Building Energy Codes for a Carbon Constrained Era: A Toolkit of Strategies and Examples

December 2017

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This report reflects the invaluable contributions of multiple individuals.

We recognize the report's lead author, Dave Hewitt.

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Finally, as this is an update to a previous report, NEEP would like to take this opportunity to re-acknowledge the authors and contributors to previous versions of this report, which continues to serve as the foundation upon which this update is based.

About NEEP

NEEP was founded more than 20 years ago as a non-profit to accelerate energy efficiency in the Northeast and Mid-Atlantic states. Today, it is one of six Regional Energy Efficiency Organizations (REEOs) funded, in part by the U.S. Department of Energy to support state efficiency policies and programs. Our long-term shared goal is to assist the region to reduce carbon emissions 80% by 2050. For more about our 2017 strategies and projects, see this 2-page overview or these project briefs. You can also watch this brief video regarding our history.

Executive Summary

Buildings consume about two-thirds of the United States' power supply and produce about 40 percent of carbon emissions.[1] Buildings that are being constructed now will have a considerable impact on our region's energy use 50 to 100 years from now. Thus, the built environment, including residential, commercial, and public structures, presents an opportunity to drastically reduce carbon emissions. Carbon reduction goals cannot be met, however, without significant gains in energy efficiency through more efficient building energy codes.

To reduce the impacts of climate change, states and communities in the Northeast and Mid-Atlantic region are adopting goals to aggressively cut carbon emissions and energy use between the years 2020 to 2050. Building energy codes – as well as related training and support – are critical tools to achieving carbon and energy reductions as they drive higher performance building practices throughout the construction industry, influencing and ultimately defining standard practice.

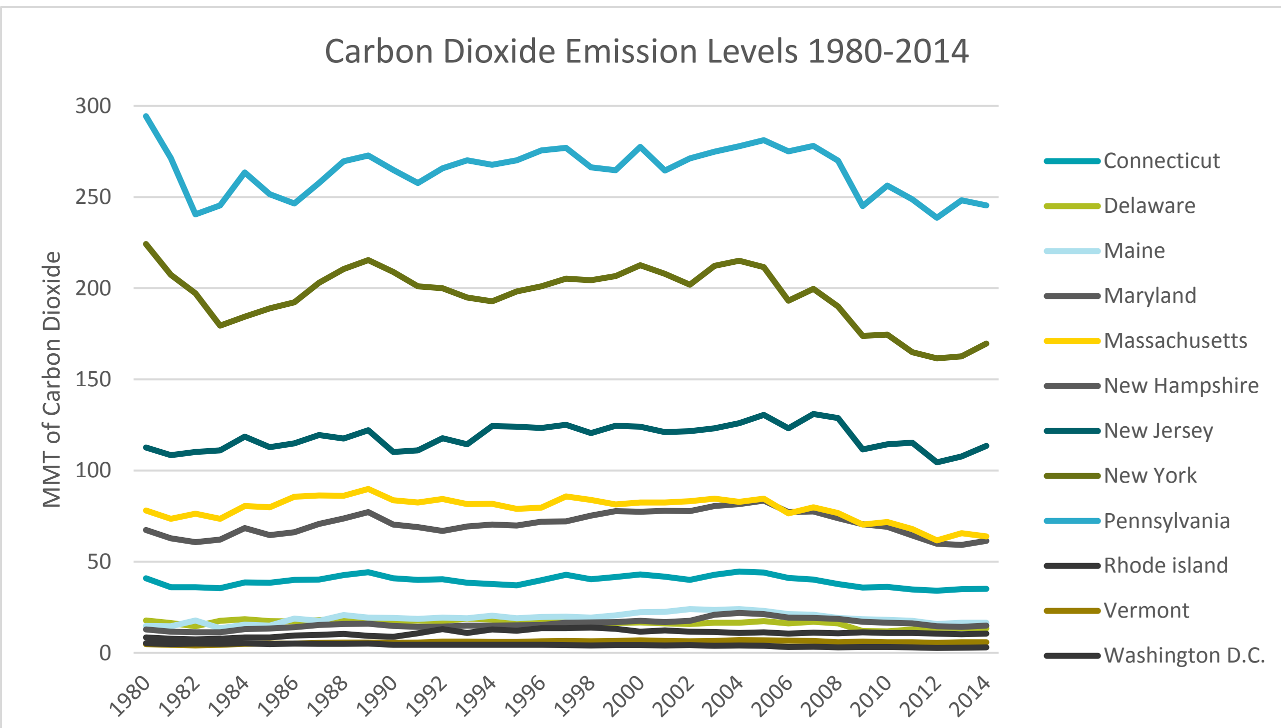

Table #1: The graph above shows carbon dioxide emission levels for each of the 12 states in the Northeast and Mid-Atlantic region between 1980 and 2014.

[1] New Buildings Institute

Based on current and projected efficiency and construction trends and analysis by the U.S. Department of Energy (DOE) and Pacific Northwest National Labs (PNNL), NEEP supports the following goals for the Northeast and Mid-Atlantic region:

2030 →	**Leading states** that have regularly adopted the energy code and set policies with an eye toward zero energy can **achieve requirements for ZEB** retrofits/new construction.
2040 →	All **new** buildings will be **designed to achieve zero energy.**
2050 →	All **existing** buildings will have been **retrofitted** through programs or initiatives that address efficiency.

NEEP also supports states and municipalities that have enacted plans and policies to address moving existing buildings based on building type and size toward deep energy retrofits, zero energy ready, and zero energy.

This report provides a set of strategies that will better position states in the Northeast and Mid-Atlantic region (the region) to achieve two critical objectives:

- **Advance building energy code development and adoption to enact zero energy buildings codes within the next 15 to 25 years;**
- **Improve the administration of building energy codes to ensure that desired performance levels are realized.**

The recommendations in this report are selected to achieve carbon reduction[2] and energy savings for new construction and additions, retrofits, and renovations. The zero energy goal focuses on new construction and existing buildings as they constitute the vast majority of energy savings opportunities. Reducing energy use across the entire building stock is integral to achieving carbon and energy reduction goals.

This report offers leading-edge strategy recommendations along with supportive explanations, best practices, and case studies to constitute a comprehensive, progressive model building energy codes strategy for the region to follow in order to achieve zero energy building (ZEBs). While some strategies should be implemented immediately, others will require incremental, cyclical action over multiple code cycles.

Strategies to advance code development to zero energy are presented as a way to transform the market over a period of years through supporting market activity and capacity building as well as advances in code. Code advances are linked to proven market leadership in high performance buildings, and state code progress will likely be preceded by advanced efficiency and ZEBs constructed by leading elements of the development community. These market activities can be supported and advanced through "stretch" codes that apply to public buildings and/or are used in local jurisdictions in coordination with aggressive carbon reduction goals as a critical strategy to advance market practice. Topics covered to advance code development to zero energy include:

1. Establish a zero energy ***buildings*** code goal and a strategy that links to carbon reduction goals;
2. Support the ***market*** in achieving advanced energy performance;
3. Implement stretch building energy codes;
4. Update the state building energy code without weakening amendments;
5. Drive efficiency in the national code development process.

Definitions

Buildings: include all residential, commercial and public structures that constitute the built environment

The Market: relating to buildings

Strategies to improve code administration[3] are equally important as strategies to advance code development. Equipping the market to design and construct a new efficient generation of buildings requires significant changes to current standard practice, and codes must be properly enforced to achieve potential benefits. Improved administrative practices include:

1. Expand energy code compliance capacity;
2. Implement electronic permit processing, plan review, inspection, and fee collection systems;
3. Quantify code compliance;
4. Allow utility program administrators to claim savings for energy code support activities;
5. Implement voluntary or mandatory building energy rating or transparency policies.

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[2] The report focuses our strategies and recommendations on achieving carbon reduction goals as opposed to broader greenhouse gas reduction goals. Carbon dioxide is the most abundant greenhouse gas derived from human activity, but other harmful greenhouse gases (such as nitrous oxide and methane) also have negative impacts on the environment.

[3] Code officials and administrators are responsible for not only adhering to the energy code but also for the following related tasks: permitting, inspections, plan review, compliance activities, interdepartmental and external communication, fee collection, data analysis, compliant review, data base and GIS.

Taken together, these two sets of strategies will dramatically change the energy performance of buildings and propel states and local governments toward achieving their carbon reduction goals.

Introduction

Buildings consume about two-thirds of the United States' power supply and produce about 40 percent of carbon emissions. Buildings that are being constructed now will have a considerable impact on our region's energy use 50 to 100 years from now. Thus, the built environment, including residential, commercial, and public structures, presents an opportunity to drastically reduce carbon emissions. Carbon reduction goals cannot be met, however, without significant gains in energy efficiency through better building energy codes.

The results of efficient code changes include lower utility bills, increased durability, and healthier working, learning, and living conditions in both new and renovated buildings. Advancing energy codes over time to make buildings more efficient is one of the most cost-effective and impactful strategies for reducing the region's energy use and carbon emissions.

States and communities in the region have adopted aggressive carbon reduction goals and some, more recently, have established goals of 100 percent renewable energy. These goals will require that the energy performance of buildings changes dramatically, both for new and renovated properties.

Table 1 below includes decarbonization goals and renewable energy targets for each of the 12 states in the Northeast and Mid-Atlantic region. These state goals and targets are important in that they serve as driving principles for the future of energy code adoption.

Table 1. Individual State Decarbonization Goals and Renewable Energy Targets

State	Near-term goal	Long-term goal	Renewable energy targets
Connecticut	10% by 2020	80% by 2050	27% renewables by 2020. Mandatory compliance.
Delaware	30% by 2030	N/A	25% renewables by 2025. 3.5% of sales from PV by 2025
Maine	10% by 2020	80% by 2050	40% by 2017 with a capacity of 8000 MW of wind energy by 2030 (5000 MW of offshore). Mandatory compliance.

Maryland	25% by 2020	N/A	20% renewables by 2022 with 20% of sales coming from Tier 1 sources and 2% of sales from solar by 2020.
Massachusetts	25% by 2020	80% by 2050	Energy sources much reach 20.5% renewable by 2020 with a 1% increase every subsequent year after. Compliance is mandatory.
New Hampshire	10% by 2020	80% by 2050	24.8% renewable by 2025.
New Jersey	Stabilize by 2020	80% by 2050	Each electricity supplier serving retail electricity customers in the State to procure 22.5% of electricity from qualified renewable energy resources by 2021.
New York	40% by 2030	80% by 2050	50% renewables by 2030. Decoupling currently being implemented.
Pennsylvania	33% by 2030	N/A	18% renewable by 2021, with 0.5% sales from solar PV by 2020.
Rhode Island	10% by 2020	80% by 2050	38.5% renewables by 2025.
Vermont	50% by 2028	75% by 2050	75% renewables by 2032. 10% of sales from distributed generation by 2032.
Washington D.C.	50% by 2032	80% by 2050	Plan to have 50% of renewables from Tier 1 by 2032 and 5% of sales from solar by 2032.

A 2016 U.S. Department of Energy (DOE) report on energy code impacts[4] and NEEP's 2015 report on energy codes and construction trends[5] demonstrate that the projected energy savings provided by building energy codes are sizeable, even when using extremely conservative estimates. However, intentional, focused action through planning and policy is needed to unlock the considerable additional energy savings potential from energy codes throughout the region.

[4] Impacts of Model Building Energy Codes
[5] Construction Codes In The Northeast: Myths And Realities Of Energy Code Adoption And The Economic Effects

Table 2. Reduction in energy use from residential and commercial code creation.

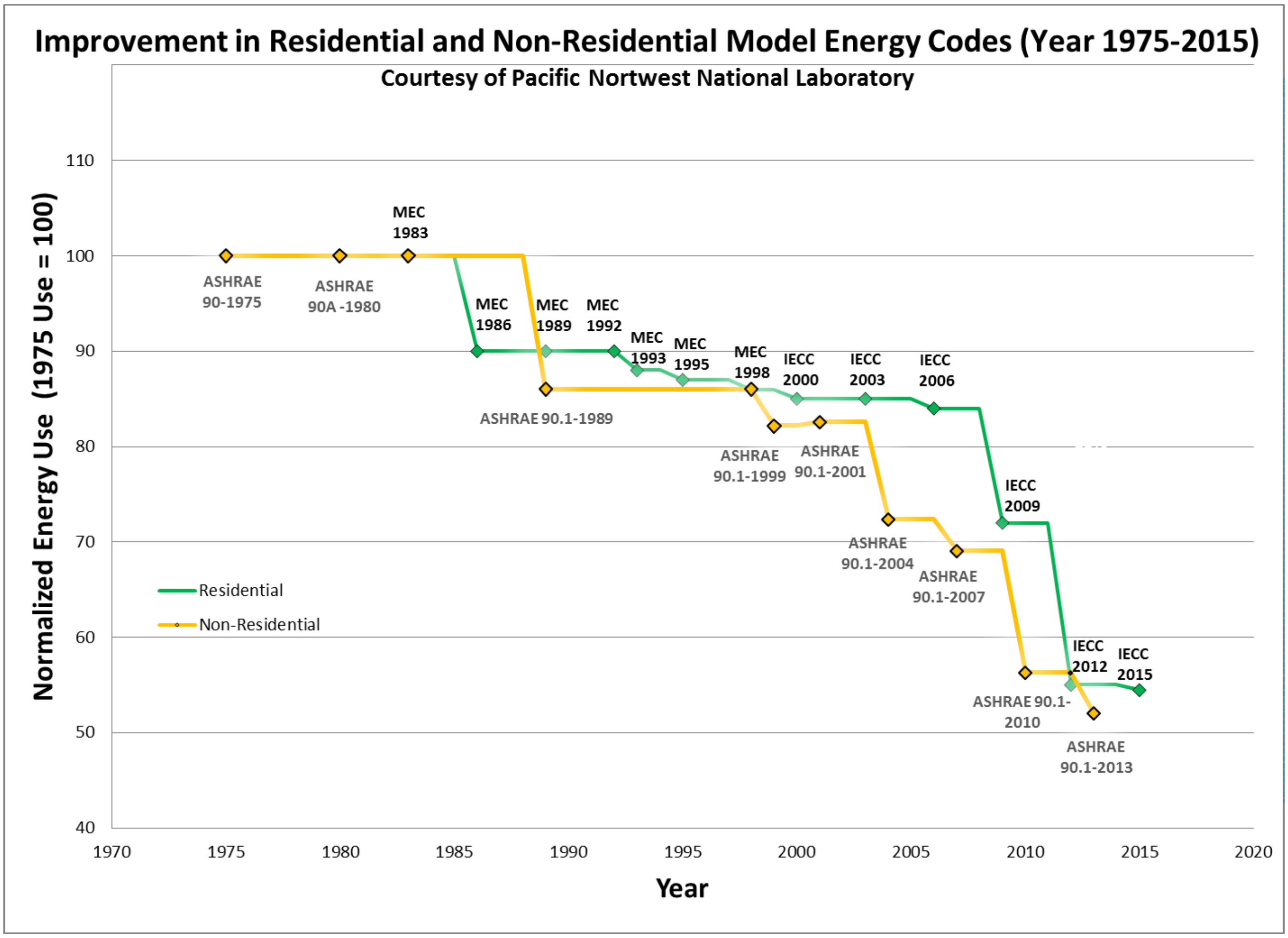

Table 2. (above) demonstrates the decrease in energy usage for each three year code cycle, for both residential and commercial buildings and codes.

Table 3. Summary of Impact of Energy Codes

Sector	**Energy Cost Savings** (2016 $ billion)	**CO2 Reduction** (MMT)
Commercial		
Annual 2030	2.24	17.57
Annual 2040	2.54	21.48
Cumulative 2010-2030	27.53	208.78
Cumulative 2010-2040	51.59	405.51
Residential		
Annual 2030	3.14	18.38
Annual 2040	3.45	21.46
Cumulative 2010-2030	41.19	234.52
Cumulative 2010-2040	74.34	435.43
Total		
Annual 2030	5.37	35.96
Annual 2040	5.98	42.93
Cumulative 2010-2030	68.72	443.3
Cumulative 2010-2040	125.93	840.94

Table 3 summarizes the impact of energy codes beginning in 2010 and ending in 2040 for all states included in the analysis. The results include savings from electricity, natural gas, and fuel oil (residential only) and are reported separately for residential and commercial codes. The cumulative primary energy savings from 2010-2040 are 12.82 quads. In terms of financial benefits to consumers from reduced utility bills, energy codes could save $126 billion dollars from 2010 to 2040. This equates to a CO2 reduction of 841 million metric tons (MMT). These savings are approximately equal to the greenhouse gases emitted by 177 million passenger vehicles driven for one year or CO2 emissions from 245 coal power plants for one year.

Why Zero Energy?

Zero energy buildings (ZEBs) are a worthwhile goal because they add no additional carbon to the atmosphere during their operation: they offer support for continued economic and population growth with no atmospheric pollution impacts from building operation. ZEBs offer optimized efficiency from renewable energy generated onsite or purchased offsite that equals the buildings annual energy consumption. For both new construction and major renovation, ZEBs represent a goal that can be obtained utilizing current design methodologies, aesthetics, and technologies at costs comparable to conventional construction.

Defining Zero Energy Buildings

In order to reach a zero energy buildings (ZEBs) target, we must define precisely what we mean by "zero energy." The U.S. DOE promulgated a set of definitions in 2015 that provides a consensus definition of ZEBs to support the growth and maturation of ZEB policies, initiatives, and actual construction.

> ***A zero energy building is "an energy-efficient building, where, on a source energy basis, the actual annual delivered energy is less than or equal to the on-site renewable exported energy."***

The DOE set of definitions also includes alternatives to the "on-site" generation of renewable energy and considers communities, campuses, and portfolios as options for scaling renewable energy development. These distributed energy resources (DER) provide another pathway to the generation of renewable energy other than on the actual building or building site. DERs provide an alternative way to meet the ZEB definition that frequently is more economical; can be built, managed and maintained by other parties; and can address issues of shading, insufficient roof area and other constraints that might apply to a particular site and building.

Industry leaders have already begun to subscribe to this definition, as the National Institute of Building Sciences, the American Institute of Architects, the U.S. Green Building Council and ASHRAE all use it with their members. DOE's A Common Definition for Zero Energy Buildings also provides guidelines for measurement and implementation, delving comprehensively into how to employ the definition for building projects. In all of NEEP's work on ZEBs, we utilize the U.S. Department of Energy's definition.

The terms "zero net energy" or "net zero energy" have previously been used in energy efficient construction – the 'net' in zero net energy indicating the net balance of a building's energy use over the year equals zero. DOE recognized that the use of "net" is not easily understood and usually has to be explained. NEEP and others in this field have dropped the use of the word "net." Zero energy is synonymous with the older terms.

Aside from consuming no more energy than they produce, ZEBs provide non-energy benefits. They promote the health and well-being of occupants (IAQ), are more durable and require less maintenance, have a higher resale value, and require a lower cost of operation and ownership. This study explores the financial feasibility of net zero energy buildings in Vermont, and the analysis shows that new construction of residential and office net zero energy buildings is a cost effective investment.

Based on current and projected efficiency and construction trends and analysis by the U.S. Department of Energy (DOE) and Pacific Northwest National Labs (PNNL), NEEP is certain that the adoption of energy codes and standards requiring the design and construction of ZEBs as well as the retrofit of existing buildings is possible by 2030 in leading states and local jurisdictions, and by 2040 throughout the region.

NEEP supports the following goals for the Northeast and the Mid-Atlantic region:

2030	**Leading states** that have regularly adopted the energy code and set policies with an eye toward zero energy can **achieve requirements for ZEB** retrofits/new construction.
2040	All **new** buildings will be **designed to achieve zero energy.**
2050	All **existing** buildings will have been **retrofitted** through programs or initiatives that address efficiency.

NEEP also supports states and municipalities that have enacted plans and policies to address moving existing buildings based on building type and size toward deep energy retrofits, zero energy ready and zero energy.

In both residential and commercial construction, including retrofits, there are examples of innovative builders, architects, and developers incorporating low-energy features. These examples include hundreds of commercial buildings and thousands of residential buildings that have achieved zero energy performance. The North American market for ZEBs will grow at an annual rate of 38 percent, increasing in size to $127 billion by 2035[6]. Broad and in-depth educational opportunities for the design and construction community as well as policy makers is needed to accelerate ZEB growth.

Achieving ZEBs is technically possible in all climate zones, as proven by the existence of numerous examples worldwide. The question is how can the advancement in performance necessary to reach carbon goals happen more expeditiously from the broader building industry?

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[6] Navigant Research, Net Zero Energy Buildings, 2016.

Changing from Early Market Movers to Codes

In order to achieve NEEP's regional goal, stakeholders must undertake several strategies and interventions. At present, only market innovators have adopted zero energy building practices, but there is a large and rapidly growing zero energy community. According to the Net Zero Energy Coalition's report "To Zero and Beyond: 2016", a total of 8,203 single family and multifamily housing units were counted in 2016, up 33 percent from the 6,177 in 2015.[7] Similarly, on the residential side, the Net Zero Energy Coalition maintains a list of residential ZEBs and found approximately 1,000 ZE homes and nearly 5,000 homes that met the DOE definition of Zero Energy Ready across the country. New Buildings Institute (NBI) maintains a database including information on around 140 zero energy commercial projects nationwide[8]. These facilities have achieved this distinction through various efforts by leading-edge owners and building professionals, frequently with support from utility or other energy efficiency programs. The Northeast Sustainable Energy Association (NESEA) also maintains a list of around 80 ZEB case studies. Many of these buildings were also pursuing other voluntary standards or point-based programs in addition to zero energy or zero energy ready. NEEP's Roadmap to Zero Energy Public Buildings progress report summarizes what has occurred within the region and around the country related to ZEBs and policies. In summary, NEEP found both national awareness of zero energy standards, definitions, policies, initiatives, and actual construction has grown and matured. A market research firm, Lux Research, projects ZEBs and nearly-zero energy buildings will grow to a $1.3 trillion market globally by 2025[9].

Northeast Sustainable Energy Association (NESEA) helps high performance building and energy efficiency professionals improve their practices by learning from and networking with each other. NESEA members include architects, engineers, educators, builders, energy consultants, policy makers, manufacturers, installers, facilities

The graphic below from The Net Zero Energy Coalition shows the number of zero energy projects, buildings, and units from 2015-2016, overall 33 percent growth during this year.

[7] Net Zero Energy Coalition
[8] New Buildings Institute
[9] https://cleantechnica.com/2012/02/06/zero-energy-building-market-to-hit-1-3-trillion-by-2035/

The US DOE's Zero Energy Ready Home (ZERH) Initiative

A zero energy ready home is one that meets all of the criteria found in the DOE Zero Energy Ready Home National Program Requirements. ZERHs are verified by a qualified third party and are at least 40-50 percent more energy efficient than a typical new home. This generally corresponds to a Home Energy Rating System (HERS) Index Score in the low to mid-50s, depending on the size of the home and region in which it is built.

Advances and cost reductions in technologies such as cold climate air source heat pumps[10] and solar photovoltaics are now enabling more builders and developers to consider ZE or ZE-ready as part of their marketing strategy.

The cost of solar and other renewable energy resources have dropped significantly, making these energy sources viable, market-ready options for home and building owners to produce a building's power. However, any additional capital to build to zero energy using on-site renewables may create cost issues, as building energy use is traditionally paid monthly, not at the beginning of a building's life. Increased use of distributed energy resources (DERs), such as community solar (at the small end of utility scale PV), can also create alternative packaging and financial options. The initial costs of renewable energy requirements can be met by a third party, and the costs associated with renewable energy can be included as part of the ongoing energy bill or a long-term lease rather than a first cost borne by the builder or developer that is directly passed to the owner. Strategies for developing and managing the renewable energy components of building energy codes are discussed in more detail later in the document.

Renewables as a part of the solution

Use of community scale renewable energy systems can be part of the solution where shading or other site/building limitations influence site choices. Off-site renewable options typically also have lower construction costs and offer different financing options including leasing, which can make alternatives to on-site power more attractive for many developers and customers.

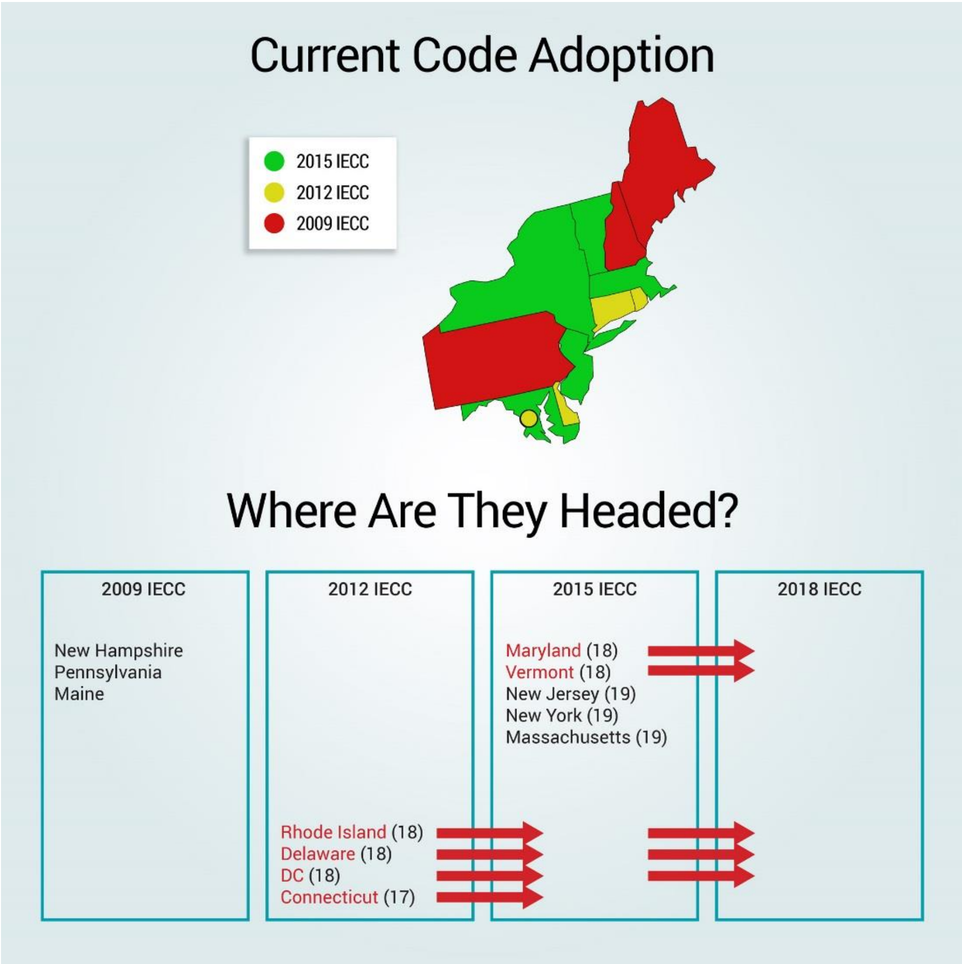
A near-term option is to have commercial and residential developers build to high performance specifications, to which a renewable energy system or renewable energy purchase or lease can be added at a later date to offset the buildings annual energy consumption. The U.S. Department of Energy offers a Zero Energy Ready Home Certification for residential buildings that effectively encourages this practice, as evidenced by the thousands of homes meeting the certification requirements.

[10] http://neep.org/initiatives/high-efficiency-products/air-source-heat-pumps/air-source-heat-pump-installer-resources

Current Status of Energy Codes in the Region

Overall, the Northeast and Mid-Atlantic region continues to serve as a national leader in energy codes adoption. However, there are opportunities to improve the efficiency of the energy code in every state. As of January 2017, each state in the region employs a version of one of the last three national model energy codes; the 2009, 2012, and 2015 IECC for residential buildings and ASHRAE Standard 90.1-2007, -2010, and -2013 for commercial buildings. Most of the region uses the newer, more efficient codes. The recommendations in this report would be enhanced by harmonizing energy code levels across the region and maintaining this improved alignment over the course of subsequent code cycles as many designers, developers and builders work across state lines.

Figure 2: Current state energy code adoption and where they are headed.



Note: IECC shorthand is used to represent the level of efficiency of both the residential and commercial code currently being enforced in each state (even in states where the commercial chapter of the IECC is not an accepted compliance path). In Maine, the energy code is not required in small towns unless opted into. Expected year of code adoption is listed in parentheses.

In addition, five of the 12 states in the region have implemented or are developing “stretch” energy codes that reach beyond base code efficiency levels. Stretch energy codes provide a set of requirements that go beyond the statewide code in their stringency. They serve several key purposes including adoption by state or local agencies for municipal buildings, adoption, where allowed, by an individual community for all buildings, in a community that may have aggressive carbon reduction goals, and they send a signal to the entire construction industry, from manufacturers to carpenters, regarding likely future statewide energy code requirements.

Achieving a ZEB Goal – Recommendations toward Zero

In the near-term, the code goal is to achieve a zero energy ready target from energy efficiency. The final step in achieving ZEBs is to demonstrate the ability to procure renewable resources of a size sufficient to generate the annual building energy load, whether on- or off-site generation.

Photo credit to Paul Torcellini.

Above is an example of a zero energy ready home located in Eastford, Connecticut. Below are strategies to advance code development to zero energy (see Objective 1 section on page 17) presented as a way to transform the market over a period of years through supporting activity and capacity building as well as incremental advances in code. Strategies to improve code administration (see the Objective 2 section on page 39) are equally important, as equipping the market to design and construct this new generation of buildings requires significant changes to current standard practice, and codes must be properly enforced to achieve all the anticipated benefits.

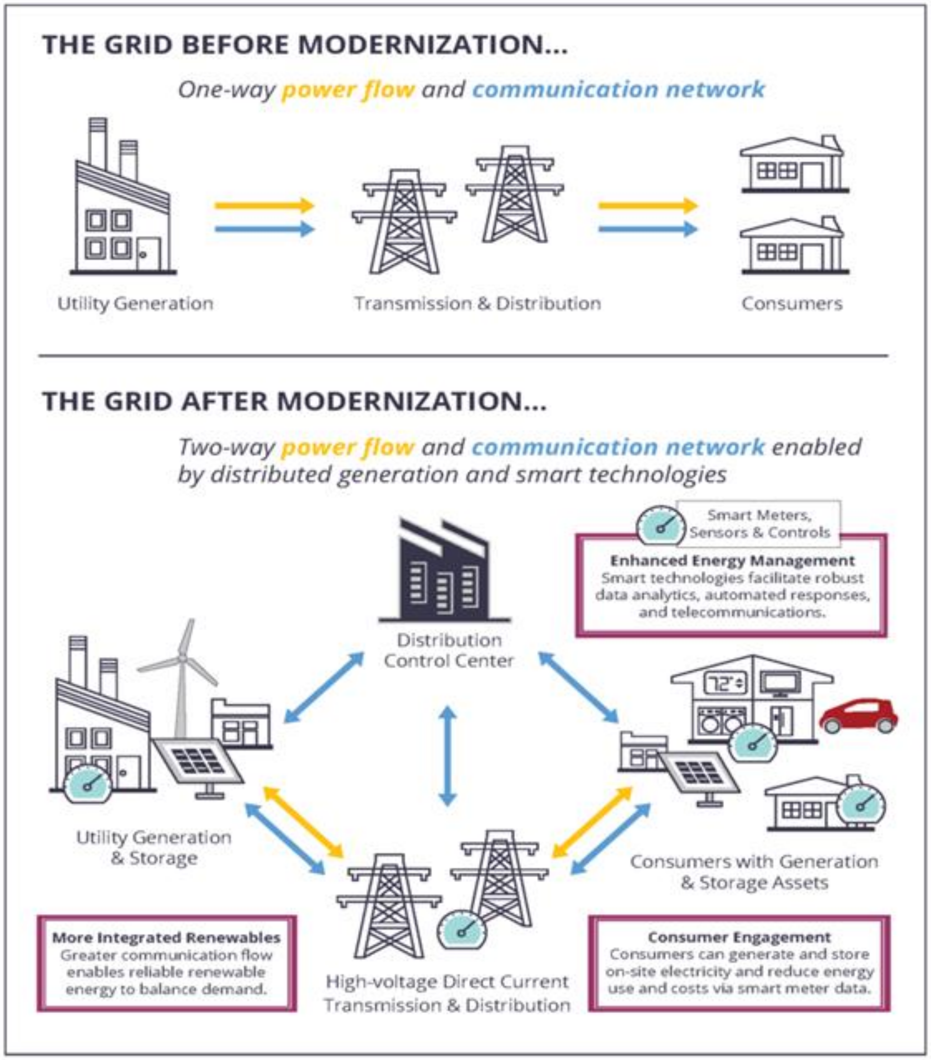
The strategies that NEEP recommends in this report are largely concentrated in the next four years (2017-2020), along with ongoing progress in phases with the cyclical nature of energy code development. While many of the recommendations in this report focus on increasing the efficiency of energy codes themselves over time, we also identify opportunities for voluntary, market-driven initiatives to support ZEB construction before it would be mandated by regulations. Over time, new technologies and improved strategies will continue to make zero energy easier to attain.

Grid Modernization - Potential Impacts on Code and Renewable Energy

The electric grid in the U.S. is changing rapidly. "Grid modernization" or "smart grid" activities are underway throughout the region. Key aspects in grid modernization include a focus on implementing two-way communication capabilities and fostering connections between the grid, customers, and distributed energy resources (DERs).

DERs are smaller scale, typically renewable generation plants that can be located on buildings or in communities, rather than traditional energy resources located hundreds of miles away. DERs can include electricity storage, which enables the grid to accommodate renewable resources where generation is intermittent, dependent on sunshine or wind, and is less predictable and controllable. Because of communication capabilities, loads in buildings can be modified a little (such as dimming lights 15 percent or modifying temperatures by two degrees) or a lot (moving water heating and electric vehicle (EV) charging to off peak times) to enable the grid to operate more efficiently and to offset peak demand. This new, modern grid is flexible, resilient, and can more readily accommodate and utilize features of buildings as part of the grid, to either generate power, store power or modify short-term loads.

The graphic below depicts the grid before modernization – a one-way power flow and communication network – compared with the grid after modernization – a two-way power flow and communication network. The grid after modernization is enabled by distributed generation and smart technologies.



Source: American Jobs Project

In the modernized grid, buildings become part of the grid infrastructure with an inclusion of innovative technologies, such as smart thermostats, load control devices, and advanced metering infrastructure. With these technologies, buildings can send power back to the grid from on-site generation, respond to utility signals to reduce loads during peak demand, or automatically read energy use and price signals to reduce demand charges by managing building energy loads and energy costs when energy is more expensive. This represents a huge change and challenge to the electric grid and utility regulators. The evolution to a modernized electric grid has begun, but there are still critical decisions to be made, and it may take multiple years to make and implement them throughout the region. Nonetheless, going forward, buildings will no longer be passive users of electricity, and buildings control and systems will be significantly modified to integrate energy efficiency and demand response.

ZEBs fit nicely into the modern grid, whether the renewables are at the building site or elsewhere in a local community. On-site or community solar/storage resources can help meet local distribution requirements, which can defer upgrades and reduce overall electric system costs. If the building or the community solar system has storage, it can be configured to "island" from the grid to keep the local power on during power outages, providing additional resiliency and customer service.

Future Thought

ZEBs can also be used as a non-wires alternative solution to defer investments in transmission and distribution infrastructure. A big part of grid mod is deferring the need for T&D investment by using EE and distributed energy resources (DER), such as storage and renewable energy mentioned here. By growing the number of ZEBs in a geographic area, the community is able to defer the need for T&D investments to meet peak load because they generate their own energy needs. This defers any additional cost from being transferred to utility customers.

One other major challenge to the grid is the anticipated rapid expansion of electric vehicles (EVs) as battery prices, and therefore EV prices, drop. All states in the region have programs and support the expansion of the EV market. EVs are expected to be price competitive with conventional vehicles by 2025[11]. As the EV market grows – and very substantial growth is expected over the next 10 to 20 years – building codes need to accommodate both EV charging infrastructure and sufficient building controls to interact with the grid. EVs are most frequently charged at home, and EV related infrastructure can easily be accommodated in most single family housing, but including appropriate infrastructure in multifamily housing may be more challenging. Additional EV charging points will be needed at work places, schools, and retailers, and code requirements may provide an opportunity to accommodate increased EV market growth by helping meet the need for charging stations on site at buildings.

Objective 1: Advance Code Development to Zero Energy

Strategies to advance code development to zero energy are presented as a way to transform the market over a period of years through supporting market activity and capacity building as well as advances in code. Code advances are linked to proven market leadership in high performance buildings, and state code progress will likely be preceded by advanced efficiency and ZEBs constructed by leading elements of the development community. These market activities can be supported and advanced through stretch codes that apply to public buildings and/or are used in local jurisdictions in coordination with aggressive carbon reduction goals as a critical strategy to advance market practice. Topics covered to advance code development to zero energy include these recommendations:

Recommendations:

1. Establish a Statewide Zero Energy Buildings Code Plan
2. Support the market in achieving advanced energy performance;
3. Implement stretch building energy codes;

[11] Bloomberg New Energy Finance, 2017

4. Update the state building energy code without weakening amendments;
5. Drive efficiency in the national code development process.

Recommendation #1: Establish a Statewide Zero Energy Buildings Code Plan

In recent years, a number of dedicated and resourceful practitioners have shown that constructing energy efficient buildings that use no more energy than they are able to produce renewably is possible, practical, and a tangible example of a clean energy future. However, since national policy and the most recent versions of the national model energy codes are unlikely to provide a ready-made path to zero energy codes to achieve carbon goals, states must take action in order to ensure continued reasonable increases in the efficiency of their energy codes.

States should develop a ZEB plan that sets targets (2030-2040) for each of the state's projected energy code update cycles to assure a zero energy code is achieved. This plan includes two key strategies described below.

- *Establish a statewide zero energy buildings goal.*
- *Create a pathway for new and existing buildings that facilitates and requires ZEBs.*

Establish a Statewide Zero Energy Buildings Goal

A number of states and communities in the region have adopted aggressive carbon reduction goals. The broad strategies of how to achieve 80 percent carbon reduction are:

1. Improve the efficiency of energy use dramatically;
2. Decarbonize the electric grid through the use of renewable power for generation;
3. Move as many end uses as possible to electricity. Use lower carbon fuels for remaining needs.

Progress has been uneven and challenging in starting on these three broad strategies. There has been solid initial movement and pathways forward for the first two of the three strategies in recent years. ZEBs are a combination of technologies and design integration that can achieve the high levels of desired efficiency, produce or otherwise acquire sufficient renewables to power the building, and can be and frequently are free of carbon fuels (making them zero carbon or zero emissions for operating energy, not just zero energy). Given the depth of savings and extent of decarbonization needed to reach carbon goals, ZEBs are a very attractive policy option to include to meet larger goals.

As part of state (and local) government commitment to long-term carbon reduction targets, a specific plan should be developed for buildings. A statewide goal statement should set a target year and a broad statement of the overall goal. An example of this reads "Beginning in 2035; all new residential and commercial buildings shall be designed and constructed to achieve zero energy performance, through either on-site or off-site renewable energy use." The goal statement could include a reference to major renovations as well and potentially could include a reference to grid optimization - tying in the new role of buildings as part of the grid infrastructure. Specific reference to appropriate climate legislation and related actions should be included.

The zero energy plan should be a comprehensive collection of strategies that promote zero energy buildings, of which energy codes are just one element. These additional elements that promote ZEBs could include:

- Administrative directives that cover state buildings to support leading by example;
- Marketing and awareness strategies, such as demonstration projects, case studies, or Governor's Awards for Excellence in Buildings;
- Capacity building efforts such as training;
- Support for sustainable building programs such as NE-CHPS, Passive House, and DOE Zero Energy Ready Homes;
- Updates to state appliance standards[12] to cover plug loads that are more occupant driven rather than building driven;
- Benchmarking and/or use of Home Energy Rating Systems to indicate performance to the broader market;
- Operation of utility rate-payer funded programs, training, marketing, and support programs for new construction and major renovations;
- Data collection, analysis, and reports that indicate the costs and benefits of the strategies;
- Development of stretch codes and other support for local jurisdictions;
- A plan to increase code stringency over time.

Codes are typically the final step in the overall strategy; they are a way to change market practices and lock in savings that cover the entire market. The overall strategy will take multiple years and several iterations of code upgrades to achieve the final goal. Each code requiring a decrease in energy use would be proceeded by activities that educate and support market changes.

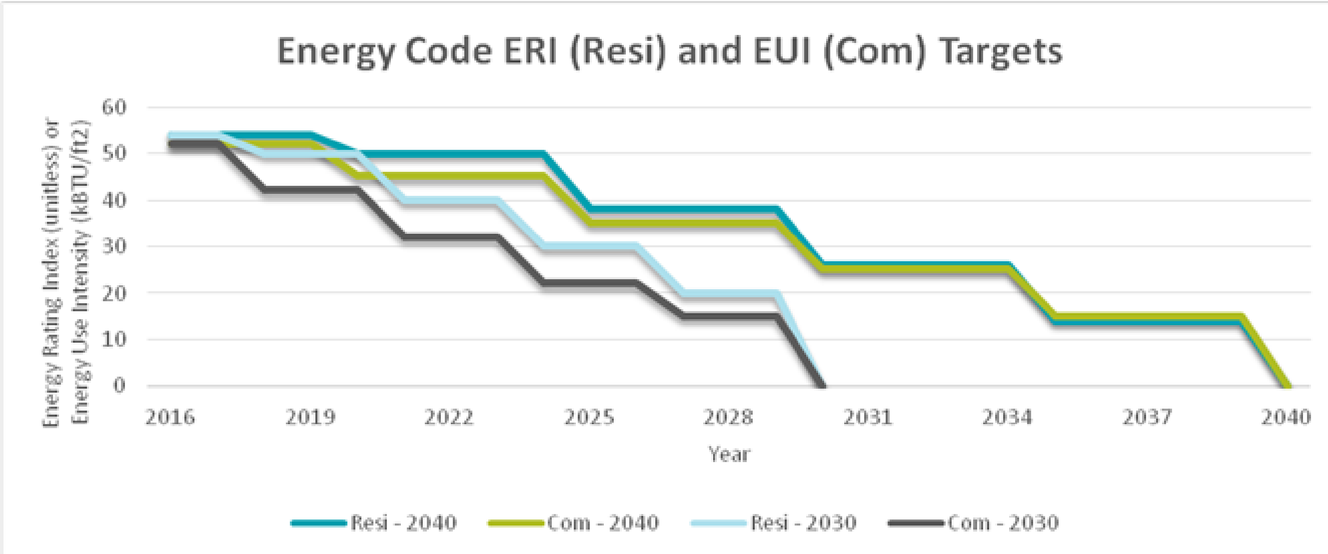
Create a Pathway for New and Existing Buildings that Facilitates and Requires ZEBs

Market transformation toward zero energy buildings will require a deliberate approach to energy code development and adoption. Specifically, each state should develop a plan that charts its intended trajectory to zero energy codes for both new construction and existing buildings in alignment with climate goals and energy policy mandates. This plan should then be refined with each code update cycle.

Figure 3 below provides an example of how a 2030/2040 zero energy goal for all buildings could be achieved through steady improvements to the energy code. These code “plateau” targets are approximate and should be set by each state to achieve this goal while meeting the needs of the local building community. Residential code targets are represented using the Energy Rating Index (ERI) popularized by the 2015 IECC, while the commercial code targets are tracked using Energy Use Intensity (EUI).

[12] http://neep.org/sites/default/files/resources/SmartEnergyHomeStrategiesReport_3.pdf

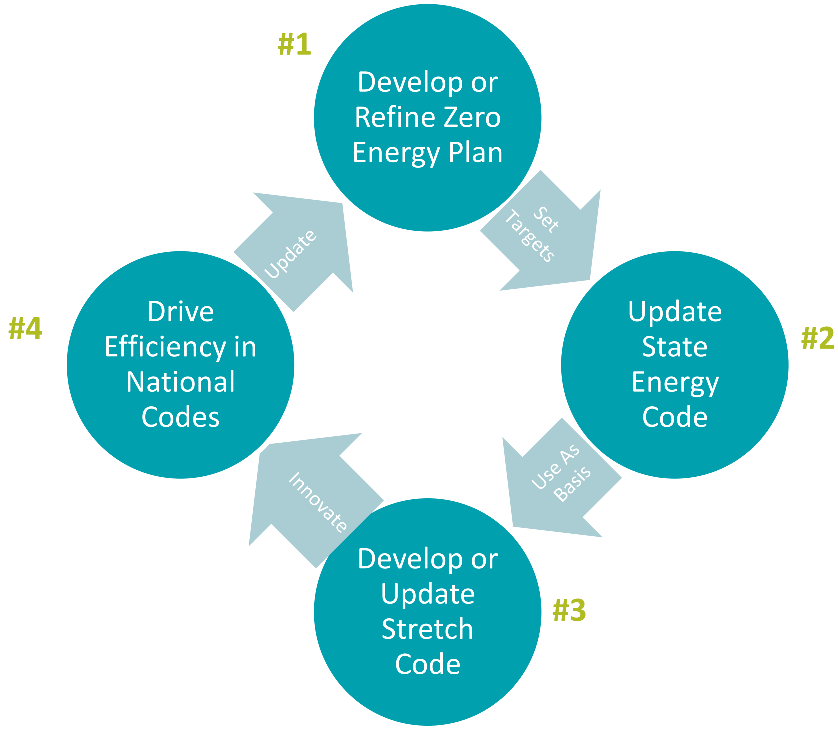
Figure 3: Paths for Achieving Zero Energy Codes by 2030 and 2040.



Energy Rating Index (ERI) is a measurement of energy performance for residential buildings. *Energy Use Intensity* (EUI) measures the energy performance of commercial buildings. The lower the ERI, the more efficient the building; the lower the EUI, the more efficient the building is on a square foot basis.

By setting a target date for the adoption of a zero energy building code, states can begin to work backward to determine how to best utilize a stretch energy code as a conduit between the currently adopted energy code and zero energy. However, these efforts should not be undertaken in a vacuum. Rather, states should regularly convene a diverse standing group of industry stakeholders in order to help ensure stakeholder buy-in with this zero energy code plan. Efforts should include evaluating the performance of the code roll out and building energy performance. Figure 7 below depicts this cycle of updates to codes, followed by updates to stretch codes and other support activities and a review of performance. These all feed into updates of the larger ZEB plan.

Figure 7: Code Development and Adoption Recommendations and Relationships



Any plan to transform the building design and construction market must be grounded in realistic expectations. While from a policy perspective it may be tempting to recommend instant, drastic increases in energy code efficiency, it is important to set energy codes at reasonable levels and make incremental changes to ensure that the very large and diverse building industry, including manufacturers, designers, contractors, building trades, and building officials, have the skills and resources needed to fully comply with and enforce the code.

Many key players in the construction industry, especially the residential construction industry, are opposed to increasing energy codes for multiple reasons, but the primary reason cited usually increases in costs, which must be passed on to buyers. Additional reasons may be complexities in complying, the need to change existing practices, and general opposition to regulations. While passing codes is sometimes straight politics, having an excellent understanding of the changes required in building design and construction, showing leadership within the industry by already building to the higher levels, providing program and marketing support, and attaining field-based cost data can be important to soften industry resistance. Energy codes may also need to shift away from prescriptive elements and toward performance-based compliance paths to provide more flexibility in meeting energy targets.

In setting these targets, it is crucial for states to project (to the extent possible) what types of new measures would be needed in order to achieve the desired levels of energy code efficiency. Anticipating potential stumbling blocks years in advance provides states with the opportunity to address stakeholder concerns in a comprehensive and collaborative fashion, as opposed to receiving new opposition to energy code updates at the public hearing stage of the energy code adoption process.

On the pathway to ZEBs, energy codes will need to incorporate the following changes:

- Progressively lower energy use over the next 20 years so that codes are eventually strict enough to facilitate ZEBs;
- Focus on performance goals rather than prescriptive requirements to allow for innovative approaches to lowering energy use;
- Include initial commissioning to ensure that buildings are performing as expected;
- Consider all energy use in the building, including plug loads, through enhanced controls and feedback to occupants;
- Demonstrate the provision of a renewable resource system matching the building energy loads that is dedicated to the building. Options include an on-site system, the procurement or dedication of a share of a community-scale renewable resource, or a long-term (20 year) renewable power supply agreement from a power provider.
- Consider requirements for regular commissioning or reports on building performance to help ensure performance over time.

Zero Energy Plans Take Shape

The District of Columbia, which is targeting implementation of a zero energy building energy code around 2030, is planning backward from 2030 in order to design staged triennial code updates that can most reasonably achieve its goal. Making this transparent will help local building industry stakeholders contextualize and prepare for the code update cycle.

https://www.aicpa.org

Rhode Island was directed by a **2015 Executive Order** to establish a stretch code usable by both public and private nonresidential buildings by 2017. The state's Zero Energy Task Force is a direct participant in the process to ensure this new stretch code can help serve as part of the bridge between the current energy code and a future zero energy code for new buildings.

http://www.retirementegg.com

Recommendation #2: Support the Market in Achieving Advanced Energy Performance

A key aspect of advancing energy codes more rapidly is to identify ways to move the leading parts of the market to a higher performance level. Changing standard practice to a higher level for some projects makes it easier to accept changes for all projects, and the experience gained can reduce the political friction around regulatory changes. Three strategies are discussed below:

- *Lead by example: construct all new public buildings and retrofit existing buildings to be ZE;*
- *Support resilient high performance building efforts;*
- *Support utility new construction program administrators.*

Lead by Example – Construct All New Public Buildings and Retrofit Existing Buildings to be ZE

It is critical to recognize the leadership potential of the public sector and its ability to facilitate building private sector experience and capacity. The road to a full-scale deployment of zero energy buildings starts with the facilities our states and communities construct with public funds.

In 2016, NEEP compiled our Roadmap to Zero Energy Public Buildings Progress Report, an update to our original 2012 Roadmap, that identifies five policy objectives for states and municipalities to make zero energy public buildings a reality across the region within the next 15 years. These critical steps are:

- **Develop a Path to Highest Performance of Exemplary Public Buildings** - A comprehensive public campaign is needed to convey a consistent message to the broadest public audience.
- **Promote the Continued Development of Exemplary Public Buildings** - States should continue to construct zero energy buildings each year.
- **Prioritize Measurement and Reporting of Public Building Energy Performance** - Establish a system for measuring and reporting building energy performance.
- **Implement Stretch Building Energy Codes** - States should establish a performance-based stretch energy code for public buildings, complete with a comprehensive program of technical and informative education that expresses the strong value placed upon all construction becoming more energy efficient and economically sustainable.
- **Create a Mechanism to Provide Capital for Energy Investments** - Lack of capital funding is probably the single most important financial barrier to greater investment in efficiency and renewable energy programs, and the knowledge and education to achieve them. In large-scale surveys, facility managers have consistently listed a lack of initial funding as the most significant barrier to energy efficiency, ranked higher than a poor return on investment, lack of technical expertise, or insufficient information. For public buildings, this lack of funding is caused in part by the split between capital and operating budgets; building construction is typically paid for out of the capital budget, whereas operations and maintenance expenses, including energy bills, come from the operating budget.

Municipal policy example: NYC Local Law 31

NYC Local Law 31, enacted in 2016, requires city-owned buildings to be designed and constructed as low energy intensity buildings. The bill requires the mayor to produce an annual report with information about capital projects subject to this bill's design and construction requirements. The mayor is also required to produce a triennial report

In our region, most states have enacted at least one of these recommendations, with several states enacting multiple recommendations.

http://www.themethighschool.org

There are multiple levels of government buildings that can contribute to achieving this strategy. Both state and local governments can and have been leading on ZEBs. Examples of familiar ZEBs include libraries, public safety buildings, transportation centers, service centers, and offices of various sizes.

Educational institutions are a major source of public interaction and an excellent choice for showcasing ZEBs. K-12 schools and higher education systems can commit either to individual building performance or campus wide goals. NEEP has authored technical guidance for K-12 schools with the Northeast CHPS (Collaborative for High Performance Schools) that multiple states and local districts have adopted. Where state funding is available for schools, state funding mechanisms can be modified to support and reward higher energy performance levels.

Support Resilient High Performance Building Efforts

A number of leading voluntary programs to encourage green or sustainable building have developed over the last two decades. Some have had a very significant impact on the market while others are newer or more targeted in their appeal, such as the schools-specific approach of the Collaborative for High Performance Schools. The programs have several benefits:

- Some level of energy efficiency above base energy code levels, and some support for additional efficiency such as appliance selection;
- Other features that the market values, such as measures to reduce indoor air pollution, use of green materials, water efficiency, support for renewable energy, and potentially some broader measures that address transportation energy, for example;

Northeast Collaborative for High Performance Schools (NE-CHPS)

NE-CHPS has been designed to provide guidance and verification for new school projects, renovations, and new schools on existing campuses to achieve high performance goals.

NE-CHPS Exemplars:

Howe-Manning Elementary School

Paul W. Crowley Metropolitan Regional Career and Technical Center

- Brand or label to support marketing and recognition, and;
- Training and some level of technical assistance and/or peer support.

Providing some sort of public support for these efforts can help broaden the market awareness of this work and increase the number of builders or developers that adopt these programs for at least part of their building production. While the U.S. Green Building Council's LEED is widespread, other programs may be stronger in some states than others, and it is useful to know about the technical specifications for the programs as well as the key organizers and proponents in each state or city. One way to improve familiarity is to attend training sessions or meetings, which can help determine whether it is appropriate and useful to form a cooperative relationship.

The extent of the relationship or support provided by these programs can vary, but there are several no-cost/low-cost ideas that might be useful to help increase knowledge of and participation in the programs. These include:

- Co-marketed training sessions;
- Use of a public space for program meetings and trainings;
- Invitations for program representatives to present at events and presentations.

A variety of other linkages and support can be provided through these voluntary efforts, depending on local circumstances and flexibility.

One area of voluntary programs that can get tricky is when public entities adopt some aspect of a program as if it were code. Voluntary programs typically have not been vetted the way that codes have, and interpretation, enforcement, and flexibility can be significant concerns. Recognizing this complexity, USGBC has worked with ASHRAE and ICC to develop "green codes" that have many of the benefits of the voluntary programs but have been designed to function better as code language. These green codes are a good option for stretch codes and are discussed in the stretch code section below.

Support Attribution Initiatives for Utility New Construction Program Administrators

New construction programs used to be a major utility (or program administrator) effort, providing significant incentives as well as technical and marketing support for better efficiency. Stronger statewide codes have reduced the opportunity for program administrators to aggressively pursue new construction efforts, as the cost-effectiveness testing required of these programs has reduced the eligible measures that can be included. However, there continue to be options for working with these programs.

Cost-effectiveness testing for ratepayer-funded programs is narrowly defined in most states and frequently is not aligned with the state's broader environmental goals. Decreasing greenhouse gas emissions and improving air quality are two very important policy goals of energy efficiency. State and local governments are extremely concerned about the damaging impacts of climate change and include related policies in many aspects of government operations. Generally, cost-effectiveness testing for ratepayer-funded efforts in many states simply has not kept pace with these efforts.

The economic impacts on the state and communities, and the health impacts on citizens and ratepayers could also be important considerations in how to measure the benefits of ratepayer funded programs but typically are not included. Additional studies on health and community economic impacts for the explicit purpose of valuing these impacts as part of cost-effectiveness screening could be conducted.

More states have begun to consider greenhouse gas emissions and other air pollution reductions, and have assigned at least some value for the purpose of cost-effectiveness testing to efficiency. Just this one change can make a significant difference in the cost-effectiveness calculation and allow for more robust new construction and major renovation efforts for program administrators.

In order to support these efforts, utilities need regulatory approval that allows these types of efforts to be undertaken with ratepayer funds. New construction programs, where utilities pay incentives for measures, must estimate the kWh savings directly associated with the measures. Training programs and pilots, non-resource programs that are considered useful and necessary, do not need to directly provide kWh savings. Funding for these activities is typically limited but is more flexible. Support from regulators or regulatory staff can encourage utilities to undertake such efforts in support of a long-term plan to improve building energy efficiency.

A final area for consideration is the location value of efficiency/DER. Some utility feeder lines or substations may be near capacity, and major new developments could force upgrades. A combination of deep efficiency, ability to manage loads, and distributed renewables may delay or defer upgrades, which means that the utility could and should allocate additional resources to reduce expensive impacts to the grid. Even if these deeper programs are not system wide, the educational value and precedents can be very useful in consideration of future code upgrades. A stretch code could potentially be used in these situations.

Recommendation #3: Implement Stretch Building Energy Codes

A stretch code goes beyond the energy efficiency requirements of the current national model code and/or the adopted state building energy code. These advanced building energy codes are becoming more popular throughout the nation both as informative guides and as sound policy changes to promote state and community commitments to reduced energy use. After Massachusetts developed the region's first stretch code in 2009, several other jurisdictions including New York, Rhode Island, Vermont, and the District of Columbia adopted or have begun developing stretch codes over the past three years.

A Statewide Stretch Code:

- Provides one state-sanctioned building standard for local jurisdictions wishing to adopt a code beyond the baseline state energy code.
- Informs architects, engineers, and other building and design professionals looking to build energy efficient buildings with an appropriate reference.
- Synchronizes criteria for ratepayer-funded energy efficiency, new construction, and renovations programs.
- Establishes criteria for state policies to incentivize high performance buildings, such as tax credits or utility demand-side management incentives.
- Points the way for changes to future national model codes and to zero energy building policies.

As more states in the region consider adopting a stretch code, it will be useful to maintain consistency when defining stretch code criteria and efficiency levels. This coordination will provide a consistent message to the market of manufacturers, designers, and builders that serve in multiple states. Key strategies to move stretch codes forward are:

- An executive order or legislation creating the stretch code for state operated buildings, public commercial buildings over certain square footage, voluntary or required for various type of public and private buildings.
- Offer state, utility, or private incentives or investment for utilization of stretch code.

  - *Include a stretch code informative appendix to the state building energy code;*
  - *Use the stretch code as a mechanism for introducing requirements for existing buildings;*
  - *Integrate the stretch code with other state energy efficiency programs.*

Include a Stretch Code Informative Appendix to the State Building Energy Code

To provide consistent guidance, states or the authority having jurisdiction (AHJ) should adopt an "informative appendix," or a section within the state building energy code that contains a listing of acceptable energy efficiency criteria and building guidelines that meet advanced energy performance requirements of a stretch code. Such adoption assures that a single, consistent, interpretable set of statewide standards is in place to inform and direct energy conservation in projects.

A key benefit of including an informative appendix is that it provides a single reference that effectively limits the number (and inevitable confusion) of stretch codes or standards being adopted and used within a state. It also provides a consistent set of requirements that can be interpreted and adapted for curricula development for public and construction industry education. This can be especially beneficial to local governments wishing to adopt building energy codes that are more stringent than the national model code and the state base code. In some states, legislation may be needed to allow local governments to adopt energy code requirements above the state minimum code requirements.

Figure 9 below references some of the most commonly considered codes for consideration as an Informative Appendix.

Advanced Building Guidelines Recommended for Potential Informative Appendix Inclusion:	
For Commercial Buildings	**For Residential Buildings (one and two family dwellings and low-rise multi-family)**
• New Buildings Institute *Advanced Buildings New Construction Guide*, a prescriptive guide for new buildings. • 2015 International Green Construction Code (IgCC)/ ASHRAE 189 • NEEP Model Commercial Stretch Code • **NBI** Multifamily Efficiency Solutions Standard **(Technical Package)***	• California 2016 Building Energy Efficiency Standards, the state's final step before developing a zero energy code. Jurisdictions should bear in mind that these standards are specific to California's climate and are typically met, even on the residential side, by modeling performance. • ENERGY STAR Certified Homes Version 3.1, which was designed to be about 15 percent more efficient than the 2012 IECC. • NEEP Model Residential Stretch Code

*Low or high rise residential multifamily

Energy Impact of the International Green Construction Code (IgCC)

The IgCC, released in 2012 and updated in 2015, is a green overlay code applicable to nonresidential buildings for the ICC's suite of I-Codes while focusing on a wide range of sustainability issues that lessen the impact of buildings on the environment. Within the IgCC energy chapter, performance-based, outcome-based, and energy use intensity-based compliance paths are available. The 2018 IgCC/ASHRAE 189.1 will be published early 2018 and will offer adopters flexible opportunities to increase energy efficiency and green high performance building features. Rhode Island and New York stretch codes basis is the IgCC. Additionally, Baltimore, Montgomery County, Maryland, Keene, New Hampshire, and the District of Columbia all use the IgCC for going beyond base codes.

For example, Massachusetts first established a performance-based stretch code in 2010 for local adoption as an appendix to the state building code that individual local governments can elect to adopt. Once adopted by a local government, it becomes mandatory for all buildings in the jurisdiction. The state's stretch code requires buildings to meet a performance target of approximately 20 percent lower energy consumption than the base code. Communities that adopt the stretch code are eligible to apply for status as a designated "Green Community" and are eligible to receive state funds through the state's Green Communities grant program.[13] To date, 176 out of 351 communities in Massachusetts (which constitutes about 60 percent of its population) have voluntarily adopted the state's stretch code.[14] This list of **2017 Competitive Grant Awards** includes the municipality, grant award, region, and description of projects funded.

CASE STUDY: A Wave of New and Improved Stretch Codes

After Massachusetts developed the region's first stretch code in 2010, there was a five-year lull in stretch code activity*. Now Vermont, New York, and Rhode Island have or are expected to implement stretch codes.

Vermont's 2016 stretch code is mandatory for projects subject to the state's Land Use and Development Act, which constitutes about one third of residential building activity, but is also available for use by any individual as a voluntary, beyond-code standard.

New York's NY Stretch program, available early 2018, aims to achieve 10-15 percent savings beyond the 2015 IECC for both residential and commercial new construction. It also features provisions for existing buildings. Development of the next version of NY stretch code based on the 2018 IECC is in development.

Rhode Island's updated commercial stretch code and new residential stretch code will be published early 2018. Rhode Island was first in the region to utilize the IgCC as the basis of its stretch code. The residential stretch code is based on the Department of Energy's Zero energy Ready Homes Program.

In 2016 **Massachusetts** updated its base code to the 2015 IECC, and also updated the state stretch code. The new stretch code is more efficient than the base code, however with a significantly reduced scope then prior stretch codes additionally the new stretch code no longer addresses existing buildings.

*The District of Columbia adopted a Green Building Code based on the IgCC in 2013, but this is a mandatory extension of its building codes.

NEEP recommends that an Informative Appendix stretch code include the following features:

- A building meeting this code or standard typically exceeds the energy efficiency of the current state building energy code by a given policy-directed minimum, e.g., 10-20 percent more efficient;
- Support for education for builders and designers to help ensure compliance and reduce enforcement issues. New tools and associated training may be needed to hit percent above requirements for designers and contractors of residential and smaller commercial buildings that historically have used prescriptive pathways;
- The code or standard must be written in code-enforceable language, and not, for example, as a building energy rating model or guideline, i.e., USGBC's LEED*, Green Globes, etc.;
- Building officials must be able to verify that the buildings meet the new code. This may include programs to train building inspectors on how to inspect for compliance. The specific code or standard should

[13] http://www.mass.gov/eea/energy-utilities-clean-tech/green-communities/gc-grant-program/

[14] http://www.mass.gov/eea/docs/doer/green-communities/grant-program/stretch-code-towns-adoption-by-community-map-and-list.pdf

include mechanisms for its enforcement, such as being tied to the Home Energy Rating System (HERS), to provide documentation to the building official;

- The authority having jurisdiction must specify within its adopted code that a building complying with a code listed in the Informative Appendix would be deemed to comply with the state energy code;
- State policymakers must also clarify that the adoption of a stretch energy code would not disqualify building owners in that jurisdiction from being eligible for the incentives or other benefits offered through that state's ratepayer-funded energy efficiency programs.
- A compliance pathway utilizing outcome-based requirements could be developed and included in stretch code documents. Model language for the outcome-based compliance is available from IgCC and other documents.
- Explanation and information related to compliance as assessed by a third-party verifier.

Use the Stretch Code as a mechanism for introducing requirements for existing buildings

The national model codes do not offer many opportunities for energy savings in existing buildings beyond the general requirement to bring the portions of the building affected by the alteration/renovation up to code. Changing the scope of the national model codes to allow for more impactful requirements for existing buildings would require considerable changes to the present building code administration and enforcement. Stretch codes provide an opportunity to address this critically important area – the vast majority of available energy savings – and can be implemented in a variety of ways to meet this end. First, stretch codes can require annual energy use disclosure (for commercial buildings) or asset rating (residential or commercial) at time of property sale listing. An example is New York City Local Law 84[15]. Second, mandatory energy audits or retro-commissioning can be imposed on buildings of a certain size or type, similar to New York City's Local Law 87[16].

Integrate the Stretch Code with other state energy efficiency programs

There are two ways that the Stretch Code Informative Appendix can interact with energy efficiency programs. First, an informative appendix should be consistent with (at minimum) and be synchronized (ideally) to the technical specifications included in rate-payer or state-funded new construction programs. Second, a municipality can use the informative appendix as the basis for its local stretch code. State policy (and the buildings plan) should ensure that utility or state financial incentives are still available to buildings meeting the informative appendix even though for that community the informative appendix is the code. Stretch codes provide a pathway forward to full state adoption, and the availability of incentives is critical to allow the market to adjust and the code to be properly enforced in early adoption jurisdictions.

Stretch codes can strategically influence other building industry market actors involved in state energy efficiency programs. Stretch codes can be a powerful motivator for manufacturers and distributors looking to compete for a future market share of products that will be required under the latest stretch code. This results in lower prices for builders and savings that are passed on to developers, as well as consumers who ultimately become those home and building owners. Besides providing consistency to previously uncoordinated state energy efficiency efforts, stretch codes ensure higher compliance rates as the latest model energy codes are adopted since a larger share of market actors will already be familiar and have experience with the new requirements.[17]

[15] NYC Benchmarking

[16] NYC Energy Audits and Retro-commissioning

[17] http://www.newbuildings.org/stretch-codes

Adopting a Stretch Code

Regional Energy Efficiency Organizations (REEOs) can assist municipalities in drafting language for ordinances or similar regulatory instruments to adopt a local stretch code. Here is a simple example of suggested language:

Suggested Statutory Language for the Adoption of a Stretch Code by t*he Authority Having Jurisdiction:*
(Name of authority having jurisdiction) shall, within one year from enactment of this section, develop specific options defining how any proposed residential or commercial building can exceed the requirements of the adopted building energy code by a minimum of XX (e.g., 10-20 percent). These options shall be set forth in such code as an informative appendix thereto. Any building that complies with an option listed therein shall be deemed as meeting the requirements of the building energy code.

Implementation of a stretch energy code builds market capacities to design and construct buildings with advanced energy efficiency features. Developing such market "know how" supports the eventual adoption of strategies that result in ZEBs. Adoption of a stretch code informative appendix makes a state building energy code dynamic and forward-looking, providing ever increasing energy savings while working in conjunction with the baseline minimum building energy code. As such, stretch codes work hand in hand with a state's pursuit of zero energy buildings.

Recommendation #4: Update the State Building Energy Code Every Three to Five Years

Key strategies for ensuring continually updating the code include:

- *Adopt the latest, most efficient national model energy code every three to five years;*
- *Maintain a technical advisory committee to inform updates to the state building energy code;*
- *Restrict state amendments that decrease the stringency and energy savings of the national model energy code.*

Adopt the latest, most efficient national model energy code every three to five years

For the health, safety, and welfare of their citizens, states should commit to using the most up-to-date building codes possible. The surest way to align a state building energy code with the latest developments in building technologies and practices is to update the state building and energy codes every three years, corresponding with the International Code Council's (ICC) update cycle. This trigger is also consistent with regular adoptions of the ASHRAE standard. Regularly updating the state building energy codes to reflect the most recent editions of national model building energy codes – specifically, the International Energy Conservation Code (IECC), and

ASHRAE 90.1 where utilized as the energy code for commercial buildings – can lead to large-scale energy and GHG emissions savings across the region[18].

However, the practical cost of adopting new codes, which includes purchasing code books and other enforcement materials, updating of compliance tools and training programs, and the opportunity cost of the investment of person hours in an extensive code review processes, must be weighed against the benefits of its adoption. This is particularly true if the new version of the code projects only modest energy savings, if compliance with the existing code version is low to moderate, or if the amount of construction in the state is relatively low. In any of these cases, limited state resources for building energy efficiency policies may be more wisely applied to improving code compliance with the current code. While it is of the utmost importance to prioritize occupant safety benefits and not persist with a code that is out of date, it may be appropriate to delay updating beyond three years provided there is a firm intention to swiftly adopt the next iteration of the code when it becomes available.

In recognition of these and other practical differences among states in the region, we propose two options:

1. States pursuing the Expedited Zero Energy Goal (2030) should update their energy codes every three years in alignment with the existing national code update cycle.
2. States pursuing the Region-Wide Goal (2040) should update their energy codes every five years.

CASE STUDY: Threading the Needle: What's the Right Way to Adopt Codes?

Pushback to Maryland's Automatic Adoption Provision

In our region, states like Maryland, Massachusetts, and Rhode Island are required to update their energy codes every three years after new versions of the model energy codes are completed – typically one year after the publication of the latest version of the code. While some of these states have had mixed success in keeping with these schedules, Maryland has been uniquely expedient in adopting the code. This is due to the fact that in Maryland, the energy code is adopted at the state level without any amendments impacting the provisions of the energy code. Enforcement of the code occurs at the local level, where different counties vary in the degree to which they enforce the code, at least in the opinion of some local stakeholders.

In January 2015, Maryland became the first state to adopt and enforce the 2015 IECC. However, new legislation in 2016 succeeded in extending the period between the release of a new version of the IECC and the mandatory statewide implementation of this new code by one year, which would provide Maryland with the opportunity to organize an Energy Technical Advisory Committee (see below) or code coalition (see recommendation #5 of this report) to assist in the adoption of a code that is reasonable for stakeholders across the state.

[18] https://www.energycodes.gov/sites/default/files/documents/Impacts_Of_Model_Energy_Codes.pdf

Unrest with Pennsylvania's Code Adoption Paralysis

Despite near-annual attempts to update its energy code, Pennsylvania has not changed it (based on the 2009 IECC) since 2010. Much of this can be attributed to the fact that in 2011, the review and advisory council (RAC), which provides recommendations on building code updates and amendments in the Commonwealth, saw its procedures amended. The RAC now requires a much more onerous supermajority "opt-in" approach to individual code changes instead of the original "opt out" approach. This revision has resulted in essentially no code changes since 2009, despite clear preference of a simple majority of RAC members. Furthermore, efforts at proposed legislation to "fix the RAC" and start a new code update cycle seem designed to create as many problems as they might fix, leaving Pennsylvania's energy code to languish in comparison with its neighbors. Removing the ill-advised legislative hurdles adopted in 2011 would allow Pennsylvania to simplify and streamline its code adoption process, benefitting municipalities, like Philadelphia, which has investigated possible routes to update their own code in light of this inaction at the state level.

Maintain a Technical Advisory Committee to inform updates to the state building energy code

To provide for a well-informed building code adoption processes, state and local code offices should maintain advisory committees or technical advisory committees (TACs) for code updates and adoptions. Technical committees are typically made up of key stakeholders, design professionals, builders and contractors, code enforcement personal, and state or local officials, which provide guidance on technical questions related to the adoption of the code. Such guidance can include pointing out possible sources of conflict with other codes or technical standards (e.g., appliance standards) as well as address the technical feasibility or cost-effectiveness of individual requirements.

The process of updating a state-specific building energy code requires a significant amount of time and effort involving research and analysis, as well as coordination with other elements of state building codes, such as the mechanical and electrical codes. Sometimes this results in an extended process that leaves the energy code out of date, and/or unnecessarily complex and inconsistent with codes from nearby states (particularly important in areas where building professionals work in multiple states, a common occurrence throughout the region). In addition, state code offices are often forced to complete the updates with limited resources and staff. A technical advisory committee can help lessen the burden on understaffed code offices and provide an invaluable technical advisory role during the state building energy code update and adoption process.

Restrict state amendments that decrease the stringency and energy savings of the national model energy code

The code development cycle process is very rigorous involving hundreds of code and industry professionals taking upward of a year or more developing the language for the version of a particular code or suite of codes. The process is open to anyone or organization wishing to submit a code change proposal and defend that proposal at national code hearings. At the end of this extensive process only state and local government members of the International Code Council (ICC) vote to approve the final language and provisions of the code. ICC staff assures that the suite of codes; for example the 2018 fuel gas code, swimming pool, and spa, residential code, commercial code, electric code, etc. do not conflict with other or federally mandates provisions such as appliance standards.

Codes are intended to be adopted as written by the ICC. Amendments even minor local amendments in one code might result in significant unintended consequences in one or more of the other adopted codes. Weakening amendments to the energy code could result in a less efficient building. The administrative chapter of the code is one area where it may be more palatable to amend to suit local needs or process. Overall state amendments and statutory language should restrict the adoption of less stringent technical building energy code provisions.

Regional Energy Efficiency Organizations (REEOs) can assist municipalities in drafting language for the continual adoption of codes. Here is a simple example of suggested language.

Suggested statutory language: *The authority having jurisdiction (AHJ) shall be required to consider for adoption, at least every three to five years, the latest edition of the International Energy Conservation Code (IECC), published by the International Code Council (ICC), that has received a positive determination from the U.S Department of Energy, together with any other energy efficiency provisions and other related building codes that the AHJ concludes are warranted. The statute shall provide that no amendments to the energy conservation code or other building codes shall be adopted that will result in a net increase in energy consumption in buildings without sound, technical justification and lifetime cost analysis data.*

In our region, a recent trend has emerged wherein states have introduced weakening amendments in updating their residential energy codes while commercial energy code updates that make larger leaps are uncontroversial in their passage. Such weakening amendments may appease some stakeholders at the time, but making such a concession without implementing a comprehensive strategy for closing the gap precipitating the amendment will likely lead to this provision being an ongoing source of contention in the future.

A better process for updating the state building energy code would require the automatic adoption of the latest edition of the national model codes as an ongoing regulatory requirement (see side box for example language), and to participate in the national code development process to influence the efficiency requirements of the model energy code.

The Negative Consequences of Weakening Amendments

Building codes are developed to be adopted and complied with as published. However, adopting entities may amend codes for various reasons, often to reduce the level of stringency that would otherwise be required. Weakening amendments are typically considered when an interested party makes the case that the amendments will reduce the cost of construction without impacting the health, safety, and welfare of the public.

Some common weakening amendments to the residential energy code include:

- Eliminating diagnostic testing - either the blower door or duct test, sometimes both;
- Allowing more air changes per hour than code;
- Reducing the amount of insulation required in a particular section of the building;
- Not requiring detailed construction drawings;
- Exempting historic buildings.

Amending the code, primarily in the direction of weakening, has various detrimental consequences and unforeseen implications. On a technical level, unless the adopting entity has technical expertise that can make all interrelated code provisions consistent to reflect the amendment, there could be conflicts within the adopted body of codes. For example, the International Energy Conservation Code has references to the International Mechanical Code, so if you make a change in one, it may require a change in the other to be consistent.

Weakening the code makes the code less cost effective to implement, disrupts potential valuation savings, causes confusion in the real estate market and among design professionals, and reduces the code's overall power to act as a driver toward further energy efficiency market transformation.

Recommendation #5: Drive Efficiency in the National Code Development Process — Particularly for Existing Buildings

- *Participate in the national model code update processes to ensure the model codes provide useful starting points for the local code adoption process;*
- *Develop flexible approaches for demonstrating compliance with the code (prescriptive options, outcome based/performance based codes);*
- *Continue to develop code change proposal(s) for the IEBC and IECC focused on increasing the usability of the codes for existing building energy use.*
- *Participate in the national model code update processes to ensure the model codes provide useful starting points for the local code adoption process.*

Once stretch codes are in place, the jurisdictions implementing them should seek to incorporate the most successful elements into national model codes as quickly as possible. Participate in the national model code update processes to ensure the model codes provides useful starting points for the local code adoption process.

States and local governments are encouraged to actively participate in national model energy code update processes to advance energy efficiency in their buildings and to help shape an important part of national energy policy. Every three years, state and local government employees and elected officials have the opportunity to help develop the next generation of building energy codes. Depending on the size of the jurisdiction, between four and 12 voting representatives are eligible to vote as ICC government members on proposed code changes that directly shape the next versions of the national model energy code (IECC). And since 2015, ICC's cdpACCESS® Platform has enabled review of testimony and voting from the comfort of the office or home. Learn how to join as an **International Code Council (ICC) Government Member.** Participation is vital for voting members; municipalities should work with mayors, city council and code offices to coordinate support or opposition to proposed amendments.

Develop flexible approaches for demonstrating compliance with the code; prescriptive options, performance-based or outcome-based codes

Performance-based codes use energy modeling software to demonstrate that a building's predicted energy consumption or cost is equal to or lower than a baseline target that has been specified by prescriptive code requirements. This baseline reference value is generated from prescriptive code components such as building materials and systems, as well as inputs from the proposed building, such as occupancy schedules. Performance-based codes are expressed in terms of "equal to" or "percent better than" energy use in comparison to the baseline prescriptive code. This strategy allows for greater flexibility because the energy modeling is capable of evaluating a variety of design strategies, components, and technologies. Buildings can benefit from modeling efforts by determining how to achieve the greatest energy savings for the least cost.

Performance-based codes can be strengthened further with mandatory minimum requirements that make compliance verification easier. In a paper entitled Re-Inventing Building Energy Codes as Technology and Market Drivers, the authors explain that a small number of mandatory minimum prescriptive requirements for certain components can help address issues that computer models may not fully capture when using a performance code path. If any of these major requirements are left off, inspectors, during a site visit, would be in the position to ensure they are corrected.

Outcome-based codes regulate actual building energy use by considering the whole building's energy use over a consecutive 12-month period after the building is occupied. Outcome-based codes require that buildings not exceed a maximum annual operating energy use.

A National Buildings Institute (NBI) publication entitled The Future of Energy Codes explains that an individual building's actual energy use goes far beyond prescriptive code components. In reality, energy consumption reflects siting, building/system design, construction quality, commissioning, operations and maintenance, interior design, tenant behavior, and plug/process loads. Outcome-based codes measure holistic building energy consumption, accounting for whole building energy uses including plug loads for the lifetime of a building. The measured performance, or outcome, would then be compared to whatever compliance standard that is set by the code, whether the code is prescriptive- or performance-based.

Currently, code compliance is determined at the time buildings are designed and constructed, with no post-construction accountability for actual performance. Outcome-based codes may take on this post-occupancy challenge through means other than code enforcement, such as tax credits and rebate strategies, to verify compliance with actual performance targets.

A problem cited by proponents[19] of outcomes-based codes is that once the relatively easy savings are achieved prescriptively through efficient envelope and equipment measures, the remaining savings can only come through careful systems-level design. These measures that go beyond the current status quo may include

[19] http://aceee.org/files/proceedings/2010/data/papers/2190.pdf

building orientation, daylighting, thermal mass, natural ventilation, and appliance and HVAC integration, all of which may be difficult to specify prescriptively in codes.

This reasoning lies behind the impetus for the Seattle pilot project, which found that prescriptive codes are going to “hit a wall” in terms of the energy savings they can yield. When thinking long-term, it is important to consider the role model energy codes will take to combat climate change and participate in the market push toward zero energy buildings.

Obtaining energy consumption data requires coordination between building departments and utilities and is a frequently voiced difficulty. This challenge has been tackled, however, by progressive cities and states already mandating building energy rating and disclosure. With this infrastructure in place, energy consumption data will be more readily available.

A Closer Look at Performance and Outcome-Based Codes

Oregon’s Whole Building Approach (WBA) was developed to comply with Section 506 of the Oregon Energy Efficiency Specialty Code (OEESC). The WBA is a performance-based compliance path which requires an applicant to demonstrate that the modeled whole building energy consumption cost for the proposed design is no greater than the minimum code-compliant building designed to prescriptive requirements. The WBA is intended to provide flexibility for complying with the OEESC.

Oregon’s WBA is a helpful way to apply the New Buildings Institute’s (NBI) explanation of performance-based codes, which describes the strategy as a modeled compliance path within a prescriptive-based code. Like prescriptive requirements, performance-based codes are proxies for actual building energy outcomes- they do not measure actual performance. They depend on underlying assumptions, which might leave gaps between them and actual performance. Outcome-based codes are intended to address these gaps.

The city of Seattle, Washington utilizes an outcome-based compliance path. An outcome-based energy code for existing and historic buildings will pair accountability for actual performance outcomes with complete flexibility in how owners of these buildings can conduct energy retrofits. Seattle’s Priority Green Permitting Program partnered with NBI and the National Trust for Historic Preservation’s Green Preservation Lab to demonstrate how the flexibility of the outcome-based performance path can improve the energy efficiency of existing buildings by shifting the code’s requirements to overall energy use reduction. Outcome-based compliance will be based on meeting actual post-occupancy energy use targets. Once met, a pre-negotiated compliance bond will be released. However, if energy efficiency targets are not met, penalties based on percentage variations from the established target will be applied.

Outcome-based energy codes can be linked to building energy rating and disclosure (see recommendation #9 of this report). NBI recognizes that better data about actual building performance is needed in order to make outcome-based energy codes possible. Building performance data must be made available to policymakers, code jurisdictions, and the market so that realistic building performance targets can be set. Disclosure ordinances, such as LL84 in New York City and Philadelphia’s Bill Number 120428-A, provide current building energy performance information to interested parties in a leasing or sale transaction. With these policies in place, cities such as New York, Philadelphia, Washington D.C., Burlington, Austin, and Seattle are better prepared to make performance and outcome-based codes a reality.

Continue to develop code change proposal(s) for the IEBC and IECC focused on increasing the usability of the codes for existing building energy use

Existing buildings represent the largest portion of the built environment. In the commercial sector, half the buildings that will be in use by 2050 have already been built,[20] and this figure can be much higher in dense, urban environments. It is vital to address increasing the efficiency of existing building as a parallel track to zero energy policies and codes for new construction. There are several approaches that can be considered:

- A whole building approach to retrofit will provide energy benefits as well as address indoor air quality and resiliency;
- An operations and maintenance plan created through commissioning can yield immediate savings;
- Common retrofit measures such as windows, lighting, and equipment upgrades can achieve an excellent capital return during their lifetime.

Commercial buildings, including multifamily buildings, is a logical place to start as the capital and return on investment is more obtainable then in residential construction. NEEP published a report addressing multifamily building retrofit that contains extensive recommendations for addressing multifamily buildings nationwide.

On the residential side, many utilities offer incentive programs, rebates, and financing for homes. Several national standards exist for residential construction such as Home Performance with Energy Star, DOE's Zero Energy Ready Homes program, and Weatherization Assistance Program (WAP) for low-to-moderate income residences. NEEP recommends creating a plan to address residential construction. Consider policies, codes, incentives, and asset rating initiatives to address this market segment. One potential strategy is to tackle the larger users first, such as homes over 3500 sq. ft., and decrease every five years to address smaller homes. Community-wide residential retrofitting has economic benefits including keeping money local, and social benefits including security and neighborhood revitalization.

Because building energy codes are largely designed for new construction, it can be unclear what requirements apply to construction in existing buildings. The complexity of building energy codes and a rigid regulatory structure has resulted in reduced compliance rates for additions, alterations, and repairs. The building community often finds it difficult to understand how to achieve compliance for a project, thereby discouraging building retrofits and improved building energy performance. Potential solutions must allow for flexibility within the code requirements in order to maximize the savings potential of building energy codes within existing buildings.

While new construction may add one to two percent annually, the country's building stock is comprised of existing real estate, with commercial buildings averaging 41.7 years old and 80 percent of residential buildings being 15 years and older.[21] Within this aging building stock, there is significant potential for energy savings through building retrofits and renovations, as additions and alterations should trigger mandatory energy conservation measures under the model building energy codes and standards. However, these potential savings are largely untapped because of the lack of guidance and awareness surrounding how codes apply to existing buildings.

The 2015 and 2018 IECC, as well as ASHRAE 100-2015, made significant progress in this regard by separating requirements for existing buildings, and efforts are currently being made to introduce language to the code to

[20] Lawrence Berkeley National Laboratory. Report LBNL-291.
[21] http://www.imt.org/codes/existing-buildings

clarify requirements in cases of change of occupancy. However, as codes start to require new construction to approach zero energy capable levels of efficiency, vastly more energy savings will have to come from existing buildings if local, state, and federal greenhouse gas reduction goals are to be achieved.

Objective 2: Improve Code Administration, Compliance and Enforcement

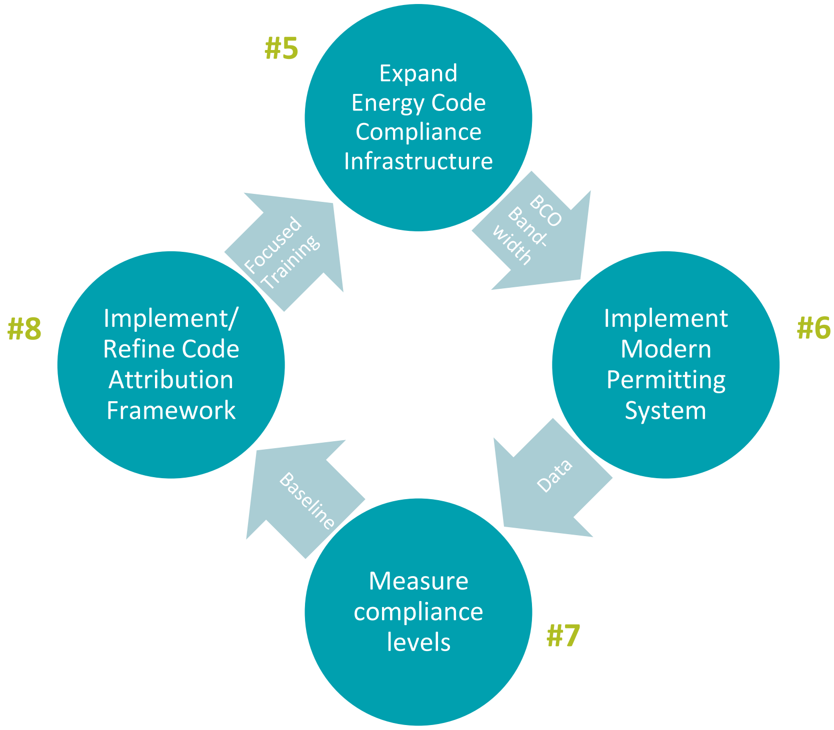
Strategies to improve code administration are equally important as strategies to advance code development. Equipping the market to design and construct new efficient generation of buildings requires significant changes to current standard practice, and codes must be properly enforced to achieve potential benefits. Improved administrative practices include the following recommendations.

Recommendations:

1. Expand energy code compliance capacity;
2. Implement electronic permit processing, plan review, inspection, and fee collection systems;
3. Quantify code compliance;
4. Allow utility program administrators to claim savings for energy code support activities;
5. Implement voluntary or mandatory building energy rating or transparency policies.

While developing and adopting efficient energy codes is important, full compliance is what realizes the energy savings they promise. Many of the barriers to energy code compliance can be traced to a shortage of time, capacity, and resources suffered by the building officials who enforce energy codes. States should implement strategies for relieving this bottleneck, including leveraging third-party inspectors and implementing electronic permitting. An improved code enforcement infrastructure should help to improve energy code compliance and make it easier to measure this progress. Performing energy code compliance assessments in phase with energy code adoption cycles allows states to identify problematic elements of the current code and direct additional resources to alleviate particular compliance gaps. These assessments also provide the first step to enable utility program administrators to claim savings for energy code compliance support activities; this would spur the development of a robust energy code training program like the one currently implemented in Rhode Island that ensures the energy code adoption schedule does not outpace the building industry's ability to comply with each code in the sequence.

Figure 10: Code Compliance and Enforcement Recommendations and Relationships



For most of the region, there is still a fair degree of uncertainty as to how much of the energy savings potential of energy codes is actually being realized. As of June 2017, about half of the states in the region have undertaken a formal energy code compliance assessment or field study of construction practices, and some states have chosen to only evaluate either their residential or commercial buildings.

The compliance question is further complicated by the fact that enforcement mechanisms vary considerably across the region. For instance, states like Maryland and Delaware organize code enforcement at the county level, Pennsylvania leaves enforcement of its residential energy code to each of its over 2,500 municipalities, and Vermont largely relies upon builder self-certification for demonstrating compliance with the energy code. Anecdotal evidence indicates differing levels of compliance across the region, but few assertions can be made without up-to-date compliance data and uniform enforcement. The recommendations in this report aim to foster high, steady levels of energy code compliance across the region and empower building departments to take a more streamlined approach to code enforcement.

Code Compliance and Enforcement Barriers

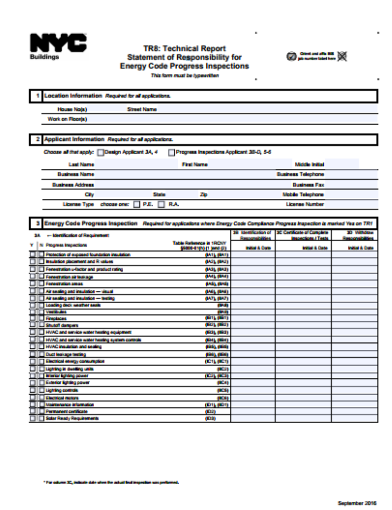
- Project documents submitted for permit often have inadequate (or no) information on compliance with energy code provisions;
- Jurisdictions have limited financial and human resources for enforcing the energy code and thus prioritize other codes they believe are more directly related to health, safety and welfare;
- The increasing complexity of the energy code coupled with the retirement of code officials result in a knowledge gap in some building offices that would prevent them from being able to fully enforce the energy code;
- Resources available to help improve energy code compliance at the individual/project level are underused by industry (e.g. builders/developers, design professionals, subcontractors) either due to ignorance or negligence;
- In some states, no gap in energy code compliance is admitted or perceived, and in others states this gap is deemed an imprudent area for the use of rate-payer funded energy efficiency programs.

Recommandation #1: Expand Energy Code Compliance Infrastructure

- *Utilize third-party energy specialists to increase compliance;*
- *Establish an energy code compliance collaborative;*
- *Develop robust training and certification requirements for code inspectors, plan reviewers and building industry professionals.*

Utilize third-party energy specialists to increase compliance

In the absence of available building inspectors and/or other appropriate checks and balances to ensure energy compliance, or in instances where local inspectors are unable to inspect for the energy code, one of the more effective ways to address compliance is the use of third-party energy specialists. Building departments do not directly hire these individuals but, with the approval of the building department, they are contracted directly by the permit applicant (under the rubric of special inspector). Third-party energy specialists undertake the energy code review and inspection role that may not happen internally due to lack of local government resources. Their work can be accepted as a report of compliance by the local official. New York City, for example, has the TR8: Technical Report State of Responsibility for Energy Code Inspections form that can be utilized for third party energy code verification. Additionally NYC conducts random audit inspections of third-party inspectors to assure quality inspections. NYC, however, does not allow third party plan review.


NYC
Buildings
TR8: Technical Report
Statement of Responsibility for
Energy Code Progress Inspections

1 Location Information

2 Applicant Information

3 Energy Code Progress Inspection

September 2016

TR8: Technical Report State of Responsibility for Energy Code Inspections form.

Third-party specialists that perform plan review and/or inspection of buildings for code compliance function as an additional resource to ensure that the energy code provisions get adequate attention by supplementing the role of the code officials. Regular building code inspectors can then spend more time on compliance with other codes and can rely on energy code reviews and inspections by the third-party specialists performing this task. Secondly, with the establishment of a mandated training and certification program (for municipal building officials, building contractors and trades, and third-party specialists) the group of people specifically trained and knowledgeable in the energy code increases. Finally, third-party specialists contract directly with the permit applicant and do not use municipal permit fees, although this does require the state government to establish a program to license the individuals, who wish to review and report compliance as approved third parties. In NYC a registered architect or professional engineer who draw the project plans must review third party inspections before filing for city approval.

Clear guidance should be established to ensure that municipalities can properly integrate third-party plan review and/or third-party energy specialists into the code enforcement process. Such guidance should include:

- Specifying the procedure within code/law that allows a municipality to establish a program that allows for the use of third-party plan reviewer/specialist to supplement existing staff;
- Separately specifying the qualifications that third parties must satisfy to be licensed to act as an agent in reviewing and recommending approval of construction;
- Specifying the type of documentation required to determine a given project's compliance with the code, where not already in the currently implemented codes;
- Specifying in the codes how a municipality will make its final determination as to the compliance of a building "approved" by a third-party specialist;
- Establishing "no conflict of interest" criteria for the role of the third-party specialist.
- A process for quality control, code of ethics, and so on.

The Code Official Shift Change

A 2014 National Institute of Building Sciences study found that over 80 percent of code officials expect to retire within the next 15 years, and more than 30 percent plan to do so within five years. Such a massive exodus of public safety professionals could have a particularly serious impact on smaller jurisdictions since more than half of the respondents work in departments of nine or fewer employees. Even Rhode Island, the smallest state in the country, is already feeling the effects of this shortage, as a lack of new building officials has forced the state to split some individuals part-time across multiple towns. While the position of code official is one that will require some modernization in order to attract the next generation of code officials and meet the needs of the future building departments, third-party energy specialists can help to stem the tide of code official retirement in the face of increasingly complex energy codes. The Energy Rating Index path for residential buildings, for instance, was introduced in the 2015 IECC in part as a mechanism for shifting some energy code compliance duties from the code official bottleneck to a competent group providing substantial capacity: HERS raters.

Establish an Energy Code Compliance Collaborative

An energy code compliance collaborative can help ease the burden on state energy offices by bringing together key stakeholders into a collaborative process and establishing a forum to support common interests around energy code adoption and compliance. In a number of states, collaboratives have already proven successful for creating an open dialogue and clearinghouse for ideas and conversation concerning energy codes. In the Northeast and Mid-Atlantic, BCAP and NEEP have assisted states such as New Hampshire, Delaware, and Pennsylvania with the establishment of code collaboratives, tasked with tackling everything from broad code adoption issues to specific compliance problems.

Designed to assist states that are struggling with declining budgets, resources, and staff, collaboratives excel by assembling a team of local experts to assist the state in reaching its compliance goals. Ideally, collaboratives are comprised of a diverse group of state and local stakeholders and take on the responsibility of advising the AHJ on energy code implementation, infrastructure, and updates, as well as carrying out the tasks necessary to ensure greater compliance with the energy code. Collaboratives can also play an important role in communicating the value of codes and standards to the greater public.

Collaboratives can play a lead role in the development of a compliance plan, which will serve as a critical roadmap for energy code implementation efforts in future years. The plan will recommend tasks within various focus areas that state agencies, local jurisdictions, and other stakeholders can complete achieving full compliance with the required energy code. See the case study on New Hampshire and Delaware's Code Collaborative experience, as well as the Pennsylvania Collaborative's Roadmap to 100% compliance by 2020.

Energy Code Collaboratives in Delaware and New Hampshire

Background: In order to meet the requirements of Section 410(a) of the American Recovery and Reinvestment Act (ARRA), states must achieve at least 90 percent compliance rates with the national model energy code (2009 IECC or higher) by 2017. These resources encouraged the development of state energy code compliance collaboratives, groups of diverse stakeholders which promote greater compliance with the energy code by creating a forum for open dialogue and a clearinghouse for the sharing of ideas and resources concerning energy codes. Energy code collaboratives are a proven best practice in New Hampshire and Delaware, as well as in ten other states.

Delaware's Division of Energy and Climate (DE&C), the legislative authority that reviews and adopts updated energy codes every three years, created the Delaware Energy Code Coalition in November of 2011, following the first recommendation in its strategic compliance plan. The coalition consists of a diverse group of state and local stakeholders representing homebuilders, building code officials, contractors, and representatives from the American Institute of Architects (AIA), Delaware Sustainable Energy Utility (SEU), ASHRAE Delaware, NEEP, and BCAP who are responsible for advising DE&C on energy code implementation, infrastructure, updates, and compliance. The coalition's goal is to achieve 100 percent code compliance by 2017 through use of the state's strategic compliance plan to address shortcomings identified in the state's gap analysis report. Recently, this coalition has leveraged its members to help promote energy code training activities, plan a code compliance assessment, and develop appropriate compromises to proposed weakening amendments when new energy codes are adopted.

New Hampshire's Energy Code Challenge supports efforts to strategize and measure the state's progress toward reaching ARRA's 90 percent energy code compliance requirement. Since 2009, New Hampshire's Office of Energy and Planning (OEP) has worked with GDS Associates to develop the goals and resources of the Code Challenge, outlined in the NH Building Energy Code Compliance Roadmap, released in April of 2012. Additional efforts and materials to help assist the state's energy code compliance goals were developed by BCAP in both the gap analysis report and strategic compliance plan and led to the development of the New Hampshire energy code collaborative, whose goal is achieving 90 percent compliance with the 2009 IECC. Members of this collaborative have done everything from countering proposals to repealing the energy code to developing recommendations for a statewide home energy labeling program that would use market forces as a mechanism to increase code compliance in the state: see the Building Energy Rating section of this report for more information.

Develop robust training and certification requirements for code inspectors, plan reviewers and building industry professionals

Having strong building energy codes does not guarantee energy efficient buildings. High levels of code compliance require education and training of building professionals among both the regulated and regulator communities – from students, designers and builders, to code officials and plan reviewers, on both the state and local levels. Municipalities need adequately trained and certified inspectors to ensure that buildings comply with the energy code. Mandating energy code training, supplemented by updated procedures, would improve compliance and increase energy savings. Encouraging building departments, design professionals, builders and trades to take advantage of existing training tools (e.g., DOE's COMcheck and REScheck), will also help enhance compliance levels and boost energy savings.

Better Buildings Workforce Guidelines

The Better Buildings Workforce Guidelines, are national guidelines promulgated by DOE to develop high quality and nationally-recognized training and certification programs to address challenges found in the energy efficiency workforce with quality, consistency, and scalability across certification and certificate programs. Four commercial building workforce credentials for key energy-related jobs: building energy auditor, building commissioning professional, building operations professional, and energy manager are available.

A well-crafted code training program should include mentoring and compliance tools for code officials and building professionals. As part of the continuing re-certification of inspectors and plan reviewers, energy code modules should be a specific requirement. Also, the state should seek to increase opportunities for training and certification and use state agencies and tools to market these opportunities

The COMcheck software is an easy method for architects, builders, designers, and contractors to determine whether new commercial or high-rise residential buildings, additions, and alterations meet the requirements of the IECC and ASHRAE Standard 90.1, as well as several state-specific codes. COMcheck also simplifies compliance for building officials, plan checkers, and inspectors by allowing them to quickly determine if a building project meets the code.

The REScheck software is a fast and easy way for builders, designers, and contractors to determine whether new homes, additions, and alterations meet the requirements of the IECC or a number of state energy codes. REScheck also simplifies compliance determinations for building officials, plan checkers, and inspectors by allowing them to quickly determine if a low-rise residence meets the code.

In Maine's recent effort to update its energy code to the 2015 IECC, the lack of continuing education requirements for building professionals was cited several times in meetings of the code development board and the energy code technical advisory group as a major impediment to adopting any new energy codes.

Many states do not specifically require energy code training for code inspectors and plan reviewers, although it is often offered as a part of continuing education opportunities. Legislation should be crafted to specifically require the AHJ to implement or develop an energy training and certification program for inspectors to assure technical comprehension and increase code compliance. Certification of candidates who will perform commercial and residential plan review/inspections is available through the ICC's certification programs and testing. Or, if states so chose, they could establish and fund similar education and certification programs that provide a valuable resource to their municipalities.

States and local code adopting entities should provide energy code training classes or seminars to cover at a minimum, the following topics:

- Building energy code plan review issues;
- Integration of plan review results into inspection tasks;
- Inspection procedures based on integration of energy issues into individual site visits;
- Field inspection issues of envelope and systems components with developed checklists;
- Interpreting energy software program results;
- Stretch code optional programs and strategies;
- Measurement tools and criteria (such as blower door and duct blaster testing);
- Code compliance verification tools and resources.

Best practices for energy code training should include the following:

- Establish a state-level training committee to oversee the development, promotion, and delivery of robust energy code training curriculum for the entire building community, including state code officials, local inspectors, and the regulated community – the architects, engineers and other building professionals, construction trades and facilities directors.
- The training committee should have the authority to approve and develop training materials and delivery options (which may include a combination of face-to-face and online training opportunities), as well as consult with building officials' education committees to ensure their support and compliance.
- Develop an annual plan for building code training and technical support – what, where, when, who, how – that leverages resources and knowledge. One available means is through certification of commercial and residential plan review/inspection candidates conducted through the International Code Council's certification programs and testing. Some training could also be accomplished through established training venues, such as community colleges and professional associations. For example, the Boston Society of Architects conducts a series of trainings throughout the state

each time the Massachusetts Board of Building Regulations and Standards updates the building codes.

- Consider various means of financial support to ensure the training program is well funded. Training could be funded through a number of resource frameworks, including tuition, grants, and state ratepayer-funded energy efficiency programs.

Recommendation #2: Implement Modern Permit Processing and Fee Collection System

- *Institute a fee for service structure that sets aside dedicated funding for plan review and inspections of energy code;*
- *Invest in IT to streamline the building permit process.*

Institute a fee for service structure that sets aside dedicated funding for plan review and inspections of energy code

Municipal budgets alone are often not able to support the costs of attaining better building energy code compliance. Instead, a user "fee for services" should be established and collected as a portion of building permit fees, thereby immunizing this function from budget shortfalls and allowing trained and certified energy code inspectors to supplement the work of local building inspectors.

This fee could accomplish two important functions:

1. First, the fees should sufficiently fund proper review of construction drawings and inspection services of buildings during and after construction;

2. Second, a small portion of the fee could be allocated to assist the state in providing the infrastructure for code inspection training and certification, code adoption, and development as well as technical support to the regulated community.

The funds generated by these fees should be separate from state general funds, deemed a 'fee for services' and impose no burden on municipal governments. The fund would, nevertheless, be under the control of either the municipal AHJ building department or the relevant authority by law. Alternatively, responsibilities for plan check reviews and inspections should lie on special inspectors to be hired by the owner in fee or permit holder.

CASE STUDY: New York City's permit processing and fee system

Recognizing the challenges of managing its large construction volume, New York City has already established a voluntary digital permit processing system supported by a progressive permit fee structure. By introducing electronic permitting, requiring an application fee of $220 per permit, and requiring professionals be certified, the New York City Department of Buildings (DOB) developed a system providing an auditing process for code compliance that allows the City to discipline those individuals who are not meeting code. Further, DOB can leverage this information for its own purposes. While DOB does not have a big enough team to analyze all this data, it is engaged in a pilot project to figure out how to tackle the most energy impactful alterations out of the 60,000 it receives annually. It is working to make this a permanent program and will be establishing a fee for alteration permits based on the findings of its study.

How Connecticut funds its training and certification infrastructure

In Connecticut, a surcharge of $0.26 per $1,000 value of permit work raises over $1 million per year for education programs. These funds support training staff at the state level, outside instructors, training materials and aids, and venues where training is conducted. Such an education/certification program should embrace all code officials, building, and fire, as well as other licensed and non-licensed professionals and trades on the basis of what their statutory needs are for continuing education. Those members of the building community that are required to attend to maintain licensure or certification are guaranteed space. These sessions can be held at local community centers. One caveat to this approach is that the fee typically applies to all aspects of building code work. Since energy code training is typically a lower priority, it is likely that only a small portion of this fee will be dedicated to energy codes.

Regional Energy Efficiency Organizations (REEOs) can assist municipalities in drafting language for statutory language to dedicate a portion of permit fees to provide energy code plan review and inspections.

Suggested Statutory Language: *Local jurisdictions shall, in accordance with the statute, incorporate into the building permit fee a fee structure sufficient to provide for the dedicated plan check and inspection of the energy code. The Commissioner of (XXX) shall adopt, in accordance with requirements of [statute] a schedule of fees to be added to local permit fees, adequate to defray the direct and indirect costs for administration of a training and certification program for code enforcement officials, design professionals, and building construction trades, to be known as the Codes Enforcement Training Fund. Such fee schedule shall carry forward to each subsequent fiscal year. Should the fund balance of such Fund exceed {$ XXX} at the end of any fiscal year, such excess funds shall be deposited in the General Fund.*

Funding for plan check reviews and inspections could come directly from building permit fees. However, the jurisdiction should make sure to dedicate a certain percentage of the building fee to the energy code to ensure it is not overlooked. Alternatively, the AHJ could simply direct the developer/owner to contract directly for the energy code plan check and inspection. This approach is appealing because it makes it more likely for the energy aspects of the project to receive attention. Whichever funding model is used, it should also be flexible enough to allow for instances where small, rural communities need to pool resources to allow for qualified energy code inspectors to be hired on a shared basis, with compliance responsibilities based on a population formula.

Invest in IT to streamline the building permit process

By instituting online permitting and inspections processes, cities and states can support code compliance more effectively and efficiently. In addition to higher compliance rates, streamlining of the building permit process – including permit submission and processing, plan submission, review and tracking, inspections, and issuing a certificate of occupancy – better positions building departments, cities, and states to attract economic development by reducing the process time by up to 80 percent annually and reducing energy costs for consumers by increasing energy efficiency. Streamlining this process, not only benefits building departments, but it also improves customer services, provides financial savings for the local government, its citizens, and private industry, and enhances compliance with building energy codes.[22]

The benefits of on-line permitting include:

- Reduced permitting time
- Improved customer service and staff efficiency
- Enhanced quality of service
- Operational savings
- Inter and Intra Departmental communication and management
- Coordination with private and public entities that provide constructions services (utilities, alarm services, renewable providers)
- Electronic record keeping
- Paper reduction
- Transparency
- Inspection scheduling
- Fee collection
- Enhanced use of online compliance software

More effective and efficient building permitting and compliance will provide data that can be combined with other GIS data fields and used as the basis of asset rating and disclosure initiatives. The data can assist states and municipalities in crafting energy efficiency policy, forecasting trends, and analyze program performance as well as the need for new programs. Ultimately, electronic online permitting will lead to enhanced compliance by equalizing the energy code with other codes, saving time and targeting training opportunities for inspectors. NEEP suggests establishing an e-permit taskforce to explore and institute a comprehensive electronic system for permitting and compliance.

Barriers to on-line permitting include:

- Cost to establish system
- Maintenance of system
- Continuous updating of data field, forms, fees
- Lack of in house IT expertise
- Training of users (both internal and external)

[22] http://www.aceee.org/files/proceedings/2012/data/papers/0193-000112.pdf

Electronic Permitting Regional Leaders

Washington, DC

The District of Columbia implemented online permitting and plan review. DC has a comprehensive electronic permitting site. The Department of Consumer and Regulatory Affairs (DCRA) offers instant online permitting called a post card permit for simple or critical repairs up through certificate of occupancy. Plans, as well as all forms and fees, can be handled through the online service. A building owner can also apply online for third-party code inspection services from certified third party vendors. DCRA is currently working on offering online technical assistance for code compliance and green building. http://dcra.dc.gov/page/dcra-online-services

Maryland

The state adopts state wide codes which then need to be adopted by local jurisdictions. The state's web page directs users to each local jurisdiction which in turn directs users to the specific permit applications. In some cases, such as in Baltimore, plan submittal can be done online. In Montgomery County, permits can be accessed online, returned online and the associated fees can be paid on line.

Montgomery County:
http://permittingservices.montgomerycountymd.gov/dps/eServices/AboutePermits.aspx
Baltimore:
http://www.baltimorecountymd.gov/agencies/permits/pdm_permitsprocess/index.html

Rhode Island

Rhode Island launched online permitting services for three entities: the state fire marshal, the state building commission and the city of North Smithfield; nine other cities will be online this fall. The building commission and fire marshal offer permits for state owned and operated buildings, and privately owned buildings will obtain permits from the city sites. City sites will have the ability to track inspections and violations. Electronic libraries tracking permit records and building codes will be a valuable resource to the state and utilities in estimating efficiency through codes and to subsequent building owners.

Recommendation #3: Measure Code Compliance Every Three to Five Years between Code Updates

- *Conduct state code compliance baseline studies and gap analyses;*
- *Reassess code compliance every three to five years in order to identify opportunities to focus resources.*

No state has successfully reached 100 percent energy code compliance, leaving a significant amount of work to be done if states are to stay true to their 2017 ARRA commitments. A number of factors result in the low compliance rates and will need to be addressed in order to maximize compliance rates and their associated energy and cost savings – these include:

- **Funding**: Local building offices suffer from chronic underfunding with respect to most of their required energy code related functions – including implementation, administration, and enforcement, as well as time budgeted for training and education. As a result, too few code officials (either plan reviewers or inspectors) exist in relation to the amount of construction that must be reviewed, permitted, inspected and approved for occupancy.

- **Priorities**: Given limited time to check and inspect construction, officials must prioritize which elements of the building code they are able to administer and enforce. Consequently, officials deal first with compliance with codes pertaining to life safety and public health issues (such as structural, fire and sanitation) before dealing with energy code compliance.

- **Training**: Code officials and practitioners do not receive sufficient mandated training on energy code issues in comparison with other important aspects of the code such as structural, health or fire safety requirements.

- **Lack of Awareness:** Architects, engineers, contractors, builders, and others may not understand or be fully knowledgeable of the energy code and its requirements, nor is professional development tied to ongoing energy code training. In addition, some elected officials pressure building departments not to stall construction projects on account of energy code noncompliance because they are under-informed about the long term importance of code compliance to their constituents relative to short term political or economic reasons.

- **First Cost versus Life-Cycle Cost**: Owners and developers are concerned with first costs and want to get buildings constructed in a timely manner to generate income and protect time and money invested. Thus, they may choose to ignore new energy requirements of the building code, particularly since the life-cycle cost/value of energy saving investments are not generally recognized in property valuations.

- **Lending Institutions:** Lenders may not send appropriate messages about the importance of energy code compliance and the consequent impact of ongoing energy costs when reviewing loan applications for construction or for the purchase of new homes or buildings. Additionally, appraisers are hampered by traditional prescribed methods that do not value energy improvements to a building.

Conduct state code compliance baseline study and gap analysis

Only after a baseline code compliance rate is established can states be equipped to make fully-informed policy decisions for improving energy efficiency in the state's building stock. Determining a state's current code compliance level is also important for identifying opportunities for increasing compliance and code savings, and identifying specific gaps in code knowledge and implementation that can be addressed through training and education. Lack of compliance with the energy code undermines the potential energy savings the code is expected to deliver.

Once a baseline compliance rate and gap analysis are determined, a comprehensive program can be designed to verify that buildings actually comply with the code. This can help ensure that code inspectors, whether local, state or third party, are correctly assessing code compliance in buildings. Knowing the actual numbers of compliant buildings, as well as the specific requirements that builders do and do not comply with, will help state agencies continually modify and improve their training programs. The baseline study will help determine the current level of compliance, identify specific areas where compliance is weak and provide recommendations on how to address these weaknesses. Regularly scheduled compliance studies are strongly encouraged in order to monitor changes in state code compliance over time and reassess code efforts. Importantly, all initial baseline compliance studies should have frequent follow-up studies to gauge the effectiveness of implemented policies.

US Department of Energy – Residential Energy Code Field Study

The US Department of Energy (DOE) is in the process of completing a three-year code compliance study in ten states (Alabama, Arizona, Georgia, Kentucky, Maryland, Michigan, North Carolina, Pennsylvania, Texas, and West Virginia). The study utilizes a comprehensive data collection methodology established by the DOE and the Pacific Northwest National Laboratory (PNNL). Data is collected and analyzed to establish baseline energy use of pre occupancy, single family residential buildings and identify strengths and deficiencies of construction practices related to energy efficiency in the state. The study will access over two hundred construction practice data points in order to:

- Establish Energy Use Intensity (kBtu/sf/year) of code-regulated energy in single family homes in the New Hampshire;
- Demonstrate compliance with ARRA mandates for energy code compliance;
- Identify deficiencies and strengths in construction practices and code compliance statewide;
- Create education and training curriculum to strengthen building energy code compliance;
- Understand potential for increased energy savings and reduction of carbon emissions from future and more rigorous code adoptions;
- Refine utility efficiency programs to assist design professionals, builders, and home owners to create beyond code efficiency;
- Establish a business case for private investment to increase energy code savings.

Data Collection

Key individual data points with largest energy impacts that will be collected include:

- Envelope air tightness (ACH50)
- Window SHGC & U-factor
- Wall insulation (R-value)
- Ceiling insulation (R-value)
- Lighting (% HE lamps)
- Foundation insulation (R-value)
- Duct leakage

At a minimum, 63 observations of each of the above in addition to 230 other data points are collected.

Summary of results to date*:

- Builders and building officials are doing a very good job meeting adopted codes;
- On average, homes are using less energy than would be expected based solely on the prescriptive code in five of six states analyzed;
- There is still significant savings potential from individual code requirements that do not comply;
- Individual requirements
    - Some are consistently better than code (e.g., windows)
    - Some are inconsistent with code (e.g., lighting)
    - Some are virtually always exactly at code (e.g., walls)
    - Nothing is consistently worse than code.

Additionally, the DOE Residential Compliance Study examines and quantifies energy saving potential from codes, carbon reduction and dollars saved from code compliance on a yearly basis statewide. Below see Residential Energy Code Study information from North Carolina.

North Carolina	NC Code – One Year
Energy Saving Potential-Million Btu/year	26,805
Total Dollars Savings Potential Per Year	$427,428
Emissions Reduction Potential – metric tons (CO_2 per year)	1,149

North Carolina Measure (One Year)	NC Total Energy Savings Potential (MMBtu)
Lighting	16,128
Envelope Tightness	14,107
Duct Leakage	18,084

Field studies are critical to understanding the patterns of compliance and their impact on energy. NEEP recommends conducting an energy code compliance field study one year to 18 months from the effective date of new code adoptions. NEEP is currently preparing for residential field studies based on the DOE methodology in the Northeast.

Information on DOE Energy Code field studies can be found at DOE Residential Energy Code Field Study.

*Data and statics above drawn from DOE Field Study webinar presentation, December 2015.

Reassess code compliance every three to five years in order to identify opportunities to focus resources

Code compliance assessments should be performed in alignment with the three to five year code update cycle discussed in the code adoption section above. Regular code compliance assessment allows for:

- Focusing limited code compliance and enforcement resources into the largest areas of demonstrated need, thereby generating the largest possible "bang for the buck";
- Using data from actual homes in the next code update cycle (in order to either demonstrate industry mastery of a code provision that could be pushed further or industry difficulty with a code provision that may be best left as is until compliance improves);
- Refining parameters used by utilities, state energy offices, and others in models used to forecast future load growth and determine the need to invest in additional energy generation capacity;
- Modifying input assumption in energy code savings attribution models in states that allow utilities to claim savings (described in the following section).

Recommendation #4: Allow Utility Program Administrators to Claim Savings for Energy Code Compliance Support Activities

Building energy codes have received considerable attention lately because of the energy-savings opportunities they present for utilities and other program administrators (PAs). Estimates that upgrades to building energy codes could offset as much as a third of all electricity consumption growth nationally through 2025.

PAs are in a strong position to support and influence markets: they typically run programs that operate in the new construction arena, and they have knowledgeable staff and resources. If they support energy code efforts, however, PA resources are diverted from other energy-efficiency opportunities, and the possibility arises that savings from traditional energy-efficiency programs will be reduced as codes increase energy-efficiency baselines. By providing PAs with an incentive to support energy codes, their focus can move away from concerns about savings erosion due to codes increasing baselines and towards a productive engagement with code officials, builders, developers, contractors, architects, and the market. By receiving credit for energy savings, PA efforts become directed towards positively impacting code adoption and maximizing compliance. These expanded opportunities allow PAs to find the strategies that most cost effectively achieve energy savings. There are two recommended strategies:

- *Work with program administrators and public utility commissions (PUC) to develop an attribution framework;*
- *Deploy program and refine with each compliance study and code update*

Work with program administrators and public utility commissions to develop attribution framework

There is no single best way to involve PAs in supporting building energy codes. The approach selected is likely to be site-specific depending on state regulatory policies, preferences of regulators and PAs, existing programs, and numerous other factors. Consequently, it is important that the process of involving PAs in code support activities be done in a way that takes into account the full scope of policies and factors that guide PA energy-efficiency activities. Key questions need to be answered such as:

- What energy savings goals do PAs have?
- How are savings goals set?
- How are savings from energy codes tracked and treated in setting and measuring achievement of goals?
- What incentives or other mechanisms are used to encourage PAs to achieve their savings goals?
- How appropriate are they for application to activities supporting energy codes?

States can use NEEP's 2013 report on Attributing Building Energy Code Savings to Energy Efficiency Programs[23] as the foundational document for launching an energy code savings attribution framework. In our region, only Rhode Island has successfully achieved full implementation of such a program.

[23] http://www.neep.org/attributing-building-energy-code-savings-energy-efficiency-programs

Attribution: Attribution is defined as the determination of the amount of the energy savings that should be credited to PA efforts in the code development, adoption, and compliance processes.

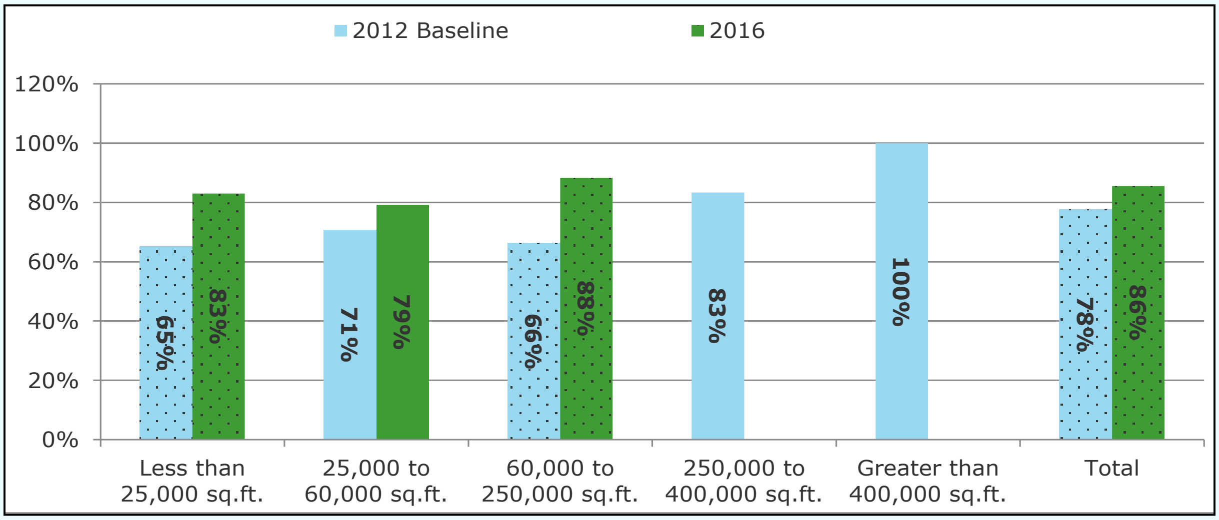
PAs are in a strong position to support and influence markets. By providing PAs with an incentive to support energy codes, their focus can move away from concerns about savings reduction due to codes increasing baselines and towards a productive engagement with code officials, builders, developers, contractors, architects, and the market. By receiving credit for energy savings, PA efforts become

CASE STUDY: Lessons from a Full Cycle of Utility Code Compliance Support in Rhode Island

National Grid—in partnership with the Rhode Island Code Commission, NEEP, and a contractor team—administers energy code support activities (the savings from which it is allowed to claim as part of its regulatory proceedings) through its Code Compliance Enhancement Initiative (CCEI). CCEI's program includes classroom and in-field training, energy code circuit rider technical support, development of code compliance documentation tools, proactive outreach to stakeholder groups, and process training for third-party energy specialists. An implementation working group suggests adjustments to various energy code training activities being delivered by CCEI, and an evaluation working group continually guides National Grid through the methodical process of claiming energy savings based on the utility's code attribution framework as agreed upon in conjunction with the state public utility commission. As shown in the table below, National Grid's attribution rates and max potential improvements increase over time.

Code Savings Attribution Rate	2014	2015	2016	2017
Residential Code Support	2%	9%	19%	24%
Commercial Code Support	2%	7%	12%	18%

In 2016, Rhode Island completed a compliance assessment updating its previous study conducted in 2012, when the state was under the 2009 IECC. As depicted in the graph below, the measured compliance rate rose from 78 percent to 86 percent (based on the PNNL methodology). While this does not seem like a large increase, it does not take into account the fact that the state also updated to a more efficient energy code (2012 IECC) since the last study, which one would expect to cause a decrease in compliance due to the introduction of new, stricter code requirements.



While a formal code compliance assessment was not performed for residential buildings, similar results were noticed in comparing figures between 2014 and 2015. For example, the initiative noticed that while building air leakage testing was a clear priority for the new code; many towns were still not enforcing duct leakage testing requirements. To fix this apparent enforcement gap, the CCEI team visited each of the towns' building departments to interact one-on-one with individual officials and inspectors. They also partnered with building officials, builders, and HVAC contractors to sponsor in-field training hosted by local builders during which all participants learned together what is required, how to perform the duct leakage test, and how performing the mandatory sealing of ductwork will result in passing this test. This yielded a 78 percent increase in the number of towns enforcing duct leakage testing and also coincided with a 32 percent reduction in measured total duct leakage. CCEI anticipates that these numbers will continue to rise as the standardized enforcement of this test will spur improved attention to duct system details at the design and installation stages by the building industry, yielding lower leakage rates and, in turn, higher rates of compliance with this code provision.

The Important Role of Utility Program Administrators:

Utility program administrators (PAs) play an important role in administrating ratepayer funded energy efficiency programs throughout the region. Below is a summary of instances where PAs have been active in code development, adoption, enforcement, and compliance, as well as additional suggestions of activities PAs could undertake to support building energy codes. States involved in the various PA supported code activities are listed in bolded parentheses at the end of each description below.

ALIGN PA PROGRAM REQUIREMENTS WITH STRETCH CODES TO PRIME THE MARKET

Enforcement and Compliance

- **Assess compliance with the existing code:** It is important to determine what the current code compliance level is for at least two reasons: (1) establishing a baseline for energy savings from new building efficiency programs; and (2) identifying opportunities for increasing compliance and code savings, particularly when it comes to informing training opportunities or gaps for utility-led training programs (see below). Many PAs and directors have conducted code compliance studies recently. PAs also can conduct regularly scheduled compliance studies to monitor changes in code compliance. **[CA, NY, MA, RI, CT, GA, UT]**

- **Conduct training of code officials and industry**: PAs and others have delivered training programs to code officials and the building industry to increase their understanding of the codes, leading to improved enforcement and compliance. **[CA, CT, NY, AZ, MA, RI, VT, CO]**
- **Provide technical assistance, materials, and equipment to code officials and industry:** PAs have provided various technical assistance (including hot lines) and materials (such as code books or builder manuals) to help code officials and practitioners (including trade groups) better understand and enforce energy codes. They also have provided equipment, in some cases, such as blower doors. Similar equipment and services can be made available to the building industry to enhance compliance. **[GA, IA, VT, MA]**
- **Support third-party enforcement:** Some PAs have funded third-parties to provide code enforcement assistance to building officials. HERS raters are one third-party example. **[GA, IA, WA]**

State Code Development and Adoption

- **Participate in national model code processes:** PAs have worked with national organizations on model codes, which then influence state codes. Organizations that PAs have worked with include the ICC, ASHRAE, DOE, and others.
- **Interact with building industry on code development:** PAs have worked with builder associations and builders to assess the feasibility of code upgrades and to gain cooperation or minimize opposition of industry. [**CA**]
- **Provide technical information and assistance to state entities:** PAs have conducted technical analyses or provided technical assistance to state code adoption entities. Technical support has included analysis of potential code changes, feasibility assessments, and estimates of costs and energy savings. PAs have also assisted with prioritizing code revisions. **[CA, NY, AZ, MA]**
- **Participate in formal state code adoption process:** PAs have provided testimony and been an active participant in the code adoption process. Where codes originate legislatively, PAs can participate in the hearings or drafting of legislation. [**CA**]
- **Advocate for state code adoption:** PAs publicly support state code adoption by advocating in the policy arena, joining coalition groups, signing onto support documents, etc. **[MA]**

Enabling Activities

- **Advocate for regulatory recognition of savings from code program:** PAs can work in the state policy arena to support recognition of savings from code programs. [**CA, AZ, MA, RI**]
- Define methods for crediting savings to specific PAs and utilities
- **Support development of an attribution framework**: PAs have recognized the need for this critical step that allows savings to be assigned to specific utilities. To date, California is the only state in which the attribution method has been applied to distribute savings between the Investor Owned Utility (IOU) that sponsor the statewide program. **[CA, MA, AZ, RI]**
- Develop method for quantifying compliance savings
- **Support development of methods for quantifying savings from changes in compliance**: Although compliance is factored into savings as measured by the California Protocol, methods for

determining savings from changes in compliance are not well defined. PAs in several areas are working to define better methods. **[CA, MA, RI]**

Additional Activities and Strategies

The following list presents this wider range of activities for PAs to consider:

Integrate code adoption and compliance efforts into energy-efficiency resource planning: Codes and their energy savings are integrated into some resource planning and energy-efficiency potential study efforts, but not in all cases and not always consistently. Codes are often assumed to be the baseline for estimating acquisition program savings, without knowing the compliance level or looking at opportunities for increasing code stringency or compliance levels. Energy-efficiency portfolios can benefit by viewing code activities from an integrated perspective with emerging technology and incentive programs.

Advocate for legislation that requires the state to adopt latest national model codes automatically: By getting on the model code cycle, states can be guaranteed to have frequent code updates. PAs can work with others to advocate for legislation setting such requirements. In states where such updates are not automatic, utilities that successfully influence a change in policy could establish a claim to the savings that result from each successive update.

Advocate for legislation that allows local governments to adopt codes exceeding state code: Legislation allowing local adoption of so-called “stretch” or “reach” codes permits code flexibility for local governments; by requiring the local code to exceed the state code, PAs can work to achieve more savings in the jurisdictions they serve.

Implement a variable rate schedule based on a building’s code compliance rating: PAs could design a rate structure that rewards more efficient buildings with a lower utility rate. This approach has been discussed in California and has been suggested by experts. It would require some type of rating system or outcome- or target-based code.

Require builders/owners to prove code compliance as a requirement for utility service and for program participation: A utility service requirement exists in Iowa for new one- and two-family residential construction and is on the books in Maryland, and possibly other states. This approach integrates the compliance requirement into the process of completing a construction project. Some utilities require buildings participating in new construction programs to demonstrate code compliance. Enforcement can be simplified by establishing a requirement that a professional architect or engineer certifies that the building complies with the code; Wisconsin has such a requirement for the architect.

Deploy program and refine with each compliance study and code update

Once a code attribution framework has been approved, a code compliance assessment must be completed before the attribution program goes into place. This is in order to establish a pre-intervention code compliance baseline. Next, key performance indicators (KPIs) should be established in order to focus program success (and, in turn, amount of savings claimed) on the most important metrics and goals. These might include the number of attendees at training events (and the results of any surveys/polls conducted), the number of inquiries fielded by energy code circuit riders, or other measures indicative of the degree of the program’s success. Consistently monitoring how the magnitude of each of these KPIs changes over time serves to confirm the implementing PA’s program or catalyze program changes.

Code support programs exist in an ever-changing building code environment, and code attribution programs only work in the presence of a true meaningful baseline from which net energy savings can be measured. Other code support programs can increase energy code compliance, and updating the energy code can cause considerable change (positive or negative) in energy code compliance rates. A new code compliance assessment must be performed periodically in order to ensure that the PA can claim an accurate amount of savings.

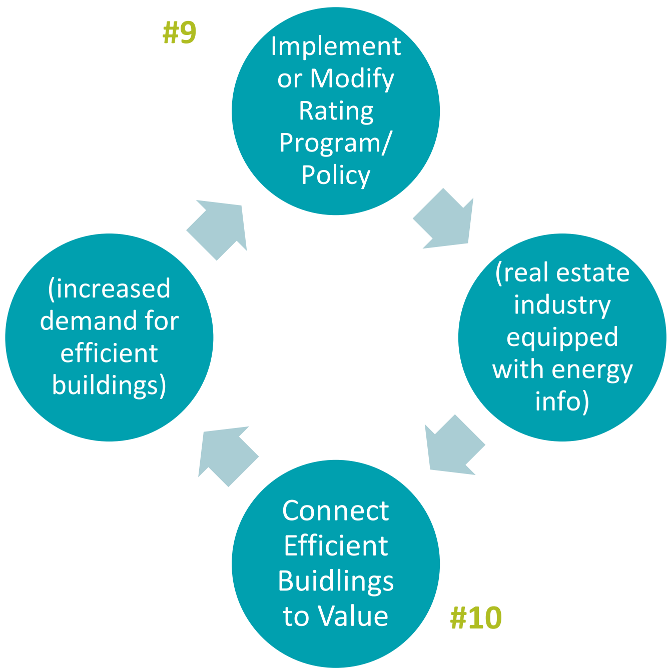
The code adoption cycle provides a natural schedule for completing new code compliance assessments, especially if updates happen in a consistent, predictable fashion as described earlier in this report. Compliance assessments should be performed as close to the end of each code cycle as possible in order to provide optimal post-program data upon which PAs can substantiate their savings claims. Pre-program baselines can either be attained through another assessment or estimated from the results of the previous assessment by using an adjustment factor in compliance rates. A good PA program will minimize any initial drop in compliance by preparing the building industry for these changes well in advance by "teaching to the new code" in all education and outreach activities.

Recommendation #5: Implement Voluntary or Mandatory Building Energy Rating or Transparency Policies

Energy codes directly impact new construction and buildings with renovation or retrofit activities. Market pressures will push the region emphatically toward reduced building energy use only when energy efficiency translates directly into value in real estate transactions. States should introduce programs that employ building asset ratings to provide the information the marketplace needs to properly value building energy efficiency. Over time these programs should be converted from voluntary ratings into mandatory disclosure policies, perhaps requiring the owners of the most inefficient properties to take corrective actions.

These energy rating programs and policies should yield increased market demand for properties built in accordance with recent energy codes that greatly outperform their counterparts on the market. This will fuel additional building industry stakeholder support for advancing steadily toward a zero energy code.

Figure 11: Building Energy Rating Recommendations and Relationships



Efforts like US DOE's Home Energy Information Accelerator are aiding jurisdictions in their efforts to get useful, asset based information into consumers' hands. In the northeast, NEEP's Home Energy Labeling Information eXchange (HELIX) project aims to auto-populate real estate listings with any relevant energy data by 2018[24]. Likewise, a similar asset based approach for commercial buildings is possible, though the Region has demonstrated significantly more interest in residential buildings thus far.

For commercial buildings, benchmarking is a widely accepted first step toward reducing building energy usage, yet navigating a sea of bills and invoices spanning multiple utilities and fuel sources can be a time-consuming process, not all building operators and facility managers are equipped to do. Thankfully, tools have been developed which provide a blueprint for increasing utility data access[25]. NEEP's 2016 report on Utility Data Access Options and Opportunities provides guidance for public sector building energy benchmarking policies and programs in the Region regarding increasing access to utility data, tracking usage as part of building energy benchmarking mandates, and guiding energy management decisions[26].

[24] http://www.neep.org/initiatives/energy-efficient-buildings/green-real-estate-resources/home-energy-labeling-information
[25] https://betterbuildingssolutioncenter.energy.gov/toolkits/energy-data-access-blueprint-action
[2626] http://www.neep.org/public-sector-building-energy-benchmarking-utility-data-access-options-and-opportunities

Four strategies are discussed below:

- *Implement a voluntary home energy labeling program;*
- *Require energy performance benchmarking of all commercial buildings;*
- *Develop legislation that would require disclosure and energy ratings and act as a trigger to upgrades in existing buildings;*
- *Connect energy code to building energy rating.*

Implement a Voluntary Home Energy Labeling Program

Over the past few years, interest in home energy ratings has skyrocketed both regionally and nationally. This interest coincides with the release of the Department of Energy's Home Energy Score (HES) program. The HES program provides an energy rating that is both rigorous enough to accurately predict a home's energy use and simple enough to be offered at very little incremental cost by utilities, energy raters, home performance professionals, home inspectors, or anyone else already providing on-site services. The development of this mass-market solution for home energy rating has seen considerable uptake across the region, as depicted in the following diagram:

Operational vs. Asset Rating, What's the difference?

Building Operational Rating	**Operational ratings are based on measured energy use (i.e., energy billing data) in a building. For example, EPA's Energy Star Portfolio Manager tool calculates an 'operational' benchmark score.**
Building Asset Rating	Asset ratings evaluate the energy performance of a building based on the thermal envelope (e.g., insulation, windows) and mechanical and electrical systems, irrespective of tenant behavior. DOE Building Energy Asset Score

However, some stakeholders are not supportive of the release of home energy ratings to the market. In order to capitalize on the interest that exists, NEEP recommends that states begin with a voluntary program in order to grow consumer demand, workforce capacity, and industry comfort with energy ratings. The two main mechanisms for scaling up the deployment of home ratings under a voluntary system are: (1) at the time of an energy audit via inclusion of the rating into existing utility home performance programs; and (2) at the time of a transaction via promotion by home inspectors, real estate agents, and others.

CASE STUDY: Vermont, Massachusetts, and the Value of Starting with Voluntary

While previous guidance has promoted that jurisdictions attempt to implement mandatory time of sale energy disclosure as soon as viable, an emerging lesson learned is that building energy rating policies should be phased in to allow adequate time for the real estate industry to buy in to this requirement. Recent attempts to mandate energy asset ratings around the time of sale in Vermont (2012) and Massachusetts (2016) were defeated by real estate organization-led opposition that was concerned that the added requirement would slow down the real estate transaction process and further complicate an already complex process. Other states, like Connecticut (2015) and Rhode Island (2017), have pursued the deployment of ratings through voluntary utility programs whereby an auditor can use the same information he/she is already collecting while visiting the building to produce a score at a small marginal fee. Vermont in particular has focused on this voluntary approach since 2012, including researching options for both residential and commercial labeling, developing a custom state label for homes, and working in partnership with the real estate community to support legislation that would require general information (as opposed to an energy audit) to be disclosed during the home sale process about home energy efficiency and opportunities provided by Efficiency Vermont to support energy retrofits.

Require energy performance benchmarking of all commercial buildings

States should require the energy performance benchmarking of all commercial buildings, using **ENERGY STAR's Portfolio Manager** or some equivalent program. Benchmarking consists of developing a record of the baseline energy use and rating of commercial buildings in order to develop data for comparison between comparable building types and sizes. Benchmarking can help guide the development of public policies that seek to maximize building energy efficiency, as well as to evaluate the efficacy of these policies. To properly develop benchmarks, states need to gather data from commercial building owners and establish an easily accessible database that contains the energy consumption information.

An effective building energy codes policy requires the accurate accounting of building energy use to track the potential savings from implementing energy efficient codes and other state policies. By having access to the data provided by benchmarking, building owners, lenders and potential buyers can make informed decisions regarding building energy use. For example, a building owner could use the information to lower energy use and make the building more commercially attractive to buyers or tenants. A potential buyer, on the other hand, can use the information to press for improvements in energy use on the part of the current building owner. Benchmarking should also help policymakers achieve energy gains by tracking the progress of policies such as building energy codes. The AHJ can use benchmarking data to inform realistic targets for outcome- or target-based codes and other programs.

Benchmarking (much like building energy rating) can help determine whether individual buildings comply with the state code as well as help track compliance across the state. State policy should seek to tie policies such as retro-commissioning[27] to benchmarking. By using benchmarking, a building's actual energy use can be compared to its predicted energy use. Consequently, the use of retro-commissioning can help reduce discrepancies between a building's predicted energy use and its measured energy use.

Develop legislation that would require disclosure and energy ratings act as a trigger to upgrades in existing buildings

A home or building energy rating indicates current performance and potential improvements regarding the structure's energy use, providing meaningful information to consumers and empowering them to consider energy performance in their decision-making. Armed with information, some consumers will give preference to more energy efficient homes and buildings, enabling markets to value energy performance, and providing a greater return on investment to projects aimed at improving building energy performance. Similarly, mandatory upgrade policies create a powerful motivation for consumers to participate in retrofit and financing programs.

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[27] Retro-commissioning refers to the practice of commissioning a building after it has been in operation for a certain period of time. It is a particularly useful practice if evidence, such as from benchmarking, indicates that the building is not meeting energy performance goals. Because retro-commissioning is done to an operational building, the commissioning is much more likely to identify and correct the problems that are hindering energy performance.

When listing a home or building for sale, owners should be required to disclose a valid energy rating to potential buyers. The same process should also apply at the time of rental (this requirement may be phased in at a subsequent stage). Mandatory time of sale energy use ratings and disclosures are a reasonable and effective way to address the energy use of existing homes and commercial buildings. Requiring energy ratings at the time of sale or lease create market incentives for both builders and current owners to make energy saving improvements in both new and existing dwellings and commercial buildings on an ongoing basis or in advance of a real estate transaction.

Time of sale/rental requirements addresses the reality that regulations governing new construction make up only one opportunity for energy savings that can be realized from residential and commercial buildings. Energy improvements to existing buildings can also generate significant savings as the number of existing buildings far outnumbers that of new construction. Even modest improvements spread widely among existing buildings can generate large energy savings. Time of sale policies introduces information into the marketplace to help the market put a value on energy efficiency. This can help buyers (or sellers) finance efficiency improvements before or after properties are leased or sold (e.g., through energy efficiency mortgages for example).

Connect Energy Code to Building Energy Rating

Building energy rating and disclosure policies encourage compliance with energy codes by providing a 'check' on whether buildings meet the baseline energy code, as well as by rewarding higher performance buildings, further emphasizing the importance of the energy code. They also facilitate code enforcement, since most or all new buildings will receive energy ratings. This is particularly useful where states have adopted a performance-based compliance track for energy codes.

Disclosure policies reduce the compliance burden via the additional value attributed to energy performance. In an ideal world, a single energy rating and building audit would be used to ensure code compliance, allow disclosure, and lead to voluntary programs and financing. Read more about recent real-world experiences across the United States, as well as key lessons learned for successful BER&D implementation in NEEP's 2012 Building Energy Rating Companion Report available on the NEEP building energy rating webpage.

Home energy ratings can help confirm compliance with the energy code as well as help track compliance across a state or given jurisdiction. Energy rating requirements can be used with respect to the sale of newly constructed homes and buildings as well. In this case, rating and disclosure policies can help ensure that the homes and buildings up for sale actually meet the energy code and perform as they have been designed.

Conclusion

Building energy codes have proven their effectiveness in reducing energy demand in the buildings sector when they are properly implemented, strictly enforced, and well aligned with other policies that impact building energy consumption. States in the Northeast and Mid-Atlantic region should consider short- and long-term energy demand reduction targets (including decarbonization goals and renewable energy targets) in order to increase the stringency of building energy codes. This will ultimately allow for states to (1) advance building energy code development and adoption to enact zero energy buildings codes within the next 15 to 25 years, and

(2) improve the administration of building energy codes to ensure that desired performance levels are realized. NEEP is committed to providing states with the resources to do so.

The ultimate objective of building energy codes should be to move towards zero energy. NEEP is certain that the adoption of energy codes and standards requiring the design and construction of zero energy buildings, as well as the retrofit of existing buildings, is possible by 2030 in leading states and local jurisdictions, and by 2040 throughout the region.

On a community level, there is an opportunity to take the lead in the development of high performance and zero energy buildings, particularly by constructing more high performance schools that will foster healthy learning environments. A new wave of building energy codes provides an improved pathway to zero energy buildings by utilizing strategic electrification – the idea of powering "end uses" (such as vehicles and space and water heating) with electricity instead of fossil fuels. Similarly, requiring the use of renewable energy sources either generated on-site or in close proximity to the site is key to achieving zero energy production from buildings.

As buildings become more energy efficient and move towards zero energy, greater attention should be given to the operation of the building and the maintenance of its systems and equipment. Due to the complexity of building systems and energy consumption, it is important to ensure that all actors involved in the planning, construction, and management of buildings understand building energy codes and their practical application. Proper building energy management, as well as an understanding of embodied energy and usage patterns, will enable further energy savings. The future of building energy codes must include clear stakeholder communication surrounding implementation that is effective, compliance that is monitored, and enforcement of any non-compliance.

Buildings are the largest consumers of energy worldwide, and they will remain an important part of our future. The number of buildings will continue to increase, adding further pressure on energy supplies around the world. The global energy demand for buildings is projected to grow an additional 30 percent by 2035.[28] While progress has been made in the development and implementation of building energy codes across the region and across the world, sharing of best practices is necessary to better inform policy makers and stakeholders of efficient and cost-effective approaches. Addressing the energy consumption of our building stock through code adoption, compliance, and enforcement is a sure strategy for reducing carbon emissions and moving towards a sustainable energy future.

[28] Policy Pathways Modernising Building Energy Codes