NBS TECHNICAL NOTE 789-1

U.S. DEPARTMENT OF COMMERCE / National Bureau of Standards

Emergency Workshop On Energy Conservation In Buildings

NATIONAL BUREAU OF STANDARDS

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Office of Standard Reference Data — Office of Information Activities — Office of Technical Publications — Library — Office of International Relations.

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[1] Headquarters and Laboratories at Gaithersburg, Maryland, unless otherwise noted; mailing address Washington, D.C. 20234.
[2] Part of the Center for Radiation Research.
[3] Located at Boulder, Colorado 80302.
[4] Part of the Center for Building Technology.

Emergency Workshop On Energy Conservation In Buildings

National Conference of States on
Building Codes and Standards

and

National Bureau of Standards
Joint Emergency Workshop on
Energy Conservation in Buildings

Held at the

U.S. Department of Commerce
Washington, D.C., June 19, 1973

Prepared by

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Office of Building Standards and Code Services
Center for Building Technology
Institute for Applied Technology
National Bureau of Standards
Washington, D.C. 20234

U.S. DEPARTMENT OF COMMERCE, Rogers C.B. Morton, *Secretary*
NATIONAL BUREAU OF STANDARDS, Richard W. Roberts, *Director*

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In late May 1973, the Office of Building Standards and Codes Services of the Center for Building Technology, National Bureau of Standards was approached by the National Conference of States on Building Codes and Standards (NCSBCS), with a request that the Bureau assist the States in preparing a workshop on energy conservation in buildings. Specifically, the Bureau was asked to identify measures that State officials could responsibly recommend to their Governors. The workshop was held on June 19, 1973.

NBS Technical Note 789, "Technical Options for Energy Conservation in Buildings," contains the technical papers presented by the staff of the Building Environment Division, Center for Building Technology, and is referred to throughout this report.

Presentations of other individuals from NBS, State and Federal Agencies, Technical societies and industry organizations are included in this report, which is a companion document to NBS Technical Note 789.

Persons from all segments of government and the private sector attended this workshop. See Appendix for list of attendees.

The Program Agenda for the NCSBCS/NBS Joint Emergency Workshop for Energy Conservation in Buildings was as follows:

Call to Order *

Mr. Bernard Cabelus, National Chairman
National Conference of States on Building
Codes and Standards (NCSBCS)

Welcome *

Dr. Richard W. Roberts
Director, National Bureau of Standards

Federal Programs Regarding the Conservation and Efficient Use of Energy *

Dr. Kenneth Lay
Deputy Under Secretary of Interior (Energy)

Introduction to Workshop *

Mr. Kenneth C. Henke, Jr.
Chairman, NCSBCS Standards and Evaluation Committee

Technical Options for Energy Conservation in Buildings

Dr. J. E. Snell **
Session Chairman, Building Environment Division
National Bureau of Standards

Energy Conservation Features for Existing Buildings--Actions to Save Energy this Summer and Next Winter

A. Things that Can be Done Without Hardship or Personal Expenditure
B. Things that Require Modest Expenditures for Readily Obtainable Materials

Summer Cooling--With and Without Extra Cost

Mr. C. W. Phillips **
Mechanical Engineer
Thermal Engineering Systems Section
Building Environment Division, CBT

Winter Heating

Mr. F. J. Powell **
Chief, Thermal Engineering Systems Section
Building Environment Division, CBT

Insulation--Fenestration--Loads

Dr. J. E. Hill **
Mechanical Engineer
Thermal Engineering Systems Section
Building Environment Division, CBT

Energy Conservation Practices for New Buildings

Dr. T. Kusuda **
Mechanical Engineer
Thermal Engineering Systems Section
Building Environment Division, CBT

Overview of Manchester Project *

Dr. Walter A. Meisen
Assistant Commissioner for Construction
Public Buildings Service, GSA

Preliminary Design Process, Manchester Building

Dr. J. E. Hill **

Mechanisms for Implementation of Energy Conservation Technology in Buildings

Mr. P. R. Achenbach **
Chief, Building Environment Division
National Bureau of Standards

Discussion of Technical Options with Speakers and Resource Experts from Professional and Industry Groups *

Energy Use Criteria in Building Standards and Regulations *

Mr. Joseph Stein
Vice President, Tishman Research Corporation

Adjournment

* These presentations are included in this report.
** These presentations are published in NBS Technical Note 789, "Technical Options for Energy Conservation in Buildings," as follows: F.J. Powell, pp. 27-71; J.Hill, pp. 72-134; T.Kusuda, pp. 135-146; P.R.Achenbach, pp. 147-172.

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NATIONAL CONFERENCE OF STATES ON BUILDING

CODES AND STANDARDS/

NATIONAL BUREAU OF STANDARDS

JOINT EMERGENCY WORKSHOP ON ENERGY

CONSERVATION IN BUILDINGS

June 19, 1973

Main Auditorium
Department of Commerce
14th and Constitution
Washington, D. C.

Kenneth C. Henke, Jr.

I hereby call to order the National Conference of States on Building Codes and Standards (NCSBCS) - National Bureau of Standards (NBS) Joint Emergency Workshop on Energy Conservation in Buildings. We are pleased to be able to follow our sponsorship of the National Symposium on Education and Training of Code Enforcement Officers, which was held last December in Austin, Texas, with another response to the national concerns present at that time. Our interest in energy conservation in buildings is reflected in the resolutions initiated by our Standards and Evaluation Committee, and then introduced by the Executive Committee. These resolutions are:

"(1) Endorse the concept that energy conservation is of national concern and that related building design and construction is properly a building code subject.

"(2) Consistent with stated NCSBCS objectives, uniform national performance-oriented reference standards should be generated.

"(3) Commend NBS and its Building Environment Division for its excellent and extensive research on environmental building factors and energy use; further, to request continued activity in this area and specifically the following:

Report to the S&E Committee with recommendations on the possible content and strategy for generation of a building-related energy conservation reference standard, including due consideration of cost implications.

"(4) After reviewing NBS Report and recommendations, the S&E Committee shall report back to NCSBCS on specific actions to be taken."

In the short period of time since these resolutions were formally adopted at our Sixth Annual Conference in Hartford, Connecticut, last month, several States have asked the National Bureau of Standards for technical assistance in developing energy conservation programs. The earlier concerns of NCSBCS, plus these recent requests to NBS, suggested the need for an emergency workshop of State officials on energy conservation. Moreover, a workshop was needed quickly before the summer was fully upon us. It is this sense of emergency that accounted for the very short notice we could give you. The workshop was needed for two reasons: one, to identify those technically-feasible action alternatives that we can recommend for our existing buildings; and, two, to see what we might recommend for energy use in future buildings. For these items we asked assistance from the National Bureau of Standards. They have responded in a very short time.

The additional purpose of this workshop is to give the States an opportunity to trade notes and experiences on what building energy conservation actions might be acceptable, given the differing situations around the country.

We are grateful that the Bureau has been able to respond in such a short time frame. I would like to introduce the person whose personal interest in NCSBCS-NBS cooperation was clearly stated when he addressed our Sixth Annual Conference last month in Hartford. What he stated in May, he is demonstrating in June. I am pleased to introduce Dr. Richard W. Roberts, Director of the National Bureau of Standards.

Dr. Richard W. Roberts

Thank you, Mr. Henke. The fact that this National Conference of States on Building Codes and Standards (NCSBCS) sponsored workshop is being held within five weeks of your Annual Conference indicates an active year ahead for your organization. We are pleased to work with you. This is an emergency workshop, called by NCSBCS and assisted by the National Bureau of Standards (NBS). "Emergency" implies a quickened pace; we have a full schedule of work for the day, so I'll be brief in my welcoming remarks. A welcome is appropriate, though, because many in this room are meeting for the first time. That's how emergencies are: they bring together people who are not often known to one another. Let me, then, welcome you and describe for you--State building officials, governors' energy aides, and concerned building industry representatives--the role of NBS in this joint workshop.

NCSBCS and NBS have been partners in the building standards and codes areas since 1967. The division of duties is roughly as follows: NBS contributes its broad-based capabilities in the measurement of building performance. We've been at this work since our founding in 1901. Our resources in laboratories and in people are known throughout the world as a source of thorough and impartial knowledge in building science.

What NCSBCS brings to this partnership is a forum, a mechanism by which the States interpret technology in terms of people's needs. The States come together in NCSBCS to share their ideas and experiences, to bring to us their research needs and then to take research findings and proceed, where they see fit, to make that knowledge a base for public policy. Almost always the means taken is through the building regulatory process.

We've been perfecting this partnership in building progress for six years now. The ability to call and organize this joint workship in one-month's time is a vivid demonstration of the state of readiness of this mechanism. When Chairman Cabelus advised us of the mounting sense of concern over energy, we were able to respond in a timely fashion with a presentation of technically-based alternatives for energy conservation in buildings; alternatives which State officials can review, and where appropriate, State officials can responsibly recommend to their governors.

The main thrust of the Bureau's research presentation this morning is to identify actions to stem the waste or inefficient use of energy in buildings. This is a highly significant issue in view of the fact that approximately one-third of the Nation's energy is ultimately used in residential and commercial buildings. Over 80% of the energy used in buildings is consumed in heating (including hot water) and air conditioning. Studies conducted by NBS indicate that on the average about 40% of the energy going into heating and air conditioning is wasted through design of the building, construction practices in implementing design, and occupant practices in using the building.

How has the Bureau come up with the findings just cited? Most of this work is taking place in the Bureau's Center for Building Technology. There are upwards of 15 different projects in the Center bearing on energy conservation, laboratory and field studies such as: air leakage and air quality, computer prediction of thermal performance in buildings, integrated community utility systems, modular-sized integrated utility systems, total energy systems for multi-building complexes, thermal physical properties of insulation and other building materials, solar heating, thermal efficiency of equipment.

The Center for Building Technology in pursuing this work, draws on resources from across the Bureau. For instance, the Institute for Applied Technology contributes overall planning and guidance, particularly in identifying points of tangency where industrial processes affect building construction methods and materials; the Electronics Division made extremely sensitive electric power meters for use in the total energy study, the Institute for Basic Standards provided calibration services on a great variety of thermal devices such as thermocouples and flow meters; the Analytical Chemistry Division developed instrumentation for measuring gaseous pollutants. You can see that research on energy conservation in building touches many parts of the Bureau.

These studies, of which you will hear more later this morning, have identified deficiencies in building practices that lead to an annual waste of energy equivalent to about 456 million tons of coal, or 65 million gallons of oil, or 9 trillion cubic feet of natural gas.

We also cannot ignor the impact on the environment which results from this prodigality. By increasing the efficiency of the use of energy in building and improving design and construction practices, the demands for energy will be significantly decreased. To be effective in alleviating the energy stress, any energy conserving innovation must be assimilated in the building industry with all deliberate speed. For this reason our program emphasizes projects which will assist those involved at the state-of-the-art level of the industry--Government agencies concerned with building, consumers, architects, and design engineers. The building regulatory system and the system of consensus standards affecting building construction have a large responsibility in all of this. This is why we are here today.

Now, just how the States elect to respond to those immediately available and technically proven actions to be described this morning, is, of course, a decision for each State. If the States wish to interact, NCSBCS is an available mechanism, it seems to us. And, we defer to you on that. Our satisfaction comes in knowing that we have been able to respond with useful research contributions to an urgent request from NCSBCS.

We are, frankly, impressed by your State officials' ability to anticipate a difficult situation ahead for the citizens you serve and then to take decisive action to tackle head-on what you perceive to be threats to the well-being of building users.

We are also gratified that we can be of assistance to you in this venture in intergovernmental cooperation. As we said to your Conference in Hartford last month, we are truly partners in progress.

I'll be leaving shortly for Capitol Hill to testify before the Energy Subcommittee of the Committee on Science and Astronautics and the Conservation and Natural Resources Subcommittee of the Committee on Government Operations, U. S. House of Representatives.

I'm due there in minutes. You may be sure that I will tell the assembled Chairmen and Committee members of the important work you are doing.

Good luck.

Kenneth C. Henke, Jr.

Our lead-off speaker this morning is Dr. Kenneth Lay, Deputy Under Secretary of the Department of the Interior. Dr. Lay, who was appointed to this position in October of 1972, also serves as Executive Director of the Department of the Interior's Energy Board. In this capacity, he is responsible for conducting studies of various energy problems and advising his Secretary and Under Secretary on policy and technical matters in this increasingly critical area.

Dr. Lay holds a Bachelor's and Master's Degree in Economics from the University of Missouri, and a Ph.D. in Economics from the University of Houston. He has been employed as a Staff Economist by EXXON Company; has served as an officer in the U. S. Navy, assigned to the Assistant Secretary for Financial Management; and, served on the staff of the Federal Power Commission. Since 1970, Dr. Lay has also been an Associate Professor and Lecturer in Economics at the George Washington University in Washington, D. C.

To bring us up-to-date on Federal programs regarding the conservation and efficient use of energy, I am pleased to introduce to you Dr. Kenneth Lay.

Dr. Kenneth Lay

Thank you, ladies and gentlemen. Welcome to Washington. We all seem to have this problem with hearings this morning. My hearings are not the same as your previous speaker, but I do have to leave in about fifteen minutes to testify on deep water ports. I don't have a formal statement. I do have a few comments I would like to make this morning to try to bring you up-to-date on some of the things that are happening in the energy conservation area. Some of these you are familiar with, some you may not be.

I think most of you know the President did deliver a message to Congress on April 18 of this year concerning energy and one of the main thrusts in that message was directed toward developing an energy conservation program in the Federal government. There were several aspects to his announcement from the standpoint of our Department. One of the more important ones was the establishment of an energy conservation office in the Department of the Interior, charged with the responsibility for pulling together and coordinating all of the energy conservation efforts of the Federal government, undertaking research and analysis of new areas of energy conservation which promise to reduce energy consumption in the future, and educating the public, to some extent through the help of the State governments, on the various things they can do to reduce energy consumption.

We think the potential in this area is extremely great. In preparation for putting the energy message together last fall, the Office for Emergency Preparedness undertook a fairly comprehensive study to determine the potential of energy conservation. That study came up with estimates that by 1980, with an extremely conscientious effort, we could save as much as seven million barrels of oil per day, or about a third of our estimated consumption by that year.

That estimate may be overly ambitious, but even if we should achieve half that much or even a fourth of that much, it would make a tremendous difference as far as imports into the United States, the outflow of dollars resulting from the imports, and reducing shortages.

As of this time we have established the new Office of Energy Conservation. We have not yet announced our Director for that Office. We do have staff people assigned who have been working with many of the Federal departments and agencies trying to pull together a short-term energy conservation program, one which will probably be announced in the very next few days. This program will be devoted primarily at reducing energy demands this summer and next fall, directed at mitigating the seriousness of the gasoline shortage, and then the heating oil shortage in the winter. This program will include many initiatives within the Federal Government, things that we hope to do in order to save energy, looking at such things as the operations of our buildings, the types of cars we buy and operate, and programs for encouraging car pooling. We will also be looking at such things as air conditioning, heating, and Government travel. Some of them are intermediate or long-term.

We also will be looking at the activities of private individuals, the private industry, at what they must do. As has been widely publicized, we have analyzed speed limit possibilities as a means of reducing gasoline consumption. In that area, if speed limits are to be adjusted, the primary action must be taken by the State governments, so we are very anxious to establish a good working relationship with the representatives of the State governments in order that we can work toward a common objective of reducing energy consumption.

If you look at our total energy problem between now and 1985, you can see the importance of energy conservation. Last year we imported about four and a half million barrels of oil per day, which is about 29 percent of our total oil requirement. This year it will jump to six million barrels of oil per day, which will be about 33 percent of our requirements. Even at those levels we are talking about dollar outflows on the energy account of between four and six billion dollars per year. Looking out to the year 1985, we are talking in terms of imports somewhere between 13 and 15 million barrels per day. In other words, between a two- and threefold increase in the current level and we are looking at dollar outflows variously estimated between 25 billion dollars and 70 billion dollars per year. Obviously, those are extremely significant numbers when you look at our total trade account. Last year our imports and exports were in the neighborhood of about 45 billion dollars, so we are looking at imports of energy which could be as great as our total imports last year.

We must do things to reduce those imports and the associated dollar outflows.

In addition to the balance of payments considerations, there is the question of whether the supplies will be available, whether in fact we can have the imports we are going to need to avoid domestic shortages.

In both the short-term and the longer term, one of the most promising policy options is energy conservation. It takes many years to turn around such things as domestic drilling, to get Alaskan pipelines built, to get nuclear plants built, and to get new refineries built. So, even with a very devoted effort in many of these areas, we have little control over those imports. Energy consumption is something we can start trimming back immediately and thus reduce our imports and the possibility of shortages.

I would like to commend your efforts here today and those of the Department of Commerce and Bureau of Standards. I think the effort you are undertaking in reviewing building codes and various State policies and Federal policies in these areas, and the research that has been done, is very good. Obviously here, as I mentioned earlier on the speed limit consideration, the States and the local governments have a most instrumental role to play.

At the Federal level, the Bureau of Standards has done some excellent research on potential savings, the General Services Administration has done some excellent research and we have every reason to believe that we could realize between 20 and 40 percent energy savings on new buildings with the appropriate construction techniques, the appropriate insulation, the appropriate lighting, window spacing, etc. These are very substantial savings and in many cases the net cost of the buildings is not greater and in some cases less.

I hope that your Conference here today will be a productive one. We in our energy conservation effort stand ready to help you as best we can. I think some of you are aware that at the Governor's Conference in Lake Tahoe week before last, one of the primary issues on the Governors' agenda was energy conservation and the energy problem. Out of that conference it was decided that the Governors would establish a working group which will represent the Governors at the Federal level in becoming more deeply involved in all energy policy matters. The intention to do that was endorsed by the Director of the Domestic Council, at his appearance at that conference and as soon as we have been notified of the members of that committee, and as soon as they are ready to sit down with us, we are anxious to do so. One of the primary items on the agenda will be energy conservation, so I am sure that you in your role here today can help your own Governors in preparing their positions on these important matters.

Again, I hope that you have a very good conference today. The effort that you are undertaking is a most important one at the Federal level and we hope at the State and local level. Thank you.

Kenneth C. Henke, Jr.

It is my pleasure to introduce at this time Mr. Bernard E. Cabelus, National Chairman, National Conference of States on Building Codes and Standards.

Bernard E. Cabelus

I am very happy to see we have some sort of a turnout this morning. I am very delighted to see that our "S" and "E" Committee has done such a good job. They have worked with the National Bureau of Standards and Department of Commerce in setting up this workshop. Thank you for the opportunity to say "hello" and I also wish you a very fruitful conference.

Kenneth C. Henke, Jr.

The main purposes of this workshop are: define the magnitude of the problem relevant to the energy demands imposed by buildings; suggest alternative techniques for conserving energy this summer and next winter that can be accomplished without any additional expenditures for equipment and products, plus those requiring only modest expenditures for readily obtainable materials and equipment; discuss ways that the State could employ for identifying or developing necessary consensus performance standards for State reference in such subject areas as insulation, fenestration, air infiltration control, site design, etc.

It is my privilege to introduce Dr. J. E. Snell, Chief, Building Service Systems Section, Building Environment Division, National Bureau of Standards. Dr. Snell will preside as Session Chairman for the morning session. Mr. C. W. Phillips, Mr. F. J. Powell, and Dr. J. Hill, members of the Building Environment Division of the National Bureau of Standards, will make presentations on Energy Conservation Practices for Existing Buildings -- Actions to Save Energy this Summer and Next Winter, with specific emphasis on things that can be done without hardship or personal expenditure and things that require modest expenditures for readily obtainable materials.

> Remarks and copies of slides and transparancies used can be found in NBS Technical Note 789--"Technical Options for Energy Conservation in Buildings," as follows: Mr. C. W. Phillips--Summer Cooling-Existing Buildings-With and Without Extra Cost, pp. 1-24; Mr. F. J. Powell--Winter Heating-Existing Buildings, pp. 25-71; Dr. J. Hill--Insulation, pp. 72-117.

Dr. T. Kusuda, Mechanical Engineer, Thermal Engineering Section of the Building Environment Division of the National Bureau of Standards, will speak on Energy Conservation Practices for New Buildings, with specific emphasis on design opportunities.

> Remarks and copies of slides and transparancies used can be found in NBS Technical Note 789--"Technical Options for Energy Conservation in Buildings," pp. 135-146.

Dr. J. E. Snell

I am privileged to introduce Dr. Walter A. Meisen, Assistant Commissioner for Construction, Public Buildings Service, General Services Administration (GSA), who will present a paper entitled "An Overview of the Manchester Project."

Walter A. Meisen

I am pleased to have the opportunity to speak to you briefly about the General Services Administration's Manchester Project and other GSA activities in the energy conservation area. The General Services Administration is the business arm of the Government. We provide the supplies, equipment, transportation, records management, office space, and other services for the civilian side of Government.

We have had a vital interest in energy conservation long before a shortage of energy gained national attention. Saving energy is good business even if there were no shortage. Energy is expensive and the costs are spiraling upward. All the normal energy sources are limited; they can be used up. Fuels purchased overseas have an adverse effect on the balance of payment and place our country in a position of dependence on others.

The Manchester Project--as it has become known--is GSA's energy conservation demonstration project. It is a 175,000 square foot office building currently under design which will be constructed in Manchester, New Hampshire.

The Manchester Project is an outgrowth of the Roundtable on Energy Conservation in Public Buildings, which was jointly sponsored by the National Bureau of Standards and the General Services Administration in May 1972. Experts from many organizations, including the private sector, were called together to explore ideas for energy conservation in the design, construction and operation of buildings. From this conference came the decision to select one project from GSA's inventory and make it an energy conservation demonstration building.

I think most of you know something about the usual design process. The architect is given a program of requirements by the owner or developer. He develops a concept for the building design and once the design is pretty well established, brings in the engineer who determines the most suitable and economical mechanical-electrical systems for the building. This process works but energy conservation can easily get short-changed.

We took a different approach for the Manchester Project. We put together a design team consisting of the usual architect-engineer, plus an energy conservation consultant, the National Bureau of Standards, and GSA as the owner. Energy conservation was made a prime design parameter to be considered equally with function, fire safety, life cycle cost, and aesthetics. Before developing a concept for the building, determinations were made as to features/systems/equipment which would contribute greatly toward a reduction in energy requirements. From the very beginning of the design process, energy saving possibilities were given major attention.

We sought ideas from many sources including the schools of architecture and engineering in the colleges and universities throughout the country; from technical societies such as the American Society of Heating, Refrigerating and Air-Conditioning Engineers, and the American Society of Mechanical Engineers; from other Federal agencies and other sources.

These ideas, plus those originating with GSA, NBS, the architect-engineer and the energy conservation consultant, were categorized and evaluated. NBS made a whole series of computer studies designed to show the possibilities for energy savings through the control of the building orientation, fenestration, configuration, and insulation. The results of all these efforts were available at the beginning of the design process.

The Manchester building will include various systems and will be instrumented to facilitate an evaluation of performace after occupancy. For example, one floor will have uniform lighting similar to that normally provided in most buildings these days; other floors will have non-uniform, task-oriented relocatable lighting; another may have lights built in the furniture; while one floor will have larger windows and be designed for the maximum use of natural illumination. Similarly, the building will be designed with different heating and air conditioning systems on the various floors for comparison purposes.

When we began this project, we announced a goal of a 20 percent reduction in energy requirements over comparable modern office buildings subjected to similar climatic conditions. Despite some penalties inherent in multiple mechanical-electrical systems, we are already convinced that we will exceed that goal by a wide margin. Dr. Jim Hill from NBS, who will speak next, will provide you with details of how careful design of the building shell can make a substantial contribution to energy savings.

Buildings must be designed to satisfy functional and aesthetic requirements. Not all the identified energy saving ideas can be included in a single project. Sometimes it will not be practical to go as far with some features as computer studies indicated desirable in order to reduce energy requirements. However, energy conservation must become a major factor in the design of all buildings.

Sometimes demonstration projects--such as the Manchester Project--get too much attention and divert efforts that could be made concurrently elsewhere. We are trying to avoid that in GSA. I would like to take a few more minutes and tell you about other efforts underway to reduce energy demands. One current GSA research study deals with air change rates and outside air requirements. Outside air must be heated and cooled depending on the season. If a reduction can be made in the amount of outside air brought into buildings, a major impact can be made on energy usage. Also, we are currently taking a hard look at lighting levels. A substantial reduction in the power required for lighting would also substantially reduce the power required for air conditioning due to a corresponding reduction of lights. Already many new Federal buildings are being designed for non-uniform, task-oriented lighting.

Solar energy seems very attractive. We have plans for an 8,000 square foot solar collector for a building to be constructed in Saginaw, Michigan. This collector is expected to provide over 70 percent of the building heating and all its hot water.

The control of energy usage in existing buildings offers the potential for great energy savings which can become effective almost immediately. You heard about this area earlier today from other speakers.

I would like to tell you a little about GSA's efforts in existing buildings before Dr. Jim Hill takes over to talk about computer studies for the design of new buildings.

GSA is represented on an intergovernmental task force on energy conservation, which is chaired by a representative of the Department of the Interior. The principal representatives on this task force are from the Office of Management and Budget, Departments of Treasury, Commerce, Interior, Transportation, Defense, GSA, Federal Power Commission, Interstate Commerce Commission and the Council on Environmental Quality.

Under the direction of the Office of Emergency Preparedness, GSA has been chairing a government conservation group which is composed of high-level representatives of the Federal agencies having real property management responsibilities.

This group was responsible for developing an "action plan" for power conservation which is applicable to all Federal facilities, civilian as well as military, and includes such structures as office buildings, post offices, space research centers, AEC installations, and warehouses. It also has been adapted for use by State and local governments and copies have been furnished to the Governors of the 50 States. This plan recognizes that in order to conserve energy the full cooperation of every building occupant is required. It includes a "message to all Federal employees" describing what needs to be done, when it is to be done, and why.

For example, building tenants are reminded that by just raising the thermostat setting from 72 to 75 degrees, turning off some of the corridor lights and closing venetian blinds or window drapes can reduce a building's electrical load during summer months anywhere from 5 to 10 percent, without noticeably affecting comfort conditions or impairing the efficiency of the employees in the building.

They are reminded to minimize the use of electrical equipment such as Xerox machines, calculators, and other office-type business machines.

The responsibilities of management officials and facilities managers are also spelled out in the plan, and guidance is provided on shutdown and rescheduling. Building operators are cautioned to avoid starting up, during peak load periods, major electrical equipment which causes heavy surges on the line.

Automatic timers are utilized to start and stop individual pieces of equipment and to turn on and off lights on predetermined schedules for the most economical operations.

We manage our utilities conservation program on a decentralized basis. We have approximately 200 building superintendents throughout the nation and each one is responsible for reviewing his costs and performance on a day-to-day basis. Staff support and overall guidance are provided from Washington and our 10 regional offices.

In addition to action previously taken we recently initiated an experimental program for cleaning out buildings during the daytime working hours of the building tenants. In this way, we will be able to turn off the lights for the entire evening hours throughout the buildings. We are reducing our lighting in hallways and selectively removing fluorescent tubes from lighting fixtures, except those which are located directly over work areas in office space. We expect to reduce lighting loads by 30 percent without interferring with provision of adequate lighting for the visual task being performed.

Our overall utilities management program contains a section which deals with emergencies. In this section, each of our field offices is required to develop procedures to be followed when an electrical brownout, blackout, or other utility shortage appears imminent. A list is prepared of all major electrical equipment, indicating which equipment is to be shut down, in what sequence, and the electrical power that can be released to the local utility company. Contact with these utility companies is made in advance and lines of communication established so that requests for power reduction can be quickly responded to. The plan also provides for the restoration of normal electric service.

The plans we have developed have already proven helpful in conserving electricity and assisting us during periods of emergencies.

In concluding, I would like to make one more observation. We realize that more research and development are required to improve the efficiency of building operations, power generating, and operating equipment. GSA is attempting to be the catalyst for the Federal government in pointing the way. We hope other Federal, State and local government agencies and the industrial sector will acknowledge our contribution and follow this lead.

Dr. J. E. Snell

Dr. J. E. Hill, Mechanical Engineer, Thermal Engineering Systems Section of the Building Environment Division will speak on Preliminary Design Process, Manchester Building.

> Remarks and copies of slides and transparancies used by Dr. Hill can be found in NBS Technical Note 789--"Technical Options for Energy Conservation in Buildings," pp. 118-134.

To complete the full scope of our presentation, I will now call on some representatives of various industries who will present their views on the subject of energy conservation. Our first speaker is the President of the American Society of Heating, Refrigerating and Air-Conditioning Engineers, Walter F. Spiegel.

Walter F. Spiegel

As President of an Engineering Society, it has been my privilege during the past year to work with many people who have exhibited abilities, enthusiasm, and mature judgment in solving engineering problems. Many of the speakers who addressed you this morning have contributed to our Society. The three attributes are very necessary ingredients for problem solving in an age of advanced technology in which a bewildered public tends to look for simplified magical solutions to solve the ills of the times. We have been promised Utopia too many times. Many a buyer is left with an unworkable product or system, and guarantees that are unenforceable. I think we have all had to come to the conclusion that there is no Santa Claus. It is not likely that any single new development--whether it is gasification of coal or breeder reactors--will solve, in one fell swoop, all the energy conservation challenges which we think are soon going to spread throughout the country. It takes a lot of engineering and planning to develop effective solutions. The interest of our Society, ASHRAE, covers a segment of energy utilization which consumes over 11 percent of the energy consumed in the United States. We have put a great deal of emphasis on this subject in the past five years. I think we predicted the problem to some extent. We already have major research projects in progress for several years, and have tried to motivate many of our technical committees to work towards solutions. The results of many of these studies are already available.

Right now there is a substantial "kit of tools" available to help our design professionals develop systems for buildings to economically utilize energy. But the design fees to do it practically are very scant in the commercial building market and the motivation on the part of owners and developers is almost totally lacking. This is part of the challenge we all must face. How then can a technical society such as ASHRAE help you? How indeed does a technical society, supported by volunteer efforts, serve a public effort where each problem solutions requires hundreds of thousands of manhours? And where each problem solution requires a mature appraisal? Consider just the four choices of energy for a building system. What does it do to the ecology? Can we provide more housing and at the same time use more energy, and so forth? Many different programs are vying for national priority. How does one choose?

I think we have somewhat of a plan to make the expertise of ASHRAE available to help solve some of these problems. We have incorporated the process of collective judgment for critical review. Our committees incorporate each segment of our industry, including design professionals, contractors, manufacturers, users, educators, government personnel, and many others. We believe it is this cross-sectional viewpoint which has been an important ingredient in our Society activity, and it is these combined panels of experts, operating from different enlightened viewpoints, which can give a special validity not only to our own Society's activities, but to the benefit of the public. It is the industry's cross-section which ASHRAE has available to guide not only its own research and technical activities, but to assist in the guidance of other groups doing work in our area of interest for the benefit of the public. You have heard Walter Meisen from GSA; his is one of the government activities with which we are cooperating. Their project manager and some of their consultants have been invited to join our technical committees. We have over 70 technical committees, staff by over 1200 volunteer engineers; each one has an expertise in his own particular field. The voice of our Society will not be a singular one, not the opinion of an individual, but it will reflect the consensus of a responsible cross-section group. When ASHRAE is called upon by a private agent to assist in a project funded by a government or university institution, we have, and will invite representatives, both from the research group and the sponsoring agency, to join one of our committees. Assistance will be of the appropriate nature.

We also have a very active and vital standards committee which generates standards for this country and through the ISO for world use. At the local level each one of our 117 chapters is prepared to respond to municipal or state requests to identify knowledgeable members to contribute as individuals, or to provide liaison with one of the society activities for general guidance. This method is not intended to be a short cut to provide true engineering, but a means to share the collective capability and judgment of a very active technical society to help plan a course before it is too late.

Dr. J. E. Snell

Our next speaker will be Mr. Joseph Demkin, American Institute of Architects.

Joseph A. Demkin

The American Institute of Architects recognized the emerging energy crisis last year when it formulated a Task Force on Energy Conservation. The charge of the Task Force is to develop a program for the AIA concerning the role of the architect in the field of energy conservation, which includes the monitoring of several research projects that will be conducted by the AIA Research Corporation. At this time, I would like to briefly touch upon some of these activities.

First, we have created an Action Plan for the development of a National Program for Energy Conservation in Buildings. This program, proposed to be carried out with the co-sponsorship of NBS, will be aimed at the design professions, Federal agencies, constructors and the financial community to achieve the common goal of energy conservation, with its associated reductions in building design, construction and operating costs. In our efforts we will identify the barriers which prevent the implementation of energy saving techniques--that is, we will look into those areas such as attitudes and education of the designer, user attitudes and requirements, regulations, codes, standards and verification of data. (The need for verification was pointed out by a statistic I heard mentioned earlier in reference to gas consumed by pilot lights on residential ranges. I've heard figures of both 10 percent and 50 percent quoted for the amount of energy utilized by the pilot light as a percentage of the total energy required by cooking.) The monitoring and measurement of actual energy for all uses in buildings is needed in order to verify where the greatest savings can be realized. Projects such as the GSA Office Building in Manchester, New Hampshire, will hopefully contribute to that kind of information.

The AIA Research Corporation is now doing a study for the Ford Foundation's Energy Policy Project entitled the Architectural and Institutional Opportunities to Conserve Energy in Building Design. One of the main thrusts of this study will be the creation of energy conserving guidelines that are performance stated--and I underline performance--so that as we move from voluntary efforts we are talking about today into the harder constraining actions of regulations and legislation, we do not stifle the imagination and innovative thinking that will be essential for the effective utilization of energy.

Another AIA research effort being proposed by Dick Stein to the NSF will measure the total energy impact of construction materials on the environment. This will be accomplished by creating indices which quantify the energy required by materials for their manufacture, assembly on-site and performance in-place. This data would permit the designer to make more effective evaluations early in the decision-making process as they relate to energy use. And now I would like to briefly mention some of the potential areas for energy saving.

While the retrofitting of our existing buildings offers a significant potential for savings, the greatest optimization of energy use will occur in future structures, for it is in the earlier stages of decision and design where long-lived energy patterns are molded. The siting and configuration of buildings, as well as the support systems of heating, ventilating, air conditioning and lighting, have a great impact on energy use since the life spans of buildings are measured in decades and centuries, whereas the useful life of appliances and machines is much shorter.

This time impact also carries over into another area offering a greater potential for savings, which is in the design of the infrastructure. How we assemble our buildings into neighborhoods, communities, cities and regions has a direct influence on transportation systems which account for about 25 percent of our total energy use. For example, although Washington, D. C. was originally planned in the late 1700's, its initial patterns continue to have a direct bearing on our present and future transportation systems. In addition, these broad-scale patterns affect the location of generating plants and the location of power distribution systems.

In closing, I would like to say that it is important that we don't re-invent the energy wheel, but that we make immediate use of present technology. This might include the transfer of technology such as the physiological criteria developed by NASA for life support systems in the space program. The available data of these and other areas could be applied to life support for buildings. Also, we must recognize that this crisis which has been brought about by the collective actions of a multitude of actors in the energy arena will only be solved by the collective efforts of all participants in the total energy chain of transmission, exploration, production and utilization. Therefore, it is most essential that the issue be viewed at all times in its full perspective so that all of our specialized actions reinforce with one another to achieve our broadest objective of efficient application of energy to both the natural and man-made environment. Thank you.

Dr. J. E. Snell

Our next resource speaker is John Kaufman from the Illuminating Engineering Society.

John Kaufman

First of all I would like to tell you a little about the IES, in case you are not familiar with its activities. It was established in 1906 with the express purpose of the advancement of the art and science of illumination and the dissemination of the resulting information. The Society has over 10,000 individual members, plus approximately 600 sustaining or company members. There are 118 sections and chapters in 12 regions.

The basis of the technical output of the Society is research performed by the Illuminating Engineering Research Institute (a separate organization from IES), whose research is performed at universities throughout the country. In addition, IES uses research from abroad as well as other research within the United States.

The IES recommendations are prepared by technical committees. There are over 30 main committees, with a total membership of about 725, of whom less than half are directly related to the lighting field. By lighting field I mean manufacturers of lighting equipment, utility people, and sellers of the equipment. The majority of members come from government, user, physician, and educator groups, other societies, and so forth. Some Society recommendations cover testing procedures, but the majority are application reports--how to light various areas. Some of these reports become American National Standards and go through the normal processing, including public review. All material produced by the Society is published in its own publications. The ones on general application are included in Lighting Design & Application, which is a monthly magazine. The more scientific and technical are published in the Journal of the IES, which is a quarterly publication. Every 6 or 7 years the Society publishes its IES Lighting Handbook, which contains summaries of all current information relating to lighting.

Now I would like to get into the aspect of energy conservation. In February of 1972 the IES, realizing its responsibility to the public, prepared 12 recommendations for the conservation of energy and the better utilization of energy used for lighting, all without affecting the quality of lighting design. I would like to quickly read these 12 points: Design lighting for expected activity (light for seeing tasks with less light in surrounding non-working areas). Design with more effective luminaires and fenestration (use system analysis based on life cycles). (By luminaires we mean lighting fixtures.) Use efficient light sources (high lumen per watt output). Use more efficient luminaires. Use thermal controlled luminaires. Use lighter finishes on ceilings, walls, floors and furnishings. Use efficient incandescent lamps. Turn off lights when not needed. Control window brightness. Utilize daylighting as practicable. Keep lighting equipment clean and in good working condition. Post instructions covering operation and maintenance.

In January 1973, at the request of New York State's Interdepartmental Fuel and Energy Committee, we prepared a report showing how these 12 points apply in building design and operation and maintenance. We also provided additional detailed information. This material is available to all interested groups. The IES now has several committees working on detailed design procedures to implement the use points. Thank you.

Dr. J. E. Snell

I would like to introduce Mr. Brian R. Landergan, National Association of Home Builders.

Brian R. Landergan

Let me say first that the National Association of Home Builders recognizes the need for energy conservation, and it is working towards that goal with our membership which is some 70,000. We, in fact, contributed to the development of those booklets, the 7 and 11 Ways for Saving Energy on the part of the consumer, and we worked with HUD in the development of its improved standard for insulation, which is part of the MPS.

It appears this effort, which I personally heard of only yesterday, is an excellent one and we want to help you achieve your goal. We do suggest, however, that conservation is only one means of alleviating the problems of energy shortages. I am sure you all recognize that there are a number of other ways to accomplish a better distribution of the available supplies. There is some question in our minds concerning the apparent emphasis that has been placed this morning on energy savings through new home construction, although I recognize that the last portion of the previous presentation was directed towards the large high-rise buildings.

Just to show there are other thoughts on this subject, I would like to quote a Mr. Irwin M. Stelzer's testimony before the Senate Interior and Insular Affairs Committee. Mr. Stelzer is President of National Economic Research Associates. Is Mr. Stelzer, by any chance in this group? In any case, what he said was, "Those who would conserve energy by focusing on direct ultimate consumers in their homes must be sobered by the fact that transportation, industrial, and commerical uses of energy account for 80 percent of the total nationally, and a like percentage of growth in energy use. Heating, cooking and the many other uses in a household contribute 20 percent of our national energy consumption. Possibilities of ending our energy shortage by focusing on residential customers would seem limited indeed." Those numbers conflict directly with those offered this morning, and would possibly conflict on a long-term basis with the savings suggested earlier by others.

New housing starts are about 3 percent of the existing housing inventory. If you say that housing consumes 33 percent of the energy, then that new housing can be expected to use slightly less than one percent of the national energy. Of course, you can't save all of the energy used in homes, because none of them are energy free and more and more of them are becoming better insulated, have double glazing, have more efficient appliances, etc.; but, if you could save another 20 percent, then what you are saving is 20 percent of less than one percent and while this is worthwhile, certainly emphasis has to be placed elsewhere to bring down the total consumption.

There are improvements in the home construction industry that are underway for energy consumption. It was noted earlier this year at a roundtable held by the American Home Magazine on Housing, that lending corporations have noted a definite increase in the use of double glazing. It was also pointed out that the two-story townhouse, which is so prevalent in this area, is a design which saves about 50 percent of the energy which is used in an equivalent one-story slab-on-grade house. Efforts are being made in our organization to encourage improved siding, the use of overhangs, the use of shade trees, use of light-colored paints and roofing. You can be certain when appliances are provided with electronic igniters and automatic pilots, and, incidentially, if you are really concerned about energy conservation, nearly half the gas used in the stoves is used by

those pilot lights. We suggest turning them out, supplying everybody with matches, and you can save one-half percent of the national consumption. In any case, when those appliances are available, they will be installed. Additionally, the National Association of Home Builders has a little booklet which I don't have with me, "Your New Home and How to Take Care of It," which is given by builders to purchasers of new homes as part of the closing package. This particular document is up for review at this time and I am certain that we will include in it a section on emphasis of savings in home operating costs through energy conservation. We will list certainly some of the partices shown in the slides this morning.

We suggest that must greater emphasis on conservation needs to be directed toward existing structures, both homes and commercial, around the country. We believe there is much room for improvement in those facilities. Of course, that will require a real selling job, a different kind of selling job than that necessary when you put these improvements in new structures, and it might require direct economic incentives, such as a tax break, for the amount spent in improvements which contribute to energy conservation. But, basically, adding insulation under existing roofs is a fairly simple job and more effective than adding insulation to walls, and while we believe that homes, older homes, are poorly insulated, we also believe that there are a great number of commercial structures that are in need of improved insulation also. It is also suggested, as I mentioned earlier, that even greater results can be achieved in energy conservation in other areas and that we mustn't forget that improvements in home energy consumption mustn't stand alone. I know you are not concerned with transportation, but consider that one ton of freight shipped by truck consumes 6 times as much energy as shipping that same ton by rail. Just a little change in shipping patterns could result in significant savings.

One final thought. It also seems inconsistent to be working so hard on energy saving in homes and buildings when Detroit has just had its biggest quarter of production of automobiles that consume more energy than ever.

NAHB is in favor of energy conservation. It is recommended however, that all means of conservation be explored and that those which achieve the greatest results in the quickest time be given the highest priority. We do want to assure you that we want to work with all of you to achieve the desired results in our sector, home building. Thank you.

Dr. J. E. Snell

The last of our resource speakers is Wilbur D. Sparks, the Director of Legislative Affairs, American Refrigeration Institute.

Wilbur D. Sparks

The Air Conditioning and Refrigeration Institute is an industry trade association, which represents more than 90 percent of the U. S. made equipment used in air conditioning systems and refrigeration systems, and consists of 183 manufacturers of these systems and their components. ARI is very interested in one of the principal subjects for this morning's discussion--efficiency in air conditioning and refrigeration. Most of what I have to say will be brief, I assure you, and will deal with air conditioning.

I want to emphasize first that an air conditioning system is more than an air conditioner, and that efficiency in air conditioning has to come not only from design of the air conditioning unit itself, but also from design of the duct work, and from the location and the insulation of the home in which the system is installed. The efficiency with which the system is used depends a great deal on the life-style of the family if it is in a home, or the work habits of the people in the office building where it is being used.

When you are talking about efficiency, a great deal depends on factors other than the efficiency of the unit itself. That is the point at which the manufacturer has control over the efficiency of the unit. But he and the user depend very heavily on the installer, the contractor, the designer who determines what size unit, what the insulation is going to be, what the glazing is going to be, all of the factors that go into the question of how efficient the unit will be. Much of this is out of control of the manufacturer.

ARI is currently certifying a number of different types of units that its manufacturers make. By certification, I mean setting up testing standards which are carried out by independent testing laboratories. These tests will show, for instance, the power input and the btu output. Now ARI is currently certifying the power input for unitary air conditioning equipment. We have a directory which will show this for all types and sizes of air conditioning equipment produced by our members. Anyone who would like to have a copy of this can contact us and get it or the directory for any of our other certification programs. So far as we know, none of our members are placing this kind of information on a label. I bring this up because there is coming to the forefront some emphasis on labels.

Through its appropriate committees, ARI is studying the possible publication of performance factors in its directory of unitary air conditioners. That would be expressed in btu's per watt hour. We are being held up right at the moment by one problem, and while I am sure this will be solved, it does illustrate the kind of complication that goes into studying performance. Before you can lay out a performance factor, you have to take into consideration that in the home the most commonly used type of residential air conditioning equipment doesn't include the fan for circulating the conditioned air. Instead, the furnace fan is used for this purpose. This furnace fan isn't a part of the air conditioner and the watt input rating of the air conditioner, therefore, doesn't include the power consumption of this fan. Because of this, the power consumption for the equipment itself doesn't reflect the energy requirement for the entire air conditioning system. I imagine that in fairly short order we will get this problem solved, and we will be publishing performance factors for each of the unitary air conditioning systems put out by our members.

I do want to dwell very briefly on the Federal labeling program and the emphasis on labeling programs which is coming to the forefront. I think these will be increasingly talked about in the future. Many of you know that coming out of the President's message, the Department of Commerce on June 5 published in preliminary form in the Federal Register, a voluntary labeling program which would call for the manufacturers of household appliances to provide to consumers, at the point of sale, certain information on the energy consumption and the efficiency of major household appliances. The preliminary draft of this regulation includes central air conditioning as a major household appliance. There may be a problem here because, while a unitary system can have a rated efficiency when it leaves the manufacturer, there are many factors entering into its ultimate efficiency. We see some problems in working out a labeling system that will be meaningful and will make it possible for consumers to compare, by cost or otherwise, the energy consumption and the efficiency characteristics when purchasing central air conditioning systems.

I had a few remarks, gentlemen, dealing with design and dealing with some technical aspects of this subject, but in view of the lateness of the hour and in view of the fact that I am not really an expert in that area and am somewhat overwhelmed by what we have heard and seen here this morning, I am not going into this. I want to emphasize that ARI is available as a resource to any of the code people or other people here. We would be glad to provide you with any information that we have in dealing with the extraordinarily difficult problem of energy conservation. Thank you.

Dr. J. E. Snell

I am sorry to report that the Home Appliance Manufacturers representative could not be with us today. I will now open the floor for some discussion, if there is someone who wishes to be heard.

Joseph Tone

I am from the State of Washington. In hearing these discussions this morning I began to wonder if there is a resource in Washington, D. C., in which plans for expanded State construction could be submitted for a critical review and analysis bringing out the findings you have had in these various technical evaluations you have had in the Washington, D. C., area. Is it possible to submit these completed plans for State buildings and have them critically analyzed?

Dr. J. E. Snell

That is a good question. I think the best answer derives from Mr. Phillips' opening remarks. That is, the research results that we are talking about, the methodology, the computer programs and so on, are rapidly becoming a part of the stock in trade of the designers and professionals in this field, and if called upon to produce in these areas I believe they can do these same things for you.

Alonzo Westbrook

I am the State Mechanical Engineer for the State of Tennessee. I would like to interject myself at this point to answer this question, in that our State Architect's Office performs exactly that function for reviewing all of our State buildings. I would say that if any of you gentlemen have similar questions, you should direct them toward either your State Architect's Office or your State Building Codes Office. I say that there are already organizations structured to perform that function.

Dr. J. E. Snell

I would hasten to add that the survey of State actions and State activities that will be on the program in the afternoon session will highlight such activities that are underway.

Kenneth C. Henke, Jr.

At this time, it is my pleasure to introduce to you Mr. Paul R. Achenbach, Chief, Building Environment Division, National Bureau of Standards. Mr. Achenbach will speak to us on Mechanisms for Implementation of Energy Conservation Technology in Buildings.

> Remarks and copies of slides and transparancies used can be found in NBS Technical Note 789--"Technical Options for Energy Conservation in Buildings," pp. 146-172.

(Mr. Kenneth Henke introduced Mr. Israel Resnick from the American National Standards Institute. Mr. Resnick explained ANSI's principal objectives and some of the methods used in developing and approving standards as American National Standards.)

Kenneth C. Henke, Jr.

I am happy to report to you that 23 out of 50 States, plus the District of Columbia, are in attendance here today. The States present represent two-thirds of the population of the Nation, so I feel we are reaching the majority of the people.

I would like to present Mr. Joseph Stein, past Building Official of the City of New York.

Joseph Stein

Thank you, Ken, for your kind introduction. Before I get to my main subject--that of energy conservation relating to design and construction and the problem role of

building codes and standards--I would like to share some of my own code experiences and then develop a thumbnail history of codes. I'll also try to define some terms for those of you who are new to the subject.

For a little background on myself, I left private practices about seven and one-half years ago to work for New York State, which I was Assistant Commissioner for Planning and Construction, in charge of its low- and middle-income housing programs. Before that and for more years than I'd care to admit, while in the private sector I was involved in construction and consulting engineering. At the beginning of 1971, I was asked to take over as Commissioner of the New York City Building Department, which is the largest in the United States (and I guess in the world), with all of its problems and challenges.

While in the private sector, I, like most of my colleagues, regarded regulatory agencies as unnecessary constraints. However, I've learned a lot after having been exposed to the problems of the other side, and I'm willing to admit I was at least partially wrong. My involvement with NCSBCS is an exiguous extension of my previous involvement with New York State. I saw hope in NCSBCS for achieving order out of the chaos and nonuniformity of code requirements, a favorite target of the codes critics.

The Douglas Commission did its famous study on industrialized housing and identified the literally thousands of independent code entities as one of the major constraints to innovation and the free interstate movement of industrialized housing units and components. It is amusing to hear some of the very same people who condemned the codes for inhibiting innovation, now calling for the codes to become the surrogate for design in this very important energy issue.

As a member of the Standards and Evaluation Committee of NCSBCS, I presented a resolution last year, while still Building Commissioner, to consider the potential problem of non-uniform and arbitrary code requirements dealing with energy and building design. Here was a perfect opportunity to deal with a problem before it surfaced. I was reasonably certain that this was an issue that would become politically attractive i.e., code requirements on energy) and I fought one of the early battles in New York City against such arbitrary building code amendments.

I don't intend using a prepared text, since I usually prepare one then deviate from it and wind up accused of being a "text" deviate. I was given an hour and a half on the program, and I certainly don't intend to speak an hour and a half. I would like to fill in those of you who are representing the Governors of your States, who are either new to the problem or are not architects or engineers. I hope I can give you a little background on codes problems and philosophy so that you all understand what we are talking about.

Building codes and building departments, or whatever they are called in your particular neck of the woods, are all products of "laissez-faire." Decisions affecting public safety were made by those who had a financial interest in what they were building and often the decisions were less than objective. As a result, government was brought into the picture and, while I shouldn't use the expression white hat or black hat, the group who came in wearing white hats to protect the public, as time went on, became more involved with regulation and eventually became the enemy, loaded with bureaucratic red tape, delays, arbitrary requirements, graft, etc., and were now considered constraints instead of saviors. Certainly, the pendulum had swung too far towards government regulation, especially in areas where we should depend more heavily on the design professional. In New York City we tried to put more responsibility on the design professionals and left to government the responsibility of monitoring their performance. As Building Commissioner, I also became aware of the fact that the legislators could pass all sorts of good laws, but if you as regulators don't have the resources to implement them, it's like having no laws at all. I also found great duplication of effort, particularly when a new problem surfaced and insufficient research or data were at hand, for example, the fire safety regulation in tall buildings. We did our own thing in

New York, as did Chicago, San Francisco, Boston and Los Angeles, to name a few. Each was reinventing the wheel, but in a slightly different way.

The "old" code philosophy, called the specification or the prescription approach, told exactly "how to" design or construct. This relatively inflexible approach, of course, can create headaches for the innovator, but it can also be the panacea for the understaffed regulatory agency or the engineer whose fee is too low to innovate.

Modern code philosophy relies on the performance approach and most progressive code groups recognize this more flexible method. Rather than being told exactly how to do something, you are now only told how the something shall perform, and of course, this approach presents problems too. It requires both expertise and a willingness to innovate by the design professions and at the regulatory end, you must also have people capable of interpreting performance, determining whether a design or construction actually does meet the required performance. This is a big problem from the regulatory point of view, that of enforcing a performance code, but be that as it may, most large or progressive regulatory agencies have adopted performance or partial performance codes.

The New York City code, for example, which is a relatively new one, passed in 1968, references to over 300 nationally-accepted standards, many of which were generated through national consensus procedures. Now this approach, I think, is a very practical first step to attaining nationwide uniformity. I don't think for the time being that a national code is practical or attainable, since the responsibilities of safety, health and welfare protection of the people are left to the States.

Traditional code philosophy concerns itself with the immediate safety of the occupants of a structure, or those in the immediate vicinity of the structure. You people sitting here should be protected from the floor collapsing and in case of fire, you should not be too far from an exit. The energy question and its possible inclusion into the codes presents a departure from this viewpoint. We also have to understand the difference between a code and a design standard. A "building code" generally addresses itself to minimum requirements to assure safety--no more, no less. A "design standard," however, is the prerogative of the owner or someone else who has a financial interest in a project. He is interested in additional performance of the structure beyond the minimum safety requirements for the occupants and he states his additional design requirements in a "design standard." To put the FHA Minimum Property Standards into proper perspective, they are more properly classified as a "design standard" rather than a "building code."

I hope I haven't lost you all with the code jargon and philosophy, but it is necessary background to understand the magnitude of the problems that can be created if the energy crisis is not properly managed in relation to building regulation. If we assume that codes are going to be administered locally or statewide or by the big cities within the States in parallel with the States, and if we assume that all the codes reference to the same national standards, we will in fact have achieved a high degree of uniformity. What would be acceptable in one area, automatically becomes accepted in another.

The important question of energy related design control by the building codes can be handled in this fashion. If, in fact, a strategy was organized to develop a national standard through consensus procedures, it would take at least a year to accomplish. Any regulatory body that wished to legislate in this energy area could reference to a national energy standard, so that for example, what is required in New York will be automatically the same as required in California (and all points in between).

I really got interested in this particular issue in the latter part of 1971, when I read a release that New York State was contemplating legislation dealing with the design and siting of buildings to conserve energy. Many manufacturers and interested groups got on the band wagon. The Masonry Council advertised masonry buildings to help conserve energy. The Producer's Council had a traveling road show on the many insulating products

that could be used to conserve energy, and others. I was also invited to join the Ad Hoc Committee on Energy Efficiency in Large Buildings of the Interdepartmental Fuel and Energy Committee of the State of New York. They, too, were thinking of recommending legislation in the areas of regulating heat loss, requiring insulation, limiting fenestration and so on, all going back to the old specification approach to design.

Just today, I was just handed a reprint from a recent copy of the Engineering News Record. Two cities in Ohio--Wooster and Cuyahoga Falls--have just amended their building codes regulating minimum amounts of thermal insulation required in buildings as an energy conserving measure. The Director of Administration in Wooster said of the codes, "If more cities had insulation requirements in their building standards we would do more to solve the energy crisis the nation is facing than any other single thing." While it makes for good press, the quotation is far from accurate.

I happen to agree with the gentleman from the National Association of Home Builders who just commented on the immediate impact of regulating new construction and its minimal immediate contribution to solving the energy crisis. I was pressured by several groups in New York City to consider recommending adoption of the FHA Minimum Property Standards for insulation into our code. If a code were to adopt these arbitrary requirements, (and these are arbitrary as they relate to a life safety document), how could you justify adopting levels of allowable heat loss which were arrived at using a cost/benefit analysis. If, in fact, heat loss is so critical, why limit the insulation to four inches? Why not go to six or eight inches or require the building to be so perfectly sealed that you could heat them with candles? Much study has to be done in this area.

If you could just consider for a moment two buildings, two hypothetically identical buildings as far as shape and configuration and occupancy. One would be a completely glass enclosed building, poorly insulated on the exterior, but with a very efficiently designed mechanical system, lighting system, heat recovery apparatus; the other building across the street, a very well insulated masonry structure, without windows, but with very poorly and inefficiently designed mechanical systems. The first building, the glass building, might very well use the same, if not less energy than the windowless building designed to satisfy arbitrary heat loss specification requirements (that only deal with the "perimeter" of the problem). The pun is intended.

Whatever energy design standard is developed, of necessity, it should be a performance standard to permit the design professions as much flexibility as they require in designing the building and, at the same time, to permit them to innovate. It must also be one that can be readily and efficiently administered by the regulatory agency. I am speaking from my own personal point of view, having thought about the problem and having thought of the horrendous possibilities of a legislative body passing a law requiring "efficient" design. A complicated structure can take anywhere from several weeks to several months to be approved by the regulatory agency that is reviewing only for absolute minima related to the occupants' safety. I think you can see what problems and time delays would result from having groups of engineers and architects critiqueing each others' designs. In this area, one approach that has been proposed, which I tend to think is workable, would be the use of energy application indices as energy design requirements. Just as this very auditorium floor may be designed for 100 pounds per square foot of live load, with the ingenuity of the engineer and architect being relied upon to design a structurally sound and economical floor system, he is not told to design in steel or concrete or any other material. The minima in the area of live loads have been established based on research and experience. It is perfectly possible and feasible to establish similar surrogates to control and to monitor energy use in buildings. Traditional code philosophy, as I pointed out before, has always prevailed, justified by States' mandate (in many cases authority was passed on to the municipalities) to protect the immediate health, safety, and welfare of the occupants in and around buildings. Philosophically, energy control may be a bit difficult to accept as

a code item. Codes have traditionally dealt with fire protection, structural integrity, ventilation, sanitation and of recent vintage, progressive codes have addressed themselves to noise control. Does conservation of energy immediately affect the occupants' health or safety? Does noise control? I think the traditionalists who regard codes as purely life safety documents will yield on this issue.

While I don't agree with the statement of the engineer or the code administrator from one of those two Ohio communities that this will have a sizeable immediate impact, that is, I don't think controlling design in new buildings will have a sizeable immediate impact on the energy picture. I think it is something that must be done considering the long-range picture. In contrast, energy use in existing buildings and retrofitting of existing buildings, perhaps is the most significant immediate task and, perhaps the highest priority item in the area of energy conservation. Even if it takes a year or a year and a half to generate a uniform national design standards that codes could reference for new buildings, and if there could be uniformity as a result, it is worth the wait. As I said, I served on the New York State Ad Hoc Committee and their excellent report was just released. I would like to read their recommendations as far as codes in relation to energy conservation in building design and construction. This is a summary, and I would hope that you would take the same message back to your respective States. It reads, "Building Codes: an in-depth study should be instituted to analyze existing building codes to determine whether they need revision in order to conserve energy. This study should be organized on a national basis using the staff and expertise of organizations such as the National Bureau of Standards. If the need for code revision is validated, then a standardized code -- (they use the word code, they mean standard) "for the State of New York should be developed based on minimum acceptable design and performance standards through national consensus procedures such as the American National Standards Institute..." They also mention that this standard, when it is generated may require modification to adjust to special conditions that exist in the larger urban centers, and that this should be recognized as well. This is usual procedure when a national standard is promulgated. The standard is adopted in toto if it suits the situation, but it can also be modified and amended to suit special local or geographic requirements. If an orderly approach is not taken, I can see another typical code reaction to a crisis (which is the sad history of codes) resulting in layers of nonuniform, and in many cases, irrelevant requirements.

The whole purpose of my rambling remarks was to give you a little background to my asking NCSBCS to adopt the resolution which is presented in the Conference brochure. I will not read it; but in essence, it recognizes that there is an energy crisis, also recognizing the fact that NCSBCS is for promoting reciprocal, uniform code requirements, and that before the situation gets out of hand that they (NCSBCS), request the National Bureau of Standards to assist them in developing a national standard that deals with energy design of buildings. Once accomplished, a regulatory agency could reference to it in the traditional manner, (as they presently do for concrete design or steel design and other areas of building code referencing).

The "S" and "E" Committee will be meeting tonight, hopefully to develop a mechanism for a uniform approach to this very critical problem. Critical in that (a) it will not solve the immediate crisis because it only addresses itself to new buildings, (b) because of an apparent ground swell by the States for using the codes to regulate energy related building design, and (c) because all of us recognize that if we do something now, certainly a significant energy savings can be realized several years hence. I think we can afford an investment of one or one and one-half years to do the job properly.

Thank you for your patience, I hope you have the message.

(A question and answer period followed.)

The Standards and Evaluation Committee of the National Conference of States on Building Codes and Standards (NCSBCS), met the evening of June 19, 1973, following the Joint Energy Workshop to consider followup action.

The major result of this meeting was the recommendation that a request for the development of a draft standard for energy conservation in new buildings be made to the National Bureau of Standards (NBS) from the Executive Committee of NCSBCS. NCSBCS National Chairman Bernard Cabelus of Connecticut conveyed this request by letter to Dr. Roberts, NBS Director, on July 12, 1973.

Dr. Roberts responded favorably to the NCSBCS request and assured NCSBCS that NBS would undertake the drafting of a performance standard as soon as staff could be reassigned. Work commenced in early September 1973. The staff task force was augmented by an advisory group from NCSBCS, the American Institute of Architects (AIA), the American Society of Heating, Refrigerating and Air-Conditioning Engineers (ASHRAE), and the American Consulting Engineers Council (ACEC).

On November 12 and 13, 1973, a Joint Workshop on Energy Standards for Conservation in Building Design was held in Washington, D. C., to assess the approach being taken in development of and to receive technical comment on the draft standard. One of the results of this Workshop was an awareness on the part of State officials that a performance-type building energy standard could not stand on its own in the regulatory environment. NCSBCS National Chairman Cabelus requested assistance from NBS in implementing the standard in a letter dated November 19, 1973.

During a debriefing following the November Workshop, Assistant Secretary of Commerce for Science and Technology, Dr. Ancker-Johnson, directed the NBS to provide assistance in identifying the activities needed to complement the energy standard and means for their accomplishment.

On February 27, 1974, both the energy document and the description of implementing tasks were presented to NCSBCS in Salt Lake City, Utah. The NCSBCS turned the energy performance criteria over to ASHRAE for processing to become an American National Standard.

The ASHRAE 90-P draft standard was available for public comment in late June 1974, with a review period extending to September 30, 1974. A second ASHRAE draft was available in early 1975, with the review period ending February 28, 1975. Committee review of the comments is taking place with final availability of the ASHRAE Standard expected by the summer of 1975.

Funds needed to pursue the assemblage of tasks needing accomplishment now identified as a "delivery system," were requested from the Federal Energy Administration. The NCSBCS organization has strongly presented the necessity for the proper implementation of such a far-reaching standard.

APPENDIX

NCSBCS/NBS JOINT EMERGENCY WORKSHOP ON ENERGY CONSERVATION IN BUILDINGS

Attendees

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State of Colorado

Bernard E. Cabelus
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State of Delaware

R. Charles Shepherd
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