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ENERGY CONSERVATION IN BUILDINGS

GOVERNMENT

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HEARINGS BEFORE THE SUBCOMMITTEE ON PUBLIC BUILDINGS AND GROUNDS OF THE COMMITTEE ON PUBLIC WORKS AND TRANSPORTATION HOUSE OF REPRESENTATIVES

NINETY-FOURTH CONGRESS

SECOND SESSION

ON

H.R. 14415

TO ESTABLISH IN THE ENERGY RESEARCH AND DEVELOPMENT ADMINISTRATION A PROGRAM OF RESEARCH, DEVELOPMENT, AND DEMONSTRATION DESIGNED TO PROMOTE ENERGY CONSERVATION FOR RESIDENTIAL, COMMERCIAL, AND INDUSTRIAL BUILDINGS AND DEVELOP METHODS FOR CALCULATING LIFE CYCLE CAPITAL AND OPERATING COSTS RELATING TO ENERGY CONSUMPTION FOR SUCH BUILDINGS; AND TO PROVIDE THROUGH THE GENERAL SERVICES ADMINISTRATION FOR THE DEMONSTRATION OF ENERGY CONSERVATION TECHNOLOGY AND EQUIPMENT IN FEDERAL BUILDINGS

AUGUST 9 AND 10, 1976

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CONTENTS

	Page
H.R. 14415: To establish in the Energy Research and Development Administration a program of research, development, and demonstration designed to promote energy conservation for residential, commercial, and industrial buildings and develop methods for calculating life cycle capital and operating costs relating to energy consumption for such buildings; and to provide through the General Services Administration for the demonstration of energy conservation technology and equipment in Federal buildings.....	1

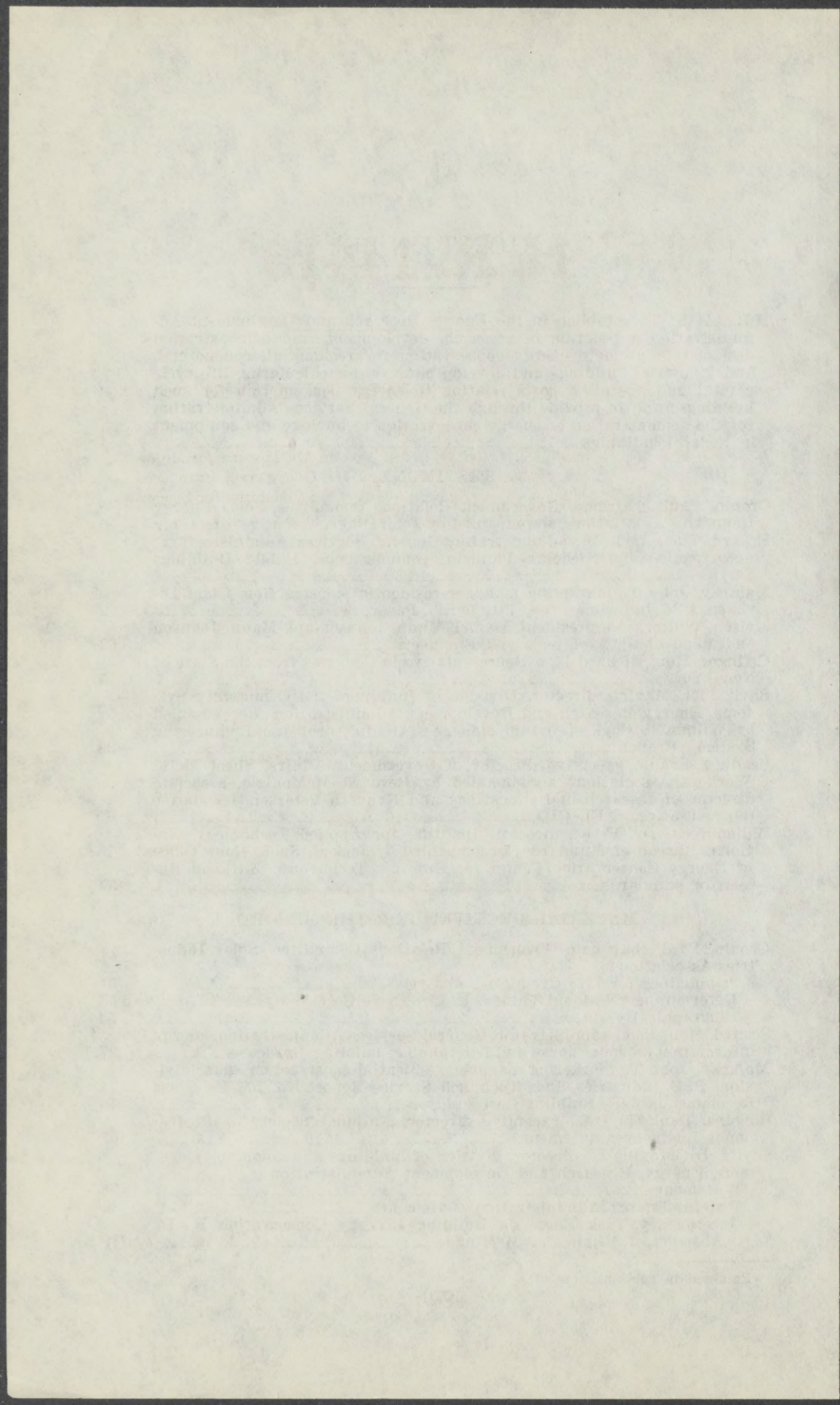
TESTIMONY

Cronin, Paul, chairman, Government Relations Committee, Solar Energy Industries Association; accompanied by John Blake, executive director...	50
Eckerd, Hon. Jack M., administrator, General Services Administration; accompanied by Nicholas Panuzio, commissioner, Public Buildings Service	21
Malarky, John T., marketing manager residential construction, Glass Division, PPG Industries, Inc., Pittsburgh, Pa.....	72
Meisen, Walter, vice president, Daniel, Mann, Johnson and Mann, Johnson and Mendenhall, Architects and Engineers.....	62
Ottinger, Hon. Richard L., a Representative in Congress from the State of New York.....	15
Savitz, Dr. Maxine, director, Division of Buildings and Community Systems, Energy Research and Development Administration; accompanied by Wilbur T. Coyle, program manager, Architectural and Engineering Systems Branch.....	28
Scaduto, Frank, executive director of Government Affairs, Sheet Metal Workers Association; accompanied by Bernard McMonigle, associate director of research and education; and Kenneth Peterson, legislative representative, AFL-CIO.....	67
Willenbrock, Dr. F. K., director, Institute for Applied Technology, National Bureau of Standards; accompanied by Jack E. Snell, chief, Office of Energy Conservation Center for Building Technology, National Bureau of standards.....	39

MATERIAL RECEIVED FOR THE RECORD

Cronin, Paul, chairman, Government Relations Committee, Solar Industries Association:	
"Guidelines for Life Cycle Cost Analysis".....	51
Determining "National Values" in Life Cycle Cost Analysis.....	53
Biographical Data.....	54
Eckard, Hon. Jack, administrator, General Services Administration, energy information on court house and federal office building, Syracuse, N.Y....	27
Malarky, John T., marketing manager residential construction, glass division, PPG Industries, Inc., Technical Service Report No. 105-B—Glass Recommendations, Building Cost Analysis.....	79
Robbins, Paul H., P.E., executive director, National Society of Professional Engineers, statement.....	101
Savitz, Dr. Maxine L., director, division of buildings and community systems, Energy, Research and Development Administration:	
Statement	28
Federal Energy Administration, statement.....	32
Interagency Task Force on Buildings Energy Conservation R+D, Abstract of Minutes of Meetings.....	(¹)

¹ Retained in subcommittee files.



FINDINGS

SEC. 2. The Congress hereby finds that—

(1) our domestic reserves of petroleum and natural gas are rapidly being depleted;

(2) the rate of depletion of these reserves can be reduced by energy conservation programs;

(3) the space heating and air-conditioning of buildings accounts for more than 20 per centum of our total domestic energy consumption;

(4) some energy conservation technologies are less capital-intensive and have lower life cycle costs than many energy production technologies;

(5) there is an urgent need for a Federal program to promote approaches in design, construction, and maintenance of buildings that will make more efficient use of fuels and energy;

(6) programs for energy conservation in buildings will stimulate industries and create job opportunities for supplying and servicing new or improved energy conserving systems and equipment;

(7) the stimulation of such industries can be facilitated by using Federal buildings to provide an initial market for these new or improved systems and services; and

(8) incorporation of energy conservation features

1 in private construction can be promoted by the develop-
2 ment and demonstration of new analytical methods to
3 establish and compare capital and operating costs of
4 buildings with and without these features.

5 POLICY

6 SEC. 3. The Congress therefore declares it to be the
7 policy of the United States that—

8 (1) it is in the national interest to increase the
9 efficiency of utilizing fuels and energy in residential,
10 commercial, and industrial buildings; and

11 (2) the Federal Government should develop, dem-
12 onstrate, and promote the use of energy conservation,
13 solar heating and cooling, and total energy systems in
14 Federal buildings.

15 TITLE I—RESEARCH, DEVELOPMENT, AND
16 DEMONSTRATION

17 CALCULATION OF ENERGY-RELATED LIFE CYCLE COSTS OF
18 BUILDINGS

19 SEC. 101. (a) The Administrator of the Energy Re-
20 search and Development Administration (hereinafter in this
21 title referred to as the "Administrator") shall promptly
22 initiate and carry out a program for the development and
23 demonstration of methods to calculate life cycle capital and
24 operating costs related to energy consumption for residen-
25 tial, commercial, and industrial buildings. The methods so

1 developed shall be suited for calculating such costs, in the
2 case of any building, both with and without the inclusion
3 of special features for energy conservation, solar heating or
4 cooling or both, and total energy systems.

5 (b) As a part of the program under subsection (a), the
6 Administrator shall disseminate such information, make
7 available such technical advice, and take such other actions
8 as will promote the widespread use and acceptance through-
9 out the economy of the methods developed under such
10 program.

11 DEVELOPMENT OF IMPROVED OR NEW ENERGY

12 TECHNOLOGIES

13 SEC. 102. (a) The Administrator shall promptly ini-
14 tiate and carry out a program for the development of im-
15 proved or new technologies in energy conservation, solar
16 heating and cooling, and total energy systems designed to
17 increase the efficiency of utilization of fuels and energy in
18 the operation of residential, commercial, and industrial build-
19 ings. Such program shall include (but not be limited to)
20 consideration of the feasibility of developing coal furnaces
21 more consistent with environmental standards, improving the
22 efficiency of existing furnaces, and utilizing geothermal and
23 waste heat.

24 (b) The program under subsection (a) shall be con-
25 ducted in a manner consistent with, and in conjunction with,

1 the programs and activities being carried out under the Solar
2 Heating and Cooling Demonstration Act of 1974 (Public
3 Law 93-409), the Geothermal Energy Research, Develop-
4 ment, and Demonstration Act of 1974 (Public Law 93-
5 410), and the Federal Nonnuclear Energy Research and
6 Development Act of 1974 (Public Law 93-577).

7 (c) As a part of or in connection with the program
8 under subsection (a), the Administrator may cooperate or
9 act jointly with the Administrator of the General Services
10 Administration in the demonstration of improved or new
11 technologies for the express purpose of reducing the use of
12 fuels and energy in the operation of Federal buildings, and
13 in so doing may pay or assist in the payment of the initial
14 incremental capital or operating costs (or both) of such
15 buildings for such times and in such amounts as he may deem
16 appropriate for the purpose of the demonstration, taking
17 into account the potential advantages of the improved or new
18 technologies to be demonstrated.

19 DESIGN AND RENOVATION OF FEDERAL BUILDINGS

20 SEC. 103. (a) The Administrator, under appropriate
21 arrangements with the Administrator of General Services and
22 other Federal officials, may participate in the preliminary
23 design of selected new Federal buildings and the renovation
24 of selected existing Federal buildings for the purpose of assur-
25 ing that the methods for the calculation of costs developed

1 under section 101, and the improved or new technologies
2 developed under section 102, will be effectively included in
3 such design or renovation.

4 (b) The head of each Federal agency having jurisdic-
5 tion over proposed new residential dwellings to be located on
6 Federal or federally administered property shall, upon the
7 request of the Administrator, enter into the arrangements
8 with the Administrator described in subsection (a) so as
9 to assure that the preliminary design of any dwellings
10 selected by the Administrator (from among the proposed
11 new dwellings) (1) will include a life cycle analysis of
12 capital and operating costs for such dwellings, both with and
13 without specially designed features for energy conservation,
14 and (2) in the case of dwellings to be placed in geographical
15 locations well situated to utilize solar energy, will include
16 optional designs for the use of solar heating or cooling or
17 both and a life cycle analysis of capital and operating costs
18 for such dwellings both with and without such use.

19 TRAINING IN LIFE CYCLE COST ANALYSIS AND ENERGY
20 TECHNOLOGIES FOR BUILDINGS

21 SEC. 104. The Administrator, in consultation with the
22 Secretary of Health, Education, and Welfare, shall prepare
23 and promote the use of educational materials and opportu-
24 nities to train students of engineering and building manage-
25 ment in the concept of life cycle cost analysis for fuels and

1 energy and in the use of conservation, solar energy, and total
2 energy technologies in the construction and renovation of
3 commerical and industrial buildings.

4 AUTHORIZATION OF APPROPRIATIONS

5 SEC. 105. There are authorized to be appropriated to
6 carry out this title—

7 (1) for the fiscal year ending September 30, 1977,
8 \$12,000,000; and

9 (2) for subsequent fiscal years, such as sums as
10 may hereafter be provided by the Congress in annual
11 authorization Acts.

12 TITLE II—DEMONSTRATION AND STANDARDS

13 OVERALL RESPONSIBILITY OF GENERAL SERVICES ADMINIS-
14 TRATION FOR IMPROVED ENERGY CONSERVATION AND
15 USE IN FEDERAL BUILDINGS

16 SEC. 201. (a) The Administrator of the General Serv-
17 ices Administration (hereinafter in this title referred to as
18 the "Administrator") shall have general responsibility on
19 behalf of the Federal Government for promoting increased
20 efficiency of fuel and energy utilization in Federal buildings
21 through the use of new and improved technologies in energy
22 conservation, solar heating and cooling, and total energy
23 systems.

24 (b) All Federal agencies and establishments, including
25 particularly the United States Postal Service, the Depart-

1 ment of Defense, the Veterans' Administration, the Depart-
2 ment of Housing and Urban Development, the Department
3 of Commerce, the Government Printing Office, the National
4 Aeronautics and Space Administration, and the Energy
5 Research and Development Administration, shall be subject
6 to the requirements imposed by or under this title and shall
7 in addition participate cooperatively with the Administrator
8 in the exercise of his responsibility under subsection (a).

9 REQUIREMENT OF LIFE CYCLE COST ANALYSIS, AND OP-
10 TIONAL ENERGY FEATURES, IN PRELIMINARY DESIGN
11 OF SPECIFIED FEDERAL BUILDINGS

12 SEC. 202. In the case of any Federal building which is
13 proposed to be constructed or renovated, and which contains
14 or will contain more than one hundred thousand square feet
15 of working space—

16 (1) the preliminary design (A) shall include a life
17 cycle analysis of capital and operating costs, related to
18 energy consumption, for the building both with and with-
19 out special design features for energy conservation, and
20 (B) except in the case of a proposed new building which
21 is to be constructed in a geographical location not suited
22 for the utilization of solar energy, shall include an op-
23 tional design or designs for the use of solar heating or
24 cooling or both and a life cycle analysis of capital and

1 operating costs for the building both with and without
2 such use; and

3 (2) if such building contains more than one million
4 square feet of working space, the preliminary design
5 shall also include a life cycle analysis of capital and
6 operating costs for the building both with and without a
7 total energy system, and (in the case of a proposed new
8 building) an optional design or designs for the use of a
9 total energy system, including where feasible a system
10 designed to use coal as the principal fuel.

11 REQUIREMENT OF OPTIONAL ENERGY FEATURES IN OTHER
12 FEDERAL BUILDINGS

13 SEC. 203. Whenever the Administrator determines, with
14 respect to any Federal building which is proposed to be con-
15 structed or renovated and to which the requirements of sec-
16 tion 202 do not otherwise apply, that the inclusion of special
17 design features for energy conservation, solar heating or cool-
18 ing or both, or total energy systems would reduce the use
19 of fuels and energy for the estimated useful life of the build-
20 ing, he shall cause a life cycle analysis of capital and operat-
21 ing costs for such building to be made both with and with-
22 out such features; and if such analysis indicates that the
23 cost of the design and construction or renovation of the build-
24 ing with the inclusion of such features will not exceed by
25 more than 5 per centum the corresponding cost which would

1 be incurred if conventional design were used, the Administra-
2 tor shall include such special energy features (or require
3 the head of the Federal agency having jurisdiction over the
4 building to include such features) in the design of such
5 building.

6 INVENTORY OF EXISTING FEDERAL BUILDINGS

7 SEC. 204. (a) In order to assist in carrying out the
8 objectives of this title, the Administrator shall conduct an
9 inventory of all Federal buildings having more than one
10 hundred thousand square feet of working space as soon as
11 possible after the date of the enactment of this Act, and
12 shall make a preliminary analysis of each such building to
13 calculate its capital and operating costs relating to energy
14 consumption during the remainder of its estimated useful
15 life both with and without modification to include special
16 features for energy conservation, solar heating or cooling
17 or both, and (in the case of buildings having more than one
18 hundred thousand square feet of working space) total energy
19 systems. Any such analysis may omit consideration of special
20 features for solar heating or cooling if the Administrator
21 determines that the building involved is unsuited (because
22 of its type, remaining useful life, or location) for the inclu-
23 sion of such features.

24 (b) The Administrator shall submit to the Congress
25 within one year after the date of the enactment of this Act a

- 1 full and complete report of the results of the inventory and
2 analysis made under subsection (a).

3 STANDARDS

4 SEC. 205. The Administrator, utilizing the personnel and
5 facilities of the National Bureau of Standards, shall develop
6 and promulgate minimum standards for equipment required
7 and analyses made under this title and section 103. In the
8 development of such standards, maximum opportunity shall
9 be given for participation by other Federal agencies, State
10 and local agencies, and the general public.

11 DESIGN COMPETITIONS

12 SEC. 206. The Administrator shall organize and conduct
13 design competitions for energy conservation features in com-
14 mercial and industrial buildings, to be held every two years.
15 The top 10 per centum of the designs submitted in each
16 such competition shall be accorded special recognition by
17 the President; and the top 20 per centum shall be certified
18 by the Administrator as suitable for inclusion in preliminary
19 designs for the construction, modification, or renovation of
20 Federal buildings under this Act.

21 REPORTS

22 SEC. 207. The Administrator shall submit to the Con-
23 gress semiannually a full and complete report on the activi-
24 ties being conducted under this title and the progress being
25 made toward the achievement of the objectives of this Act.

1 AUTHORIZATION OF APPROPRIATIONS

2 SEC. 208. There are authorized to be appropriated to
3 carry out this title—

4 (1) for the fiscal year ending September 30, 1977,
5 \$25,000,000; and

6 (2) for subsequent fiscal years, such sums as may
7 hereafter be provided by the Congress in annual au-
8 thorization Acts.

ENERGY CONSERVATION IN BUILDINGS

MONDAY, AUGUST 9, 1976

HOUSE OF REPRESENTATIVES,
SUBCOMMITTEE ON PUBLIC BUILDINGS AND GROUNDS
OF THE COMMITTEE ON PUBLIC WORKS AND TRANSPORTATION,
Washington, D.C.

The subcommittee met at 10:12 a.m. in room 2167 Rayburn House Office Building, Hon. Bo Ginn (chairman of the subcommittee) presiding.

Mr. GINN. The Subcommittee on Public Buildings and Grounds will please come to order.

This morning and tomorrow morning the subcommittee will be holding hearings on H.R. 14415, the Energy Conservation in Buildings Act of 1976.

The bill consists of two titles, whereby title I has been referred to the House Committee on Science and Technology, and title II has been referred to the Committee on Public Works and Transportation.

The legislation deals with more efficient use of energy, particularly in buildings. It is designed to allow the Federal Government to set an important example in energy conservation, to encourage the use of these methods and practices in the private sector, and to further develop an energy conscience throughout the Nation.

Further, the legislation attempts to set up a comprehensive, organized leadership for a closely integrated, high-priority program of conservation of energy in all Federal buildings.

Title I provides for ERDA to develop and demonstrate methods of calculating life-cycle costs, to disseminate information about these methods, to train engineers to use these methods, and to cooperate with the General Services Administration to demonstrate the technology developed. Twelve million dollars is provided under title I.

Title II gives the General Services Administration the overall responsibility on behalf of the Federal Government for promoting increased efficiency of fuel and energy utilization in Federal buildings through the use of new and improved technologies in energy conservation, solar heating and cooling, and total energy systems. Twenty-five million dollars has been provided to finance title II of this legislation.

We have been afforded ample evidence that the growing shortage of energy is not an easy situation to resolve.

However, energy conservation in buildings provides a great opportunity for savings realizable in a short period of time.

We are pleased to have with us also this morning the ranking minority member of our subcommittee, Congressman Walsh. Congressman Walsh, would you care to make an opening statement?

Mr. WALSH. Thank you very much, Mr. Chairman.

I apologize for being late, but the plane schedules up in New York are a little slow this morning because of some bad weather, as usual, up there.

I am delighted to welcome all the witnesses here and look forward to the testimony on this extremely important matter.

I think what we are doing here can have great meaning in the field of energy and help us to really conserve energy and save some of our great resources.

I have no further statement, Mr. Chairman. Thank you.

Mr. GINN. Thank you, Mr. Walsh.

We are also pleased to have with us this morning the chairman of the Subcommittee on Energy Research and Development, on the Committee of Science and Technology, Congressman McCormack.

Mr. McCormack would you care to make any opening remarks?

Mr. McCORMACK. Thank you, Mr. Chairman.

I want to congratulate you, Chairman Ginn, for the leadership that you have exhibited here. It is a pleasure to cosponsor with you H.R. 14415, the Energy Conservation Buildings Act to coordinate the activities of my subcommittee with yours in handling this bill.

I think this is an extremely important matter.

We talk a great deal of energy conservation, but what is important is that we come to understand just what it is. What it really means in terms of numbers; what we can or cannot do.

I think it is important to recognize that the Association of Refrigerating and Air Conditioning estimates that in 1975, the total energy consumed by all buildings is 75.4 quads. By 1990 it will be 24.2 quads—this is a mass equivalent to 11.5 billion barrels of oil a day. This is assuming conservation programs of considerable significance.

But I think this is the course we must follow. We anticipate that today there are approximately 69 million homes in this country which will expand to about 95 million homes by the year 1990. At the rate we are building all those homes, it is critically important that we build all these homes with energy efficiency. That is why I believe these hearings and this legislation is so very important, and I want to thank you for the opportunity you have afforded me to join you here at this time.

Mr. GINN. Thank you very much for being here.

As I understand it, your subcommittee is in the process of having hearings on title I of the bill now. We appreciate you coming by this morning to help us get underway with hearings on title II.

We are very pleased to have several outstanding witnesses here before the subcommittee regarding this legislation.

If there is any Member of the House who is vitally interested in this subject, he is our first witness this morning. He has talked with me on numerous occasions about it. He has pushed for this type of legislation.

And so, at this time, I am very pleased to welcome Congressman Dick Ottinger from the State of New York.

Dick, you may proceed as you see fit.

TESTIMONY OF HON. RICHARD L. OTTINGER, A REPRESENTATIVE
IN CONGRESS FROM THE STATE OF NEW YORK

Mr. OTTINGER. Thank you very much, Mr. Chairman.

I really do appreciate your interest in pushing this forward.

In informal talks with my subcommittee chairman, as I serve on Mr. McCormack's Subcommittee on Energy Research Development, I think we are getting close to an accommodation, and I hope, close to the time when we can see the two committees go forward to get this very important legislation in place.

It presents a tremendous opportunity to us.

The thing that I think we are together on now is that the Federal buildings, first of all, constitute a tremendous potential for energy consumption in and of themselves. The Federal Government uses about 3 percent of the energy used in the United States.

The potential for savings by the Federal Government in using energy saving techniques and using solar energy is very substantial in and of itself.

The most important thing about this legislation, as I see it, is that it will show the way. It will create a market for energy conservation technology, and particularly for solar energy, that should bring the initial price—which has been the obstacle in getting solar energy used—down to a point where it is much more economically feasible to use such technology. It will give private builders experience in installing this equipment because the Federal Government uses almost entirely private builders to construct its own buildings.

So I am very anxious that this technology not be held in the research stage, while we continue to perfect better and better technology throughout the years. And I think Mr. McCormack and I now see eye-to-eye on this, that it is important in title II of this legislation that we apply existing technology to Federal buildings where it is feasible to do so.

Of course, that is going to vary, particularly with solar, from section to section of the country.

But, in most sections of the country, I think that for solar hot water heating and probably for solar space heating, it will prove to be economically feasible on a life-cycle basis to install solar equipment.

That presents a very exciting possibility for us, and Mr. McCormack and I both agree that there are a lot of people out there pushing equipment that is not technically sound equipment, and that it is important that ERDA have a role in this to insure and qualify the equipment to make sure that the Government is going to be purchasing and installing equipment which can, in fact, do the job.

The main problem in getting the Federal Government into an extensive program of applying existing technology is apparently the question of the discount which presently is offered, and we have heard some testimony on this. The Federal Government agencies involved are going to work with us to try to get a better formula.

It is, however, exceedingly important that the Federal Government not only do the life-cycle cost analysis but also the purchasing. The Federal Government does keep its buildings over their full life and, therefore, ought to be able to achieve the savings that are possible

through making a greater initial cost. An initial outlay in having that equipment will save fuel and, therefore, save money for the Government over the life of the buildings.

The Government ought to be directed to do that, and the discount rate is going to be critical here. I do not come to you this morning with a formula myself, but I would hope that we could work with private industry segments of the solar industries and with the Government in working out a formula that would require the Federal agencies to proceed on a life-cycle basis where the equipment is sound and where that basis is going to be economical.

It is going to mean a tremendous amount—not only in the Federal Government itself—but in educating the construction energy on the outside as to the feasibility of this technology and the savings that are achievable in private construction, and therefore, I think, will have a tremendous multiplier effect.

I would like to go through some of the particulars in the legislation that I think need adjustment in order to achieve this objective, and through the history of the legislation very briefly first.

Last July, Senator Garv Hart, Senator Gaylord Nelson, Congressman Gilbert Gude, and I introduced the Conservation and Solar Energy Federal Buildings Act of 1975. Although the bill was reintroduced several times for the 80 cosponsors who joined us, we have referred to the "parent" bill as H.R. 8711 and its companion, S. 2095.

Two days of hearings were held before your subcommittee on October 29 and 30, 1975, on H.R. 8711 as well as H.R. 7080. H.R. 7080, introduced by Mr. Cleveland and Mr. Howard of your committee in May 1975, served as background for our bill; we added emphasis to the use of solar energy and the concept of "life-cycle cost analysis."

In addition to the hearings held on the House side, 2 days of hearings were also held on November 4 and 5, 1975, before the Senate Subcommittee on Buildings and Grounds of the Committee on Public Works.

It is naturally very heartening to me to have this subject before you now with your new subcommittee chairman Bo Ginn, to whom I have spoken about my profound interest and concern with this legislation designed to show the country that we are truly serious about conservation and solar energy. We can lead the country forward by setting an example and creating a market through the use of solar and conservative practices on our own Federal buildings.

The particular bill before you now, which has been referred to both the Science and Technology Committee, of which I am a member, and the Public Works Committee, is similar in many ways to H.R. 8711, and I am truly hopeful that we will move forward. I would, however, like to comment generally on the legislation and submit specific comments that I should ask you to consider when you mark up the bill.

We are all aware of the necessity of using the existing techniques and technology for the conservation of energy as well as the production of energy from the most available and pollution free source we have—the sun. I am sure you will be hearing about the benefits of this path from the witnesses you will have during the hearings.

I particularly commend the remarks of our former colleague, Paul Cronin, who spoke last week before our Science and Technology Sub-

committee praising the work of GSA. Mr. Cronin is extremely knowledgeable about solar energy and its most practical applications.

He is addressing himself to this problem of the discount rate, which I referred to before.

I also commend to you the testimony of Mr. Leo Daly who represents the AIA which has done so much valuable analysis of the potential of conservation of energy in the design of new buildings and the renovating or "retrofitting" of existing buildings.

I might also add that I was very impressed by the testimony of Mr. Jack Eckerd, the Administrator of General Services, when he testified before the House Government Operations Committee just 2 weeks ago, on July 28. Mr. Eckerd's four areas of concern for GSA were:

1. The design of all new buildings so that they are highly efficient;
2. The institution of buildings operating standards and practices in the large inventory of existing buildings to reduce usage;
3. The retrofitting of our existing buildings to make them more energy efficient;
4. And the use of existing solar energy technology, as well as new technology as it develops to provide hot water, building heating, and eventually cooling. These set out my concept for this legislation perfectly and reinforce my view that GSA should lead the Federal Government building program forward in cooperation with other Federal agencies.

Here I think it is very important to take a look at what the role of these different agencies ought to be. I think that ERDA ought to have charge of the standards that are going to be set for the particular equipment that will be used, but that GSA or the Defense Department, the people that are actually building buildings, ought, once equipment is certified, to be not only encouraged, but required, where our life cycle cost basis makes sense, to use energy efficient equipment, and they ought to have charge at that point.

The area of coordination is one that I would like to discuss for a moment as I think this is an aspect of the legislation before both committees which is rather murky at this point. It is extremely important to me that we not, as the saying goes, recreate the wheel again, and that we take advantage of work that has already been done.

Several Government agencies have already done work that should be a part of the Federal Government building program. ERDA's research and development on solar energy and conservation, both on technology development and life cycle analysis is important.

FEA has been the lead agency in conservation through operating economies in buildings; its Federal energy management program achieved a reduction of 24.3 percent energy use through the most basic housekeeping measures on a demonstration program it has conducted.

FEA has also in its solar division done considerable work on a solar energy project for Federal buildings. Also, NBS has prepared for HUD and ERDA the long awaited "Intermediate Minimum Property Standards for Solar Heating and Domestic Hot Water Systems." I think that that is very useful work, and will enable the Government to move much more rapidly in this area.

Finally, the GAO report to Congress (LCD 75 313) regarding Federal projects has analyzed the use of life-cycle cost analysis and

indeed recommends on page 30 that "the Secretary of Defense and the Administrator of GSA direct the cooperation and coordination of efforts to refine LCC (life-cycle costing) analysis and its application to pre-award evaluations to facilitate its use in Federal construction projects."

I mention all this because I am concerned that the bill before you should establish the most practical and efficient coordination. I am aware that the problem of energy program coordination between ERDA and FEA, although many of the difficulties are being resolved now through the memorandum of understanding between the two agencies, is still rather unclear.

The main line of distinction with respect to jurisdiction, in my view, should be that ERDA's responsibility ends at research and development and demonstration of new technology, while operating agencies have responsibility for application of new and existing technology.

That has been certified by ERDA. This will minimize the areas of overlap and best utilize ERDA scientific expertise. I just mention this because I would hate to have us produce legislation which would create more rather than less bureaucratic problems.

For this reason I strongly recommend that your subcommittee strive as much as possible to have the lead coordination for Federal buildings given to those agencies such as GSA and DOD who have the majority of Federal building projects under their purview. Those agencies should work in conjunction particularly with ERDA where new technology will be developed and standards established for acceptable existing buildings.

In keeping with my above comments, I would ask for a reconsideration of section 103 which I think should be in title II under your jurisdiction rather than in title I.

I would like now to comment on the specific aspects of the legislation before you. I would urge that you consider the addition of the words "solar energy systems" to the title of the bill, both in the opening description and in the formal title.

I think that the principal advantage that you will see coming out of your life-cycle costing effort is going to be a finding that solar applications are in fact usable and advisable from an energy economic standpoint at the present time.

I think that that emphasis ought to be reflected in the title and all the way through the legislation.

Mr. Cronin, when he testified last Wednesday before the Science and Technology Subcommittee on energy research, development and demonstration, stressed the importance of considering solar energy as energy production and not strictly as a conservation measure, and for this reason I think that solar energy should have its own identification in the title and description of the bill. I would recommend that you eliminate the word "demonstration" from title II of the bill.

The purpose of this bill is not primarily to demonstrate new technology, but to get existing technology into use and create a market for it, as opposed to the Solar Cooling and Heating Act, of which Mr. McCormick is the author, which is designed to create new technology. Both he and I have been urging that that be put in place as quickly as possible.

The idea of this ought to get existing energy into use, and create a market for it.

I would, therefore, change "demonstration" to "use of," and I would also strongly stress the need for the inclusion of the word "existing" as well as "new" technologies, in the key operating language of the legislation.

It is essential that this legislation continually stress the need for a program within the Federal Government that uses technology we already have available.

I would also call your attention to the need to include the word "existing" in title II of the bill in section 201. GSA surely should be given the responsibility for promoting the use of "new, improved and existing technology" in energy conservation, solar heating and cooling, and total energy systems.

I would call your attention to the need for definition of terms in the bill. I think this will be a very important piece of legislation for guidance not only in legislation but also for implementation of local building practices.

Therefore, I would hope that the staffs of the committees will define in an additional section of the bill such terms as "total energy systems," "solar energy," and "life-cycle cost."

I would also like to ask you to consider a section in title II which would direct the Administrator of GSA and the Secretary of Defense, in consultation with other Federal agencies, to develop and publish guidelines to assure that the most effective and efficient measures for conservation and solar energy systems are incorporated in the design, construction and renovation of federally owned and federally assisted buildings.

These guidelines would incorporate the work done on life-cycle cost analysis called for in title I of the bill before you; they would incorporate standards such as the ones now being formulated by NBS. They should also call for continued coordination with the work being done by ERDA and FEA. I am attaching language that was used in H.R. 8711 for such guidelines.

Finally, I would direct your attention to the section in H.R. 8711 which asks for increased cost limitations to accommodate energy equipment in Federal buildings. I suggest that this provision be added to the legislation before you to address the problem of higher first costs.

I believe it is more efficient to have this included in title II rather than the provision for ERDA to assist in the payment of initial first costs which appears in section 102(c) of title I.

I and my able staff assistant, Joanne Shorey, who did more than anyone to draft, study and research H.R. 8711, are available to help you on any of your future work on this legislation.

I greatly appreciate the interest you have shown in this legislation. If we can get a meaningful solar and conservation Federal buildings program started in this Congress, I am convinced that it will be one of the most significant achievements made toward environmentally and economically energy independence.

Thank you, Mr. Chairman.

Mr. GINN. On behalf of the subcommittee, we certainly want to thank you for appearing before us and sharing with us your thoughts on this important subject.

We are well aware of your intense interest in this legislation, and we want to thank you again for appearing.

We also realize that you are on a very tight schedule, but if you have time for questions, there may be some members of the subcommittee that would like to ask you some questions. Do you have time?

Mr. OTTINGER. I do, indeed.

Mr. GINN. Mr. Walsh?

Mr. WALSH. Thank you, Mr. Chairman.

I would like to congratulate our colleague, Mr. Ottinger, on a very fine statement. It certainly shows you did a lot of work on this study, and went over this legislation in great detail.

I would like to clear up one point.

You referred to 3 percent of the total energy consumed as being the Federal Government's consumption.

Now, does that include all of the Federal Government organizations and units, the Defense industry, and everybody else?

Mr. OTTINGER. The Federal Government's own activities, not its contracted activities.

Mr. WALSH. Just what it uses itself?

Mr. OTTINGER. Yes.

Mr. WALSH. This would be gasoline and oil, and all of those?

Mr. OTTINGER. Right, it includes transportation, which is the other major category.

Mr. WALSH. Thank you very much.

I have no other questions.

Again, I congratulate our colleague for a very fine statement.

Mr. GINN. Mr. McCormack?

Mr. MCCORMACK. Thank you, Mr. Chairman.

I had ample opportunity to work with Mr. Ottinger on other occasions, so I have no questions.

Mr. GINN. Mr. Hagedorn?

Mr. HAGEDORN. Thank you, Mr. Chairman.

I just want to congratulate Mr. Ottinger on a very fine statement. He has obviously done a lot of work on the subject, and you are to be commended for your efforts.

Mr. OTTINGER. Thank you very much.

Mr. GINN. No further questions. I certainly want to thank you for coming, and congratulate your staff assistant, Joanne Shorey, for the staff work.

In far too many instances the staff work is overlooked, and we get the credit, but I want to say I appreciate your giving her credit for that, and we would like to call on her also.

Mr. OTTINGER. That also applies to the lady on your right, Nancy Vitali.

Mr. GINN. Thank you, we think that is understood.

Thank you very much.

Mr. GINN. We are very pleased to have with us as our next witness, the distinguished Administrator of the General Services Administration, Mr. Jack M. Eckerd, who hails from the great State of Florida. With him is Mr. Nick Panuzio, Commissioner of the Public Buildings Service, GSA.

Gentlemen, we are delighted to have you with us, and you may proceed as you wish.

TESTIMONY OF HON. JACK M. ECKERD, ADMINISTRATOR, GENERAL SERVICES ADMINISTRATION; ACCOMPANIED BY NICHOLAS PANUZIO, COMMISSIONER, PUBLIC BUILDINGS SERVICE

Mr. ECKERD. Thank you, Mr. Chairman and members of this subcommittee.

I welcome the opportunity to discuss the important issue of energy conservation in Federal buildings. The cost of supplying our Federal buildings with needed energy is increasing. GSA believes we should speed up our move to conserve energy in both our new buildings and in existing buildings. Before commenting on H.R. 14415, let me discuss briefly the accomplishments of GSA in the area of energy conservation.

We have found the cost of constructing an energy-efficient building to be virtually the same as a conventionally designed building.

In other words, there is a tradeoff. We find that even though there are additional components going into an energy-efficient building, there are other areas where the mechanicals are decreased.

In other words, we need less air conditioning, less lighting. So we find it is pretty much a tradeoff that comes out about equal. But a saving of 40 to 50 percent in energy consumption can be expected with an energy-efficient building.

GSA plans to have 26 new energy-efficient buildings by 1979 in which there will be an energy cost avoidance—a saving—of more than \$4 million a year. Converted to today's average price for oil, this represents a contribution of about 400,000 barrels of oil to the Nation's oil supply.

In our existing Federal buildings much has been accomplished to save energy through changes in our operating standards and practices. Energy consumption by heating, cooling, and lighting in GSA-controlled space was reduced 27 percent from fiscal year 1973 to 1975. Compared with fiscal 1973 the first three quarters of fiscal 1976 show a 27.8-percent reduction.

In real terms this reduction is equivalent to saving approximately 2,800,000 barrels of oil a year, a maximum savings achieved with a minimum of capital investment.

The Energy Policy and Conservation Act—Public Law 94-163—directs the President to establish a 10-year plan for improved energy-efficiency in all Federal buildings, not only those controlled by GSA.

When fully developed, this 10-year plan will provide efficiency standards for lighting, heating, and insulation and will include provisions for replacing or retrofitting to meet these standards.

GSA is working with FEA and ERDA to help develop guidelines aimed at identifying retrofit projects for Federal buildings. Test surveys are currently being undertaken by GSA and FEA to see how possible guidelines would work with respect to selected Federal buildings.

Solar radiation, an inexhaustable and nonpolluting energy source, demands our attention. So far, there has been limited exploration of the potential for solar energy in this country. The technology is emerging, but the Federal Government must continue to encourage research and development to improve this technology and reduce the cost.

To assist this development, GSA is cooperating with ERDA in solar heating and demonstration projects. Supplementary solar energy systems are being provided to both of GSA's demonstration projects, our energy conservation demonstration building in Manchester, N.H., and our environmental demonstration project at Saginaw, Mich. Both systems will be operating during the 1976-77 winter heating season. They will provide a substantial amount of the energy required to heat, cool, and provide hot water in these two buildings.

GSA also has other solar systems planned or under construction. In fact we are studying the feasibility of including solar energy as a part of the initial design of each new Federal building, either during construction of the building or for easy addition after it is built.

Moreover, we are examining the feasibility of retrofitting solar energy systems to selected existing buildings. Section 101 of H.R. 14415 requires ERDA to develop and demonstrate methods to calculate life-cycle capital and operating costs, and section 102 directs that ERDA coordinate its actions in life-cycle costing with GSA and the other agencies to reduce consumption of energy in Federal buildings.

However, GSA has already initiated a program to conserve energy in Federal buildings. We are working with FEA and ERDA in some areas H.R. 14415 addresses, particularly the 10-year plan required by the Energy Policy and Conservation Act (Public Law 94-163). The GSA Manchester and Saginaw demonstration projects are examples of such cooperative efforts.

Title II of the proposed legislation would give: GSA broad new responsibilities to promote new technologies for energy conservation, solar heating, and cooling, and total energy systems throughout the Federal Government.

GSA would also be required to work with all other Federal agencies to carry out this new mandate. However, because this includes projects in many buildings not controlled by GSA, and in types of structures where we have limited experience, these new responsibilities would present certain difficulties.

First: The increase in staff necessary to adequately accomplish this task would be costly.

Second: Since our primary experience has been in the design, construction, and operation of general purpose office buildings, our expertise with respect to hospitals, residences and military facilities, for example, is limited.

We at GSA are pleased with this subcommittee's concern about energy conservation in Federal buildings. We have made significant progress in the energy conservation field, and we are committed to continuing the development of policies and programs to advance this effort. We do not believe, however, that this legislation is necessary because it would duplicate existing authority.

Now, if you have any questions, we would be glad to answer them, or furnish the desired information for the record.

Mr. GINN. First, may I thank you for your statement, Mr. Eckerd?

You commented about duplication of effort with regard to this legislation.

As I understand it, H.R. 12169, the FEA Extension Act has just been finished in Congress. Under title III, energy conservation stand-

ards are set for Federal buildings. The bill will set energy conservation performance standards; and, through the Senate section, all Federal buildings must be in compliance with or exceed the standards.

Under the Senate, section 310, ERDA and the National Bureau of Standards, with HUD, will do research and demonstration to support the standards and their implementation.

How do the provisions in H.R. 12169, conference report, compare with: one, the EPCA 10-year plan;

Two: The FEMP plan, and;

Three: ERDA's efforts, and;

Four: H.R. 14415, the bill we are working on here?

Mr. ECKERD. I was only speaking, Mr. Chairman, to our own participation in this program, and all I can say is that we have already developed very strict guidelines in the development of our new buildings.

For instance, we have set ourselves standards that architects must meet in the design of the new building, which requires them to bring this building in at about 55,000 Btu's per square foot. This compares to an average that we have now in our Federal buildings of about 200,000 square feet. So we have set pretty strict guidelines in this area.

We have a retrofit program that we have identified, and have documented the 50 most critical, the worst users of energy in our entire 10,000 buildings that we control. We have pegged the cost of it, and we know it is going to cost \$140 million. We feel it has a pay out in our life of about 7 years, so we feel that we have about done what this bill would call for us to do, except the mandate of us having to participate in some areas. It is going to require considerable additional staff in our GSA Agency.

I do not mean that we have done everything that we can, by any means.

Every time I walk into a building like this, or our own buildings, and see it at 72°, I know we have not accomplished the maximum that we hope to in the future.

I do feel that we are doing about all we can conceivably do now, and looking ahead in the future on our new buildings, and retrofitting old buildings.

Mr. GINN. Mr. Walsh?

Mr. WALSH. Thank you, Mr. Chairman.

One of the things that intrigued me, when we had some testimony before this subcommittee last year, was the matter of insulation, and this plays an extremely important part, as I am sure you are more aware than I am, in energy savings, and from the testimony that we had, it did not seem that there was a great increase in the technology of insulation.

About all they seem to be able to do in order to save energy in buildings is to double the amount of insulation.

What research is going on in the field of insulation?

Mr. ECKERD. Well, sir, I could tell you that I did visit our building in Manchester, N.H., about 4 or 5 months ago. It was the one that I referred to. It is opening in October, complete with solar energy, and in that building, an experimental building, we completely reversed the old principle of insulation.

We have the insulation panels on the outside of the building instead of being on the inside, and they are not just double thick, they are the same type of insulation.

We will closely monitor this building with ERDA, with cooperation with ERDA, we have a feeling that it is more energy efficient to put insulation on the outside.

Mr. Panuzio can elaborate further on the technique we are experimenting with.

Mr. WALSH. But this is the same type of insulation, there is nothing new in the field, as far as you know?

Mr. PANUZIO. Basically, the composition, it is the same. It is a question of techniques as to where you use it, and so on, that we are trying to take a look at.

Mr. WALSH. My basic question is what research is being done in the field of insulation.

Mr. ECKERD. Well, sir, we depend on our architects and engineers primarily to supply this information.

In other words, we do not attempt to tell them, when we ask them to design a building, how to put in the insulation, what type of insulation to use, and what its thickness should be. We simply give them a very strict requirement as to what we expect that building to come in at, the amount of Btu's it will use, and we feel over a period of time, in these 26, 28 new buildings, that we will have different techniques demonstrated, and by monitoring those, hopefully we can arrive at some conclusions, and hopefully we will have some innovative new type insulation installed in some of these buildings.

Mr. PANUZIO. Unfortunately, Mr. Congressman, we have to rely on that method for research and development, because GSA does not carry with it the arm of having research and development programs which we can fund just for the sake of determining this, so we have to use the method Mr. Eckerd is saying, of having the architects come in with suggestions, and the research and development has to be left to other agencies.

Mr. WALSH. I would submit then, gentlemen, that the basic purpose of this bill, would be to provide a program of research and development in the field of insulation, where you are not doing anything at the present time.

So it would seem to me that there would be legislation of this kind. I have no further questions, Mr. Chairman.

Mr. GINN. Mr. McCormack?

Mr. MCCORMACK. Thank you, Mr. Chairman.

Mr. Eckerd, I appreciate your testimony this morning. I want to congratulate you and GSA in everything you have been doing.

I want to suggest, however, a line of thought that I expressed to the Energy Research and Development Administration when they testified before my subcommittee on this legislation.

Fundamentally, they said, we have the authority under the act to do this job, and my response to them was, do you have the directive—are you doing it, and do you have the directive to do it?

Do you have the directive to order them to do this job?

The answer was, of course, they did not, and the answer was, of course, that they are not conducting this program nearly as successfully as the legislation sets out.

I think that the work, the accomplishments of the General Services Administration have been laudatory, but is it not true that there is a great deal more that would be done under this act in terms of establishing programs throughout Federal buildings, GSA buildings particularly, that could be done without the legislation?

Mr. ECKERD. Would you like to comment on that?

Mr. PANUZIO. Yes; I believe there is. No question in my mind.

What I think Mr. Eckerd is testifying, is that under the existing authority, we are doing as much as we possibly can within Federal buildings, and this legislation does not give us that much more to do within our own area.

Obviously, the ability to coordinate the work with other Federal agencies, and having in a sense a clearinghouse of a design activity, and other construction activity of all Federal agencies, is similar to what we have been doing, that the legislation does do, and is effective.

Obviously, the ability for us to do that, to go beyond the scope of what we already have, will require staff, and it will require funding, because many of the things we have been able to accomplish in GSA have been done with our own staff people, and to do this adequately with the number of other agencies, and coordinate an effort that would affect hospitals and military bases, and so on, would require the additional help.

But the coordinating aspects of section 2 are very valid, and can help.

Mr. McCORMACK. Judging by your own testimony, the value of your accomplishments to date, in terms of dollars and units of energy saved now and in the future, would easily lead one to extrapolate to a larger program. The benefits therefrom suggest that they would easily justify the additional cost of this bill, by additional staff and manpower.

I think we can all perceive that. But this brings us then to the other question, that is, this whole business of coordination.

I sense a certain confusion being created by legislation in this field in general.

We now have three or four pieces of legislation which are law, and which may become law, and which tend to overlap. At the present moment for example, our solar demonstration program established for solar heating will presumably have 1,000 units on the line under the Solar Heating and Cooling Act of 1974 by 1977.

It would seem to me that we may be in need of some advice and counsel from you as to how to avoid unnecessary confusion within the various agencies of the Federal Government which might be created by moving too rapidly.

This is one of the reasons that this bill was written with the rather simple method of coordination that shows up in title II of the bill. I wonder if I could request that you make such recommendations as you feel are appropriate for avoiding the trap of overloading the administration with duplicating, overlapping, or confusing legislation, and that you give to the subcommittee such recommendations as you may have on simplifying coordination and administration.

Mr. ECKERD. Very happy to do that, sir.

Mr. McCORMACK. Anything that you could have by the end of the month would be very appreciated.

Mr. McCORMACK. Now, may I ask one other question, Mr. Eckerd? Are you familiar with the ACES program that is being promoted by the energy program in Knoxville, Tenn., where they have the set reservoir under the ground in a large tank?

Mr. ECKERD. I have not seen that one. I have seen the one in Gainesville, Fla., with the same principle.

Mr. McCORMACK. This is the heat pumps, and they are actually freezing the tank in the wintertime, taking it down, and running it down below the temperature of the ice.

They take heat out of the ice, and reverse the process in the building. They just dedicated these buildings, which are part of the ERDA research and development program.

Since cooling programs are obviously one of the most expensive aspects, one of the most expensive portions of energy consumption, for an average building, air-conditioning is, I presume, in many areas, more expensive than heating.

Mr. ECKERD. Especially in Florida, yes, sir. And Georgia.

Mr. McCORMACK. Although there is no technology immediately obvious for solar air-conditioning as such, we hope to have a technology in the near future. There is certainly nothing available before us at the moment, but the ACES program may be an extremely attractive avenue to pursue, and I recommend it to you.

You may want to look at it and see what ERDA is doing in this particular area.

Mr. ECKERD. Yes, sir; I saw a similar installation at the University of Florida, in Gainesville, where they took a home and supplied about 8 tons of air-conditioning.

When I asked the cost, it was about \$10,000, and that was about 3 years ago, and I asked when they could sell it, and they said that home developers, when they get the price down to \$5,000, they could sell the package in homes.

I think we are about ready to have some breakthroughs.

Mr. McCORMACK. The nice thing about this system is it uses technology. So, to that extent, it looks quite attractive.

Thank you, Mr. Chairman.

Mr. GINN. Mr. Hagedorn?

Mr. HAGEDORN. Yes, Mr. Eckerd, I have just one question.

You have mentioned by 1979 you are going to have 26 new buildings that are going to be energy efficient, and cost avoidance.

What percent of that 26 is the number of new buildings that you are going to be building? Will they all be built to these standards, or will this just be a small portion?

Mr. ECKERD. No; all the buildings, this is our whole inventory.

Mr. HAGEDORN. Thank you.

Mr. GINN. Mr. Holland?

Mr. HOLLAND. No questions.

Mr. GINN. Mr. Ottinger?

Mr. OTTINGER. Thank you, Mr. Chairman.

I appreciate your letting me ask questions.

I just want to ask one question; that is, when you purchase buildings at the present time, do you purchase them on the basis of the lowest first cost, or are you at the present time purchasing the lowest life-cycle cost?

Mr. ECKERD. We use life-cycle costing, sir, in our buildings.

Mr. OTTINGER. Are you putting solar in your buildings to see if it would be economical for either hot water heating and space heating?

Mr. PANUZIO. We are considering those as part of any new buildings that we have come along and design, yes.

Mr. ECKERD. Some of these 26 buildings we hope will have some form of solar energy in them.

Mr. OTTINGER. Thank you.

Mr. GINN. Mr. Walsh has a question, I think.

Mr. WALSH. The new Federal building in Syracuse is being occupied at the present time. I have not seen it, but I understand that my office will be moving in there, probably next week. It has not been dedicated yet, but I was wondering if you could give me some statistics on what you have done in that building along energy saving lines?

Mr. ECKERD. Yes, sir.

When would you need that, Mr. Walsh?

Mr. WALSH. Any time you get a chance, within the next couple of weeks.

Mr. ECKERD. I thought you were going to be there for the dedication. When is that?

Mr. WALSH. We have not set a date.

Mr. GINN. Without objection, the additional information will be made a part of the record.

[The following was received for the record:]

[From the GSA Fact Sheet, Office of Construction Management, Aug. 20, 1976]

COURTHOUSE AND FEDERAL OFFICE BUILDING, SYRACUSE, N.Y.
(Energy Information)

GENERAL DESCRIPTION

The facility consists of a twelve-story office building and a three-story courthouse having a gross area of 370,000 square feet. It includes a basement and interior parking for 120 vehicles. The exterior of the structure is faced with cast stone.

DESIGN AND CONSTRUCTION SCHEDULED

The design began in August 1970 and was completed in February 1972. The construction contract was awarded in December 1972 and the construction was substantially completed in August 1976.

OCCUPANCY STATUS

The occupancy of the building began in May 1976 in the completed portions of the building. Full occupancy is not quite complete in August 1976.

ENERGY CONSERVATION INFORMATION

The design of the building was completed 21 months before GSA established an energy budget/goal for all new office buildings in November 1974.

However, the original design provided for a reasonably energy efficient building. Engineering decisions were made as to the most advantageous type of heating and cooling systems for the project. Fuel and energy analyses were made. The building heating, ventilation and airconditioning systems were provided with a central control panel to facilitate close control of the operation. This central control panel makes it relatively easy to add, (in the future) an automatic energy management equipment to further control energy usage. The building is well insulated, has approximately 28 percent fenestration and should operate with an acceptable energy efficiency.

Action was taken during the construction period to substitute task-oriented lighting for uniform lighting which results in a savings of well over 50 percent of the energy used for lighting. This reduction in lighting will also reduce the airconditioning load.

Operational procedures are in effect which will reduce energy usage. These include: lower thermostat settings in winter; higher thermostat settings in summer; minimum operating hours for mechanical systems; reduced outside air quantities, etc.

Since the building occupancy is not yet 100 percent complete, meaningful actual energy use data is not yet available. However, the building is expected to be a better performer from the standpoint of energy usage than the typical GSA or commercial office building.

Mr. GINN. Are there any additional questions?

Does staff have any questions?

Mr. Eckerd and Mr. Panuzio, we want to thank you for taking the time to talk with us this morning.

Our next witness is Dr. Maxine Savitz, director, Division of Buildings and Community Systems, Energy Research and Development Administration, accompanied by Mr. Wilbur T. Coyle, program manager, Architectural and Engineering Systems Branch.

Dr. Savitz and Mr. Coyle, we are delighted to have you with us this morning, and we want to welcome you to our subcommittee, and ask you to proceed as you see fit.

TESTIMONY OF DR. MAXINE SAVITZ, DIRECTOR, DIVISION OF BUILDINGS AND COMMUNITY SYSTEMS, ENERGY RESEARCH AND DEVELOPMENT ADMINISTRATION; ACCOMPANIED BY WILBUR T. COYLE, PROGRAM MANAGER, ARCHITECTURAL AND ENGINEERING SYSTEMS BRANCH

Dr. SAVITZ. I would like, if possible, to submit the entire statement for the record and just summarize it.

Mr. GINN. Without objection, so ordered.

[The statement referred to follows:]

STATEMENT OF DR. MAXINE L. SAVITZ, DIRECTOR, DIVISION OF BUILDINGS AND COMMUNITY SYSTEMS, ENERGY, RESEARCH AND DEVELOPMENT ADMINISTRATION

Mr. Chairman and Members of the Subcommittee: I appreciate this opportunity to present views of the Energy Research and Development Administration on the proposed Energy Conservation in Buildings Act of 1976 (H.R. 14415, 14290). The Bill proposes a program of research, development and demonstration designed to promote energy conservation for residential, commercial and industrial buildings and to develop methods for calculating life cycle capital and operating costs relating to energy consumption for such buildings.

Mr. Chairman, I would also like to submit for inclusion in the hearing record a brief statement prepared by FEA describing its responsibilities and actions with respect to energy conservation federal facilities. Congress authorized the development of a ten-year program for conservation in federal buildings in the Energy Policy and Conservation Act and the President by Executive Order (E.O. 11912) has delegated that duty to FEA's Federal Energy Management Program (FEMP). FEA has, for several years, had the lead role in monitoring the program of federal agencies in cutting energy consumption in federal facilities and operations. In this regard, the amount of energy used by the Federal Government has been reduced by 24 percent since 1973, the equivalent of over 250,000 barrels of oil per day.

Conservation is a matter of particular interest and importance because it represents a major short-term means of meeting our energy requirements. As you know, the Federal Non-Nuclear Energy Research and Development Act

(P.L. 93-577) cites as a first governing principle that energy conservation shall be a primary consideration in the design and implementation of the Federal non-nuclear energy program. ERDA's RD&D programs are, I believe, faithful to that principle.

ERDA has given conservation high importance. The current National Plan for Energy Research Development and Demonstration (ERDA 76-1) selects conservation technologies for increased attention and ranks those technologies along with several supply technologies as being of the highest priority for National action. Of course, the predominant effort to develop and utilize conservation technologies must continue to come from the private sector if we are to realize the full potential energy savings from conservation. For the Federal program, we note that the FY 1977 conservation budget is considerably greater than the FY 1976 budget, reflecting the importance and careful consideration being given to the programs. Further, because of such renewed emphasis on conservation, the Office of Conservation has been reorganized to provide the needed management attention to the increased scope of the conservation program. We have established separate divisions for buildings, industry, transportation, energy storage systems, energy conversion and electric energy systems, so that the proper management emphasis can be given to each of these areas.

Major elements of the ERDA conservation program include efforts to reduce energy consumption in buildings through more efficient space conditioning and utilization of waste heat, to achieve greater efficiency in processes used by energy intensive industries, to assist in the development of technologies for converting waste to energy or synthetic fuels and to exploit potential energy savings in transportation by demonstrating alternative engines and energy conserving accessories.

Title I of H.R. 14415/14290 directs that the Administrator of ERDA shall develop and demonstrate "methods to calculate life cycle capital and operating costs" for buildings. Section 102 of the Bill provides that the Administrator is to carry out a program for demonstrating new conservation technologies. That same section specifies that in executing the program the Administrator may "cooperate or act jointly" with the General Services Administration (GSA) for the express purposes of reducing consumption of energy in Federal buildings and the renovation of selected existing buildings. It is ERDA's view that everything that is included in Title I of the bill is currently being performed within ERDA and FEA.

Title II invests GSA with general responsibility for promoting increased efficiency in energy use in Federal buildings through the utilization of new technologies. To that end, the Bill directs GSA: to include in any significant construction or renovation a life cycle cost analysis, to conduct an inventory and analysis of Federal buildings with a view to the potential for energy savings with conservation technology, to develop equipment standards, and to conduct design contests for energy savings in Federal buildings. As the FEA statement for the hearing record indicates, this inventory and energy analysis of federal buildings would be a new and costly effort.

Although ERDA's enabling act does not specifically mandate conservation programs for Federal buildings nor derivation of life cycle costing methods, both of these can be accomplished under the existing authority, specifically the Federal Non-Nuclear Energy Research and Development Act and the Energy Policy and Conservation Act. Before enacting such far-reaching legislation, careful consideration should be given to the adequacy of existing efforts and the costs and benefits that are likely to result.

The objectives of the Buildings and Community Systems programs are to conduct research, development and demonstration activities which accelerate and/or complement those underway and planned in the private sector, and to foster acceptance of energy savings technology and more effective energy use in buildings, community systems and consumer products, with minimum socioeconomic and/or environmental impacts.

Our efficiency targets in the near term are to permit a decrease in unit energy consumption for an immediate savings on the order of 0.8 million Barrels Per Day Equivalent (BPDE) by 1980 and by 1985 to permit a decrease in existing buildings and community systems of 20% and in new buildings and community systems by 30% for a total projected energy savings of 2.4 million BPDE.

In the mid-term (by 2000) we hope to decrease energy consumption in existing buildings and community systems by 30% and in new buildings and community systems by 50% for a total projected energy savings of 4.1 million BPDE.

The overall strategy for achieving these goals, involving ERDA, FEA, HUD, and other Federal agencies will be to:

Encourage and support the installation of existing energy efficient technologies as soon as possible.

Develop and implement in the Federal sector new energy efficient technologies and appropriate institutional improvements.

Develop and commercialize systems which will reduce the dependence on petroleum and natural gas.

Disseminate information about existing and new technologies concerning efficient energy systems.

Accelerate/complement private sector efforts in development of new technology.

We have embarked on four major technology development thrusts within the buildings and community systems program. These are:

1. Architectural and Engineering Systems.

2. Community Energy Technology.

3. Urban Waste Technology.

4. Technology and Consumer Products.

1. Our Architectural and Engineering Systems program encompasses RD&D to develop technologically advanced energy savings measures for use in both commercial and residential buildings. Research is also being performed to lead toward the development of performance standards to be utilized by the buildings industry and state and local governments.

Typical projects include:

Energy use in office buildings.

Energy conservation in restaurants and supermarkets, hospitals, and schools. GSA Energy Conservation Demonstration (Manchester).

Annual Cycle Energy Systems (ACES).

Minimum Energy House.

Research for performance standards in new buildings.

Innovative financing.

Life cycle costing relative to buildings.

2. Community Systems research, development and proof-of-concept experimentation is performed to evaluate the role in community development for integrated utility systems, urban density/energy relationships, zoning and land use patterns and innovative approaches and technologies to determine and demonstrate the optional community design patterns from an energy viewpoint.

Typical projects include:

Advanced technology mix energy system.

District heating and cooling systems retrofit.

Ekistic energy community model.

Land use and energy.

Comprehensive community planning.

3. An additional aspect of the Community Systems program is in the area of urban waste technology research, development and demonstration for recovery of energy from urban wastes. We are working closely with the Environmental Protection Agency (EPA) on this and have executed an Interagency Agreement (IAA) with them.

Typical projects include:

Bioconversion including anaerobic digestion and enzymatic hydrolysis.

Pyrolysis.

Direct combustion of waste.

4. Technology and consumer products research to assure that technologically advanced energy savings measures are identified and developed for use in such areas as appliances and other consumer products; heating, ventilating and air conditioning systems; lighting systems; etc. Work is also underway to develop energy efficient materials for use in buildings.

Typical projects include:

Integrated appliances.

Water heater retrofit.

Energy efficient light sources/ballasts (LITEK).

Insulating and optical materials.

Advanced heat pumps.

Building system controls.

Among specific projects we are conducting which are related to the programs outlined in H.R. 14290 are:

1. DEVELOPMENT OF PERFORMANCE STANDARDS

ERDA is working in cooperation with Department of Housing and Urban Development (HUD), Federal Energy Administration (FEA), National Bureau of Standards (NBS), and others to undertake the research necessary to develop and promulgate standards for new construction.

In FY 1976, a program for the development and dissemination of energy conservation standards for new buildings was initiated. Several evaluation activities were undertaken and the research plan developed. In FY 1977 priority will be placed upon research necessary to promulgate energy conservation standards for new buildings.

2. MEASUREMENTS AND ANALYSIS OF THE GSA ENERGY CONSERVATION DEMONSTRATION BUILDINGS IN MANCHESTER, NEW HAMPSHIRE

During FY 1976 the General Services Administration (GSA) completed construction on a multi-story office building in Manchester, New Hampshire. It was designed to demonstrate energy conservation through proper building design and operation. During the design phase of the project, the NBS assisted GSA and its energy consultants in evaluating the effects of various alternative designs for the building. In FY 1976, ERDA financed the extension of that work including the development of measurements packages of the building's energy consumption performance; economic analysis; evaluation; installation and operation of a solar system; and several experiments on ventilation, air leakage, illumination, and human acceptance. The information from the demonstration and experiments will be available as design and operation guides for new building construction, both in the government and private sector.

3. ANNUAL CYCLE ENERGY SYSTEM (ACES)

The ACES concept is a house in which the energy requirements for heating are extracted from water by a heat pump. The water thus cooled is stored and used during the summer for cooling. This significantly reduces the energy input to the dwelling unit. This is a jointly funded project with participation from HUD, TVA, University of Tennessee and ERDA. The demonstration house utilizing the ACES concept and all the required monitoring and evaluation devices has been completed during FY 1976. The demonstration house was dedicated on July 30, 1976 in Knoxville, Tennessee.

In FY 1977 the actual operation of the ACES system will be conducted and the data collected will be analyzed for practical and cost-effective application potential in the commercial market place. Recommendations for further research, development and demonstration in housing and other buildings types will be promulgated. A market survey will be conducted by the National Association of Home Builders (NAHB) Research Corporation for determination of market penetration of the ACES concept in the housing market. Further testing of ACES will be extended in some cases by the private sector, for example in Richmond, Va. and Philadelphia, Pa. Commercial size ACES applications will be explored by the Southern Interstate Nuclear Board (SINB) for selection of a state-owned office building utilizing ACES. The Veteran Administration has received bids to build a 60 bed nursing home in Delaware utilizing the ACES concept for heating and cooling the building.

4. ENERGY RELATED TO BUILDING PROCESS

In FY 1976, the Center for Advanced Computation (University of Illinois) and Richard Stein, AIA of New York City, will be preparing a report on the energy used in the building industry for the construction of buildings. During FY 1976 this study traced the energy consumed in the production of building materials, transportation and handling, and placement in the final building location.

In FY 1976 the report on total energy consumption was completed and in FY 1977 a catalog of energy units required for each building type will be prepared for use by designers in order to determine the optimum energy efficiency.

5. LIFE CYCLE COSTING FOR ERDA FACILITIES

ERDA Facilities and Construction (FCM) has a contract with Reynolds, Smith and Hills to develop a desk guide handbook for life cycle costing, employing energy conservation. It will be available the end of this month. It will be referenced in an ERDA manual entitled "Energy Management" to be evaluated for the ERDA facilities construction program.

6. LIFE CYCLE COSTING FOR SOLAR

Martin-Marrietta is under contract to develop methods for the use of life cycle costs in the design of solar application for residences. The work will be completed by the end of this year.

7. COMMUNITY OPTIMIZATION OF ENERGY CONSUMPTION SEWELL'S POINT

This project will provide for demonstration and evaluation of the optimum mix of conservation technologies that may be implemented in existing communities when institutional barriers are minimized. Existing energy usage patterns of the complex (4,528 acres; 2,841 buildings, 12,000 military residents; 17,000 civilian employees; \$20.5 million annual energy budget) will be analyzed and new/modified generation and/or energy delivery systems and community designs and operational patterns will be developed to obtain minimum energy consumption consistent with economics and habitability. Existing or emerging conservation technologies will be considered. Individual building retrofit for conservation will be accomplished. The effort will also be coordinated with transportation studies linking this community with the greater Norfolk, Va, region for intercommunity travel. Intracommunity travel is a part of this demonstration program. The work is jointly sponsored by ERDA/DOD through an interagency agreement.

8. In the *International Energy Agency* we are particularly interested in the Energy Conservation R&D Working Group of which ERDA had lead responsibility.

For example, we have recently signed an Implementing Agreement with the Federal Republic of Germany on a cooperative research program dealing with large central heat pumps system on energy conservation buildings complexes located in Wiehl and Eslingen in Germany. This program will allow us to receive the benefits of a \$5,000,000 research program for the expenditure of \$240,000.

We believe that there is a large potential for energy conservation in the buildings sector and that research may play an important role in achieving that potential.

We are committed to the principle that the private sector and marketplace forces should be allowed to operate to the maximum extent possible. The rate of application and introduction of conservation technologies in specific instances will be determined by the comparative economics and social acceptability of the available alternative.

We believe that there is sufficient authority in ERDA's and FEA's enabling acts which allow these agencies to accomplish the purposes of H.R. 14415/14290. Hence, we are unable to support this bill because it would unnecessarily duplicate existing authority.

Mr. Chairman, I would be happy to answer any questions of the Subcommittee.

Dr. SAVITZ. Also I would like to submit for the record a statement of the Federal Energy Administration which describes its responsibility with respect to the Federal energy management.

Mr. GINN. Without objection, so ordered.

[The following was received for the record:]

STATEMENT OF THE FEDERAL ENERGY ADMINISTRATION

To assist the Subcommittee in its consideration of H.R. 14290, the following statement summarizes those activities of the Federal Energy Administration which concern energy conservation in Federal facilities and operations.

The Office of Energy Conservation and Environment, which has responsibility for the conservation activities of the Federal Energy Administration, administers the Federal Energy Management Program (FEMP).

The forerunner of what is now FEMP was originally established as a part of the Office of Energy Conservation in the Department of the Interior by Executive Order 11726 in June 1973, and was assigned the initial responsibility for reducing energy consumption within the Federal Government by 7 percent during Fiscal Year 1974. Sixteen Federal departments and agencies were promptly organized into a data gathering and reporting network from which baseline energy consumption levels were developed for FY 1973. It was discovered that these 16 agencies consumed 2.26 quadrillion BTU's of energy, 94 percent of the Federal Government's total energy consumption and about 3 percent of the Nation's total energy consumption. After the Arab Embargo and the subsequent energy crisis, FEMP became an integral part of the newly created Federal Energy Administration. At that time, FEMP operated in a "crisis-response" mode. Because of the energy crisis, FEMP activities were directed towards short-term, simple actions which Federal agencies could perform quickly to save energy, such as turning off lights, reducing thermostat settings, and reducing operating hours of ships and airplanes. These simple activities resulted in an energy savings in FY 1974 of 24 percent over FY 1973, or more than three times the President's 7 percent goal. This savings was equivalent to 90.5 million barrels of oil, which would have cost \$725 million. This is enough energy to run about one million homes for a year.

For FY 1975, the FEMP's reporting network was expanded to include 26 departments and agencies which account for 99.7 percent of all Federal buildings, employ more than 98 percent of all Federal personnel, and operate more than 99 percent of the Government's vehicles. President Ford also set a goal of maintaining energy use at a level 15 percent below the FY 1973 baseline. The Federal Government's energy use was reduced by 24.3 percent, in spite of the fact that more Federal agencies were involved and that prohibitions on certain energy use were relaxed. These reductions in energy use were accomplished without adverse effect on the quality and quantity of Government services provided during FY 1975. The energy saved in FY 1975 equaled 563.5 trillion BTU's, the equivalent of over 97 million barrels of oil. The energy saved represents a cost avoidance of over \$930 million for FY 1975, and a total two-year cost avoidance of over \$1.65 billion.

The Federal Government's energy usage is compiled under two major categories: Building and Facility Operations, and Vehicle and Equipment Operations. The FY 1975 energy use in the Building and Facility Operations category was 15.2 percent under the FY 1973 baseline, more than President Ford's stated goal of 15 percent for the year, while the savings for the Vehicle and Equipment Operations category was 30.1 percent. Furthermore, the Federal Government's use of energy resources has been cut from nearly 3 percent of the National total to 2.42 percent. These efforts demonstrate that energy management techniques can work in a real world environment.

After the oil crisis eased, FEMP was given the responsibility for developing, promulgating and disseminating energy conservation guidelines to achieve long-term energy savings within the Federal establishment. These operations were centered on the development and publication of Federal Management Circular FMC 74-1 (which now has three supplements) and a number of Federal Property Management Regulations (FPMR 101-38.10, 101-26.5, 101-39.6, 101-20.116, etc.), all of which were developed by the Federal Energy Administration in cooperation with the General Services Administration and published under GSA auspices.

During FY 1975, FEMP began providing guidance and technical assistance on energy management methods to Federal, State, and local government, non-government institutions, and to the private sector. A series of site visits were conducted in 287 representative Federal installations across the country to review their energy conservation activities and to confirm the energy reductions reported to the FEMP office. These visits revealed that 92 percent of the sites visited had implemented the guidelines on building operations. A summary of the results of the site-visitation program is contained in FEA's Energy Conservation Paper Number 38.

Pursuant to a Presidential request in October 1974, FEA and GSA, together with 22 other Federal agencies, began identifying long-range initiatives for energy conservation in the operations and facilities of the Federal Government.

The goal of this planning effort is to carry out Federal operations at an energy consumption level no greater than that in 1975, while continuing to meet the expanding needs of the Federal Government.

The Energy Policy and Conservation Act (P.L. 94-163), enacted in December 1975, directed the President to develop a ten-year plan for energy conservation in buildings owned or leased by Federal agencies. This responsibility was delegated to FEA by Executive Order 11912 on April 13, 1976. The ten-year plan will include mandatory lighting efficiency standards, mandatory thermal efficiency standards and insulation requirements, restrictions on hours of operation, thermostat controls, and other conditions of operation, as well as plans for replacing or retrofitting to meet these standards. Under this Act, the FEMP program is developing a series of energy standards for new Federal buildings. These new standards will provide for the optimization of energy conservation within such buildings.

FEA is also working closely with other Federal agencies through Interagency Agreements to demonstrate specific energy conservation measures having wide application to Federal buildings. For example, Interagency Agreements have been executed with the National Park Service for a comprehensive energy plan (\$40,000); the U.S. Postal Service for architectural and engineering surveys (\$16,000); the Indian Health Service for an architectural and engineering survey (\$30,000); and GSA and the Defense Department for energy management systems (\$100,000 and \$500,000 respectively).

FEMP is working with State and local governments and private individuals to transfer the expertise and experience developed in the above programs and to provide technical assistance as needed.

Dr. SAVITZ. ERDA has given conservation high importance. The current national plan for Energy Research Development and Demonstration, commonly known as ERDA 76-1, this year's version, selects conservation technologies for increased attention, and ranks those technologies along with several supply technologies as being of the highest priority for national action.

The predominant effort to develop and utilize conservation technologies must continue to come from the private sector if we are to realize the full potential energy savings from conservation. The Federal Government can create the right policy and right climate for these actions to occur.

It is most appropriate to talk about some of the programs in the division which are related to the legislation to show what kind of research, development, and demonstration activities are underway and which accelerate and complement those programs in the private sector toward the more effective use of energy in buildings.

All of our projects are examined with an eye toward a minimal societal or economic impact. They identify and examine the problems for possible solutions.

Some of the specific projects that we have in process now are concerned with the development of performance standards. We have been working in cooperation with the Department of Housing and Urban Development, Federal Energy Administration, the National Bureau of Standards and GSA, to undertake the research necessary to develop standards for new construction which could be used in implementing both the Energy Policy and Conservation Act, Public Law 94-163, and also title III of the Energy Conservation and Production Act of 1976, Public Law 94-385.

In this current fiscal year, we have developed a program plan for energy conservation performance standards, and several projects are underway in implementing that plan. We have been working with GSA in their Manchester, N.H., building in providing them and the

Bureau of Standards funds to allow the measurement and evaluation of that building so that once it is occupied, we will be able to see how much the projected energy savings are actually obtained.

The building has been constructed with monitoring and sensing devices so that we will be able to fully document the energy savings and where they occur.

Congressman McCormack mentioned the ACES program, the annual cycle energy system which takes advantage of equal heating and cooling loads in the buildings. It features a heat pump in connection with a water storage system. Heat is removed from water during the wintertime by the heat pump for heating the house causing ice to be formed; and then, in the summer, instead of using an air-conditioner, you can circulate chilled water from the ice to cool the dwelling.

A demonstration ACES building has been built on the campus of the University of Tennessee. The house was opened 2 weeks ago, and we are collecting data on that.

A private developer in Richmond, Va., has incorporated the system into a housing development he is building, consisting of 200 homes. One will have the ACES system.

The Veterans' Administration is building a 60-bed nursing home in Delaware, and will have the ACES concept as part of it. Bids have been received for that project.

In addition, the Southern Interstate Nuclear Board, the technical arm for the Governors of 17 southern States, is considering adopting ACES in one of the office buildings in that region.

It looks like a useful concept which will eventually be very cost-effective.

In addition to some specific building projects, we are interested in the energy in the building process. What is the energy that goes into the materials themselves, that goes into buildings, the transportation, and construction? We have been developing some data so that we can make the tradeoffs as to what the most efficient materials would be in construction.

Within ERDA there are several studies on life-cycle costing. ERDA's facilities and construction management office has a contract with Reynolds, Smith & Hills to develop a desk guide handbook for life-cycle costing, utilizing energy conservation, and that manual should be available at the end of this month.

The solar program is developing a method for use of life-cycle costing in design of solar application for residences.

We are looking with the DOD into the possibility of what is the best energy system for an existing complex, consisting of 4,528 acres, 2,841 buildings, 12,000 military residents, 17,000 civilian employees, and \$20.5 million annual energy budget. The base will be analyzed, and new/modified generation and/or energy delivery systems and community designs and operational patterns will be developed to look over the DOD inventory and to make the most useful use of scarce energy resources.

We are active in the International Energy Agency in working with several programs in the buildings program. Of particular interest is one with heat pumps where the Germans have a \$5 million project in Wiehl and Eslingen. We will be able to obtain some of the data and learn from the application with the IEA.

We really believe that there is a large potential for energy conservation in the buildings sector, and that research may play an important role in achieving that potential.

We are committed to the principle that the private sector and marketplace forces should be allowed to operate to the maximum extent possible, and that the rate of application and introduction of conservation technologies in specific instances will be determined by the comparative economics and social acceptability of the available alternative.

We believe that there is sufficient authority in ERDA's and FEA's enabling acts which allow these agencies to accomplish the purposes of H.R. 14415.

At this time, we feel that the bill would duplicate existing authority. I would be happy to answer any questions.

Mr. GINN. Mr. Walsh.

Mr. WALSH. Thank you, Mr. Chairman.

What is there that is input into the new Federal buildings?

When do you get into the picture?

Dr. SAVITZ. In several cases: along with the FEMP program, we coordinate and consult with the FEA people as they are developing guidelines for Federal buildings; in the development and in the review. We share our own experience learned from ERDA's own facilities.

We work also with GSA, as we said, who as a developer, is building new energy efficient buildings; we are helping to document the results as in the Manchester, N.H., building.

Mr. WALSH. As I understand it then, you actually do not have any contact with the actual architect and engineers that design the new Federal buildings except through GSA?

Dr. SAVITZ. ERDA has its own facilities, and we have direct contact with those architects and engineers. The ones at GSA, we would not necessarily.

Mr. WALSH. How closely are you working with GSA in the retrofitting of existing buildings?

Dr. SAVITZ. We have been working closely with them. We use the GSA energy conservation guidelines for existing office buildings that they put out a year ago—for retrofitting of ERDA facilities which include many different types of buildings, such as laboratories and the whole range of facilities.

We are doing a guide now that will aid ERDA facilities in analyzing their own building for retrofitting for energy conservation.

We have good communication with GSA.

GSA also participates in an R. & D. task force, that meets each month that has all the Federal agencies involved with buildings and building conservation participating. It is a regular forum.

Mr. WALSH. How often does that forum meet?

Dr. SAVITZ. Once a month, the third Monday of every month.

Mr. WALSH. For how long a period?

Dr. SAVITZ. It meets for about 2 hours. The way that the agenda is currently structured there is a brief overview by ERDA and by FEA on new research and new legislative initiations. Then each month a different agency or two different agencies go into some depth on their

program as it relates to buildings conservation which enables us to get a more in depth look.

Mr. WALSH. Are minutes kept of those forums?

Dr. SAVITZ. Yes.

Mr. WALSH. Would they be available to the subcommittee?

Dr. SAVITZ. Yes, they would.

Mr. WALSH. I think, Mr. Chairman, it might be valuable if they would submit the minutes of those forums to the subcommittee.

Mr. GINN. I agree, and without objection, the documents will be retained in the subcommittee files.

Mr. WALSH. There is another question that I should probably have directed to Mr. Eckerd.

If you cannot answer it, feel free not to.

But I am concerned about the use of the word "conservation" in the whole field of energy. And, in my judgment, we do not have a national energy conservation policy.

And as I ride around Washington at night, I see the tremendous use of electricity here in buildings. I have yet to see in any building that I have been in any suggestion that we turn out the lights in the building at night. And as far as I know, we have no conservation policy of that nature in Washington or throughout the country.

Now, maybe you could enlighten me on that.

Dr. SAVITZ. Well, I know that guidelines, thermal and lighting guidelines, were issued a year ago by GSA and FEA and an Executive order implementing the Federal management program was issued which gives energy guidelines and also the goals for reducing the energy usage. The implementations of that program do not say, as I recall, turn the lights off at night. But many of the agencies to reach this, have reduced their lighting at night. And their operating procedures have changed. They will not run all their equipment and lights all weekend, if buildings will not be operating full scale.

Mr. WALSH. Well, I appreciate the fact that is not your field, but I am concerned, and again I should have directed this question to Mr. Eckerd, that GSA does talk about an energy saving of 20 or 25 percent, maybe more than that. I think they might be able to do more if there was more attention given to the conservation policy.

And perhaps at some future date, Mr. Chairman, we can suggest something like that to them.

I have no further questions.

I do compliment you for the study that has been done in your testimony. Thank you very much.

Mr. GINN. Dr. Savitz, like Mr. Eckerd, you referred to the inter-agency task force at work. You made reference to the existing laws on the books and, therefore, come to the conclusion that this legislation would be duplicative in nature.

What we are trying to do without discounting the valuable work currently being done by the Interagency task force in existing laws is to try to get a handle and give some agency, or make some agency fully responsible for Federal buildings.

We are of the opinion that GSA would be the appropriate agency.

Do you really find fault with the legislation in that we are trying to get a handle on all of the work that is being done to coordinate, to give

one single agency the responsibility of implementing rather than just research for implementing some of the practices, some of the things that have been discovered thus far?

Dr. SAVITZ. I feel that the operating agencies very definitely should be responsible for applying the options, be they new technologies to be utilized or existing options in their buildings.

In the Federal program, in general, GSA, along with FEA, has had the lead in that program in implementing it, which has come through the various Executive orders. They have been doing this.

The DOD does their own implementing. They closely coordinate with GSA.

Mr. GINN. You are satisfied up to this point that GSA is doing everything it can to implement energy conservation concepts and need concepts?

Dr. SAVITZ. Yes.

And we are working very closely with them in trying to—and I think the Manchester, N.H., energy conservation demonstration program is a good example of trying to bring new technologies into Government buildings. It is also interesting that its cost is compatible with normal construction type of cost.

Mr. GINN. Thank you.

Mr. Holland?

Mr. HOLLAND. No questions.

Mr. GINN. Mr. Ottinger?

Mr. OTTINGER. Thank you.

I was somewhat surprised—I should have followed it up—but GSA says it is presently purchasing, on the basis of life-cycle cost, on that equation.

As I understand it, if that is indeed the case, the difficulty in getting new energy saving technologies actually applied to existing buildings is the discount rates they have to apply.

Can you address yourself to that?

Because this bill attempts to say that GSA will have to purchase the buildings if it is economic on a life-cycle basis.

I understand that the discount that they are presently using is so low to buy solar on buildings—

Mr. COYLE. The Office of Management and Budget, for purposes of uniformity, as the prime purpose, as I understand, dictates to all the Federal agencies that they use a discount factor—I believe it is presently in the neighborhood of 7 percent.

The Federal agencies really do not have much discretion there. The main purpose of a common discount rate, of course, is that one agency will not take a discount rate to their advantage, and another one would pick one that would be to their advantage.

Federal agencies are all using the uniform discount rates.

Mr. OTTINGER. With respect to application of solar, that 7 percent discount rate is not large enough to make it feasible, so that this legislation could perform a very useful purpose, it seems to me, in two respects.

One is to permit a sensible discount rate to permit the application of solar.

And, second, it permits a price differential in title II. As I recall it, it is just a flat 5 percent additional cost permitted to pay for energy sources.

Mr. COYLE. A very slight rate. I agree with your comment.

Mr. OTTINGER. So that this legislation would be helpful in getting conservation technology applied even if we did not address ourselves to that discount.

Mr. COYLE. If there were some discretion concerning discount rates applied other than 7 percent, you would get better answers on the solar part of the equation.

However, I do not believe this legislation is changing that discount rate.

Mr. OTTINGER. Well, perhaps we ought to do that specifically.

What discount rate is applied to solar that you would recommend?

Mr. COYLE. I have no comment on that. I am not working on the solar portion of the equation myself.

We would have to get that for the record for you.

Mr. OTTINGER. We asked in the Science Committee if that would be supplied by the solar industry people and by ERDA.

Mr. COYLE. We could provide that for the record.

Mr. GINN. We would appreciate it being supplied and have it made a part of the record at this point.

[The following was received for the record:]

A discount rate of 10% is dictated by OMB Bulletin A94, "Discount Rates to be used in Evaluating Time-Distributed Costs and Benefits." Bulletin A104 provides a discount rate of 7% in the evaluation of lease vs. buy decisions by Federal agencies.

In the case of present value analyses of solar options, we are of the opinion that a discount rate of 7% would be equitable if the life cycle of solar equipment is estimated to be 20 years or more. Life cycle costing should be mandated in the consideration of various options.

After a period of one year of experience at using 7% as a discount rate, the resulting data could be subjected to a sensitivity analysis to determine what variations of 1% in the rate would effect the decisions to use solar decisions.

Mr. OTTINGER. Thank you.

Mr. GINN. If there are no additional questions, Dr. Savitz and Mr. Coyle, we want to thank you for being with us this morning.

We very much appreciate your testimony.

Our next and final witness for the morning is Dr. Willenbrock, Director of the Institute for Applied Technology, National Bureau of Standards.

We appreciate your being with us today, and you may proceed as you see fit.

TESTIMONY OF DR. F. K. WILLENBROCK, DIRECTOR, INSTITUTE FOR APPLIED TECHNOLOGY, NATIONAL BUREAU OF STANDARDS; ACCOMPANIED BY JACK E. SNELL, CHIEF, OFFICE OF ENERGY CONSERVATION CENTER FOR BUILDING TECHNOLOGY, NATIONAL BUREAU OF STANDARDS

Dr. WILLENBROCK. I am accompanied by Dr. Jack E. Snell, who is the chief of the Office of Energy Conservation.

Mr. GINN. We are delighted to have you also, Dr. Snell.

Dr. WILLENBROCK. I want to thank you, Mr. Chairman, and members of the subcommittee for this opportunity to testify before your committee today on H.R. 14415. In my testimony, I will discuss the energy conservation programs being carried out at the National Bureau of Standards (NBS).

Since H.R. 14415 requires advances in technology, I will examine the life-cycle costing concept and address the technical problems involved in developing and implementing design standards for new buildings and in developing retrofit procedures for existing buildings.

THE NATIONAL BUREAU OF STANDARDS ENERGY CONSERVATION PROGRAMS

Energy conservation continues to be a top priority of the National Bureau of Standards. The NBS' Institute for Applied Technology (IAT) houses three units which conduct a comprehensive technical energy conservation program—the Office of Energy Related Inventions, the Center for Consumer Product Technology, and the Center for Building Technology.

The Office of Energy Related Inventions was established at NBS by section 14 of the Federal Nonnuclear Energy Research and Development Act of 1974, Public Law 93-577. This office reviews and evaluates all promising energy-related inventions, particularly those of individual inventors and small businesses, roughly 60 percent.

As authorized by the Energy Policy and Conservation Act, Public Law 94-163, the Center for Consumer Product Technology is currently developing test methods and energy use estimates for labeling the energy efficiency of appliances to support the Federal Energy Administration and the Federal Trade Commission. This Center conducts research on energy efficiency target analysis and life-cycle costing.

Finally, the Center for Building Technology houses the Nation's largest building research laboratory. This Center conducts energy conservation research for improving the efficiency of energy use in buildings, in communities, and in industry.

For example, NBS studies the thermal performance of the building enclosure and its heating, ventilating, and air-conditioned systems. NBS measures how much energy is used in the buildings and considers the effects of temperature, humidity, and other environmental factors on human health, productivity, and welfare.

NBS develops technical data, measurement technology, performance criteria, and standards to facilitate improved efficiency of energy use in buildings and in community utilities. NBS also supports the Department of Commerce in aiding industry to conserve energy.

NBS develops new measurement technologies by which industry's use of energy may be evaluated. Energy conservation alternatives are verified and disseminated to the small- and medium-sized industries which lack the technical expertise for developing their own energy conservation programs.

Under the Solar Heating and Cooling Demonstration Act of 1974, Public Law 93-409, we are developing test procedures for solar components, evaluating residential heating and cooling systems, and assisting in the solar demonstration programs.

In support of the Energy Research and Development Administration (ERDA) and the Department of Housing and Urban Development (HUD), NBS developed interim performance criteria for residential and commercial buildings and intermediate minimum property standards for solar energy components and systems.

The three IAT programs, which comprise the NBS energy conservation effort, currently examine new promising technologies and the life-cycle costs of varied building design and equipment alternatives. These ongoing programs, along with other Federal agencies' energy conservation programs, are already conducting research, development, and demonstration programs similar to those called for in H.R. 14415.

Life-cycle costing is not a new concept. Numerous Federal agencies, including the GSA and the Corps of Engineers, are starting to use this principle to evaluate whether new dams, roads, or buildings should be constructed. However, this concept is not used generally by the public.

Like the Federal Government, whose primary past concern has been capital costs, the homeowner or small business owner has been concerned with initial outlay rather than future operation and maintenance costs. A major concern is promoting the wide use of this established principle.

The theory of life-cycle cost analysis is well developed. Now, we must look for ways to reduce the obstacles to using this concept. Lack of understanding and acceptance and need for information on engineering applications present the biggest constraints to life-cycle costing, especially in considering energy conservation. It is these two areas which the NBS now addresses.

A major emphasis of any Federal energy conservation program should be informing the public on the potential benefits of including energy conservation design features in buildings.

In a recent NBS publication, entitled "Retrofitting Existing Housing for Energy Conservation: An Economic Analysis," we presented an economic analysis for retrofitting existing housing to conserve energy. This document has received widespread distribution and acceptance in the building community.

The publication was simplified for the nontechnical homeowner into a second document entitled, "Making the Most of Your Energy Dollars in Home Heating and Cooling." This consumer document provides the homeowner with the means to determine the most effective way to invest limited dollars in a retrofit program to attain maximum energy conservation savings.

With your permission, Mr. Chairman, I would like to submit copies of both of these reports.

Mr. GINN. Without objection, so ordered. The documents received will be placed in the subcommittee files.

Dr. WILLENBROCK. Expanding public acceptance of a life-cycle costing approach to energy conservation is only one major emphasis. Examining each element of the life-cycle costing formula is an even bigger concern. It is impossible to evaluate and justify an energy conservation design feature if there is little information on what that alternative is, for example, the heat pump, how much it will cost to operate and maintain and how much energy it will save.

The NBS is currently doing life-cycle costing research on various components and systems to determine whether their use in buildings is cost effective.

For example, one ongoing NBS research project is examining windows to determine the energy usage and cost of which alternative window sizes, designs, and accessories save the most energy. Research shows that there are considerable energy leaks around window frames.

Taking that premise, the designer might say that fewer or no windows would save energy. On the other hand, another designer might add more windows to the building design to make use of natural light and ventilation and to consider the human working requirements.

These two designers would have used different approaches to saving energy—one reduced energy leakage and the other reduced the energy needed for lighting.

The NBS is looking at the tradeoffs associated with various window options and other building components.

To make these tradeoffs, the designer must know how long the equipment or building equipment will last. This evaluation of service life and durability is a major problem in determining the benefits and costs of solar heating and cooling systems.

If we are to use solar energy soon, we cannot wait 20 years to see if the collectors are still functioning. It is imperative that testing procedures be developed to simulate actual wear and weathering on the component and to measure how long the component will function in service. The National Bureau of Standards is currently working to develop methods for testing various solar systems.

A second technical prerequisite to making such tradeoffs is the ability to predict the thermal performance of a building.

The NBS has developed a computer model for predicting the energy a building will use based on the weather, the properties of the building enclosure, and the temperature, humidity and ventilation inside the buildings. Measuring the seasonal efficiency, or the amount of energy used during various times of the day or months of the year also is essential to evaluate the type of equipment or building component needed in a building.

I might interpolate at this point, Mr. Chairman, that the Manchester building that you heard spoken about by both of the previous testifiers, is one where we use the computer system to investigate ahead of time the design mode, and we are able to assist the designer to include his design from the standpoint of energy efficiency.

Finally, it is necessary to forecast the anticipated costs of energy and labor and to predict how the buildings will be used. None of these parameters are directly influenced by technical research, but all are essential in determining the total life-cycle costs.

As one can readily see, studying the life-cycle costs of an entire building, not just one component or system, presents a difficult task. Frequently, there are no data on the costs and benefits of building design alternatives. It is therefore hard to evaluate and validate the life-cycle costs of various building designs.

The NBS is currently addressing life-cycle costs in developing energy conservation performance standards for new buildings and energy budgets in support of the Energy Research and Develop-

ment Administration and the Department of Housing and Urban Development.

This research will provide a consistent format for addressing wide variations in climate, energy costs, and performance requirements of buildings across the United States.

The NBS also is conducting a facilities study to develop a methodology for estimating the life-cycle cost of consumer products. The application of this life-cycle cost concept to consumer products is a relatively recent occurrence.

Current activities of the NBS energy labeling and energy efficiency programs for major home appliances may be viewed as a thrust toward this direction. The life-cycle cost projects are expected to contribute to an improved consumer awareness in the marketplace and to establish a formal procedure for the analysis and evaluation of products as they relate to national goals. The NBS effort in life-cycle costing will assist the General Services Administration in making Government procurement of major home appliances.

The National Bureau of Standards, with the support of the Department of Housing and Urban Development (HUD), the Federal Energy Administration (FEA), and the Energy Research and Development Administration (ERDA), is working toward the development and implementation of energy conservation standards for all types of new buildings.

As early as July 1973, the National Conference of States on Building Codes and Standards, an organization of building regulatory officials from State and local governments, requested the NBS to develop an interim standard for energy conservation in new buildings which could be used as a basis for energy conserving building codes.

The conference wished to avoid the State legislatures' adoption of differing code requirements which could fragment the market for building materials and systems and add unnecessary costs to the construction process.

In response, the NBS developed a report on design requirements which was turned over to the American Society of Heating, Refrigerating, and Air-Conditioning (ASHRAE), with the recommendation that it be processed by ASHRAE and the American National Standards Institute, as a national consensus standard.

I have here a copy of this standard, and with the Chairman's permission will submit it to you.

Dr. WILLENBROCK. To further this work on energy conservation standards, NBS is now considering life-cycle costing in the development of an energy budget approach. An energy budget is the amount of energy needed per year to operate a building. It depends on the size, location, and use of the buildings.

A properly developed budget can lead to a greater saving of energy, greater freedom for the designer, and most cost-effective use of materials, systems, and construction procedures.

To develop a meaningful budget, the NBS is conducting research to predict the performance of a building throughout its useful life. With this performance prediction capability, the NBS will be able to evaluate better the life-cycle costs of buildings and various energy conserving design features.

In its construction of new buildings, the Federal Government is in a unique position to test and evaluate the application of available standards and new concepts for improved standards.

For example, advanced concepts for energy conservation in buildings are being explored at the GSA demonstration office building in Manchester, N.H., which you heard about. NBS assisted GSA in the design of the building and of the data collection systems to evaluate how well the building and selected energy conservation options perform. With the support of ERDA, the NBS plans to evaluate the future potential of the techniques employed at Manchester.

I have here a copy of a recent report on this building, and with your permission, Mr. Chairman, I will also submit that for the record.

Mr. GINN. Without objection, so ordered. The report will be retained in the subcommittee file.

Dr. WILLENBROCK. Now, if I can turn to the retrofit of existing buildings.

The technical challenges that face us with existing buildings are different than those encountered in developing standards for new buildings. Many of the existing building features are expensive to change.

A rational methodology must be available to examine each building as a specific case. Thus, improved life-cycle costing and technical procedures, methodologies, and measurement techniques are required to permit us to design, develop, and carry out cost-effective retrofit programs. A thorough understanding of the thermal performance of materials and components, as well as the ability to predict their performance, is essential if we are to carry out effective retrofit programs of existing buildings.

NBS has carried out several experiments related to the retrofit of residential buildings.

For example, at its site in Gaithersburg, Md., a 2,054-square-foot wood-frame house, constructed in the early 1950's, has been retrofitted over the past several years. By staging the various retrofit phases, that is adding insulation in selected places, adding storm doors and windows, studying air leakage, we were able to check out our computer-based calculation procedures. We were able to reduce energy requirements 52 percent and came within 10 percent of our predicted results.

We have also studied the thermal characteristics of a four-bedroom townhouse, first in our environmental chamber, and then outside under the prevailing weather conditions in Gaithersburg.

We validated our computer-based dynamic load simulation program to within 8 percent. More recently, this townhouse has been equipped with solar panels and we are evaluating a solar heating and cooling system.

Again we will compare these experimentally obtained results with our theoretical predictions.

While we have made considerable progress on retrofit techniques for residential occupancies, our efforts also are being directed toward research for larger buildings.

Again I can give an example from our own experience at the NBS facilities in Gaithersburg. We decided to use our own extensive facilities as an experimental base.

Our site contains $2\frac{1}{4}$ million square feet of building area and uses, on the average, 115 million kWh of electricity and 780 billion Btu of heating fuel annually. As a result of modifying our operating procedures, we reduced our energy use between fiscal year 1973 and fiscal year 1975 by 20 percent.

This energy savings translated to a dollar savings of approximately \$888,000 in utility bills over what they would have been if the conservation measures had not been enacted.

In addition to this low investment, immediate impact program, we also are involved in a long-range major retrofit program which include the installation of a computerized automatic central control system in one of our general purpose laboratory buildings. This system will control the heating and ventilating, and air-conditioning systems, and also will monitor all 10 air-conditioning zones, and energy flows. It is presently under construction.

We are predicting that, with this system, we will be able to operate our Gaithersburg facilities with 40 percent less energy than we used in fiscal year 1973. We estimate the payback period to cover the cost of computer equipment will be less than 3 years.

NBS is working with industry, the Building Owners and Managers Association, the Federal Energy Administration, and ERDA in developing an approach to evaluate the energy and use characteristics of existing buildings. This effort will give us data needed to provide rational methodologies for retrofitting.

We have had much experience in studying characteristics of existing buildings. We have worked with GSA and the Building Research Advisory Board support on a study on fire and live-loads of office buildings.

Previously, we have evaluated existing structures for their ability to withstand wind and seismic forces. In these studies, the individual characteristics of buildings selected are examined in a scientific manner with statistically valid sampling techniques. Applying such techniques to the energy requirements of existing buildings should enable us to develop procedures for various categories of buildings.

Despite these and other projects, practical, technical procedures are not yet available to develop systematically a comprehensive retrofit program for all types of existing buildings. Techniques need to be developed to classify existing buildings. Then efficient analytical and measurement methods need to be developed to identify those modifications which will be technically feasible and cost-effective.

In conclusion, I should like to state that NBS supports the development and use of life-cycle cost analyses in selecting energy-conserving design alternatives in the construction and renovation of all types of buildings. Also we believe that the development and demonstration of new and improved technologies for Federal buildings would provide valuable data and experience in the practical applications of such technologies.

In commenting on the policy and programmatic implications of H.R. 14415, the NBS defers to the General Services Administration and the Energy Research and Development Administration.

These comments conclude my prepared statement. I would be pleased to answer any questions.

Mr. GINN. First, Dr. Willenbrock, may I thank you most sincerely for your excellent statement. It is one of the most interesting statements I have ever heard as a member of this subcommittee.

During your testimony, Mr. Walsh and I were both amazed of the broad scope of your work in NBS, and we are certainly looking forward, along with the remainder of the country, I am sure, in receiving the benefits of the great work that you are doing.

So we really thank you for being here this morning.

Mr. Walsh, do you have any questions?

Mr. WALSH. Yes, Mr. Chairman.

I, too, want to congratulate Dr. Willenbrock on the work that is being done. It is simply amazing and reassuring, and the progress, if the progress continues, might make me change my mind about oil deregulation.

We seem to be moving fairly well in the oil field in many places.

I recently read about a new fuel that is being developed, and I am not sure that you heard about it, but again it goes back to the question I raised about insulation. This is a type of film, as I understood it, that could be placed on windows, and the amazing feature of it is that it would retain the heat that was in and would prevent any heat loss through the window.

It would also do the same with cold air, and yet it would permit the transmission of light. And this film could be made out of just about anything, even gold, and it was so thin that even using gold, the cost would not be prohibitive.

I was wondering if you had heard anything of this?

Dr. WILLENBROCK. I have. But the expert is Dr. Snell.

I would like to turn the question over to him.

Dr. SNELL. Yes, we have worked with this product. As you have indicated, there are a variety of such films and a variety of modifications one can make to existing window systems.

We have looked at several of these in the NBS site study that Dr. Willenbrock spoke about. The computer analysis of the effect of those films indicated in our case, with the window size orientation and percentage use, it would not pay off relative to other technologies that had a higher impact.

It is not to say that this technology does not bear closer looking into and, indeed, we are.

The durability of such materials need to be considered while looking at the life-cycle tradeoffs. We do not at this point have ready answers.

Mr. WALSH. That is a brandnew technology then, as I understand it, and do you really feel that you could pass judgment on it at this point, or is the technology too new to evaluate?

Dr. SNELL. I would say it is too early to pass judgment on it at this time.

Mr. WALSH. It certainly sounds like a very hopeful process.

If more research and development could be done on it, I think it would offer some interesting possibilities.

Dr. WILLENBROCK. One of the major efforts we have been making at NBS is developing test methods for determining the life-cycle performance. In this way you can predict how it is going to perform. It is setting the technical basis for the life-cycle cost analysis which

is basically an economic analysis. Unless you have the technical base, you cannot do the job well. And the development of those test procedures is where we feel our major efforts should be.

Mr. WALSH. Thank you very much, Mr. Chairman.

Mr. GINN. Mr. Ottinger?

Mr. OTTINGER. Thank you.

I, too, was impressed by the nature of your activities.

My basic question is, if you got all this work, very good work on developing standards for both energy conservation in new buildings and in retrofitting old buildings, why is it not being applied?

What are the obstacles, at least within the Federal Government, to having these life-cycles stand and having the application applied generally?

If you can have the kind of savings that you have achieved in your Gaithersburg work, and if that is capable of generalization, why are we not doing that in all Federal buildings now and can this legislation help?

Dr. WILLENBROCK. I cannot answer the question of why more is not being done in more buildings, Mr. Ottinger.

I can say that our technical results are promulgated widely throughout the Federal agencies. We run workshops for the building technologists of the Federal construction agencies. We make a systematic attempt to make sure that everyone knows what we are working on and what our results are, then these results should be applied throughout the Federal agencies. Also, by issuing reports, we try to promulgate our work more widely throughout the technical community.

Mr. OTTINGER. We provided in this legislation for a 5-percent cost differential for saving techniques in solar energy. That obviously ought to be a different percent for retrofitting than it should be for new buildings, it would seem to me, and I wish you would comment on that.

Five percent of the cost of the new building is going to be a substantial amount. Five percent of retrofitting may not be enough in and of itself to make it economically feasible.

Dr. WILLENBROCK. I am not in a position to pull a percentage out of the air. I would suggest that through the appropriate cost-benefit analysis, you might get an indication as to what factors are important in encouraging retrofitting buildings with energy conservation measures.

In the retrofit of our existing laboratories, we are collecting data, for basing judgments on the cost-effectiveness of our energy conservation practices.

Mr. OTTINGER. We are going to have to go into that.

Could you provide us with some data that would be helpful to us?

Dr. WILLENBROCK. Yes.

Just to make sure I understand what you are specifically concerned about what sort of analysis would lead to appropriate designs and construction decisions for retrofitting. Is that right?

Mr. OTTINGER. That is right.

The Federal agencies are reluctant to pay higher first costs for their building because it comes out of their budgets.

One of the devices we have considered is actually used in the legislation as it now applies—ERDA supplies that extra money. Even

though you are going to have a life-cycle costing. I am not sure of the degree of accuracy of GSA purchasing new buildings on a life-cycle cost basis because of this constraint.

It is clear that the 7 percent discount rate is a constraint, and I would like you to address yourself to that, too.

But what we provided in here is that ERDA will supply the 5 percent of the additional first cost of a Federal Agency installing conservation saving devices, including solar.

I think that may be enough for new buildings. I think that a different percentage rate ought to be applied for retrofits, and we ought to take some figure with the best information that we have available to us to make that provision.

Dr. WILLENBROCK. We concentrated our first effort on energy conservation standards in new buildings since they were the easiest to look at. We are now actively working in the retrofit area.

I might point out to you that in connection with the energy conservation standard issued last fall as a building standard, FEA had the Arthur D. Little Co. do a study on what the additional initial cost of meeting the standards would be.

Although there would be a saving of 40 to 60 percent on most buildings, the initial cost of the building would actually be somewhat reduced according to the Arthur D. Little studies.

There are enough savings as Mr. Eckerd stated in his testimony, so that you can more than pay for the additional insulation and other requirements for an energy conserving building. Not only were you saving energy in the 40- to 60-percent range and thus reducing the life-cycle cost but you were also reducing the initial cost of the building.

This result indicates that there is a tremendous amount that can be done by a good building design. This is an area in which we hope to make a major impact.

Mr. GINN. If there are no additional questions, again, Dr. Willenbrock, we want to thank you and Dr. Snell for your excellent testimony.

I would like to ask one more courtesy of you, if I might.

At some future date would it be possible for members of this subcommittee to visit your facilities and be briefed and see firsthand the work that you are doing?

I think it would be most interesting and very helpful.

Dr. WILLENBROCK. Yes, sir, we would be more than pleased to have you come. You set the date and we will arrange the tour.

Mr. GINN. Thank you.

We will be in touch with you.

Thank you very much.

It has come to the attention of the Chair that the House is scheduled to go into session tomorrow morning at 11 o'clock. We had planned to resume our hearings tomorrow at 10 o'clock.

Hearing no objection, then in an effort to get around our subcommittee meeting while the House is in session, the subcommittee will meet at 9:30 in the morning in room 2257.

The subcommittee stands recessed.

[Whereupon, at 11:42 a.m. the subcommittee recessed, to reconvene at 9:30 a.m., Tuesday, August 10, 1976.]

ENERGY CONSERVATION IN BUILDINGS

TUESDAY, AUGUST 10, 1976

HOUSE OF REPRESENTATIVES,
SUBCOMMITTEE ON PUBLIC BUILDINGS AND GROUNDS
OF THE COMMITTEE ON PUBLIC WORKS AND TRANSPORTATION,
Washington, D.C.

The subcommittee reconvened at 10:57 a.m., pursuant to recess, in room 2175, Rayburn House Office Building, Hon. Bo Ginn (chairman of the subcommittee) presiding.

Mr. GINN. The meeting of the Subcommittee on Public Buildings and Grounds will please come to order.

We are delighted again today as yesterday to have some very distinguished witnesses appear before us on the subject of H.R. 14415, and to present our very first distinguished witness, I have the pleasure of calling on the former chairman of this subcommittee, my great friend and leader, the gentleman from Wyoming, Mr. Roncalio.

Mr. RONCALIO. I want to thank the gentleman for those gracious words. I shall remind you that flattery will get you everywhere.

I am delighted to have an opportunity to say a few words about Paul Cronin. He is a former Member of the Congress with whom I have had the pleasure of serving on the Interior and Insular Affairs Committee and on a number of subcommittees during the 93d Congress. He has been in two fields important in helping this Nation solve some of its most difficult problems, one of fuel, and the other the proper utilization of the fuel energy sources that we have.

Mr. Cronin is the spokesman for the Solar Energy Industries Association, and he has his own company. I think what he has to say will be of assistance not only to this subcommittee, but to all Members of the Congress. I am hopeful that those of us who are responsible for the expenditure of Federal moneys, can take a look at what the various agencies are doing and can make some basic changes as to whose responsibility it is to see that Government dollars are best spent for solar pilot projects on which so much of our Nation's future energy savings depend.

So I am happy to commend, Mr. Chairman, our former colleague, Paul Cronin.

Mr. GINN. Before you begin your remarks, to further indicate the degree of popularity that you still hold in the Congress, may I present the ranking minority member, Mr. Walsh, who has a few remarks he would like to make.

Mr. Walsh.

Mr. WALSH. Thank you very much, Mr. Chairman.

I am pleased to welcome all of our witnesses here today for the second day of hearings on H.R. 14415.

Yesterday all of the witnesses favored the objectives of the bill although administration witnesses felt that existing authority can accomplish the same ends as those contained in this bill.

However, I feel that, and I am sure the chairman agrees, the administration is lax and complacent in moving forward with a comprehensive energy savings policy.

During questioning yesterday I asked the representative of ERDA just what ERDA is doing in regard to coordination with GSA in its construction of new buildings and renovation of existing buildings.

I was not too pleased to learn that although there is some coordination, ERDA primarily involves itself with its own facilities in energy conservation techniques. In essence, the agency involved in energy research and development is not necessarily talking with the agency involved in the construction of public buildings.

The bill before us today is designed to bring the two agencies together, among other things. The bill also directs GSA to step up its activities in energy conservation. The Federal Government uses 3 percent of the total energy consumed in the United States, and just lowering that percentage by just a fraction would mean a significant savings in energy alone. That is something that Congress can do for the country in its quest for energy self-sufficiency.

I, too, am delighted to welcome you, Paul. Paul and I came into the Congress at the same time, and I believe his loss as a Congressman has been sorely felt. He had a great background on the Hill from previous experience in the congressional office. He had a distinguished career while he was here, and I am sure that the field he is now in—the private sector, will bring together all of the talent he displayed so ably on the Hill.

Paul, we are delighted to have you here. I am sure that you know what the problems are, and we are very anxious to hear some of your solutions.

Mr. GINN. I think, Paul, you have been well presented for the record, and may I state Mr. Cronin is chairman of the Government Relations Committee of the Solar Energy Industries Association.

He is accompanied by Mr. John Blake, executive director.

Mr. Cronin, at this time you may proceed as you see fit. We are delighted to have you.

TESTIMONY OF HON. PAUL CRONIN, CHAIRMAN, GOVERNMENT RELATIONS COMMITTEE, SOLAR ENERGY INDUSTRIES ASSOCIATION, ACCOMPANIED BY JOHN BLAKE, EXECUTIVE DIRECTOR

Mr. CRONIN. Thank you very much, Mr. Chairman, and I should like to thank my two former colleagues for their very kind words and, particularly the comments which I hope to respond to in our question and answer period.

I appreciate this opportunity to present testimony on behalf of the Solar Energy Industries Association in support of H.R. 14290, "The Energy Conservation in Buildings Act of 1976." I had the pleasure of presenting testimony on title I of this bill before the Subcommittee on Energy Research, Development, and Demonstration of the Science and Technology Committee of which I am a former member.

As was stated then and previously, we believe that this legislation is one of three measures immediately important to the accelerated development and commercialization of solar heating and cooling. It is anticipated that within no more than 15 years with an accelerated commercialization program, solar energy can replace 1 million barrels of crude oil per day.

In fact, we can easily replace $1\frac{1}{2}$ million barrels with today's technology almost immediately, if the Government wants to do so.

The other measures needed are:

One: Added emphasis upon market development oriented activities in the solar demonstration program and in other programs;

Two: A tax credit incentive program to assist in overcoming "first cost" barriers, which we certainly hope will survive the conferees of the tax bill.

Title I of this bill requires the Energy Research and Development Administration to develop and demonstrate methods of calculating life-cycle capital and operating costs related to energy consumption for residential, commercial, and industrial buildings.

It is important that Government take the lead in establishing the methods used in life-cycle cost analysis and follow through by applying them to their own construction programs. In general, solar installation, as well as most conservation measures, increase the first cost of a building while reducing future operating costs.

The conventional means of analyzing such alternatives heavily discount future savings and thus, are heavily weighted in favor of minimum first cost.

Unfortunately, as the results of the Government's efforts to apply business methods to administrative decisionmaking, Government agencies have widely adopted methods of analysis which, by heavily discounting future savings, result in the agencies becoming as first cost conscious as the private sector.

Indeed, in many cases, the specific procedures adopted ignore the effect of probable future inflation upon future costs while at the same time recognizing the effect of the expectation of inflation upon interest rates and adopt discount rates which are consistent with the expectations of future inflation. Decisionmaking based upon these somewhat contradictory premises is particularly first cost sensitive.

Therefore, we recommend that language be added to title I of H.R. 14290 which will express the intent of Congress that life-cycle costs be analyzed in such a manner as to insure that they will not be overly sensitive to first cost and will recognize the realities of increasing cost of conventional energy. This intent should be repeated in section 205 of title II. A detailed discussion of this recommendation is attached as "Guidelines for Life Cycle Cost Analysis," and I would ask, Mr. Chairman, this also be included in the record.

Mr. GINN. Without objection, your attachment will be inserted into the record at this point.

[Item referred to follows:]

GUIDELINES FOR LIFE CYCLE COST ANALYSIS

There are many approaches to a life cycle cost analysis. Even though one may begin with the same capital cost addition for solar equipment or an energy conserving design and the same quantity of "conventional" energy resources saved

at the same current price, the methods used in making the analysis can profoundly affect the conclusion reached. In basic concept, the installation of a solar system is that of making a current investment upon which the investor expects to realize a return from savings over a period of time. This is similar to but in some important respects different from the similar investment concept in which the investor makes an investment today upon which he expects to realize a future profit. The difference is a philosophical difference.

One frequent analytical method used involves the determination of the net present worth of the future cash flow from savings or from added profits by discounting the future cash flows by a factor related to the value of money. Since this method involves discounting future cash flows, it is sometimes termed "discounted cash flow analysis." Since the discounting is compounded, generally year by year, the present value of savings or added profits which occur a substantial number of years in the future tends to become insignificantly small if the discount rate used is substantial. The general use of this analytical tool encourages the potential investor to think primarily in terms of only near-term benefits. In effect, it encourages the potential investor to be extremely first cost sensitive.

The difficulty with this method of analysis becomes much more pronounced when discount rates reflecting the "value of money" under today's circumstances are used, while at the same time, the general effect of future inflation and the specific effect of escalation in the cost of the commodity being saved is ignored. Interest rates today are relatively high, have been relatively high for some time and in all probability will continue to be relatively high. This fact alone is an admission of the probability of future inflation. Conceptually, it simply recognizes the fact that the decisions of an individual or corporation to "save"—meaning to forego present consumption for future benefit and future consumption—effectively determine interest rates. If the individual or corporation expects that inflation will continue in the future, he necessarily "demands" an interest rate which will somewhat more than offset future inflation. Otherwise, he might just as well go ahead and consume today rather than saving today and consuming tomorrow.

As mentioned above, there is a philosophical difference between the evaluation of a capital investment intended to produce a future savings and one intended to produce a future additional profit. There is much less certainty that future profits will escalate as a result of inflation than there is that future cost savings will escalate. In a competitive economy, when an investment is made which is expected to produce a future profit, one must allow for the probability that competitors will make comparable current investments and the possibility that their future pricing policies in a competitive market will be predicated upon the initial cost of the investment rather than upon its inflated future replacement cost. The investor making an investment to reduce costs, in this case by reducing consumption of commodities whose market value is expected to escalate, is much more certain that the future savings will, indeed, escalate.

A method of analysis which is much less sensitive to first cost is one in which the cumulative cost of ownership represented by the sum of first cost and interest on the unamortized or undepreciated portion of first cost over time is compared with the cumulative savings over time with the total time interval extended to encompass the lifetime of the investment. Since the unamortized or undepreciated portion of the investment is subject to interest charges at going rates, the value of money is, indeed, recognized. However, it is not exaggerated. Furthermore, this approach fully recognizes the future position of the investor rather than substantially ignoring it as does the "present worth" method when used in association with relatively high discount rates.

Since the "present net worth" method of analysis has been used by many in the private sector and, we understand, is now used by Government agencies in very many cases, we believe that it is important that H.R. 14290 specifically point out that it is the intent of Congress that the life cycle cost analyses to be performed will be of the second or "cumulative cash return" type.

Specifically, it is recommended that a new Subsection (b) be added to Section 101 of Title I of the present text as follows and that the present Subsection (b) be redesignated as Subsection (c) :

"Section 101(b). It is the intent of Congress that the life cycle cost of a solar or other alternative energy system or of energy conservation measures be considered as the sum of their initial cost, their annual cost of maintenance over the

lifetime of the installation and the annual cost to the Government of borrowed funds applied to that portion of the initial cost which has not been amortized by savings in conventional energy costs at the end of each year. In calculating savings, the effect of inflation in costs generally, as well as the effect of expected escalation in conventional energy costs, is to be considered. A life cycle cost savings shall be determined as having been realized whenever analysis indicates that the sum of the annual cost savings over the lifetime of the equipment or of the building to which it is to be applied, whichever comes first, exceeds the cumulative cost of ownership."

Section 205 of Title II should contain an added sentence as follows :

"The standards promulgated for the analyses required shall recognize the intent of Congress as expressed in Section 101 (b) in Title I."

DETERMINING "NATIONAL VALUES" IN LIFE CYCLE COST ANALYSIS

BALANCE OF PAYMENTS SAVINGS

The gross heat content of a barrel of imported crude oil is approximately 5.9 million Btu and its delivered cost to the U.S. is approximately \$12.00 per barrel. This converts to \$2.03 per million Btu. However, we must consider that energy savings from conservation or the energy produced by a solar system or other alternative energy system apply at the point of use in the structure. Thus, the gross heating value of the barrel of crude oil must be reduced to offset losses in refining and transportation and further reduced either by combustion losses when the refined product is burnt in a heating system or by the losses encountered in converting petroleum products into electric energy and transmitting the electric energy to the load. The sum of these losses varies from approximately 40 percent to approximately 65 percent.

Therefore, the potential balance of payments savings per million Btu saved by conservation or produced by a solar or other alternative system ranges between \$3.38 and \$5.80. The average of this range is \$4.59 per million Btu.

We may now discuss the effect of the \$4.59 per million Btu balance of payments savings upon the economy—and thus, its "National value" and its value to the Federal Government. The present foreign exchange system has been described as a "managed float." This means that the relative values of the various currencies are allowed to change over time in order to compensate for balance of payments deficits or surpluses. If imports rise or other factors are encountered which would result in a balance of payments deficit, the national currency loses value. This reduces the price in foreign currency of goods available for export, making the nation's exports more competitive in world markets and increasing export volume, while increasing the domestic price of imports, and, in the case of those imports which are not essential, reducing import volume. The increase in the domestic price of imported goods is directly inflationary. It is unquestionably true that reducing the volume of energy imports will reduce the rate of inflation for these reasons.

In the case of many major oil producers, the system does not work well since the income derived from the sale of petroleum at cartel prices substantially exceeds that needed to pay for their imports and large payments balances accumulate. This is also inflationary and ultimately, probably more so than in the case of devaluation of the currency. The balances accumulated by the oil producers represent the export by the U.S. of a portion of the "spread" between production and consumption.

This "spread" is the source of capital funds. In a free economy, such as ours, the consumer does not willingly tolerate reductions in its consumption such as would be needed to increase the "spread." Thus, the large payments surpluses accumulated by some of the oil producers reduce the availability of capital, which has the immediate effect of increasing interest rates for that remaining available which is, in turn, inflationary. At longer range, since high interest rates and limited capital availability reduce investments intended to expand capacity or increase productivity, shortages occur which are inflationary.

As a final irony, inflation in the United States and in the other countries who are customers of the OPEC cartel leads directly to price increases by the cartel which serve to further exacerbate the problem.

The inflationary effects of excessive energy imports, discussed in somewhat cursory fashion above, have a real and direct impact upon the Federal Government by increasing the interest rate upon the Federal debt. Furthermore, monetary policies which are applied periodically by the F.R.B. to restrain inflation and prevent the development of accelerating inflationary spirals have a depressing effect upon the economy—reducing Federal revenues and at the same time, increase Federal interest costs.

The purpose of this discussion has been to demonstrate qualitatively that excessive imports of foreign energy are highly “leveraged” in their effect upon the economy, upon inflation and upon the Treasury. It would require a most sophisticated “economic model” to accurately quantify these effects. Considering the extent to which they are “leveraged,” I believe it is fair to assign a “National value” to the imports saved equal to their cost. As derived above, this is \$4.59 per million Btu.

THE VALUE OF “INDEPENDENCE”

In previous testimony, we have pointed out the importance of reducing the undue influence by the oil producers upon our National policies, which is implicit in the extent to which energy imports have become essential to our economy. If we believe that the economic power acquired by the oil producers will never be used, the “value” of reducing this power is nothing. If we fear that this power may be used in a manner adverse to our interests, the “value” of reducing it could be very large. Any judgment made must be subjective.

Recognizing these and other “values” we proposed that, in the analyses required to be made by Title II, the annual costs of the energy conservation and/or solar or alternative measures taken be credited with \$5 per million Btu saved and that this value be escalated year by year to the extent determined as applying to commercial energy costs as called for in proposed Section 101(b) in Title I.

BIOGRAPHICAL DATA

PAUL W. CRONIN

Mr. Cronin is a member of the Board of Governors of the Solar Energy Industries Association and Chairman of the organization's Government Relations Committee.

He is President and majority stockholder of Sunsav, Inc., Lawrence, Massachusetts, the exclusive world-wide licensee of the manufacturing and marketing rights of the ITEK Corporation's solar collector and related solar technology.

As a former United States Representative to the 93rd Congress, Mr. Cronin was a member of the Energy Subcommittee of the Committee on Science and Astronautics. He was a co-sponsor of the Energy Reorganization Act of 1973, the Solar Heating and Cooling Demonstration Act of 1973, and the Solar Energy Research, Development and Demonstration Act of 1974.

SEIA is a trade association formed by manufacturers, contractors, consulting engineers, architects and interested individuals to foster and accelerate development and marketing of solar energy conversion systems through public, governmental and industry communications. Another objective is to develop public interest positions with respect to legislation and regulation and to advise opinion leaders in government, industry and the scientific community.

Mr. CRONIN. In turning to title II of the bill we would suggest additional language to clarify the actions to be taken after life-cycle cost analysis. Title II, section 202, as now written does not mandate any specific actions to be taken dependent upon the results of the life-cycle cost analysis required. The “National Value” issues discussed below should be recognized in the decisionmaking process. Therefore, we recommend the addition of subsections (3) and (4) to section 202 of title II as follows:

II.202(3): In preparing the life cycle cost analyses required in subsections (1) and (2), the national value of energy conserved and energy produced from alternate sources shall be recognized by crediting against the cost of ownership

of the conservation, solar, or other options, the sum of \$5 per million Btu conserved or produced during fiscal year 1977 and in subsequent years, the sum of \$5 per million Btu times the escalation factor determined in accordance with section 101 of Title I.

II.202(4): Whenever the life cycle savings, calculated in accordance with section 101 of title I and including the credit provided in section 202(3), exceed the life cycle costs of the conservation, solar or other options so calculated, the Administrator shall include such special energy features (or require the head of the Federal agency having jurisdiction over the building to include such features) in the design of such building.

The new subsection (4) proposed limits the required adoption of the "special energy features" to instances in which they are cost-effective. Therefore, there is no need in section 202 for the percentage of cost limitation incorporated in section 203 as now written to be applied. [As now written, section 203 would require that the special energy features be adopted regardless of the results of life-cycle cost analysis if their inclusion did not add more than 5 percent to cost.]

Title II, section 203. As now written, this section relates to other Federal buildings besides the largest buildings covered in section 202. It requires that the optional energy features be included in the design of the covered buildings if the analysis indicates that they will reduce energy consumption, provided that their inclusion does not increase costs by 5 percent.

The present section 203 does not require that the result of the life-cycle cost analysis be favorable to the optional energy features. We agree that, as a matter of policy, modest conservation or alternative energy expenditures are warranted in the case of the smaller buildings, even if not fully cost justified.

At the same time, cost-justified expenditures should not be limited to 5 percent or any set percentage of total cost. Therefore, we recommend that section 203 be rewritten as follows:

Section 203.—Whenever the Administrator determines, with respect to any Federal building which is proposed to be constructed or renovated and to which section 202 does not apply, that the inclusion of special design features for energy conservation, solar heating or cooling or both, or total energy systems would reduce the use of fuels and energy for the estimated useful life cycle of the building by five percentum or more, he shall cause a life cycle cost analysis of capital and operating costs for such building to be made with and without such features.

(1) Whenever the life cycle cost savings calculated in accordance with section 101 of title I and including the credit provided in section 202(3) exceed the life cycle costs of the conservation, solar or other options so calculated, the Administrator shall include such special energy features (or require the head of the Federal agency having jurisdiction over the building to include such features) in the design of such building.

(2) In the event that the life cycle cost analysis required by subsection (1) does not indicate that the life cycle cost savings exceed the life cycle costs of the conservation, solar or other options; but the analysis indicates that the cost of the design and construction of a new structure with the inclusion of such features will not exceed by more than five percentum the corresponding cost which would be incurred if conventional design were used, or in the case of a structure to be renovated, will not exceed by more than seven and one-half percentum the sum of replacement cost of the structure to be renovated and the corresponding renovation cost which would be incurred if conventional design were used, the Administrator shall include such special energy features (or require the head of the Federal agency having jurisdiction over the building to include such features) in the design of such building.

Mr. GINN. Mr. Cronin, before you get further into the statement, may I announce there is a regular quorum, and if it meets with the approval of the other members of the subcommittee and the distinguished witnesses, we will recess for 15 minutes to give us a chance to run over and vote and come back.

Mr. CRONIN. Perfect timing.

Mr. GINN. We will be back in 15 minutes.

Mr. CRONIN. Thank you, Mr. Chairman.

[Short recess.]

Mr. GINN. The subcommittee will resume the hearing.

Mr. Walsh is on his way back, therefore, Mr. Cronin, will you please proceed.

Mr. CRONIN. Thank you, Mr. Chairman.

You will note that we have added a provision relating to the smaller buildings covered by section 203 which effectively exempts those in which potential energy savings are less than 5 percent of total energy use from the requirements for life-cycle cost analysis. This is reasonable to avoid the burden imposed by requiring life-cycle cost analysis in instances in which the expected gains are minimal.

In the case of renovations (retrofits), we have added replacement cost of the renovated structure to the cost of renovation in establishing the base cost and have changed the percentage from 5 percent to 7½ percent in defining those cases in which conservation or other options are to be adopted, even if not cost justified.

It should also be pointed out that energy conservation measures and/or the addition of solar energy equipment to Government facilities provides special national benefits which the government can consider in life-cycle cost analysis. Such benefits include reduced dependence upon foreign energy sources, favorable impact upon our balance of payments, reduced pollution and stimulation of the domestic economy.

The Federal Government, in its decisionmaking process, can and should take the "value" of these national benefits into consideration. A detailed discussion of determining some of these national values is attached to this testimony.

Section 202 which provides for design competitions for energy conservation, and presumably solar energy installations, in commercial and industrial buildings states that, "the top 20 per centum (of the competition) shall be certified by the administrator as suitable for inclusion in preliminary designs for the construction, modification, or renovation of Federal buildings under this Act."

Our concern is locking in only those companies found suitable by the Government. Some mechanism must be provided for other companies to be included.

I would like to conclude my testimony by pointing out to the subcommittee the distinction between energy conservation and solar energy. Solar is a renewable energy resource produced by the user which reduces the need for depletable energy resources.

Thus, the individual or institution who installs solar equipment becomes an "energy producer" rather than just an "energy consumer." For this reason we feel that equal emphasis should be placed on solar energy in the language of the bill as is placed on energy conservation.

Mr. Chairman, I would be happy to answer any questions of the subcommittee.

Thank you.

Mr. GINN. Thank you very much, Mr. Cronin.

On behalf of the subcommittee, I just want to thank you for your very able statement. It is obvious from learning more, but from some of our colleagues on the subcommittee, and from listening to your statement, that you are well qualified to testify on this subject today.

Mr. WALSH, do you have any questions?

Mr. WALSH. Yes, Mr. Chairman, thank you.

I was interested in doing some research, just last night and today, that the whole process of life-cycle cost analysis is not new in your theory—it was developed by Adam Smith about 200 years ago in a treatise entitled "Wealth of a Nation." He did not quite call it that, but it is interesting that we are coming around to that way of thinking.

I, too, want to congratulate Mr. Cronin on his testimony, and my question relates to something that you may not be able to answer, but several years ago when I served on the Public Service Commission in New York State we took a trip over to, I believe it was Connecticut, to inspect a fuel cell development that was going on over there, and I was wondering if you could tell us anything about the state of technology of the fuel cell, are you familiar with it?

Mr. CRONIN. Yes, I am.

Probably when you are talking about Connecticut, you were at the United Technology to see it, and I know they have been the——

Mr. WALSH. It was an aeronautical firm, as I recall.

Mr. CRONIN. Right. They been doing a great deal of work with NASA on the fuel cell.

Mr. WALSH. Right.

Mr. CRONIN. And the development of utilizing—splitting water to get the hydrogen to run this fuel cell. It is still relatively expensive, but I would say that that is definitely going to be a source of energy supply some 10 to 20 years down the road for a significant portion of our Nation's energy, but at the moment it is not economically feasible, say, other than the space effort.

Mr. WALSH. As I recall, the fuel cell could take any form of energy and turn it into electrical energy.

Mr. CRONIN. I believe that that is theoretically possible, but I do not think they have been able to do it quite that way yet. At the moment it is basically a hydrogen operated cell.

Mr. WALSH. Do you feel that the state of solar energy is such that it is practical to install it in new homes?

Now, up in our section of the country, where I know in Syracuse we have had about 2 days of sunshine in the last 60 days, we are a little concerned about it.

Mr. CRONIN. Right, very definitely.

In fact, the effective use of solar goes back even further than Adam Smith, because we have been able to utilize it successfully in many parts of the world for many years.

My company, for example, has five complete systems that we sell, domestic hot water for space heating assist, space heating, swimming pool heating, and for air-conditioning. We sell the complete package.

and in each case the package is designed to pay for themselves with the energy they save from 5 to 7 years.

Now, your area in Syracuse is not unlike mine in New England, and we are pretty much under the same sun path, and in that area you can today provide 5 to 7 year payback for this type of equipment.

For example, I started to mention at the beginning of the testimony that if the Government chose to put forth a national policy today to save a million and a half barrels today, and if you will remember the project independence goal was a million barrels by the end of the early 1980's, could do that by just mandating that the Government would pay for domestic hot water heating to be in every house in the United States.

Today we use over a billion and a half—

Mr. RONCALIO. Say that again, that this Government would mandate what?

Mr. CRONIN. To put a solar domestic hot water heating system in every house in the United States, because today hot water accounts for better than a million and a half barrels of oil, and so solar hot water is 200 years old, and there are many nations that get all of their hot water from solar.

We could do that in the United States. There are some portions where we would not get quite 100 percent. We would probably get 80 to 90 percent, but it would still be cost-effective, and in the process of doing it, since it is a labor-intensive industry, and basically a small business, as opposed to a large systems approach to thinking, it would have tremendous impact on unemployment and, also, on the tax income to the United States of America, let alone the money we would save on the balance of payments.

So there are many parts of solar that are not only available today, but have been available for a couple of hundred years, but as long as America has the lowest energy prices in the world, which we still do, and as long as a great deal of our populous are fat, dumb, and happy when it comes to energy, that is not going to be our national policy.

I do not wish to indicate that solar is 100 percent here. There is still a great deal of solar that is in the future, that is, for ERDA, that is, air-conditioning, things of that sort that do need additional R. & D. but there is much that—

Mr. WALSH. I recall a few years ago, when we first got concerned about energy, I did have some research into the effect of—use of pilot lights and hot water heaters, and stoves, and working with the American Gas Institute, I believe it was called, we were able to show that if you could turn out all of the pilot lights in this country that use natural gas, or any other kind of gas for pilot lighting, you could probably save about one-half of 1 percent energy, or one-half of 1 percent gas, and here we are talking about saving 3 percent in all Federal buildings, and I think that is something, too, that could be done very readily, by the use of automatic sparkers, and things like that, to ignite them.

Mr. CRONIN. It is a very significant savings.

Mr. WALSH. No further questions.

Thank you, Mr. Cronin.

Mr. GINN. Unfortunately, it appears we have another quorum.

Do you possibly have time to give us another 15 minutes to run over and vote?

Mr. CRONIN. I would be glad to wait.

Mr. GINN. We extend our apologies to all of the witnesses, and we are most anxious to conclude these hearings, and if you can bear with us, we shall return within 15 minutes.

Mr. CRONIN. Thank you, Mr. Chairman.

[Short recess.]

Mr. GINN. The subcommittee will resume its hearings.

Mr. Roncalio, do you have questions of the witness?

Mr. RONCALIO. Thank you, Mr. Chairman. Just a few.

I am not clear about the facet of this bill which would have ERDA develop and demonstrate methods of calculating life-cycle capital and operating costs related to energy consumption for residential, commercial, and industrial buildings.

Why do you want that in this bill, the creation of training in life-cycle cost analysis in section 104, so that you can come up with a formula for applying grants for construction of those places?

Mr. CRONIN. Well, frankly, the position of the association is that if GSA were to utilize this life-cycle costing, they would then wind up putting in solar and other energy-saving installations in each of our Federal buildings.

Mr. RONCALIO. May I ask at this point then, should the GSA be given this program, rather than ERDA?

Mr. CRONIN. The Association's position is that they should both be involved.

My personal position is that I think GSA is so far superior to any of the other Federal agencies, and I say this from personal experience, and I would like to just digress for a minute on that, when I was here in the 93d Congress we worked very hard on the Solar Heating and Cooling Demonstration Act.

Mike McCormack and myself, and with high hopes, at the time, hoped the Congress would have ordered installed 1,200 units within the year using existing technology, and off-the-shelf equipment.

Well, now, better than 3 years later HUD has 16 units in the field of those 1,200, and they have gotten additional money since then.

By contrast, my company just recently won a bid with GSA on the new Federal building in Manchester, N.H., that is being used as an energy demonstration.

We wound up having the highest performance and lowest cost in the system. GSA, through their building service people, that is run by Larry Breder, in region I, did just an incredible job from the beginning to the end, they understood what the system was all about.

They are used to building buildings, and they know how to get them done well. They are also very efficient in letting out contracts, perhaps because rather than any other segment of the Government they have been dealing with the private sector, and getting buildings constructed.

And, they had some appreciation for what our problems would be, and when they occurred, they worked with us to resolve them.

We get that whole GSA problem out of the way in a matter of weeks.

To deal with HUD for a project that would be worth 1 percent of what this cost would take a small businessman, and do not forget that

95 percent of the solar energy companies are small businessmen, would take them 3 months to fill out HUD's paperwork, and most small businessmen cannot do it.

So they are operating to kill the industry, as opposed to helping. GSA recognizes the facts of life, and I cannot say enough good words for how GSA, in just our personal experience, did an absolutely incredible job in solving this problem.

Mr. RONCALIO. I hope we can give serious consideration to your statement. I think ERDA has enough to do on the nuclear front, on the synthetic fuels front, and on the short-term problems. I think perhaps GSA ought to take this on as its particular part of the overall picture.

Mr. CRONIN. If I could respectfully suggest to the subcommittee, ERDA very definitely has a function, as its title indicates, research and development, and I think in the solar area, in addition to those you have mentioned, in high tension for general generating facilities, things of that sort. ERDA very definitely has a role to play with research and development, but when it comes to demonstration, I do not think the Government has a unit that can demonstrate things in the building area any better than GSA can, and if there is some way that the Congress can get GSA involved in these demonstrations I think it is going to help the country move forward a lot faster than we are today.

Mr. RONCALIO. Mr. Chairman, I should think, in conclusion, that we might have the subcommittee staff prepare a possible new section for this legislation to give GSA that demonstration role and the necessary funding, and maybe we could hear from GSA people on that, as well.

Mr. CRONIN. We would be glad to work with you, Nancy, in anyway we can.

Mr. GINN. Mr. Cronin, in view of the laudatory remarks concerning General Services Administration, do you think then that we are being reasonable in this legislation in requiring GSA to take the lead in conservation of energy in Federal buildings?

Mr. CRONIN. Again, the association's position is that they should be equal.

My personal position is very definitely GSA should have the lead, because I think that what we are talking about in this bill, and what we are talking about in most of the areas of the Government involved with solar, is existing off-the-shelf technology, so in effect, what you are saying is that you are buying a heating system, or you are buying a water system, and the fact that it is run by solar is incidental.

It is a heating or water system. There is no great research and development technique. There is no great expertise needed to purchase these things.

GSA has been in the business of buying heating systems and water heaters for years. They can evaluate them pretty easily, and quickly, and I think they usually get a pretty good value for their dollar spent.

So I think that we are talking about existing technology, very simple technology, and I personally feel that GSA is admittedly qualified to do it.

Mr. GINN. Is there any question in your mind that industry is not in a position to respond adequately, intelligently and financially to the new technology that is being developed?

Mr. CRONIN. Not at all. In fact, just the reverse. I think that we have found over the last 3 to 4 years that many people like myself started into this industry, expended a large amount of their own dollars, without any Government assistance, and have really fought the front lines in anticipation of the Government making a commitment to really solving the energy problem.

We in solar have a major contribution to make, and it was put to me by a member of our Association in California recently.

He said:

I feel kind of like the Marines that landed on the beach, you are there with your rifle in hand, and all of a sudden all of the boats take off, and there is no air support, and you are kind of left on the beach by yourself.

I think many people in the industry feel this way. They feel that, okay, we have an energy crisis, and an embargo a few years ago. The Government said, we are really concerned about the future of America. We want to make sure that we have an adequate supply of energy.

So as a result they went out and invested their own money in solar, they reached the beach, but the Government forgot to come in with the second tier of support.

So I think industry is ready, but the question is whether Government is ready.

Mr. GINN. I note in your testimony you have suggested that in the case of renovation the figure of 5 percent be changed to 7½ percent in defining those cases in which conservation or other options are to be adopted.

Will 7½ percent be adequate to include solar energy equipment in retrofitting buildings?

Mr. CRONIN. Yes, provided that the total concept is considered.

For example, if you have a very energy inefficient old building, and you just add solar to it, you are going to just waste about as much as you did with your old system, so assuming retrofitting would include insulation, things of this sort, to make the building more energy efficient, yes, but during one of the recesses, one of our future witnesses, and I had a brief discussion about another way that this problem could be solved, and that is to include operation cost, as well as your capital cost, and once you do this, of course, you wind up very quickly getting the 5 to 7½ percent being more than adequate, because then you are talking about replacing the increasingly expensive cost of fuel with a fixed capital cost and no fuel charge in effect.

Mr. GINN. Does either of our staff counsel have questions?

Mr. Walsh, do you have any additional questions?

Mr. WALSH. No.

Mr. GINN. Mr. Cronin, you have been very patient in understanding our dilemma this morning with regard to the constant interruptions you have had, but nevertheless, you made a very able statement and presentation, and on behalf of the subcommittee, again we want to express our appreciation to you.

Thank you very much.

Mr. CRONIN. Thank you very much, Mr. Chairman, I appreciate it.

Mr. GINN. Our next witness really needs no presentation to this subcommittee, in that he has appeared before us on numerous occasions during the time that he served with the General Services Administration.

The members of the subcommittee will recall that he served at one time as Commissioner of the Public Buildings Service of the General Services Administration.

We all recall that he was with GSA for approximately 20 years, and if anyone understands the inner workings of GSA, we certainly think it is our next witness, Mr. Walter Meisen, who is presently with the Architect and Engineering Firm of Daniel, Mann, Johnson & Mendenhall.

Wally, you certainly should feel free to proceed as you see fit, and we are delighted to have you here.

TESTIMONY OF WALTER MEISEN, VICE PRESIDENT, DANIEL, MANN, JOHNSON & MENDENHALL, ARCHITECTS AND ENGINEERS

Mr. MEISEN. Thank you very much, Mr. Chairman.

I am Walter Meisen, and I am vice president with Daniel, Mann, Johnson & Mendenhall, which is an international architectural engineering and design firm.

I was formerly acting commissioner of PBS, and assistant commissioner for Construction Management at GSA, and in those capacities I was directly involved with GSA's energy conservation programs.

I wish to say that I am very happy to be here today to offer some testimony on this bill, and I wish to also say that I strongly support the intent of this bill.

In fact, I wish that when I had been at GSA that this bill had been law. It would have made some of the things that we were trying to do in GSA a lot easier to do.

I would like to make just a few brief comments before answering any questions you might have.

Mr. GINN. Please proceed.

Mr. MEISEN. There is considerable discussion in this bill about standards for energy conservation in buildings, and I would strongly urge that performance oriented standards be considered, if they are included as part of this bill.

I would say that about 90 percent of the savings in energy that have been achieved by GSA have been as a result of challenging existing prescriptive standards of the way you should do things. Any new prescriptive standards would have the difficulty of going out of date as quickly as some of the current ones are going out of date. I think we should always stress we are looking for performance, and performance probably being the conservation, or the savings of energy. If we write goal-oriented performance specifications or performance goals we will have a much better chance of achieving economies and breakthroughs in technology than if we specify precisely how we should save.

I think solar collection is probably one of the best examples. There are no prescriptive standards as yet, and I would hope that we never have any prescriptive standards on how solar energy should be utilized.

I think we should allow the technology to develop the most efficient uses. I strongly urge consideration of performance oriented goals, rather than prescriptive goals.

Second, I would urge the passage of the strong support that this bill is attempting to achieve in the solar energy field.

However, I would further urge that this be in the form of stimulating current usage of existing technology, rather than continued emphasis on research and development.

I believe that today, as our previous witness testified, there is the technology available to achieve major savings in energy conservation simply by the widescale use of solar energy as it exists today.

I would think that any program which initiates a large buy of solar collectors from the industry would be very beneficial in this regard.

I think that one of the major shortcomings that we have today in most industries involved in solar energy are concerned about initiating mass production techniques, because technology is moving so quickly that they may be producing yesterday's collectors, and new ones may have developed.

As a result, very few firms, if any, have gone into a major investment to try and mass produce, and yet with mass production I think the cost of solar collectors could be decreased considerably by factors of one and three.

Third, I would like to speak just briefly on the whole concept of life-cycle costing as it is outlined in this bill.

We have found in GSA that we could design a building that was more than 50 percent efficient over the current building designs, with a reduced first cost.

What I am saying is that we can save over 50 percent of the energy and have a building that costs no more per square foot than previous standard buildings had cost.

This is not to say that we cannot make a building cheaper—what I am concerned about life-cycle costing is that if we were to design a totally energy efficient building and, let us say, we were able to do that for 30 or 40 percent of the energy that a standard building today might utilize, then it would still be possible to make that building cheaper.

What we found was that by leaving out certain light fixtures, and reducing the size of air-conditioning equipment, which is saving you money, we could offset the cost of additional insulation and additional energy conserving features, and come out with a wash within a same cost building.

Now, if I were a developer I might go and take all of the credits, leave out the light fixtures, reduce the temperature for controlling and heating, and not put back any of the pluses the insulation, and the correct orientation, and come out with the cheapest cost building. It would be cheaper than a building today that is very energy inefficient. What I am saying to you is that I am concerned that when we start using life-cycle analysis people will get down to a very efficient building, but then they will leave out the insulation, leave out the double glazing, and say it is too expensive—I am going to take all of the credits, I am going to lower the heating, raise the air-conditioning temperature, reduce the lighting, but I am not going to put in the insulation, and what we will end up with is a very cheap building that is very energy inefficient.

So I think the most important point to be made is that there is no reason why an energy efficient building should cost any more than typical buildings cost today.

Once we make those economies, however, we have to be careful that we do not go and then strip all of the bonuses out and just take the credits. This is a danger of life-cycle costing.

I would suggest that you consider relative life-cycle efficiency of buildings, as opposed to the strict cost of the total life cost of a building. I think if this is done you can readily see which building is more energy efficient.

You can put a cost standard on energy, and make a pretty reasonable management decision as to which building design should be accepted.

Finally, I would agree again with our previous witness that I think you should make a correction to page 9, on line 24, and I have that written out, and that correction would be merely to delete the word "or" before renovation and insert "and operation" after renovation so that you are considering the cost of the design and construction, renovation, and operation of the building before you add the 5 percent, and I think the 5 percent would be reasonable.

I have no further comments, Mr. Chairman, except that I would be very happy to answer any questions the subcommittee might have.

Thank you.

Mr. GINN. Certainly we want to thank you, Mr. Meisen, for your very practical and enlightening statement. I have enjoyed hearing you testify once again.

Mr. Walsh, do you have any questions?

Mr. WALSH. Thank you, Mr. Chairman.

I did not realize that Mr. Meisen had left the General Services Administration, and I would like to take this opportunity to wish him the best of good fortune in his new venture.

Mr. MEISEN. Thank you.

Mr. WALSH. We certainly appreciate the time you have taken to come here today and testify, and I think I would agree with you when you talk about your concern about life-cycle cost analysis, I think what you are saying is that what many of us have said about competitive bids all along, that if you go to competitive bidding you get the cheapest possible product, and sometimes it is not the best.

Mr. MEISEN. It is not the best, right.

Mr. WALSH. The other question I wanted to ask related to Mr. Cronin's testimony, and I think we are fortunate in having you here with your background to comment on this.

I refer to section 202, which states that the top 20 percent of the competition shall be certified by the Administrator as suitable for inclusion in preliminary design for construction, and so on.

Mr. Cronin said our concern is looking at only those companies suitable by the Government, some mechanism must be provided for other companies to be included.

How would you feel about that?

Mr. MEISEN. Yes, I would share his concern. I do not think there is any monopoly on good ideas and good concepts, and I would think that the Government, as well as the private sector, should feel free

to utilize any concepts that prove to be reasonably economical in the life-cycle range for inclusion.

What this smacks of is a prequalified list, and I think that that would be detrimental, but I do think that the bill should encourage the widest dissemination of any ideas that develop from such a competition, without limiting to any percentage the ideas, but any of the ideas that prove to be cost-effective in energy conserving in a life-cycle analysis should be given wide publicity at Government expense.

Mr. WALSH. Thank you, very much, Mr. Meisen.

I have no further questions, Mr. Chairman.

Mr. GINN. Mr. Oberstar?

Mr. OBERSTAR. Thank you, Mr. Chairman, and thank you, Mr. Meisen, for a very practical presentation.

Mr. MEISEN. Thank you.

Mr. OBERSTAR. One that will be very, very helpful to this subcommittee, particularly me, in view of your previous perspective on this issue, and I was encouraged by your comments that at the outset you now wish that way back last year when we were first holding these hearings that the legislation had been enacted and put into force—so do I.

I wish we had been able to move expeditiously and put this legislation into practice.

I am particularly interested in your support of the concept of using existing technology rather than spending a great deal of time and effort and money on developing new technology.

Is that the conclusion you have drawn as a result of the hearings, as a result of your experience from within GSA, or is it a part of your liberation?

Mr. MEISEN. No. It is a feeling I have long had, Mr. Congressman.

I have a very strong faith, and I have always had a strong faith in the private enterprise system, and one of the best ways to get research and technology going is to buy a product and then cause competitors to try and get in on that market, and they will do the research and development for you, for a piece of the market.

The problem is, there is no market today, where we are demanding much research and development, and yet it is awful hard to see the light at the end of the tunnel—no one is buying collectors in any volume, and as such I feel there is enough very practical equipment available today, and capable of being produced that would save considerable energy, and if we just bought the model T, the rest of the developments will come, just as a result of that buy, but in addition we will have gained much, just from the model T.

We will still be so far ahead of ourselves than we are now.

Mr. OBERSTAR. That is my feeling.

Now, as we explored this issue in the course of our hearings last year, one of the questions that repeatedly came to the fore was that there is not enough capacity in the industry to produce solar equipment and, second, there are not enough engineers experienced in solar energy installation, and its counterments to be able to handle them.

I think our subsequent hearings on that testimony demonstrated that there are available engineers, and that there are, at least there would be production capacity in industry to produce enough solar collectors, or whatever other equipment would be required.

Now, my question is, supposing we were to authorize a program starting with, initially, 10,000 Federal buildings—say, 10,000 of the largest Federal buildings, to retrofit them.

Is there, in your opinion, enough capacity in industry, or would there soon—how much time lag would there be in order to get up to speed?

Mr. MEISEN. I think the capacity is easily achieved. Most solar collectors are not the exotic thing we would like to make them out to be.

I would think that anyone producing radiators for General Motors, for example, could readily convert if they had the inclination, to producing solar collectors.

I am not sure that we should say we should retrofit 10,000 Federal buildings. I think one of the more practical initiatives might be in the hot water heating that was mentioned earlier, or in the furnishing to homeowners of collectors by the Government at a reasonable cost.

I was just figuring out the amount of money that is currently included in the writeup of this bill. It would probably buy 20,000 domestic hot water heaters that were solar-oriented. I know, we all have the feeling that the Government has wasted \$37 million on many less fruitful projects, and maybe a reasonable expenditure of a purchase of a volume of collectors, and ask the homeowner, either through a tax credit, to pay for them, or to give them to homeowners and have them pay for the installation and insulation of their homes in exchange for that, might be the double-edge sword that gets us both producing capability and quite a bit of energy saving, and I think you could help a lot of social programs, just say, on public housing, or on families under a certain income, who then would have their electrical bill reduced, or oil bill reduced, but I think a purchase—a major purchase by the Federal Government would be a great incentive to pushing the solar industry to where it could be.

Mr. OBERSTAR. I fully agree with that.

I think we ought to press ahead in the way you have just suggested, but also in retrofitting Federal buildings, and not just looking prospectively to the future of insisting all future Federal buildings be equipped with this. One final thing that I am not quite clear on is your distinction between life-cycle costing and life-cycle efficiency.

Mr. MEISEN. I am talking about a relative efficiency, Mr. Congressman.

In other words, if you go through the full life cycle of analysis rather than putting a dollar amount for the cost of energy in each year over the life of the building, start out with saying this one design which costs x dollars more, and costs the same amount of money is 30 percent more efficient on energy use than the alternate design. Based on that 30 percent more efficiency, if you took a payback period of 10 years, what kind of costs for energy would you have to assume to pay it off in 10 years, and you can say, well, gentlemen, if it is 30 percent more efficient, even if energy stays at the current cost, it will pay off in less than 10 years, or you could make some management judgments on how much energy could have to go up in order to pay off that extra cost in a 10-year period, or what is the reasonable amortization period for the investment. However where life-cycle costs is challenged is in the arbitrary numbers that people put out, to say what electricity is going to cost in the year 1978, and someone can

always argue with that because it is crystal-balling, but you cannot argue with relative efficiency, that this design is 30, 40, or 10 percent more efficient than the alternate design.

And based on that relative efficiency, how much would energy have to increase in cost in order to pay back in a reasonable period of time, and then management can make, or Congress can make an assumption that it is reasonable to assume that the cost will go up that much.

I think you will find that that 5 percent will be right on the nose if you include the total life-cycle efficiency of the building.

Mr. OBERSTAR. Thank you very much, Mr. Chairman.

Mr. GINN. Mr. Meisen, like the other distinguished witnesses who have testified, and who are waiting to testify, we certainly want to apologize to you for the interruptions that you have had, and thank you once again for your appearance today.

It has been very, very helpful to the subcommittee.

Mr. MEISEN. Thank you.

By the way, if I could make one closing statement.

In your opening remarks you mention about the Federal Government using 3 percent of the energy in buildings, and that is, of course, true.

I hope that the Congress will never overlook the impact of demonstrations—that the demonstration by the Government has on the private sector.

I can tell you that my present company right now would not think of designing a building that exceeded the goals established back in GSA, and most owners are insisting that the same conservation measures that are used in many Government buildings today are incorporated in their designs, so while the Government only uses 3 percent, the impact of Government onto the private sector is immense, and so any savings you can make in Government will very much feed back to the private sector.

Mr. GINN. That is encouraging.

Thank you very much.

Mr. MEISEN. Thank you, Mr. Chairman.

Mr. GINN. Our next witness is Mr. Frank Scaduto, director of governmental affairs, Sheet Metal Workers International Association. Mr. Scaduto is accompanied by Mr. Bernard McMonigle, associate director, research and education, and Mr. Kenneth Peterson, legislative representative of the association.

We are delighted to welcome you gentlemen to the subcommittee, and ask that you proceed as you see fit.

You may read your statement in its fullness, or you may have it inserted in the record, and speak to us extemporaneously.

TESTIMONY OF FRANK SCADUTO, DIRECTOR OF GOVERNMENTAL AFFAIRS, SHEET METAL WORKERS ASSOCIATION; ACCOMPANIED BY BERNARD McMONIGLE, ASSOCIATE DIRECTOR, RESEARCH AND EDUCATION, AND KENNETH PETERSON, LEGISLATIVE REPRESENTATIVE, AFL-CIO

Mr. SCADUTO. Thank you, Mr. Chairman.

This is a statement from the Sheet Metal Workers International Association before your Subcommittee on Public Buildings and Grounds, on H.R. 14290, the Energy Conservation in Buildings Act of 1976.

Of course, this is somewhat similar to H.R. 14415, if I recall, and the energy crisis of recent years, and the spiraling fuel costs which characterize it, have demonstrated the need for energy conservation and solar energy.

The current imbalance between the domestic supply and the demand for fuels and energy is likely to continue unless a Federal effort is made to test, utilize and promote conservation measures and new forms of energy. This effort can be promoted greatly by the demonstration of energy conservation technology in Federal buildings.

Over 25 percent of all the energy used in the United States is consumed in the industries in which sheet metal workers are employed, and primarily in the heating, ventilating, air-conditioning systems, and related systems in space heating.

The modification of these systems in public buildings, as well as the private sector can be accomplished at relatively low cost, and make a huge dent in the Nation's energy consumption.

The project independence blueprint estimates that the equivalent of almost half a million barrels of oil per year can be saved by 1985 through an accelerated energy conservation program in residential and commercial buildings.

Among the energy conservation options readily available for Federal buildings are as follows:

Exchangers to transfer heat from exhaust air, before it is exhausted to the atmosphere, to incoming fresh air in schools, hospitals, and other buildings where health considerations require a heavy air turnover.

Installation of heat pumps to perform both the heating and cooling functions at a considerable savings of electricity.

The replacement of constant volume air circulation systems—which vary temperature to provide constant comfort level—with variable volume systems—which hold air temperature constant, and vary volume to maintain comfort level.

And also solar energy which is nonpolluting, inexhaustible, and can become inexpensive. However, the full potential of solar energy will not be realized until the cost of solar hardware is reduced through mass manufacturing.

To increase public demand for energy conservation and solar hardware, a program of Federal assistance is necessary. This assistance should include, but not be limited to, tax credits and loans for the purchase and installation of energy conserving and solar equipment, direct subsidies to assist in the purchase of energy conserving and solar equipment, and Federal grants and contracts to the research community and manufacturers for the development of energy conservation and solar technologies.

Crucial to the promotion of energy conservation is the increased utilization, in Federal buildings, of these technologies. The energy conservation incentives provided in H.R. 14290 are a step in the right direction.

The Sheet Metal Workers International Association has become active in energy conservation and solar energy not only because it makes sense for America's energy needs, but because even figured conservatively, energy saving modifications would put thousands of construction workers back to work.

Energy conservation and the use of solar energy can have a large impact on unemployment. It has been estimated by the Stanford Research Institute that one-fourth of the dollars invested in solar heating and cooling will go to the labor costs of installation.

In addition, there will be many jobs created fabricating the collectors, storage tanks, ducting, and allied equipment necessary for a solar installation.

A Federal program to promote energy conservation and the use of solar energy will not only aid in achieving energy independence, but it will help to put Americans back to work.

Dollars now being spent on expensive fossil fuels from abroad would be better spent reducing joblessness by harnessing less expensive, inexhaustive energies at home. It is national folly that, while the need for energy conservation is so great, the skilled craftsmen, who make energy efficient buildings a reality, sit idle.

As a result of our interest in energy conservation, our union has taken several steps:

We are educating our membership to the possible impact of energy conservation and solar energy. At a recent conference of our union's business agents, we devoted nearly 2 days to energy developments and the part our union can play.

We commissioned the Stanford Research Institute and the Mitre Corp. to make studies of the impact on the sheet metal industry of solar development and energy conservation. A copy of both of these studies has been presented to every Member of Congress.

Our national training fund, recognized as one of the best of occupational training programs, devotes much of its curriculum to energy conservation. Instructors are given special training in solar systems.

The fund has donated \$40,000 to the construction of a solar heated apprenticeship school in Detroit. Another \$50,000 is being spent on a training film on the installation of a solar collector.

Additionally, the fund has donated \$50,000 to Colorado State University for the installation of sophisticated monitoring equipment being used in its solar energy research.

As you know, the AFL-CIO has been working for legislation to establish America's energy independence. The Federation's Executive Council has endorsed financial assistance for alternative sources of energy and "to projects to conserve energy usage including construction of energy efficient buildings and retrofitting old ones."

The AFL-CIO joins with the Sheet Metal Workers International Association in endorsing H.R. 14290, the Energy Conservation in Buildings Act of 1976, and urging swift, positive action by this committee and the full Congress.

The passage of H.R. 14290 will help achieve the goals of fossil fuel conservation, solar energy development and new job opportunities for Americans.

Mr. Chairman, I do not think when Ken Peterson was introduced that it was mentioned he is legislative representative of the AFL-CIO, and I want to make that a matter of record.

This is the extent of our remarks. I would be happy to answer any questions the subcommittee may have.

Thank you.

Mr. GINN. Thank you very much, Mr. Scaduto.

We have 10 minutes to get over and vote, and would it greatly inconvenience you to give us time to go and vote and come back?

Mr. SCADUTO. No, sir.

Mr. GINN. We will apologize to you, and we shall return very shortly.

Mr. WALSH. Mr. Chairman, with your permission, I would like to make a closing remark, because I cannot come back.

Mr. GINN. By all means.

Mr. WALSH. I will catch up with you.

I would like to express to our witnesses here, Mr. Scaduto and Mr. Peterson, and Mr. McMonigle my appreciation for the interest of the sheet metal workers, and what they have shown in this field.

I have copies of the Mitre study, and the Stanford Institute study, and I find them to be a very, very valuable research background for all of the questions on energy, and I am well aware of the interest, and I am well aware of the commitment that the sheet metal workers have to this field, and I want to congratulate you on this.

I am sorry I will not be able to get back, but again, if there is anything I can do to be of help, Mr. Peterson is well acquainted with my office, and I am sure he can find the door.

Mr. PETERSON. Thank you very much.

Mr. SCADUTO. Thank you, Congressman.

Mr. WALSH. Thank you.

[Short recess.]

Mr. GINN. The subcommittee will reconvene at this time.

Mr. Oberstar will be here momentarily.

I do want to take this opportunity to thank you for your very, very fine presentation.

It was certainly apparent from your testimony that you are interested, and have many, many qualified people who are certainly up to what it takes to do what is necessary to conserve energy in the solar energy field.

I particularly find it impressive that your union, with its own funds, and on your own initiative, have conducted these remarkable studies, which I would like to have placed in the record, if it meets with your approval, sir.

Mr. SCADUTO. Yes, it does.

Mr. GINN. They are very good.

We would appreciate those prepared by the Stanford Institute, and the Mitre Corp. They will be retained in the subcommittee files.

Your industry obviously is leading the way for the Nation on the development of solar energy, and we certainly want to thank you for being here today.

May I ask if you have any difficulty coping with solar energy needs and the technology required for the installation of such equipment?

Mr. SCADUTO. Do we have any what?

Mr. GINN. Any difficulty.

Mr. SCADUTO. No, we have no difficulties whatsoever.

Mr. GINN. By passing this legislation then, we would help put back to work a rather substantial percentage of your members who are presently unemployed, as I understand the situation.

Not only would we contribute substantially to resolving the Nation's energy problem, but also assist in resolving our recession problem as well.

Do you think the legislation would be beneficial in that respect?

Mr. SCADUTO. That is true, it would no doubt be beneficial.

Mr. GINN. Mr. Oberstar, do you have any questions?

Mr. OBERSTAR. Thank you very much, Mr. Chairman, and again my thanks and appreciation to President Scaduto and your association, and particularly, Ken Peterson, who is an old, old friend of mine, for a valuable and very useful contribution to the work of this subcommittee. Those two studies that the sheet metal workers commissioned, which were presented to our subcommittee last year in the course of hearings that we held, I thought were exceptionally well done and an extremely valuable contribution.

And, as I recall from that testimony, one of the two studies—and I do not remember which one it was—demonstrated that if the existing technology alone were used, without adding new technology, and applied to the type of legislation we are considering here today, retrofitting existing Federal buildings, and outfitting new Federal buildings with existing solar energy technology, that there would be a \$2 billion industry created, and 135,000 new jobs created, and that is, as I recall, about the equivalent of the existing dues paying membership of the sheet metal workers, am I correct?

Mr. SCADUTO. That is true, Congressman.

Mr. OBERSTAR. Well, with that kind of evidence at our hands, moving ahead on a program that uses existing technology, that we do not need a vast and massive investment of Federal funds in some new and as yet untried technology, I just think that we ought to be moving ahead, we ought to be enacting legislation that will do that, give the Federal Government, in a big way, a leadership role in the solar energy field, and creating jobs, stimulating an industry where there has been as much as 25 percent unemployment among the people that you represent.

Mr. SCADUTO. Yes, Congressman.

I would like to add to that just this, that everything you say is true, the fact that we do have hundreds of thousands of Federal buildings today that by simply retrofitting the existing heating and air-conditioning systems there would be a tremendous savings in energy use. I made reference in my statement, when we say retrofitting, we are talking about getting a constant volume system which is running all the time to the installation of valves that are on the market today, and we have companies talking to Federal agencies, trying to get Federal buildings retrofitted—they have valves, and when they install them into the present system they go from a constant volume to a variable volume, which reduces the cost of energy in all of these buildings.

Skilled people are not working today. They are available, and a lot of related industry, including the sheet metal workers, are—we have companies who have manufactured, patents, and manufactured these valves, and they are trying to sell them today, and they have had some success.

Everything is here. We do not need any more research. The market is there, the opportunity is there. All we have to do is just start to move in that direction.

Mr. OBERSTAR. I fully agree, and I am glad to have you before our subcommittee today, and thank you very much for your strong support.

Mr. SCADUTO. Thank you, sir.

Mr. GINN. Thank you.

I fully agree also with your assessment, that we need to get on with the job. Mr. McMonigle and Ken Peterson, do either of you gentlemen have comments that you would like to make?

Mr. PETERSON. No, I would just like to thank the chairman and the members of the subcommittee for the consideration they have given to us and the members of the staff for their cooperation.

Mr. GINN. Ken, we thank you. You have been around the Hill for years, enlightening us on what we ought to be doing for the American people, and it is good to have you here with the presence of all three of you, and we thank you for being here.

Again, we apologize for the interruption.

Mr. SCADUTO. Thank you.

Mr. GINN. Our next witness is Mr. John T. Malarky, marketing manager, residential construction, Glass Division, PPG Industries, Inc.

Mr. Malarky, I want to certainly express our gratitude for your patience and understanding of the situation we have had with regard to the interruptions today.

We are very much appreciative of your being here today to comment on this legislation and, at this time, I invite you to proceed as you wish.

**TESTIMONY OF JOHN T. MALARKY, MARKETING MANAGER,
RESIDENTIAL CONSTRUCTION, GLASS DIVISION, PPG INDUSTRIES,
INC., PITTSBURGH, PA.**

Mr. MALARKY. Thank you, Mr. Chairman.

I have a very brief statement, and I am sure we can be done in less than 10 minutes.

Mr. Chairman and members of the subcommittee, thank you for the opportunity of testifying before the subcommittee on H.R. 14415.

My name is John Malarky. I am a marketing manager for the glass division of PPG Industries, Inc.

PPG Industries is a major U.S. corporation with principal businesses of flat glass, chemicals, and coatings, among others.

I am here today to address the general provisions outlined in H.R. 14415, the Energy Conservation in Buildings Act of 1976.

My testimony deals with general support of the intent of H.R. 14415, plus an additional item which we believe will help to make H.R. 14415 considerably more effective for conserving energy.

On November 15, 1973, another employee of our company first testified before the House on the provisions of the Solar Heating and Cooling Demonstration Act of 1974. Much progress has been made since then in all energy areas, yet at the same time, some of the concerns we raised then are still not resolved.

In November 1973, national concerns for energy conservation in buildings, and for ways to conserve energy, not only in residential housing, but public and commercial buildings as well, were just beginning. At that time we stressed that the domestic flat glass industry was directly involved in energy conservation, as well as in the new field of power generation through solar energy.

Technologies existed then, as now, to accomplish vast energy conservation to a greater degree, but there was, and still is, the problem of how to accomplish the job. Although cost of energy has gone up, the availability of some fuels, such as natural gas, has gone down.

Also it is still true that in the construction of most buildings, energy efficient design is sacrificed for lower initial costs.

The flat glass industry in the United States has taken the lead for the last several years in promoting the benefits of more efficient and energy conserving use of glass in both new construction and repair or remodeling of existing buildings and homes.

We have presented ample evidence to correct the erroneous notion, developed 4 years ago, that glass in a building is energy wasting, and we have continually stressed the efficient use of all building materials in our contacts with Federal, State, and local government bodies.

Some people in the United States will voluntarily construct energy efficient buildings because it is good for them, or it is more efficient over a long period of time, and/or they should do these things to help the country out of the energy crunch. Others require additional motivation.

We believe the provisions in H.R. 14415 will again direct the attention of building professionals, Federal, State and local energy coordinators, and others influential in the energy area, to the need for clear direction on the subject of energy conservation in buildings.

We wholeheartedly support this intent. As new energy conservation methods are refined, we must place greater emphasis on a coordinated approach to energy savings.

We have a recommendation which we think will coordinate the drive to achieve meaningful energy savings. We believe that the application of an energy budget concept for the new construction of public and commercial buildings, and a combination of energy budget and all other incentives for residential housing, will be an effective way to deal with one of the Nation's most critical energy concerns.

The concept of energy budget is well known, easily understood, and available for use now. It simply means that just as buildings are built based on a financial budget expressed in dollars per square foot of floor area, so can they be built based on an energy budget expressed in energy consumption per square foot of office space, based upon occupancy, geographical location, building use, and control of building systems to insure optimum operation.

Two important facts point to the need for standards regarding energy conservation in building construction:

No. 1: In considering the importance of energy efficient design, the one factor most frequently missed is the multiplier aspect of energy conservation.

Here, for example, is a fully researched and proven concept that shows how energy savings can be compounded: For every unit of electrical heating energy saved through conservation, about 6 to 10 fewer units of fossil fuel have to be located and mined to make that unit of electrical power available at the point of use.

The savings result because less energy is lost through energy consuming processes such as mining, fuel combustion, and generation and transmission of electricity through powerlines.

If fewer units of coal or oil have to be converted to electricity, then fewer units of fuel have to be searched for, dug or pumped out of the ground, and transported to the combustion site.

Then, the process of compounding the exact savings from the reduced need for such operations is complex, because there are obviously many variables.

However, as much as one-half of the energy now consumed in buildings could be saved, and new buildings could be designed to use even less.

No. 2: The requirement of energy budget construction does not restrict or prohibit the use of any building materials. Thus, we create no artificial material shortages, we do not mandate the commercial use of specific products, and we do not unnecessarily limit the architect's freedom to design structures which are aesthetically, as well as functionally, compatible with the human environment.

The flat glass industry and other industries associated with building construction feel a certain frustration regarding energy conservation. In spite of all the laws that have been passed, or how many financial incentives are offered, there are still some individuals who are not concerned with energy conservation and ultimately energy independence.

It is equally important to encourage energy savings in federally supported buildings as well as in other areas of construction.

All other programs, including the efficiency and life-cycle costing studies proposed in H.R. 14415, would be reinforced by an energy budget approach.

With the addition of design energy budget concepts, coordinated energy savings will be easier to achieve. The key to successful implementation of the energy budget concept is understanding and cooperation from both Government and industry upon a coordinated and flexible program.

The possibility of yet another energy crisis will never be far from this Nation unless we take action in support of energy independence.

PPG Industries, and others in the flat glass industry have, from our experience in all forms of building construction, reached the conclusion that there is no single incentive that will successfully motivate building owners.

If H.R. 14415 can help us to come more quickly to an implementation of an energy budget program for the building industry, then let us move as quickly as we can to that point.

Thank you for inviting us to appear here today. We will be happy to respond to any questions.

Mr. GINN. Thank you very much for your excellent statement, Mr. Malarky.

I noticed that you mentioned the proposed energy budget will be a more effective way of saving energy.

Would you care to be more specific and expand on that point, please?

Mr. MALARKY. Yes, sir, by more effective we mean the energy budget would apply a maximum energy consumption per square foot of floor area per structure type, depending on the structure and the geographical location.

Within this constraint the architect and design professionals must build a functional building to meet the owner's requirement, using whatever materials and systems he wishes and whatever aesthetic appearance he wishes, yet the end result will be a structure which can be operated within the design energy limit.

Thus, you put a lid on your energy consumption. You have a known point from which to start.

An energy budget program can be designed to start at a rather high level, with a lower level as a goal. For example, you will recall the GSA experimental building in Manchester, N.H., that was mentioned earlier. The amount that was specified for that building was 55,000 Btu's per square foot of floor space. This could represent the ultimate goal.

We are suggesting you start out with something considerably higher than that, and over a period of time program it so that the energy budget per building declines to the desired goal.

We feel that this is a very positive way of achieving energy savings, and will allow system tradeoffs as required by the design professional to achieve that energy level.

Mr. GINN. Can you give us an example of an actual building which uses this tradeoff concept, and what the outcome was?

Mr. MALARKY. Well, sir, there are a number of buildings, three of which I can speak. The IBM building in Chicago, Ill., which in fact uses a considerable amount of glass, about 65 percent of the exterior walls, was found to be one of the more energy efficient buildings in the Chicago area.

Another building, and I just came across this recently, is the Richard B. Russell Federal Office Building and U.S. Courthouse in Atlanta, which is expected to consume no more than 55,000 Btu's per square foot of floor area. This building has 40 percent glass in the exterior wall.

Finally, the best example and one we are rather proud of is in Dallas, Tex., the First International Tower Building. It has an entire facade of reflective high performance glass, 65 percent of which is vision area. Yet it is the most energy efficient building in the Dallas area as reported in an article in the Dallas newspaper, and stated by the engineer on the job, Herman Bloom.

We analyzed the building through our computer analysis that we have at PPG Industries. Herman Bloom confirmed the energy level that they were working at was between 65,000 and 70,000 Btu's annually per square foot floor area.

Typically, office buildings have been found to operate between 150,000 and 200,000 Btu per square foot on average. So this is a

significant savings and was accomplished by using tradeoffs between the lighting system, heating and cooling system, and the glass facade.

If you are able to use tradeoffs, and use them effectively, we believe that you can design a highly energy efficient building.

I would like to introduce at this point a brochure which PPG uses. It is a Building Cost Analysis, a computer analysis service which computes the life-cycle cost of building alternatives. We are currently updating it to include energy budget calculations.

If I may—just one more point, Mr. Meisen mentioned earlier that we can achieve energy efficiency by choosing energy efficient buildings over other alternatives. An energy efficient building could easily be one that complies with an energy budget, and the other alternatives represent typical buildings which do exist in construction today.

Mr. GINN. Mr. Malarky, without objection the document will be made part of the record following your testimony.

[See page 79.]

Mr. GINN. Without objection I think I have seen this building in Dallas which has reflective glass. This is a building that appears as you view it to be mirrors.

Mr. MALARKY. Yes, a very reflective building, a mirror-like facade.

Mr. GINN. Most unusual, and it is a beautiful building, as well as being very energy efficient.

Mr. MALARKY. I will take the opportunity to give you a picture that we have.

Mr. GINN. Yes. That is the building I have seen.

Mr. Oberstar, do you have any questions?

Mr. OBERSTAR. Thank you, Mr. Chairman.

And again, a very helpful statement, Mr. Malarky, brought from an industry in a practical standpoint, and I think it is very useful for the subcommittee.

Mr. MALARKY. Thank you.

Mr. OBERSTAR. I would like to explore a little further your understanding or meaning of the term "energy budget construction."

Just what do you understand by that, what does industry mean, and—

Mr. MALARKY. Energy budget construction, as I perceive it, is a building which is designed and constructed to operate at a predetermined energy consumption level.

This is a design criteria, not necessarily an operation criteria.

Mr. OBERSTAR. Well, how does this compare to one of the terms we used in the bill under consideration, "life-cycle cost analysis?"

Mr. MALARKY. It compares very favorably with it, and it supports it.

Mr. Meisen mentioned the point that under life-cycle costing the building owner can get credits by reducing his lighting and reducing the heating. However even if he does not take advantage of putting in energy-efficient components the life-cycle cost looks good. In this case life-cycle costing is building a building cheaper. By leaving it open ended and not having an energy constraint for that building, an owner will be able to do that, but if he has an energy budget which he had to meet then he must put those energy saving components into the building.

Mr. OBERSTAR. Are you suggesting that the subcommittee ought to include in this legislation a directive that Government building con-

struction should reflect energy budget construction requirements and life-cycle costing, and life-cycle efficiency as standards itself?

Mr. MALARKY. Yes, I do. I would prefer that they are introduced initially on a voluntary basis, but an energy budget should be established for people to have goals and objectives to strive for. In a period of time—maybe 5 years—the program should be reviewed. If the voluntary phase is not being achieved, then something else should be considered.

Mr. OBERSTAR. Is your industry in the business of producing solar energy components?

Mr. MALARKY. Yes, we are.

Mr. OBERSTAR. And also in the insulation and the glass?

Mr. MALARKY. Insulation, glass and building facade components.

Mr. OBERSTAR. And I have seen some equipment used in the space program that is highly effective as insulating material.

In fact, in one demonstration I saw you could put your hand into a rather relatively small, say about 8- by 10-inch container which was so well insulated that the heat from the hand made it feel as though you had it over a stove.

Now, are we very far away from developing that kind of insulating material to be used on a commercial basis, to be used in home construction, and office building construction?

Mr. MALARKY. This is one area PPG does not participate in, the opaque insulating material, such as fiberglass and wall insulation materials. We do not make that. We have a Fiberglass division, but they do not make insulation material; per se, for building construction.

Mr. OBERSTAR. I see.

Then in your solar energy component do you see any problem with industry being able to supply the equipment that would be required for the kind of legislative program that we are suggesting with this legislation?

Mr. MALARKY. Absolutely not. We have been ready for years.

Mr. OBERSTAR. You would be able to, with on-the-shelf technology, without new programs being developed, swing right into the introduction and production?

Mr. MALARKY. We are currently in full production. We are producing—we are not producing many, but we do have the facilities at this time, and we are ready to go. We have substantial production capability. I agree with the other testimony, that there is sufficient capacity in the industry to handle this easily.

Mr. OBERSTAR. And you can provide the need for residential homes, as well as office buildings?

Mr. MALARKY. Yes.

Let me make one point here.

We make the solar collector component. We do not make the entire system at this time. But I believe that the system is available per se, as has been mentioned earlier, through plumbing and heating supply stores as standard off-the-shelf items.

Once the collector is made available, the next step of completion is a system that could be a heating and cooling contractor job.

Mr. OBERSTAR. That is a key element. I want to get at it.

The problem has repeatedly been raised that we do not have capacity in the industry to produce and meet the needs, and we have got to develop new technology.

Mr. MALARKY. No, sir.

Mr. OBERSTAR. You are saying it is nonsense, you are ready to go, you are producing, and just give us an order.

Mr. MALARKY. Congressman, I think the problem is what people perceive as being ready.

We have the technology today. We have pool heaters. We have water heaters. We can heat space. The problem we may have is that we do not have off-the-shelf solar equipment which can provide total heating and cooling. This is what I would call the next phase of development. Space heating and water heating is available, it is here now and it is ready.

Mr. OBERSTAR. And the mass production market would give you the opportunity to lower your costs, I would assume?

Mr. MALARKY. I believe so. We would be happy to try that out.

Mr. OBERSTAR. We are going to try to help you, and thank you very much, Mr. Chairman.

I think your testimony has been very, very helpful.

Mr. MALARKY. Thank you.

Mr. GINN. I surely want to agree with your testimony, which has been very helpful, and I certainly want to commend you for being an excellent witness, and commend your company for the job that you are doing to help conserve energy. We hope by the enactment of this legislation, if we are successful, to give industry that necessary impetus to move ahead with the mandate to agencies such as GSA, to let us go on with the job.

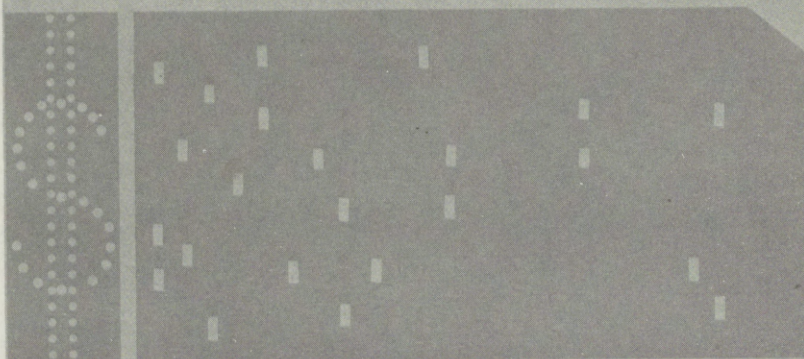
If there are no further witnesses, the subcommittee stands adjourned.

[Whereupon, at 1:12 p.m., the subcommittee adjourned, subject to the call of the Chair.]



GLASS
RECOMMENDATIONS

**BUILDING COST
ANALYSIS**



PPG INDUSTRIES

TECHNICAL SERVICE REPORT **NO. 105-B**

"The economic success of a project is generally determined in the first few weeks of preliminary design..."

R. D. Steyert

Architectural Economic Consultant

"Architectural Economics: the Concept of Total Cost". Architectural Record, Oct. 1970.

INDEX

Cost Analysis Objectives	
Introduction	2
Comfort & Economy	
Thermal Comfort	3-4
Condensation Control	4
Building Cost Analysis	4
Architectural Economics	
Total Building Costs	5-6
Comfort/Productivity	5-6
Building Cost Analysis Service	
How to Obtain a PPG Glass	
Conducting Building	
Cost Analysis	7
Sample Data Input Sheets	8-9
Sample Computer Printout	
Sheets	10-11
Sample Building Cost	
Analysis Summary	12
Discussion of Results	13
Appendix	
Instructions for Completing	
Data Input Sheets	14-17
Performance & Cost Factor	
Data Tables	18-19
Sample Data Input Sheet	20
References	21
Architectural	
Representatives	22

INTRODUCTION

This cost analysis service has been developed to help architects, builders, engineers, and owners understand the effect of fenestration on costs and to encourage detailed objective study of available glass alternatives by design professionals.

This service is offered at no charge and is designed to illustrate the effects of various high performance glass products on heat gain and loss in buildings, occupant comfort and productivity and the overall conservation of energy thereby increasing the return on investment for the owner/tenant.

Early in the project design stage, it is essential to obtain a first approximation of the effect of glass performance on construction and operating costs using, if necessary, cost estimates and rough project design criteria. A rough economic analysis obtained with this computer program may reveal substantial profit opportunities and indicate that a more detailed professional study of glass selection best suited to the needs of the project is warranted.

Economic advantages together with comfort and aesthetic advantages are obtainable on many projects through careful correlation of fenestration design and glass selection with environmental control systems at an early stage of project development. Often the comfort and aesthetic advantages far out weigh capital or operating cost justification. The economic potential of comfort environment related to total building costs is discussed on pages 5 and 6. Information on how to obtain a PPG

Building Cost Analysis on your own building appears on page 7.

Sample data input sheets listing building costs and design criteria are shown on pages 8 and 9. These data input sheets are keyed to a programmed computer analysis of overall owning and operating costs. Sample computer printout sheets on pages 10 and 11 show the computer's analysis of data provided on pages 8 and 9. A sample analysis summary and discussion of results appears on pages 12 and 13. Careful selection of input data will enable the PPG computer to evaluate the effect of several glass alternatives upon owning and operating costs. Dollars per square foot of rentable floor area is the cost unit used. The influence of fenestration on installed and annual operating costs for mechanical heating and cooling equipment is indicated by the output data. The influence of fenestration on comfort and people productivity is illustrated on pages 5 and 6.

**The input data required has been simplified to make the program easier and quicker to use.*

The program permits reliable glass performance comparisons for rectangular buildings with uncomplicated vertical facades.

The program does not evaluate partial shading by nearby buildings, large overhangs, etc.

For complex structures, rough comparisons can be made if the professional uses a "rectangular simulation" as the basis for input data.

TRADEMARKS:

The following registered trademarks of PPG Industries, Inc. are included in this publication: Solarban, Twinlow, Spandrelite.

BEAUTY, COMFORT AND ECONOMY IN GLASS-WALLED BUILDINGS

The comfort and well-being of people in buildings is important to designers, owners and tenants. Architects and engineers find that people respond to a comfortable environment. Owners/tenants sensitive to this response allocate 30-45% of the building budget to comfortable environmental control through heating, cooling and lighting systems. Only 1% to 2% invested in glass can exert a significant influence on the effectiveness and cost of the heating and cooling equipment. Realization is growing that people work, play, learn and live more effectively in a place that provides visual beauty, thermal comfort and piece of mind. A satisfying place to plan with inspiration, to learn with insight, or to work productively can be created by the design professional with existing knowledge and material.

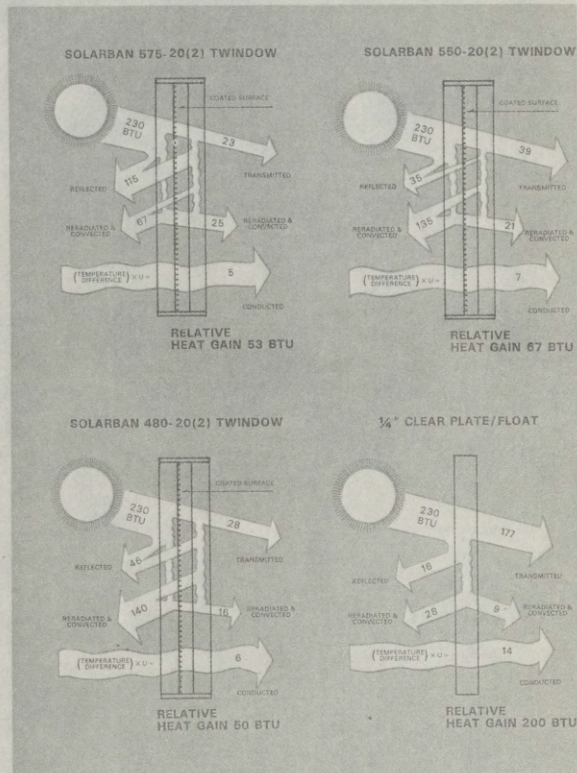
The most comfortable and aesthetically attractive building may also be the most economical and profitable.

Clients insist that comfort be provided economically. Properly insulated buildings work with mechanical heating and cooling systems to provide comfort for people within reasonable building and operating budgets.

Careful glass selection for a given project is important to building beauty and to comfort and economy. The professional performing a specific objective study based on real project costs and upon his chosen design criteria helps to insure that windows will complement the building's mechanical heating and cooling systems.

There is growing evidence that comfort has a favorable influence on productivity. The greater the comfort of building occupants (employees), the greater their productivity. As clients become more aware of these long range profit possibilities, the demand for greater comfort in a pleasing atmosphere increases.

Fig. 1—Summer Heat Gain Performance Comparison OUTDOORS—89 F INDOORS—75 F



SUMMER

Thermal comfort can be increased in the summer with PPG environmental glasses chosen to reduce directly transmitted solar radiation. Tinted glass, TWINDOW and SOLARBAN TWINDOW units all can help to re-

duce the direct transmission of solar radiant energy. The owner may enjoy dollars saved by environmental control glass selected to complement the mechanical cooling system. Refer to Figures 1 and 2-A.

Fig. 2 A—Indoor Glass Temperatures*—Summer (In Sun)

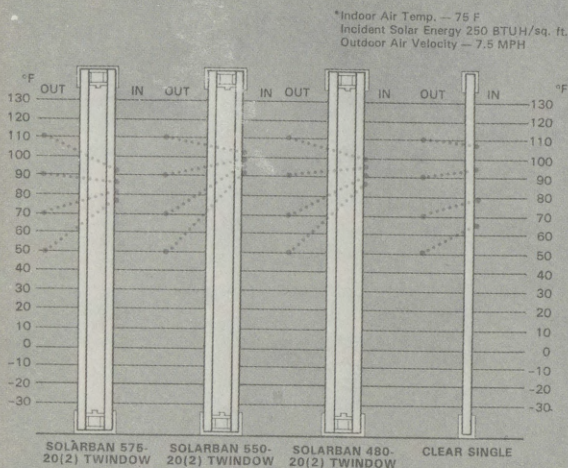
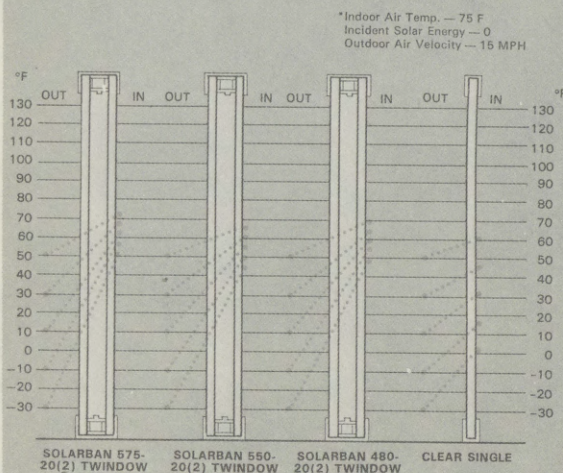


Fig. 2 B—Indoor Glass Temperatures*—Winter (At Night)



WINTER

Winter comfort can be increased in buildings with carefully engineered mechanical heating systems chosen to work as a team with high performance glass products.

Higher indoor glass surface temperatures in winter minimize down drafts and reduce the number of occasions when condensation will occur. TWINDOW and SOLARBAN TWINDOW units achieve higher indoor surface temperature in winter. Refer to Figure 2B.

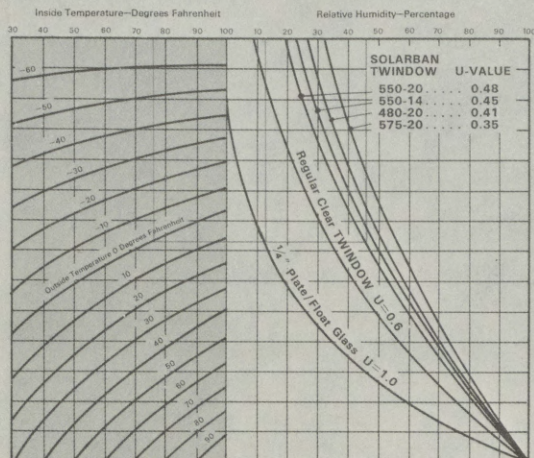
CONDENSATION CONTROL

Healthier, static-free humidity levels can be maintained and condensation can be avoided at much lower outdoor temperatures with SOLARBAN TWINDOW Insulating units. For example, when it is 0 F outdoors and 75 F indoors, 45% relative humidity can be maintained with SOLARBAN 550-20 TWINDOW versus 12% relative humidity with 1/4-inch plate/float glass. With Heated TWINDOW in a well insulated wall, any desired indoor relative humidity may be maintained. For other comparisons see Figure 3—Condensation Prediction Chart.

BUILDING COST ANALYSIS

PPG's Building Cost Analysis Service provides an easy means to estimate the beneficial effect that high performance insulating glass such as TWINDOW and SOLARBAN TWINDOW have on total building cost. Tangible dollar savings in terms of reduced owning and operating costs for effective mechanical systems frequently will justify TWINDOW or SOLARBAN TWINDOW on specific projects.

Fig. 3—Condensation Prediction Chart



ARCHITECTURAL ECONOMICS

TOTAL BUILDING COSTS

Sophisticated procedures and equipment used in building design have opened the door of architectural economics revealing greater profit opportunities. Architects, owners and tenants are aware that costs other than initial cost have significant influence on the real total building profit picture. The January, 1971 publication of GSA Public Buildings Service "Performance Specifications for Office Buildings" reported, "an analysis shows that the life costs of the system (building) over forty

years are approximately:

92% Cost of people to process information (salaries)

6% Maintenance and operation facilities

2% First cost of the building."

Realizing that an office or a school building without people is of little value to anyone, the real total building cost must include (a) capital or initial costs, (b) operating costs and (c) people costs.

Figure 4 shows how these costs, allocated to appropriate services and functions, relate to one another, initially and over a ten year operating period of a 15 story office building.

COMFORT/PRODUCTIVITY

Professional economic consultants, administrative educators and government agencies are recognizing "a growing awareness of the interdependence of productivity and the general well-being of employees fostered by well designed and aesthetically outstanding facilities."

Improved comfort for building tenants means increased value for building owners and potential savings for tenants.

Thermal comfort benefits of high performance glasses provide value for the building project. Glass in airtight, resilient glazing installations is an excellent sound isolation material and contributes to acoustical comfort. Glass may be selected to provide a wide range of brightness control values for visual comfort.

Recent studies show that comfort directly influences performance hence productivity. It can be shown that physical improvements during the construction or initial cost stage of a building such as improved insulation which improves occupant comfort/productivity could generate substantial savings over the life of the building to the owner/tenant.

High performance insulating glass can deliver this kind of improvement.

For more information on this subject refer to the list on the back cover for the address and telephone number of the Architectural Representative nearest you. If you prefer, forward inquiries to: Manager of Technical Services, PPG Industries, Inc., One Gateway Center, Pittsburgh, Pa. 15222.

* Building Types News Vol. 1, No. 5 May 14, 1971

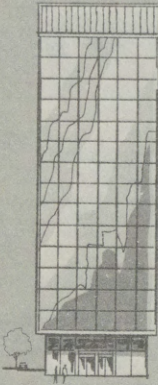
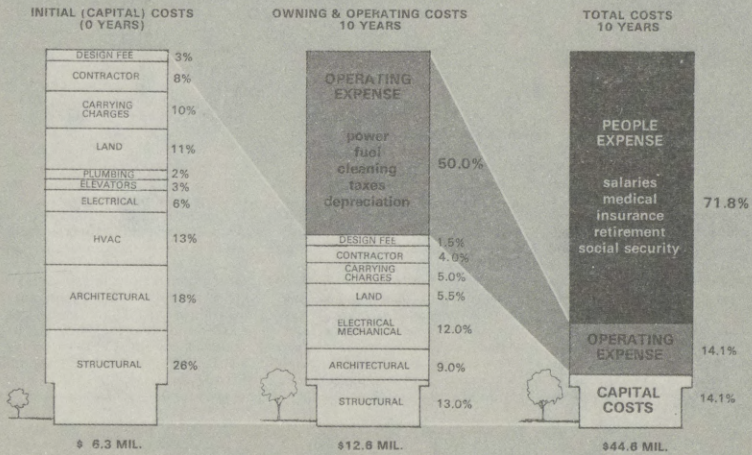
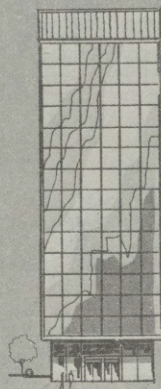


Fig. 4 — 15 STORY OFFICE BUILDING IN CHICAGO





CONSIDER A FIFTEEN STORY OFFICE BUILDING IN CHICAGO

* Cost Analysis Example:

Wall Area (spandrel, frame, etc.) 40,000 Sq. Ft.

Vision Glass Area 40,000 Sq. Ft.

HOW TO OBTAIN A PPG BUILDING COST ANALYSIS

1. Early in the preliminary design stage (even conceptual), consider the glass area on outdoor elevations for your project.
2. Building Cost Analysis Data Input Sheets are obtainable from your PPG Architectural Representative. Names, Phone Numbers, and Addresses are on the back cover of this report. Review the performance of PPG environmental glass products with your PPG Representative.
3. Collect essential input data. For your convenience a range of representative values for other components is given in Tables A, B and C, pages 18 and 19. *If the Consulting Mechanical Engineer has values more applicable to the project, use them.* In the early project design stage data estimates will be necessary in many instances. General Contractor's and Owner's Accountants may be helpful sources for other cost data. Sample completed Data Input Sheets are shown on page 8 and 9.
4. Pages 14 through 17 provide instructions and representative data useful in filling out the Data Input Sheets.
5. Review cost and performance data with the Consulting Mechanical Engineer for the project. Complete Data Input Sheets with his assistance.
6. Give the completed forms to your PPG Representative. He will transmit them to Pittsburgh, Pennsylvania, for analysis by PPG computer at no cost to you.
7. Your PPG Representative will deliver the report and discuss its implications with you.

* Example of Building Cost Analysis (See Sketch above)

The conditions for the cost analysis of this proposed building are these glass and wall areas and:

Glass Alternatives

- 1/4 inch clear plate/float
- 1 inch SOLARBAN 550-20 (2) TWINDOW units

Mechanical Systems

- Comfort Air Conditioning with electric powered mechanical cooling
- Heating with gas fired furnaces

A completed data input sheet is shown on the next page and detailed steps for filling in the input data sheet are shown on pages 14 through 17. Data input sheets may be obtained from your PPG representative.

(SAMPLE)

PROJECT DESCRIPTION

DATA INPUT SHEET

PPG Building Cost Analysis

Technical Service Report 105-B

(PLACE JUST ONE LETTER IN EACH SQUARE)

[illegible]

(Include sketch of proposed building on separate paper)

1. Geographic Location _____ CHICAGO, ILL _____
2. Building Orientation 1 (N, E, S, W), 2 (NE, SE, SW, NW) _____ 1 _____
3. Glass Alternatives and shading device: (Circle item that applies)
- A. 1/4-in. CLEAR PLATE/FLOAT (Type of Glass) { With Indoor Shading _____ DRAPER—Light, Med., Dark WEAVE: Open, Semi, Closed
Without Indoor Shading _____ ROLLER—White, Dark
VENETIAN—Light, Med., Dark
- B. 1-in SOLARBAN 550-20(2) (Type of Glass) { With Indoor Shading _____ DRAPER—Light, Med., Dark WEAVE: Open, Semi, Closed
Without Indoor Shading _____ ROLLER—White, Dark
VENETIAN—Light, Med., Dark
- C. _____ (Type of Glass) { With Indoor Shading _____ DRAPER—Light, Med., Dark WEAVE: Open, Semi, Closed
Without Indoor Shading _____ ROLLER—White, Dark
VENETIAN—Light, Med., Dark

	N/NE	E/SE	S/SW	W/WNW
4. Vision Glass Area (Square Feet)	10000	10000	10000	10000
5. Installed Glass Cost in Dollars/Sq.Ft. A. <u>2.10</u> B. <u>5.50</u> C.				
6. Installed Indoor Shading Device Cost in Dollars/Square Foot.			1.25	
7. Wall Area in Square Feet (Excluding window glass area)			40,000	
8. Wall Type Number (From Table "A", page 18)			4	
9. U-Value for Wall (From Table "A", page 18)			0.15	
10. Installed Wall Cost in Dollars/Square Foot.			6.00	
11. Roof Area in Square Feet.			15,600	
12. Roof Type Number (From Table "B", page 19)			3	
13. U-Value for Roof (From Table "B", page 19)			0.10	
14. Floor Area, Estimated Rentable Square Feet—All Floors.			164,000	
15. Number of Floors at Grade and Above.			15	
16. Number of Floors, Below Grade.			1	
17. Number of People in Building (during normal use)			3,000	

NOTE: ITEMS 1 THRU 25 ARE MINIMUM DATA NECESSARY TO COMPUTE COST ANALYSIS.
ITEMS 26 THRU 34 WILL BE INSERTED AS SHOWN BY PPG IF NOT SUPPLIED BY ENGINEER.

18. Occupancy Hours (during normal use) From 8 a.m. to 5 p.m.
(If 24 hr use, print 1 a.m. to 12 p.m.)
19. Outdoor Air Ventilation in Cubic Feet per Minute per Square
Foot of Floor Area (often 0.35 to 1.00 cu. ft./min./sq. ft.) 0.3
20. Infiltration in Air Changes per Hour
(often 0.5 to 2 air changes per hour) 1.0
21. Electric Lighting Level in Watts per Square Foot of Floor Area
(often 3 to 8 watts per square foot) 5.0
22. Electricity Cost in Cents per Kilowatt Hour
(From Table "C" on page 19) 1.2 ¢
23. Electricity Cost Application Number (See page 16) 2
24. Heating Energy or Fuel Cost in Cents per Therm
(From Table "C" on page 19) 8.0 ¢
25. Mechanical System Utilization Factor 0.6 Heating 2.5 Cooling

OFFICE OR APART. PUBLIC BLDG.
(5 STORIES AND UP) (SCHOOL)
Circle or insert appropriate number

26. Life of Building in Years (Depreciation
period—often 20 to 50 years) 40 40 40
27. Estimated Capital (Initial) Cost of Building
(Dollars per Sq. Ft. of Rentable Floor Area) 35 38 20 6,300,000
28. Estimated Initial Cost of Building excluding
Walls, Windows and Mechanical System... (Often 65% to 75% of Item 27) 4,500,000
29. Estimated Initial Land Cost including
Site Work and Landscaping (Often 5% to 15% of Item 27) 600,000
30. Federal Tax Rate on Building Income
(If a public building, enter 0)
(often about 50%) 50 0 50 %
31. Real Estate Tax Rate
(If a public building, enter 0)
(often about 4%) 4 0 4 %
32. Interest Rate on Financing Required
(often 5% to 10%) 6 8 5 8 %
33. Estimated Initial Cost of Mechanical
Cooling System (Dollars per Ton)
(often \$400 to \$1500 per ton) 1,000 1,000 1000
34. Estimated Initial Cost of Mechanical Heating
System (Dollars per Million BTU)
(often \$14,000 to \$20,000 per million Btu) 16,000 16,000 16000

Signed:

Architect: Bob DavisConsulting
EngineerJohn Taylor

SAMPLE COMPUTER PRINTOUT SHEET (RESULTS OF COST ANALYSIS)

PPG BUILDING COST ANALYSIS *

ATTACHED IS A DATA OUTPUT SHEET LISTING PRELIMINARY ESTIMATES OF CERTAIN PROJECT DESIGN CRITERIA AND ESTIMATED BUILDING COMPONENT EVALUATION COSTS. THESE DATA HAVE BEEN EXAMINED BY A PPG COMPUTER UTILIZING A PROGRAM DESIGNED TO EVALUATE THE RELATIVE COSTS OF GLASS ALTERNATIVES ON TOTAL BUILDING COST. THE COMPUTER'S RELATIVE EVALUATION BELOW IS SIMPLY A FIRST APPROXIMATION. IT IS NOT INTENDED TO BE USED AS THE BASIS FOR PROJECT DESIGN. ALTERNATIVES WORTHY OF DETAILED OBJECTIVE STUDY BY THE DESIGN PROFESSIONAL. THIS RELATIVE ANALYSIS IS NOT INTENDED AS AND SHOULD NOT BE USED AS THE BASIS FOR PROJECT DESIGN.

PROJECT- 15 STORY OFFICE BUILDING

CHICAGO, ILL.

CATE- GLASS ALTERNATE- A

ARCHITECT- BOB DAVIS

ENGINEER- JOHN TAYLOR

DESCRIPTION 1/4 CLEAR PLATE/FLOAT
OF GLASS- WITH MEDIUM SEMI-OPEN DRAPES

1. ESTIMATED INSTALLED COST OF GLASS	84000.	DOL. FOR	40000.	SG. FT.	
2. ESTIMATED INSTALLED COST OF INDOOR SHADING DEVICE	50000.	DOL. FOR	40000.	SG. FT.	
3. ESTIMATED INSTALLED COST OF MECHANICAL HEATING SYSTEM	138255.	DOL. FOR	8.33	MIL BTU/HR CAPACITY	
4. ESTIMATED INSTALLED COST OF MECHANICAL COOLING SYSTEM	863672.	DOL. FOR	864.	TONS CAPACITY	
5. ESTIMATED ANNUAL OPERATING CCST OF MECHANICAL HEATING SYSTEM	12411.	DOL. FOR	7265497088.	BTU	
6. ESTIMATED ANNUAL OPERATING CCST OF MECHANICAL COOLING SYSTEM	16513.	DOL. FOR	9487323136.	BTU	
7. ESTIMATED PRESENT WORTH OF BUILDING	60.28	DOL. PER SQ FT OF RENTABLE FLOOR	40.	YRS. AT	8.0 PCT.
8. ESTIMATED ANNUAL COST OF OWNING AND OPERATING BUILDING	5.05	DOL. PER SQ FT OF RENTABLE FLOOR AREA			

* COPYRIGHT BY PPG INDUSTRIES, INC.

PPG BUILDING COST ANALYSIS

ATTACHED IS A DATA OUTPUT SHEET LISTING PRELIMINARY ESTIMATES OF CERTAIN PROJECT DESIGN CRITERIA AND ESTIMATED BUILDING COMPONENT INSTALLATION COSTS. THESE DATA HAVE BEEN EXAMINED BY A PPG COMPUTER UTILIZING A PROGRAM DESIGNED TO EVALUATE THE RELATIVE EFFECT OF GLASS ALTERNATIVES ON TOTAL PROJECT COSTS. THE ANALYSIS WAS CONDUCTED IN ORDER TO ESTABLISH A BASIS FOR THE SELECTION OF THE MOST ECONOMIC GLASS ALTERNATIVE. THE ANALYSIS WAS CONDUCTED IN ORDER TO ESTABLISH A BASIS FOR THE SELECTION OF THE MOST ECONOMIC GLASS ALTERNATIVE. THE ANALYSIS WAS CONDUCTED IN ORDER TO ESTABLISH A BASIS FOR THE SELECTION OF THE MOST ECONOMIC GLASS ALTERNATIVE.

PROJECT- 15 STORY OFFICE BUILDING

DATE- CHICAGO, ILL. GLASS ALTERNATE- B

ARCHITECT- BOB DAVIS

ENGINEER- JOHN TAYLOR

DESCRIPTION 1IN. SOLARBAN 550-20 (2) TWINDOOR
OF GLASS- WITH MEDIUM SEMI-OPEN DRAPES

1. ESTIMATED INSTALLED COST OF GLASS	220000.	DOL. FOR	40000.	SG. FT.	
2. ESTIMATED INSTALLED COST OF INDOOR SHADING DEVICE	50000.	DOL. FOR	40000.	SG. FT.	
3. ESTIMATED INSTALLED COST OF MECHANICAL HEATING SYSTEM	114535.	DOL. FOR		7.16 MIL BTU/HR CAPACITY	
4. ESTIMATED INSTALLED COST OF MECHANICAL COOLING SYSTEM	732925.	DOL. FOR		733. TONS CAPACITY	
5. ESTIMATED ANNUAL OPERATING CCST OF MECHANICAL HEATING SYSTEM	10950.	DOL. FOR	6446428160.	BTU	
6. ESTIMATED ANNUAL OPERATING CCST OF MECHANICAL COOLING SYSTEM	14965.	DOL. FOR	9196351488.	BTU	
7. ESTIMATED PRESENT WORTH OF BUILDING	60.07	DOL. PER SQ FT OF RENTABLE FLOOR	- 40. YRS. AT	8.0 PCT.	
8. ESTIMATED ANNUAL COST OF OWNING AND OPERATING BUILDING	5.04	DOL. PER SQ FT OF RENTABLE FLOOR AREA			

* COPYRIGHT BY PPG INDUSTRIES, INC.

SAMPLE BUILDING COST ANALYSIS SUMMARY



Building Cost Analysis

TO: Mr. A. Gud Client
New Buildings, Inc.
Chicago, Illinois

DATE:

REFERENCE:
15 Story Office Bldg.
Chicago, Illinois

ARCHITECT: Bob Davis

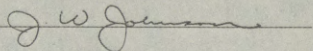
ENGINEERS: John Taylor

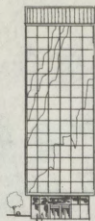
(Cost of Systems in Dollars)

Cost Comparisons

System Description	"A"	"B"	Cost Comparison Alternate "B" with Alternate "A"
	1/4-inch Clear Plate/Float with Indoor Shading	1-inch SOLARBAN 550-20 (2) TWINDOW with Indoor Shading	
1. Vision Glass Area (40,000 sq. ft.)	\$ 84,000	\$220,000	\$136,000 Increase in Initial Glass Cost.
2. Indoor Shading Device	50,000	50,000	
3. Mechanical Heating System	133,260	114,540	
4. Mechanical Cooling System	863,670	732,920	
Total Mechanical	996,930	847,460	\$149,470 Savings in Initial Heating and Cooling Equipment.
5. Annual Heating Operation	12,410	10,950	
6. Annual Cooling Operation	16,510	14,960	
Total Mechanical Operation	28,920	25,910	\$3,010 Per Annum Savings in Operating Costs.
7. Estimated Present Worth (Dollars per sq. ft. of Rentable Floor Area)	60.28	60.07	
8. Estimated Annual Cost of Owning & Operating Building (Dollars per sq. ft. of Rentable Floor Area)	5.05	5.04	

This service has been developed to help architects, builders, engineers and owners understand the effects of fenestration on costs and to encourage detailed objective study of available glass alternatives by the design professional.

SIGNATURE 



DISCUSSIONS OF COST ANALYSIS RESULTS

INITIAL (CAPITAL) AND OPERATING COSTS

The Building Cost Analysis Report on the 15-story office building in Chicago, Illinois, shows an increase of initial glass cost of \$136,000 if 1-inch SOLARBAN 550-20 (2) TWINDOW is selected instead of 1/4-inch clear. However, with an estimated \$149,470 reduction in initial mechanical heating and cooling equipment costs, the owner has a potential savings of \$13,000. Also, the owner has a potential savings of heating and cooling equipment operating costs of \$3,000 per year.

These figures are based on estimated costs established early in the building design stage and may not be representative of final cost. However, the relationship between the glass alternatives will prevail.

ESTIMATED PRESENT WORTH AND ESTIMATED ANNUAL OWNING AND OPERATING COSTS

The estimated present worth and the estimated annual costs of owning and operating a building are inserted for the owner's benefit.

Present worth is defined as the present value of an owner's total future costs of the building over the expected life of the building. Present worth is a term for the *time value of money*.

"The idea behind the time value of money is simply recognition of the fact that money invested earns money. If you put \$1,000 into a savings bank at 5% interest, in 14 years you will have \$2,000 in the bank. That is to say, the future worth of the present amount of \$1,000 at 5% interest in 14 years is \$2,000.

Conversely, the present worth (sometimes called discounted value) in 1970 of a future amount of \$2,000 in 1984 at 5% is \$1,000. If a housewife were offered \$1,000 next week or \$1,000 14 years from now, she wouldn't need a consultant or economist to decide which to take. But, if she were offered \$1,000 next week or \$2,000 14 years from now, she might not so readily realize that the two offers are equivalent."

If the owner of the 15-story office building in Chicago were to use the SOLARBAN 550 TWINDOW, Item #7, Estimated Present Worth of building, \$60.07 per sq. ft. rentable floor area represents the total amount of money needed today to pay all future costs incurred on the building.

OWNING AND OPERATING COSTS

The owning and operating costs are the actual expected costs per year to operate the building.** The estimated annual cost of owning and operating the building can be used in conjunction with the rent to determine the owner's initial Return on Investment (R.O.I.).

RETURN ON INVESTMENT

A simple way of determining the return on investment (R.O.I.) is by dividing the building profit per year by the initial investment of the owner in the building.

Thus: $R.O.I. = \text{EARNINGS} / \text{INVESTMENT}$

Where:

Earnings = rent - owning and operating costs (Item #8, page 12).

Investment = the initial building cost—the financed initial cost or the "out-of-pocket" money directly invested by the owner.

Assuming 85% financed initial cost and \$5.90 rent per sq. ft.:

Earnings = rent - Item #8, page 12 = \$5.90 - \$5.04 = \$.86 per sq. ft. of rented floor area.

Investment = $(100\% - 85\%) \times \$38.00$ per sq. ft. = $15\% \times \$38.00$ per sq. ft. = \$5.70 per sq. ft. of rentable floor area.

$R.O.I. = (0.86 / 5.70) \times 100 = 15\%$

The cost of the money borrowed to construct the building is included in the owning and operating costs.

PAYBACK

A building owner may also be interested in the number of years required to recover his investment.

Assuming an average Return on Investment of \$0.86 per sq. ft. of rentable floor area.

The average payback time from earnings is:

Investment / Earnings = \$5.70 / \$.86 = 6.7 years.

Or:
 $\frac{100\% \text{ ROI}}{\text{ANNUAL ROI}} = \frac{100\%}{15\%} = 6.7 \text{ years.}$

COMFORT & PRODUCTIVITY

In addition to the potential benefits illustrated above, the thermal and visual comfort benefits of high performance glass can contribute substantially to the profit picture and increase Return on Investment as illustrated by the Comfort and Productivity Relationship illustrated on pages 5 and 6.

**"Architectural Economics; the concept of total cost". R. D. Steyer, Architectural Economic Consultant, Architectural Record, October, 1970.

*"Owning and Operating costs are sometimes referred to as uniform annual costs and are calculated by:

Present worth x capital recovery factor.
 Capital recovery factors are a function of time (years) and interest rates and can be found in ASHRAE Guide & Data Book-Systems 1970, chapter 41, p. 637, table 4.

cost in dollars per square foot for glass alternatives A, B and C.

Item 6—Installed Indoor Shading Device Cost in Dollars per Square Foot

Print local installed shading device cost.

Item 7—Wall Area in Square Feet

Print the total wall area of proposed building excluding window glass area (Item 4), i.e., total wall area — window glass area = wall area.

Items 8 & 9—Type Number and U-Value for Wall

Table A, Wall Performance Data and Type Numbers, page 18—Technical Service Report 105B. For more com-

plete information, refer to 1967 ASHRAE Handbook of Fundamentals, Chapter 26, pages 435-441.

Item 10—Installed Wall Cost in Dollars per Square Foot

Print the local installed wall costs in dollars per square foot.

If wall is SPANDRELITE glass, include cost of installed glass + frame.

If more than one material used in Spandrel & Column area, use average cost.

$$\text{i.e., brick + glass} = \frac{\$5.80 + \$6.20}{2}$$

$$= \frac{\$12.00}{2} = \$6.00 \text{ per sq. ft. of wall area.}$$

Item 11—Roof Area in Square Feet
Total roof area in square feet.

Items 12 & 13—Type Number and U-Value for the Roof

Table B, Roof Performance Data and Type Numbers, page 19—Technical Service Report 105B. For more detailed information, refer to 1967 ASHRAE Handbook of Fundamentals, Chapter 26, pages 445-448.

Item 14—Floor Area

Estimated rentable floor area in square feet (approximately 70% of total floor area).

Items 15 & 16—Self Explanatory

	N/NE	E/SE	S/SW	W/NW
4. Vision Glass Area (Square Feet)	10000	10000	10000	10000
5. Installed Glass Cost in Dollars/Sq.Ft. A. <u>2.10</u> B. <u>5.50</u> C. <u>—</u>				
6. Installed Indoor Shading Device Cost in Dollars/Square Foot			\$1.25	
7. Wall Area in Square Feet (Excluding window glass area)			40,000	
8. Wall Type Number (From Table "A", page 18)			4	
9. U-Value for Wall (From Table "A", page 18)			0.15	
10. Installed Wall Cost in Dollars/Square Foot			\$6.00	
11. Roof Area in Square Feet			15,600	
12. Roof Type Number (From Table "B", page 19)			3	
13. U-Value for Roof (From Table "B", page 19)			0.10	
14. Floor Area, Estimated Rentable Square Feet—All Floors			164,000	
15. Number of Floors at Grade and Above			15	
16. Number of Floors, Below Grade			1	

NOTE: ITEMS 1 THRU 25 ARE MINIMUM DATA NECESSARY TO COMPUTE COST ANALYSIS.
ITEMS 26 THRU 34 WILL BE INSERTED AS SHOWN BY PPG IF NOT SUPPLIED BY ENGINEER.

INSTRUCTIONS FOR COMPLETING DATA INPUT SHEETS

Item 17—Number of People in Building

Print total number of people expected in the building during daylight hours and normal use.

Item 18—Occupancy Hours

Print 1 a.m. to 12 p.m. if 24-hour use. Otherwise, print actual hours of occupancy.

Item 19—Outdoor Air Ventilation

Print the rate of outdoor air ventilation in cubic feet per minute for each square foot of total floor area.

Refer to 1967 ASHRAE Handbook of Fundamentals, Table 1, page 468.

Item 20—Infiltration in Air Changes per Hour

Number of air changes per hour. Does not include infiltration due to opening and closing doors, windows, etc.

Refer to 1967 ASHRAE Handbook of Fundamentals, Table 1 page 409.

Item 21—Self Explanatory**Item 22—Electricity Cost in Cents per Kilowatt Hour**

See Table "C," Approximate Cost and Utilization Factors for Various Energy Sources, page 19—Technical Service Report 105B.

Item 23—Electricity Cost Application Number

Print "1" on data input sheet if electricity cost is to be applied to lighting, heating and cooling; or "2" if applicable to lighting and cooling only; or "3" if electricity cost applies to lighting alone.

Item 24—Energy of Fuel Cost in Cents per Therm

See page 19, Table "C"—Approximate Cost and Utilization Factors for Various Energy Sources—Technical Service Report 105B. Refers to energy or fuel for heating only.

17. Number of People in Building (during normal use)	3,000
18. Occupancy Hours (during normal use)	From 8 a.m. to 5 p.m.
(If 24 hr use, print 1 a.m. to 12 p.m.)	
19. Outdoor Air Ventilation in Cubic Feet per Minute per Square Foot of Floor Area (often 0.35 to 1.00 cu. ft./min./sq. ft.)	0.30
20. Infiltration in Air Changes per Hour (often 0.5 to 2 air changes per hour)	1.0
21. Electric Lighting Level in Watts per Square Foot of Floor Area (often 3 to 8 watts per square foot)	5.0
22. Electricity Cost in Cents per Kilowatt Hour (From Table "C" on page 19)	1.2 ¢
23. Electricity Cost Application Number (See page 16)	2
24. Heating Energy or Fuel Cost in Cents per Therm (From Table "C" on page 19)	8.0 ¢
25. Mechanical System Utilization Factor (From Table "C" on page 19) Heating	0.6
Cooling	2.5

Item 25—Mechanical System Utilization Factor

Utilization factors refer to the efficiency of the heating and cooling equipment. Select appropriate utilization factors for heating and cooling systems from Table "C"—Approximate Utilization Factors for Various Energy Sources—page 19, Technical Service Report 105B.

NOTE:

Items 1 through 25 are minimum data necessary to compute cost analysis. Items 26 through 34 will be calculated as shown and inserted if

not supplied.

The data in the columns titled Office or Apartment Buildings and Public Building (School) have been supplied for the convenience of the architect or engineer not wishing to disclose this information. Items 26 through 32 are data required to establish present worth and the annual owning and operating costs per square foot of rentable floor space. This cost with the proposed rental income per square foot can be used to determine the owner's Return On Investment. See discussion on page 13.

	OFFICE OR APART. (5 STORIES AND UP)	PUBLIC BLDG. (SCHOOL)	
	Circle or insert appropriate number		
26. Life of Building in Years (Depreciation period—often 20 to 50 years).....	40	40	<u>40</u>
27. Estimated Capital (Initial) Cost of Building (Dollars per Sq. Ft. of Rentable Floor Area) ..	35	<u>38</u>	20 <u>6,300,000</u>
28. Estimated Initial Cost of Building excluding Walls, Windows and Mechanical System... (Often 65% to 75% of Item 27)			<u>4,500,000</u>
29. Estimated Initial Land Cost including Site Work and Landscaping..... (Often 5% to 15% of Item 27)			<u>600,000</u>
30. Federal Tax Rate on Building Income (If a public building, enter 0) (often about 50%).....	<u>50</u>	0	<u>50</u> %
31. Real Estate Tax Rate (If a public building, enter 0) (often about 4%).....	<u>4</u>	0	<u>4</u> %
32. Interest Rate on Financing Required (often 5% to 10%).....	6	<u>8</u>	5 <u>8</u> %
33. Estimated Initial Cost of Mechanical Cooling System (Dollars per Ton) (often \$400 to \$1500 per ton).....	1,000	1,000	<u>1000</u>
34. Estimated Initial Cost of Mechanical Heating System (Dollars per Million BTU) (often \$14,000 to \$20,000 per million Btu) ..	<u>16,000</u>	16,000	<u>16,000</u>
Signed:			
Architect: <u>Bob Davis</u>	Consulting Engineer: <u>John Taylor</u>		

PERFORMANCE AND COST FACTOR DATA TABLES

TABLE "A" WALL PERFORMANCE DATA** AND TYPE NUMBERS

Select Wall Type Number Most Nearly Corresponding to Color and Weight of Wall for Item #8 on Data Input Sheet.

Wall Description (If Specific Construction has not been Determined)	Weight of Wall Pounds/Square Foot	Wall Type Number
Light-Weight Construction — Light Color Outdoors	Up to 30	1
Medium-Weight Construction — Light Color Outdoors	30 to 100	2
Heavy-Weight Construction — Light Color Outdoors	100 and Over	3
Light-Weight Construction — Dark Color Outdoors	Up to 30	4
Medium-Weight Construction — Dark Color Outdoors	30 to 100	5
Heavy-Weight Construction — Dark Color Outdoors	100 and Over	6

Select Thermal Conductance (U-Value) for Wall Construction under Consideration for Item #9 on Data Input Sheet.

Curtain Walls:							
Exterior	Wall Insulation	Approximate U-Value with Insulation				Wall Type Number	
		None	1"	2"	3" or More	Dark	Light
Insulated Spandrelite	Factory Fabricated with Fiber Glass and Foil Vapor Barrier	—	0.15	—	—	4	1
	Factory Fabricated with Rigid Urethane Foam Insulation	—	0.15	0.08	—	—	—
Spandrelite or Metal Panels (Lightweight Construction)	Blanket & Batt (Fiber Glass, Cotton, Mineral, Wood Fiber)	1.0	0.21	0.12	0.08	4	1
	Boards & Slabs Expanded Urethane	1.0	0.15	0.08	0.06	4	1
	Fiber Glass, Mineral Fiber, Expanded Polystyrene or Rubber	1.0	0.21	0.12	0.08	4	1
	Foamglas® (Cellular Glass)	1.0	0.29	0.17	0.12	4	1

*Reg. TM of Pittsburgh Corning Corp.

Masonry Walls:								
Exterior		Backing	Interior	Approximate U-Value with Insulation			Wall Type Number	
				None	1"	2"	Dark	Light
Brick	Medium Weight Construction (6 in.)	None	None or Plaster Lath & Plaster	0.66 0.39	0.19 0.16	0.11 0.10	5 5	2 2
	Medium Weight (8 in.)	Common Brick	None or Plaster Lath & Plaster	0.43 0.29	0.17 0.14	0.10 0.09	5 5	2 2
	Heavy Weight (12 in.)	Common Brick	None or Plaster Lath & Plaster	0.32 0.24	0.14 0.13	0.09 0.09	6 6	3 3
	80+ /Ft. ³ Poured Concrete (Medium-Weight Construction) (6 in.)	None	None or Plaster Lath & Plaster	0.31 0.23	0.14 0.12	0.09 0.08	5 5	2 2
		(8 in.)	None	None or Plaster Lath & Plaster	0.25 0.19	0.13 0.11	0.09 0.08	5 5

** More detailed thermal conductance data for a wide range of wall construction alternatives may be obtained from tables incorporated in the 1967 ASHRAE Handbook of Fundamentals, Chapter 26, Pages 435-441.

TABLE "B" ROOF PERFORMANCE DATA* AND TYPE NUMBERS

Select Roof Type Number Most Nearly Corresponding Weight of Roof for Item #12 on Data Input Sheet.

Roof Description (If Specific Construction has not been Determined)	Roof Type Number
Light-Weight Construction	1
Medium Light-Weight Construction	2
Medium Heavy-Weight Construction	3
Heavy-Weight Construction	4

Select Thermal Conductance (U-Value) of Roof Construction under Consideration for Item #13 on Data Input Sheet.

(Summer Conditions, downward flow)

Type of Roof Deck (Built-up roofing in all cases)	Roof Deck Thick- ness (inches)	Type of Suspended Ceiling	Approximate U-Value Insulation on Top of Deck or Above Ceiling, Inches				Number Roof Type
			None	1	2	3	
Flat Metal	—	None	0.67	0.23	0.15	0.10	1
		Gypsum Bd. & ½" (Lg. wt.) Plaster	0.32	0.17	0.12	0.09	1
		Acoustical Tile (¾") (on Furring)	0.23	0.14	0.11	0.08	1
Concrete (light-weight aggregate on Gypsum Board	2	None	0.27	0.15	0.11	0.08	2
		Gypsum Bd. & ½" Plaster	0.69	0.12	0.09	0.06	3
		Acoustical Tile (¾") (on Furring)	0.15	0.11	0.08	0.07	3
	6	None	0.12	0.09	0.08	0.06	4
		Gypsum Bd. & ½" Plaster	0.10	0.08	0.07	0.05	4
		Acoustical Tile (¾") (on Furring)	0.09	0.06	0.06	0.04	4
Gypsum Slab on ½" Gypsum Board	2	None	0.32	0.18	0.12	0.09	3
		Gypsum Bd. & ½" Plaster	0.21	0.74	0.10	0.06	3
		Acoustical Tile (¾") (on Furring)	0.17	0.12	0.09	0.07	3
	4	None	0.23	0.15	0.10	0.08	3
		Gypsum Bd. & ½" (Lg. wt.) Plaster	0.17	0.12	0.09	0.07	3
		Acoustical Tile (¾") (on Furring)	0.14	0.11	0.08	0.07	3
Wood	1	None	0.40	0.19	0.13	0.09	1
		Gypsum Bd. & ½" Plaster	0.24	0.15	0.11	0.08	1
		Acoustical Tile (¾") (on Furring)	0.19	0.13	0.10	0.07	1
	2	None	0.28	0.16	0.11	0.08	2
		Gypsum Bd. & ½" Plaster	0.19	0.13	0.10	0.07	3
		Acoustical Tile (¾") (on Furring)	0.16	0.11	0.09	0.07	3

TABLE "C" APPROXIMATE COST AND UTILIZATION FACTORS FOR VARIOUS ENERGY SOURCES

Select cost of energy expressed in cents per therm for Item #24 on Data Input Sheet. The Consulting Mechanical Engineer for the project will be able to suggest appropriate utilization factors for the project for Item #25 on the Data Input Sheet.

	Cost of Energy (Cents per Therm) One Therm equals 100,000 BTU	Annual System Energy Utilization Factor-Heating	Annual System Energy Utilization Factor-Cooling
Electricity—3,415 BTU/KWH			
75¢/KWH	22.0	Resistance Heating; 0.9 to 1.0 Heat Pump; 1.4 to 2.0	Mechanical Cooling; 2.0 to 3.0 Heat Pump; 1.5 to 3.0
1.0 ¢/KWH	29.3		
1.2 ¢/KWH	35.1		
1.7 ¢/KWH	49.8		
2.5 ¢/KWH	73.4		
Gas—1,000 BTU/Cubic Foot			
40¢/1000 cubic feet	4.0	0.4 to 0.7	(Absorption Cooling)
60¢/1000 cubic feet	6.0		
90¢/1000 cubic feet	9.0		
120¢/1000 cubic feet	12.0		0.4 to 0.5
Oil—140,000 BTU/Gallon			
8¢/Gal	5.7	0.4 to 0.5	
14¢/Gal	10.0		
17¢/Gal	12.1		
20¢/Gal	14.3		
Coal—13,500 BTU/Lb			
\$19/Ton	7.0	0.3 to 0.4	
\$22/Ton	8.1		
\$25/Ton	9.3		

* More detailed thermal conductance data for a wide range of roof construction alternatives may be obtained from the 1967 ASHRAE Handbook of Fundamentals, Chapter 26, Pages 445-448.

Technical Service Report 105-B

(PLACE JUST ONE LETTER IN EACH SQUARE)

[illegible]

(Include sketch of proposed building on separate paper)

1. Geographic Location
2. Building Orientation 1 (N, E, S, W), 2 (NE, SE, SW, NW)
3. Glass Alternatives and shading device: (Circle item that applies)

A.	(Type of Glass)	{ With Indoor Shading	{ DRAPE—Light, Med., Dark WEAVE: Open, Semi, Closed ROLLER—White, Dark
{ Without Indoor Shading		{ VENETIAN—Light, Med., Dark	
B.	(Type of Glass)	{ With Indoor Shading	{ DRAPE—Light, Med., Dark WEAVE: Open, Semi, Closed ROLLER—White, Dark
{ Without Indoor Shading		{ VENETIAN—Light, Med., Dark	
C.	(Type of Glass)	{ With Indoor Shading	{ DRAPE—Light, Med., Dark WEAVE: Open, Semi, Closed ROLLER—White, Dark
{ Without Indoor Shading		{ VENETIAN—Light, Med., Dark	

N/NE	E/SE	S/SW	W/NW

- | | |
|--|--|
| 4. Vision Glass Area (Square Feet) | |
| 5. Installed Glass Cost in Dollars/Sq.Ft. A..... B..... C..... | |
| 6. Installed Indoor Shading Device Cost in Dollars/Square Foot | |
| 7. Wall Area in Square Feet (Excluding window glass area) | |
| 8. Wall Type Number (From Table "A", page 18) | |
| 9. U-Value for Wall (From Table "A", page 18) | |
| 10. Installed Wall Cost in Dollars/Square Foot | |
| 11. Roof Area in Square Feet | |
| 12. Roof Type Number (From Table "B", page 19) | |
| 13. U-Value for Roof (From Table "B", page 19) | |
| 14. Floor Area, Estimated Rentable Square Feet—All Floors | |
| 15. Number of Floors at Grade and Above | |
| 16. Number of Floors, Below Grade | |
| 17. Number of People in Building (during normal use) | |

NOTE: ITEMS 1 THRU 25 ARE MINIMUM DATA NECESSARY TO COMPUTE COST ANALYSIS.
ITEMS 26 THRU 34 WILL BE INSERTED AS SHOWN BY PPG IF NOT SUPPLIED BY ENGINEER.

REFERENCES

"Solar Effects On Building Design" by Elmer B. Queer and Everett R. McLaughlin, Pennsylvania State University. Copyright by Building Research Institute, Inc., 1963.

This paper incorporates the basic concept upon which PPG's Computer Analysis is based.

"Architectural Economics: the Concept of Total Cost." R. D. Stevert, Architectural Economic Consultant, Architectural Record, October, 1970.

G.S.A. Public Building Service Report January, 1971. "Performance Specifications for Office Buildings"

Performance Data Sheet S-5, SOLARBAN TWINDOW.

Technical Service Report # 102A "Glass Product Recommendations—Comfort Air Conditioning"

PPG's Building Cost Analysis Service utilizes programmed PPG product performance, weather, heat flow and accounting data plus selected data from pages 19 through 21 of Technical Service Report #102A. Product performance data in Technical Service Report #102A is tabulated under ASHRAE 1967 Handbook table numbers so that engineers may use Handbook procedures, confident that desired glass performance is available in standard products.

Copies of Technical Service Report #102A are available to engineers and architects from a PPG Representative. Refer to the back cover of this report.

ASHRAE Handbook of Fundamentals (1967 Edition)

This comprehensive engineering handbook is published by the American Society of Heating, Refrigerating and Air Conditioning Engineers. The Handbook sets forth practices followed by most experienced engineers. Chapters 26 and 28 of the 1967 Edition cover glass performance.

ASHRAE Guide and Data Book Systems (1970 Edition)

Chapter 41 of this 1970 Edition incorporates owning and operating costs for mechanical equipment, energy costs and related costs.



ARCHITECTURAL REPRESENTATIVES

Architects and Engineers are invited to consult with our staff of Architectural Representatives. Located in key cities across the nation, PPG Architectural Representatives are highly qualified to provide specific design and product application data for all PPG products.

Refer to the list below for the address and telephone number of the Architectural Representative nearest you. If you prefer, forward inquiries to R. W. McKinley, Manager, Technical Services, PPG INDUSTRIES, One Gateway Center, Pittsburgh, Pa. 15222.

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NATIONAL SOCIETY OF PROFESSIONAL ENGINEERS,
Washington, D.C., August 19, 1976.

Hon. BO GINN,

Chairman, Subcommittee on Public Buildings and Grounds, Public Works and Transportation Committee, U.S. House of Representatives, Washington, D.C.

DEAR CONGRESSMAN GINN: On behalf of the National Society of Professional Engineers, the American Society of Mechanical Engineers and the Institute of Electrical and Electronics Engineers, with a combined membership of over 290,000, I am writing to express our views on H.R. 14415, the Energy Conservation in Buildings Act of 1976 (formerly H.R. 14290). We understand that your Subcommittee on Public Buildings and Grounds conducted hearings last week in anticipation of reporting a bill in the near future. We therefore ask that our statement on this bill be included in any published report the subcommittee plans.

There are a number of aspects of this bill which warrant elaboration, but allow me to state at the outset that our three societies fully endorse the broad objectives of H.R. 14415—developing new programs and technology promoting energy conservation in buildings. Engineers have long recognized that it is good business to minimize energy costs, even if energy sources are plentiful. The conservation efforts of members of the engineering profession, and of our national engineering societies, have intensified as the energy crisis has expanded in recent years.

H.R. 14415, in our view, encompasses some basic approaches to lessening that crisis. We are particularly impressed with provisions of the bill calling for a commitment to innovation in design and construction, and an emphasis on the development of solar heating and cooling, coal, geothermal and waste heat and total energy systems. We do believe, however, the bill could be strengthened with language requiring the Administrators of the General Services Administration and the Energy Research and Development Administration to consult with engineering societies to insure inclusion of the broadest technical perspectives and the maximum utilization of professional expertise. The societies have worked closely and productively with GSA on many other occasions in the past, and we believe could contribute in a significant way to the development of the programs outlined in this bill. We would hope also that ERDA will contract with the private sector to conduct the research and development aspects of the projects proposed by this bill and that the sponsors of the bill do not intend in any way to discourage private sector activity in this area. Also, you may want to amend the bill to include an appropriate role for the National Institute of Building Sciences.

H.R. 14415 correctly acknowledges, in our view, that the greatest potential for conserving energy is through the modification of existing facilities. A significant percentage of all buildings in use today will remain in use past the year 2000. One of our highest priorities therefore should be to conserve energy in these buildings. This includes Federal buildings since the Commissioner of the Public Buildings Services estimates that 80 percent of all existing Federal buildings will be in operation at the turn of the century.

We also note with particular interest that the bill calls for the preparation and promotion of educational materials and for the training of students of engineering and of building management in the concepts embodied in energy conservation for buildings. We suggest, however, that you may want to amend Section 104 to provide that the Administrator of ERDA work directly with the private sector and with engineering colleges rather than with the Department of Health, Education and Welfare. We agree that as the Nation is forced to rely less on fossil fuels, it is essential to train professional engineers to develop new systems and to improve building management techniques.

We would like to suggest that the subcommittee, however, give additional thought to provisions of the bill in Sections 101(a) and 202 requiring the Administrator of ERDA to undertake calculations of life cycle cost evaluations.

This is a complex concept which should be encouraged but the procedures perhaps ought not to be legislated. It involves a variety of factors beyond energy conservation. It could be a valuable tool, as many societies and groups within the Federal Government have concluded jointly, but it should not be undertaken without industry-wide contributions and participation. The requirement that it be developed by ERDA perhaps should not be precipitously frozen into legislation.

We believe it is important to view conservation, in practical terms, as only part of the solution to our national energy crisis. By some estimates, the United States will consume more energy within the next 25 years than in its entire history, despite rigorous conservation measures.

To resolve permanently our current crisis, we must develop a comprehensive and coordinated energy program and substantially reduce our dependence on foreign sources of energy. We have for some time advocated this approach which would include at a minimum: (1) the development of effective conservation programs; (2) an increase in the production of all existing domestic forms of energy; (3) rapid expansion of sources with demonstrated reserves and productive potential and; (4) provisions for adequate research, development, funding and other needed stimuli of new energy sources.

The subcommittee is to be commended for its undertaking in the development of energy conservation programs. We would welcome the opportunity to work with you or your staff as you progress with this legislation and would be glad to help in any way possible.

James C. Hughes, Director of Legislative and Government Affairs for the National Society of Professional Engineers, 2029 K Street, N.W., Washington, D.C. 20006 (telephone 331-7020), will serve as contact on this subject for our societies.

Sincerely,

PAUL H. ROBBINS,
Executive Director, NSPE.



