State Energy Efficiency Policies
Options and Lessons Learned

A Series of Briefs

Brief #7

Building Energy Codes

Matthew Brown

Building Energy Codes

Policy Description

Building energy codes set minimum energy efficiency standards that residential or commercial buildings must meet. Builders usually have the choice of meeting a code in one of two ways: (1) by installing certain prescriptive measures such as specified insulation levels or windows of a certain efficiency, or (2) by installing their choice of measures that in combination bring a building's energy performance to a specified level. States adopt statewide building codes except in "home rule" states, in which local governments adopt those codes. Local government code officials, with some exceptions, enforce building codes.[1]

Policymakers in the United States began to devote attention to building codes in the 1970s after the oil price shocks of that decade; in 1975 Congress passed the Energy Policy and Conservation Act and then an amendment to that Act in 1978 that required any state receiving federal funds to also put in place energy codes for new buildings.[2] More than a decade later, the Energy Policy Act of 1992 (EPAct 1992) required that states adopt a commercial building code and that they consider adopting a residential energy code.[3] Two sets of model building codes now serve as the basis for most state energy efficiency codes; one is typically used for residential construction and the other for commercial construction.

The model code for residential buildings, originally covered under the Council of American Building Officials' Model Energy Code - CABO MEC, is now set by the International Code Council (ICC), and is known as the International Energy Conservation Code (IECC). The ICC promulgated its first code in 1998 and the most recent IECC is the 2006 version. Each of the iterations of the code has contained requirements for heating and air conditioning systems, some lighting systems, air leakage and thermal performance of the building envelope, while making allowances for different climate zones around the country. With each triennial revision, the code has generally become somewhat more stringent, reflecting new technology and experience in energy efficient design. Some revisions to the code have focused less on making it more stringent than on simplifying it and making compliance easier; the 2006 code differed from the 2003 code largely because it attempted to simplify compliance. The ICC updates its energy code every three years, and the next IECC update will apply to 2009 and beyond.

The American Society of Heating, Refrigerating, and Air Conditioning Engineers (ASHRAE) develops the standard for the commercial buildings; the current ASHRAE code is called ASHRAE 90.1 and was first released in 1975. ASHRAE issues updates to the code approximately every three years; like the IECC code, the standard has become increasingly stringent over the years. ASHRAE 90.1-2007 is the most recent code and ASHRAE 90.1 for 2010 is now under development.[4] ASHRAE's latest commercial building model code is now adopted by reference in each edition of the IECC, so states can adopt both codes by adopting the latest IECC.

There is some overlap between the two codes. States can follow the commercial provisions of the IECC for commercial construction or they may follow the ASHRAE code for commercial construction. The ASHRAE model code can apply to residential structures that exceed three stories.[5]

EPAct 1992 requires that when ASHRAE or the ICC updates its model energy code, the U.S. Department of Energy (DOE) must determine whether the new code would save energy compared to the existing code. If the DOE rules that the new codes would improve energy efficiency, states are required to adopt the commercial building codes and to consider adopting the residential codes within two years of the DOE ruling.[6,7]

States adopt particular iterations of the codes, such as IECC 2006 or IECC 2003. Five states still reference the older model energy code, while others adopt new versions of the codes automatically – meaning that, as ASHRAE or the ICC develop new codes, they are automatically incorporated into the state code by reference. Many of these states are described in the section on code updates below. Many states also make amendments to the model codes to allow for specific climatic or other conditions in their state.[8]

Local building departments perform the work of inspecting facilities and reviewing plans, and do so under state laws that may require a minimum level of training on building codes. These building code inspectors are charged with inspecting for compliance with not only energy codes, but also safety, plumbing, electrical and other codes. As a result, building energy codes may not receive a great deal of attention among code inspectors; this fact tends to lower compliance rates in many states. In addition, building energy codes are not intended to compromise safety, health or environmental requirements contained in other applicable codes or ordinances. This may be interpreted to mean that safety, health or environmental codes take precedence over energy codes.[9]

The energy savings potential from commercial and residential building codes is substantial. The Government Accountability Office (GAO) produced a report on Gulf Coast reconstruction following Hurricanes Katrina, Rita and Wilma in 2005 that estimated the energy and dollar savings potential of re-building to high energy code levels after the hurricanes.[10] According to the report, Louisiana's decision to adopt the latest model energy codes in the wake of the hurricanes could save the state at least $20 to $28 million annually. That figure is equal to $167 to $233 per household per year, or 24 to 28 percent of heating and cooling costs in each household.[11] Gulf state commercial buildings could see savings of 7 to 34 percent of overall energy costs, depending on building type. The GAO determined that even larger savings could be realized for both types of buildings through voluntary implementation of energy-efficiency measures beyond those found in the minimum building code and appliance standard requirements.[12]

Current Status and State Experience

This discussion of building codes is divided into two sections: (1) issues related to code adoption and (2) issues related to code enforcement and compliance.

Code Adoption

According to the Building Codes Assistance Project the majority of states have adopted statewide building codes for the residential and/or commercial sectors, although the version of the code that each state references varies widely. For residential codes, 26 states meet the 2006 IECC or equivalent, 11 states and Washington, D.C., meet the 1998-2003 IECC or equivalent and 13 states meet the 1998 IECC or have no statewide code. For commercial codes, 2 states meet the 2009 IECC/ASHRAE 90.1 – 2007 or equivalent, 26 states meet the 2006 IECC/ASHRAE 90.1 – 2004 or equivalent, 9 states and Washington, D.C., meet the 1998-2003 IECC/ASHRAE 90.1 – 1999/2001 or equivalent and 13 states have codes that precede the 1998 IECC/ASHRAE 90.1 – 1999 or have no statewide code.

States can adopt a model code with amendments; this ability to alter the model code allows states to customize it to their own circumstances. According to a report from the GAO, these amendments may weaken the code. Georgia, for instance, adopted the 2006 residential code, but then made changes to it that rendered it similar to the previous version of the

code from 2003.[13] States can also adopt codes that are more stringent than the model code; California's Title 24 code is more stringent than the existing IECC. The following two maps illustrate the status of residential and commercial building code adoption across the United States.

Some states shown on the maps above do not have either statewide code because they are "home rule" states, meaning that cities, counties or other local government entities decide whether to adopt building energy codes. Other states do not have codes because they have simply not developed the political will to adopt them. In these cases, local governments within those states sometimes adopt the most recent and most stringent building code. For example, Phoenix, Chicago and Denver each have adopted an energy code – Phoenix has adopted the 2006 IECC, Denver the 2003 IECC and Chicago its own energy conservation code that is based on the 2006 IECC and 2004 ASHRAE 90.1.[14]

Kansas is another home rule state that adopts building codes on a jurisdiction-by-jurisdiction ba-

Figure 1:

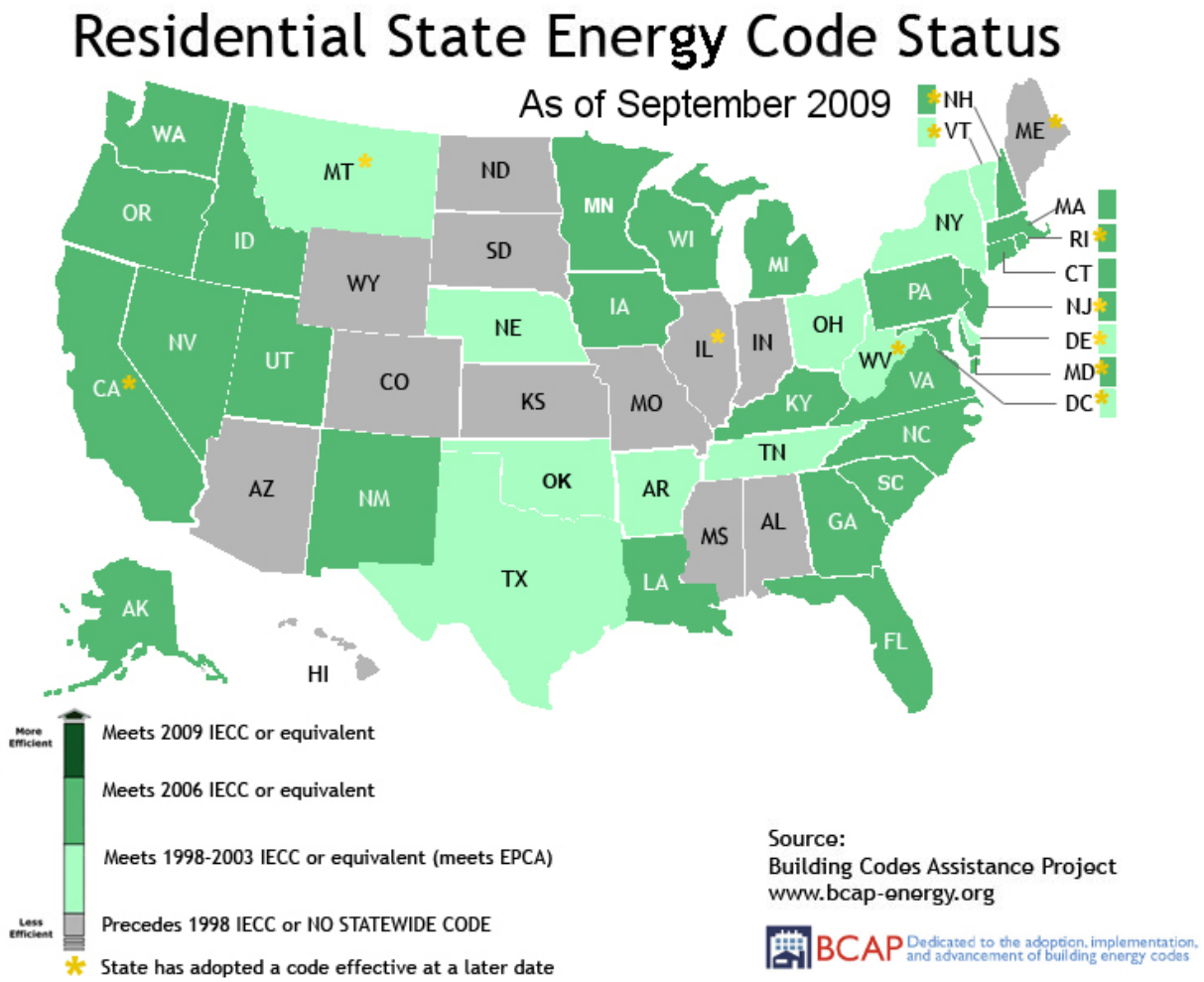
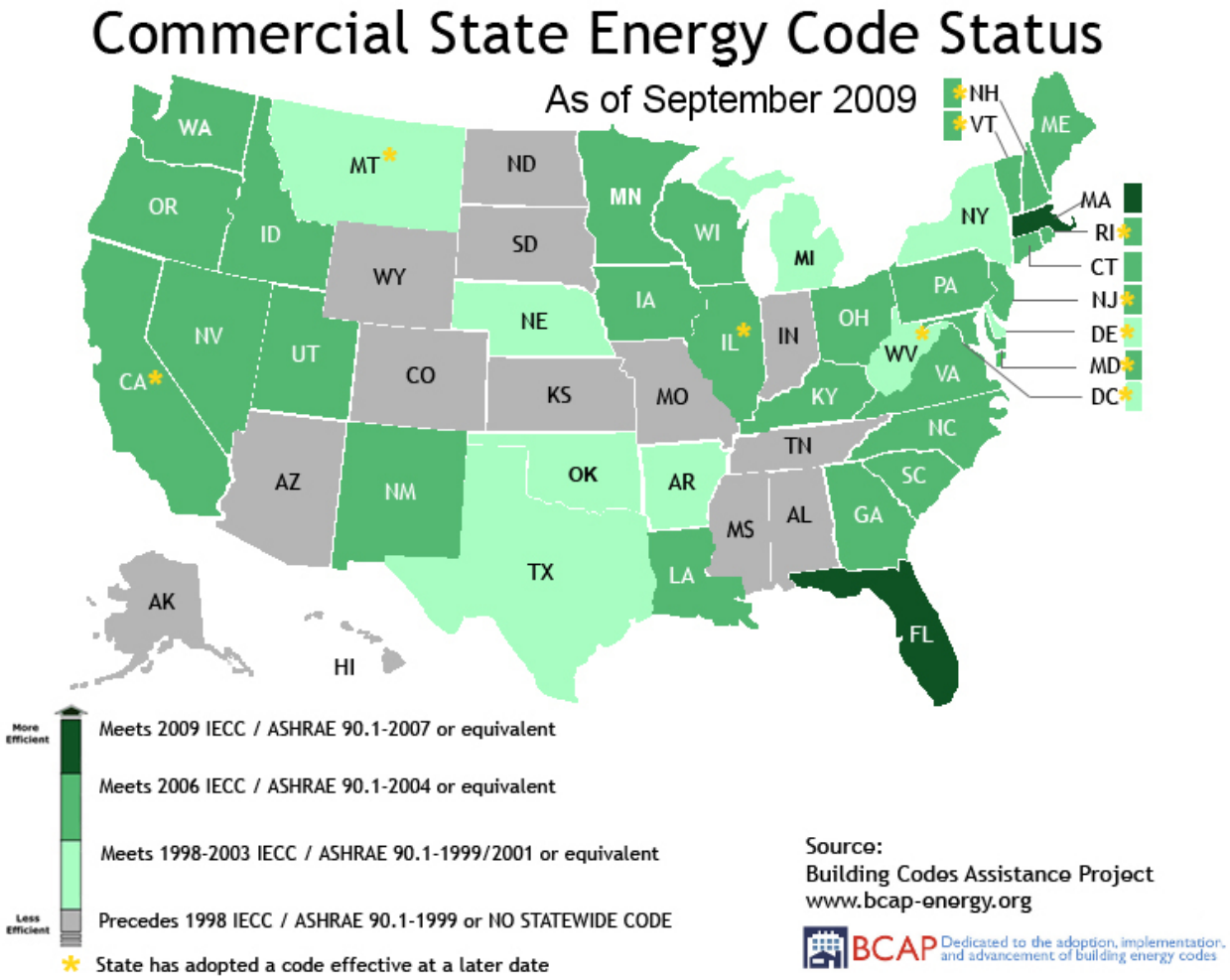


Figure 2:



sis; however, it has enacted legislation to require an energy information label to be shown to all prospective purchasers of new homes in the state.[15] This label displays the 2006 IECC requirements on one side and the home's energy-related characteristics (insulation R-values, for instance) on the other side of the label. This label updates a previous one that had displayed the energy-related characteristics of the home, but that had no comparative information about the IECC requirements. Displaying both the 2006 IECC requirement and the characteristics of the home for sale provides context and comparative information that the homebuyers can use when they assess whether or not to buy the home. The Kansas labeling approach is an interim step that may be useful in the absence of statewide energy codes. However, the state has no money to enforce the energy label requirement, and has done no study of how effective it has been. Staff at the Kansas Corporation Commission speculate that many realtors use it, but that many smaller builders around the state may not be aware of the form or the requirement to use it.[16]

Code Updates

New versions of the commercial and residential codes are likely to be more stringent than the existing codes. The next update to the IECC will be released in 2009 and will replace the 2006 code. These code updates sometimes are more significant than others. For instance, the 2006 IECC update of the 2003 code did not make major changes to the code requirements; it focused on making the code easier to comply with. Among other changes, it reduced the number of climate zones for different insulation, window, air leakage and other requirements from 19 different zones (often with slightly different requirements) to seven larger zones.[17] The 2009 IECC code, on the other hand, is expected to contain several major revisions that will make energy efficiency requirements significantly more stringent than those in the 2006 code. An analysis performed by the consulting group ICF International estimates that homes built to the 2009 IECC standards will save 12.2 percent under the simple "prescriptive" method and could save 14.7 percent or more using the more complex "performance-based" method. [18]

The next update to the commercial ASHRAE code will take effect in 2010. In 2007, ASHRAE adopted a goal that buildings meeting Standard 90.1-2010 should use 30 percent less energy than buildings that met its 2004 code.[19] In that year, DOE signed a memorandum of understanding to support ASHRAE's efforts to improve the commercial codes by 30 percent. DOE and ASHRAE agreed to work together on a number of initiatives in service of this goal, including training programs, cooperative research, and the development of guidance for exceeding the minimum efficiencies as set in the current ASHRAE 90.1 code.[20]

States can adopt legislation that requires a periodic review and update of the energy code. At least 15 states and the District of Columbia have a streamlined process that requires consideration of each new model code as it is updated. Maryland's building code law, for instance, requires that the Department of Housing and Community Development work to propose legislation every three years to update the codes. According to Maryland staff, this code update adoption process has worked seamlessly for the past three code cycles.[21] Some states use a more streamlined process. Maine's code is updated without the need for new legislation; existing legislation prohibits the Maine code from falling more than one three-year cycle behind the model code.[22] These regularly scheduled updates simplify the update process and synchronize it with the IECC and ASHRAE code updates. Table 1 lists many of the states that have an automatic code update process built into their code legislation.

The data on code adoption and code updates, as presented in the maps above, show that, although many states have adopted at least one of the two most recent commercial or residential codes, many others have not yet done so.

Advanced Codes and Incentives to Exceed Code

The following bullets describe several states that have adopted energy codes that are more stringent than the most recent national model codes, incentives to exceed the codes, or regulations to achieve energy savings beyond the most recent model code:

- Hawaii enacted legislation in 2007 that required every county to establish a procedure to expedite permits for buildings that are Leadership in Energy and Environmental Design (LEED) certified at the Silver level or higher.[23] LEED Silver buildings exceed current ASHRAE 90.1 standards for building energy efficiency, and also contain non-energy-related requirements, such as water efficiency.

Table 1: Examples of States with Automatic Code Updates

State	Code Change Cycle
District of Columbia	Codes are usually reviewed every three years with the publication of the new editions of the model code.
Georgia	New editions of codes are reviewed as soon as practicable after publication.
Idaho	Three-year code review cycle, concurrent with the publication of new editions of model codes.
Iowa	State energy code is reviewed on a three-year code cycle corresponding to the IECC.
Kentucky	Updated every three years with publication of new code
Louisiana	Beginning in January 2007, codes are upgraded every three years.
Maine	For commercial building code, Maine considers the most recent version of 90.1 with positive DOE determination. Most recent adoption was effective July 27, 2005. The Technical Codes and Standards Board will adopt the 2009 IECC on Jan 1, 2010. It will be effective July 1, 2010.
Maryland	Codes are usually reviewed every three years with the publication of the new editions of the model code.
Massachusetts	The state Board of Building Regulations and Standards (BBRS) is required to revise the building code to the latest version of the IECC every three years.
New Jersey	Three-year code cycle concurrent with the publication of new editions of the model codes.
New Mexico	Generally reviewed at least every three years with the publication of the new editions of the model codes.
New York	The State Fire Prevention and Building Code Council maintains and periodically updates New York's Uniform Fire Prevention and Building Code and its Energy Conservation Construction Code, as well as adopting higher or more restrictive standards upon the recommendation of local governments. Executive law requires the Code Council to hold meetings at least four times a year, and these mandated meetings are typically scheduled at the last meeting of each prior year.
Oregon	Code update begins every three years with the availability of new editions of, or supplements to, the Uniform Codes
Pennsylvania	Updated every three years with publication of new code
Rhode Island	Three-year code review/change cycle concurrent with publication of new editions of model codes.
Utah	Code changes are ongoing with new editions of codes adopted when they become available.
Vermont	Updated every three years with publication of new code
Virginia	Three-year review cycle concurrent with the publications of new editions of the model codes.

Source: Building Codes Assistance Project, Northeast Energy Efficiency Partnership, and InterEnergy Solutions, 2008.

- In 2009, the Massachusetts Board of Building Regulations and Standards (BBRS) approved Appendix 120AA as an optional amendment to the 7th edition of the Massachusetts Building Code 780 CMR. This optional "stretch code" was developed in response to the call for improved local building energy efficiency in the state. The appendix, which includes both residential and commercial stretch codes, is designed to be about 30 percent more stringent than the 2006 IECC/ASHRAE 90.1-2004. Towns and cities may adopt Appendix 120AA as an alternative to the base energy efficiency requirements of 780 CMR and the forthcoming 8th edition, to be based on the 2009 IECC (Massachusetts is required by the Green Communities Act of 2008 to adopt each new IECC edition within one year of its publication).

- According to a report by the Florida Solar Energy Center, Florida's current energy code will likely result in new homes that are about 17 percent more efficient than homes built to the standards of the 2006 IECC and about 3 percent less than the 2009 IECC.

- Connecticut legislation passed in 2009 (HB 6284) requires the state to update the state building energy code and to create green building standards. Under the law, the State Building Inspector and the Codes and Standards Committee must revise the State Building Code to incorporate the residential and commercial codes of the 2012 IECC within 18 months of its publication. It also requires that all new construction greater than $5 million and all renovations greater than $2 million meet LEED-Silver standards. [24]

- Maine enacted legislation in April 2008 that required the state to adopt the 2009 IECC by 2010. This legislation gives builders, inspectors and others time to plan for the upcoming code change, and provides certainty to the builders and inspectors communities about which code the state will adopt, even before the 2009 code has been finalized. Prior to adopting this legislation Maine had no statewide building code. The requirement to adopt the 2009 IECC applies to municipalities with populations greater than 2,000 people.[25]

- Oregon adopted a code in 2008 that exceeds its previous energy code by 15 percent.

  The Oregon code takes an innovative approach to advanced codes. The higher energy efficiency requirements for Oregon have their origin in the Western Governors' Association's goals, adopted through its Clean and Diversified Energy Initiative process, which called for western states to adopt building codes that were 30 percent more stringent than existing national model codes.[26] Governor Kulongoski of Oregon issued an executive order requiring that the state adopt, through administrative procedures, a new building code that was 15 percent more efficient that the previous code as a result. (Oregon's existing code was already more stringent than the 2006 IECC). [27]

  According to staff that was responsible for developing this code at the Oregon Department of Energy (OR DOE), the state aimed to meet the 15 percent goal without requiring a change in basic construction practices in the state (an example of a change to basic construction practice would be to require double-studs for extra thickness and therefore greater insulation in walls). When, however, Oregon staff modeled the energy savings from an initial set of measures, the measures did not yield a 15 percent savings for all buildings. As a result, the OR DOE developed a new plan that requires two tiers of compliance. The first is a set of mandatory, prescribed measures that is largely related to making the building envelope as efficient as pos-

sible, but that also includes a requirement that 50 percent of all fixed lighting in the structure be high efficiency. The second tier is a set of nine measures, from which builders must pick at least one in order to meet the standard.[28]

According to OR DOE staff, the combination of these compliance tiers will yield slightly more than 15 percent energy savings in new residential construction. One point of interest is that the new Oregon building code gives homebuilders the option of choosing to install a furnace with an energy efficiency rating of 90 AFUE or higher to comply with the second tier of the building code. This approach is unique because furnace standards are usually found in an appliance standard, not a building code. In addition, the minimum standard of 90 AFUE exceeds the federal appliance standard for furnaces. In general, federal government appliance standards preclude states from setting any appliance standard that exceeds federal standards. But because Oregon has set up this measure as an option rather than a requirement, Oregon staff believe it does not conflict with federal law.[29]

Code Enforcement and Compliance

Often, and despite the efforts to develop new and advanced energy codes, rates of compliance with existing codes are low. Therefore, in addition to asking how stringent codes should be, policymakers need to pay attention to compliance rates and enforcement training for existing codes. This section addresses code compliance and enforcement.

Residential Code Compliance

Limited compliance data, wide ranges in the data that do exist, and a nonexistent national protocol for evaluating codes have contributed to a system that in many states is not producing the results that most policymakers desired when they instituted building codes. National average energy code compliance data is not available, according to the Building Codes Assistance Project (BCAP).[30] According to a 2005 BCAP study that compiled data on compliance with residential energy codes from studies around the country, compliance varied a great deal, but in many states hovered around 50 percent.[31] Table 2 provides data available as of 2005 for residential code compliance.

Table 2: Building Code Compliance Rates[32]

State	Code	Compliance Rate
Arkansas	1992 MEC	55%
Iowa	2000 IECC	2.84%
Idaho	1996 Idaho Residential Energy Standard	51.9%
Louisiana	2000 IECC	65.3%
Massachusetts	1998 Massachusetts Residential Energy Code	46.4%
New York (Long Island)	2002 NY Residential Energy Code	0%
Oregon	2003 IECC	100%
Vermont	RBES, a code based on the 2000 IECC	58% +/- 8% margin of error
Washington	1997 Washington State Energy Code	93.6%

Source: Residential Energy Code Evaluations: Review and Future Directions. Building Codes Assistance Project, 2005. Source for Idaho, Oregon and Washington data: NEEA Codes and Standards Support Project: MPER #2, Northwest Energy Efficiency Alliance, 2008.

A 2007 study in California examined residential and non-residential compliance with California's Title 24 building code. The results (see Table 3), show that non-compliance ranges from 100 percent with non-

residential building duct testing standards to 28 percent with hardwired lighting requirements in homes.[33]

Further research can dig more deeply into code compliance questions. The Northwest Energy Efficiency Alliance (NEEA) examined code compliance in Oregon and Washington; Table 4 shows the results, by sector and measure. The data show compliance rates between 42 percent and 100 percent, depending on the component The data also show some variability depending on the housing sector, with multifamily housing at the lowest compliance rate across most components.

Table 3: Summary of California Building Measure Non-Compliance

Measure	Estimated Non-Compliance Rate	Precision of Estimate
Residential		
Hardwired lighting	28%	3%
Window replacement	68%	7%
Duct improvement	73%	1%
Non-Residential		
Lighting controls under skylights	44%	10%
Cool roofs	50%	3%
Ducts in existing buildings	100%	2%
Duct testing/sealing in new buildings	100%	1%

Source: Quantec Statewide Codes and Standards Market Adoption and Noncompliance Rates, prepared for California Energy Commission, 2007.

These data do not tell the whole story, however: non-compliance may mean that the building failed to incorporate elements that were important to its energy performance, or it could mean that the building failed to incorporate relatively small features that could mean very little to the overall performance of the home. A 1996 study examined the relationship between code compliance and actual energy performance of homes and found that only 55 percent of homes complied with all the measures specified in the Oregon Energy Code at the time.[35] However, 85 percent of the measures that were installed were installed correctly, and 98 percent of the homes tested in the study were within 5 percent of the code's energy efficiency target for heat loss. In other words, overall measures of compliance such as those shown in Table 2 are difficult to interpret without information on how incompliance is defined and what effect the missing measures have on overall home energy efficiency.[36]

Table 4: Compliance Rate Summary (within 10% of code)

State	Home type	Windows[34]	Wall	Floor	Roof	Overall
Oregon	Multifamily	42%	100%	78%	81%	78%
Oregon	Single Family	85%	98%	83%	96%	94%
Washington	Multifamily	78%	92%	87%	95%	84%
Washington	Single Family	92%	97%	69%	97%	91%

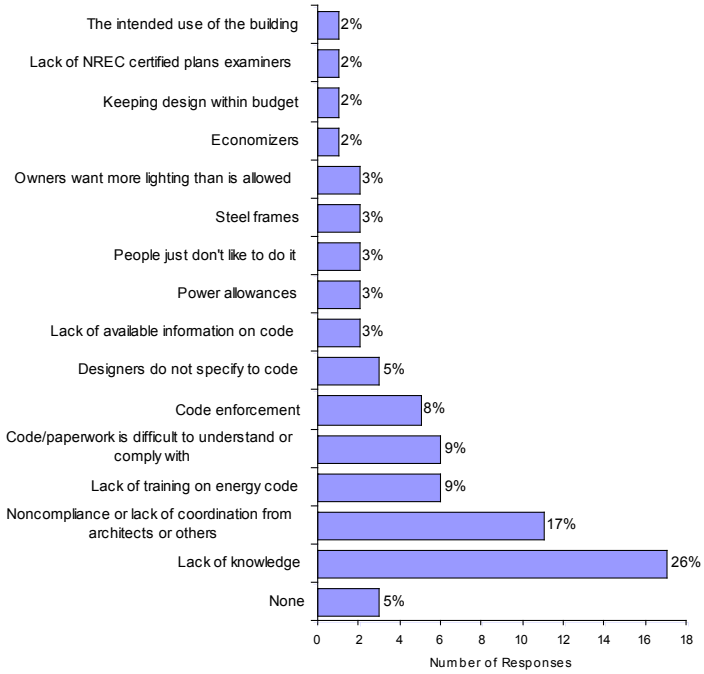
Source: NEEA Codes and Standards Support Project: MPER #2, Northwest Energy Efficiency Alliance, 2008.

Barriers to Residential Code Compliance

A 2008 report from NEEA and a 2001 report from the Peregrine Energy Group for the Northeast Energy Efficiency Partnership (NEEP) both gathered data on barriers to code compliance. They found that a lack of knowledge and understanding of codes was the most important compliance barrier in northwestern states,

and lack of interest on the part of homeowners and contractors was the most important compliance barrier in northeastern states. Figure 3 presents data from the 2008 NEEA report, which focused on the Pacific Northwestern states. The data show that code officials' lack of understanding of the existing code, and their lack of training, are among the largest barriers to compliance with the code, which points to the value of ongoing education and outreach programs to explain the building code.[37]

Figure 3: Biggest Obstacles in Energy Code Compliance (Survey of Code Officials)



Source: "NEEA Codes and Standards Support Initiative," Northwest Energy Efficiency Alliance, 2008.

The Peregrine Energy Group's study of barriers to code compliance, which focused on New Hampshire and Rhode Island, found that resistance to energy efficiency measures because of cost cutting was also an important factor. The barriers identified in New Hampshire and Rhode Island included, in order of importance:[38]

1. Contractor/homeowner lack of interest in energy codes
2. Cost-cutting/Rushed jobs
3. Codes are hard to understand
4. Inspectors lack training
5. Homeowners want large windows – too much glass

The survey asked local code inspectors in New Hampshire and Rhode Island what features they typically checked when they examined a house for compliance. The results show, at least for these two New England states, a wide variation in measures that the code inspectors examined. This is indicative of the fact

Table 4: Residential Measures Typically Checked (By Frequency)

Measure	New Hampshire	Rhode Island
Attic/Wall Insulation	91%	93%
Foundation Insulation	67%	75%
Pipe Insulation	46%	61%
Window Efficiency	44%	29%
Window Sealing	19%	29%
Furnace	18%	4%
Vapor Barrier	13%	14%
Sealing Penetration	9%	n/a
Home Matches Plan	3%	n/a
Duct Construction	1%	n/a

Source: Peregrine Energy Group, 2001. Study performed for Northeast Energy Efficiency Partnership.

that most inspectors may rarely inspect for each and every measure that the code requires. Inspectors appear to almost always check for insulation levels, for instance, but only occasionally check for window sealing measures.[40]

Commercial Code Compliance

A 2007 national study of commercial energy code compliance focused on architects, lighting designers, electrical engineers, building contractors and others who were in the role of specifying equipment for commercial building projects. The sample size was 431 respondents, or 4.3 percent of the total number of people who received the survey nationwide; for most questions, the results were not sorted by state. [40]

The survey found that a significant number of respondents did not know what the commercial building energy code was: close to 50 percent of respondents either reported they did not know what the code was, or did not answer the question. Of those who did know the requirements, about 80 percent of reported that they complied with the code requirements. The survey also found that, perhaps due to stricter standards and stricter enforcement on the West Coast, West Coast respondents indicated a much higher rate of compliance with the code's mandatory lighting shutoff requirements and a much higher awareness of their firm's compliance rate than did respondents from elsewhere in the country.[41]

The study noted that, in most cases, inspectors made no physical inspection of buildings, relying instead on reviews of building plans and certifications from the contractors that the buildings met code. Some noted that the expectation that the building would not receive a physical inspection could lead to code violations. The study asked respondents to share their views on why they did not comply with code requirements, and were asked to rank six reasons for lack of compliance. The ranking was as follows.

Table 5: Barriers to code compliance in the commercial sector

Barrier	Rank
Value engineering (best performance efficiency measures)	5.1
Lack of awareness/knowledge among design team	4.5
Lack of awareness of approval process	4.4
Energy code is not strictly enforced	4.4
Code language is unclear and not actionable	4.2
Lack of commercially available products	3.6

Source: Commercial Energy Code Compliance Study, Zing Communications, 2007.
** 1-7 scale with 7 representing a "very significant barrier."*

Addressing Code Compliance and Enforcement

Simple Codes

Both Oregon and Washington attribute their relatively high success with energy code compliance to simple, prescriptive energy codes that are easy to understand. According to NEEA staff, Oregon's building codes underwent a major re-write in the mid-1990s that resulted in a far simpler prescriptive code. Code compliance increased from the mid-50-percent range to close to 90 percent over the ten years that followed.[42]

Education and Training

Education and training programs for building inspectors, architects, engineers and general contractors are also important. Although state support for education and training on building energy codes is typically low,

Oregon and Washington have both invested heavily in education and training since the mid-1990s.[43] Connecticut requires building inspectors to undertake 90 hours of training every three years in order to maintain their licenses. The building inspectors' office conducts these trainings, but other organizations in the state, such as the institute of Sustainable Energy and the Northeast Energy Efficiency Partnership, supplement the state training with their own training sessions. The higher energy prices in recent years have raised the profile of energy efficiency and, according to staff in Connecticut, while in 1999 most building inspectors barely "knew what the 1995 model energy code did," they now see energy efficiency as a higher priority – if not top priority – item.[44] Arizona conducts education and training for inspectors involving in-person workshops, video, online webcasts and in-house training for inspectors.[45]

Maine law makes provisions to plan for and fund training and enforcement of the building code. It appoints a statewide committee to, among other tasks, develop a plan for training, enforcement and technical assistance for municipal officials and to review plans for new construction, reconstruction, repairs and renovations. Funding comes from a fee (four cents per square foot of occupied new or renovated space) that is levied by the state. The bill also appropriated funding for one person in the Maine policy office to oversee development of the new code and two new staff people in the state building code office. Maine's approach has the effect of allows the building industry to plan for the new code and gives the state the opportunity to educate and train the industry prior to the time that the 2009 code comes into effect.[46]

Enforcement

Enforcing codes is difficult because, while local building inspectors bear responsibility for enforcing codes, each state has a crew of many hundreds or thousands of building inspectors who must be educated on energy codes and inspection techniques. California, for instance, has 560 local building departments scattered throughout the state, each with multiple building inspectors, who perform site visits, in addition to other personnel who are in charge of reviewing building plans. These local government employees are responsible for reviewing far more than just building energy codes; they must inspect buildings for compliance with safety, fire, plumbing and other codes. With these many different demands on their time, energy codesare secondary to their support for life, health, and safety codes.

In order to support the local code officials, California will hire five new employees at the California Energy Commission who will be responsible for supporting enforcement activities at the local level. Referred to informally as "circuit riders" by the CEC enforcement staff, the individuals will conduct training, accompany local building inspectors on site visits, work with the California Building Officials organization[47], and develop an online "learning academy" to provide an additional resource to current or potential building inspectors. The Head of Enforcement for building codes expects that the additional staff will also help to pinpoint areas of non-compliance and to give the state a better and more nuanced understanding of compliance.[48]

California is also undertaking a partnership with its state licensing board to encourage compliance with building energy codes. This partnership is the result of complaints that licensed contractors who obtain appropriate permits for their jobs have made about other contractors who have not applied for permits. The complaints arise because the contractors who comply with state regulations worry that contractors who do not comply with regulations can secure more business by underbidding them. The goal of the partnership is

to make enforcement easier by educating contractors about energy efficiency and focusing specifically on the contractors who fail to comply with the California building energy code.[49]

Complementary or Alternative Policies to Building Energy Codes

- States can use the adopted building codes as a base standard and then provide incentives to builders or purchasers that exceed them. Hawaii enacted expedited permitting for LEED-certified buildings in 2007. Local governments have adopted incentives as well. Houston City Council adopted the Green Building Resolution, which set a target of LEED-Silver certification for new construction, replacement facilities and major renovations of city-owned buildings and facilities with more than 10,000 square feet of occupied space.

- Education and training programs are essential yet challenging elements for achieving results from building codes, especially given the disaggregated nature of the homebuilding industry.

- Funding for enforcement of codes is critical; state governments set most codes, but tens of thousands of local government inspectors across the nation enforce them. These code enforcement officials are in charge of not only energy codes but also safety and other building standards. As a result, the burden placed on these enforcement officials can be significant. Models such as that being pursued in California, wherein state governments support local code officials through education, training and enforcement-related support, can benefit the enforcement process.

- Labels that provide information on a building's energy attributes, such as the one that Kansas requires be presented to new-home buyers, may serve as an additional communication tool to inform the general public about building energy codes.

- Energy efficiency requirements for state-owned or state-funded buildings that may exceed model energy codes provide a way for government facilities to demonstrate high-efficiency buildings.

- California and Austin, TX are "commissioning" buildings (Cx) to foster better integrated design for commercial buildings. Massachusetts has adopted a "Mini-Cx" in its energy code as well.[50]

- Pacific Northwest National Lab (PNNL) and the U.S. Department of Energy are developing guidance for the "90 percent compliance" measurement to help increase the consistency of measurement across the country.[51]

- Texas A&M Energy Systems Laboratory (ESL) is developing the International Code Compliance (IC3) software not only to demonstrate compliance for IECC residential requirements, but to gather, compile, and report data to DOE for the American Recovery and Reinvestment Act (ARRA) "90 percent compliance" metric.[52]

- The Building Code Assistance Project (BCAP) has initiated pilot programs in the areas of: "energy code ambassadors" for communities, a third party enforcement model, a HERS-AS-Codes (Vermont is participating), commissioning (Cx) for code compliance, Community Energy Efficiency management (CEEM), a national energy code awareness plan and campaign and other infrastructure and training development.[53]

Observations on the Effectiveness of Building Energy Codes

Automatic code upgrades based on national model code revisions offer a mechanism to keep codes up-to-date. However, the majority of states do not have such automatic code update processes.

Although 15 states and the District of Columbia have an automatic code update process, or at least a process that simplifies code updates, 35 states do not. This disparity is partly responsible for the wide variety of codes from one state to another. Although automatic updates are not politically feasible in all cases, they provide certainty and give states the ability to conform to codes that reflect the most recent developments in energy efficiency technology.

Code compliance appears low, but figures must be read with care

In general, the data for compliance with building codes show that compliance rates are poor. Care should be used in analyzing this data, however, because a failure to comply with every element of a prescriptive code may not mean that the building as a whole is energy inefficient. In addition, overall figures that show a lack of code compliance may mask important differences related to specific sectors. For example, Oregon's multi-family code compliance appears worse than its single-family building compliance. This indicates that additional training may be necessary that is targeted to that sector. Finally, data on code compliance is limited and requires additional study.

Although not a lot of recent information on compliance exists, Oregon and Washington appear to have well-developed codes that achieve relatively high levels of compliance.

Whether it is because of long-standing and well-funded education and training programs or simple and understandable prescriptive building codes, Oregon's and Washington's codes appear to have achieved greater compliance rates than those in other states.

Education and training are critical to both compliance and enforcement of building codes

Education and training for building contractors and building inspectors appear to be critical to the success of codes. Connecticut, Washington and Oregon have training and enforcement programs that may offer models to other states. New legislation enacted in Maine not only creates an oversight and planning process for training but also establishes a funding mechanism for this training and appropriates money to the relevant state agencies to perform this training. This legislation also requires the state to adopt the 2009 code before the ICC has finalized it, meaning that it has provided time for training in advance of code adoption and certainty to builders and inspectors as to what code they will be required to address. California has adopted a new approach that combines education and training with enforcement, and will hire full time employees at the California Energy Commission to support local building code inspectors in their energy codes. California staff admits that while this may help to address certain compliance and enforcement deficiencies in the state, five new employees to support 560 local building departments will only be able to offer limited support.[54]

Further Resources on Building Energy Codes

The Building Codes Assistance Project offers educational resources on building codes as well as information on state building code activity. Visit www.bcap-energy.org and www.bcap-ocean.org.

The Northwest Energy Efficiency Alliance offers information and research on building codes with a focus on the Pacific Northwest. Visit www.nwalliance.org.

The U.S. DOE building codes program offers educational resources, surveys of state activity and a database of papers on building codes. Visit http://www.energycodes.gov/implement/code_compliance.stm.

Endnotes

1. In some cases, state governments take on the enforcement duties. Louisiana is an example; in 2007, a bill was passed requiring all commercial buildings in the state to comply with ASHRAE 90.1-2004. This legislation is called the Commercial Building Energy Conservation Code (CBECC), and is enforced by the Office of the State Fire Marshal, Code Enforcement and Building Safety.
2. Building Codes Assistance Project. http://www.bcap-energy.org/node/18.
3. Section 101, Energy Policy Act of 1992 (*P.L.* 102-486).
4. Building Codes Assistance Project. http://www.bcap-energy.org.
5. U.S. Department of Energy. http://www.energycodes.gov/training/presentations.stm.
6. Section 101, Energy Policy Act of 1992 (*P.L.* 102-486).
7. Building Codes Assistance Project. http://www.bcap-energy.org.
8. *Ibid*.
9. Personal communication with Mike DeWein, Building Codes Assistance Project, September 2009.
10. U.S. Government Accountability Office, Report to Congressional Addressees, *Important Challenges Must Be Overcome to Realize Significant Opportunities for Energy Efficiency Improvements in Gulf Coast Reconstruction*, June 2007. http://www.gao.gov/new.items/d07654.pdf.
11. The gross savings numbers are higher than would normally be expected, due to the large number of buildings destroyed in the hurricanes, but the savings percentages should be typical, given similar climate and existing codes.
12. Energy Efficiency: Important Challenges Must Be Overcome to Realize Significant Opportunities for Energy Efficiency Improvements in Gulf Coast Reconstruction, June 2007, pg. 5. This paragraph was taken in large part from "Reducing Carbon Dioxide Emissions through Improved Energy Efficiency in Buildings", Joe Loper, Steve Capanna, Selin Devranoglu, Nils Petermann and Lowell Ungar, Alliance to Save Energy, DRAFT, 2008. http://ase.org/content/article/detail/4816.
13. "Energy Efficiency: Long-standing Problems with DOE's Program for Setting Efficiency Standards Continue to Result in Forgone Energy Savings," U.S. GAO Report 07-42, January 2007.
14. Building Codes Assistance Project, "Status of Residential State Energy Codes" and "Status of Com-

mercial State Energy Codes," September 2007, accessed July 2008. http://www.bcap-energy.org/node/123.

15. H.B. 2036 of 2007. Energy Efficiency Disclosure Form available for download at http://www.kcc.ks.gov/energy/.
16. Personal communication with Jim Ploger, Kansas Corporation Commission, July 2008. The Kansas government exerts little regulatory control over builders – no homebuilder registration requirement exists in the state, for example.
17. U.S DOE Building Energy Codes Program. http://www.energycodes.gov.
18. The Energy Efficient Codes Coalition. http://www.thirtypercentsolution.org.
19. *ASHRAE Insights, 30% Energy Saving Is Target*, accessed April 2008. http://www.ashrae.org/publications/detail/16468.
20. *ASHRAE, DOE Partner to Improve Energy Efficiency*, July 2007, http://www.ashrae.org/pressroom/detail/16399.
21. Personal communication with David Cronin, Maryland Energy Administration, May 2008.
22. Maine L.D. 2257 of 2008. http://janus.state.me.us/legis/ros/lom/LOM123rd/123S1/PUBLIC699.asp.
23. Hawaii Section 46-19.6. http://www.capitol.hawaii.gov/hrscurrent/Vol02_Ch0046-0115/HRS0046/HRS_0046-0019_0006.HTM.
24. Code Status: Connecticut, Building Codes Assistance Project. http://bcap-energy.org/node/58.
25. Maine L.D. 2257 of 2008. http://janus.state.me.us/legis/LawMakerWeb/summary.asp?ID=280028350.
26. Clean and Diversified Energy Reports, Western Governors' Association. http://www.westgov.org/wga/initiatives/cdeac/cdeac-reports.htm.
27. Personal communication with Alan Seymour, Oregon Department of Energy, May 2008.
28. "Simple Overview of 2008 Residential Energy Requirement," Oregon Building Codes Division and Oregon Department of Energy, January 2008. http://www.oregon.gov/ENERGY/CONS/Codes/docs/Overview_012308.pdf. The nine measures from which builders can choose are: high efficiency HVAC (including the option of choosing a 90 AFUE furnace); high efficiency ducts; high efficiency building envelope; zonal electric heat, ductless furnace or ductless heat pump and certain building envelope measures; high efficiency windows/ceiling/lighting; high efficiency windows/ceiling/water heating; high efficiency water heating/lighting; solar photovoltaics; solar hot water heating.
29. Personal communication with Alan Seymour, Oregon Department of Energy, May 2008.
30. For a compilation of compliance studies, see U.S. Department of Energy, *Baseline Studies*, http://www.energycodes.gov/implement/baseline_studies.stm. Arkansas reports that 36 of 100 homes in the study sample did not meet the HVAC requirements of the state energy code.
31. BCAP staff indicate that they are not aware of significant changes in compliance rates since these studies were conducted. Personal communication with Aleisha Kahn, Building Codes Assistance Project.
32. According to BCAP, these studies were carried out with differing methodologies, so the results are not perfectly comparable, and many have sampling problems stemming from bias toward self-selection and convenience, usually leading to unrealistically high results.
33. "Statewide Codes and Standards Market Adoption and Noncompliance Rates," prepared for Southern California Edison by Quantec, May 2007. http://www.calmac.org/publications/Codes_and_Standards_Final_Report.pdf.
34. Note that, since the inspection occurred after occupation, the NFRC labels were no longer attached. Inspectors used low-e detectors.
35. Note that the low compliance rate for Oregon at

the time of the study preceded a major re-write of the Oregon residential energy code. According to David Cohan of the Northwest Energy Efficiency Alliance, the rewrite produced a far simpler code that was easier to comply with.

36. "Residential Building Code Compliance: Implications for Evaluating the Performance of Utility Residential New Construction Programs," Ed Vine, Lawrence Berkeley National Laboratory, May 1996. This data reflect a study with building codes in place as of 1996. These figures may change as codes become more stringent.
37. "NEEA Codes and Standards Support Project: MPER #2," Prepared for Northwest Energy Efficiency Alliance by Quantec, April 2008. http://www.nwalliance.org/research/reports/E08-184.pdf.
38. Presentation entitled "Local Code Official Survey for Northeast Energy Efficiency Partnership," Peregrine Energy Group. 2001. The fact that this survey was presented in 2001, before energy prices had begun their steady increase through much of the decade, likely influences the results from this survey. In particular, the top finding, that homeowners and contractors were not interested in energy efficiency and energy codes, may be less relevant as energy prices have risen.
39. *Ibid*.
40. "2007 Commercial Energy Code Compliance Study," Zing Communications, Inc., January 2007. Visit http://www.aboutlightingcontrols.org/education/pdfs/2007%20Commercial%20Energy%20Code%20Compliance%20Study.pdf.
41. *Ibid.*
42. Personal communication with David Cohan, Northwest Energy Efficiency Alliance, May 2008.
43. *Ibid.* and "Non-Compliance with the Washington State Nonresidential Energy Code: Causes and Consequences," 1997. http://www.energycodes.gov/implement/code_compliance.stm.
44. Personal communication with Doug Schanne, Connecticut Office of Building Inspection, May 2008.
45. "Building Energy Codes in Arizona: Best Practices in Code Support, Compliance, and Enforcement," Jeff Schlegel and Beth Nelson, Southwest Energy Efficiency Project, August 2007. http://www.energycodes.gov/implement/pdfs/az_compliance_sweep_2007.pdf.
46. Maine LD 2257 of 2008. http://janus.state.me.us/legis/LawMakerWeb/summary.asp?ID=280028350.
47. For more information see http://www.calbo.org. Personal communication with Eurlyne Geiszler, Head of Enforcement for Building Codes, California Energy Commission, May 2008.
48. *Ibid*.
49. Building Codes Assistance Project, "Third and Fourth Roundtable Discussion on Energy Code Compliance and Evaluation," July and August 2009.
50. Building Codes Assistance Project, "Second Roundtable Discussion on Energy Code Compliance and Evaluation," June 2009.
51. *Ibid*.
52. *Ibid*.
53. Personal communication with Eurlyne Geiszler, Head of Enforcement for Building Codes, California Energy Commission, May 2008.

About the Alliance to Save Energy

The Alliance to Save Energy is a coalition of prominent business, government, environmental and consumer leaders who promote the efficient and clean use of energy worldwide to benefit consumers, the environment, the economy and national security. The Alliance advances energy efficiency policies, conducts research on various energy-related topics, and increases awareness and knowledge about the many ways that energy consumption can be reduced in the United States and throughout the world. For more information about the Alliance and its activities, please visit www.ase.org.

Acknowledgements

This series is made possible by support from Oak Ridge National Laboratory, the US Department of Energy and the Corporate Associates of the Alliance to Save Energy.

Author: Matthew Brown

Matthew Brown is a Partner with ConoverBrown LLC, a consulting firm that focuses on clean energy policy and finance. He provides a combination of (1) analytical and project management services on clean energy for state, federal and local government clients and (2) financial design for clean energy programs for private and public sector clients. He has performed work for a variety of domestic and international clients, including the U.S. Agency for International Development, for which he assisted in the development of clean energy policy in Liberia; SEEDCo, a community development financial institution seeking to build new energy efficiency lending programs in Colorado; and state governments and national associations seeking assistance in the clean energy arena. Prior to founding InterEnergy Solutions, Mr. Brown was the Energy Program Director for the National Conference of State Legislatures (NCSL), where he managed programs that advised high-level state officials on energy regulation, energy policy, energy efficiency, renewable energy, energy/air issues and energy security. He has advised state legislatures, provided expert testimony in over 35 states and for the Federal Energy Regulatory Commission on energy policy and regulation, and written extensively on the subject. Mr. Brown also served as the Director of Special Projects for the New York City Department of Telecommunications and Energy, where he was responsible for establishing several public-private partnerships to build alternative fuel vehicle infrastructure and for intervention with the State's Public Service Commission on renewable energy issues. Prior to this he worked with the accounting and consulting firm of KPMG Peat Marwick. Mr. Brown holds an MBA from New York University and a BA from Brown University.