Chapter Three

Investing in Physical Capital and Information

A period of prosperity and fiscal strength provides a natural opportunity for the beneficiary, whether a household, corporation, or country, to consider spending more on investments—current expenditures intended to provide future gains. When effective, investments can redistribute the benefits of a prosperous period over a longer span of time or even help to sustain and extend the prosperity. Of course, not all investments provide an adequate future payoff.

The federal government supports many kinds of investments, some directly and others through grants it provides to state and local governments and other recipients. This chapter explores some options that have been prominent in recent Congressional discussions about possible investments in physical capital (tangible structures and equipment, such as roads, water pipes, and government buildings) and information (such as statistical data and scientific knowledge).[1] The options included are not endorsed by the Congressional Budget Office (CBO) or intended as a complete catalogue of the worthwhile possibilities; other options, in the same areas and others, could also illustrate the benefits and costs of federal investments.

The benefits take the form of increased efficiency and equity. Gains in efficiency boost the total national value of goods and services, including items like clean air and leisure time, which are valuable even though they are not marketed; equity is said to increase when those goods and services are distributed in a way that is judged to be fairer and more just. Some federal investments seek to reduce the costs of government operations or improve government "products" that benefit people indirectly (such as military preparedness, the census, and the administration of justice). Others focus on providing more direct benefits to parties outside the government—for example, the construction of roads or funding of research and training of graduate students. Some of those latter investments are efficiency-oriented, including efforts to increase economic growth, while others directed at certain parts of the country or particular classes of individuals, firms, or communities are equity-oriented.[2]

In principle, federal investments can improve economic efficiency by correcting for specific factors that keep the private sector and state and local governments from providing the optimal levels of certain goods and services. For example, federal funding for some types of basic research whose results are unlikely to be protected by patent may fill a gap because private firms, with no incentive to create benefits for other firms, could invest too little in such research. Similarly, federal funding can sometimes avoid the coordination problems that state governments would face in developing national systems such as the air traffic control system.

1. Other important types of investments, such as education, are discussed in Chapter 2.

2. For a detailed discussion of the potential impacts on economic growth of federal investments in infrastructure, education, and research and development, see Congressional Budget Office, *The Economic Effects of Federal Spending on Infrastructure and Other Investments*, CBO Paper (June 1998).

Federal spending has its own weaknesses and limitations, however. It can distort financial incentives, leading recipients and beneficiaries to make choices that do not reflect the full social costs. For example, a municipality using federal grant money to pay the major share of the costs of a sewage treatment plant might build one that is too expensive. Federal funding can also lead to "fiscal substitution"—that is, the displacement of investments that state or local governments or private parties would have made on their own. In addition, spending that is based on equity concerns or political considerations can reduce efficiency when the gains to the beneficiaries are not commensurate with the resources invested. Congressional earmarks in spending for infrastructure and research are often criticized on those grounds.

Though careful analysis is critical in identifying which federal investments are likely to yield more benefits than costs, measuring those costs and benefits is often difficult.[3] Costs are appropriately measured as opportunity costs—the gains forgone by not putting the invested funds to their best alternative use. When the feasible alternatives include reducing the federal debt or cutting distortionary taxes, the opportunity cost of a particular federal investment may be greater than its dollar cost, depending on how the revenues are collected and spent.[4]

One difficulty encountered in measuring benefits is the valuation of government products that do not trade in the marketplace. In some cases, dollar values can be estimated or inferred from related goods and services; for example, analysts refer to average hourly wages in valuing time lost to roadway congestion. In other cases, no reasonable monetization of the benefits is possible, so analysts must settle for estimating a proposed investment's cost-effectiveness, which can then be compared against some desired minimum. A second difficulty, for investments that seek to directly benefit nonfederal parties, lies in estimating the responses of the intended beneficiaries. For example, the value of federal grants to help a metropolitan area provide real-time traffic reports on the Internet would depend not only on the system's technical performance but also on the number of people who chose to access the information and adjust their trips to avoid reported congestion.

The sections that follow discuss potential investments in:

- Passenger transportation,
- Drinking water and wastewater systems,
- Nondefense research and development (R&D),
- The maintenance of physical assets owned by the federal government,
- Federal systems for financial management, and
- Data collection.

The sections reflect the wide differences in the scope of the potential investments: investments affecting agencies across the entire federal government, such as investments in asset maintenance and financial management, are necessarily discussed in overviews and some brief case studies; conversely, the narrower category of investments in water infrastructure is explored in more detail. Common to all six sections, however, are discussions of the policy considerations and the arguments for and against additional federal spending.

The six areas differ in the amount of additional federal spending they could absorb. On the basis of current spending levels and some available cost estimates, one can say roughly that passenger transportation, water infrastructure, civilian R&D, and the maintenance of federal assets could each absorb additional billions of dollars annually—in some cases, perhaps tens of billions—whereas additional spending on data collection and federal financial management systems could be in the hundreds of millions. The sections include relevant information, as available, on the order of magnitude of potential spending but do not provide detailed cost estimates of specific proposals.

3. See *Report of the President's Commission to Study Capital Budgeting* (February 1999). The report emphasizes the importance of information, analysis, and planning in federal decisions about capital spending.

4. Variability of the opportunity costs of tax revenues is discussed in Charles L. Ballard and Don Fullerton, "Distortionary Taxes and the Provision of Public Goods," *Journal of Economic Perspectives*, vol. 6, no. 3 (Summer 1992), pp. 117-131.

Passenger Transportation

Increased stress on the nation's transportation infrastructure—highways, mass transit, airports, air traffic control, intercity rail, waterways, locks and dams, and ports and harbors—has made the level of federal support an issue of continuing Congressional interest. That stress comes in large part from growth in population and economic activity. More commuters are crowding the roads, causing congestion and costly delays. Growing air travel for both business and pleasure in the postderegulation era has challenged the capacity of the air traffic control system to handle flights safely without undue delays and has created bottlenecks at some airports. Despite greater use of telecommunications, more freight is being transported—more raw materials and equipment and tools to factories and more products (including every tangible product sold over the Internet) to users and consumers. International trade, too, is on the rise, increasing demands on ports and harbors.

The federal government has played a large role in financing transportation infrastructure. Federal spending on highways, mass transit, aviation (air traffic control and airports), and rail totaled about $41 billion in 2000 and will markedly increase over the next several years for each of those modes except rail. The Transportation Equity Act for the 21st Century, passed in 1998, authorized increases in highway and transit spending of about 50 percent for the period 1998 to 2003, to about $30 billion a year for highways and $7 billion a year for transit. The Wendell H. Ford Aviation Investment and Reform Act for the 21st Century, passed in 2000, authorized federal spending on aviation to rise roughly 40 percent over the period of 2001 to 2003, to about $13 billion a year. In contrast, federal subsidies for Amtrak have been gradually declining, except for a one-time infusion of $2.2 billion provided under the Taxpayer Relief Act of 1997, and the Amtrak Reform and Accountability Act of 1997 calls for Amtrak to be self-supporting for its operating costs by the end of 2002.

Federal aid for highways, transit, and airports is generally provided in the form of grants to state and local governments and governmental units such as port authorities and metropolitan transit authorities. The federal government imposes numerous and complex rules governing the use of grants, which can specify what types of projects are eligible, impose financial reporting standards, require that state and local entities provide matching funds, and withhold federal funds in certain cases—for example, if states do not enforce laws on drinking and driving. Thus, although the federal government does not make direct decisions about investments in highways, transit, and airports—except for projects earmarked in legislation—it does shape such decisions indirectly through grants and their conditions.

In contrast, the federal government owns and operates the air traffic control system, and so it makes the spending and investment decisions directly. In the case of Amtrak, the federal government provides direct subsidies, with certain restrictions on the use of the funds.

Could further increases in federal funding of transportation infrastructure yield benefits that exceed the costs? This section does not provide the detailed analyses necessary to answer that question, but it does discuss areas of the nation's passenger transportation system where some observers see unmet needs and suggest greater investment. To meet one such need, improving intercity travel, the federal government could increase spending to modernize the air traffic control system more rapidly, expand the capacity of airports, and upgrade and expand the intercity passenger rail system. To improve travel at the metropolitan level, the federal government could provide more aid to mass transit and incentives for state and local governments to improve transportation for poor and elderly people as well as commuters. The federal government could also encourage more cost-effective use of transportation infrastructure by fostering congestion pricing (tolls that vary according to the traffic), which can strengthen motorists' incentives to avoid crowded roads, and other technological initiatives that increase the capacity of roads. Finally, it could take steps to ensure that state and local governments properly maintain their infrastructure so that it lasts longer and provides greater levels of service.

Although the focus here is on possible options for increasing federal spending, a lack of money is

not always the constraint keeping the transportation system from better serving the public. Sometimes technical or managerial problems have hindered agencies' efforts, such as the program of the Federal Aviation Administration (FAA) to modernize the air traffic control system. In other cases, environmental issues have loomed large. Investments in new roads must overcome concerns about the effects on wetlands, air and water pollution, the loss of habitat for endangered species, noise, and what critics contend is the ugliness of suburban sprawl. Many projects at airports encounter those objections plus even stronger ones about noise. Similarly, the construction of dams and the dredging of shipping channels and harbors present problems of what to do with the dredged materials and how to mitigate the effects on fish.

Moreover, increasing federal funding would not necessarily result in a net increase in spending for transportation infrastructure; it might instead result in cutbacks of an equal amount by state and local governments. That is, state and local governments might simply substitute federal funding for their own. The federal aid programs for highways and airports attempt to address the problem by requiring matching funds, but whether such requirements succeed in discouraging fiscal substitution is unclear. Increased federal funding might also preempt private investments in transportation systems.[5]

Improving Intercity Passenger Travel

Following deregulation of the airline industry in 1978, air travel burgeoned. The nation's aviation infrastructure has had difficulty keeping pace with the steep increases in the numbers of passengers and flights, so additional investments in the air traffic control system and in airport facilities could help. Investments in Amtrak could also help intercity travel by diverting some passengers from airplanes to rail. Of course, more money could also be spent on highways, but that option is not included in this discussion because any need for more rural interstate highways—the roads primarily used by intercity travelers—appears to be outweighed by the highway needs in urban areas, where congestion is a major problem.

5. Gabriel Roth, "Road Financing in the U.S.," *Transportation Quarterly*, vol. 50, no. 4 (1996), pp. 107-114.

Improving Air Travel: Increasing Funding in Order to Modernize the Air Traffic Control System More Rapidly. A perennial problem for air travelers is delays; in 1998, roughly 306,000 flights were delayed 15 minutes or more, an increase of almost 25 percent from 1997.[6] One major source of delays is the limited capacity of the nation's air traffic control system. As the number of flights has skyrocketed, the system has not kept pace.

The airline industry has long pressed for improvements that would enhance the capacity of both the air traffic control system and airports. In March 2000, the Congress passed legislation that authorizes nearly $3 billion a year over the next three years for the air traffic control system's facilities and equipment. Could additional spending by the federal government, which owns and operates the system, reduce delays while maintaining or improving the safety of air travel? Possibly, but the FAA's experiences over the past two decades lend credence to an argument to defer increases until after significant managerial reforms have occurred.

In 1981, the FAA announced plans to modernize the air traffic control system by the end of that decade. No doubt that presented a difficult challenge, as the FAA has described: to install equipment that uses advanced technologies in an environment that must work essentially 24 hours a day every day of the year (the FAA's specifications allow for five minutes of downtime a year) with complete accuracy and reliability and no room for human error in using the equipment.

But nearly two decades and some $25 billion later, the FAA's effort is still far from completion.[7] Like the flights it is intended to speed, the modernization project has been plagued with delays—along with cost overruns. In some cases, the FAA proceeded so slowly that by the time it had determined

6. Federal Aviation Administration, Office of System Capacity, *1999 Aviation Capacity Enhancement Plan* (December 1999), p. v, available at www.faa.gov/ats/asc/pub/capacity_office_pubs/99_ace/chapters.pdf.

7. The original 1981 estimate of the cost of modernizing the system was $12 billion; however, that figure cannot readily be compared with actual spending to date, nor with the latest $42 billion estimate for the ultimate total cost, because the scope of the project has been expanded.

the specifications of new equipment and was ready to procure it, the technologies it specified were no longer current. Such problems have been recounted in a series of reports by the General Accounting Office (GAO).[8] Although the FAA has had some recent success with components of its modernization program—such as a radar system used for the separation of aircraft, drug interdiction, and the defense of U.S. borders and a system that automates the collection and dissemination of selected weather data—other projects are behind schedule and over budget.[9]

One approach to finding productive uses of additional money is to focus on potential safety problems. Judging by official reports, one such problem is an increasing number of runway incursions, in which an aircraft or other vehicle inadvertently encroaches on an active runway where aircraft have clearance to land or take off. The FAA has been trying to reduce the risk with a program called the Airport Movement Area Safety System—but that program too has encountered problems and has been delayed. Again, whether more funding would resolve the problems effectively is unclear.

Another approach to spending additional money productively might involve having the FAA adopt a strategy of buying more off-the-shelf equipment and planning on continual upgrades as they become available. A question about such upgrading, however, would be its ability to meet the agency's strict requirement of reliability with virtually no downtime.

Improving Air Travel: Expanding the Capacity of Airports. Large increases in the number of airline passengers have strained many airports, which must provide enough gates to handle the additional flights, enough facilities and amenities to ease the inconvenience of flight delays, adequate and accessible ticket counters, efficient and accurate baggage-handling systems, sufficient parking facilities, and enough roads and rail lines to provide access. In addition, security equipment and procedures for screening passengers and baggage have been added to airports that were not originally designed with those concerns in mind, thus complicating travelers' journeys through airports and adding to airports' investment needs.

Legislation passed in March 2000 nearly doubled federal funding for airports, to more than $3 billion a year over the next three years. But airports could always use more money. Major airports continue to embark on expansion programs to meet growing demands, and smaller airports sometimes strain to install equipment that would improve safety and security. In keeping with the federal interest in public safety and national security, additional federal funding could help in expediting the installation of modern security equipment and reconfiguring the layout of facilities to ease movement through airports while maintaining a high level of security.

Large commercial airports are generally able to finance additional investments from their own sources of funds. In addition to federal aid, they receive revenues from landing fees, terminal-area rentals, parking fees, and other charges imposed on users; those revenues can be used in turn to back bond issues, which give airports access to private capital to meet their needs. Yet large airports receive about 40 percent of all federal aid for airports.[10] Whether additional federal aid for large airports would increase the total amount of investment or whether it would merely substitute for funding from airports' own sources is unclear.

In that light, one policy option for the federal government would be to direct any additional aid to the smaller commercial airports, which have fewer users from which to derive fee revenues and less access to private financing. Smaller airports could use increased federal aid for projects and equipment to enhance safety, such as better navigational aids, improved runway and taxiway lighting, and so forth. Such investments, and others used to install security screening equipment, could help bring smaller com-

8. See, for example, *National Airspace System: Persistent Problems in FAA's New Navigation System Highlight Need for Periodic Reevaluation*, GAO/RCED/AIMD-00-130 (June 2000); *Air Traffic Control: Status of FAA's Modernization Program*, GAO/RCED-99-25 (December 1998); *Air Traffic Control: Improved Cost Information Needed to Make Billion Dollar Modernization Investment Decisions*, GAO/AIMD-97-20 (January 1997); and *Aviation Acquisition: A Comprehensive Strategy Is Needed for Cultural Change at FAA*, GAO/RCED-96-159 (August 1996).

9. General Accounting Office, *Air Traffic Control: Status of FAA's Modernization Program*, pp. 2-3.

10. "Large airports" here refers to the 70 or so airports that the FAA categorizes as large- and medium-hub airports, which serve nearly 90 percent of the airline passengers in the United States.

mercial airports up to the same standards as large ones, which could induce more passengers to fly into and out of smaller airports. That redistribution of passengers could expand the capacity of the entire system by relieving congestion at large airports and attracting more airline service to small communities.

Critics of federal aid to airports contend that air travel is a service that provides primarily private benefits and that any public spillover benefits from airports are primarily local and regional in nature and at best could justify public support only from local or regional governments. In addition, citing the fact that large airports can fund all or most of their needs from private sources, critics argue that smaller airports' need for public assistance indicates that they do not pass the market test of covering costs with revenues from users and other beneficiaries. Thus, opponents of federal support to smaller airports view such subsidies primarily as transfers that are intended to promote local economic development.[11]

Improving Passenger Rail. In addition to providing funds to expand the capacity of the aviation system, the federal government could help improve intercity passenger travel by investing more heavily in rail service. Increased rail service could alleviate congestion on highways as well as in the air. But increasing funding for rail would mark a change from current federal policy, which calls for Amtrak to cover its operating costs out of its own revenues by the end of 2002.

The amounts of federal funding provided for passenger rail service pale beside those for highways and aviation. The federal government has provided about $25 billion for Amtrak since it was created in 1971; the Congress appropriated $521 million for it in 2001. In comparison, federal highway funding is now running at about $30 billion a year and is authorized at about $170 billion over the period of 1998 to 2003; for aviation, $40 billion over 2001 to 2003 is authorized. However, federal spending on Amtrak comes out of the general fund, whereas most funding for highways and airports (along with some funding for air traffic control) is financed through user taxes.

In creating Amtrak, the federal government took over the passenger operations of private railroads, most of which were experiencing severe financial difficulties in the late 1960s. Passenger operations were especially unprofitable as they faced growing competition from airlines and from automobile travel on the newly built Interstate Highway System. The premise behind the federal takeover was for federal subsidies to redress the problem of deferred maintenance and to upgrade track and modernize railcars and thereby restore the profitability of passenger rail service. Thus, the National Railroad Passenger Corporation (Amtrak's official name) was to become profitable after a few years and no longer need federal subsidies.

That profitability has not been achieved. Amtrak still loses money on almost all of its routes; the exception, according to Amtrak, is that Metroliner service between Washington, D.C., and New York City covers its operating costs with passenger revenues (and other Northeast Corridor service in general reportedly almost reaches that threshold). The original plans for Amtrak were demonstrably overambitious; in light of the subsidies other countries give their passenger rail operations, it may be unrealistic to expect a nationwide rail system to be profitable. In any event, the revised target set by the Congress in 1997 is for Amtrak to cover its operating costs by the end of 2002, implicitly acknowledging that the federal government may continue to be called upon for capital assistance.

Proposals for supporting passenger rail service raise two central questions: first, whether the federal government should subsidize at all a service that in principle could be run as a private enterprise; and second, as in the case of airports, whether any subsidies should favor the "needier" parts of the system, such as the routes that serve relatively few riders, or the parts that are closer to self-supporting. Clearly, in the Northeast Corridor, Amtrak is providing service that passengers value, as shown by their willingness to pay. A key to the attractiveness of that service is that the alternatives—highway and air travel—are congested and subject to delays. Moreover, the areas along the corridor are populous, providing a large number of prospective passengers, and several intermediate cities between Boston, New York, and Washington help create a demand for trips that are

11. For a broader discussion of federal financing of small airports, see Congressional Budget Office, *Financing Small Commercial-Service Airports: Federal Policies and Options*, CBO Paper (April 1999).

not long enough to be practical by airplane. Federal assistance focused on the Northeast Corridor would reinforce significant new investments Amtrak has made there in recent years to upgrade track and complete electrification of the line for its new high-speed Acela trains. The Acela trains, which can travel at up to 150 miles per hour, are expected to cut about an hour from travel times between Boston and New York and save about 15 minutes between New York and Washington.

Other corridors have some of the same characteristics, although none has quite the confluence of factors that makes passenger service as viable as it is in the Northeast Corridor. In the Midwest, for example, the line that connects Chicago, Milwaukee, Madison, and Minneapolis/St. Paul serves cities with airports where travelers can face significant delays due to congestion and bad weather, but it has lower population densities and hence fewer potential passengers at intermediate points between the major cities.

In addition to looking at current and potential demand for rail service along specific corridors, the federal government might also take into account the willingness of state and local governments to match federal subsidies, which would provide an indication of how much local taxpayers value rail service. Even people who never ride trains may benefit from them because of reduced congestion on highways and at airports.

Alleviating Urban Traffic Congestion

The transportation problem that affects most urban travelers in their daily lives is traffic congestion. The Texas Transportation Institute estimated that "congestion cost travelers in 68 urban areas 4.3 billion hours of delay, 6.6 billion gallons of wasted fuel consumed, and $72 billion of time and fuel cost in 1997."[12] Despite the size of the problem, urban congestion is inherently local or regional, not national, and so the justification for federal involvement can be questioned. But the federal government's support of urban highways and mass transit gives it influence in those areas because it can direct how federal aid may be used.

How to use that influence to address congestion problems is a contentious issue. Although additional highway construction can help in some cases, opportunities to build or widen roads are increasingly limited by a combination of a scarcity of land, neighborhood opposition, and concerns over adverse environmental impacts. Even where construction is feasible, some argue that it would be ineffective because it would promote additional traffic that would soon restore the original levels of congestion. Accordingly, at the same time that the Congress has provided substantial increases in funding for highways, interest has mounted for other approaches, such as reducing automobile traffic through the use of mass transit, telecommuting, congestion pricing, and other forms of demand management and increasing the capacity of existing roadways through the use of computer and communications technology.

Promoting Mass Transit. The federal government currently provides about $7 billion a year in aid for mass transit. Targeting additional aid efficiently could be difficult. Except along corridors with high population densities—which often developed along streetcar lines before the advent of the automobile—buses are generally far more cost-effective, but rail systems attract much more popular support.

For cities that have rail transit systems, probably the greatest return for the dollar is in keeping those systems in good repair. In some cities, subway systems have suffered from deferring the maintenance of cars, track, and escalators and elevators at stations. In general, federal aid has not been available for operation and maintenance (O&M) costs, although major overhauls of equipment are eligible for such aid. One policy option, discussed below, which could be applied to transportation infrastructure in general or rail systems in particular, would be to allow federal aid to be used for O&M.

For areas that do not have the densely populated corridors needed to support rail transit, a more relevant question is how to make bus service more attractive. One way might be to address the common complaint that potential bus passengers are not sure of the

12. David Schrank and Tim Lomax, *The 1999 Annual Mobility Report: Information for Urban America* (College Station, Tex.: Texas Transportation Institute, Texas A&M University System, November 1999), p. xvii, available at http://mobility.tamu.edu.

routes, schedules, or fares. Some options for making this information more readily available might involve the use of modern communications systems. For example, providing route and schedule information over the Internet in a user-friendly form could allow riders and potential riders to customize the material for their specific needs—and have the side benefit of lowering transit agencies' costs for publishing printed schedules. Improved technology could also let passengers know the location of the bus they are waiting for and its expected time of arrival at their stop.

Another complaint is that buses are slow, often stopping every few blocks to take on and let off passengers and getting stuck in traffic. One solution is to have dedicated lanes for buses on major roads—a practice that has enjoyed some success in attracting commuters. Another is to equip buses with transponders that cause traffic lights to turn green for them. Finally, charging motorists for using roads during peak periods—that is, congestion, or value, pricing (discussed in more detail below)—may make bus service more attractive compared with driving.

In sum, additional federal aid for mass transit would probably be more effective if spent on bus service—including expanding routes, increasing frequencies, buying new equipment—and on maintaining existing rail systems than if spent on new rail lines.

Curbing Automobile Traffic. If public policies cannot get people out of their cars and into buses or trains, perhaps they can reduce traffic or congestion in other ways.

Carpooling is one possibility. Some federal money has gone to communities to promote carpools and facilitate their formation—for example, through the use of computer programs that match people by location, work schedule, preferences about music and smoking, and other factors. Some people who have unpredictable schedules, not easily accommodated by traditional carpools, may also be able to share rides through "instant" carpools. In northern Virginia, instant carpools have become common through the use of "slug lines," in which ride-seeking commuters—the slugs—wait at commuter parking lots for drivers—body snatchers—who need riders in order to use HOV (high-occupancy-vehicle) lanes. The slug lines probably reduce the number of cars on the road—although they also probably reduce the demand for bus service. Whereas the lines are a low-tech approach to instant carpooling, high-tech communications—such as instant messaging on wireless equipment—might also facilitate it.

Another solution that uses modern technology is congestion pricing. Reflecting the basic economic principle that prices are fundamental to clearing markets, congestion pricing implements the idea that a shortage of roadway capacity indicates a need for a higher price. Until fairly recently, the lack of a practical way to charge people without creating further congestion was a major barrier to congestion pricing, but the introduction of electronic toll collection has now lowered that barrier. The first examples of congestion pricing are found on two new roadways in southern California and one in Texas, which reserve lanes for high-occupancy vehicles and for vehicles with single occupants who are willing to pay a toll. The tolls on those so-called HOT (high-occupancy toll) lanes are set at levels that control the demand and keep traffic flowing freely; they reflect the amount of congestion in the unrestricted lanes and vary by time of day. In 1998, the Congress authorized $51 million through 2003 for pilot projects in congestion pricing.

Making Highways and Vehicles Smarter. A number of computer and communications technologies have a successful track record or offer an encouraging prospect for helping to alleviate congestion. Sensors that detect traffic volumes have proven effective in smoothing the flow of traffic, by modulating the length of stoplights on city streets or adjusting the entry rate of vehicles onto limited-access highways. And equipment being introduced that alerts drivers if their cars are too close to ones in front or if they start to change lanes into paths of other vehicles can prevent accidents that tie up traffic. Advanced technologies such as those are the focus of the federal Intelligent Transportation Systems (ITS) program, for which the Congress has provided about $1.3 billion over the six-year period of 1998 to 2003.

Improving the Mobility of Urban Residents Without Cars

Less visible than the general problem of urban traffic congestion but also fundamental to improving the quality of people's lives are the mobility problems of people who cannot drive or cannot afford to buy a car. State and local governments can address the issue; indeed, they are better positioned than the federal government to take account of local geography and preferences, and many already focus some efforts on the needs of the poor, the elderly, and the disabled—using both local funds and federal grant money.[13]

But the Congress could decide to provide additional federal funding to reduce the financial burden on areas with high proportions of transit-dependent residents or to support other national goals. For example, funding to meet the mobility needs of the poor could contribute to the national goal of getting people off the welfare rolls and into the workplace by making it easier for them to get to their jobs. New jobs are frequently created in the suburbs, especially in office parks, far away from the inner cities where many welfare recipients live. Mass transit systems often do not serve the needs of such "reverse" commuters. In particular, most rail transit systems were designed to transport commuters from suburbs to employment centers in cities, not to suburban office clusters or industrial parks. Some companies located in the suburbs now offer van service to shuttle employees between the nearest rail station and the office, but others have not found it in their interest to provide such service. Whether a local transit system could provide the service efficiently would depend principally on how many passengers would use it and what they would be willing to pay.

Reverse commutes often involve one, two, or even three transfers, lengthening a trip that would have taken 20 or 30 minutes by car to more than two hours. That extra time away from home—for which child care arrangements may be needed—can be a significant barrier for people trying to break into the labor force and support themselves and their families. And in some cases, public transit systems do not operate late enough at night or early enough in the morning to serve people whose shifts at such entry-level jobs as cleaning offices or working in hotel kitchens extend outside traditional commuting hours.

In addition to the commuting needs of people who do not own cars are the mobility needs of people who do not drive because of age or disability. The number of elderly people who have stopped driving because they can no longer see as well or react as quickly as they once did is growing. More might prefer to stop driving if doing so did not have such a profound effect on their ability to live independently.

Of course, one option to help meet the needs of those who depend on mass transit is to provide more federal aid to local agencies so that they can expand their rail and bus systems. But simply increasing traditional service offerings may not be cost-effective—again, because current routes do not necessarily serve the specific needs of the transit-dependent population. The low densities in the suburbs make it costly to provide transit service not only for reverse commuters but also for the elderly who live there.[14]

A second set of options would support transit services that are more targeted to specific needs and conditions. For example, the federal government could assist suburban communities in operating transit systems using buses that are smaller and less expensive than typical urban buses and drivers who are hired for more limited hours (for just the morning and evening peaks, for instance). Although such service still typically needs subsidies, the subsidies may be lower than those to a larger system, and the service provided could be more tailored to the needs of the local community. The federal government could also support van service from low-income urban areas to jobs in the suburbs—service that could be provided either by privately owned shared-ride vans like those used by some commuter vanpools or by exist-

13. Under the Temporary Assistance for Needy Families program, federal block grants can be used to provide transportation services to welfare recipients and other people with low income. Also, the Transportation Equity Act for the 21st Century authorizes grants to transit agencies and other qualified groups to help welfare recipients commute to work.

14. A transit agency that has few passengers on a bus route—perhaps too few to cover even the operation and maintenance costs, let alone the capital costs and other fixed costs—may reduce the number of buses, and therefore the frequency of service, leaving the service less attractive to potential riders and contributing to a downward spiral in ridership.

ing transit agencies. Even if operated with sufficient frequency throughout the day and night, van service might prove more cost-effective than expanding bus service that requires multiple transfers.

A third area to explore is the use of computer and communications technologies. The federal government's ITS program includes a number of applications to public transit. By letting transit managers track the locations of vehicles and communicate with drivers, using computers to map out the most efficient routes to pick up and deliver passengers, and keeping passengers informed about the expected time of arrival of their vehicles, ITS applications could produce on-call, door-to-door service. Such service would be costly, though—perhaps more costly than what passengers are willing and able to pay in fares plus what taxpayers at the federal, state, and local levels are willing to pay in subsidies.

A fourth approach would be to give targeted financial assistance to low-income urban residents without cars. For example, the federal government could provide grants or loans directly to people leaving the welfare rolls who want to buy cars or vans for the purpose of transporting themselves or their neighbors to jobs. Low-income elderly people who cannot drive could be given vouchers for reduced fares on taxis. With some modifications (to use other specialized services in areas not well served by taxis, for example), such assistance could be provided in rural areas as well.

In sum, the mobility needs of those without cars are not the standard suburb-to-downtown commuter trip nor the crosstown trip. The most cost-effective responses may be to target federal assistance at projects and programs with high benefit-cost ratios but allow a wide range of different uses in accord with local needs and opportunities.

Investing in Maintenance

Federal support for transportation infrastructure has traditionally focused on new construction and capital equipment, but an option for increased spending would be to authorize more funding for necessary maintenance. Historically, the opening of new facilities—roads, canals, mass transit lines, airports—has generated more public attention than their maintenance. Elected officials have received credit for bringing new projects to their districts, culminating in elaborate ribbon-cutting ceremonies. Spending money to maintain those systems is not so glamorous; it is just part of the day-to-day activities of state and local governments. Yet that spending is valuable in preserving capital investments over their useful lives. Moreover, it staves off reconstruction projects that can be so costly and inconvenient to travelers. For example, small potholes that are not repaired can worsen and ultimately damage cars. Further neglect can lead to erosion of a road's or bridge's substructure, weakening it and hastening the end of its useful life. At that point, major reconstruction is needed, involving higher costs; closed lanes; and, often, massive traffic jams.

Federal grants for highways, transit, Amtrak, and airports have been largely restricted to capital spending, although in some cases they have covered major maintenance expenses as well. There are several reasons for such restrictions. Besides the greater political appeal of capital investments, their tangibility makes it easier for the federal government to monitor what grants are being used to buy. Further, the federal government has shied away from offering operating assistance that could diminish the incentives of state and local governments to control such costs.

Restricting federal grants to capital investments has disadvantages, however. It precludes federal money from being spent on some maintenance activities that may yield a higher return at the margin than money spent on a new facility.[15] It also makes capital investments appear less expensive than O&M to state and local governments, which pay only about 20 percent of the cost of capital projects (under many federal programs) but 100 percent of the cost of O&M. Those distorted relative prices may lead local governments to favor overly large and expensive systems, to conduct too little O&M, and even to let capital investments deteriorate until they need the massive reconstruction that would qualify for a capital grant.

15. Again, in some cases, federal legislation does include heavy overhaul and maintenance within the definition of construction.

Viewed from the standpoint of improving efficiency, the issue is how to provide state and local governments with incentives to conduct the appropriate amount of O&M. If current policy leads to too little spending on O&M but equal treatment of capital and O&M for cost-sharing purposes would encourage wasteful spending, then one solution could be for the federal government to share some lower percentage of O&M costs. Some experimentation might help to identify the efficient federal share and to develop acceptable methods of oversight.

Drinking Water and Wastewater Infrastructure

Many observers believe that spending on the nation's drinking water and wastewater systems has been inadequate for some time. Indeed, a consortium of municipal agencies and industry associations estimates that the nation needs to double the current annual capital investment of $23 billion to adequately maintain, replace, and modernize the systems.

But views vary widely on the appropriate federal role, if any, in paying for water infrastructure. Currently, large urban systems finance the vast majority of their capital spending from local sources—primarily charges paid by residential and commercial ratepayers—but rural systems rely heavily on federal and state assistance. Proponents of increased federal support argue that federal laws and regulations are driving a large share of the current and projected investment needs and that leaving the funding burden with local water systems would require water rates that were unaffordable for many rural and low-income households. Opponents argue that future needs could be significantly reduced if water systems were pushed to operate more efficiently and that any public support would more appropriately come from state or local governments.

The History of Federal Involvement with Local Water Systems

Except as a builder of dams and other major public works used to supply water, the federal government played a relatively minor role in funding or regulating local water systems before 1972. The Public Health Service had published drinking water standards as early as 1914 and updated them in 1925, 1946, and 1962, but those standards were federally enforced only for water supplies used on interstate railroad trains. As for wastewater, matching grants for 30 percent to 50 percent of the cost of constructing publicly owned treatment works became available in 1956, but initially the amount of funding was limited, and no federal requirements existed for such facilities.

With the passage of the Federal Water Pollution Control Act Amendments of 1972, later designated the Clean Water Act, the Congress adopted the goal of restoring and maintaining the quality of the nation's waters, thereby protecting their usefulness for fishing and swimming. Toward that goal, the act required that municipal wastewater discharged to surface waters be treated using "secondary" (biological) methods to reduce the levels of key pollutants by 85 percent; increased the federal matching share for constructing public wastewater facilities to 75 percent; and greatly expanded the available funding.[16] Consequently, federal outlays for wastewater treatment grants rose 10-fold in real terms during the 1970s, reaching a high of $8.4 billion (in 1997 dollars) in 1980.[17] In total, the Congress appropriated $73 billion (in nominal dollars) from 1973 through 2001.

The Congress's stated original intent was to provide a temporary period of expanded funding for constructing secondary treatment facilities—and, indeed, funding has declined sharply since its inflation-adjusted peak in 1980. Amendments in 1981 cut the authorization for wastewater grants in half and reduced the federal matching share to 55 percent for facilities built after 1984. Then in 1987, legislation was enacted to phase out the construction grant program by 1991 and replace it with grants to capitalize state revolving funds, with the states matching 20

16. Secondary treatment involves the consumption of pollutants by bacteria and other organisms; typically, air is supplied to the wastewater to stimulate the organisms' activity. Primary treatment methods using gravity and mechanical methods (such as screens and skimming devices) generally remove 45 percent to 50 percent of pollutants.

17. Congressional Budget Office, *Trends in Public Infrastructure Spending*, CBO Paper (May 1999), pp. 102-104.

percent of each federal dollar. The revolving funds provide several types of financial support to wastewater facilities—including loans at or below market interest rates, guarantees for new local bond issues, and purchases of existing bonds—but do not make grants. The 1987 law envisioned that loan repayments would allow the state funds to operate without ongoing federal support and therefore authorized federal contributions only through 1994; nevertheless, the Congress has continued to appropriate funds each year since then, including $1.35 billion for 2001. Meanwhile, the goal of providing secondary treatment of all wastewater has been nearly reached: according to the Environmental Protection Agency's (EPA's) data, as of 1996 only 176 of the 14,000 public treatment facilities discharging effluent streams to surface waters were providing less than secondary treatment—and some of those are exempt from the requirement because they in fact discharge to sufficiently deep ocean waters or to other facilities that in turn provide secondary treatment.

The first major federal legislation on drinking water came in 1974, with the passage of the Safe Drinking Water Act. Support for the act reflected concerns that the Public Health Service's drinking water standards were based on inadequate and obsolete data, that state and local officials were not adequately monitoring water systems, and that pollutants found in drinking water were carcinogenic. The law required EPA to set standards, called "maximum contaminant levels," by reference to ideal "maximum contaminant level goals"—levels at which no adverse health effects are known or anticipated. Specifically, the law directed EPA to set the standards as close to the goals as possible without making them unaffordable for large water systems with relatively clean sources of water. In 1986, the Congress amended the law to require EPA to develop standards for 83 specific contaminants and for additional sets of 25 contaminants every three years.

Neither the original act nor the 1986 amendments authorized federal funding, but as the number of standards and the costs of meeting them grew, so did support for providing financial assistance to water systems. Thus, one of the key provisions of the act's 1996 amendments created a program of state revolving funds for drinking water and authorized $9.6 billion through fiscal year 2003 in capitalization grants to be matched by an additional 20 percent from recipient states, as in the case of the wastewater funds.[18] (Appropriations through fiscal year 2001 for the drinking water funds have totaled $4.4 billion.) Other major provisions revoked the requirement that EPA regulate an additional 25 contaminants every three years, authorized the agency to adopt less stringent contaminant standards if necessary to keep costs from exceeding benefits, and required it to identify "variance technologies" for use by small systems judged unable to afford to comply with the relevant standards. As discussed below, small drinking water and wastewater systems tend to face significantly higher costs per household.

Federal programs besides EPA's also provide financial support for investments in water infrastructure. The Rural Utilities Service of the U.S. Department of Agriculture (USDA) provides a mix of loans and grants for water and waste-disposal projects in communities with fewer than 10,000 people; the program received $744 million in 2001, including $100 million from a supplemental appropriation. Drinking water and wastewater projects may also receive funding through the Public Works and Development Facilities Program (administered by the Economic Development Administration in the Commerce Department) or the Community Development Block Grant program (administered by the Department of Housing and Urban Development) if they meet the relevant criteria. The former program focuses on job creation and the latter on community development that benefits low- and moderate-income people. Still other programs focus on assistance to specific groups or locations, such as Indian tribes, native Alaskan villages, Appalachia, and unincorporated settlements on the U.S.-Mexican border.

Investment Needs

Dramatic incidents in recent years have highlighted problems associated with inadequate spending on water infrastructure. In 1993, contamination of the

18. Unlike the revolving funds for wastewater facilities, those for drinking water systems allow states to provide grantlike assistance: in particular, states may use up to 30 percent of their capitalization grants to forgive principal or to subsidize negative interest rates on loans for systems serving disadvantaged communities, as defined by state criteria.

Milwaukee water supply by cryptosporidium caused 400,000 cases of gastrointestinal illness and an estimated 50 to 100 deaths. That same year, two people in Atlanta were killed by falling into a sinkhole created by the collapse of a storm sewer. Problems with water systems led to two sinkholes at least 30 feet deep in Baltimore in 1997 and to one in Manhattan that did millions of dollars of damage in 1998.

Less catastrophic failures occur regularly and demonstrate the widespread nature of the problems. According to EPA's data, 880 wastewater facilities receive flows from "combined sewer systems," which commingle storm water with household and industrial wastewater, and frequently overload during heavy rain or snowmelt. EPA estimates that such overflows discharge 1.2 trillion gallons of storm water and untreated sewage per year. Even "sanitary sewer systems," which do not commingle storm water with household and industrial wastewater, overflow and leak because of blocked pipes, failed pumps, inadequate maintenance, or excessive demands. According to *U.S. News & World Report*, a draft EPA report estimates that overflows and leaks from those systems result in a million illnesses each year.[19]

In part, these problems are the natural consequence of aging pipes and equipment. Though less visible than treatment facilities, pipes and related distribution equipment actually account for about three-quarters of the value of water systems. According to estimates, drinking water systems have 800,000 miles of pipes, and sewer lines cover more than 500,000 miles.[20] The rule of thumb is that a sewer pipe lasts 50 years (although actual useful lifetimes can be longer, depending on maintenance and local conditions). A 1998 survey of 42 municipal sewer systems by the American Society of Civil Engineers found that existing pipes average 33 years old, suggesting that many are, or soon will be, in need of replacement.[21]

The amount of money required for water systems is uncertain but substantial. The best available estimates from EPA total about $340 billion over 20 years, or an average of $17 billion per year. That total includes $138.4 billion from the agency's first survey of the needs of drinking water systems, conducted in 1994 and 1995; $128.0 billion from its most recent (1996) survey of wastewater systems' needs eligible for federal funding; and a supplemental estimate, based on additional survey and modeling work, of $81.9 billion in needs for preventing overflows from sanitary sewers, representing a net increase of roughly $70 billion over the most comparable figures from the 1996 survey.[22]

A recent report by the Water Infrastructure Network (WIN), a consortium of 21 industry, municipal, and nonprofit associations, estimates that nationwide needs for investment in water infrastructure average $47 billion per year (in constant 1997 dollars) over the period of 2000 to 2019, twice the reported current spending of $23 billion.[23] Of that $47 billion, $37 billion represents actual infrastructure costs, and $10 billion represents interest costs.[24] Interest costs aside, that estimate is more than twice the analogous figure based on EPA's surveys.

19. David Whitman, "The Sickening Sewer Crisis," *U.S. News & World Report*, June 12, 2000, p. 17.

20. American Society of Civil Engineers, "Issue Brief: Drinking Water" (undated); Parsons Engineering Science, Inc., Metcalf and Eddy, and Limno-Tech, Inc., *Sanitary Sewer Overflow (SSO) Needs Report* (prepared for the Environmental Protection Agency, Office of Wastewater Management, May 2000), p. 2-2. The estimate of sewer lines is for systems with separate sanitary sewers; given the same assumptions, systems that combine sanitary wastewater and storm water add roughly 140,000 more miles to the overall total.

21. American Society of Civil Engineers, *Optimization of Collection System Maintenance Frequencies and System Performance* (prepared for the Environmental Protection Agency, November 1998).

22. Environmental Protection Agency, Office of Water, *Drinking Water Infrastructure Needs Survey: First Report to Congress* (January 1997) and *1996 Clean Water Needs Survey: Report to Congress* (September 1997). The total needs estimated in the latter report included an additional $11.5 billion to address "nonpoint" pollution from agriculture and silviculture (forestry) and urban runoff and to protect groundwater, estuaries, and wetlands.

23. Water Infrastructure Network, "Clean & Safe Water for the 21st Century: A Renewed National Commitment to Water and Wastewater Infrastructure" (undated), available from the American Water Works Association (Washington, D.C., www.awwa.org/govtaff/win/finalreport.pdf) and the Water Environment Federation (Alexandria, Va., www.wef.org/PublicInfo/Newsroom/PressReleaseArchives/2000/041200.jhtml).

24. To determine the interest costs, the report assumes that 75 percent of the capital is financed by 20-year bonds at a real interest rate of 3 percent.

Whether total water infrastructure needs (before interest costs) lie closer to $17 billion or $37 billion per year is impossible to say. Both sets of estimates could be too high if they reflect overly pessimistic assumptions about technical progress and the amount of piping that needs to be replaced. However, some features of EPA's $17 billion estimate tend to understate total needs. For example, the wastewater survey excluded routine replacement of sewer pipes, which is not eligible for financing from the state revolving funds, and the drinking water survey excluded costs arising from population growth. Moreover, according to EPA staff, respondents to either survey may have lacked the time or information to document some of their needs, especially those occurring later in the 20-year period. Also, being the first of its kind, the drinking water survey may have suffered from some misunderstandings, as suggested by the fact that at least 24 percent of the responding large utilities reported no needs related to transmission and distribution.[25] According to EPA staff, follow-up visits to some community water systems revealed that their survey responses under reported total needs by an average of 55 percent.[26]

Adding interest costs makes the estimate of $17 billion in annual capital needs derived from EPA's surveys roughly comparable to the current spending level of $23 billion. Even if that estimate proved to be correct, however, many local water systems would be likely to come under increased financial pressure from rising costs for operation and maintenance, in part the result of more complex treatment systems. The report of the Water Infrastructure Network estimates that O&M will average $49 billion per year over the 2000-2019 period, up from $34 billion in 1994, notwithstanding a 25 percent savings from improved efficiency.[27]

The needs faced by individual water systems will depend on many local factors, including the quality of their source water (for drinking water systems) and the average age of their pipes. The size of a system is another important factor: treatment costs in particular are subject to economies of scale. For example, on the basis of EPA's data on the costs of monitoring and treatment to comply with the drinking water standards in force as of September 1994, CBO estimates that the average cost per household was about $4 per year in systems serving more than 500,000 people but $300 per year for systems serving no more than 100 people.[28] Although large systems serve the great majority of customers, most water systems are small.[29] For example, 59 percent of the roughly 54,000 publicly or privately owned community drinking water systems serve 500 people or fewer, and 85 percent reach no more than 3,300 people. The majority of wastewater systems are also small.[30]

As with costs, charges also vary significantly among water systems. EPA's analysis of data collected by the state of Ohio, for example, shows that although the average rate charged by municipalities in the state for a given amount of household water and wastewater use was $570 per year in 1997, the charge exceeded $800 in 18 percent of municipalities and $1,000 in more than 2 percent. Water prices have risen significantly in real terms—the statewide

25. Stratus Consulting, Inc., *Infrastructure Needs for the Public Water Supply Sector* (prepared for the American Water Works Association, Washington, D.C., December 1998), p. 2-5.

26. Community drinking water systems are defined as those with at least 15 service connections used by year-round residents or otherwise serving at least 25 year-round residents; the systems need not be publicly owned.

27. Water Infrastructure Network, "Clean & Safe Water," pp. 2-4 to 3-2.

28. New calculation, based on data in Congressional Budget Office, *The Safe Drinking Water Act: A Case Study of an Unfunded Federal Mandate* (September 1995), pp. 16-17.

29. Just 7 percent of community drinking water systems serve more than 10,000 people, but they supply 80 percent of those served by community systems; and systems with more than 100,000 customers represent 1 percent of systems but 44 percent of all people served. Similarly, wastewater facilities serving more than 10,000 people account for 89 percent of the population that EPA estimates will be served by existing or new public facilities in the year 2016. See Environmental Protection Agency, "EPA Safe Drinking Water Information System Factoids," available at www.epa.gov/safewater/data/99factoids.pdf, and Environmental Protection Agency, *1996 Clean Water Needs Survey*, p. 16.

30. EPA projects that 60 percent of the 30,000 "facilities" needed by 2016 will serve fewer than 3,500 people each (Environmental Protection Agency, *1996 Clean Water Needs Survey*, p. 16). But according to EPA staff, the universe of facilities includes some pipe networks and projects to control pollution from nonpoint sources, as well as wastewater treatment facilities. Privately owned wastewater systems, such as household septic systems, are excluded from statistics on public treatment facilities; otherwise, the percentage share for small systems would be even higher.

average in Ohio had been $440 in 1985, measured in 1997 dollars—and they will continue to rise, in light of the needs for replacing aging pipes and equipment, implementing new regulations, and reducing sewer overflows. The WIN report estimates that without additional public funding, 22 percent of households nationwide will spend more than 4 percent of their income—a threshold that EPA uses as a test of affordability—on water and wastewater by 2009, up from 16 percent of households in 1989 and 18 percent in 1997.

The government agencies and private companies that own water systems also differ in their reliance on public assistance. Nationwide, user charges provide the vast majority of money going to water utilities and cover essentially all operating costs, for which outside funding is generally not available. For capital spending, however, public support plays a larger role; small rural systems in particular depend heavily on loans and grants from the Rural Utilities Service, the federally supported state revolving funds, other federal programs noted above, and state-level aid programs. Even large systems draw on some federal assistance: responses from 97 large wastewater utilities to a 1999 survey by the Association of Metropolitan Sewerage Agencies showed that an average of 9.6 percent of funds for capital improvements between 1999 and 2003 were expected to come from loans from state revolving funds and another 2.0 percent from federal grants.[31]

Those current financing patterns shed limited light on future needs for federal funding, however. On the one hand, they may obscure the extent to which even large utilities have been deferring important investments for lack of available funds. On the other hand, they also do not reveal the extent to which future needs could be reduced through more efficient pricing, investment, and management, nor the prospects for increased contributions from ratepayers (particularly of large systems) or state or local governments.

Options for Increased Federal Spending

If the Congress wished to increase federal support for water infrastructure, it could do so in various ways. The options include (1) across-the-board increases in funding for all community water systems and publicly owned wastewater systems, (2) increased support for the costs of complying with federal standards, (3) increased support for small systems and/or low-income ratepayers, and (4) increased research and development for treatment and distribution technology. The second and third options represent alternatives to the broader first option but are not mutually exclusive, and the fourth option could be combined with any of the others.

Across-the-Board Increases. Perhaps the most straightforward way for the federal government to provide additional support would be to do more of what it is already doing—that is, to increase federal contributions to the state revolving funds for drinking water and wastewater systems. However, some argue that the revolving funds are an inadequate answer to current and future needs because they merely reduce interest costs and otherwise leave the burden on ratepayers to fund all investments. To go further, the Congress could revive the construction grant program for wastewater facilities and extend it to drinking water systems as well. At the extreme, across-the-board funding could conceivably absorb $15 billion or more per year in additional spending if the federal government assumed responsibility for closing the entire "funding gap" estimated by the Water Infrastructure Network.[32]

The primary argument for substantial across-the-board increases is that the needs are so great, they cannot be met without federal help. In the words of the WIN report, "The bottom line is that without a significantly enhanced federal role in financing drinking water and wastewater infrastructure, critical investments may not occur."[33]

31. Association of Metropolitan Sewerage Agencies, *The AMSA Financial Survey, 1999* (Washington, D.C.), p. 47.

32. Interest costs represent $10 billion of the $23 billion annual gap in capital spending estimated in the WIN report. Those costs would presumably be much lower if the federal government provided a major infusion of up-front grant money.

33. Water Infrastructure Network, "Clean & Safe Water," p. 5-2.

By itself, that argument is at best incomplete. However large the needs may be, they are no less affordable for utility ratepayers—households, commercial and industrial businesses, and so forth—in the aggregate than for taxpayers, because the two are largely the same. A more complete version of the argument might state that because the costs are so large, some ratepayers should help other ratepayers through a federal redistribution. That rationale points most directly to increased support for low-income households and high-cost (small) systems, as discussed below, but supporters of broad federal assistance might argue that universal assistance is a simpler or more stable way to accomplish the redistribution than targeted assistance.

Another argument that can be made for broad support of wastewater systems is that they often have positive externalities—that is, they often confer a benefit on downstream water users who do not pay for the systems. Indeed, one justification for the original construction grant program under the Clean Water Act was that it was appropriate for the government to help defray the costs of meeting the new wastewater standards because much of the benefit of each community's investment would accrue to others.

Conversely, one argument against federal assistance to water systems is that their problems are generally issues of local or regional concern. By that view, wastewater facilities may have deserved their original support on a short-term basis, to help communities adjust to a major statutory change, but should now be held responsible for their own contributions to water pollution, just as industrial dischargers are.

A related argument against broad federal support of water systems is that intervention in local issues can distort incentives and undermine efficiency. The greater the federal support, the lower the pressure on utility managers to minimize costs rather than face angry ratepayers, and the smaller the incentive for ratepayers to reduce their water use in light of its full costs to society.

Improvements in efficiency could significantly affect both the supply of and demand for water services. On the supply side, the quality of management, operations, and maintenance can have a major impact on water utilities' capital needs (for example, on how often pipes need to be overhauled or replaced); and water utilities, as publicly or privately owned monopolies, may not yet have been sufficiently challenged to operate efficiently. Indeed, in draft comments on EPA's forthcoming study of the alleged financing gap, the agency's Environmental Financial Advisory Board expressed its belief that "pollution-prevention and cost-effective management tools and techniques hold great promise in coping with the major financial implications of the Gap."[34] Increased federal aid could undermine the prospects for improved operational efficiencies—in part, by distorting choices between spending on capital and spending on O&M.

On the demand side, higher average water use in the United States than in other high-income countries (525,000 gallons per person per year, compared with, for example, 310,000 gallons in Canada and 221,000 gallons in Belgium) and higher use from public supplies than from private wells (350 versus 200 gallons per day for a household of four) both suggest that there is room for users to reduce their consumption if confronted with prices that fully reflect long-run capital needs.[35] Federal aid could continue to shield ratepayers from the true costs of their water use and undermine utilities' incentives to eliminate subsidies and cross-subsidies in their rate structures, charge higher prices during periods of peak use, or take other steps to reduce inefficient demand.

A final objection to across-the-board increases in federal funding is that some of the money would merely substitute for funds that would have been provided by ratepayers or from general revenues of state or local governments. Data from the early years of the construction grant program for wastewater facilities suggest such fiscal substitution: although federal support for investment in those facilities rose by $7.5

34. Pat Phibbs and James Kennedy, "Advice from Industry, Others Needed to Avert Crisis in Water Systems, EPA Says," *Environment Reporter*, March 10, 2000, p. 439. Pollution prevention can reduce costs by protecting sources of drinking water and by reducing the contamination faced by wastewater facilities. Thus, efficient management of water systems may go beyond the operations of the systems themselves to include some pollution-prevention measures.

35. Environmental Protection Agency, Office of Water, *Water on Tap: A Consumer's Guide to the Nation's Drinking Water* (July 1997), p. 7.

billion per year from 1970 to 1980 (in 1997 dollars), investment by state and local governments (including public utilities) fell by $1.8 billion, effectively negating about one-quarter of the federal increase. According to a more detailed analysis, which took into account factors that might otherwise have led to increased state and local investment, each dollar of federal construction grants reduced other capital spending by 67 cents.[36] Supporters of increased federal funding argue that provisions to reduce fiscal substitution—for example, requirements to at least maintain previous levels of nonfederal spending—could be included in new grant programs. They also argue that the needs—including the growing needs for operation and maintenance—are so large relative to the funding likely to become available, state and local governments will be little tempted to reduce their own spending.

Funding to Meet the Costs of Federal Standards. A program intended to help water systems pay for investments needed to comply with federal water standards would have much in common with a more general assistance program. However, the maximum amount of assistance the federal government could conceivably provide would be lower than the maximum of $15 billion per year under the general approach because some large categories of costs—notably, routine replacement of pipes—would be excluded.

More specifically, the potential maximum here would depend on which requirements were deemed eligible for assistance. If the only eligible costs were those for complying with federal drinking water standards, the maximum would average just $1.5 billion per year over 20 years (according to EPA's latest surveys, which may understate relevant costs, as noted above)—less than the current appropriations for state revolving funds. That definition of eligibility excludes all investments in wastewater systems on the grounds that restrictions on discharging pollutants into the water are better viewed as exercises of police power to protect downstream users and the environment rather than as impositions of federal standards that supersede local preferences. Alternatively, one could include the costs for secondary and advanced treatment of wastewater on the grounds that those costs reflect federal standards for how clean effluent waters should be.[37] Adding those costs raises the potential federal contribution to $3.7 billion per year (again, based on the estimates in EPA's surveys). If the costs of preventing overflows from sanitary sewers and combined sewers were also deemed eligible, the maximum amount of federal assistance under this policy could reach $10 billion per year.

Focusing on the costs of meeting federal standards, whether narrowly or broadly defined, adds a fairness argument to the case for federal assistance. If federal policymakers determine that the national interest is served by imposing uniform standards, it seems reasonable to consider whether the nation as a whole should bear the costs—especially in cases in which local costs seem likely to exceed local benefits, as is true of many drinking water standards applied to small systems.[38]

But just as across-the-board increases in federal assistance could undermine efficiency, aid targeted at the costs of meeting federal standards could distort incentives and reduce pressure on system managers to improve their operations. A second argument against such aid is that it would entail difficulties in defining and measuring the costs of meeting the standards. In many cases, the only feasible definition of the cost of a standard would be the total cost of compliance; yet under that definition, a significant share of the federal aid would merely reimburse local systems for costs they would have incurred voluntarily in the absence of the requirement. For example, without a standard from EPA limiting the concentration of some newly recognized contaminant to 5 parts per billion (ppb), various water utilities might have chosen on their own to meet that same standard or to install equipment that would attain some less stringent standard, such as 10 or 15 ppb, rather than to do nothing. Arguably, implicitly reimbursing local sys-

36. James Jondrow and Robert A. Levy, "The Displacement of Local Spending for Pollution Control by Federal Construction Grants," *American Economic Review*, vol. 74, no. 2 (May 1984), pp. 174-178.

37. Advanced treatment reduces the amount of suspended solids and biological oxygen demand by more than the 85 percent typically required or reduces other contaminants, such as nitrogen and phosphorus.

38. For a discussion of the types of considerations that might justify uniform national standards, see Congressional Budget Office, *Federalism and Environmental Protection: Case Studies for Drinking Water and Ground-Level Ozone* (November 1997).

tems for money they would have spent anyway, a form of fiscal substitution, would reduce the fairness gains produced by the aid. And measuring total compliance costs could itself be problematic: nationwide estimates could neglect important variations in local circumstances and be skewed by pessimistic industry analyses, while system-specific reimbursements would require extensive auditing of costs to prevent abuse. Finally, one could argue that such assistance would be unfair to those water systems (and their ratepayers) that had already invested to meet the standards, unless the aid was also available retroactively.

Support for Small Systems and Low-Income Households. Consistent with the primary argument used by supporters of increased federal assistance—namely, that water utilities and their customers simply cannot afford to pay the necessary costs—another relevant policy alternative would focus aid on the neediest systems and households.

The Congress could target funding to small rural systems, to low-income households, or both. Focusing on the water systems might be simpler—it could be accomplished, for example, by expanding the existing programs of USDA's Rural Utilities Service—but could leave low-income households in urban and suburban areas struggling to pay rising water bills. In either case, the amount of federal spending would depend on how narrowly the aid was targeted. The department reported that it had a $3.3 billion backlog of requests in 2000, whereas the program received $744 million in funding in 2001.

Targeted federal support would probably be more efficient than broader aid because that approach would confront more water systems with the full costs of their investment and operational choices and more ratepayers with the full costs of their consumption decisions. Conversely, some systems that did not receive federal aid might unwisely defer necessary investments and maintenance until disastrous failures occurred. Also, a targeted program might not reach all equally needy households, especially if the aid went solely to water systems on the basis of their size.

Research and Development. A fourth option for increased federal support would be to increase spending on R&D that could reduce water systems' costs and improve efficiency. Relevant subjects include not only treatment technologies but also pipe materials and methods of construction, maintenance, and demand management. Currently, the federal government spends roughly $10 million per year on such research; two industry groups, the Water Environment Research Foundation and the American Water Works Association Research Foundation, add a similar amount from private funds. How much more could be productively spent is uncertain, but the current effort is certainly small relative to the size of the industry or its projected investment needs.

Unlike the previous options (with which it could be combined), this last approach focuses on reducing the resource costs involved in water services and thus the amount that must be spent to close the alleged funding gap. One argument for the option is that the federal government has a stronger incentive than do individual states and water systems to take account of the nationwide benefits that would accrue from a particular research finding or innovation; therefore, federal support could improve efficiency by funding worthwhile projects that other parties would not. However, proponents of more aggressive federal aid would argue that while support for R&D is important, it is unlikely to make a large enough contribution to the pressing needs of the coming decade.

Civilian Research and Development

Research and development are important in many areas other than drinking water and wastewater, of course, and many in the Congress are exploring ways in which to augment federal support for R&D, especially in light of the more visible role technology has come to play in U.S. economic growth. Some legislative proposals seek to increase civilian R&D across the board, while others seek to implement a more selective approach—for example, focusing on information technology or on medicine and human biology. Other ideas prominent in the policy debate would focus additional R&D funding on universities (because of the special role they play in the creation and dissemination of technical knowledge); on particular scientific fields thought to have been neglected

recently; or on interdisciplinary research, which might go unfunded through standard peer review mechanisms but has a higher potential for new breakthroughs.

Rationales for Increasing Federal R&D

Federal R&D is usually justified one of two ways. First, it may be necessary in order to fulfill a federal mission, such as defense. As noted below, most federal R&D is mission-related. Second, it may help the economy or society at large by correcting for a market failure that would otherwise lead to too little investment in some types of R&D. As with research on water systems, the market failure arises because the benefits of R&D do not accrue only to the performer or sponsor of the work; rather, they spread—often at low or no cost—to others in the society through the dissemination of scientific information and copycat inventions. Representing society at large, the federal government can take such spillover benefits into account and thus may be willing to fund research whose likely payoff would seem inadequate from the narrower perspectives of private investors or even state governments.

Currently, the economy is in the midst of a technology and science boom—a situation that presents both opportunities and problems for those who would increase the federal investment in R&D. On the one hand, possible uses of federal funds abound. As knowledge expands through the resolution of simpler questions, the subsequent questions tend to be more difficult and to require more resources; therefore, there are now more scientists than ever doing R&D. On the other hand, nonfederal, especially private, spending on R&D is at an all-time high. Surveys from the National Science Foundation (NSF), while not perfectly consistent with appropriation data, suggest that industry spends roughly twice as much on R&D as the federal government does. Consequently, federal R&D funds must be well targeted if the goal is to support activities that private actors would not fund on their own.

Another consequence of the boom in technology and science is a tight labor market for researchers. Because the number of scientists and engineers qualified to do R&D is limited and can grow only slowly, some share of current federal spending on R&D may go to increase researchers' wages—particularly in fields such as aeronautical engineering, for which federal spending represents a large fraction of total demand—rather than to increase national R&D activity overall. According to one analyst, higher salary levels of scientists and engineers working in R&D accounted for between 8 percent and 30 percent of the increase in federal R&D spending from 1968 to 1994.[39] However, that estimate is probably overstated because the analysis does not control for other factors—such as the growth in private R&D and the increased technical intensity of the economy as a whole—that may have had a greater impact on those wages. Moreover, higher wages can be expected to help attract additional researchers over time. Indeed, the combined share of natural scientists, engineers, mathematicians, and computer scientists in the labor force rose from 2.4 percent in 1982 to 3.4 percent in 1999, roughly a 40 percent increase, which suggests that R&D spending over that period did not encounter long-lived shortages of skilled personnel.

Federal R&D Funding Considered by Function and Category

For fiscal year 2001, the federal government is providing an estimated $90.9 billion in budget authority for the conduct of R&D and for facilities and major equipment devoted to R&D. That amount represents a 9 percent increase over the 2000 level of $83.3 billion.

Mission-Related R&D. One way to categorize most federal R&D is by its mission. Most R&D funded by federal agencies in recent years has been devoted to furthering federal missions in four principal areas: in decreasing order of spending, defense, health, space exploration, and energy. In 2001, those four missions accounted for $77.7 billion, or 85 percent of the total budget authority devoted to R&D and related equipment and facilities. (Proposals for increased spending on defense-related R&D are discussed in Chapter 4 of this volume.)

39. Austan Goolsbee, "Does Government R&D Policy Mainly Benefit Scientists and Engineers?" *American Economic Review*, vol. 88, no. 2 (May 1998), pp. 298-302.

The end of the Cold War has brought about a shift in federal R&D spending. Budget authority for federal civilian R&D rose from $25.5 billion in 1990 to $45.3 billion in 2001. By contrast, defense R&D funds increased only from $41.0 billion to $45.5 billion over the period. In constant dollars, civilian R&D funds rose 30 percent, while defense R&D funds fell 19 percent.

Federal Funding for the Science and Technology Base. An alternative to classifying federal R&D by mission is to divide it into three types: basic research, applied research, and development. Less than a quarter of federal R&D budget authority is devoted to basic research, while more than 50 percent goes to development. Federal missions vary widely in their need for near-term technologies versus long-run knowledge. For defense, the bulk of R&D funding goes to development, and just 3 percent to basic research. For health, by contrast, funding of basic research accounts for 55 percent of all R&D budget authority.

Many analysts have long argued that much of the spending that federal agencies classify as development (for weapons and other technical systems) does not go toward developing new products and should be considered advanced engineering support rather than R&D. By that view, government data overstate the federal contribution to R&D. That classification problem is not solved by separating out defense R&D: some civilian R&D funds, especially those of the National Aeronautics and Space Administration (NASA), are for technical systems, while some defense research does contribute to the long-term science and technology base.

In response to those concerns, the National Academy of Sciences developed a measure of the federal contribution to the science and technology base by excluding the funding of advanced technical systems. The academy argues that its measure better indicates the level of federal investment in new science and technology. According to the academy's tally, federal budget authority for the science and technology base has risen in recent years from $42.7 billion in 1995 to $52 billion in 2000, an increase of 22 percent.[40] Adjusted for inflation, the increase is 13 percent.

The Clinton Administration developed an alternative approach to the same problem in defining the scope of its 21st Century Research Fund. The budget authority for that narrower set of R&D programs has risen over the last six years, from $31.2 billion in 1995 to $44.9 billion in 2001, a nominal increase of 44 percent.

A different measure of the federal contribution to the science and technology base considers federal R&D funds that ultimately go to universities. Universities are unique performers of research in that they have an explicit training function for the next generation of scientists and engineers; indeed, research funds that go to universities often end up supporting research performed by graduate students. Universities also have a built-in technology transfer mechanism, in that most students leave and go to work in industry, where they typically bring their knowledge to bear on a related range of practical problems. Federal R&D funding for university research has grown in recent years, from $12.4 billion in budget authority in 1995 to an estimated $16.5 billion in 2000, an increase of 33 percent. Over two-thirds of the growth, $2.8 billion of the total increase of $4.1 billion, came in 1999 and 2000.

Most of that growth in federal support of academic R&D reflects the rise in funding for biomedical research, primarily at the National Institutes of Health (NIH). NIH funds more than $10 billion in university research, accounting for 60 percent of all federal funding for academic research. Between 1995 and 2001, budget authority for NIH's R&D rose from $10.8 billion to $19.6 billion, driving an increase for the health mission from $11.4 billion to $21.4 billion.

Options for Increasing Federal R&D

Several different approaches have been suggested for increasing federal support of R&D, some of which

40. The Academy recently changed its methods of accounting for atomic energy defense activities, but the estimates from different years remain comparable.

have been introduced in legislation. Among the available options are setting targets for increased aggregate spending, continuing to emphasize biomedical research, emphasizing scientific fields thought to have been neglected in recent years, focusing on particular types of recipients (such as universities or businesses), and focusing on innovative or interdisciplinary research outside the mainstream "research base."

Setting Higher Aggregate Targets. One bill introduced in the 106th Congress, S. 296, proposed to authorize a steady increase in the aggregate level of civilian R&D funding, specifically, a 2.5 percent annual increase above the rate of inflation through fiscal year 2010. That bill would have doubled aggregate civilian R&D from $34 billion in 1998 to $68 billion in 2010 and commissioned a study from the National Academy of Sciences to determine funding priorities in science. A related approach that received some attention was to fix civilian R&D as a percentage of total nondefense discretionary spending.

Opponents of across-the-board increases say that R&D policy should be driven not by aggregate tallies, but by Congressional decisions on particular programs. Many in the Congress who support increasing the overall level of R&D would vote against particular R&D programs or would focus additional resources on specific areas. For example, another bill introduced in the 106th Congress, H.R. 2086, focused only on computer networking and information technology, authorizing an increase of $6.9 billion between 2000 and 2004 across several different agencies.

Increasing Biomedical Research. Another option for increasing R&D is to continue the current policy of concentrating R&D increases on medical research at NIH. Between 1995 and 2001, budget authority for NIH rose by $8.8 billion, or 81 percent, while federal spending on other civilian R&D grew only 15 percent, roughly keeping pace with inflation.[41]

The economic benefits of improved health are large, if sometimes difficult to measure. Between 1965 and 1996, the average age at death increased by seven years, primarily because of reductions in deaths from cardiovascular disease.[42] Multiplying seven extra years by the population of the United States and by even a modest valuation of the worth of a year of life produces very large gains for the nation. Thus, even incremental gains against major diseases, such as cancer, could have enormous economic benefits.

Much of the gain in longevity has resulted from changes in behavior, such as a reduction in smoking, but medical technology has also played a substantial role. For example, according to a recent report from an organization that advocates increased federal funding of biomedical research, technological improvements in the treatment of cardiovascular disease yielded gains of about $500 billion per year from 1970 to 1990. That estimate reflects the results of two studies: one which found that the value of increased longevity from the total reduction in cardiovascular deaths averaged $1.5 trillion annually over the period and a second which estimated that one-third of the reduction in deaths came from improvements in medical technology used just after acute cardiovascular attacks, such as heart attacks, and in long-term treatments of chronic conditions, such as hypertension.[43]

Even if that estimate of $500 billion in welfare gains is correct, not all of that amount can be credited to the basic research program at NIH: some basic research is funded privately, and pharmaceutical companies and other medical technologists build on the basic results. Notwithstanding the uncertainty and imprecision, however, the magnitude of the estimate illustrates the claim that biomedical research may have large payoffs.

41. Budget authority for civilian R&D outside of NIH was $22.4 billion in 1995 and $25.8 billion in 2001. Some individual agencies or programs did more than keep pace with inflation; for example, the National Science Foundation's budget authority for R&D rose from $2.4 billion to $3.2 billion during the period.

42. The Albert & Mary Lasker Foundation, "Exceptional Returns: The Economic Value of America's Investment in Medical Research" (New York: The Albert & Mary Lasker Foundation, 2000), p. 3, available at www.laskerfoundation.org/fundingfirst/papers/Funding 20First.pdf.

43. David Cutler and Srikanth Kadiyala, "The Economics of Better Health: The Case of Cardiovascular Disease"; Kevin Murphy and Robert Topel, "The Economic Value of Medical Research" (papers presented at the Conference on the Economic Value of America's Investment in Medical Research, Washington, D.C., December 2-3, 1999, and cited in The Albert & Mary Lasker Foundation, "Exceptional Returns," p. 8).

While analysts generally agree that the rapid increase of the last several years in federal funding for biomedical R&D has been justified by the potentially large benefits, some contend that further increases in R&D could be better spent elsewhere. Those analysts note, for example, that the biggest recipient of funds at NIH since 1972, when the "War on Cancer" was declared, has been the National Cancer Institute, yet the age-adjusted mortality rate from cancer has fallen only 6 percent. As discussed next, such critics join other parties in arguing for additional funding to be directed toward other fields of science and engineering.

Targeting Neglected Scientific Fields. The recent emphasis on funding for NIH—which has historically focused its efforts on a relatively narrow set of fields in biology and medicine, leaving the National Science Foundation and others to fund physics, chemistry, math and computer science, and other fields relevant to health—has shifted federal spending on basic research in the sciences and engineering. Between 1990 and 1999, the share of that funding going to biomedical research rose from 41 percent to 44 percent; at the same time, the share going to physics, chemistry, and other physical sciences dropped from 18 percent to 14 percent, and the share for basic engineering fell from 20 percent to 18 percent, continuing a long-standing decline from the 1970 level of 31 percent. NIH's leaders have recently begun to increase its support for some fields outside of its traditional core, especially computer science, and is helping the Department of Energy with the capital costs of developing light sources needed for X-ray crystallography. But NIH's portfolio of basic research remains narrow in comparison to the range of investments in science funded by the Department of Defense in recent decades.

Some analysts argue that the Congress should increase funding for research in physical sciences and engineering, even if only to serve its stated goal of rapid progress in life sciences research. They argue that no scientific field progresses in isolation and that recent progress in biomedicine has come in large part because of gains in other fields that have provided key scientific instruments and techniques used by biological and biomedical researchers—including ultrafast computers and software (critical to progress on the human genome), X-ray crystallography, nuclear magnetic resonance imaging, electron microscopy, and the use of particle accelerators to produce synchrotron radiation for imaging. They further note that as human knowledge increases, old fields combine in new ways. The sequencing of the human genome has created such a field—bioinformatics, which analyzes human genetics using information technologies, taking advantage of the parallels between human genes and computer software.[44] The effort to investigate the implications of those commonalities and apply them to the search for new drugs and other medical research is aided by the current vitality of U.S. software research.

The value of any cross-fertilization effect among disciplines is difficult to measure, however. Analysts studying the patterns of the diffusion of new ideas by analyzing the footnotes, bibliographies, and other citations in scientific articles find that the overwhelming percentage of the citations are generally within disciplines—that is, chemists cite chemists, physicists cite physicists, and biologists cite biologists. That finding may suggest that marginal changes in federal funding in one field are unlikely to affect progress in others, notwithstanding some interdisciplinary borrowing of tools and methods, and thus that the value of balanced funding to achieve a particular research goal may be overstated.

Some supporters of increased funding for physical sciences and engineering make the more direct argument that the current research portfolio simply leaves unfunded too many promising projects in those fields; many such supporters point to the distribution of R&D funding from the 1960s through the 1980s as illustrating a more balanced portfolio. Others argue that physics and other physical sciences received disproportionate support during the Cold War because of their closer connection to the defense mission. As the urgency of that mission has waned, they claim that a shift in R&D priorities is entirely appropriate.

If the Congress wished to adjust funding shares among research fields, the current appropriation mechanisms would not make it easy to do so. Because the five agencies with the largest R&D respon-

44. Ken Howard, "The Bioinformatics Gold Rush," *Scientific American*, July 2000, pp. 58-63.

sibilities are covered in four different appropriation bills, changes in funding for one science cannot be traded off directly against changes for others. Only within the budget for NSF can such trade-offs be made directly and explicitly (and even that relatively broad budget currently covers little in energy or space research). Accordingly, one reason that some in the Congress seek to double NSF's budget by 2006 is to create room for a desired balance among research fields.

Targeting Specific Types of Recipients. Widespread interest exists in focusing federal R&D programs (outside of mission-specific areas) on basic research by universities. By focusing on university research, advocates argue, the federal government is least likely to pay for research that duplicates or would otherwise be funded by commercial interests. As noted above, private R&D funding exploded in the last five years and is now about twice the federal level. In addition, venture capital for startups, mostly in technology-based industries, has grown from $4 billion per year in the late 1980s to nearly $50 billion today.

Acknowledging that private parties place much more emphasis on commercial applications, industry observers suggest that the main role for federal funding is in basic research, especially at universities, colleges, and nonprofit research institutions. Industry spent only $1.8 billion for university research in 1998, whereas the federal government spent $15 billion.

Advocates of increased federal funding for university research point to both short-term and long-term benefits. In the short term, as described earlier, research provides the venue in which to train students, most of whom subsequently go to work in industry, where they contribute to the economy directly.

In the longer term, society benefits as the knowledge generated by the research becomes incorporated in future generations of products and their manufacture. Studies have shown that those less direct, long-term economic benefits are quite high. In reviewing such studies, CBO found that while federally funded R&D as a whole provided society with a low economic return—partly because it is dominated by mission-specific programs, such as national defense and space exploration, whose immediate goals are other than economic—federal R&D funds spent on academic research did yield a substantial return (as did private R&D).[45]

In the past, some analysts have advocated targeting some federal funds at early stages of business R&D to fill in gaps in venture capital and other private funding. The rapid growth in venture capital has reduced such calls for federal funding, except in instances in which the R&D fulfills other federal goals, such as energy conservation and environmental protection. (For example, see the discussion of the Partnership for a New Generation of Vehicles, option 270-08 in Chapter 5.)

Whether venture capital funding will continue to flow so readily is unknown. Much of the current boom may reflect the ability of companies backed by venture capital to issue stock and recoup the invested funds rapidly. In the past, such companies had to exhibit a history of revenue and earnings growth before they could issue stock on the public exchanges. At present, the market for initial public offerings (IPOs) is down from its highest levels; should the stock market cool to the point that startup companies find it harder to place IPOs and attract venture capital, federal policymakers might again find themselves encouraged to supplement the efforts of venture capital firms.

Targeting Innovative Research. A substantial portion of the funds of every R&D program goes to repeat grantees. Those researchers are very often veterans in their fields, with long histories of success and publication and a commitment to the existing mainstream research agenda. According to some analysts, that approach provides little room in a budget for new breakthrough ideas or interdisciplinary approaches, so they propose setting aside money from each agency's research budget to fund ideas that are novel or do not fit in the current categories. Agencies that already have small programs targeted at such ideas, such as NIH and NSF, could increase the proportion set aside for them.

45. Congressional Budget Office, *The Economic Effects of Federal Spending on Infrastructure and Other Investments*, CBO Paper (June 1998).

One argument against such set-asides is that novel and interdisciplinary research is difficult to evaluate, almost by definition, leaving agencies no reliable means by which to rank proposals competing for the same funds. Peer review has proven to be the most successful mechanism for evaluating mainstream research proposals, but set-aside programs seek to avoid the alleged conservative bias of standard peer review. A second argument is that such set-asides could be harder to sustain in the future, when the fiscal climate for R&D spending may be tighter. Finally, proposals for increased set-asides arguably undervalue the teaching role played by the mature researchers.

Maintenance of Federal Assets

Although long-lived assets owned by the federal government are fundamental to many public services, regular maintenance (along with renovation and replacement) of those assets is sometimes delayed. Deferring maintenance is sometimes an appropriate short-term strategy for coping with a budget squeeze, but the current surplus may provide an opportune time for the federal government to increase funding for maintenance and reduce agencies' reported backlogs of needed projects.

The inventory of federal assets is large and diverse, and spread across every state and territory and more than 160 foreign countries. According to the *Financial Report of the United States Government, 1999*, the federal government holds "property, plant, and equipment" worth approximately $298 billion, excluding assets associated with national defense.[46] Those holdings include office buildings, embassies, courthouses, penitentiaries, laboratories, monuments, utility systems, post offices, border crossing stations, space launch facilities, dams, ships, aircraft, and spacecraft. Properly maintained, federal facilities provide a productive and safe environment for the private citizens, foreign visitors, elected officials, and federal employees who use them, and they reflect well on the nation as a whole. In some cases, federal buildings also embody and preserve history, culture, and exceptional architecture.

Conversely, assets that have deteriorated due to deferred maintenance can have adverse consequences. For example, problems with heating, cooling, and other critical building systems can disrupt government services and even render structures unusable. Structural failure can threaten public safety. Certainly, physical decay can mar buildings' appearances. And delayed maintenance can increase repair costs, sometimes dramatically—as when neglect of a leaky roof leads to extensive water damage.

According to the National Research Council (NRC) and other observers, agencies across the federal government have accumulated significant backlogs of maintenance and renovation needs.[47] The problem is partly one of funding: federal agency representatives participating in a 1998 study indicated that the maintenance funding they receive regularly falls short of the NRC's suggested range of 2 percent to 4 percent of the aggregate current replacement value of government buildings.[48]

Inadequate information and other management weaknesses have also contributed to the problem of deferred maintenance.[49] As discussed below, many federal agencies have historically lacked an accurate inventory of their assets, the starting point for an assessment of maintenance needs. Even in some cases in which accurate inventories have been available, information about the consequences of deferring maintenance has not been incorporated into agencies' decisionmaking, or forward-looking strategic plans to anticipate the need for repairs and renovations (and thus to request funding in a timely fashion) have been absent.

Another factor that may contribute to the backlog of federal maintenance projects is the requirement of the Davis-Bacon Act that not less than locally prevailing wages be paid on federal contracts

46. Department of the Treasury, *Financial Report of the United States Government, 1999*, p. 49, available at www.fms.treas.gov/cfs/99frusg/99frusg.pdf.

47. See, for example, National Research Council, *Stewardship of Federal Facilities: A Proactive Strategy for Managing the Nation's Public Assets* (Washington, D.C.: National Academy Press, 1998).

48. Ibid, p. 15.

49. Ibid, pp. 17-18.

for construction, alteration, repair, painting, and other maintenance activities. Nonfederal employees covered by the act often receive higher wages than they would otherwise because of the way "prevailing wages" are defined and measured. By raising labor costs, the act reduces the amount of maintenance that can be accomplished within a given budget. (More discussion of the effects of the Davis-Bacon Act can be found in options 920-05-A and 920-05-B in Chapter 5.)

The Extent of the Problem

While many agencies and outside observers have noted the problem of deferred maintenance, no one has succeeded in quantifying the full extent of it. The size and composition of the maintenance backlog are always in flux, as assets deteriorate from normal use and the forces of nature and as maintenance, renovation, and replacement projects are initiated and completed. Definitional issues also impede the tally, since there are no universal definitions for when assets need repairs or guidelines for the extent of the repairs needed. Further, the extent of repairs can vary significantly, depending on whether the goal is simply to keep an asset operational or to return it to a like-new condition.

Until recently, federal agencies were not required to assess or report outstanding maintenance, and very few did. However, as of 1998, the Statement of Federal Financial Accounting Standards No. 6, *Accounting for Property, Plant and Equipment*, requires agencies to disclose their deferred maintenance in their financial statements. Complying with that reporting requirement has proven difficult.[50] Some agencies have been hampered in their efforts because they lack an accurate accounting of their holdings. According to the General Accounting Office, the federal government as a whole lacks adequate systems and controls to provide accurate information on the number and value of assets it holds.[51] In addition, the diversity of missions and assets within some agencies has complicated their efforts to develop consistent policies and guidelines for complying with the requirement.

Although comprehensive data on the federal government's maintenance backlog are lacking, the information available for certain agencies helps illustrate the nature and extent of a broad problem. The following subsections examine the circumstances of three agencies, chosen to reflect the wide variety of federal assets: the General Services Administration (GSA), the National Park Service, and the Coast Guard.

Deferred Maintenance of Federal Buildings

Most federal personnel work in one of the 1,682 buildings owned, operated, and maintained by GSA's Public Building Service. The relationship between GSA and the federal agencies it houses is like that of a landlord and tenant: GSA provides space and services to federal agencies and in return collects rental assessments that approximate commercial rates for comparable space and services.

As a group, federal buildings suffer from a significant amount of deferred maintenance. GSA recently estimated that it needs $4 billion to eliminate its backlog of 5,585 outstanding maintenance projects. That estimate is almost six times the agency's 2001 appropriation for repairs and alterations. Most of the identified projects are relatively minor and inexpensive; a small number, however, are major and very expensive. The bulk of the estimated costs—60 percent—stems from the repairs needed for 44 buildings, each of which requires more than $20 million in work. Some of the repairs listed in GSA's maintenance backlog were first identified over 10 years ago.

The precise size and composition of the backlog have been called into question. A recent review by GAO of GSA's database of needed repairs and alterations noted multiple problems: not all repairs were included in the database; some repairs that were included were already in progress or completed; some data were incorrectly repeated; and some cost estimates were not current.[52] Notwithstanding those con-

50. General Accounting Office, *Deferred Maintenance Reporting: Challenges to Implementation*, GAO/AIMD-98-42 (January 1998).

51. Letter from David M. Walker, Comptroller General of the United States, to the President, the President of the Senate, and the Speaker of the House of Representatives, March 20, 2000.

52. General Accounting Office, *Federal Buildings: Billions Are Needed for Repairs and Alterations*, GAO/GGD-00-98 (March 2000), p. 8.

cerns, there is little doubt that GSA's backlog of maintenance projects is extensive.

According to GSA, the primary cause of the maintenance backlog is that funding failed to keep pace as needs grew. The maintenance demands of GSA's buildings are increasing because of their advancing age; half of the buildings are more than 50 years old.[53] Also, repairs are growing more costly because of the need to accommodate the improved electrical and telecommunications capabilities that are essential to modern office operations.

Money to operate and repair GSA's buildings comes from the Federal Building Fund, a revolving fund supported by rental assessments and annual appropriations. The Congress exercises control over the fund by setting limits on the total amount that can be drawn and by approving specific projects. To commence a repair project whose cost exceeds $1.93 million, GSA is required to prepare a prospectus and obtain approval from the Office of Management and Budget (OMB) and the House and Senate committees responsible for public works. In fiscal year 2001, the Congress appropriated $671 million in new obligation authority from the Federal Building Fund for repairs and alterations, less than President Clinton's request of $721 million, which in turn was below the $900 million GSA proposed as an annual budget for repairs for 2001 to 2005.[54]

Both GAO and the National Research Council have cited a lack of strategic planning by GSA as another factor contributing to the maintenance backlog. GSA does not have a comprehensive plan that identifies all needed repairs, establishes the relative merits of various projects, and proposes a strategy to repair the most deteriorated structures. Such a plan would help the agency better target its limited repair resources and help the Congress make more informed decisions about general funding levels for repairs and the funding of specific projects.

53. National Research Council, *Stewardship of Federal Facilities*, p. 17.

54. General Accounting Office, *Federal Buildings: Billions Are Needed*, p. 8.

Deferred Maintenance in the National Parks

Over its 84-year history, the National Park Service has acquired a large and diverse inventory of assets tied to its mission of preserving natural and cultural resources for the enjoyment, education, and inspiration of current and future generations. Within the 376 units it manages—including not only parks but also parkways, cemeteries, historic homes, forts, caverns, and trails—the Park Service owns and maintains over 16,000 permanent structures, 1,500 bridges and tunnels, 5,000 housing units, 1,500 water and waste systems, and 400 dams. The Park Service values those assets at over $35 billion.[55]

Determining the appropriate level of maintenance spending for the national parks is complicated by the character of the Park Service's goals and the type of services and benefits that parks provide. Quantifying the natural and cultural preservation that parks provide or the enjoyment, education, and inspiration that they produce is difficult—as is ascertaining the connection between the funding for maintenance and the achievement of these goals. For example, the benefit to park visitors from renovating housing for park employees is indirect and hard to measure. Not surprisingly, spending on maintenance may take a back seat to other spending options that provide more visible returns, such as the creation of new parks. The Park Service has been assigned 60 new parks and other units since 1979.

Of course, new parks add to the demands on the Park Service's maintenance budget, as do increases in the number of visitors. The large and growing popularity of the national parks—which are expected to receive 290 million visits in fiscal year 2001, up 30 million from 1996—is perhaps the biggest single cause of the maintenance backlog. And like many other federal assets, national park facilities are aging and demanding more frequent and costly maintenance and repairs.

55. Statement of Barry T. Hill, Associate Director, Energy, Resources, and Science Issues, Resources, Community, and Economic Development Division, General Accounting Office, before the Subcommittee on Interior and Related Agencies of the House Committee on Appropriations, published as General Accounting Office, *National Park Service: Maintenance Backlog Issues*, GAO/T-RCED-98-61 (February 4, 1998).

For several years, advocates for the national parks have argued that pressure to maintain governmentwide fiscal discipline has kept maintenance funding at inadequate levels. The National Parks and Conservation Association suggests that the parks need $630 million in additional annual funding for operations—roughly a 40 percent increase—to meet ongoing requirements, including keeping abreast of regular maintenance needs. And according to information that the Park Service provided to the House Appropriations Committee, the service sought $1,625 million for operations and $308 million for construction and major maintenance for fiscal year 2001, but the President's budget request ultimately reduced those amounts by about 10 percent and 40 percent, respectively, to $1,454 million and $180 million. Combined, the requested amounts represent roughly $5.60 for each visitor the Park Service expects during the year.[56] Of course, the Congress need not be bound by the President's request, and indeed the actual appropriations for 2001 are higher: $1,467 million for operations (including $78 million for park police) and $242 million for construction.

Estimates of the size of the accumulated backlog are imprecise. Major components of the backlog include work on roads, bridges, dams, and employee housing.[57] A 1998 GAO report suggests that some guest lodging—which is also owned by the federal government, though it is managed privately—needs substantial renovation.[58] Additional projects include efforts to protect trails and shorelines from erosion. According to the Park Service's estimates, the backlog tripled from $1.9 billion in 1987 to $6.1 billion in 1997. GAO has criticized those estimates because the underlying data were often several years old, included some items that constituted improvements or completely new construction, and did not reflect a consistent set of definitions and criteria.[59] The Park Service has conceded the shortcomings of its previous estimates of the size of the backlog; its latest estimate, as of the end of fiscal year 2000, is $4.1 billion. Even that smaller figure, however, dwarfs the service's recent budgets for such maintenance.[60]

The Congress has taken several steps in recent years to address the backlog of park maintenance projects. The annual appropriation for construction and major maintenance, which covers new construction as well as rehabilitation of existing assets, has steadily increased; it rose most recently from $225 million in 2000 to $242 million in 2001. Moreover, the Congress appropriated an additional $50 million for deferred maintenance needs of the Park Service in 2001, along with $100 million for other federal land-management agencies, and signaled its interest in providing that same funding annually through 2006 by establishing a "federal deferred maintenance" subcategory within a new conservation category of discretionary spending under the Balanced Budget and Emergency Deficit Control Act of 1985. Also, beginning in 1997, the Park Service and other agencies have been able to augment their appropriations with new and increased fees retained under the Recreational Fee Demonstration Program, which has brought the Park Service $457 million in additional funding in its first four years. More recent authorities, such as the National Park Passport Program and the retention of concession fees, have further increased the revenues available to the service for maintenance and other purposes. The Park Service expects to retain $180 million from all fee programs in 2001.

Whether the Park Service can make productive use of any further increases in funding is open to debate. Opponents argue that the immediate impact of the money available under the Recreational Fee Demonstration Program was limited and that the service should not be given any more funding until it has

56. The President's total budget request for the Park Service was $2,042 million, including nearly $300 million for land acquisition and assistance to states, $72 million for the Historic Preservation Fund, and $68 million for recreation and preservation.

57. General Accounting Office, *National Park Service: Efforts to Identify and Manage the Maintenance Backlog*, GAO/RCED-98-143 (May 1998).

58. General Accounting Office, *National Park Service: The Condition of Lodging Facilities Varies Among Selected Parks*, GAO/RCED-98-238 (August 1998).

59. General Accounting Office, *National Park Service: Efforts to Identify and Manage the Maintenance Backlog.*

60. An additional type of maintenance problem, not included in the above estimates, is the protection of native species and local ecosystems against encroachment by invasive plants and animals. In the 194 parks where invasive species are recognized as a serious problem, managers have identified needs for $63 million in projects involving plants and $18 million in projects involving animals.

shown that it can effectively use the amount already available. Supporters of further increases argue that the agency needed time to build up its capacity to review and manage projects but has now done so (as evidenced by obligations of $91.5 million in fiscal year 2000, nearly doubling the 1999 level); that current funding levels are still small relative to needs; and that delay will only compound the problem as assets continue to deteriorate.

Deferred Maintenance of the Coast Guard's Cutter Fleet

As the fifth armed military service of the United States, the Coast Guard performs a variety of missions—from participating in overseas military and peacetime operations to enforcing marine regulations and conducting search-and-rescue, drug interdiction, and border enforcement actions. Its area of responsibility covers millions of square miles of ocean and thousands of miles of coastline. To accomplish its missions, the Coast Guard employs a fleet of about 45 deepwater cutters (the service's largest vessels), 80 large patrol boats, and 190 aircraft and helicopters. The fleet of cutters—which operates 50 miles or more beyond the coast—is growing older, and many of the ships need to be modernized or replaced. On average, the cutters are 27 years old, close to their planned service life of 35 years.

To replace its aging cutters (and eventually its other deepwater ships), the Coast Guard has determined that it needs a procurement budget of roughly $15 billion over the next 20 years. That level of funding—roughly twice the current level of about $400 million per year—reflects the service's plans to operate a somewhat smaller fleet of cutters with greater capabilities than the ships they replace. That scenario illustrates the general point that "maintenance" is not a precise concept, in that what the Coast Guard describes as maintenance of its capabilities can also be viewed, at least in part, as improvement of its capital stock.

Critics have argued that the Coast Guard has not adequately studied or justified its need to acquire new cutters.[61] GAO suggests that proper upgrades and maintenance could extend the service lives of existing ships at a much lower cost than that for buying new vessels. The Coast Guard has yet to convince GAO that its existing ships and aircraft cannot meet the expected requirements of future missions. Furthermore, the vessels that the Coast Guard is proposing to acquire are still on the drawing board, and critics argue that it is too early to tell whether the eventual designs would meet the service's needs.

Addressing the Deferred Maintenance Problem

Reducing the existing governmentwide backlog of deferred maintenance projects in a cost-effective manner would probably require a combination of better management and more money. The evidence and analyses from GAO and other experts indicate that federal agencies must improve their accounting systems to better track and monitor the condition of their durable assets and must make better use of the data in identifying, prioritizing, and budgeting for maintenance. (Options for improving accounting and financial management systems are discussed in the next section.) Some current backlogs, however, are too large to be cleared within current maintenance budgets, no matter how efficiently the funds are allocated. For the future, agencies' sustained attention and an ongoing commitment to fund maintenance on a timely basis would be critical to keeping large backlogs of deferred maintenance from recurring.

Federal Financial Management

Like other organizations, the government needs reliable information on its assets, commitments, revenues, and costs if it is to make good decisions, run efficiently, and report accurately to its stakeholders—in this case, elected officials and the public. In re-

61. General Accounting Office, *Coast Guard's Acquisition Management: Deepwater Project's Justification and Affordability Need to Be Addressed More Thoroughly*, GAO/RCED-99-6 (October 1998).

sponse to long-term needs and legislative requirements, federal agencies are in the process of a major overhaul of financial operations and reporting. However, much remains to be done. In its recent audit of the *Financial Report of the United States Government, 1999*, GAO found continuing weaknesses in federal financial practices and information.[62]

The Current Status

According to the Office of Management and Budget, federal agencies spent about $7.4 billion on financial management in 1999. That amount includes operating costs as well as investments in information systems. Substantial resources have been devoted to complying with a host of new requirements under the Chief Financial Officers (CFO) Act of 1990, the Federal Financial Management Improvement Act of 1996, the Government Performance and Results Act of 1993, and other mandates. Prior to the CFO Act of 1990, for example, neither the government as a whole nor individual agencies prepared annual financial statements outlining assets, liabilities, and other items. The act also required agencies to develop systems that provide complete, accurate, and timely reporting of financial and operating information. About $2.0 billion of the amount spent in 1999 is associated with computer-based financial management systems.

The considerable efforts devoted to improving the management of the government's financial affairs have had mixed results. Agencies continue to update their financial management systems, and according to the government's overall financial statement for 1999, the quality of the resulting information has improved.[63] More agencies produce annual financial reports now than ever before, and each year more of those statements receive favorable audit opinions; moreover, the government now reports annually on federal financial activity as a whole. Agencies have also experimented successfully with doing business electronically, with tougher and smarter debt-collection methods, and with other practices intended to strengthen the management of the government's finances.

Yet serious problems remain, as noted in GAO's audit report of the government's financial statement for 1999 and its ongoing series of reports on "high-risk" agencies and programs.[64] For example:

- Some major agencies and the federal government as a whole cannot report accurately the value of property, plant, equipment, and other assets. As discussed above, such deficiencies hamper efforts to identify and plan for maintenance needs; they also limit the government's ability to safeguard assets and to control fraud.

- Several agencies continue to have trouble producing and reporting reliable financial information; for instance, GAO reports that no major part of the Department of Defense can pass the test of an independent financial audit.

- Some agencies cannot reconcile their account information with information maintained by the Department of the Treasury.

- The Internal Revenue Service cannot report accurately on accumulated unpaid tax assessments and has inadequate systems to protect against the disclosure of proprietary information and theft.

- And some federal agencies are having trouble producing accurate subsidy estimates for major credit programs—for example, the Federal Housing Administration's Mutual Mortgage Insurance Program, which insures home loans made by private lenders.[65] Such problems make it difficult for the Congress to monitor and control costs for the more than $1 trillion in outstanding direct loans and loan guarantees.

62. The audit can be found in Department of the Treasury, *Financial Report, 1999*, pp. 19-41. For a review, see Congressional Budget Office, *Statement of Barry B. Anderson to the Meeting of the Federal Accounting Standards Advisory Board* (July 3, 2000).

63. Department of the Treasury, "Secretary's Message," in *Financial Report, 1999*, p. 1.

64. See, for example, General Accounting Office, *High-Risk Series: An Update*, GAO-01-263 (January 2001).

65. Congressional Budget Office, *Credit Subsidy Reestimates, 1993-1999*, CBO Paper (September 2000).

Providing Support for Improving Federal Financial Management

In part, the difficulty the government has had in getting its financial house in order reflects the sheer magnitude of the task. As the federal financial report for 1999 observes, the government is the nation's largest employer and landowner. A lack of resources may also be partly to blame. The amount that agencies have spent for financial management has remained fairly constant for the last five years, despite increased requirements imposed by the CFO Act and other legislation. If the Congress chooses to provide more support for federal financial management, it could direct resources to a number of different kinds of activities, some of which are described below. (Although the 106th Congress already acted to approve or reject the specific dollar figures mentioned in some of the examples, they are included here to illustrate the kinds of additional investments that could be made in future years or in other agencies.)

Improving Financial Management Systems. OMB's *Federal Financial Management Status Report and Five Year Plan* for 1999 argues that timely, reliable, up-to-date computer-based systems to record, process, store, and track financial information are essential if agencies are to improve their performance. In addition to providing better data more quickly to management, such systems can reduce errors, provide faster services, and help limit fraud. Many systems now used by agencies are at the end of their useful lives or simply do not represent the best of current technology. Many agencies, for example, still use separate systems for different aspects of financial management. Such arrangements often involve data entry at several points in the processing of various transactions, slowing activity and increasing the chance of error. Often, different organizations within an agency—such as the budget and the contracting offices—use different systems, making the task of aggregating information difficult.

The Congress has many opportunities to support efforts to improve financial management because most agencies are at some point in the long process of improving their systems and few have completed the work. The Department of Agriculture, for example, has been phasing in a new system for several years. Also, the Office of Personnel Management continues to upgrade its systems and to increase its financial management staff—an effort for which it received about $2 million in 2001.

Hiring and Training High-Quality Financial Management Personnel. The Congress could also provide more funding for agencies' staffing requirements. OMB's status report on financial management places a priority on ensuring that agencies have high-quality financial management personnel; however, financial management and related offices in some agencies have not received increases in staff for years, despite increases in workload. OMB's report also argues that professional development to train and develop current employees is key to maintaining a highly qualified financial workforce. Illustrating that view, the President's budget request for the Department of Agriculture asked for $2 million and 14 new employees in 2001 in part to support a financial management training program, but the Congress rejected the request, as it has similar proposals in recent years.

The challenge of providing high-quality staff may grow as a large number of senior employees in finance and related functions reach retirement age and leave the government. To attract talented young employees, the government will need to provide both competitive salaries and modern tools—financial management systems and procedures—for them to work with.

Expanding Electronic Systems. The government is conducting more of its business electronically—a practice that the Congress could seek to accelerate. In one example, the government plans to expand its use of electronic benefit transfers, now available to many recipients of food stamps and Social Security payments, to the nutrition program for women, infants, and children. The Small Business Administration is planning to implement a system so that citizens can apply for disaster loans electronically. And the Internal Revenue Service plans to allow taxpayers to authorize the agency to deduct tax payments from bank accounts. Electronic systems can strengthen financial management by reducing manual processing, improving accuracy, speeding transactions, and providing for better coordination of information.

Supporting Efforts to Improve Financial Management Governmentwide. The Congress could also support the efforts of agencies that must devote resources to governmentwide financial management

activities. OMB's Office of Financial Management, for example, provides general guidance and direction for agencies' efforts. OMB also prepares annual status reports on improvement activities. The Department of the Treasury must prepare annual financial statements for the government as a whole. GAO audits the financial statements for both the government as a whole and individual agencies. It also identifies and recommends solutions for continuing problems in federal financial management, including waste, fraud, and abuse, and reports on the status of financial practices in various agencies. The Office of Personnel Management has worked with OMB and others on revising job standards, improving training, and boosting recruitment and retention for federal financial management personnel. The General Services Administration has assisted with various electronic commerce programs. Various agencies of government support the work of the Federal Accounting Standards Advisory Board, charged with developing accounting standards for government, and the Joint Financial Management Improvement Program, charged with developing standards for financial management systems.

The payoff from giving greater priority and support to improving financial management could be substantial. The National Performance Review noted that given the enormous sums involved, even small improvements could result in large savings.[66] Better financial management could mean that managers have sound information with which to develop plans and make operating decisions, maintain control over assets, and report to the Congress and the public. Many have argued that the goals of the Government Performance and Results Act—such as improvements in the efficiency of federal operations, in the quality of federal services, and in the ability to distinguish successful from unsuccessful programs—will be impossible to realize without improved financial information systems. (For more information on the act and its implementation to date, see Appendix A.)

Conversely, given the poor performance of some agencies thus far, the Congress may reasonably wonder what benefits would derive from further investment in financial management. In general, management improvements may seem less worthwhile than programs with more direct, and often more certain, benefits to citizens. Some argue that the best way to improve federal financial reporting is to contract with private firms for financial services, and that doing so might allow spending to be reduced rather than increased.

66. National Performance Review, *From Red Tape to Results: Creating a Government That Works Better and Costs Less*, 1993, p. 81.

Federal Statistics and Data Collection

The federal government produces statistics on a broad range of subjects, including population, economic activity, public health, crime, and educational attainment. Those statistics inform Congressional and public debate on budgetary and other important issues and are used widely in planning, forecasting, and decisionmaking. The Clinton Administration maintained that inadequate funding has hampered the government's ability to keep statistical information timely and accurate in the face of rapid changes in the economy and society. The Congress could help by providing additional funds.

Federal Statistical Programs

According to the Office of Management and Budget, the government spent about $4 billion on major statistical programs in 1999, up from $2.5 billion in 1995. Most of that increase is attributable to the census, which causes a jump in spending on federal statistics every 10 years. Excluding work on the 2000 census, federal spending on statistics in 1999 totaled $3.1 billion, an increase of $0.6 billion over the 1995 level. OMB's report *Statistical Programs of the United States Government, 2001,* shows that 13 federal departments and nine independent agencies have such programs. However, those in just four departments—Commerce, Health and Human Services (HHS), Labor, and Agriculture—account for the bulk of government spending on statistical programs.

The Department of Commerce. Commerce, which accounted for about one-third of all federal spending on statistics in 1999, is the government's major producer of information on population and the economy. The department's Bureau of the Census conducts the decennial census and, between those censuses, makes

estimates of the populations of states, counties, and other places. The bureau also conducts periodic censuses of manufacturing, construction, and other businesses. The Bureau of Economic Analysis develops the national income and product accounts, the basic measure of the level of economic activity in the United States. The department also collects data on foreign investment, trade, and the weather.

The Department of Health and Human Services. HHS produces statistics on the nation's health and health care financing. The Centers for Disease Control and Prevention and the National Institutes of Health produce statistics on the nature and extent of health and illness. The department's Agency for Healthcare Research and Quality produces information on the cost, quality, and other aspects of the health care system. Its Health Care Financing Administration develops health care spending statistics for the United States; processes claims for 39 million Medicare beneficiaries; and collects statistical data on costs, quality of care, and access to health care services for Medicare and Medicaid beneficiaries.

The Department of Labor. The Labor Department's Bureau of Labor Statistics (BLS) produces statistics on employment, unemployment, consumer expenditures, prices, and living conditions, among other things. The department also produces other information on the labor market (for example, wages in selected industries) and data on workplace accidents.

The Department of Agriculture. USDA's National Agricultural Statistics Service produces data on farm acreage, crop yields, livestock inventories, chemical use on farms, prices for farm products, world agricultural production, and other agricultural concerns. The Economic Research Service provides economic analyses of issues related to agriculture, food, the environment, and rural development. The department also conducts soil surveys, prepares water supply forecasts, and inventories forest lands.

Major Programs in Other Agencies. The Department of Transportation produces information on transportation systems, aviation safety, fuel consumption, vehicle accidents, and other transportation matters. Data on crime, prisons, and immigration come from the Department of Justice. The Department of Education serves as the federal source of information on primary and secondary schools and postsecondary institutions. The Internal Revenue Service produces annual data on income, taxes, and other matters. Extensive data on energy and natural resources is available from the Departments of Energy and the Interior. Finally, the Environmental Protection Agency produces information on the quality of air and drinking water and on hazardous substances in the environment.

Increasing Support for Federal Statistical Programs

Agencies across government are engaged in extensive efforts to keep statistical information timely, accessible, and relevant in a rapidly changing world. If the Congress decides to increase its support of such efforts, it could try to accelerate initiatives to make information more available, to improve the accuracy and relevance of existing data, or to collect new types of data. Again, some of the examples below include dollar figures to suggest the magnitudes of possible investments.

Expanding the Availability of and Access to Information. Information has little value if users cannot find and get timely access to it. In recent years, many agencies and the government as a whole have focused on the Internet as a means of expanding access to federal information. Under the guidance of the Interagency Council on Statistical Policy, for example, major statistical agencies worked to establish a central Web site (www.fedstats.gov) from which users can access statistics from many different agencies. The agencies continue to expand and improve that site. Currently, they plan to add the capability to do customized searches for information and to broaden the scope of the data covered. Individual agencies are working on similar efforts on their own Web sites. The Environmental Protection Agency, for example, recently established a single on-line source of information on a wide variety of environmental issues. Users can find information there on air quality in specific areas, water safety at beaches, and pollution-prevention techniques. In a similar fashion, the Bureau of Justice Statistics at the Department of Justice is attempting make the crime data it puts on the Internet more accessible, the Internal Revenue

Service is expanding the amount of data available electronically through its home page, and the Department of Transportation is attempting to upgrade the technology used to respond to requests for traffic safety information.

Strengthening Existing Information. To be useful, data need to be accurate and focused on the uses to which they will be put. Statistical agencies have under way a broad range of efforts to improve the information they produce and to keep abreast of new methods and developments. The BLS has nearly completed a multiyear effort to update the consumer price index (CPI), the nation's primary source of information on changes in consumer prices, and incorporate information from a larger sample. Consistent with recommendations of an advisory commission, new indexes will consider changes in the quality of products and in consumers' selections as prices change.[67] The BLS also plans a number of improvements to the producer price index, the measure of prices in the business sector, including expanding the index to cover the construction industry and increasing the coverage of businesses that provide services. The Bureau of the Census continues efforts to expand the number of communities covered by the American Community Survey, which provides data on economic, demographic, and other characteristics of local communities. That survey could allow the government to allocate nearly $200 billion in federal resources annually on the basis of more timely and accurate information. (The Congress did not provide the $3.4 million increase the President requested for the survey in 2001.) In accord with the recommendations of the National Research Council, the bureau also plans to improve its measures of economic well-being and poverty, in part by accounting for the full range of assistance available to the poor. Improved measures would permit decisionmakers to better monitor the effectiveness of programs to improve economic well-being. And EPA would like to extend its surveys of harmful emissions—for example, by requiring monitoring of urban air quality at additional times of the day.

Collecting New Information. As new developments occur and new issues arise, the government may need to collect new information. For example, the Census Bureau received an additional $8.5 million in 2001 to collect data on electronic commerce, which has become an important part of the U.S. economy and been a significant factor in the recent surge in economic productivity. That data will allow better measurement of spending on personal consumption and other key activities and support efforts by the Bureau of Economic Analysis to maintain accurate national economic accounts; the information will also help government decisionmakers to assess policy issues such as whether to allow taxation of sales made over the Internet. Also, the BLS received $4.3 million for 2001 to support a survey of how Americans spend their time. That survey will produce previously unavailable information on the relationship between public policies and individuals' behavior. For example, as large numbers of baby boomers begin retirement, how they choose to spend their time in work or leisure will have implications for public policies on transportation and retirement programs. But the Congress rejected a request for $1.3 million in 2001 to allow the Bureau of Justice Statistics to measure crimes against the disabled and hate crimes.

Should the Federal Government Spend More on Statistics?

Federal data are critical. Citizens, workers, academics, businesses, and governments at all levels use federal statistics in planning, monitoring trends, making decisions, and identifying and solving problems. Federal data on the economy, for example, affect the uses to which billions in public and private resources are put and are critical to decisions made by the Congress and the President. Data on local communities and industries from the Bureau of the Census and the Bureau of Economic Analysis can influence companies' plans for expansion into new locations, help banks decide on the wisdom of loans to certain types of businesses, and determine how billions of dollars in federal assistance are distributed among localities. The CPI is used in some contracts to determine allowable increases in prices, in Social Security to determine annual increases in benefits, and in some employee pay and benefit plans to determine increases in compensation.

67. Advisory Commission to Study the Consumer Price Index, *Toward a More Accurate Measure of the Cost of Living: Final Report to the Senate Finance Committee* (December 4, 1996).

Other federal data also help guide decisions and resources. Federal transportation data help in planning highways, airports, and other transportation facilities. Good data on traffic safety help the government and communities plan responses to reduce traffic fatalities, which are the nation's third leading cause of death. Federal information on disease helps the nation prevent illness and find cures. Federal data on education help in assessing the success of the nation's schools.

Supporters of increased funding for federal statistical programs argue that the many important uses to which such information is put make the maintenance and improvement of statistical work a critical federal responsibility.[68] In their view, even small investments in improvements to economic and other data can result in significant contributions to the economy and to well-being by helping to ensure that resources are directed toward their best use. Supporters also argue that government is uniquely positioned to collect and disseminate data because of the reach and breadth of its activities. In addition, some feel that entrusting to government the task of gathering information helps ensure the accuracy and fairness of the data.

Economists and others have warned, in particular, about the lack of funding for economic statistics. Many warn of serious implications for the nation if poor data mislead decisionmakers in business and government about the course of the economy, inflation, wages, and other important economic factors. Proponents point out that many improvements, particularly in economic statistics, would not be expensive or increase reporting burdens significantly. For example, if firms had to report only slightly more detail about withheld taxes, analysts would be much better able to understand and forecast revenues in the near term. Such detail would also provide more useful information about the current state of the economy and provide some insight into recent changes in wages and income distribution.

Critics worry about burdening private firms and others with additional requirements to provide data and information. Some who oppose more funding believe that the rights and privacy of citizens are put at risk when government holds a great deal of information. They point, for example, to the misuses of information collected by the Internal Revenue Service. They also view data collection as leading to the expansion of government. According to that view, data collection is a critical first step leading to more regulation and other governmental activity. Such critics contend that localities and private firms will find the resources to produce the data they need.

Other critics of increased funding for statistics worry that such funds will produce more data but not necessarily better data. Some call for a central statistical agency to ensure, among other things, a better coordinated and thus more efficient federal statistical effort. While acknowledging that some statistical programs, particularly those covering the economy, have received only modest increases in funding in recent years, they note a large increase in total funding for statistical programs. They suggest that some needs for more data might be met by reassessing priorities in information and diverting funds from less important efforts or by contracting out parts of statistical operations—for example, the processing and dissemination of information.

68. See, for example, Michael Boskin, *Some Thoughts on Improving Economic Statistics to Make Them More Relevant in the Information Age* (prepared for the Joint Economic Committee, United States Congress, October 1997). The report examines problems with the nation's economic statistics and opportunities to improve their usefulness to policymakers.