Building Codes for Energy Efficiency

This fact sheet highlights the benefits of building energy codes and describes several steps that parties working under the National Action Plan for Energy Efficiency can take to advance cost-effective energy efficiency through the adoption, implementation, and enforcement of codes.

Overview

Parties working to create a sustainable, aggressive national commitment to energy efficiency under the National Action Plan for Energy Efficiency are exploring the opportunities for increased energy efficiency through new or improved building energy codes. Energy codes require new and existing buildings undergoing major renovations to meet a set of minimum requirements for energy efficiency. For parties pursuing energy efficiency as a cost-effective resource, codes can be a critical piece of a comprehensive approach.

Energy consumption in buildings accounts for one-third of all the energy used in the United States and two-thirds of the total electricity demand. To address this demand, building codes have been used for nearly three decades and are a cost-effective strategy to overcome barriers to energy efficiency in buildings. In combination with appliance standards, energy codes that are well-designed, implemented, and enforced can lock in cost-effective energy savings of 30 to 40 percent at the time of building construction compared to standard practices.[1] In addition to lowering energy bills, energy codes can reduce load growth and the need for new energy generation capacity while limiting air pollution and greenhouse gas emissions. Recognizing these benefits, a majority of states have adopted building energy codes in some form for residential and commercial construction (DOE, 2006).

Benefits of Building Energy Codes

Building energy codes provide states and municipalities across the country a range of energy, environmental, and economic benefits. Highlights from several jurisdictions are summarized below and in Table 1.

Energy

Energy benefits of building codes include saving on energy bills, reducing peak energy demand, and improving system reliability. For example, California's building standards have helped save businesses and residents more than $15.8 billion in electricity and natural gas costs since 1975, and these savings are

About Building Energy Codes

Energy codes typically specify requirements for "thermal resistance" in the building shell and windows, minimum air leakage, and minimum efficiency for heating and cooling equipment. These measures can help eliminate inefficient construction practices and technologies with only modest increases in up-front project costs.

New construction and major renovation represent cost-effective times to incorporate energy-efficiency measures into buildings because these improvements save energy throughout the life of those buildings and can be expensive to adopt later.

Building energy codes are typically developed at the national level, adopted at the state level, and implemented and enforced by local governments.

expected to climb to $59 billion by 2011 (CEC, 2003). When fully implemented, the state's new 2005 building efficiency standards are expected to yield peak energy use reductions of 180 megawatts (MW) annually—enough electricity to power 180,000 average-sized California homes (Motamedi et al., 2004).

According to the U.S. Department of Energy (DOE), if all states adopted and fully implemented American Society of Heating, Refrigerating, and Air-Conditioning Engineers (ASHRAE) Standard 90.1-1999, a model energy code for commercial buildings, then building owners and tenants would lower their utility bills by $110 million the first year and save $5.7 billion over 10 years. The country would save 16 trillion British thermal units (Btu) of energy that first year and almost 800 trillion Btu cumulatively over 10 years. The magnitude of each state's savings depends on many factors: the efficiency of its current building practices; the stringency of the code it adopts; its population, climate, and building construction activity; and the effectiveness of code training and enforcement (DOE, 2007).

Environment

States and municipalities are also finding that energy codes can improve the environment by reducing air pollution and greenhouse gases. For example, the New York Energy Conservation Construction Code is estimated to reduce carbon dioxide (CO_2) emissions by more than 500,000 tons annually and sulfur dioxide (SO_2) by nearly 500 tons per year (DOE, 2002). Similarly, the 2001 Texas Building Energy Performance Standards are projected to reduce nitrogen oxide (NO_X) emissions statewide by more than 2 tons each "peak" day and more than 1 ton each average day, which helps the state meet Clean Air Act requirements for non-attainment areas (Haberl et al., 2003).

Economics

Building energy codes can also help grow the economy. States and municipalities benefit from greater investment in energy-efficient capital equipment and new jobs installing equipment and monitoring building compliance. While spending on energy services typically sends money out of state, dollars saved from efficiency tend to be re-spent locally (Kushler et al., 2005; Weitz 2005a). Codes become even more cost-effective during periods of high heating and cooling fuel prices.

At the building level, the "payback period" on any increase in upfront costs is typically short. A Nevada study estimated that upgrading the energy efficiency of commercial buildings to comply with the code would cost about $1.60 per square foot but would result in $0.68 per square foot of energy bill savings per year, meaning a simple payback of about 2.4 years (Geller et al., 2005). Similarly, it is estimated that

Table 1. Benefits of Building Energy Codes

Jurisdiction	Building Energy Code	Projected Energy and/or Demand Savings	Other Information	Reference
California	2005 Title 24 Building Efficiency Standards for residential and commercial construction	180 MW reduction in annual energy demand (equivalent to the electricity requirements of 180,000 average-sized California homes)	$43 billion in electricity and natural gas savings by 2011	www.energy.ca.gov/title24/
Phoenix, Arizona	2004 IECC Supplement for residential construction	18 percent reduction in residential energy consumption; 21 percent reduction in electricity use; 10 percent decrease in natural gas use	Increase in upfront cost is $1,517; payback period is 3.9 years (based on simple payback); life-cycle cost savings is $11,228 per home	www.epa.gov/cleanenergy/pdf/gta/guide_action_chap4_s3.pdf
Texas	2001 IECC for residential and commercial construction, including a solar heat gain standard for windows	1.8 billion kilowatt-hour savings over 20 years; 1,220 MW of peak demand avoided	Code is approved for 0.5 tons per day of NO_x emissions credits in its state plan for improving ozone pollution	www.seco.cpa.state.tx.us/sa_codes.html
All 50 States	2006 IECC for residential and commercial construction	Savings potential if all states adopted IECC is 6.6 quadrillion BTUs over 20 years	Would reduce more than 100 million metric tons of carbon equivalent emissions	www.bcap-energy.org/

while a new home built to the International Energy Conservation Code (IECC) in Phoenix, Arizona, will cost an average of $1,517 more than a home built without the code, the difference will be repaid to homebuyers in 3.9 years (based on simple payback). The life-cycle cost savings associated with improved energy efficiency from adopting the IECC is $11,228 per home (Kinney et. al., 2003).

While the upfront costs of code compliance can be recouped over short payback periods, the savings do not always accrue to the entity paying the initial compliance costs. This "split incentive" occurs when a developer or builder sees higher costs that are repaid over time to the building owner or occupants.

State, Local, and Utility Action

The status of state adoption of residential and commercial codes is provided below in Figures 1 and 2.

State Codes: Residential Sector

In 1978, California became the first state to include energy requirements in its code. Today, 40 states and the District of Columbia use a version of the Model Energy Code (MEC) or IECC model energy code, or their own equal-or-better code for residential buildings. Eleven of these 40 states are using the most stringent version of the IECC approved by DOE. While nine states have not adopted a statewide code, several large municipalities within three of these states have adopted the 2003 IECC (BCAP, 2007a).

Figure 1: Status of Commercial State Energy Codes

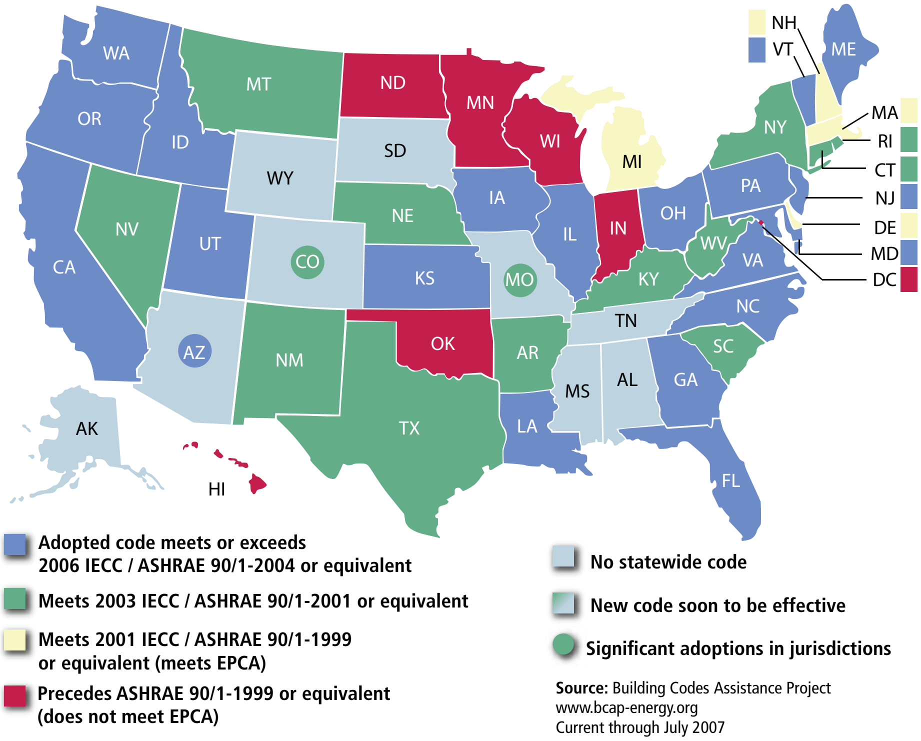
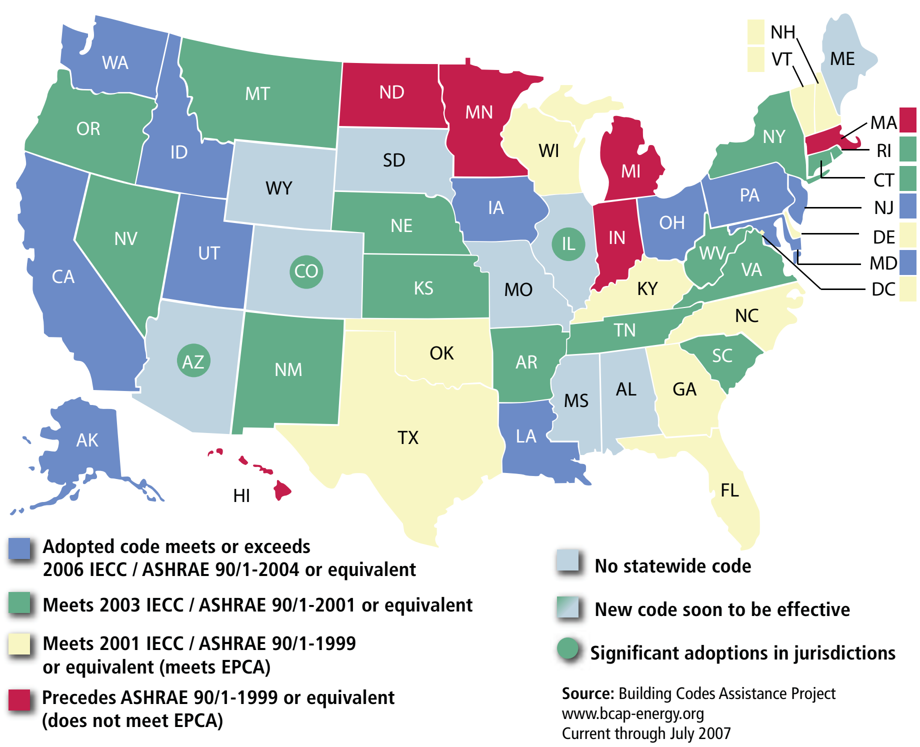


Figure 2: Status of Residential State Energy Codes



State Codes: Commercial Sector

A total of 40 states and the District of Columbia use a version of the ASHRAE or IECC model energy code for commercial buildings. Of these, 19 states are using the most recent code that DOE has approved. Nine states have not adopted a commercial building code, although several large municipalities within three of these states have adopted the 2003 or 2006 IECC.

Local Codes

In states with "home rule" laws (in which municipalities are granted greater self-government), local officials can adopt their own codes. For example, two Arizona cities—Phoenix and Tucson—are taking this approach and thereby affecting a large portion of the state's overall building stock. Alternatively, home rule states can revise existing law to allow for statewide building energy codes. Texas followed this approach, primarily in an effort to improve the state's air quality.

Utility Actions

Utilities can play several roles in support of building energy codes. One key role is partnering with states and localities during code adoption or modification to fill information gaps, provide analytic support, and engage stakeholders. Utilities can help educate the building and enforcement communities about specific requirements contained in new codes.

Model Building Energy Codes

States have adopted a wide array of commercial and residential model energy codes across the country. The energy code that applies to most residential buildings is the International Energy Conservation Code (IECC), which supersedes the Model Energy Code (MEC). The federal Energy Policy and Conservation Act (EPCA) of 1992 requires states to review and adopt the MEC (and its successor, the IECC), or submit to the Secretary of Energy its reasons for not doing so.

Most commercial building energy codes are based on ASHRAE/IESNA Standard 90.1, jointly developed by ASHRAE and the Illuminating Engineering Society (IES). EPCA requires states to adopt the most recent version of ASHRAE Standard 90.1 that the U.S. Department of Energy (DOE) has determined will save energy, currently 90.1-1999. Alternatively, states can follow the commercial building provisions of the IECC.

Role for Utilities

Support effective implementation of codes:

- Educate stakeholders about key provisions, incentives, and compliance options.
- Partner with jurisdictions to sponsor code compliance training.
- Provide technical assistance to builders, contractors, architects, and code officials.

Integrate codes into resource planning:

- Explicitly account for codes in base case load forecast of long-term resource planning.
- Support efforts to gather and analyze data.

Advocate for adoption of stronger codes:

- Work proactively with state and local code jurisdictions.
- Provide analysis to support stronger code adoption.
- Propose code amendments that further strengthen provisions for reduced peak demand.

For example, electric and gas utilities in Washington state spearheaded a Utility Code Group (UCG) in the mid-1990s to inform stakeholders about key code provisions, incentives, and compliance options. UCG developed a training program and disseminated information to industry audiences through an initiative to advance innovative enforcement and evaluation mechanisms. This precedent laid the groundwork for subsequent success—a recent construction practice survey found that 94 percent of homes in Washington met or exceeded code requirements for the building envelope (Ecotope, 2001).

Another important role for utilities is to integrate codes into the resource planning process. As utilities develop long-term plans, they can explicitly modify their base case load forecast to account for codes and standards, along with the impacts of ratepayer-funded energy efficiency programs. This is accomplished by forecasting the impacts of a new national or state building code, then making assumptions about compliance, and finally applying it to estimates of new construction. The Northwest Power and Conservation Council and the California Energy Commission (CEC) both incorporate these savings into their planning process.

An additional role for utilities is to strengthen existing model codes. In California, utilities have long partnered with state officials to support the improvement of the pioneering Title 24 building standards. For their efforts, California utilities receive credit on shareholder incentives for building standard enhancements that they propose and that are adopted by the CEC. The resulting savings count toward their energy efficiency targets and are incorporated into overall forecasts of energy and demand savings.

Opportunities for Additional Energy Savings With Building Codes

While substantial progress has been made, state and local governments can continue to incorporate new technologies and features into their codes (Prindle et al., 2003; BCAP, 2007b; Weitz 2005b). The American Council for an Energy-Efficient Economy (ACEEE) estimates that upgrading residential building codes could save an “average” state about $650 million in homeowner energy bills over a 30-year period (Prindle et al., 2003). With energy consumption expected to rise 20 percent in the residential sector and 19 percent in the commercial sector by 2020, the potential energy savings from further building code improvements can be significant.

For states that have building codes but are interested in achieving additional cost-effective energy efficiency, the following best practices are recommended:

- *Update building energy codes* to ensure that recent technological and design improvements are captured.
- *Establish monitoring, evaluation, and enforcement procedures* to improve the effectiveness of existing codes.
- *Engage key stakeholders,* including local building officials, homebuilders, utilities, building supply companies, and contractors for insulation, heating, and cooling equipment.
- *Hold regular education and training sessions* for homebuilders and building officials before and after the effective date of the new energy code requirements.

Steps to Achieve Energy Savings Through Building Codes

- Adopt building codes that capture the cost-effective savings as technologies advance and reflect the state’s prevailing climate conditions.
- Train homebuilders and building officials.
- Establish monitoring, evaluation, and enforcement procedures.
- Consider pursuing "beyond code" building programs, such as ENERGY STAR.
- Leverage other energy efficiency funding sources.
- Take advantage of DOE technical and grant assistance.

Source: EPA, 2006

- *Consider pursuing "beyond code" building programs,* such as ENERGY STAR®,that achieve additional cost-effective energy efficiency.
- *Leverage other clean energy funding sources* to support building energy codes. For example, New York and Wisconsin are using public benefits funds to support implementation and enforcement. California is using utility resource procurement dollars to advance its code.
- *Take advantage of DOE technical and grant assistance* to states to facilitate building code adoption and implementation.

For states without energy codes, a typical starting point is to hold stakeholder discussions and launch formal studies to determine whether codes make sense in their area. Adopting a consensus-driven approach can minimize legal disputes and avoid delays in code implementation.

For jurisdictions with unique circumstances not addressed by model codes, it may make sense to add or remove certain code provisions that are not cost-effective or otherwise appropriate for local circumstances. In all cases, successful energy code programs require sufficient budget and staff resources to involve stakeholders, support implementation, and evaluate progress.

Stakeholders can go beyond codes and lock in even greater energy savings through advanced appliance standards. In recent decades, this approach has been used in tandem with codes to ensure that equipment installed in homes and buildings is energy-efficient.

Notes

1. Determined using the Building Codes Assistance Project (BCAP) calculator that compares each state's current code to the 2006 International Energy Conservation Code (IECC) for residential and commercial construction. The sum of savings in all 50 states produces a 30 to 40 percent savings range.

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