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Evaluation of the Plan to Conserve Energy in Federal Buildings through Retrofit Programs. EMD-78-2; B-178205. December 22, 1977. 14 pp.

Report to Secretary, Department of Energy; by Monte Canfield, Jr., Director, Energy and Minerals Div.

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Authority: Energy Policy and Conservation Act (P.L. 94-163). Department of Energy Organization Act (P.L. 95-91). Executive Order 11912. Executive Order 12003. OMB Circular A-94. Office of Federal Procurement Policy Letter 76-1.

Buildings consume about 39% of the total energy used by the Federal Government. Energy conservation in these facilities, therefore, is essential in any program to reduce the Government's use of energy. The Department of Energy (DOE) has developed a comprehensive plan to reduce energy use in existing Federal buildings through retrofit programs.
Findings/Conclusions: DOE's draft plan defines retrofit as changes made to a building or its equipment to increase energy efficiency. The plan proposes that each Federal agency owning or operating buildings: reduce energy consumption by 20% compared to 1975 consumption, perform retrofit surveys on all federally owned buildings by 1981, establish formal operating and maintenance guidelines for energy management, and prepare a 10-year plan for retrofitting existing buildings.
Recommendations: The Secretary of Energy should develop a method for evaluating and selecting projects which will account for benefits over a project's expected life and consider the time value of money; establish a procedure whereby proposed retrofit projects of all agencies will be centrally approved by DOE to ensure that only those projects generating the greatest benefits are funded; include a section in the plan requiring personnel developing bid packages to consider energy efficiency when purchasing or replacing building equipment; include a requirement for agencies to use the retrofit handbook developed by DOE for performing initial building surveys; develop specific procedures for agencies to follow to support the need for an Energy Management System; and develop a definition for retrofit projects to distinguish them from normal repair and alteration projects. (SC)

UNITED STATES
GENERAL ACCOUNTING OFFICE

Evaluation Of The Plan To Conserve Energy In Federal Buildings Through Retrofit Programs

Buildings consume about 39 percent of the total energy used by the Federal Government. Energy conservation in these facilities, therefore, is essential in any program to reduce the Government's energy use.

The Department of Energy has developed a comprehensive plan to reduce energy use in existing Federal buildings through retrofit programs. However, several areas should be further developed before it is submitted to the President for final approval, including:

--Better procedures and criteria for evaluating, selecting, and approving retrofit projects.

--Improved funding mechanisms for energy conservation retrofit projects.

--Improved procedures for evaluating Energy Management Systems.

--Better marketing and use of the retrofit handbook.

EMD-78-2

DECEMBER 22, 1977

UNITED STATES GENERAL ACCOUNTING OFFICE
WASHINGTON, D.C. 20548

ENERGY AND MINERALS
DIVISION

B-178205

The Honorable
The Secretary of Energy

Dear Mr. Secretary:

We surveyed the efforts of the Department of Energy (DOE), 1/ General Services Administration (GSA), Veterans Administration (VA), and U.S. Postal Service to conserve energy in Federal buildings and facilities by developing and implementing retrofit programs.

During our survey DOE received a draft plan from a contractor entitled "10-Year Plan for Improving the Energy Efficiency of Federal Buildings." The President directed DOE to develop this plan; it describes various proposals responsive to legislative and executive mandates affecting Federal buildings. We included as an integral part of our survey the retrofit portion of the plan because it discusses the concepts, objectives, and strategies the Government will pursue to make existing Federal Buildings energy efficient.

We understand the plan will be reviewed by other executive agencies and will then be submitted to the President for final approval. By evaluating the retrofit portion in the draft stage and bringing the results of our survey to your attention at this time, we hope to aid you in formulating policies and procedures in this area. We discussed this report with members of your staff and GSA, VA, and Postal Service officials. Their comments were included as appropriate.

1/Our work was actually performed at the Federal Energy Administration. Its programs and functions were transferred to the newly formed DOE, operational on October 1, 1977.

BACKGROUND

The case for retrofitting as a cornerstone of energy management in Federal buildings is compelling. The Government owns over 400,000 buildings which consume about 753 trillion British thermal units (Btu) of energy annually--about 39 percent of the Government's total energy use costing almost $1.7 billion. DOE predicts that, without energy use reductions, the Government's energy expenditure could easily double within the next 10 years. A retrofit program can minimize the impact of this virtually certain cost increase and, therefore, should be a major element of any overall program to reduce the Government's use of energy.

In December 1975 the Congress passed the Energy Policy and Conservation Act (Public Law 94-163) which requires the President to develop and implement a 10-year plan to reduce energy use in Federal buildings. In April 1976 Executive Order 11912 directed DOE to develop this overall plan and required each Federal agency to develop an individual energy conservation plan.

In April 1977 the President issued the National Energy Plan which called for the growth of energy demand to be restrained through conservation and improved energy efficiency. Parts of this plan were implemented on July 20, 1977, with the issuance of Executive Order 12003 which mandated certain energy conservation measures for Federal buildings and automobile purchases. The order greatly expanded DOE's authority for developing and implementing the "10-Year Plan for Improving the Energy Efficiency of Federal Buildings."

GAO EVALUATION OF THE RETROFIT PORTION OF THE 10-YEAR PLAN

DOE's draft plan defines retrofit as changes made to a building or its equipment to increase energy efficiency. DOE proposes to require that each Federal agency owning or operating buildings:

--Reduce energy consumption in existing buildings by 20 percent compared to 1975 consumption. This goal should be accomplished by 1985.

--Perform retrofit surveys on all federally owned buildings by the end of fiscal year 1981. After surveys are complete, funding, design, and construction of projects will begin.

--Establish formal operating and maintenance guidelines for energy conservation and management.

--Prepare a 10-year plan which covers retrofitting existing buildings. This plan is to be submitted to DOE within 6 months after the issuance of DOE guidelines.

--Submit data on its buildings and energy use with their plans, to be updated annually.

DOE's plan is very comprehensive and provides agencies detailed guidance for developing a retrofit program. Several elements of the draft plan are specially noteworthy:

--The plan requires that federally owned buildings 1/ be surveyed by September 30, 1981, to identify potential retrofit projects. We believe that a reasonable time frame to complete the survey is allowed and agency energy managers will have a list of retrofit alternatives from which to select.

--The plan requires that each agency submit its retrofit plans to DOE for review and approval. We believe that this requirement will provide a degree of coordination found lacking in current energy conservation measures of executive agencies.

--The plan establishes milestones for agencies to submit plans, survey buildings, and initiate conservation activities.

--The plan provides guidance and sample formats for agencies to use in reporting energy consumption, retrofit projects, and building inventory data. We believe that this will result in more accurate data and greater coordination.

1/Excludes buildings to be eliminated from the Federal inventory by 1983.

--The plan requires that each agency develop an equipment maintenance program which focuses on such energy intensive building equipment as heating, ventilating, and air conditioning systems. We believe that this is a particularly important aspect of the plan because proper maintenance of such equipment can save considerable energy.

--In connection with the 10-year plan, DOE prepared a retrofit handbook to assist agency managers in conducting building surveys and identifying retrofit projects. We believe that the manual can be used for initial building surveys, thereby eliminating some of the costs of having private consultants perform these surveys.

In our opinion, these elements represent sound planning concepts for achieving energy conservation objectives in existing buildings that should not be compromised during review and final approval of the plan. However, we identified the following issues that should be addressed or expanded on in the overall plan:

--Better procedures to evaluate and select retrofit projects.

--Central approval and funding for retrofit projects.

--Considering energy efficiency when purchasing or replacing equipment.

--Better marketing and use of the retrofit handbook.

--Improvements in evaluating Energy Management Systems (EMS).

--Criteria to distinguish retrofit from normal repair and alteration projects.

Better procedures to evaluate and select retrofit projects

DOE's plan lacks specific criteria and procedures for agencies to follow in evaluating and selecting retrofit projects. Some agencies are using a project's payback period (calculated by dividing a project's cost by its annual cost avoidance) as a basis for selecting retrofit projects for funding. Generally, projects with the shortest payback

periods are funded. This method is incomplete because benefits during a project's complete life and the time value of money are not considered. 1/

Differences in expected economic lives of projects can greatly affect the total level of benefits to be achieved and projects' benefit-cost ratios. For example, consider three projects to conserve natural gas, each with the same investment cost ($600,000) and the same annual benefits ($100,000) but with economic lives of 6, 14, and 22 years, respectively. Using a 10-percent discount rate and an 8-percent differential fuel cost-escalation factor, it can be shown that the benefit-cost ratios for these projects are 1/1, 2/1, and 3/1, respectively. The payback method, however, makes no allowance for different economic lives; thus, these projects will all have the same annual savings, investment costs, and consequently, payback period.

The methods we observed agencies using to evaluate and select projects are also inconsistent with Office of Management and Budget (OMB) Circular A-94 because discounting to present value and differing lengths of project economic life are not included. Circular A-94 requires an agency to use discounting of benefits and costs when its programs or projects commit the Government to costs or benefits extending 3 or more years. Most energy conservation projects will have benefits extending beyond the time stated in the circular.

Recently, in Executive Order 12003, the President reinforced the use of economic analysis concepts, as set forth in Circular A-94, for making decisions on which retrofit projects to fund. This order requires DOE to develop a method, consistent with Circular A-94, for estimating and comparing life cycle capital and operating costs for energy conservation projects in Federal buildings. How agencies are to use economic analysis to evaluate and select retrofit projects remains vague. We believe that DOE's 10-year plan should state precisely how economic analysis is to be used in the decisionmaking process and, as part of its management control mechanism, insure that agencies are doing so properly.

VA program officials believe that benefit-cost analysis requires making assumptions about future energy prices, the accuracy of which cannot be verified. Consequently, they believe a better evaluation method is to calculate the

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1/The time value of money is the difference between the value of a dollar today and its value at some future point in time if invested at a stated rate of interest.

investment cost per million Btu saved annually per project. DOE officials responsible for developing the plan also consider benefit-cost analysis unnecessarily complex. They stated that during the program's first years, many projects that would save energy could be readily identified, and therefore, no need would exist for sophisticated analysis.

We disagree with the views of these officials. We believe that the requirements in Circular A-94 and Executive Order 12003 which emphasize the necessity for an economic analysis of energy projects are sound. Evaluation methods, including benefit-cost analysis, typically rely on estimates for benefits, costs, economic life and, as VA pointed out, future energy prices. While it is never possible to precisely predict future energy costs, we believe that reasonably accurate estimates can be made. Title VIII of the Department of Energy Organization Act (Public Law 95-91) requires DOE to evaluate and develop projections of foreseeable trends in energy prices. Such projections should be used by all Federal agencies to insure consistent treatment of this important element when evaluating and selecting retrofit projects.

Regarding VA's comment about using project investment cost per million Btu saved as a method for evaluating projects, we believe that the decisionmaking process should highlight the value of energy savings. Computing the investment cost per million Btu saved does highlight energy saving effectiveness by relating the annual energy saved to the project's investment, but it does not account for the differing costs of energy forms or the value of benefits received from projects with different life expectancies.

In summary, we support the use of benefit-cost analysis because of its completeness in considering all benefits and costs over a project's expected life, and we believe that DOE should include in the 10-year plan provisions for agencies to use this method in evaluating and selecting retrofit projects.

Central approval and funding for retrofit projects

Each agency is currently responsible for evaluating and selecting retrofit projects identified as a result of surveys at its buildings. This procedure does not insure from a national, interagency standpoint that those retrofit projects which will result in the greatest total benefits will be funded first. A comparison of the projects of two agencies

revealed several instances where one agency was funding projects which saved less energy than projects which were not funded by the other agency.

The DOE draft plan establishes a mechanism for gathering data on agency retrofit projects. The plan does not, however, clearly state how this information will be used. Furthermore, it fails to indicate that an effort will be made to centrally review and approve agency projects. Consequently, unless the plan is modified we believe that optimum use will not be made of the limited funds that are available for retrofitting Federal buildings to make them more energy efficient.

In addition, DOE's plan does not require agencies to dedicate funds for retrofit projects. Two of the three agencies surveyed lacked such provisions, and funds designated for energy conservation were used for projects in other areas.

In GSA, for example, most retrofit funds are included in the repair and alteration budget category. This line item also includes funds for other programs such as high-rise fire safety, projects for the handicapped, and space alteration projects. Although GSA's budget documents specifically identify funds for energy conservation retrofit projects, this money can be used for other purposes once allocations are made to field offices. Regional officials can reprogram funds for all projects under $100,000 without headquarters approval. GSA Region IX officials said that funds from the energy conservation area were reprogramed to other repair and alteration categories.

They emphasized that the authority to reprogram repair and alteration funds gives field managers flexibility in responding to changes in priorities. However, we believe that such flexibility will continue to result in funds identified for energy conservation projects being reprogramed into other areas and, thus, a loss of control over the energy conservation program by responsible agency managers.

We believe that a procedure should be incorporated into the plan which requires that all agency retrofit projects be centrally approved by DOE. We also believe that retrofit program funds should be controlled to prevent their use for other purposes. This could be accomplished by having all retrofit program funds appropriated to DOE, which could then allocate these funds to projects throughout the Government. Another method for controlling program funds would be to require agencies to identify and dedicate within their budgets specific funds for energy conservation retrofit projects.

Although not as effective as centralized funding, dedicated agency funding can provide a greater degree of control than currently available.

Considering energy efficiency when purchasing or replacing equipment

Air conditioners, boilers, and fans are large energy users in most buildings. In August 1976 the Office of Federal Procurement Policy issued Policy Letter 76-1 which indicated that Federal agencies should consider energy efficiency in all procurements. Neither the DOE draft plan nor the agency plans we surveyed addressed this important point. Consequently, procurements may be based primarily on initial cost without considering the equipment's energy efficiency.

For example, a chiller, the cooling device of an air conditioning system, was recently purchased for a Federal office building in Los Angeles. An engineering firm hired to develop the building energy profile reported that the new chiller used about 57 percent more energy than the unit it replaced.

A method that can be used for insuring that energy efficiency is considered when purchasing or replacing equipment is life cycle costing--a technique for evaluating the total cost of a product over its useful life. This analysis includes initial cost plus the present value of all costs associated with owning and operating the equipment such as energy, maintenance, and repair costs and estimated salvage value. The following chart shows how life cycle costing could have been used to purchase a more energy efficient chiller than the unit discussed above.

	Relative Chiller Efficiency		
	Chiller		
	A	B	C
Chiller size (tons)	500	500	500
Design efficiency (kW/tons)	.632	.752	.890
Annual energy use (kWh) (note a)	577,504	646,341	714,034
Annual energy cost ($.03/kWh)	$ 17,325	$ 19,390	$ 21,421
Present value of operating costs (note b)	$225,102	$251,932	$278,321
Purchase price	$ 59,910	$ 53,480	$ 57,960
Life cycle cost	$285,012	$305,412	$336,281

a/Annual energy use based on operating data provided by GSA, Region IX.

b/Present value operating costs based on a 15-year economic life, 10-percent discount rate, 8-percent energy escalation rate, and no salvage value.

Chiller C, the least efficient, requires almost 24 percent more energy annually than chiller A, the most efficient. Additionally, over its 15-year life, the least efficient chiller will cost the Government over $50,000 more than the most efficient unit.

Although Executive Order 11912 gave the Office of Federal Procurement Policy responsibility for establishing procurement policy with respect to equipment efficiency, we believe that the DOE and agency retrofit plans should also emphasize this point. The plans should require procurement specialists to consider energy efficiency when purchasing or replacing building equipment by using life cycle costing. This would not only insure increased energy savings but also increased value for the procurement dollar.

Better marketing and use of the retrofit handbook

DOE has developed a handbook to aid in identifying and evaluating retrofit projects, but we found that it has been inadequately distributed and that DOE's draft plan lacks a requirement for agencies to incorporate its use into their retrofit programs. Agencies we contacted were hiring consultants to perform initial building surveys; having in-house staff perform these surveys, using the retrofit handbook developed for this purpose, was not considered. Using consultants will be a costly and time-consuming process. For example, VA plans to hire consultants to perform surveys in 100 health care facilities, estimated to take 3 years and to cost $1.2 million.

The retrofit handbook may not enable agency staffs to identify all the projects trained consultants might find, but it was intended to be used in performing initial building surveys. Moreover, the handbook should enable building managers to identify many retrofit projects almost immediately at little or no additional cost to the Government.

DOE appears to have done a good job of distributing the handbook to agency headquarters staffs but not to the regions. For example, GSA sent a copy of the handbook to each of its regional offices. In Region IX, however, building managers and their staffs responsible for using the manual had never even seen it. GSA's regional coordinator said that the handbook was not distributed throughout the region because only one was available. GSA officials also said that DOE had made no attempt to encourage the use of the handbook in the region.

DOE Region IX officials had a copy of the handbook, but they told us it had not been distributed and no efforts were being made to encourage agencies to use it.

DOE headquarters officials felt that they lacked sufficient authority and funding to require that agencies use the handbook. This matter should be addressed in the 10-year plan. Namely, the plan should require agencies to perform in-house building surveys and use consultants selectively. The retrofit handbook should be promoted as one method to accomplish this requirement. Also, DOE's regional offices should actively market the handbook through demonstrations to local agency officials.

Improvements in evaluating Energy Management Systems

An Energy Management System (EMS) can be described as equipment that monitors and/or controls energy use for one or a group of buildings to conserve energy and reduce costs. These systems offer potential as a retrofit action, and several agencies are considering this technology.

DOE's draft 10-year plan requires that agencies evaluate their buildings to determine simple energy conservation measures before considering installing an EMS. For purposes of reviewing agency plans which include an EMS, the plan states that DOE will assume that a preliminary evaluation was made and that savings estimated for the system include no savings achievable through simpler, less costly measures. In our opinion, such an assumption is unwarranted.

For example, in a March 1977 letter to the Department of Defense, we pointed out several weaknesses in the Department's purchase and operation of the systems. Specifically, the Department was

--procuring them without adequate competition;

--failing to plan and coordinate their purchase, to take advantage of joint system use and avoid unnecessary duplication; and

--funding them with energy conservation funds even though most of the savings justifying the purchases were not energy related.

We suggested that (1) further purchase of the systems be deferred until the Department could prepare adequate procurement and use guidelines and (2) systems not primarily used for conserving energy should not be purchased with Energy Conservation Investment Program funds.

DOE, through interagency agreements, has funded several EMS demonstration projects. We found no evidence in the agreements or related documents that the facilities in which these systems were to be installed were surveyed to determine if simpler, less costly measures were available to achieve the same energy savings. Some of the problems found at the Defense Department may be applicable to DOE-funded projects. For one such project, almost 60 percent of the dollar savings justifying the system would be derived from such nonenergy-related areas as reduced personnel. On another project,

6 of the 10 benefits listed were not energy related. Although these projects may be desirable, we believe funds intended specifically for energy conservation should not be expended on projects which result in primarily nonenergy-related benefits.

In view of these problems, we believe that DOE should not assume that agencies are performing adequate building surveys and evaluations before installing these systems. Instead, the 10-year plan should specify procedures for agencies to follow in justifying and purchasing the systems. When reviewing agency plans, DOE should also insure that these procedures are included. When DOE participates in decisions to fund systems, the detailed evaluations should be reviewed to insure that all alternatives have been considered and cost savings associated with energy reductions are clearly identified.

Criteria to distinguish retrofit from normal repair and alteration projects

Agencies used energy conservation funds for many projects which, although they may save energy, appeared to be normal repair and alteration projects. Neither the 10-year plan nor the agencies' internal guidelines specify the categories under which projects should be funded. Without such criteria, energy conservation funds may be used for normal repair and alteration projects.

For example, GSA's fiscal year 1978 retrofit program included numerous projects which appeared to be normal maintenance or repair and alteration: boiler replacement, new fuel tanks, window replacement and repair, extension of heating lines, and conversion to steam heat. Projects such as these accounted for over 17 percent of the $11 million in retrofit funds programed for that year. GSA officials said that many of these projects were planned before the energy conservation program. They added that a system was being developed to separate energy conservation from other types of projects.

Some of the projects may save energy, but we believe that they should be considered normal maintenance and repair. We found no evidence to suggest that the equipment was being installed solely to save energy; rather, it was being replaced because it was old and no longer worked properly. Section 431(4) of the Energy Conservation and Production Act (Public Law 94-385) contains a comprehensive definition of an energy conservation measure. We believe that DOE's plan should contain a similarly detailed definition of a retrofit measure, which includes specific criteria for distinguishing retrofit from repair and alteration projects.

CONCLUSIONS AND RECOMMENDATIONS

Between fiscal years 1973-76, energy consumption in Federal buildings and facilities had been reduced by over 146 trillion Btu--a 16-percent reduction during the 3-year period. Much of this saving accrued from such short-term, low-investment type projects as reducing lighting levels, adjusting thermostats, and changing building operating hours. However, future energy reductions will require proper planning and much larger capital investments.

We believe that the draft plan DOE has prepared for Federal agencies to follow in developing and carrying out retrofit programs in their buildings and facilities is very comprehensive and will assist agencies in developing satisfactory programs. However, several areas should be improved before the plan is submitted to the President for final approval. Accordingly, we believe that DOE should incorporate the following items into the retrofit portion of the "10-Year Plan for Improving the Energy Efficiency of Federal Buildings."

We recommend that you:

--Develop a method for evaluating and selecting projects which will account for benefits over a project's expected life and consider the time value of money. An analysis, such as the one required by OMB Circular A-94, should be made for each proposed project requiring retrofit funds.

--Establish a procedure whereby proposed retrofit projects of all agencies will be centrally approved by DOE. This procedure should insure that only those projects generating the greatest benefits are funded. You should also obtain better control of program funds by (1) seeking legislation which provides that all funds for executive branch energy conservation retrofit projects be appropriated to DOE or (2) requiring agencies to identify and dedicate within their budgets funds for energy conservation retrofit projects.

--Include a section in the plan requiring personnel developing bid packages to consider energy efficiency when purchasing or replacing building equipment. The life cycle costing techniques could be employed.

--Include a requirement for agencies to use the retrofit handbook developed by DOE for performing initial building surveys. Also, involve DOE

regional offices in the retrofit handbook marketing effort through, for example, demonstrations at the regional Federal Executive Board meetings.

--Develop specific procedures for agencies to follow to support the need for an EMS. When reviewing agency plans, DOE should insure that these procedures are included. When DOE participates in decisions to fund these systems, the detailed evaluations should be reviewed to insure that all alternatives have been considered and cost savings associated with energy reductions are clearly identified.

--Develop a definition for retrofit projects, to distinguish them from normal repair and alteration projects.

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We appreciate the cooperation of the DOE staff with whom we dealt during our survey and shall appreciate being advised of the actions taken on the matters discussed in this report.

As you know, section 236 of the Legislative Reorganization Act of 1970 requires the head of a Federal agency to submit a written statement on actions taken on our recommendations to the Senate Committee on Governmental Affairs and the House Committee on Government Operations not later than 60 days after the date of the report and to the House and Senate Committees on Appropriations with the agency's first request for appropriations made more than 60 days after the date of the report.

We are sending copies of this report to the four committees mentioned above and to the chairmen of energy-related congressional committees. We are also sending copies to the Acting Director, Office of Management and Budget; the Administrators, General Services and Veterans Affairs; and to the Postmaster General.

Sincerely yours,

Monte Canfield, Jr.
Director