Chapter 1

Introduction and Summary

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INTRODUCTION

The Federal Government is the Nation's largest single energy consumer. In fiscal year 1989, it spent $8.7 billion on energy in its own facilities and operations, and another $4 billion subsidizing the energy expenses of low-income households (see figure l-l). The energy purchases paid for by the Federal Government were over 3 percent of the total Americans spent on energy in that year. Much of this energy is inefficiently used. For example, it appears that commercially available, cost-effective measures including high efficiency lighting and carefully operated heating, ventilating, and air-conditioning (HVAC) systems could likely conserve at least 25 percent of the energy used in Federal buildings with no sacrifice to comfort or productivity.

Improving energy efficiency has several benefits, both for the government and for the Nation as a whole. Inefficient use of energy needlessly exacerbates reliance on imports of oil from foreign sources, contributes to local and global environmental concerns such as smog and climate change, and consumes capital and operating expenditures which would be better invested elsewhere.

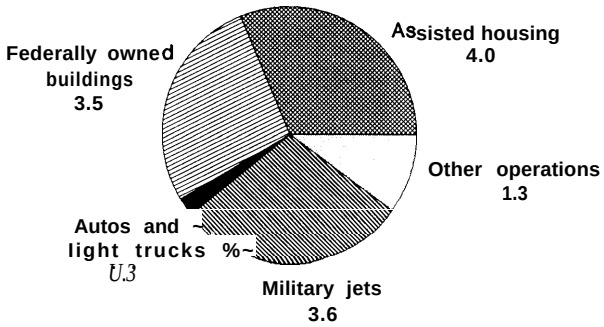
The Federal Government has an opportunity to set a good example for efficient energy use while reducing Federal spending, reliance on imported oil, and adverse environmental impacts. It has broad experience using electricity, natural gas, petroleum products, and other energy in housing, office buildings, hospitals, transport, and other facilities and operations. From lighting to HVAC equipment to automobiles, Federal procurement could also expand market opportunities for producers of efficient technologies, demonstrate measures useful in the private sector, and encourage more research and development (R&D) by manufacturers.

Since the mid- 1970s, Congress and the executive branch have developed several programs to improve energy efficiency in Federal facilities and operations. According to the Department of Energy (DOE), between 1975 and 1989 these programs saved close to $7 billion (or about 5 percent of Federal energy spending), far more than the $2.5 billion invested in energy conservation measures. Despite this achievement, considerably greater savings still are possible. Many energy industry observers believe that efficient technologies could greatly reduce energy use in the United States and reduce environmental impacts while increasing productivity. Yet Federal agencies' use of many energy efficient measures is low. For example, inefficient, costly-to-operate lighting is still common throughout the millions of square feet of office space owned or leased by the Federal Government and its contractors.

The failure of Federal agencies to fully implement the use of energy efficient technologies results from a variety of factors. Overall, energy efficiency is not central to most agencies' missions and has received a relatively low priority. Reflecting the low priority, there is a shortage of trained personnel and a scarcity of the capital needed to make even short-term investments. Several other constraints seem important, as well. These include a lack of incentives, a lack of systematic assessment of opportunities, and uncertainty about the cost and performance of some technologies. Many of these factors apply to the private sector as well as to the Federal Government. An examin ation of energy efficiency measures and the technical and institutional impediments to their use is important in developing effective, low cost energy policies not only for the Federal Government but for the economy as a whole.

This report examines opportunities for improving the efficiency of Federal energy use and spending, concentrating on opportunities in federally owned buildings. Some opportunities for Federal vehicle fleets are also discussed. The report also briefly describes some specialized but large Federal energy uses such as military aircraft. Prospects for energy efficiency gains in federally assisted housing are also briefly discussed since the Federal Government spends several billion dollars each year on the energy used in those households. Although assisted housing is not the focus of this report, it is included to give a more complete picture of Federal spending on energy.

Figure I-l—Federal Spending on Energy, Fiscal Year 1989



SOURCE: U.S. Department of Energy, Federal Energy Management Program, "Report on Federal Government Energy Management and Conservation Programs," October 1990.

Chapter 2 reviews the diverse policies and programs the Federal Government has pursued to improve its energy efficiency. Chapter 3 examines the technical and economic prospects for improving efficiency to reduce Federal spending on energy in buildings, including both federally owned buildings and federally assisted housing. Chapter 4 describes the energy used in general operations, including automobile fleets and military operations. Chapter 5 presents case studies of energy use and prospects for savings in six federally owned, leased, and assisted facilities. Chapter 6 describes the main constraints to improved energy efficiency in Federal facilities, including both technical and institutional impediments, Finally, chapter 7 suggests congressional policy options in light of the existing, untapped technical and economic opportunities for energy savings.

FEDERAL SPENDING ON ENERGY

Federal spending on energy can be categorized in four groups: 1) federally owned and leased buildings, 2) federally assisted housing, 3) Federal auto and truck fleets, and 4) specialized operations, predominantly military mobility. This section describes those categories and how energy is used in them. The Federal agencies with the largest energy use are noted at the end of the section.

Federally Owned and Leased Buildings

The Federal Government owns and leases around 500,000 buildings of various sizes, construction, and uses. About 51,000 of these are commercial buildings[1] owned by the government in the United States with between 1 and 2 billion square feet of floor space. Federal buildings are highly diverse, including offices, retail shops, hospitals, and industrial facilities. The Federal Government also owns 422,000 housing units for military families, and afar smaller number in the Departments of the Interior, Transportation, and other agencies. The government leases about 7 percent of its floor space from private owners.

The Department of Defense (DOD) owns about two-thirds of the Federal Government's total domestic floor space. Federal agencies own most of the building space they occupy, but also often lease some of their space either from private companies or from the General Services Administration (GSA), which owns and leases commercial space on their behalf. Because GSA manages some property for other agencies, it is the third largest owner (after DOD and the U.S. Postal Service (USPS)) of Federal buildings, with nearly 9 percent of the total government-owned building space.

In fiscal year 1989, the energy used in Federal buildings cost the U.S. Treasury around $3.5 billion.[2] Most of the energy is used just to make the buildings inhabitable, that is, to provide light and HVAC. Large amounts of additional energy are used to power the wide assortment of appliances and equipment used in the buildings, ranging from computers to conveyor belts to stoves.

Electricity is the dominant energy form used in Federal buildings in terms of total annual spending ($2.4 billion in 1989). Electricity is essential for powering lights, electronic equipment, and the wide array of motors found in everything from HVAC equipment to elevators to conveyor belts and is also used for heating and cooking. Lighting alone accounts for about 30 percent of electricity use in commercial buildings. While electricity is extremely versatile, it is also the most expensive per unit of energy delivered to the Federal Government (at an

[1]Defined as "roof~ and walled structures used predominant tly for a nonresidential, nonagricultural, and nonindustrial purposes' with floor space over 1,000 square feet, as in U.S. Department of Energy, Energy Information Administration, *Characteristics of Commercial Buildings 1986, DOE/EIA-0246(86)* (Washington, DC: U.S. Government Printing Office, September 1988), p. 3.

[2]An additional unestimated amount was spent on energy used in leased buildings for which the Federal Government does not pay utilities directly.

average $17/million Btu, electricity is about four times more costly than natural gas).

Natural gas is the second most heavily used fuel, accounting for about $0.5 billion in 1989. It provides most of the energy for space heating, water heating, and cooking. Fuel oil is also used for heating and accounted for about $0.35 billion in 1989. Other energy forms include coal and purchased steam.

Federally Assisted Households

As of 1989 there were over 90 million households for about 240 million people in the United States.[3] The Federal Government subsidizes part or all of the utility bills in about 9 million of these households. Two executive agencies are responsible for the vast majority of indirect Federal expenditures on residential energy use: the Departments of Housing and Urban Development (HUD) and Health and Human Services (HHS).[4] These two agencies subsidize or provide assistance payments for residential utility bills for low income Americans.

Each year, HUD spends from $2 to $3 billion subsidizing the energy bills for 3.6 million federally assisted housing units. There are two main HUD-assisted housing programs: a low-income public housing program and the Section 8 rental housing assistance program which can be used in privately owned housing. Both programs are administered by HUD-regulated local public housing authorities (PHAs), of which there are about 2,700 nationwide.

HHS's Low Income Home Energy Assistance Program (LIHEAP) assists about 6 million low-income households in meeting the costs of residential heating or cooling. Some LIHEAP recipients live in HUD-assisted housing, but the majority do not. HHS provides grants to the States, Indian tribes, and territories which administer the program. In fiscal year 1989, HHS spending on LIHEAP totaled $1.4 billion.

A few main energy uses constitute the majority of residential energy consumption and spending. By far the highest on the list both in terms of total energy use and spending is space heating. Natural gas supplies over two-thirds of the energy used for space heating. Most households also have a water heater, which on average consumes 18 million Btus/year, making that the next largest residential energy use. As with space heating, natural gas provides two-thirds of the energy used in water heaters.

Refrigerators are the largest single use of residential electricity, consuming about 20 percent of the total. Nearly every household has a refrigerator, which on average consumes about 1,500k Wh/year.[5] Air conditioning is the second largest residential electricity use after refrigerators. A large list of other uses including cooking, dishwashers, clothes washing and drying, lighting, and electronic equipment such as televisions make up the remaining 16 percent of household energy.

Federal Auto and Truck Fleets

In total the Federal Government owned 106,108 sedans, 15,973 station wagons, and 323,479 light trucks in 1988. In addition, there were 12,641 buses and ambulances and 55,481 medium and heavy trucks. DOD and USPS have the largest fleets, each with about 30 percent of the total. GSA, which has oversight responsibility over federally owned and leased passenger vehicles, has about 20 percent of the total. Almost every Federal agency owns at least one vehicle and may lease many others from the GSA Federal Fleet Management System. With few exceptions, the Federal automotive fleet is petroleum-fueled (i.e., gasoline and diesel fuel), although there are some alternate fuel vehicles (e.g., natural gas). Each year, the Federal Government replaces about 100,000 of its cars and light trucks, accounting for about 1 percent of domestic production. About 50,000 of these are procured by GSA.

Increasingly, the Federal auto fleet is relying on compacts. In 1988 compacts outnumbered other classes of sedans by almost 2:1. The shift in the makeup of the Federal fleet to smaller, more fuel efficient cars has resulted in higher fleet average fuel mileage. In 1989, the Federal Government bought 329 million gallons of gasoline at a cost of $309 million. In 1989, the average Environmental Protection Agency (EPA) fuel economy rating of the Federal automobile fleet was 29.4 miles per gallon (mpg), 7 percent higher than the minimum corporate

[3]This population estimate does not include the homeless and people living in institutions (e.g., military barracks and prisons).

[4]As noted previously, the Department of Defense owns about *400,000* military housing units.

[5]Refrigerators in federally owned or assisted housing may be smaller with less energy-using features (e.g., through-the-door ice dispensers) than the average.

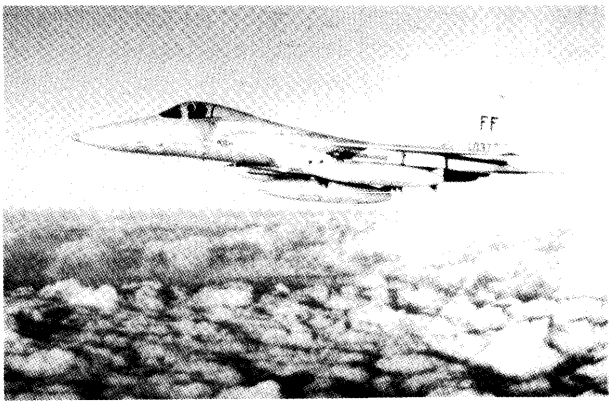


Photo credit: General Dynamics

Military aircraft consumed over 3.6 billion dollars' worth of jet fuel in fiscal year 1989.

average fuel economy requirement for manufacturers.

Other Operations

In fiscal year 1989, the Federal Government consumed about $4.9 billion worth of energy in highly specialized operations. By far most of the energy used in operations is defense-related in the form of military mobility energy. Military mobility refers to activities such as flying aircraft, sailing naval vessels, and operating tanks and other land-based military equipment. In fiscal year 1989, military aircraft and surface equipment consumed over $3.6 billion in jet fuel and about $0.6 billion in diesel fuel.

Much of the remaining energy for operations is also defense-related, used by DOD in various processes and by DOE in its uranium enrichment facilities and production nuclear reactors. Production reactors are industrial facilities for producing nuclear fuel and nuclear weapons materials. Non-defense operations using large amounts of energy include DOE's research facilities such as reactors and linear accelerators.

Federal Agencies With the Largest Energy Use

The five Federal agencies using the most energy in their facilities and operations are, in order: DOD, DOE, USPS, the Department of Veterans Affairs, and GSA. Together they consume over 90 percent of the Federal Government's total.

DOD is by far the largest consumer of energy in the Federal Government. In fiscal year 1989, DOD consumed over 80 percent of the energy used in the Federal Government (see figure 1-2). DOD used nearly 1.6 quadrillion Btus costing more than $2 billion in its 1,896 million square feet of buildings. DOD's facilities are extremely diverse, including residences, offices, and food service and health care facilities. DOD also spent about $4.6 billion on energy for general operations, the majority for military mobility.

The largest consumer of energy among the civilian agencies is DOE. Energy-intensive processes such as nuclear research and development and production of nuclear materials accounted for nearly 40 percent of DOE's energy use. The USPS, with its vast number of post offices and delivery operations is the next largest Federal consumer. Veterans Affairs ranks next with its 174 medical centers. Rounding out the five largest agencies is the GSA, in its role as provider of some of the office space used by other agencies.

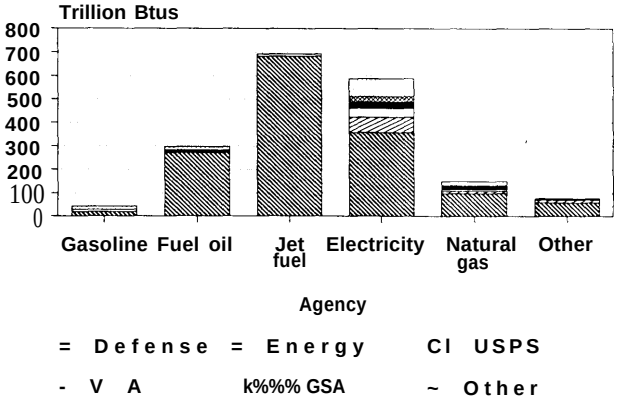
In addition to the $8.7 billion spent by Federal agencies in their own facilities and operations, HUD spent about $2.5 billion subsidizing utility expenses in HUD-assisted housing, and HHS spent about $1.4 billion on energy assistance for low-income households.

PROSPECTS FOR ENERGY- AND COST-SAVINGS

After many years of both R& J.) and commercial use throughout the private sector and within the Federal Government, it is clear that energy efficient technologies can work well and reduce costs. Federal agencies estimate that between 1975 and 1989, their energy efficiency programs for Federal facilities and operations saved $7 billion, or about 5 percent of the $128 billion spent on energy during that time.[6] Savings from many of these programs continue to accrue.

[6] Estimates for 1975-84 from the U.S. Department of Energy, "Annual Report on Federal Government Energy Management Fiscal Year 1985," DOE/CE-0171, August 1986, table C, p. C-1. Estimates for 1985-89 from the U.S. Department of Energy, "Annual Report to Congress on Government Energy Management and Conservation Programs, Fiscal Year 1989," Oct. 3, 1990, table E, p. 74.

Figure 1-2—Energy Consumption by Agency Facilities and Operations, Fiscal Year 1989



SOURCE: U.S. Department of Energy, Energy Information Agency, "Annual Energy Review 1989," DOE/EIA-0384(89), May 1980.

Considerable additional savings appear possible, although Federal agencies have not developed estimates of the potential energy- and cost-savings or of the capital and other resources required to attain those savings. The best information available (which is only very approximate) indicates that a reduction in energy use of *at least* an additional 25 percent is technically feasible and economically attractive for both federally owned and federally assisted buildings. That represents an annual savings of nearly $900 million in federally owned buildings, although achieving those savings could require initial investments on the order of $2 to $3 billion. Additional cost-effective savings would be possible with further investments, although any precise estimates are more speculative.

Performance of Energy- and Cost-Saving Measures

There are no magic technologies which will revolutionize Federal energy use (or private-sector energy use). Rather, there are many diverse technologies which work well that together can substantially reduce energy use and spending. For nearly every application of energy, measures are available that can improve the efficiency of use. Many have attractive cost and performance characteristics. Some energy- and cost-saving measures, such as motion detectors to control lights in occasionally used spaces, and highly efficient electronic ballasts and fluorescent T-8 tubes, have commercially proven economic and operating performance. Eventually, use of these approaches may become the standard rather than the exception that they currently are.

Not all energy efficiency programs have performed as well as expected.[7] Sometimes new technology does not perform as it should, as in the case of the excessive premature failure rate which plagued some early electronic ballasts. As a corollary, technologies are continually being improved and refined, or they will disappear from the market. The demonstrated high reliability of currently available electronic ballasts again provides a good example. Unfortunately, as with any evolving technology (and as with many well-established technologies), some products have marginal to poor performance and economics but have yet to be driven off the market.

Because of the wide variety of buildings, uses, technologies and other conditions, it is possible that good technologies can be misapplied, resulting in poor performance or unmet economic expectations. For example, because compact fluorescent lamps are larger and heavier than the incandescent bulbs they replace, there are many light fixtures in which they cannot be used. Thus, a program to replace all incandescent bulbs in a building with compact fluorescent could produce considerable dissatisfaction.

Deciding which measures to pursue often requires careful engineering and economic analyses. Successful programs, those which reduce energy use and overall costs, also often require ongoing, dedicated efforts to ensure that they work initially and continue to work. Some measures have highly site-specific economic and performance characteristics, requiring fairly detailed engineering and economic analyses. For example, the benefits of adding an energy monitoring and control system in a facility depend on the type of HVAC equipment in place and possible plans to replace existing equipment, as well as the buildings' external characteristics and internal layout and occupancy. Similarly, opportunities to delamp, or reduce lighting in over lit areas, can only be determined from a properly conducted site survey which evaluates current lighting levels and the levels

[7] In this report, ' 'energy efficiency program' refers to a combination of energy efficient technology and an institutional system to select and implement tbat technology.

which would result after delamping. Another factor causing the benefits of efficiency measures to be site-specific is that energy prices vary considerably across the country. For example, the average price of electricity for commercial customers in 1989 ranged from a high of $0.099/kWh in the State of New York to a low of $0.041/kWh in the State of Washington.[8] While the applicability of many measures is site-specific, agencies often conduct site surveys including engineering and economic analyses to identify candidate measures, although inadequate funding and staffing have constrained full implementation.

Savings Prospects in Federally Owned Buildings

There is little question that a large fraction of the Federal Government's $3.5 billion direct annual spending on energy in its own buildings could be greatly reduced using existing, proven technologies. For example, at the four federally owned facilities in OTA'S case studies, the facility personnel estimated that an average savings of at least 25 percent in annual operating cost and energy use appears achievable with proven and highly cost-effective technology. This saving requires no change in occupant comfort or productivity; rather, it involves more effective use of energy, either through more efficient equipment or through improved operations and maintenance practices. OTA's case study estimates were intended to include only highly cost-effective options in which the capital costs and other costs of implementation are small compared to the savings, with simple paybacks of under 3 years. Some measures such as improved operation and maintenance or using high-efficiency lighting systems supported by utility rebates have paybacks of under 1 year. A less stringent economic test which is more consistent with the cost of capital to government would produce considerably higher estimates of savings potential (see box l-A).

The Federal Government has not developed estimates of either the governmentwide potential for energy and cost savings or of the capital and other resources required to attain those savings. Similarly, none of the individual Federal agencies contacted by OTA have produced such estimates for their own facilities and operations although some are undertaking such efforts. All cite difficulties of performing the information collection and analyses required even for approximate estimates. Although building audits mandated under the Energy Conservation Policy Act were conducted at most major facilities a decade ago, there has been no Federal effort to compile the results, much less to keep results current. The same appears to be true of the facility energy surveys mandated under the Federal Energy Management Improvement Act of 1988.

The lack of reasonably detailed, comprehensive analytical effort to date should not be interpreted as representing a lack of energy efficiency opportunities. Although Federal agencies have not published overall estimates of prospects for efficiency gains, they often take the public position that large gains are possible. It is important to note that many relatively easy, low risk energy- and cost-saving measures with excellent economic characteristics have yet to be implemented at Federal facilities. These measures range from using higher efficiency lights and equipment to improved operation and maintenance of HVAC systems. The best options currently available appear to be attractive under virtually any set of reasonable assumptions of future energy prices.

Savings Prospects in Federally Assisted Households

As with the Federal Government's commercial buildings, there seems little question that increased use of existing, proven technologies would reduce a large fraction of the $4 billion spent on residential energy by the government in federally assisted housing. This savings requires no loss of occupant comfort and frequently actually increases comfort, as in the case of repairing broken windows and stopping drafts. Since space heating is the leading residential energy use, many opportunities for energy and cost savings depend on promoting higher efficiency heating equipment and weatherization programs. Opportunities for savings are large. For example, a comprehensive study for HUD of energy-saving opportunities in public housing published in 1988 estimated the potential for over 30 percent savings with an average payback of 4.5 years using measures such as weatherstripping and insulation and door and window repairs. Similarly, facility managers at OTA's case study of one public housing

[8] U.S. Department of Energy, Energy Information Administration, *Electric Power Annual 1989* (Washington DC: U.S. Government Printing Office, January 1991), table 30, p. 59.

Box I-A—Annual Returns on Investment of 4 to 40 Percent: How High Is Highly Economic?[1]

Consider a project to replace a Federal building's fluorescent lamps and ballasts with well-proven high efficiency components. Is this project economically attractive if it costs $100,000 initially, has a 15-year life and saves $40,000 annually? What if it saves $12,000 annually? The answers depend on the Federal Government's investment criteria.[2]

The discount rate, or minimum annual return on investment, is the key investment criteria considered in economic analysis of investment options. The discount rate reflects the natural preference to have money sooner rather than later, and the cost of obtaining funds for investment. Under current law, the discount rate to be used in Federal energy analyses is set by the Secretary of Energy.[3] As specified by DOE, the discount rate is now based on the interest rate on U.S. Treasury bonds after removing the effects of inflation, subject to a floor of 3 percent and a ceiling of 10 percent.[4] Currently, 30-year Treasury bonds have a nominal yield of about 8 percent, which translates to 4 percent after inflation. Treasury notes and Treasury bills, which have shorter terms of under 3 years, currently have even lower yields, as low as 2 percent after inflation.

Because so many energy efficiency opportunities in the Federal Government are currently untapped and because there are severe data and analytical limits on existing governmentwide opportunities, this study focuses on measures with much higher returns on investment, typically 30 percent or more+ (A project with a 3-year simple payback and a 10-year life has a return on investment of about 30 percent+) These investments are very highly economic, exceeding by several times the Treasury's cost of borrowed funds. They are also far higher than the average rate of return on electric utility investments (under 14 percent nominally in 1991). A lower rate more consistent with cost of funds would result in higher estimates of savings potential. Although this study focuses on highly attractive economic measures, it does not intend to suggest that a high discount rate is appropriate in analyzing Federal energy efficiency opportunities.

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[1]For an in-depth discussion of the practical aspects of economic analysis of energy investments, see U.S. Department of Commerce, National Bureau of Standards (now called the National Institute of Standards and Technology), *Comprehensive Guide for Least-Cost Energy Decisions*, NBS Special Publication 709 (Washington, DC: U.S. Government Printing Office, 1987).

Also, for a handbook tailored for use by Federal agencies, see U.S. Department of Commerce, National Bureau of Standards, *Life-Cycle Costing Manual for the Federal Energy Management Program, NBS* Handbook 135 (Rev. 1987) (Washington, DC: U.S. Government Printing Office, 1987).

2For the lighting retrofit example saving $40,000 annually, the project is economically attractive whether the discount rate is 3 percent or 10 percent. But if it saves $12,000 annually, it is attractive only if the discount rate is below about 8.4 percent.

[3]Federal Energy Management Improvement Act, 1988, Public Law 100-615.

[4]10 CFR 436, as revised November 1990.

authority estimated that cost-effective savings of at least 30 percent could be realized.

Studies of weatherization programs in both public housing and other low-income housing (i.e., those funded by HHS and DOE) have found considerable savings potential, although results are variable. To gain abetter understanding of the potential gains and best methods to use, DOE's Weatherization Assistance Program recently began a comprehensive 3-year, $5-million review of performance. This analysis should help identify the economically and technically most effective programs for the future.

Energy- and cost-saving opportunities for appliances exist in all types of federally owned and assisted housing as well. For example, a simple program of using the most efficient and economic new refrigerators available, perhaps coupled with early refrigerator retirement, offers the prospect of reducing electricity used in federally assisted residences by a few percent. It would also encourage and support private sector development and commercialization of new, more efficient refrigerators. Such an early retirement program for other appliances such as water heaters and air conditioners could also save both gas and electricity cost-effectively. Of course, energy efficiency and cost are only two of several attributes (e.g., durability, features, operating performance) to consider when selecting any appliance or equipment.

Savings Prospects in Passenger Vehicle and Truck Fleets

As in the case with the Federal Government's owned and leased facilities, further efficiency gains appear possible. For example, for 1991 GSA's Automotive Commodity Center has contracted to

purchase 13,000 passenger sedans with EPA-estimated mileage of 26 combined, all with automatic transmission.[9] There are other vehicles in the class that have better mileage ratings, including four domestically produced models which get 27 mpg with an automatic transmission. The manual transmission versions get 28 mpg. However, performance, first cost, and resale value all differ, complicating any assessment. Other, more novel efforts such as increasing the Federal Government's teleconferencing capabilities appear to have both energy and nonenergy benefits in reducing some types of travel.

Several experimental programs with alternative fuels and vehicle designs are underway in Federal agencies. For example, the Interagency Fleet Management System currently operates 25 methanol flexible-fuel sedans, with 40 more to be placed into service in the near future. Also, a procurement for light trucks fueled by compressed natural gas is under way.

Savings Prospects in Other Operations

Because of the highly specialized nature of other operations energy use (primarily military mobility), examination of opportunities for energy and cost savings there are largely beyond the scope of this report. However, there are energy-saving activities and opportunities even in military mobility, although not performed primarily to save energy. For example, there are many flight simulators in use by the Department of Defense. They supplement actual flying time to allow for improved pilot training with greater safety and lower cost. Part of the cost savings results from greatly reduced fuel consumption (e.g., fighter aircraft may consume more than 1,000 gallons of jet fuel each hour). Similarly, there are simulators for surface vehicles such as tanks. Although the use of simulators increases electrical load, this is far more than offset by the reduction in petroleum consumption.

CONSTRAINTS TO IMPROVED FEDERAL ENERGY EFFICIENCY

How is it possible that large energy- and cost-saving opportunities remain untapped by the Federal Government? There is no single, simple explanation. However, there are several constraints to more effective energy efficiency efforts, some major and some minor.

Table l-l-Constraints on Improved Federal Energy Efficiency

Resource constraints
Priorities favor other agency needs
Energy efficiency is not central to most agencies' missions
Energy is a small component of most agencies' expenditures
Little senior management interest
Many measures require initial capital spending
Many measures require personnel
Many facilities have no energy coordinator
Information constraints
Opportunities have not been systematically assessed
Agencies are uncertain of technical and economic performance
Does this technology really work?
Would the facility be better off waiting for next year's model?
Lack of metered energy-use data
Too little information sharing between agencies
Energy-use decisions are dispersed, made by thousands of individuals
Implementation requires coordinated effort from diverse parties
Too little training and education for diverse parties
Lack of Incentives
Dollar savings often do not accrue to energy savers
Energy costs are readily passed through budgets
Federal procurement policies often favor status quo
Procurement practices are complex, often restrictive

SOURCE: Office of Technology Assessment, 1991.

Constraints to improved Federal energy efficiency can be grouped as either: 1) funding and personnel limitations largely reflecting energy efficiency's relatively low priority, 2) a lack of information about the available opportunities, or 3) incentives which do not encourage efficient energy management (see table l-l).

It is important to note that despite the constraints, there are many examples of highly motivated Federal employees who find ways to save energy and money for the government, and take advantage of whatever energy efficiency opportunities they can. Winners of the annual Federal Energy Efficiency Awards presented by DOE's Federal Energy Management Program are good examples. The best practices found in Federal facilities demonstrate that, although there are constraints to improving Federal energy efficiency, none are fundamental obstacles which cannot be overcome.

[9]This represents only a portion of the automobiles to be purchased in 1991. Also, note that the Corporate Average Fuel Economy requirement is 27.5 mpg.

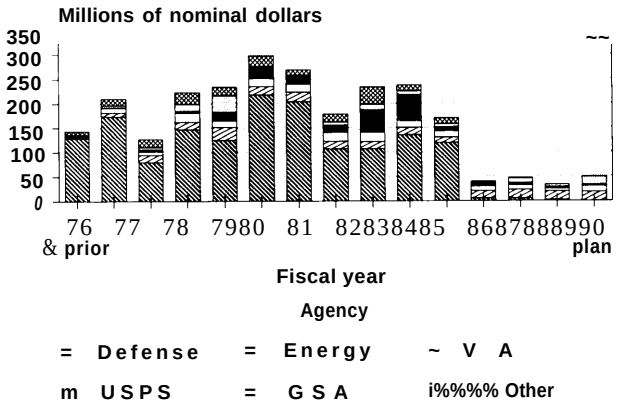
Resource Constraints

Adequate, stable funding is a common constraint to improved Federal energy efficiency. Many energy- and cost-saving projects such as replacing lamps and fixtures require a commitment of funding, including annual operating and maintenance costs or initial capital costs, or both. However funding for energy efficiency investment is often in short supply not only in the Federal Government, but in the private sector as well. Many energy efficiency projects have rapid paybacks of 3 years or less, representing a return on investment far higher than the Treasury's cost of funds. Despite these opportunities, Federal agencies have not sought and have not received a stable source of funding for even their most productive energy efficiency projects over the years, reflecting the low priority placed on energy efficiency. For example, the total capital budget earmarked specifically for energy efficiency projects in federally owned facilities dropped from a high of $297 million in 1981 to under $50 million in 1990, a decline of over 80 percent in nominal dollars (see figure 1-3).[10] Adjusted for inflation, the decline in conservation investments between 1981 and 1990 has been nearly 90 percent. That trend has begun to reverse, with GSA and DOD alone increasing their energy efficiency investments from under $7 million in fiscal year 1989 to $40 million in fiscal year 1991.

There are two main private sector supplements to direct Federal funding. Participation in utility rebate programs is one source of private sector funding which the Federal Government has recently begun exploring. In these programs, utilities encourage their customers to use more efficient devices or operating strategies, which can help the utility avoid the cost of building new powerplants. Utility programs may provide engineering expertise as well as funding. Prospects for increasing Federal participation in utility efficiency programs are excellent, with both utilities and the government benefiting.

Another private sector funding source is shared energy savings (SES) contracting, which has been promoted in the Federal Government since 1986. Under SES contracts, private companies use their own capital and personnel to perform energy efficiency improvements. Their services may include

Figure 1-3—Direct Federal Energy Efficiency Funding, Fiscal Years 1976-90



SOURCE: U.S. Department of Energy, Federal Energy Management Program, "Annual Report to Congress on Federal Government Energy Management and Conservation Programs, "fiscal years 1981-89; and "Federal Ten-Year Building Plan," DOE-CE-0047, September 1983.

energy audits, purchase and installation of new equipment, efficient operation and maintenance of equipment, and training of personnel. In exchange, the contractors receive a specified portion of the cost savings for a number of years. This system provides agencies a private-sector alternative to Federal funding and staffing for energy efficiency investments, although by sharing the savings, it reduces the government's total cost-saving potential (since those savings are shared).

Only four SES projects had been implemented by the end of 1990, representing a small fraction of the thousands of major Federal facilities. Federal agencies are becoming increasingly familiar with the SES approach and the program has been revised to provide expanded incentives for military facilities, but some implementation questions remain. Among them are whether current incentives are adequate to encourage greater use, and whether the contracts can be sufficiently simplified despite the need for terms such as the design of payment provisions tied to projected or actual energy savings and energy prices.

In addition to capital investment and at least as important, most energy- and cost-saving projects require a commitment of well-trained personnel. Personnel familiar with energy efficiency opportuni-

[10]Note that some energy efficiency projects maybe combined with major maintenance, so total efficiency spending is higher than this indicates. For example, when a roof needs repair, adding insulation is often part of the project, although the project is not labeled as an energy efficiency effort. Similarly, when a boiler fails and is replaced, use of a higher efficiency unit may be considered normal maintenance and not an efficiency investment.

ties are needed at all levels, from the operations crews at a facility to the decisionmaking management of the agency. As in the case of funding, qualified personnel are typically in short supply, reflecting the low priority placed on improving energy efficiency. Among the most important personnel for identifying, implementing, and following through on energy efficiency measures are energy coordinators at individual facilities or in regional offices. However, many Federal facilities have no explicit, trained energy coordinator. Energy efficiency projects, to the extent they are developed, are pursued in the spare time of facility staff. Typically, this staff is charged with other critical missions, such as maintaining and operating existing equipment. Often, they have many additional projects which they could pursue depending on priorities, ranging from addressing environmental and safety hazards such as transformers laden with PCBs and asbestos floor tiles to planning for new facilities.

Photo credit: Pacific Northwest Laboratory

Mobile energy laboratories provide expertise and equipment to assist energy efficiency efforts at Federal facilities.

Information Constraints

One obvious information constraint is the lack of coordinated, comprehensive estimates of both the potential energy and cost savings and the capital and other resources required to attain those savings in federally owned facilities and operations. Information about potential savings and costs is basic both for determining whether additional energy efficiency efforts are worthwhile and if so, for program planning and budgeting. The absence of basic, governmentwide information of this type appears to be a serious shortcoming in current Federal energy management efforts.

In contrast to the lack of information for federally owned facilities, HUD has produced estimates of the potential energy and cost savings as well as the investment required in HUD-assisted housing. HUD's studies provide a basis for internal HUD planning as well as congressional budget requests,

Uncertainty about the economic and technical performance of some energy efficiency technologies constitutes another information constraint. Does this technology really work? Would the facility be better off waiting for next year's model, which may have fewer bugs, cost less, and perform better? Since many energy efficiency measures are relatively new and not industry standard practice, these are eminently reasonable questions. Furthermore, the lack of detailed, metered data on energy use in Federal facilities complicates analysis of prospective measures and monitoring results of implemented measures. For example, some military bases may have only a few meters monitoring the energy use of thousands of buildings.

Uncertainty is at least partly in the mind of the user and can often be reduced through training and information sharing. Even well-demonstrated measures such as lights linked to occupancy sensors may be unfamiliar to a facility manager. Using any technology besides that which is already in place can entail some risk since no facility engineer wants complaints of inadequate lighting, or of buildings too hot in summer and too cold in winter. Nor do facility staff want to spend money and time unnecessarily on unproductive measures. Despite the wealth of diverse experiences with energy management techniques in Federal facilities, much more remains to be done to share the knowledge gained in those experiences.

The Federal procurement system often does not help reduce uncertainty. For example, for many commonly used items available through the Federal Supply System, there is little information comparing their life-cycle energy and economic characteristics. Similarly, facility engineers are given little information about the performance of light bulbs, which are supplied by DOD's Defense Logistics Agency. In contrast, GSA's Household Appliances Schedule, which includes products such as refrigerators, water heaters, and room air conditioners, lists items identified as having the lowest life-cycle cost. Often,

the only information on product performance is that provided by the vendors. A purchaser must be aware of the opportunities for energy savings, and be willing to dedicate time and effort to learning about the alternative products. In absence of awareness, time, and effort, purchasers may be expected to continue to use standard replacement products rather than new energy efficient equipment.

The large number and diversity of parties involved in energy-use decisions exacerbates information constraints two ways. First, for many energy efficiency projects, the activities of the diverse parties need to be carefully coordinated to ensure that project conception, design, budgeting, and implementation all take place. That involves a considerable flow of information about engineering, economics, funding, and staffing between a wide range of agency personnel. Second, education and training about the opportunities and performance of energy-efficiency measures must be diverse, reflecting the diverse information needs and perspectives. Developing appropriate education and training programs requires considerable effort. For example, boiler operators and mechanics need to be aware of the importance of maintenance programs, as well as the specific mechanical steps required for their boilers. Facility managers and agency management, on the other hand, do not need to know how boilers and other equipment work. However, to make appropriate manpower and budgeting decisions, they need to be aware of the importance of energy-related maintenance programs in minimizing operating costs of a facility.

Lack of Incentives

Neither rewards nor penalties have been widely and systematically used in the Federal Government to encourage energy efficiency. There are notable exceptions (e.g., GSA's bonuses for facility personnel), but generally, facility managers have neither rewarded nor penalized staffs; regional and headquarters offices neither rewarded nor penalized facilities; and Congress neither rewarded nor penalized agencies. The lack of incentives contributes to the low priority placed on energy efficiency. Recently enacted incentives for DOD facilities should greatly reduce this constraint, if properly implemented.

The complexity of the Federal Government's procurement system creates some disincentives to use of new energy- and cost-saving measures. Federal procurement is naturally complex, reflecting the diverse goals of the process. While the foremost goals are ''economy, efficiency and effectiveness,'' also included are socioeconomic development (e.g., for small, disadvantaged businesses), and efforts to promote competition and to protect against fraud and abuse. Together with the diversity of products and services noted above, the result is a complex system. Difficulties of identifying and then justifying the use of novel energy-efficient products and services can be a built-in disincentive to change.

POLICIES FOR FEDERAL ENERGY EFFICIENCY

Since the 1970s, both the executive branch and Congress have worked to promote energy efficiency within Federal agencies. Each new piece of legislation or program has combined past experience with new approaches in an effort to promote further efficiency gains in Federal agencies. Executive Order 12759, signed on April 17, 1991, is the most recent example of the ongoing Federal effort. Despite the array of programs developed over the past 15 years, the Federal Government still has many cost-effective opportunities to improve energy efficiency in its facilities and operations.

There are good reasons for Congress' continuing interest in Federal energy efficiency. The potential benefits include:

1. promoting use of energy efficient measures throughout the economy by demonstrating their cost and performance;
2. accelerating manufacturers' development of energy efficient technologies, again for use throughout the economy not just in the Federal Government;
3. learning first-hand which approaches work as a basis for national policy (e.g., while the Federal government is not entirely analogous to the private sector, many of the constraints on Federal energy efficiency and their solutions pertain to the private sector);
4. reducing Federal spending without reducing services; and
5. reducing energy-related environmental and security problems.

However, while the benefits of improved Federal energy efficiency can be great, there are costs as well. The effort involved can be considerable, requiring initial capital investment, allocation of staff, and the attention of Congress and senior executive branch personnel.

Options for Improving Federal Efficiency

Just as there is no single constraint explaining the failure to harness many opportunities, there is no single, simple policy that will ensure greater energy efficiency in the Federal Government. Fortunately, none of the constraints pose fundamental obstacles; rather, all can be addressed by a variety of initiatives. Some new initiatives involve simply making widespread use of the best practices found in individual facilities today.

Table 1-2 lists several options Congress could consider for Federal energy management. The default option, maintaining the status quo, will capture only a fraction of the potential gains. If Federal energy efficiency is viewed as worth pursuing more vigorously, dedicating resources to it in the form of staffing and investment funding is essential. Dedicating resources naturally entails initial costs, although those should be rapidly paid back by reduced energy costs. Several other potentially useful options such as setting standards of performance, revising procurement policies, and creating incentives for agencies and personnel require modest or negligible initial costs and are grouped here as encouraging agency efforts. Finally, promoting research, development, and demonstration can be useful not only in developing new energy efficient technologies, but for ensuring that current experiences translate into improved policies for the future.

Maintaining the Status Quo

Current Federal efforts together with a general improvement in the efficiency of HVAC and lighting equipment on the market should help to gradually improve Federal energy efficiency. However, the improvements will be only a fraction of the available cost-effective energy- and cost-saving measures. At the current low level of energy efficiency funding and staffing for individual agencies, it would take decades to make all the economically attractive investments. During that time, tens of billions of dollars would be unnecessarily spent to buy inefficiently used energy.

Table 1-2—Policy Options for Federal Energy Efficiency

Maintaining the status quo
Dedicating resources
Increasing funds for investment
Supporting an adequate staff: using money wisely
Encouraging agency efforts
Setting standards for performance
Rewarding agencies and individuals for energy and and cost savings
Revising procurement: information, life-cycle costing, and simplification
Following through and enforcing
Promoting research, development, and demonstration

SOURCE: Office of Technology Assessment, 1991.

Dedicating Resources: Higher Priority for Energy Efficiency

There are several billion dollars' worth of highly cost-effective energy-efficiency investment opportunities in federally owned and assisted buildings. Many of these measures have very high returns on investment, several times higher than the Treasury's cost of funds. It appears that a gradual increase in Federal investment at least to the level of the early 1980s could produce high returns for the foreseeable future. One novel method of funding which could be considered is a revolving loan fund. Also, to help ensure that funding levels are appropriate, the Federal Energy Management program could be required to provide estimates of the government-wide potential energy and cost savings and the capital investment required to attain those savings in its annual report to Congress.

Adequate funding alone is not enough to assure the greatest energy and cost savings for the Federal Government. It is at least as important to have a trained, competent, and motivated staff at individual Federal facilities, in central and regional agency offices, and in offices such as FEMP dedicated to successful implementation of energy-saving measures. As one step to ensuring appropriate staffing, Congress could require the agencies, the Office of Personnel Management, and FEMP to report on agency staffing (as well as investments) in FEMP's annual report to Congress. DOE's expertise in applying energy efficiency measures (e.g., the Institutional Conservation Program) could be a useful supplement to agency staff.

Encouraging Agency Efforts

Setting Standards--Some existing minimum standards or requirements for energy efficiency could be expanded. For example, Federal agencies are required by the Federal Energy Management Improvement Act of 1988 to reduce energy consumption in their existing buildings by 10 percent in 1995 relative to 1985. That requirement filled a void left when the energy-saving targets of Executive order 12003 lapsed in 1985. It is a modest goal, less by at least a factor of two than should be readily achievable using current commercial measures. Nevertheless, extending this requirement beyond 1995 together with a new minimum savings target based on life-cycle costs could help promote greater continuity in Federal energy efforts. Also, the standard could be expanded to include energy used in operations. The goals set by Executive Order 12759 provide agencies with valuable guidance. However, they are not based on an analysis of existing opportunities and could potentially be strengthened.

Creating Incentives--Creating more rewards for Federal agencies and for facility staff that successfully pursue energy-and cost-saving measures is one way to promote implementation of efficiency efforts. Although incentives for energy performance have been the exception rather than the rule in Federal facilities, the exceptions are useful models which could be more broadly applied. For example, the incentives for DOD facilities included in the National Defense Authorization Act for fiscal year 1991 could be expanded to other agencies. DOD's new incentives need to be monitored to ensure that they are being properly and fully implemented, and revised as necessary. Also, part or all of GSA's bonus program for facility personnel in its National Capitol Region may be worth replicating in other regions and other agencies. Key issues in establishing an incentive system include which facilities and personnel should be eligible for awards, the methods used to demonstrate that energy and cost savings actually occur, the amount of the awards, and in the case of agency incentives, possible restrictions on the use of incentive funds.

Revising Procurement--Some Federal procurement policies could be revised to encourage greater use of energy efficient products and services. There are several possible changes in the procurement system which may be worth considering. One possibility is to provide information on energy use characteristics of products provided to agencies by the Federal Supply Schedule Program, through the Federal Supply Catalog managed by GSA, and of the lighting products provided by the Defense Logistics Agency. A second possible procurement change is to increase the use of life-cycle costing when selecting goods and services ranging from light bulbs and ballasts to service contracts for HVAC equipment operation and maintenance. A third possibility is to simplify some procurement policies for new energy efficient products and services. This is particularly important since many energy efficiency measures are relatively new. For example, changing the regulations governing SES contracts to simplify them and increase agency flexibility may help promote that novel form of private financing of Federal efficiency measures.

Following Through and Enforcing--Finally, following through on Federal energy management programs is essential to achieving full energy- and cost-saving potential. Ongoing congressional attention helps raise the priority of energy efficiency efforts within Federal agencies. To further demonstrate ongoing interest, Congress could consider encouraging regular or occasional reports by inspector generals at the key agencies with most responsibility for Federal energy use and management.

Promoting Research Development

Continuing and possibly expanding research, development, and demonstration (RD&D) efforts is important to innovation and the practical application of new energy efficient measures. But even for economically attractive new commercial products, gaining consumer acceptance and widespread use both within the government and the private sector takes considerable time and could benefit from increased demonstration efforts and information sharing. Research into preferences and perspectives of facility managers can be useful in developing programs which best deliver energy- and cost-saving technologies. By demonstrating the cost and performance of efficient technologies and operating strategies to the maximum cost-effective potential in at least some of its own facilities, the Federal Government could help reduce the risk and uncertainty perceived by managers both in other Federal facilities and in the private sector.