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**Energy Standards and Model Codes Development,
Adoption, Implementation, and Enforcement**

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Executive Summary

This report provides an overview of the energy standards and model codes process for the voluntary sector within the United States. The report was prepared by Pacific Northwest Laboratory (PNL) for the Building Energy Standards Program and is intended to be used as a primer or reference on this process.

Building standards and model codes that address energy have been developed by organizations in the voluntary sector since the early 1970s. These standards and model codes provide minimum energy-efficient design and construction requirements for new buildings and, in some instances, existing buildings.

The first step in the process is developing new or revising existing standards or codes. There are two overall differences between standards and codes. Energy standards are developed by a consensus process and are revised as needed. Model codes are revised on a regular annual cycle through a public hearing process. In addition to these overall differences, the specific steps in developing/revising energy standards differ from model codes.

These energy standards or model codes are then available for adoption by states and local governments. Typically, energy standards are adopted by or adopted into model codes. Model codes are in turn adopted by states through either legislation or regulation.

Enforcement is essential to the implementation of energy standards and model codes. Low-rise residential construction is generally evaluated for compliance at the local level, whereas state agencies tend to be more involved with other types of buildings. Low-rise residential buildings also may be more easily evaluated for compliance because the governing requirements tend to be less complex than for commercial buildings.

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1.0 Introduction

During the last 20 years, Pacific Northwest Laboratory (PNL) has been involved in numerous building energy standard and model code activities for the U.S. Department of Energy (DOE). These activities (which include standard and code development, research and evaluation of all phases of the process, and State and public education) take place within the Building Energy Standards Program conducted by PNL for the DOE Office of Codes and Standards.

As one of its many education efforts within the Program, PNL is providing this overview of the U.S. voluntary sector energy standards and model codes process, which includes development, adoption, implementation, enforcement, and training. This report is intended to be used as a primer or reference for those desiring to understand this process.

1.1 Background

The energy-efficient design and construction of new residential and commercial buildings is a vital part of an effective energy, economic, and environmental strategy. Through effective design and construction of new buildings, less energy is used, which causes a reduction in energy expenditures and environmental pollutants. In addition, the continual development and use of new technologies for energy efficiency create economic opportunities for business and industry.

One of the impediments to achieving energy-efficient design and construction is economics. Consumers who buy houses, for instance, are rarely motivated by a home's level of energy efficiency. Up-front costs, rather than life-cycle costs, are typically more important to home buyers. Owners of commercial buildings generally pass energy costs onto consumers or tenants, eliminating any incentive for the design or construction of more energy-efficient buildings. Without an incentive or market force, no immediate compelling reason exists for insisting upon more energy-efficient design and construction.

Because the market place does not uniformly secure energy-efficient design and construction on its own, minimum requirements must be established through the use of energy standards and model codes.

Building standards and model codes that address energy have been developed by organizations in the voluntary sector since the early 1970s. Tables 1.1 and 1.2 show the predominant energy standards and model codes. Most energy standards are developed by the American Society of Heating, Refrigeration, and Air Conditioning Engineers (ASHRAE). The Illuminating Engineering Society (IES) of North America also co-sponsors one energy standard with ASHRAE. Most national model codes are developed by the Building Officials and Code Administrators International (BOCA); International Conference of Building Officials (ICBO); Southern Building Code Congress International (SBCCI); and their "umbrella" organization, the Council of American Building Officials (CABO).

Table 1.1. Predominant Energy Standards and Committees

Standard/Committee	Description
<i>ASHRAE/IES Standard 90-75, "Energy Conservation in New Building Design"</i>	Published in 1975, this document was the first to comprehensively address the design and construction of new buildings from an energy standpoint.
<i>ANSI/ASHRAE/IES Standard 90A-80 and ASHRAE/IES Standard 90B-75, "Energy Conservation in New Design," and ASHRAE 90C-77, Annual Fuel and Energy Resource Determination."</i>	These documents separate the original Standard 90-75. The documents include revised and more rigorous prescriptive provisions (90A-80), a restatement of a whole building performance alternative contained in Sections 10 and 11 of 90-75 (90B-75), and publication of a methodology to determine the impact of a building design on natural resource use (90C-77).
<i>ANSI/ASHRAE/IES Standard 90Aa-87, addendum to "Energy Conservation In New Building Design"</i>	This addendum provides a minor update and revisions to 90A-80.
<i>ASHRAE/IES Standard 90.1-89 "Energy Efficient Design of New Buildings Except New Low-Rise Residential Buildings"</i>	This document provides a complete revision to the previous ASHRAE standards for buildings, excluding low-rise residential buildings. A new approach is described to address thermal envelope design, and more rigorous systems and equipment provisions are provided.
<i>ASHRAE/IES Standard 90.1-1989 Users Manual 1993</i>	This manual provides detailed instruction for the design of commercial and high-rise residential buildings so they comply with ASHRAE/IES Standard 90.1-1989.
<i>ASHRAE/IES 90.1b-1992, 90.1d-1992, and 90.1e-1992, addenda to "Energy Efficient Design of New Buildings Except New Low-Rise Residential Building"</i>	These addenda provide minor updates and revisions to Standard 90.1-1989. Additional addenda are in the developmental process.
<i>ASHRAE Energy Code for High-Rise Residential and Commercial Buildings, 1993</i>	This document contains a code language version of ASHRAE/IES Standard 90.1-89 that is more suitable for adoption and enforcement, yet technically equivalent to the mandatory minimum provisions in the standard.
<i>ASHRAE SSPC 90.1</i>	This standing committee within ASHRAE is charged with updating and maintaining Standard 90.1 that is "in code language suitable for adoption."
<i>ASHRAE Standard 90.2-1993, "Energy Efficient Design of New Low-Rise Residential Buildings"</i>	This document provides a complete revision to the previous Standard 90A-1980 as it applies to low-rise residential buildings.
<i>ASHRAE SSPC 90.2</i>	This standing committee within ASHRAE has the same charge as SSPC 90.1 only for Standard 90.2.

Table 1.2. Predominant National Model Codes

Model Code	Description
<i>Model Code for Energy Conservation (MCEC) in New Building Construction, 1977</i>	This document was developed in 1977 by the Building Officials and Code Administrators International (BOCA), International Conference of Building Officials (ICBO), Southern Building Code Congress International (SBCCI), and the National Conference States on Building Codes and Standards.
<i>Council of American Building Officials (CABO) Model Energy Code (MEC)</i>	<p>The document first developed in 1982 has been maintained by CABO and is revised each year through an annual code change cycle.</p> <p>The technical provisions of the 1994 MEC for low-rise residential buildings are formatted after, and are essentially the same as, the ANSI/ASHRAE/IES Standard 90A-1980, except that the thermal envelope provisions for one- and two-family residential buildings are more stringent and the equipment efficiency provisions are the same as ASHRAE/IES 90.1-89. For high-rise residential and commercial buildings, the 1994 MEC adopts ASHRAE/IES Standard 90.1-89 by reference.</p>
<i>CABO One- and Two-Family Dwelling Code (OTFDC), 1994</i>	The OTFDC adopts by reference the 1993 CABO MEC.
<i>BOCA National Building Code (NBC), BOCA National Mechanical Code (NMC), and BOCA National Plumbing Code (NPC)</i>	<p>The 1993 editions of the NBC, NMC, and NPC contain requirements for energy conservation. Chapter 13 of the NBC addresses the design and construction of the building thermal envelope through a reference to ANSI/ASHRAE/IES 90A-80 and 90Aa-87 and the 1993 CABO MEC. Either can be used, although for low-rise residential buildings 90A-80 would be much less rigorous. It is important to note also that the NBC adopts by reference the CABO OTFDC as an alternative to the NBC.</p> <p>Chapter 19 of the NMC contains provisions for mechanical systems and equipment that represent a codified version of requirements from ASHRAE/IES Standard 90.1-89. The NPC contains water conservation requirements for certain plumbing fixtures but does not address water heater efficiency.</p>
<i>BOCA National Energy Conservation Code (NECC), all 1993 editions</i>	All the BOCA NBC, NMC, and NPC 1993 provisions are also compiled and published in one document as the 1993 NECC. With the addition of an administrative chapter by BOCA, the NECC is a stand-alone model code.
<i>ICBO Uniform Building Code (UBC), 1994</i>	The energy provisions are found in Appendix Chapter 13 of the 1994 edition and adopt the 1993 CABO MEC by reference.
<i>SBCCI Standard Building Code, 1994</i>	The energy provisions are found in Chapter 13 of the 1994 edition and adopt the 1993 CABO MEC by reference, but allow compliance with ANST/ASHRAE/IES Standard 90A-80 as an alternative for low-rise residential buildings.

These standards and model codes are available to be adopted by those, such as state and local government, that want more efficient design and construction of new buildings. Although state and local governments usually adopt the standards and model codes through the legislative and regulatory process, others have also taken an active interest, including utilities, lenders, and contractor licensing boards. In addition to this interest, the Federal government recently focused renewed attention on energy standards and model codes through the National Energy Policy Act of 1992 (EPACT), which mandates state adoption of certain energy-related provisions for commercial buildings.

1.2 Important Definitions and Report Organization

The following terms provide a foundation for the process described in this report:

- **Energy Standard.** The term "standards" has a different applicable definition for each industry or function. For example, those who conduct product testing and evaluation would refer to a standard as one which establishes minimum construction and performance provisions for a given product. Others involved in rating products would likely consider a standard a methodology for securing data and calculating certain engineering factors.

The term "design standards" refers to documents written for the design and construction of buildings that typically contain minimum provisions for a specific subject area, such as accessibility, seismic restraint, and energy-related aspects of the building. Therefore, "energy standards" (abbreviated as "standards" in this report) are those documents (or parts of design standards documents) that contain minimum provisions for the energy-related aspects of the building. These energy standards provide some requirements as well as recommendations, suggestions, and non-mandatory provisions. Unlike model codes, energy standards are not fully enforceable; however, they do provide a firm technical foundation for specific provisions in model codes, and they do provide solid engineering recommendations.

- **Model Code.** This is a document that is written in mandatory, enforceable text that can be readily adopted and applied to regulate building design and construction. Unlike a standard, which typically deals with one subject area, a model code generally deals with all areas of building design and construction. In some ways, a model code can be considered a mandatory standard for an entire building. In addition, unlike standards, model codes will contain an administrative chapter that governs the process that is required to implement and enforce the provisions in the code.

This report outlines the energy standards and model codes process. Section 2.0 begins with the development of standards and codes. Section 3.0 describes their adoption. Sections 4.0 and 5.0 provide overviews of enforcement and training, which are both essential to the success of the process. Appendix A lists the addresses for energy standard organizations and model code groups.

2.0 Development

The voluntary consensus and public hearing processes described here for developing and revising standards and model codes are critical to widespread support for their adoption. It should be stressed that these processes are not competitive but complimentary. The technical foundation for many standards provisions acts as the basis for revisions to the model codes.

2.1 Developing and Revising Energy Standards

The ASHRAE process for developing standards is described here because energy standards are typically developed by ASHRAE in conjunction with the IES and other standards organizations that address energy issues have development procedures similar (but not identical) to ASHRAE (e.g., the voluntary consensus process used by the American Society of Testing and Materials [ASTM], Air Conditioning and Refrigeration Institute [ARI], and the Underwriters Laboratories).

The process begins when a need is identified for a new ASHRAE standard or for revisions to an existing standard. As shown in Figure 2.1, a Standards Project Committee (SPC) or Standing SPC (SSPC) (typically 5 to 13 voting members) develops the text of the standard or revisions thereto. The committee is comprised of voting members who represent the interests of standard users, producers of affected products, and others with a general interest in the subject. The committee's work can include a range of activities from producing a totally new standard to minor revisions of an existing standard.

Next, the new or revised standard is subjected to public review. Comments are considered by the SPC or SSPC. If accepted and not substantive, changes are readily incorporated into the standard without another review. If substantive, another public review is required. During the process, every attempt is made to resolve comments; however, differing positions sometimes make it impossible to reach agreement, in which case some form of compromise or mediation is initiated.

When a consensus (significant agreement by a majority of the parties but not necessarily unanimity) has been reached, the standard is submitted through the ASHRAE Standards Committee and Technology Council to the ASHRAE Board of Directors for approval. Commentors who are not in agreement with the final decision may appeal the approval of the standard. If an appeal is upheld, further revision, public comment, and resolution must take place prior to publication. If the appeal is denied, publication of the standard proceeds.

It can take as little as 2 years to develop a new ASHRAE standard, although those concerning the energy subject area typically take longer. The procedures used by ASHRAE require that a new standard or revision to an existing standard be completed within 5 years; however, extensions for an additional 5 years are possible. The key activities associated with ASHRAE standards development occur

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Figure 2.1. Standard Development Process

at the Annual (June) and Mid-Winter (January) meetings of the Society. The process of developing and revising standards and responding to public comments typically occurs at these meetings; whereas, public review of standards would occur 2 to 4 months after each meeting. When a standard is published, the SPC responsible for the document is disbanded, unless a SSPC was responsible, in which case the SSPC can continue to interpret the document and consider further revisions.

Two key examples of the energy standards development process include the following:

- Formed in 1983, ASHRAE SSPC 90.1 became responsible for maintaining the provisions of ASHRAE/IES Standard 90 applicable to other than low-rise residential buildings. It took 6 years to finalize revisions to Standards 90A-80 and 90B-75 as Standard 90.1-89. After three public reviews and two appeals, these revisions were published in 1989 as ASHRAE/IES Standard 90.1-1989. Since 1989, numerous addenda to this standard have been developed. Some have been published and others are undergoing development and review. Further revisions are being developed for the next generation of the standard. It is estimated the next version of the standard will be approved for public review in 1995.
- Formed in 1984, the ASHRAE SPC 90.2 became responsible for maintaining the provisions of ASHRAE Standard 90 applicable to low-rise residential buildings. The committee completed that process in 1993 with the publication of ASHRAE Standard 90.2-93. In 1993, the SSPC 90.2 was formed. This committee is responsible for maintaining ASHRAE Standard 90.2-93. In 1994, the committee finalized its structure and membership and developed a strategic plan. Its initial order of business is expected to include resolution of short-term technical issues associated with ASHRAE 90.2-93. Additional efforts will include complete revision of the standard and identification of long-range research leading to support for future revisions. During 1994, a presidential panel of ASHRAE also developed a code version of ASHRAE Standard 90.2-93.

2.2 Developing and Revising Model Codes

As shown in Figure 2.2, model codes are developed by a somewhat different process than that used for developing standards. Unlike standards, which are revised on an as-needed basis and subject to the time needed to secure consensus, model codes are revised on a regular annual cycle through an open public-hearing process. Although not all identical, the model code processes are very similar and are depicted in general terms in Figure 2.2.

Anyone wanting to suggest revision to a model code can request a code change form, prepare a recommended change and substantiation, and participate in open public debate. All proposed changes are published and distributed for review about 1½ months prior to an open public hearing. Testimony for and against each change is heard, and a committee typically made up of building regulatory officials (usually 7 to 11 members) votes on a recommendation for each code change (approval, denial, or approval as revised). The results of this first hearing are then published.

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Figure 2.2. Model Code Development Process

In some cases (ICBO, BOCA, CABO), those wishing to have a proposed code change reconsidered and discussed at a second public hearing may submit a challenge or negative ballot to the committee's recommended action. In other cases (SBCCI), all proposed code changes are put on the agenda for the second hearing. At this second hearing, additional information from proponents and opponents is presented. Based on the results of the discussion, the voting membership of the sponsoring model code organization votes to uphold or overturn the previous recommendation of the code committee on the code change. (The process for the CABO Model Energy Code differs at the second hearing in that the same committee members vote again, as opposed to any group of "members" of CABO. Based on the persuasiveness of the arguments or revisions submitted through the negative ballot process, the MEC committee could overturn their prior recommendation. A party not in agreement with the final outcome does have recourse to appeal to the CABO Board of Directors.) Since a "majority rules" approach determines what is approved, the process cannot be considered a consensus of opinion, although the majority of code changes recommended for approval from the first hearing are approved with little dissention by the voting membership.

Shortly after the second meeting, a new edition of the model code (every 3 years) or supplement to the previous edition (in years when a new edition is not published) is published.

3.0 Adoption

Energy standards are typically adopted by reference by states or adapted into model codes, which in turn are adopted by states through either legislation or regulation. Alternatively, the provisions of the standards can be adapted by the states into state laws or regulations.

A generic overview of the adoption process is presented in the steps below:

1. *A Legislative or Regulatory Agency Initiates Change.* A draft of proposed changes or revisions is made by legislative committees or state agencies that have regulatory authority to promulgate energy codes. This may involve conducting technical research and other activities associated with developing or supporting the proposal. Change can also be initiated by interested and affected parties.
2. *A Legislative or Public Review Process of The Proposal.* This process generally involves input by interested and affected parties. It may take the form of providing public notice in certain prescribed publications, filing notices of intent, or holding public hearings when the public is invited to submit oral or written comments on the changes.
3. *Revision and Finalization of Legislation and Regulations.* The results of the review process are incorporated into the proposal, and the final document is prepared for approval.
4. *State Approving Authority Review of Regulations.* Revisions to regulations may be submitted to the designated authority in the state for final approval or for filing. This state authority is frequently the Secretary of State, or the state's Attorney General or Commissioner of Public Safety, or it may be the regulatory agency or board with authority to promulgate the code. When filed or approved, the code is put into effect, usually on some specified future date.

3.1 Three Primary Adoption Mechanisms

The details of the adoption process described in the following subsections differ depending if a legislative, regulatory, or municipal (local government) approach is taken.

3.1.1 Adoption Through Legislation

Legislation can include the complete text of an energy standard or model code, although this is rarely the case. Usually, the legislation references a specific energy standard or model code document that is already published. For example, the Maine "Energy Efficiency Building Performance Standards Act" (10 MRSA Chapter 21, Sections 1410-1420) adopts the current edition of ASHRAE Standard 90 (ASHRAE/IES 90.1-89) by reference for commercial buildings and prescribes specific mandatory

insulation standards for residential buildings. Additionally, such legislation will frequently contain administrative provisions that cover such items as enforcement, updating, variances, and authority for actions under the law.

Rather than specifying and adopting certain standards or model codes, legislation can delegate authority to a state agency, council, or committee and empower them to develop and adopt regulations governing the energy-related aspects of building design and construction. In this instance, those so empowered use their administrative and regulatory procedures to develop the requirements. For instance, the North Carolina Department of Insurance is empowered to promulgate building construction regulations that apply to all new construction in the state. Assisting them with that task is a Building Code Council composed of individuals with varying involvement in building design and construction. Through an established and published process, codes for the state are developed and adopted. In some instances, the administrative provisions of the energy code may be adopted by legislation and the technical provisions by regulation, or vice versa.

Table 3.1 identifies where state-level authority resides for promulgation of energy requirements for building design and construction and the scope of that authority. This scope is important because multiple processes could be applicable in a state, differing only as to buildings covered. For instance, a State Department of Education could have regulating authority to establish criteria for schools, with provisions for other buildings addressed through legislation.

3.1.2 Adoption Through Regulation

When a state agency, council, or committee has authority to adopt regulations, they must follow specific state requirements (usually addressed in the enabling legislation) for development, revision, and adoption of the regulations. The technical provisions of their regulations may either be unique to that state or the regulations may adopt by reference national standards or a model code. If a state adopts regulations, it will typically include its own administrative provisions within the regulations and may amend the document that it adopts. For instance, the New Jersey Department of Community Affairs, Division of Codes and Standards, has authority to promulgate "Regulations for the New Jersey Uniform Construction Code." In those regulations (N.J.A.C. 5:23-3.18), the BOCA National Energy Conservation Code, among others, is adopted by reference. Administrative functions (such as enforcement, variances, interpretations, violations) are also provided for in the New Jersey Uniform Construction Code and specify how the adopted code is to be implemented and enforced.

A key factor in a state's ability to regulate the energy-related aspects of design and construction is the extent to which the state has authority over adoption, administration, implementation, and enforcement of building construction regulations. In some states, no such authority exists. For instance,

Table 3.1. State Authority for Energy Codes

State	Authority	Scope of Authority
Alabama	Regulation by Building Commission	State owned and funded projects
Alaska	Regulation by Department of Community and Regional Affairs	State-financed community and residential buildings
Arizona	Regulation by Department of Commerce as directed by legislation	New capitol projects (state-buildings)
Arkansas	Regulation by Energy Office within Industrial Development Commission	State-owned building
California	Regulation by Energy Commission as directed by legislation	All buildings
Colorado	None - would require legislation	Past legislation established a Board to adopt standards as opposed to putting them into legislation
Connecticut	Regulation by Codes and Standards Committee and State Building Inspector	All buildings
Delaware	Legislation	New nonresidential public building > 5000 ft ²
Florida	Legislation with revision by the Department of Community Affairs	All buildings
Georgia	Regulation by Board of Community Affairs	All buildings
Hawaii	Legislation	All commercial buildings
Idaho	Legislation	State-funded buildings
Illinois	None - would require legislation	Legislature Considering Options
Indiana	Regulation by Fire Prevention and Building Commissions	All buildings
Iowa	Regulation by State Building Code Commissioner, approved by Building Code Advisory Council	All state or locally owned public buildings and those open to the public
Kansas	Legislation	Public buildings
Kentucky	Regulation by Board of Housing, Buildings, and Construction	All buildings, except single-family dwellings, which are not occupied by local governments
Louisiana	None - would require legislation	State Fire Marshall does adopt health and life safety standards
Maine	Legislation	All buildings
Maryland	Legislation	All buildings
Massachusetts	Regulation by Building Code Commission	All buildings
Michigan	Regulation by Construction Code Commission	All buildings
Minnesota	Regulation by Department of Public Service, Energy Division	All buildings
Mississippi	Regulation by Department of Economic and Community Development	State-owned and state-leased buildings

Table 3.1. (contd)

State	Authority	Scope of Authority
Missouri	Regulation by Office of Administration, Division of Design and Construction	State-funded buildings
Montana	Regulation by Department of Commerce, Building Code Bureau	All buildings
Nebraska	Regulation by Building Energy Conservation Board	All buildings
Nevada	Regulation by Office of Community Services	All buildings
New Hampshire	Regulation by Public Utilities Commission	All buildings
New Jersey	Regulation by Department of Community Affairs	All buildings
New Mexico	Regulation by General Construction Bureau	All buildings
New York	Regulation by Energy Office	All buildings
North Carolina	Regulation by Building Code Council	All buildings
North Dakota	Regulation by Office of Management and Budget	All buildings
Ohio	Regulation by Board of Building Standards	All buildings
Oklahoma	Regulation by Office of Public Affairs	State-owned and state-leased buildings
Oregon	Regulation by Building Codes Agency	All buildings
Pennsylvania	Legislation with revisions by Building Energy Conservation Committee	All buildings
Rhode Island	Regulation by Building Codes Standards Committee	All buildings
South Carolina	Legislation	All buildings
South Dakota	None - would require legislation	Past standard established by legislation
Tennessee	Legislation	All buildings
Texas	Regulation by Building Commission	State buildings and residential buildings of state-supported institutions of higher education
Utah	Regulation by Building Code Commission	All buildings
Vermont	Regulation by Department of Labor and Industry	Publicly funded buildings
Virginia	Regulation by Board of Housing and Community Development	All buildings
Washington	Regulation by Building Code Council	All buildings
West Virginia	Legislation	All buildings
Wisconsin	Regulation by Building Code Advisory Review Board	All buildings
Wyoming	Regulation by Department of Fire Prevention and Electrical Safety	All buildings other than farm buildings

while Maine adopts ASHRAE/IES Standard 90.1-89 by reference, no agency within the state has been granted authority to enforce compliance. The legislation does call for a civil penalty of 5% of the value of the construction for violating the law. In Pennsylvania, the Building Energy Conservation Standards Committee has authority to update the technical requirements of the statewide energy code; however, no statewide building code exists, and no state agency has authority to promulgate a statewide building code. In this situation, the infrastructure to support implementation of any statewide code does not exist. In most states, a single state agency has been given authority to promulgate such regulations. In those cases where multiple state agencies, committees, or councils are involved, the authority, which typically comes with a single agency program, may be diluted.

3.1.3 Adoption by Local Governments

If a state has limited or no authority to adopt an energy standard or model code or write its own energy code, units of local government may assume that responsibility and adopt their own codes. Local governments may also be free to adopt standards or codes that augment and are more stringent than those adopted by the state. Most local government regulations are contained in the Municipal Code of the locality (county, city, township, borough). Within the Municipal Code are numerous titles, one of which covers building construction and within which energy provisions are typically adopted. Most local governments that adopt energy provisions adopt a model code by reference and apply their administration provisions from other building construction regulations to implementation and enforcement of the energy code.

3.2 Timing of Adoption and Revision

The revision and update cycles of the national standards organizations and model code groups have a major influence on the timing of adoption by state and local governments. Most state regulatory agencies that adopt energy criteria adopt new provisions in concert with the publication of a new edition of a national standard or model code. This may occur either through a regulatory process or automatically because the regulations or legislation refer to "the most recent edition" - meaning that when the energy standard or model code is updated, it is automatically adopted by the state. Several states have laws requiring adoption of the most recent edition of a particular model code. For example, legislation in New Jersey provides for annual adoption of the latest BOCA national codes and allows only administrative changes to be made to that adopted model code.

Some states have regular code revision/update cycles for adoption of revisions to their energy standards and codes. Many tend to follow the revision cycle of a model code. These states are shown in Table 3.2 along with the model code. Any changes to these national standards and model codes would ultimately have a profound influence on these states.

Other states use some provisions of energy standards and model codes but essentially write their own codes. These states are shown in Table 3.3. As footnoted in this table (see footnote b in Table 3.3.), most of these states have regular revision cycles for these energy codes.

Table 3.2. States that Follow the Revision Cycle of a Model Code

State	Model Code	State	Model Code
Connecticut	NBC	Nevada	MEC
Georgia	MEC	New Jersey	NBC
Indiana	MEC	New Mexico	MEC
Iowa	MEC	Ohio	NBC
Kentucky	NBC	South Carolina	MEC
Maine	Standard 90.1 ^(a)	Tennessee	MEC
Maryland	NBC	Utah	MEC
Michigan	NBC	Virginia	NBC
Montana	MEC	West Virginia	NBC
Nebraska	MEC	Wyoming	MEC
(a) This standard deals with commercial high-rise residential building types.			

The states, listed in Table 3.4, have no statewide code, although they could have some energy provisions applicable to certain state buildings. The remaining states have adopted a code but do not have a regular revision cycle.

Formal adoption occurs when the legislation or regulation is passed and officially signed. Typically, there is a period of time after adoption and before the legislation or regulation becomes effective and compliance is required. This period between adoption and effective date is typically 30 days to 6 months, depending upon the state or the rules under which the regulatory agency must operate. Adoption may also be tied to the publication date of an energy standard or model code (e.g., "This regulation shall take effect one month from publication of the adopted model code"). This grace period allows those regulated to become familiar with any new requirements and initiate their use in the design and construction process. When the energy standard or model code goes into effect, compliance is ensured through some means of enforcement.

Table 3.3. States that Write Their Own Energy Codes

State	State
Alaska ^(a)	New Hampshire
California ^(b)	New York ^(b)
Florida ^(b)	North Carolina ^(b)
Hawaii	Oregon ^(b)
Idaho	Pennsylvania ^(b)
Kansas	Rhode Island ^(b)
Maine ^(a)	Vermont ^(a)
Massachusetts ^(b)	Washington ^(b)
Minnesota ^(b)	Wisconsin ^(b)
(a) The energy codes within this state deal only with low-rise residential buildings.	
(b) This state has a regular revision cycle for its energy codes.	

Table 3.4. States with No Statewide Energy Code

State	State
Alabama	Louisiana
Alaska ^(a)	North Dakota
Arizona	Oklahoma
Colorado	South Dakota
Delaware	Texas
Illinois	Vermont ^(a)
(a) This state has an energy code for commercial and residential high-rise buildings.	

4.0 Implementation and Enforcement

Adopting an energy standard or model code and establishing an effective date means a law has been legally enacted. Without enforcement (and training, which is discussed in Section 5.0), there is no guarantee (other than market place demand) that new construction will be designed and built to the adopted energy standard or model code.

Indeed, the issue of enforcement has a direct bearing on securing the conservation potential intended in the standards and model codes. Expectations for each state are different, based on the authority of state and local governments to conduct activities associated with enforcement. While some states are well situated to implement more rigorous energy standards and codes, other states need major changes to their regulatory infrastructure to create a platform from which to effectively enforce energy standards and model codes. Other states need resources and a manpower commitment if they are to implement more effective enforcement.

Although very few studies have been identified that address the adequacy of enforcement, studies in California, Oregon, Washington, and New York indicate that what is intended by the energy standard or model code is not always implemented in practice. (Note that these studies typically rely on survey work rather than field inspections.) A study conducted in New York (NYSEO 1993) found that virtually 100% of the residential structures inspected in the field (150 in 75 locations) did not meet the code or were not constructed pursuant to the approved plans.

Enforcement involves the following activities to help ensure compliance:

- review of plans
- review of products, materials, and equipment specifications
- review of tests, certification reports, and product listings
- review of supporting calculations
- inspection of the building and its systems during construction
- evaluation of materials substituted in the field
- inspection immediately prior to occupancy.

In some instances, such as with the adoption of ASHRAE/IES Standard 90.1-89 by the state of Maine, no enforcement authority is given to any state or local government agency. Enforcement is addressed by the courts if and when legal action is sought by the building owner against the designer and/or contractor(s).

When a state agency enforces an energy standard or model code, more uniform enforcement throughout the state occurs than if enforcement is conducted by a number of local agencies. Plan review is generally performed by one office, and although there may be numerous state field inspectors, they are all bound together by one agency. This helps ensure uniformity and establishes a focal point for all in the building construction community. Even so, state resources, funding, and staff are often limited, and plan reviews and construction inspections may not be performed as thoroughly as may be warranted. Where the state does not conduct enforcement activities, the authority may fall on local government.

Local enforcement agencies are closer to the construction site and in more direct contact with the local building design and construction community. This contact establishes the potential for more regular enforcement during design and construction. One limitation at the local level, however, is the availability of financial and manpower resources to support enforcement activities. Another limitation is that with each local jurisdiction having enforcement authority, considerable variations may exist among jurisdictions, possibly leading to some noncompliance across a state. Finally, compliance can be affected if the state agency is unaware of the enforcement activities at the local level, has little contact with local governments' enforcement activities, or such a state agency does not exist. However, a state code agency that actively supports local governments in their efforts to enforce the state code can help enhance the level of compliance.

Some states offer local jurisdictions the opportunity to petition to conduct enforcement privileges that are usually the responsibility of the state. In these cases, the local jurisdiction must demonstrate enforcement capability and then receive state approval before conducting any enforcement activities. This strategy offers the advantages associated with state enforcement, recognizes those local governments with equivalent capabilities, and helps ensure comparable levels of compliance. Even in these cases, however, continued state oversight is necessary to ensure that the appropriate level of enforcement is being carried out by the approved local jurisdictions. A hybrid approach has the state conducting the plan review and the local authority conducting the construction inspection.

4.1 Enforcement for Specific Building Types

Because there are differences between enforcing compliance in low-rise residential and in commercial and high-rise residential construction, each is discussed separately below. The main reason for discussing these building types separately is that low-rise residential construction is generally evaluated for compliance at the local level, whereas a state agency tends to be more involved with other types of buildings. In addition, low-rise residential buildings may be more easily evaluated for compliance because the governing standards and codes tend to be less complex than for commercial buildings.

4.1.1 Low-Rise Residential Buildings

Of the almost 40 states with a state energy standard or model code that applies to low-rise residential construction, 85% rely solely on local governments for enforcement and compliance. If

enforcement is not conducted by local governments, states may conduct enforcement activities either by specific direction in legislation or regulations or by default. For instance, the state of Connecticut conducts plan review and field inspections in jurisdictions that do not have a building department. This approach recognizes that some local governments may not have the base of support to establish building departments. New Mexico conducts plan reviews and construction inspections unless the local jurisdiction has building officials who have been certified to enforce the code. This approach recognizes that local authorities need certain capabilities and resource levels to carry out this activity. In Oregon, cities and counties have the opportunity to elect to enforce codes. If they do not, responsibility for enforcement is assumed by the state. In Wisconsin, the state may assume enforcement authority in jurisdictions with a population of less than 2500. Maine is the only state where enforcement for low-rise residential buildings is conducted at the state level.

Some states have unique enforcement strategies, where the authority does not rest with state or local government agencies. In Kansas, enforcement of the thermal standards is handled by the local utilities, which receive certified plans from the owner or architect. The utility reviews the plans, and if compliance is found, the building is connected to utility services. In Maryland, the utility collects a certificate of compliance from the builder when the building is located in a jurisdiction that has not adopted and does not enforce an energy standard or code. In Iowa, builders hire state-certified professional engineers or architects to perform plan reviews if the building has over 100,000 ft³ of volume. The engineers certify the plans and then submit them to the state for review.

4.1.2 High-Rise Residential and Commercial Buildings

Of the almost 40 states with some form of state commercial energy standard or code, only Maine and Wisconsin have enforcement authority that rests at the local level. Several other states have state-level enforcement by default because local government does not conduct enforcement activities. For example, if a county in Wyoming has qualified personnel, it is given enforcement authority; if it does not have qualified personnel, the state conducts enforcement activities. Local jurisdictions in Montana may petition the state to conduct their own enforcement of the state code. In Kentucky, the Board of Housing, Buildings, and Construction enforces standards for larger commercial construction projects, in part because the state has the necessary resources.

In situations where enforcement of the state building energy standard or code is delegated to local government, the state may still play a supporting role. A state agency may provide guidance for enforcement through such materials as plan review and compliance worksheets. New Jersey furnishes local building departments with a worksheet that simplifies the energy calculations to be performed during plan review. Massachusetts has developed an energy code compliance check list for local building officials. Florida provides compliance forms that must be submitted to the state by the building contractor after plan review.

A state may also provide support to local building departments through certification of building officials. For example, Connecticut, New Jersey, and Oregon all require building inspectors to be state-certified. In other states, building officials must attend continuing education and training sessions to maintain certification.

In a few states, it is an architect or engineer who determines compliance. Indiana, Iowa, Massachusetts, and Ohio use architects or engineers to certify plans as complying with the code. The plans are submitted to the state with the signature of the architect or engineer performing the plan review, indicating that the structure as designed and specified satisfies the adopted regulations. A signature on the plans often compels the reviewer to be extremely thorough when stating that the submitted plans comply with the energy code.

Three states involve utilities in enforcement. The local utilities in Kansas receive certified building plans from the owner or architect of the new construction. The utility staff members review plans, and if they comply with the adopted requirements, the new building can be connected to utility service. Utilities in Iowa require energy approval from the Iowa Building Code Bureau or local building departments before the new construction receives utility service. The New Hampshire Public Utilities Commission, which has authority to promulgate codes, is also required by law to conduct training for local building officials to keep them current on the building energy codes.

4.2 Adequacy of Enforcement

It is difficult to gauge the level of compliance with energy standards and model codes in various states because of the lack of a recognized metric and availability of limited field data. The level of compliance in a state, however, may be inferred from the existence of a requirement for plan review and construction inspections (also referred to as field inspections). About 40% of the states with an energy standard or code require both plan review and construction inspections. In the remaining states with standards or codes, the local jurisdiction determines if plan reviews and/or construction inspections must be performed and how they must be conducted.

A survey was conducted of state energy office or building regulatory agency staff. The staff members were asked to evaluate the adequacy of enforcement of the energy code, assigning one of three degrees of adequacy: "very good," "good," or "poor." Of the 30 responses, 9 states rated enforcement of the energy standard or code for commercial and high-rise residential buildings as "very good," 15 state authorities rated enforcement as "good," and 6 rated enforcement as "poor."

Contributors to successful enforcement were identified as the knowledge level of architects and engineers involved in commercial construction (in California, Delaware, Massachusetts, Nevada, and Ohio), sound conservation efforts and the importance given to energy conservation in construction (in Michigan and New Mexico, respectively), and education and training provided to the construction and enforcement communities (in North Carolina and Virginia).

The following areas for improvement were identified in the survey:

- provide increased or mandatory education and training on the energy code
- hire more staff to keep up with construction starts
- provide resources, particularly funding, to hire more staff and to provide training on the energy code
- increase consciousness of enforcement officials about the importance of energy conservation in construction
- simplify the energy code to be easier to understand and use
- provide software to support building design compliance evaluations
- transfer a Federal commercial building program to the states as a possible enhancement to state programs
- facilitate contact with other states to support individual state programs. Using experiences and lessons learned by more advanced states, less advanced states would have an opportunity to simplify and expedite the process of developing a more successful building energy standard or code enforcement program.

5.0 Training

Training is essential to the success of all aspects of the energy standards and model codes process. Without effective training of all those involved in the process, the use, impact, and growth of the standards and codes are severely limited. It is training that ties the process together (i.e., development, adoption, and enforcement).

5.1 Training Sources

Key training sources are described in the following subsections.

5.1.1 Organizations

State energy offices and state agencies responsible for promulgation and implementation of building construction regulations are the most common sources of training on building standards and energy codes. Universities and community colleges also offer educational programs on specific topics related to building construction regulations and may target one group, such as engineers or building inspectors. However, they are open for the general public to attend. College and university programs often use professionals, such as architects and engineers, to conduct training. They sometimes are under contract to the state agencies responsible for codes or to the energy office.

Utilities are also involved to varying degrees in offering training on energy codes and, more often, energy conservation in buildings. These programs target building officials, but they may also be open to the general public.

The model code organizations (BOCA, SBCCI, and ICBO) provide regular training on their own model codes, as do professional societies such as ASHRAE and IES. Training programs may also be available through trade associations such as the National Association of Home Builders.

Although the state of California does not mandate training for building officials, the California Building Codes Institute, under contract to the California Energy Commission, provides training and training materials for plan reviewers and construction inspectors. One successful method for approaching training is to conduct training at a local building department, which can involve inviting neighboring building departments to attend onsite construction inspection training and providing videos on construction inspections (per conversation with Roger Shelton of the California Building Codes Institute, August 19, 1992).

5.1.2 Utility-Sponsored Conservation Programs

As previously noted, where state legislation or regulations are not feasible, local government may take the initiative or energy-conscious design and construction may be totally dependent on market

forces. In these instances, and as additional steps beyond a minimum standard or code, others may implement voluntary design and construction programs.

There is little doubt of the potential energy savings that can be accrued from utility demand side management (DSM) or other nonregulatory programs. In 1990, the Electric Power Research Institute (EPRI) estimated that energy-efficient technologies could reduce U.S. electricity consumption in the year 2000 by 24-44% (Nadel 1991).

Through their DSM programs, utilities can and, in many states, do play an important role in the acceptance and incorporation of energy-efficient technologies and design and construction practices in the residential, and commercial, building sectors. New-construction DSM programs can actually form the basis for an energy-efficiency partnership between a utility and a builder. Utility-sponsored education and training workshops on energy-efficient technologies offered to builders often result in both increased awareness and skills. It is from such experiences that builders become energy-efficiency advocates rather than adversaries. Also, utilities can actually become players in adopting energy codes and standards by providing technical consultants or industry support representatives to those who regulate new construction or who are regulated.

Utility conservation efforts, however, vary greatly from state to state. A recent study by the Government Accounting Office found such states as California and New York providing incentives to utilities to decrease electricity production while other states, such as Illinois, having a surplus of generating capacity that does little in support of conservation programs (*The Energy Daily*, June 24, 1992).

Utilities can and do assist in upgrading construction practices within their service area by

- encouraging more energy-efficient practices in construction, using approaches different than the typical building regulatory approach
- increasing the public's awareness of the savings accrued from energy-efficient residences and thus increasing market demand for them
- working with builders to create a market demand for better energy-efficient technologies and materials.

Most states (47) were identified as having utility-sponsored residential new construction and/or rating systems, including California, Washington, Oregon, Idaho, Florida, Georgia, Nebraska, Minnesota, Wisconsin, and New York.

One voluntary conservation program, the Good Cents Program, has over 279 utilities serving over 25 million residential customers in 29 states, and it estimates that over 500,000 Good Cents Homes have been built in the United States. An effort underway in New England is known as the Energy Crafted Homes of New England. It is a consortium of utilities in Massachusetts, Rhode Island, and

New Hampshire whose purpose is to reduce utility electric load and reduce peak demand by reducing energy use in new single-family and multifamily residences by 50% from levels in the new Massachusetts Energy Code. Connecticut, whose legislature requires that a home energy rating system be integrated into state residential energy programs, is looking into this program.

5.1.3 Other Voluntary Programs

Other sources of voluntary programs are in the residential area. One program is the home energy rating systems (HERS). A HERS program has been used in approximately 20 states and is being considered in a number of others. Energy Rated Homes of America, for instance, uses a rating tool which provides a numerical point score of 0-100. The points are then translated into a graphic "zero to 5 star" rating. It should be noted that different rating methods are used to rate a home. For example, Good Cents and Super Good Cents Homes employ a binary rating system in which a house is rated "Yes" or "No" according to whether it is built to standard.

The adoption of a HERS approach has a twofold payoff - one for the builder and one for the buyer. The builder receives recognition for having built a residence to a set of energy-efficient requirements and the home-buyer gets lower energy costs and (in some cases) the opportunity to qualify for an energy-efficiency mortgage. In some states (Florida, California, and New York), a HERS approach is integrated with the state energy code as one of numerous paths to compliance.

In addition to the Good Cents and Energy Crafted Homes Programs and HERS, there are a number of state energy offices that offer, or are in the process of developing, energy-efficiency residential programs (e.g., providing training to builders). Many state energy offices are working with utilities to develop either joint programs or programs that complement each other.

5.2 Status of State Mandatory Training

Eight states require building code officials to attend regular training.

- North Carolina requires that local inspectors have a minimum 45 hours of class work and at least 2 years experience to qualify for state certification. A continuing education program for inspectors is under development.
- The New Hampshire legislature mandates that the state conduct periodic training on building codes to keep inspectors up to date on the code and to train new inspectors.
- Officials in New Jersey must be licensed, which in turn requires certain continuing education on an annual basis.
- In Ohio, building inspectors are state-certified and must attend continuing education to maintain their certification. These classes are taught regularly by architects and engineers.

- Oregon requires building officials to attend ongoing education and training programs to maintain state certification.
- In Rhode Island, building inspectors and plan reviewers are required to complete 90 hours of educational courses every 3 years to maintain certification.
- Virginia requires all building code officials to attend training on new state codes to maintain their certification.
- Wisconsin requires building inspectors and plan examiners to receive continuing education. They must all be certified by the state.

6.0 References

Nadel, S. 1991. *Achievable Electricity Conservation Potential: The Role of Utility and Non-Utility Programs*. ACEEE, Washington, D.C.

New York State Energy Office (NYSEO). 1993. *An Evaluation of the New York State Energy Construction Code Program*. NYSEO, Albany, New York.

Appendix A

Standard Organizations and Model Code Groups

Appendix A

Standard Organization and Model Code Groups

Key contacts for energy standard organizations and model code groups are shown below:

American Society of Heating, Refrigerating and Air-Conditioning Engineers (ASHRAE)

1791 Tullie Circle NE

Atlanta, GA 30329

(404) 636-8400

Publishes, among others, Standards 90.1 and 90.2.

Building Officials and Code Administrators International (BOCA)

4051 West Flossmoor Road

Country Club Hills, IL 60478-5795

(708) 799-2300

Publishes the National Codes

Council of American Building Officials (CABO)

5203 Leesburg Pike, Suite 708

Falls Church, VA 22041

(703) 931-4533

Publishes the CABO One and Two Family Dwelling Code and Model Energy Code

International Conference of Building Officials (ICBO)

5360 South Workman Mill Road

Whittier, CA 90601

(310) 699-0541

Publishes the Uniform Codes

Southern Building Code Congress International (SBCCI)

900 Montclair Road

Birmingham, AL 35213

(205) 591-1853

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