe, Accountable, Flexible, Efficient Transportation Equity Act: A Legacy for Users, was enacted in 2005 and is due to expire at the end of 2009. The law provides specific amounts of contract authority for the period from 2005 to 2009, and it authorizes appropriations for certain programs that are not funded through contract authority. It also specifies annual obligation limitations, which may be superseded each year by limitations set in appropriation acts.

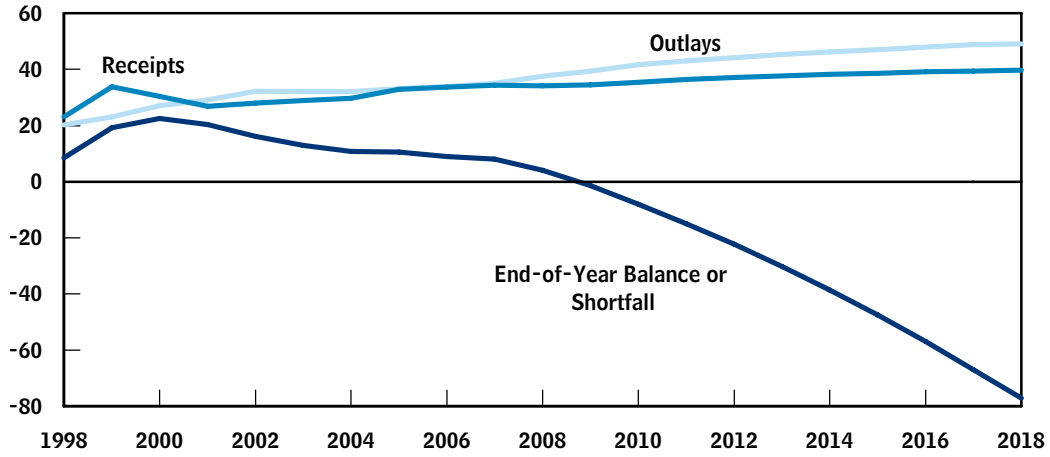
In 2007, the obligation limitation included in the appropriations act was $47.7 billion, and the total in outlays from both accounts of the trust fund came to $39.2 billion. In 2008, the Congress added $1 billion to the obligation limitation for highways, specifically to repair bridges; the total obligation limitation was $50.2 billion.

1. Other agencies within the Department of Transportation that also receive funding from the Highway Trust Fund include the Federal Motor Carriers Administration and the National Highway Transportation Safety Administration. In 2007, those two entities received a total of about 3 percent of the trust fund's budgetary resources.

Figure B-1.

Actual and Projected Highway Account Receipts, Outlays, and Balances or Shortfalls, 1998 to 2018

(Billions of dollars)



Source: Congressional Budget Office.

Note: Actual data are in nominal dollars for 1998 through 2007. Data projections for 2008 to 2018 assume that the Highway Trust Fund's taxes, which are scheduled to expire in 2011, will be reauthorized at current levels. Under current law, the Highway Trust Fund cannot incur negative balances. A negative level is a projected shortfall, reflecting the trust fund's inability to pay obligations out of estimated receipts. Assumptions are based on authorization levels for SAFETEA-LU, the Safe, Accountable, Flexible, Efficient Transportation Equity Act: A Legacy for Users.

Spending from the trust fund started to increase rapidly in 1999 because of changes enacted in the Transportation Equity Act for the 21st Century (TEA-21), which provided budget authority and contract authority of $218 billion over the 1998–2003 period (an average of $36.3 billion per year). Consequently, annual outlays rose by 40 percent from 1999 to 2003. SAFETEA-LU, which provided contract authority of $286 billion (an average of $57.2 billion per year), represented a further significant increase in funding. From 2005 to 2007, outlays from the trust fund grew from about $30 billion to $35 billion, an increase of about 3 percent per year.

Balances in the highway account were steady during the 1980s and in the first half of the 1990s—they stayed in the vicinity of $10 billion. Receipts substantially exceeded outlays from 1996 to 2000, and the unexpended balance in the highway account (sometimes called the cash balance) grew from $10 billion in 1995 to a peak of about $23 billion in 2000 (see Figure B-1). Revenues fell sharply in 2001 but have increased steadily since then—at an average rate of about 3.4 percent per year through 2007. Spending generally has exceeded revenues since 2001, and by the end of 2007, unspent balances in the highway account had declined to about

Table B-1.

Actual and Projected Highway Trust Fund Receipts, 1998 to 2018

	Highway Account		Transit Account		Total Trust Fund	
	Receipts (Billions of dollars)	Share of GDP (Percent)	Receipts (Billions of dollars)	Share of GDP (Percent)	Receipts (Billions of dollars)	Share of GDP (Percent)
1998	23.1	0.26	3.5	0.04	26.6	0.30
1999	33.8	0.36	5.5	0.06	39.3	0.42
2000	30.3	0.31	4.6	0.05	35.0	0.36
2001	26.9	0.27	4.6	0.04	31.5	0.31
2002	28.0	0.27	4.6	0.04	32.6	0.31
2003	29.0	0.26	4.8	0.04	33.7	0.31
2004	29.8	0.25	4.9	0.04	34.7	0.30
2005	32.9	0.26	5.0	0.04	37.9	0.30
2006	33.7	0.26	4.9	0.04	38.5	0.29
2007	34.3	0.25	5.1	0.04	39.4	0.28
2008	34.1	0.24	5.0	0.03	39.1	0.27
2009	34.5	0.23	5.0	0.03	39.6	0.26
2010	35.4	0.22	5.2	0.03	40.6	0.26
2011	36.4	0.22	5.3	0.03	41.6	0.25
2012	37.1	0.21	5.3	0.03	42.4	0.24
2013	37.6	0.21	5.4	0.03	43.1	0.24
2014	38.2	0.20	5.5	0.03	43.6	0.23
2015	38.6	0.19	5.5	0.03	44.1	0.22
2016	39.0	0.19	5.5	0.03	44.6	0.21
2017	39.4	0.18	5.5	0.03	44.9	0.21
2018	39.7	0.18	5.6	0.02	45.3	0.20

Source: Congressional Budget Office.

Notes: After 2007, revenues are estimated; GDP = gross domestic product.

$7.4 billion. In general, balances in the mass transit account also have been falling since 2000, although more slowly than in the highway account. At the end of 2007, the balance in the mass transit account totaled about $7.3 billion. If recent trends persist and spending from the trust fund continues to exceed its revenues, the balances in the highway account will be depleted during fiscal year 2009.[2]

The highway account receipts shown in the figure also are shown in the Table B-1, which expresses those receipts as a share of GDP and provides comparable figures for the mass transit account and for the trust fund as a whole. Because of decreased consumption of gasoline and diesel fuel, CBO projects, receipts will not keep pace with GDP over the next 10 years, and total receipts will decline as a share of GDP, from 0.27 percent in 2008 to 0.20 percent in 2018.

2. The Highway Trust Fund cannot incur negative balances. A negative number indicated in the figure represents a projected shortfall, reflecting the trust fund's inability to pay obligations out of estimated receipts.