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A HISTORY OF THE BUILDING ENERGY
STANDARDS PROGRAM

D. L. Shankle
J. A. Merrick
T. L. Gilbride

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Pacific Northwest Laboratory
Richland, Washington 99352

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FOREWORD

This report is one in a series of documents describing research activities in support of the U.S. Department of Energy (DOE) Building Energy Standards Program (the Program). The Pacific Northwest Laboratory (PNL) leads the Program for DOE.

The overall problem being addressed by the Program (and other programs at DOE) is that new commercial and residential buildings now being designed, built, and occupied do not use currently available, technically feasible, and economically justified technologies and practices to eliminate the wasteful use of energy. The Program seeks to advance the energy-conserving design and construction of buildings by promoting and assisting the development and implementation of energy efficient codes and standards that are technically feasible, economically justified, and environmentally beneficial. These activities are required of DOE by Title III of the Energy Conservation and Production Act (Public Law [PL] 94-385) as amended by the Energy Policy Act of 1992 (PL 102-486). The long-term goal of the Program is to make sustainable, energy-efficient building design and construction common practice.

The Program's approach to meeting this goal is to initiate and manage individual research and standards and guidelines development efforts that are planned and conducted in cooperation with representatives from throughout the buildings community. Projects under way involve practicing architects and engineers, professional societies and code organizations, industry representatives, and researchers from the private sector and national laboratories. Research results and the technical justification for standards criteria are provided to standards development and model code organizations and to federal, state, and local jurisdictions as a basis to update their codes and standards. This approach helps to ensure that the standards incorporate the latest research results to achieve maximum energy savings in new buildings, yet remain responsive to the needs of the affected professions, organizations, and jurisdictions. It also assists in the implementation, deployment, and use of the codes and standards.

This report documents the history of the Program at PNL. Other publications of the Program are listed in Appendix A of this report.

Readers with questions, comments, or suggestions about this document or the work it describes are encouraged to contact the author(s), Program Managers, or Project Managers.

Jeffrey A. Johnson
Building Energy Standards Program
Pacific Northwest Laboratory

Jean J. Boulin
Office of Codes and Standards
U.S. Department of Energy

ABSTRACT

This report describes the history of the Pacific Northwest Laboratory's (PNL's) work in development of energy standards for commercial and residential construction in the United States. PNL's standards development efforts are concentrated in the Building Energy Standards Program (the Program), which PNL conducts for the U.S. Department of Energy (DOE) Office of Codes and Standards. The Program has worked with DOE, the American Society of Heating, Refrigerating and Air-Conditioning Engineers, Inc. (ASHRAE), and other building codes and standards organizations to develop, evaluate, and promulgate energy standards in all sectors of the building industry.

This report describes the recent history of U.S. code development and PNL's contributions through the 1980s and early 1990s, up to the passage of the Energy Policy Act of 1992. Impacts to standards development resulting from the passage of this act will be described in other reports.

SUMMARY

Since the 1970s the Pacific Northwest Laboratory (PNL) has participated in numerous building code and energy standards development activities for the U.S. Department of Energy (DOE). These efforts are concentrated in the Building Energy Standards Program (the Program), which PNL conducts for the DOE Office of Codes and Standards. Program activities are described in this report and are summarized below.

The Program has supported DOE in the issuance process by conducting required economic analyses and environmental assessments of the standards, assisting with responses to comments elicited by Notices of Public Rulemaking, and assisting with development of the Notices of Interim Rulemaking. Demonstration phases required by congressional mandate have also been instituted to assess the impacts of the commercial and federal residential standards to the design and building community, as well as to consumers.

COMMERCIAL STANDARDS ACCOMPLISHMENTS

Program staff contributed to the following commercial standards development efforts:

- Participated in ASHRAE Special Project 41 to revise Standard 90A-1980
- Participated in ASHRAE SPC 90R activities to develop ASHRAE/IES Standard 90.1-1989. This revision took into account beneficial solar gains, interaction of building envelope components, and seasonal and part-load efficiencies. It also allowed builders options in demonstration compliance with the standards.
- Helped develop DOE's Interim Commercial Standard.
- Developed the ENVSTD and LTGSTD software programs to help non-federal designers calculate compliance with the complex envelope and lighting requirements of the commercial buildings standard.

VOLUNTARY RESIDENTIAL STANDARD ACCOMPLISHMENTS

Program staff contributed to the following Voluntary Residential Standard development efforts:

- Participated in ASHRAE Special Project 53 to revise the Voluntary Residential Standard.
- Conducted technical, economic, and environmental assessments of the Voluntary Residential Standard.
- Developed ARES software, which helps code developers generate standard requirements based on local parameters such as climate, economic variables, energy prices, and construction cost.
- Developed ACRES software, which builders can use to demonstrate compliance with one of the Voluntary Residential Standard paths.

FEDERAL RESIDENTIAL STANDARDS ACCOMPLISHMENTS

Program staff contributed to the following federal residential standards development efforts:

- Conducted a demonstration and evaluation of DOE's Interim Federal Residential Standard.
- Developed COSTSAFR software, which federal housing administrators can use to generate cost-effective compliance criteria for federal housing projects.
- Developed CAPS software, which building designers can use to evaluate different combinations of conservation measures for compliance with the federal standard.

MANUFACTURED HOME STANDARDS ACCOMPLISHMENTS

Program staff revised and evaluated HUD's Manufactured Home Construction and Safety Standards.

TECHNOLOGY TRANSFER ACTIVITIES

Program staff have conducted numerous technology transfer activities to implement DOE's objectives of furthering energy standards development and use nationwide. In addition to participating with standards and code organizations in code development and revisions as noted above, Program staff also:

- Interact with construction industry professional and trade groups through membership in organizations, giving presentations at national and international meetings, and publishing in construction and code trade journals.

- Operate a 24-hour, toll-free code hotline.
- Produce an informative quarterly standards newsletter.
- Monitor status of energy codes nationwide to track code adoption, enforcement, and compliance.
- Conduct assessments of state- and local-level training needs.
- Provide technical assistance to states for code adoption and implementation of other requirements of the Energy Policy Act of 1992.

The standards have yet to be fully implemented because the standards development process has had to meet strict congressional requirements for public comment and review and for demonstration and evaluation phases before final standards can be promulgated. The HUD standard and the DOE Voluntary Residential Standard are just concluding the public review and comment phases. Passage of the Energy Policy Act of 1992 changes the standards arena by requiring states to adopt statewide building energy codes.

ABBREVIATIONS

ACRES	Automated Compliance for Residential Energy Standards Software
ANSI	American National Standards Institute
ARES	Automated Residential Energy Standard Software
ASHRAE	American Society of Heating, Refrigerating and Air-Conditioning Engineers, Inc.
ASTM	American Society of Testing and Materials
BEC	Building Energy Code
BEPS	Building Energy Performance Standards (DOE)
BESP	Building Energy Standards Program (the Program)
BNEC	Basic National Energy Code
BOCA	Building Administrators and Code Officials International
CABO	Council of American Building Officials
CAPS	Computerized Automated Point System Software
CIBSI	Chartered Institutes of Building Services, International
COSTSAFR	Conservation Optimization Standard for Savings in Federal Residences Software
DOD	U.S Department of Defense
DOE	U.S. Department of Energy
ECM	energy conservation measure
ECPA	Energy Conservation and Production Act
ENVSTD	Envelope Standard Software developed by PNL
EPCA	Energy Policy and Conservation Act of 1975 (PL 94-163)
ERDA	Energy Research and Development Administration
FEDRES	Federal residential standards (informal)
FEMI	Federal Energy Management Improvement Act (PL 100-615)

FR	<i>Federal Register</i>
ft ²	square-foot
HERS	Home Energy Rating System
HUD	U.S. Department of Housing and Urban Development
HVAC	Heating, ventilation, and air conditioning
ICBO	International Conference of Building Officials
IES	Illuminating Engineering Society of North America
LBL	Lawrence Berkeley Laboratories
LTGSTD	Lighting Standard Software developed by PNL
MCEC	Model Code for Energy Conservation
MEC	Model Energy Code
MPS	Minimum Property Standards
NAECA	National Appliance Energy Conservation Act of 1987 (PL 100-12)
NBC	National Building Code
NBS	National Bureau of Standards (now called NIST)
NBSIR	National Bureau of Standards Interagency Report
NCSBCS	National Conference of States on Building Codes and Standards
NECC	National Energy Conservation Code
NECPA	National Energy Conservation Policy Act (PL 95-619)
NIST	National Institute of Standards and Technology (formerly NBS)
NMC	National Mechanical Code
NOPR	Notice of Proposed Rulemaking
NWPPC	Northwest Power Planning Council
PL	Public Law

PNL	Pacific Northwest Laboratory
Program (the)	Building Energy Standards Program
SBC	Standard Building Code
SBCCI	Southern Building Code Congress International
SPC 90R	Standards Project Committee 90 Revision
UBC	Uniform Building Code
USC	U.S. Code
VOLRES	voluntary residential standards (informal)

CONTENTS

FOREWORD	iii
ABSTRACT	v
SUMMARY	vii
ABBREVIATIONS	xi
1.0 INTRODUCTION	1.1
1.1 HISTORY OF FEDERAL STANDARDS DEVELOPMENT EFFORTS AND LEGISLATION	1.2
1.2 HISTORY OF ASHRAE AND CODE ORGANIZATION STANDARDS DEVELOPMENT	1.6
1.3 OUTLINE OF REPORT	1.12
2.0 COMMERCIAL STANDARDS	2.1
2.1 OVERVIEW AND HISTORY OF COMMERCIAL STANDARDS DEVELOPMENT . .	2.1
2.1.1 ASHRAE Special Project 41	2.1
2.1.2 ASHRAE Standards Project Committee 90 Revision . . .	2.3
2.1.3 Commercial Standards Demonstration Phase	2.5
2.1.4 Addendum to the Interim Commercial Standard	2.5
2.2 COMMERCIAL STANDARDS SOFTWARE	2.7
2.2.1 ENVSTD	2.7
2.2.2 LTGSTD	2.9
3.0 RESIDENTIAL STANDARD	3.1
3.1 OVERVIEW AND HISTORY OF RESIDENTIAL STANDARD DEVELOPMENT . .	3.1
3.2 VOLUNTARY RESIDENTIAL STANDARD SOFTWARE	3.3
3.2.1 ARES	3.3
3.2.2 ACRES	3.7

4.0	FEDERAL RESIDENTIAL STANDARDS	4.1
4.1	OVERVIEW AND HISTORY OF FEDERAL RESIDENTIAL STANDARDS DEVELOPMENT	4.1
4.2	FEDERAL RESIDENTIAL STANDARDS SOFTWARE	4.3
4.2.1	COSTSAFR	4.3
4.2.2	The Point System	4.6
4.2.3	CAPS	4.8
5.0	MANUFACTURED HOME CONSTRUCTION AND SAFETY STANDARDS	5.1
5.1	OVERVIEW AND HISTORY OF MANUFACTURED HOME STANDARDS DEVELOPMENT	5.1
5.2	DEVELOPMENT OF MANUFACTURED HOME STANDARDS	5.1
5.2.1	Life-Cycle Cost Minimization	5.2
5.2.2	Optimum Energy Conservation Measures	5.2
5.2.3	Aggregation of Climate Zones and U-Values	5.2
6.0	IMPLEMENTATION/TECHNOLOGY TRANSFER	6.1
6.1	PARTICIPATION IN NATIONAL STANDARDS AND MEC ACTIVITIES	6.1
6.2	INTERACTIONS WITH CONSTRUCTION INDUSTRY PROFESSIONALS AND TRADE GROUPS	6.1
6.3	TOLL-FREE HOTLINE	6.2
6.4	PROGRAM NEWSLETTER	6.2
6.5	MONITORING THE STATUS OF ENERGY CODE ADOPTION NATIONWIDE	6.2
6.6	NEEDS ASSESSMENTS, TRAINING PLANS, AND REPORTS ON STATE EXPERIENCES WITH ENERGY CODES	6.2
6.7	DIRECT SUPPORT TO STATES TO ENCOURAGE ENERGY CODE ADOPTION	6.3
6.8	ENERGY CONFERENCES AND MEETINGS	6.3
6.9	TECHNICAL SUPPORT FOR IMPLEMENTING REQUIREMENTS OF THE ENERGY POLICY ACT OF 1992	6.4
7.0	REFERENCES	7.1

APPENDIX A - BUILDING ENERGY STANDARDS PROGRAM PUBLICATIONS LIST . . .	A.1
APPENDIX B - STATUS OF STATE ENERGY CODE ADOPTION	B.1
APPENDIX C - ROLE OF STANDARDS IN BUILDING ENERGY EFFICIENCY	C.1

FIGURES

1.1	Federal Legislation Impacting Building Energy Standards Development	1.4
1.2	Evolution of DOE Standards Development Efforts	1.6
1.3	Evolution of Voluntary Codes and Standards	1.8
1.4	History of Residential Energy Standards and Codes Development . .	1.9
1.5	Revisions to Model Energy Code	1.11
2.1	ENVSTD24 Screen Layout	2.8
2.2	LTGSTD24 Screen Layout	2.9
3.1	ARES Menu System	3.4
3.2	ARES Menu for the Steps to Create Standard	3.5
4.1	COSTSAFR Flow Chart	4.5
4.2	Sample Sections of Point System Compliance Form	4.8

TABLES

2.1	Timeline of ASHRAE Commercial Standards Development	2.2
2.2	Evaluation of DOE Commercial Standards Demonstration	2.6

1.0 INTRODUCTION

This report describes work conducted by the Pacific Northwest Laboratory (PNL) to assist the U.S. Department of Energy (DOE) in developing and promulgating building energy standards to improve the energy efficiency of new commercial and residential buildings. To facilitate standards development efforts, PNL and DOE implemented the Building Energy Standards Program (the Program). The Program is operated for DOE's Office of Codes and Standards, which is within the DOE Office of Building Technologies. (Appendix A of this report lists Program publications to date.)

The DOE Office of Codes and Standards is accountable for developing energy efficiency standards for all major building categories, including

- commercial buildings
- residential buildings built for and occupied by federal agency personnel
- residential buildings built in the private sector.

Commercial building standards address multifamily, high-rise residential buildings as well as the more obvious commercial building types (e.g., schools, offices, restaurants, and retail stores). The federal residential standards, which are mandatory for federal agencies, address single-family and multifamily low-rise buildings (three stories or less, primarily military housing). The private-sector residential category is covered by the model residential standards, which are voluntary. The model standards apply to essentially the same building types as those in the federal residential category.

The Program assists DOE with standards development and implementation activities in all three of these building areas. DOE supports technical research that forms the basis for non-federal standards and develops and promulgates its own energy standards for federal buildings. In addition, DOE has proposed code changes to the Model Energy Code (MEC) (CABO 1983) developed and periodically updated by the Council of American Building Officials (CABO) and is becoming more active at the state level. DOE also supports improving

the application and use of energy standards through efforts such as demonstration programs and education and training.

In addition to assisting DOE with its standards development, the Program also supports the U.S. Department of Housing and Urban Development (HUD) with the revision of that agency's energy conservation standard for manufactured housing.

An important aspect of the Program's approach is interaction with building industry organizations, to obtain and exchange information that will facilitate standards development and adoption throughout the nation. Program staff interface daily with such organizations as the American Society of Heating, Refrigerating and Air-Conditioning Engineers, Inc. (ASHRAE), the American Institute of Architects, and the National Association of Home Builders, as well as state and local energy and code officials.

The legislative history preceding the creation of the Program and overviews of federal and industry standards development efforts are presented below.^(a)

1.1 HISTORY OF FEDERAL STANDARDS DEVELOPMENT EFFORTS AND LEGISLATION

Even before the energy crisis and oil embargo of 1973, steps were being taken at the federal level to promote energy conservation in new building construction. In 1971 and 1972, President Nixon, in his Energy Messages to Congress, provided energy policy directives that provided the initial guidance for the formation of energy standards (Taylor et al. 1992).

The first policy directed the Secretary of HUD to reduce maximum permissible energy loss by about one-third for a typical 1,200-square-foot (ft²) home and even more for larger homes. The second policy directed the Secretary to issue revised insulation standards for apartments and other multifamily structures not covered by the earlier policy. The thermal envelope criteria applicable to low-rise residential structures included in the HUD Minimum Property Standards (24 CFR 200.929) became the first of what were to become

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(a) Much of the following discussion is pulled from Taylor et al. (1992). For additional history, see Appendix C (D&R 1992).

many modern-era building energy codes and standards (Taylor et al. 1992). This activity is highlighted in Figure 1.1, along with other notable standards and codes developments over the past 20 years.

In 1974 Congress passed the National Manufactured Housing Construction and Safety Standards Act (PL 93-383). In response, HUD implemented its Manufactured Home Construction and Safety Standards (24 CFR 3280), which became the preemptive national standard in 1976 and represented the first set of standards for all manufactured housing.

The Energy Conservation and Production Act of 1976 (PL 94-385) included Title III, the Energy Conservation Standards for New Buildings Act of 1976, and Title IV, the Energy Conservation in Existing Buildings Act of 1976. The New Buildings Act established the initial requirements for the development and implementation of performance standards for all new residential and commercial buildings.^(a) The standards were to be "designed to achieve the maximum practicable improvements in energy efficiency and increases in the use of non-depletable sources of energy..." (42 USC 6831). The original act did not distinguish between standards for federal and private-sector buildings, and there were no requirements for demonstration projects.

The New Buildings Act required HUD to develop, promulgate, implement, and enforce energy performance standards. On August 4, 1977, the act was amended by the Department of Energy Organization Act (PL 95-91, Title III, Sec. 304[a]), which transferred from HUD to DOE the responsibility for developing and promulgating the standards.

On November 28, 1979, DOE published proposed building energy performance standards in the *Federal Register* (44 FR 68120 et seq.). The notice was controversial and generated over 1,800 comments. Many comments expressed

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(a) "Federal building energy standards" are described in The Energy Policy Act of 1992 (PL 102-486) as energy consumption objectives to be met without specification of the methods, materials, or equipment to be employed in achieving those objectives, but including statements of the requirements, criteria, and evaluation methods to be used, and any necessary commentary.

FIGURE 1.1. Federal Legislation Impacting Building Energy Standards Development (D&R 1992)

concern that the standards were neither technically nor economically achievable. Others argued that the proposed standards relied too heavily on the use of a complex computer program to evaluate building energy consumption. This program was viewed as neither easily understood nor affordably available to most builders. The standards were viewed by industry as lacking their input or collaboration in the development process. As a result of these comments, the standards were not enacted.

The New Buildings Act was amended by the Housing and Community Development Act of 1980 (PL 96-399, Section 326, 94 Stat. 1649) on October 8, 1980. This amendment required DOE to promulgate Interim Standards, which would apply only to new federal buildings. Additionally, the amended act required DOE to conduct demonstration projects in at least two geographical areas. Following the demonstration phase, DOE was to develop and promulgate final standards.

On August 13, 1981, Congress again amended the New Buildings Act to include development of standards for private-sector construction. The Omnibus Budget Reconciliation Act of 1981 (PL 97-35, Title 10, Subtitle D) amended the act to create the term "voluntary performance standards." This eliminated the provision for a possible statutory sanction for noncompliance. It added a provision that, except for federal buildings, "voluntary standards shall be developed solely as guidelines for the purpose of providing technical assistance for the design and construction of energy efficient buildings" and extended the time to meet the reporting requirement for demonstration programs.

The legislative changes that have taken place since the enactment of the New Buildings Act in 1976 have led to changes in direction and focus for standards development, as shown in Figure 1.2. DOE first separated its residential and commercial standards development. DOE then separated residential interim standards development efforts into a voluntary standard for the private-sector, the Voluntary Residential Standard (see Chapter 3), and another, mandatory standard for federal residential buildings, the Interim Federal Residential Standard (see Chapter 4). Commercial building standards would also be voluntary for the private sector and mandatory for the federal

FIGURE 1.2. Evolution of DOE Standards Development Efforts

sector. For non-federal buildings, voluntary performance standards serve only as guidelines for design and construction. The Interim Commercial Standard (see Chapter 2), which went into effect in 1986, specified performance requirements for new construction starting in 1989.

In 1986, DOE funded ASHRAE to form Special Project 41 to develop recommendations for the Congressionally mandated residential energy standards. The recommendations of Special Project 41 form the basis for the federal Voluntary Residential Standard that was proposed in 1992. Demonstration phases were initially prescribed for private-sector residential and commercial buildings, with final standards promulgation to follow the outcomes of the demonstrations. However, the Energy Policy Act of 1992 (PL 102-486) rescinded the requirement for a demonstration phase for the Voluntary Residential Standard.

Finally, in 1990 the Cranston-Gonzalez National Affordable Housing Act (PL 101-625) required HUD to update its Minimum Property Standards to at least equal the latest MEC.

1.2 HISTORY OF ASHRAE AND CODE ORGANIZATION STANDARDS DEVELOPMENT

In an effort to provide uniformity to the requirements being placed on building design by various state and local governments, the National Conference of States on Building Codes and Standards (NCSBCS) requested in 1973 that

the National Bureau of Standards develop standards for energy conservation in new building design (see Figure 1.3). In early 1974, the Bureau published *Design and Evaluation Criteria for Energy Conservation in New Buildings* (NBS 1974). This document was used as the basis for a national voluntary consensus standard published by ASHRAE in cooperation with the Illuminating Engineering Society of North America (IES) and under procedures approved by the American National Standards Institute (ANSI). ANSI/ASHRAE/IES Standard 90-1975, *Energy Conservation in New Building Design*, was published by ASHRAE in August 1975 (ASHRAE 1975).

For the first time, a document was available that could be adopted by those wishing to regulate the energy conservation of new buildings. The adoption of this document was spurred by The Energy Policy and Conservation Act of 1975 (PL 94-163) which, in part, provided federal financial support to states that adopted an energy standard for new construction no less stringent than Standard 90-1975. This presented a reason for state and local governments to adopt energy standards and created a large "market" for referenceable energy standards (Taylor et al. 1992).

Some states adopted Standard 90-1975, as early as 1974, before ASHRAE finalized it. The means of implementation for provisions addressing new construction was commonly through the state or local building regulatory process, which included a review of plans and inspection of construction. The building regulatory community was not familiar with standards language, and many felt it was impossible to enforce any document not written in code language. Efforts to adapt Standard 90-1975 into enforceable code language were initiated (Taylor et al. 1992).

Separate efforts were conducted by each of the U.S. model code organizations to incorporate energy conservation provisions in their model building codes (see Figure 1.4). Beginning in 1976, the Building Officials and Code Administrators (BOCA), International Conference of Building Officials (ICBO), and Southern Building Code Congress International (SBCCI) developed and incorporated energy provisions into their respective codes. These energy provisions could be found in the *Basic Energy Conservation Code* (BOCA 1978), the *Uniform Building Code* (ICBO 1978), and the *Standard Building Code*

[†]National Bureau of Standards, "Commerce News", February 28, 1974

FIGURE 1.3. Evolution of Voluntary Codes and Standards

FIGURE 1.4. History of Residential Energy Standards and Codes Development (Taylor et al. 1992)

(SBCCI 1979). Concurrently, DOE (known at that time as the Energy Research and Development Administration [ERDA]) saw the need for a national-level energy code document to serve the needs of state and local governments. With ERDA support, NCSBCS, BOCA, ICBO, and SBCCI developed and published the *Model Code for Energy Conservation in New Building Construction*, known as the MCEC (DOE 1977). State and local governments now had the documents to adopt as energy codes or incorporate into existing building construction regulations (Taylor et al. 1992).

In 1979, the HUD Minimum Property Standards were revised; they remain the same today as they did at that time. In 1930, Standard 90-1975 was revised as ANSI/ASHRAE/IES Standard 90A-1980 (ASHRAE 1980). Working with IES, ASHRAE updated the technical criteria of the original standard. A year later, BOCA published a new edition of its energy code.

In the early 1980s, less emphasis was placed on energy conservation and regulations. Federal support for the programs of the 1970s waned, and state and local governments were left to do more with less. Support for maintaining the MCEC was not forthcoming from DOE, and the states were not willing to update the document through NCSBCS. The private sector took over through the Council of American Building Officials (CABO), which represents the interests of the three model code groups: BOCA, ICBO, and SBCCI. Their first efforts in 1983 resulted in the publication of the *Model Energy Code* (CABO 1983). The MEC can be considered a version of the MCEC updated to be technically compatible with Standard 90A-1980. Evolution of the MEC is shown in Figure 1.5.

At about this time, others in the voluntary sector initiated efforts to develop alternative strategies to these energy codes and standards. Builders developed thermal performance guidelines, utilities developed programs directed at more efficient construction, and the concept of home energy rating systems was raised. In addition, the 1980 Pacific Northwest Electric Power Planning and Conservation Act (PL 96-501) led to the creation of the Northwest Power Planning Council (NWPPC), which developed and promulgated Model Conservation Standards applicable in the Pacific Northwest (NWPPC 1982).

During the 1980s, the voluntary sector maintained and updated energy codes and standards. These efforts included the revision of Standard 90A-1980

FIGURE 1.5. Revisions to Model Energy Code

in 1987 and the publication of an addendum to the standard. The MEC is updated periodically (revisions were published in 1986, 1989, and 1992) as is the BOCA Building Energy Code.

As shown in Figure 1.4, a number of energy codes and standards are available today for application to new residential construction. State and local governments desiring to regulate the energy efficiency of new residential construction can adopt any of these documents. While many do, others develop their own provisions. Builders, utilities, lenders, and others are also involved in the selection and adoption of standards and guidelines.

1.3 OUTLINE OF REPORT

This report provides a detailed discussion of the efforts of DOE and the Program, together with ASHRAE and other code organizations, to continue development and promulgation of building energy standards.

Chapter 2 describes commercial standards development. Chapter 3 discusses voluntary residential standards development. Chapter 4 discusses federal residential standards development. Chapter 5 discusses manufactured home energy conservation standards. Chapter 6 highlights technology transfer and standards implementation efforts. Chapter 7 contains references.

Appendix A lists Program publications. Appendix B describes the status of energy code adoption in each state. Appendix C is a history of legislation and voluntary standards pertaining to energy efficiency in buildings (D&R 1992).

2.0 COMMERCIAL STANDARDS

The first section of this chapter describes the history of efforts by the Program, in conjunction with DOE, ASHRAE, and other code organizations, to develop energy standards for commercial buildings. The second section describes software developed by the Program to assess compliance with the DOE Interim Commercial Standard.

2.1 OVERVIEW AND HISTORY OF COMMERCIAL STANDARDS DEVELOPMENT

In the 1980s, two major initiatives were sponsored by DOE in response to the New Buildings Act, as amended. These two initiatives were special projects coordinated by ASHRAE: Special Project 41 and Special Project 53. Special Project 41 is discussed below. The evolution of ASHRAE's efforts, from forming Special Project 41 to publishing ASHRAE/IES Standard 90.1-1989, are shown in Table 2.1. Special Project 53 was formed in 1985 by ASHRAE, which subcontracted with the Program to develop energy standards for low-rise residential buildings; the Project is described further in Chapter 3.

2.1.1 ASHRAE Special Project 41

In April 1982, ASHRAE and the Program jointly formed Special Project 41 to conduct research on energy conservation in building design. Special Project 41 brought together experts in the design, construction, and estimating fields to determine what revisions to Standard 90A-1980 were feasible and cost-effective. Through the use of energy consumption simulations, sample buildings were designed, modified, and redesigned with a view toward the energy use reduction attributable to different product and system strategies. The costs associated with the products and systems were reviewed as well, and decisions were made concerning what design strategies were cost-effective.

The results of this effort were evaluated and provided a basis for a series of recommendations on how Standard 90A-1980 could be revised to more effectively address energy conservation in new buildings. These recommendations were used in the ASHRAE/IES process for developing a consensus standard (Hadley and Halverson 1993). The results of this project demonstrated that

TABLE 2.1. Timeline of ASHRAE Commercial Standards Development

1982	ASHRAE forms Special Project 41 to revise Standard 90A-1980
January 1983	ASHRAE Standards Committee votes to develop a standard for commercial and high-rise residential buildings
January 1984	ASHRAE Standards Committee votes to develop a standard for low-rise residential buildings
July 1985	ASHRAE Standards Project Committee 90 Revision (SPC 90R) issues Standard 90.1P for consensus review
August 1986	SPC 90R issues second draft of 90.1
November 1987	SPC 90R issues third draft of Standard 90.1
1987	DOE issues draft federal sector version of Standard 90.1 for public comment
October 1988	ASHRAE Standards Committee recommends publishing Standard 90.1
January 1989	DOE publishes Interim Rule for multifamily high-rise (10 CFR 435, Subpart A) compatible with Standard 90.1-1989
January 1989	ASHRAE Board of Directors approves Standard 90.1-1989
December 1989	IES Board of Directors approves Standard 90.1-1989
Note: Shading indicates DOE activities.	

significant, effective improvements could be made to the existing national standard, Standard 90A-1980. These findings were submitted to ASHRAE.

In January 1983, ASHRAE's Standards Committee voted to develop a standard for commercial and high-rise residential buildings. In January 1984, the committee voted to develop a standard for low-rise residential buildings. These two standards would replace Standards 90A-1980 and 90B-1975, two national standards that had formed the technical basis for most of the nation's state building energy codes. ASHRAE's decision, in 1983, to separate

commercial/multifamily high-rise residential standards from low-rise residential standards reflects the thermodynamic and construction differences between these two building types.

2.1.2 ASHRAE Standards Project Committee 90 Revision

Based on the information gained from Special Project 41, the ASHRAE Standards Committee formed the Standards Project Committee 90 Revision (SPC 90R) to revise Standard 90A-1980. Researchers on Special Project 41 noted that Standard 90A-1980 treated building envelopes fairly simplistically and did not take into account the complex interaction of building envelopes with other building systems. The standard ignored many phenomena important in commercial building design, such as beneficial solar gains through fenestration and daylighting. Researchers developed a new approach to specifying building envelope requirements that allowed designers greater flexibility in complying with envelope criteria.

A new commercial and multifamily high-rise building standard was needed to address the design of lighting; exterior envelope (walls, windows, and roofs); electric power distribution; and heating, ventilating, and air conditioning (HVAC) systems and equipment. Seasonal and part-load efficiencies of equipment were addressed for the first time by SPC 90R.

Compliance with the revised standard was to be demonstrated by using any of four alternative paths: a prescriptive path, a systems performance path, and two building performance paths that considered the overall performance of a proposed design. These paths accommodated designs ranging from small and simple buildings to large, complex and innovative ones.

In 1983, the development, background research, and testing of the proposed new commercial standard conducted by Special Project 41 were completed. The findings were published in a four-volume series, *Recommendations for Energy Conservation Standards and Guidelines for New Commercial Buildings*, issued as 40 documents (PNL 1983). The recommendations for the standard were then submitted to DOE for its use as a mandatory standard for federal commercial buildings; the recommendations were also submitted to the ASHRAE/IES committee for developing revisions to Standard 90A-1980.

DOE published ASHRAE's recommendations as a Notice of Inquiry in the *Federal Register* on January 26, 1984 (49 FR 3245). The Program worked with ASHRAE to evaluate public comments and modify the standard appropriately. SPC 90R completed its draft Standard (Standard 90.1P) modification of for consensus review in July 1985. After reviewing and resolving public review comments, SPC 90R issued a second review draft of the standard in August 1986. Revisions again took place, and a third public review was held in November 1987. A revised draft with nonsubstantive changes completed the consensus process. Publication of Standard 90.1 was recommended by ASHRAE's Standards Committee and Technology Council in October 1988; approved by the ASHRAE Board of Directors on June 29, 1989; and approved by the IES Board of Directors on December 7, 1989. The title of the standard was *Energy Efficient Design of New Buildings Except Low-Rise Residential Buildings* (ASHRAE 1989).

In an effort to improve the federal version of the new standard and yet maintain compatibility with the private-sector commercial standard, DOE elected to use a slightly modified version of ASHRAE/IES draft Standard 90.1-1989. The Program conducted the economic analysis and regulatory impact analysis on this revised draft standard. DOE issued a Notice of Proposed Rulemaking for the federal standard. The comment period and public hearing process were completed in 1987. The public comments were incorporated into the revised standard, and DOE published the completed Interim Commercial Standard, "Energy Conservation Voluntary Performance Standards for Commercial and Multi-Family High Rise Residential Buildings: Mandatory for New Federal Buildings; Interim Rule," in the *Federal Register* on January 30, 1989 (54 FR 4538). The federal standard contains performance requirements for new construction starting in 1989; compliance is voluntary for commercial and multi-family high-rise residential buildings, mandatory for new federal buildings (DiMassa, Hadley, and Halverson 1993). This Interim Commercial Standard (10 CFR 435, Subpart A) is consistent with Standard 90.1-1989. More stringent performance requirements for construction starting in 1993 were also developed by DOE in its non-residential standard.

2.1.3 Commercial Standards Demonstration Phase

In 1992, the Program conducted a demonstration of the energy conservation potential of the DOE Interim Commercial Standard. The project modeled 10 commercial building types (apartment, church, school, hotel, anchor retail, small shopping, warehouse, and small, medium, and large office) in six different climate locations in the United States. The modeling simulated buildings constructed to three standards: ANSI/ASHRAE/IES Standard 90A-1980, the DOE Interim Commercial Standard, and the DOE Commercial Standard that would replace the Interim Commercial Standard in 1993. The buildings were modeled using a computer program called DOE-2.1C, written by Lawrence Berkeley Laboratory (LBL 1984). Results from the demonstration are reported in Di Massa, Hadley, and Halverson (1993), as well as in DOE's report to Congress on commercial standards (Hadley 1992).

The purpose of the demonstration was to evaluate the impacts of the standards in four major areas. These four issues and the Program's findings are listed in Table 2.2.

Additionally, a lighting assessment study was conducted. A Technical Review Panel, comprising representative lighting manufacturers, users, and designers, became part of the evaluation process. Panel team members included representatives selected from the International Association of Lighting Designers, IES, and the National Electrical Manufacturers Association. The panel reviewed the study design and analysis plans and selected the commercial building types for study.

2.1.4 Addendum to the Interim Commercial Standard

When Standard 90.1-1989 was undergoing public review, the Gas Appliance Manufacturers Association commented that the commercial standards were too restrictive with respect to the 1992 standby loss requirements for gas-fired commercial service water heaters. Representatives of the association's water heater division presented a proposal to the ASHRAE SPC. 90.1 Service Water Heater Task Group that eased the standby loss requirements while increasing the thermal (combustion) efficiency of large gas-fired units.

TABLE 2.2. Evaluation of DOE Commercial Standards Demonstration

Area	Impact	Findings
1	Could aesthetically pleasing, buildings be designed under the standards?	The DOE commercial standards do not adversely impact the design of new buildings. The compliance paths of the standards allow for significant creativity and innovation in building design while maintaining energy efficiency and complying with the standard.
2	What impact would incremental changes in construction costs have on designers and builders? How will small builders be affected? Will renter/purchasers in the multifamily high-rise market be impacted?	Building simulations performed during the demonstration show that commercial and multifamily high-rise buildings can be designed to comply, with minimal impacts on overall construction costs. The energy efficiency levels required by the standards are cost-effective. The flexibility of the standards' compliance paths allows designers to use a variety of lighting, HVAC equipment, and envelope component materials to design buildings with energy efficient components at equivalent or lower cost than buildings designed to the older Standard 90A-1980. Implementation of the standards should not affect the ability of small construction companies to bid on energy efficient commercial or multifamily high-rise projects. There should be no adverse impact on the ability of people with low to moderate incomes to rent or purchase a unit in a multifamily high-rise complex built to the new standard.
3	What impact would the standard have on annual energy use and energy savings?	There is the potential for significant energy savings from DOE commercial building standards compared to Standard 90-1980. When averaged across all building types and all climate locations, the energy savings potential is 13% for DOE's Interim Commercial Standard and 18% for the performance requirements that became effective in 1993. The greatest savings occur in the retail building type. The annual whole-building energy conservation potential in Interim Commercial Standard retail buildings is approximately 27%. Savings of 6% more is possible with implementation of the 1993 requirements. Energy conservation for the remaining nine building types ranges from 7% for the apartment to 24% for the warehouse (Hadley and Halverson 1993).
4	What impacts would the commercial standards have on lighting design?	The reduced lighting power allowances of the standards provide high energy savings potential. Because the standard does not dictate the use of specific energy efficient equipment for each building component but allows the designer to choose any combination of component products that will fit the performance target, the designer has considerable flexibility in choosing lighting equipment. The new standard also accounts for daylighting. The LTGSTD software tool helps designers with lighting compliance (Hanlon and Connell 1993).

The Program conducted a technical analysis of this proposal to assess the energy equivalency between the reduction of the standby loss requirements and the increase in the thermal efficiency level for gas-fired service water heaters (Somasundaram et al. 1992). It recommended a minimum thermal efficiency requirement of 80% for commercial gas-fired water heaters. This recommendation and its inclusion as an addendum to the standards (Standard 90.1B) ensure that the entire stock of commercial units will be designed and used in

the most energy efficient manner possible. Part of the industry has already achieved these efficiency requirements in currently available water heater designs.

2.2 COMMERCIAL STANDARDS SOFTWARE

In 1986 the Program developed a spreadsheet-like microcomputer program, called ENVSTD (for Envelope Standard), to aid non-federal designers in calculating compliance with the complex envelope requirements of the commercial buildings standards. A related lighting compliance software program, LTGSTD (for Lighting Standard), was also developed. These two software tools are described below.

2.2.1 ENVSTD

The ENVSTD software package is a commercial standards performance compliance design tool used for determining compliance with the building envelope system performance path requirements of DOE's Interim Commercial Standard. ENVSTD was designed to facilitate the commercial building designer's use of the standards dealing specifically with building envelope design. It can help the designer evaluate the relative thermal performance of alternative building envelope designs and suggest directions for improving that performance.

The initial version of ENVSTD consisted of Lotus spreadsheet macros. These were later expanded into a more sophisticated, powerful software program that incorporates regression equations that describe the complex, multi-dimensional relationships among building envelope characteristics. The latest version of ENVSTD is Version 2.4 (Connell and Hanlon 1993).

ENVSTD simplifies the task of performing the calculations to determine if a design complies with the standards. The calculations automatically performed by ENVSTD exactly duplicate the requirements and compliance calculations contained in the standards. Users enter data on the proposed wall, roof, and foundation configurations on two input screens: the exterior wall screen and the other requirements screen shown in Figure 2.1.

FIGURE 2.1. ENVSTD24 Screen Layout (Connell and Hanlon 1993)

Users of ENVSTD get immediate feedback on the impact of their envelope design. Users can flexibly and interactively evaluate tradeoffs of envelope characteristics. Many combinations of building envelope characteristics can meet energy efficiency criteria. The program displays a "passes" or "fails" message for each screen, depending on whether or not the input data defines a building that complies with the envelope standard. This feature of the system performance path provides great flexibility to designers. Each designer can decide which characteristics are most appropriate, given aesthetic, thermal, or other considerations.

The ENVSTD program provides designers with an easy-to-use means for demonstrating that their building designs comply with the building envelope system performance path of the DOE Interim Commercial Standard. It aids designers in understanding the relative importance of various envelope components in their climate location. Online help is available for each data entry in ENVSTD. The program automatically calculates the location-specific predicted annual total heating and cooling coil loads for the design. Concurrent with this calculation, ENVSTD computes the criteria or maximum permissible

loads based on the specified location and internal loads. ENVSTD performs an immediate check for compliance with the system performance requirements.

2.2.2 LTGSTD

LTGSTD is a computer software program developed by the Program to help commercial building designers and other users assess whether a particular building complies with the lighting requirements detailed in Section 3 of the Interim Commercial Standard. To evaluate compliance of a proposed design with the lighting requirements of the standards, a user enters data about the building's proposed lighting configurations, floor area, and building type. The data is entered on four input screens: the main screen, the space screen, the controls screen, and the exterior lighting screen, shown in Figure 2.2.

FIGURE 2.2. LTGSTD24 Screen Layout (Hanlon and Connell 1993)

The program deals with both exterior and interior lighting designs. LTGSTD automatically calculates the compliance values for interior lighting power allowance and exterior lighting power allowance. If the design lighting power does not exceed the compliance values, the building design complies with the lighting power requirements of the standards.

LTGSTD performs lighting power calculations automatically, saving the designer the time of doing complex manual calculations. The original version of LTGSTD consisted of Lotus spreadsheet macros, but the program has been

updated and expanded, making it more powerful and easier to use. The latest version of LTGSTD, Version 2.4, was issued in 1993 (Hanlon and Connell 1993).

3.0 RESIDENTIAL STANDARDS

The first section of this chapter describes the history of efforts by PNL, in conjunction with DOE, ASHRAE, and other code organizations, to develop voluntary building energy standards for residential buildings. The second section describes software developed to ensure compliance with the DOE Voluntary Residential Standard.

3.1 OVERVIEW AND HISTORY OF RESIDENTIAL STANDARDS DEVELOPMENT

In April 1985, PNL subcontracted with ASHRAE to assist in developing energy standards for low-rise residential construction. ASHRAE's experience in writing consensus standards, together with its practice of involving building industry representatives in standards development, made it a logical conduit for obtaining industry input to DOE's standards development process. ASHRAE formed a Technical Evaluation Committee of eight professionals comprising building industry architects, engineers, builders, manufacturers, educators, and consultants. The committee's task was to provide recommendations and input on the development of residential standards. This task was designated by ASHRAE as Special Project 53.

Based on legislative requirements and DOE's and ASHRAE's previous experience developing standards, the ASHRAE Special Project 53 committee established certain important objectives in developing residential standards. The standards should

- be based on defensible data and procedures
- provide multiple compliance alternatives
- be economically viable to the homeowner
- utilize local climate and cost data
- be based on energy performance
- be easy to implement and enforce.

The committee worked to identify reliable sources of construction cost data, energy estimating procedures, and state-of-the art construction practices. They designed an economic viability test based on a typical home

buyer's perspective. Only those energy-conserving features that passed this test were considered as requirements of the standards.

To ensure that the needs and concerns of building code officials were incorporated in development of the standards, PNL subcontracted with the NCSBCS to obtain input from the code community. NCSBCS assembled and maintained communication with an informal committee of advisors from various state, county, and local code jurisdictions to periodically review the work and progress of the ASHRAE committee.

In concert with the code official representatives, ASHRAE worked to develop compliance paths that would serve the needs of virtually all builders. Three compliance paths were developed:

1. simple prescriptive criteria, generally expressed as nominal R-values^(a) for the various envelope components
2. a point system, which allows builders to trade off thermal efficiency among components but still reach an overall energy efficiency points target
3. a full energy performance evaluation.

PNL also subcontracted with Lawrence Berkeley Laboratory to regenerate a database from a previous DOE project and include new data. This data would give annual heating and cooling loads for 881 representative climate locations in the United States, indexed by component insulation levels, window type, and orientation.

The comprehensiveness of the database required a significant number of calculations to derive the standards requirements. To avoid excessive effort and complexity, PNL and ASHRAE staff decided to take a new approach to promulgating the standards. They decided to embody the necessary data and calculation procedures in a microcomputer software program. A software program was developed specifically for code officials by Program staff. This computer program, called the Automated Residential Energy Standard (ARES), was designed to assist the code-writing official in developing a customized standard that

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(a) The R-value represents the thermal resistance of a building element.

can accommodate local conditions. ARES generates compliance materials that allow a builder to demonstrate when a house complies with the standard.

The Voluntary Residential Standard, embodied in the ARES software program, was tested for 12 geographically and climactically disparate locations. Economic impacts were assessed. An environmental assessment was also conducted per the requirements of the National Environmental Policy Act and the Council on Environmental Quality. The "Draft Energy Conservation Interim Voluntary Performance Standards for New Non-Federal Residential Buildings; Request for Public Comments and Announcement of Public Hearings" was published in the *Federal Register* on August 31, 1992 (57 FR 39424 et seq.)

The required public review and comment phase for the Voluntary Residential Standard is just concluding. Under the Energy Policy Act of 1992, a demonstration phase is no longer required. The Voluntary Residential Standard is further described in the following section.

3.2 VOLUNTARY RESIDENTIAL STANDARD SOFTWARE

This section describes the ARES software, which can be used by code developers to create a residential energy standard, and the Automated Compliance for Residential Energy Standards (ACRES) software, which can be used by builders to demonstrate compliance with the Voluntary Residential Standard.

3.2.1 ARES

ARES is a software tool that was developed to assist standards and codes developers in creating a residential energy standard based on local parameters such as climate, economic variables, energy prices, and construction cost information (see Figure 3.1). This information is used to determine, from a consumer's viewpoint, the most economical way to install energy conservation measures in a house (DOE 1989).

When used to generate a standard (see Figure 3.2), ARES examines the costs of various energy conservation measures and their effects on energy consumption. ARES evaluates all allowable designs for cost-effectiveness and identifies the measures that result in the overall residential design with the minimum life-cycle costs. The annual space-conditioning and water-heating cost for this design becomes the standard for determining compliance.

FIGURE 3.1. ARES Menu System (Lortz and Taylor 1989)


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<<<<<<<<<<  STEPS TO CREATE A STANDARD  >>>>>>>>>
Step 1. Retrieve saved inputs from disk
Step 2. Choose location, housing type, and foundation types
Step 3. Choose energy types and change energy prices
Step 4. Select minimum and disallowed levels for ECMs
Step 5. Create Packages and Points
Step 6. Save inputs to disk

EXIT

```

Press (Return) to perform, use Arrows or Tab to move, ? for help.

FIGURE 3.2. ARES Menu for Steps to Create Standard (Lortz and Taylor 1989)

Although the fundamental criterion for compliance is equivalence with a target energy bill, that fact is never "expressed" in the standard. Users add up dimensionless "points" to score the various proposed measures as to their impact on the efficiency of the design.

ARES provides for three compliance paths. The end user may select from the following paths:

1. a set of prescriptive packages of conservation measures (the simplest but most prescriptive compliance path)
2. a point system (a more complex but flexible route to compliance)
3. a whole residential unit energy performance approach (gives the greatest design freedom but the highest level of complexity to achieve compliance).

ARES is intended for use by codes and standards developers. However, builders can use the printed output of the ARES program to demonstrate compliance. The ARES user's guide describes how to use the program, suggests methods for obtaining and deriving input data, and provides interpretation of the output (Lortz and Taylor 1989).

The development of ARES and its database were done with input from the building industry and scientific community. PNL contracted with ASHRAE to

form a Technical Evaluation Committee to provide oversight and recommendations for development of the residential energy standard. Technically defensible energy data and cost-benefit procedures authored or selected by the ASHRAE Technical Evaluation Committee were used to define criteria in ARES. PNL also contracted with NCSBCS to review ongoing development and to manage an informal group of code officials who reviewed PNL's work.

ARES provides code developers with maximum flexibility in setting local energy and economic values for standards. The format is unique among current energy standards because it provides the ability to accurately reflect changes in time-sensitive parameters such as costs. It also accommodates local climate and economics. These options are shown in the ARES menu flowchart in Figure 3.1. Codes derived using ARES are entirely responsive to local climate and economic conditions.

By using ARES, code developers can fine tune the standard at any time and develop new standard levels. This gives control to local codifiers, who are generally in the best position to consider the technical and political ramifications of the requirements.

ARES embodies a wide range of energy-related conditions that can be addressed and displayed. The scope of conditions that can be covered includes ranges of building types and sizes, a selection of conventional energy conservation measures (ECMs) (insulation, glazing, etc.), heating and cooling conditions, a wide range of climate variables including window orientation and infiltration, equipment efficiencies and sizing, high mass construction, and improved technologies.

The procedures developed in ARES encourage the use of new technologies by either providing explicit credit for their use or providing mechanisms for easily updating the standard to give proper credit to new technologies. An important related capability is that of responding to shifts in the cost and/or performance of current technologies. For example, the thermal performance of windows continues to improve over time; ARES can account for this.

ARES determines energy conservation measures that are economically justified under local conditions. Code developers may input local prices of fuels, economic variables such as local mortgage interest rates, property and

income tax rates, and ECM construction costs. Using these data, ARES identifies for each locality the combination of ECMs that result in the minimum overall life-cycle costs to the homeowner.

Program staff conducted an economic analysis of the proposed Voluntary Residential Standard (Marsh et al. 1989). The national net effect of the standard, assuming full penetration, ranges from nearly \$930 million in net benefits for 1988 construction to \$1,035 million for 1992 construction, based on the net present value of energy savings and capital costs over a 15-year period. From the homeowners' perspective, using life-cycle costs based on a 7-year horizon, the net present value of the energy savings reaches \$1.1 billion in 1992. Capital costs for this period reach \$575.8 million for a net benefit of \$507.5 million to homeowners for 1992 construction (Marsh et al. 1989).

HUD used a modified version of ARES to develop new thermal protection criteria for its national-scope Manufactured Home Construction and Safety Standards. HUD is using ARES to update these standards for site-built construction. The use of the DOE-developed software allowed HUD to perform a much more rigorous analysis of manufactured home economics in much less time than would have been otherwise required. The manufactured housing standards revisions resulting from the ARES analyses are expected to result in life-cycle savings between \$300 million and \$400 million for the manufactured homes built each year.

HUD's use of ARES exemplifies its usefulness beyond its original intent of developing standards for geographically limited locales. This is indicative that the ARES software is a solid technical foundation on which future tools for standards development, compliance demonstration, energy design, and other uses may be built.

3.2.2 ACRES

The ACRES computer software program was designed for use by builders to demonstrate compliance with one of the voluntary residential energy standards compliance paths, the component performance or "point system" approach (DOE 1991).

The "point system" is a collection of data tables and calculation worksheets that allows the builder to trade higher energy efficiency levels in some components for lower levels in others. The point system allows tradeoffs between all major building components, including ceiling, wall, and floor insulation; heating and cooling equipment efficiency; window type and orientation; infiltration control measures; and domestic water heating equipment. For example more insulation could be added to the ceiling to compensate for a less efficient window type, as long as the overall design meets or exceeds a specified point level. Each point equals \$100 saved in energy cost over the life of the building. The point system provides information to determine whether the tradeoff is adequate to maintain annual energy costs at the target level. The points allotted to various conservation levels are directly proportional to estimated annual fuel bills.

A user's guide demonstrates use of the ACRES program and how to verify that the design meets the requirements of the standards (DOE 1991). ACRES will run on any IBM-compatible computer that runs MS-DOS. ACRES has only three basic menus so it is easy to learn.

ACRES was designed with the builder or building official in mind. It makes compliance with the standards easier because it automates the point system. The microcomputer speeds up the process of searching through data tables and doing the necessary calculations to account for the energy impacts of various tradeoffs. In states with energy codes that contain point systems, this is the most popular method of compliance (CEC 1989).

The flexibility of the ACRES program makes it a preferred method for demonstrating compliance with the Voluntary Residential Standard. When building a house, builders are constrained by customer preferences and by what building materials are available locally. ACRES allows builders to meet the standard by meeting a performance target instead of by using specific types of building components; therefore, builders have more flexibility to meet the design requests of their clients and to work with available materials.

4.0 FEDERAL RESIDENTIAL STANDARDS

The first section of this chapter describes the history of efforts by the Program, in conjunction with DOE, ASHRAE, and other code organizations, to develop federal energy standards for residential buildings. The second section describes software developed to assess compliance with the Interim Federal Residential Standard.

4.1 OVERVIEW AND HISTORY OF FEDERAL RESIDENTIAL STANDARDS DEVELOPMENT

The New Buildings Act established the initial requirements for the development and implementation of performance standards for new residential buildings. The standards were to be "designed to achieve the maximum practicable improvements in energy efficiency and increases in the use of nondepletable sources of energy...." (42 USC 6831). The original act did not distinguish between standards for federal and private-sector buildings, and did not require a demonstration project.^(a)

The Housing and Community Development Act of 1980 amended the New Buildings Act, requiring DOE to conduct a three-step process promulgating interim standards, conduct a demonstration project, and develop and promulgate final standards. The original legislation and amendments through 1980 were intended for private-sector buildings receiving federal financial assistance. In 1981, the Omnibus Budget Reconciliation Act modified the requirements to make the standards voluntary for the private sector. They continued, however, to be mandatory for the federal sector. In response to this amendment, DOE separated its residential interim standards development and demonstration efforts into one standard for voluntary private-sector standards and another for mandatory federal residential standards.

The federal residential standards, which are mandatory for federal agencies, set forth energy consumption goals, specifying the criteria and

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(a) Federal buildings were defined as "any building to be constructed by, or for the use of, any Federal agency which is not legally subject to State or local building codes or similar requirements" (PL 94-385, Title III, Sec. 303 [42 USC 6831]).

evaluation methods to be used, while allowing flexibility on how to meet those goals. The standards generate minimum energy efficiency requirements by applying the life-cycle cost methodology developed for federal projects. Easy-to-use software programs were developed that embodied the standards and allowed users flexibility in how to comply with the standards.

The standards initially were published in the *Federal Register* for public comment on August 20, 1986 (51 FR 29754). Four support documents were issued with the standards: The Users Manual, The Technical Support Document, The Environmental Assessment, and the Economic Analysis. The standards were revised following the public comment period. The next version of the standards was issued for public comment in the *Federal Register* on August 25, 1988 (53 FR 32536). The Interim Federal Residential Standard became mandatory for federal agencies on February 21, 1989. The Interim Standard was amended in 1991 (56 FR 3764).

A demonstration of the Interim Residential Standard was conducted by the Program in compliance with the provisions of the New Buildings Act (Lee et al. 1992). The purposes of the demonstration project were to evaluate the impacts of the standards on energy savings in federal housing projects and to assess the effects on the federal procurement process used by agencies, designers, and contractors. Federal agencies that build their own residential units were targeted for the demonstration. The demonstration included five housing projects--four military services and one federal civilian agency--located in five geographically and climactically diverse areas of the country.

Each of the housing projects in the demonstration was treated as a case study to determine the impact of the standards on each project and to evaluate use of the standards. The results from each case study were examined to determine common themes and summarize the findings. Current federal agency and private-sector design/construction practices were documented to provide a baseline from which to measure incremental impacts of the standards (Lee et al. 1992).

4.2 FEDERAL RESIDENTIAL STANDARDS SOFTWARE

Congress required DOE to develop energy efficiency standards for housing that were performance based. Such standards require houses to perform to certain levels of energy efficiency, rather than requiring that specific measures or devices be installed. To be consistent with the performance-based requirement and to produce the maximum practicable improvements in energy efficiency, DOE sought to develop energy conservation standards that set requirements based on project-specific conditions. These conditions included local climate, types of houses, applicable fuel prices, and local construction costs.

Early in the development process it became clear that a software tool would be needed. Initial development of the software, which was called Conservation Optimization Standard for Savings in Federal Residences (COSTSAFR), started in 1984. This section describes COSTSAFR, the point system compliance forms it generates, and the Computerized Automated Point System (CAPS) software that was developed by the Program to help builders comply with the standard.

4.2.1 COSTSAFR

The COSTSAFR software is designed to be used by federal officials responsible for federal housing procurement. COSTSAFR operates on IBM-compatible personal computers. Its primary purpose is to produce point system compliance forms (Lucas, Connell, and Lee 1991). (This point system is further discussed in Section 4.2.2 below.) Each form provides a list of the most cost-effective energy conservation choices for a number of building components in one type of residential building. The form also gives the user a point total representing a minimum reduction in energy costs that must be achieved. This reduction is the target that any building design must meet to comply with the standards. COSTSAFR is intended to be simple to operate, requiring the user to enter only basic information relating to a federal housing construction project. A user's manual provides the information needed to operate COSTSAFR (DOE 1988a).

The COSTSAFR program does a project-specific, life-cycle cost analysis using a 25-year period of analysis and a federal discount rate established by the Federal Energy Management Program. For a given run, the life-cycle cost analysis produces an "optimum design," which is the set of efficiency measures with the lowest life-cycle cost based on the measures included in COSTSAFR. The total energy cost savings for the optimum design determine a point total that represents the target energy cost reduction the designer must meet to comply with the standards. Technical support documents provide detailed information about the economic and technical underpinnings of the standards and the software (DOE 1988b, 1988c).

To obtain project-specific conditions, the user enters data that include the year of occupancy, project location, allowable foundation and housing types, allowable space heating fuel and equipment types, whether air-conditioning is included, allowable domestic hot water equipment types, and fuel costs. COSTSAFR analyzes seven different prototypical houses: single- and double-section manufactured houses; ranch, two-story, and split-level detached houses; and town house and apartment low-rise attached housing.^(a)

The efficiency measures incorporated in COSTSAFR include envelope component (ceiling, wall, and floor) insulation levels; window types; heating and cooling equipment types and efficiencies; and refrigerator/freezer and water heater types and efficiencies. In performing the life-cycle cost analysis, COSTSAFR accesses two databases. One database contains all measure cost data, including initial cost, maintenance cost, replacement costs, and salvage values. COSTSAFR provides options that allow the user to adjust the database for inflation and local construction costs, or to change individual measure costs. The second database contains energy consumption data for each measure. The energy database was created with the DOE-2.1 building simulation model (DOE 1988c). COSTSAFR has separate energy data for each house type and a full set of separate measure energy data for each of 45 predefined climate zones within the United States.

(a) COSTSAFR analyzes both mid- and end-units in town houses and low-rise attached housing, and generates separate compliance forms for the mid- and end-units, if desired.

Figure 4.1 shows the COSTSAFR structure including the three data sources, the analysis performed, and the output (point system) produced. COSTSAFR analyzes four types of energy end uses: space heating, space cooling, water heating, and refrigeratory/freezers. For space heating and cooling,

FIGURE 4.1. COSTSAFR Flow Chart (Lee et al. 1992)

COSTSAFR calculates the energy required to heat and cool (condition) indoor spaces based on envelope insulation levels and window types, and adjusts these to account for heating and cooling equipment efficiencies. Five heating fuel/equipment types are included in COSTSAFR: natural gas, oil, liquid petroleum gas (or propane), electric furnaces, and electric heat pumps. The water heating and refrigerator/freezer end-uses are independent from the space heating and cooling. Water heater types included are natural gas and electricity; propane can be substituted for natural gas. The COSTSAFR user can exclude refrigerator/freezers if desired.

Three versions of the COSTSAFR software have been issued to the public to date. The initial version (Version 1) was issued in the *Federal Register* for public comment on August 20, 1986 (51 FR 29754). About 200 public comments were received. The COSTSAFR program was modified in 1987 to respond to public comments and to make general improvements. A new version of the software (Version 2) was issued August 25, 1988 (53 FR 32536). Another version (Version 3) was issued on the same date for public comment (53 FR 32547). Version 2 reflects the Final Interim Rule, which became effective on February 21, 1989. Version 3 is similar to Version 2 but has new, improved window energy data and the additional measure category of walls with thermal mass (i.e., heavyweight materials to take advantage of solar energy). Version 3 was further improved to become Version 3.1, which was issued on January 31, 1991 (56 FR 3764).

4.2.2 The Point System

The energy efficiency requirements of the standards are presented in point system compliance forms produced by COSTSAFR. The paper version of these compliance forms is about seven pages long. Each form is customized so that the energy efficiency requirements stated on the form are based on the location, fuel costs, and building type of the particular project. The point system compliance forms are used by designers (usually prospective housing contractors) to develop a design that complies with the DOE standards (Lucas and Lee 1991).

COSTSAFR calculates points for all measures included in the database. COSTSAFR determines points for a specific measure by comparing its life-cycle

energy cost savings with those of the least energy efficient measure in the COSTSAFR database for that component. For example, the least efficient measure for ceilings is R-11 insulation so the points for R-19 ceiling insulation are related to the life-cycle energy cost savings that R-19 provides when compared with R-11. One point equals \$100 saved in energy cost over the life of the building. The set of measures that produces the lowest life-cycle cost (including first cost, energy cost, and all other costs) constitutes the optimum design choice. The point total for the optimum design establishes the target that buildings must meet.

The designer uses the point system to evaluate selected measures for each component in a house design. The point system tells the designer how many points each selected measure is worth. The points from the complete set of measures selected by the user produce a point total. To show compliance with the standard, the user's point total must meet or exceed the target determined by COSTSAFR.

The designer must make a measure selection for each of the following components: ceiling, wall, and floor insulation; infiltration controls; window types and areas; space heating and cooling equipment and efficiencies; water heater type and efficiency; and refrigerator/freezer efficiency (if desired by the federal agency). The designer also may select window coatings or treatments (e.g., low-emissivity glazing), sun spaces, movable window insulation, and roof color to improve energy efficiency.

Figure 4.2 shows sample sections of the point system. The ceiling and wood frame wall sections of the point system are shown for a split-level house in Denver, Colorado. The numbers in the heating and cooling columns are the COSTSAFR-generated, project-specific points. The optimized selections are shown beneath each list of options.

The requirement of meeting a minimum point total ensures that a cost-effective level of energy conservation is met. The points assigned to individual options in the point system represent energy cost savings and do not include nonenergy costs. Although COSTSAFR includes all costs in determining the optimal measures that establish the required point total, the point system compares alternative measures only for their effect on energy

POINT SYSTEM FOR:		pg. 1
Split Level Houses		
federal HOUSING PROCUREMENT		Design #: _____
Denver, CO		Unit type: _____
RFP# _____		Proposer: _____
 A: CEILING INSULATION POINTS		
	Heating	Cooling
R-11	0.0	0.0
R-19	3.3	0.0
R-30	5.9	0.0
R-38	6.9	1.1
R-49	7.7	1.3
R-60	8.2	1.4
The Optimized Selection: R-19		
		Points for A: _____
		H C
 B: WALL INSULATION POINTS (Select either Wood Frame or Thermal Mass Walls)		
Wood Frame Walls		
	H	C
R-11	0.0	0.0
R-13	1.3	0.0
R-19	5.2	0.0
R-24	7.3	0.0
R-26	8.0	0.0
The Optimized Selection: R-19		
		Points for B: _____
		H C

FIGURE 4.2. Sample Sections of Point System Compliance Form
(Lee et al. 1992)

costs. One reason is that the DOE standards are intended primarily to be energy conservation standards. A second reason is that designers will be motivated to minimize construction costs when they make their design choices because they want to have a competitively low bid. Therefore, the point system allows the designers flexibility in minimizing their construction costs, at the same time ensuring that a cost-effective level of energy conservation is met or exceeded.

4.2.3 CAPS

The point system can be completed on paper or by using a computer program called CAPS. Either format can be used to specify a set of measures that complies with the standard for any given project.

The CAPS software is an easy-to-use program that allows the user, the building designer, to input design selections into a personal computer

(Baechler, Lee, and Lucas 1991). Even for users with limited computer experience, the CAPS program offers some significant advantages over the paper format. The CAPS program automatically does all the calculations necessary to determine the point total obtained for the user-selected measures, eliminating the possibility of math errors. Furthermore, CAPS instantly calculates the point total when the user selects a measure and notifies the user whether the design complies with the standards. This software provides the user with immediate feedback on the impact of any measure selection and allows designers to quickly test a variety of approaches for meeting the standards.

At the time the demonstration project was conducted, use of a post-processor for COSTSAFR, called POSTSAFR, was necessary to prepare COSTSAFR point system files for CAPS. The sole role of POSTSAFR was to process the point system file into a format that CAPS required. The updated versions of the COSTSAFR and CAPS software issued in 1991 completely eliminated the need for POSTSAFR.

The Program also developed an Alternative Compliance Procedure (ACP) that allows analysis of unusual designs and innovative measures not included in COSTSAFR.

5.0 MANUFACTURED HOME CONSTRUCTION AND SAFETY STANDARDS

This chapter describes the legislative history of manufactured home standards and the Program's contributions to standards development efforts.

5.1 OVERVIEW AND HISTORY OF MANUFACTURED HOME STANDARDS DEVELOPMENT

The Housing and Community Development Act of 1987 (PL 100-242) required the HUD to revise its energy conservation standards for manufactured housing. HUD contracted with PNL to assist in developing a revision to the energy conservation requirement in HUD's existing Manufactured Home Construction and Safety Standards. The law requiring revision of the HUD energy conservation standards and the accompanying conference report set requirements for the selection of energy efficiency measures. These measures were to be selected based on the following considerations:

- costs and benefits calculated from the homeowner perspective (retail level)
- consideration of manufactured home design and factory construction techniques
- separate evaluation of single- and double-wide homes.

5.2 DEVELOPMENT OF MANUFACTURED HOME STANDARDS

The proposed revisions to the Manufactured Home Construction and Safety Standards reduce energy consumption by one-third compared to the old HUD standards. The energy savings impact of the revisions will be high as they would preempt all other manufactured home standards and would be mandatory for the approximately 200,000 manufactured homes built annually in the United States.

The proposed revisions meet the congressional stipulations of the Housing and Community Development Act by minimizing life-cycle cost, optimizing measures, and establishing climate-specific U-value^(a) requirements.

(a) The U-value represents the thermal conductance of a building element.

5.2.1 Life-Cycle Cost Minimization

HUD used a modified version of ARES to develop new thermal protection criteria for its national-scope standard and is using ARES to update its Minimum Property Standards for site-built construction. The use of the DOE-developed software allowed HUD to perform a much more rigorous analysis of manufactured home economics in much less time than would have been otherwise required. ARES contains a life-cycle cost model, a cost minimization model, and a building thermal energy simulation model. PNL conducted extensive surveys and analyses to determine the inputs for ARES; these included energy prices (current regional energy prices and energy price escalation rates), financial, economic, and energy efficiency measure cost parameters. With these inputs, as well as the location and building type, ARES identified the set of energy efficiency measures that minimizes a homeowner's total life-cycle cost for a home in a specific location, using a specific heating system and energy type. The revisions resulting from the ARES analyses are expected to result in life-cycle savings between \$300 million and \$400 million for the manufactured homes built each year.

5.2.2 Optimum Energy Conservation Measures

A set of candidate optimum measures and their incremental costs was selected for use in the analysis based on extensive manufacturer surveys. Only measures determined to be available in commercially produced homes were included as candidate options. The standard optimally benefits the manufactured home owner by encouraging use of those measures that save energy while ensuring the lowest total construction and operating costs to the manufactured home owner. As directed by Congress, single- and double-wide homes were considered separately.

5.2.3 Aggregation of Climate Zones and U-Values

The Program staff established maximum transmission heat loss coefficients of building components (U-values) in a number of climate zones. U-value optimums for each of the 881 cities in the ARES database, energy/equipment types, and prototype homes (single- and double-wide) were aggregated in a series of steps to U-values for four climate zones in the United States.

The manufactured home standard is described in terms of an overall U-value which manufacturers must calculate for each model of home they make. A manual was produced that clarified any ambiguities and specified calculations that can be used for determining compliance with the standard.

The thermal portion of the HUD standard was issued for public review and comment in the *Federal Register* on February 24, 1992 (57 FR 6420). The comment period closed May 25, 1992, and comments are undergoing review by HUD with assistance from the Program.

6.0 IMPLEMENTATION/TECHNOLOGY TRANSFER

The Program has undertaken numerous activities to increase the visibility of building energy standards and to promote their implementation.

6.1 PARTICIPATION IN NATIONAL STANDARDS AND MEC ACTIVITIES

Program staff have reviewed the technical requirements of the standards and energy codes produced by such organizations as ASHRAE, IES, American Society for Testing and Materials, CABO, BOCA, ICBO, SBCCI, and NWPPC. For example, extensive analyses of thermal efficiency improvements in the MEC envelope components of low-rise residential buildings have been formally submitted to CABO for consideration in its revision of the MEC. Program staff actively participate on ASHRAE technical committees to support improvements in ASHRAE standards. They have attended meetings to present proposed changes that would transfer current energy standards technology into the national standards and model energy codes. Program staff have prepared the comments, rebuttals, and documentation necessary to the process.

6.2 INTERACTIONS WITH CONSTRUCTION INDUSTRY PROFESSIONALS AND TRADE GROUPS

Program staff have interacted with the federal- and private-sector energy design and construction industry professionals and trade groups to conduct joint activities to promote building energy standards. Staff have worked with federal-sector professionals, especially the military services, to promote the use of standards in federal housing construction. PNL is working with the American Institute of Architects to promote standards use among practicing architects and to enhance professional architectural education regarding the standards. The Program is supporting ASHRAE in the development of a Manual of Acceptable Practices for applying ASHRAE Standard 90.1-1989. The manual will be accompanied by other training materials and professional development seminars, all offered by ASHRAE.

6.3 TOLL-FREE HOTLINE

The Program established a toll-free hotline (1-800-445-6505) that operates 24 hours a day to take questions from the public regarding commercial and residential energy standards. Callers receive a response within one business day. The hotline provides technical assistance and is a mechanism for gaining feedback regarding the standards, especially during the public comment phase of standards development.

6.4 PROGRAM NEWSLETTER

The Program produces a quarterly newsletter, *Setting the Standard*, that is mailed to over 2,500 building and energy professionals nationwide. The newsletter promotes the exchange of information on building energy issues, and provides updates on program progress in standards development and implementation.

6.5 MONITORING THE STATUS OF ENERGY CODE ADOPTION NATIONWIDE

The Program monitors the status of state and local government energy code adoption. It established and maintains a current library of national, regional and state codes, standards, legislation and regulations for energy efficiency in buildings. This information is kept in a database and is also reported in the legislatively mandated annual report to Congress on the status of state and local government adoption and enforcement of energy standards. Appendix B provides a listing of the current status of state building energy standards adoption that was prepared by Program staff in 1993 as part of a draft report to Congress on the impacts of the Energy Policy Act of 1992 (Lee and Gilbertson 1993).

6.6 NEEDS ASSESSMENTS, TRAINING PLANS, AND REPORTS ON STATE EXPERIENCES WITH ENERGY CODES

Program staff have conducted numerous surveys and assessments of the state and local energy code community to determine what their needs are

relative to energy code adoption, enforcement and compliance. The Program has produced the following assessments and surveys of state and local government energy code implementation:

- *Building Energy Standards Training Needs Assessment* (Shankle et al. 1992a)
- *Important Factors and Proposed Framework for Developing a National Training Plan for Building Energy Standards* (Shankle et al. 1992b)
- *Status of State and Local Adoption of Energy Standards for New Commercial Buildings* (Boulin and Conover 1992)
- *Adoption, Implementation and Enforcement of Commercial Building Energy Codes in New Mexico and Arizona* (Callaway, Thurman, and Shankle 1991)
- *California's Experience with Nonresidential Building Efficiency Standards* (Lesperance, Powell, and Waltemath 1992).

States with sophisticated energy codes such as California have been assessed in terms of their experiences with energy code development, adoption, and enforcement, as well as lessons learned.

6.7 DIRECT SUPPORT TO STATES TO ENCOURAGE ENERGY CODE ADOPTION

The Program has regularly contacted all 50 states regarding the status of their residential and commercial energy codes and answered questions of a general nature. Direct technical assistance in energy code development and/or legislative or regulatory support has been provided to the following states: Pennsylvania, North Carolina, Missouri, Minnesota, Georgia, Oklahoma, Maryland, Tennessee, Connecticut, Arizona, Massachusetts, Utah, Oregon, California, Washington, Wisconsin, South Dakota, and New Hampshire.

6.8 ENERGY CONFERENCES AND MEETINGS

DOE and Program staff regularly attend meetings of national standards and code organizations, such as ASHRAE. Program staff have had standards research papers peer reviewed and accepted for presentation at many national and international conferences such as The American Council for an Energy-Efficient Economy Summer Study on Energy Efficiency in Buildings; the

Building Simulation Conference, sponsored by the International Building Performance Simulation Association; the Buildings for the 21st Century Conference, sponsored by CIBSI, Australia; CLIMA 2000, the World Congress on Heating, Ventilation, Refrigerating, and Air Conditioning held in Yugoslavia and the Netherlands; Technology: A Key to World Progress Conference, sponsored by the International Technology Institute; and the ASHRAE annual and winter meetings. Numerous journal articles written by Program staff and coauthored by industry representatives have appeared in ASHRAE journals.

6.9 TECHNICAL SUPPORT FOR IMPLEMENTING REQUIREMENTS OF THE ENERGY POLICY ACT OF 1992

Direct technical support to states and other implementation activities will become even more important in the future as DOE and the states begin to carry out the mandates of the Energy Policy Act of 1992. States will be required to review their residential energy codes and compare them to CABO's most current MEC. States will be required to adopt commercial building energy codes that are equivalent to or more stringent than ASHRAE's Standard 90.1-1989. DOE will be required to provide technical assistance and incentives to states to meet these mandates. The Program's record of accomplishments in the areas of standards technical development and implementation will position it to be an important player in future national energy standards activities. For DOE, Program staff recently prepared the Report to Congress in Response to the Energy Policy Act of 1992, which clarifies policy impacts of the 1992 legislation (Lee and Gilbertson 1993).

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APPENDIX A

BUILDING ENERGY STANDARDS PROGRAM PUBLICATIONS LIST

APPENDIX A

BUILDING ENERGY STANDARDS PROGRAM PUBLICATIONS LIST

The following is a partial list of documents prepared by Program staff.^(a) This list was current as of May 1993. For an updated list, contact the Building Energy Standards Program at (509) 375-3615.

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- (a) Documents marked with an asterisk (*) are available to DOE and DOE contractors from the Office of Scientific and Technical Information, P.O. Box 62, Oak Ridge, TN 37831. Copies are available to the public from the National Technical Information Service, 5285 Port Royal Road, Springfield, VA 22168 (1-800-553-6847). To obtain documents not marked with an asterisk, readers should contact the publisher listed for the desired document.

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APPENDIX B

STATUS OF STATE ENERGY CODE ADOPTION

APPENDIX B

STATUS OF STATE ENERGY CODE ADOPTION

The following table shows which, if any, commercial and residential building codes are being enforced in each state in the United States. The information was prepared by Program staff as part of a report to DOE for Congress by Lee and Gilbertson 1993.^(a) The information was current as of July 1993.

TABLE B.1. Summary of State Actions to Update Building Energy Efficiency Codes

State	Commercial Building Code		Residential Building Code	
	Current Code	Actions/Plans to Meet or Exceed ASHRAE/IES Standard 90.1-1989	Current Code	Actions/Plans to Meet or Exceed 1992 Model Energy Code (MEC)
Alabama	State-owned/funded buildings >4000 ft ² subject to State Building Energy Conservation Code.	Code is reviewed in January of each year; no specific actions planned.	If locally adopted, 1983 MEC used via reference in Standard Building Code.	No specific actions planned.
Alaska	No state energy code but all state-funded buildings must follow Alaska Energy Efficiency Standard.	Not known.	State-funded buildings only; voluntary mortgage programs set lower rates for meeting State standard.	Optional standard scheduled for review in 1995; no specific action planned.
Arizona	Codes established by local jurisdictions.	AZ is aware of the Act's requirements.	Codes established by local jurisdictions.	AZ is aware of the Act's requirements.
Arkansas	MCEC 1977.	New energy code drafted based on MEC 1992, referencing Standard 90.1-1989; will go into effect in 1994.	MCEC 1977.	New energy code drafted based on MEC 1992; will go into effect in 1994.
California	State-developed codes equal to or more stringent than Standard 90.1-1989.	None required.	State-developed codes equal to or more stringent than MEC 1992.	None required.

(a) Lee, A. D., and W. L. Gilbertson. 1993. *Building Energy Efficiency Standards Activities Conducted Pursuant to Title I Subtitle A, Section 101 of the Energy Policy Act of 1992*. PNL-8925, Pacific Northwest Laboratory, Richland, Washington.

TABLE B.1. (contd)

State	Commercial Building Code		Residential Building Code	
	Current Code	Actions/Plans to Meet or Exceed ASHRAE/IES Standard 90.1-1989	Current Code	Actions/Plans to Meet or Exceed 1992 Model Energy Code (MEC)
Colorado	State provides only guidance to local jurisdictions.	Questionnaire sent to municipalities to collect information.	State provides only guidance to local jurisdictions.	Questionnaire sent to municipalities to collect information.
Connecticut	Statewide code based on BOCA National Code (1986-88) with Connecticut Supplement.	CT plans incorporating Standard 90.1-1989 into next code issue with prescriptive alternative for small business.	State energy code based on CABO MEC 1986.	CT planning to update to CABO MEC 1989 by Dec/Jan 1994 and will likely adopt the more stringent codes.
Delaware	Standard 90A-1980 for state buildings. No statewide code; local jurisdictions typically use BOCA or SBCCI codes.	DE is considering options such as MEC and 90.1.	No statewide code; local jurisdictions typically use BOCA or SBCCI codes.	DE is considering options such as MEC and 90.1.
Florida	Florida Energy Efficiency Code based on Standard 90-1975 modified to be climate-specific.	Energy code revised on 2-year cycle; new code based on Standard 90.1-1989 takes effect 1/1/94.(b)	Florida Energy Efficiency Code is state-developed.	Energy code revised on 2-year cycle; code usually follows CABO MEC upgrades.
Georgia	State energy code based on MEC 1986.	Updates scheduled every 6 years; 1993 update to Standard 90.1-1989 overturned through suit by builders; planned to go into effect in 1994.	State-developed energy code based on MEC 1986.	Updates scheduled every 6 years; 1993 update to MEC 1989 overturned through suit by builders; planned to go into effect in 1994.
Hawaii	HI code uses a variation of Standard 90.1-1989 adapted to its unique climate.	HI is already in compliance with the Act with exceptions based on climate.	Residential energy code is State-developed, adapted to unique climate.	Not known.
Idaho	No statewide code; codes implemented at the local level.	May reinstate a statewide code similar to 1989 MEC.	ID has state-developed residential energy code enforced at the local level.	May reinstate a statewide code similar to 1989 MEC.
Illinois	No statewide code; local codes based on BOCA or Standard 90.1-1989; State-owned facilities use Standard 90-1975.	Not known.	Local codes based on BOCA.	Not known.

TABLE B.1. (contd)

State	Commercial Building Code		Residential Building Code	
	Current Code	Actions/Plans to Meet or Exceed ASHRAE/IES Standard 90.1-1989	Current Code	Actions/Plans to Meet or Exceed 1992 Model Energy Code (MEC)
Indiana	Statewide code was updated in December, 1992, from MEC 1989 to CABO MEC 1992.	IN believes it is already in compliance.	Statewide code was updated in December 1992 from MEC 1989 to CABO MEC 1992.	IN believes it is already in compliance.
Iowa	Mandatory State energy code based on MEC 1989.	IA plans to stay with MEC, updating to MEC 1992 in 1993.	Mandatory State energy code based on MEC 1989.	IA plans to update to MEC 1992 in 1993.(b)
Kansas	Statewide code adopted at local level based on ASHRAE 90-75 and heat loss requirement.	KS planning to update to the Act's requirements.	State-developed residential code adopted at local level.	KS planning to update to the Act's requirements.
Kentucky	State energy code adopts 1990 BOCA National Building and Mechanical Codes (NBC, NMC) which incorporate Standard 90A-1980.	Not known.	State code based on the 1989 CABO which adopts MEC 1989 by reference or NBC 1990; site-built single-family homes not subject to code unless locally adopted.	Not known.
Louisiana	Not known.	Not known.	Not known.	Not known.
Maine	State commercial code is Standard 90.1-89.	ME plans code review and comparison to highlight and study any exceptions.	Multifamily homes use the commercial code; single-family homes use a state-developed code.	ME plans code review and comparison to highlight and study any exceptions.
Maryland	Compliance with State code is mandatory; code is based on latest edition of BOCA.	State is developing plans to comply with the Act.	Compliance with State code is mandatory; code is based on latest edition of BOCA.	State is developing plans to comply with the Act.
Massachusetts	Statewide code is based on Standard 90.1-89 criteria.	In compliance.	Statewide code is state-developed prescriptive code.	In compliance.
Michigan	Statewide commercial code is ASHRAE 90.A-1980 and references BOCA Part IV.	Administrative Rules are updated every three years.	Residential code references BOCA Part IV.	MI likely to change from ASHRAE to MEC at the next review.

TABLE B.1. (contd)

State	Commercial Building Code		Residential Building Code	
	Current Code	Actions/Plans to Meet or Exceed ASHRAE/IES Standard 90.1-1989	Current Code	Actions/Plans to Meet or Exceed 1992 Model Energy Code (MEC)
Minnesota	Statewide code based on 1989 MEC with amendments that exceed Standard 90.1-1989.	In compliance.	Statewide code based on 1989 MEC with amendments that exceed 1992 MEC.	In compliance.
Mississippi	MS uses Southern Standard Building Code which includes Standard 90.1-1989; it is not mandatory.	MS evaluating present code, plans to study code comparisons and develop legislation.	MS uses Southern Standard Building Code; it is not mandatory.	MS evaluating present code, plans to study code comparisons and develop legislation.
Missouri	State buildings use Standard 90-1975; local codes govern private construction.	Under legislative study.	Governed by local codes.	Under legislative study.
Montana	In 1992, adopted 1989 MEC amended to require higher R-values.	1993 legislation will require more stringent energy codes.	In 1992, adopted 1989 MEC amended to require higher R-values.	1993 legislation will require more stringent energy codes.
Nebraska	Statewide code is based on the 1989 MEC.	Consensus is building to bring codes up to 1992 MEC standards.	Statewide code is based on the 1989 MEC.	Consensus is building to bring codes up to 1992 MEC standards.
Nevada	Code is based on the 1986 MEC.	Not known.	Code is based on the 1986 MEC.	Not known.
New Hampshire	Code based on Standard 90.1-1989.	Complies with Standard 90.1-1989.	State-developed prescriptive code in effect.	Not known.
New Jersey	Uniform Construction Code has adopted BOCA NBC 1990, NMC 1990, NCEC 1990 (each with 1991 supplements).	Under review.	Uniform Construction Code has adopted CABO One and Two Family Dwelling Code 1989 with 1990 and 1991 supplements.	Under review.
New Mexico	Adopted the 1989 MEC in January, 1993.	Not known.	Adopted the 1989 MEC in January, 1993.	Not known.
New York	State-developed code.	Not known.	State-developed code.	Not known.
North Carolina	State-developed code, plus SBCCI.	Not known.	State-developed code, plus SBCCI.	Not known.
North Dakota	Code is based on ASHRAE 90-75.	Not known.	Code is based on ASHRAE 90-75.	Not known.

TABLE B.1. (contd)

State	Commercial Building Code		Residential Building Code	
	Current Code	Actions/Plans to Meet or Exceed ASHRAE/IES Standard 90.1-1989	Current Code	Actions/Plans to Meet or Exceed 1992 Model Energy Code (MEC)
Ohio	State energy code is based on 1987 NECC.	Not known.	State energy code is based on BOCA NBC.	Not known.
Oklahoma	State energy code based on Standard 90.1-1989 for state-owned buildings only.	Not known.	Not known.	Not known.
Oregon	State commercial code is similar to Standard 90.1-1989.	Commercial code is reviewed every three years; presently under review.	State-developed code is based on regional Model Conservation Standards.	OR believes its residential code is more stringent than any in the U.S.(a)
Pennsylvania	State code based on ASHRAE 90A-1980 adopted by reference.	No specific plans yet finalized.	State-developed code is adopted/enforced at local level; not all localities enforce it.	Present code developed in 1986 is under review; future plans not known.
Rhode Island	Statewide code based on BOCA 1993 with state-developed lighting.	RI believes its code is as comprehensive as Standard 90.1-1989.	State-developed code.	RI plans update to the 1993 BOCA and 1992 MEC at next update session scheduled January, 1996.
South Carolina	Commercial code based on the 1992 MEC adopted by 23 of 46 counties.	Updates scheduled every three years based on the MEC revision pattern.	Residential code based on 1992 MEC adopted by 23 out of 46 counties.	Updates scheduled every three years based on the MEC revision pattern.
South Dakota	There is no State commercial code.	SD is reviewing the 1992 CABO MEC and wants help.	There is no State residential code.	SD is reviewing the 1992 CABO MEC and wants help.
Tennessee	TN uses the 1977 MEC for all buildings but local adoption is required.	TN plans to update to Standard 90.1-89.	TN uses the 1977 MEC for all buildings but local adoption is required.	TN plans to update to the 1992 MEC.
Texas	State energy code based on Standard 90.1-89.	Not known.	Not known.	Not known.
Utah	UT uses CABO 1989 MEC with insulation and weatherization supplements.	Not known.	UT uses CABO 1989 MEC.	Not known.

TABLE B.1. (contd)

State	Commercial Building Code		Residential Building Code	
	Current Code	Actions/Plans to Meet or Exceed ASHRAE/IES Standard 90.1-1989	Current Code	Actions/Plans to Meet or Exceed 1992 Model Energy Code (MEC)
Vermont	State uses Burlington Energy Code which is similar to Standard 90.1-1989; code applies only to publicly funded buildings.	VT would like to know what other states are doing.	State-developed.	VT would like to know what other States are doing.
Virginia	VA uses the BOCA National Building Code.	In the process of updating to the 1993 codes.(b)	VA uses the BOCA National Building Code.	In the process of updating to the 1993 codes.(b)
Washington	State code based on Standard 90A-1980.	Standard 90.1-89 scheduled for 1994.	State-developed energy code.	Not known.
West Virginia	State uses the 1990 edition of the BOCA code.	Update scheduled for 1994.	State uses the 1990 edition of the BOCA code.	Update scheduled for 1994.
Wisconsin	State-developed code based on ASHRAE 90A-1980.	Not known.	State-developed code based on Standard 90A-1980.	Not known.
Wyoming	Code based on 1989 MEC.	Not known.	Code based on 1989 MEC.	Not known.
(a) Code adopted since passage of the Energy Policy Act of 1992. (b) Code amended since passage of the Energy Policy Act of 1992. Key: Act = the Energy Policy Act of 1992 ASHRAE = American Society of Heating, Refrigerating and Air-Conditioning Engineers, Inc. BOCA = Building Administrators and Code Officials International CABO = Council of American Building Officials MCEC = Model Code for Energy Conservation MEC = Model Energy Code SBCCI = Southern Building Code Congress International				

APPENDIX C

ROLE OF STANDARDS IN BUILDING ENERGY EFFICIENCY

(D&R International Ltd. 1992)

The Role of Standards in Building Energy Efficiency

Legislative Developments, 1975-1990
Part I

Federal Agency Policy
Part II

Voluntary Codes and Standards, 1973-1990
Part III

Conclusion and Analysis
Part IV

April 1992

*Prepared for the U.S. Department of Energy's
Office of Codes and Standards*

TABLE OF CONTENTS

Abbreviations	page i-iii
Definitions	page iv-vi

Part I -- Legislative Developments, 1975-1990

Legislative Time Line	page 2
Social and Political Background	page 3-8
Legislative History	page 9-28

Part II -- Current Federal Agency Policy

Introduction	page 30-31
Dept. of Energy	page 32-35
Dept. of Housing and Urban Development	page 36-40
Farmers' Home Administration	page 41-43

Part III -- Voluntary Codes and Standards

Voluntary Developments Time Line	page 45
Introduction	page 46-47
Standards	page 48-50
Codes	page 51-52

Part IV -- Conclusion and Analysis

Summary, the Federal Role in Developing Building Energy Efficiency Standards	page 54-55
Current and Future Federal Developments	page 56-58

Appendices

Federal Code References	page 59-61
Red-line of ECPA, Title III	page 62-69
Bibliography	page 70-71

ABBREVIATIONS

Federal Agencies:

CAB--Civil Aeronautics Board
DOC--Department of Commerce
DOD--Department of Defense
DOE--Department of Energy
DOI--Department of the Interior
DOT--Department of Treasury
ERDA--Energy Research and Development Administration
FmHA--Farmers' Home Administration
FAA--Federal Aviation Administration
FEA--Federal Energy Administration
FHA--Federal Housing Administration
FMC--Federal Maritime Commission
FNMA--Federal National Mortgage Association
FPC--Federal Power Commission
FTC--Federal Trade Commission
GAO--Government Accounting Office
GSA--General Services Administration
HUD--Department of Housing and Urban Development
ICC--Interstate Commerce Commission
NBS--National Bureau of Standards, now the National Institute of Standards and Technology (NIST)
NIBS--National Institute of Building Sciences
NIST--See NBS
OMB--Office of Management and Budget
PHA--Public Housing Agency
USDA--Department of Agriculture
USPS--United States Postal Service
VA--Veterans Administration

Legislation:

CFR--Code of Federal Regulations

Pub. L--Public Law

U.S.C.--United States Code

ECPA--Energy Conservation and Production Act, Pub. L 94-385; it includes Title III, the Energy Conservation Standards for New Buildings Act of 1976, and Title IV, the Energy Conservation in Existing Buildings Act of 1976.

EPCA--Energy Policy and Conservation Act, Pub. L 94-163

FEMI--Federal Energy Management Improvement Act, Pub. L 100-615

NAECA--National Appliance Energy Conservation Act of 1987, Pub. L 100-12.

NAHA--Cranston-Gonzales National Affordable Housing Act, Pub. L 101-625.

NECPA--National Energy Conservation Policy Act, Pub. L 95-619

SEECA--Solar Energy and Energy Conservation Act of 1980, Title V of the Energy Security Act, Pub. L 96-294

Others:

ANSI--American National Standards Institute

ASHRAE--American Society of Heating, Refrigerating, and Air Conditioning Engineers, Inc.

BEPS--Building Energy Performance Standards, proposed by DOE in the late 1970s.

BOCA--Building Officials and Code Administrators International

CABO--Council of American Building Officials

EIS--Environmental Impact Statement, required for Federal regulations.

ESCo--Energy Service Company

FMHCSS--Federal Manufactured Home Construction and Safety Standards, HUD standards for manufactured housing.

ICBO--International Conference on Building Officials

IES--Illuminating Engineering Society of North America

MCEC--Model Code for Energy Conservation, the forerunner of the MEC, based on ASHRAE Standard 90-75.

MEC--Model Energy Code, a voluntary building code promulgated by CABO.

MPS--Minimum Property Standards, developed and implemented by HUD.

NAHB--National Association of Home Builders

NCSBCS--National Conference of States on Building Codes and Standards

NEC--National Energy Code, a voluntary building code promulgated by BOCA.

NES--The Bush Administration's National Energy Strategy.

NOPR--Notice of Proposed Rulemaking. Precedes the promulgation of standards by a Federal agency.
OPEC--Organization of Petroleum-Exporting Countries
SBCCI--Southern Building Code Conference International

DEFINITIONS

These definitions are taken directly from legislation pertaining to building energy efficiency. Each term is central to building codes and standards or energy efficiency provisions in the legislation.

* signifies a definition currently in use.

Pub. L 94-385, August 1976

* Building Code: a legal instrument that is in effect for a State or unit of general purpose local government, the provisions of which must be adhered to if a building is to be considered in conformance with law and suitable for occupancy and use.

* Building: any structure that includes provisions for a heating or cooling system, or both, or for a hot water system.

Residential Building: any structure that is constructed for and developed for residential occupancy.

Commercial Building: any building other than a residential building, including any building developed for industrial or public purposes.

Performance Standards: energy consumption goal or goals to be met without specification of the methods, materials, and processes to be employed in achieving that goal or goals, but including statements of the requirements, criteria, and evaluation methods to be used, and any necessary commentary.

Pub. L 95-619, November 1978

Life Cycle Cost: the total cost of owning, operating, and maintaining a building over its useful life, including fuel and energy costs, determined on the basis of a systematic evaluation and comparison of alternative building systems.

* Energy Performance Target: a rate of energy consumption that is the minimum practically achievable, taking into account life-cycle costs, by adjusting maintenance and operating procedures, or by modifying a Federal building's equipment or structure, or both.

Pub. L 96-294, June 1980

Residential Building: any building used as a residence that contains not more than 4 dwelling units and has a system for heating or cooling, or both.

* Multi-family Residential Building: any building used as a residence that contains five or more dwellings and has a system for heating or cooling, or both.

* Commercial Building: any building other than residential or multi-family residential that is used primarily to carry on business (including nonprofit) and is not used primarily for the manufacture or production of raw materials, products, or agricultural commodities.

Pub. L 96-399, October 1980

* Manufactured Home: a structure, transportable in one or more sections, which in the traveling mode, is eight body feet or more in width or forty body feet or more in length, or when erected on site is 320 or more square feet, and which is built on a permanent chassis and designed to be used as a dwelling with or without a permanent foundation when connected to the required utilities, and includes plumbing, heating, air conditioning, and electrical systems contained therein; except that such term shall include any structure that meets all requirements of this paragraph except the size requirements and with respect to which the manufacturer voluntarily files a certification required by the Secretary [of HUD] and complies with the standards established under Section 42 U.S.C. 5401 et. seq.

Pub. L 99-272, April 1986

* Energy Savings: a reduction in the cost of energy from a base cost established through a methodology set forth in contract, utilized in an existing federally-owned building or buildings or other federally-owned facilities as a result of

- the lease or purchase of operating equipment, improvements, altered operating and maintenance or technical services, or
- the increased efficient use of existing energy sources by cogeneration or heat recovery, excluding any cogeneration process for other than a federally-owned building or buildings or facilities.

Pub. L 100-12, March 1987

* **Energy Conservation Standard:** a performance standard that prescribes a minimal level of energy efficiency or a maximum quantity of energy use for a covered product, determined in accordance with test procedures prescribed under Sec. 323 of EPCA; or a design requirement for the products specified in paragraphs 6, 7, 8, 10, 13 of Sec. 322 and includes any other requirement which the Secretary [of Energy] may prescribe.

Pub. L 100-357, June 1988

* **Residential Building:** a structure or portion of a structure that provides facilities or shelter for a human residency except that such term does not include any multi-family residential structure of more than three stories above grade.

Pub. L 100-615, November 1988

* **Energy Conservation Measures:** any measures that are applied to a Federal building that improve energy efficiency and are life cycle cost effective and that involve energy conservation, cogeneration facilities, renewable sources, improvements in operation and maintenance efficiencies, or retrofit activities.

* **Life Cycle Cost:** the total costs of owning, operating, and maintaining a building over its useful life (including such costs as fuel, energy, labor, and replacement of components) determined on the basis of a systematic evaluation and comparison of alternative building systems, except that in the case of leased buildings, the life cycle cost shall be calculated over the effective remaining term of the lease.

* **Renewable Energy Source:** includes but is not limited to sources such as agricultural and urban waste, geothermal energy, solar energy, and wind energy.

Pub. L 100-625, November 1990

* **Housing:** includes manufactured housing and manufactured housing lots.

PART I: *Legislative Developments*
1975-1990

The Role of Standards in Building Energy Efficiency

1975

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Legislative Time Line

*EPCA—12/22/75

*ECPA—3/14/76

*DOD Authorization Act—5/4/77

*DOE Organization Act—8/4/77

*Military Construction Act—9/8/78

*NECPA—11/9/78

*Housing and Community Development Act—12/21/79

*Energy Security Act—6/30/80

*Housing and Community Development Act—10/8/80

*Omnibus Budget Act—8/13/81

*Military Construction Act—5/11/83

*Supplemental Appropriations Act—11/30/83

*Consolidated Budget Reconciliation Act—4/7/86

*Conservation Service Reform Act—8/28/86

*NAECA—3/17/87

*Housing and Community Development Act—02/05/88

*NAECA Amendments—6/28/88

*FEMI Act—11/5/88

*Cranston-Gonzales NAHA—11/28/90

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2 of 2

Social and Political Background

Background, OPEC and the Energy Crunch

By 1973, U.S. production of oil and natural gas had failed to keep pace with growing domestic demand, forcing the purchase of more and more foreign petroleum to meet American needs. The world's largest oil and natural gas producers, primarily the economically underdeveloped Arab and Latin American countries, revived the Organization of Petroleum-Exporting Countries (OPEC) in an effort to control the flow and price of oil. In response to what they perceived as an exploitation of their primary natural resource by the industrialized Western countries, the members of OPEC succeeded in unifying the policy goals of the cartel and implementing policy as they had been unable to do since its formation in 1960.

When the Arab-Israeli conflict erupted again in 1973, the Arab-members of OPEC embargoed oil exports to the U.S because of U.S. support for Israel. This act caused an explosion of energy problems for the U.S. and other nations that depended heavily on imported oil. For the first time in 100-plus years of the petroleum era, supplies became both scarce and expensive. The American consumer was faced with much higher prices and gasoline lines due to shortages at service stations. To combat the situation, President Nixon issued Executive Order 11748 on December 4, 1973, establishing the Federal Energy Office (FEO), which became responsible for coordinating "the production, conservation, use, control, distribution, and allocation"¹ of petroleum supplies within the United States. The FEO quickly drafted employees from many other Federal agencies to soothe angry consumers and respond to the short-fall crisis.

In 1974, the FEO had been elevated to cabinet status and renamed the Federal Energy Administration (FEA). The FEA was given the responsibility for not only controlling fuel allocations but also for increasing domestic supplies and investigating energy conservation programs. Because the FEA was established as a regulatory agency, it first explored the possible implementation of a series of energy-related standards at the State and local levels. These standards were intended to immediately reduce energy use and establish a basis for long-term energy efficiency.

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¹Executive Order 11748, Federal Energy Office, Sec. 2, December 4, 1973.

President Nixon left the White House in 1975 and Gerald Ford became the 38th President of the United States. Due to a break in hostilities in the Middle East and an effective distribution system at home, lines at the gas pumps had become a phenomenon of the past. Although the fighting in the Middle East had ceased, fuel prices in the U.S. stabilized at a much higher level than before 1973. The United States learned a valuable lesson from the embargo and resulting oil crisis -- a national energy policy was essential if the nation was to have a secure and reliable supply of energy for the future.

The Seventies, Carter and an Active Government

As a result of the energy shortage, Congress passed milestone energy legislation in December of 1975, the Energy Policy and Conservation Act (EPCA). Among its provisions were mandatory national appliance standards for 13 common household appliances and the provision for a State grant program. The State grant program included five requirements for the receipt of State funding, including the establishment of State-wide building standards. The resulting State grant program regulations published in 1976 required States to set building standards that were no less stringent than the prescriptive standards for new residential and commercial buildings recently set by the American Society of Heating, Refrigerating, and Air-Conditioning Engineers, Inc. (ASHRAE Standard 90-1975), a national voluntary standards organization. Within a year, 27 States had adopted standards.

In 1976, the effects of the Arab oil embargo had by no means dissipated and there was a heightened awareness of the importance of efficiency in the country. The Ford Administration responded by setting a policy designed to develop reliable energy sources, which the Administration hoped would beget economic independence and security from politically unfriendly, and thus potentially unreliable, petroleum suppliers. That year Congress passed another major piece of energy legislation, the Energy Conservation and Production Act (ECPA), which required the Secretary of the U.S. Department of Housing and Urban Development (HUD) to establish, develop, and promulgate energy performance standards for new residential and commercial buildings. These standards were to be strict and any States failing to comply would have Federal aid withheld. Additionally, the legislation required Federal agencies to meet or exceed the standards. EPCA also required the Administrator of the FEA to set guidelines for renovating existing buildings as part of the State grant program requirements.

The establishment of the Energy Resources Development Administration (ERDA) also took place in 1976. ERDA, formerly the Atomic Energy Commission (AEC), was tasked with studying the use of fossil fuels and developing alternative forms of energy. While FEA was primarily a regulatory agency, ERDA was expected to function primarily as a research agency. Together they began to work to address energy issues.

Energy prices continued to increase as Jimmy Carter assumed the Presidency in 1977. In response, President Carter declared U.S. energy problems to be the "moral equivalent of war" and therefore deserving of a unified, cabinet-level organization to make energy policy and address energy problems. The U.S. Department of Energy (DOE) was formed from FEA, ERDA, and some Department of Agriculture and Department of Interior programs. With the organization of DOE as a cabinet agency, the responsibility for development of new building standards was transferred from HUD to DOE, yet the responsibility for standards implementation remained at HUD. 1977 also marked the first authorization of military energy conservation projects.

In 1978, the third major piece of energy conservation legislation was passed. The National Energy Conservation Policy Act (NECPA) contained requirements for energy conservation in apartment buildings, and a report by the Federal Trade Commission (FTC) studying the potential of utility and home heating oil supplier imposed residential energy conservation measures -- the precursor of today's utility demand-side management programs. NECPA also required the Secretary of Energy to direct the Federal National Mortgage Association (FNMA) to begin making loans and credits for energy conserving improvements. In addition, NECPA broadened the federally-mandated energy conservation programs established by earlier legislation to include agricultural buildings, schools, hospitals, and local government buildings. NECPA became the foundation for future legislation addressing renewable energy resources, an aspect of energy efficiency that was neglected until this time.

NECPA also had a major effect on building standards. First, it amended ECPA to require that building performance targets be set for all new federal buildings. Until NECPA, building standards had been prescriptive. NECPA also amended the Housing Act of 1949 and required that the U.S. Department of Agriculture's Farmer's Home Administration (FmHA) and HUD's Federal Housing Administration (FHA) loan and loan-guarantee programs contain energy performance requirements. This provision meant that a significant percentage of the home loans in the country would, in the future, be made based on some energy requirements. The Housing Act was further amended in 1979 to increase the thermal requirements in HUD's minimum property standards.

In 1979, DOE published proposed new building standards mandated by ECPA. Because of their very nature as performance standards rather than prescriptive standards, these standards were met with a great deal of controversy and opposition. Over 1,800 individuals, companies, and trade associations commented on the proposed performance standards. Clearly, the U.S. building industry was not ready to accept mandatory progressive energy conservation standards.

The United States received another jolt to its energy supply in 1979 with the fall of the Shah in Iran and his replacement by the Ayatollah Khomeini. The virulently anti-Western Khomeini stopped the flow of petroleum to the U.S., cutting off what had been one of the country's most reliable sources under the Shah's government. Although not as severe as the OPEC embargo, the loss of Iranian oil created a substantial shortfall, prompting more action by the Federal government to secure future supply.

The result of this action was the final piece of legislation of the Carter era, the Energy Security Act, was passed in June 1980. While most of its major energy efficiency provisions were for the expansion of renewable energy in an attempt to offset the Iranian embargo, it did include some provisions that affected building standards. The federal building provisions of NECPA were amended to require that all new and retro-fitted federal building designs be based on life-cycle cost provisions developed by DOE. It also amended the NECPA provisions regarding State energy conservation plans for commercial buildings and multi-family dwellings, and it required consensus between Federal agencies on factors and data used to develop energy conservation standards for all residential, commercial, and agricultural buildings.

In October 1980, the Housing and Community Development Act included changes to the provisions governing the DOE new building standards program first established by ECPA. These amendments postponed the original deadline for the establishment DOE's building standard to 1983, and changed the nature of the standards by requiring DOE to first establish interim standards, followed by demonstration projects to prove viability, and finally to promulgate final standards. Federal buildings were required to meet the interim standards.

The Reagan Years, Deregulation and Growth

Following the 1980 Presidential election, the federal government's commitment to energy conservation changed, and DOE's building standards program felt the effects. The Reagan Administration brought with it a more conservative approach to energy policy. Emphasis was placed on increasing energy supplies through traditional sources, while funding for

energy conservation and renewable energy programs dropped dramatically. The DOE standards for new building were a particular target as industry regulations were targeted for removal to stimulate economic growth. Legislation was passed in 1981 that made the standards voluntary for the private sector, although building energy standards remained mandatory for Federal construction. During the early Reagan era DOE also altered its approach to developing the standards. Deregulation ended what had been an almost entirely federal exercise in favor of private industry efforts. Because of the tremendous backlash from the private sector after its 1979 proposed standards, DOE decided to work with ASHRAE, a private-sector organization that was developing voluntary standards. Their cooperative efforts brought the private sector into the DOE standards development process.

The Eighties was a period of little energy efficiency and energy standards legislation. In 1984, the Housing Act was again amended, this time to strengthen the FmHA, FHA, and HUD-code housing (for mobile homes) energy provisions. Later in 1987, the National Appliance Energy Conservation Act was passed, which established energy conservation standards for certain consumer products used within buildings and updated the standards developed in 1975 with the passage of EPCA. The only other significant piece of energy legislation to pass during this time was the Federal Energy Management Improvement Act of 1988, which required energy consumption reductions of 10% in Federal buildings by 1995 (over 1985 levels).

Bush, the Nineties and Environmental Awareness

Energy efficiency, and hence building energy standards, regained a place of prominence during the beginning of the Bush Administration. Bush, vowing to be the "environment President", was elected at the peak of a cycle of concern with environmental issues by the American public, typified by recycling, the mainstreaming of organizations such as Greenpeace and the Sierra Club, and the prominence of 'green' events like Earth Day.

Legislatively, November 1990 saw the passage of the Cranston-Gonzales National Affordable Housing Act, which required energy efficiency standards for public housing. The new law also encouraged the Joint HUD-DOE initiative, a program in which DOE assists HUD in improving energy efficiency in public housing and other types of federally aided housing.

The standards that were mandated by the 1976 legislation were finally promulgated by the DOE beginning in 1988. As noted above, an initial effort to develop performance standards in 1979 met heavy opposition from the building industry. The standards program was virtually abandoned, in terms of funding and legislative support, after this setback until the

late Eighties. With the revival of the program, DOE promulgated interim standards for residential buildings in 1988, and followed these with interim standards for commercial and multi-family buildings in 1989. The residential standards were slightly amended in 1991. A recent project in conjunction with ASHRAE culminated in recommendations for voluntary standards for new non-federal housing, which are expected in the near future. Final standards in all three categories are awaiting the results of demonstration projects with the interim standards.

The Future, the Gulf War and Comprehensive Legislation

The domestic price increases and oil supply uncertainty that accompanied the Iraqi invasion of Kuwait in August of 1990 demonstrated that the U.S. is not yet immune to threats of disruption of fuel from foreign suppliers. Although supply was never interrupted due to the fractured state of OPEC, the Gulf crisis evoked many memories of the 1973 embargo. Despite successfully securing supply through military action, prices stabilized early in 1991 at rates higher than those before the Gulf War began.

The Persian Gulf crisis renewed action on energy policy and the development of comprehensive legislation in both Houses of Congress. Two major comprehensive energy bills have emerged that include provisions for strengthening building energy efficiency standards. The Senate bill, S. 1220, was initially defeated late in 1991, in large part due to two controversial provisions: the development of the Arctic National Wildlife Refuge in the search for petroleum, and CAFE standards requiring minimum performance levels for automobile efficiency. However, the bill was reintroduced as S. 2166, without those provisions and passed the Senate in February of 1992. The comprehensive energy legislation in the House of Representatives, H.R. 776, also includes building energy standard provisions, passed committee mark-up on March 12, but has not yet passed the full House. Given the constraints of an election year, it is still uncertain whether or not a bill that includes standards will pass before the end of the 102nd Congress, although passage of S. 2166 in the Senate considerably increases the likelihood of comprehensive energy legislation in 1992.

Legislative History

1975

The **ENERGY POLICY AND CONSERVATION ACT**, Pub. L 94-163, December 22, 1975

* Sec. 322 listed appliances to be targeted for conservation and efficiency standards.
They are:

- Refrigerators and refrigerator-freezers
- Freezers
- Dishwashers
- Clothes dryers
- Water heaters
- Room air conditioners
- Home heating equipment (not furnaces)
- Televisions
- Ranges and ovens
- Clothes washers
- Humidifiers and dehumidifiers
- Central air conditioners
- Furnaces, and
- any other product which the Administrator chooses.

Later amended by NAECA, Sec. 3.

* Sec. 325 required the Administrator of the FEA to set energy improvement targets for 13 appliance products based on manufacturer reports and the Administrator's determination of the greatest possible efficiency improvements, which must be at least 20%.

--If Administrator perceived that this efficiency target would not be met, they can prescribe standards for the highest feasible efficiency increase.

Later amended by ECPA, Sec. 161 to direct NBS to develop improvement targets and the Administrator of FEA to promulgate targets.

Later amended by NECPA, Sec. 422.

Later amended by NAECA, Sec. 5 to set standards for January 1, 1990 and establish procedure for new or amended standards.

* Sec. 326 required manufacturers to label these products according to efficiency.

Later amended by NAECA, Sec. 6 allowing manufacturers to submit information on the feasibility of efficiency standards.

* Sec. 327 superseded state laws enacted after this Act.

Later amended by NAECA, Sec. 7 which allowed exceptions.

* Sec. 338 required a report by the Administrator of FEA to the Congress and the President on the progress of this program.

Later amended by NAECA, Sec. 10 to continue the mandate for the report.

* Sec. 362 required the Administrator of the FEA to set guidelines for State energy conservation feasibility reports and voluntary energy efficiency plans.

--To be eligible for Federal aid, States had to submit reports on energy efficiency plans that would include mandatory thermal standards and mandatory efficient lighting standards for new and renovated non-federal buildings.

* Sec. 363 provided technical and financial assistance to States to prepare reports and develop energy conservation plans.

* Sec. 364 required the Administrator to set energy conservation goals for each State.

* Sec. 366 defined the terms 'public building' and 'transportation controls'.

Later amended by ECPA, Sec. 431 which redefined these terms.

* Sec. 381 required the President to coordinate Federal agency actions and to develop mandatory standards for energy conservation and efficiency².

--President was to develop a 10-year plan for energy conservation in buildings owned and leased by the Federal government.

--Plan must include lighting, thermal, and insulation requirements.

--President was to submit a report to Congress detailing the steps taken to comply with this section.

Later amended by NECPA, Sec. 501 to include all federal agencies.

* Sec. 382 required certain agencies (CAB, ICC, FMC, FPC, and FAA) to study and report to Congress on energy conservation practices.

Later amended by NECPA, Sec. 302 to add Sec. 391-400, which included hospital and school buildings in conservation programs.

Later amended by NECPA, Sec. 311 to add Sec. 400A-J, which included local government buildings and public care institutions in conservation programs.

1976

The **ENERGY CONSERVATION AND PRODUCTION ACT**, Pub. L 94-385, August 14, 1976

* Sec. 161 amended EPCA, Sec. 325 to direct NBS to develop an energy-efficiency target for the appliances named in EPCA, Sec. 322 and to direct the Administrator of FEA to prescribe such targets.

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²The President delegated these responsibilities to the FEA.

Title III, the Energy Conservation Standards for New Buildings Act of 1976

* Except for Sec. 306 (Federal buildings), all of this Title later amended by Omnibus Budget Act of 1981, Sec. 1041 to make performance standards voluntary.

* Sec. 304(a) required the Secretary of HUD, within three years, to develop and promulgate efficiency standards for new residential and commercial buildings.

--To be done in consultation with the Administrator of the FEA, the Secretary of Commerce, and any other interested parties (Sec. 309).

--Utilization of the services of NIBS (Sec. 310).

--Periodic review and update of these standards.

Later amended by Housing and Community Development Act of 1980, Sec. 326 to extend the deadline for promulgation of standards.

Later amended by Omnibus Budget Act of 1981, Sec. 1041 to make voluntary standards solely guidelines for technical assistance, except in Federal buildings. Also made the deadline April 1, 1984.

* Sec. 305 provided that as soon as standards are in place, any State that failed to comply would have Federal aid for any new construction of residential or commercial buildings within the State withheld.

--Provided for HUD grants to States that adopted and implemented the performance standard.

Later deleted by Omnibus Budget Act of 1981, Sec. 1041.

* Sec. 306 required all Federal agencies to meet or exceed the performance standards for any new buildings.

Later amended by Housing and Community Development Act of 1980, Sec. 326 to allow the agencies to meet the interim standards until development of the final standards.

Later amended by Omnibus Budget Act of 1981, Sec. 1041 to make the deadline April 1, 1984.

* Sec. 307 provided for grants to state and local governments to assist them in adopting and implementing performance standards.

Later deleted by Omnibus Budget Act of 1981, Sec. 1041.

* Sec. 311 required the Secretary of HUD to monitor State and local codes and the implementation of conservation efforts.

Title IV, the Energy Conservation in Existing Buildings Act of 1976

* Sec. 432 required the Administrator of the FEA to set guidelines for supplemental State efficiency and conservation plans.

--Include one or more model state energy conservation plan.

--Administrator of FEA may promulgate guidelines for supplemental State plans for eligibility for Federal assistance.

* Sec. 462 Comptroller General to report to Congress on the activities of the FEA and HUD under this Act.

1977

The DEPARTMENT OF DEFENSE AUTHORIZATION ACT OF 1977, Pub. L 95-26, May 4, 1977

* Chapter IX, Military Construction

--Provided \$16,796,000 for energy conservation or pollution abatement

projects for the Army.

--Provided \$20,330,000 for energy conservation or pollution abatement projects for the Navy.

--Provided \$20,000,000 for energy conservation or pollution projects for the Air Force.

The **DEPARTMENT OF ENERGY ORGANIZATION ACT**, Pub. L 95-91, August 4, 1977

* Sec. 301 abolished the FEA and the ERDA, combined their functions, and replaced them with the DOE.

* Sec. 304 transferred responsibility for the development and promulgation of conservation standards for new buildings, as mandated in ECPA, Sec. 304, from HUD to DOE.

-- HUD remained responsible for the implementation of the standards.

* Sec. 401 established the Federal Energy Regulatory Commission.

* Sec. 656 required the designation of a conservation officer by DOD, DOC, HUD, DOT, USDA, DOI, USPS, and GSA.

* Sec. 657 required an annual report to Congress.

* Sec. 801 required the President to submit a National Energy Policy Plan to the Congress.

1978

The **MILITARY CONSTRUCTION AUTHORIZATION ACT OF 1979**, Pub. L 95-356, September 8, 1978

* Sec. 804 required that 25% of all new DOD facilities under design, except family housing, must include solar energy systems to the extent it is cost-effective.

--All family housing must include solar systems, to the extent it is cost-effective.

--Solar system(s) considered cost-effective if the original investment differential can be recovered over the expected life of the facility.

The **NATIONAL ENERGY CONSERVATION POLICY ACT**, Pub. L 95-619, November 9, 1978

* Sec. 224 required a report on the potential for energy conservation in apartment buildings.

* Sec. 225 called for a study by the Federal Trade Commission including residential energy conservation measures by utilities and home heating suppliers.

Later amended by Conservation Service Reform Act of 1986, Sec. 104 to include alternative plans in Sec. 226.

Later amended by Conservation Service Reform Act of 1986, Sec. 103, by adding Sec. 226, which allowed States to formulate alternative plans for conservation by utilities.

Later amended by Conservation Services Reform Act of 1986, Sec. 105 by adding Sec. 228 which ended authority on June 30, 1989.

* Sec. 242 directed the Secretary of Energy to direct the National Mortgage Association to begin making loans and credits for energy conserving improvements.

* Sec. 252(a) amended Sec. 526 of the National Housing Act to require an increase in energy performance requirements through FHA standards until the standards

mandated by Title III of ECPA take effect.

* Sec. 252(b) amended **Housing Act of 1949** to require the Secretary of Agriculture to promote energy saving techniques for FmHA-assisted housing.

* Sec. 253 required a study by HUD, in coordination with USDA, VA, Treasury and DOE, using NIBS to determine the need for and feasibility of mandatory Federal action to require that all residential dwellings meet energy efficient standards.

--Secretary of Energy to comment on effects on the economy as a whole.

--Report to Congress within a year on results (by Nov. 9, 1979).

Later amended by SEECA, Sec. 562 to add Sec. 261-270, which required State prototype plans for residential energy efficiency.

* Sec. 302 amended **EPCA**, adding **Sec. 391-400** to include hospitals and school buildings in conservation programs

--Secretary of Energy to prescribe rules.

--Grants to States, or individual institutions, to conduct energy audits and for conservation programs.

--Voluntary State submission of plans.

* Sec. 311 amended **EPCA**, adding **Sec. 400A-J** to include local government buildings and public care institutions in conservation programs.

* Sec. 422 amended **EPCA**, **Sec. 325** to give the Secretary of Energy the power to set standards for 13 appliances named in **EPCA** if he feels substantial energy savings are possible.

--Must first have the written views of the Attorney General.

--If standard prescribed, must be reviewed every five years.

* Sec. 501 made the 10-year plan for energy conservation by Federal Agencies under **Sec. 381** of **EPCA** applicable to all Executive Agencies and the USPS.

* Sec. 522 required the Secretary of Energy, with GSA, to develop and carry out a program to demonstrate the application of solar heating and cooling technologies in Federal buildings.

* Sec. 545 established the use of life-cycle cost methods for Federal buildings.

Later amended by Energy Security Act, Sec. 405 to change method for life-cycle costing.

Later amended by the FEMI Act of 1988, Sec. 2.

* Sec. 546 required the Secretary of Energy, with GSA, NIBS, and OMB, to establish and publish energy performance targets for Federal buildings compatible with energy conservation performance standards developed by HUD.

Later amended by the FEMI Act of 1988, Sec. 2.

* Sec. 623 requires the Secretary of Energy to report to Congress on the coordination of Federal energy conservation programs involving State and local government.

* Title VII--Energy Conservation for Commercial Buildings and Multi-family Dwellings added by SEECA, Sec 565.

Later repealed by Conservation Reform Services Act of 1986, Sec. 201, except for State plans established under Sec. 721 before August 1, 1984, which must end by January 1, 1990.

* Title VIII--Shared Energy Savings added by Consolidated Omnibus Budget Reconciliation Act of 1985, Sec. 7201 allowing federal agencies to enter into shared energy savings contracts for energy efficiency improvements.

1979

The **HOUSING AND COMMUNITY DEVELOPMENT AMENDMENTS OF 1979**, Pub. L 96-153, December 21, 1979

* Law invalidated the final rule revision 6A, titled "Increase in thermal requirements for HUD minimum property standards."

1980

The **ENERGY SECURITY ACT**, Pub. L 96-294, June 30, 1980

Title IV, the Renewable Energy Resources Act of 1980

* Sec. 405 established life-cycle energy cost for Federal buildings by amending Sec. 545 of NECPA (served for Federal buildings until 1989).

Title V, the Solar Energy and Energy Conservation Act of 1980

* Sec. 504 defined terms.

Later amended by Supplemental Appropriations Act, 1984, Sec. 463 to include air-conditioning systems with better than average efficiency ratings.

* Sec. 505 established the Solar Energy and Energy Conservation Bank in HUD, and empowered it to give loans for residential and commercial energy improvements by amending the Federal National Mortgage Charter Act.

* Sec. 514 set eligibility conditions for financial assistance for residential and commercial energy improvements.

Later amended by Supplemental Appropriations Act, 1984, Sec. 463 to relax regulations.

* Sec. 561 established a program for providing assistance to State and local government to encourage demonstration programs in energy conservation.

* Sec. 565 amended NECPA, adding Title VII requiring the Secretary of Energy to promulgate rules for State energy conservation plans for commercial buildings and multi-family dwellings in coordination with the EPCA.

--Optional State submission of Energy conservation plans.

--Required the Secretary of Energy to approve any State/local plans, that met NECPA requirements, for the development of a prototype residential and commercial/multi-family building efficiency plan.

* Sec. 595 required consensus between Federal agencies on factors and data used to develop energy conservation standards for all residential, commercial, and agricultural buildings.

The **HOUSING AND COMMUNITY DEVELOPMENT ACT OF 1980**, Pub. L 96-399, October 8, 1980

* Sec. 104 required the development of comprehensive community-wide energy use strategies.

* Sec. 211(q)(11) required the Secretary, when practicable, to insure mortgages which are secured by low income properties that contribute to land and energy conservation.

* Sec. 308 renamed 'mobile home' as 'manufactured housing'.

* Sec. 310 increased mortgages 20% for solar energy use or residential conservation measures when implemented with minimum property standards.

* Sec. 323 required a study and report to Congress on factory built housing.

* Sec. 326 amended ECPA, Sec. 304a and 306 to extend the deadline for the promulgation of final conservation standards until April 1, 1983, but required interim standards for new commercial and residential buildings by August 1, 1981.

--Called for a demonstration project of energy savings in two geographic regions for commercial and residential buildings, with a report to Congress.

* Sec. 326 required Federal building compliance with the new interim standards, and Federal compliance with the final standards when they are developed.

* Sec. 331 continued local standard exemptions to the HUD minimum property standards.

--Required an analysis and report to Congress on the costs of heating and cooling buildings that comply with the increased thermal requirements under the minimum property standards. Allowed for exemptions for certain types of buildings.

* Sec. 339 authorized FNMA to loan money for energy improvements and solar energy systems that meet the National Housing Act and NECPA requirements.

* Sec. 508 amended the Housing Act of 1949 to include the setting of cost-effective energy conservation standards under the powers of the Secretary of HUD.

1981

The OMNIBUS BUDGET ACT OF 1981, Pub. L 97-35, August 13, 1981

* Sec. 1041 amended ECPA, Title III to make energy conservation standards voluntary.

--Except for Sec. 306, Federal buildings, voluntary performance standards shall be developed solely as guidelines for providing technical assistance for the design and construction of Federal buildings.

--Deleted ECPA Sec. 305 and Sec. 307 withholding State funds and conditioning State grants on energy conservation.

1983

The **MILITARY CONSTRUCTION AUTHORIZATION ACT OF 1984**, Pub. L 98-115, May 11, 1983

* Sec. 104 allowed the Secretary of the Army to provide funding for energy efficient improvements for the Army.

* Sec. 204 allowed the Secretary of the Navy to provide funding for energy efficiency improvements for the Navy.

* Sec. 304 earmarked over \$10 million for energy conservation by the Air Force.

The **SUPPLEMENTAL APPROPRIATIONS ACT OF 1984**, Pub. L 98-181, November 30, 1983

* Sec. 405 amended the **National Housing Act** to require performance requirements for new residential housing, other than manufactured homes, must be at least as effective as the existing minimum property standards in effect on September 30, 1982.

* Sec. 405 required FHA mortgaged-property, other than manufactured homes, to comply with one of the nationally recognized model building codes, or an equivalent.

--The Secretary of HUD was to determine the comparability of state and local codes with the models.

* Sec. 463 amended **SEECA**, **Sec. 504** and **Sec. 514** by stating that the Board of the Solar Energy Bank may not limit the amount of financial assistance for the purchase of residential or commercial energy conserving measures.

--Contractor, owner, or tenant to guarantee improvements for one year.

--Within 90 days, the Board was to issue regulations for financial assistance for active and solar energy systems in new and existing residential and multi-family residential buildings.

--Residential audit not required for financial assistance.

* Sec. 503 amended the **Housing Act of 1949** to specify that Federally-funded mortgages under the Rural Housing Act are available for manufactured housing to meet energy conserving requirements.

--Energy conserving requirements shall be cost-effective and reduce the operating costs.

--Established so the increase in the loan for energy conserving measures does not exceed the projected savings from the improvements themselves.

--Study and Report to Congress within 18 months comparing construction costs, energy savings, and projected lifetime energy savings.

* Sec. 506 amended **Sec. 509** of the **Housing Act of 1949** to add energy performance requirements to buildings under USDA jurisdiction, specifying that the Secretary of Agriculture shall approve building standards if they are in accordance with:

--Minimum property standards by HUD or by USDA,

--The standards in any voluntary national model building codes, or

--Manufactured housing standards.

* Sec. 506 stated that the Secretary of Agriculture must promote energy conservation by use of standards for new residential buildings.

--These standards should, when practicable, be consistent with HUD standards and incorporate energy performance requirements.

1985

The CONSOLIDATED OMNIBUS BUDGET RECONCILIATION ACT OF 1985,
Pub. L 99-272, April 7, 1986

* Sec. 7201 amended NECPA, adding the following sections:

--Sec. 801 allowed Federal agencies to enter into shared savings contracts specifically for energy efficiency improvements.

--Sec. 802 required payments by Federal agency to be funded only by specific energy conservation appropriations.

--Sec. 803 required agencies to report to the Secretary of Energy.

--Sec. 804 defined 'energy savings'.

1986

The **CONSERVATION SERVICE REFORM ACT OF 1986**, Pub. L 99-412, August 28, 1986

* Sec. 103 added Sec. 226 of NECPA to allow States to formulate alternative plans for residential energy conservation by utilities.

--These plans were to be in effect until June 30, 1989.

--Plans must result in 2% or more in annual residential energy conservation savings.

--Entities certifying plans must make yearly reports to the Secretary of Energy.

--Customers of utilities subject to the alternative plan may request the Secretary hold a hearing.

--States may provide incentives to the utilities.

* Sec. 104 required the Secretary of Energy to report to Congress on energy saving results and the Comptroller General shall submit a report evaluating the utility and home heating supplier plans.

--Amended NECPA, Sec. 225 to allow the alternative plans to satisfy NECPA requirements.

* Sec. 105 added NECPA, Sec. 228 to terminate the authority under these sections as they expire on June 30, 1989.

* Sec. 201 repealed NECPA, Title VII, which had required conservation in commercial buildings and multi-family dwellings.

--State conservation plans in place before August 1, 1984, with respect to regulated utilities, will remain in place until January 1, 1990.

* Sec. 202 required the Secretary of Energy to demonstrate innovative technology with industry partners in order increase energy efficiency in commercial buildings.

1987

The NATIONAL APPLIANCE ENERGY CONSERVATION ACT OF 1987, Pub. L 100-12, March 17, 1987

* Sec. 3 amended EPCA, Sec. 322 listing the 12 consumer products to which standards are to be assigned and provided that the Secretary of Energy may name other products.

* Sec. 4 amended EPCA, Sec. 323 that had established test procedures for 13 appliances, to add room air-conditioners, direct heating equipment, and pool heaters to this list.

* Sec. 5 amended EPCA, Sec. 325 to set conservation standards the first of which was assigned for January 1, 1990.

--Any person may petition the Secretary of Energy to amend a standard.

--Amended standards must be designed to achieve the maximum improvement in energy efficiency.

--Secretary may set stronger standards or standards for additional products only if they are economically justified (to include Attorney General determination).

--Procedure for new or amended standards included publication in the Federal Register and public comment.

--Compliance with standards determined through the established test procedures.

--Exemption for small manufacturers for up to 24 months (small defined as less than \$8 million for 12 month operation).

* Sec. 6 amended EPCA, Sec. 326 to allow the Secretary of Energy to require manufacturers to submit information on the feasibility of proposed energy efficiency standards.

* Sec. 7 amended EPCA, Sec. 327 which had stated that this law supersedes any State(s) regulation made after the effective date of this act.

--States can petition for an exemption.

--Exemption for certain building code requirements for new construction.

* Sec. 10 required the Secretary of Energy to continue to report to Congress as required by EPCA, Sec. 338.

The HOUSING AND COMMUNITY DEVELOPMENT ACT OF 1987, Pub. L 100-242,
February 5, 1988

* Sec. 569 amended the Sec. 604 of the National Manufactured Housing Construction and Safety Standards Act of 1974, to add the following subsection:

--Federal manufactured home construction and safety standards established by the Secretary [of HUD] shall include preemptive energy conservation standards.

--These standards to be cost-effective performance standards, providing alternative practices that result in net estimated energy consumption equal to or less than the specified standards.

1988

NATIONAL APPLIANCE ENERGY CONSERVATION AMENDMENTS OF 1988, Pub. L 100-357, June 28, 1988

* Law added fluorescent lamp ballasts to the list of products covered by NAECA.

The **FEDERAL ENERGY MANAGEMENT IMPROVEMENT ACT OF 1988**, Pub. L 100-615, November 5, 1988

* Sec. 2 amended NECPA to alter the following sections:

* Sec. 543 required all Federal agencies apply energy conservation measures to buildings to reduce consumption by 10% of 1985 levels by 1995.

--Excluded buildings where energy intensive activities are performed.

--Required agency submission of plan(s) to meet this goal and also required the performance of energy surveys.

* Sec. 544 required the Secretary of Energy to establish life-cycle cost methodology for Federal buildings.

--Done in coordination with GSA, DOD, NIBS, and OMB.

--Life-cycle cost analyses to be used in designing new Federal buildings and retro-fitting existing ones.

--Leasing preference to buildings that minimize life-cycle costs.

* Sec. 545 required each agency to specify funds for energy conservation in the President's annual budget.

* Sec. 546 required each agency to establish an incentive program for energy conservation.

* Sec. 547 created an inter-agency task force to assess the progress of all agencies in achieving energy savings, to collect and disseminate information on conservation, and develop options for use in conservation.

--To meet at least twice per year.

* Sec. 548 required each agency to report annually to the Secretary of Energy.

--The Secretary of Energy shall report to Congress annually.

* Sec. 3 required the Secretary of Energy to carry out an energy survey to determine the cost-effective energy savings available and make recommendations for achieving these savings.

1990

The CRANSTON-GONZALES NATIONAL AFFORDABLE HOUSING ACT, Pub. L 101-625, November 28, 1990

* Sec. 109 required the Secretary of HUD to promulgate energy efficiency standards for the construction of public housing and housing receiving Federal mortgage assistance.

--To meet CABO-MEC standards.

--CABO standards to be developed by a task force of interested parties.

* Sec. 257 required the Secretary of HUD to create a model program to provide safe and efficient affordable housing for low-income people, including those receiving assistance under Title IV of ECPA.

* Sec. 502 required the Secretary of HUD to assess public housing agency performance including energy consumption.

--Adjustments for unit sizes.

--Adjustments for different climatic and geographic regions.

* Sec. 508 included cooling requirements in energy consumption standards in a manner identical to that used to determine the heating degree day adjustment factor.

* Sec. 523 established a HUD demonstration program to encourage the use of private energy service companies (ESCOs) and provided technical assistance to five Public Housing Agencies (PHAs) to demonstrate potential energy savings in five public housing projects through ESCo contracts.

--Secretary of HUD to report to Congress as soon as practicable after one year from the enactment of this Act on the results of this demonstration.

* Sec. 943 established the National Commission on Manufactured Housing to study and investigate the **National Manufactured Housing Construction and Safety Standards Act of 1974** and to determine the need for revised and additional standards.

* Sec. 944 called for an efficiency standard in which changes over time in residential energy efficiency may be compared to be established and required the Secretary of HUD to report to Congress on any activity undertaken to increase energy efficiency including an analysis of the Joint HUD/DOE program of 1990.

* Sec. 945 required HUD to establish a five-year plan for increased energy efficiency in newly constructed, rehabilitated, and existing housing using the assessments gathered under Sec. 944, and to provide progress reports biennially.

* Sec. 946 required HUD, in consultation with DOE, to promulgate a plan making housing more affordable by using mortgage financing incentives for energy efficiency.

* Sec. 952 established the Advanced Building Technology Council within NIBS to identify and evaluate new technologies.

* Sec. 961 required HUD to establish a program demonstrating methods for improving energy efficiency.

PART II: *Federal Agency Policy*

The Role of Standards in Building Energy Efficiency

Introduction

Summary

Federal agencies became involved with building energy standards in 1975 with the passage of EPCA. Further legislation, notably ECPA and NECPA, expanded and redefined the federal role. This legislation has put a number of requirements for all agencies, as well as specific requirements for several agencies. The two central agencies are DOE and HUD³. DOE is responsible for the development and promulgation of standards, while HUD is charged with implementing them. FmHA has also developed and implemented its own standards. Several other agencies are also involved in standards-related work, either due to their large number of buildings or their ability to evaluate the need or applicability of standards. The first category includes GSA, VA, USPS, and DOD. These agencies all have significant quantities of buildings that must meet energy standards. The second group is comprised of NIST, OMB, and to a lesser extent, DOC and DOT. These agencies do not have a use for the standards, rather they are consulted during the development of the standards for any number of reasons relating to their jurisdiction.

Agency Requirements

There have been a number of legislative requirements that federal agencies were to meet since 1975.

- * Sec. 381 of EPCA required the President to develop a ten-year efficiency plan for buildings owned or leased by the government.
- * Sec. 306 of ECPA required all federal agencies to meet or exceed ECPA standards for any new buildings. This was later amended to push back the deadline to match the deadline for the development of the standards.
- * Sec. 656 of DOE Organization Act required USDA, DOC, DOD, DOI, DOT, GSA, HUD, and USPS to designate an energy conservation officer.

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³For the purposes of energy efficiency requirements, HUD incorporates the Federal Housing Administration, FHA.

* Sec. 501 of NECPA made the ten-year efficiency plan in Sec. 381 of EPCA applicable to all executive agencies and the USPS.

* Sec. 595 of SEECA required consensus between federal agencies on factors and data used to develop energy conservation standards.

Standards Development

The two agencies most closely linked with energy building standards are HUD and DOE. With the creation of the DOE in 1977, the responsibility for the development and promulgation of standards was taken from HUD. HUD retained implementation duties however, due to its large stock of housing. This dichotomy has resulted in the development and use of two distinct standards, minimum property standards by HUD and energy performance standards by DOE. FmHA, within the USDA, has also developed separate standards for its housing. The majority of other federal agencies use the DOE standard, with the exception of FHA, which uses the HUD standards.

Agency Policy

Each of the three agencies, DOE, FmHA, and HUD with responsible for the development of building energy efficiency standards is profiled in a following section. Each section contains background information on the agency and its role in the development or use of energy standards, the current standards in use, the legislative mandate or development for the standards, the development or progression of the actual standards, and a conclusion that evaluates the agency's role in standards.

Department of Energy Policy

Background

The creation of the DOE in 1977 during the peak of energy efficiency legislation brought the mandate for the development of standards under central control. Efficiency standards had been nominally under HUD domain, but these were primarily related to domestic appliances and state conservation plans. Building standards, mandated by ECPA in 1976, had yet to be developed. The newly created DOE lobbied hard in meetings with HUD and OMB to control the development of the standards, and were successful in gaining the powers granted to HUD under EPCA and ECPA except for implementation authority which remained with HUD. After several delays, due to a combination of new legislation, policy changes, and inadequate funding the DOE began to promulgate interim standards in the middle-Eighties. The new legislation called for interim standards, a demonstration program, a report to Congress, and then final standards. Final interim standards were published in 1989 and 1991. Final standards are expected after the results of the demonstration projects are enhanced.

Current Standards

For residential buildings, the interim standards, 10 CFR 435, promulgated in the Federal Register on August 25, 1988 (Vol 53, Number 165) and amended in the Federal Register on January 31, 1991 (Vol. 56, Number 21) are mandatory for new federal buildings, and serve as guidelines for new non-federal buildings. DOE plans to publish voluntary standards for new non-federal housing in the near future, having recently completed a project with ASHRAE that culminated in recommendations for such standards. Commercial and multi-family building standards, 10 CFR 435, were published in the Federal register on January 30, 1989 (Vol. 54, Number 18). They are mandatory for new federal buildings, and are suggested voluntary performance standards for the non-federal sector.

Legislative Development

As discussed in the "background" section above, the DOE was granted standards development powers at its creation, under the ECPA and EPCA legislation. EPCA called for efficiency standards for appliances and State efficiency planning. ECPA, Title III gave DOE the mandate for the development of mandatory efficiency standards for all new

residential and commercial buildings, which were to be promulgated by February 1980. With the passage of NECPA in 1978 the standards program was expanded to include schools, hospitals, and local government buildings. Life-cycle costing for federal buildings was established. SEECA, passed in 1980, included commercial and multi-family buildings in the standards program. However, this was the last piece of pro-conservation legislation until 1987. Standards had yet to be promulgated as the deadline was continually pushed back, first by the **Housing and Community Development Act of 1980**, which called for interim standards by August 1, 1981 and final standards by April 1, 1983. In 1981, all energy conservation standards were made voluntary for new non-federal buildings by the **Omnibus Budget Act of 1981**, and penalties for non-compliance were eliminated. This Act also delayed the promulgation of standards until April 1, 1984. The legislative mandate for efficiency and conservation was continually weakened over the next five years as the cheap cost of energy combined with the massive deregulation pursued by the Reagan administration to reduce the need for energy efficiency in the eyes of policy makers. The **Conservation Service Reform Act of 1986** repealed the commercial and multi-family provisions included by SEECA. The passage of NAECA and FEMI in 1987 and 1988 began a period of upswing in efficiency legislation by updating the appliance efficiency standards of EPCA and calling for specific energy savings in federal buildings through life-cycle costing and incentive programs.

Residential Buildings Standards Development

In November of 1979, DOE published a notice of proposed rulemaking (NPR) for performance standards in accordance with the ECPA mandate. The proposal was extremely controversial, generating volumes of response from interested parties. The NPR failed to gain popular support for four reasons:⁴ 1) industry was excluded from the development of Building Energy Performance Standards (BEPS) and thus would not support them, 2) they were to be mandatory federal standards rather than a consensus industry standard, 3) BEPS was a new kind of standard (performance-based rather than prescriptive), unfamiliar to those in the field, and 4) BEPS was based on DOE-2, which was largely unproven at that time. Due to the volume of criticism, this NPR was not acted on. Legislative and policy changes slowed the program in the early eighties. When DOE revived the standards program, its goals were different. The Eighties version of the standards were to be voluntary for all non-federal buildings, and demonstration projects required to illustrate the effectiveness of the

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⁴*Energy Conservation Standards for New Buildings Proposed Program Plan, Office of Building Energy Research and Development, April 1984, revised October 1984, p 5.*

interim standards. Additionally, development was to be done in close proximity with industry groups to facilitate widespread acceptance. On August 20, 1986, DOE published proposed interim standards for new federal residential buildings, requiring the calculation of an energy-consumption goal using a specific computer program as the primary calculating tool. DOE promulgated interim standards on August 25, 1988 with a revised version of the computer program designated COSTSAFR (Conservation Optimization Standard for Savings in Federal Residences) that allows calculations to be made for various building types and climatic regions throughout the United States. DOE also published proposed thermal mass credits for walls and glazing options to be included in the next iteration of COSTSAFR. An alternate path for compliance with the interim standards was proposed. The new version of COSTSAFR, version 3.0 was adopted on January 31, 1991. The interim standards were amended, incorporating all of the proposals presented in August of 1988. Final standards are expected after analysis of current demonstration projects.

Commercial and Multi-family Residential Buildings Standards

Early development of these standards follows the same path as residential standards. When DOE revived the program in the mid-eighties, it decided to develop commercial/multi-family standards on a separate track, primarily due to legislative changes discussed above. DOE published a NOPR on May 6, 1987 for new federal commercial and multi-family buildings, which was intended to also serve as a guideline for non-federal buildings. On January 30, 1989, DOE published interim standards for commercial and multi-family buildings, based on the comments received in response to the May, 1987 proposal. Final standards are expected after the analysis of results from ongoing demonstration projects.

Conclusion

From its inception in 1976 the standards development process has undergone a number of significant changes. DOE was given the mandate for the development of standards in 1977, but HUD still had implementation authority. The scope of the standards was gradually increased by successive legislation until 1980, when a drastic reversal began. The date for promulgation was pushed back more than once. For the duration of the Reagan administration, legislation stripped DOE of both scope and authority for the development of standards. Only federal buildings were left untouched, all private sector compliance and sanctions were deleted from the mandate and standards were made voluntary for these buildings. DOE has seen its role grow slightly in the past years with the passage of NAECA and FEMI.

Early attempts at standards, notably the proposed rules of 1979, met stiff resistance from all sectors of the building community for their stringency and format. However, the standards DOE has published are still tougher than those developed by other organizations, notably CABO and ASHRAE. But while several federal agencies are using DOE standards exclusively for their new buildings, their acceptance by the private sector has not significantly improved since 1979. The closer working relationship with ASHRAE and CABO that is being cultivated through joint research and collaboration should help promote the use of DOE standards by making all standards more compatible.

Department of Housing and Urban Development Policy

Background

The Department of Housing and Urban Development is responsible for carrying out laws, rules, and regulations pertaining to U.S. housing policy. A number of organizations are interned in the Department, including the Federal Housing Administration (FHA), which administers Federal loans and mortgages in cities where the population exceeds 20,000. HUD funds are used only in Federally-assisted housing, that includes public housing, Federally-assisted mortgages, and other programs such as HOME and HOPE, designed to help house lower income families. Therefore, affordability is a particularly important influence on the development of HUD regulations. To make housing as affordable as possible, HUD attempts to keep public housing mortgages or rent low through the consideration of the incremental costs of operating a home. Energy costs are a vital element of these operating costs, so energy standards are mandatory for new public and Federally-assisted housing.

HUD standards have developed on two distinct tracks. The first set of standards are Minimum Property Standards (MPS), in use in public housing. The second set are Federal Manufactured Home Construction and Safety Standards (FMHCSS), used in manufactured housing.

Current Standards

HUD adheres to MPS in the construction of new public housing and housing mortgaged by the FHA. MPS are internal HUD regulations based on legislative mandates. They include requirements for construction, safety, and materials, as well as thermal requirements. The thermal requirements are the criteria for the energy performance of a newly constructed home under HUD jurisdiction, and are in 24 CFR 200(s)929. MPS standards for multi-family homes differ from those for single-family housing or manufactured housing. Additionally, the energy efficiency requirements of the MPS depend on the type of fuel used to generate power in the home. This distinction is unique among building energy efficiency standards.

Current Federal Manufactured Home Construction and Safety Standards (FMHCSS), are implemented by HUD as standards for mobile homes only. HUD has recently published a NOPR to amend FMHCSS to "include preemptive standards significantly upgrading the existing energy conservation requirements."⁵ These amendments can be found in 24 CFR 3280.

Legislative References

HUD has figured prominently in legislation concerning energy efficiency. The original mandate for the development of standards was given to HUD under EPCA and ECPA, but DOE successfully gained control of the development of these standards. MPS were referenced in the Housing and Community Development Amendments of 1979, which invalidated the final rule revision 6a, "Increase in Thermal Requirements for HUD Minimum Property Standards," a proposed increase in PHA-controlled housing. The Housing and Community Development Act of 1980 increased mortgages by 20% for solar energy use or residential conservation measures when implemented with MPS, while continuing local standard exemptions to the MPS. The Cranston-Gonzales NAHA required HUD to develop standards for PHA-controlled housing.

The National Manufactured Housing Construction and Safety Act of 1974 established manufactured housing standards, the FMHCSS. These were not referenced again in legislation until the Housing and Community Development Act of 1987, when the standards were amended to require HUD to include energy conservation standards. In 1990, the Cranston-Gonzales NAHA established a national commission to develop recommendation for further modernizing the Manufactured Housing Construction Safety and Standards Act of 1974.

Minimum Property Standards Development

Before the Department of Energy existed, the Department of Housing and Urban Development was tasked with developing national energy standards for new buildings. This was done initially by including thermal requirements in the Minimum Property Standards. When the responsibility for developing standards was transferred to the Department of Energy upon its organization in 1977, HUD continued to use the MPS as the criteria for

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⁵*Federal Register*, Vol. 57, No. 35, "Summary" section, February 24, 1992.

energy efficiency requirements for public housing, Federally-assisted mortgages, and other housing stock under its control. HUD continued to use MPS as the DOE standards program was unable to promulgate an accepted standard for Federal buildings until 1988.

Thermal energy requirements were first included in the MPS in the early 1970's, and became effective June 24, 1974. On April 16, 1979, HUD proposed an update of the MPS to increased the thermal requirements. These new standards for new construction became effective on September 30, 1982. The thermal requirements for the MPS were updated again in 1987, and have remained unchanged since that time.

In the late 1970's, HUD attempted to further regulate energy performance in housing stock controlled by Public Housing Authorities (PHAs). On December 28, 1978, HUD published in the Federal Register a NOPR to require PHA review of their existing buildings, identification of those with a potential for energy conserving improvements and a determination of the cost effectiveness of these measures. The proposed rule was later invalidated by both HUD internal regulations and the Housing and Community Development Act of 1979⁶. This ruling temporarily closed the issue of retro-fitting existing housing stock controlled by the PHAs within HUD, however, passage of the Cranston-Gonzales NAHA has reopened that question.

During the mid-eighties (1984, 1985, and 1986) acceptable private sector standards were found that could be referenced by HUD in place of the Federal agency MPS that covered the same technical issues -- except for one. The private, voluntary standards did not address thermal insulation standards for one and two family dwellings. A private sector standard, the model energy code, was found to have thermal insulation standards for multi-family and care type housing, but no such standards was found for one and two family dwellings.

In 1987 and 1988, however, the CABO model energy code became the first such private sector code to promote energy saving techniques that were at least as effective as the MPS for one and two family dwellings. The Department of Housing and Urban Development therefore published a NOPR on November 5, 1990 to reference the thermal insulation standard in the Model Energy Code instead of the Federal agency standards developed through the MPS 24 CFR 200.926(d). HUD is working with DOE to get the new rule in place as soon as possible. Progress has been delayed by a lack of attention at HUD and some HUD confusion about whether this new ruling will fulfill the requirements of Sec. 109 of the Cranston-Gonzales NAHA of 1990 that requires HUD to develop energy efficiency

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⁶See above section detailing legislative references.

standards for PHA-controlled housing.

Manufactured Housing Standards Development

Thermal requirements for manufactured housing were first introduced by the **National Manufactured Housing Construction and Safety Act of 1974**. The standards developed in response to this Act, the FMHCSS, were designed to improve safety and construction practices. In 1982, HUD announced its interest in adopting a voluntary code or standard to replace the FMHCSS. The replacement was to occur by having the HUD standard reference the voluntary code or standard, which HUD would implement and enforce. However, this replacement was delayed five years as HUD completed revisions of its own standards. Finally in 1988, HUD announced that CABO was selected to develop a model standard that the FMHCSS would reference. An additional set of standards was developed by the Manufactured Housing Institute. Both recommendations form the basis for the NOPR HUD issued on February 24, 1992, in its attempt to update the FMHCSS.

Conclusion

The energy requirements in the MPS are substantially different from voluntary codes and standards and from other Federal standards. The energy provisions in the FMHCSS also differ substantially from other standards. However, HUD is taking steps towards implementing the CABO Model Energy Code in place of MPS, and referencing the MEC in the FMHCSS. The MEC contains more stringent provisions that would bring HUD regulations into compliance with many State requirements. This compliance is essential for builders, regulators and consumers. The uniformity created by HUD's adoption of the MEC, expected through acceptance of the new proposed rule sometime in mid-1992, is an important development to bring Federal and voluntary energy conservation requirements closer together.

The comprehensive energy legislation before Congress includes provisions governing manufactured housing standards. S. 2166, the National Energy Security Act of 1991 would amend the Cranston-Gonzales NAHA to make the energy efficiency and thermal requirement evaluation of manufactured housing a more important function of the Commission on Manufactured Housing. Additionally, S. 2166 gives the Secretary of Energy the task of evaluating manufactured housing energy codes and testing the performance of this type of housing to determine cost effectiveness of manufactured housing constructed to the standards established by the Commission. The House of Representatives has a similar comprehensive bill, H.R. 741, which also requires the Secretary of Energy to assess energy performance of manufactured housing and make recommendations to the Commission.

Farmer's Home Administration Policy

Background

The Farmers Home Administration (FmHA) is organized under the Department of Agriculture. FmHA insures mortgages for housing in rural areas (which comprise 90% of the United States privately owned land area), as well as in cities with a population below 20,000. Their funding authorization is in the \$1.5 billion range. By comparison, the Federal Housing Authority in HUD, which insures urban mortgages, has a budget of nearly \$5 billion. FmHA only provides Federally-secured loans for families with incomes of \$15,600 or less per year.

Current Standards

The current thermal performance construction standards implemented by the Farmers Home Administration are in Part 7 of the Code of Federal Regulations, Section 1924a, exhibit D.

Legislative References

FmHA building energy standards are not based on any legislative mandate. Instead, FmHA has insisted their borrowers adhere to these standards based on cost effectiveness and to reduce energy costs and usage. Despite the absence of a legislative mandate, there are some legislative references noting the USDA's responsibility to provide energy efficient housing upon the development of the FmHA standards. In 1978, NECPA, Sec. 252(b) required the Secretary of Agriculture to promote energy saving techniques for FmHA-assisted housing. The Housing and Community Development Act of 1980, Sec. 508 amended the Housing Act of 1949 to give the Secretary of the USDA the authority to set energy conservation standards for buildings under USDA jurisdiction. The passage of the Supplemental Appropriations Act of 1984 specified the Secretary of Agriculture to approve building standards in accordance with HUD MPS, voluntary national model building codes, or manufactured housing standards, and further required the Secretary of Agriculture to promote energy conservation by use of standards for new residential buildings that are consistent, when practicable, with HUD standards and incorporate energy performance requirements.

Standards Development

Originally, the Farmers Home Administration used the Department of Housing and Urban Development minimum property standards (MPS) to guide their building practices. Up until 1976, HUD MPS included no energy efficiency provisions.

In 1975, twenty-five homes insured by FmHA mortgages were returned to FmHA stock when twenty-five families moved out of their FmHA-insured homes. This unusually high turnover stimulated a FmHA investigation, that determined the extremely cold winter had produced energy bills in these homes that were as much as, or greater than, the mortgage payments. Although the mortgages were relatively low, the energy costs of the homes made them unaffordable for these families.

In the wake of this investigation, FmHA decided it would no longer use the HUD MPS, and would instead develop its own standards. These standards would include efficiency provisions to reduce the cost of energy, thus saving energy and ensuring affordability. Participants from HUD, VA, GSA, DOE, and the Tennessee Valley Authority worked with FmHA to develop the new standard. Within a week of its development, the National Bureau of Statistics (Now the National Institute of Science and Technology) approved the new standard, which FmHA decided to adopt.

The thermal performance construction standards for the FmHA Rural Housing Loan Program were first published in the Federal Register in October 25, 1977 in the form of a Final Rule. They were scheduled to take effect March 15, 1978. The National Association of Home Builders and the Concrete Masonry Association felt that these standards had been developed too quickly and that a number of organization had been unable to comment on the standards. NAHB's specific concern was that FmHA did not have an environmental impact statement (EIS) to accompany the standards. FmHA used the Department of Housing and Urban Development EIS instead. NAHB failed in their efforts to delay the new standards, which became active March 15, 1978.

Conclusion

Farmer's Home Administration thermal performance standards have not changed for the last 13 years except for technical amendments. They are still considered progressive within the housing industry. Minnesota is the only State that has developed more stringent thermal standards (maximum height for component of R-45, the FmHA standard is R-38).

Additionally, Farmer's Home Administration thermal performance standards are generally stricter than HUD building standards. However, HUD building energy standards differ based on whether electricity, natural gas, or propane is used in the building, while FmHA thermal performance standards do not differ for different fuel types.

ASHRAE, HUD, DOE and others have expressed an interest in FmHA thermal performance standards as a feasible model for building energy codes. The FmHA does not have any plans to update its standard in the near future, however the standards for slab edge will be clarified in response to recent inquiries from the States of California and Indiana. These States have expressed confusion about the climactic region differentials involved in the FmHA standards.

PART III: *Voluntary Codes and Standards*
1973-1990

The Role of Standards in Building Energy Efficiency

1973
1974
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1976
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1980
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Voluntary Codes & Standards Timeline

- * NBS (NIST) begins work on "design criteria to attain energy conservation in new buildings"⁴ at the request of NCBCS
- * NBS (NIST) document NBSIR 74-452 "Design and Evaluation Criteria for Energy Conservation in New Buildings" delivered to NCSBCS and immediately transmitted to ASHRAE as a basis for development of a
- * ASHRAE/ANSI/IES 90-1975 "Energy Conservation in New Building Design" adopted from edited NBSIR 74-452
- * EPCA legislation provides grant money to States adopting or exceeding 90-75 standard
- * ERDA (DOE) grant to NCSBCS to adapt 90-75 into code language
- * ECPA legislation creates Federal mandate for development of energy efficiency standards
- * DOE publishes MCEC-77, a code version of 90-75 developed by BOCA, ICBO, NCSBCS, and SBCCI
- * DOE publishes NOPR for performance standards (BEPS) in November, but they fail to get industry support and are not enacted
- * 90-75 revised by ANSI/ASHRAE/IES to be 90A-1980
- * BOCA promulgates National Energy Code
- * Omnibus Budget legislation makes DOE standards mandatory for federal buildings, but voluntary for other buildings
- * CABO begins update of MCEC-77
- * DOE and ASHRAE begin collaboration on commercial and multi-family building standards
- * CABO update of MCEC-77 comes out as Model Energy Code (MEC) based on 90A-80 requirements
- * CABO begins periodic review of MEC
- * ASHRAE project to replace parts of 90A-80 & 90.B-75 with 90.1 for all buildings except low-rise residential
- * BOCA update of NEC published
- * ASHRAE project to replace the remainder of 90A-80 & 90.B-75 with 90.2 for low-rise residential buildings
- * CABO update of MEC published
- * DOE publishes NOPR for new federal residential buildings
- * ASHRAE & IES sign agreement to cosponsor energy standards
- * BOCA update of NEC published
- * ASHRAE publishes 90A-a-87 addendum to 90A-80
- * DOE publishes NOPR for new federal commercial and multi-family buildings
- * DOE promulgates interim standards for new federal residential buildings
- * DOE promulgates interim standards for new federal commercial and multi-family buildings
- * CABO update of MEC published
- * ASHRAE/IES publish 90.1-89, a revision of 90A-80 and 90.B-75 for all buildings but low-rise residential
- * BOCA update of NEC published

⁴ National Bureau of Standards, "Commerce News", February 28, 1974.

Introduction

Summary

With the energy crisis of the early Seventies⁷, the state building code officials began to see the need for energy efficiency standards. NCSBCS, at that time a young association with no permanent staff, was among the first to recognize that the fragmented state of State building codes could be replaced by a uniform, nationally accepted code. NBS, acting as the secretariat for NCSBCS, developed a research report in the form of a building energy efficiency standard for use on a national level. This document was passed on from NCSBCS to ASHRAE (under recommendation from NBS) as the basis for the development of a voluntary consensus standard. After passing through an ASHRAE general meeting and being modified by ASHRAE, Standard 90-75 was born. It was the first national energy efficiency standard for new buildings.

At this time the EPCA legislation passed Congress, creating a State grant program for states that included 90-75 or more stringent requirements for new buildings. This legislation, and the ECPA and NECPA legislation that followed it, created the mandate for the federal government to get involved in building energy efficiency. It would be several years, however, before the government was able to co-opt the building community to gather widespread support for standards. Initial efforts at performance standards alienated the industry and many years were to pass before they worked together.⁸

Shortly after the promulgation of 90-75 the three largest regional building code organizations--BOCA, ICBO, and SBCCI--formed CABO in an attempt to overcome the difficulties of national cooperation. NCSBCS, receiving support from the newly created DOE, rewrote 90-75 into enforceable code language to further its adoption by builders and regulators. This document, MCEC-77, became the precursor to the MEC. CABO later adapted the MCEC and revised it as the MEC. Since that time, both the ASHRAE standard and the MEC have been periodically updated. Typically, the promulgation and implementation of codes has followed the development of standards by several years.

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⁷See Social and Political Background section in Part I of this report.

⁸See DOE Policy section on residential building standards development.

The following sections will illustrate the development of standards and codes, particularly the ASHRAE/IES "Energy Conservation in New Building Design" and the CABO Model Energy Code as they relate to each other and to the work being done at DOE. The roles of the major organizations in the development of building energy efficiency standards and codes will be discussed.

Voluntary Building Energy Efficiency Standards

Introduction

State building code officials began to see the need for energy efficiency standards during the energy crisis of the early Seventies. Several groups, including ASHRAE, ANSI, and ASTM had already promulgated standards covering thermal performance of building elements, but there was no widely accepted standard covering the energy consumption of an entire building. Three key groups took the lead in the development of a new standard: ASHRAE, NBS, and NCSBCS. NCSBCS was instrumental in initiating the development of early standards, as well as translating this language into enforceable code.⁹ NBS was responsible for much of the early research and drafting of standards. ASHRAE served first as a forum for gaining widespread support from the building community and promulgating the standard, and later played a primary role in updating and revising standards to keep pace with technological and regulatory developments. Interaction with the Federal government throughout the development of efficiency standards has been an important, although not always positive, part of the process. The role of these groups and this interaction will be discussed in this section.

The First Standard

NCSBCS was among the first organizations to recognize that the replacement of State building energy codes with a uniform, nationally accepted code could result in more efficient implementation and significant energy savings. It was 1973, and States were scrambling to meet their energy needs in the face of an effective oil embargo without a recognized national guideline. NCSBCS, composed of representatives from State government, saw the need for such a document to coordinate building regulations. As a relatively young organization without permanent staff, NCSBCS needed to contract the work out. NBS, acting as the secretariat for NCSBCS, developed a document which was "a set of design and evaluation criteria for energy conservation in most types of new buildings."¹⁰ This document was presented to NCSBCS in early 1974, who immediately passed it on to ASHRAE (under recommendation from NBS) for sponsorship as a consensus building energy standard. After

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⁹See following section, Voluntary Codes.

¹⁰Foreword, NBSIR 74-452, February 27, 1974.

passing through an ASHRAE general meeting and being revised by ASHRAE, Standard 90-75, Energy Conservation in New Building Design, was approved in the summer of 1975. It was the first national energy efficiency standard for new buildings and remains (in updated form) the foundation of building efficiency standards and codes.

Early Federal Role

In 1975, the EPCA legislation passed Congress, providing grant money to States that adopted 90-75 or stricter requirements for new buildings. The Federal incentives in EPCA were instrumental in spurring many states to adopt energy standards at least as stringent as 90-75. This legislation, and the ECPA and NECPA legislation that followed it in the next two years, created the mandate for the federal government to get involved in building energy efficiency. The creation of DOE (from ERDA and the FEA) in 1977 centralized the Federal energy efficiency community, and provided a focus for future Federal activities. However, initial DOE efforts at a performance standard (BEPS) in 1979 aggravated much of the building community for their failure to incorporate this community's views in the development of the proposed standard. This setback, combined with a number of other factors,¹¹ un-tracked the DOE program for several years. It would be several years before the government learned the value of co-opting the building community in the development of standards to ensure widespread support and acceptance.

The Eighties & Nineties--ASHRAE Prominence, DOE Revival

ASHRAE began its periodic review of 90-75 in 1977 to update the standard to reflect the current state of building technologies and the research that had transpired since its passage. The ASHRAE Board of Directors also recommended that a revised draft undergo concurrent review by ANSI. By 1979 the bulk of the Standard (sections 1-9) was ready for publication, however, the remaining three sections were not. ASHRAE decided the urgent need for the information in the first nine sections (designated 90.1)¹² warranted immediate action. The result was Standard 90A-80, a more stringent document than 90-75, reflecting the advances

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¹¹See DOE Policy and Summary, the Federal Role in Developing Building Energy Efficiency Standards sections for more information on the failure of BEPS and the relationship of DOE to industry.

¹²"...90.1 would consist of Sections 1-9; 90.2 Sections 10 and 11; and 90.3 Section 12." Foreword, ASHRAE Standard 90A-1980, p. i, 1980. Section 12 was later disassociated from Standard 90 "because it has potential use for all building energy conservation standards...", ASHRAE Journal, p. 44, May 1983.

made in the efficiency field over those five years. Many States moved to adopt 90A-80, but many others continued to use the older standard. In 1982, the ASHRAE Standards Committee formed an Ad-Hoc Committee to begin work for the revision of 90A-80. Early in 1983, another Ad-Hoc Committee was formed to address the residential aspects of Standard 90, paving the way for ASHRAE to "establish a second Standard 90 committee to write a second Standard 90 on residential construction."¹³ In 1987, ASHRAE published 90A-a-87 Addendum, primarily an update of the residential requirements of 90A-80. ASHRAE and IES promulgated standard 90.1-89, Energy Conservation in New Buildings, Except Low-Rise Residential. Most recently, the project committee has submitted five addenda for public review. The proposed standard for low-rise residential buildings, ASHRAE 90.2, has recently undergone public review, and the project committee is now considering two drafts of additional changes.

DOE has worked closely with ASHRAE in the development of Federal standards in the Eighties and into the Nineties, enabling it to publish interim standards for Federal buildings closely related to the voluntary standards promulgated for the private sector. This cooperation has also allowed the DOE to assume a role in the development of ASHRAE standards by providing technical analysis and computational support, as a substitute for mandatory Federal standards.

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¹³ ASHRAE Journal, p 44, May 1983.

Voluntary Building Energy Efficiency Codes

Introduction

Voluntary energy efficiency codes evolved out of the same needs and circumstances as did standards in the middle-Seventies. However, there are two key differences between them.¹⁴ First, codes are by their nature written in language designed to facilitate enforcement by regulators. While each code is usually based on or compatible with a recognized standard, it is the code which is adopted because of its enforceable provisions. The other significant difference is procedural. Voluntary consensus standards are adopted under nationally recognized consensus procedures (such as those prescribed by ANSI), while codes are usually adopted from these standards by model code organizations and then further adopted by the regulatory body using them (in most cases a state or local government) to fit its specific needs.

The First Code

NCSBCS, receiving financial support from ERDA (DOE), rewrote 90-75 into enforceable code language to further its adoption by building officials. The Model Code for Energy Conservation in New Building Construction, MCEC-77 was technically compatible with 90-75 at the time it was published in 1977. The MCEC was the first enforceable building code that addressed an entire new building, rather than building components. It has served as the model for adapting standards into code, used by model code organizations in the development of their codes. Additionally, MCEC remains on the books of some states to this day.¹⁵

The Model Energy Code

CABO, in conjunction with the largest three regional model code organizations and NCSBCS, later adapted the MCEC as a foundation for a new code, the Model Energy Code. The first version of the MEC, published in 1983, was technically equivalent to Standard 90A-80. Since that time, the MEC has been periodically updated, often incorporating

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¹⁴Information taken from State and Local Adoption and Enforcement of Energy Standards. Report to Congress (draft), section 2, "Background", Battelle Memorial Institute.

¹⁵Information taken from NCSBCS Energy Directory, 1991 edition.

elements of the standards developed by other organizations, especially ASHRAE. The update process was in fact largely based on adapting the MEC to meet ASHRAE standards until the mid-Eighties, when the process became more pro-active. Several groups, including DOE staff and ASHRAE members, aggressively pursued an update of MEC to strengthen thermal performance standards in the MEC, a task that had not yet been accomplished under the consensus procedures used to update ASHRAE standards.¹⁶ The MEC was updated in 1986 and again in 1989, and will likely undergo a significant update in 1992 to match the development of Standard 90.1-89 by ASHRAE, which has been codified to some degree in the Pacific Northwest, but not elsewhere.

The National Energy Code

BOCA published their National Energy Code (NEC) in 1981 in response to the development of the MCEC and Standard 90A-80, while ICBO and SBCCI chose to reference the CABO MEC. The NEC is widely in use in states under BOCA jurisdiction. It undergoes a periodic update every three years to incorporate annual supplemental changes, the latest edition having been promulgated in 1990. Again, substantial changes are expected in response to the development of 90.1-89.

DOE Role

As noted above, the DOE was instrumental in the early stages of code development. It provided the funds and the impetus for the work NCSBCS did in developing the MCEC-77. However, DOE did not play a significant role for the next ten years as CABO and BOCA progressed through iterations of their codes. Recently DOE has been much more active with ASHRAE, and involved in proposing modifications to the MEC and using the model codes as guidelines for developing its own standards.

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¹⁶*Better Building Codes for Energy Efficiency, the Alliance to Save Energy, revised September 1991, page 4.*

PART IV: *Conclusion and Analysis*

The Role of Standards in Building Energy Efficiency

Summary. the Federal Role in Developing Building Energy Efficiency Standards

Legislation

The initial effort to develop and enforce national mandatory standards to all commercial and residential buildings as drafted in the Energy Conservation and Production Act in 1976 was met with heavy resistance due the nature of the standards produced. The conservative building industry, long resistant to regulation, viewed the performance-based standards proposed by DOE in 1979 as unacceptable. Therefore, a strong push was made to alter the Federal government's role in the enforcement of building energy efficiency standards. EPCA, ECPA, and NECPA, the high points of efficiency legislation, were all passed before 1979. Even with the recent concern over strengthening energy efficiency standards, as reflected in legislation introduced in 1991,¹⁷ regulations and legislation for all non-Federal buildings has focused primarily on voluntary building energy standards since the apparent abatement of the energy crisis and the advent of the Reagan Administration, near simultaneous events in the early 1980's.

The reasons for a focus on voluntary standards are simple. Efficiency became much less of a priority when energy costs, especially gasoline prices, decreased. Public focus shifted first to economic concerns (the recession of the early Eighties) and later to national defense priorities. Congressional priorities moved with this shift. Funding levels for efficiency standards were drastically reduced, and the program was slowed considerably. Deregulation was also a large priority of the Reagan Administration. Hence, any mandate for national performance standards faced an uphill battle with the White House.

A number of factors brought efficiency back into prominence in Congress as the Eighties came to a close. The environmental movement gained credence in mainstream America, as well as on Capitol Hill. The Gulf crisis and ensuing war with Iraq highlighted the need for energy security. The Federal government successfully revived its standards program at the end of the 1980's as funding was restored, and legislative efforts were renewed with the passage of the NAECA standards and the Cranston-Gonzales NAHA. Comprehensive efficiency legislation may pass Congress in 1992¹⁸.

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¹⁷See Part IV, Current and Future Federal Developments for in-depth discussion.

¹⁸*ibid*

Relationship to Private Sector Efforts

Industry efforts to develop efficiency standards began some years earlier than those at DOE, with the work done by NBS for NCSBCS. ASHRAE/IES/ANSI Standard 90-1975, adopted from this early work, was the first significant building energy efficiency document, and remains influential in its revised forms, to this day. But it was the period of little activity on the Federal level, 1980-1988, during which private sector efforts were essential to the advancement of efficiency. During this time, States were predominantly charged with enforcing standards, and the successful efforts by NCSBCS and CABO to rewrite ASHRAE standards into enforceable code language began to be adopted on the State level. The Model Energy Code is now in wide use, and along with ASHRAE Standards 90A-80 and 90.1-89 has become the consensus efficiency document. Numerous States accepted these voluntary standards and codes developed in parallel to Federal regulations¹⁹ and are incorporating them into mandatory provisions. This trend is expected to continue²⁰. In recognition, current legislation includes references to these documents and the DOE has begun to work in conjunction with industry in the development of Federal standards. Remembering the difficulties that resulted in early efforts to establish performance standards, close cooperation between the Federal government and the private sector is essential if progress is to continue in an age of rapid technological advancement and restrictive economic conditions.

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¹⁹See Part III, Voluntary Codes and Standards.

²⁰See Current and Future Federal Developments.

Current and Future Federal Developments

Current Legislation--Codes and Standards

Current efforts to improve building energy performance standards are driven in large part by the National Energy Strategy (NES), the Administration's plan for the United States energy policy. The NES, released in 1989, is now the basis for almost all energy legislation and regulation that the Federal government pursues. The Legislative branch, taking its cue from the NES, is formulating comprehensive legislation in an attempt to further secure the U.S. energy future. The development and implementation of building energy efficiency codes and standards as a part of increased energy efficiency, is one facet of energy policy considered in pending legislation.

Legislative efforts concerning energy performance standards are progressing on two dimensions. First, Congress is considering strengthening the **mandatory** energy efficiency standards currently in place for Federal buildings. These efforts would require adherence to established energy standards, which would have to be at least as stringent as the nationally recognized model energy codes.

Second, pending legislation would require Federal support for the continued development of voluntary building energy codes. When the DOE standards program was all but abandoned early in the Reagan Administration, the building industry took up much of the work, continuing to refine and update codes and standards to meet the technological threshold. These industry-developed codes and standards form the basis for the forthcoming Federal recommended standards for privately-owned residential and commercial buildings. Current legislative efforts would require DOE input into the model energy code in consultation with CABO, ASHRAE, the National Conference of States on Building Codes and Standards, and other interested organizations. Incentive funding would be available to States and local jurisdictions that adopt building energy codes at least as stringent as those developed and promulgated by these groups.

Efficiency Rating

Aside from increasing the strength of both Federal mandatory and private sector voluntary energy codes, legislators are interested in the establishment of a voluntary energy efficiency rating system. Legislation currently under consideration would require the Department of Energy to promulgate voluntary guidelines to be used by State and local governments,

utilities, builders, and others that would enable the assignment of an energy efficiency rating to residential and commercial buildings. This would allow comparison of buildings by builders, utilities, consumers, and any other end-users with an interest in the energy performance of a specific building. The value of efficiency could be quantified, and its importance would increase with acceptance of the ratings system. Additionally, in keeping with the National Energy Strategy, Congress is also concerned with strengthening energy efficiency mortgages. With a credible rating system, efficient buildings could receive a mortgage that accounted for this recognized efficiency.

The Future

Energy efficiency and performance standards for buildings will continue to receive consideration in Federal legislation. Federal building energy codes and standards should be especially prominent because the government is tasked with both the development of standards and compliance with these standards. Responding to the mood of the country, there has been a recent recognition in government that Federal buildings should be a showplace for energy efficient technologies and a model for acceptance of efficiency principles.

Conversely, it is likely that the Federal mandate for developing standards for private-sector commercial and residential buildings will soon lapse. Efficiency in private stock will instead depend upon standards and model codes emanating from organizations such as ASHRAE and CABO, that have been effective in past efforts to develop and promulgate material which, if not uniformly adopted, has at least enjoyed widespread acceptance on a national level. This is not to suggest that DOE will abandon standards to the private sector, but that it will likely work within frameworks developed in the private sector and in conjunction with organizations that enjoy widespread industry support.

Conclusion

As conventional sources of energy become a scarcer resource, the opportunities for efficiency in the building sector represent a potential area for vast energy savings. Current legislation would establish a Federal buildings fund from utility rebates and other energy savings monies, to be used on energy efficiency improvements in Federal buildings.²¹ Given this

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²¹S. 1040, page 43.

large opportunity, we can expect both Federal and voluntary energy efficiency standards to become stricter as technology pushes the limits of efficiency and increases the potential savings. Current legislation reflects the need for improvement in building efficiency standards and implementation, and has already begun to cite voluntary standards in recognition of the need for concerted action and uniform policy. Binding Federal legislation can play a key role in the development of stricter standards, particularly standards for Federally owned and operated buildings. The Federal government also has a crucial role to play in cooperation with State governments and the building industry, as the adoption of nationally recognized voluntary energy codes and standards increases in private-sector buildings.

APPENDIX A

Current Law Cross-Reference List

This appendix cites the United States Code reference to legislation pertinent to building standards, as detailed in Part I of this report.

Pub. L 94-163

The ENERGY POLICY AND CONSERVATION ACT OF 1975
42 U.S.C. 6201 et. seq.

Pub. L 94-385

The ENERGY CONSERVATION AND PRODUCTION ACT OF 1976
42 U.S.C. 6831 et. seq.

Pub. L 95-26

The DEPARTMENT OF DEFENSE AUTHORIZATION ACT OF 1977
None

Pub. L 95-91

The DEPARTMENT OF ENERGY ORGANIZATION ACT OF 1977
42 U.S.C. 7101 et. seq.

Pub. L 95-356

The MILITARY CONSTRUCTION AUTHORIZATION ACT OF 1979
42 U.S.C. 5502 et. seq.

Pub. L 95-619

The NATIONAL ENERGY CONSERVATION POLICY ACT OF 1978
42 U.S.C. 6371 et. seq.
42 U.S.C. 8201-8272

Pub. L 96-153

The HOUSING AND COMMUNITY DEVELOPMENT AMENDMENTS OF 1979
12 U.S.C. 1703

Pub. L 96-294

The ENERGY SECURITY ACT OF 1980

12 U.S.C. 1701 et. seq.

12 U.S.C. 3601 et. seq.

42 U.S.C. 1437

42 U.S.C. 6801 et. seq.

42 U.S.C. 8201 et. seq.

Pub. L 97-35

The OMNIBUS BUDGET ACT OF 1981

42 U.S.C. 6801 et. seq.

Pub. L 98-115

The MILITARY CONSTRUCTION AUTHORIZATION ACT OF 1984

10 U.S.C. 2825

Pub. L 98-181

The SUPPLEMENTAL APPROPRIATIONS ACT OF 1984

12 U.S.C. 1701 et. seq.

12 U.S.C. 3610 et. seq.

42 U.S.C. 5401 et. seq.

Pub. L 99-272

The CONSOLIDATED OMNIBUS BUDGET RECONCILIATION ACT OF 1985

42 U.S.C. 8201 et. seq.

Pub. L 99-412

The CONSERVATION SERVICE REFORM ACT OF 1986

42 U.S.C. 8201 et. seq.

Pub. L 100-12

The NATIONAL APPLIANCE ENERGY CONSERVATION ACT OF 1987

42 U.S.C. 6201 et. seq.

Pub. L 100-242

The HOUSING AND COMMUNITY DEVELOPMENT ACT OF 1987

42 U.S.C. 5301

Pub. L 100-357

The NATIONAL APPLIANCE ENERGY CONSERVATION AMENDMENTS OF 1988
42 U.S.C. 6201 et. seq.

Pub. L 100-615

The FEDERAL ENERGY MANAGEMENT IMPROVEMENT ACT OF 1988
42 U.S.C. 8201 et. seq.

Pub. L 101-625

The CRANSTON-GONZALES NATIONAL AFFORDABLE HOUSING ACT OF 1990
42 U.S.C. 1401 et. seq.
42 U.S.C. 12701 et seq.

APPENDIX B

Redline/Strikeout Version of the ENERGY PRODUCTION AND CONSERVATION ACT PUBLIC LAW 94-385 AUGUST 14, 1976

KEY TO AMENDMENTS

P.L. 94-385, Energy Conservation
and Production Act

Plain and Bold text

P.L. 96-399, Housing and Community
Development Act

Red Lined = text added

~~Red Lined/strikeout = Text deleted~~

P.L. 97-35, Omnibus Budget Reconciliation
Act of 1981

Underlined italic bold = Text added

**~~Underlined italic bold/strikeout = Text
deleted~~**

TITLE III -- ENERGY CONSERVATION STANDARDS FOR NEW BUILDINGS

SHORT TITLE

Sec. 301. This title may be cited as the "Energy Conservation Standards for New Buildings Act of 1976".

FINDINGS AND PURPOSES

Sec. 302.(a) The Congress finds that:

(1) large amounts of fuel and energy are consumed unnecessarily each year in heating, cooling, ventilating, and providing domestic hot water for newly constructed residential and commercial buildings because such buildings lack adequate energy conservation features;

(2) Federal voluntary performance standards for newly constructed buildings can prevent such waste of energy, which the Nation can no longer afford in view of its current and anticipated energy shortage;

(3) the failure to provide adequate energy conservation measures in the newly constructed buildings increases long-term operating costs that may affect adversely the repayment of, and security for, loans made, insured, or guaranteed by Federal agencies or made by Federally

insured or regulated instrumentalities; and

(4) State and local building codes or similar controls can provide an existing means by which to assure, in coordination with other building requirements, and with a minimum of Federal interference in State and local transactions, that newly constructed buildings contain adequate energy conservation features.

(b) The purposes of this title, therefore, are to--

(1) redirect Federal policies and practices to assure that reasonable energy conservation features will be incorporated into new commercial and residential buildings receiving federal financial assistance;

(2) provide for the development and implementation, as soon as practicable, of *voluntary* performance standards for new residential and commercial buildings which are designed to achieve the maximum practicable improvements in energy efficiency and increases in the use of nondepletable sources of energy; and

(3) encourage States and local governments to adopt and enforce such standards through their existing building codes and other construction control mechanisms, or to apply them through a special approval process.

DEFINITIONS

Sec. 303. As used in this title:

(1) The term "Administrator" means the administrator of the Federal Energy Administration; except that after such Administration ceases to exist, such term means any officer of the United States designated by the President for purposes of this title.

(2) The term "building" means any structure to be constructed which includes provision for a heating or cooling system, or both, or for a hot water system.

(3) The term "building code" means a legal instrument which is in effect in a State or unit of general purpose local government, the provisions of which must be adhered to if a building is considered to be in conformance with law and suitable for occupancy and use.

(4) The term "commercial building" means any building other than a residential building, including any building developed for industrial or public purposes.

(5) The term "Federal agency" means any department, agency, corporation, or other entity or instrumentality of the executive branch of the Federal Government, including the United States Postal Service, the Federal National Mortgage Association, and the Federal Home Mortgage Corporation.

(6) The term "Federal building" means any building to be constructed by, or for the use of, any Federal agency which is not legally subject to State or local building codes or similar requirements.

(7) The term "Federal financial assistance" means (A) any form of loan, grant, guarantee, insurance, payment, rebate, subsidy, or any other form of direct or indirect Federal

Assistance (other than general or special revenue sharing or formula grants made to States) approved by any Federal officer or agency; or (B) any loan made or purchased by any bank, savings and loan association, or similar institution subject to regulation by the Board of Governors of the Federal Reserve System, the Federal Deposit Insurance Corporation, the Comptroller of the Currency, the Federal Home Loan Bank Board, the Federal Savings and Loan Insurance Corporation, or the National Credit Union Administration.

(8) The term "National Institute of Building Sciences means the institute established by section 809 of the Housing Community Development Act of 1974.

(9) The term voluntary "performance standards" means an energy consumption goal or goals to be met without specification of the methods, materials, and processes to be employed in achieving that goal or goals, but including statements of the requirements, criteria and evaluation methods to be used, and any necessary commentary.

(10) The term "residential building" means any structure which is constructed and developed for residential occupancy.

(11) The term "secretary" means the Secretary of Housing and Urban Development.

(12) The term "State" includes each of the several states, the District of Columbia, the Commonwealth of Puerto Rico, and any territory and possession of the United States.

(13) The term "unit of general purpose local government" means any city, county, town, municipality, or other political subdivision of a State (or combination thereof), which has a building code or similar authority over a particular geographic area.

PROMULGATION OF ENERGY CONSERVATION VOLUNTARY PERFORMANCE STANDARDS FOR NEW BUILDINGS

Sec. 304.(a)(1) As soon as practicable, but in no event later than three years after enactment of this title, the Secretary, only after consultation with the Administrator, the Secretary or Commerce utilizing the services of the Director of the National Bureau of Standards, and the Administrator of the General Services Administration, shall develop and publish in the Federal Register for public comment proposed voluntary performance standards for new commercial buildings. Interim voluntary performance standards for new commercial buildings shall be promulgated by August 1, 1981, and for at least the 12-month period beginning on such date, the Secretary of Energy shall conduct a demonstration project utilizing such standards in at least two geographical areas in different climatic regions of the country. Prior to ~~the effective date of final performance standards promulgated pursuant to this paragraph~~ April 1, 1984 and not later than 180 days after completing such demonstration project, such Secretary shall transmit to both Houses of the Congress a report containing an analysis of the findings and conclusions made as a result of carrying out such project, including at least an analysis of the effect such standards would have on the design, construction costs, and the estimated total energy savings (including types of energy) to be

realized from using such energy standards in commercial buildings. Final voluntary performance standards shall be promulgated ~~within 6 months after the date of publication of the proposed standards by April 1, 1984, and shall become effective within a reasonable time, not to exceed 1 year, after the date of promulgation, as specified by the Secretary.~~

(2) As soon as practicable, but in no event later than three years after enactment of this title, the Secretary, only after consultation with the Administrator, the Secretary of Commerce utilizing the services of the Director of the National Bureau of Standards, and the Administrator of the General Services Administration, shall develop and publish in the Federal Register for public comment proposed voluntary performance standards for new residential buildings.

~~Interim~~ voluntary performance standards for new residential buildings shall be promulgated by August 1, 1981, and for at least the 12-month period beginning on such date, the Secretary of Energy shall conduct a demonstration project utilizing such standards in at least two geographical areas in different climatic regions of the country. Prior to ~~the effective date of final performance standards promulgated pursuant to this paragraph April 1, 1984~~ and not later than 180 days after completing such demonstration project, such Secretary shall transmit to both Houses of the Congress a report containing an analysis of the findings and conclusions made as a result of carrying out such project, including at least (A) an analysis of the effect of such standards on builders (especially on small builders) and on the cost of constructing such buildings and the impact of such cost on the ability of low- and moderate-income persons to purchase or rent such buildings, and (B) an analysis of the estimated total energy savings to be realized (including the types of energy) to be realized from utilizing such standards in residential buildings. Final voluntary performance standards for such buildings shall be promulgated ~~within 6 months after the date of publication of the proposed standards by April 1, 1984, and shall become effective within a reasonable time, not to exceed 1 year after the date of promulgation, as specified by the Secretary.~~

(3) In the development of voluntary performance standards, the Secretary shall utilize the services of the National Institute of Building Sciences, under appropriate contractual arrangements.

(4). Except in the case of Federal buildings as required under section 306, voluntary performance standards under this subsection shall be developed solely as guidelines for the purpose of providing technical assistance for the design and construction of energy efficient buildings.

(b) All voluntary performance standards promulgated pursuant to subsection (a) shall take account of, and make allowance or particular exception as the Secretary determines is appropriate for, climatic variations among the different regions of the country.

(c) The Secretary, in consultation with the Administrator, the Secretary of Commerce, the Administrator of the General Services Administration, and the heads of other appropriate

Federal agencies, and the National Institute of Building Sciences, shall periodically review and provide for the updating of voluntary performance standards promulgated pursuant to subsection (a).

(d) The Secretary, if he finds that the dates otherwise specified in this section for publication of proposed, or for the promulgation of final, voluntary performance standards under subsection (a)(1) or (2) cannot practicably be met, may extend the time for such publication or promulgation, but no such extension shall result in a delay of more than 6 months in promulgation.

APPLICATION OF ENERGY CONSERVATION PERFORMANCE STANDARDS FOR NEW BUILDINGS

Sec. 305. (a) Subject to the provisions of subsection (c) and after the effective date of final performance standards for new commercial and residential buildings pursuant to section 304(a), no Federal financial assistance shall be made available or approved with respect to the construction of any new commercial or residential building in any area of any State, unless—

- (1) such State has certified, in accordance with regulations of the Secretary, that—
  - (A) the unit of general purpose local government which has jurisdiction over such area has adopted and is implementing a building code, or other construction control mechanism, which meets or exceeds the requirements of such final performance standards; or
  - (B) such State has adopted and is implementing, on a statewide basis or with respect to such area, a building code or other laws or regulations which provide for the effective application of such final performance standards;
- (2) such new building has been determined, pursuant to any applicable approval process described in subsection (b), to be in compliance with such final performance standards; or
- (3) such new building is to be located in any area in which the construction of new buildings is not of a magnitude to warrant the costs of implementing final performance standards, as determined by the Secretary after receiving a request for such a determination (and material justifying such request) from the State in which the area is located; except that the Secretary may rescind such a determination whenever the Secretary finds that the amount of construction of new buildings has increased in such area to an extent that such costs are warranted.

The Secretary shall review and conduct such investigations as are deemed necessary to determine the accuracy of such certifications and shall provide for the periodic updating thereof. The Secretary may reject, disapprove, or require the withdrawal of any such

~~certification after notice to such state and an opportunity for a hearing.~~

~~(b)(1) The provisions of this subsection shall not apply to any area subject to the jurisdiction of a unit of general purpose local government or of a State described in subsection (a)(1), and the provisions of this subsection and the approval process applicable under this subsection shall cease to apply to any area at such time as the Secretary receives a certification under subsection (a)(1) with respect to such area.~~

~~(2) The Secretary shall have overall responsibility for the effective application of the applicable approval process described in this subsection in any area not exempted therefrom pursuant to paragraph (1).~~

~~(3) As used in this section, the term "approval process" means a mechanism and procedure for the consideration and approval of an application to construct a new building and which involves (A) determining whether such proposed building would be in compliance with the final performance standards for new buildings promulgated under section 304, and (b) administration by the level and agency of government specified by the Secretary pursuant to paragraph (4).~~

~~(4) The level and agency of government which shall administer the approval process described in this subsection is--~~

~~(A) first, the agency which grants building permits on behalf of the unit of general purpose local government which has jurisdiction over the area in which new construction is proposed, if such agency is willing and able to administer such approval process;~~

~~(B) second, if the agency described in subparagraph (A) is not willing and able to administer such approval process, any other agency of the unit of general purpose government described in such paragraph which has the authority to administer such approval process, if such agency is willing and able to administer such approval process; and~~

~~(C) third, if no agency described in subparagraphs (A) and (B) is willing and able to administer such approval process, any agency of the State in which new construction is proposed which has authority to administer such approval process, if such agency is willing and able to administer such approval process.~~

~~(e) The President shall transmit the final performance standards for new buildings to both Houses of Congress upon the date of promulgation of such standards pursuant to section 304(a), for review by the Congress under this subsection to determine whether the sanction set forth in the introductory clause to subsection (a) is necessary and appropriate to assure that such standards are in fact applied to all new buildings. Such sanction shall be deemed approved as necessary for such purpose (and shall thereafter be enforced, directly and indirectly, by each applicable person and governmental entity) if the use of such sanction is approved by a resolution of each House of Congress in accordance with the procedures specified in section 552 of the Energy Policy and Conservation Act; except that for~~

~~purposes of this section the 60 calendar days described in section 552(b) and (c)(2) of such Act shall be lengthened to 90 calendar days.~~

FEDERAL BUILDINGS

Sec. 306. The head of each Federal agency responsible for the construction of any Federal building shall adopt such procedures as may be necessary to assure that any such construction of any Federal building shall adopt such procedures as may be necessary to assure that any such construction meets or exceeds the applicable ~~final performance standards promulgated pursuant to this title. interim performance standards promulgated pursuant to section 304(a) upon the effective date of the final performance standards promulgated pursuant to such section.~~ Not later than April 1, 1984, the head of each agency shall adopt such procedures as may be necessary to assure that construction of any Federal building meets the applicable voluntary performance standards.

GRANTS

~~Sec. 307. (a) The Secretary may make grants to States and units of general purpose local government to assist them in meeting the costs of adopting and implementing performance standards or of administering State certification procedures or any applicable approval process to carry out the provisions of section 305.~~

~~(b) There is authorized to be appropriated for the purpose of carrying out this section, not to exceed \$5,000,000 for the fiscal year ending September 30, 1977. Any amount appropriated pursuant to this subsection shall remain available until expended.~~

TECHNICAL ASSISTANCE

Sec. 308. The Secretary (directly, by contract, or otherwise) may provide technical assistance to States and units of general purpose local government to assist them in ~~meeting the requirements of this title.~~ furthering the design and construction of energy efficient buildings.

CONSULTATION WITH INTERESTED AND AFFECTED GROUPS

Sec. 309. In developing and promulgating voluntary performance standards and carrying out other functions of this title, the Secretary shall consult with appropriate representatives of the building community (including representatives of labor and the construction industry,

engineers and architects), with appropriate public officials and organizations of public officials, and with representatives of consumer groups. For purposes of such consultation, the Secretary shall, to the extent practicable, make use of the National Institute of Building Sciences. The Secretary may also establish one or more advisory committees as may be appropriate. Any advisory committee or committees established pursuant to this section shall be subject to the provisions of the Federal Advisory Committee Act.

SUPPORT ACTIVITIES

Sec. 310. The Secretary, in cooperating with the Administrator, the Secretary of Commerce utilizing the services of the Director of the National Bureau of Standards, and the heads of other appropriate Federal agencies, and the National Institute of Building Sciences, shall carry out any activities which the Secretary determines may be necessary or appropriate to assist in the development of voluntary performance standards under section 304(a) and to facilitate the implementation of such standards under section 304(a) and to facilitate the implementation of such standards by state and local governments. Such activities shall be designed to assure that such standards are adequately analyzed in terms of energy efficiency, stimulation of use of nondepletable sources of energy, institutional resources, habitability, economic cost and benefit, and impact upon affected groups.

MONITORING OF STATE AND LOCAL ADOPTION OF ENERGY CONSERVATION STANDARDS FOR BUILDINGS

Sec. 311. The Secretary, with the advice and assistance of the National Institute of Building Sciences, shall--

- (1) monitor the progress made by the States and their political subdivisions in adopting and enforcing voluntary energy conservation standards for new buildings;
- (2) identify any procedural obstacles or technical constraints inhibiting implementation of such standards;
- (3) evaluate the effectiveness of such prevailing standards; and
- (4) within 12 months after the date of enactment of this title, and semiannually thereafter, report to Congress on (A) the progress of the States and units of general purpose local governments in adopting and implementing energy conservation voluntary performance standards for new buildings, and (B) the effectiveness of such standards.

APPENDIX C

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