

Commercial Building Energy Standards Implementation: Myth vs Reality

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Since the advent of building energy standards almost 20 years ago there have been numerous codes, standards, and regulations (herein after referred to as standards) developed, adopted, and applied to new commercial building design and construction. The development of these standards occurs primarily at the national level, while adoption and implementation occurs at the state and local levels of government. Many assume that the mere adoption of a standard ensures that compliance is achieved and energy conserving buildings automatically result from the process. This assumption accounts for the myth that all buildings are constructed in compliance with the adopted standard and in reality many are not. There are many different processes by which standards are adopted and actually implemented, and they directly affect how close reality is to the myth. The paper presents the different processes used throughout the U.S. to adopt and implement building energy standards for new commercial buildings, reviews available studies on compliance, discusses the reasons for reduced compliance, and suggests programs to improve today's realities.

Introduction

The adoption of building energy standards occurs at all levels of government. At the national level, the U.S. Department of Energy (DOE) adopts standards and applies them to Federal buildings. State governments also adopt standards, as do units of local government. Adopting standards through legislation, regulation, or other means establishes requirements for new building design and construction. In short, the adoption of a particular energy standard for new commercial buildings establishes legal requirements that influences the design and construction of the structure. Depending upon the administrative provisions architects, engineer, contractors, manufacturers, owners and others will share in the compliance responsibility. State and local government may enforce the standard to ensure compliance. Just as there are speeders in areas with posted speed limits, new commercial buildings can be occupied and not meet the adopted building energy standard. Implementation and enforcement is the key to ensuring that real buildings meet the adopted standard.

To establish a basis for discussing the implementation of building energy standards there are numerous "myths" and "realities" that must be highlighted. These help to explain the wide variation between the technical requirements of the adopted building energy standard and actual building construction. Table 1 shows some "myths" and "realities" associated with building energy standards.

Ways to bring the realities more in line with the myths are needed. So the true potential for energy use reduction envisioned in the standards is captured. Bridging this gap can begin by studying the methods by which state and local governments adopt, implement, and enforce building energy standards. Recognizing that the process varies from state-to-state and within states and matching energy standards programs to state and local capabilities, will help temper the realities. The political process, utility costs, governmental responsibilities, varying human and financial resources, and just the fact that practices differ across the United States make it impossible for any one method of adoption, implementation, or enforcement to address the problem adequately. The solution to improved energy conservation through standards adoption lies in knowing which variables affect the potential for success, their relative importance, and designing programs to booster support for those that are most important.

Can the level of stringency affect the potential for successful implementation? Yes. The effort needed to implement and enforce a building energy standard is directly related to the complexity and stringency of that standard. A simple standard that is not too stringent has a higher probability of being implemented successfully. Conversely, a more complex standard, or one with very stringent provisions, can be more difficult to implement and will require a higher level of resource support and

Table 1. Myths and Realities of Energy Standards Implementation

Myths	Realities
All involved in the building process have a copy of the adopted standard	Some involved in the building process have a copy of the adopted standard
The stringency or complexity of an energy standard does not affect compliance	The more stringent, or complex the standard, the more difficult it is to achieve compliance
A/E sealed plans meet the energy standard	A/E's seal plans without necessarily determining compliance or they simply specify "building to meet current energy code"
Distributors provide equipment and materials that comply	Materials and equipment that do not comply are provided to job sites
All necessary details and information concerning energy are shown on the plans	Plans generally lack all necessary information concerning energy
What is specified in the plans is delivered and installed	The contractor typically installs whatever is delivered to the site
All materials are installed per the manufacturer's instructions	Instructions are typically missing on the job site
Inspections are performed throughout the construction process	Building materials and systems are regularly installed without inspection
State and local governments have sufficient manpower and money to enforce an energy standard	State and local governments are having to do more with less and have a priority to focus seriously on life safety issues with available resources
Plan reviews are conducted	Permit fees are collected
Those who fail to comply receive penalties	Penalties for non-compliance are not often levied
All involved are adequately trained to carry out their functions related to energy standards	Some training is available but not all attend
Standards enforcement is a career	Turnover in code enforcement frequently occurs

expertise during enforcement to ensure compliance. Contrary to a recent study (Union of Concerned Scientists, 1992), the pre-existence of a code enforcement network does not mean that upgrades to codes can be achieved at relatively low incremental costs. Moreover, the network may not exist or be fully functional for energy in many areas of the country.

Can the means of adoption affect the expected level of compliance? Yes. There being no national preemptive energy standard for commercial buildings, state and local government are free to adopt their own standards. A

building energy standard may be adopted through state legislation and contain no means for enforcement other than legal recourse against the designer or builder. Conversely the legislation may direct local government to adopt an energy standard but provide no oversight by the state or sanctions on local government. Where state legislation has granted regulatory authority to a state agency to develop and adopt (but not enforce) standards these issues may arise again. The agency may have little authority or control over local government enforcement or may be understaffed and unable to enforce adequately the standards themselves.

Can the means of enforcement affect the expected level of compliance? Yes. All codes will require a registered architect or engineer's seal on commercial building plans when submitted, but may not require their involvement during construction. In some states the responsibility for enforcement and compliance during construction rests with the architect or engineer of record, who must certify that the building as built meets the adopted building energy standards. This places accountability with the designer and allows state and local government to mediate disputes between the architect/engineer (A/E) and those constructing the building. Most approaches, however, are variations of the typical plan review and construction inspection process employed by many state and local government agencies. Plans and specifications are reviewed for conformance to the standard and then inspections are made during construction to ensure that the building is constructed in accordance with the approved plans. Where plans are not reviewed for energy by state or local government, the seal of the registered A/E will generally be accepted as evidence of design compliance. In some states the designer must complete a special certificate stating the building design complies.

Regardless of the means of adoption, there is a need for standards enforcement. When asked what code was used in one jurisdiction, the person in charge of the building department replied "the red one". When asked about plan review and inspection the same person said these were not done and the "red book" was used only to calculate permit fees. Builders in one northwest state (Washington State Building Code Council, 1991) indicate that lack of compliance is not their problem and when the standard is enforced then they will get concerned. Communications with states and a review of the handful of field studies that evaluate actual construction indicate buildings are not being designed and constructed to meet the adopted building energy standards. This situation cannot be improved by national preemption of state government, for without some federal enforcement mechanism the level of compliance would be unaffected. It can be improved by: 1) Conducting more field studies to identify the areas in the design, construction, and enforcement process that need support; 2) identifying and designing different standards criteria, and adoption, implementation, and enforcement processes that will bolster those weak points; and, 3) Adopting those criteria and processes to best fit the political and administrative realities, and technical and financial capabilities of the state and local governments in question.

Research Approach

The research utilized a number of approaches to obtain information about adoption, implementation, and enforcement. This included verbal and written contact with the states, a review of state and local rules and regulations and published state studies on the issue, and professional experiences on building energy standards adoption, implementation, and enforcement. This research is being conducted in support of a continuing effort to improve the effectiveness of building energy standards through identification and treatment of weak points associated with standards adoption, implementation, and enforcement.

Contact with the States

Through direct contact with state agency staff in energy offices, building code commissions, and utility commissions, information on adoption, implementation, and enforcement of building energy standards was obtained. This included copies of rules and regulations, codes, and studies as well as views and anecdotal information from those contacted.

State Rules and Regulations

Rules and regulations, including legislation, ordinances, and municipal codes, adopted by state and local governments contain information about the authority for adoption and how the adopted standards are to be implemented and enforced. This includes the responsibility of state and local government in the review and approval process, the information required to be submitted with building plans, and the procedures for building inspection. Many are found in the administrative section of the building code or, where there is a separate energy standard, the energy code.

Selected State Studies on Compliance

Of the many states that do not conduct plan review and inspection at the state level, few have audited or monitored the implementation and enforcement of building energy standards by local government. There is some communication between state agencies and local governments on standards implementation and enforcement. From these communications staff at the state level are familiar with what is happening in the field, but not enough to report on the level of compliance with the energy standard. Massachusetts, for instance, feels their

standards are being enforced because there are requests for energy standards variances before their building code board (Plouffe). The lack of state resources to conduct field monitoring or compliance studies may be the reason. A fairly rigorous search found that only California (California Energy Commission 1989, 1991), Florida (Stanton), New York (McQueen), Oregon (Friday), and Washington (Washington Building Code Council 1991) had studied and evaluated building construction for compliance and had monitored the implementation and enforcement process within local government. Of these all surveyed those involved in building, design and construction, and a few included a review of building plans and/or construction in the field. The New York study, for instance, evaluated 2 single family dwellings in each of 75 randomly selected localities for plan and actual construction compliance. The Washington reviewed enforcement levels through 155 surveys to jurisdictions and 104 surveys to code officials.

Professional Experience

The authors have experience in working with state and local government on building energy standards adoption, implementation, and enforcement.

This includes in depth activities associated with state energy standards development and deployment as well as direct involvement in the education and training of state and local officials in over 20 states. These activities have also included working with state and local government in plan review and construction inspection. Through these activities the authors have gained an insight into the real world of building energy standard adoption, implementation, and enforcement.

Results

Based on the outlined research approach it is possible to portray the adoption, implementation, and enforcement aspects of building energy standards. It is important to understand that each state is different and has different capabilities associated with building energy standards adoption, implementation, and enforcement. On one extreme, some states have no authority to adopt such standards. On the other extreme the state conducts all such activities. Bridging these extremes are numerous state and local government scenarios. Because each state is different no one approach or method will uniformly apply throughout the U.S. The ability of a state to adopt, implement, and enforce building energy standards can be evaluated and, using the approaches from successful states with similar capabilities, improvements in compliance can be obtained.

Adoption of Building Energy Standards

There are numerous ways in which building energy standards are adopted by state government, as shown in Table 2.

Where the state does not adopt such standards then authority for adoption reverts to local government. This could be county government having the authority to preempt cities or with the cities themselves. The means of adoption include development and publication of building energy standards, or "home grown provisions", as well as reference to national level building energy standards documents. As shown in Table 2, states primarily adopt

Table 2. Methods of Energy Standards Adoption

- Legislation
 - containing specific standards
 - referencing other standards documents
 - referencing other standards documents with amendments
 - granting authority to adopt standards to a state agency
- Regulation
 - containing specific standards
 - referencing other standards documents
 - referencing other standards documents with amendments
- Promulgation as a separate regulation
- Incorporation as a chapter in another regulation

building energy standards by either legislation or regulation. Where a state does not adopt building energy standards, local government typically adopts standards by ordinance and locates the requirements in the local municipal code title dealing with building construction. In addition some utilities have authority to adopt standards as a condition for utility service.

In most states with a statewide standard, legislative authority is typically given to a Building Commission, Utility Commission, or other state agency. This authority generally gives them the authority to promulgate rules and regulations governing energy in new commercial

buildings. Oversight of these actions is generally done by the Governor, a legislative review committee or other state agency or office. The energy standards may be a separate document or part of a package of state building construction regulations and will contain administrative as well as technical requirements.

In a minority of states with statewide authority, legislation may adopt therein certain building energy standards. The legislation will contain the administrative provisions related to implementation and enforcement as well as the technical standards directly or by reference.

The divergence in adoption, and ultimately implementation and enforcement, occurs because each state has different methods of imposing rules and regulations on its citizens. In Alabama an administrative Council of the state building commission approves changes to the energy standard while in Alaska the Lt. Governor has final signatory authority. In Arkansas the state DOE has legislative authority with revisions required to proceed through the state legislative council. The California Energy Commission submits proposed regulations for public comment and, after completing the rule making, submits the rules to the Office of Administrative Law for approval. In Connecticut approvals are required from the Codes and Standards Committee, Department of Public Safety, Attorney General, and Legislative Review Committee. In Florida the Secretary of state is the ultimate authority for standards approval. Indiana requires attorney general and governor approval of regulations proposed by the Building Safety Commission. In Kansas the state legislative process is used to adopt standards with proposals submitted through the State Corporation Commission, similar to New Hampshire where the Public Utilities Commission is responsible. Legislative action is required in Maine and Tennessee because the specific energy standards are referenced in the enacting legislation.

Updating of the adopted standards is also an issue. In some cases the adopting legislation or regulations refer to a specific edition of an energy standard. In others the term "most recent edition", or similar language is used. Where updating of the energy standard is through regulation it is possible for revisions to be made every month, although most states revise their standards on a three year cycle. The frequency of adoption will affect implementation and enforcement because of the effort involved in getting the building community familiar with any new standards.

The common thread to state adoption scenarios is the legislative authority granted to a state agency to promulgate rules and regulations, or the adoption of standards directly in the legislation. Through these processes

building energy standards are proposed, public input obtained, and the standards finalized. Upon adoption they become law and implementation and enforcement activities are undertaken to assure they are satisfied.

Implementation of Building Energy Standards

Implementation can be considered an activity that occurs pursuant to adoption of an energy standard. Implementation involves development and distribution of educational and outreach materials, technical assistance, and other activities to further the application of the standard by the design and construction community. To implement an energy standard a copy of the standard must be obtained. Where the standard is adopted by reference in legislation or regulation it would be the responsibility of the building community to order and secure a copy of the standard from the publisher. In most cases this will cost money. In some cases it is likely copies will not be secured until enforcement activities dictate a copy be obtained. Where the state publishes amendments to an adopted standard or develops their own energy standards they are likely to be the publisher and distributor, although some states contract this activity to a publishing house. In most instances it will be the responsibility of those in the building community to obtain a copy of the standard from the publisher, although a few states forward copies at no cost.

After a copy of the standard is secured users of the standard will need technical support. Very few standards are self-explanatory and without need of interpretation. In some states there are hotlines or technical assistance services available. In New York, for instance, the state energy office provides this type of service. In others, such as North Carolina, the agency responsible for the state building code will provide support. Generally speaking the state agency granted regulatory authority over the standard will provide technical support. The level of that support will depend upon available resources within that state agency.

Education and training are also important to successful implementation and many states develop manuals or workbooks for their standard. Some states charge for these products while others automatically mail them to members of the design and construction community. Assuming these documents are available the time to read and use them is also a consideration. Members of the building community are generally very busy and do not have the time to devote to such educational endeavors. Those that are implementing the standards will generally make an attempt to use these documents as they have

time. Others may benefit from their availability. The remainder in the design community may have made up their minds that they are not going to make an effort to apply the standard unless the standard is going to be enforced.

In conjunction with education and training efforts and to improve the level of compliance with energy standards a number of states provide simplified prescriptive menus, fact sheets, and other materials that help "demistify" the complexity of the adopted standard. Where the lighting criteria require the "ground up" development of a lighting power budget on a room-by-room basis the establishment of a total building watts/sq.ft. table can improve the application of the standard. This is especially important for small commercial buildings where a registered architect or engineer may not be involved in the project. Other approaches simplify thermal envelope criteria into prescriptive limitations on glass area as a percentage of wall area based on glass type and shading coefficient. The unification and simplification of calculation methodologies also improves the ability to implement the standards.

Securing, reading, understanding, and applying the energy standard adopted is critical to the satisfaction of the provisions therein and the realization of the conservation potential within the standard. Although the standard may be adopted, and therefore law, the existence of the standard must be known to, and readily understood by, those in the building community. Without implementation efforts by the states there can be little recognition and application of the standard, unless enforcement efforts and penalties create an awareness of the law and spur efforts to comply.

Enforcement of Building Energy Standards

Throughout the U.S. there are a number of ways in which energy standards are enforced. The majority of enforcement techniques are regulatory in nature and seek to identify and correct violations. Through such efforts compliance with the adopted standard, or the law, is intended to be assured. Some, however focus on incentives.

In one state the energy standard adopted for state buildings is stated in terms of an annual energy use budget. Meeting the budget in the design stage assures an approval to construct. Exceeding the budget by a certain percentage assures a bonus on the designers fee, one half paid upon design approval and one half paid after the first year of building operation within budget. This approach gives the designer some incentive and vested interest to implement the standard and can reduce the level of enforcement normally required.

Coupling utility programs with energy standards, electric utilities can also increase the level of compliance. In some instances the electric utility becomes the enforcement agency, conducting plan review and inspection functions for new commercial construction and withholding permanent service until the building complies. In others, incentives such as cash, technical support, and preferential rates are provided. For the most part, however, enforcement efforts are undertaken by state and local government and focus on finding and correcting violations.

Typically the designer must submit plans and specifications to the regulatory agency having review and approval authority, although in some states there is no enforcement authority and the resolution of violations is left up to the courts. In many states plan review and approval is conducted by the state. This activity can range from a detailed review and evaluation of every aspect of the design submittal to an agency stamp that the materials have been submitted. Typically manpower resources, standards complexity, time, and budgetary issues determine how thorough a review can be conducted. In one state the review consists of receipt of a filing fee and an "approval to construct" being affixed to the plans without any evaluation of the plans and specifications. With the fee paid and state stamp, the designer was free to build, assuming all local regulations had been satisfied.

In other instances local government has the responsibility for determining compliance with the energy standard. Where the state has adopted the standard and passed the responsibility to enforce the standard on to local government the level of plan review tends to be rather lax. Where the local government receives financial and technical assistance from the state or has adopted the standard without state intervention the level of enforcement tends to be more rigorous.

Field experience in reviewing plans shows that all of the necessary information with which a determination of compliance in the plan review stage is never present. Material specifications for insulation, equipment, and lighting are omitted in many cases. Where the person doing plan review has time they will generally request the missing information. In other instances they review those things for which data are provided. Still in others they accept the architect or engineer's statement that "building materials and systems to be per energy code".

Discrepancies between plans and calculations are not uncommon. Studies conducted by the California Energy Commission auditing local enforcement of Chapter 53 of the state building code on energy conservation showed that 8 of 44 commercial building plans reviewed had higher lighting wattages than those included in the compliance

calculations. Of the same plans, 25% took unacceptable switching credits for natural lighting. These studies also found that 9 of 49 commercial building plans reviewed had no calculations provided. The same number of buildings had a significantly larger glazing area on the plans compared with that included in the calculations. In other states, local government response to plan review is they don't have time to do it or they accept the seal of the architect or engineer. In still others an approval to construct is granted as long as the permit fee is paid.

Field inspection seeks to assure that during construction of the building the materials and systems specified on the plans and specifications are provided to the site and properly installed. Field inspection is typically conducted by local government, although state agencies may be involved as well. Most inspections combine consideration of energy features with building, structural, mechanical, electrical, accessibility, and other inspections carried out during construction. With a few exceptions there are no inspectors whose sole responsibility is identification of energy standard violations. Violations typically found are the installation of materials and systems different than those specified on the plans. This includes glass type and area, heating and cooling equipment, as well as lighting fixtures and lamps. In addition improper application of materials and equipment is also a violation of the standards. Inspection activities are intended to address this as well.

Some states apply methods of enforcement different than the standard building inspection. Wisconsin, for instance, requires the architect or engineer of record to certify at occupancy that the building was constructed to meet the state energy standard. Inspectors then become third party mediators in disputes between the architect or engineer and the contractor building the structure. North Carolina and others provide a special form for energy code compliance that must be sealed by the architect or engineer and which carries the threat of loss of license for a violation. In Oklahoma the contractor licensing board has the authority to take away the contractor's license if violations are found.

A recently published energy conservation document cited upgrading building codes as a solution to improving the U.S. energy outlook for the future. Buildings are being constructed today in states that have adopted energy standards that are over 15 years old. Those buildings, however, are not in compliance with those standards. Due to things such as high turnover in building departments, limited budget and resources for enforcement, lack of effective penalties, pressures to address other issues such as seismic design and accessibility, and limited state

support the present enforcement system, with few exceptions, cannot ensure that new upgraded standards are satisfied. Before upgrading standards to the point where they are multiple revisions ahead of the capabilities of the enforcement system, support for and enhancements to that system need to be made. When local officials pray for the state to publish a thicker energy standard so it can be used as a doorstop the message is clear that they need support. Without that support the speed limit signs can continue to become more conservative and the police will be unable to handle the number of speeders.

Conclusions

There are a wide range of different state and local building regulatory programs throughout the United States.

The standards adopted must fit with the state or local legislative, regulatory, technical, and administrative capabilities to be most effectively implemented.

The rate of compliance is directly related to the stringency and complexity of the standard.

Upgrades in commercial standards will not be fully utilized until the implementation and enforcement network is upgraded as well.

The methods by which standards are enforced have a direct bearing on the level of compliance.

Buildings are not being designed and constructed to meet adopted building energy standards.

Information on adopted standards is readily available from state and local government and very few have monitored or audited the real level of compliance.

The frequency with which standards revisions are adopted and become effective affects implementation and enforcement success.

Few standards are self-explanatory and without need of interpretation, fostering difficulty in implementation and enforcement that must be addressed through hotlines, manuals, and other support materials.

Unification and simplification of standards criteria improves the ability to implement the standards and enhances compliance.

The vigor with which state and local government enforces standards has a direct bearing on the use of the standards by the design and construction community.

Incentives to designers to satisfy standards can reduce the level of enforcement needed to assure compliance.

Available manpower resources, time, financial support, and standards complexity directly affect the ability to enforce standards. This is more pronounced where the state adopts the standards and places enforcement responsibility with local governments.

Where a state agency performs functions associated with implementation and enforcement there is a higher probability that compliance will be achieved.

The present state and local enforcement infrastructure is not equipped to ensure that new upgraded commercial standards are satisfied.

The present adoption and implementation process for commercial standards does not assign accountability or levy penalties at a level that would enhance compliance.

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Endnotes

1. It is understood that energy standards also include energy codes, model codes and other terms. For the purposes of the paper the term energy standard is used throughout but is intended to cover these other terms within the context of the presentation.

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