Building Energy Codes

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U.S. DEPARTMENT OF
ENERGY

Energy Efficiency &
Renewable Energy

Building Energy Codes 101

An Introduction

Building Energy Codes
U.S. Department of Energy

In order to provide a basic introduction to the varied and complex issues associated with building energy codes, the U.S. Department of Energy's (DOE's) Building Energy Codes Program (BECP), with valued assistance from the International Codes Council (ICC) and the American Society of Heating, Refrigerating and Air-Conditioning Engineers (ASHRAE), has prepared *Building Energy Codes 101: An Introduction*. This guide is designed to speak to a broad audience with an interest in building energy efficiency, including state energy officials, architects, engineers, designers, and members of the public.

For these purposes, the term "Building Energy Codes" is used within this document as a generic term that includes ASHRAE 90.1 (a standard), the IECC (a code), and other forms of building energy standards, guidelines, laws, rules, etc. that are adopted as part of the larger body of building codes and required to be satisfied as a condition for approval to construct and occupy buildings.

For a more comprehensive discussion of building energy codes, please refer to the additional resources referenced in the Appendix, on the BECP website (**www.energycodes.gov**), and watch for the BECP companion document, Energy Codes 201: An In-Depth Discussion.

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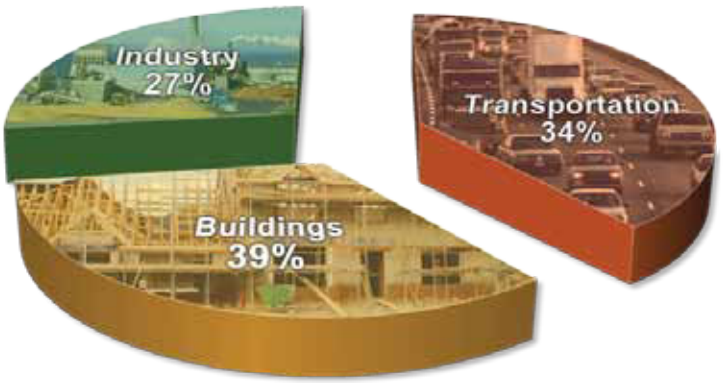
Introduction

Introduction

The effects of energy use in buildings are nationwide, worldwide, and varied. Having a fundamental impact on people's lives, these effects include the economic well-being of the nation, the United States' dependence on foreign oil, and national security. On an individual basis, even human health can be affected by building energy use when rising energy costs render a conditioned, comfortable, healthy indoor environment unaffordable. On a larger scale, carbon emissions, which are directly tied to building energy use, affect the health of our planet.

Some sobering statistics help drive home the reality of building energy use:

- Nearly 5 million commercial buildings and 115 million residential households in the United States consume nearly 40 percent of the nation's total primary energy[1]
- Buildings consume 70 percent of electricity in the United States[2]
- In 2007, carbon dioxide (CO_2) emissions attributable to lighting, heating, cooling, cooking, refrigeration, water heating, and other building services totaled 2517 million metric tons[3] – this is 40 percent of the U.S. total and 8 percent of the global total.



What can be done to curb the significant and ever-growing impact of building energy use?

The adoption and enforcement of more stringent building energy codes in communities across the country is a critical component. This document provides a basic introduction to the many aspects of building energy codes, including their:

- Benefits in terms of the current energy, economic, and environmental challenges facing our world today
- Challenges in terms of adoption, implementation, compliance, and enforcement
- Development processes led by the International Codes Council (ICC) and American Society of Heating, Refrigerating and Air-Conditioning Engineers (ASHRAE)
- Adoption and incorporation into building design and construction by states and jurisdictions
- Enforcement at the state and local level.

More stringent building energy codes are part of the energy solution

Code benefits and challenges

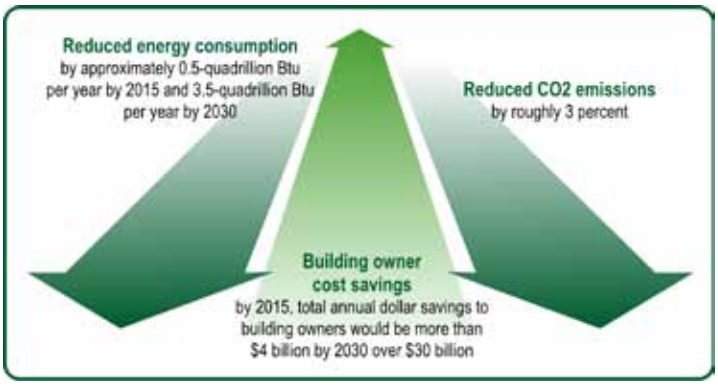
Code benefits and challenges

Stringent building energy codes offer considerable benefits that can be felt far into the future. Recent research[4] shows that if the 2006 International Energy Conservation Code® (IECC) and ANSI/ASHRAE/IESNA[5] Standard 90.1-2004 were upgraded to be 30 to 50 percent more stringent, adopted among states, and effectively implemented, significant benefits would be gained in terms of energy consumption, cost savings, and CO_2 emissions reduction:

- **Reduced energy consumption:** The effects of improved residential and commercial building codes would reduce primary energy use in buildings by approximately 0.5-quadrillion Btu per year by 2015 and 3.5-quadrillion Btu per year by 2030. This is equivalent to power generated by 260 medium (450-MW) power plants.[6]
- **Building owner cost savings:** By 2015, total annual dollar savings to building owners would be more than $4 billion. That figure may rise to over $30 billion by 2030. Even accounting for the increased investment cost of the measures, the net benefits to the nation are large.
- **Reduced CO_2 emissions:** CO_2 emissions would be reduced by roughly 3 percent in terms of the projected national CO_2 emissions in 2030.

Code challenges

Though the savings of more stringent building energy codes is clear, there are challenges involved in their adoption, implementation, compliance, and enforcement. For example, adoption is not automatic in most states. Without statewide adoption, jurisdictions are left without state guidance or resources, and builders can face a patchwork of codes across their region. Adding complication, the challenges of implementation, compliance, and enforcement vary depending on the jurisdiction; lack of training as well as lack of manpower are often cited as roadblocks to proper enforcement. As with any aspect of building codes, plan review and inspections take time, and this must be accounted for in department staffing. Training is critical to the design, building, and enforcement communities. Not only is there a need for understanding new code language, but new construction techniques and new materials and technologies must be considered and understood.



While investing in energy efficiency can save money down the road, choosing less energy-efficient methods of design or construction can save money now. Thus, builders are often challenged to justify the expense of incorporating energy-saving measures.

Increasing building energy efficiency such as what is achieved by BECP's efforts, resulting in

Less energy **consumption**
Less cost **for consumers**
Less carbon **added to the environment.**

Consider this case in point: Studies show that transforming the building sector to employ more energy-efficient designs, equipment, and solar power could cut projected overall household energy expenses in 2030 from $285 billion to $130 billion. Failing to catalyze building-sector transformations will raise the cost of meeting long-term climate goals by at least $500 billion per year globally.[7]

The role of technology in building is also important and must be balanced in terms of accessibility to the technology, ease of use, and associated costs. Finally, human behavior must be taken into account and can be influenced by public energy-use policies designed to create public awareness, empowerment, and incentives.

Building energy code development

Building energy code development

Building energy codes[8] are minimum requirements for energy-efficient design and construction for new and renovated residential and commercial buildings.[9] A component of a complete set of building regulations that govern all aspects of the design and construction of buildings, building energy codes set an energy-efficiency baseline for the building envelope, systems, and equipment. Improving these minimum requirements or broadening the scope of energy codes softens the environmental impact of buildings as well as generates additional energy and cost savings over the decades-long, or even centuries-long, life cycle of a building.

Baseline codes: IECC and ASHRAE 90.1

Two primary baseline building energy codes may be adopted by states and local jurisdictions to regulate the design and construction of new buildings: the International Energy Conservation Code® (IECC), and the ANSI/ASHRAE/IESNA Standard 90.1 Energy Standard for Buildings except Low-Rise Residential Buildings. The IECC addresses all residential and commercial buildings. ASHRAE 90.1 covers commercial buildings, defined as buildings other than single-family dwellings and multi-family buildings three stories or less above grade. The IECC adopted, by reference, ASHRAE 90.1; that is, compliance with ASHRAE 90.1 qualifies as compliance with IECC for commercial buildings.

The IECC is developed under the auspices of the ICC using a government consensus process. Per this process, all interested parties may participate, but the final vote on the content of the codes is made by individuals associated with federal, state, or local governments who are also members of the ICC. The IECC is one of 14 model codes developed under the auspices of the ICC that combined provide the foundation for a complete set of building construction regulations. The ICC codes are updated every three years, providing a model the jurisdiction can adopt as is, or modify. Because the IECC is written in mandatory, enforceable language, state and local jurisdictions can easily adopt, implement, and enforce the IECC as their energy code. Before adopting the IECC, state and local governments often make changes to reflect regional building practices, or state-specific energy-efficiency goals.

✓ **The IECC applies to both residential and commercial buildings. Updated about every three years, the most current version available is the 2009 IECC.**

✓ **ASHRAE 90.1 applies to commercial buildings (including multi-family high-rise buildings). Also updated about every three years, the most current version available is ASHRAE 90.1-2007.**

Both the IECC and ASHRAE 90.1 are developed, revised, and adopted in open public forums.

ASHRAE 90.1 is developed under the auspices of the American Society of Heating, Refrigerating and Air Conditioning Engineers using the ANSI consensus process, which requires a balance of interests. All interested parties can participate by addressing the committee during deliberations, participating in subcommittees, or commenting during the public review process. The final vote of the project committee includes members from a balance of all interests, not limited to government representatives. Revisions in the development and maintenance of the standard occur on an ongoing basis and are not approved without achieving this balanced consensus, or substantial agreement reached by directly and materially affected interest categories. Before adopting ASHRAE 90.1, state and local governments often make changes to reflect regional building practices, or state-specific energy-efficiency goals.

Code collaboration

Both the IECC and ASHRAE 90.1 are developed, revised, and adopted in open public forums. The openness and transparency of these processes is critical to widespread acceptance of the end result. Stakeholders representing a cross-section of interests are involved in maintaining these documents and include:

- The design community, including architects, lighting, designers, and mechanical and electrical engineers
- The code enforcement community, including building code officials, representatives of code organizations, and state and local regulatory agencies
- Builders and contractors
- Building owners and operators
- Industry and manufacturers for the building industry
- Utility companies
- Energy advocacy groups
- The academic community
- Federal agency staff, including the Building Energy Codes Program (BECP).

Code maintenance relies on collaboration for a successful outcome.

Code maintenance relies on collaboration for a successful outcome. Collaboration keeps these documents current with technological, economic, and policy concerns, giving each stakeholder an opportunity to participate in updating and maintaining the codes. This focus of building industry resources at the national voluntary level is critical to a balanced and fair process, addressing such issues as market viability, industry fairness, and construction costs, to name just a few. Without the ICC, ASHRAE, or other organizations, each federal agency, state agency, or local government agency would need to conduct the development of similar provisions themselves. Aside from the countless resources required, the uniformity of codes across jurisdictions—so critical for the building industry—would be sacrificed. Building science and building energy efficiency are just two considerations in designing code changes. Energy codes and standards are compromise documents forged from a wide range of issues and concerns.

In Detail: The IECC process

How is the IECC Revised and who can participate?

The IECC is revised every three years per a well-defined revision process, as defined in Figure 1. Anyone may propose a revision to the IECC by submitting suggested changes to the code text along with supporting documentation. Proposed code changes are commonly submitted by a number of representative stakeholders. The ICC publishes proposed changes and distributes them to the public for review. This review occurs about six weeks prior to an open public hearing held to discuss the proposed revisions.

At the public hearing, testimony for and against each code change proposal is presented to the Code Development Committee responsible for a particular ICC code. Each committee is typically composed of seven to 11 individuals appointed by the ICC. The committee is represented by government members, code officials, home builder representatives, industry groups, and other interested and affected parties.

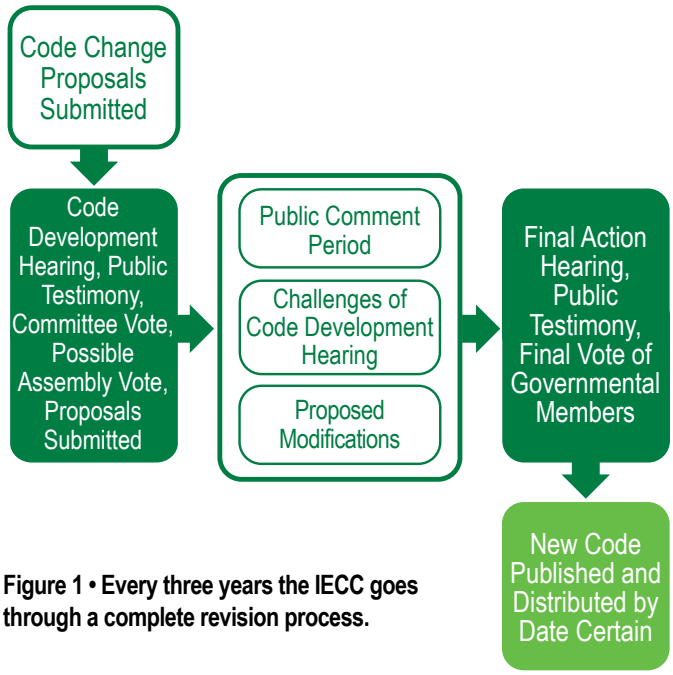


Figure 1 • Every three years the IECC goes through a complete revision process.

How are decisions about the IECC made?

The committee receives testimony and then votes to recommend a disposition on each change (approve, deny, or approve as modified, at the hearing). The committee's decision may be overturned by a "floor action"—a two-thirds affirmative vote of ICC members in attendance. The ICC publishes the results of the first hearing and those wishing to challenge the results of the first hearing may submit a public comment proposing the change. Their submission will place the code change on the agenda for a second public hearing. All public comments are published so that interested parties can present additional information on each change at a second public hearing. The final disposition of all changes is then decided by a vote of the governmental members (as distinguished from industry members) of ICC in attendance at the second public hearing. The ICC process allows for an appeal to the ICC Board of Directors concerning the action of the second hearing. Those changes approved at the second hearing are then implemented in the ICC codes and the finished documents represent the next edition of the ICC codes.

What is the timing of the IECC Process?

Proposed changes to the IECC are submitted once during each three-year revision cycle by any interested and affected party. Typically, proposed changes are submitted 18 months prior to the publication of a new version of the IECC. The Code Development Hearings occur approximately six months after the code change proposals are submitted. The results of the

In the 2012 ICC code cycle, BECP staff and their collaborators proposed code changes for residential and commercial buildings. If adopted, these revisions will increase building efficiencies by 30 percent over the level of the 2006 IECC and ASHRAE 90.1-2004.

Code Development Hearings are released three months after the hearings. Any interested and affected party is allowed to submit public comments up to six months after the results are released. The Final Action Hearings are held approximately four months after public comments are received. The final printed version of IECC is typically released in the calendar year following the Final Action Hearings. The most recently published ICC energy code is the 2009 IECC. The final public hearings for the 2012 IECC are scheduled for October 2010. All of the proposed changes approved during the final action hearings will be published in the 2012 IECC.

In Detail: The ASHRAE 90.1 Process

How is ASHRAE 90.1 revised and who can participate?

ASHRAE 90.1 is continually maintained through the development, review, and issuance of addenda to the Standard with approved addenda collected and a new edition published every three years. ASHRAE establishes project committees (the consensus body) of a minimum of five voting members from a broad representation of stakeholders. In some instances, ASHRAE will co-sponsor standard development. In the case of ASHRAE 90.1, their co-sponsor is IES.

How are decisions about ASHRAE 90.1 made?

After the committee proposes and approves, for public review, addenda to the standard, those addenda are approved by the Standards Project Liaison Subcommittee and are then made available for public review. Commenters provide written comments and the committee must address those comments and attempt to resolve the commenter either by accepting their comment in some manner, or if not, advising the commenter why their comment cannot be accepted. Once all commenters indicate the issues are either resolved, are unresolved (but do not wish to delay publication), or are unresolved, then the revision to the standard moves forward for approval.

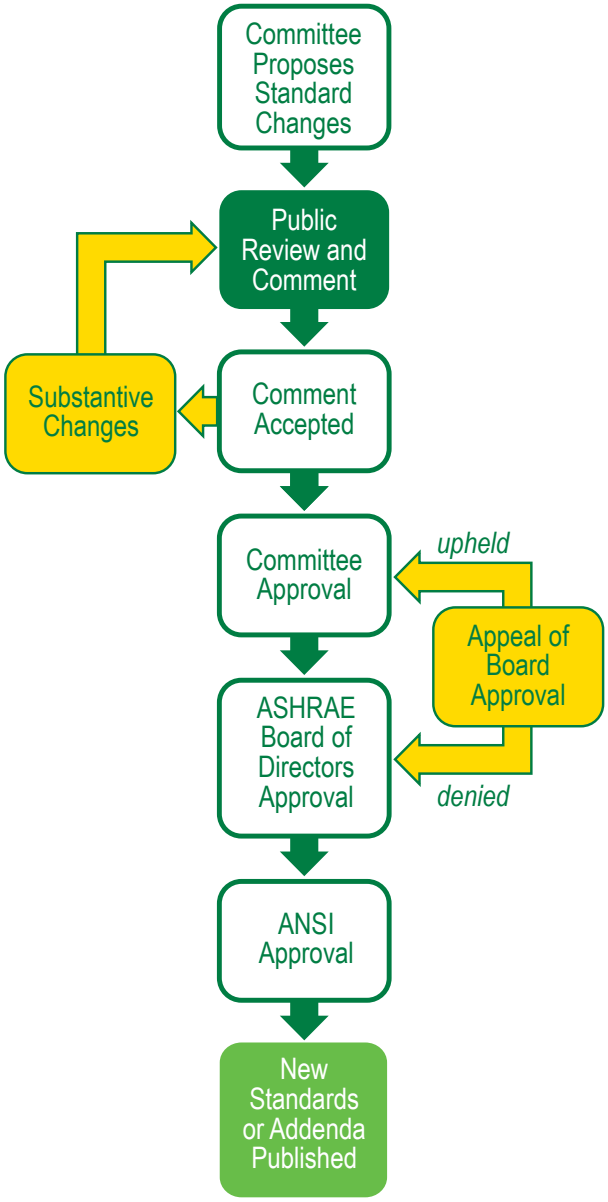


Figure 2 • ASHRAE 90.1 is continually maintained through the development, review, and issuance of addenda, with approved addenda collected and a new edition published every three years.

Approved interim revisions (called addenda) are posted on the ASHRAE website in a supplement, once every 18 months, and are included in the next published version.

The committee responsible for the maintenance and revision of ASHRAE 90.1 for each addendum attempts to reach a resolution with the commenter. In some cases, this requires a further revision to the proposed addendum; in others, an impasse is reached. If the changes proposed are considered non-substantive, then another public review is not necessary; the revisions to the Standard will then move forward for publication approval. Changes deemed substantive require additional public review. Occasionally, when the committee maintaining and revising ASHRAE 90.1 feels the changes can be approved (either because there are no outstanding unresolved comments, or if there are some, they are resolved or cannot be resolved), the revisions to the standard are submitted for approval to the ASHRAE Standards Committee, the Technology Council, and then the Board of Directors.

Those who have submitted unresolved comments can appeal the Board of Directors' approval. An ASHRAE Appeals Panel reviews the record and addresses the appeal. If the appeal is upheld by the panel, the revision is sent back to the ASHRAE 90.1 committee for further work. If it is not upheld, the Board of Directors' approval stands, the addendum is approved by the American National Standards Institute (ANSI), and the addendum proceeds to publication if no appeals are received at ANSI. Unresolved commenters that have completed the ASHRAE appeals process may appeal the ANSI approval of the addendum. If the appeals at ANSI are denied or no appeals are received, then the addendum is published.

What is the timing of the ASHRAE 90.1 process?

A supplement to ASHRAE 90.1 is published once every 18 months and the complete standard is published, with approved addenda, once every three years. However, anyone may propose a revision to the Standard at any time. Approved interim revisions (called addenda) are posted on the ASHRAE website in a supplement, once every 18 months, and are included in the next published version. Key activities relating to revisions, including responding to public comments and continuous maintenance change proposals, typically occur during one of ASHRAE's annual (June) or winter (January) meetings. Public review of the Standard typically occurs two months after one of these meetings in either March or September.

Adoption of energy codes at the state and local level

Adoption of energy codes at the state and local level

Adoption of energy codes can occur directly through legislative action or by regulatory action through agencies authorized by the legislative body to oversee the development and adoption of codes. When adoption is accomplished through legislation, a committee may be appointed to provide recommendations and/or draft the legislation. When adoption occurs through a regulatory process, states and local governments often appoint an advisory body comprising representatives of the design, building construction, and enforcement communities. This advisory panel recommends revisions that should be considered for adoption. In basing their recommendations on model energy codes, the advisory panel considers modifications to the model codes to account for local preferences and construction practices. The panel also may serve as a source of information during the adoption process. Their recommendations then enter a public review process.

Overview of the adoption process

The code adoption process *generally* includes the following steps (note that the details of the adoption process vary depending on whether the energy code is adopted by legislation, regulation, or a local government):

1. A change is initiated by a legislative or regulatory agency with the authority to promulgate energy codes. Interested or affected parties also may initiate a change. An advisory body typically is convened and will recommend a new energy code or revisions to an existing energy code.
2. The proposal undergoes a public review process consistent with the legislative or regulatory process under which the code is being considered. Public review options include publishing a notice in key publications, filing notices of intent, or holding public hearings. Interested and affected parties are invited to submit written or oral comments.
3. The results of the review process are incorporated into the proposal, and the final legislation or regulation is prepared for approval.
4. The approving authority reviews the legislation or regulation. Revisions may be submitted to the designated authority for final approval or for filing.
5. After being filed or approved, the code becomes effective, usually on some specified future date. This delay creates a grace period that allows those regulated to become familiar with any new requirements. The period between adoption and effective date typically varies from 30 days to six months.

Visit www.energycodes.gov/implement/state_codes/ for more information on the adoption rates and compliance plans of each state.

Timing the adoption and revision of state and local codes

Some states adopt or revise energy codes in concert with the publication of a new edition of new codes, such as the ICC Codes or ASHRAE Standard. This may occur either through a legislative or regulatory process, or when the state regulation or legislation refers to "the most recent edition," in which case the adoption will simply occur automatically without formal action. The effective date of a new adoption can also be tied to the publication date of an energy standard or model energy code, e.g., "This regulation shall take effect one month from publication of the adopted model energy code."

Other states review the new editions on a case-by-case basis to consider adoption, without a designated time line for adoption.

How energy codes affect building design and construction

How energy codes affect building design and construction

Baseline building energy codes—the IECC and ASHRAE 90.1—currently address the energy-efficiency requirements for the design, materials, and equipment used in nearly all new construction, additions, renovations, and construction techniques. Their requirements affect the overall energy efficiency of any structure and can reduce the energy needed to maintain a healthy, comfortable, and fully functioning indoor environment. Quite comprehensive in nature, the codes apply to:

- Wall, floor, and ceiling
- Doors and windows
- Heating, ventilating, and cooling systems and equipment
- Lighting systems and equipment
- Water-heating systems and equipment.

Building envelope

Local climate plays a role in the energy code requirements for the material selection and techniques used to construct the building envelope. Code requirements specify the insulation levels in the floor, ceiling, and walls and are intended to seal the building against air leakage and moisture migration. The defined energy-efficiency levels of doors and windows take into consideration heat loss and gain, depending on whether heating or cooling of the building is the predominant concern, and daylighting. Designers and contractors must make sure that the building materials and installation are completed as specified for the building to comply with the code.

Heating, ventilating, and cooling

HVAC systems are composed of equipment that creates conditioned air or tempered liquid, conveys air or liquid through passageways (ducts and plenums) or pipes, and automatically regulates the amount to be conveyed via recirculation or exhausting. HVAC system efficiency can be improved by adding equipment that can convert delivered gas or electric power efficiently or by using economizers, which allow the automatic use of outside air or allow users to regulate space conditions. Energy codes provide minimum criteria for the size of HVAC systems and equipment, taking into consideration the energy demands of the building space.

Lighting and electrical

Energy efficiency for lighting is gained by using efficient sources of illumination, considering the number and location of lights throughout the space, and considering the control systems for appropriate operation. The energy codes provide minimum criteria to provide effective lighting control. Motor and transformer efficiency is also covered in this area.

Water heating

Water-heating energy efficiency depends upon water-heating equipment, delivery, and operational controls. Energy codes provide minimum criteria to effectively heat and deliver hot water.

Note that both the IECC and ASHRAE 90.1 provide for exceptions; however, one can typically assume their building must comply with the code.

What Do Codes Mean for the Architect?

Architects need to design buildings that meet all the adopted local building codes within the building owner's budget. Complying with a building energy code is an additional challenge and affects the design of all building systems (e.g., building envelope, heating, ventilating, and air conditioning (HVAC), and lighting). Complying with energy codes also affects the materials selected for the building by requiring, for example, glazing with correct efficiencies, proper insulation levels, and lighting controls that meet the intent of the code.

To minimize the first cost for the project, the architect must work collaboratively with the HVAC and lighting designer to optimize the building design and take advantage of the increased efficiencies in the building. For example, increased insulation levels and efficient windows coupled with an efficient lighting system will reduce the heat loss from the building and heat gain from the lighting system. With such efficiencies in place, the HVAC contractor can optimize the heating and cooling system to reduce the higher first costs of the building's increased efficiencies. The benefit for the building owner is reduced utility bills for the life of the building.

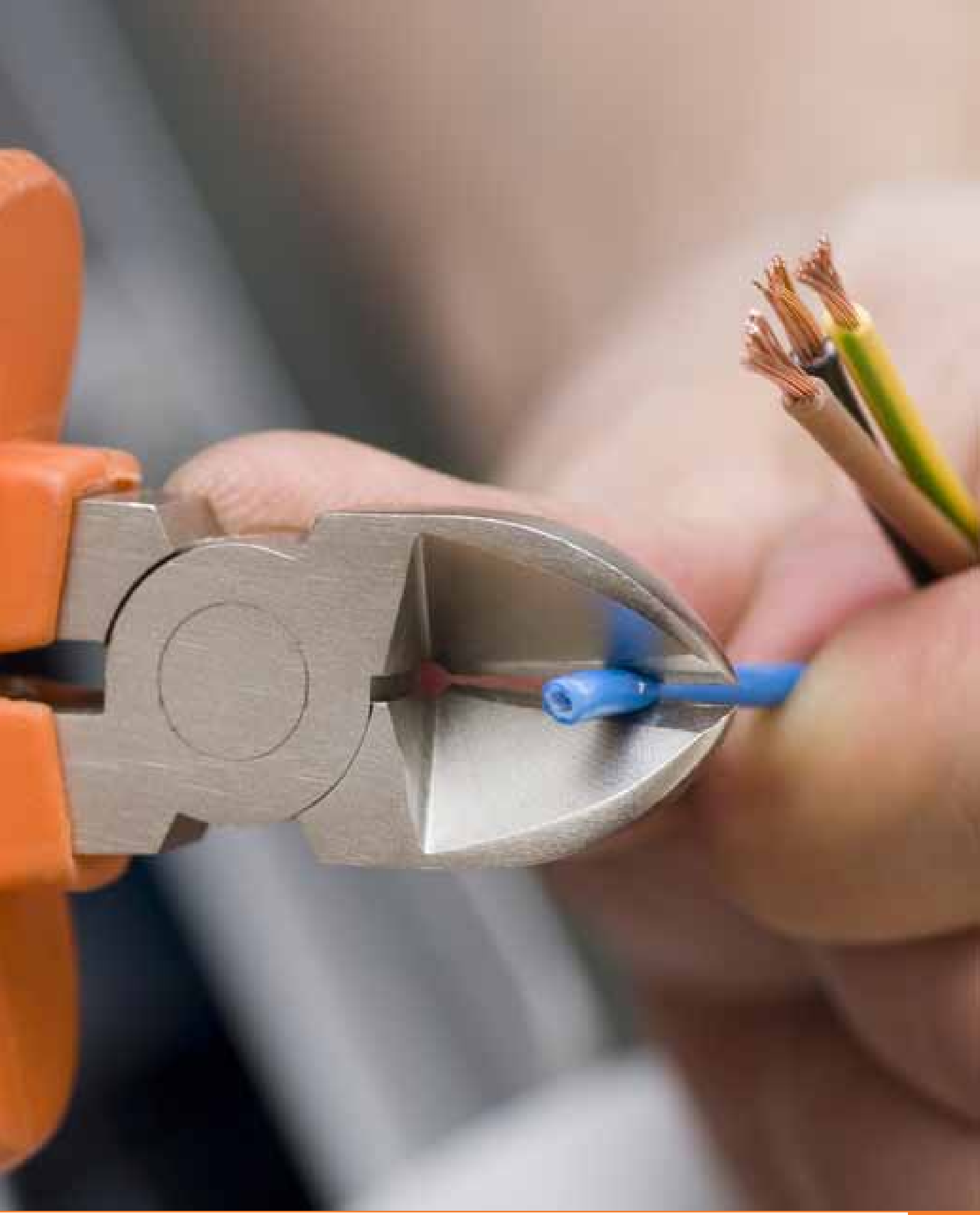
Architects can learn about compliance with the IECC and ASHRAE 90.1 through training provided and sponsored by the American Institute of Architects. AIA also provides training on going above code to promote integration of energy-efficient and sustainable design into new buildings.

What Do Codes Mean for the Builder?

Builders face similar compliance challenges with local building codes and applicable energy codes. They must keep the building within budget, whether it is established by the building owner or their own business model. The builder must select products and materials that best fit the design of the building and satisfy the requirements of the energy code. For example, the builder may use 2" X 6" studs (instead of 2" X 4") for walls in a home so that higher levels of insulation can be installed to meet the code. Increasing the wall framing sizing will impact the cost of finish materials used in the building and may affect its design.

As with architects, builders must collaborate with their subcontractors to take advantage of the reduction in system sizes that result from the increased efficiencies installed in the building. Buildings that comply with an energy code will have higher levels of efficient materials and systems, leading to a decrease in the first cost for the efficiency measures.

The National Association of Homebuilders Research Center developed construction techniques for residential construction that will reduce the first cost of the building while still ensuring the home meets the structural requirements set by the code. By using advanced design practices a building can be built with a minimal increase in first cost and also comply with the energy code. Ultimately, the building owner will benefit with reduced energy bills and a comfortable, healthy home.



Energy code enforcement and compliance

Energy code enforcement and compliance

Enforcement, or making sure that a building is in compliance with an energy code, is the last step in the building process. Like the other steps on the path—energy code development through the ICC and ASHRAE processes, adoption of those codes by states and jurisdictions, and code-compliant design and construction—enforcement is critical to realizing energy efficient buildings. The responsibility to enforce the building energy code falls upon states or jurisdictions, and the responsibility to comply with the building energy code falls on developers, designers, and contractors. Education and communication regarding energy codes are vital to the effective delivery of both enforcement and compliance.

Enforcement strategies will vary according to a state or local government's regulatory authority, resources, and manpower and may include all or some of the following activities:

- 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.

State enforcement

States generally enforce the energy code for state-owned or state-financed construction. Depending on the resources of the local government, some states enforce energy code for certain building types or locations. Plan review is typically performed by one office. Though there may be numerous state field inspectors, both review and inspection agencies are controlled by one organization. The building construction community benefits because this arrangement offers them a single point of contact from plan review to building inspection. State resources determine the extent of building plan reviews and construction inspections. When resources are limited, fire and safety codes can take precedence over energy code enforcement.

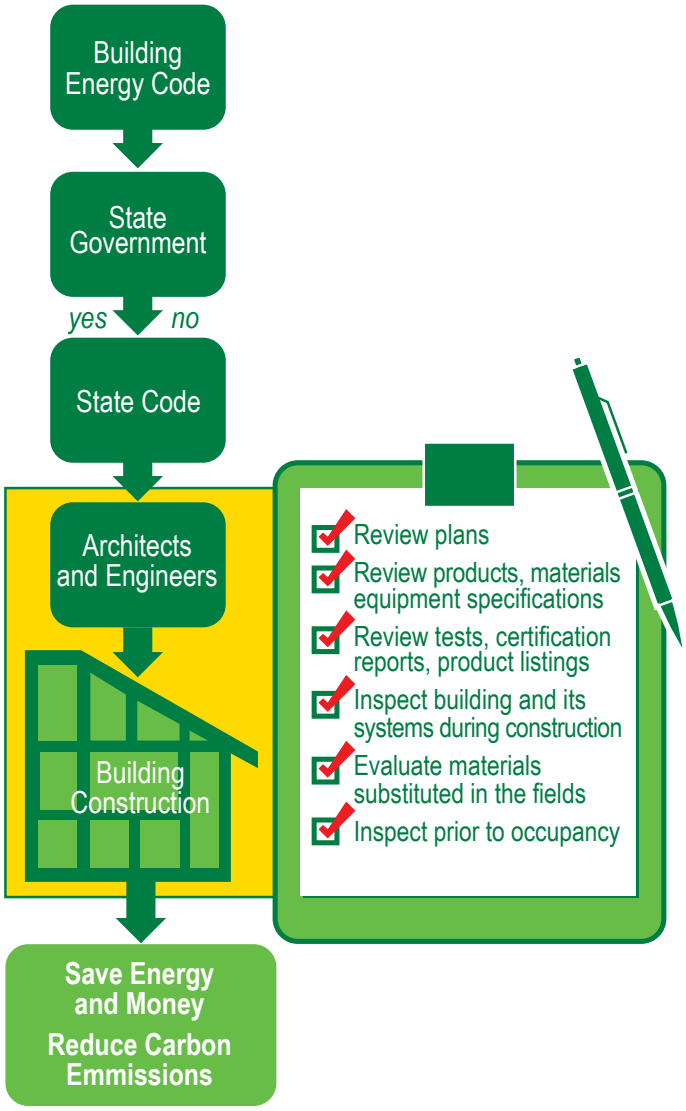


Figure 3 • The responsibility to enforce the building energy code falls upon states or jurisdictions, and the responsibility to comply with the building energy code falls on building owners, and developers, designers, contractors.

Local enforcement

Where local agencies are authorized and have the resources they will enforce the adopted codes. The proximity of local agencies to the construction site and design community offers the potential for more regular enforcement. As with states, the availability of resources determines the extent to which plan reviews and construction inspections can be performed. Also as with states, resource limitations can affect enforcement of energy codes when the local agencies are also responsible for fire and safety code enforcement.

Because jurisdictions vary, local enforcement may lead to differences in the rate of code compliance across a state. Compliance is enhanced when a state code agency actively supports local governments in its efforts to enforce the state code. Some states allow local jurisdictions to conduct enforcement activities that are usually the state's responsibility. This strategy offers the advantages associated with state enforcement, recognizes those local governments with equivalent enforcement capabilities, and helps ensure comparable levels of compliance. Continued state assistance helps to ensure a consistent level of enforcement by local jurisdictions. A hybrid approach might involve the state conducting the plan review, and the local authority conducting the construction inspection.

It is important to note that compliance will be increased if the adopting agency provides resources to the code officials to enforce the energy code and prepares the building construction community to comply with it. It is also important for all stakeholders to know when a new code is expected and understand its requirements. Many states or jurisdictions start this education process several months in advance of an energy code change—often before adoption of the code itself. The more publicity and training on the new code, the more it will be accepted and used.

DOE's easy-to-use code compliance software, **RES***check* and **COM***check*, as well as associated training and support resources, are available for download at no cost at www.energycodes.gov/compliance_tools.stm.

COMcheck™

REScheck™

Compliance tools

An important focus of education and training for building energy code enforcement and compliance are the tools available to facilitate enforcement and compliance. BECP, ICC, ASHRAE, and other organizations all supply tools and materials that make building energy code implementation and training easier for states and local jurisdictions. (See the appendix for additional resources.)

There are several common methods available to document compliance, including prescriptive forms, software-generated forms, and modeling runs. Local jurisdictions can generate simplified prescriptive forms, typically for residential construction. The one- or two-page form lists the minimum requirements for that climate zone, allowing the applicant to simply show the appropriate details on the submitted plans, and fill out the form, noting insulation levels, efficiencies, and the like.

Software programs such as RES*check*™ and COM*check*™ can also be used to demonstrate compliance. The user inputs building component areas, efficiencies, and other specifications to generate a compliance report. The software allows flexibility and trade-offs between components. For example, a designer may choose to include a greater glass area on a particular wall for a view corridor, and compensate by increasing insulation levels elsewhere.

Beyond-code programs

Beyond-code programs

Progressive states and local jurisdictions with a focus on energy efficiency and/or sustainability are increasingly building upon the baseline building energy codes and adopting beyond-code programs, either as their minimum codes or as a component of a program that provides incentives to those that comply. The programs are referred to in various terms–beyond-code programs, green building programs or codes, stretch codes, and above-code programs. What they have in common as a key component is building energy efficiency; they may have more rigorous requirements than minimum energy codes and/or address additional issues not covered in the energy codes.

Most beyond-code programs use the IECC and/or ASHRAE 90.1 as a baseline, with additional requirements beyond that. Jurisdictions are both mandating these programs and offering them with incentives to those who voluntarily comply.

The relationship between beyond-code programs and the baseline energy codes

Designers, builders, plan reviewers, inspection staff, and all interested parties still need to thoroughly understand the underlying baseline energy code when working with a beyond-code program.

Most beyond-code programs use the IECC and/or ASHRAE 90.1 as a baseline, with additional requirements beyond that. Jurisdictions are both mandating these programs and offering them with incentives to those who voluntarily comply. They vary widely in scope–from a simple requirement to comply 10 percent above the current IECC, to comprehensive programs that also include such elements as water conservation, site selection and design, etc. As of August 2009, there were over 300 instances of beyond code program adoption of states and jurisdictions nationwide.

Initially serving as a proving ground, beyond-code programs are used to make efficiency improvements in the residential and commercial building marketplace which, over time, become acceptable as a typical practice and are often submitted to the ICC or ASHRAE processes as a code change proposal. High-efficacy lighting systems for residential homes is one example of this process. These lighting systems have been included in incentive programs for some time and are now required in the IECC.

Each jurisdiction adopting a beyond-code program or stretch code must determine how they will verify compliance. This will vary depending on the type of program and staffing.

Complying with beyond-code programs

Each jurisdiction adopting a beyond-code program or stretch code must determine how they will verify compliance. This will vary depending on the type of program and staffing. Often, when adherence to a third-party program is required, the jurisdiction will require submittal of verification from the third-party program. When the program is locally developed, such as the City of Albuquerque, it becomes the code for which the department conducts plan reviews and inspections. When the program specifies a percentage above the IECC or ASHRAE 90.1, RES*check*, COM*check*, or other modeling programs such as Energy Plus, can be used and submitted for plan review.

Conclusion

Conclusion

Building energy codes can play a key role in reducing building energy costs, our nation's reliance on foreign oil, and carbon emissions as well as in increasing the comfort of our homes and offices. Though the building energy codes world is not without its challenges, the benefits far outweigh the barriers. Crafted in open public forums, all stakeholders and interested and affected parties are welcome to participate in the building energy codes development processes. And the processes used to update both the IECC and ASHRAE 90.1 are designed to make sure the interests of varied stakeholders are considered, including those pertaining to industry, of importance to building scientists, and affecting financial viability. Building energy codes are readily available for states and jurisdictions to adopt, and a broad range of enforcement and compliance tools are available to help policy makers, designers, builders, and the enforcement community successfully implement building energy codes. Building energy codes are a baseline of energy efficiency that constantly drive beyond-code programs to improve. As code cycles iterate from one to the next, today's beyond-code programs become the baseline of tomorrow. Ultimately, the energy codes community will converge on its true goal—buildings with zero energy use.

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Appendix

Following is a description of and contact information for organizations and groups mentioned in the document, in addition to other national and regional resources.

Description	Contact
National Contacts and Resources	
The International Code Council (ICC) is a membership association dedicated to building safety and fire prevention. ICC develops the codes and standards used to construct residential and commercial buildings, including homes and schools. ICC is the publisher of the International Energy Conservation Code. They are a resource for code books and training. Local chapters are active in most states. They are the publisher of the ICC-700-2008 National Green Building Standard, and the International Green Construction Code currently under development in conjunction with the American Society for Testing and Standards (ASTM) and the AIA.	**www.iccsafe.org** **ICC** 500 New Jersey Avenue, NW, 6th Floor, Washington, D.C. 20001 Phone: 888-ICC-SAFE (422-7233)
American Society of Heating, Refrigerating and Air-Conditioning Engineers (ASHRAE) is an international membership organization of advancing heating, ventilation, air conditioning, and refrigeration through research, standards writing, publishing, and continuing education. They are a resource for standards, education, research, and training. Local chapters are active throughout the country. They are the publisher of ASHRAE 189, currently under development in conjunction with IESNA and USGBC and is being developed for inclusion into building codes.	**www.ashrae.org** **ASHRAE** 1791 Tullie Circle, N.E. Atlanta, GA 30329 Toll-free for Customer Service: 800-527-4723 (U.S. and Canada only) Phone: 404-636-8400
The U.S. Department of Energy's (USDOE) Building Energy Codes Program is an information resource on national energy codes. They work with other government agencies, state and local jurisdictions, national code organizations, and industry to promote stronger building energy codes and help states adopt, implement, and enforce those codes.	**www.energycodes.gov**
American Institute of Architects (AIA) is the leading professional membership association for licensed architects, emerging professionals, and allied partners.	**www.aia.org** **American Institute of Architects** The American Institute of Architects 1735 New York Ave. NW Washington, D.C. 20006-5292 Phone: 800-AIA-3837 or 202-626-7300
Energy & Environmental Building Alliance (EEBA). The stated mission of EEBA is to provide education and resources to transform the residential design, development, construction, and remodeling industries to profitably deliver energy efficient and environmentally responsible buildings and communities.	**www.eeba.org** **EEBA** 6520 Edenvale Boulevard, Suite 112 Eden Prairie, MN 55346 Phone: 952-881-1098
The Building Codes Assistance Project (BCAP) provides advocacy at the state and regional level, serves as clearinghouse for energy code information, develops resources to support code compliance, and provides energy code training and workshops.	**www.bcap-energy.org** **Building Codes Assistance Project** 1850 M Street, NW, Suite 600 Washington, D.C. 20036
The Alliance to Save Energy's (ASE) stated mission is to promote energy efficiency worldwide to achieve a healthier economy, a cleaner environment, and greater energy security. With relation to building energy codes, they are involved in policy advocacy, energy-efficiency projects, technology development and deployment, and public-private partnerships.	**www.ase.org** **Alliance to Save Energy** 1850 M Street, NW, Suite 600 Washington, D.C. 20036 Phone: 202-530-4356

Description	Contact
The National Association of Home Builders (NAHB) is a national trade association focused on policy, education, and research.	**www.nahb.org** **National Association of Home Builders** 1201 15th Street, NW Washington, D.C. 20005 Toll Free Phone: 800-368-5242 Local Phone: 202-266-8200
Regional Code Organizations – Most states belong to a regional code organization which will support their efforts to advance building energy codes. They provide policy guidance, access to research, training, etc.	
Southwest Energy Efficiency Project (SWEEP) is a regional non-profit organization that promotes greater energy efficiency in a six-state region that includes Arizona, Colorado, Nevada, New Mexico, Utah, and Wyoming and facilitates regional partnerships. Their programs include buildings and energy codes, utilities, transportation, industrial efficiency and combined heat and power.	**www.Swenergy.org** **Southwest Energy Efficiency Project** 2260 Baseline Rd. #212 Boulder, CO 80302 For general requests: Email: info@swenergy.org Phone: 303-447-0078
Northeast Energy Efficiency Partnership (NEEP) is a regional non-profit organization that facilitates regional partnerships to advance the efficient use of energy in homes, buildings, and industry in the Northeast U.S. states of Connecticut, Maine, Massachusetts, New Hampshire, New Jersey, New York, Rhode Island and Vermont.	**www.neep.org** **Northeast Energy Efficiency Partnerships, Inc.** 5 Militia Drive Lexington, MA 02421 Phone: 781-860-9177
Midwest Energy Efficiency Alliance (MEEA) is a regional non-profit organization that facilitates regional partnerships. As a central source for information and action, MEEA raises awareness, facilitates energy efficiency programs, and strengthens policy across the Midwest region, including the states of Illinois, Indiana, Iowa, Kansas, Kentucky, Michigan, Minnesota, Missouri, Nebraska, North Dakota, Ohio, South Dakota, and Wisconsin.	**www.mwalliance.org** **Midwest Energy Efficiency Alliance** 645 N Michigan Ave Ste 990 Chicago, IL 60611 Phone: 312-587-8390
Northwest Energy Efficiency Alliance (NEEA) is a regional non-profit organization that facilitates regional partnerships, whose stated mission is to mobilize the Northwest to become increasingly energy efficient for a sustainable future. NEEA works with the states of Washington, Idaho, Montana, and Oregon.	**www.nwalliance.org** **Northwest Energy Efficiency Alliance** 529 SW Third Ave., Suite 600 Portland, OR 97204 Phone: 800-411-0834 or 503-827-8416
Southeast Energy Efficiency Alliance (SEEA) is a regional non-profit organization that facilitates regional partnerships to promote and achieve energy efficiency through networking, program activities, and education. MEEA is active in the 11-state region of Alabama, Arkansas, Florida, Georgia, Kentucky, Louisiana, Mississippi, North Carolina, South Carolina, Tennessee, and Virginia.	**www.seealliance.org** **Southeast Energy Efficiency Alliance** P.O. Box 13909 Atlanta, Ga. 30324 Phone: 866-900.7332 or 404-931-1518

Endnotes

1 Energy Information Administration, *Annual Energy Review 2007*, Figure 2.1a, Energy Consumption by Sector Overview. **http://www.eia.doe.gov/emeu/aer/consump.html**.

2 U.S. Energy Information Administration. Electric Power Annual Report. Table 7.2. Retail Sales and Direct Use of Electricity to Ultimate Customers by Sector, by Provider, 1996 through 2007 (Megawatthours). **http://www.eia.doe.gov/cneaf/electricity/epa/epat7p2.html**.

3 Source: U.S. Energy Information Administration, *Electric Power Annual 2007,* State Electricity Profiles 2007, United States.

4 Belzer D, M Halverson, and S McDonald. 2009. *A Retrospective Analysis of Commercial Building Energy Codes: 1990-2008, Draft.* Building Energy Codes Program, Pacific Northwest National Laboratory, Richland, Washington.

5 The American National Standards Institute/ASHRAE/Illuminating Engineering Society of North America.

6 450 MW as a typical power plant size was based on the range in size of power plants installed in 2006. Refer to the following to see the complete range: *Buildings Energy Data Book*, Table 6.2.7, "Characteristics of New and Stock Generating Capacities, by Plant Type." **http://buildingsdatabook.eere.energy.gov/TableView.aspx?table=6.2.7**.

7 Houser T. 2009. *The Economics of Energy Efficiency in Buildings.* Policy Brief 09-17, Peterson Institute for International Economics, Washington, D.C. Accessed January 13, 2009, at **http://www.iie.com/publications/pb/pb09-17.pdf**.

8 The term "building energy codes" is used within this document as a generic term that includes ASHRAE 90.1 (a standard), the IECC (a code), and other forms of building energy standards, guidelines, laws, rules, etc. that are adopted as part of the larger body of building codes and required to be satisfied as a condition for approval to construct and occupy buildings.

9 A separate set of federal building codes and standards apply to buildings constructed or used by any federal agency that is not legally subject to state or local building codes. They are not the focus of this document. More information can be found at **www.energycodes.gov/federal**.

The U.S. Department of Energy's Building Energy Codes Program is an information resource on national model energy codes. We work with other government agencies, state and local jurisdictions, national code organizations, and industry to promote stronger building energy codes and help states adopt, implement, and enforce those codes.

BECP Website:
www.energycodes.gov

BECP Technical Support:
techsupport@becp.pnl.gov
www.energycodes.gov/support/helpdesk.php

For more information, contact:

Jean Boulin, Program Manager
Phone: 202-586-9870
Email: Jean.Boulin@ee.doe.gov

Contact the EERE Information Center 1-877-EERE-INF (1-877-337-3463) or visit **eere.energy.gov/informationcenter.**

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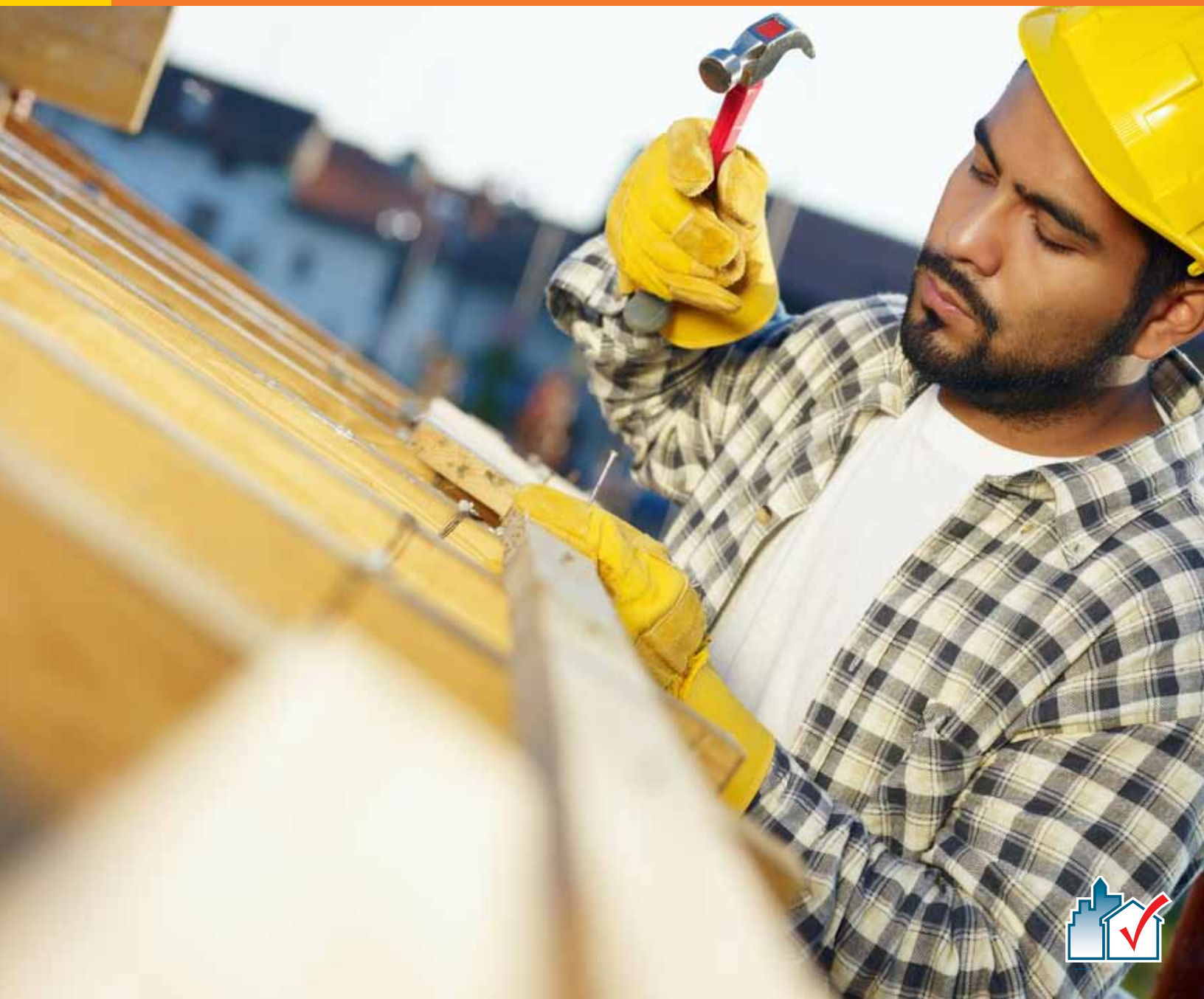
Building Energy Codes 101

Training Manual



In order to provide a basic introduction to the varied and complex issues associated with building energy codes, the U.S. Department of Energy's (DOE's) Building Energy Codes Program (BECP), with valued assistance from the International Codes Council (ICC) and the American Society of Heating, Refrigerating and Air-Conditioning Engineers (ASHRAE), has prepared *Building Energy Codes 101: An Introduction*. This guide is designed to speak to a broad audience with an interest in building energy efficiency, including state energy officials, architects, engineers, designers, and members of the public.

For these purposes, the term "Building Energy Codes" is used within this document as a generic term that includes ASHRAE 90.1 (a standard), the IECC (a code), and other forms of building energy standards, guidelines, laws, rules, etc. that are adopted as part of the larger body of building codes and required to be satisfied as a condition for approval to construct and occupy buildings.

For a more comprehensive discussion of building energy codes, please refer to the additional resources referenced in the Appendix, on the BECP website (**www.energycodes.gov**).

Introduction

The effects of energy use in buildings are nationwide, worldwide, and varied. Having a fundamental impact on people's lives, these effects include the economic well-being of the nation, the United States' dependence on foreign oil, and national security. On an individual basis, even human health can be affected by building energy use when rising energy costs render a conditioned, comfortable, healthy indoor environment unaffordable. On a larger scale, carbon emissions, which are directly tied to building energy use, affect the health of our planet.

The adoption and enforcement of more stringent building energy codes in communities across the country are critical components to curbing the significant and ever-growing impacts of building energy use. This document provides a basic introduction to the many aspects of building energy codes, including their:

- Benefits in terms of current energy, economic, and environmental challenges facing our world today
- Challenges in terms of adoption, implementation, compliance, and enforcement
- Development processes led by the International Code Council (ICC) and American Society of Heating, Refrigerating, and Air-Conditioning Engineers (ASHRAE)
- Adoption and incorporation into building design and construction by states and jurisdictions
- Enforcement at the state and local level.

NOTES

What are **building energy codes**?

Energy codes are:

- Minimum requirements for energy-efficient design and construction:
  - new and renovations
  - residential and commercial.
- A component of a complete set of building regulations:
  - structural, plumbing, electrical, energy, etc.
- Energy-efficiency baselines for:
  - building envelope, lighting systems, and equipment.

Energy codes apply to:

- Building envelope walls, floors, ceilings, doors and windows;
- Heating, ventilating, and cooling systems and equipment
- Lighting systems and equipment; and
- Water-heating systems and equipment.

For **building envelope**, the energy code:

- Includes requirements that vary by climate (i.e., location of the building)
- Specifies insulation levels in floor, ceiling, and walls
- Has the intent to seal the building against air leakage and moisture migration.

For heating, ventilating, and cooling, the energy code:

- Provides minimum criteria for the size of systems and equipment,
  - taking into consideration the energy demands of the building space.

Most energy codes include exceptions.
Some possible examples of exceptions: *Buildings on a historical register and "low energy" buildings* (as defined by the code).

Building envelopes = the building components that separate conditioned space from unconditioned space or the outdoors.

HVAC = heating, ventilating, and air conditioning

NOTES

HVAC systems are composed of equipment that:

- Creates conditioned air or tempered liquid
- Conveys air or liquid through passageways (ducts and plenums) or pipes
- Automatically regulates the amount to be conveyed via recirculation or exhaust.

HVAC system efficiency can be improved by adding equipment that can convert delivered gas or electric power efficiently or by using **economizers**.

> **Economizers allow the automatic use of outside air.**

For lighting and electrical systems, the energy code:

- Provides minimum criteria to provide effective lighting control
- Covers motor and transformer efficiency (commercial buildings).

Energy efficiency for lighting is gained by using efficient sources of illumination, considering:

- The number and location of lights throughout the space
- The control systems for appropriate operation.

For water-heating systems, the energy code:

- Provides minimum criteria to effectively heat and deliver hot water.
- Water-heating energy efficiency depends upon
  - Water-heating equipment
  - Delivery
  - Operational controls.

NOTES

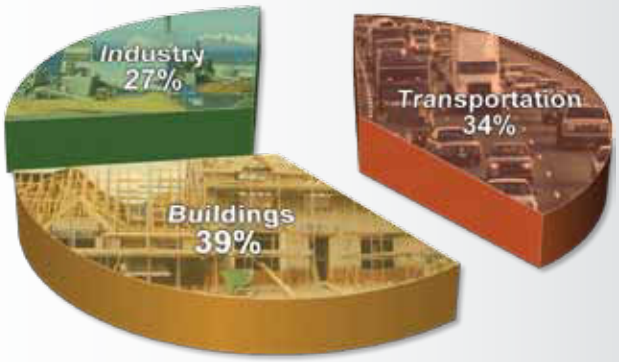
Why are **building energy codes important?**

Stringent building energy codes offer considerable benefits that can be felt far into the future.

Buildings use a lot of energy and create a lot of emissions:

- Nearly 5 million commercial buildings and 115 million residential households in the U.S. consume nearly 40 percent of the nation's total primary energy[1]
- Buildings consume 70 percent of electricity in the U.S.[2]
- In 2007, carbon dioxide (CO_2) emissions attributable to lighting, heating, cooling, cooking, refrigeration, water heating, and other building services totaled 2517 million metric tons[3] – this is 40 percent of the U.S. total and 8 percent of the global total.

More stringent building energy codes are part of the energy solution.



Research[4] shows that if the 2006 International Energy Conservation Code® (IECC) and ANSI/ASHRAE/IESNA Standard 90.1-2004 were upgraded to be 30 to 50 percent more stringent, adopted among states, and effectively implemented, significant benefits would be gained in terms of energy consumption, CO_2 emissions reductions, and cost savings.

ANSI/ASHRAE/IESNA = The American National Standards Institute/American Society of Heating, Refrigerating, and Air-Conditioning Engineers/ Illuminating Engineering Society of North America.

NOTES

Reduced energy consumption:

- The effects of improved residential and commercial building codes would reduce primary energy use in buildings by approximately:
  - 0.5-quadrillion Btu per year by 2015 and
  - 3.5-quadrillion Btu per year by 2030.

This is equivalent to power generated by 260 medium (450-MW) power plants.[5]

Reduced CO_2 emissions:

- CO_2 emissions would be reduced by roughly 3 percent in terms of the projected national CO_2 emissions in 2030.

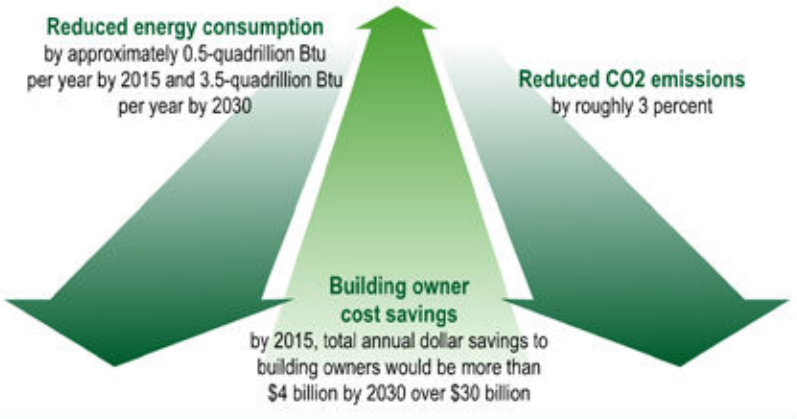
Building owner cost savings:

- By 2015, total annual dollar savings to building owners would be more than $4 billion. That figure may rise to over $30 billion by 2030. Even accounting for the increased investment cost of the measures, the net benefits to the nation are large.

Why are more stringent building energy codes a challenge?

Once developed, codes must still be adopted, implemented, complied with, and enforced.

- Adoption is not automatic in most states. Without statewide adoption, jurisdictions are left without state guidance or resources, and builders can face a patchwork of codes across their region.
- Challenges of implementation, compliance, and enforcement vary by jurisdiction:
  - Lack of training
  - Lack of manpower.



Training is critical. There is a need for understanding new code language, new construction techniques, and new materials and technologies.

Savings resulting from more stringent building energy codes occur in the future, while choosing less energy-efficient methods saves money now. Builders are therefore often challenged to justify the first-cost of energy-efficient measures.

NOTES

What are the **baseline energy codes**?

ICC's IECC

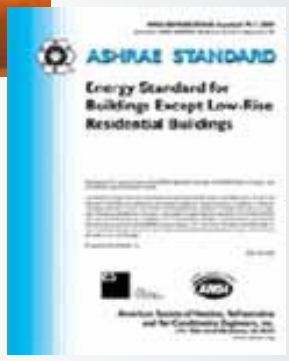
- Covers residential and commercial buildings
- One of 14 model codes developed under ICC
- Revised every three years
- Written in mandatory, enforceable language, easily adoptable by states and local jurisdictions.

ASHRAE's Standard 90.1

- Covers commercial buildings and high-rise, multifamily residential buildings
- Complete standard published every 3 years
- Supplement published every 18 months
- Continually maintained through development, review, and issuance of addenda—approved addenda are collected for the new edition
- Co-sponsored by the Illuminating Engineering Society of North America.

CODE LANGUAGE EXAMPLE: *"Recessed luminaires installed in the building thermal envelope shall be sealed to limit air leakage between conditioned and unconditioned spaces."*

IECC



ASHRAE Standard 90.1

ICC = International Code Council
IECC = International Energy Conservation Code
Examples of other "I" codes:
IRC = International Residential Code
IBC = International Building Code
IMC = International Mechanical Code

NOTES

How is the IECC developed?

The IECC is developed using a **government consensus process**.

- Allows all interested parties to participate.
- Final vote on the content is made by individuals associated with federal, state, or local governments (who are also members of the ICC).

How is ASHRAE 90.1 developed?

ASHRAE 90.1 is developed using the American National Standards Institute (ANSI) consensus process, which requires a **balance of interests**.

- There is a 90.1 project committee which is made up of subcommittees, including Envelope, Lighting and Power, Mechanical, Energy Cost Budget, and Format and Compliance.
- All interested parties can participate by addressing the committee during deliberations, participating in the committee or subcommittees, or commenting during the public review period.
- Final vote of the project committee includes members from a balance of all interests, and is not limited to government representatives.

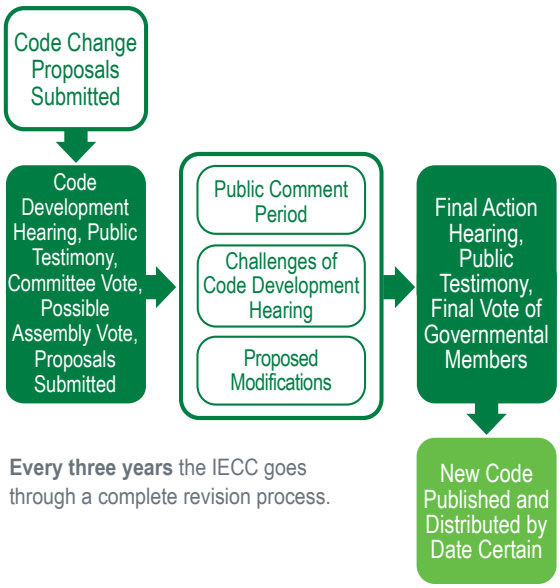
Who are the stakeholders involved in maintaining these codes?

- **The design community**, including architects, lighting designers, and mechanical and electrical engineers
- **The code enforcement community**, including building code officials, representatives of code organizations, and state and local regulatory agencies
- Builders and contractors
- Building owners and operators
- Industry and manufacturers for the building industry
- Utility companies
- Energy advocacy groups
- The academic community
- Federal agency staff, including the Building Energy Codes Program (BECP)

NOTES

What are the steps involved in revising the IECC?

- Anyone may propose a revision by submitting code text and supporting documentation.
  - The form is available at **www.iccsafe.org**
- ICC publishes proposed changes and distributes to public for review.
  - The review happens approximately 6 weeks before an open public hearing held to discuss the proper revisions.
- At the public hearing, testimony for and against each code change proposal is presented to the IECC Code Development Committee.
  - Committee is typically composed of 7 to 11 individuals appointed by the ICC.
  - Committee is made up of government members, code officials, home builder representatives, industry groups, and other interested and affected parties.
- After testimony, the committee votes to recommend a disposition on each change. They may:
  - Approve
  - Deny
  - Approve as modified.
- The committee's decision may be overturned by a "**floor action**."
- ICC publishes results of the first hearing;
  - These results may be challenged by submitting a public comment.



Every three years the IECC goes through a complete revision process.

The ICC process allows for an appeal to the ICC Board of Directors concerning the action of the second hearing.

- All public comments are published.
  - Interested parties may present additional information on each change at a second public hearing.
- A second public hearing is held.
  - The final disposition of all changes is decided by a vote of the governmental members (as distinguished from industry members) of ICC in attendance.
- Approved changes from the second hearing are implemented in the IECC, and the finished documents represent the next edition of the IECC.

Floor action = two-thirds affirmative vote of ICC members in attendance at hearing.

NOTES

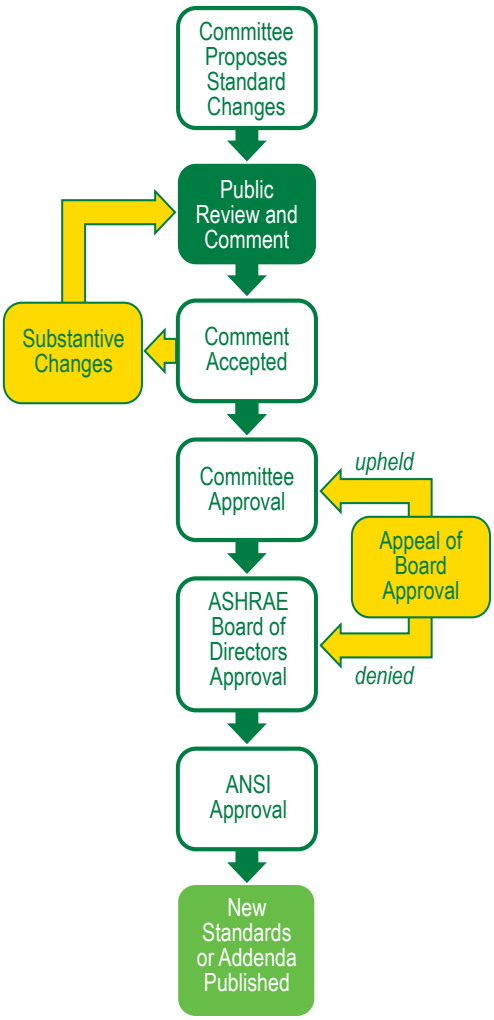
What are steps involved in revising ASHRAE 90.1?

- Any interested party, including the project committee, may propose a change to the standard.
- The project committee develops and approves addenda for public review.
- The Standards Project Liaison Subcommittee approves addenda and makes them available for public review.
- Written comments are accepted from the public.
- The committee must address *every* comment and attempt to resolve either by:
  - Accepting the comment in some manner, or
  - Advising the commenter why their comment can't be accepted.
- Resolution with commenters can result in a further revision to the proposed addendum or an impasse may be reached.
- Proposed changes are deemed either substantive or non-substantive:
  - If non-substantive, another public review isn't necessary and revision moves forward for publication approval
  - If substantive, additional public review is required.

Once all commenters indicate the issues are:

- Resolved
- Unresolved (but don't wish to delay publication), or
- Unresolved,

the revision to the standard moves forward for approval.



ASHRAE 90.1 is continually maintained through the development, review, and issuance of addenda, with approved addenda collected and a new edition published every three years.

NOTES

Occasionally, when the committee maintaining and revising 90.1 feels the changes can be approved (either because there are no outstanding unresolved comments, or if there were some, they are resolved or cannot be resolved), the revisions to the standard are submitted for approval to the ASHRAE Standards Committee, the Technology Council, and then the Board of Directors.

ASHRAE 90.1 Appeals Process

Those commenters who remain unresolved can appeal to the Board of Directors.

- An ASHRAE Appeals Panel reviews the record and addresses the appeal:
  - If upheld, the revision goes back to 90.1 committee for further work.
  - If not upheld, the Board of Directors' approval stands, the addendum is sent to ANSI for approval.
  - Unresolved commenters that have completed the ASHRAE appeals process may appeal the ANSI approval of the addendum. If the appeals at ANSI are denied or no appeals are received, then the addendum is published.

NOTES

How do the **energy codes** get adopted at the state or local level?

Adoption can occur directly through legislative action or by regulatory action through agencies authorized by the legislative body to oversee the development and adoption of codes.

- **By legislation**: A committee may be appointed to provide recommendations and/or draft the legislation.
- **By regulatory process**: States and local governments often appoint an advisory panel comprising representatives of the design, building construction, and enforcement communities.

The panel:

- Recommends revisions that should be considered for adoption
- May also serve as a source of information during the adoption process.

> **Advisory panel recommendations typically account for local preferences and construction practices**

Recommendations then enter a public review process.

Timing the Adoption

Some states will:

- Adopt or revise energy codes in concert with the publication schedule for IECC and 90.1
- Automatically adopt "the most recent edition" without any formal action needed.

The effective date of a new adoption can also be tied to the publication date of IECC or 90.1.

Other states review the new editions on a case-by-case basis to consider adoption, without a designated timeline for adoption.

CODE LANGUAGE EXAMPLE: *"This regulation shall take effect one month from publication of the adopted model energy code."*

NOTES

Once adopted, what do energy codes mean for architects and designers?

Buildings they design must meet code and be within the building owner's budget.

Systems within the buildings must comply:

- Building envelope
- HVAC
- Lighting.

Complying materials must be selected for the building, such as:

- Windows with correct efficiencies
- Proper insulation levels
- Lighting controls.

Buildings must be designed to take advantage of the increased efficiencies in the building.

EXAMPLE: *Increased insulation levels and efficient windows coupled with an efficient lighting system will reduce the heat loss from the building and heat gain from the lighting system.*

The HVAC contractor can then optimize the heating and cooling system to reduce the higher first-costs of the building's increased efficiencies.

Once adopted, what do energy codes mean for builders?

- Buildings they build must meet code and stay within the building owner's budget.
- Materials and products must be selected that best fit the design of the building and satisfy the energy code requirements.
- Collaboration among subcontractors is a must to take advantage of efficiencies installed in the building.

EXAMPLE: *The builder may use 2"x 6" studs (instead of 2"x 4") for walls in a home so that higher insulation levels can be installed to meet the code. Increasing the wall framing size will impact the cost of finish materials used in the building and may affect its design.*

NOTES

What about **energy code** enforcement and compliance?

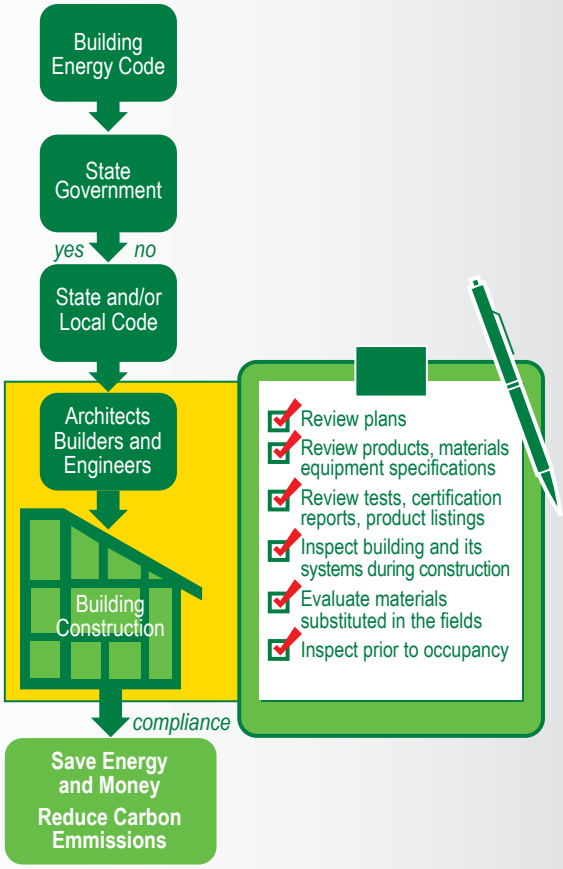
Energy Code Enforcement and Compliance

Compliance and enforcement are critical to realizing energy efficient buildings.

- States and jurisdictions have responsibility for enforcement.
- Developers, designers, and contractors have responsibility for compliance.
- Education and communication regarding energy codes are vital to both enforcement and compliance.
  - Need to include all stakeholders involved, and
  - Need to occur in advance of an energy code change.

Enforcement strategies vary according to a state or local government's regulatory authority, resources, and manpower, and may include all or some of the following activities:

- Review of plans
- Review of products, materials, and equipment specifications



The responsibility to enforce the building energy code falls upon states or jurisdictions, and the responsibility to comply with the building energy code falls on building owners, developers, designers, and contractors.

NOTES

- 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.

State Enforcement

- Generally for state-owned or state-funded construction
- May enforce for certain building types or locations
- Plan review is typically performed by one office.
- Both review and inspection agencies are controlled by one organization
  - Gives the building community a single point of contact
- State resources determine the extent of building plan reviews and construction inspections
- Fire and safety ("health and life safety") codes take precedence over energy code enforcement.

Local Enforcement

- Resource limitations can affect enforcement.
- Proximity to construction sites and design community offers the potential for more regular enforcement.
- Because jurisdictions vary, local enforcement may lead to differences in the rate of compliance across a state.

Some states allow local jurisdictions to conduct enforcement activities that are usually the state's responsibility.

This strategy:

- Offers advantages associated with state enforcement
- Recognizes those local governments with equivalent enforcement capabilities
- Helps ensure comparable levels of compliance.

> **A hybrid approach to enforcement is also possible and may involve the state conducting the plan review, and the local authority conducting the construction inspection.**

How is compliance demonstrated?

Several common methods include:

- Prescriptive forms
- Software-generated forms
- Software modeling runs.

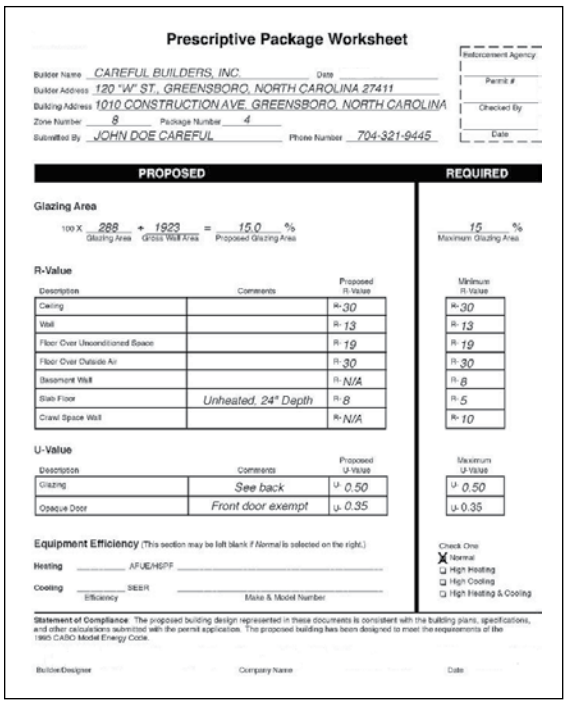
Prescriptive forms are usually 1-2 pages and may be generated by the local jurisdiction (typically for residential construction).

These forms:

- List the minimum requirements for that location.
- Allow the applicant to simply show the appropriate details on the submitted plans and fill out the form, noting insulation levels, efficiencies, and the like.

Software programs such as RES*check*™ and COM*check*™ offered by the Department of Energy's Building Energy Codes Program (BECP):

NOTES



Prescriptive Package Worksheet

Builder Name: CAREFUL BUILDERS, INC. Date:
Builder Address: 120 "W" ST., GREENSBORO, NORTH CAROLINA 27411
Building Address: 1010 CONSTRUCTION AVE. GREENSBORO, NORTH CAROLINA
Zone Number: 8 Package Number: 4
Submitted By: JOHN DOE CAREFUL Phone Number: 704-321-9445

Reviewed Agency | Permit # | Checked By | Date

PROPOSED	REQUIRED
Glazing Area: 100 X 288 (Glazing Area) ÷ 1923 (Gross Wall Area) = 15.0 % (Proposed Glazing Area)	15 % (Maximum Glazing Area)

R-Value

Description	Comments	Proposed R-Value	Minimum R-Value
Ceiling		R-30	R-30
Wall		R-13	R-13
Floor Over Unconditioned Space		R-19	R-19
Floor Over Outside Air		R-30	R-30
Basement Wall		R-N/A	R-8
Slab Floor	Unheated, 24" Depth	R-8	R-5
Crawl Space Wall		R-N/A	R-10

U-Value

Description	Comments	Proposed U-Value	Maximum U-Value
Glazing	See back	U-0.50	U-0.50
Opaque Door	Front door exempt	U-0.35	U-0.35

Equipment Efficiency (This section may be left blank if Normal is selected on the right.)

Heating: _____ AFUE/HSPF _____
Cooling: _____ SEER _____
Efficiency / Make & Model Number

Check One:
X Normal
☐ High Heating
☐ High Cooling
☐ High Heating & Cooling

Statement of Compliance: The proposed building design represented in these documents is consistent with the building plans, specifications, and other calculations submitted with the permit application. The proposed building has been designed to meet the requirements of the 1995 CABO Model Energy Code.

Builder/Designer Company Name Date

REScheck Software
Compliance Certificate

Project Title: Model 123
Report Date: 06/28/07
Data filename: C:\Program Files\Check\REScheck\Model 123.rck

Energy Code: 2006 IECC
Location: Hickman, Kentucky
Construction Type: Single Family
Conditioned Floor Area: 400 ft2
Glazing Area Percentage: 10%
Heating Degree Days: 4004
Climate Zone: 4

Construction Site: Orchard Hills Subdivision
Owner/Agent:
Designer/Contractor: ABC Construction, Hickman, KY

Compliance: Passes on UA
Maximum UA: 115 Your Home UA: 110 = 4.3% Better Than Code

Assembly	Gross Area or Perimeter	Cavity R-Value	Cont. R-Value	Glazing or Door U-Factor	UA
Ceiling 1: Flat Ceiling or Scissor Truss	400	30.0	0.0		14
Wall 1: Wood Frame, 16" o.c.	640	13.0	0.0		46
Window 1: Vinyl Frame:Double Pane SHGC: 0.40	64			0.300	19
Door 1: Solid	20			0.600	12
Floor 1: All-Wood Joist/Truss:Over Unconditioned Space	400	19.0	0.0		19

Compliance Statement: The proposed building design described here is consistent with the building plans, specifications, and other calculations submitted with the permit application. The proposed building has been designed to meet the 2006 IECC requirements in REScheck Version 4.1.0 and to comply with the mandatory requirements listed in the REScheck Inspection Checklist.

Name - Title Signature Date

EXAMPLE: *A designer may choose to include a greater glass area on a particular wall and compensate for heat loss/gain by increasing insulation levels elsewhere.*

- Involve user inputs for building component areas, efficiencies and other specifications and generate a compliance report.
- Allow flexibility and trade-offs among components.

What is DOE's role in energy codes?

Federal law requires DOE to determine whether revisions to

- The residential portion of the IECC would improve energy efficiency in the nation's residential buildings
- ANSI/ASHRAE/IESNA Standard 90.1 would improve energy efficiency in the nation's commercial buildings.

When DOE determines that a revision would improve energy efficiency, each state has two years to review the energy provisions of its residential or commercial building code.

NOTES

- **Residential buildings.** A state has the option of revising its residential code to meet or exceed the residential portion of the IECC.
- **Commercial buildings.** A state is required to update its commercial code to meet or exceed the provisions of Standard 90.1.

> **The statement issued concerning the energy efficiency of the revision is referred to as "DOE's determination."**

Building Energy Codes

DOE's Building Energy Codes Program (BECP) supports states and local governments in their efforts to implement and enforce building energy codes. This support includes:

- Developing and distributing easy-to-use compliance tools and materials
- Providing financial and technical assistance to help adopt, implement, and enforce building energy codes
- Participating in the development of baseline energy codes; and
- Providing information on compliance products and training, and energy code-related news.

What are beyond-code programs?

- Codes that build upon the baseline building energy codes, IECC and 90.1
- May include more rigorous requirements beyond the baseline codes and/or address additional issues not covered in the baseline codes
- Are referred to in various terms – beyond-code programs, green building programs or codes, stretch codes, and above-code programs
- Elements of beyond-code programs become the baseline codes of tomorrow.

Complying with beyond-code programs often requires verification by a third party.

> **Progressive states and local jurisdictions with a focus on energy efficiency and/or sustainability are increasingly building upon the baseline building energy codes and adopting beyond-code programs, either as their minimum codes or as a component of a program that provides incentives to those that comply.**

Conclusion

Building energy codes can play a key role in reducing building energy costs, our nation's reliance on foreign oil, and carbon emissions, as well as increasing the comfort of our homes and offices.

Though the building energy codes world is not without its challenges, the benefits far outweigh the barriers.

Crafted in open public forums, all stakeholders and interested and affected parties are welcome to participate in the building energy codes development process.

The processes used to update both the IECC and ASHRAE 90.1 are designed to make sure the interests of various stakeholders are considered.

Building energy codes are readily available for states and jurisdictions to adopt, and a broad range of enforcement and compliance tools are available to help policy makers, designers, builders, and the enforcement community successfully implement building energy codes.❖

NOTES

[1] Energy Information Administration, *Annual Energy Review 2007, Figure 2.1a, Energy Consumption by Sector Overview.* **http://www.eia.doe.gov/emeu/aer/consump.html**.

[2] U.S. Energy Information Administration. Electric Power Annual Report. Table 7.2. Retail Sales and Direct Use of Electricity to Ultimate Customers by Sector, by Provider, 1996 through 2007 (Megawatthours). **http://www.eia.doe.gov/cneaf/electricity/epa/epat7p2.html**.

[3] Source: U.S. Energy Information Administration, *Electric Power Annual 2007, State Electricity Profiles 2007*, United States.

[4] Belzer D, M Halverson, and S McDonald. 2009. *A Retrospective Analysis of Commercial Building Energy Codes: 1990-2008, Draft.* Building Energy Codes Program, Pacific Northwest National Laboratory, Richland, Washington.

[5] 450 MW as a typical power plant size was based on the range in size of power plants installed in 2006. Refer to the following to see the complete range: *Buildings Energy Data Book, Table 6.2.7, "Characteristics of New and Stock Generating Capacities, by Plant Type."* **http://buildingsdatabook.eere.energy.gov/TableView.aspx?table=6.2.7**.

The U.S. Department of Energy's Building Energy Codes Program is an information resource on national model energy codes. We work with other government agencies, state and local jurisdictions, national code organizations, and industry to promote stronger building energy codes and help states adopt, implement, and enforce those codes.

BECP Website:
www.energycodes.gov

BECP Technical Support:
techsupport@becp.pnl.gov
www.energycodes.gov/support/helpdesk.php

For more information, contact:

Jean Boulin, Program Manager
Phone: 202-586-9870
Email: Jean.Boulin@ee.doe.gov

Contact the EERE Information Center 1-877-EERE-INF
(1-877-337-3463) or visit **eere.energy.gov/informationcenter.**

U.S. DEPARTMENT OF ENERGY | Energy Efficiency & Renewable Energy

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