Closing the Gap on Building Energy Codes to Achieve Carbon Reductions

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ABSTRACT

Building energy codes are effective policy tools capable of producing a significant and widespread impact on US carbon emissions, and are consequently identified in almost every local climate initiative currently underway. Unfortunately, critical breakdowns at multiple levels have severely limited the ability of codes to deliver their expected impact. To realize the full extent of climate-related benefits, energy codes should 1) affect all new construction, 2) be applied to buildings during major renovations to improve energy performance, and 3) be updated every few years to keep up with advancing technology and energy efficiency goals. However, a very different set of events is occurring. Although, federal, state, local governments and utilities all have necessary and critical roles in adopting, administering, and enforcing energy codes, as well as reaping the benefits, their activities have not been sufficiently comprehensive or robust. This paper will discuss how climate issues are driving codes forward and how this new focus has generated fresh urgency to revamp the code development and implementation processes to achieve potential energy savings. It will further report on existing and possible enhanced policy roles for federal, state, and local levels – highlighting both best practices and pitfalls encountered across the country. The paper includes the potential energy, environmental and economic impacts, drawing upon ongoing research and over a decade of experience in advocating for action on codes, and provides recommendations for using codes as an effective tool to address our nation's current climate concerns.

Introduction

State policy actions to reduce carbon emissions have surged over the last few years in the presence of increasing concerns over the consequences of global warming and in the absence of comprehensive federal action. Experts have warned that we have reached a pivotal junction, not just for the environment, but the economy, as well. Failing to act, we risk losing 5 percent of global gross domestic product (GDP) annually "now and forever" and, in the worst case, face losses of up to 20 percent annually. Alternatively, if we act decisively we can avoid the worst consequences and limit the impact to a loss of 1 percent GDP annually (Stern). Although the federal government has recently taken steps to address energy use and emissions through appliance standards and corporate average fleet economy (CAFE) standards for automobiles, significant opportunities to reduce emissions from the buildings sector remain untapped.

The opportunity to reduce carbon emissions in the building sector, through energy codes, is appealing as a proven and cost-effective approach and is a strategy being incorporated into state and local climate policy. However, while codes have the potential to produce a meaningful impact on energy consumption and emissions, there are significant failures in the process that need to be understood and addressed. These "weak links" in an otherwise promising strategy, are prevalent across all levels of code development, adoption, and implementation. The encouraging news is that the largest barriers to developing an effective process may be the lack

of understanding on code policy and infrastructure failures. Once recognized and addressed, there is hope that energy codes will deliver the anticipated savings on building sector emissions.

State Climate Change Solutions – An Unprecedented Driver for Energy Codes

Potential for Energy Code Improvement

Comprehensive efforts to address climate change consistently identify the opportunity in the buildings sector as one of the largest, most cost-effective, and established ways to reduce carbon emissions. Each of the state climate change action plans completed in the last two years or currently under development incorporates building energy code measures as a leading strategy.

Energy use in buildings accounts for almost 40 percent of the total energy consumed in the US and more than 70 percent of the electricity produced (EIA 2006a, 2006b). Perhaps not as widely known, the average home emits twice the greenhouse gas of the average car. Consequently, activities addressing climate change seem to quickly zero in on the opportunities in the buildings sector.

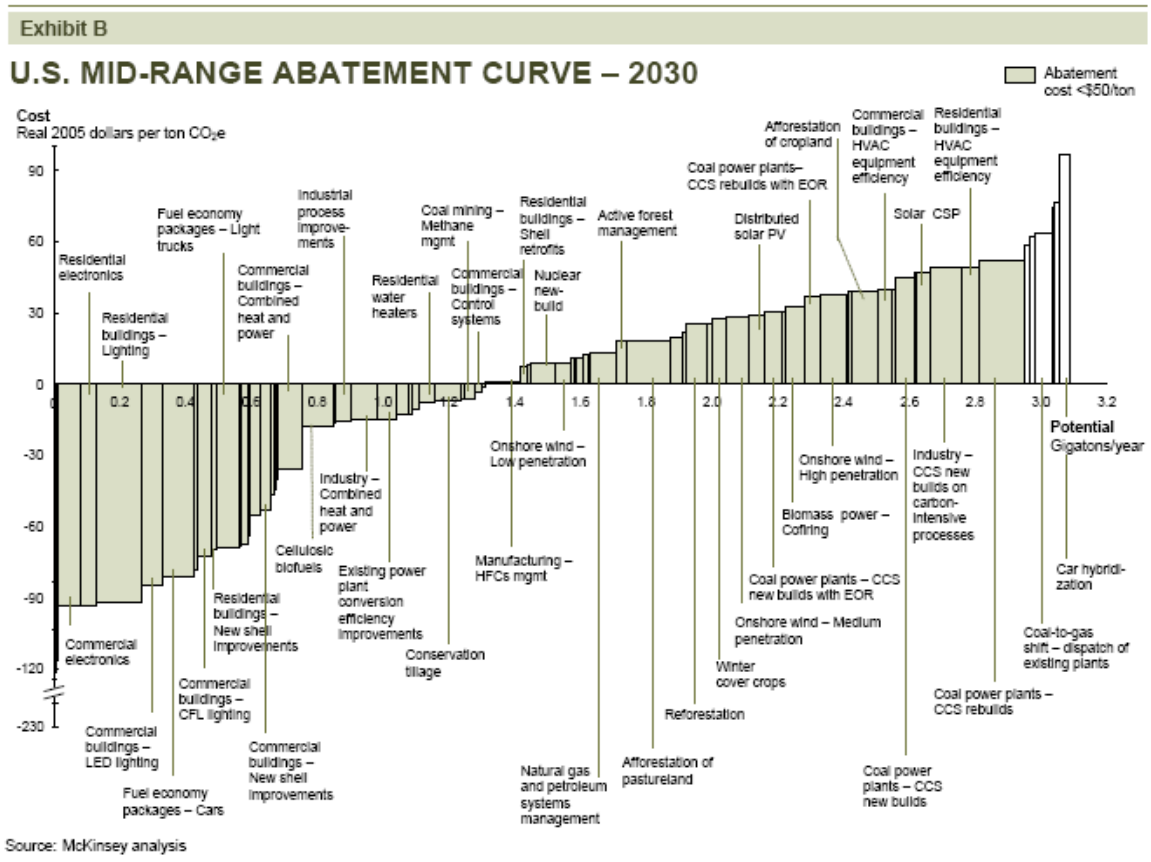
However, the buildings sector is more than just a significant contributor of greenhouse gases – it is a sector where opportunities exist to cost-effectively save energy. A study released in 2007 by the McKinsey Global Institute provides even greater support for including building and codes as a key part of a carbon reduction strategy. The report, *Curbing Global Energy Demand Growth: The Energy Productivity Opportunity*, presents the case for large opportunities to "contain energy growth in economically attractive ways" while reducing carbon dioxide emissions (McKinsey 2007). The study compared policies to abate carbon dioxide based on the resulting energy productivity (defined as, "the level of output we achieve from our use of energy"). Figure 1 demonstrates how these policies, which are all based on existing technologies and have an internal rate of return of at least 10 percent, compare to associated cost to reduce carbon dioxide. Lighting and envelope improvements for commercial and residential buildings, as well as residential water heaters and commercial control systems, were designated as policies that had a negative cost.

Codes have a significant impact potential over time because efficient technologies can be incorporated and applied to all new construction. Once a new building is constructed, it is very expensive and often impossible to achieve the energy efficiency that can be economically built in at the time of construction. If model building energy codes were strengthened by 30 percent starting in 2010 and by 50 percent around 2020—and if all states implement the codes— the country would save 2.6 quadrillion Btus of energy in year 2030. By 2050, the cumulative energy savings would reach approximately 11 quadrillion Btus.[1] The building market continues to demonstrate that efficient technologies and designs can significantly improve the energy performance of a building by reducing peak energy demand, air pollution, and greenhouse gas emissions.

[1] Savings calculated by the Building Codes Assistance Project; estimates use state data on existing energy usage, new housing starts, and new commercial square footage, combined with national averages for projected construction rates and fuel mix. Percent improvements in efficiency are based on the 2006 IECC and ASHRAE Standard 90.1-2004 for residential and commercial sectors, respectively.

Energy codes have historically focused on technology and ignored opportunities for energy saving in buildings through installation, testing, and performance. Progressive state and utility programs have achieved energy efficiency through an emphasis on building performance. Most notably, ENERGY STAR uses a performance-based rating for commercial buildings. The increase in commissioning has also highlighted the importance of *how* a building uses energy rather than only focusing on its components – and is incorporated into the current national commercial model energy code. Codes are generally expected to continue in this direction if they are to move toward big goals for improved energy efficiency.

Figure 1. Building Component Efficiency Opportunities



Understanding State Climate Initiatives

The past few years have witnessed a growing number of state, regional, and local climate initiatives as more entities adopt broad policies to address global warming and pair them with specific calls to action.

- The 2007-2008 Chair of the National Governors' Association, Governor Tim Pawlenty, focused his year-long initiative on *Securing a Clean Energy Future*, with a goal of reducing dependency on imported oil and lowering greenhouse gas emissions.
- The 2007-2008 strategic agenda for the Western Governors' Association is *Energy and Climate Change – the Challenge of our Times*.

- Members of the Midwestern Governors' Association developed the *2007 Energy Security and Climate Stewardship Platform for the* Midwest, committing their state or province to reducing carbon dioxide and other greenhouse gas emissions while maximizing energy resources and economic opportunities.

States are also taking individual action on climate and energy issues. Governor Napolitano established the Arizona Climate Change Advisory Group in 2005. The subsequent stakeholder process resulted in adoption of a statewide goal to reduce Arizona's greenhouse gas emissions, by 2020, down to levels produced in 2000. By 2040, emission levels in Arizona are to be 50 percent below this same baseline (Napolitano 2006). California, a state that is the twelfth largest greenhouse gas emitter in the world, put emissions reduction at the forefront of the policy agenda and set the goal of lowering emission levels to 1990 levels by 2020. By year 2050, California's goal is to have reduced emissions 80 percent below 1990 levels.

To add further depth to state initiatives, local city governments are pursing parallel policies. The US Conference of Mayors announced in February 2008 that 800 of its members (representing all 50 states) had signed a historic agreement pledging to reduce carbon dioxide emissions 7 percent below levels in 1990 by the year 2012. ICLEI's Cities for Climate Protection has been in operation since 1993 and continues to engage local government in the US (and worldwide) on addressing global warming and air pollution emissions. Both of these organizations are engaging in discussions around building energy codes as an action step for their respective members under these initiatives.

It is in these 'action plans' that energy codes surface to further define activities in the areas of energy efficiency and buildings. California's Integrated Energy Action Plan puts forward the goal of increasing building energy efficiency standards to produce, with on-site generation, net-zero energy homes by 2030 and commercial buildings by 2030. The following are two detailed examples of initiatives linking codes to climate and energy goals (California 2007).

National governors' association. As the 2007–2008 Chair of the National Governors Association (NGA), Minnesota Governor Tim Pawlenty launched a major energy initiative, *Securing a Clean Energy Future*[2]. This initiative enlists the efforts of all governors to reduce America's growing reliance on foreign oil, reduce overall energy consumption through efficiency and conservation, and cut our nation's contribution to greenhouse gas emissions. It includes a series of national summits, guidance documents, and formation of public-private agreements to advance clean energy. Consideration of the role of building codes is a part of each of these activities. NGA held an "experts dialogue" in December, 2007, to identify key opportunities for the states to improve energy use in the building sectors. Improved use of building codes and enhanced training and enforcement issues were of the top recommended actions. NGA also held a state workshop on this topic in May, and in June will release both a resource guide on state best practices that will further address energy codes and the *Clean and Secure State Energy Actions* report that will highlight building code activity.

Midwest governors' association. The Midwestern Governors Association (MGA) released their *Energy Security and Climate Stewardship Platform for the Midwest—2007* in November 2007. States adopting all or part of the MGA Platform include Illinois, Indiana, Iowa, Kansas,

[2] For more information, see www.nga.org/ci

Michigan, Minnesota, Missouri, Nebraska, North Dakota, Ohio, South Dakota, and Wisconsin, as well as the Canadian Province of Manitoba. It recommends that state building codes for energy efficiency be strengthened, with corresponding strengthening of training and building code enforcement. The MGA Platform further recommends that 1) market-based certification programs be used to make energy efficiency a selling-point for the buildings; 2) building codes be updated automatically to keep up with the latest in efficiency and technology; 3) financing mechanisms be created to aid in upgrading the energy efficiency of the existing building stock; 4) states make an investment in training of architects, builders, and code officials in effective and efficient code compliance; and 5) incentives be established to exceed building codes and encourage the development of zero-net energy buildings. The MGA Platform also recommends retrocommissioning existing public-owned properties to demonstrate the payback of effective efficiency programs to the private sector.

Since the MGA Energy Summit, states have been moving forward with their plans for implementing the Platform. Prominent examples are:

- The Iowa Climate Change Action Council (ICCAC), created by Governor Culver's signature on Senate File 485 on April 27, 2007, has evaluated a number of proposals that are before their "Energy Efficiency and Conservation" subcommittee, ranking building-codes related proposals, such as improving building codes, promoting beyond code incentives, and training builders and building operators as *High* for potential greenhouse gas emission reductions and *Low* for cost per ton of carbon abatement (ICCAC 2008). The ICCAC has released a short interim report making recommendations for target dates and goals for greenhouse gas reduction, but has not yet made a recommendation on building codes to Governor Culver.
- The Michigan Climate Action Council (MCAC), established on November 14, 2007 by Executive Order No. 2007-42, has established a "Residential, Commercial, and Industrial" Technical Work Group (RCI TWG) that will evaluate building codes proposals for recommendation to Governor Granholm. The MCAC RCI TWG has not yet made recommendations on any proposals.
- In Minnesota, the Minnesota Climate Change Advisory Group (MCCAG) was formed when Governor Pawlenty signed the "2007 Next Generation Energy Act." The MCCAG RCI TWG has made recommendations to the Group, which are currently in draft form and being finalized for submission to the governor (MCCAG 2008). Among a number of recommendations, the draft unanimously supports improving statewide building codes on a 3-year upgrade cycle to correspond with the ICC code cycle, creating green building guidelines based on *Architecture 2030,*and providing tax incentives that would encourage increased energy efficiency,
- The Illinois Climate Change Advisory Group (ICCAG) was created under Executive Order 2006-11 by Governor Blagojevich. It has recommended that Illinois establish energy efficient construction codes for residential and commercial buildings that exceed international standards, and create an energy efficiency code for all state government buildings (ICCAG 2007a). Specifically, the ICCAG Power/Energy Subgroup has recommended that Illinois adopt, by 2010, a residential code equivalent to the current Energy Star Homes standard, or 15 percent beyond the 2006 IECC, and a commercial code that reduces energy consumption 25 percent beyond current code levels (ICCAG 2007b).

- In Wisconsin, Executive Order 191 established the Governor's Task Force on Global Warming in April 2007. The Task Force's interim report, "A Wisconsin Strategy for Reducing Global Warming," recommends that Wisconsin pass legislation to establish the IECC as the residential and commercial energy code for the state within eighteen months of promulgation. They also recommend the creation of a high-performance green building code with incentives to achieve higher efficiency performance, and establishing a goal of achieving net-zero energy commercial buildings by 2030 and residential buildings by 2040 (Wisconsin 2008).

Code Processes, Policy Failures, & Opportunities

For codes to be truly successful as a policy tool for carbon reduction, major barriers and market failures have to be acknowledged and addressed. The country's model energy codes are widely assumed to be in place and enforced. Stronger codes are, therefore assumed to deliver savings beyond a code-dependant baseline. However, there are multiple breakdowns in the process that extend from development through the varied levels of adoption, all the way to enforcement on the local level.

Code development and enforcement exists in an environment where the primary focus is health and safety. Codes are updated to better protect the occupants who inhabit buildings, incorporating new developments in building technology and practice as a mechanism for accomplishing this goal. Meanwhile, the objectives of energy codes have focused on the country's energy problems. The 1975 Energy Policy and Conservation Act sought to address petroleum price regulation and allocation. It was amended in 1978 to require states receiving federal government funding to initiate mandatory programs, including energy conservation standards for new buildings. The intention is for model energy codes to prevent energy intensive construction and keep pace with a dynamic industry. The goal of saving energy contrasts with the primary goal of other codes, to protect health and safety. Efforts to utilize the energy code to keep up with the country's energy needs have not only been largely ignored in the past by the code development process, but the absence of milestones and requirements for energy efficiency improvements have enabled efforts to oppose energy code advancement.

Similarly, the enforcement community protects the population by assuring that buildings are constructed properly. Reviewing plans and inspecting material installation for energy efficiency is a very different, in fact highly specialized, activity. Coupled with the financial and staff constraints that are the norm rather than the exception for building departments, the resulting conditions only promote shortcuts and buildings that fall through the cracks with substandard designs/construction.

The following sections outline the actions that need to occur to develop, adopt, and implement the energy code–addressing the breakdowns at each level and suggesting state and local action to remedy these process failures.

Step 1: National Model Energy Code Development

The Energy Policy Act (EPAct) of 1992 designated the *IECC* and *ASHRAE Standard 90.1* as the national model energy codes. These are updated by their respective organizations and published every three years, at which time the US Department of Energy conducts an

analysis to determine if additional energy efficiency gains were made. If so, the most recent version becomes the new national model code.

What are the National Model Building Energy Codes?
Residential: *The International Energy Conservation Code (IECC), developed by the International Code Council (ICC)*
Commercial: *ANSI/ASHRAE/ANSI Standard 90.1 for Buildings except for Low-Rise Residential Buildings*

The development processes for the two publications differ in how states can participate, although both are open to public input. In the ASHRAE process, public comment is allowed on committee-proposed changes to the standard, and ASHRAE members as well as the general public/non-members can participate in development through technical committees. The International Code Council (ICC) process also facilitates public comment; comment is allowed on all code change proposals, which themselves are submitted directly by the general public. Proposals are then supported and opposed through open debate in front of an ICC-appointed committee (specific to the each code), who then votes to approve or disapprove the change. Regardless of committee decisions, proposals can be brought in front of the ICC membership for vote (by ICC members only) in a subsequent "Final Action Hearing."

Policy failure: absence of efficiency milestones for code development. EPAct allows US DOE to approve any increase in energy savings in the code, no matter how small. Not only can it be a minor increase, but it may only affect some parts of the country. It is also feasible that, in the same code, other areas could see a reduction in efficiency. Efficiency improvements have not been an organizational priority for code development organizations. The difficulty, and added failure, is that the processes are not designed to meet efficiency goals. ICC is a convener of its development process and does not impose any restrictions or mandates for the outcome of the hearing and voting process. The ASHRAE process, where changes to Standard 90.1 are supposed to meet cost-effective criteria, recently adopted the goal of improving efficiency of 90.1 by 30 percent in 2010 (over 90.1-2004). The outcome of this shift will be seen shortly.

Without goals to improve baseline energy efficiency, there is a missed opportunity. An agreed-upon national path for energy codes would 1) allow states and utilities to cooperatively line up goals for advanced voluntary programs; 2) aid manufacturers to better predict the development path and timeline for products; and 3) enable builders and designers to participate constructively in the process and contribute to *how* code improvements can be achieved.

Although all states adopt codes, energy and otherwise, there is little discussion among local policy makers around the development of the model codes they adopt and reference. There are notable exceptions: Oregon, Washington, and New York are a few of the states that have a visible presence at the hearings held by the ICC to develop residential code revisions. Due to its somewhat obscure nature, code development is subject to special interests and shielded from the energy and environmental goals of states. Particularly in the ICC process, industry organizations, building associations, and individual product manufacturers, while sharing important perspectives, can monopolize the debate. Energy code development has pursued a

truly bottom basement approach rather than seeking to establish a mechanism to lock in cost-effective technology and practices to save energy.

State and Local Opportunities:

- Pursue concrete improvement goals for the energy code through national policy (as was proposed in drafts of the 2007 Energy Bill and in current climate legislation).
- Work against institutional barriers with the ICC to incorporate goals for IECC improvement.
- Participate in both the ICC and ASHRAE processes–providing local perspective on energy goals for the building sector. These committees and organizations do not often hear about the policy-related activities in which codes end up playing a role.
- Engage in the decision-making process of codes–directly casting votes in the ICC process to adopt energy efficiency code improvements.

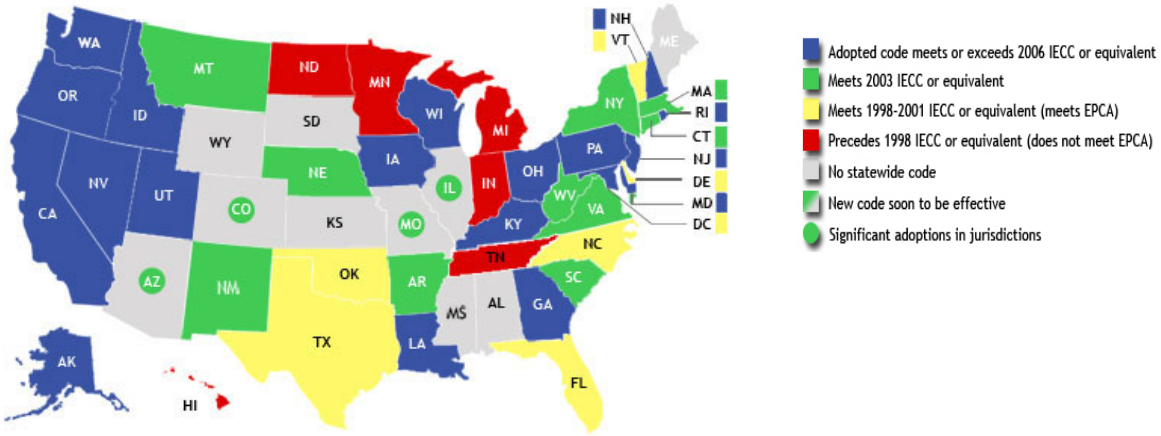
Step 2: State Adoption

As described above, national model building energy codes are officially updated once they are released by their development organization and the US Department of Energy has determined that there has been some improvement in energy efficiency. This triggers state action based on requirements also set out in EPAct. Under this legislation, states are required to adopt the commercial model codes (or an equivalent code). They are not required to adopt the residential code but if they choose not to, they must submit a letter to US DOE stating the reasons for their decision.

The adoption of energy codes is intimately tied to the legislative environment at the state and local level. Some states have a purely legislative process, whereby the legislation references the code or standard and often adds administrative provisions addressing enforcement, updates, variances, and authority. Alternatively, the state can legislate the authority of administrative and/or technical provisions of the code to a regulatory body. Some states may have a single authority for the energy codes while other states may have several entities involved. "Home rule" states have limited ability to impose building requirements on municipalities. In a "home rule" state, the adoption responsibility falls on units of local government. This makes for an assortment of various codes in place throughout a single state with various editions and an assortment of enforcement, compliance, update cycles, and education levels. This variety also occurs in many states with state-adopted codes but where final adoption and/or enforcement decisions are left up to local jurisdictions.

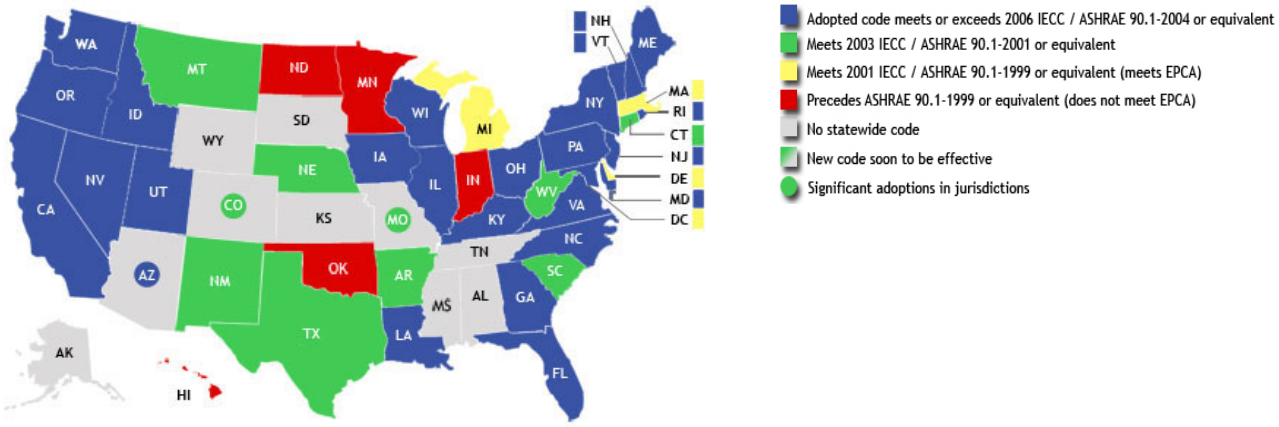
Policy failure: inconsistent state adoption. There are no penalties or incentives for states to adhere to EPAct requirements on code adoption. Despite a process that allows energy codes to lag behind, codes are nevertheless well vetted and appropriate for buildings all over the country. Yet many states do not want an energy code at all or have not undertaken the process to update in many years. This failure results in energy codes over ten years old guiding construction (Figures 2 and 3).

Figure 2. Residential State Code Adoption



Source: Building Codes Assistance Project (2008)

Figure 3. Commercial State Adoption



Source: Building Codes Assistance Project (2008)

State and Local Opportunities:

- Simplify the process by adopting automatic code updates. States, including Iowa and most recently Maine, have legislation that updates the state code when new versions are released. The states benefit from a predictable cycle and can plan training and implementation efforts accordingly.
- Take a leadership role in building support for new codes. Code updates include new technology and practices as well as clarifications and improved formats to support their use. Develop cost and savings information and work with US DOE, regional energy efficiency organizations and others to conduct advocacy based on the real impact of codes and not special interest propaganda.
- Leverage energy codes to accomplish state energy and climate goals. Recognize the impact of codes by incorporating them into comprehensive climate initiative. Not only

will codes deliver savings, but this driver will support and elevate the importance of effective implementation.

Step 3: Municipality Adoption/Support/Enforcement

One of the most commonly overlooked levels for codes, from a policy perspective, is the municipal building department. State adoption of a building code does not guarantee energy savings, as previously described. The largest issue and most essential element associated with achieving the benefits of a successful energy code is ensuring compliance in each building. States typically adopt a statewide code but there are many variations on the next step. Local jurisdictions may or may not have to adopt the same code, and may or may not have to enforce it. States typically provide resources to municipalities to support compliance and enforcement, although the level to which these funds are sufficient is questionable given the increasing documentation of poor code compliance in states.

Policy failure: insufficient local implementation/compliance. A study undertaken by the Building Codes Assistance Project (BCAP) in 2005 pulled together results of state studies on code compliance from around the country. Although the studies were different in their methodology and size, the general result was a 40 to 60 percent average compliance rate. This issue is gaining attention as states and local governments seek to get more out of energy codes as a policy tool for addressing climate change. More recent studies point to continued levels of low compliance.

Local jurisdictions hold the key to greater energy efficiency results because compliance and enforcement actions take place on this level. In fact a 2008 nationwide study by BCAP, found overwhelmingly that builders and designers suggest code enforcement as a strong motivator for code compliance. Essentially, the success of the code is determined by the local government's capabilities to ensure compliance and enforcement. Local building officials interpret and enforce the intent of codes for builders and designers. Therefore, a consistent level of understanding of the techniques and requirements of a new code throughout the jurisdiction directly impacts compliance and enforcement.

The failures, as reported in BCAP's 2008 study of code officials and commercial code end users, point in a few distinct directions. Overwhelmingly, a significant shortcoming has been in the area of training–not simply the lack of trainings, though more are needed, but in how end users of codes and code officials are trained. In the commercial sector, there is a preference among code officials to seek training on and enforce the commercial requirements of the IECC. Designers and engineers prefer ASHRAE Standard 90.1, and also appear to follow many different versions of the code. Clearly, there is a significant disconnect between these two groups who are at odds with each other when it comes to demonstrating compliance and enforcing requirements.

A second failure area is in the amount of staff. The typical code official not only enforces both the residential and commercial codes, but also enforces mechanical, electrical, and/or structural codes. Code officials consistently report an inability to spend sufficient time on project sites to inspect for code compliance. The energy code is also reported to be a lower priority and is thus edged out by other codes when time is short. In general, code officials want to improve their enforcement-95 percent want more training and resources-but they are limited by their workloads.

A final significant failure area in local compliance that was cited is complexity of the code. This is an issue that can be addressed both by training and resources but should be acknowledged on its own as an area that needs to be addressed, especially for code officials.

State and Local Opportunities

- Revisit state legislation regarding local code adoption and enforcement. The state code should be the minimum code enforced throughout in order to establish an effective baseline and avoid confusion over codes for builders, designers, and code officials.
- Prioritize energy efficiency in code enforcement. Building departments should be invited into discussions on leveraging the energy code to achieve city and state goals.
- Fully fund building code requirements to ensure adequate staffing, training, and enforcement at the local levels.
- Train code officials and end users together and establish clear guidelines on the code that should be used and enforced.

Conclusions

Climate initiatives need energy codes to deliver a significant amount of energy savings to help meet their carbon reduction goals and, at the same time, energy codes need climate concerns to drive them forward, as intended, to prevent energy-intensive construction. These climate initiatives put a new spotlight on the potential benefits and policy failures that have surrounded energy codes for almost 15 years. Nevertheless, codes remain a low-cost, effective strategy to reduce carbon. The following two recommendations summarize primary actions to address policy and process failures and impact energy use and carbon emissions in the built environment.

Recommendation #1 – Participate in national code policy and development. Local climate-related goals can be aided by effective national policy and strong model codes.

Recommendation #2 – Create effective state-level policy to lead the state on energy codes by automatically updating to current model codes, requiring local adoption and enforcement, and establishing sufficient funding and leadership on compliance and enforcement.

Making careful and effective policy decisions on energy codes today will dramatically shape the long-term impact of the buildings sector on our climate. If the recommendations in this report are fully implemented, we would begin to realize the potential energy savings that building energy codes cost-effectively offer in curbing carbon emissions.

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