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Nuclear Safety

July 2001

**U.S.
INFRASTRUCTURE**

**Agencies' Approaches
to Developing
Investment Estimates
Vary**



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Abstract The federal government has spent an average of \$149 billion (in constant 1998 dollars) annually since the late 1980s on the nations infrastructure. 1 A sound public infrastructure plays a vital role in encouraging a more productive and competitive national economy and meeting public demands for safety, health, and improved quality of life. For example, transportation systems directly support the nations economy by facilitating the movement and manufacture of goods. Public office buildings, courthouses, and other facilities support noneconomic goals and allow federal agencies to carry out their missions. At least a portion of federal financed infrastructure has benefits that accrue primarily to the states and local communities rather than the nation as a whole. In addition, state and local governments and the private sector play important roles in developing, operating, and financing significant portions of infrastructure. The federal government plays a prominent role in identifying the nations infrastructure investment needs. Little, however, is known about the comparability and reasonableness of individual agencies estimates for infrastructure needs. In fact, even the concept of infrastructure need is difficult to define and to distinguish from wish lists of capital projects. This report responds to your request for information on infrastructure investment or needs estimates compiled by six federal agencies the U.S. Army Corps of Engineers, Environmental Protection Agency (EPA), Federal Aviation Administration (FAA), Federal Highway Administration (FHWA), Federal Transit Administration (FTA), and General Services		Monitoring Agency Acronym
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United States General Accounting Office
Washington, DC 20548

July 20, 2001

The Honorable George V. Voinovich
Ranking Minority Member
Subcommittee on Clean Air, Wetlands,
Private Property, and Nuclear Safety
Committee on Environment and Public Works
United States Senate

Dear Senator Voinovich:

The federal government has spent an average of \$149 billion (in constant 1998 dollars) annually since the late 1980s on the nation's infrastructure.¹ A sound public infrastructure plays a vital role in encouraging a more productive and competitive national economy and meeting public demands for safety, health, and improved quality of life. For example, transportation systems directly support the nation's economy by facilitating the movement and manufacture of goods. Public office buildings, courthouses, and other facilities support noneconomic goals and allow federal agencies to carry out their missions. At least a portion of federal financed infrastructure has benefits that accrue primarily to the states and local communities rather than the nation as a whole. In addition, state and local governments and the private sector play important roles in developing, operating, and financing significant portions of infrastructure.

The federal government plays a prominent role in identifying the nation's infrastructure investment needs. Little, however, is known about the comparability and reasonableness of individual agencies' estimates for infrastructure needs. In fact, even the concept of infrastructure "need" is difficult to define and to distinguish from "wish lists" of capital projects. This report responds to your request for information on infrastructure investment or "needs" estimates compiled by six federal agencies—the U.S. Army Corps of Engineers, Environmental Protection Agency (EPA), Federal Aviation Administration (FAA), Federal Highway Administration (FHWA), Federal Transit Administration (FTA), and General Services

¹Infrastructure has been defined in a number of ways. Broadly defined, infrastructure can include facilities, structures, and land for public use and for other purposes, such as national defense. See *U.S. Infrastructure: Funding Trends and Opportunities to Improve Investment Decisions* (GAO/RCED/AIMD-00-35, Feb. 7, 2000).

Administration (GSA)—as well as the Appalachian Regional Commission (ARC).² As you requested, we focused on the following infrastructure areas—water resources (inland and deep draft navigation, flood control, and shore protection), hydropower, water supply, wastewater treatment, airports, highways, mass transit, and public buildings. For these seven agencies and specified types of public infrastructure, we agreed to address the following: (1) What are the agencies’ estimates for infrastructure investment and how do the estimates compare in terms of how they are developed and used? (2) To what extent do the agencies’ procedures for developing the estimates embody practices of leading government and private-sector organizations?

We did not independently verify the agencies’ investment estimates, but we did rely on past reviews of these data by us and others that examined the soundness and completeness of the methodology and/or data used to develop the estimates. We incorporated findings from these reviews as appropriate. The amount of information we present concerning an estimate reflects the extensiveness of past reviews and does not imply that an estimate is better or worse than other estimates. For some agencies—ARC, the Army Corps, EPA, and FTA—we did not have past reviews related to the estimates to draw upon. We reviewed agencies’ documentation of their procedures to develop the estimates, but we did not verify whether these procedures were followed. We compared agencies’ procedures with some of the capital decisionmaking practices used by leading government and private sector organizations that we identified and reported on in 1998.³ This report focuses on those leading practices that relate to developing and using investment estimates. We included practices such as establishing a baseline inventory of assets, using cost-benefit analysis to identify economically justified investments, and ranking and selecting projects for funding based on established criteria. See appendix I for additional information on our scope and methodology.

Results in Brief

The seven agencies we reviewed each estimated billions of dollars for investment in infrastructure. The estimates ranged from GSA’s calculation of \$4.58 billion (in current dollars) over 1 to 5 years to repair public

²In this report, we will refer to all seven entities, including ARC, as agencies.

³*Executive Guide: Leading Practices in Capital Decision-Making* (GAO/AIMD-99-32, Dec. 1998).

buildings to FHWA's estimate of \$83.4 billion (in constant 1997 dollars) per year over 20 years to improve highways. The estimates prepared by the Army Corps (for water resources and hydropower) and GSA are for federal spending; the other estimates are for spending from federal, state, and local sources. Each of the seven agencies developed their investment estimate using data from localities, states, or agency regional offices and aggregating that information to produce a national estimate for infrastructure investment. The estimates, however, were developed using different analytical procedures. For example, FHWA used benefit-cost analysis for its highway estimate, while EPA used engineering-based approaches for its drinking water and wastewater estimates. The investment estimates cannot be easily compared or simply "added up" to produce a national estimate of infrastructure investment needs because of differences in the methods used, time periods covered, and spending sources. A fundamental reason that the estimates are prepared differently and lack comparability is that they are developed and used for different purposes. The Army Corps and GSA use the information to help determine the financial resources needed to manage and/or repair their own assets. The other five agencies develop estimates at the request of the Congress to provide general information to decisionmakers or to help direct funding to recipients of federal assistance.

Each of the seven federal agencies we reviewed had procedures for developing infrastructure investment estimates that reflected some practices used by leading government and private sector organizations. No agency had procedures for all eight leading practices. Not following a leading practice does not necessarily represent a deficiency on the part of an agency because, in some cases—such as ARC's and EPA's estimates—those practices that are not applied by the federal agency may be implemented by state or local governments. The Army Corps had the highest conformance to the leading practices, with procedures that reflected six of the eight practices. Among the agencies, FHWA and FTA came closest to reflecting an important leading practice—conducting comprehensive assessments of the investments needed to meet outcomes by focusing on the amounts needed to maintain or improve the condition and performance of highways and transit systems. The remaining five agencies developed estimates that are summations of the costs of projects eligible to receive federal funding or projects identified by the Congress and others, rather than comprehensive estimates of investments needed to achieve outcomes. All seven agencies had procedures that called for reviewing data developed by states and others, and five agencies considered alternative noncapital ways to address unmet investment requirements. By comparison, the agencies were less likely to follow

practices such as developing a long-term capital plan, using cost-benefit analysis as the primary method to compare alternative investments, ranking and selecting projects for funding based on established criteria, and budgeting for projects in useful segments.

We make several observations in this report. First, for the most part, these investment estimates are totals for the entire infrastructure network—involving all levels of government and the private sector. The federal government's role in financing these amounts should be recognized and, in some cases, this role might be small compared to other levels of government or the private sector. Second, these investment estimates can change significantly over time, with changes in the efficiency of delivering infrastructure services or pricing strategies that alter the demand for services. Third, these investment estimates focus on the condition of facilities rather than the performance outcomes that can be expected from the investments. The passage of the Government Performance and Results Act signaled a shift in federal focus from inputs (such as the condition of highways and airports) to outcomes (such as improved mobility). In the infrastructure area, we caution against relying on measures of need based primarily on the condition of facilities and instead suggest comparing the costs and benefits of alternative approaches for reaching outcomes, including noncapital alternatives.

Background

To determine what would be sufficient to meet the nation's demand for infrastructure services such as efficient and safe mobility and clean water is not simple. The investment requirements depend on (1) the supply of service—what facilities exist, their condition and maintenance, how efficiently they are operated, and how services might be provided other than through capital spending—and (2) the demand for such services by the public, which can be influenced, in part by the price charged for infrastructure services and the state of the economy. Infrastructure investment estimates can vary greatly depending on the extent to which such factors are considered in investment calculations. For example, the investment required to maintain or rehabilitate existing facilities could differ significantly from the investment required to meet a specified level of service. Moreover, focusing on the provision of service, rather than the condition of a structure or facility, can lead to the consideration of less costly, noncapital alternatives to meeting the demand for infrastructure. For example, to meet a specified level of service on roads, such as keeping traffic flowing at the speed limit, decisionmakers might consider changing the timing of traffic lights rather than building new lanes. Furthermore, future investment needs are not a predetermined reality and can be affected by more efficient use of existing infrastructure. For example,

technological improvements can increase the efficiency of infrastructure. In addition, pricing strategies can affect the use of infrastructure—relatively higher fees can encourage users to economize on their consumption.

Selected Federal Agencies’ Roles in Developing Infrastructure

The seven agencies we reviewed develop information on infrastructure investment requirements because of their roles in financing and developing infrastructure. (See fig. 1.) ARC, the Army Corps, EPA, FAA, FHWA, and FTA provide funding for transportation, water supply, and wastewater treatment infrastructure that is owned, operated, and maintained by others. GSA and the Army Corps are directly responsible for acquiring and maintaining federal office buildings and dams and flood-control structures, respectively.

Figure 1: Selected Agencies' Roles in Developing Infrastructure

Army Corps

- The Army Corps' civil works program develops and/or manages water resources projects such as deep draft harbors, commercially navigable channels, lock chambers, and hydropower plants. In addition, the Army Corps assists local governments in developing water supply and treatment facilities.
- The Congress provides funding to the Army Corps for work in all of those areas on a project-by-project basis. Each Army Corps project has a nonfederal cosponsor that shares in the cost. In addition, fees from vessel operators are used to fund half the cost of new construction and major rehabilitation of the commercial fuel-taxed inland waterway system.
- Other federal agencies—including EPA—provide funding for investment in water infrastructure.

EPA

- EPA provides funding for the construction and improvement of drinking water and wastewater treatment facilities—which are owned and operated by local governments or private entities—through grants to capitalize state revolving funds. Federal grants provide the "seed" money for the state programs, which prioritize projects and provide financial assistance to eligible recipients for eligible capital improvements. As a condition of receiving federal funds, states provide a matching amount into their revolving funds equal to 20 percent of the total grant. The revolving funds provide several types of financial support to drinking water and wastewater facilities, including loans at or below market interest rates, guarantees for the issuance of new local bonds, and purchase of existing bonds.
- Other federal programs also provide financial support for investment in water infrastructure, including the Department of Agriculture, which provides loans and grants for water and waste-disposal projects in communities with fewer than 10,000 people; the Army Corps; the Department of Housing and Urban Development's Community Development Block Grant Program; and the Commerce Department's Public Works and Development Facilities Program.

DOT

- DOT's FAA provides airports with grants for capital development, including projects such as building new runways or remodeling passenger terminals. FAA allocates most grants on the basis of (1) a legislated formula that is tied to the number of passengers that an airport enplanes and (2) categories earmarked for specific types of airports and projects. FAA allocates the remaining funds for projects identified by the airports.

DOT (continued)

- DOT's FTA provides funding for mass transit (such as buses and railcars) primarily through formula and capital investment grants, that generally require a state/local match of at least 20 percent. The formula grants provide capital and planning assistance for mass transit in urbanized and nonurbanized areas. The capital assistance grants to state and local agencies fund new transit systems and improvements to existing systems. FTA provides capital assistance grants for particular projects, based on demographic criteria or the demonstrated needs of urban areas.
- DOT's FHWA provides states, localities, and others with grants that partially fund the construction and improvement of urban and rural highways and bridges, including major maintenance of interstate highways.^a States generally provide a 20-percent match and determine how to spend the money within broad federal guidelines.

ARC

- ARC funds highway construction for the Appalachian Development Highway System (ADHS)^b—a 3,025 mile system of highways that is under construction within Appalachia.^c Prior to 1998, ARC received its own appropriation for construction of the ADHS.
- Since the enactment of the Transportation Equity Act for the 21st Century in 1998, ARC has received funding through the Highway Trust Fund. The money ARC receives is distributed to the states on the basis of their percentage share of the cost to complete the entire ADHS and is complemented by a state match of no less than 20 percent.

GSA

- GSA constructs and manages buildings, including courthouses, border stations, and offices, for federal agencies. GSA is responsible for repair and alterations for about 1,800 buildings.
- The primary means of financing the operating and capital costs associated with federal space owned or managed by GSA is the Federal Building Fund, a revolving fund supported by rental assessments to federal agencies and annual appropriations. The Congress exercises control over the fund through the appropriations process that sets annual limits on how much can be expended for various activities.
- Other federal agencies, including the Departments of Defense and Energy and the Postal Service, also own federal buildings.

^aFor this report, we excluded bridges from our analysis and included only FHWA's estimate for highways.

^bARC also provides funds for economic development, sewer, and education projects.

^eAppalachia includes all of West Virginia and parts of 12 states; Alabama, Georgia, Kentucky, Maryland, Mississippi, New York, North Carolina, Ohio, Pennsylvania, South Carolina, Tennessee, and Virginia.

^fGSA also leases facilities for federal agencies.

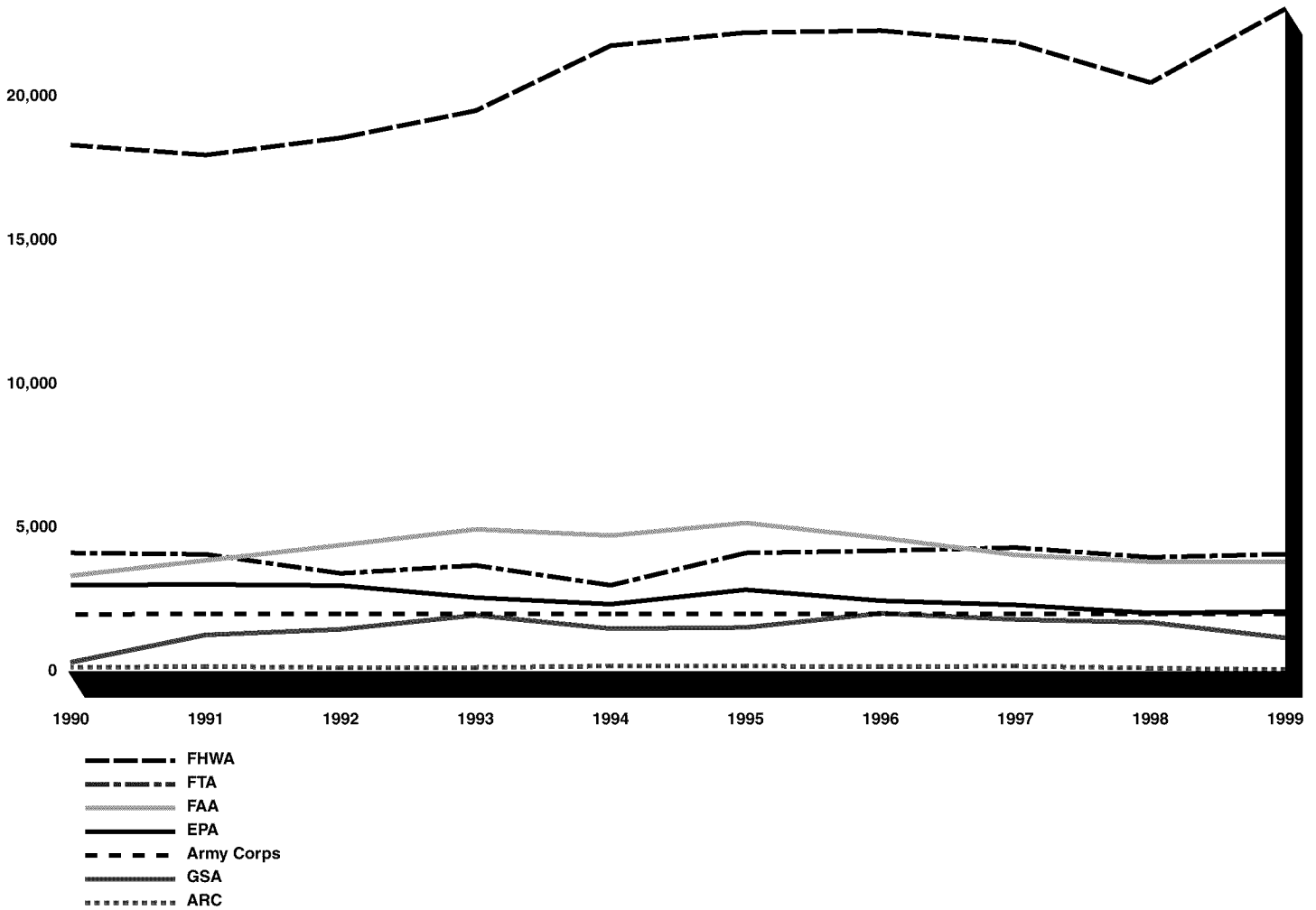
Sources: ARC, the Army Corps, EPA, DOT, and GSA.

At the request of the Congress, EPA, FAA, FHWA, and FTA periodically prepare long-term infrastructure investment estimates. Every 5 years, ARC prepares an estimate of the cost to complete the Appalachian Development Highway System, which it finances by distributing federal funds to states within Appalachia. GSA maintains information on the investment needs for public buildings and the Army Corps maintains information on the investment needs for water resources (inland and deep draft navigation, flood control, and shore protection), hydropower, water supply and wastewater treatment.

The investment estimates developed by the seven agencies will be funded, at least in part, by federal financing. The Army Corps' estimate only includes the federal portion of investment. GSA's estimate for investment in public buildings will be financed entirely with federal funds. Figure 2 shows the spending trends from fiscal years 1990 to 1999 for the seven agencies. Spending (in constant 2000 dollars) ranges from an average of \$150 million per year for ARC to an average of \$20.6 billion per year for FHWA. Although these seven agencies have made large investments in public infrastructure, state and local governments and the private sector play important roles in financing significant portions of some infrastructure, such as water treatment and supply and transportation.

Figure 2: Infrastructure Spending for Selected Agencies, Fiscal Years 1990 Through 1999

25,000 Dollars in millions.



Note: All amounts are in constant 2000 dollars.

Source: GAO's analysis of OMB's data.

Leading Practices and Guidance to Improve Infrastructure Planning

Preparing investment estimates is a capital decisionmaking activity by federal agencies. In 1998, we identified the practices of leading government and private-sector organizations in capital decisionmaking.⁴ During that review, we found that conducting a comprehensive needs assessment is an important first step in an organization's decisionmaking process for infrastructure because it allows an organization to (1) consider its overall mission, (2) identify the resources needed to fulfill both immediate requirements and anticipated future needs on the basis of results-oriented goals and objectives that flow from the organization's mission, and (3) consider both capital and noncapital approaches to addressing these goals. The following leading practices relate to developing and using investment estimates:

- conduct a comprehensive assessment of the resources needed to meet an agency's mission and results-oriented goals and objectives;
- establish a baseline inventory of existing assets, evaluate their condition, determine if they are performing as planned, and identify excess capacity;
- consider alternative ways to address needs, including noncapital alternatives;
- use cost-benefit analysis as a primary method to compare alternatives and select economically justified investments;
- rank and select infrastructure projects for funding based on established criteria;
- budget infrastructure projects in useful segments;
- develop a long-term capital plan that defines capital asset decisions; and
- establish procedures to review data developed by others and using independent reviews of data and methods to further enhance the quality of estimates.⁵

The leading practices we identified reflect requirements that the Congress and Office of Management and Budget (OMB) have placed on federal agencies that are aimed at improving federal agencies' capital decisionmaking practices. These requirements relate to aspects of investment estimates, such as developing cost information, measuring the benefits of proposed investments, and using investment estimates as a first

⁴ *Executive Guide: Leading Practices in Capital Decision-Making* (GAO/AIMD-99-32, Dec. 1998).

⁵ This practice was identified as a result of information collected during this review.

step toward acquiring infrastructure. These requirements include, for example, the Chief Financial Officers' Act of 1990, which required the development of accounting and financial systems to report cost information and that the principles used in accounting for program costs be consistent with those used in developing program budgets. In addition, the Government Performance and Results Act of 1993 (Results Act) required agencies to develop mission statements, long-range strategic goals and objectives, and annual performance plans. The Results Act emphasized identifying and measuring outcomes, including benefits. In addition, the Congress enacted the Federal Acquisition Streamlining Act of 1994 to improve the federal acquisition process. Title V of the act was designed to foster the development of (1) measurable cost, schedule, and performance goals and (2) incentives for acquisition personnel to reach these goals. To help agencies integrate and implement these and other requirements,⁶ OMB added a section to its annual budget preparation guidance (Circular A-11) requiring agencies to provide OMB with information on major capital acquisitions and to submit a capital asset plan and justification. This guidance is supplemented by OMB's *Capital Programming Guide*, which provides detailed steps on planning, budgeting, acquiring, and managing infrastructure and other capital assets. The steps in OMB's guide include the concepts covered by our 10 leading practices.

Agencies Develop and Use Investment Estimates Differently

The seven agencies we reviewed produce investment estimates for water resources, hydropower, water supply, wastewater treatment, airports, highways, mass transit, and public buildings. Some estimates—for water resources, hydropower, and public buildings—are developed for federal spending; the other estimates are developed for spending from federal, state, and local sources. The estimates cannot easily be compared because they were developed using different methods, time periods, and funding sources. A fundamental reason that the estimates were prepared differently and lack comparability is that they are developed and used for different purposes. Some agencies use the information to determine the financial resources needed to manage and/or repair their own assets, and

⁶In addition, the Clinger-Cohen Act of 1996 was enacted to improve the implementation and management of information technology projects by requiring that agencies engage in capital planning and performance and results-based management. The Statement of Federal Financial Accounting Standards, No. 6, *Accounting for Property, Plant, and Equipment*, requires agencies' financial statements to report deferred maintenance for all property, plant, and equipment.

other agencies develop estimates at the request of the Congress to provide general information to decisionmakers or to help direct funding to recipients of federal assistance.

Agencies Have Identified Vast Amounts of Investment Estimates

The seven agencies identified investment amounts that vary from GSA's estimate of \$4.58 billion over 1 to 5 years to repair public buildings to FHWA's estimate of \$83.4 billion each year over 20 years to preserve and improve the nation's highways. The investment estimates are summarized in table 1.

Table 1: Selected Agencies' Infrastructure Investment Estimates

Agency	Activities and assets included in estimate	Activities and assets excluded from estimate	Time period covered	Total estimate (in billions)
ARC	Construction of highways within portions of 13 states	Maintenance, retrofit, or improvements to completed highways	1997-completion	\$8.5 ^a (1995 dollars)
Army Corps	Construction and major rehabilitation of water resources projects and major rehabilitation of hydropower projects nationwide	Non-construction costs, projects not under construction, and critical operations and maintenance work	2001-completion	\$38.0 ^a
EPA	Construction and upgrade of drinking water supply systems nationwide	Costs due solely to population growth and costs not eligible for federal funding	1999-2018	\$150.9 ^a (1999 dollars)
EPA	Construction and upgrade of wastewater treatment collection facilities nationwide	Costs due solely to population growth and costs not eligible for federal funding	1996-2016	\$139.5 ^a (1996 dollars)
FAA	Construction, replacement, and rehabilitation of airport facilities nationwide	Costs not eligible for federal funding	1998-2002	\$35.1 (constant 1998 dollars)
FHWA	Improvements to the nation's highways based on several scenarios ^b	Costs to construct new roads	1998-2017	\$50.8 - \$83.4 per year for 20 years ^b (constant 1997 dollars)
FTA	Replacement and refurbishing of mass transit vehicles and facilities nationwide based on four scenarios ^c and construction of new systems		1998-2017	\$10.8 - \$16.0 per year for 20 years ^c (constant 1997 dollars)
GSA	Repair and alteration of public buildings	Buildings owned by federal agencies other than GSA	Up to 5 years	\$4.58 ^a
GSA	Construction of border stations, federal office buildings, and courthouses		Up to 7 years	\$0.75 to \$0.8 per year for 5 to 7 years ^a

^aCurrent year dollars.

^bFHWA modeled several scenarios—including cost beneficial investments needed to maintain the current physical condition—that provided a range of estimates.

Source: GAO's analysis of agencies' data.

⁶FTA's analysis included scenarios that produced estimates ranging from investments needed to maintain current condition and performance of mass transit to investments needed to improve its current condition and performance.

Note: Estimates for the Army Corps and GSA are federal investments. Estimates for the remaining agencies are a combination of federal, state, and other investment sources.

The investment estimates cannot be easily compared or simply “added up” to produce a national estimate of all infrastructure investment needs because of differences in the methods used, time periods covered, and funding sources. For example, EPA used engineering-based approaches to develop costs for its drinking water and wastewater treatment estimates. By contrast, FHWA developed a computer model to forecast the future condition of and improvements to highway segments that uses cost-benefit analysis as the primary criteria for including improvements in its overall investment estimate. In addition, the estimates involve differing time periods. For example, FAA’s estimate of airport infrastructure investment covers 5 years, while ARC and the Army Corps produce estimates of undefined time periods for highways and water resource projects, respectively. Some agencies prepared their estimates in constant year dollars—ARC’s estimate is in 1995 dollars—while other agencies, such as GSA, presented their estimates in current dollars. The estimates also include differing funding sources: estimates by the Army Corps and GSA include only the costs to the federal government, while estimates by the other five agencies include total costs to federal, state, and local organizations.

Estimates Used Data From Local, State, or Regional Sources

Each of the seven agencies used data from various localities, states, or agency regional offices and aggregated those data to produce a national estimate for infrastructure investment. Each agency’s process for developing its investment estimate is summarized below. They are described in detail in appendix II.

The Army Corps estimated that \$38 billion in federal funds was required to complete water resources and hydropower infrastructure projects already under construction as of March 30, 2001. Infrastructure projects included in this estimate were initially identified by local governments, groups, and/or private citizens, who requested assistance from the local Army Corps district office. According to an Army Corps official, regional Army Corps personnel evaluate the requests and determine both the seriousness of the problems and the need for immediate solutions. Project costs are estimated by engineers and other professionals using existing industry data. The agency also uses cost-benefit analysis to determine which projects are economically justified and would assist the agency in reaching

its goals, such as environmental protection and flood mitigation. The evaluation and cost estimate is sent to the agency's headquarters, and selected projects are submitted for funding as part of the Department of Defense's annual budget.

FAA estimated that \$35.1 billion in federal and nonfederal funds was required for airport infrastructure from 1998 to 2002. Data for the investment estimate come primarily from airport plans—such as airport master plans and layouts—which include proposals and cost estimates for specific infrastructure projects at individual airports. FAA officials in field offices review each project, and approved projects are entered into a FAA database. FAA officials in headquarters review the database for anomalies in the data, then add up the estimated cost of each project to produce an overall investment estimate. Because this estimate is not a spending plan, FAA has reported that it makes no attempt to prioritize the projects or determine if the benefits of specific projects would exceed their cost. This estimate is prepared and submitted to the Congress biennially, as required by statute.

FTA also used local sources of data to estimate an investment of \$10.8 billion to \$16.0 billion per year for mass transit systems (such as buses and railcars) from 1998 to 2017, depending on whether the condition and performance of mass transit systems would be maintained or improved. The estimates cover both federal and nonfederal shares of costs. FTA used data from local urban transit agencies to determine the age and condition of mass transit infrastructure and then estimated the cost of either maintaining or improving that infrastructure. FTA used an estimate developed by its Transit Economic Requirements Model. The model performed a benefit-cost analysis to determine if replacing an asset was economically justified. The model then aggregated the cost of all the infrastructure projects that were justified by benefit-cost analysis to determine the total investment estimate for the nation's mass transit systems. FTA uses this estimate to provide general support for its budget and information on changes in mass transit systems.

ARC estimated that it would cost \$8.5 billion from state and federal sources to complete the Appalachian Development Highway System. To do this, it relied on state highway officials within Appalachia, who determined the estimated cost to complete individual highway corridors within their particular state that are part of the highway system. These estimates used engineering structural criteria to estimate the cost of constructing highway corridors. The estimate included costs for project design, environmental mitigation, rights of way access, and construction.

ARC officials provided instructions to the states for computing this estimate and reviewed the estimates by comparing the costs to the costs of similar highway projects within that state and to FHWA's data on construction costs. The costs were not adjusted for inflation. ARC then aggregated the data from each state to produce an overall estimate of the cost to complete the entire highway system. ARC uses this estimate as the basis for allocating funds appropriated for the Appalachian Development Highway System. Specifically, ARC calculates each state's percentage share of the total cost to complete the highway system and distributes funding to each state accordingly.

In May 2001, GSA's data indicated that \$4.58 billion in federal funds was required over the next 5 years to meet the repair and alteration needs of public buildings. GSA estimated that an additional \$250 million to \$300 million was required annually over the next 5 years to construct new border stations and federal office buildings, and \$500 million annually was required over 5 to 7 years to construct new courthouses. Investment projects are identified by regional offices, which are expected to determine the best way to meet the agencies' space requirements. The cost data for projects that have estimated costs of between \$10,000 and less than \$1.99 million are developed using engineering criteria and are derived from various sources, including contractors, safety inspectors, and senior-level building management staff. Projects that have estimated costs greater than \$1.99 million are evaluated by headquarters officials and ranked in order of priority. GSA's cost data are used as input in determining funding priorities.

EPA estimated that \$150.9 billion in federal, state, and local funds was needed for capital investment in drinking water facilities between 1999 and 2018. Only costs eligible for funding under the Drinking Water State Revolving Fund were included. These costs were not adjusted for inflation. To develop the estimate, EPA surveyed all of the large water systems in the United States as well as a sample of the medium water systems. In addition, EPA conducted site visits to 599 small systems and extrapolated data from these surveys and site visits to compute the total investment estimate. The surveys and supporting cost documentation for medium and large systems were submitted to states for review and were subsequently reviewed by EPA. The agency uses the results of this estimate to allocate monies to the states for the Drinking Water State Revolving Fund based on each state's share of the total investment amount.

In 1996, EPA estimated that \$139.5 billion in federal and state funds was needed between 1996 and 2016 for water pollution control, primarily for capital investment in already-existing wastewater treatment facilities. Only costs eligible for funding under Title VI of the Clean Water Act were included in the estimate. These costs were not adjusted for inflation. EPA developed the estimate from a nationwide database of wastewater treatment facilities that is periodically updated by surveying the states. The states provided revised estimates of capital investment needs from their documented plans, which were supplemented by costs modeled by EPA when the state lacked this information. In addition, EPA modeled the costs for each state for combined sewer overflows and activities to control stormwater runoff and nonpoint sources of pollution. The Congress has used this information as one consideration in appropriating funds for capitalization grants to the states, through the Clean Water State Revolving Fund loan program. According to EPA, the estimate is also used to assist in program planning and evaluation.

In May 2000, FHWA issued investment estimates for highways for the years 1998 to 2017. These estimates ranged from \$50.8 billion per year for cost-beneficial improvements that would maintain the current physical condition of highways to \$83.4 billion per year for all improvements that would improve pavement condition and reduce highway users' travel costs. The estimates included both federal and nonfederal portions of funding and were in constant 1997 dollars. To determine the estimates, FHWA used data from a statistically drawn national sample of 125,000 highway segments as well as information from the states on forecasts such as travel growth. FHWA officials reviewed the data submitted by the states, looked for anomalies or unusual patterns, and asked the states to correct serious flaws and improve some data submissions. FHWA used a computer model to simulate the effects of infrastructure improvements on a sample of highway data and used a benefit-cost analysis to identify economically justified highway improvements. FHWA's estimate is used by legislative and executive branch offices to obtain general information on the nation's overall need for investment in highways.

Agencies' Procedures Reflect Some Leading Practices, but This Does Not Guarantee Accurate Estimates

The federal agencies we reviewed all had procedures for developing their infrastructure investment estimates that reflect some leading practices that we identified, although some agencies followed more leading practices than others. However, following the leading practices does not ensure a quality investment estimate and each estimate had limitations associated with the quality of the data used in developing it. The strengths and limitations of each investment are summarized in appendix II.⁷ Correcting such limitations will improve the quality and reliability of the agencies' investment estimates.

None of the agencies we reviewed had procedures for all eight of the leading practices. Not following a leading practice does not necessarily represent a deficiency on the part of an agency because, in many cases, when these practices are not applied by the federal agency, they are implemented at the state or local level. For example, for EPA's drinking water investments, six of eight practices are undertaken at the local or state level, according to agency officials. The Army Corps had the highest conformance to the leading practices, with procedures that reflected six of the eight practices, such as establishing an inventory of assets and their condition and using cost-benefit analysis to select among investment alternatives. Among the seven agencies, FHWA and FTA came closest to conducting comprehensive assessments of the investments needed to meet results-oriented agency goals—the estimates were results oriented by focusing on the amounts needed to maintain or improve the performance of highways and transit systems; but the estimates did not consider alternative, noncapital ways to address investment needs. The remaining five agencies developed estimates that are summations of the costs of projects eligible to receive federal funding or projects identified by the Congress and others, rather than comprehensive estimates of investments needed to achieve outcomes. All seven agencies had procedures that called for reviewing data developed by states and others and four agencies considered alternative noncapital ways to address unmet investment requirements. By comparison, the agencies were less likely to follow practices such as developing a long-term capital plan, using cost-benefit analysis as the primary method to compare alternative investments, ranking and selecting projects for funding based on

⁷ We considered agency procedures that reflected leading practices and factors that enhanced the soundness or completeness of an estimate to be strengths of an estimate. We considered factors that detracted from the soundness or completeness of an estimate or its source data to be limitations of an estimate.

established criteria, and budgeting for projects in useful segments. Figure 3 shows each agency's level of conformance to the leading practices.

Figure 3: Agencies' Application of Leading Practices For Determining Investment and Funding Decisions

Leading practices	ARC	Army Corps ^a	EPA Drinking water	EPA Waste water	FAA	FHWA	FTA	GSA
1. Conduct a comprehensive assessment of the resources needed to meet an agency's mission and results-oriented goals and objectives.	○	○	○	○	○	◐	◐	○
2. Establish a baseline inventory of existing assets, evaluate their condition, determine if they are performing as planned, and identify excess capacity.	◐	●	◐	◐	○	◐	●	●
3. Consider alternative ways to address unmet investment needs, including non-capital approaches.	○	●	◐	◐	●	○	○	◐ ^b
4. Use cost-benefit analysis as a primary method to compare alternatives and select the best investment solution.	◐	●	◐	◐	○	●	●	○
5. Rank and select projects for funding based on established criteria.	◐	●	◐	◐	●	◐	◐	●
6. Budget for projects in useful segments.	◐	○	◐	◐	◐	○	◐ ^c	◐ ^b
7. Develop a long-term capital plan that defines capital asset decisions.	◐	●	◐	◐	◐	◐	◐	◐
8. Establish procedures to review data developed by others and use independent reviews of data and methods to further enhance the quality of estimates.	●	●	●	●	●	●	●	●

Legend

- Agency has procedures that reflect this practice.
- ◐ Agency has procedures that partially reflect this practice or practice applies to limited areas.
- ◐ Agency lacks procedures that reflect this practice; practice may be followed by state, local, or other federal entity that provided input to the estimate.
- Agency lacks procedures for implementing this practice.

Notes

- ^a Applies to water resources and hydropower estimates only.
- ^b Applies only to new construction.
- ^c Applies to certain new projects.

Source: GAO's analysis of agencies' procedures for developing investment estimates.

Practice 1: Conduct a Comprehensive Assessment of the Resources Needed to Meet Mission and Results-Oriented Goals

An important first practice of leading organizations is to conduct a comprehensive assessment or analysis of program requirements by identifying and documenting the resources needed to meet the organization's results-oriented goals and objectives that flow from the organization's mission. This type of assessment is results-oriented in that it determines what is needed to obtain specific outcomes—such as improved mobility on highways or reduced flight delays at airports—rather than identifying the resources needed on a project-by-project basis. Furthermore, placing the focus on results drives an organization to consider alternative, noncapital ways to fulfill program requirements. Until recently, agencies have not been required to relate their planned infrastructure spending to their missions and goals, so evaluating these plans has presented a challenge to agencies and the Congress. This situation changed with the enactment of the Government Performance and Results Act of 1993 and corresponding revisions to OMB Circular A-11. Since then, federal agencies—including the seven we reviewed—were required to develop mission statements, long-range strategic goals and objectives, and annual performance plans and to link annual performance plans to capital planning efforts. The benefit of conducting a needs assessment linked to achieving objectives is that managers will be able to determine what is needed to obtain specific outcomes rather than what is needed to maintain or expand existing capital stock.

Although each agency we reviewed prepared estimates directly related to their mission, no agency prepared a comprehensive assessment of the resources (and strategies) to achieve mission-focused outcomes. For example, an evaluation of the effectiveness of ARC's highway construction estimate is directly related to its mission, which is to enhance economic development in Appalachia.⁸ However, ARC's investment estimate is a compilation of cost estimates to construct specific highway corridors, rather than a comprehensive determination of the resources needed to meet its mission.

The investment estimates by FTA and FHWA come closest to being comprehensive assessments of resources needed to meet results-oriented goals. Both agencies focus on the resources needed to achieve specific outcomes—maintaining or improving the performance of the nation's

⁸ARC evaluated the effectiveness of its highway construction program towards meeting its mission and concluded that the program (1) enabled the region to be better able to compete for economic opportunities; (2) created thousands of jobs; and (3) increased population, wages, and travel efficiencies in that area.

mass transit systems and highways. Performance includes factors related to the quality of service such as congestion on highways and waiting times and reliability of transit service. FTA examines how these outcomes could be achieved by maintaining or improving existing transit facilities and assets and by constructing new systems to meet forecasted capacity needs. FHWA's estimate models improvements to maintain or improve existing highways—it excludes new construction. However, these estimates do not comprehensively consider alternatives to meeting investment needs—for example, neither estimate considers alternative, noncapital ways to address investment needs. The remaining agencies do not prepare estimates to achieve outcomes. Rather, they prepare investment estimates that are summations of projects' costs: projects eligible to receive federal funding (EPA and FAA) and projects identified by others, including the Congress, local communities, and other federal agencies (ARC, the Army Corps, and GSA).

Practice 2: Inventory Existing Assets and Identify Their Condition and Performance and Excess Capacity

Leading organizations establish an inventory of current assets and their condition and determine if the assets are performing as planned. By routinely assessing the condition of assets and facilities, decisionmakers can evaluate the capabilities of current assets and plan for their replacement. In addition, OMB's *Capital Programming Guide* instructs agencies to evaluate the capacity of their existing assets for major programs, to determine if they are performing as planned. OMB's instructions cover assets funded by federal grants for capital investment as well as those owned by federal agencies.

Inventory information on infrastructure assets—including their condition and performance—can assist decisionmakers in identifying excess infrastructure capacity that is draining its resources. This is particularly important for federal buildings and facilities. For example, in 1998, the National Research Council reported that the number of excess federal facilities appeared to be increasing as agencies realigned their missions in response to changing circumstances.⁹

Of the agencies we reviewed, the Army Corps, FTA, and GSA maintain inventory and evaluation information on assets. For example, the Army Corps collects information on the condition of equipment at hydropower

⁹See *Stewardship of Federal Facilities: A Proactive Strategy for Managing the Nation's Public Assets*, National Research Council (Washington, D.C.: 1998).

plants, particularly turbines, and uses this information to determine repair and rehabilitation needs. GSA maintains an inventory that identifies the location, type, and availability of its buildings. According to agency officials, GSA maintains separate information on the condition of these buildings. In addition, GSA has programs that oversee the disposal of excess and surplus real property. In contrast, ARC, EPA, FAA, FHWA do not maintain inventories, but some of them rely on inventories kept by state or local agencies. For example, states maintain highway inventories and provide input to FHWA's investment estimate. According to EPA officials, local communities maintain inventories of their water and wastewater infrastructure.¹⁰ Over the next few years, new financial reporting standards released by the Government Accounting Standards Board will require the financial statements of state and local governments to disclose information on capital infrastructure assets, such as their physical condition.

Practice 3: Consider Alternative Ways to Address Investment Needs, Including Noncapital Approaches

Leading organizations consider a wide range of alternative approaches to satisfy their needs, including noncapital alternatives, before choosing to purchase or construct facilities or other capital assets. OMB incorporated this practice in its *Capital Programming Guide*, which suggests that federal agencies select alternatives to acquiring new capital assets to achieve the same programmatic goals whenever practicable and more cost beneficial. OMB also suggests that agencies consider options such as meeting objectives through regulation or user fees, using human capital rather than capital assets, and applying grants or other means beyond a direct service provision supported by capital assets.

Army Corps, EPA (wastewater), FAA, and GSA indicated that efforts are made at their agencies to identify noncapital solutions to some of their investment needs and, where feasible, to implement those rather than acquiring new capital assets. However, it is not clear how routinely agencies follow this practice or, in some cases, what value is added by this practice. For example, according to EPA officials, decisions on pursuing noncapital ways to address infrastructure needs are often conducted at the local level. For example, a public water system may choose to implement a water conservation plan as an alternative to adding additional storage and treatment capacity to a system.

¹⁰EPA maintains a database of cost and technical information on publicly-owned wastewater facilities.

Practice 4: Use Cost-Benefit Analysis to Identify Economically Justified Investments

Some leading organizations use cost-benefit analysis as a tool to ensure that the organization's investment will obtain the greatest benefits for the least cost. A cost-benefit analysis, which OMB suggests for federal agencies, compares the costs and benefits of alternative investments in order to identify those investments that are economically justified (greatest net benefits) and achieve agency goals at the least cost. The types of analysis can range from a complete cost-benefit analysis—which includes full life-cycle costs, estimating and discounting cash flows, and determining the return on the investment based on a specified discount rate—to an analysis that compares alternatives and recommends the most cost-effective (least-cost) option for achieving a specific goal.

Three agencies we reviewed—Army Corps, FHWA, and FTA—conduct cost-benefit analyses of proposed projects and use the results as a main factor in developing their investment estimates. For example, FHWA's computer model, which is used to determine future investment requirements, simulates the effects of infrastructure improvements for highway segments and compares the relative benefits and costs associated with alternative improvement options. Only improvements for which the benefits exceed the cost are included in the overall estimate. According to EPA officials, cost-benefit analyses are done at the local level for drinking water and wastewater investment, as utility managers consider projects needed for public health and water quality purposes. In addition, according to an ARC official, states conduct cost-benefit analyses to help determine the routes of new highways.

Practice 5: Rank and Select Projects For Funding Based on Established Criteria

Leading organizations have defined processes for ranking potential infrastructure investments in order to find those that are the most cost effective for achieving organizational goals over the long-term, and for selecting and budgeting those projects for full up-front funding or funding in useful segments. The organizations implement these practices by establishing a framework for reviewing and approving decisions concerning infrastructure and other capital assets, ranking and selecting projects on the basis of established criteria and technical analyses, and preparing long-term plans for infrastructure and capital development. OMB's guidance to federal agencies on the ranking and selecting of infrastructure investments advises them to consider the availability and affordability of the investment, and whether the costs and benefits of the new asset will merit their inclusion in the agency's portfolio of proposed assets that are considered for funding. For the agencies that we reviewed, the Army Corps, FAA, and GSA have processes in place to rank and select investment projects for funding. For example, GSA staff assess the merits

of proposed projects with the aid of computer-based software that uses five weighted criteria—including economic return, project risk, and project urgency—to rank projects that are competing for funding.

In some cases—ARC, EPA, FHWA, and some FTA projects—state, local or other federal entities are responsible for determining which investment projects to fund. For example, officials with ARC and EPA told us that capital projects funded by their agencies are ranked and selected by the state agency or entity in charge of a particular project. Hence, while ARC provides funding for highways, the state departments of transportation prioritize and rank the highway investment needs for their particular state. Similarly, individual states rank drinking water projects that are funded through EPA based on a priority system that focuses on public health, compliance, and the economic needs of the community. FHWA and FTA projects that are funded by formula grants are also prioritized at the state or local level.

Practice 6: Budget for Projects in Useful Segments

A strategy that has proven useful to organizations in dealing with the problems posed by full funding in a capped budget environment is to budget for projects in useful segments. This means that when a decision has been made to undertake a specific capital project, funding sufficient to complete a useful segment of the project is provided in advance. OMB has defined a useful segment as a component that either (1) provides information that allows the agency to plan the capital project, develop the design, and assess the benefits, costs, and risks before proceeding to full acquisition (or canceling the acquisition) or (2) results in a useful asset for which the benefits exceed the costs even if no further funding is appropriated.

For the agencies we reviewed, investment estimates, particularly those that involve the construction or rehabilitation of an asset, are often based on the full cost of projects. In two cases—FTA and GSA projects that exceed a dollar threshold—the projects are funded based on their full costs and the funds are spent over a period of years. However, funding for other federal agencies' investment projects are often made for only part of the estimated cost or part of a usable asset—a part that would not be usable if no further funding were provided. Such incremental funding is usually sufficient to cover obligations estimated to be incurred in one fiscal year.

Incrementally funding infrastructure projects could affect the quality and reliability of investment estimates if the full estimated costs of projects are

not made apparent at the time that initial funding decisions are made. For example, most of the Army Corps' multiyear water resource projects are funded at each phase. For instance, in fiscal year 1986, the Army Corps estimated the federal share of work it intended to do on a water resources' project in Petersburg, WV at \$14 million. The estimate did not include over \$600,000 appropriated to the Army Corps between fiscal years 1986 and 1989 to study the proposed project. The agency requested and received funds each fiscal year for various phases of the work until fiscal year 1997, by which time the total federal share of the work had increased to \$20.4 million, due to inflation and cost overruns. As another example, ARC officials told us that prior to fiscal year 1999, it had been difficult for the agency to develop realistic estimates for the cost of completing the highways under its jurisdiction because funding was limited and was only sufficient to construct a few sections each year. Although ARC's funding for fiscal year 1999 was revised to guarantee a minimum level of funds each year, the amount does not fully fund the states' highway investment estimates.¹¹

Practice 7: Develop a Long-Term Capital Plan That Defines Capital Asset Decisions

Leading organizations use capital plans, which generally cover multiyear periods, to establish priorities for implementing organizational goals and objectives and to manage resources and debts over the long-term. The capital plans are updated either annually or biennially, depending on the changing needs of the organizations or, in the case of federal agencies, legislative and/or executive requirements. Developing a long-term capital plan enables an organization to review and refine a proposed project's scope and cost estimates over several years, which helps to reduce cost overruns. While out-year cost estimates are preliminary, they help to provide decisionmakers with an overall sense of a project's funding needs. As a project moves closer to the year of implementation, its scope becomes more clearly refined and cost estimates also can be refined to more accurately reflect actual project costs.

Among the agencies we reviewed, the Army Corps prepares a long-term capital plan to document specifically planned projects, plan for resource use over the long-term, and establish priorities for implementation. FAA prepares a long-term plan that is an aggregate of local airport plans; priorities for implementation are established during the annual budget

¹¹ In some cases, states prefinance segments of the ADHS and are reimbursed over time by funds distributed by ARC.

process and are not part of the long-term capital plan. In the case of GSA, its long-term capital plan for courthouse construction is prepared by the Judicial Conference of the United States.¹² However, the Conference's role in this process is limited because it does not have independent authority to lease, construct, plan, or design space. In addition, we reported in 2000 that GSA lacks a multiyear capital plan for repairs and alterations.¹³ For the other agencies we reviewed, capital plans may be developed at the state or local levels or by other federal entities. For example, in the case of ARC and FHWA, the states are responsible for developing long-term capital plans for their highway and other transportation needs. According to EPA officials, local water and wastewater utilities develop capital improvement plans for infrastructure needs, the results of which are used by EPA in developing its estimates.

Practice 8: Establish Procedures to Review Data Developed By Others, and Use Independent Reviews of Data and Methods to Further Enhance the Quality of Estimates

The agencies we reviewed use data from a variety of sources, including states, municipalities, and contractors, to determine how much it will cost to acquire, construct, repair, or maintain federal and public infrastructure. The quality of the cost estimates prepared by federal agencies depends heavily on the quality of this data. By reviewing capital investment data prepared by others, agencies can enhance the quality of their investment estimates. In addition, an independent review of the data and methods used to develop the estimates can further enhance quality and help ensure that investment decisions are supported by quality information. All agencies we reviewed have procedures for reviewing the data provided by outside sources. FHWA also had independent reviews to critique and refine the methods used to produce the estimate. For example, FHWA's computer model for developing its estimate was reviewed by transportation and economic experts to both assess and improve it. In June 1999, the experts found that FHWA has strengthened the model over time and that recent refinements have increased its applicability and credibility. In addition, FTA has under way a review of its methodology for determining transit investment estimates.

¹²The Judicial Conference of the United States is composed of the Chief Justice of the United States and other federal judges who consider policy and legislative and administrative issues affecting the federal courts.

¹³GSA told us that by the end of December 2001, it will establish a 3- to 5-year capital plan for repair and alteration investments. That plan must then be coordinated with the Administration.

Nonetheless, officials at ARC, EPA, FAA, FHWA, FTA, and GSA acknowledged that the data used to develop their investment estimates might not have been sufficiently comprehensive or accurate. For example, EPA reported that its most recent investment estimates for drinking water supply, issued in February 2001, were derived from a 1999 nationwide survey of the documented needs of community water systems. However, EPA officials stated that the estimates might understate water supply needs because some water systems submitted cost estimates covering a 2- to 5-year period, rather than the 20-year period requested by EPA.

Inaccurate data and assumptions can affect the quality of investment estimates. For example, the National Academy of Sciences found that flawed data created unsound economic assumptions in the Army Corps' draft feasibility study for the navigation system infrastructure on the Upper Mississippi River and Illinois Waterway. This resulted in inadequate forecasts of future events, such as the level of barge shipping rates and grain demand, which compromised the integrity of analysis and led to an overstatement of the level of investment. Since this project is not yet under construction, it is not part of the Army Corps' \$38 billion investment estimate.

In addition to promoting inaccurate estimates of investment needs, erroneous data can affect agencies' assessments of repair and maintenance needs for existing infrastructure. For example, in March 2000, we reported that GSA's database of needed repairs and alterations had numerous problems, such as repairs that were not included in the database, some repairs that were included but were already in progress or completed, some incorrect reporting of data, and some cost estimates for repairs that were not current. Since the review, GSA has taken steps to improve the quality of the data used to manage its inventory of buildings.

GAO Observations

Some perspective is called for in reviewing the investment estimates by the seven agencies. First, for the most part, these investment estimates are totals for the entire infrastructure network—involving all levels of government and the private sector. The federal government's role in financing these amounts should be recognized; and, in some cases, this role might be small compared to other levels of government or the private sector. Second, these investment estimates can change significantly over time with changes in the efficiency of delivering infrastructure services or pricing strategies that alter the demand for services. For example, the consolidation of smaller water systems or the introduction of user charges can reduce the need to expand or replace infrastructure. Third, these investment estimates focus on the condition of facilities rather than the

performance outcomes that can be expected from the investments. The passage of GPRA signaled a shift in federal focus from inputs (such as the condition of highways and airports) to outcomes (such as improved mobility). In the infrastructure area, we caution against relying on measures of need based primarily on the condition of facilities and instead suggest comparing the costs and benefits of alternative approaches for reaching outcomes, including noncapital alternatives.

Agency Comments

We provided a draft of this report to ARC, EPA, DOT, GSA, and the Department of Defense (DOD) for review and comment. EPA said that the report clearly distinguishes between federal agencies that directly invest in infrastructure and agencies, such as EPA, that manage programs to fund infrastructure. GSA stated that the database used to derive the estimate for public building repair and alteration costs is continually changing as work items are tracked from identification to completion and that the database does not represent investment needs, rather it provides input to decisions that determine funding priorities. We revised this report to indicate that the data are used as input to funding decisions. GSA also stated that the draft report did not acknowledge that the agency uses cost-benefit analysis as one criterion in making investment decisions and that GSA has made progress in improving the accuracy of its data. We did not make any changes to this report based on these comments because both items were already included. Written comments by EPA and GSA and our responses to GSA's comments appear in appendices III and IV. ARC, EPA, DOT, and GSA provided technical clarifications, which we included in this report where appropriate. DOD had no comments on this report.

We conducted our review between December 2000 and July 2001 in accordance with generally accepted government auditing standards.

We are sending copies of this report to the Secretaries of the Departments of Transportation and Defense; the Administrator, EPA; the Commissioners of GSA and ARC; and the Director, Office of Management and Budget. Copies will also be made available to others upon request. If you or your staff have any questions about this report, please call me at (202) 512-2834. Key contacts and major contributors to this report are listed in appendix V.

Sincerely yours,

A handwritten signature in black ink, appearing to read 'P. F. Guerrero', with a long horizontal flourish extending to the right.

Peter F. Guerrero
Director
Physical Infrastructure

Appendix I: Objectives, Scope, and Methodology

Our report focuses on infrastructure investment estimates compiled by six federal agencies—the U.S. Army Corps of Engineers, Environmental Protection Agency (EPA), Federal Aviation Administration (FAA), Federal Highway Administration (FHWA), Federal Transit Administration (FTA), and General Services Administration (GSA)—and the Appalachian Regional Commission (ARC). For these agencies and selected types of infrastructure (see table 2), we addressed the following objectives: (1) What are the agencies’ estimates for infrastructure investment and how do the estimates compare in terms of how they are developed and used? (2) To what extent do the agencies’ procedures for developing the estimates embody practices of leading government and private-sector organizations?

Table 2: Federal Agencies and Types of Infrastructure Included in the Report

Infrastructure area	Federal agency						
	ARC	Army Corps	EPA	FAA	FHWA	FTA	GSA
Highways	X				X		
Water resources		X					
Hydropower		X					
Water supply			X				
Wastewater treatment			X				
Airports				X			
Mass transit						X	
Public buildings							X

To identify agencies’ infrastructure investment estimates, we obtained and analyzed the most recent estimates reported by ARC, EPA, FAA, FHWA, and FTA. For the Army Corps, we used estimates for water resources and hydropower that the agency prepared in March 2001. The Army Corps does not develop investment estimates for water supply and treatment. For GSA, we obtained information from the Inventory Reporting Information System (IRIS)—a computerized database of information on building repairs and alterations. According to GSA database managers, the data we used were representative of the repair and alteration needs contained in IRIS as of May 2, 2001. GSA’s estimate for building construction was developed by GSA staff for the building priorities identified by the Judicial Conference of the United States and other federal agencies. We did not independently verify the agencies’ investment estimates, but we did rely on past reviews by us and others that examined the soundness and completeness of the methodology and/or data used to develop the estimates. We incorporated findings from these reviews as appropriate.

To obtain information on the procedures agencies used to develop these investment estimates and how agencies used the estimates, we interviewed officials from ARC; the Army Corps' Planning and Policy Division, and Programs, Formulation and Evaluation Branch; EPA's Office of Ground Water and Drinking Water and Office of Wastewater Management; the Department of Transportation's FAA, FHWA, and FTA; and GSA's Office of Portfolio Management. We reviewed agencies' documentation of the procedures used to develop the estimates, but we did not verify whether these procedures were followed. We also relied on our past reviews of FAA, FHWA, and GSA for information on how these agencies develop and use the investment estimates.

To accomplish our second objective, we used leading practices contained in our report *Executive Guide: Leading Practices in Capital Decision-Making*. We also reviewed laws and related guidance issued by the Office of Management and Budget (OMB), including the Government Performance and Results Act of 1993, the Federal Acquisition Streamlining Act of 1994, the Clinger-Cohen Act of 1996, OMB's Executive Order 12893 (Jan. 26, 1994), OMB Circular A-11, and OMB's *Capital Programming Guide*. In addition, we reviewed the *Statement of Federal Financial Accounting Standards, No. 6, Accounting for Property, Plant, and Equipment*. We also reviewed reports by the U.S. Advisory Commission on Intergovernmental Relations, National Council on Public Works Improvement, the President's Commission on Capital Budgeting, and the National Academy of Sciences. We compared the procedures used by each agency to develop infrastructure investment estimates with the leading practices, which are listed in figure 4. The first seven practices were identified in our executive guide.

The eighth practice—establish procedures to review data developed by others and use independent reviews of data and methods to further enhance the quality of estimates—was identified as a result of information collected during this review. We found that each estimate relied to some extent on data provided by others, such as the states. In past reviews, we have noted problems with the consistency of data that is collected from states and other sources. For example, DOT collects information on pavement condition from the states. Our review of the statistic used to indicate pavement condition demonstrated that states reported no information on 7 percent of the miles on the National Highway System, varied in their approaches to measuring and reporting the statistics, and

did not follow uniformly DOT's guidance for making these measurements.¹⁴ The independent review of data and analytical methods can enhance the quality of estimates. For example, given the uncertainty associated with predicting future impacts of regulatory alternatives, we recommended rigorous and independent peer review to enhance the analyses.¹⁵ Furthermore, it has been noted by others that over time FHWA has continuously improved its model to estimate investment needs.¹⁶ FHWA has used an independent review of the model to help make improvements.

¹⁴ *Transportation Infrastructure: Better Data Needed to Rate the Nation's Highway Conditions* (GAO/RCED-99-264, Sept. 27, 1999). According to DOT, the states reported pavement condition data for all of the sample pavement sections included in the department's investment estimate. Therefore, the missing data on pavement condition did not effect DOT's calculations.

¹⁵ *Regulatory Reform: Agencies Could Improve Development, Documentation, and Clarity of Regulatory Economic Analyses* (GAO/RCED-98-142, May 26, 1998).

¹⁶ *Highway Performance Public Works: A New Federal Infrastructure Investment Strategy for America*, U.S. Advisory Commission on Intergovernmental Relations (Nov. 1993).

Figure 4: Selected Leading Practices Related to Infrastructure Investment Estimates

Leading practices

- Conduct a comprehensive assessment of the resources needed to meet an agency's mission and results-oriented goals and objectives.
- Establish a baseline inventory of existing assets, evaluate their condition, determine if they are performing as planned, and identify excess capacity.
- Consider alternative ways to address unmet investment needs, including noncapital alternatives.
- Use cost-benefit analysis as a primary method to compare alternatives and select the best investment solution.
- Rank and select infrastructure projects for funding based on established criteria.
- Budget infrastructure projects in useful segments.
- Develop a long-term capital plan that defines capital asset decisions.
- Establish procedures to review data developed by others and use independent reviews of data and methods to further enhance the quality of estimates.

Appendix II: Agencies' Infrastructure Investment Estimates

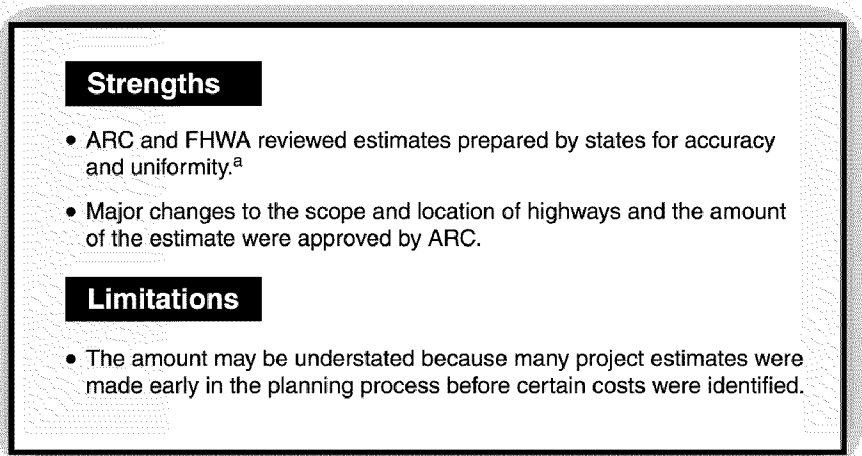
ARC's Investment Estimate for the Appalachian Development Highway System

In 1997, the Appalachian Regional Commission (ARC) estimated that it would cost \$8.5 billion (in current 1995 dollars) to complete the Appalachian Development Highway System (ADHS), a 3,025 mile system of highways that is designed to bring economic development to Appalachia.¹⁷ The amount is for initial construction only—it does not include maintenance, retrofits, or safety improvements to completed segments of the highway system. According to ARC officials, this estimate is probably understated due to the limited amount of detailed information available in 1997 and because the estimate was prepared before obtaining public input or identifying and addressing environmental or historic preservation concerns about specific highway corridors. ARC plans to issue an updated estimate in 2002.

The major strengths and limitations of ARC's estimate are summarized in figure 5. We have not done prior work related to ARC's investment estimate or data used for the estimate. The amount of information we present concerning the estimate does not imply that it is better or worse than others.

¹⁷ Appalachia includes all of West Virginia and parts of 12 states: Alabama, Georgia, Kentucky, Maryland, Mississippi, New York, North Carolina, Ohio, Pennsylvania, South Carolina, Tennessee, and Virginia.

Figure 5: Strengths and Limitations of ARC's Investment Estimate for Highways



Note: We considered procedures that reflected leading practices and factors that enhanced the soundness or completeness of an estimate to be strengths of an estimate. We considered factors that detracted from the soundness or completeness of an estimate or its source data to be limitations of an estimate.

^aReflects a leading practice.

How the Estimate Was Developed

To produce an estimate for the highway system, each of the 13 states within Appalachia estimated the cost to complete the system within their state, and ARC aggregated the estimates. ARC and the Federal Highway Administration (FHWA) distributed an instruction manual to each state that detailed the methods and criteria for arriving at the estimate. Each state's department of transportation, in conjunction with the local FHWA office, then prepared a detailed estimate of the cost to complete the unfinished portions of the highway system within their state. The states produced these cost estimates using preliminary or final plans, specifications, and estimates to the extent they were available. At a minimum, ARC's instructions indicated that the states should have preliminary layouts of the proposed road and all major structures and interchanges so that reasonably accurate estimates could be made for items such as construction and paving. In addition, qualified appraisers were used to help determine the cost of rights-of-way and any relocation expenses. ARC and FHWA reviewed states' estimates to ensure uniformity and accuracy. They assessed the reasonableness of the cost estimates by comparing them to the costs of similar highway projects within the state and FHWA's data on construction costs. In addition, major changes to the scope and location of highways and the amount of the estimate had to be reviewed and approved by ARC, according to agency officials. ARC then

totaled the estimates from each state and calculated the total cost to complete the highway system.

Many of the estimates were made before the highway segments had undergone the planning process mandated by the National Environment Policy Act and, therefore, may be understated. This planning process includes obtaining input from the public, federal and state agencies, and historical societies and assessing any environmental or historic preservation concerns. Some states will not go through this planning process until a particular highway corridor is the next construction project. As a result, many of the highway estimates that ARC relied upon were made before this planning process occurred. As states go through this process, construction costs can rise dramatically if new concerns, such as environmental issues and historic preservation, result in changes to highway routes or even legal cases to determine the routes.

How the Estimate is Used

ARC uses the estimate to distribute funding made available through the Highway Trust Fund to each state based on each state's percentage share of the remaining highway system. For example, according to the latest estimate, 15.3 percent of the cost to complete the highway system is for highways within West Virginia. As a result, ARC gives 15.3 percent of its annually appropriated monies for the highway system to West Virginia. Each state sets its priorities for completing the highway system within its state with the funds received from ARC.

Related Reports

Appalachian Development Highway System: 1997 Cost to Complete Report, Appalachian Regional Commission, Aug. 1997.

Appalachian Development Highways: Economic Impact Studies., Wilbur Smith Associates, July 1998.

Instruction Manual for Preparation and Submission: 1997 Estimate of Cost to Complete the Appalachian Development Highway System, Appalachian Regional Commission, Sept. 1996.

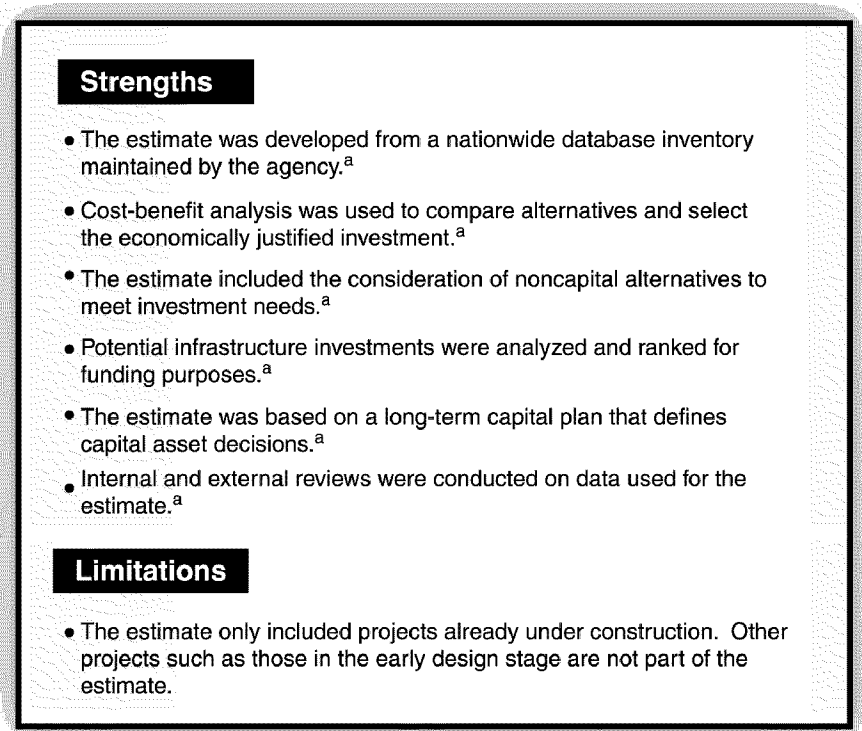
U.S. Army Corps of Engineers' Investment Estimate for Water Resources and Hydropower

The U.S. Army Corps of Engineers estimated that, as of March 30, 2001, it had about \$38 billion in unmet water resources (inland and deep draft navigation, flood control, and shore protection) and hydropower infrastructure investment requirements for its civil works program. This estimate includes only projects that are already under construction. Of that amount, about \$37 billion is for the construction of new water resource projects, \$217 million is for the major rehabilitation of water resource projects, \$400 million is for the major rehabilitation of hydropower plants, and \$182 million is for other work at hydropower plants. In addition to the \$38 billion, the Army Corps estimated that in fiscal year 2002, it would require \$835 million to perform critical operations and maintenance work on water resources and related land projects, and \$80 million in critical maintenance on the Mississippi River and tributaries' projects. The Army Corps does not develop an investment estimate for water supply and wastewater treatment requirements. Instead, the Congress and local interests estimate water supply requirements for individual projects, and local governments are responsible for determining wastewater investment requirements.

According to Army Corps officials, the amount estimated for water resources and hydropower investments might be inadequate because it does not consider increases in the cost of completing a project over time due to changing economic conditions. Those officials stated that it takes an average of 12 years for the Army Corps to complete most projects. During this time, increases in inflation and the costs of labor and material could result in higher project costs than anticipated. In addition, there are concerns that the quality of the estimate may be affected by inaccurate data and assumptions. For example, the National Academy of Sciences found that flawed data created unsound economic assumptions in the Army Corps' draft feasibility study for the navigation system infrastructure on the Upper Mississippi River and Illinois Waterway. This resulted in inaccurate forecasts of future events, such as the level of barge shipping rates and grain demand, which compromised the integrity of analysis and led to an overstatement of the level of investment needed. As a result of problems with this draft feasibility study, the Army Corps plans to redo it. Since this project is not yet under construction, it is not part of the Army Corps' \$38 billion investment estimate.

The major strengths and limitations of the Army Corps' estimate are summarized in figure 6. We have not done prior work related to the Army Corps' investment estimate or data used for the estimate. The amount of information we present concerning the estimate does not imply that it is better or worse than others.

Figure 6: Strengths and Limitations of the Army Corps' Investment Estimate for Water Resources and Hydropower Facilities



Note: We considered procedures that reflected leading practices and factors that enhanced the soundness or completeness of an estimate to be strengths of an estimate. We considered factors that detracted from the soundness or completeness of an estimate or its source data to be limitations of an estimate.

^aReflects a leading practice.

How the Estimate Was Developed

The water resources and hydropower estimates were developed by aggregating the funds required to construct and rehabilitate specific projects. Initially, Army Corps' district offices submit lists of proposed water resource problems (projects) in their area—including those identified by local governments, organizations, and private citizens—to division commanders who assess the projects based on several criteria.¹⁸ The criteria include (1) whether a project is in accord with the agency's current policy; (2) the urgency of resolving the problem; (3) geographic

¹⁸ The Army Corps refers to activities that are studied and/or investigated before construction as "problems." For this report, we will use "project."

distribution; (4) the economic viability of the recommended plan; (5) local support for the project; (6) the possibility of nonfederal participation in the project; (7) the scheduled project completion date; and (8) the impact on fish, wildlife, and/or wetlands. A prioritized list of projects is submitted to the Assistant Secretary of the Army for Civil Works, who further screens the projects based on conformance to the administration's priorities and political sensitivity. The projects selected by the Assistant Secretary are included in the Department of Defense's budget submission to OMB and, if approved, in the President's budget submission to the Congress. Ultimately, the Congress determines which projects to fund. Funded projects undergo several lengthy reviews by the Army Corps, including a feasibility study to investigate and recommend solutions to water resources problems. The costs of such studies and other non-construction costs are not part of the Corps' overall investment estimate.

The estimate for hydropower investment is based on the Army Corps' inspections, tests, and evaluations of that equipment to determine service condition. If the results of those assessments show trends of unexpected deterioration, management decides whether the problem can be corrected by routine repairs or whether it is a capital need that requires rehabilitation or major repairs.

The investment estimate for water supply is derived by local interests who engage the services of architectural and/or engineering firms to determine the costs for water supply projects. The local interests can also request assistance from an Army Corps' field office in establishing a project's cost. The local interests, rather than the Army Corps, relay that figure to the Congress.

How the Estimate is Used

The Army Corps uses the water resources and hydropower investment estimates to determine the financial resources needed to manage, repair, and rehabilitate the assets under its jurisdiction and for new construction. The Army Corps uses the water supply estimate to provide planning, design, and construction assistance to projects sponsored by local interests when specifically directed, authorized, and funded by the Congress.

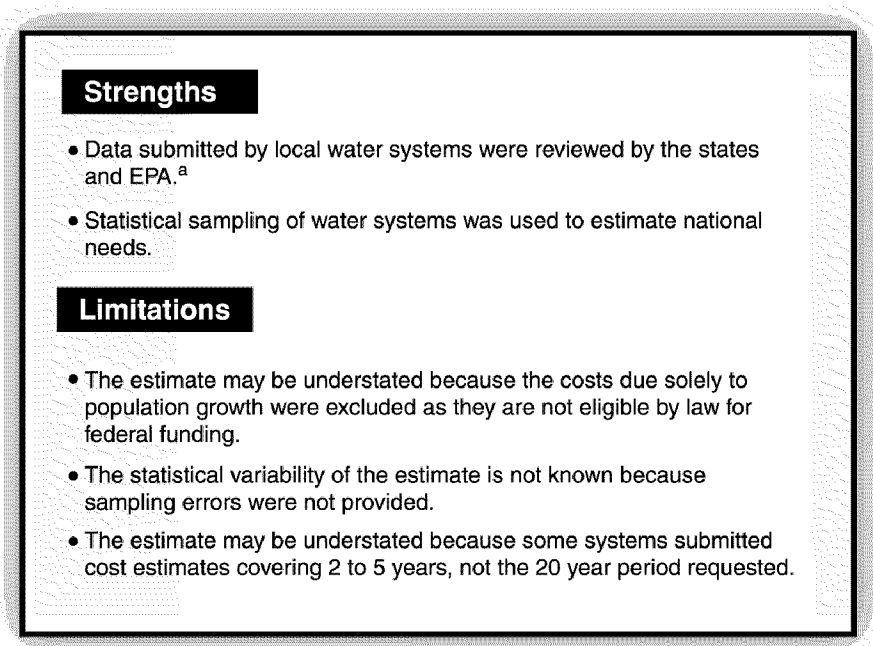
Related Reports

Inland Navigation System Planning: The Upper Mississippi River-Illinois Waterway, Report of the National Research Council (Feb. 28, 2001).

EPA's Investment Estimate for Drinking Water Facilities

The Congress required the Environmental Protection Agency (EPA) to survey public water systems that are eligible for assistance from the Drinking Water State Revolving Fund (DWSRF) about their capital investment needs every 4 years. EPA's second survey, issued in February 2001, estimated that \$150.9 billion (in current 1999 dollars) was needed from 1999 to 2018. Of that amount, \$31.2 billion was needed to comply with existing and proposed regulations of the Safe Drinking Water Act. The major strengths and limitations of EPA's estimate are summarized in figure 7. We have not done prior work related to EPA's investment estimate or data used for the estimate. The amount of information we present concerning the estimate does not imply that it is better or worse than others.

Figure 7: Strengths and Limitations of EPA's Investment Estimate for Drinking Water Facilities



Note: We considered procedures that reflected leading practices and factors that enhanced the soundness or completeness of an estimate to be strengths of an estimate. We considered factors that detracted from the soundness or completeness of an estimate or its source data to be limitations of an estimate.

^aReflects a leading practice.

In contrast to EPA's estimate, the Water Infrastructure Network (WIN)—a consortium of 21 industry, municipal, and nonprofit associations—

estimated that investment needs for drinking water will average about \$24 billion per year through 2019 (expressed in constant 1997 dollars). Of the \$24 billion estimated by WIN, \$19 billion is for capital investment and \$5 billion represents financing costs.

How the Estimate Was Developed

EPA's estimate was derived from a nationwide survey mailed to medium and large-sized water systems. All of the nation's largest systems (serving more than 40,000 people) and a random sample of medium systems (serving more than 3,300 people and fewer than 40,000 people) were included in the survey. The water systems were asked to submit documentation of the purpose and scope of each project so that EPA could verify that the projects met the eligibility criteria for funding by the DWSRF. EPA also required that each project cost be supported by documentation indicating that the cost had undergone an adequate degree of professional review. The systems returned the completed questionnaires and supporting documentation to the states for review. The states had the option of providing supplemental documentation on the project or its cost. The states then forwarded the completed questionnaires to EPA for review. EPA reviewed the project components that were included in cost estimates, modeled costs for projects that lacked cost documentation, and deleted projects that were ineligible for funding under the DWSRF. The infrastructure demands of small systems were obtained through site visits to approximately 599 systems, with at least 6 systems selected in each state. EPA conducted an additional 100 site visits to assess the demands of not-for-profit noncommunity water systems. The survey was designed to provide state-level estimates of medium and large systems and national-level estimates of small systems with a precision target of 95 percent +/- 10 percent. A precision target of 95 percent +/- 30 percent was established for the not-for-profit noncommunity water systems.

The estimates, however, might understate water supply needs because some systems submitted cost estimates covering 2 to 5 years rather than the 20-year period requested by EPA. Further uncertainties exist with the estimate because the water supply survey excluded costs arising solely from population growth.

How the Estimate is Used

EPA uses the results of the most recent survey to allocate monies from the DWSRF to the states, basing each state's allocation on its share of the total national investment amount, with a minimum allotment of 1 percent of available funds. Each state develops a priority system for funding projects

based on public health criteria specified in the 1996 Safe Drinking Water Act. In addition, EPA uses the survey as a tool for allocating the Tribal Set-Aside (up to 1.5 percent of the DWSRF annual appropriation) to American Indian and Alaskan native village water systems.

Related Reports

Congressional Budget Office, Statement of Perry Beider before the Subcommittee on Environment and Hazardous Materials, Committee on Energy and Commerce, U.S. House of Representatives (Mar. 28, 2001).

EPA Office of Water, *Drinking Water Infrastructure Needs Survey: Second Report to Congress* (EPA 816-R-01-004, Feb. 2001).

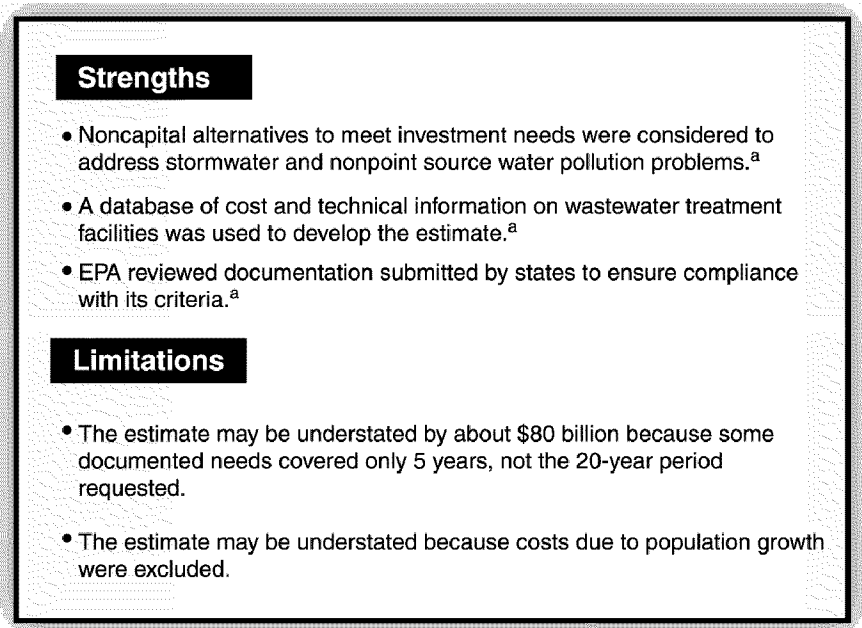
Water Infrastructure Network, *Clean & Safe Water for the 21st Century: A Renewed National Commitment to Water and Wastewater Infrastructure* (undated, available from the American Water Works Association).

EPA's Investment Estimate for Wastewater Facilities

EPA periodically reports to the Congress on the nation's investment needs for municipal water pollution control facilities, primarily wastewater treatment facilities. In the 1996 clean water needs survey report, EPA estimated that \$139.5 billion (in current 1996 dollars) was needed over the years 1996 to 2016 to satisfy water pollution control needs. The total included \$44.0 billion for wastewater treatment, \$10.3 billion for upgrading existing wastewater collection systems, \$21.6 billion for new sewer construction, and \$44.7 billion for controlling combined sewer overflows. The investment estimate included costs for facilities used in conveyance, storage and treatment, and recycling and reclamation of municipal wastewater. In addition, the estimate included the costs for structural and nonstructural measures to develop and implement stormwater and nonpoint source pollution programs. The overall investment estimate did not include costs that were ineligible for federal assistance under Title VI of the Clean Water Act, such as house connections to sewers and costs to acquire land that is not a part of the treatment process. The estimate did not include information on private wastewater treatment facilities and those serving Indian tribes and Alaskan native villages. More recently, EPA estimated that the amount may be closer to \$220 billion because some needed work probably had not been documented and reported by the states. EPA expects to submit its next clean water needs survey report to the Congress in August 2002.

The major strengths and limitations of EPA's investment estimate for wastewater facilities are summarized in figure 8. We have not done prior work related to EPA's investment estimate or data used for the estimate. The amount of information we present concerning the estimate does not imply that it is better or worse than others.

Figure 8: Strengths and Limitations of EPA's Investment Estimate for Wastewater Facilities



Note: We considered procedures that reflected leading practices and factors that enhanced the soundness or completeness of an estimate to be strengths of an estimate. We considered factors that detracted from the soundness or completeness of an estimate or its source data to be limitations of an estimate.

^aReflects a leading practice.

How the Estimate Was Developed

EPA maintains a database of cost and technical information on publicly owned wastewater treatment facilities, which is used to develop the investment estimate. The database included about 16,000 wastewater treatment facilities and 21,000 sewage collection systems in 1996, when the last estimate was made. The database includes information on individual facilities' projects and programs that target documented water quality or public health problems. EPA periodically requests information from the states to update this database. In the 1996 clean water needs survey, the states were asked to identify projects to build or expand treatment facilities to accommodate the capacity required by the existing

population over the next 20 years. EPA also requested the states to update the documentation for projects already in the database with estimated costs greater than \$5 million if the documentation was dated prior to 1990. EPA reviewed all documentation submitted by the states to ensure compliance with its established criteria. Generally, documentation—such as capital improvement plans—was acceptable if it included details concerning the proposed project, such as a definition of the problem, a description of the solution, and cost estimates. If the documentation lacked cost estimates, EPA estimated the cost using models. However, the documentation provided to EPA sometimes covered only a 5-year period—not the 20-year period asked for. Therefore, EPA officials believe the estimates are conservative.

In addition, EPA modeled states' costs for combined sewer overflows (releases of raw sewage from systems that convey sewage and stormwater in the same pipes) and activities to control stormwater runoff and nonpoint sources of pollution. Furthermore, EPA reported that it believes the investment estimates were understated for sanitary sewer overflows (releases of raw sewage from sanitary sewer collection systems) and that it was developing updated cost estimates separately from the 1996 clean water needs survey.

How the Estimate is Used

According to EPA, the clean water needs survey is also used to assist the federal government and the states in program planning, policy evaluation, and program management and to inform the Congress of the magnitude of the needs. Private firms, public interest groups, and trade associations use the survey information in marketing, cost estimating, and policy formation.

Related Reports

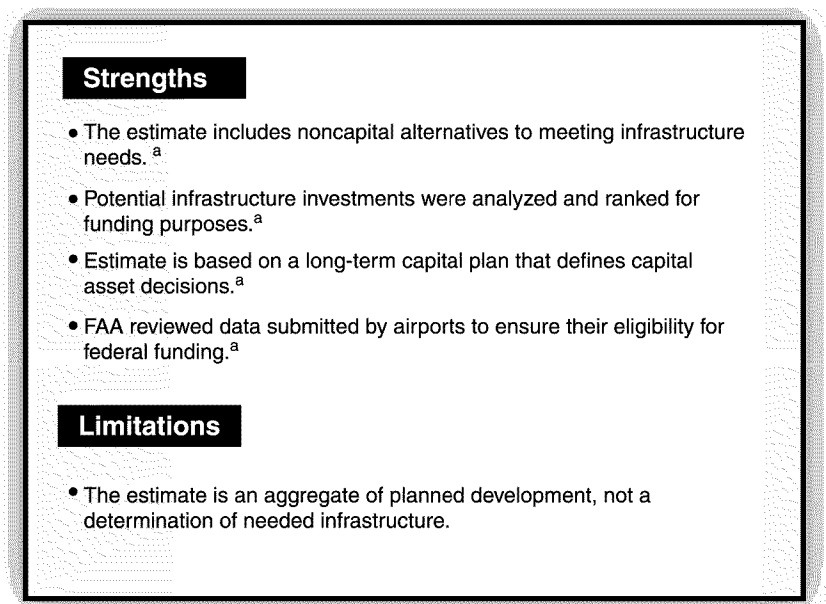
EPA 1996 Clean Water Needs Survey (CWNS) Report to Congress (EPA 832-R-97-003, Sept. 1997).

FAA's Investment Estimate for Airports

In 1999, the Federal Aviation Administration (FAA) submitted to the Congress its most recent investment estimate for the nation's airports—\$35.1 billion (in constant 1998 dollars) for the years 1998 to 2002. A significant portion of this estimate is for projects that will bring existing airports up to current design standards (37 percent), develop passenger terminal buildings (16 percent), or add capacity to congested airports (13 percent) at 3,561 airports and proposed airports in the United States. The estimate only includes projects that are eligible for funding under FAA's Airport Improvement Program. The major strengths and limitations of the

estimate are summarized in figure 9. In a previous report, we reviewed the database used to develop the estimate, and we have included the results of that review in our analysis. The amount of information we present concerning the estimate does not imply that it is better or worse than others.

Figure 9: Strengths and Limitations of FAA's Investment Estimate



Note: We considered procedures that reflected leading practices and factors that enhanced the soundness or completeness of an estimate to be strengths of an estimate. We considered factors that detracted from the soundness or completeness of an estimate or its source data to be limitations of an estimate.

^aReflects a leading practice.

How the Estimate Was Developed

FAA determined its investment estimate using the National Plan of Integrated Airport Systems (NPIAS) database. NPIAS includes the estimated cost of individual infrastructure investment projects requested by airports. The projects originate primarily from airport plans, including master plans. Airport officials may consider noncapital alternatives to address unmet infrastructure requirements when producing these plans. For example, officials may consider altering operational procedures or practices to allow more airplanes to use one runway instead of requesting funds for an additional runway. If noncapital alternatives do not exist, airport officials request funding for a capital project within their plans, which contain specific proposals and cost estimates for each project. FAA

officials in field offices review each project within each airport plan to determine if the project is eligible and justified. A project is eligible if it qualifies for federal funds under the Airport Improvement Program.¹⁹ A project is justified based on a judgmental decision by FAA district officials. For example, one airport in central Texas proposed adding four new runways to the airport, which FAA officials considered unjustified because the amount of air traffic served by the airport was insufficient to merit the additional runways. Projects and plans that are approved by FAA at the district level are then entered into the NPIAS database, along with the estimated costs. FAA officials in Washington then review the data in NPIAS and ensure that district officials have included only projects that are eligible for federal funding and are justified. FAA officials add up the estimated cost of these projects and produce an overall investment estimate.

How Estimate is Used

FAA submits the estimate to the Congress, as required by statute.

Related Reports

Report to Congress: National Plan of Integrated Airport Systems (NPIAS) (1998-2002). U.S. Department of Transportation, Federal Aviation Administration (Mar. 12, 1999).

Airport Development Needs: Estimating Future Costs (GAO/RCED-97-99, Apr. 7, 1997).

Airport Financing: Funding Sources for Airport Development (GAO/RCED-98-71, Mar. 12, 1998).

FHWA's Investment Estimate for Highways

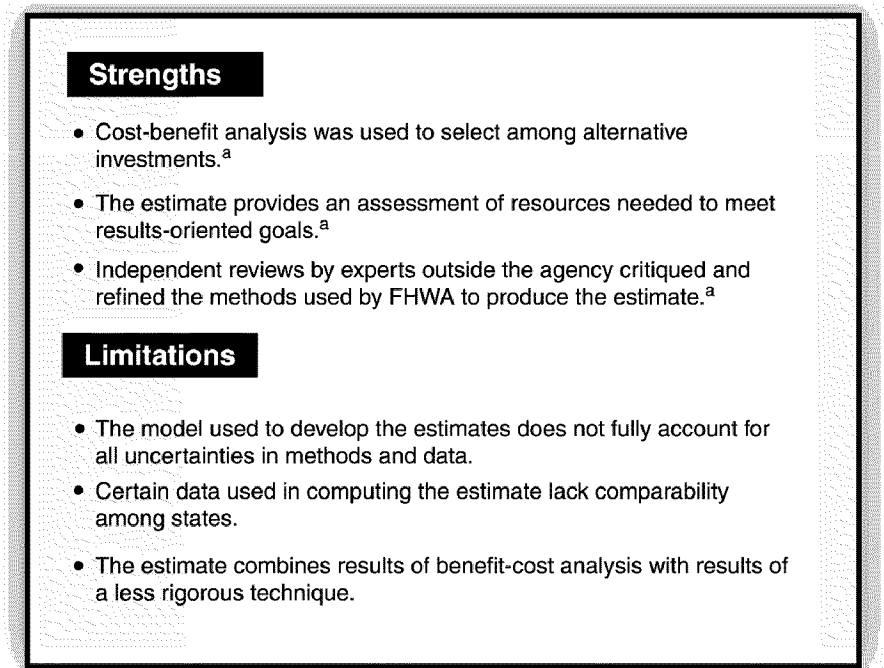
In May 2000, FHWA submitted to the Congress its most recent biennial estimate of a range of investment needs for the nation's highway and bridge investment needs. First, it estimated that \$83.4 billion²⁰ per year over 20 years (1998 to 2017) in highway investment would be economically justified based on the benefits of the investment exceeding the cost. Second, it estimated that \$50.8 billion per year over 20 years would be

¹⁹Generally, the Airport Improvement Program allows for all types of airport development except for automobile parking structures, hangars, air cargo buildings, or the revenue producing areas of large terminals.

²⁰ FHWA's estimate is in constant 1997 dollars.

needed to maintain the current physical condition of the nation's highways. Third, it estimated that \$53.9 billion a year over 20 years would be needed to maintain the current cost to users (such as travel-time costs, vehicle-operating costs, and crash costs). These estimates of highway investment cover all public road mileage—3.95 million miles in 1997.²¹ The major strengths and limitations of FHWA's investment estimate are summarized in figure 10. In a June 2000 report, we reviewed FHWA's model used to develop these estimates, and we have included the results of that review in our analysis. The amount of information we present concerning the estimate does not imply that it is better or worse than others.

Figure 10: Strengths and Limitations of FHWA's Investment Estimate



Note: We considered procedures that reflected leading practices and factors that enhanced the soundness or completeness of an estimate to be strengths of an estimate. We considered factors that detracted from the soundness or completeness of an estimate or its source data to be limitations of an estimate.

^aReflects a leading practice.

²¹ While FHWA also includes bridge investment requirements in the report to Congress, we have only included FHWA's estimate for highways in this analysis.

How the Estimate Was Developed

FHWA developed the estimate using data from a statistically drawn national-level sample of about 125,000 highway segments throughout the United States. This sample included data on a variety of highway conditions, including pavement roughness, traffic levels, and lane width. The states also provided FHWA with forecasts on such matters as travel growth. FHWA staff reviewed the data submitted by the states and looked for anomalies or unusual patterns. FHWA asked the states to correct serious flaws and improve data submission for minor flaws. Finally, FHWA division offices periodically reviewed state data collection procedures to ensure consistency among states. The corrected information was inputted into FHWA's Highway Performance Monitoring System.

FHWA primarily used the Highway Economic Requirements System (HERS) model to determine future investment requirements. It assessed the current condition of the sample highway segments and then projected future condition and performance of the segments based on expected changes in factors such as traffic volume. Based on this information, the model simulated the effects of infrastructure improvements for the highway segments and compared the relative benefits and costs associated with alternative improvement options. While FHWA's model analyzes these sample sections individually, the model is designed to provide estimates of investment requirements valid at the national level and does not provide improvement recommendations for individual highway segments. FHWA acknowledges that some HERS data, particularly emissions data, varies in quality.

To reach a total estimate for highway investment requirements, FHWA supplements results of this model with external adjustments to account for (1) classes of highways not included in either the statistical sample or the model²² and (2) certain types of capital investment. FHWA acknowledges that the estimates are not based on benefit-cost analysis and are less rigorous than the HERS results. The model currently does not directly consider new roads or system enhancements—improvements primarily related only to safety, traffic operations, or environmental enhancements—as part of its analysis. According to FHWA's most recent estimate, FHWA assumed those types of improvements will consume the

²² Rural minor collectors, rural local roads, and urban local roads are the three classes of highways not included in the statistical sample, and their future needs are not estimated by the model.

same overall percentage of highway capital investment as they have in the past.

FHWA has had transportation and economic experts review the model to assess and improve it. In June 1999, the experts found that FHWA has strengthened the model over time and that recent refinements have increased its applicability and credibility. Also, FHWA staff and consultants continually look for ways to improve the model. For example, FHWA officials told us they plan to eliminate a computational shortcut for their next estimates, which they plan to issue in 2002. FHWA used this shortcut to approximate the lifetime benefits associated with an improvement. In addition, the National Cooperative Highway Research Program is reviewing FHWA's methodology for determining its investment estimate.

We found the model was reasonable despite some limitations. First, the model cannot completely reflect changes occurring among all highways in the transportation network at the same time, since the model analyzes each highway segment independently. Second, the model cannot estimate the full range of uncertainties within which its estimates vary because it is not designed to completely quantify the uncertainties associated with its methods, assumptions, and data. In making estimates, the model relies on a variety of estimating techniques and hundreds of variables, all of which are subject to some uncertainties. For example, we have reported that pavement roughness data reported by the states to FHWA are not completely comparable, partly because the states use different devices to measure roughness. Third, FHWA uses two different approaches in compiling the estimate. The benefit-cost analysis used in the HERS model is not comparable to the analysis used to estimate investment needs for roads outside the sample and other kinds of road projects. Nevertheless, FHWA combines these estimates and characterizes both as economically justified.

How the Estimate is Used

The highway estimate provides federal officials a source of information for decisionmaking concerning investments. In particular, legislative and executive branch officials use the estimate to obtain general information on the nation's need for infrastructure investments. Also, some groups may use the estimate in discussions about the level of federal funding for highways.

Related Reports

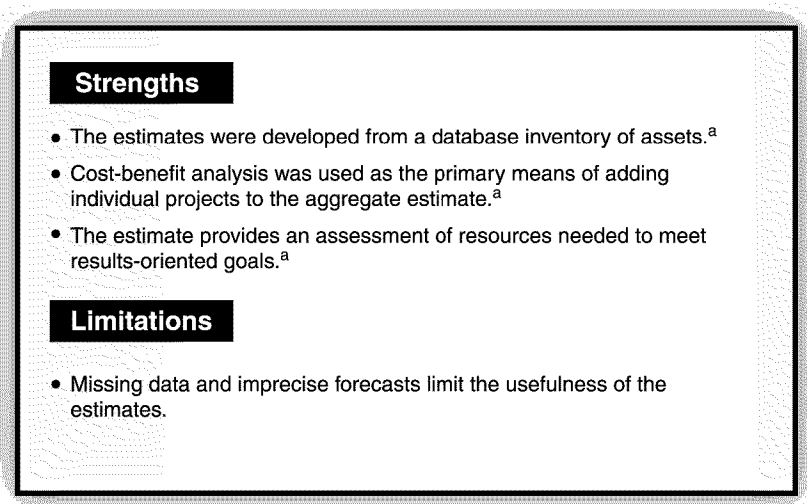
1999 Status of the Nation's Highways, Bridges, and Transit: Conditions & Performance. U.S. Department of Transportation, Federal Highway Administration and Federal Transit Administration (May 2, 2000).

Highway Infrastructure: FHWA's Model for Estimating Highway Needs Is Generally Reasonable, Despite Limitations (GAO/RCED-00-133, June 5, 2000).

FTA's Investment Estimate for Mass Transit Systems

In May 2000, the Federal Transit Administration (FTA) submitted its biennial estimate to the Congress on the nation's mass transit systems, including buses, rail cars, and ferries. The report covered 1998 to 2017 and estimated investment requirements under four scenarios, depending on whether the condition and/or the performance of existing mass transit systems was maintained or improved. FTA estimated that the average cost for these four scenarios ranged from \$10.8 billion to \$16.0 billion per year (in constant 1997 dollars). This estimate is based on incomplete data and imprecise predictions, which limit the usefulness of the estimate. The major strengths and limitations of FTA's investment estimates are summarized in figure 11. We have not done prior work related to FTA's investment estimate or data used for the estimate. The amount of information we present concerning the estimate does not imply that it is better or worse than others.

Figure 11: Strengths and Limitations of FTA's Investment Estimates



Note: We considered procedures that reflected leading practices and factors that enhanced the soundness or completeness of an estimate to be strengths of an estimate. We considered factors that detracted from the soundness or completeness of an estimate or its source data to be limitations of an estimate.

^aReflects a leading practice.

FTA's first scenario—"Maintain Conditions and Performance"—estimates the capital investment needed to maintain the average condition of mass transit assets over the 20-year period and add new capacity to maintain current vehicle usage levels as passenger travel increases. The second scenario—"Maintain Conditions and Improve Performance"—estimates the investment needed to maintain the average existing conditions of mass transit assets and to improve the service coverage and/or frequency of mass transit service. The third scenario—"Improve Conditions and Maintain Performance"—estimates the investment needed to bring the average condition for each major asset type to "good" while maintaining current vehicle usage levels as transit passenger travel increases. The fourth scenario—"Improve Conditions and Improve Performance"—estimates the investment needed to bring the average condition for each major asset type to "good" and also improve service quality by increasing the area covered by mass transit and/or increasing the frequency of mass transit service. The estimates for these four scenarios taken from the Department of Transportation's 1999 Conditions and Performance report, are shown in table 3.

Table 3: Investment Estimates for Mass Transit

Scenario	Average annual cost (billions of dollars)
Maintain conditions and maintain performance	\$10.8
Maintain conditions and improve performance	\$14.4
Improve conditions and maintain performance	\$11.1
Improve conditions and improve performance	\$16.0

How the Estimates Were Developed

FTA developed its investment estimates using the National Transit Asset Inventory. This inventory includes information on the age of buses and railcars and on maintenance facilities. FTA estimates the condition of buses and rail cars based on their age, using data gathered by the agency over time from surveys of the condition of vehicles. The information for this database is collected by every transit agency in an urbanized area that receives federal assistance, according to an agency official.

FTA used the Transit Economic Requirements Model to determine the future infrastructure and asset needs for transit. This computerized model predicts the changes that will occur to transit infrastructure and vehicles over time and the investments needed to maintain or improve current conditions and performance of mass transit systems. To forecast needs for the condition of assets, the model includes aggregate data on the condition of assets based on a 1 to 5 scale and uses a benefit-cost analysis to determine if the benefit of replacing an asset (and thus improving its condition) outweighs the cost of the replacement. If the benefit outweighs the cost, the project is added to the final cost as reported by the model. To forecast needs for the performance of assets, FTA uses predictions of the number of future passengers developed by Metropolitan Planning Organizations (MPO). FTA uses this information to determine future capacity needs. Capacity needs are expressed as either more frequent service or a new system. The Transit Cooperative Research Program⁷ is reviewing FTA's methodology for determining its investment estimates. According to FTA, the results of this review will be considered in developing FTA's next estimates in 2002.

Missing data and imprecise predictions limit the accuracy of the investment estimates. For example, the database lacks future travel

⁷ The Transit Cooperative Research Program is a cooperative effort of FTA, the Transportation Research Board, the Transit Development Corporation, and the American Public Transportation Association that conducts and disseminates transit information.

forecasts for the New York City area. In addition, according to FTA, some MPOs submit data that vary in quality. According to FTA, the agency also does not have complete information on the condition of fare collection systems, stations, and maintenance facilities that are part of the mass transit systems. Finally, according to FTA, it is difficult to predict the growth in travel over time.

How the Estimate is Used

According to FTA, the investment estimate is used to provide broad, general support for FTA's budget and to help tie the budget to the levels of performance discussed in the estimate. The estimate provides information to FTA and the Congress on changes in the condition and performance of mass transit. Finally, the estimate serves as a baseline for performance goals mandated under the Government Performance and Results Act and identifies the performance goals FTA is likely to achieve in the future.

Related Reports

1999 Status of the Nation's Highways, Bridges, and Transit: Conditions and Performance, U.S. Department of Transportation: Federal Highway Administration and Federal Transit Administration (May 2, 2000).

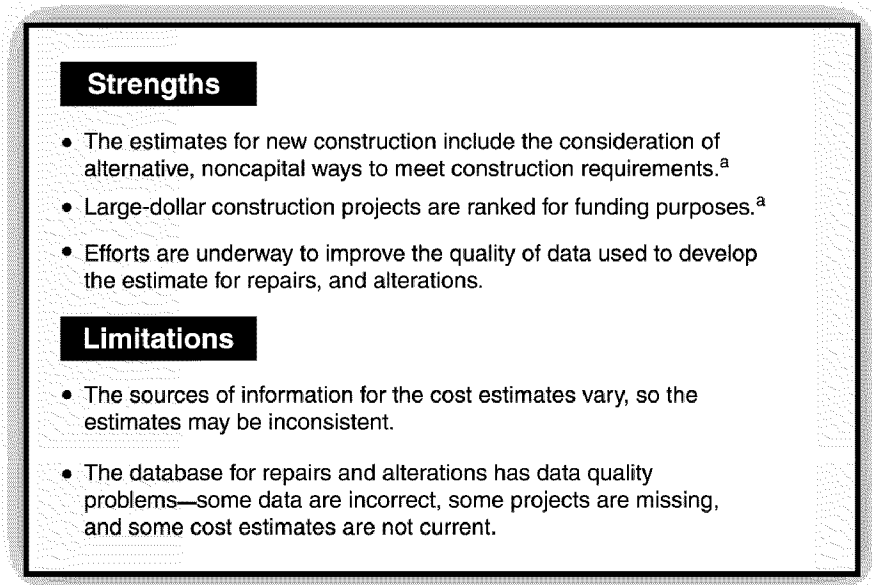
GSA's Investment Estimate for Public Buildings

GSA's data indicated that, as of May 2, 2001, it would cost \$4.58 billion for repairs and alterations of public buildings. This estimate included both items currently needed and future work items to be undertaken over the next 5 years. Examples of repairs and alterations include repairs to major building components, such as electrical, heating, ventilation, and air conditioning systems; fire alarm and sprinkler systems; and other fire and life safety items. In fiscal year 2001, GSA estimated that an additional \$250 million to \$300 million was needed annually over the following 5 years for new building construction for border stations and federal office buildings. In addition, in fiscal year 2001, the Judicial Conference estimated \$500 million was needed annually over the following 5 to 7 years to construct new courthouses.⁹ The major strengths and limitations of these investment estimates are summarized in figure 12. In previous reports, we reviewed the database used to develop the estimate of repairs and alterations, and we have included the results of that review in our analysis.

⁹The estimate for courthouse construction comes from the Judicial Conference of the United States' 5 to 7 year courthouse project plan. The Judicial Conference is composed of the Chief Justice of the United States and other federal judges who consider policy and legislative and administrative issues affecting the federal courts.

The amount of information we present concerning the estimate does not imply that it is better or worse than others.

Figure 12: Strengths and Limitations of GSA's Investment Estimates



Note: We considered procedures that reflected leading practices and factors that enhanced the soundness or completeness of an estimate to be strengths or an estimate. We considered factors that detracted from the soundness or completeness of an estimate or its source data to be limitations of an estimate.

^aReflects a leading practice.

How the Investment Estimates Were Developed

GSA develops cost estimates when it determines that repairs and alterations are needed.¹⁰ GSA's overall estimate for repairs and alterations was derived from information contained in the Inventory Reporting Information System (IRIS), a database of projects. The projects are identified and entered into the database at the regional level. The projected cost data are derived from various sources, including contractors, safety inspectors, and building engineers. The database includes current and future projects. Work items in the database may be updated daily by regional office staff as new work is identified and completed work is deleted.

¹⁰GSA manages its infrastructure needs through the Capital Investment and Leasing Program. Under this program, it works with other agencies to determine space needs and then determines the best way to meet these needs within anticipated budget levels.

GSA's process for developing investment estimates for new construction projects also begin, with evaluations at the regional level. GSA regional staff evaluate existing facilities, the availability of sites for new construction, and the disposition of old facilities. Using a computer model, GSA's regional staff compare the cost of construction to the cost of leasing space. The computer model uses cost estimates based on benchmark values that are specified for locations around the country. The regional offices submit their recommendations for construction projects along with the computer analysis and other data to GSA headquarters for review.

GSA identifies projects that make up its overall investment estimate as prospectus-level or nonprospectus-level: prospectus-level projects have estimated costs of \$1.99 million or more, and nonprospectus-level projects have estimated costs greater than \$10,000 and less than \$1.99 million.¹¹ GSA prioritizes prospectus-level investment projects as preparation for the annual budget process. The regions identify proposed projects and submit the proposals, along with supporting data, to GSA headquarters for review and funding consideration. There, headquarters staff and the capital investment panel¹² assess the merits of each proposed project and rank the projects with the aid of computer-based software called "Expert Choice." The model uses five weighted criteria to rank the projects that are competing for funding. These criteria consider, in weighted order, (1) economic return—whether the project will generate additional revenue for the Federal Building Fund, the source of funds for GSA's repair and alterations and construction projects; (2) project risk—whether the project will begin in the planned fiscal year and use the authorized funding; (3) project urgency—whether the project will correct building conditions that are unsafe or involve severe deterioration; (4) community planning—whether the project will protect the building's historic significance and positively impact the local community; and (5) customer urgency—the project will have a positive impact on the tenant agencies' operations or mission. GSA officials, however, stated that the Expert Choice model is not the sole basis for decisions; the model is not intended to replace the professional judgment and knowledge of staff. During the

¹¹GSA's Administrator is authorized to annually adjust the dollar threshold that defines prospectus-level projects. The threshold was \$1.99 million for fiscal year 2001 projects. GSA must provide detailed support for each prospectus-level project that it plans to undertake and have OMB approve and the Congress fund these projects before starting work.

¹²The members of the capital investment panel vary from year to year, but the panel always includes senior managers from GSA headquarters and regional offices.

assessment process, each project is assigned a numerical score and then ranked in order of priority. The projects with the higher scores usually became candidates for funding. For fiscal year 2001, GSA assessed the merits of 27 repair and alterations design projects proposed by its regional staff and selected 12 to recommend for funding.

In 2000, we reported problems with the quality of data contained in IRIS. For example, we found that not all repairs were included, some repairs that were included were already in progress or completed, some data were incorrectly reported, and some cost estimates for repairs were not current. In addition, the projects that make up the estimate for repairs and alterations are expressed in unadjusted dollars; in some cases the year that the estimate was made is not included in the database. We have also reported that the lack of a multiyear plan for repairs and alterations affects the agency's ability to make investment decisions.

In response to recommendations made in our previous reports, GSA is engaged in several activities intended to improve its IRIS database and enhance the management of its inventory of buildings. For example, the agency is undertaking efforts to validate the quality and consistency of IRIS, such as revising work item codes to be more descriptive. In addition, the agency has significantly reduced the number of overdue work items in the database, thereby improving the quality of the database, according to GSA officials. GSA is also implementing a building condition assessment survey, which provides automated cost estimates using industry-accepted software. GSA began a pilot program in one region in 2000 and has expanded the program to its other 10 regions. The agency expects to complete initial building condition assessments on the entire inventory of buildings by the end of September 2001. It plans to review information gathered in these assessments and enter new work items into the IRIS database. Existing work items will be updated with the results of the condition assessments.

How the Estimate Is Used

GSA's IRIS database is used as input in determining funding priorities. For prospectus-level projects, GSA's headquarters staff review the estimates submitted by the regions, apply the Expert Choice model and professional judgment, and then select projects for inclusion in the agency's budget proposal that is sent to OMB. For nonprospectus-level repairs and alterations projects, GSA's headquarters staff allocate a portion of all funds for repairs and alterations to each regional office based on regional priorities.

Related Reports

Federal Buildings: Funding Repairs and Alterations Has Been A Challenge—Expanded Financing Tools Needed (GAO-01-452, Apr. 12, 2001).

Federal Buildings: Billions Are Needed for Repairs and Alterations (GAO/GGD-00-98, Mar. 30, 2000).

General Services Administration: Many Building Security Upgrades Made but Problems Have Hindered Program Implementation (GAO-T-GGD-98-141, June 4, 1998).

Federal Buildings: Actions Needed to Prevent Further Deterioration and Obsolescence (GAO/GGD-91-57, May 13, 1991).

Appendix III: Comments From the Environmental Protection Agency



UNITED STATES ENVIRONMENTAL PROTECTION AGENCY
WASHINGTON, D.C. 20460

JULY 11, 2001

OFFICE OF
WATER

Mr. Peter F. Guerrero
Director, Physical Infrastructure
General Accounting Office
Washington, DC 20548

Dear Mr. Guerrero:

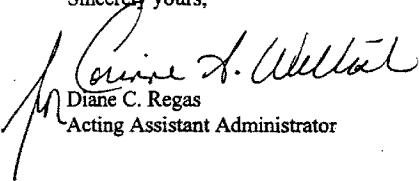
Thank you for giving the Environmental Protection Agency's (EPA) Office of Water the opportunity to review the proposed General Accounting Office (GAO) report *U.S. Infrastructure: Agencies' Approaches to Developing Investment Estimates Vary*. We know that comparing the methods different agencies use to identify their needs is a difficult task, given that the purposes of, and methods for, the surveys vary widely. We believe GAO has done an excellent job summarizing the programs and indicating how procedures follow leading practices for infrastructure estimates that had been identified by GAO in an earlier report. The report also clearly distinguishes between federal agencies that directly invest in infrastructure, such as the General Services Administration (GSA), and those that manage programs to fund infrastructure, such as the EPA.

We have reviewed the report, focusing in particular on those sections that describe how the EPA drinking water and wastewater needs surveys are conducted. We have no significant comments on those portions of the report that deal with our drinking water needs survey. Minor editorial comments related to the Clean Water Needs Survey are attached. We found that the report addressed many of the comments and concerns we had expressed in discussions during the development of the report. In particular, we appreciate the clarification indicating that, while EPA's analysis may not directly follow leading practices, these practices are incorporated into our needs assessments or addressed at state and/or local levels.

**Appendix III: Comments From the
Environmental Protection Agency**

I appreciate the opportunity to be of service and look forward to the final report. Should you need additional information or have further questions please contact me or Cynthia C. Dougherty, Director of the Office of Ground Water and Drinking Water at (202) 260-5543 regarding the Drinking Water Needs Survey, or Michael B. Cook, Director of the Office of Wastewater Management at (202) 564-0748 regarding the Clean Water Needs Survey.

Sincerely yours,



Diane C. Regas
Acting Assistant Administrator

Appendix IV: Comments From the General Services Administration

Note: GAO comments supplementing those in the report text appear at the end of this appendix.



GSA Public Buildings Service

JUL 6 2001

Mr. Peter F. Guerrero
Director, Physical Infrastructure
U.S. General Accounting Office
Washington, DC 20548

Dear Mr. Guerrero:

Thank you for providing the General Services Administration an opportunity to comment on the draft GAO report entitled "U.S. Infrastructure: Agencies' Approaches to Developing Investment Estimates Vary" (GAO-01-835).

The report noted that GSA calculated an investment of \$4.58 billion over 1 to 5 years to repair public buildings. As reported in the April 2001 GAO report, "Federal Buildings: Funding Repairs and Alterations Has Been A Challenge – Expanded Financing Tools Needed," the work item inventory is not static. The status of building systems and needs of the inventory are continually changing. Please note also that our IRIS work item database does not represent the investment needs of the inventory. This database merely tracks the status of work items through initial identification, design, construction, and completion. GSA applies asset management business principles to decide where to invest its limited funds. Decisions are based not just on building condition assessments, but also on current building utilization, projected building need, and economic return. Buildings that have been identified for possible disposal or that have no current or projected federal need are not candidates for full system replacements or modernizations.

We appreciate the difficulties involved in looking at eight federal agencies with varied missions and infrastructure needs and measuring these agencies against the same criteria of leading practices; for example, leading practice 4: "Use cost-benefit analysis as a primary method to compare alternatives and select the best investment solution." Although GSA utilizes cost-benefit analysis in ranking prospectus-level projects and the highest weighting in the Expert Choice model is for economic factors, GSA is not credited with employing this leading practice because other criteria, such as health and safety, are considered. We rank the health and safety of our tenant agencies as a major factor in making investment decisions.

We would also like to point out that the progress that GSA has made in data accuracy and needs evaluation since the March 2000 GAO report "Federal Buildings: Billions Are Needed for Repairs and Alterations" is not reflected in this report.

U.S. General Services Administration
1800 F Street, NW
Washington, DC 20405-0002
www.gsa.gov

See comment 1.

See comment 2.

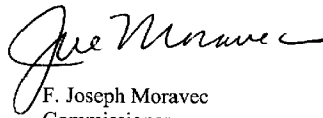
See comment 3.

**Appendix IV: Comments From the General
Services Administration**

- 2 -

Editorial comments on the report have been provided to Teresa Spisak, Assistant Director, Physical Infrastructure, and are enclosed for your review. If we can provide any additional information or assistance, please contact Ivan Swain, Director of Capital Investment and Leasing, Office of Portfolio Management, at (202) 501-0638.

Sincerely,



F. Joseph Moravec
Commissioner

Enclosure

GAO Comments

The following are GAO's comments on GSA's letter dated July 6, 2001.

1. We revised the report to indicate that the database is used as input to funding decisions.
2. We note in the report that GSA uses economic benefits as one criterion ranking and selecting projects for funding.
3. We note in the report that GSA is engaged in activities intended to improve the quality and consistency of its database on repairs and alterations and provide examples of those activities.

Appendix V: GAO Contacts and Staff Acknowledgments

GAO Contacts

Peter F. Guerrero (202) 512-2834
Teresa F. Spisak (202) 512-2834

Acknowledgments

Other key contributors to this report were Phillis Riley, Sharon Dyer, John Shumann, Christine Bonham, Catherine Colwell, Michael Curro, William Dowdal, Timothy Guinane, Trina Lewis, Lisa Turner, and Alwynne Wilbur.

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