

Setting Goals for Improving Energy Efficiency in Federal Facilities

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The Federal Government is the Nation's largest single energy consumer. The energy bill for Federal residential and commercial buildings in 1990 alone totaled \$4 billion. It is generally acknowledged that much of this energy is inefficiently used, and a variety of legislation and Executive Orders to improve efficiency have been instituted over the past two decades. However, the goals established in those laws have typically not been fully met.

Goals currently or previously in place include the following: 1) Each agency must reduce building energy consumption per square foot by 10 percent in 1995 relative to 1985, and by 20 percent in 2000; 2) Agencies must consider life-cycle costs when procuring major energy-using equipment; 3) All cost-effective measures must be implemented by 1990; and 4) Agencies were to perform surveys and estimate potential energy efficiency gains.

Congressional and Presidential goals for improving Federal energy efficiency serve the dual purposes of: 1) establishing priorities for agency energy efficiency efforts; and 2) providing a measure of the success of agency efforts. This paper examines different goals and their meaning in the face of challenges such as: 1) conflicts with other National goals (e.g., controlling the Federal deficit, which constrains capital for investment); 2) practical problems in implementation (e.g., complexity of performing life-cycle cost analyses); and 3) a lack of incentives to meet goals. Finally, the paper suggests some options which could make future goals more productive.

Energy Use in Federal Buildings

The Federal Government is the Nation's largest single energy consumer and building owner. In fiscal year (FY) 1990, it spent \$4.0 billion on energy in its own residential and commercial buildings (U.S. Department of Energy 1991). Over two thirds of the total was spent on electricity, with natural gas and fuel oil accounting for most of the rest (see Figure 1).

Federal buildings are highly diverse. The Federal Government owns around 500,000 buildings of various sizes, construction, and use in the United States with a combined floor area of about 2.8 billion square feet. Over 10% of these are commercial buildings with about 2 billion square feet of floor space (U.S. GSA 1990a; EIA 1988). Federal commercial buildings include offices, schools, retail shops, hospitals and other uses as shown in Figure 2. By far the largest Federal user of energy in commercial buildings is the Department of Defense (DOD), with about two-thirds of the total floor space. The Federal Government also owns over 420,000 housing units totaling about 0.7 billion square feet, primarily to house over 1.4 million military personnel and their families (OTA 1991). In

addition to federally owned buildings, the government leases about 7 percent of its floor space from private owners (U.S. General Services Administration 1990b).

Much of the energy in Federal buildings is used inefficiently and there are excellent opportunities for energy and cost savings. Although basic analyses have not been performed by the responsible Federal agencies, there is some indication that at least 25% and perhaps as much as 40% of Federal building energy could be saved using a wide variety of currently available, cost-effective measures (OTA 1991; Hopkins 1991; Currie 1992). Although there are important exceptions, Federal facilities have generally not taken full use of many proven energy efficient measures such as occupancy sensors that turn off lights when not needed, high efficiency lamps, ballasts, and fixtures. Careful operation and maintenance of heating, ventilating and air conditioning equipment, often with the aid of properly functioning energy management and control systems, could also improve efficiency and reduce costs.

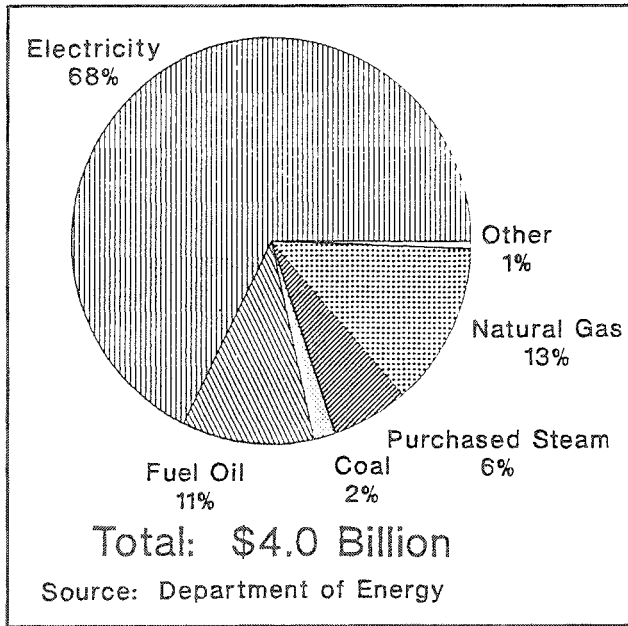


Figure 1. Federal Building Energy Codes - Fiscal Year 1990

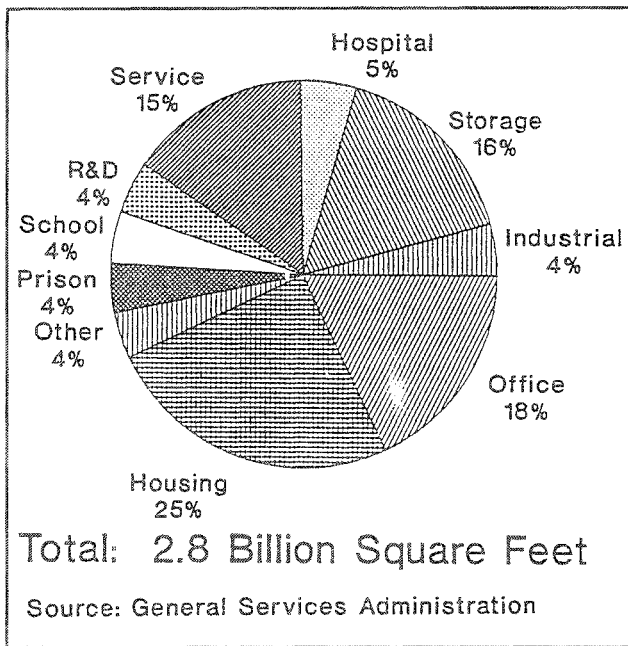


Figure 2. Use of Federal Buildings

Current Energy Efficiency Goals for Federal Facilities

Since the mid-1970s, Congress and the executive branch have promulgated several laws in the form of legislation and executive orders intended to improve Federal energy

efficiency. An important feature of these laws has been establishment of broad energy efficiency goals for Federal agencies to meet (e.g., a percentage energy reduction target).² These goals serve the dual purposes of: 1) establishing priorities and guidance for agency energy efficiency efforts; and 2) providing a measure of the success of agency efforts. The following sections describe current and past goals and the extent to which these goals have been met.

The approach of establishing goals in law for the Federal government to meet is common and certainly not unique to energy efficiency. One example of a notable goal outside the field of energy is that for the budget deficit (e.g., the Balanced Budget and Emergency Deficit Control Act of 1985, P.L. 99-177). That law set five year targets for Federal deficit reduction. Another example is the "Superfund" legislation (i.e., Comprehensive Environmental Response, Compensation, and Liability Act of 1980, as amended by the Superfund Amendments and Reauthorization Act of 1986). That law sets specific goals for the U.S. Environmental Protection Agency regarding the number and schedule of site assessments and environmental cleanup of hazardous substances.

What Federal Energy Efficiency Goals Have Been Established?

Four types of goals have recurred over the history of Federal energy efficiency efforts. They are: 1) percentage reduction targets for energy use, to be met however the agencies see fit; 2) economic optimization goals calling for agencies to assess and implement cost-effective measures; 3) goals specifying building design and construction standards agencies must follow; and 4) goals for performing surveys and estimating potential savings. Table 1 lists several examples of these goals set in law.

Percentage Reduction Targets. Executive order (EO) 12003 of July 20, 1977 was the earliest law establishing percentage reduction targets for Federal building energy use. That order directed agencies to achieve "to the maximum extent practicable" for existing Federal buildings a "reduction of 20 percent in the average annual energy use per gross square foot of floor area in 1985" relative to 1975. Responsibility for achieving this goal rested with the head of each agency, although the Administrator of the Federal Energy Administration was charged with developing basic procedures for all the agencies to follow. Also established was a goal that new buildings should have "a reduction of 45 percent in the average annual energy requirement" relative to average buildings in 1975.

Table 1. Major Federal Energy Management Laws

<u>Law</u>	<u>Goals Established</u>	<u>Level of Attainment by 1992</u>
EPCA 1975	Implement mandatory energy efficiency standards for procurement policies.	Energy considered in procurement of some consumer items.
	Implement energy conservation standards for Federal buildings, and plans for retrofitting to meet standards.	Interim standards for new buildings have been developed. No evidence that design and construction meets standards. No standards for existing buildings established.
EO 12003 1977	By 1985, 20% reduction in energy per square foot in existing buildings relative to 1975.	16.6% reduction attained by 1985.
	By 1985, 45% reduction in energy per square foot in new buildings relative to average buildings in 1975.	No evidence of having been met.
NECPA 1978	Energy Audits for existing large buildings by 1979.	Record of original audits often lacking; largely outdated.
	Life Cycle Cost (LCC) minimization for all new buildings.	Not met.
	Audits for existing buildings by 1980.	Record of original audits often missing; results largely outdated.
FEMIA 1988	LCC minimizing retrofits for all existing buildings by 1990.	Not performed. Requirement deleted from law by FEMIA, 1988.
	By 1995, 10% reduction in energy consumption per square foot for existing buildings relative to 1985.	Too early to tell. Trend from 1985-1990 is in wrong direction based on source accounting.
	Energy Survey of representative sample of existing buildings.	Not performed.
EO 12759 1991	By 2000, 20% reduction in energy consumption per square foot for existing buildings relative to 1985.	Too early to tell. Trend from 1985-1990 is encouraging using site accounting as specified.
	Base procurement of energy-related products on LCC.	Energy considered in procurement of some items.

Key:

EPCA: Energy Policy and Conservation Act, 1975, P.L. 94-163.

EO 12003: Executive Order 12003, July 20, 1977.

NECPA: National Energy Conservation Policy Act, 1978, P.L. 95-619.

FEMIA: Federal Energy Management Improvement Act, 1988, P.L. 100-615.

EO 12759: Executive Order 12759, April 17, 1991.

The Federal Energy Management Improvement Act of 1988 (FEMIA) updated the EO 12003 goal for existing buildings, calling for a 10% reduction in energy use per square foot of floor area in 1995 relative to 1985. Executive Order 12759 issued on April 17, 1991 extended the FEMIA goal to the year 2000, requiring a 20 percent reduction from 1985 levels.

*Optimal Economic Efficiency Goals*³. Federal energy goals stressing optimal economic efficiency have "life cycle cost" (LCC) analysis at their heart. LCC analysis is a systematic economic evaluation method which accounts for all costs during a product's "life cycle," including operating and maintenance costs as well as initial costs. The National Energy Conservation Policy Act of 1978 (NECPA) directed the Secretary of Energy to establish practical procedures for LCC analysis. The procedures are codified in 10 CFR 436 Subpart A, and described in Ruegg (1987).

NECPA required that "all new Federal buildings be life cycle cost (LCC) effective" and that "cost evaluation shall be made on the basis of LCC cost rather than initial cost." Similarly, all existing Federal buildings with more than 1000 square feet were to have been audited for LCC minimizing retrofits, and those retrofits were to have been implemented by January 1, 1990. Although NECPA assigned responsibility for developing LCC methods to the Secretary of Energy, responsibility for implementing the LCC requirements rested with each agency.

As required by NECPA and FEMIA, the application of LCC focuses on efficiency opportunities for the energy used in making a building habitable: that is, building shell and lighting, heating, ventilating and air conditioning equipment. EO 12759 of 1991 further requires procurement of energy-efficient products such as refrigerators, computers and copy machines by Federal agencies based on life-cycle cost. Previously, the Energy Policy and Conservation Act of 1975 (EPCA) required the President to revise procurement policies with respect to energy efficiency although the analyses and procedures to be used were not defined. Rather, EPCA set a very general goal of integrating energy efficiency considerations into basic and wide-ranging Federal practices (e.g., procurement) which incidentally effect energy use.

Design Standards for Buildings. EPCA directed the President to develop and implement "a 10-year plan for energy conservation" for Federal buildings including "mandatory lighting efficiency standards, mandatory thermal efficiency standards and insulation requirements, restrictions on hours of operation, thermostat controls and other conditions of operation, and plans for replacing or

retrofitting to meet such standards." EO 12003 directed the Administrator of the Federal Energy Administration to develop those standards. That responsibility was transferred to the newly created Secretary of Energy in 1977. Development of the standards for new buildings was a long time coming. DOE promulgated interim building energy performance standards (BEPS) for new residential buildings in 1988, and for new commercial and multi-family high rise buildings in 1989 (U.S. DOE 1988; U.S. DOE 1989).⁴ Standards for existing Federal buildings have not been developed.

Goals of Identifying Energy Efficiency Opportunities. EO 12003 required Federal agencies to conduct "to the maximum extent practicable" energy audits of all existing buildings with more than 5000 square feet of floor space. NECPA extended the requirement to all Federal buildings with more than 1000 square feet of floor space. This information was to support development of the 10 year energy efficiency plans and retrofit efforts noted above.

A decade after the audits required by EO 12003 and NECPA, Congress in passing FEMIA again sought to develop an information base on existing energy use and efficiency opportunities. It directed the Secretary of Energy to conduct an energy survey of "a representative sample of buildings owned or leased by the Federal Government..." to determine the maximum potential cost effective energy savings.

Are Federal Energy Efficiency Goals Met?

Most or all of the goals set over the past fifteen years for Federal energy efficiency improvement have not been met. In most cases, goals have lapsed partly met as summarized in Table 1. Failure to fully meet goals is not unique to Federal energy efficiency efforts. For example, efforts to meet budget goals set over the past decade have regularly fallen well short of the mark. Instead of attaining a balanced budget by FY 1991 as set out in the Balanced Budget and Emergency Deficit Control Act of 1985 the actual deficit was over \$300 billion dollars, considerably higher than in 1985.

Attainment of Percentage Reduction Targets. The 20% reduction target established in EO 12003 lapsed partly met in 1985. In 1985, Federal agencies reported a 16.6% reduction in building energy use per square foot relative to 1975 (U.S. DOE 1987b). (This reduction is calculated using the source, rather than the site accounting method. Source accounting had historically been emphasized in DOE reports prior to 1991.) The DOE annual reports for FY 1986 through 1991 do not address the

question of whether the 45% reduction target for new buildings has been met.

It is too early to forecast whether the 10% reduction target for 1995 established in FEMIA in 1988 or the 20% target set forth in EO 12759 in 1991 will be met.⁵ Initial evidence is mixed. Between 1985 and 1990, energy use per square foot actually increased by 1.9% using the historically emphasized "source" accounting method. There is some debate over the appropriate accounting method to use, however, as discussed below. Using the site accounting method, as DOE began emphasizing in 1991, energy use per square foot has declined by 5.4%, over half way to the 1995 goal.

Attainment of Economic Energy Efficiency Goals.

The retrofit of buildings to minimize LCC as required by NECPA passed largely unmet as evidenced by the large amounts of untapped efficiency potential remaining. No analysis has been performed by the agencies to estimate the level of attainment of this goal. Rather, DOE has noted various difficulties in determining how to define and track attainment (U.S. DOE 1987b), in part due to an inability to account for partial retrofits. For example, in many facilities, some but not all LCC retrofits were performed raising a question of whether or not to count that floor space as having met NECPA requirements.

Similarly, revision of procurement policies to promote LCC has been partially accomplished. Of the thousands of products available from the Federal supply system, a few have been chosen based on their life-cycle cost including household products such as refrigerators, water heaters, and room air conditioners listed on the General Services Administration's Household Appliances Schedule. For most other energy-using products such as lamps, agencies purchasing from the Defense Logistics Agency and the Federal Supply Service had been given little or no guidance as to life-cycle cost prior to FY 1992. Beginning in FY 1992, the Defense Logistics Agency (DLA), with the assistance of the General Services Administration, greatly expanded its support of Federal facilities considering use of energy efficient lighting products such as compact fluorescent lamps. To help familiarize Federal facility personnel with energy efficient lighting opportunities, DLA has established a toll-free telephone hotline to answer questions about energy saving lamps and distributes a special catalog called Energy Saver Bulbs (Defense General Supply Center 1991).⁶

Other procurement policies continue to impede use of novel methods to promote cost effective energy efficiency opportunities. For example, procurement policies have

constrained Federal facilities from participating in utility programs which cofund investments in energy efficient devices (utility rebate programs). Cumbersome procurement policies have also hampered efforts to use shared energy savings (SES) contracts. Even the Department of Energy (DOE) had still not brought an SES project to completion by the end of 1991, although one DOE facility (Lawrence Berkeley Laboratory) awarded a contract for one of its buildings. In total fewer than ten Federal SES contracts had been awarded government-wide by the end of 1991, 6 years after authorization by Congress (U.S. DOE 1991b). At least one of those contracts was later canceled. The use of SES to date covers only a minuscule fraction of the approximately 500,000 federally owned buildings. Efforts continue to improve SES procurement policies.

Attainment of Performance Standards for New Buildings.

DOE's development of the energy standards for new Federal buildings took over a decade after passage of EPCA. In the interim, standards developed by the American Society of Heating, Refrigerating and Air Conditioning Engineers and the Illuminating Engineering Society were used. DOE's annual reports on Federal energy management do not discuss the extent to which new Federal building design has met the standards. Nor do those reports discuss the extent to which energy standards in building design have been translated into actual construction, commissioning and operation.

Goals of Identifying Energy Efficiency Opportunities.

As of early 1992, analyses of the potential of energy efficiency opportunities in representative buildings have not been performed by DOE as required under FEMIA in 1988. Although there were audits performed in the late 1970s and early 1980s as required by NECPA and EO 12003, they are largely out of date and appear to provide little or no basis for current Federal energy management efforts.

Challenges to Establishing Meaningful Goals

Several factors confound efforts to establish meaningful, attainable goals which promote Federal energy efficiency. Among these are: 1) conflicts between energy efficiency and other Federal goals and agency missions (e.g., capital investment constraints related to Federal deficit limits); 2) practical problems in implementation (e.g., complexity of performing life-cycle cost analyses); and 3) a lack of incentives to meet goals.

Conflict Between Energy Efficiency and Other Federal Goals

Budget and Personnel Constraints. While the benefits of improved Federal energy efficiency can be great, there are costs as well. The effort involved can be considerable, in particular requiring initial capital investment and staffing and the attention of Congress and senior executive branch personnel. In any agency, investments of both money and personnel in energy efficiency opportunities have to compete with other Federal activities for priority. Agency budgets reflect the competing priorities between primary agency missions and other activities such as improving energy efficiency.

There is little disagreement that many highly profitable energy efficiency opportunities exist. However, the primary agency activities against which efficiency investments must compete are also typically presented as highly productive and in the national interest. The result is a conflict between the availability of funds and the broader national goal of controlling the deficit, which according to the Office of Management and Budget will reach nearly \$400 billion for FY 1992 (Office of Management and Budget 1992).

As is the case with funding, trained personnel are often in short supply in Federal agencies. In addition to capital investment, most energy- and cost-saving projects require a commitment of personnel familiar with energy efficiency opportunities. This expertise is needed not only in implementing energy efficient retrofits but also in simply using existing equipment efficiently. As noted in one National Research Council report (1990) on heating, ventilating and air conditioning systems, "[i]n some Federal facilities, as in some private buildings, systems receive almost no maintenance until something serious goes wrong. In Federal agencies, inadequate maintenance can be traced primarily to tight budgets and unrealistic personnel ceilings." The need for Federal expertise exists even if contractors perform the actual implementation rather than Federal employees. For example, Federal contract managers must have sufficient expertise to properly draft the contracts and monitor contractor performance.

Procurement Objectives. While the foremost goals of procurement are "economy, efficiency and effectiveness," (see 48 CFR 19, Oct. 1, 1983) also included are socio-economic development (e.g., for small, disadvantaged businesses), and efforts to promote competition and to protect against fraud and abuse. Together with the great variety of energy-related goods and services, these different goals make procurement policies complex. The

complexity of Federal procurement can result in a cumbersome or confusing process which impedes use of novel energy efficient goods and services, and application of LCC methods.

Goals Can Be Confusing to Apply and Interpret

Applying LCC Analysis. Applying life cycle cost analysis is inherently harder than simply minimizing first costs. It involves using forecasts of fuel prices, maintenance requirements, equipment performance and other factors for which reliable data are often lacking. Further, LCC analysis involves a host of calculations to combine these factors and also adjust for the time-value of money (e.g., preference for a dollar in hand today over a dollar next year). To familiarize Federal facility personnel with LCC analysis, DOE and the General Services Administration developed training courses on life-cycle cost methods as well as the evaluation tools to develop the basic input data needed. One example of the complexity of applying LCC analysis to building energy efficiency opportunities can be seen in ASEAM2. This DOE-sponsored microcomputer model simulates building energy use as needed for performing LCC calculations. According to some potential users of early versions of ASEAM2, "the fact that it resides on 16 floppy diskettes is somewhat intimidating" (Neve and Salthouse 1988).

Site or Source Energy Accounting for Percentage Targets. Even such seemingly clear goals as percentage energy use reductions can be subject to considerably different interpretations. As specified by DOE in the Federal Register (U.S. DOE 1979) when interpreting the percentage targets set in EO 12003, agency goals and reports have been based on both energy used at the source and energy used at the site.⁷ For a discussion of the benefits of source accounting, see Rosenfeld (1992) or Hopkins (1991). U.S. DOE (1979) provides support for the use of site accounting as well as source accounting.

The difference between site and source accounting is substantial since electricity is the major, but not sole, form of building energy (see Figure 2). For example, between 1985 and 1990, the Federal government's building energy use per square foot increased 1.9% using source accounting. However, using site accounting gives a far more favorable impression of agency efforts, showing a decline of 5.4% (U.S. DOE 1991a). DOE's reports have historically emphasized source accounting. Beginning in its FY 1990 report, however, DOE has begun to emphasize energy use based on site rather than source accounting (U.S. DOE 1991a). The report included no

explanation for the change. Consistent with that change, the goal set in EO 12759 is explicitly based on site accounting.

Given the substantial difference between the measures, a natural question is which should be used when setting percentage reduction targets? There are valid reasons in support of each accounting method, and either one can be used as a simple to understand metric. However, once a target is set, the choice of measure should consistently be applied. Thus, the goal established in EO 12759 should consistently be based on site accounting. Similarly, although FEMIA does not specify which measure to use, that law passed at a time when source accounting was considered the norm and emphasized in DOE reports. For this reason, source accounting seems most appropriate for use in judging whether FEMIA's 1995 goal is met.

How to Apply Building Energy Performance Standards. The mandatory BEPS for new Federal buildings established under EPCA provide another example of a goal which can be difficult both to interpret and to implement. Rather than prescribing design and construction practices, BEPS instituted a performance-based approach which was a "radical departure from standard practices of the building community" (U.S. DOE 1987a). One indication of the potential difficulty of applying BEPS is seen in the overwhelmingly unfavorable comments DOE received from the public when examining whether the mandated Federal standard should also be mandated for non-Federal buildings. The majority of those commenting noted the difficulty and expense of performing the energy and economic analyses required.

Lack of Incentives to Meet Goals

Neither penalties nor rewards have been widely used in the Federal Government to promote attainment of energy efficiency goals. There are notable exceptions, but generally, facility managers have neither rewarded nor penalized staffs for their energy efficiency performance; regional and headquarters offices neither rewarded nor penalized facilities; and Congress neither rewarded nor penalized agencies. For example, when the 20-percent reduction goal from Executive Order 12003 lapsed unmet in 1985, there were no apparent penalties.

Many agencies' headquarters or regional energy offices set targets for energy use at facilities to promote the long-term, energy-reduction goal required by FEMIA and EO 12759. But since there has been no systematic auditing of facilities' spending on energy nor the opportunities for

savings, these goals are assigned somewhat arbitrarily and it's difficult to justify enforcing them through use of penalties.

Can Goals Be Made More Useful?

Although often unmet, past goals for Federal energy efficiency appear to have been productive. For example, the 16.6% reduction in energy use per square foot (using source accounting) in 1985 relative to 1975, although falling short of the 20% goal, resulted in billions of dollars saved. There is some evidence that, although part of the savings may have occurred even absent the goal, the heightened awareness and attention made a more conducive atmosphere for efficiency efforts. In particular, shortly after the goal lapsed capital investment funding for energy efficiency projects plummeted by about a factor of four (see Figure 3). This drop occurred despite the enormous extent of remaining profitable opportunities for efficiency gains.

Still, the low level of attainment of previous energy management goals and the large remaining untapped potential suggest that goals could be made more useful. Among the opportunities for improvement based on the experience gained from past goals are: 1) linking the goals with the resources made available for meeting them (or committing the resources necessary to realize the goals); 2) creating incentives which encourage meeting goals; and 3) creating model facilities to improve the analytic basis of goals, making the goals not only achievable but also challenging.

Link Goals with Resources

Even with the most carefully set achievable goals and with the enthusiasm of management, meeting goals requires budget and personnel resources. There are several billion dollars' worth of profitable energy-efficiency investment opportunities in federally owned buildings (OTA 1991), as high as \$5 to \$10 billion by one expert estimate (Currie 1992). Put another way, meeting the goals of minimizing life cycle costs requires about 50 to 100 years' worth of activity at the rate of investment in FY 1991 (in which \$0.1 billion was spent on retrofits). The discrepancy between the goal and the resources applied to meet it is immense and reduces the credibility of the goal.

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 and in central and regional agency offices dedicated to successful

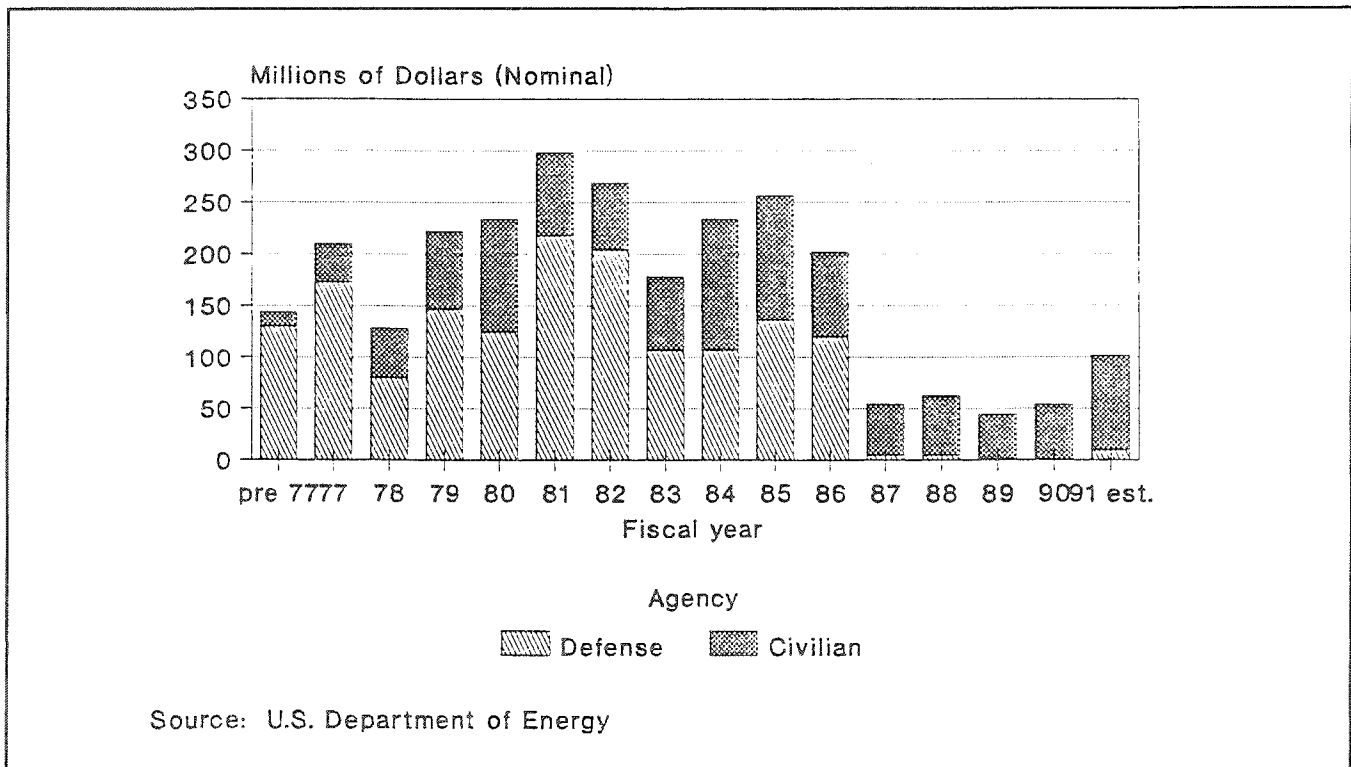


Figure 3. Direct Funding for Federal Energy Efficiency Investments

implementation of energy-saving measures. Minimizing risks while benefiting from commercial or forthcoming technologies requires a competent energy staff. Staff expertise is essential given that the applicability of many measures is site-specific and that some poorly performing products are often available along with the good.

Expand Incentives to Encourage Meeting Goals

Because energy is not central to most agencies' mission, and because energy costs are such a small component of most agencies total spending, energy efficiency naturally receives a relatively low priority. Creating incentives to encourage meeting goals is one way to raise priorities for energy 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 FY 1991 could be expanded to other agencies. DOD's new incentives need to be monitored to ensure that they are being effectively 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. These examples are discussed in more detail in OTA (1991).

Create Model Facilities to Improve Analytic Basis

The percentage energy reduction targets set by EO 12003, FEMIA and EO 12759 provide valuable guidance to the agencies and provide Congress and senior agency management with a measure of performance which is easy to apply. However, the targets are not based on an analysis of existing opportunities and could potentially be strengthened. For example, one expert assessment suggests a profitable potential of 40% or more reduction in Federal building energy bills (Currie 1992).

As required of DOE under FEMIA (but not performed to date), a survey of energy efficiency opportunities in Federal facilities could provide an improved basis for setting a target. The number of facilities surveyed and the

acceptable level of detail and accuracy need to be balanced against the cost and time required. Relatively simple, approximate analyses which are readily revised would provide an appropriate level of information to policy makers in allocating resources and cost far less to produce than detailed, site specific engineering audits. Implementing and monitoring all measures meeting minimum cost-effectiveness criteria in showcase or model facilities could help demonstrate the validity of the surveys. Examples of this type of demonstration which are partly underway can be found at the Army's Fort Hood in Texas and Fort Lewis in Washington (Secrest et al. 1991).

Endnotes

1. The author directed preparation of the report Energy Efficiency in the Federal Government (OTA 1991) upon which much of this paper was based. However, the views expressed in this paper are those of the author and not of the Office of Technology Assessment nor of the Technology Assessment Board.
2. Another important feature of the laws is to authorize certain activities e.g., allowing agencies to accept electric utility rebates for investment in efficiency measures.
3. There may be nonmonetary factors or externalities which can and should be included in economic analysis of the efficiency of energy use. Environmental and international security externalities are two examples of externalities resulting from energy use (see e.g., Ottinger 1990).
4. The building energy performance standards were made mandatory for new Federal buildings and voluntary for nonfederal buildings.
5. For a discussion of one agency's efforts and attainment for the FEMIA goal, see U.S. GAO (1992).
6. DLA's lamp hotline is 1-800/DLA-BULB [1-800/352-2852].
7. The distinction between site and source applies to electric energy use to account for efficiency losses in generation, transmission, and distribution. While each kilowatt-hour of electricity is equal to 3,412 Btus at the site, on average 11,600 Btus of fossil fuels are required to generate and deliver it. The source accounting system makes each unit of electric energy 3.4 times as important as each unit of fossil energy.

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