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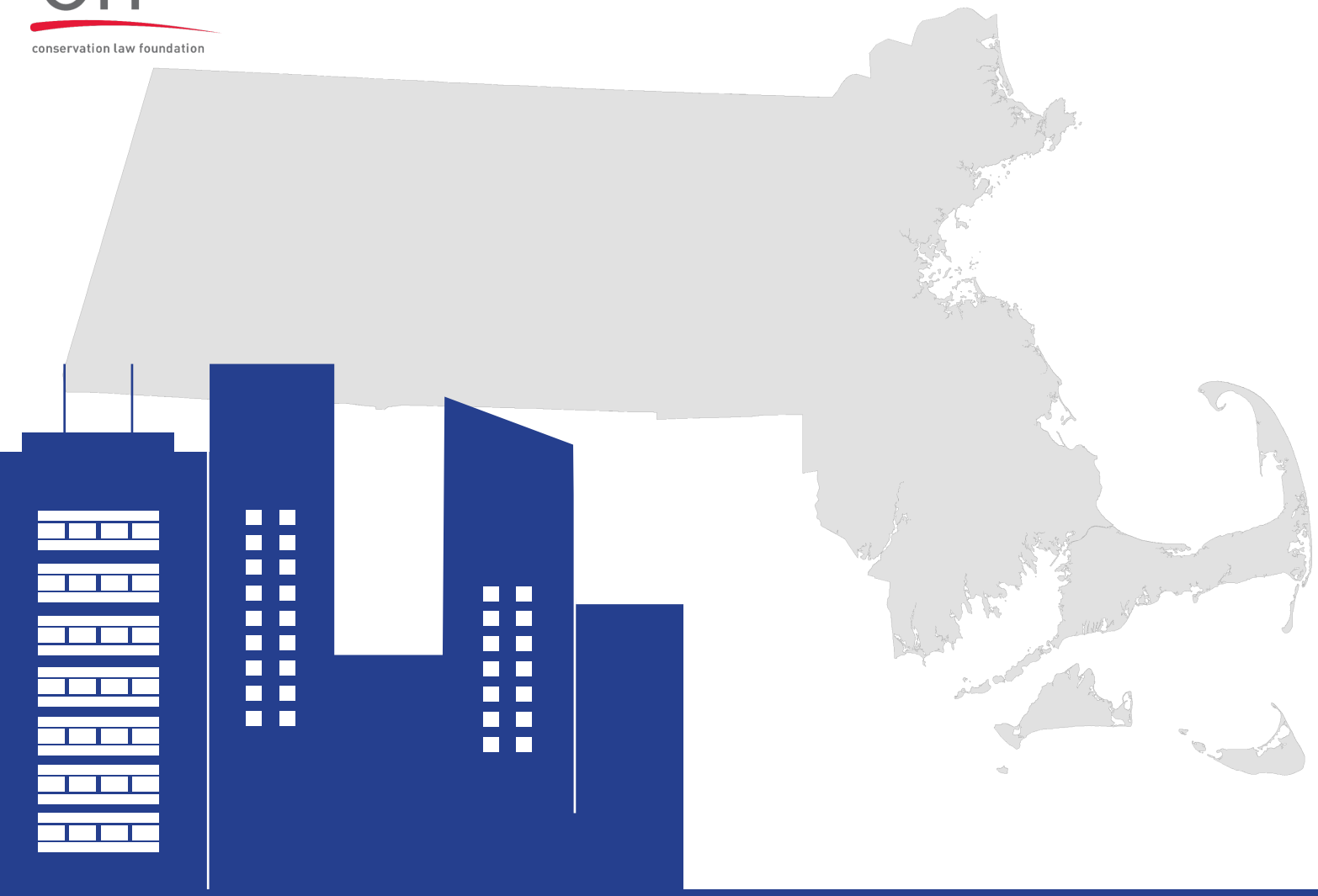

The Massachusetts State Building Code & Climate Change

A legal primer and
summary of convenings

March 2019

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DISCLAIMER

Part V of this paper includes summaries of several stakeholder convenings held by CLF over the course of 2018. Parts I-IV of this paper and any recommendations therein do not necessarily reflect the opinions of those participants or consensus. Similarly, the summary of the discussions from these stakeholder convenings does not necessarily reflect the views of CLF or individual participants. Pathways for reform identified in this report are for discussion purposes only and may not reflect CLF's position or that of any other participant. This review is meant to provide information about, and a range of perspectives on, the Massachusetts state building code and climate risk based on legal research and the views of a representative but necessarily incomplete range of experienced practitioners.

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Executive Summary

The purpose of the Massachusetts State Building Code (MSBC) is "to establish minimum requirements to safeguard the public health, safety, and general welfare through structural strength, means of egress facilities, stability, sanitation, adequate light and ventilation, energy conservation, and safety to life and property from fire and other hazards attributable to the built environment, and to provide safety to fire fighters and other emergency responders during emergency operations."[1] Extreme weather and the increasing number and severity of climate risks bear on each and every one of these purposes. The MSBC's credibility as a standard for design and construction practices, and its efficacy in meeting these stated purposes, can be sustained only if the MSBC responds to climate conditions that have changed and will continue to change the nature and degree of the "hazards attributable to the built environment."

Currently, the MSBC relies entirely on historical meteorology to regulate the built environment and ignores increasingly sophisticated and accurate climate modeling of future conditions. Flood standards in the MSBC are tied to Federal Emergency Management Agency (FEMA) data for the 100-year flood zones, which rely on historical patterns. Similarly, 30-year trailing average temperatures are used to size mechanical equipment for heating and cooling, and past hurricanes and blizzards set design wind speeds and live loads that determine the strength of roofs, windows, and structural elements. Given the increasing divergence between past and anticipated conditions, the MSBC is increasingly an anachronism.

Energy use in buildings determines the contributions of the built environment to greenhouse gas (GHG) emissions, the resilience of the built environment to extreme and disruptive weather, and the speed with which communities can recover after catastrophic events. The building sector currently accounts for 39 percent of carbon dioxide emissions in the United States per year, more than any other sector,[2] and so is essential to meeting the Commonwealth's mandates for reducing greenhouse gas emissions.

Despite its current shortcomings, the MSBC could be the starting point for protecting the region's economy, the health and safety of our communities, and the integrity of the trades and professions responsible for the built environment as our climate changes. Design and construction standards, material specifications, validated climate projections and assumptions, and updated siting criteria can help communities adapt, become more resilient, and recover more quickly as the climate changes. More efficient energy systems, distributed generation, microgrids, and standards for locating and protecting energy equipment and utilities can dramatically increase the resilience of the built environment to extreme weather. The current

[1] 780 CMR 101.3.

[2] *Buildings and Climate Change*, U.S. GREEN BLDG. COUNCIL, https://www.eesi.org/files/climate.pdf.

challenge is changing a slow and incremental codification process to one that can respond to rapidly evolving conditions so that the Commonwealth might realize the MSBC's potential.

Obstacles to Building Code Reform

Addressing these issues will require not only code revisions, but also potentially a transformation in the regulatory framework and governance structure for the MSBC. Conservation Law Foundation (CLF) convened a series of meetings with practitioners between January and April 2018 to help inform the content of this paper. Many common issues surfaced, including the preemption of local building standards, the role of zoning, the limitations of the state's code amendment process, and reliance on the International Code Council model codes. Concerns also arose about the potential unintended consequences of allowing more flexibility at the local level to impose different or more stringent building codes, including inconsistency in standards across the state and competitive disadvantage in attracting development and investment to the Commonwealth.

Pathways for Change in Massachusetts

In the course of our dialogue among interested practitioners and supplemental research, CLF identified four distinct and plausible pathways for code reform to address climate mitigation and adaptation in the MSBC.

- ### Amendments to the Tenth Edition of the MSBC

  The Board of Building Regulations and Standards (BBRS) is statutorily required to revise the building code every five years and anyone can submit code change proposals. The BBRS is currently considering the Tenth Edition of the code, which may provide a near-term opportunity for proposing climate-related code reforms. While CLF's research suggests that the code amendment process may not be conducive to extensive or comprehensive climate change reforms, smaller changes may be feasible through this process.

- ### Adoption of a new model code or certification program

  A softer approach to code reform could be to provide more flexibility and opportunities for cities and towns to opt into, or incentivize developers to build to, higher building standards. This could be accomplished in a number of ways, including through voluntary certification programs or through the adoption of existing model codes geared toward environmental sustainability like the International Green Construction Code (IgCC).

- ## Changes to or replacement of the Stretch Energy Code

  Massachusetts currently has an optional "Stretch Energy Code," which municipalities can adopt to employ a higher minimum standard than the MSBC for the energy efficiency of new buildings. The existing Stretch Energy Code provides a number of opportunities to address climate change. For example, it could be updated to include more stringent requirements, it could provide additional tiers of requirements that cities and towns can opt-into, or it could be replaced altogether with a more rigorous set of standards.

- ## New legislation

  Filing legislation to compel greater consideration of climate change in the MSBC, or to overlay additional mitigation or adaptation requirements outside of the code, could provide an alternative to the BBRS amendment process. A legislative alternative could be adopted more quickly, bypassing the often glacial pace of the code amendment process, but may sacrifice the institutional and procedural benefits – primarily that of uniformity – attributed to the current code amendment process, balky as it may be.

These pathways are not necessarily mutually exclusive; they can be pursued together.

This paper does not provide substantive recommendations on code revisions and specifications. However, next steps should include convening a coalition of stakeholders to identify leading design strategies to promote adaptation and reduce carbon emissions. This group should identify current building code specifications that actively impede the identified design strategies or fail to support and incentivize them, as well as develop recommendation for code revisions that can help overcome these challenges.

Introduction and Background

In 2016, CLF began a nearly two-year-long research project examining liability risks associated with private and public sector failures to adapt to climate change. In the spring of 2017, as part of that work, CLF held several climate liability workshops for professionals from both sectors.

The resulting report from that research (Climate Adaptation Liability Report) found that compliance with explicit regulatory requirements, including building codes, does not necessarily shield design professionals from liability, as many building and design regulations do not address the risks that science has shown are anticipated due to climate change.[3]

Although the original intent of building codes in the United States was to protect property from loss or damage, public health and public safety have also become an important focus of the code. However, many observers recognize that existing codes do not address the risk to people and property from extreme weather events. Codes have relied on historical meteorological data to address weather-related building requirements, but this method assumes that the climate is stable over time. As new technology continues to deepen our knowledge of future conditions and increases the sophistication and accuracy of climate predictions, we know that the climate is not stable and that the kind and degree of likely climate change is, increasingly, ascertainable by design and building professionals from publicly available sources. We must update our codes to reflect these developments.

For example, flood standards referenced in building codes are often based on FEMA data for the 100-year flood zones, which rely on historical patterns. Similarly, 30-year trailing average temperatures are used to size mechanical equipment for heating and cooling. Past hurricane and blizzard data are used to set design wind speeds and live loads that determine the strength of roofs, windows, and structural elements.

Changes to building codes are also often reactive. Past revisions have primarily been in response to catastrophic loss caused by fires and other events that have resulted in significant loss of life. There have been few attempts to proactively revise building codes to account for predicted future climate conditions. However, building energy codes[4] *have* been used proactively to reduce energy use and greenhouse gas emissions for new buildings. And this overhaul of the energy codes has delivered results. Code-compliant homes built to 2012

[3] Deanna Moran & Elena Mihaly, *Climate Adaptation and Liability: A Legal Primer and Workshop Summary Report,* CONSERVATION LAW FOUNDATION and BOSTON GREEN RIBBON COMMISSION 9 (2018), https://www.clf.org/wp-content/uploads/2018/01/GRC_CLF_Report_R8.pdf.

[4] Energy codes are just one of many building codes, such as fire, electrical, structural, or plumbing codes. Energy codes cover, for example, the walls/floors/ceiling insulation, windows, air leakage, and duct leakage.

standards used about half the energy consumed by a standard home constructed in 1975.[5] U.S. cities like Los Angeles and New York and countries like Canada, Australia, and New Zealand have advocated for going even further on energy use and responding to extreme weather events through code modernization.[6]

Attendees at CLF's climate liability workshops – including architects, engineers, regulators, and others – noted that in Massachusetts, the MSBC precludes cities and towns from mandating more climate-ready design and climate adaptation measures. Municipalities are generally prohibited from adopting design and construction standards more stringent than those contained in the MSBC, and local zoning regulation may not address matters addressed in the building code. At the same, it can sometimes be difficult for design professionals to advocate for building features that go beyond minimum code requirements when there is little incentive for developers to do so.

Following the release of its Climate Adaptation and Liability Report, CLF convened practitioners to discuss the building code challenges that surfaced during the 2017 workshops. CLF hosted three meetings between January and April 2018. The discussion from these meetings is summarized in Part V of this paper. In addition, CLF conducted legal and best practice research to help educate and guide stakeholders on possible pathways forward for incorporating climate change risk into the MSBC.

While the original focus of these convenings was climate adaptation, participants expressed strong interest in both climate mitigation- and adaptation-based reforms to the MSBC. Mitigation is defined here as strategies to reduce emissions of, and stabilize levels of, greenhouse gases in the atmosphere. The building sector currently accounts for 39 percent of carbon dioxide emissions in the United States per year, more than any other sector.[7] Adaptation is defined here as the process of adjusting to actual or expected future climate conditions to reduce risks to people and assets.[8] Climate-ready design and construction practices should include both mitigation and adaptation measures. Following such practices should result in new and existing buildings that (i) have ultra-low carbon emissions consistent with Intergovernmental Panel on Climate Change (IPCC) mid-century goals, and (ii) reduce risk to people and property by minimizing damage and disruption from expected changes in our climate.

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[5] Lauren Urbanek, *The Climate is Changing. So Why Aren't State Building Codes?,* NATIONAL RESOURCES DEFENSE COUNCIL BLOG, Apr. 5, 2018. https://www.nrdc.org/experts/lauren-urbanek/climate-changing-why-arent-state-building-codes

[6] *Resilience of Buildings to Extreme Weather* Events, AUSTRALIAN BUILDING CODES BOARD (2014), https://www.abcb.gov.au/Resources/Publications/Consultation/Resilience-of-Buildings-to-Extreme-Weather-Events.

[7] *Buildings and Climate Change*, U.S. GREEN BLDG. COUNCIL, https://www.eesi.org/files/climate.pdf.

[8] Christopher B. Field et al., *Climate Change 2014: Impacts, Adaptation, and Vulnerability Part A: Global and Sectoral Analysis,* INTERGOVERNMENTAL PANEL ON CLIMATE CHANGE 40 (2014), https://www.ipcc.ch/site/assets/uploads/2018/02/WGIIAR5-PartA_FINAL.pdf

Addressing the current shortcomings of the MSBC is essential for mitigating and adapting to climate change. This paper does not provide specific recommendations for building code revisions; rather it provides a snapshot of the current limitations of the MSBC and potential strategies and opportunities for modernization. This is not an exhaustive review – it serves as a starting point for stakeholders to examine ways to retool the MSBC to better enable climate-ready design and construction.

PART ONE

Massachusetts Legal/Policy Framework for Climate Change

Massachusetts has made great strides in addressing climate change over the past decade, with the adoption of several laws and policies addressing both adaptation and mitigation. Most notably, the legislature passed the Global Warming Solutions Act (GWSA) in 2008, which requires the Commonwealth to establish economy-wide greenhouse gas emissions reduction targets, including a 25 percent reduction from all sectors of the economy below the 1990 baseline emission level by 2020, and at least an 80 percent reduction by 2050.[9] While the focus of the GWSA was emissions reduction, the statute does address adaptation to a limited extent. Specifically, the GWSA amended G.L. c. 30, § 61 to require state agencies to consider reasonably foreseeable climate impacts such as sea level rise in the issuance of permits, licenses, and other administrative decisions. However, the impact of this provision is limited, as it merely requires consideration, and not action.

The Massachusetts legislature also passed the Green Communities Act (GCA) in 2008, which represented a significant shift in the state's energy policy.[10] The GCA expanded investment in energy efficiency programs; allowed cities and towns, businesses, and residents to take advantage of net metering programs; required electric utilities to enter into long-term contracts for new grid-connected renewable power sources; expanded the state's renewable energy portfolio standard requirements; and allowed electric utilities to construct and own/operate solar photovoltaic systems.[11] The GCA also established a municipal grant program, which allows municipalities who have met the "Green Community" designation criteria to apply for funding to implement energy efficiency measures, construct renewable energy projects, or develop other strategies to reduce fossil fuel energy consumption.[12]

In 2016, Governor Charlie Baker signed Executive Order No. 569 (E.O. 569), which established an integrated climate change strategy for the Commonwealth. It requires, among other things, the promulgation of regulations to implement the GWSA, as well as coordination and consistency among new and existing efforts to mitigate and reduce greenhouse gas emissions

[9] CLF was instrumental in the GWSA's enactment in 2008. Alongside Green Energy Consumers Alliance and four teenage plaintiffs, CLF later sued the Massachusetts Department of Environmental Protection over the Commonwealth's failure to enforce the GWSA. In 2016, the Supreme Judicial Court ruled in CLF's favor, prompting Governor Baker to issue Executive Order No. 569. *See Kain v. Dep't of Envtl. Prot*., 474 Mass. 278 (2016).

[10] Paul J. Hibbard et al., *The Impacts of the Green Communities Act on the Massachusetts Economy: A Review of the First Six Years of the Act's Implementation*, ANALYSIS GROUP 1 (2014).

[11] G.L. c. 25A, § 10.

[12] *Green Communities Designation and Grant Program*, Section under *Energy,* COMMONWEALTH OF MASS., https://www.mass.gov/green-communities-designation-grant-program.

and adapt to the impacts of climate change.[13] E.O. 569 also requires the state to develop a climate adaptation plan and a technical assistance program for municipalities to assess climate vulnerabilities, and contains a directive that state agencies evaluate how their policies, programs, and assets may be vulnerable to predicted climate change impacts.

Last session, the legislature passed an Environmental Bond Bill, which codified many of the requirements of E.O. 569, and the Commonwealth has already completed or put into motion many of the bill's deliverables.[14] For example, the Commonwealth developed the Municipal Vulnerability Preparedness (MVP) program to meet its obligations to provide a technical assistance framework for cities and towns. The program provides support for municipalities to plan for climate resiliency and implement key climate adaptation strategies. Communities that complete the program become certified as MVP communities and are eligible for grant funding and other benefits. As of October 2018, there were 74 MVP-designated communities, with another 80 communities completing an initial planning grant with the intention of seeking MVP designation.[15]

[13] Mass. Exec. Order No. 569 (Sept. 16, 2016).
[14] 2018 Mass. Acts 209.
[15] *Municipal Vulnerability Preparedness Program – Municipal Designation Status*, EXEC. OFFICE OF ENERGY AND ENVTL. AFFAIRS (2018), https://www.mass.gov/files/documents/2018/10/17/master-list-of-mvp-municipal-status-10-12-18.pdf.

PART TWO

Overview of Zoning and Building Law in Massachusetts

Understanding the interplay between zoning and building codes and the associated restrictions on local government is critical to addressing climate-ready design and construction in Massachusetts. This section will survey the main areas of law governing building design and construction in Massachusetts: zoning and municipal police powers, the state building code, and the Massachusetts Stretch Energy Code.

The Zoning Act and Municipal Police Powers

Zoning is the quintessential form of local building and land use regulation. It is broadly defined as the "division of a municipality or other local community into districts, and the regulation of buildings and structures according to their construction and the nature and extent of their use, or the regulation of land according to its nature and use."[16] In other words, local zoning traditionally governs the form and use of land and structures, based on the unique circumstances and characteristics of districts and neighborhoods.

Zoning ordinances typically specify different requirements governing development by zone or district, such as setbacks and building density and size. Overlay zoning is sometimes employed to superimpose additional requirements on an existing zone because the area of the overlay zone has special characteristics, such as natural resources (e.g., wetlands or beaches).

Under the Zoning Enabling Act (the Zoning Act), Massachusetts defines "zoning" as "ordinances and bylaws, adopted by cities and towns to regulate the use of land, buildings, and structures to the full extent of the independent constitutional powers of cities and towns to protect the health, safety and general welfare of their present and future inhabitants."[17] In short, all land use regulation in Massachusetts can be considered "zoning" if it is enacted within a municipality's constitutional powers and pursuant to the Zoning Act.

As codified in the Zoning Act, the Commonwealth's authority to issue zoning laws is derived from its "police power" – a general authority to promulgate legislation for the protection of public health, safety, morals, and welfare.[18] As explained by the Supreme Judicial Court, the police power "extends to all matters which concern [a state's] internal regulation."[19] Under the Home Rule Amendment to the Massachusetts Constitution, cities and towns in Massachusetts have the authority to exercise all police powers of the Commonwealth that are not inconsistent

[16] 82 Am. Jur. 2d, *Zoning and Planning,* § 2 at 387 (1976).
[17] G.L. c. 40A, § 1A (1975).
[18] *See* MASS. CONST. pt. 2, ch. 1, § 1, art. IV.
[19] *Commonwealth v. Bearse*, 132 Mass. 542, 546 (1882).

with the Constitution and the laws of the Commonwealth (including the Zoning Act).[20] While it is difficult to establish the precise boundaries of police powers to create zoning regulations, the Supreme Judicial Court has developed extensive case law on permissible zoning, including preserving street surfaces,[21] preserving agricultural land and its value,[22] and stabilizing the use of property.[23] Furthermore, cities and towns may consider planning and future growth when enacting zoning laws.

In Massachusetts, as with most states, permissible zoning objectives include securing safety from flooding, facilitating the adequate provision of water and drainage, and conserving the value of land and buildings.[24] However, the Zoning Act specifically provides that "no zoning ordinance or by-law shall regulate or restrict the use of materials, or methods of construction of structures regulated by the state building code[.]"[25] There is some question as to the enforcement of the statute and potential flexibility for municipal regulation given that municipalities with historic district overlays[26] often integrate guidelines for building materials, color, scale, and more.[27]

The distinction between the scope of local zoning laws and that of the MSBC is not always clear, but in some cases, municipalities have successfully implemented resiliency programs via zoning laws without running afoul of the MSBC. Some examples include limiting the types of uses in certain at-risk areas, influencing types and form of structures through height and setback requirements, prohibiting new or expanded development areas at risk of flooding, and offering zoning-based incentives for going above and beyond minimum code requirements.[28,29] Cities and towns may also impose more stringent requirements through special permits because they are a form of discretionary, conditional approval. Under this scenario, the city or town is not mandating the more stringent standards; instead, the applicant is voluntarily taking on the

[20] *See* MASS. CONST. art. 89, § 6 (amended 1966).
[21] *Opinion of Justices*, 234 Mass. 597 (1920).
[22] *Town of Burlington v. Dunn*, 318 Mass. 216 (1945).
[23] *Everpure Ice Mfg. Co. v. Bd. of Appeals of Lawrence*, 324 Mass. 433, 435 (1949).
[24] The Zoning Act, G.L. c. 40A.
[25] G.L. c. 40A, § 3.
[26] Note that G.L c. 40C explicitly allows for the adoption of ordinances or by-laws establishing historic districts.
[27] See for instance the Design Guidelines and Procedures for the Historic Business District in Chatham, MA. The Guidelines and Procedures describe the desired design, siting, scale, materials and colors to be used in the Historic Overlay District of the town. TOWN OF CHATHAM, HBDC DESIGN GUIDELINES AND PROCEDURES (approved Oct. 7, 2015), https://www.chatham-ma.gov/sites/chathamma/files/uploads/hbdc_design_guidelines_and_procedures.pdf.
[28] The Town of Hull's zoning bylaw includes a section on incentives for constructing buildings that are adapted to and resilient to the impacts of climate change on coastal communities in designated floodplain districts. Incentives include a rebate of up to $500 on the building permit fees. *See* TOWN OF HULL, ZONING BY-LAW OF THE TOWN OF HULL (2018), http://www.town.hull.ma.us/Public_Documents/HullMA_BComm/ZBL%202018%20STM.pdf.
[29] In 2010, the town of Oak Bluffs on Martha's Vineyard adopted amendments to its Floodplain Overlay District By-law which prohibits new residential development and expansion of existing development in FEMA flood Zones V, VE and AO. The amendments also require that construction in Zone A meet design criteria and performance standards and go through a special permitting process. *See* TOWN OF OAK BLUFFS, THE TOWN OF OAK BLUFFS FLOODPLAIN OVERLAY DISTRICT BY-LAW (2010), https://www.mass.gov/files/documents/2016/08/sm/oak-bluffs-bylaw.pdf.

more stringent standards in exchange for the right to build where it otherwise is not permitted.[30]

Additionally, the Massachusetts Department of Public Health has adopted the State Sanitary Code to protect the health, safety, and well-being of the occupants of housing and of the general public. The State Sanitary Code is enforced by local boards of health, which may also adopt additional regulations necessary for the particular locality. Included within these rules is the State Housing Code, which requires buildings to be fit for human habitation.[31] Dwellings must exclude wind, rain, and snow, be weather-tight and watertight, and be free from chronic dampness. Climate change obviously bears on these standards, particularly increased coastal flooding and more frequent storm activity. Prolonged power outages caused by extreme weather events can raise human health issues with respect to access to clean air and light, as well as sanitation issues. The State Public Health Law also grants municipal boards of health the power to abate nuisances that "may be injurious to the public health."[32]

The State Sanitary and Housing Codes provide regulatory minimums and enable municipalities to promulgate more restrictive regulations to achieve their goals of abating nuisances and protecting public safety if they are not in conflict with other laws. Municipalities may seek to use their authority to further specify what conditions are dangerous to health and safety. Municipalities primarily accomplish this through local boards of health pursuant to G. L. c. 111, § 31. However, municipalities would likely be prohibited from promulgating sanitary codes that conflict with the MSBC.[33]

Massachusetts State Building Code

All buildings in the Commonwealth are subject to the MSBC.[34] As set forth above, the purpose of the MSBC is to "establish minimum requirements to safeguard the public health, safety and general welfare through structural strength, means of egress facilities, stability, sanitation, adequate light and ventilation, energy conservation, and safety to life and property from fire and other hazards attributable to the built environment, and to provide safety to fire fighters and emergency responders during emergency operations."[35] Authority to develop and enforce the MSBC is vested in the Board of Building Regulations and Standards. The BBRS is housed

[30] G.L. c. 40A, § 9 ("Zoning ordinances or by-laws shall provide for specific types of uses which shall only be permitted in specified districts upon the issuance of a special permit. Special permits may be issued only for uses which are in harmony with the general purpose and intent of the ordinance or by-law, and shall be subject to general or specific provisions set forth therein; and such permits may also impose conditions, safeguards and limitations on time or use.").
[31] G.L. c. 111, § 127B.
[32] G.L. c. 111, § 122.
[33] G.L. c. 111, § 127A.
[34] G.L. c. 143, § 94.
[35] 780 CMR NINTH EDITION, BASE VOLUME, § 101.3.

within the Executive Office of Housing and Economic Development (EOHED) under the Division of Professional Licensure.

The BBRS is made up of eleven members appointed by the governor.[36] Each member is appointed for a term of five years and is eligible for reappointment. The principle objectives of the BBRS are to formulate "[u]niform standards and requirements for construction and construction materials, compatible with accepted standards of engineering and fire prevention practices, energy conservation and public safety . . . [and to adopt] modern technical methods, devices and improvements which may reduce the cost of construction and maintenance over the life of the building without affecting the health, safety and security of the occupants or users of buildings."[37]

Like most states, Massachusetts relies heavily on the building codes promulgated by the International Code Council (ICC),[38] a U.S.-based non-profit organization dedicated to "developing model codes and standards used in the design, build and compliance process to construct safe, sustainable, affordable and resilient structures."[39] The International Building Code (IBC) came into existence, in large part, for commercial reasons, enabling builders and design professionals to operate with greater uniformity and predictability across state lines.

The ICC's family of model codes is a fully coordinated set of construction codes. They are developed through a governmental voting process, which leaves the final determination of code provisions in the hands of public safety officials in each jurisdiction who, with no vested financial interest, can legitimately represent the public interest. These codes are updated every three years and are designed to work together or as stand-alone codes. Included in the family of codes are: a Building Code, an Energy Conservation Code, an Existing Building Code, a Fire Code, a Fuel Gas Code, a Green Construction Code, a Mechanical Code, a Performance Code, a Plumbing Code, a Private Sewage Disposal Code, a Property Maintenance Code, a Residential Code, a Swimming Pool and Spa Code, a Wildland Urban Interface Code, and a Zoning Code.

For existing buildings, facilities and systems, the IBC addresses such concerns as life safety issues related to use and occupancy classifications, means of egress, mechanical, electrical and plumbing systems, structural design, lighting and ventilation, accessibility, and energy conservation. The IBC applies to all occupancies, including one- and two-family dwellings and townhouses that are not within the scope of the International Residential Code (IRC), which defines requirements for detached one- and two-family dwellings and townhouses. The

[36] The current makeup of the BBRS includes two building inspectors, the state Chief of Inspections, a registered architect, a representative of the building trades, the head of a local fire department, a registered mechanical engineer, a registered structural engineer, two contractors, and the state Fire Marshal.
[37] G.L. c. 143, § 95.
[38] Massachusetts also uses National Fire Protection Association (NFPA) based codes and homegrown codes like the State Plumbing Code and Massachusetts Architectural Access Board's (MAAB) regulations.
[39] *About the International Code Council*, INT'L CODE COUNCIL, https://www.iccsafe.org/about-icc/overview/about-international-code-council/.

International Energy Conservation Code (IECC) encourages energy conservation through efficiency in envelope design, mechanical systems, lighting systems, and the use of new materials and techniques. As previously noted, through a governmental consensus process that ensures public interest protections, ICC develops these codes to be fully coordinated across the entire family of model codes.

The MSBC actually consists of several international model codes, with various amendments to the model codes promulgated by the BBRS.[40] The MSBC is separated into two distinct volumes: the Residential volume regulates all one- and two-family structures and townhouses that are three stories or less, as well as their accessory structures, and the Base volume regulates all structures that are not covered by the Residential volume.[41]

The current edition (Ninth Edition) of the MSBC became effective October 20, 2017 and applies to all new projects permitted on or after January 1, 2018. The new edition of the code is based on 2015 modifications made to the ICC's model codes, including:

- International Building Code,
- International Residential Code,
- International Existing Building Code,
- International Mechanical Code,
- International Energy Conservation Code,
- International Swimming Pool and Spa Code, and
- Portions of the International Fire Code.

The BBRS is required to review, revise, and amend the MSBC as needed at least once every five years[42] with additional amendments as needed.[43] State law further requires the BBRS to update the energy provisions of the MSBC within one year of any revision to the IECC.[44] However, in practice, it often takes longer for the BBRS to make updates to both base and energy codes.

The MSBC does not specifically address the impacts of climate change, nor does it generally require the use of climate-ready building practices.[45] However, a 2016 update to the building code requires new development in flood hazard areas as defined by the MSBC (areas with a one percent annual flood risk based on FEMA Flood Insurance Rate Maps (FIRM)) to elevate buildings and their mechanical systems with two feet of "freeboard" above the base flood

[40] 780 CMR NINTH EDITION, § 115 et seq.
[41] *Massachusetts State Building Code – 780 CMR,* Section under *Board of Building Regulations and Standards*, COMMONWEALTH OF MASS., https://www.mass.gov/massachusetts-state-building-code-780-cmr.
[42] It is worth noting that this five-year review timeline is not in line with the three-year timeline that ICC employs for updates to model codes and therefore, the MSBC is not always updated to the international standard in a timely manner.
[43] The BBRS has also periodically updated certain codes on a more frequent basis.
[44] G.L. c. 143, § 94.
[45] Building code provisions that address resiliency would be fully consistent with the public health and safety objectives of the code, and would also reduce long term maintenance costs, another code objective.

elevation.[46] Freeboard is the additional height used as a factor of safety in setting the minimum elevation of a structure, or for floodproofing measures applied to a structure to provide a higher level of protection for certain structures based on importance, or to compensate for factors that may increase flood heights and uncertainties inherent in determining flood frequencies and flood elevations.[47]

However, the MSBC's reliance on FEMA's FIRMs is problematic. First, FEMA FIRMs are of varying ages and levels of quality. Second, the maps rely exclusively on historical data and do not incorporate forward-looking climate data. As such, they significantly underestimate current and future flood risks.[48] The MSBC relies on FEMA FIRMs in two key ways: (1) the establishment of base flood elevations and (2) the application of flood-resistant construction standards.[49]

One important challenge for municipalities is to speed the rate at which existing buildings and structures are retrofitted for future climate conditions. This will become even more imperative – and difficult – as climate change accelerates later in the century. Another limitation of the MSBC in this context is that it generally only applies to new construction and substantial repairs, alterations, additions, and changes of use to existing buildings and structures. The existing thresholds at which modifications to existing buildings would trigger requirements for other improvements to bring them into code compliance may be set too high to effectively address this challenge.

The MSBC only sets minimum standards. The decision to incorporate any measures beyond the MSBC requirements is left to individual developers and property owners. In addition, as discussed in Part A above, the MSBC preempts all municipal ordinances in the state relating to building standards.[50] Municipalities and other local governing bodies may not adopt standards that are inconsistent with the MSBC even if they are more stringent than the base code. However, state law allows for municipalities to apply to the BBRS for permission to impose more restrictive provisions to account for "special conditions prevailing within such city or town."[51] In accordance with G.L. c. 143, § 98, the BBRS may then approve such additional restrictions if it finds that the more restrictive standards are "reasonably necessary" and conform to national standards. This BBRS petition process is separate from the Home Rule petition process, which requires legislative action. While the BBRS has entertained several municipal petitions over the years, few have been approved. In one case, the Town of

[46] *Protecting Coastal Property from Major Storm Damage*, MASS. DEP'T OF ENVTL. PROT. (2008), https://www.mass.gov/guides/protecting-coastal-property-from-major-storm-damage.
[47] American Society of Civil Engineers, *Flood Resistant Design and Construction, ACSE 24,* Section C1.2 (2014).
[48] *See, e.g.,* U.S. DEP'T OF HOMELAND SECURITY, OFFICE OF INSPECTOR GENERAL, OIG-17-110, FEMA NEEDS TO IMPROVE MANAGEMENT OF ITS FLOOD MAPPING PROGRAMS (2017).
[49] The MSBC primarily addresses flood risk through Appendix 115.G, which establishes standards for flood-resistant construction in the 100-year flood plain as established by the relevant community's FIRM. While the Appendix does not discuss climate change or its impacts, the flood-resistant construction standards do contemplate extreme weather.
[50] *St. George Greek Orthodox Cathedral of W. Mass. v. Fire Dep't. of Springfield*, 462 Mass. 120, 122-127 (2012).
[51] G.L. c. 143, § 98.

Egremont was authorized to require sprinklers in single- and two-family homes due to sparse fire department personnel and extreme rural conditions.[52] But others, including proposals to ban wood roof shingles and shakes and a request for a differing pool enclosure requirement, both on Cape Cod, were denied. The BBRS has never received a petition related to climate change.

Current Massachusetts Standards for Environmental Factors

The ICC establishes climate zones as part of the IECC. These climate zones set out requirements for both exterior and interior design conditions, materials, systems, and equipment that are appropriate for the climate in which building construction takes place. The entire state of Massachusetts is considered zone five, and the code sets out requirements for building envelopes in the state, including standards for foundations, windows and doors, insulation, lighting, HVAC systems, and ducts.[53] Note that at the time of this writing, the MSBC is based on the 2015 version of IECC, not the most recent version published in 2018. However, the 2018 IECC is under consideration at the BBRS and is on track to take effect by July 2019.

Building standards for environmental factors such as wind, flooding, heat, seismic activity, and snow loads are based on design standards laid out in the International Building Codes of 2015, which in turn are informed by the American Society of Civil Engineers (ASCE) Standards. ASCE 7 sets out minimum structural design loads for floods, snow, earthquakes, wind, and other environmental factors and ASCE 24 sets out standards for flood resistant design and construction. The Commonwealth bases its building standards on the ICC Code, but amends the MSBC to account for local issues.[54]

For example, Chapter 16 of the MSBC sets specific design factors for snow loads, wind speeds, and seismic parameters for all 351 municipalities. The values are unique to Massachusetts and are presented to the BBRS by its Structural Advisory Committee. The underlying data source for these specific design factors and their variation across the state is unclear, though it is likely based on ASCE 7 standards, which rely on historical data as opposed to future projections of environmental conditions. Again, relying on historical climate patterns rather than forward-looking data underestimates current and future risks.

As previously discussed, flood standards in the code rely on FEMA FIRMs, which are official federal maps of a community that delineate the Special Flood Hazard Areas (SFHAs) in the state.

[52] The measure was soon repealed due to water availability and other issues.
[53] *IECC Compliance Guide for Homes in Massachusetts*, ALLIANCE TO SAVE ENERGY (2015), https://www.ase.org/sites/ase.org/files/massachusetts_2015_iecc.pdf.
[54] 780 CMR NINTH EDITION, ch. 16: Structural Design Amendments.

Massachusetts Stretch Energy Code

The MSBC includes an optional "Stretch Energy Code" (Stretch Code), which municipalities can adopt to employ a higher minimum standard than the MSBC for the energy efficiency of new buildings.[55] Cities and towns can implement the higher Stretch Code standard by a vote of the city council or a town meeting article. The Stretch Code was first adopted by the state in 2009 when the BBRS approved the Appendix as an optional amendment to the Seventh Edition of the MSBC. As of November 2018, more than 70 percent of the municipalities in Massachusetts have adopted the Stretch Code.[56] However, changes to the Stretch Code have not kept up with changes to the 2018 IECC, and as a result, there is very little difference between the Stretch Code and the base code today. This means that municipalities which have adopted the Stretch Code with the intention of adopting more stringent standards are no longer meeting that goal.

The Stretch Code is the result of the passage of the 2008 Green Communities Act, which requires municipalities seeking Green Community designation to, among other things, minimize the life-cycle cost of newly constructed homes and buildings by utilizing energy efficiency, water conservation, and other renewable or alternative energy technologies.[57] In essence, the GCA created an incentive for municipalities in the Commonwealth to adopt a more stringent energy code that requires greater energy efficiency in buildings than the mandatory statewide base code. This incentive is primarily based on the eligibility of GCA communities to apply for state grant funding. The Stretch Code appears to have been a compromise between the BBRS and the Massachusetts Department of Energy Resources (DOER) for achieving the provisions of the GCA. Specifically, it was a compromise between demands for stricter standards and concern over the potential for multiple and inconsistent building energy standards around the Commonwealth.[58]

While the development and adoption of building energy codes is within the sole jurisdiction of the BBRS, state law requires that it consult with DOER on energy codes. Specifically, BBRS has authority to "to adopt and fully integrate the latest International Energy Conservation Code as part of the state building code, together with any more stringent energy-efficiency provisions that the board, in consultation with the department of energy resources, concludes are warranted."[59] The reference to "more stringent energy-efficiency provisions" would categorically apply to the Stretch Code. The Stretch Code is also performance based, meaning It requires homes to meet a HERS (Home Energy Rating System) index rating target, rather than

[55] *See* 780 CMR NINTH EDITION 115 AA.

[56] *See* MASS. DEP'T OF ENERGY RES., STRETCH CODE ADOPTION, BY COMMUNITY (2018), https://www.mass.gov/files/documents/2018/11/28/stretch-code-towns-adoption-by-community-map-and-list.pdf.

[57] Green Communities Act (An Act Relative to Green Communities), G.L. c. 7, § 39D (2008).

[58] TOWN OF NEEDHAM, THE MASS. STRETCH ENERGY CODE: AN EXPLANATION AND ANALYSIS (2010), http://www.needhamma.gov/DocumentCenter/Home/View/3255.

[59] G.L. c. 143, § 94.

requiring the installation of specific levels of energy efficiency for each building element (e.g., windows, wall insulation, roof insulation, furnace).[60]

On January 1, 2017, both the base energy code and the Stretch Code were updated. As previously mentioned, the difference between the two is less significant now than it has been in the past. In fact, the updated Stretch Code will be incorporated into the updated base code. New residential construction in a municipality that has adopted the Stretch Code will need to follow the Performance Path of the base code and achieve a HERS rating of 55, rather than following the Prescriptive Path of the base code. The updated Stretch Code will also apply to new commercial buildings over 100,000 square feet and certain other types of commercial buildings.[61]

[60] The HERS rating is a measure based on a home's total expected energy use and overall efficiency. It is calculated by a certified HERS rater using accredited software, which uses information on the design of the energy systems in a home to calculate the annual energy needs. *See* MASS. DEP'T OF ENERGY RES., GREEN COMMUNITIES DIVISION, 2017 STRETCH ENERGY CODE (2017).

[61] Ibid.

PART THREE

Best Practices in the U.S.

The incorporation of climate data into design and building codes and standards, regulations, and laws is a relatively new focus for government entities, and as a result, there are few available models. The limited authority of Massachusetts cities and towns to adopt more stringent standards than the state minimum further complicates the applicability of existing models. In places like California and New York City, there is more local flexibility to amend relevant design and construction codes; however, local amendments and homegrown codes are not always advisable as they may complicate practice and subject design professionals to varying standards.

The best practices summarized here are not all statutory or regulatory in nature. Some may simply require reporting of certain information, or consist of voluntary guidelines, but municipal or regional bodies can nevertheless encourage resilient and sustainable design and construction practices with these strategies.

In fact, some Massachusetts cities have already begun to pursue non-code alternatives to encourage adaptation and mitigation. Boston's Green Ribbon Commission collaborated with local professional societies, including the Boston Society of Architects (BSA), to examine possible "best practices" for climate change adaptation and resilience for existing buildings. A 2013 report from the BSA, *Building Resilience in Boston,* outlined a number of technical strategies for resilient development, some of which have since been implemented by the City of Boston.[62]

For example, the 2013 report recommended developing a geospatial map of different forward-looking climate change scenarios and a vulnerability checklist to be considered when developing policies and projects. A few months later, the Boston Planning and Development Agency (BPDA) announced the "Climate Change Preparedness and Resiliency Guidelines" as an addition to Article 80 of the Boston Zoning Code. These guidelines require a checklist to be completed and approved before the BPDA authorizes final approval of new development projects. This checklist was updated in 2017 to include geospatial mapping of future climate risks. Other recommended strategies, like elevating new residential structures above design flood elevation or locating building mechanicals above the expected flood elevation, remain voluntary options in cities like Boston, in part, due to MSBC preemption.

In 2013, the City of Boston also promulgated a Building Energy Reporting and Disclosure Ordinance (BERDO), which requires buildings over 35,000 square feet to report annual energy

[62] *Building Resilience in Boston: "Best Practices" for Climate Change Adaptation and Resilience for Existing Buildings*, BOSTON SOCIETY OF ARCHITECTS (2013), https://www.architects.org/sites/default/files/Building_Resilience_in_Boston_SML_0.pdf.

and water usage.[63] Every five years, buildings must report the ways in which they are improving their energy performance, for example by lowering energy usage, decreasing reliance on fossil fuels, or getting an energy assessment. BERDO compliance can be accomplished in a number of ways through a combination of measures to achieve carbon emissions reductions. For example, buildings that are certified as "highly efficient" are exempt from BERDO Energy Action and Assessment requirements.[64]

Despite these positive steps, one overarching challenge continues to be utilizing climate data to inform building codes. In the flood context, codes for freeboard elevations are not based on forward-looking data, but rather on past flood experience. In the face of climate change, this is certain to be insufficient, especially for structures with a design or useful life of 50 years or more. The city of Myrtle Beach, South Carolina addressed this issue through city zoning requirements that any new residential construction located in a 100-year FEMA floodplain be elevated at least three feet above BFE.[65] However, this option is unavailable to cities and towns in Massachusetts because it would conflict with the MSBC, which sets elevation standards in floodplains. While Massachusetts cities and towns likely cannot require climate-related design standards through as-of-right zoning, some communities are requiring certain higher standards as a condition for a special permit. [66]

State and City Models for Climate-Ready Codes

Two cities and three states provide examples of best-practices for Massachusetts. While practices in other states and cities around the U.S. may not be directly applicable to Massachusetts, they can provide options for supplementing current MSBC restrictions through incentives and voluntary programs. To the extent that codes in other jurisdictions are more stringent than the MSBC, they may also inspire state level amendments that could be proposed to the BBRS or through legislation.

The relevant practices of New York City and Denver, as well as Rhode Island and a few leading Western states (California and Washington) are summarized below.

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[63] *Building Energy Reporting and Disclosure Ordinance ("BERDO")*, CITY OF BOSTON (2018), https://www.boston.gov/environment-and-energy/building-energy-reporting-and-disclosure-ordinance.

[64] GREENOVATE CITY OF BOSTON, BERDO: ENERGY ACTION AND ASSESSMENT HOW-TO GUIDE 6 (2018), https://www.boston.gov/sites/default/files/document-file-10-2018/berdo_action_assessment_how-to_guide_10.3.2018.pdf.

[65] *Zoning and Flood Protection*, Section on *Services,* CITY OF MYRTLE BEACH, http://www.cityofmyrtlebeach.com/services/flood_protection/index.php.

[66] "The Planning Board may at its discretion issue a Special Permit allowing new and existing buildings within a Special Flood Hazard Area, as defined by the latest edition of 780 CMR, to be elevated beyond the prescribed height limit to provide flood proofing by meeting or exceeding the flood elevation requirements of said CMR. Buildings cannot exceed the elevation required to comply with 780 CMR by more than four feet." *See* Town of Hull, *Zoning By-Law*, art. III, § 39B (2014).

New York City

New York City (NYC) is among several cities in the Northeast that, being more populous than many states, operates under its own building code. For this reason, revising building codes in NYC to address climate change is easier than the statewide approach required in Massachusetts. In 2018, NYC enacted several laws to improve buildings' energy efficiency including a more stringent energy code and energy grades. Specifically, a law adopted in January 2018 requires the New York City Energy Conservation Code (NYCECC) to reflect the most recent version of the New York State Energy Research and Development Authority's (NYSERDA) model stretch energy code, which is estimated to be approximately 25 percent more efficient than the IECC 2018 residential provisions.[67]

NYC has also adopted a robust benchmarking law that requires owners of commercial and multifamily buildings 25,000 square feet and greater measure their annual energy and water consumption. The disclosure requirements also mandate that buildings receive an energy efficiency "letter grade" based on the building's energy benchmarking score. In 2020, each building in the city will be assigned a letter grade and building owners will be required to post the grade and the building energy score on the structure (similar to requirements for health grades).[68] In addition, NYC passed a law to require energy audits and retro-commissioning[69] in buildings greater than 50,000 square feet.[70]

Denver

In 2016, Denver, Colorado adopted code amendments requiring that garages for new single family and duplex homes include the infrastructure necessary to support charging an electric vehicle.[71] The city's Climate Action Plan includes goals for a new building code[72] that would

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[67] Tom Walsh, *New York City Adopts Laws to Increase Energy Efficiency*, BURNHAM NATIONWIDE, April 10, 2018.
[68] N.Y.C. Local Law No. 84 (2009), N.Y.C. Admin. Code.
[69] Retro-commissioning is "the process of ensuring that the energy systems in an existing building are installed as per the design intentions, functionally tested, and capable of being operated and maintained, according to the owner's operational needs." https://www1.nyc.gov/site/buildings/business/energy-audits-and-retro-commissioning.page
[70] N.Y.C. Local Law No. 87 (2009), N.Y.C. Admin. Code.
[71] *Buildings in Denver to be safer, more energy-efficient with adoption of new building code*, Section on *Community Planning and Development*, CITY OF DENVER (Mar. 8, 2016), https://www.denvergov.org/content/denvergov/en/community-planning-and-development/news/2016/Denver-new-building-code-2016.html.
[72] The Denver Climate Action Plan states, "Denver will support stronger building codes by adopting the 2018 IECC to ensure that new construction and major renovation projects are highly efficient. The City will also continually improve codes over time by adopting code updates, creating new policies and incentives like stretch codes, and enforcing them; eventually increasing the code to net-zero for all new buildings. Intermediate strategies also include establishing a green lease program, providing incentives for high-performing, LEED and net-zero buildings, and providing training and outreach to drive investments in energy efficiency and behavioral-based energy efficiency." *See* CITY OF DENVER, DENVER 80x50 CLIMATE ACTION PLAN 5 (2018),

mandate net-zero construction by 2035, with incentives in the interim years for achieving LEED certified and/or net-zero construction.[73] However, municipalities in Colorado differ from Massachusetts because Colorado does not have a mandatory statewide energy code and municipalities are not prohibited from adopting local energy codes. Local enforcement agencies in jurisdictions that have adopted building codes are required to enforce the provisions of the residential energy code at the local level without state approval.[74]

Rhode Island

Rhode Island has enacted various changes to state law over the past twelve years that may serve as a more relevant model for Massachusetts because Rhode Island cities and towns are similarly prohibited from exceeding the state building code.[75] In 2006, the state's Building Code Commission amended the state building code to require that sea level rise be considered in the creation of new regulations, and later required that development in coastal zones be at least one foot above base flood elevation.[76]

In 2016, Rhode Island's statutory definition of building height was amended to exclude up to five feet of freeboard in flood hazard areas. In 2018, further legislative changes to state zoning rules allowed owners of or applicants for new building projects located in flood hazard areas to voluntarily calculate building height based on the Rhode Island Coastal Resource Management Council's (CRMC) design elevation maps, which are higher than FEMA base flood elevations.[77] These design elevation maps are for the 100-year flood, but take into consideration various sea level rise scenarios of between one and twelve feet, allowing projects to build higher off the ground while still complying with zoning requirements.[78] The changes to the definition of building height in Rhode Island have been somewhat controversial among some municipal planners because development of taller buildings on the shoreline, rather than managed retreat from environmentally-sensitive areas, could be an unintended consequence.[79]

CRMC also incentivizes voluntary adoption of more stringent building standards by offering expedited permitting for projects built to the bronze standard of the Fortified Home Program, a certification sponsored by the insurance industry to help homes better withstand catastrophic weather events. The expedited permit review applies to the CRMC permit-review procedures

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https://www.denvergov.org/content/dam/denvergov/Portals/771/documents/EQ/80x50/DDPHE_80x50_ClimateActionPlan.pdf.

[73] *Id*. at 8.

[74] BUILDING CODE ASSISTANCE PROJECT, STATE CODE STATUS: COLORADO (2018), http://bcapcodes.org/code-status/state/colorado/.

[75] R.I. GEN. LAWS § 23-27.3-100.1.7.

[76] Kristen L. Miller et al., *Sea-level Rise Adaptation Policy in Various States*, OLR RESEARCH REPORT (2012).

[77] *See* S.B. 2413, 2018 Gen. Assemb., Reg. Sess. (RI 2018).

[78] RHODE ISLAND COASTAL RESOURCES MANAGEMENT COUNCIL, SHORELINE CHANGE SAMP VOL. I, CH. 3: ASSESSING COASTAL HAZARD RISK 38 (2017).

[79] Frank Carini, *Planners Concerned New Rules Could McMansion R.I.'s Coast*, ECORI NEWS (June 24, 2018).

for residential projects. The Fortified Home construction standards and methods were developed by the Insurance Institute for Business and Home Safety (IBHS) and address extreme weather risks like hurricanes, high winds, hail, and severe thunderstorms.

California

The California Building Standards Code applies statewide. The California Building Standards Commission (CBSC) creates and adopts the code. Occasionally, the California legislature passes laws requiring that the CSBC, in its updates to the building code, consider solutions to certain environmental concerns. For example, in 2012, the legislature required the CSBC to consider incorporating a strategy to help reduce the urban heat island effect in the upcoming 2014 code update.[80] The legislature has also required that the CBSC adopt building standards for installation of electric vehicle charging infrastructure[81] and graywater infrastructure.[82]

In 2011, California was the first state to adopt a mandatory green building standards code known as CALGreen. CALGreen sets a baseline of mandatory measures, but also includes more rigorous, tiered, suggested regulations that local jurisdictions can adopt. The voluntary regulations apply to indoor and outdoor water use, construction waste diversion, mandatory inspection of energy systems, the use of low-pollutant emitting construction materials, and energy efficiency.[83] CALGreen standards and the voluntary regulations were one of the implementation efforts following passage of AB 32, California's Global Warming Solutions Act. State offices for housing, community development, and health planning – plus industry stakeholders and other interested parties – all took part in the development of the new mandatory standards. The California Air Resources Board has estimated that the CALGreen standards will reduce emissions by at least three million metric tons by 2020.[84]

In addition to cities and towns adopting more stringent tiers of CALGreen, municipalities across California have instituted various other measures to improve building efficiency.[85] These include: LEED or GreenPoints building requirements, prescriptive measures, performance standards, requirements for municipal buildings, enforcement checklists, incentives, and even

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[80] CAL. HEALTH & SAFETY CODE § 18941.9 (2013).
[81] CAL. HEALTH & SAFETY CODE § 18941.10 (2014).
[82] CAL. HEALTH & SAFETY CODE § 18941.8 (2011).
[83] *Green Building*, Section on *Sustainability*, BUILDING IN CALIFORNIA (2018), http://buildingincalifornia.com/green-building/.
[84] *Guide to the 2016 California Green Building Standards Code*, STATE OF CALIFORNIA viii (2016), https://www.documents.dgs.ca.gov/bsc/CALGreen/CALGreen-Guide-2016-FINAL.pdf.
[85] Experts have failed to reach a consensus about the exact causes of increasing construction costs in California although some have suggested that regulations, including building codes, are partly to blame. It is also unclear whether there is any evidence that the inconsistency in building codes among different cities and towns is a factor. *See: Understanding the Drivers of Rising Construction Costs in California,* TERNER CENTER FOR HOUSING INNOVATION, UC BERKELEY, https://ternercenter.berkeley.edu/construction-costs. For a general discussion on costs and benefits of code updates and compliance, *See: The Value and Impact of Building Codes*, ENVIRONMENTAL AND ENERGY STUDY INSTITUTE (2013), https://www.eesi.org/papers/view/the-value-and-impact-of-building-codes.

comprehensive ordinances that combine multiple measures. Whereas LEED certification applies to commercial buildings, the GreenPoints Rated program focuses on the efficient design and construction of residential buildings. Several cities and counties across California have adopted local ordinances that recommend or require the use of LEED ratings for commercial projects and GreenPoints for residential ones.[86] Prescriptive building code measures adopted locally include roof capacity for solar panels in West Hollywood and efficient water heaters and the use of EnergyStar appliances in Santa Monica.[87]

Many cities, towns, and counties in California have adopted performance standards for building energy efficiency. Any municipality that seeks to create an energy efficiency ordinance that is stricter than the state's regulations must have approval from the California Energy Commission. In some cases, these requirements are applied specifically to state or municipal buildings. Dozens of California localities, including large cities such as Los Angeles, San Francisco, Sacramento, and Oakland, require that municipal buildings of a certain size be LEED certified.[88] In San Francisco and Costa Mesa, municipal buildings must meet LEED Gold standards.[89]

For many California cities, enforcement of green building requirements is key. Some cities, including Santa Monica and Palo Alto, require green building verification prior to the issuance of occupancy permits. San Mateo County requires a bond of $1.50 per square foot to ensure green building standards are met. Other municipalities such as Livermore and Rohnert Park go further – their ordinances provide for the issuance of civil and criminal penalties for violating green building practices.[90]

It may also be possible to require retrofits over time for structures that are increasingly at risk of climate-related impacts like flooding. San Francisco's Mandatory Soft Story Retrofit Program (MSSP) may provide a model for this type of regulation. The program was created in 2013 as a multi-year community-based effort led by the Earthquake Safety Implementation Program and enforced by the City's Department of Building Inspection. The MSSP amends the building code to ensure the safety and resilience of San Francisco's housing stock to earthquakes through the retrofitting of existing buildings meeting certain eligibility criteria over a seven-year period. Other cities and towns have enacted additional building codes that require new developments to anticipate future energy needs.

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[86] *State and Local Government Green Building Ordinances in California*, STATE OF CALIFORNIA 4 (2011), http://ag.ca.gov/globalwarming/pdf/green_building.pdf.
[87] *Id*. at 6.
[88] It is worth noting that Boston was the first city in the U.S. to require private buildings over 50,000 square feet to be LEED certifiable. The city accomplished this through a zoning provision. *See* John Dalzell, *Celebrating the 10th Anniversary of Boston's Green Building Market Transformation,* U.S. GREEN BUILDING COUNCIL, Jan. 11, 2017.
[89] *State and Local Government Green Building Ordinances in California*, STATE OF CALIFORNIA 8 (2011), http://ag.ca.gov/globalwarming/pdf/green_building.pdf.
[90] *Id*. at 9.

Washington

The State of Washington also has a statewide building code. However, the statewide code only establishes minimum standards and municipalities are "authorized to amend the state building code" so long as the amendments do not diminish the state-set minimum performance standards.[91] Although municipalities can adopt local building ordinances that are more restrictive than the state code, any local amendments that affect single or multi-family homes are subject to review and approval by the State Building Code Council.[92] The council reviews these amendments to determine if they meet any of five jurisdiction-specific criteria: climatic conditions; geologic or seismic conditions; environmental impacts such as noise and dust, etc.; life, health, or safety conditions; and other special conditions.[93] Washington does not require that municipalities get state approval before amending local codes for commercial properties.

Financial Incentives

Perhaps the most valuable tools for municipal or regional authorities to encourage resilient construction are development and financial incentives. Such incentives are typically aimed at new construction and can provide benefits to developers at a low cost to the public. Incentives can include rebates, permit variances, and increased floor-area-ratio or number of units, but most offer expedited permit processing and lower permit fees. One illustrative example is Chicago's "Green Permit Program," in which commercial developers can reduce permitting times by committing to meet certain LEED standards.[94] Anaheim, Chula Vista, Los Angeles, Santa Monica, and other California cities also offer expedited permit processing, while San Francisco offers expedited permitting for LEED Gold buildings, floor-area-ratio and height waivers, rebates for photovoltaic installations, and rebates for water and energy efficiency.[95]

Municipalities in Massachusetts have begun to offer similar incentives. Weymouth, for example, has recently used its FEMA funding[96] to create a grant program to assist property owners in elevating their homes above the projected flood plain.[97] In addition, the 2013 BSA report notes that Weymouth has a successful water conservation program. Any new water use applicants in the town are required to offset projected water consumption in a 2:1 ratio

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[91] *See* WASH. REV. CODE § 19.27.040 (1990).
[92] WASH. REV. CODE § 19.27.060(1)(a) (2002).
[93] WASH. ADMIN. CODE § 51-04-030 (1990).
[94] *Overview of the Green Permit Program*, from *Department of Buildings,* CITY OF CHICAGO (2018), https://www.cityofchicago.org/city/en/depts/bldgs/supp_info/overview_of_the_greenpermitprogram.html.
[95] *State and Local Government Green Building Ordinances in California*, STATE OF CALIFORNIA 8 (2011), http://ag.ca.gov/globalwarming/pdf/green_building.pdf.
[96] It is worth noting that a substantial shortcoming of the program is that federal funding is only available following a Presidential major disaster declaration.
[97] *Home Elevation Grant Program,* from *Dep't of Planning & Cmty. Dev.,* TOWN OF WEYMOUTH (2018), https://www.weymouth.ma.us/planning-community-development/pages/home-elevation-grant-program.

through water conservation measures.[98] If a developer wants to build a new subdivision, they must first determine the water consumption of the project and then pay for water conservation retrofits that will save twice as much water as the new development will use. Using a different approach, Hull has provided $500 towards the cost of building permits to builders who voluntarily add two feet of freeboard beyond the building code requirements since 2009.[99]

[98] *Building Resilience in Boston: "Best Practices" for Climate Change Adaptation and Resilience for Existing Buildings*, BOSTON SOC'Y OF ARCHITECTS 89 (2013), https://www.architects.org/sites/default/files/Building_Resilience_in_Boston_SML_0.pdf.

[99] FEMA, HIGH MARKS FOR BUILDING HIGHER: HULL'S FREEBOARD INCENTIVE PROGRAM (2010), https://www.mass.gov/files/documents/2016/09/pn/freeboard-incentive-program-hull.pdf.

PART FOUR

Pathways for Change in Massachusetts

A variety of public- and private-sector stakeholders in Massachusetts have expressed interest in reforming the MSBC to better address climate change. Practitioners consulted for this report included regional planning associations, local governments, engineers, architects, attorneys, academics, professional societies for design and construction professionals, and other industry professionals. The environmental advocacy community in Massachusetts has also expressed significant interest in this issue. The position of some, but not all, of these stakeholders is that the current process by which building codes are adopted and amended is cumbersome and time-consuming. This section outlines some of the potential barriers to and opportunities for influencing the current system and discusses the feasibility of different approaches.

While the discussion below includes both mitigation and adaptation, different strategies may be better-suited for each. In particular, the direct and undeniable nexus between adaptation measures and public health and safety may provide a compelling basis for state-level code amendments. In contrast, mitigation measures that address end-use energy conversion[100] and increase energy efficiency standards may have more success through legislation than through the BBRS amendment process. It should be acknowledged that the development of codes through legislative action could create new issues, as legislators do not always recognize the collateral consequences for design and construction professionals.

The Baker administration has expressed interest in building code reform. The recently released Massachusetts State Hazard Mitigation and Climate Adaptation Plan ("the Plan") identifies review of the state building code as a high priority action item. Specifically, the Plan contemplates assessing the feasibility of "incorporating hazard mitigation and resilience into standards."[101] This action is to be coordinated by the Executive Office of Housing and Economic Development (EOHED). The BBRS, which is housed within the Office of Public Safety and Inspections, is currently under the oversight of EOHED. The Plan lists the relevant climate considerations for the MSBC as: precipitation changes, sea level rise, rising temperatures, extreme weather, and earthquakes. Energy efficiency is not mentioned.

The Plan, and the Baker administration's proclaimed commitment to climate change, may signal a political willingness at the state level to achieve some of the goals outlined below and increase the likelihood of accomplishing these goals through an administrative process. Moreover, under the state's Global Warming Solutions Act, emissions reductions are required by law. Since the commercial and residential building sector currently accounts for 39 percent

[100] This refers to the conversion of fossil-fuel burning heating and building services to 2050-compliant alternatives.
[101] *Massachusetts State Hazard Mitigation and Climate Adaptation Plan*, EXEC. OFFICE OF ENERGY AND ENVTL. AFFAIRS 14 (2018), https://www.mass.gov/files/documents/2018/10/26/SHMCAP-September2018-Full-Plan-web.pdf.

of carbon dioxide emissions in the United States annually, the Commonwealth must find a way to address this source of emissions to comply with the GWSA's GHG reduction targets.

The following options for reform reflect legal research, as well as discussions with relevant practitioners. Building on that research and those discussions, CLF considered four distinct reform pathways: (1) building code amendments through the existing BBRS process for the Tenth Edition of the MSBC; (2) adoption of the International Green Construction Code or another opt-in, additive standard; (3) updating, replacing, supplementing, or expanding the existing Stretch Code; and (4) new legislation. These pathways are not necessarily mutually exclusive; they can, and in some cases should, be pursued together. The pathways explored below do not necessarily reflect CLF's views or priorities; they are meant to be an informative starting point for a dialogue around climate-related code changes.

Tenth Edition Massachusetts State Building Code

The current process for proposing amendments to the MSBC is overseen by the BBRS. The BBRS is statutorily required to revise the building code every five years and hold public hearings each May and November to consider any proposed modifications. Anyone can submit code change proposals to BBRS. With the Ninth Edition of the code in effect, the BBRS has turned its attention to the Stretch Code amendments and adoption of the Tenth Edition. Ideally, the Tenth Edition changes will be effective in 2019 or 2020. Although the law requires revision of the code every five years, that does not always happen in practice. For example, eleven years elapsed between the promulgation of the Sixth and Seventh Editions of the MSBC. Regardless, the upcoming amendment process may provide an opportunity for the proposal of climate-related code reforms.

CLF's research suggests that the code amendment process may not be conducive to extensive or comprehensive climate change reforms based on the past success (or lack thereof) of climate-inspired amendment proposals and the perceived lack of interest from board members in addressing these issues through state-level amendments. This is particularly true for energy-related reforms, which are sometimes viewed as being outside the scope of the BBRS' statutory mandate. However, smaller changes – particularly those related to public health and safety – may be feasible.

The following code amendments were discussed in the stakeholder convenings as potentially feasible through this process:

- Apply the flood standards in Appendix 115.G of the MSBC, including floodproofing and freeboard, based on the projected one percent annual chance floodplain and base flood elevation within the estimated life of the structure. Reference authoritative statewide flood projection maps that incorporate climate change, rather than FEMA FIRMs;

- Require recommissioning for commercial projects at least once every five years (this would interface with building disclosure ordinances passed at the local level);[102]
- Require "eco-roofs" (white roofs, green roofs, solar photovoltaic, and/or solar thermal), which enable the appropriate roof types for building climate mitigation;
- Revise the Structural Design Chapter of the Base Code, including Table 1604.11, which sets minimum standards for snow loads, wind speeds, and seismic parameters, to reflect climate projections rather than historical records.

These amendments are geared more toward climate adaptation than mitigation efforts because of the aforementioned nexus between adaptation measures and public health and safety. However, past revisions of this nature and scale have not always fared well at the BBRS – two such proposals considered during the approval of the Ninth Edition of the MSBC were unsuccessful despite significant stakeholder and administration support.

The first was a proposal to reinsert stringent standards for the Coastal A Zone into the code that were previously deleted from the Eighth Edition of the MSBC. The proposed amendment would have required more stringent design and construction standards for lands meeting the definition of Coastal A Zone, which is a high hazard flood zone subject to breaking waves between one and a half and three feet, within a FEMA special flood hazard area, and landward of a V Zone (subject to breaking waves three feet or higher) or landward of an open coast without mapped coastal high hazard areas. Because of the presence of damaging waves, FEMA recommends that V Zone design, construction, and certification practices be used in Coastal A Zones.

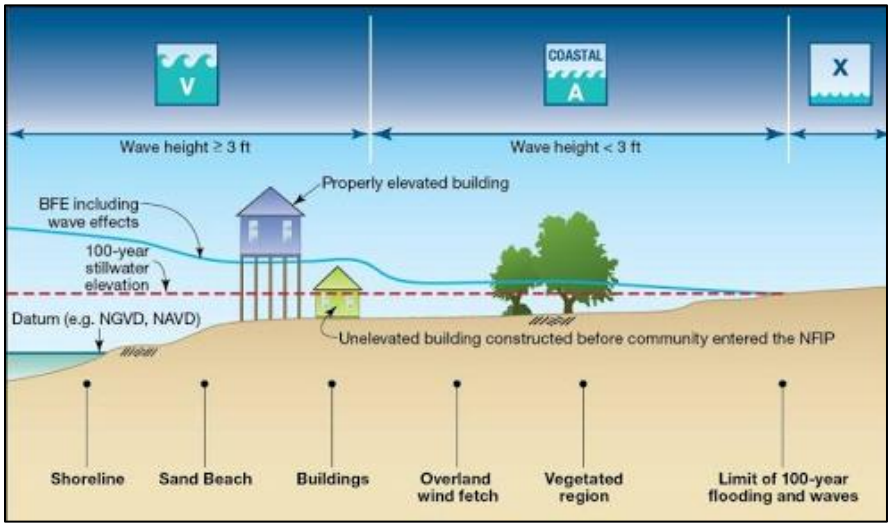

Image source: FEMA Region II

[102] G.L. c.143, § 94(r) already charges the BBRS with preparing a report evaluating the advisability of a requirement of periodic commissioning for large non-residential buildings and evaluating related approaches.

The amendment was not approved by the BBRS for the Ninth Edition of the MSBC, despite the urging of the Secretary of Energy and Environmental Affairs, who stated that the amendment was in the best interests of the Commonwealth and would reduce risks from storm surge, flooding, and other impacts from coastal storms, and increase the resilience of property, public safety, and local/regional economies.[103]

The second proposed amendment, commonly referred to as "EV-ready," would have required four percent of parking spaces at new commercial buildings to be wired for electric vehicles (EV). While this amendment was geared more toward mitigation than adaptation, it is referenced here in the context of feasibility because of its relatively narrow scope. New homes would have been required to have one space wired for an electric vehicle. Although the amendment was not approved by the BBRS for the Ninth Edition of the MSBC, it is important to note that at the time of this writing, the BBRS has scheduled a public hearing on BBRS and DOER proposals for amendments to the proposed 2018 IECC, one of which is the inclusion of EV charging stations.[104]

Some cities and towns have also considered requesting permission from the BBRS to implement more stringent standards at the local level pursuant to G.L. c. 143, § 98. While it is unlikely that any one city or town would be successful in meeting the "special conditions" threshold in the context of climate change, all coastal communities could submit a joint petition for flood-related provisions that would meet the special condition requirement. However, this would likely require consensus among all coastal communities in the state, which may not be feasible.

Ultimately, securing a comprehensive package of reforms through the BBRS process may be difficult. Nevertheless, advocates for building code reform should consider pursuing several of these pathways simultaneously. For example, advocates might pursue more narrow and specific amendments through the BBRS process while also pursuing broader change through legislation.

Another alternative may be to focus advocacy efforts on ICC. Several participants in CLF's convenings discussed this possibility and noted that Massachusetts cities and towns have the ability to register representatives to vote on amendments at the ICC level.

To vote, a city or town's representative must register as the Primary Representative of the "Government Member," defined as "any governmental unit, department or agency engaged in

[103] While the Coastal A Zone language was deleted from the 8th Edition, the 9th Edition states that "the design and construction of buildings and structures located in flood hazard areas, including coastal high hazard areas shall be in accordance with Chapter 5 of ASCE 7 and ASCE 24. In using ASCE 24-14, delete all references to coastal A zone standards. For minimum elevation requirements for lowest floor, bottom of lowest horizontal structural member, utilities, flood-resistant materials and wet and dry flood-proofing refer to tables in ASCE 24 which are to be amended as shown below. The design and construction of buildings and structures located in coastal dunes shall be in accordance with Appendix G."

[104] Note that some cities in Massachusetts have attempted to mandate electric vehicle charging infrastructure through Home Rule petitions.

the administration, formulation, or enforcement of laws, ordinances, rules or regulations relating to the public health, safety and welfare."[105] When Government Members join or renew their Membership with the ICC, they are eligible to register four, eight, or twelve voting representatives, depending on the city or town's population. A variety of municipal professionals are eligible to be registered as voting representatives, including members of city councils or boards of selectmen, members of planning departments, city and town managers, sustainability directors, and energy managers.

At the time of this writing, there is an active campaign by the Massachusetts Climate Action Network, the Metropolitan Area Planning Council, Massachusetts Sierra Club, and Northeast Energy Efficiency Partnerships to register voting representatives in Massachusetts cities and towns to vote on the 2021 IECC.

If sweeping changes were accomplished at the ICC, they could be applied in Massachusetts without state-specific amendments. However, BBRS could still choose to exclude specific provisions of the ICC's codes through MSBC amendments.

Model Codes and Certifications

The ICC created the International Green Construction Code in response to increasing desire for a regulatory framework specific to green commercial construction. The IgCC is an overlay code that adds green provisions on top of existing codes like the IECC and the IBC.

The IgCC applies to all occupancy types except low-rise residential buildings under the IRC and covers natural resources, water and energy conservation, operations and maintenance for new and existing buildings, building materials, and more.[106] The IgCC requires minimum achievements in all building areas and allows for project electives (i.e., criteria that are not included in code requirements but can be used on a given project). The overlay code also emphasizes building performance, including features such as a requirement for building system performance verification along with building owner education, to ensure the best energy-efficient practices are carried out.[107]

As of May 2018, five states[108] in the U.S. have adopted some edition of the IgCC. Another eleven states have one or more state or local agencies/jurisdictions that have adopted an edition of the IgCC without the code being used as a standard for all buildings.[109] If the IgCC

[105] *Fees & Information*, Section on *Membership*, INTERNATIONAL CODE COUNCIL, https://www.iccsafe.org/membership/join-icc-dues-applications/.
[106] 2018 International Green Construction Code®.
[107] *The AIA Guide to the IgCC*, THE AMERICAN INSTITUTE OF ARCHITECTS 28 (2016), http://aiad8.prod.acquia-sites.com/sites/default/files/2016-04/Ind-AIAGuidetotheIgCC.pdf.
[108] Adopting states include Rhode Island, Maryland, Florida, North Carolina, and Oregon.
[109] *International Codes-Adoption by State,* INTERNATIONAL CODE COUNCIL (May 2018), https://www.iccsafe.org/wp-content/uploads/Master-I-Code-Adoption-Chart-May-Update.pdf.

were adopted in Massachusetts as part of the Tenth Edition of the MSBC, it would be additive to existing code requirements.

On the incentive side, the Fortified Home Program, which is currently used in Rhode Island, may be an option for Massachusetts. As discussed above, in 2016, Rhode Island began offering expedited CRMC permit-review for residential projects meeting the bronze standard of the Fortified Home Program. In approving the accelerated permit rule, CRMC stated that Fortified Home certification standards would help to "strengthen structures, help [the] economy because businesses will realize that [the state] is prepared for future risks along the coast, and they will bring more work for the residential construction industry."[110]

Some cities and towns in Massachusetts are already offering incentives to (or in some cases mandating) projects that meet the certification requirements of programs like Fortified Home. For example, a commonly used certification standard is LEED, or Leadership in Energy and Environmental Design. The City of Boston zoning code now requires that all large projects achieve at minimum the 'certifiable' level under LEED (i.e., that a project could be certified because it meets the requirements even though actual certification is not required). The zoning requirement has not been challenged, and because there are a variety of ways for a project proponent to meet the LEED standard, it is arguably not a prescriptive requirement. It may be possible to include a similar requirement through zoning for another certification program like Fortified Home. Similarly, incentives could be offered for meeting Passive House requirements, a nationally recognized standard for energy efficiency.

Changes to the Stretch Code

Another possibility considered by CLF for reforming the MSBC to better address climate change is through the green community energy efficiency criterion in the Green Communities Act, G.L. c. 25A, § 10(c)(6),which sparked the state's adoption of the Stretch Code in 2009.

Updating the Stretch Code

The existing Stretch Code could be updated through the BBRS amendment process to include more stringent requirements in the Tenth Edition of the MSBC. As previously mentioned, the Stretch Code and the base code are much closer today than when it was originally adopted in 2009. The BBRS is expected to adopt the 2018 version of the IECC in the coming months, which will further narrow the difference between the base and Stretch codes. While it is unclear whether significant amendments to the Stretch Code could be accomplished through this process as a political matter,[111] the statutory objectives of the GCA are also relevant here.

[110] Paul F. Eno, *CRMC Okays Expedited Permitting for Fortified Homes*, THE RHODE ISLAND BUILDER (Dec. 2016).
[111] G.L. c. 143, § 94(o) says that the BBRS, with the help of DOER, can propose more stringent requirements than the IECC.

Adoption of the Stretch Code is one of the conditions a municipality must meet to apply for designation as a Green Community and thus be eligible for grants to pay for energy saving projects in municipal buildings. Specifically, the GCA requires municipalities seeking Green Community designation to "require all new residential construction over 3,000 square feet and all new commercial and industrial real estate construction to minimize, to the extent feasible, the life-cycle cost of the facility by utilizing energy efficiency, water conservation, and other renewable energy technologies."[112] As discussed previously, the current Stretch Code allows municipalities to satisfy this condition while avoiding both preemption by the MSBC and inconsistency in municipal requirements across the state. Any changes to the Stretch Code would automatically apply in all municipalities that have adopted it.

Arguably, when the 2018 IECC takes effect in Massachusetts, the role of the Stretch Code in meeting the statutory objectives of the GCA will be frustrated. This legal uncertainty over whether the Stretch Code will continue to be an adequate way for cities and towns to retain their Green Community designation could be a lever for securing revisions. However, the Stretch Code is not a statutory requirement of the GCA; it was merely a solution devised by the BBRS and DOER to help communities meet the criterion of designation without creating varying standards in different communities. Further, DOER does not have the authority to adopt revisions to the Stretch Code without the cooperation of the BBRS. G.L. c. 25A, § 10(a) states that the green communities division is to assist cities and towns to "reduce energy consumption and costs and reduce pollution" among other things. Therefore, it would be up to the BBRS and DOER to determine whether the Stretch Code should continue to be the vehicle for meeting the energy efficiency criterion of the statute. Considering that the agreed-upon approach in 2009 was to create a Stretch Code, for consistency purposes, among other reasons, it is likely that this would continue to be the preferred tool.

Supplementing the Stretch Code

CLF also examined whether the current language of the GCA gives municipalities more flexibility in adopting standards more stringent than the Stretch Code – specifically, whether the code could contain a menu of green building features (like the IgCC) that a project owner could select or a municipality could specify.

This concept is similar to a regulation at the heart of a recent Massachusetts case, *St. George Greek Orthodox Cathedral of Western Massachusetts, Inc. v. Fire Department of Springfield*.[113] In this case, the Supreme Judicial Court considered a MSBC provision permitting the installation of *any one of four types* of approved "fire protective signaling systems" in buildings throughout the Commonwealth.[114] In 2006, the City of Springfield enacted an ordinance that specified only

[112] G.L c. 25A, § 10(c).
[113] *St. George Greek Orthodox Cathedral of W. Mass. v. Fire Dep't of Springfield*, 462 Mass. 120 (2012).
[114] *Id.*

one of the four permissible types of systems.[115] The Court ruled that the MSBC preempted Springfield's ordinance, reasoning that the legislature expressly stated its intention to ensure "uniform standards and requirements for construction and construction materials" in G.L. c. 143, § 95.[116] Furthermore, the statute provided that all municipal by-laws and ordinances "in conflict with the state building code shall cease to be effective."[117] The Court also referenced G.L. c. 143, § 98, pursuant to which a municipality "may request that the board allow it to utilize more restrictive standards than the code."[118] From this language, the Court concluded that the legislature intended to limit the manner in which municipalities may act and that such a provision would serve no purpose if the code did not preempt Springfield's ordinance.[119]

The *St. George* opinion suggests that Massachusetts courts are concerned about the possible resulting patchwork of building regulations and may not be receptive to restrictive local ordinances or by-laws relating to building design and construction. According to the Court, upholding the Springfield ordinance "would permit a similar narrowing of options in such sections, sanctioning the development of different applicable building codes in each of the Commonwealth's 351 cities and towns, precisely the result that promulgation of the code was meant to foreclose."[120]

Although the BBRS arguably has the authority to replace or supplement the current Stretch Code with a menu of green building features, a municipality does not appear to have authority to specify which options a developer could choose from that menu at this time. The BBRS would likely need to include explicit language in the menu to enable municipalities to be more precise in their individual requirements.

Further, the language in G.L. c. 25A, §§ 10(c)(6) and 10(e) focuses more on the authority of the director of the Green Communities Division to adopt rules for the program and consider alternate standards than on municipal authority to impose such rules and standards. The GCA does not clearly authorize municipalities to impose more stringent energy standards than the Stretch Code for purposes of meeting the Green Community designation criteria. A municipality could attempt to demonstrate the efficacy of a more stringent standard than the Stretch Code to satisfy the Green Community criteria, but the Green Communities Division within the DOER has ultimate discretion to consider whether these alternatives satisfy the criteria.

DOER states in its Green Communities guidance that municipalities must demonstrate that "the alternative standard minimizes the life cycle energy costs of all new construction and is

[115] *Id.* at 122.
[116] *Id.* at 126.
[117] *Id.*
[118] *Id.* at 127.
[119] *Id.* at 127-29.
[120] *Id.* at 130.

enforceable by the community."[121] This enforceability requirement appears to be a reference to the *St. George* case and to G.L. c. 40A, § 3, which prohibits municipal zoning from regulating materials and methods of construction already regulated by the state building code.

Replacing the Stretch Energy Code

One fairly controversial option may be to replace or expand the Stretch Code with a new set of requirements. This option could require a legislative amendment to the GCA. Some practitioners have commented on the waning effectiveness of the Stretch Code and signaled interest in an alternative vehicle for meeting the energy efficiency criterion of the GCA. As previously mentioned, because the Stretch Code is not required by statute, other options and tools for meeting the GCA could be developed.

Expanding the Stretch Code to Consider Climate Adaptation

There does not appear to be a clear grant of authority in the GCA for municipalities to adopt building resiliency standards writ-large, including adaptation-focused standards. If the Stretch Code was expanded beyond the subject matter of the GCA, the statute itself may need to be amended.

This is not an advisable pathway for reform. First, at its core, the GCA is an energy conservation and efficiency statute. For that reason, building resiliency standards focused on adaptive measures may not fit the Green Communities criteria, especially considering that § 10(c)(6) of the GCA limits the alternative standards to "alternative measures that advance *the purpose* of the green communities program as effectively as adherence to the requirements."[122]

Second, the GCA is inextricably tied to the Green Communities program, which has not, to date, been focused on climate adaptation measures. In contrast, the state's new Municipal Vulnerability Preparedness program may provide a better platform for tying adaptation requirements to community designation criteria or grant funding opportunities. Connecting the MVP program to adaptation-focused code requirements would likely require new legislation.

Finally, some stakeholders may be hesitant to amend the GCA or shift focus away from mitigation efforts in favor of adaptation. For these reasons, it may not be appropriate to attempt to address climate adaptation through the GCA. Alternatively, climate adaptation could be addressed through a new, separate stretch code, which would likely require legislation.

[121] *Green Communities Designation and Grant Program Guidance,* MASSACHUSETTS DEPARTMENT OF ENERGY RESOURCES (Aug, 2018), https://www.mass.gov/files/documents/2018/08/10/gc-program-guidance.pdf
[122] G.L. c. 25A, § 10(c)(6) (emphasis added).

New Legislation

Legislation may be the best option for pursuing comprehensive changes that are too complex or contentious for the BBRS amendment process. As previously mentioned, the GCA was the impetus for the current Stretch Code. Similar legislation could be aimed at climate adaptation, energy efficiency, or both. Legislation could directly or indirectly implicate building codes. Legislation could also serve to clarify existing provisions and standards or create the broader framework under which BBRS would be responsible for adopting appropriate code changes.

Direct Measures

Direct measures would address specific code standards and requirements through legislation. For example, a direct mitigation measure might include a building recommissioning requirement and/or requirements that building owners submit a maintenance plan and schedule to ensure that buildings are being operated effectively. A direct adaptation measure might require passive survivability for critical facilities or expand the geographic extent of flood standards referenced in Appendix 115.G of the MSBC beyond the FEMA SFHA based on local climate science.[123,124]

Some stakeholders focused more on adaptation requirements may be interested in establishing a new, separate stretch code. As previously mentioned, a new set of adaptation-focused building code requirements could be required by legislation and tie into the existing MVP program. This type of legislation could take many forms, but if it were modeled after the GCA, it would likely establish criteria for communities seeking MVP designation that would necessitate a building stretch code.

Narrower, issue-specific legislation could also be used to replicate some of the efforts of other states. For example, legislation could be aimed at clarifying that climate mitigation/adaptation explicitly meets the "special conditions" requirement for municipal petitions under G.L. c. 143, § 98. Legislation could also direct BBRS to develop voluntary tiered measures through an appendix to the MSBC similar to CALGreen. In CALGreen, the voluntary tiers are intended to further encourage building practices beyond the minimum code requirements and may be adopted by local governments. For example, one of CALGreen's voluntary residential measures is for cool roofs for reduction of heat island effect.[125] While this tiered system would likely be

[123] Massachusetts is currently in the process of producing predicted sea level rise and flood data for the entire state using sophisticated modeling technology. This could serve as a foundation for adjusting the geographic extent of these standards and could be referenced by the code. However, there are other open data sources on sea level rise and flood risk available as well.

[124] Note that this is also included as a recommendation for changes through the BBRS amendment process. While it is within the BBRS' authority to make this change through an amendment to the MSBC, it may be more feasible and time-efficient to implement this change through a legislative mandate.

[125] CALIFORNIA ENERGY COMMISSION, BUILDING ENERGY EFFICIENCY STANDARDS FOR RESIDENTIAL AND NONRESIDENTIAL BUILDINGS, tit. 24, pt. 6 (2016).

supplemental to the existing Stretch Code requirements, the two may need to be reconciled to streamline municipal adoption of voluntary standards.

Massachusetts could create performance standards for buildings and phase them in over time over without necessarily being prescriptive about code requirements. Specifically, Massachusetts could consider factoring emissions reductions into performance measures in order to help meet GWSA GHG emissions reduction targets and phase performance standards in over an extended timeframe. While the specifications needed to meet these milestones would be left to the BBRS, there would be a statutory mandate to meet them.

Indirect Measures

Indirect legislative measures could influence climate-ready design and construction through non-code alternatives. For example, legislation could give state agencies the authority to condition approval of permits, licenses, financing, and other approvals on disclosure of climate-related risks and require a statement from the developer of how climate vulnerability has been addressed and mitigated.

Similarly, the legislature could require an affirmative determination by an Executive Office, for example, the Secretary of Energy and Environmental Affairs, that a proposed state project, permit, or license has adequately addressed climate risks. This would be similar to the public benefit determination that the Secretary is required to make pursuant to G.L. c. 91, § 18B for tidelands projects. The public benefit determination includes specific standards and requirements, as well as a public review process.

Indirect measures might also include greater risk disclosure requirements, for example, requiring that property owners and developers disclose climate-related risks to potential tenants and buyers. This could create greater leverage for design professionals in working with clients who are resistant to incorporating climate-ready standards into their projects and may also have implications for legal liability.

Legislation amending G.L. c. 40A, § 3 could allow municipalities to have some measure of zoning control over the application of building codes when climate concerns warrant different building standards. For example, municipalities could be authorized to create more restrictive green building standards that are reasonably necessary because of local climactic, geological, or topological conditions. It is worth noting that municipalities can currently impose these types of standards as conditions of a special permit or by establishing performance standards and requiring property owners to determine the building measures they will employ to achieve those performance standards. However, more stringent building standards still cannot be required by "as of right" zoning and cannot apply to all properties in a city or town.[126]

[126] *Supra* at 25.

As discussed previously, several other states have taken a legislative approach to building codes. In 2012, the California legislature required that the California Environmental Protection Agency develop an Urban Heat Island Index and to design it so that "cities can have a quantifiable goal for heat reduction."[127] The legislature also required the CBSC to adopt, approve, codify, and publish mandatory building standards for the installation of electric vehicle charging infrastructure for parking spaces in multifamily dwellings and nonresidential development.

In Rhode Island, recent legislation requires that any property or structure located in a FEMA SFHA exclude freeboard from the building height calculation.[128] Building height must also be measured from BFE but provides the owners and applicants may establish a BFE that is higher than the official FEMA FIRMs based on CRMC's elevation maps, which include sea level rise projections. However, local zoning codes in Massachusetts often include definitions of building height for the purposes of zoning and it is unclear how these definitions would interact with an amended building height calculation in the MSBC.

While pursuing new legislation to address the shortcomings of the MSBC may be a quicker pathway to modernization than the BBRS administrative process, it would require significant coalition building and lobbying efforts. Additionally, the deadline for filing a bill for the current Massachusetts legislative session has passed. This means that any legislative effort that cannot be achieved through an already-filed bill would have to wait until the next session in 2020.

Current Legislation

There have been at least two bills introduced this legislative session that would influence climate-ready design and construction through direct or indirect measures. The first, *An Act promoting sustainable investment, economic security and fiscal responsibility with respect to climate risks seeks*, is an indirect measure that seeks to insert code-like requirements through permitting, financing, and utility regulation.[129] Specifically, the bill would allow the state to deny an application, or condition approval on, a demonstration by the applicant that the project or proposal adequately considers and addresses climate risks. For investor-owned utility companies, the bill also requires that costs proposed or incurred for capital investment projects consider and address climate risks to avoid imprudent use of ratepayer dollars.

The second, *An Act to establish a net zero stretch energy code*, is a direct measure that would require the BBRS, in consultation with DOER, to establish a definition for "net zero buildings" and use the definition to develop a net zero stretch energy code.[130] In implementing this bill, the BBRS would be required to develop a tiered implementation plan for the so-called "net zero

[127] AB 296, Chapter 667, Statutes of 2012.
[128] *See* S.B. 2413, 2018 Gen. Assemb., Reg. Sess. (RI 2018).
[129] H841, 191st Gen. Court of the Commonwealth of Mass. (Mass. 2019).
[130] H2865, 191st Gen. Court of the Commonwealth of Mass. (Mass. 2019).

stretch energy code," accommodate the needs of environmental justice communities, and consider prioritizing regional renewable energy generation.

Next Steps

As stated previously, several of these reform pathways could be followed simultaneously. Additionally, this report simply provides the contextual and legal basis for pursuing building code reform – not substantive recommendations on code revisions and specifications. A recommended next step is for a coalition of stakeholders, including technical professionals such as members of the BSA, the American Council of Engineering Companies, National Association of Homebuilders, and state and municipal staff, to identify leading design strategies to promote adaptation and reduce carbon emissions. Strategies should be prioritized based on feasibility and current technological capacity. This group should also identify current building code specifications that actively impede the identified design strategies, or fail to support and incentivize them.

PART FIVE

Summary of Convenings

Between January and April 2018, CLF held three convenings to discuss the current state of the MSBC and opportunities for modernization to address changing climate conditions. These convenings were guided by moderated discussion questions and in some instances, included a presentation on the state of climate change and climate science. Each of these meetings was tailored to the participants and did not follow a consistent format; therefore, the summary of the discussions may differ substantively by group. The discussion at these convenings also helped inform CLF's legal research contained earlier in this report. The following discussion is a snapshot of these three meetings and the themes that emerged. Full meeting notes and participant affiliations are included in the Appendices at the end of this paper.

Challenges for Code Reform

Participants from each of the three sessions identified current challenges to reforming the MSBC, as well as their own concerns about certain modifications. Not all of the concerns or challenges discussed in these sessions are identified here. For a full overview, please see Appendix A.

Governance & Consistency

A recurring concern for participants in each session was the process for building code revision. In particular, participants noted that modernizing the state code is not a one-time task and may require the creation of a new body to manage information and science, that the current structure may lack the flexibility needed to accommodate changing climate science, and that the executive branch may be ill-equipped to handle the complexity of climate issues. Note that under current law, the BBRS is required to make a "continuing study" of the operation of the state building code and other construction laws to ascertain their effect on construction cost and effectiveness with respect to health, safety, energy conservation, and security.[131]

A threshold challenge is incorporating dynamic, forward-looking climate data into the code. Assessing the complexities of evolving climate science, building appropriate flexibility into the code, and determining how to incorporate building life span factors are tasks that some participants felt the BBRS and the Executive Branch may not be well-suited to undertake.

Participants also acknowledged the potential for inconsistent requirements across the state as a barrier to amending the code or increasing local flexibility or authority. Specifically, the BBRS prefers a high level of consistency in the application of codes across the state and seeks to minimize state-level amendments to ICC codes. Some participants felt strongly that the BBRS is

[131] G.L. c. 143, § 94(c).

statutorily tasked with ensuring state-wide consistency in code requirements and that local variation negatively impacts the construction industry. Different codes in different parts of the state could be chaotic and burdensome and different codes between Massachusetts and neighboring states could have implications for the economic competitiveness of the state in the region or could increase costs for developers. However, other participants felt that more flexibility at the local level is warranted given the environmental, health, and public safety risks posed by climate change and ultimately, the long-term viability of the economy.

There was a similar division of opinion over whether code revisions should be take place at the state or ICC level. Some participants supporting ICC-level changes noted that the extent of revisions are more conducive to international code amendments, while others feared that relying on the ICC to make changes would be more difficult and take longer. However, almost all stakeholders agreed that the Commonwealth should send representatives to the ICC to advocate for climate-related changes.

Unintended Consequences

Another shared concern among participants was the potential for unintended consequences. In particular, some code revisions could have indirect and negative impacts on environmental sustainability and health and could increase complexity and make code enforcement more difficult.

Participants expressed concern that if Massachusetts used code provisions from similarly situated states, bigger air conditioning systems, less insulation, and related requirements might be the result, which runs contrary to energy efficiency goals. Also, the more complex the code specifications are, the more difficult they are to enforce. Such specifications may require greater bandwidth and training for code officials and could make it more difficult for homeowners to understand when remodeling or making repairs. For example, tight building envelopes could cause mold issues if air circulation is not simultaneously addressed. Similarly, a homeowner might decrease the effectiveness of the building systems by replacing windows or other components without understanding the potential impact on overall house performance. Stakeholders expressed a need for stringent requirements to be tempered with a regard for what is reasonable and practical.

Equity

Participants identified the potential equity implications of more stringent codes related to major renovations. Specifically, all work must comply with the Massachusetts Architectural Access Board's (MAAB) accessibility code if the project cost is equal to 30 percent or more of the assessed value of the existing building. Such a threshold can be an issue in terms of equity among communities because property and building values differ dramatically across the state.

If disadvantaged communities are discouraged from redeveloping because of code compliance costs, the overall economy could suffer.

Areas of Opportunity

Several areas of opportunity were identified during the three stakeholder convenings for both adaptation and mitigation. Many of these suggestions are captured in the pathways section above. The following opportunities generated some consensus among different stakeholder groups:

Flood-resistant construction

The need to address sea level rise and other flood-related climate impacts in codes was noted by a number of participants. Recommendations included:

- Establishing a design flood elevation in the code with varying freeboard requirements based on local geographic risk;
- Using updated maps with forward-looking data rather than relying on FEMA FIRMs; and
- Establishing a consistent practice for elevating critical equipment above future flood levels and addressing the use of temporary flood barriers.

Municipal officials had mixed views on the accuracy of existing FEMA FIRMs for current conditions and there was a recognition that some cities and towns may have more accurate FEMA maps than others. However, there was general agreement that FEMA maps are not ideal long-term planning tools because they do not account for future conditions like sea level rise.

Participants also noted that the code currently does consider the design life of a structure, but this factor could be used to vary freeboard requirements in addition to geographic risk.

Building performance

In each of the three convenings, participants discussed the need to address building performance. Disclosure requirements and recommissioning were widely supported. There was general consensus that in many cases, buildings are not being operated as intended, which decreases their effectiveness and could also present air quality health risks. There was some debate about how best to approach this issue and concern about the feasibility of code compliance and enforcement if commissioning requirements were more stringent. One recommendation was to revise the code to require that commercial projects be recommissioned at least every five years. Participants noted that this would interface with building disclosure ordinances passed at the local level.

There was also a recommendation for Massachusetts to require owners to submit a maintenance plan and schedule to complement the recommissioning process. However, this

requirement would not be included in the building code and would need to be addressed separately. Finally, participants noted that the ICC has an international performance code that has been adopted in 16 states. Massachusetts could consider adopting that ICC code to address some of the building performance challenges.

Education and cost studies

Participants agreed that there are many unknowns in code modernization for climate change. As previously mentioned, there are few national and international examples of comprehensive reforms. Important resources for developing and lobbying for code reforms include studies on the effectiveness of code compliance, case studies on the negative aspects of certain materials like glass, best practice research on measuring code compliance through e-permitting, and studies on the cost impact of code updates.

Many participants expressed concerns that the increased complexity of codes could inhibit enforcement. There is a need for training materials and resources for both construction industry professionals and code officials and inspectors. For the construction industry, resources should be made available to understand any proposed changes and clearly lay out a pathway for compliance. For code officials, training may be needed to fully understand code updates and properly enforce them. However, training for code officials may not be enough to ensure proper enforcement given the current lack of code compliance due to bandwidth and resources challenges. Finally, training may be beneficial for building operators and managers.

International code reform advocacy

All participants agreed that local officials should advocate at the ICC for changes to international model codes. There was some disagreement about whether this should be pursued alone or in combination with state-level reform efforts. It was unclear whether the ICC is willing to make comprehensive reforms or is well-suited to make reforms based on changing local conditions. On the other hand, industry experts noted that adopting new ICC codes with fewer state-level amendments would likely be more attractive to the BBRS and therefore more successful. There may be a need to inform local officials of their ability to register and vote at the ICC level.

Non-code Alternatives

Participants were split on the issue of non-code alternatives, including local incentives. Some participants noted that providing incentives for owners and developers to voluntarily adopt higher standards could be the best way to introduce new requirements. Financial incentives could motivate owners and developers to overcome the learning curve of new standards and the economic benefit would help pave the way to mandatory requirements down the road.

Other participants, including many municipal officials, noted that incentives are “not a silver bullet” and that density and height bonuses and other special exceptions can drastically change the locality’s planned vision for an area. They also noted that owners and developers will only do what makes financial sense unless required to do more. Ultimately, they may not choose to take advantage of an incentive. If cities and towns are forced to incentivize everything they want a project proponent to accomplish, community objectives may be adversely affected.

Finally, participants noted tension between increasing requirements for owners and developers and retaining flexibility for design professionals. There was some concern that making codes too prescriptive in an effort to make them more effective (and more predictable for owners/developers) could inhibit a design professional’s ability to innovate.

Appendix A: Stakeholder Convening Meeting Notes

Stakeholder Meeting I: Design Professionals

The first of the three stakeholder convenings was held in January 2018 and hosted in partnership with the Boston Society of Architects and the American Institute of Architects, Massachusetts Chapter. Attendees included architects, engineers, design and permitting consultants, climate scientists and others.

The meeting began with a general, unmoderated discussion about big issues in approaching building code reform in the context of climate change. These included addressing uncertainty of climate science, governance structures, and the political context for reform.

- **Uncertainty:** participants discussed the uncertainty of climate change projections and how best to build flexibility into the code given this constraint; specifically by "collapsing" uncertainty based on probability. For example, with respect to different sea level rise (SLR) scenarios, if there is over an 80 percent chance of two feet of sea level rise (SLR) by 2080, four feet of SLR by the end of the century, and six feet of SLR in 100 years from now, there is a high probability that there will be four feet of SLR in the next 100 years. Although we may not know exactly when it will happen, it will happen eventually. By thinking in terms of "collapsed uncertainty," we can select appropriate thresholds based on the design life of structures.
- **Governance:** the governance structures in place, or not in place, for managing this type of code modernization was also a concern. The consensus was that modernizing the MSBC is not a one-time task and may require the creation of a body with expertise in climate science to participate in the process on an ongoing basis. Codes will need to be continually updated as climate science develops and flexibility needs to be built into the process to allow for periodic change.
- **Political Context:** participants discussed two general schools of thought regarding building code reform: some believe that the code is a policy document while others believe it is just a minimum standard for public safety. Participants in the first school of thought asserted that every law and regulation is a policy document and that a decision *not* to regulate is a policy (i.e. if the MSBC does not address climate change then it is not a priority for the Commonwealth). Participants in the second school of thought asserted that the code is merely a minimum standard for safety and should not be used to encourage the growth of specific sectors of the economy by, for example, specifying the use of certain materials. Instead, the developer or owner, not the Commonwealth, should determine the best technologies to achieve energy efficiency. In addition, because the code applies statewide, some geographic areas may have different

priorities. For example, Western MA may not have the same interests or priorities as coastal communities. This dynamic could cause the building code to become a political issue.

Moderated Question #1: How do we address climate change through codes and standards?

This part of the discussion diverged into recommendations and priorities for mitigation, adaptation, and both.

Considerations for Mitigation:

- Performance-based codes – Codes need to regulate actual building energy use, not just designed energy use (intended use). A disclosure ordinance that applies statewide could be a solution.[132] Alternatively, the ICC has an international performance code that could be adopted. Sixteen other state have already adopted it.
- Stronger Commissioning Requirements – Buildings owners often do not have the expertise to handle and maintain a structure's operating systems. As a result, buildings do not perform as intended. Massachusetts could consider requiring owners to submit a maintenance plan and schedule. While the building code cannot require this, the commissioning process could require re-commissioning of buildings a year or two after completion to ensure they are operating correctly.
- Unintended Consequences – Updating the code to reflect changing conditions could have unintended consequences. For example, bigger air conditioning systems and less insulation may seem logical in the face of warmer weather but this runs counter to the state's mitigation goals. Many states with warmer climates have energy systems that are over-designed and may not serve as good models. At the same time, infrastructure in Massachusetts, and across New England, is not currently prepared to deal with the kind of extreme heat that is projected.
- Net zero and embodied energy of materials – Massachusetts should consider the embodied energy of the materials used to create net zero structures. A net zero building could have 30 years' worth of embodied energy in its materials. Codes or incentives should prioritize the reuse of existing buildings and purpose them as material banks. Demolition costs should also be considered – there is an end of life process/cost. The code should be revised to more thoroughly consider front end impacts.

Considerations for Adaptation:

- Greater flexibility in design – Code updates should incorporate greater flexibility for design; for example, changing methods of height calculation so that developers are not

[132] There are currently a number of city ordinances on reporting energy usage but these are not building code requirements.

penalized for elevation. Some jurisdictions have higher freeboard standards in zoning codes but the MSBC could give cities specific and consistent guidelines for freeboard (to the extent practicable based on region and impacts) as the code already does for design loads for ground load, seismic, and wind.

- Wider consideration of impacts –The code does not currently account for certain impacts like wildfires because they are not common in Massachusetts. However, the probability of wildfires is increasing and the 2013 State Hazard Mitigation Plan shows several wildfire high-risk areas around the state. It may be necessary to consider additional codes or an overlay code to prepare for these impacts (for example, the International Wildland Urban Interface Code).
- Critical Equipment Guidelines – The code should include standard protocols for the placement of critical equipment especially in high-risk areas. The current code requires the placement of critical equipment one to two feet above base flood elevation in FEMA Special Flood Hazard Areas (SFHA), but this is based on historical, not forward-looking data and is fairly limited in geographic scope. While some developers use forward-looking data to make decisions about the elevation of critical equipment (and some cities and towns are *incentivizing* it), a consistent practice would bring more certainty to design professionals.
- Reconsider strategies and materials – Massachusetts may need to rethink the structural design of features like underground parking to account for the increasing risk of floods and extreme weather. For example, better drainage standards may be preferable to pumps. This may be both a structural and materials issue. Related structural issues should also be considered; for example, during Tropical Storm Sandy, cars in parking garages floated up to the ceiling and the force of the cars pushing against the roof caused structural damage to some of the buildings (some buildings even collapsed).
- Reconcile interplay with existing regulations – Another important consideration is how building codes interface with existing regulations like the Wetlands Protection Act, Chapter 91 and others. One possibility may be to supplement the statewide code provisions with overlays that relate to specific climate zones that are more at risk. The term “climate zones” as referenced in the MSBC does not incorporate forward-looking climate conditions and the entire state currently falls within climate zone five.
- Greater consideration of human impact – Climate adaptation on a site-by-site basis could unintentionally be maladaptive. Strategies should consider the broader context and may require greater oversight and coordination. For example, if a structure can withstand floodwaters but the water does not recede right away, occupants will be required to shelter in place. Standards for residential buildings in high-risk areas should account for this risk by integrating strategies and tools for resilience like community spaces and amenities in the case of extreme weather or sheltering.

Mitigation/Adaptation Dual Considerations:

- Forward-looking data – Buildings are designed based on energy consumption models, but the models are based on historic data rather than forward-looking data. Similarly, design inputs (like structural loads) should be gathered from climate projections rather than historical records.
- Passive Survivability – Structures should be able to withstand major storm events and passively survive and remain comfortable for those sheltering in place. For example, if the power is lost, the structure should have thermo-resilience, operable windows, access to natural light, added insulation, potable water, etc. This is not only a mitigation issue (because there are huge opportunities for energy efficiency) but also an adaptation strategy.
- Avoid & minimize – Massachusetts should consider a holistic system in which climate impacts are avoided or minimized when unavoidable and otherwise require appropriate documentation of steps to mitigate harm. Europe is already using "climate impact statements," which demonstrate consideration of impacts and entire firms and industries advise on this requirement.

Key priorities are summarized in chart below:

Mitigation	Dual	Adaptation
• Performance-based codes • Strong commissioning requirements • Net zero and consideration of embodied energy of materials	• Incorporate forward looking data • Passive survivability (energy efficiency and sheltering in place) • Avoid and minimize	• Greater flexibility in design • Critical equipment guidelines • New strategies/materials • Reconcile interplay with existing regulations • Wider consideration of impacts (International Wildland Urban Interface Code) • Greater consideration of human impact (not just physical/structural)

Moderated Discussion II: How do we prioritize and implement reform goals?

Top considerations:

- **Articulate the problem**
  The building code is based on backward-looking information instead of forward-looking information, which presents difficulties for implementing climate adaptation and mitigation measures. Cities and towns are currently circumventing shortcomings in the building code by incorporating resilience measures into zoning that should be in building codes. If this continues, Massachusetts could end up with a large number of different sets of requirements.
- **Prioritize reforms**
  Stakeholders need to build on clear policy and scientific assumptions. What are some of the baseline assumptions in our code that are no longer accurate? What are the highest impact climate conditions that we need to address today, next year, etc.?
- **Costs and capturing value**
  Design professionals and others must be prepared to show the cost of reforms. Changes to the code will have to undergo the standard financial analysis and need to properly capture value/conduct risk identification and allocation (i.e. what risk, over what timespan, who and what suffers if system fails, and who owns that risk).
- **Broad coalition of allies**
  Many designers and developers are looking for guidance on this and are eager for information. For some groups and professional societies, it will be important to demonstrate how their members can comply with new codes easily and without extreme cost burden.
- **Equity**
  How does the building code define “major renovations” for purposes of triggering compliance with code updates? Will this standard apply in less affluent cities and towns where building real estate values are much lower, resulting in burdensome requirements?

Stakeholder Meeting II: Industry Experts

The second of the three stakeholder convenings was held in February 2018 and hosted in partnership with the American Institute of Architects, Massachusetts Chapter. Attendees included building inspectors and commissioners, fire protection engineers, professional society members and others.

The meeting began with a recap of the first stakeholder convening with design professionals and participant reactions.

Key reactions:

- Participants expressed concern that MSBC requirements are effectively becoming proprietary, as reflected in the BBRS's consideration of electric vehicle charging stations. The building code should be a minimum safety document – not one that prefers some materials or products over others. The code should provide minimum requirements for *all* materials and facets. It also needs to be consistent throughout the Commonwealth, unless there are significant, location-specific safety issues.
- Building science can be complicated and the learning curve associated with new requirements like the Stretch Code can be problematic. However, in the Stretch Code context builders overcame cost issues and adapted. Having a clear pathway to compliance will be important for any code changes to gain support. Alternatively, the state should consider easing the design and building world into change by using incentives rather than mandates. These may prepare the industry for changes that eventually will be made code so they are familiar with them (and how to comply with them) before they become mandates.
- Participants were concerned about unintended consequences. For example, building envelopes that are "too tight," can cause issues like mold growth. Similarly, homeowners may not understand the complexities of code sufficiently to remodel or make repairs. For example, if a homeowner replaces a window without understanding how that impacts the rest of the system, the entire structure may operate less effectively. The more complicated the regulations, the harder it is for the owner or developer to understand or comply with them.

Moderated Discussion I – Addressing Climate Change through Codes and Standards

This part of the discussion focused on considerations and priorities for mitigation and adaptation separately.

Adaptation Considerations

- **Flooding** is incorporated into the MSBC using the accepted FEMA standard. Flood standards are referenced in ASCE24 and the base flood elevation is based on FEMA FIRMS with some freeboard based on building classification. However, it is unclear when FEMA might change its flood standards to incorporate forward-looking data or consider the design life of a structure. Temporary flood barriers, which are a commonly used adaptation measure, are not addressed in the MSBC. The MSBC may need to include standards for temporary barriers to avoid egress issues. Finally, cities and towns already have some flexibility with standards in floodplains through zoning. Local zoning can establish incentives for builders to exceed the minimum code.

- **Wind:** Putting mechanicals on the roof to avoid flood damage is a best practice, but it can have unforeseen consequences. Rooftop mechanical systems require larger structural members to carry the weight of the units. Larger structural steel/wood members carry a larger amount of embedded carbon, thus increasing rather than reducing the carbon footprint. Current wind load assumptions may not account for large, roof mounted mechanical equipment or accurately reflect the extent of climate change. The size of rooftop mechanical equipment is growing because current energy codes require the use of more mechanical ventilation. Energy codes now restrict the flow of fresh air through walls, roof and window assemblies, and as a result, mechanical systems must bring fresh air into the building as well as circulate it to avoid CO2 build-up.

- **Heat** is addressed in the code to some extent because structural engineers consider expansion and contraction of joints using an assumed temperature range. However, the temperature range is growing on both the low and high ends, which necessitates reconsideration of range *and* duration assumptions. Heat is therefore difficult to address in the code because both current and future temperatures must be considered, which is challenging when the assumed temperature range is so large. Massachusetts may be able to look to other states that have addressed heat in their codes and have similar climates. However, if the state designs to those standards, it may also be creating excess capacity, which would be contrary to energy efficiency goals. For the most part, codes do not require air conditioning but this may become more necessary going forward for certain facilities like nursing homes, schools, hospitals, etc. While there is currently a threshold for warming in the code, there is no threshold for cooling. This could be a health/safety issue as more extreme heat for longer durations persists. However, there is a policy element to setting “design temperature” through the code –

there are other ways to keep people comfortable. Any changes to the code should also take into consideration the indirect effects of extreme heat; for example, the impact of frequent and long-term air conditioning use on indoor air quality.

- **Wildfires** are not currently addressed in the code. In other states like California, there are complex considerations like cutting back vegetation, double tasking pool to sprinkler system, etc. However, adaptation measures for wildfires can be unaffordable for the average homeowner.

- **Other** adaptation options discussed included building materials and structural requirements. These may need to be considered individually based on their useful life and the feasibility of adapting them in the future. Some components of a structure, like building systems/mechanicals need to be replaced three or four times over the design life of a structure. It may not be necessary to adopt those systems to a 50-100 year standard – it could be sufficient to look out 15-25 years. Other components of a structure (like the walls) are much harder to change in the future. Alternatively, windows are easy to change. They also are not dictated in the code, (besides minimum U and R values which indicate resistance to heat). It's up to the owner to determine the performance of windows. However, it may be important to consider reflectivity of windows in the code. There are documented instances of vinyl siding melting off because windows of adjacent properties are too reflective. Reflectivity may also have traffic safety implications affecting drivers' vision or melting asphalt.

Mitigation Considerations

- **The code should not be too prescriptive.** If the code is too complex it will not be administered and enforced efficiently. Questions arise about who owns the process, what level of training is required; whether building officials are qualified to do inspections on passive and net zero buildings, etc. The more complex the code, the more people will look for ways to circumvent it. These practical considerations should be considered in setting minimum standards. It could also be cost-prohibitive for some property owners if an engineer is required to interpret and execute complex code requirements for a single- or two-family home. Very prescriptive codes may also present liability questions about who owns the risk. In most cases, there are a number of professionals working on a single project with different roles and tasks. They rely on each other to meet minimum standards for their respective tasks and professionals have to comply with the minimum building standards and contractual requirements to avoid liability. There is interest in better understanding of risk identification and allocation.

- **Incentives versus mandates:** It may be beneficial to move requirements out of the building code and make them the subject of incentives, which could motivate the client and allow the builder to get over the learning curve. Financial backing would help the transition from optional to mandatory items. This has been done in other contexts –

easing the transition to a new standard by incentivizing it, allowing designers/builders to get familiar with it, and then slowly folding it into the building code.

Other Considerations

- **Consistency:** Designers should be able to come from anywhere in the country. The more state-specific amendments, the more challenges for out-of-state professionals. Building officials prefer uniform national requirements.

- **Unforeseen consequences:** The reactive approach thus far has been to identify a problem and create a code to solve the problem, but not thinking far enough ahead to foresee new problems.

- **Equity issues:** The building code applies not only to new construction but also to substantial renovations/alterations. The Massachusetts Architectural Access Board's (MAAB) accessibility code has a threshold requiring access improvements if renovation cost is 30 percent of a structure's assessed value. These thresholds can be an issue in terms of equity among communities because property values and building values in some parts of the state are less than in others. If developers and owners in communities with lower property values cannot afford to comply with updated code requirements, this could have implications for the overall economy.

Strategies and Levers

- **Education:** could be an important lever for getting greater buy-in for changes. The market could shift to address consumer demand if more tenants/buyers start asking what the building owner/developer has done to prepare for climate change. Developers often do not have a long-term interest and will not go beyond the code (in most cases) unless these questions are raised by consumers. At the same time, some professionals may resist changes to the code if they perceive them as complex or if they don't understand the underlying issues. There should be a discussion with higher education deans/faculty training future professionals (engineers, architects, building inspectors, contractors) about how they can adapt their curriculum to cover climate change issues.

- **Changes at the ICC versus the State level:** The Stretch Code, an opt-in standard, is an example of communities in Massachusetts wanting more restrictive energy standards. The Stretch Code soon became the model code at the ICC and acted as a proof of concept. Now, the base code has caught up to the Stretch Code. It is unclear whether this should be addressed through changes made at the state level or through the ICC code development process (CDP). Ultimately, building officials prefer codes to be as uniform as possible so that one state or community is not at an economic disadvantage because it is more challenging for professionals to design and develop there. For that

reason, representatives could be sent from Massachusetts to ICC to try to effect change at the national level. Changes at the international code level may also be more attractive because when Massachusetts passes a state amendment, the Insurance Services Office, Inc. ("ISO") has to be convinced that the state amendments are superior (more stringent) to the IBC and IRC base standard. The ISO Building Code Effectiveness Classifications (BCEGS) metric evaluates municipalities at the local level based on the code adopted with or without amendments in combination with the administration and enforcement of those codes. This data is normalized across the municipalities in a state to establish a State level rating. When insurance companies purchase the ratings from ISO, it can have an impact on the costs of individual property owners and personal property insurance.

- **Financial Incentives:** If consumers want it, builders will build it. Providing financial incentives to developers could motivate clients and help get builders over the learning curve. These do not have to be dollars – there may be other carrots that cities and towns can provide that would motivate developers (relaxed regulations, streamlined process, tax incentives, etc.). Another option would be to change how federal disaster funds are prioritized or allocated based on certain building requirements.

Moderated Discussion II: Opportunities for Reform

- Flood standards: It would be useful to amend the Tenth Edition of the MSBC to incorporate the results of the statewide projection dataset. This would mean minimum standards that are higher than the FEMA standard. The overall structure of the code would not change.
    - Design Flood Elevation (DFE) could be easily established in the MSBC. This could be done through DFE tables – there is a provision in ASCE24 that bases freeboard on either the base flood elevation (determined by FEMA) or the design flood elevation;
    - There are already wind and snow load tables which vary by community and a similar table could be added which addresses flooding;
    - A design life factor could be introduced into freeboard requirements. For example, if a shed will only be standing for 20 years, the freeboard requirement should not be the same as for a structure with a 100-year design life. There could be a pilot in Massachusetts as proof of concept for national code changes;
    - Massachusetts should send representatives to the ICC to argue for changes based on projection data for future climate conditions.

- Heat: Small changes could be made to the code to address heat issues.
    - The code could require white rubber roofs instead of black roofs. This is already fairly common practice and could help with cooling in the summer but could be counterproductive in the winter.

- Building Performance:
    - Improve building performance – buildings are often not being operated as designed. This is a significant health threat with regard to air quality issues. The state should consider a re-commissioning process. If the owner knows that every five years a building report card will be prepared, this prospect could create an incentive to improve building performance.
    - Require that commercial projects be re-commissioned at least every five years. This could interface with building disclosure ordinances passed at the local level to address compliance.

Stakeholder Meeting III: Municipalities

The third and final stakeholder convening was held in April 2018 and hosted in partnership with the Metropolitan Area Planning Council (MAPC).

The meeting began with a discussion of ongoing initiatives in the cities and towns present as they relate to climate change.

Summary of current activities

In general, many Massachusetts cities and towns are addressing climate change through commitments to both mitigating greenhouse gas emissions and adapting to climate impacts. Several participants are currently involved in or seeking to become involved in the state's Municipal Vulnerability Preparedness (MVP) program. Many cities and towns are incentivized by opportunities for grant funding and are more likely to take on initiatives that are financially supported at the state level, such as the Green Communities and MVP programs. Likewise, peer pressure was acknowledged as an important driver for action. In particular, the MAPC Metro Mayors Coalition Climate Preparedness Taskforce encourages cities and towns to keep up with their peer communities.

Several municipalities have received citizen petitions for more standards on GHG emissions and adaptation. Municipalities identified the primary adaptation priorities as flooding (from sea level rise and extreme storms) and heat, but are also concerned about post-extreme weather services like snow removal. Some municipalities are actively updating zoning and other local requirements but grappling with how to require better construction based on specific climate data they have generated for the locality. On the mitigation side, Boston and Cambridge have building energy reporting and disclosure ordinances. In municipalities where capacity and resources are more limited, existing staff are being tasked with climate adaptation and resilience even though it may not be their area of expertise. There is a significant amount of work underway in municipalities that is not classified as "climate resilience" but fulfils the same purpose; for example, open space protection, stormwater management, and other functions.

Moderated Discussion I: Current concerns with state code

Municipalities are encountering the MSBC as a barrier to pursuing mitigation and adaptation activities, either conceptually or practically. Some municipalities committed to particularly aggressive carbon reduction goals believe that deeper interventions in the building sphere are needed, but such initiatives undertaken at the local level will likely conflict with the MSBC. While some officials gave specific examples of how the current code inhibits them from reaching their goals (like carbon neutrality) other concerns about the MSBC appeared to be more conceptual. Regardless, many are looking to regulate beyond the current Stretch Code

and are looking for ways to circumvent existing legal obstacles through zoning or other methods.

Some municipalities look to Boston's Article 37 provisions as an example of regulating energy more strictly through an alternative mechanism. However, there is some reluctance to use the Boston method as a model because of concern that it may be vulnerable to legal challenge. Boston asserts that Article 37 does not dictate code and therefore does not conflict with the MSBC; rather, it codifies LEED certification and LEED provides many alternative ways to meet the requirements.

Other specific areas of concern relating to current code requirements included:

- **Building Materials:** For example, glass buildings rely heavily on active power systems, which frustrate thermal resilience goals. Glazing is also an issue.

  There is a market component to the materials issue. If manufacturers of materials and products were making more efficient options, they would likely be used. For example, manufacturers have already made changes to U values on glass from about 0.35 to 0.27 and lower.

  There were mixed opinions on the current progress toward energy efficiency for new buildings. Some municipalities expressed the opinion that insulation, heating systems, and windows are the three major building components needed to reduce fossil fuel consumption and that new homes are being heated with reduced energy. However, others observed that projects tend to meet only the minimum requirements. The concern was expressed that the current code and minimum standards send the wrong signal. Performance can likewise be an issue. The building may be designed to be energy efficient but is not operated as designed.

- **Commercial system modeling:** Participants expressed a desire for the Stretch Code to address the current loopholes in modeling, stating that energy modelling often gets "gamed" so that efficiencies are lost. Projects meet the code but omit emissions reductions that could have easily been implemented.

- **Existing loopholes in project review:** Many project proponents model an ideal scenario of a building's fitting out and permits are issued on that basis, but subsequent fit out changes do not include revised modelling. Lab/office mixes are particularly concerning because labs get certain exemptions and later changes in the mix do not affect the prior approvals.

- **Legal authority for development review:** It is unclear whether there are any legal pathways for municipalities to assess greenhouse gas performance through zoning or administratively. Municipalities are interested in requiring proponents to stand behind

their designs through some type of disclosure. Sometimes requiring proponents to fill out paperwork and answer questions is not enough because they are not required to provide good answers. Some municipalities are already nesting policy initiatives within development review guidelines.

- **Inaccurate Information:** Participants expressed mixed views on the accuracy of existing FEMA FIRMs for current conditions as some municipalities may have more accurate FIRMs than others. However, there was general agreement that FEMA FIRMs are not ideal long-term planning tools because they do not account for future conditions like sea level rise.

  Some municipalities, including Cambridge and Boston, have created their own flood maps based on current and future conditions. The primary concern with floodplain designation is that nothing beyond the FEMA-designated floodplain triggers the flood-resistant construction standards in the MSBC. While municipalities have the authority to regulate a more expansive floodplain through zoning and other local measures, they cannot require development to meet flood-resistant construction standards outside the FEMA-designated floodplain.

- **Enforcement:** While enforcement can be challenging for the existing code because of lack of resources and staff, it can also be challenging to assess developments that go beyond the code voluntarily, for example, building to Passive House standards. The HERS rating is not being done for many renovation projects when buildings are a combination of old and new and only the new part is updated. One readily available and free metric to address this issue of new versus old construction is the ResCheck and ComCheck programs issued by the U.S. Department of Energy. They can be used for new construction, additions, and/or alteration projects.

- **Incentives:** Adopting the Stretch Code was a way for municipalities to get Green Community status, which resulted in opportunities for grant funding. This was a big impetus for participation in the program and adoption of the code. In addition, there are some more progressive pathways already available supplemental to the base code, for example, Passive House but not many projects take this route. Incentives may be a way to get developers and builders to consider these options.

  At the same time, incentives are not a silver bullet. In the current market, developers will do only what makes economic sense. If municipalities are forced to incentivize everything they want commitments to the community may suffer and the character of the community may be changed in unexpected ways.

- **Data and reporting:** It is difficult to comply with annual reporting on HERS ratings because getting reliable information is challenging. For example, HERS ratings by zip code for new construction are not available. The result can sometimes be higher HERS ratings slipping through the cracks.

- **Process for Change:** Even municipalities looking to circumvent building code challenges through other means can face barriers to getting those changes passed locally. For example, zoning changes currently require a 2/3 super majority vote.

Moderated Discussion II: Getting to building code modernization

Participants discussed strategies for achieving building code reform and some of the concerns over taking various approaches.

International Reforms: First, many municipalities—but not all—are aware that they have the ability to register officials to vote at the ICC on proposals. Some municipalities were aware that they had voting spots but were unsure if anyone was registered to vote. There was also confusion around who within the municipality is eligible to register to vote – whether it has to be a relevant specialty or department like the building commissioner or code enforcement officer. Staff at the municipality that are eligible to vote may not have the level of buy-in to code revisions as planning staff or other departments actively working on climate policy. Encouraging more municipalities to register and vote on ICC proposals or strategically engage around advocacy at the ICC for climate-related reforms could be one strategy for paving the way for change.

Complexity and Enforcement: While most municipal officials agreed that greater flexibility in the code at the local level would be helpful in achieving climate mitigation and adaptation goals, others expressed concern that more stringent codes could be an impediment to enforcement. Building officials are so busy that they are mostly only checking for life safety, proper insulation installation, windows, and other items that are easier to check. Most building inspectors who are involved in plan review do not have the training to determine if the buildings meet the Stretch Code, which has become complex and hard to monitor in the field and in the office. Building departments may need a mechanical engineer on staff just to inspect residential buildings because of the tradeoffs between building envelopes and systems.

Municipalities expressed concern that determining whether buildings comply with the Stretch Code is already a challenge and could become more difficult in light of performance-based energy standards. In many cases, there is no municipal capacity to monitor this and more manpower or muscle is needed for enforcement efforts.

Along these same lines, there are concerns about the complexity of the existing Stretch Code, which some believe has set the stage for unintended consequences, such as those regarding

fresh air flow problems. Revising the requirements of the Stretch Code would need to acknowledge the current shortcomings.

In municipalities that do not have building energy disclosure ordinances, it is hard to know whether the Stretch Code has helped achieve energy efficiency and climate goals. The capacity of inspection services in many municipalities is limited because they lack a system to collect information on Stretch Code compliance and reporting is not systematic enough to do planning-level benchmarking. As a result, many municipalities have a hard time understanding how they are complying at a community-wide level and what the impact is. However, the Stretch Code has been adopted in over 200 cities and towns, so more developers and builders may be building to this level even without the local ability to monitor it effectively.

Governance: Municipalities are concerned whether the current organization of the executive branch has the ability to handle the complexity of climate issues facing the state and localities. A different form of governance could be required in order to be effective. Municipalities were split on whether changes should be prioritized at a state-level, local-level or both. Some believed that the biggest fix is at the state level and that these issues are harder to tackle from the ground up. Others felt that while a one-size-fits-all approach has benefits, creating flexibility at the local level for those who have the capacity to explore changes could incubate solutions that could eventually be scaled up.

Some were interested in the idea of a home rule petition, where cities and towns would jointly sign on to design and implement more stringent building codes at the local level pursuant to Chapter 143. Another option of interest was a tiered approach that would allow municipalities to opt-in to more stringent requirements – some agreed that it would be easier to opt-in to a state approved code than to create it at the local level.

There was some uncertainty around who the “trusted voice” is on code specification and whether or not proposals from municipalities would be well-received by industry. Municipalities may not have the most leverage because they are a trusted authority on minimum standards but not always a trusted voice on “value-added techniques” not required by code.

Flexibility and Financing: Municipal officials also noted that when considering code revisions it is important to preserve flexibility because risks will change over time. One option may be to tie requirements to the lifespan of the structure but perceived uncertainty in climate science could pose a barrier to indexing codes to evolving predictions. An unintended consequence of making codes more prescriptive or complex could be lack of enforcement. There was a suggestion to address knowledge gaps through training and continuing education for contractors and potentially offering a certificate program.

As we look for more or different requirements, developers need to be able to comply, which may mean identifying financing options through either incentives or other mechanisms. Some municipal officials suggested there may be a role for a LEED-like approach in creating a market

incentive for resilience but it is unclear whether accepted standards exist yet. One notable exception may be the "RELi" action list and credit catalog, which has been adopted by the U.S. Green Building Council (USGBC). RELi was rolled out in 2012 as a LEED Resilient Design pilot credit. RELi is a national consensus standard, developed through an American National Standards Institute (ANSI) process, focused on creating resilient buildings and communities. However, it is not currently operating as a certification process but as a set of guidelines.

On the climate adaptation side, one concern for many municipalities are single-family homeowners and smaller property owners who do not currently fall into robust review processes. One option for bringing these smaller properties into the fold may be resilience audits modeled off of existing energy efficiency audit programs. Some municipal officials who have experience with this residential resilience audit concept noted that the same measures are usually recommended for most properties and it is probably not necessary to perform individual property audits.

Municipalities recognize the complexity of retrofitting historical buildings to meet newer codes. The majority of Massachusetts' building stock is existing rather than new development so having a strategy that addresses both is important. Some officials indicated that having a toolkit that provided guidance on climate resilience options for older or historic buildings would be helpful. Officials also noted that the carbon footprint within the building stock is primarily residential (one-, two-family and multi-family), making it even more important to address residential retrofitting. There was specific interest in establishing performance requirements for different building types to put more force behind the current benchmarking and score carding approach.

Barriers to progress

There was consensus that some of the current barriers to implementation are internal resistance and lack of knowledge, as well as bandwidth, training and political will. While many municipalities are actively engaging in the dialogue around climate change and even drafting plans and goals – it has been a challenge to determine what those goals mean in practice. For example, making a case for a commitment to carbon neutrality is easy but specific recommendations for code revisions that will make that goal a reality are much harder.

Along these same lines, there was an acknowledgement that there are differing levels of climate literacy and/or commitment on these issues across municipal departments. Some municipal staff actively pursuing these goals may need buy-in from staff in other departments who do not know the issues as well or do not have the bandwidth to address them. In addition, evolving climate science has created an excuse for the "wait and see" approach. The result has been endless studies that incorporate the newest information, data, and models but little action on implementation. There is a need for inter-departmental climate efforts. Using something like the public works capital budget could bring everyone equally into the fold.

There is also a need for transparency, which helps to drive resident and business (especially small business) initiatives within the community. Transparency can be important for taking steps on implementation and provides universities and private companies with the knowledge and data they need to take actions of their own.

There was general interest in updating the building codes in some way – whether it is a work-around strategy through a zoning provision like Boston's Article 37, a petition to the BBRS pursuant to G.L. c. 143 § 98 or other options. However, some officials were concerned that incorporating these provisions through zoning may not provide the greatest legal protection because preemption become an issue down the road.

Municipal Priorities

Participants were asked to list their top priorities (not in ranked order) on climate resilience. They named the following (note that not all of these priorities interface with the building code):

- Participate in the Municipal Vulnerability Preparedness (MVP) Program;
- Educate municipal staff, contractors, and technical professionals about climate resilience measures and codes to create buy-in;
- Overcome challenges associated with Town Meetings/City Council by developing an effective strategy for presenting climate resilience proposals;
- Overcome Massachusetts-specific governance issues – specifically the lack of buy-in for master plans;
- Integrate climate resilience into existing planning initiatives and work and get greater buy-in across departments;
- Broaden the conversation so that the narrative is not "no development" and focused more on how we achieve climate-resilient development;
- Get a generator so that servers are not compromised during extreme weather events;
- Develop an emergency management plan;
- Dredge culverts for stormwater management;
- Expand tree canopy and determine where new trees should be planted;
- Update the building codes in some way;
- Establish performance requirements for different building types;
- Conduct a feasibility study for a downtown microgrid;
- Retrofit existing buildings and provide incentives/financing to make improvements at key points of renovation process;
- Address social resilience by engaging human services more in this work; and
- Focus on heat vulnerability and urban heat island effect by transforming the urban landscape.

Additional research needs

Participants were also asked to identify areas of research or data that would be helpful for climate adaptation and mitigation strategies and to consider the types of revisions that are needed in state law and codes to achieve their goals. The following needs were identified:

- Studies on the effectiveness of code compliance for different aspects of the code;
- Case studies on the negative aspects of glass buildings;
- Best practice research on measuring code compliance including e-permitting;
- Evidence that supports the "this is what the market wants" argument (i.e. if tenants knew the tradeoffs of what they were sacrificing would they be less interested); and
- Best ways for collecting and storing information about buildings (HERS ratings, heating and cooling systems information, building construction type, date of last major renovation, solar PV panels, etc.).

Appendix B: Stakeholder Convening Participant Affiliations

January 2018: Design Professionals
Convening hosted by: Conservation Law Foundation; Boston Society of Architects; and American Institute of Architects, Massachusetts Chapter

- Achiterra
- Arup
- Bergmeyer
- Boston University
- Cosentini Associates
- Donovan Hatem LLP
- Finegold Alexander Architects
- Fused Studios
- GZA
- Halvorson Design
- Massachusetts Institute of Technology
- Noble, Wickersham & Heart
- The Green Engineer, Inc.
- US Green Building Council

February 2018: Industry Experts
Convening hosted by: Conservation Law Foundation and American Institute of Architects, Massachusetts Chapter

- The American Council of Engineering Companies, Massachusetts Chapter
- Associated General Contractors of Massachusetts
- Home Builders & Remodelers Association of Central Massachusetts
- Kleinfelder
- Weston & Sampson
- BVH Integrated Services
- Building, Fire, and Access, Inc.
- Anonymous affiliation – town Building Commissioner

April 2018: Municipalities
Convening hosted by: Conservation Law Foundation and Metropolitan Area Planning Council

- Town of Cohasset
- Town of Concord
- Town of Winchester
- City of Melrose
- City of Cambridge
- City of Somerville
- City of Boston