

Dr. 152

SAN/1230-2

A TRAINING PROGRAM FOR ENERGY CONSERVATION IN NEW BUILDING CONSTRUCTION

VOLUME I 9-1

ENERGY CONSERVATION TECHNOLOGY MANAGEMENT AND ENERGY CONSERVATION

DECEMBER 1977

MASTER

ENERGY CONSERVATION TECHNOLOGY SERIES 000

Prepared For The
U.S. DEPARTMENT OF ENERGY
Washington, D.C.

UNDER CONTRACT No. E[04-3] 1230

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A TRAINING PROGRAM FOR ENERGY CONSERVATION IN NEW- BUILDING CONSTRUCTION

VOLUME I.

ENERGY CONSERVATION TECHNOLOGY;
MANAGEMENT AND ENERGY CONSERVATION

44 ENERGY CONSERVATION TECHNOLOGY SERIES 000

DEVELOPED BY

BUILDING OFFICIALS & CODE ADMINISTRATORS INTERNATIONAL, INC.
INTERNATIONAL CONFERENCE OF BUILDING OFFICIALS
SOUTHERN BUILDING CODE CONGRESS INTERNATIONAL, INC.
NATIONAL ACADEMY OF CODE ADMINISTRATION

MASTER

FOR

NATIONAL CONFERENCE OF STATES ON BUILDING CODES AND STANDARDS, INC.

DECEMBER 1977

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EB

ECT COURSES

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The preparation of the training program and instructional materials for the Energy Conservation Technology (ECT) courses was made possible by the professional contributions of the following persons and organizations:

Stephen N. Davis

William N. Dripps

Enviro-Management & Research, Inc.

Melvyn Green, P.E.

Midwest Environmental Research Corporation

The Model Code Group

Building Officials and Code Administrators
International, Inc.

International Conference of Building Officials

Southern Building Code Congress International, Inc.

National Academy of Code Administration

ABSTRACT

Under the sponsorship of the United States Department of Energy, a Model Code for Energy Conservation in New Building Construction has been developed by those national organizations primarily concerned with the development and promulgation of model codes. The technical provisions are based on ASHRAE Standard 90-75 and are intended for use by state and local officials.

The subject of regulation of new building construction to assure energy conservation is recognized as one in which code officials have not had previous exposure. It was also determined that application of the model code would be made at varying levels by officials with both a specific requirement for knowledge and a differing degree of prior training in the state-of-the-art.

The above described national organizations consisting of National Conference of States on Building Codes and Standards, Inc. (NCSBCS), Building Officials and Code Administrators International, Inc. (BOCA), International Conference of Building Officials (ICBO), Southern Building Code Congress International, Inc. (SBCC), and the National Academy of Code Administration (NACA), developed a training program and instructional materials for code officials to assist them in the implementation and enforcement of energy efficient standards and codes. The training programs prepared are:

- VOLUME I Energy Conservation Technology - Management and Energy Conservation (ECT Series 000);
- VOLUME II Energy Conservation Technology for the Building Inspector (ECT Series 100);
- VOLUME III Energy Conservation Technology for Plan Examiners and Code Administrators (ECT Series 200);
- VOLUME IV Energy Conservation Technology - Advanced Course for Plan Examiners (ECT Series 300).

Key words: Administrative procedures; ASHRAE 90-75; Educational material - codes; Buildings; Building Codes; Energy conservation; Model codes; Training programs - energy conservation.

PREFACE

Under the sponsorship of the United States Department of Energy (DOE) the National Conference of States on Building Codes and Standards, Inc. (NCSBCS), in conjunction with the three model code groups, Building Officials and Code Administrators International, Inc. (BOCA), International Conference of Building Officials (ICBO), Southern Building Code Congress International, Inc. (SBCC), developed a Model Code for Energy Conservation in New Building Construction. The technical provisions of this document are based on ASHRAE 90-75 and it is intended for use by state and local building officials in the implementation of a statewide energy conservation program.

In addition, the NCSBCS, the Model Code Groups, and the National Academy of Code Administration (NACA) have developed instructional materials and a training program for state and local building code officials which will assist them in the implementation and enforcement of energy efficient standards and codes. The instructional materials were edited by Glendon R. Mayo, P. E. Briefly, the training program consists of the following Energy Conservation Technology (ECT) courses:

<u>Intended Audience</u>	<u>ECT Series Number</u>	<u>Volume</u>	<u>Title</u>
Code Policy Administrators	000	I	ENERGY CONSERVATION TECHNOLOGY - MANAGEMENT AND ENERGY CONSER- VATION
Building Inspectors	100	II	ENERGY CONSERVATION TECHNOLOGY FOR THE BUILDING INSPECTOR 100 Introduction to Energy Conservation 101 Energy Fundamentals 102 Model Energy Code 103 Model Energy Code Application
Plan Examiners and Code	200	III	ENERGY CONSERVATION TECHNOLOGY FOR PLAN EXAMINERS AND CODE ADMINISTRATORS 200 Introduction to Energy Conservation 201 Energy Fundamentals 202 Model Energy Code 203 Model Energy Code Application

Plan Examiners 300 IV ENERGY CONSERVATION TECHNOLOGY -
ADVANCED COURSE FOR PLAN EXAMINERS
300 Introduction to Energy
Conservation
301 Energy Fundamentals
302 Model Energy Code
303 Model Energy Code Application

COURSES

VOLUME I ENERGY CONSERVATION TECHNOLOGY - MANAGEMENT AND ENERGY CONSERVATION

SERIES 000

Intended Audience: Appointed and elected administrators of state and local governments.

Course Descriptions:

ECT-000. Management and Energy Conservation. Designed to acquaint public administrators at the policy making level with the meaning and implications for government of legislation relative to energy conservation standards for buildings, to underscore the need for training for employees responsible for implementing the new Model Energy Conservation Technology educational program now available. Optimization of agency resources and development of ability to handle technical demands will be considered as will the new technical skills required.

VOLUME II - ENERGY CONSERVATION TECHNOLOGY FOR THE BUILDING INSPECTOR

SERIES 100

Intended Audience: Personnel engaged in the inspection of buildings for compliance with approved plans.

Course Descriptions:

ECT-100. Introduction to Energy Conservation. Review of the energy situation, nationally and worldwide, establishing the importance of energy conservation in building construction. Discussion of recent research and trends. Illustrated with examples of buildings designed with energy conservation in mind.

ECT-101. Energy Fundamentals. Review of Energy Terminology and applications including heat transfer and insulation terms and practices involved in building so as to conserve energy.

ECT-102. Model Energy Conservation Code. An analysis of the Model Energy Conservation Code's requirements covering its administrative, plan review and inspection provisions and their impact on building construction.

ECT-103. Model Energy Conservation Code Application. Application of the Model Energy Conservation Code to achieve the building standards and inspection standards anticipated in ECT-102. Product recognition (labeling and approvals) and installation requirements will be included. The application of the Code's requirements to building, mechanical, plumbing and electrical inspections will be identified. The administrative, plan review and enforcement factors involved in achieving the code requirements also will be covered. Plan review is to include accepted practices for achieving the code requirements. The course will include practical examples of how these concepts can be applied to on-the-job situations.

VOLUME III - ENERGY CONSERVATION TECHNOLOGY FOR PLAN EXAMINERS AND CODE ADMINISTRATORS

SERIES 200

Intended Audience: Personnel involved in the review of plans or inspection of conventional residential buildings and small commercial and industrial buildings.

Course Description:

ECT-200. Introduction to Energy Conservation. Review of the energy situation, nationally and worldwide, establishing the importance of energy conservation in building construction. Discussion of recent research and trends. Illustrated with examples of buildings designed with energy conservation in mind.

ECT-201. Energy Fundamentals. Introduction and application of energy terminology and formulas including basic principles of heat flow in building construction.

ECT-202. Model Energy Conservation Code. An analysis of the Model Energy Conservation Code's administrative, plan review and inspection provisions and their impact on building construction.

ECT-203. Model Energy Code Application. Application to the Model Energy Conservation Code provisions and requirements to accomplish its energy conservation objectives. Product recognition (labeling and approvals), installation requirements and review of sample plans that illustrate principles and practices involved in designing energy conserving buildings will be included. The building, mechanical, plumbing and electrical inspections involved in applying the Code's requirements also will be identified. Incorporation of the code's administrative, plan review, inspection and enforcement provisions in the regular operations of the code administration agency will be discussed. Plan review will cover design provisions and accepted practices that meet the energy conservation requirements set forth in the Code.

VOLUME IV - ENERGY CONSERVATION TECHNOLOGY - ADVANCED COURSE FOR PLAN EXAMINERS

SERIES 300

Intended Audience: Personnel involved in review of plans or inspection of all buildings including those incorporating complex systems.

Course Description:

ECT-300. Introduction to Energy Conservation. Review of the energy situation, nationally and worldwide, establishing the importance of energy conservation in building construction. Discussion of recent research trends. Illustrated by examples of buildings designed with energy conservation in mind.

ECT-301. Energy Fundamentals. College level review of thermo-environmental energy principles that relate to energy conservation including energy terminology and formulas.

ECT-302. Model Energy Conservation Code. An analysis of the Model Energy Conservation Code's requirements covering its administrative, plan review and inspection provisions and their impact on building construction. Emphasis will be placed on systems analysis, design provisions and accepted practices.

ECT-303. Model Energy Conservation Code Application. Application of the Model Energy Conservation Code to the plan review process and in the design of energy conserving buildings. Information will be provided relative to performance and innovative design approaches and to product acceptance systems. The effect of this code upon the regular administrative, plan review, inspection and enforcement activities of the code administration agency will be indicated.

INTRODUCTION

One of the major goals set forth in the contract between the United States Department of Energy and the National Conference of States on Building Codes and Standards, Inc. (NCSBCS), together with the major model code groups, concerning the development of a Model Code for Energy Conservation in New Building Construction was filling the recognized need to provide uniform training in the implementation and enforcement of this code by the building officials.

It is recognized that the field of energy conservation was an area not previously entered into by code officials. Further, it was recognized that those presently serving their states and communities as well as those who would necessarily become involved in the future would be at differing levels at the curve of understanding the subject.

It was also determined that a specific introduction into the subject of energy conservation as would be encountered in applying codes and standards was needed for those in a policy-making position in the various states. The rationale for an orderly and coherent adoptive process for a uniform method of energy conservation enforcement appeared the most positive method to quickly assure that a start would be made on energy conservation methods in buildings.

A successive series of training manuals was developed by the Building Officials & Code Administrators International, Inc. (BOCA), International Conference of Building Officials (ICBO), Southern Building Code Congress International, Inc. (SBCC), the National Academy of Code Administration (NACA), and the National Conference of States on Building Codes and Standards, Inc., for the United States Department of Energy, using personnel who were both well acquainted with the topic and who were currently involved in the continuing educational process for code officials. The results are presented in four volumes, each of which is oriented toward a specific audience and their need-to-know. The training program is entitled:

A TRAINING PROGRAM FOR ENERGY CONSERVATION IN NEW BUILDING CONSTRUCTION

VOLUME I - ENERGY CONSERVATION TECHNOLOGY - MANAGEMENT AND ENERGY CONSERVATION (ECT Series 000)

This training manual is both an introduction to the need for energy conservation in buildings and a definition of the need for and the role of the enforcement of official for energy conservation.

VOLUME II - ENERGY CONSERVATION TECHNOLOGY FOR THE BUILDING INSPECTOR
(ECT Series 100)

This training manual contains the basic information necessary to acquaint the field building inspector with the concepts of energy conservation in buildings and instructs him in the basic techniques of field inspection of energy compliance.

VOLUME III - ENERGY CONSERVATION TECHNOLOGY FOR PLAN EXAMINERS AND CODE ADMINISTRATORS (ECT Series 200)

This manual contains a more in-depth training in the review techniques and concepts required by the plan examiners and code officials in administering the code for conventional construction.

VOLUME IV - ENERGY CONSERVATION TECHNOLOGY - ADVANCED COURSE FOR PLAN EXAMINERS (ECT Series 300)

This manual contains training material that will be needed by plan examiners in the building departments involved in major or complex structures who are thoroughly familiar with the conventional principles and application of energy conservation requirements in building construction, but who will be faced with the responsibility of reviewing and approving involved complex technical alternative solutions to the problem of conserving energy in buildings.

These training modules are prepared on the basis of the assumed level of comprehension of the student. It is entirely possible that they may be used individually or in toto, depending upon the level of the student.

Comments and recommendations by instructors and participants are invited to assure that the revisions of these training materials which will be undertaken on a periodic basis are responsive to the needs of state and local building officials.

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CHAPTER 1

INSTRUCTORS' GUIDELINES

These guidelines are prepared for the instructor who will be presenting the material to a selected audience and are to be incorporated into the instructor's presentation.

CLIENTELE OF COURSE

State and local government administrators with policy-making responsibilities concerning the energy conservation activities of their jurisdictions.

PURPOSE OF COURSE

The threefold purpose of the course is:

First, to make clear the seriousness of the energy crisis and the significance of energy conservation in buildings as a major method of making America less energy dependent until new domestic sources can be developed.

Second, to inform these public officials about the role of the Model Energy Conservation Code and the Energy Conservation Technology training program for their building officials in enabling their governments to achieve the needed energy conservation in new construction in their jurisdictions.

Third, to underscore the necessity and importance both of securing adoption of the Model Energy Conservation Code or comparable legislation by all states and municipalities and training their building officials to administer it by sending them to the Energy Conservation Technology courses.

MAJOR TOPICS

The manual contains a comprehensive factual overview of the topics to be dealt with during the course. These are listed below:

- I. ENERGY CRISIS FACTORS AND IMPLICATIONS: Introduction to and update on the causes and consequences of the energy crisis.
- II. ENERGY CONSERVATION: Outline of its tools and goals and a strategy for achieving energy conservation in buildings.

- III. THE CODE ADMINISTRATOR AND THE CODE ADMINISTRATION AGENCIES, STAFFS AND FUNCTIONS: A brief review of the legal role of the building official and the nature of his organization and operation in large, medium, and small size state or local government jurisdictions; plus evidence of his need for a specific program of technical training to enable him to administer the Energy Conservation Code.
- IV. THE MODEL ENERGY CONSERVATION CODE: A description of its purpose and major features.
- V. THE ENERGY CONSERVATION TECHNOLOGY CURRICULUM: Outlines of the series of courses; whom each will serve; and why they require this training.

The manual contains several tables and is to be augmented by a series of slides and fact sheets. The latter also are recommended to be included in the packet of materials provided to the course attendees. A copy of the List of Slides which contains their titles and, where not self-evident, a description of each, and a copy of the Fact Sheets Index are included in Appendix A.

In presenting the five topics of the seminar, it will be important to draw upon your own knowledge of the energy issue; regional factors that affect energy usage in your state; relevant information about state and local energy codes, if any; and prevailing code administration provisions and practices. Some indication of the nature of the information you will need and the questions you are likely to be asked is provided in the next section of these guidelines.

SPECIAL RESOURCES, ISSUES AND QUESTIONS

RESOURCES: To obtain data about the energy situation in your area, these sources should prove helpful:

1. The regional offices of the Federal Energy Administration, United States Department of Energy. (Resource Item A.)
2. The state energy office or agency. If you do not know who heads it, call your state's Delegate to the National Conference of States on Building Codes and Standards (NCSBCS) because he or she either will be in charge of the energy program or will know who is. (Resource Item B.)
3. The model code groups. Building Officials and Code Administrators International, Inc., International Conference of Building Officials, Southern Building Code Congress International, Inc. (Resource Item C.)

4. Energy Conservation In New Building Design: An Impact Assessment of ASHRAE Standard 90-75, prepared for the Federal Energy Administration by Arthur D. Little, Inc. This report provides regional energy consumption data and a comparison of the cost of the additional design services required to effect energy conservation with the average annual energy savings produced in five prototype buildings located in four different regions. The buildings include:

- single family detached house
- low-rise apartment
- office building
- retail store
- school

(Excerpts and tables from the report are included in Resource Item D.)

5. The nature of the work and responsibilities of the building official are described in a 1975 statewide study entitled: Toward a New Jersey Career Development System in Code Administration. It will provide useful background information on Part III for those instructors who have not had extensive contact with building code administrators heretofore. (The pertinent excerpts from this study constitute Resource Item E.)
6. A brief paper concerning "Backgrounds of Students, Energy Conservation Technology Program" contains additional information about the expected clientele of the Energy Conservation Technology courses. (Resource Item F.)

ISSUES: In order to accomplish the courses' objectives it will be necessary to make sure the attendees know the facts about the following issues:

1. Difference between a building standard and a building code.

A building standard is a recognized building material or building practice established as one capable of producing the specified performance or results when used in construction. Objective tests are used to determine the safety of those recommended as building standards.

In contrast a building code is a law or ordinance whose provisions are mandatory rather than recommended.

To illustrate - A building code may require a door with two hour fire rating. The related building standard will indicate the

variety of building materials and practices that can be used to meet the requirement.

2. Basis and nature of the legal role of the building official.

Because very few public administrators at the policy making level are fully aware of the law enforcement responsibilities of their building officials, these two points must be made clear:

- a. Under the 10th Amendment to the United States Constitution, state governments and (subject to state law), their municipalities are empowered to pass laws and ordinances, including building codes, to protect the public's health, welfare and safety and to exercise their police power to enforce same.
- b. As the administrator of state or local building legislation, the building official is obligated legally to enforce every section of all such laws, codes and ordinances that regulate:

- building construction
- additions
- demolition
- building occupancy and use

in order to protect the health, welfare, and safety of building occupants, users, owners, and the general public.

To summarize, the law makes it mandatory, not optional, for building officials to enforce the provisions of the state or local building legislation under their jurisdiction so that the public's health, welfare and safety will be protected.

QUESTIONS: You will need to check on the status of state and local building energy legislation in your state and the prevailing provisions for building code administration as background for answers to some of the questions you may be asked. The National Conference of States on Building Codes and Standards, Inc., state delegates and the Model Code Groups - Building Officials and Code Administrators International, Inc., International Conference of Building Officials, and Southern Building Code Congress International, Inc. (Resource Item C), can provide you with this information if you have not had much prior experience with the operation of code administration agencies. The following questions are those most likely to be asked and the correct answers or approach to the answers also are indicated.

In the past most building officials seem to have managed to administer various code changes with little or no formal training. Why do they need special training to handle the plan review and inspections under the new energy conservation code?

To be able to administer and enforce the code's energy conservation requirements, the code officials will need to know about new insulation materials and practices, heat transfer and heat resistance factors, and related design formulae that few, if any, ever have encountered before. Through the Energy Conservation Technology Courses, they will be able to obtain the specific knowledge they require as quickly as possible.

Who is supposed to attend the various courses in the Energy Conservation Technology training program?

The ECT-100 series is for current building inspection personnel; those who make field inspections of buildings under construction to make sure these comply with the building plans.

The ECT-200 series is for the current plan examiners, and building code administrators who also review plans, in the medium and small size community. They review plans for buildings other than those that are highly complex.

The ECT-300 series is for the current professional graduate architect or engineer plan examiners usually found only on the staffs of the large code administration agencies who will need training concerning the use of system analyses to achieve energy conservation in complex buildings.

Will it be necessary to hire an entire new staff to administer the new energy conservation code?

In general, "No". The Energy Conservation Technology program provides a means of training existing code officials to administer and enforce the energy conservation legislation. In some cases where the new construction is complex and/or increasing, for example, an agency may need to add a mechanical engineer as required by the complexity and volume. An alternative is to use the plan review services of the model code organizations (see Resource Item C).

What will be the costs of enforcing the new energy code; that is, how many more inspectors and how much more plan review time will be needed to handle the additional workload?

The additional inspection and plan review time required will depend on the buildings to be inspected and the prevailing inspection patterns in the code administration agency. There should be little or no need for staff additions to perform the new energy conservation plan review and inspection work on one- and two-family houses. However, additional staff time will be needed for more complex structures.

Everyone knows the ASHRAE 90-75 standard is subject to future revisions, since major new energy conservation methods already are being investigated. Why, then, should any state or community adopt a Model Energy Conservation Code based on ASHRAE's Standard instead of waiting for further developments?

There are two major reasons for adopting the ASHRAE based code:

First, ASHRAE 90-75 is the best energy conservation standard developed to date. Because the Model Energy Conservation Code is based on this standard and covers its provisions comprehensively, this code reflects the state-of-the-art for fostering energy conservation, and conservation action is required now.

Second, in 1976 the national government was authorized and directed to promulgate proposed energy conservation performance standards for new residential and commercial buildings as soon as possible, and no later than 1979, for public comment. Six months later, final performance standards are to be published, and these shall take effect no later than one year thereafter. After these go into effect, the national government will be required to withhold all federal financial assistance for the construction of any new residential or commercial building in any area of any state unless that state and its municipalities have adopted and are implementing a building code or other laws and regulations with comparable energy conservation requirements. ("Energy Conservation and Production Act", Public Law 94-385, adopted August 14, 1976.)

Therefore, unless the states adopt appropriate energy conservation legislation, the authorized moratorium on federal assistance for new construction will seriously hamper the construction industry within their boundaries.

What is the relation between the provisions of the Model Energy Conservation Code and future HUD requirements?

Historically, when the national government has moved to fill a legislative or programmatic gap, it has tended to follow the state-of-the-art. Therefore, if there is enough state and local energy

conservation code action now, it will tend to set the pattern for the planned 1979 federal energy conservation performance standards. In contrast, lack of state and local action will mean their views and concerns will have much less impact on the federal standards, and they will be needlessly delaying their contribution to the essential national effort to achieve energy independence. (See Resource Item G for additional information useful in responding to those who still may question the reality of the need to conserve.)

What is the final reason that administrators should urge their code administration officials to take the Energy Conservation Technology training?

It is the legal responsibility of these code officials in every city and state to enforce the code properly or be subject to suit. This subject (energy conservation) being one to which the majority have not had exposure through previous activity requires immediate formal training, such as is being offered in the ECT series.

RESOURCE ITEM A

FEDERAL ENERGY ADMINISTRATION REPRESENTATIVES

<u>REGION</u>	<u>NAME/ADDRESS</u>	<u>STATES WITHIN REGION</u>
	John D. Rivera Craig Othmer Federal Energy Administration 1200 Pennsylvania Avenue, N.W. Washington, DC 20461	
I	Ed Finigan Federal Energy Administration 150 Causeway Street Boston, MA 02114 (617) 223-3701	Maine, Vermont, New Hampshire, Massachusetts, Connecticut, Rhode Island
II	Harry Silverstein Federal Energy Administration 26 Federal Plaza Room 3206 New York, NY 10007 (212) 264-1021	New York, New Jersey, Puerto Rico, Virgin Islands
III	J.A. LaSala Federal Energy Administration 1421 Cherry Street, RM 1001 Philadelphia, PA 19102 (215) 597-3890	Pennsylvania, West Virginia, Virginia, Washington, D.C., Maryland, Delaware
IV	Bob Biccum Federal Energy Administration 1655 Peachtree Street, N.E. Eighth Floor Atlanta, GA 30309 (404) 526-2837	Kentucky, Tennessee, North Carolina, South Carolina, Florida, Mississippi, Alabama, Georgia, Canal Zone
V	Thomas A. Sanders Federal Energy Administration 175 West Jackson Boulevard Third Floor Chicago, IL 60604 (312) 353-8420	Minnesota, Wisconsin, Michigan, Illinois, Indiana, Ohio

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VI	Jim Aanstoos Federal Energy Administration P.O. Box 35228 2626 West Mockingbird Lane Dallas, TX 75235 (214) 749-7345	New Mexico, Oklahoma, Texas, Arkansas, Louisiana
VII	Marvin Webb Federal Energy Administration Twelve Grand Building 112 East 12th Street Kansas City, MO 64142 (816) 374-2061	Missouri, Kansas, Iowa, Nebraska
VIII	Tom Strand Federal Energy Administration 1075 South Yukon Street P.O. Box 26247, Belmar Branch Lakewood, CO 80226 (303) 234-2420	Montana, North Dakota, South Dakota, Wyoming, Utah, Colorado
IX	Harry Dotson Federal Energy Administration 111 Pine Street, Third Floor San Francisco, CA 94111 (415) 556-7216	California, Nevada, Arizona, Hawaii, America Samoa, Guam, Trust Territories of the Pacific
X	Dave Swett Federal Energy Administration 1992 Federal Building 915 Second Avenue Seattle, WA 98174 (206) 442-7280	Washington, Idaho, Oregon, Alaska

RESOURCE ITEM B

STATE DELEGATES to the
NATIONAL CONFERENCE OF STATES ON BUILDING CODES AND STANDARDS, INC.

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(M) - Midwestern Region
(N) - Northeastern Region
(S) - Southern Region
(W) - Western Region

* Not an Official Delegate, only receiving mail until Official Delegate is appointed.

** Official State Delegate Alternate.

RESOURCE ITEM C

THE MODEL CODE GROUPS

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International Conference of Building Officials (ICBO)
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(213) 699-0541

Southern Building Code Congress International, Inc. (SBCC)
3617 - 8th Avenue, So.
Birmingham, Alabama 35222
(205) 252-8930

RESOURCE ITEM D

REGIONAL ENERGY CONSERVATION COST DATA*

The following information is excerpted from the source document:

D. Conclusions (pages 5 - 7 of above Paper)

Single Family Residence

Table B-1 Summary of Annual Energy
Consumption (by Region) for
Prototypical Single-Family
Residence (page 238 of above Paper)

Low Rise Apartment Building

Table B-2 Summary of Annual Energy
Consumption for Low-Rise
Apartment Building (page 239 of above Paper)

* Source: Energy Conservation in New Building Design:
An Impact Assessment of ASHRAE Standard 90-75.
Conservation Paper Number 438 (Washington, D.C.:
U.S. Government Printing Office, 1975).
(Cited hereafter as Energy Conservation...
Paper 438.)

D. CONCLUSIONS

Within the report are many findings, observations, and recommendations concerning ASHRAE 90's effect on building energy consumption, its influences on physical changes in the buildings, its implications on the owning and operating costs of buildings, its potential impact on the nation's energy consumption in construction, its possible economic impact on several selected markets and participants within the construction sector, and its impact on building habitability. The more important conclusions are as follows:

1. Impact on Building Energy Consumption

Under a strict interpretation of the standard, ASHRAE 90 is very effective in reducing annual energy consumption in all building types and locations. The unweighted average reduction in annual energy consumption relative to 1973 construction and operational practices across the four locations investigated were as follows:

Single-Family Residence	- 11.3%
Low-Rise Apartment Building	- 42.7%
Office Building	- 59.7%
Retail Store	- 40.1%
School Building	- 48.1%

ASHRAE 90 may be seen as less effective in reducing annual energy demand in the detached single-family residence than in the larger residential and nonresidential buildings. This lower effectiveness may be explained in part by the moderately high overall thermal efficiency assumed for the conventional residences. However, the ASHRAE 90 modified residences in both the Northeast (New York City), North Central (Omaha) locations met the standard with single glazing and a minimum reduction in glass area.

The standard appears to be more effective in the colder climates because of the larger percentage of annual energy demand in all construction accounted for by space heating and the inherent effectiveness of ASHRAE 90 in reducing annual heating requirements. In general, the decrease in space heating requirements accounted for 60 to 75% of the total reduction in actual energy consumption.

The lowest unit-energy consumption obtainable in the prototypical buildings after the prescriptive/performance approach (Sections 4 through 9) had been made was on the order of 67,000 to 72,000 Btu per square foot. This consumption is considerably greater than the General

Services Administration announced "goal" of 55,000 Btu per square foot. ADL does not believe the implementation of ASHRAE 90 alone would suffice to meet the GSA goal for any building type similar to those investigated.

If measured in terms of energy reduction potential, the most "effective" sections in the document will vary by type of building. With few exceptions, all of the sections have some influence on the reduction in annual energy consumption. Changes in winter design conditions (Section 5) and supplied domestic hot water temperatures (Section 7) appear to be the most effective parameters for the single-family residence, while those chapters dealing with HVA/C equipment, systems, and control (Sections 5 and 6) appear to be most effective in non-residential construction.

2. Impact on Physical Characteristics

The application of ASHRAE 90 brought about the following physical differences in the conventional versus ASHRAE 90 modified buildings:

Exterior Glass - Glass area (percent fenestration) was reduced in approximately two-thirds of the buildings. Reductions were as much as 30%, but most were less than 20%. One region - the North Central - required reductions in glass area for all buildings.

Exterior Wall - Decreases in glass area were balanced by increases in net wall area; virtually all increases were less than 8%.

Insulation - Additional insulation requirements for residential construction varied from 80 to 300 pounds per unit. Increased requirements for insulation in commercial construction were even greater than those needed in residential construction.

Lighting - Reductions in lamps and lamp fixtures varied by building type, and averaged 24% and 22%, respectively, for nonresidential construction.

HVA/C System Capacities - Reductions in heating system capacities were significant, averaging 42%, while reductions in cooling systems were generally less, averaging 31%. The greatest reductions were found in the school building. Auxiliary HVA/C equipment, including pumps, towers, fans, supply fans, etc., also showed a significant reduction, averaging 44% in rated kilowatt capacity.

3. Impact on Building Economics

Based on 1975 energy costs compiled by ADL, annual savings in operating costs ranged between \$0.05 and \$1.05 per square foot, but were generally

within the range between \$0.20 and \$0.70 per square foot. Savings in single-family residences (\$0.05 to \$0.14 per square foot) were lower and less broader than those for commercial construction (\$0.12 to \$1.05 per square foot). Percent Savings in annual energy costs ranged from 9-15% in the single-family house to 30-40% for commercial buildings. The savings may be large enough to induce building owners to follow the standard on a voluntary basis providing they had such decision information available to them and providing financial institutions recognize that the loan quality is improved.

The initial construction costs of those buildings modified under the standard prescriptive/performance approach were shown to be less than those of conventional buildings. Unit savings range from \$0.04 to \$0.94 per square foot, with the greatest savings experienced in office buildings.

ASHRAE 90 generally increases the cost of the exterior wall, floors, roof, and domestic hot water system. Glazing costs may be higher or lower depending upon building type. Unit costs for lighting, and particularly HVA/C equipment and distribution systems, were significantly lower and tended to offset the increase in other costs. Average changes in unit costs are as follows:

	<u>Dollars Per Square Foot</u>
Single Family Residence	- 0.02
Multi-Family Residence	- 0.41
Office Building	- 0.63
Retail Store	- 0.18
School Building	- 0.44

For the prototypical buildings investigated, the cost of additional design effort was found to be between \$0.09 and \$0.36 per square foot of floor area. With the exception of the single-family residence, the straight payback of design services due to energy cost savings was found to be less than one year, and less than six months in most cases. Average additional design costs were as follows:

	<u>Dollars Per Square Foot</u>		<u>Straight Payback</u>
	<u>Annual Energy Savings</u>	<u>Additional Design Services</u>	
Single-Family Detached Residence	0.07	0.24	2.9 years
Low-Rise Apartment	0.31	0.09	3.4 months
Office Building	0.40	0.16	2.5 months
Retail Store	0.68	0.09	7.6 months
School	0.70	0.15	4.6 months

Excerpt from Energy Conservation . . . Paper 438, p. 238*

TABLE B-1

SUMMARY OF ANNUAL ENERGY CONSUMPTION FOR PROTOTYPICAL SINGLE-FAMILY RESIDENCE

	<u>Northeast</u> (1,600 sq. ft.)	<u>North Central</u> (1,600 sq. ft.)	<u>South</u> (1,675 sq.ft.)	<u>West</u> (1,705 sq.ft)
<u>CONVENTIONAL</u>				
Electricity (kwh)	18,600	12,300	36,501	49,505
(1000 Btu/sq. ft.)	39.8	26.2	74.4	99.1
Oil (gals)/gas (1000 cu.ft.)	1,557 (oil)	259 (gas)	—	—
(1000 Btu/sq. ft.)	137.2	170.0	—	—
Total Energy (1000 Btu/sq.ft.)	177.0	196.2	74.4	99.1
<u>ASHRAE 90-75 MODIFIED</u>				
Electricity (kwh)	15,793	11,295	33,024	44,838
(1000 Btu/sq.ft.)	33.7	24.1	67.3	89.8
Oil (gals)/gas (1000 cu.ft.)	1,330 (oil)	212.7 (gas)	—	—
(1000 Btu/sq.ft.)	117.2	139.6	—	—
Total Energy (1000 Btu/sq.ft.)	150.9	163.7	67.3	89.8

*SOURCE: Kling-Lindquist, Inc., estimates.

Excerpt from Energy Conservation . . . Paper 438, p. 239*

TABLE B-2

SUMMARY OF ANNUAL ENERGY CONSUMPTION FOR LOW-RISE APARTMENT BUILDING

	<u>NORTHEAST</u> (18,000 sq.ft.)	<u>NORTH CENTRAL</u> (18,000 sq. ft.)	<u>SOUTH</u> (18,000 sq.ft.)	<u>WEST</u> (18,000 sq.ft)
<u>CONVENTIONAL</u>				
Electricity (kwh)	404,564	185,369	236,870	199,698
(1000 Btu/sq.ft.)	76.7	35.1	44.9	37.9
Oil (gal)/gas (1000 cu.ft.)	22,595 (oil)	4,184 (gas)	4,088 (gas)	4,452 (gas)
(1000 Btu/sq. ft.)	177.0	244.1	238.5	259.7
Total Energy (1000 Btu/sq.ft.)	253.7	279.2	283.4	297.6
<u>ASHRAE 90-75 MODIFIED</u>				
Electricity (kwh)	258,530	98,321	114,762	110,850
(1000 Btu/sq.ft.)	49.0	18.6	21.8	21.0
Oil (gals)/gas (1000 cu.ft.)	9,626 (oil)	2,925 (gas)	2,428 (gas)	2,428 (gas)
(1000 Btu/sq. ft.)	75.4	170.6	141.6	141.6
Total Energy (1000 Btu/sq. ft.)	124.4	189.2	163.4	162.7

*SOURCE: Kling-Lindquist, Inc., based on computer simulation.

RESOURCE ITEM E

ROLE AND RESPONSIBILITIES OF THE BUILDING OFFICIAL*

OVERVIEW OF BUILDING CODE AND HOUSING

CODE ADMINISTRATION IN NEW JERSEY

By Dorothy H. Cronheim

The health and safety of the people of New Jersey and those who visit the state on business or pleasure, and the costs of the buildings they buy or rent are affected directly everyday by the adequacy and currency of (1) the standards set forth in the state and local building codes and housing codes; and (2) the knowledge and skills of the administrative, supervisory and inspection personnel responsible for the administration and enforcement of these code requirements.

This report on code administration in New Jersey contains the results of a statewide examination of the size and nature of the present inspection forces, the areas where the present provisions need to be strengthened or changed, and the specific tasks code administration personnel need to perform to administer and enforce their respective building codes and housing codes adequately and effectively. It identifies the essential knowledge and skills required for the proper performance of these tasks by everyone from the entry level inspector trainee to the top level code administrator. A proposed career development system and a core curriculum course also are described herein. These have been designed to provide code administration personnel who have not otherwise acquired the requisite knowledge and abilities with the training required to enable them to perform properly the duties assigned to them.

The report contains short and medium range recommendations for strengthening the art and science of code administration and code enforcement throughout the Garden State. It also outlines their implications, including the actions required to begin implementing a modern code administration process. This part of the report will

*Source: Building Code and Housing Code Administration Committee, Toward a New Jersey Career Development System in Code Administration (Trenton, N.J.: Synectics, Inc., 1975) pp. vii-viii.

provide an overview of:

- *The status of building code and housing code administration in the state.
- *The major problems that needlessly hinder the committed code official's efforts to do the job well.
- *The opportunities before New Jersey for achieving far more adequate and effective code enforcement statewide.

This achievement is possible. It is also essential in order to overcome the needless limitations in the provisions for code administration that all too often have resulted in failures to prevent the slipshod or dangerously faulty construction of some of the new buildings in New Jersey that endanger those who use them, and to enforce code standards effectively enough to overcome the inadequate and unsafe maintenance of numerous existing dwellings that jeopardize the health and safety of far too many residents of this state.

Basic Factors Involved in Code Administration Process, Including Code Enforcement

This introductory section outlines for readers unfamiliar with the code administration process the chief elements in the administration of a building code and a housing code. It is suggested that those readers familiar with the process turn to page 31.

Building Code Administration Process

Once the state or local building code is adopted, the code administration staff is responsible for administering, interpreting and enforcing the code's standards. This entails the review of plans to ensure their compliance with the standards, prescriptions of changes therein where necessary, approval of properly prepared plans and issuance of a building permit for construction in accordance with these plans.

The plan review and approval procedure well may require consultation with highly trained technical experts, especially when high rise or other complicated structures are involved. This is necessary because many code requirements are based on the technical performance standards set by approved professional organizations in the construction industry, and few if any of the numerous part-time building officials are likely to have sufficient technical knowledge and competence to handle the complex plans without outside assistance. In addition, numerous and

continuing changes in construction technology and materials have become characteristic of building industry in recent years. This means that even the most knowledgeable inspector of today cannot possibly keep sufficiently informed about the effects of such changes on her or his routine work unless provided with appropriate training on a continuing basis.

It is also necessary for building officials to be sufficiently familiar with pertinent state laws, such as those governing environmental protection and other matters affecting construction practices; and local ordinances, such as those regulating housing, electrical, plumbing and zoning practices. Officials require this knowledge in order to be in a position to make sure no permits or certificates of occupancy are issued unless and until requirements of the related legislation have been met.

Once permits are issued, a series of inspections must be made at various points in the construction process to ensure compliance with the code standards provided for in the approved plans. This work requires at least three or four checks of the building under construction if it is a simple structure. As soon as one goes from a one or two family house to a complicated structure - a high rise apartment house or office building, a shopping mall, or an industrial park with a wide variety of construction types - more inspections are required. Moreover, on these complicated construction projects unless the builder has a resident engineer or architect at the site to supervise the job, which is not a common practice, the municipal building official will need to utilize appropriate professional assistance to assure that the work done actually meets the required code standards for fire and structural safety and mechanical system adequately.

Where the inspection agency is understaffed and its personnel are undertrained, or its part-time or full-time staff does not include persons with the expertise required to handle the occasional or numerous projects being built in the area, either of the following costly practices may result. First, the project may be held up at one or more of the stages where inspections are required until the local inspector or the professional hired to assist her or him can find the time to make the inspections. When this happens, it adds needlessly and excessively to the cost of the building and the subsequent purchase price or rent that must be paid by its users. Second, the inspection agency may end up making fewer inspections than required, or inadequate inspections, and may not even be able to retain the services of any required professional because of its staff and budget limitations. When this occurs, those who use, buy or rent the building and the owners of

adjoining and surrounding properties will be subject to whatever hazards, higher costs or damaging defects that may result.

One or two examples will illustrate the seriousness of the problems that have resulted from code administration staffs that were undertrained, undersized or uncoordinated. No building is better than its foundations. Many owner occupants of new houses have been faced with the costly problems of damp or flooded basements after they moved in because the time and money spent on waterproofing the foundation by the builder was less than required to last, at best, more than the customary one year guarantee period. A building department with a trained staff of adequate size would have made the foundation inspections at the time required to prevent improper waterproofing.

Inadequate sewage drainage systems can also cause great health hazards and necessitate costly repairs, and this problem has affected owners or occupants of a wide variety of housing types ranging from very expensive one family houses to inexpensive mobile homes. After the site engineer or builder submits percolation test reports concerning the soil conditions of the lots where the housing is to be built, the county or municipal health officer needs to spot check the reports to make sure these are valid. In addition, where the building agency chief has been adequately trained, she or he will not issue a permit to construct the proposed housing until the required check has been made by the health officer. In the absence of the necessary inspection and code enforcement action, housing with septic tanks has been built on soil not meeting the required standards of drainage. As a result, after the homes were occupied the human sewage effluent from the septic disposal system saturated the surface of the lawns because it could not leach downward.

In carrying out their duties, adequately trained building inspection officials are capable of providing two especially important services to builders and the public. Such officials are able to interpret the code requirement questions of builders that often give them an awareness of less costly alternate construction materials and practices they can use to meet required performance standards. Such building officials also have the knowledge and competence required to spot improper or uninformed do-it-yourself home improvers and order such practices corrected before they cause needless deaths, injuries, or other serious consequences.

Besides refusing to approve an application for a building permit until the building plan meets code standards or informally advising the violator to correct the condition before the next inspection, the building official has four other methods of causing those who build, enlarge or alter buildings to comply with standards.

First, the official may issue a stop order that prevents the builder or rehabilitation contractor from proceeding with the work until the appropriate corrective action is taken. This method is seldom utilized unless those involved in the project refuse to respond to the building official's informal request that the improper work be corrected. However, like the fist in a velvet glove, mention of the power to use a stop order usually helps to generate appropriate responses from builders without any need to actually issue an order or take the case to court.

Second, the building official may refuse to issue a certificate of occupancy until the builder meets all required code standards. This means no one may make use of the building; because this prevents the owner from selling or renting it. This power is a strong stimulant to achieve code compliance.

Third, the condemnation hearing may be used when a building has become structurally unfit for safe human habitation, occupancy or use. If the facts support the charges, the owner can be ordered to either have the property vacated and boarded up until all necessary health and safety standards are met if it still is salvable, or to have it demolished.

Fourth, where all other methods fail or where a violation is uncovered after a building is in use, the building official may file charges against the owner in the appropriate court in order to have the violator tried, and, if convicted, ordered to take the actions needed to correct same.

In addition, if a building has been vacated due to fire or other damages, or has its windows and doors broken and is vandalized or otherwise damaged inside after it becomes vacant, the owner can be ordered to board it up and keep it securely boarded. This is necessary to prevent entry by curious children and adults, or derelicts or other undesirables. The former would endanger themselves primarily, but the latter are quite likely to endanger the health, safety and security of those who occupy or own adjoining properties. Yet, in many cities insufficient inspection staffs mean that such vacated or abandoned buildings become or are left insecure, thus contributing to the deterioration of the areas in which they are located and constituting a real hazard to others.

Whenever condemnation hearings or court actions occur, the building inspectors require legal advise to prepare their cases properly and effective representation by the state or local prosecutor to win them. Too often the needed professional assistance is not forthcoming when the inspection agency must depend on such help as a part-time municipal attorney who has been given so many other duties that he or she cannot or does not spend any time or enough time on building inspection cases.

This means the inspection agency does not obtain the successful prosecution that is warranted by the evidence and clearly necessary to overcome the dangerous and illegal conditions that prompted the initiation of the condemnation hearings or court trial. In all such cases, the public is the loser.

RESOURCE ITEM F

BACKGROUNDS OF STUDENTS'
ENERGY CONSERVATION TECHNOLOGY PROGRAM

A 1970 nationwide study of local building code administration agencies and personnel generated responses from 896 municipalities, 96.7% of which had building codes.¹

Much of the information below concerning the education and experience of the clientele for the three series of courses in the ECT program was drawn from that study or based upon it.

ECT-100

CLIENTELE - Inspectors from small (under 25,000 population), medium(25,000-100,000 population) and large (over 100,000 population) size municipalities.

STAFF SIZE AND DUTIES - In the small communities, the code administration agencies are staffed by one or two persons who perform the inspections and all other code administration functions. The inspectors in the medium sized agencies generally spend most if not all of their time on building inspections. In the larger agencies, building inspectors only make building inspections and some even inspect only certain classes of buildings such as industrial, commercial or residential structures.

EDUCATION AND AGE - Over half have completed high school, one third have had some college and twelve per cent are college graduates. Eighty-three percent are distributed evenly among the 30-39, 40-49 and 50-59 year age groups.

OTHER QUALIFICATIONS - Union building trade experience ranks first, that as a general contractor second and that in nonunion building trades third, as most common occupation backgrounds of inspectors. Those with union building trades backgrounds are employed most often by the large agencies. On the West Coast, chiefly, a small percentage of college graduates with degrees in architecture or engineering serve as building inspectors. In small and medium size communities, the inspectors usually have had contracting or nonunion trades experience.

EXPERIENCE - Most recently appointed building officials' mean years of experience in code agency was 2.7, while the maximum was 36 years.³ The mean was 9.9 for senior building officials, which would include inspectors with some supervisory responsibilities, and the maximum was 44 years as of June, 1970.⁴

ECT-200

CLIENTELE - Code Administrators and plan checkers.

STAFF SIZE AND DUTIES - These students will be drawn primarily from medium size communities with staffs ranging from 5 to 50 in number. In their agencies they either are responsible for the general administration of the building code program, including some of the plan review work, or they spend most of their time reviewing plans.

EDUCATION AND AGE - Like the chief building officials referred to in The Municipal Year Book article, about 40% of these students have had some college, almost 30% are college graduates and more than 68% are between 40 and 59 years of age.⁵ In general, the plan checkers will hold architectural or civil engineering degrees.

OTHER QUALIFICATIONS - Substantial experience as a small contractor, limited experience as an architect or engineer will characterize these students.

EXPERIENCE - Best estimate is that most of the code administrators have had more building department experience than the plan checkers. 6.7 is the median and 8.6 the mean years of experience for chief "building officials" or "code administrators" in cities of all sizes.⁶

ECT-300

CLIENTELE - Code Administration agency plan review professionals registered as architects or engineers. These students will be primarily, if not exclusively, from large municipalities.

STAFF SIZE AND DUTIES - They are the plan review specialists of the large code administration agencies and spend virtually all of their time on the plan review function.

EDUCATION AND AGE - The vast majority of this student group will consist of degree holding architects or civil engineers. Possibly a very small number of mechanical engineers will be included among them. Their average age is not known.

OTHER QUALIFICATIONS - They will be registered architects or registered engineers and will have had substantial experience in the private sector as practicing design professionals.

EXPERIENCE - No information is available that would permit a meaningful estimate of the average amount of time these professional plan reviewers have served their code administration agencies.

¹Charles G. Field and Francis T. Vantu, "Local Regulation of Building Agencies, Codes and Politics", the Municipal Yearbook, 1970 (Washington, D.C.: International City Management Association, 1970), p. 139.

²Ibid., "Table 1/9. Formal Education and Ages of Local Building Officials", p. 146.

³Ibid. "Table 1/10 Years in Building Department as of June, 1970 for Local Building Officials", p. 146.

⁴Loc. cit.

⁵Op. cit. "Table 1/9", p. 146.

RESOURCE ITEM G

ENERGY CONSERVATION TECHNOLOGY PROGRAM
SUGGESTED COURSE TIME ALLOCATIONS

Series	Number	Title and Topics*	Hours
ECT	000	<u>Management and Energy Conservation</u> Seminar for State and Municipal Energy Officials	1
		<u>Energy Conservation Technology for the</u> <u>Building Inspector</u>	
ECT	100	Introduction to Energy Conservation	1
	101	Energy Fundamentals	5
	102	Model Code for Energy Conservation in New	4
	103	Building Construction - cited hereafter as "Model Energy Conservation Code" Model Energy Conservation Code Application	<u>8</u>
			18
		<u>Energy Conservation Technology for Plan</u> <u>Examiners and Code Administrators</u>	
ECT	200	Introduction to Energy Conservation	1
	201	Energy Fundamentals	6
	202	Model Energy Conservation Code	6
	203	Model Energy Conservation Code Application	<u>12</u>
			25
		<u>Energy Conservation Technology - Advanced</u> <u>Course for Plan Examiners</u>	
ECT	300	Introduction to Energy Conservation	1
	301	Energy Fundamentals	6
	302	Model Energy Conservation Code	8
	303	Model Energy Conservation Code Application	<u>16</u>
			31

*Although the topics for the Series ECT-100 through ECT-300 are identical, the material covered is more complicated and in more depth in the longer series.

RESOURCE ITEM H

AMERICA'S NEED TO ACHIEVE ENERGY INDEPENDENCE*

"The United States is an "energy intensive" nation: it comprises only 6% of the earth's population but consumes 31% of the world's annual energy output. America's per capita consumption of the energy is eight times that of the rest of the world. Its demand for energy has been increasing at an annual rate of 4 to 5% for the past decade.

Although the U.S. is completely dependent on energy to meet its needs, the nation's concern about an adequate energy supply is relatively recent, sparked by the 1973 oil embargo. At that time the United States became acutely aware of the extent to which it had been relying upon foreign sources of supply and the dangers involved.

That the United States until that time took energy largely for granted is not surprising. ...through 1950 it had enough fossil fuel to meet not only its own demands, but also to maintain reasonably successful export of fossil fuels. By 1960 the situation had changed and, although the U.S. still exported fossil fuels, the amount of imports had begun to grow, so much so, in fact, that imports of petroleum accounted for 19% of domestic consumption. By 1975, it accounted for 37% of domestic consumption.

Causes of the nation's growing domestic energy gap (the difference between domestic energy demand and domestic energy supply) have been attributed to several key factors:

- a. Reduced exploration for crude oil since 1956 and reduced production since 1970.
- b. Consumption of natural gas in excess of the discovery rate since 1968.
- c. Environmental regulations which have restricted the use of coal (of which the nation has an estimated 800-year supply at current consumption rates).
- d. Technical and regulatory restrictions which have slowed the projected rate of nuclear energy development.

These conditions were not unknown. They had caused relatively little concern, however, because the nation believes the pledges of oil-

*Excerpt from ECT-200 Course Introduction.

producing nations not to use petroleum as a political weapon. The situation changed dramatically in 1973 when OPEC nations cut back production and embargoed oil supplies to the United States.

While most Americans remember the embargo as a near-panic created by severe gasoline shortages, statistics indicate that far more than temporary inconvenience was involved.

In fact, the nation's gross national product (GNP) dropped by \$10 to \$20 billion dollars; 500,000 workers became unemployed, and drastic inflationary cost escalations were forced upon all petroleum-based goods and services.

In retrospect, many now regard the oil embargo as a blessing in disguise. It has the positive effect of making the nation aware of its serious energy problems. This awareness, in turn, has resulted in comprehensive planning and action to overcome these problems and so make the United States energy independent for the mid- and long-term future.

Unfortunately, these plans have not moved along as quickly as they had been projected. As a result:

- * Domestic production of petroleum and natural gas is down;
- * Cost of an imported barrel of oil is up;
- * The rate of coal production has not changed;
- * Utility companies have cancelled or deferred, for economic reasons, a substantial portion of additional planned electric generating capacity, and
- * Energy waste continues.

In fact, the United States is more vulnerable to an oil embargo than it was in the fall of 1973."

CHAPTER II

STUDENT'S MANUAL

Part I. ENERGY CRISIS FACTORS AND IMPLICATIONS

THE CAUSES OF THE ENERGY CRISIS

Energy supplies and energy usage in the United States and the world directly affect the energy dependence of all nations. Despite the traditional abundance of fossil fuels on the North American continent, the supply is limited and America already is using more oil than it can supply domestically. All of the world's currently exploitable fossil fuels will be depleted eventually and present forecasts are that the end of the fossil fuel era may be reached in America by 2,000 A.D.¹

Specifically, what factors brought about the energy crisis that confronts the United States?

First, the historic development and growth of America's economy occurred throughout a long period when natural resources were more than ample and this led many to assume its energy resources were as abundant as the rest.²

Second, the widespread and rapid growth in the demand for energy produced a buyer's market for it, a small return on investments in energy production and a decline in the development of domestic resources.³

To illustrate:

- a. Coal production reached its peak in 1947.
- b. Crude oil exploration was declining until the oil embargo generated an upsurge in 1974.
- c. Since 1968 the consumption of natural gas has outpaced the discovery of new supplies.⁴

Moreover, as Figure 1 reveals, America's consumption of energy fuels as recently as 1974 was far out of proportion to the existing reserves that could be recovered economically using today's technology.⁵

The third cause of the energy crisis was the decline in the development of domestic supplies and the rise in their prices that led the industrial, transportation and residential/commercial energy users in America to become increasingly dependent upon the traditionally inexpensive foreign oil sources. As a result by 1973, 35% of the oil used in the U.S. was being imported.⁶

WHAT ARE THE ROOTS OF OUR ENERGY PROBLEM ?

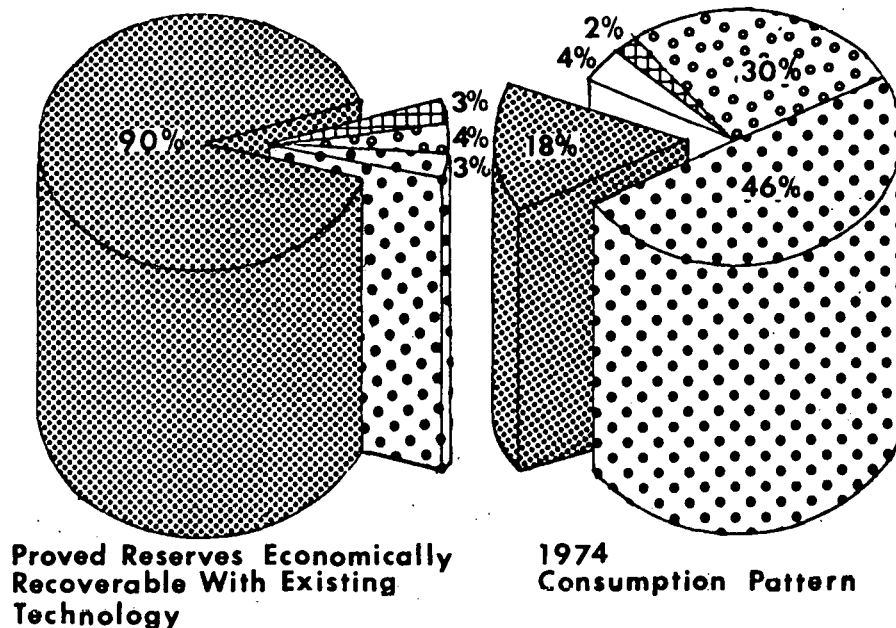
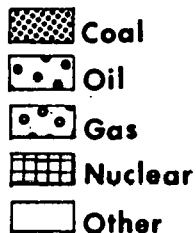


FIGURE 1⁵

The drastic increase in our dependence on oil imports since 1950 is depicted in Figure 2.

HOW DID WE BECOME SO VULNERABLE TO OIL IMPORTS ?

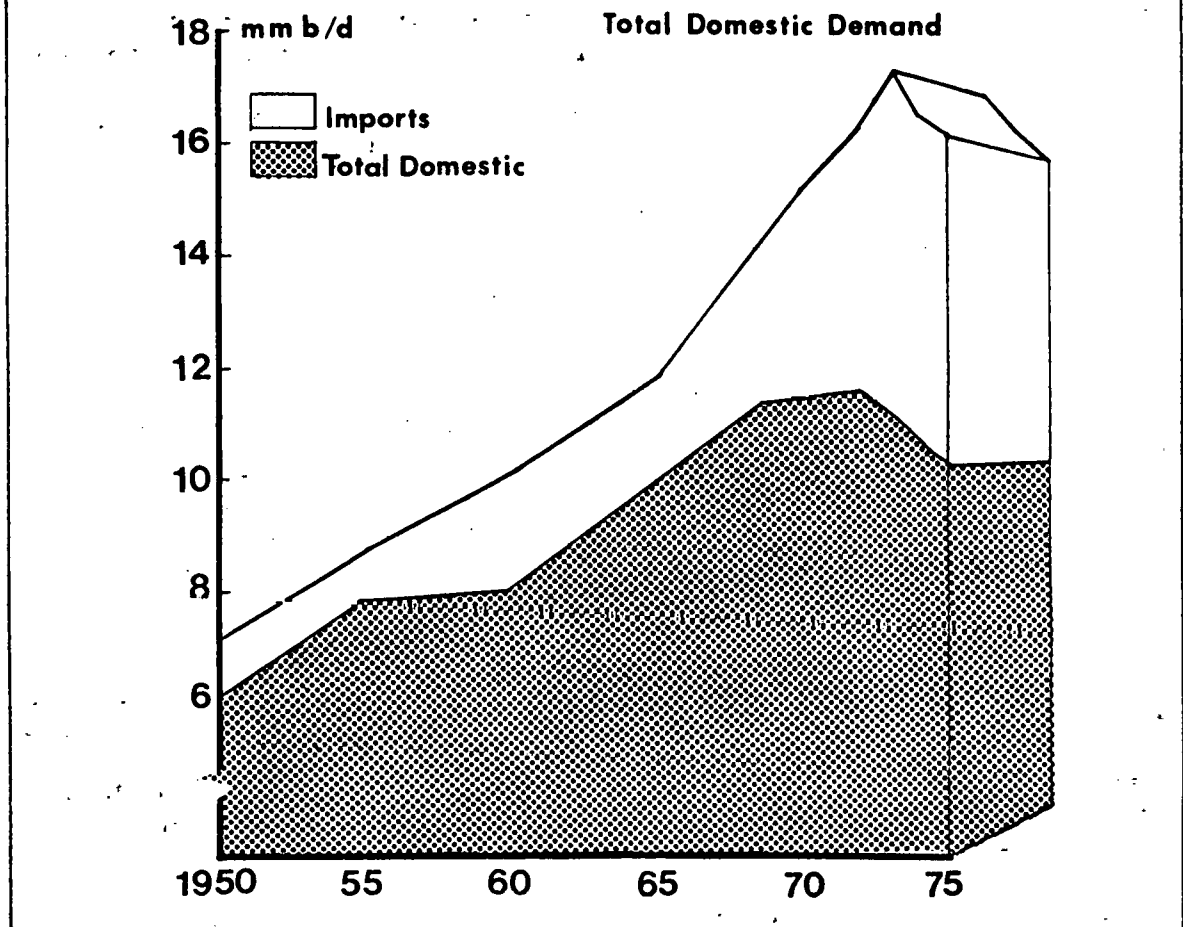


FIGURE 27

The situation was underscored by the 1973 oil embargo. The embargo did not cause it, but it did affect oil prices. Translated into dollars, by 1975 the United States was spending 27 billion dollars or \$125 per person for imported oil as compared with about \$15 per person in 1970.⁸

CONSEQUENCES OF THE ENERGY CRISIS

The capacity to fill the gap between supply and demand in America is affected by the size of the gap and the availability of imports. The developing nations of the world now are increasing their demand for energy significantly. Therefore, the rate of depletion of the international fossil fuel supplies, including oil, also has been accelerated. Because over 50% of the known oil reserves are in the Arabic countries, the United States and other major oil users have become vulnerable to their demands. Conservation measures that will reduce the rate of growth in the demand for energy and also decrease the waste are essential means of bridging the time lag between the exhaustion of America's existing energy sources and her development of new ones.

Consequently, it is of critical importance that major use be made of energy conservation efforts both to help carry America through that time lag and to help her achieve energy independence. In order to understand what needs to be done and why, it is in order to explore some of the other known facts about the demand, consumption, supply, waste and use of the existing domestic energy sources and the technological efforts to tap or develop others.

U.S. ENERGY DEMAND

"Energy demand grew at a rate of 3.6 percent in the 20 years before the 1973 embargo."⁹ "If the current higher prices of oil continue (about \$13 per barrel in 1975 dollars) energy demand will be much lower and the greatest reductions in energy growth/can be expected/in the household/commercial and transportation sectors"¹⁰, for these respond sharply to higher prices for fuel.

Figure 3 indicates national energy consumption trends by economic sector between 1950 and 1990 and also shows the projected impact of the embargo in reducing the rate of increase.

U.S. ENERGY CONSUMPTION

The implications of the demand situation become clearer when one examines the national energy consumption pattern and the types of fuels consumed. One third of the world's energy is consumed by the United States even though it has only 6% of the world's population.¹² In 1974, this (Fact Sheet 1) is how the total consumption amounting to 71,002 trillion British thermal units (Btu)* was distributed:¹³

*Btu = quantity of heat required to raise the temperature of one pound of water one degree Fahrenheit at or near 39.2°F.

HOW MUCH ENERGY WILL THE NATION CONSUME ?

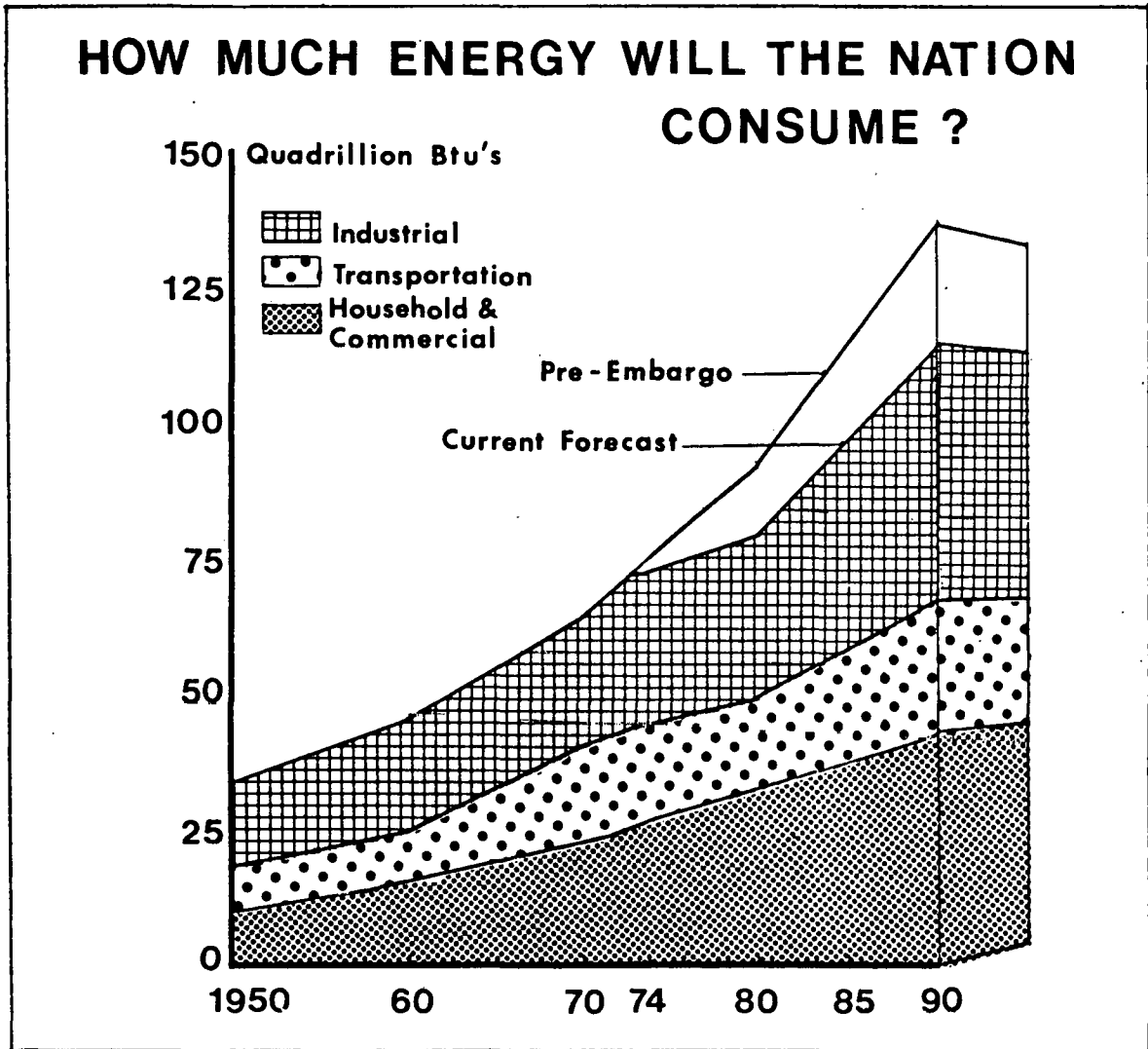


FIGURE 3¹¹

While each American used the energy equivalent to 17 barrels of oil during 1900, by 1970 the amount had reached 57 barrels and, if the 3.6% to 4.8% growth rate of recent years continues, by 1985 the per capita consumption could reach 88 barrels a year.¹⁶

FACT SHEET 1

U.S. ENERGY CONSUMPTION IN 1975 14, 15

Total Consumption - 71,002 trillion Btu's*

Petroleum	5.95 billion barrels/year	46.1%
Coal	554 million short tons	18.4%
Natural Gas	19,985 billion feet ³	28.7%
Nuclear Power	155 billion kilowatt hours	2.3%
Hydropower and Geothermal	304 billion kilowatt hours	4.5%

*This equals 200 trillion tons per day or 34 million barrels of oil equivalent.

U.S. ENERGY SUPPLIES

The source of the U.S. energy supply in the past fifty years went from reliance on coal for 78% of the supply in 1920 to reliance on oil (46%) and natural gas (30%) for 76% of the total in 1974.¹⁷ Fact Sheet 2 indicates the changing sources in greater detail.

FACT SHEET 2

SOURCES OF U.S. ENERGY SUPPLY, 1920, 1950, 1974¹⁷

Sources	Percent of Total Supply		
	1920	1950	1974
Coal	78	38	18
Oil	14	39	46
Natural Gas	4	18	30
Hydroelectric	4	5	4
Nuclear	-	-	2

By 1985, how will the U.S. meet its growing energy demands? Use will be made of the same primary energy sources; namely, gas, oil, coal, nuclear, and hydroelectric power, and a 40% increase in the total domestic supply is predicted.¹⁸

The expected increases are depicted in Figure 4.

HOW WILL THE NATION MEET ITS GROWING ENERGY DEMANDS BY 1985?

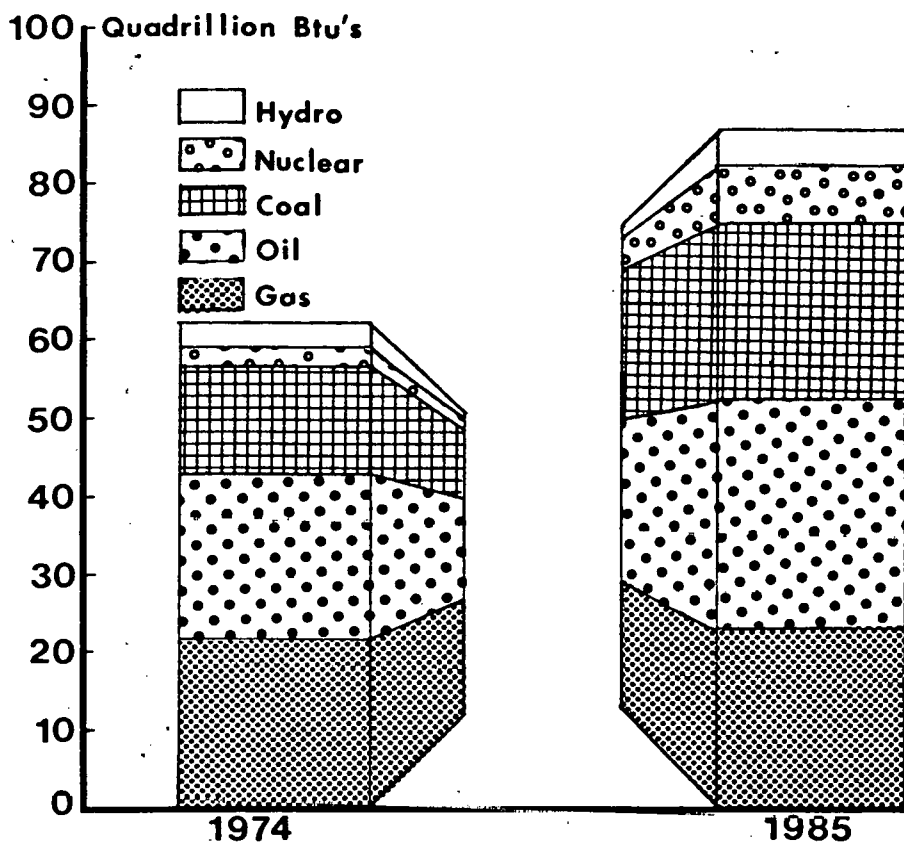


FIGURE 419

Even if all of these domestic energy sources reach the projected levels, however, some shortages still will have to be made up through oil imports.

Because of the extensive research and development work already underway, substantial increases are being achieved in the nuclear energy supply and this expansion can be expected to continue now and later. The immediate prospects for added supplies from other new energy technologies are not as bright.

"The contribution to domestic energy supplies of solar, geothermal and synthetic fuels will be only about one percent (1%) by 1985

and, as Figure 5 suggests, they will not begin to contribute in a major way until after 1990."²⁰

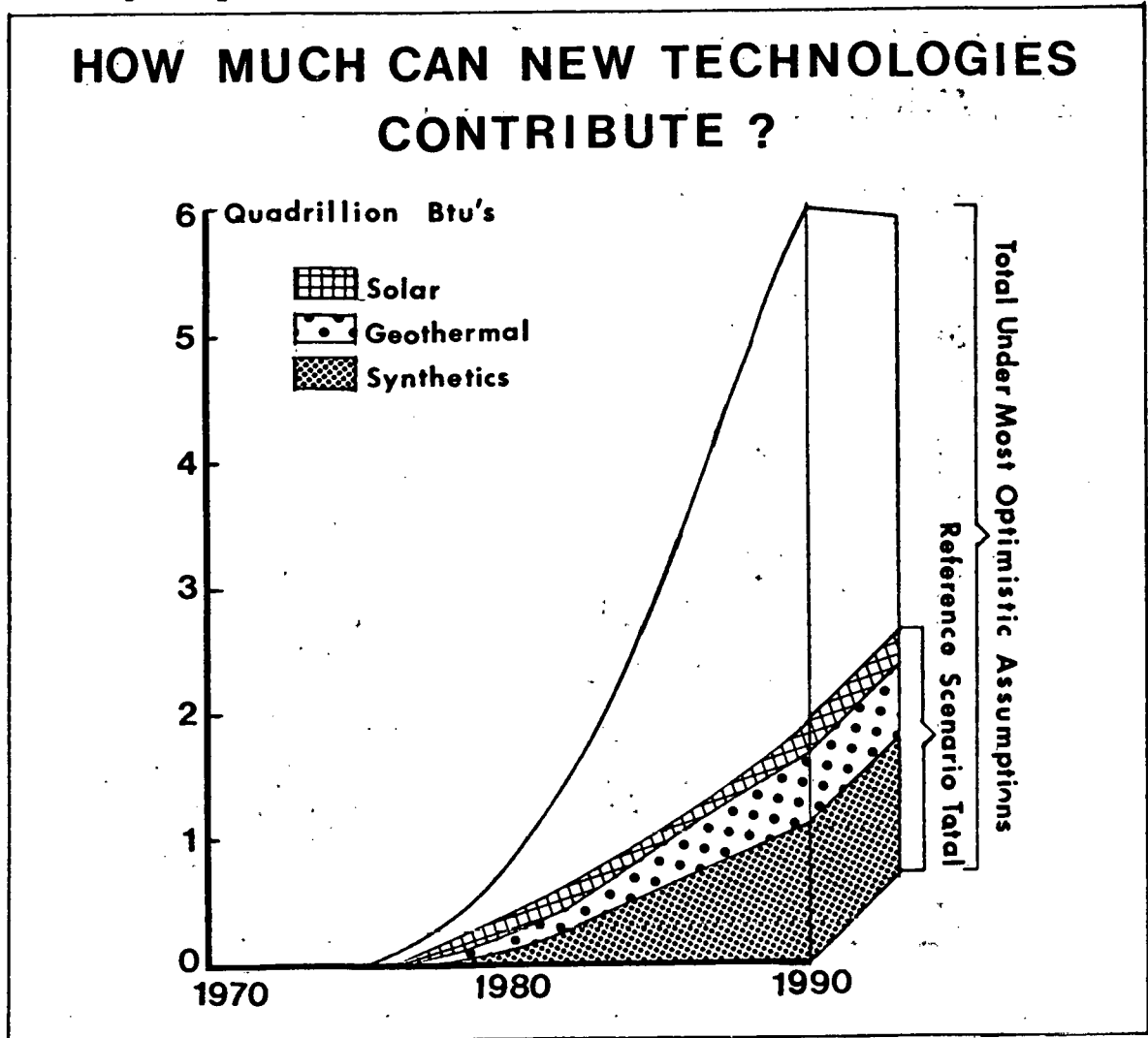


FIGURE 5²¹

U.S. ENERGY WASTE AND USE

Needless energy inefficiencies in buildings, appliances and automobiles, failure to level off the peakload use of utilities, and the inefficient methods used to transmit and store energy all contribute to the fact that Americans waste over 40% of the energy they use.²² Energy flow pattern charts developed by the staff of the Joint Committee on Atomic Energy show, for example, the 1950 pattern and forecast that for 1980.²³ The figures in both document the nation's growing dependence on energy imports and the high percentage of the total supply that is lost instead of used as shown in Fact Sheet 3.

FACT SHEET 3

UNITED STATES ENERGY FLOW CHART:

COMPARISON OF 1950 PATTERN WITH 1980 FORECAST²³

<u>Flow Pattern Elements</u>	<u>Million Bbls/Day Oil Equivalent</u>	
	<u>1950</u>	<u>1980</u>
Sources of Energy Supply		
Imports	.9	22.0
Domestic	<u>15.2</u>	<u>26.3</u>
Total Supply	16.1(100%)	48.3(100%)
Energy Conversion Losses During		
Electrical energy generation	1.4	8.1
Residential/commercial uses	.9	2.6
Industrial uses	1.4	3.4
Transportation and other uses	<u>3.8</u>	<u>10.4</u>
Total Losses	7.5(47%)	24.5(51%)
Energy Used By		
Residential/commercial sector	2.7	7.3
Industrial sector	4.2	9.6
Transportation and other sectors	<u>1.7</u>	<u>6.9</u>
TOTAL	8.6(53%)	23.8(49%)

The actual and the anticipated energy imports rose from .9 to 22.0 million barrels per day oil equivalent between 1950 and 1980. The portion lost instead of used in 1950 was 47% while a 51% loss was projected for 1980.²⁴

SUMMARY

Having noted all of these facts, how can the American energy situation be summed up?

First, as Figure 6, depicting the World Energy use in tons of coal equivalent and the U.S.'s 1970 share of that reveals, world energy use has increased markedly since 1900, and the U.S. share has been extremely high. In fact, it still is.

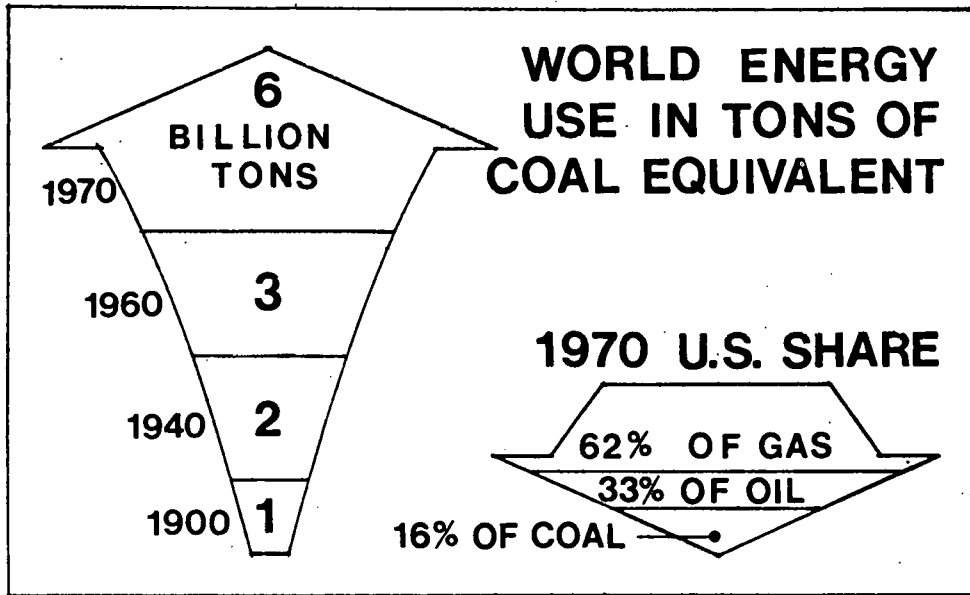


FIGURE 6²⁵

Second, the projected U.S. demand for oil (Figure 7) and gas (Figure 8) in 1985 will not be met unless a significant share of the supply can be obtained through imports.

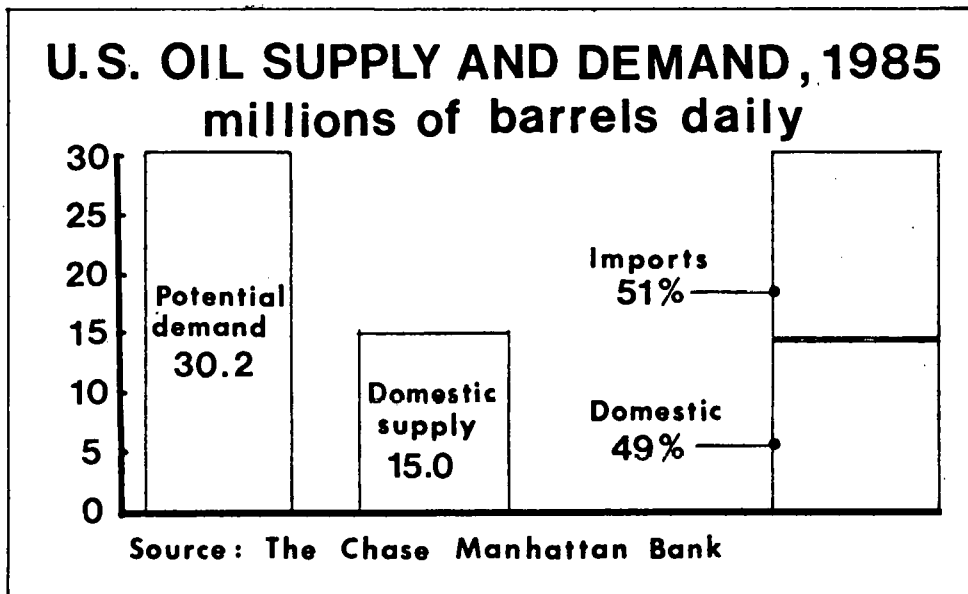


FIGURE 7²⁶

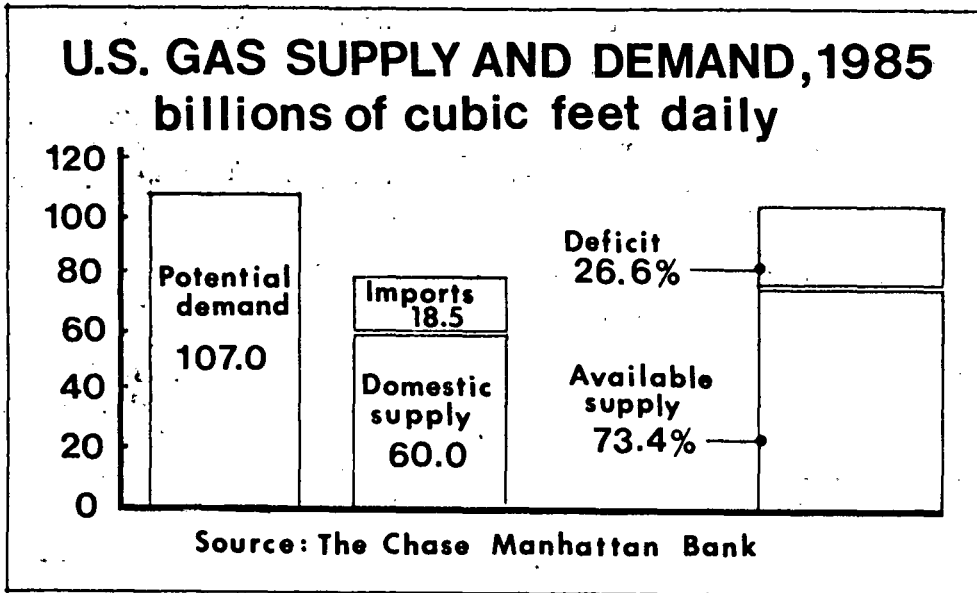


FIGURE 8²⁷

Therefore, not only has there been an energy gap between the U.S. energy supply and consumption, but the projections (Figure 9) indicate that it will continue in the years immediately ahead at least.

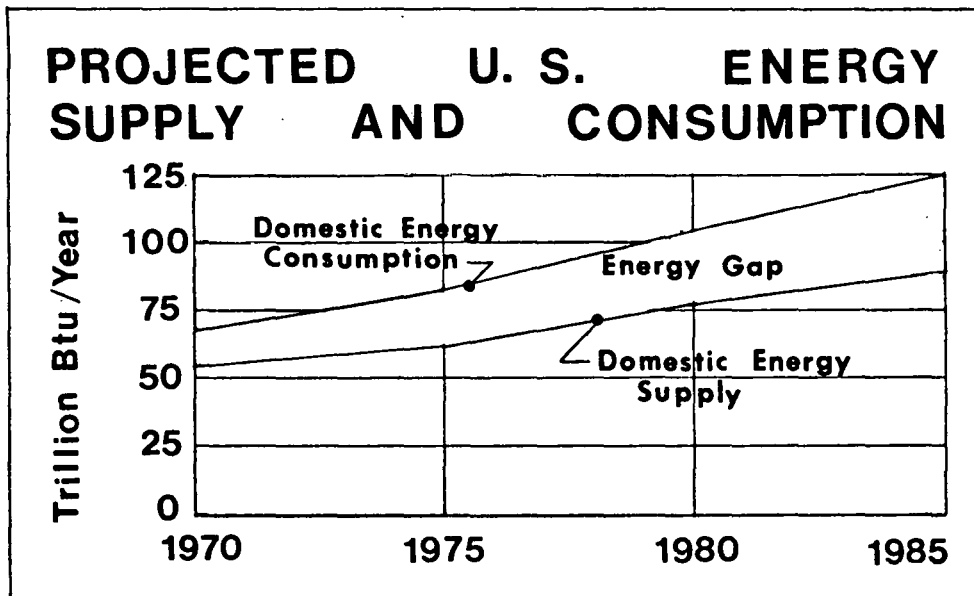


FIGURE 9²⁸

Third, fossil fuels are severely limited; and development of non-fossil sources will require substantial capital and time.

Because energy consumption in the United States has been increasing at a rate of 4 to 5 percent a year and our supply is not large enough to meet the demand, we now buy 38% of the oil we use abroad.²⁹ That oil cost the U.S. 26 billion dollars in 1974. Those same billions of dollars could have:

paid the salaries for 4 1/2 million jobs; or,
could have covered the cost of building 500,000 new homes.³⁰

The price of that oil is arbitrary and unfair, but it must be paid to meet the nation's energy demands until new sources can be developed.³¹ It even is possible that its cost will go up further if the Oil Producing Export Countries decide to raise the price again. They also can choose to discontinue selling oil to the United States.

Consequently, you and those who live and work in your states and communities have substantial reasons for your growing concern about the energy crisis. As a result of this crisis, you and many others in the public domain have been led to ask "What can and should we do about it?"

Positive action to achieve energy conservation is the answer.

PART II. ENERGY CONSERVATION

THE TOOL AND THE GOALS

Energy conservation is the chief tool the United States has at its disposal now to make itself less vulnerable to threats of oil embargoes and the cost of further price increases in the immediate and near future. To be able to continue enjoying the viable economy the United States knows and wants, development and use of a full array of conservation measures are musts.

Vigorous conservation efforts also will accomplish several related goals:

- The amount of oil America needs to buy abroad at high prices will be reduced; and,
- The money thus saved can be invested instead to generate more new jobs and new housing at home.³²

Through such efforts, the growth rate in America's demand for energy can be curbed, as these effect significant reductions in the amount of energy now used and wasted. Energy conservation in buildings will be of tremendous importance in this respect because, as Figure 10 indicates, residential and commercial buildings use about one third of the entire U.S. energy supply.³³

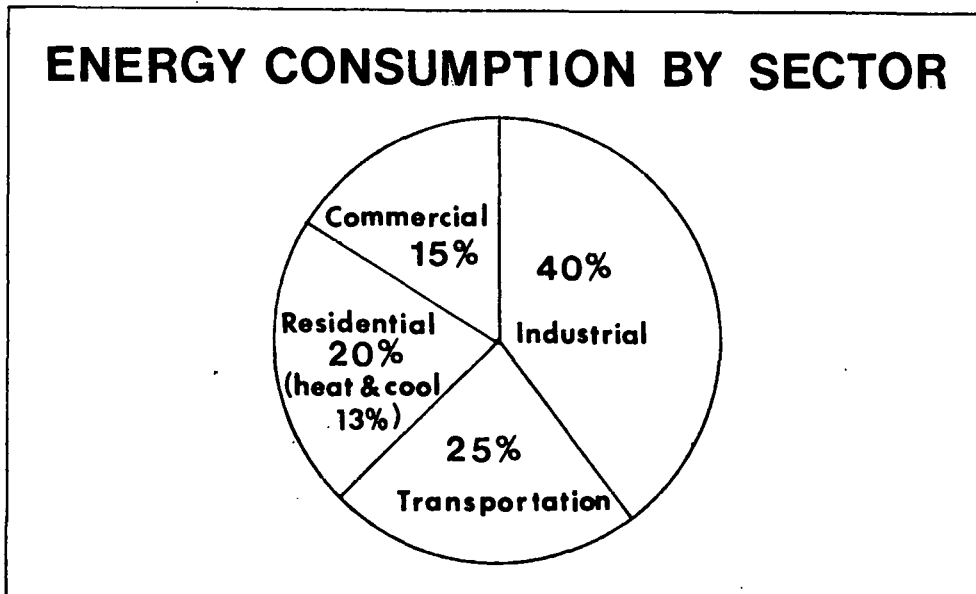


FIGURE 10³⁴

The next three figures indicate the reason why energy conservation in the commercial and residential sector is so important.

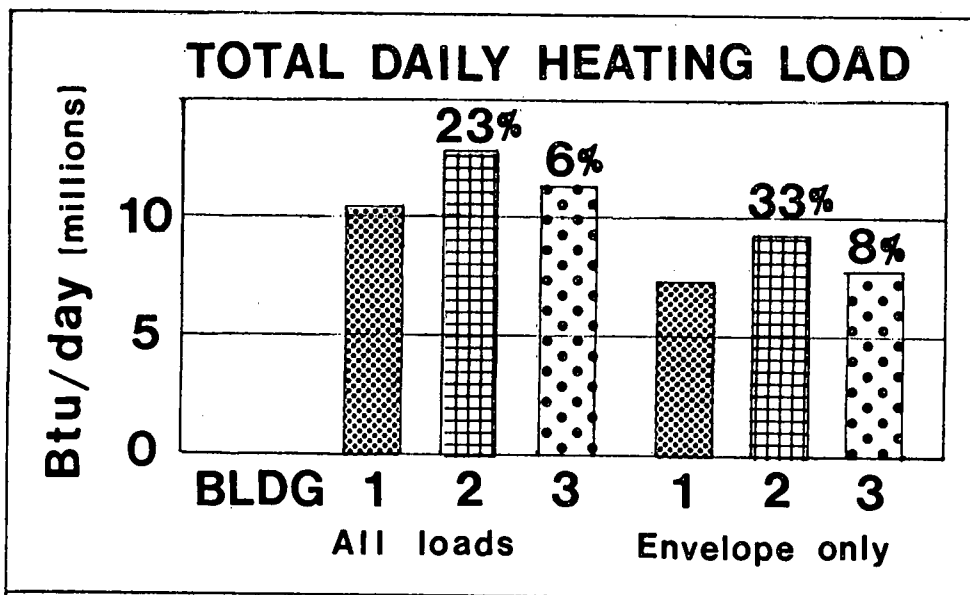


FIGURE 11³⁵

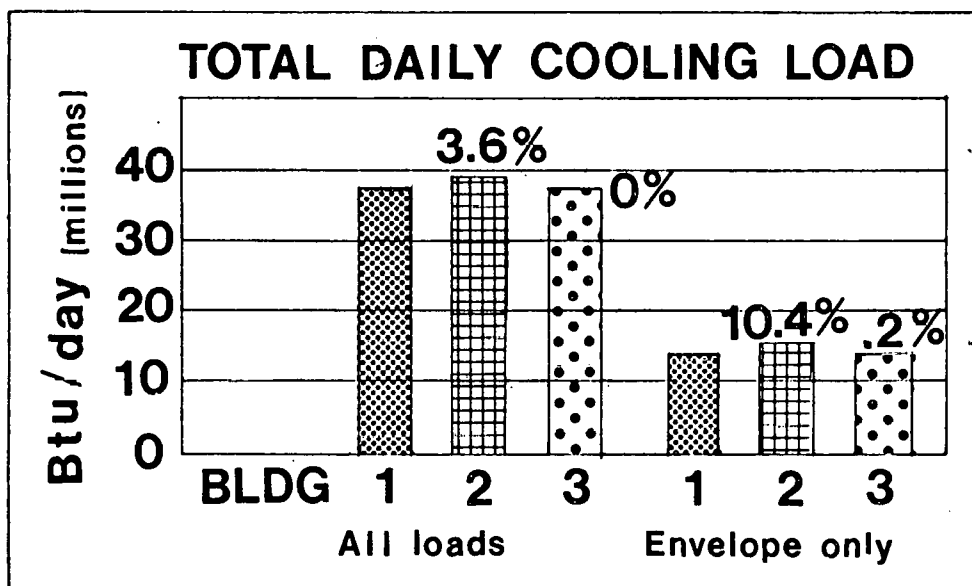


FIGURE 12³⁵

Through application of an energy conservation code's requirements about 85% of the energy consuming elements shown in Figure 13 can be regulated to achieve greater energy efficiency as well as a reduction in the amount lost or wasted. It thus will produce significant benefits to owners and tenants.

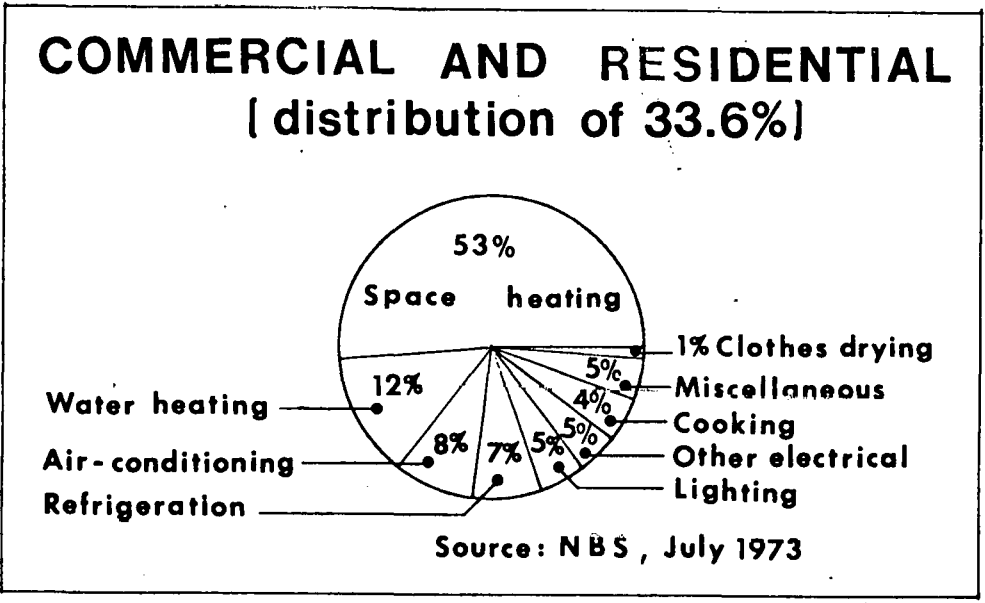


FIGURE 13³⁵

Calculations made for five types of prototypical "conventional" buildings and "ASHRAE 90 modified" buildings in 1973 in four sections of the United States, namely, Northeast, North Central, South and West, showed that the cost of the additional design services required to achieve energy cost savings was paid back through these savings in less than one year, except in the case of the single family residence. These were the average savings and additional design costs:

Dollars Per Square Foot

	<u>Annual</u> <u>Energy Savings</u>	<u>Additional</u> <u>Design Services</u>	<u>Straight</u> <u>Payback</u>
Single-Family Detached Residence	0.07	0.24	2.9 years
Low-Rise Apartment	0.31	0.09	3.4 months
Office Building	0.40	0.16	2.5 months
Retail Store	0.68	0.09	7.6 months
School	0.70	0.15	4.6 months

STRATEGY FOR ACHIEVING CONSERVATION IN BUILDINGS

Because of the great importance of energy conservation in buildings, the National Conference of States on Building Codes and Standards, Inc., the three model code groups - Building Officials & Code Administrators International, Inc., International Conference of Building Officials, and Southern Building Code Congress International, Inc. - and National Academy of Code Administration joined forces, with funding support from the U.S. Department of Energy to develop a Model Energy Conservation Code and Energy Conservation Technology educational program consisting of this publication for you and a series of training courses for your code officials who will administer the energy code requirements. Builders and contractors who comply with these new code standards will produce new residential and commercial buildings, as well as alterations and additions, that conserve energy. In order to have the knowledge required to achieve code compliance from both groups, your code officials will need to take the technical training available to them through the Energy Conservation Technology courses.

Public administrators with policy making powers concerning energy conservation, such as yourselves, frequently are not too familiar with the operations of their local or state code administration agency or agencies. It is important to have this background in order to understand why it will be essential for your code officials at various levels to take this technical training. Therefore, it will be useful to take a few minutes now to indicate who they are and to examine some of the things they will need to know and do to make sure the building done in your municipalities and states meets the code's energy conservation requirements.

PART III. THE CODE ADMINISTRATOR, THE CODE ADMINISTRATION AGENCIES, THEIR STAFFS AND FUNCTIONS

THE BUILDING OFFICIAL AS CODE ADMINISTRATOR

BASIS AND NATURE OF LEGAL OBLIGATION

The tenth amendment to the United States Constitution empowers state governments and, subject to state law, their municipalities both to pass laws and ordinances - including building codes, to protect the public's health, welfare and safety, and to use the police power also vested in them to enforce such laws. Therefore, as the administrator of state or local building legislation, the building official is legally obligated to enforce every section of all such laws, codes and ordinances that regulate building construction, occupancy and use in order to protect the health, welfare and safety of the general public. This obligation is mandatory.

CODE ADMINISTRATION ROLE

The fundamental tasks of the building official as code administrator are to administer, to interpret and to enforce the building code and all related codes placed under his or her jurisdiction. These entail not only the traditional administrative duties, but also require an understanding of the role of the legislative and judicial processes in keeping the codes current and relevant as well as securing code compliance when it proves necessary to resort to court action.

THE BUILDING OFFICIAL'S PRINCIPAL STAFF MEMBERS AND THEIR ROLES

The basic code administration staff consists of the building official, the plan examiner and the inspector, even though the building official alone may be able to and may well perform all three functions in a small, predominantly residential community. The plan examiner checks the plans submitted to the agency to determine whether these meet the building code's requirements or, if not, to indicate why these are unacceptable. The inspector is responsible for the field checks of buildings that are under construction or are undergoing additions, alterations, repairs or demolition to make sure the work done and the materials used comply with the plans approved by the plan examiner. This work necessitates visits to the building site at various times during the construction process. The exact number of field checks depends upon the complexity of the construction job, prevailing local practice and the adequacy of the size of the inspection force.

Municipal and state inspection agencies in jurisdictions that have adopted the BOCA, ICBO, or SBCC model codes can turn to these model code

groups for plan reviews and other technical assistance when they either do not have enough personnel to perform such functions or do not have a staff member with the professional qualifications required to check plans for complex buildings.

TYPICAL ORGANIZATION, STAFFING AND FUNCTIONS OF LARGE, MEDIUM AND SMALL SIZE AGENCIES

THE LARGE DIVISION OR DEPARTMENT

The large code administration agency's staff normally will include field inspectors, plan examiners, supervisors and the code administrator who heads the agency. The building inspectors usually will be responsible for different specialties, such as one- and two-family versus high rise multiple dwellings. Probably the division or department will administer several related codes, including the building, housing, mechanical and zoning codes, and possibly the electrical and plumbing codes, as well. When it is responsible for more than one code, the large division or department usually will assign different inspectors to work on different codes if the staff size makes this possible. Its plan examiners customarily will be registered architects or engineers with substantial experience. They will have the formal background required to review plans for buildings of diverse complexity covered by existing codes.

THE MEDIUM SIZE CODE ADMINISTRATION AGENCY

Like the large agencies, those of medium size also usually include inspectors, plan examiners and a code administrator on their staff. These may or may not have supervisory personnel, other than the administrator. The agencies are not as likely to be responsible for more than two or three codes. Instead, there often will be separate building, electrical, housing and plumbing bureaus. In the medium size code administration agency, a code administrator who has had substantial construction experience also may perform the plan examination function; or else the agency may have a staff architect or engineer of limited experience to do it. All of them would need to seek outside technical assistance, however, when plans are submitted for complex buildings.

THE ONE OR TWO PERSON CODE AGENCY

When a code agency has only one or two staff members, both are likely to perform the inspection and plan examination functions, and the senior person in experience will function also as the code administrator. Most of the construction in communities with such a

small staff will consist of one- and two-family houses, plus a few multiple dwellings and some small commercial structures. In such towns, the staff most likely will have to have any complex building plan they receive checked by an outside technical code expert.

Given the variety of code administration agencies and staffs, generally, what kind of additional technical knowledge will the inspectors, plan examiners and code administrators require to perform their respective new energy conservation code functions? Why will they need special training in energy conservation to enable them to administer and enforce the new energy code?

The answer lies in the fact that energy conservation is an entirely new subject area for code officials, with current staff members not able to perform these duties until they receive proper training in that subject. By providing for their attendance at such necessary training, the municipal and state code administration agencies will minimize their need for additional staff.

REASONS AN ENERGY CONSERVATION TECHNOLOGY TRAINING PROGRAM IS NEEDED BY CODE ADMINISTRATION STAFFS

The members of these staffs require this training because few, if any, have had any prior education or experience involving:

- energy fundamentals,
- heat transfer factors,
- new insulation materials and practices or,
- the diverse design methods that must be known and understood

in order to check building plans and inspect buildings under construction for compliance with the new code's energy conservation requirements.

The three series of Energy Conservation Technology courses have been designed to provide the specific technical knowledge and training code administrators, plan examiners and inspectors will require to administer and to enforce the Model Energy Conservation Code.

These staffs will need to have working knowledge of the daily heating and cooling loads, plus all the other building elements and equipment used in these commercial and residential buildings that currently contribute to the use of over 33% of America's energy supply.

The origin, purpose and major features of the Model Energy Conservation Code will be reviewed next.

PART IV. THE MODEL ENERGY CONSERVATION CODE

INTRODUCTION

In response to the 1974 energy embargo, the American Society of Heating, Refrigerating and Air Conditioning Engineers, Inc., appointed a committee to develop the energy conservation standard now identified as ASHRAE 90-75. Approximately 5,000 written comments were sent to the committee after it released the first draft of the standard. The committee chairman, Mr. Jack Tumilty, estimated that the 100 individuals who worked on the last draft contributed one million hours of voluntary effort to the final document. In the process, they had to deal with various problems such as, a) the disagreement among HVAC designers about which are the best energy conservation techniques for new construction and, b) the lack of conclusive data that the application of a single generalized energy conservation standard would produce similar effects either on all building types or in different locations.

The final results of those efforts is ASHRAE 90-75, which is a voluntary consensus document. It is still subject to challenge from some quarters. Nevertheless, to date it is the most comprehensive energy conservation standard available. This is why its technical provisions have been used as the basis of the Model Code for Energy Conservation in New Building Construction referred to elsewhere in this manual as the "Model Energy Conservation Code".

In support of the ongoing effort of the Department of Energy (DOE) to "develop energy conservation standards for building construction, the National Conference of States on Building Codes and Standards, Inc. (NCSECS) has undertaken the development of a model energy conservation code for state and local building officials. This work has been done with funding from ERDA in cooperation with the three model code groups: Building Officials and Code Administrators International, Inc. (BOCA), International Conference of Building Officials (ICBO) and Southern Building Code Congress International, Inc. (SBCC), and the National Academy of Code Administration (NACA)."³⁶ Besides modifying the American Society of Heating, Refrigerating and Air Conditioning Engineers, Inc., energy conservation design standard ASHRAE 90-75 into an adoptable code format, provisions have been made both for "a formalized field feedback system and (for) bringing energy products into the ongoing product acceptance systems currently available..."³⁷

PURPOSE

The Model Energy Conservation Code has been developed to serve two major purposes. First, to provide energy conservation standards for building construction based upon the technical portions of ASHRAE 90-75, but

written in code enforceable language and including administrative provisions to facilitate its adoption and implementation by state and local governments. Second, it has been prepared so as to take into account the various code documents reflecting energy standards already developed by the model code groups, the Building Code Modernization Council and several states, even though none cover all the specific areas regulated by ASHRAE 90-75.³⁸ Thus, technical compatibility among the various codes has been insured.

FEATURES OF THE CODE

What, then, are the major features of the Model Energy Conservation Code?

First, it is based upon the technical portions of ASHRAE 90-75.

Second, it contains administrative provisions that permit this code to be adopted either as is or, with revisions, as a part of a statewide or model code.

Third, the ASHRAE standard has been reorganized so that its systems analysis (energy budget-limit analysis) standards appear first in the code, its performance "design criteria" second, and acceptable practices standards have been added as the third element of the technical provisions.

Fourth, the Code also provides for non-depleting energy sources and has an appendix containing the relevant sections of standards referenced in ASHRAE.

The systems analysis provisions permit innovative design concepts and/or the use of non-depletable energy sources such as solar energy. Design analysis provides for conventional design of the building envelope and mechanical systems for energy efficient usage. The acceptable practices provisions pertain to residential buildings of three stories or less that are of conventional frame or masonry wall construction and small (less than 5,000 square feet) commercial buildings.

In essence, then, the Model Energy Conservation Code is a self-contained document that can be used by itself without excessive reference to other standards. Copies of the Code can be obtained from NCSBCS or any of the three model code groups. Their full names and addresses are listed in Fact Sheet 4 together with that of the National Academy of Code Administration (NACA).

Energy conservation is relatively new as a national priority item both for America and for state and local code officials. The Model Energy

Conservation Code will play a significant part in furthering the nation's efforts to achieve energy independence if those responsible for administering the new Code's standards have the technical knowledge required to do so. They must have appropriate education and training in this field to obtain the needed knowledge because it is too complicated to be acquired without formal instruction. For this reason the complete energy conservation program includes a series of courses in Energy Conservation Technology. The characteristics of the Energy Conservation Technology curriculum will be outlined.

PART V. ENERGY CONSERVATION TECHNOLOGY CURRICULUM

The Energy Conservation Technology Curriculum consists of three series of courses designed, respectively, for: a) inspectors, b) plan examiners and code administrators who review plans based on the Model Energy Conservation Code's Design Criteria or Accepted Practices provisions and, c) the professional, architect/engineer plan examiners who review such plans and those involving the complex systems analyses also. The four courses in each series include:

First - An introduction to energy conservation

Second - Energy fundamentals

Third - The Model Energy Conservation Code and

Fourth - Application of the code

The nature, depth and extent of the material to be covered in each Energy Conservation Technology (ECT) series have been planned to meet the specific needs of the various categories of code officials who will attend. The inspectors' series of four courses will take about 18 hours, the series for those examining plans for all but the very complicated buildings will require about 24 hours of class time and that for the graduate, professional architect/engineer plan examiners who will have to learn systems analyses will involve approximately 34 class hours.

Fact Sheet 5 in the Fact Sheet Index of suggested materials contains a list of the courses in each series and the time allowed for each.

The full series of courses was offered in four states early in 1977 as a pilot prototype effort. The courses can be offered in your area in accord with the Energy Conservation Technology Curriculum course schedules, cost and enrollment information that currently is being prepared. Plans for offering the revised version of these courses nationwide are being completed.

ENERGY CONSERVATION TRAINING COST BENEFIT: Besides the technical necessity of enrolling their code administration staffs in the Energy Conservation Technology courses, the state and local governments that do so also will help to minimize any need to hire additional personnel. If such training is not given to the existing staff for whom it has been designed, these governments will not be able to implement their new Model Energy Conservation Codes without employing new code administration personnel.

ENROLLING FOR SUCH TRAINING: Achievement of energy conservation in

building construction is a matter of vital national significance. Each of you has policy-making responsibilities for the conservation efforts in your individual states and communities. The Model Energy Conservation Code and the Energy Conservation Technology Curriculum offer you invaluable practical tools for assuring that the critically important conservation goals for buildings will be met by those engaged in construction in the municipalities and states throughout America.

FOOTNOTES

- 1Federal Energy Administration, Speaking of Energy (Washington, D.C.: U.S. Government Printing Office, July, 1975), p.27
- 2Ibid., p.1
- 3Loc. cit.
- 4Loc. cit.
- 5Federal Energy Administration, 1976 National Energy Outlook: Executive Summary (Washington, D.C.: U.S. Government Printing Office, 1976), p.2
- 6FEA, Speaking of Energy, p.3
- 7FEA, 1976 National Energy Outlook, p.3
- 8Loc. cit.
- 9Ibid., p.4
- 10Loc. cit.
- 11Loc. cit.
- 12FEA, Speaking of Energy, p.3
- 13Loc. cit.
- 14U.S. Department of the Interior, Energy Perspectives 2 (Washington, D.C.: U.S. Government Printing Office, June, 1976, p.63
- 15FEA, Speaking of Energy, p.3
- 16Loc. cit.
- 17Ibid., p.4
- 18Ibid., p.5
- 19FEA, Speaking of Energy, p.5
- 20Ibid., p.13
- 21Loc. cit.
- 22Op. cit. p.65
- 23Understanding the National Energy Dilemma: A report of the Joint Committee on Atomic Energy (Washington, D.C.: Georgetown University Center for Strategic and International Studies, May, 1973), unpaginated Charts A and D. The 1980 projections are based upon work of the National Petroleum Council and the U.S. Department of the Interior as interpreted by the Lawrence Livermore Laboratory.
- 24Loc. cit.
- 25"Energy Slide Collection," Portland Cement Association's Arlington, Virginia Office, 1976.
- 26Loc. cit.
- 27Loc. cit.
- 28Loc. cit.
- 29FEA, Speaking of Energy, p.66
- 30Loc. cit.
- 31FEA, Speaking of Energy, p.66
- 32Loc. cit.
- 33Ibid. p.70
- 34Energy Slide Collection, op. cit.

FOOTNOTES (Cont.)

35Source of Slides 11-14, loc. cit.

36Melvyn Green and Associates, Inc. "Model Energy Conservation Code: Program Phase I Report", El Segundo, California, August, 1976, Introduction", lf. 1.

37Loc. cit.

38Ibid., Task V, lf. 1.

APPENDIX A.1

INSTRUCTOR'S LIST OF SLIDES

- | NO. | TITLE |
|--------|---|
| 1. | WHAT ARE THE ROOTS OF OUR ENERGY PROBLEM?
(Recoverable reserves versus energy consumption pattern) |
| 2. | HOW DID WE BECOME SO VULNERABLE TO OIL IMPORTS?
(Marked rise in imports versus uneven growth in domestic supplies) |
| 3. | HOW MUCH ENERGY WILL THE NATION CONSUME?
(Industrial, transportation, household/commercial use 1950-1990, including pre-embargo and current forecasts) |
| 4. | HOW WILL THE NATION MEET ITS GROWING ENERGY DEMANDS BY 1985?
(Shows hydro, nuclear, coal, oil and gas, 1974 and 1985) |
| 5. | HOW MUCH CAN NEW TECHNOLOGIES CONTRIBUTE?
(Shows solar, geothermal and synthetics 1975-1990) |
| 6. | WORLD ENERGY USE IN TONS OF COAL EQUIVALENT |
| 7. | U.S. OIL SUPPLY AND DEMAND, 1985 |
| 8. | U.S. GAS SUPPLY AND DEMAND, 1985 |
| 9. | PROJECTED U.S. ENERGY SUPPLY AND CONSUMPTION
(Makes energy gap clear) |
| 10. | ENERGY CONSUMPTION BY SECTOR
(Commercial 15%, Residential 20%, including 13% for heating and cooling) |
| 11-12. | THE TOTAL DAILY HEATING LOAD AND COOLING LOAD
(All loads and envelope only) |
| 13. | COMMERCIAL AND RESIDENTIAL (DISTRIBUTION OF THE 33.6% ENERGY THEY CONSUME) - PIE CHART
(Space heating 53%, water heating 12%, air conditioning 8%, refrigeration 7%, lighting 5%, other electrical 5%, cooling 4%, miscellaneous 6%) |

APPENDIX A 2

MANAGEMENT AND ENERGY CONSERVATION SEMINAR

MEMORANDUM

To: All Enrollees

In re: Energy Conservation Code and Training Programs: New State and Local Government Tools for Effective Action Concerning the Energy Crisis.

This seminar concerns the nationwide energy crisis whose reality is documented by some of the fact sheets in this packet. There is a marked gap between America's energy demand and domestic supply that must be reduced in order to ease the crisis until new sources can be developed. Energy conservation in new commercial and residential buildings is one of the few highly viable means now available through which the nation's energy independence can be fostered.

Accomplishment of that objective will require strong and positive supportive action by state and local governments throughout the United States. The essential steps they need to take in this connection include:

1. Adoption of energy conservation legislation, such as the Model Code for Energy Conservation in New Building Construction.
2. Enrollment of their building officials and other code administration personnel in the Energy Conservation Technology (ECT) Training Program.

The latter has been designed to provide the different members of the code administration team with the specific technical knowledge they require to enable them to administer and to enforce the new energy conservation legislation.

The members of existing code administration staffs cannot be expected to perform this new function without such training since few, if any, have had any prior education or experience with heat transfer principles, the special formulas or different insulation practices that are among the new factors involved in energy conservation in new construction. By sending their current staffs to the ECT courses, state and local governments will make it unnecessary to hire many, if any, new staff members.

The national government is in the process of developing energy conservation performance standards for promulgation in 1979. Nevertheless state and local governments should proceed with their plans to adopt energy conservation codes now for these reasons:

First, standards cover recommended practices and materials that will accomplish specified objectives in construction but they are voluntary, not mandatory. In contrast, a code sets forth legal requirements that contractors and builders must follow in the state or municipality that has adopted the code.

Second, it is customary for the national government to follow the prevailing state of the art when it promulgates new standards. Therefore, the state and local governments that adopt energy conservation codes now also will be helping to shape the contents of the 1979 federal standards.

Third, the U.S. Energy Conservation and Production Act (Public Law 94-385, dated August 14, 1976) provides that states and municipalities that have not adopted appropriate energy conservation legislation by the time the new performance standards are promulgated will be subject to a severe penalty: No federal financial assistance will be made available or approved for the construction of any new commercial or residential building within their boundaries.

Fourth, the state and municipal governments which adopt energy conservation codes now and provide for their enforcement will be contributing immediately to reductions in the amounts of energy required to heat and cool the new commercial and residential structures being built in their areas and thus will help to generate savings on energy expenditures by their residents and office owners and tenants.

To summarize, the adoption of state and local codes that require energy conservation in new buildings and the provision of adequate training to those who will administer and enforce these code requirements constitute vitally important means of helping America reduce its dependence on energy imports as much as possible until it can achieve energy independence again. Cooperation from all 50 state governments and their municipalities will be necessary to obtain that objective.

APPENDIX A 3

FACT SHEETS FOR STUDENTS

ENERGY CONSERVATION TECHNOLOGY

MANAGEMENT AND ENERGY CONSERVATION (ECT-000)

FACT SHEETS INDEX

<u>No.</u>	<u>Topic</u>
1.	U.S. Energy Consumption in 1974
2.	Sources of U.S. Energy Supply, 1920, 1950 and 1974
3.	United States Energy Flow Chart: Comparison of 1950 Pattern with 1980 Forecast
4.	Energy Conservation Program Developers' Names, Addresses and Telephone Numbers
5.	Energy Conservation Technology Course Titles and Hours
6.	Other Seminar Lecture Data
	a. U.S. Oil Supply and Demand, 1985
	b. U.S. Gas Supply and Demand, 1985
	c. Projected U.S. Energy Supply and Consumption

MANAGEMENT AND ENERGY CONSERVATION (ECT-000)

FACT SHEET 1

U.S. ENERGY CONSUMPTION IN, 1975*

<u>Total Consumption:</u>	71,002 trillion Btu's ¹	100%
Petroleum	5.95 million barrels/day	46.1%
Coal	554 million tons	18.4%
Natural Gas	19,985 billion feet ³	28.7%
Nuclear Power	155 billion kilowatt hours	2.3%
Hydropower and Geothermal	304 billion kilowatt hours	4.5%

¹This equals 200 trillion tons per day or 34 million barrels oil equivalent.

*Source: U.S. Department of the Interior, Energy Perspectives 2 (Washington, D.C. U.S. Government Printing Office, June, 1976) p. 63.

MANAGEMENT AND ENERGY CONSERVATION (ECT-000)

FACT SHEET 2

SOURCES OF U.S. ENERGY SUPPLY, 1920, 1950 AND 1974*

Sources	Percent of Total Supply		
	1920	1950	1974
Coal	78	38	18
Oil	14	39	46
Natural Gas	4	18	30
Hydroelectric	4	5	4
Nuclear	-	-	2

*Source: Federal Energy Administration Speaking of Energy (Washington, D.C.: U.S. Government Printing Office, July, 1975). p.4.

MANAGEMENT AND THE CONSERVATION OF ENERGY (ECT-000)

FACT SHEET 3

UNITED STATES ENERGY FLOW CHART:

COMPARISON OF 1950 PATTERN WITH 1980 FORECAST*

Flow Pattern Elements	Million Bbls/Day Oil Equivalent	
	1950	1980
Sources of Energy Supply		
Imports	.9	22.0
Domestic	<u>15.2</u>	<u>26.3</u>
Total Supply	16.1(100%)	48.3(100%)
Energy Conversion Losses During		
Electrical energy generation	1.4	8.1
Residential/commercial uses	.9	2.6
Industrial uses	1.4	3.4
Transportation and other uses	<u>3.8</u>	<u>10.4</u>
Total Losses	7.5(47%)	24.5(51%)
Energy Used By		
Residential/commercial sector	2.7	7.3
Industrial sector	4.2	9.6
Transportation and other sectors	<u>1.7</u>	<u>6.9</u>
TOTAL	8.6(53%)	23.8(49%)

*Source: Summarization of data in Chart A and Chart D of "Energy Flow Pattern in the United States 1950 and 1980" contained in Understanding the National Energy Dilemma: A Report of the Joint Committee on Atomic Energy (Washington, D.C.: Georgetown University Center for Strategic and International Studies, 1973), not paginated.

MANAGEMENT AND ENERGY CONSERVATION (ECT-000)

FACT SHEET 4

ENERGY CODE PROGRAM DEVELOPERS' NAMES AND ADDRESSES

National Conference of States on Building Codes and Standards, Inc. (NCSBCS)
1970 Chain Bridge Road
McLean, Virginia 22101 (703) 790-5750

The Model Code Groups:

Building Officials and Code Administrators International, Inc. (BOCA)
1313 East 60th Street
Chicago, Illinois (312) 947-2580

International Conference of Building Officials (ICBO)
5360 S. Workman Mill Road
Whittier, California 90601 (213) 699-0541

Southern Building Code Congress International, Inc. (SBCCI)
3617 - 8th Avenue, So.
Birmingham, Alabama 35222 (205) 252-8930

The National Academy of Code Administration (NACA)
1970 Chain Bridge Road
McLean, Virginia 22101 (703) 821-8171

MANAGEMENT AND ENERGY CONSERVATION (ECT-000)

FACT SHEET 5

ENERGY CONSERVATION TECHNOLOGY PROGRAM

Course Titles and Hours*

<u>Series Number</u>	<u>Title</u>	<u>Hours</u>
ECT 000	Management and Energy Conservation (Energy Administrators' Seminar)	1
ECT 100	Energy Conservation Technology for the Building Inspector	1
101	Introduction to Energy Conservation Energy Fundamentals	5
102	Model Energy Conservation Code	4
103	Model Energy Conservation Code Application	8
	(Inspectors' Course)	<u>18</u>
ECT 200	Energy Conservation Technology for Plan Examiners and Code Administrators	1
201	Introduction to Energy Conservation Energy Fundamentals	6
202	Model Energy Conservation Code	6
203	Model Energy Conservation Code Application	12
	(Course for Plan Examiners/Code Admin- istrators from small and medium size communities)	<u>25</u>
ECT 300	Energy Conservation Technology - Advanced Course for Plan Examiners	1
301	Introduction to Energy Conservation Energy Fundamentals	6
302	Model Energy Conservation Code	8
303	Model Energy Conservation Code Application	16
	(Course for Graduate Professional Architect/ Engineer Plan Examiners)	<u>31</u>

*The course titles in the ECT 100, 200 and 300 series are the same. However, the contents of each series has been designed specifically for the indicated attendees and the coverage of certain elements is more extensive in the higher numbered series.

MANAGEMENT AND ENERGY CONSERVATION (ECT-000)

FACT SHEET 6

OTHER DATA FROM SEMINAR LECTURE: Charts a, b and c

Chart a*

PROJECTED SOURCES OF POTENTIAL U.S. DEMAND FOR OIL, 1985

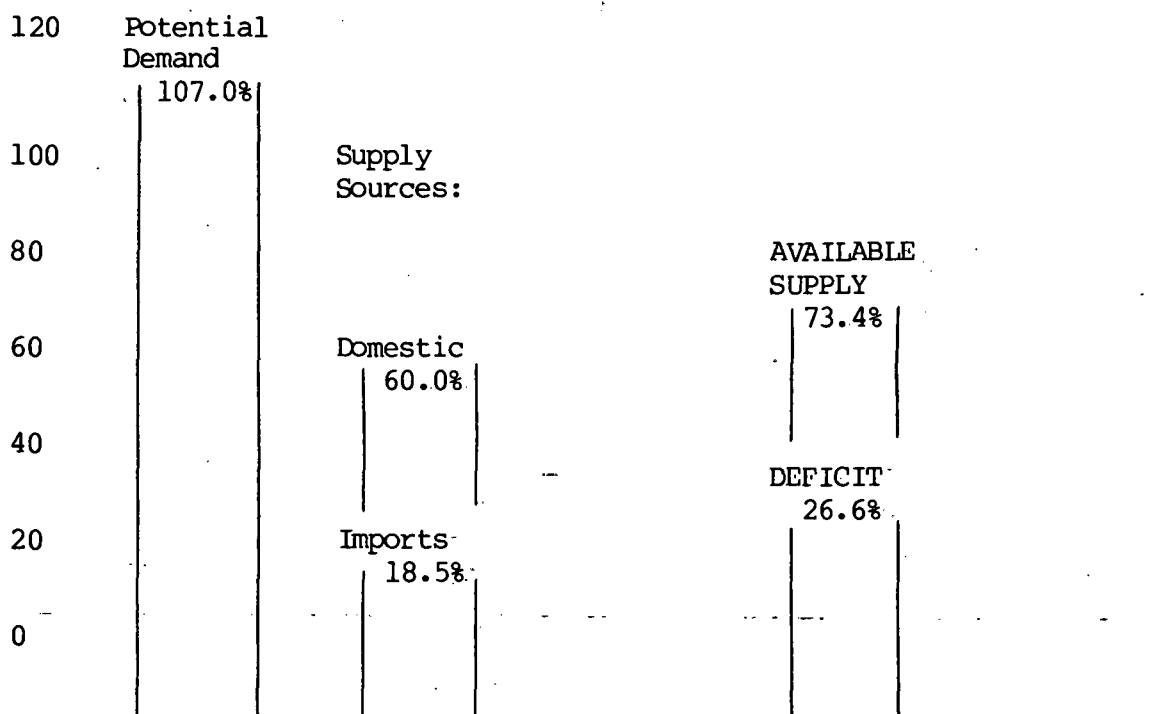
	IMPORTS 51%	
	DOMESTIC 49%	

*Source: Chase Manhattan Bank

FACT SHEET 6 (Cont.)

Chart b*

U.S. GAS SUPPLY AND DEMAND, 1985 - Billions of cubic feet daily



*Source: Chase Manhattan Bank

Chart c

