



# VOLUNTARY RESILIENCE

# STANDARDS

**AN ASSESSMENT OF MARKET OPTIONS FOR BOSTON'S LARGE COMMERCIAL BUILDINGS**

# ACKNOWLEDGEMENTS

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[A Better City](#) is a diverse group of business leaders united around a common goal—to enhance Boston and the region’s economic health, competitiveness, vibrancy, sustainability and quality of life. By amplifying the voice of the business community through collaboration and consensus across a broad range of stakeholders, A Better City develops solutions and influences policy in three critical areas central to the Boston region’s economic competitiveness and growth: transportation and infrastructure, land use and development, and energy and environment.

To view a hyperlinked version of this report online, go to [http://www.abettercity.org/docs-new/Voluntary\\_Resilience\\_Standards.pdf](http://www.abettercity.org/docs-new/Voluntary_Resilience_Standards.pdf)

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We also want to extend a thank you to participants in a focus group session held on the current status of and needs for resilience in the commercial building sector. These participants have chosen to remain anonymous.

This report is a companion report to a national document focused on resilience standards for all facility types. Descriptions of standards in the national report have been used here if they apply to Boston's large commercial buildings. The national report is available for download: <http://www.mc-group.com/voluntary-resilience-standards-an-assessment-of-the-emerging-market-for-resilience-in-the-built-environment/>. The national report was funded by a collaboration of the Energy, Kresge, and Barr Foundations. That document can be referenced as:

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# CONTENTS

Introduction .....	4
Methodology.....	4
The Boston Context .....	4
Available Voluntary Resilience Standards .....	5
Building Resilience in LA Framework .....	5
Envision .....	6
Fortified: Commercial and Safer Business Programs ..	6
LEED Pilot Credits for Resilient Design .....	7
Performance Excellence in Electricity Renewal .....	7
Resilience-based Earthquake Design Initiative .....	8
RELi Resiliency Action List + Credit Catalog.....	8
Sustainable SITES Initiative .....	9
Standards Comparison .....	9
Current Market and Opportunities for Growth .....	12
Recommendations and Next Steps.....	12

## INTRODUCTION

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In the five years since Hurricane Sandy, the number of voluntary resilience standards available for use has grown rapidly to assist developers, building owners, property managers, and tenants in preparing for the potential impacts of climate change. The intent of these standards is to shift the building sector toward more robust adaptation and preparedness practices; they are thus analogous to two programs that have driven the development of sustainable facilities: the Leadership in Energy and Environmental Design (LEED) standards and the even more ambitious Living Buildings Challenge. But whereas these green building certifications have been incorporated into local ordinances—and, because of their ability to increase property values, are sought after by developers<sup>1</sup>—resilience standards are at a much more nascent stage of development.

There are many emerging voluntary standards that provide related (and sometimes overlapping) guidance for increasing resilience in the built environment. Throughout this report, such tools—which include certifications, benchmarking systems, planning frameworks, and design principles—will be referred to collectively as “resilience standards.” Based on their applicability to the commercial real estate sector and Boston context, eight of these standards are reviewed in this report.

This report provides an overview of climate impacts projected to affect Boston over the next half century, describes each of the eight resilience standards relevant to Boston’s large commercial facilities, provides a comparison of these standards, and analyzes their ability to support resilience to extreme temperatures, sea-level rise, extreme precipitation, and severe weather in Boston’s commercial building stock.<sup>2</sup> Although the report concludes that no single available standard provides sufficient guidance and technical support to implement measures to address multiple hazards, the report does highlight options that both new and existing facilities can use to facilitate planning today. Collaboration and coordination between existing standard developers could be used to create more holistic guidance to address the needs of facilities.

## METHODOLOGY

The research for this report was conducted in parallel with a national effort to identify, classify, and compare voluntary resilience standards (please see the Acknowledgements section for further information). The research team conducted desk research on the standards, identifying areas of differentiation and points of comparison. The team also conducted 22 interviews with representatives from 20 organizations involved in the development of resilience standards, the

deployment of resilience initiatives, or the management of facilities that incorporate resilient features. A four-person focus group was held; one participant was an industry association representative and the other three were either facilities managers or advisors. The interviews and focus group meetings examined opportunities, levers, and strategies driving market adoption of resilience standards, as well as barriers and gaps within the market. This report employs the analytical approach developed from the national process within the local Boston context.

For the remainder of this document, the term resilience standards refer to guidance, benchmarking, protocols and frameworks for commercial real estate building design, construction or maintenance. These standards are distinct from individual resilience technologies or measures. Resilience technologies are already being used within Boston to adapt to climate change including elevated critical equipment and flood barriers. These local actions are profiled further in the following section. Additional information on mitigation impacts and the economics of these technology options is available in A Better City’s [Building Resilience Toolkit](#), which is updated annually.

## THE BOSTON CONTEXT

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Preparing for major, climate-induced change is a focus of citywide planning efforts in the City of Boston. In December 2016, the City released the [Climate Ready Boston](#) report; this included consensus-based climate projections for the city as well as a vulnerability assessment focused on the hazards of coastal and riverine flooding, stormwater flooding, and extreme heat.<sup>3</sup> The report identified eight highly vulnerable areas, including Downtown and South Boston, where the city’s business core is located. The report also recommended strategies for making communities, buildings, and infrastructure more resilient to climate hazards. For new buildings, the report recommends updating zoning and building regulations to support climate readiness; for existing buildings, it recommends retrofitting to protect against climate hazards. Currently, the Boston Planning and Development Agency (BPDA) requires developers of all major new construction or renovation projects to complete the city’s [Climate Change Resiliency and Preparedness Checklist](#), which provides guidance on how to take present and future climate conditions into account.<sup>4</sup> In 2017, the BPDA began to update the checklist to incorporate climate data from Climate Ready Boston and best practices from the building sector. A final version is expected to be approved in the fall of 2017.

Ahead of potential policy and regulatory action from the city and state, Boston’s leading building owners and developers are proactively preparing their buildings for climate change. Partners HealthCare, for example, built

two new buildings—Spaulding Rehabilitation Hospital in Charlestown and an office building in Assembly Row—with resilience in mind: the first floors are elevated; critical equipment has been located on higher floors, rather than in the basement; and the buildings feature back-up generators. Partners also developed its own internal resilience checklist for project development.<sup>5</sup> The plans for the General Electric (GE) headquarters in the Fort Point district also elevate the ground floor and critical equipment above projected rising sea levels.<sup>6</sup> Similarly, Boston Properties has reviewed its investments portfolio-wide for threats from climate change, modeling future scenarios for sea-level rise and storm surge, and has implemented infrastructure improvements and put emergency response protocols in place. For example, the company has a portable flood barrier on hand for its Atlantic Wharf property in Downtown.<sup>7</sup>

The profiled businesses and institutions investing in resilience are all part of the Boston Green Ribbon Commission (GRC), an organization which has been committed to advancing the City’s climate preparedness since 2010. The GRC is a group of business, institutional, and civic leaders working to develop shared strategies to fight climate change and build more resilience in the city. A Better City staffs the Commission’s Commercial Real Estate Working Group and coordinates closely with the GRC to engage the city’s major commercial real estate owners and their portfolios. This includes providing forums for discussion and resources, such as the [Building Resilience Toolkit](#), to help building owners mitigate and prepare for the effects of climate change.<sup>8</sup> The aim of these efforts is to broaden the adoption of climate preparedness strategies throughout Boston’s building stock.

In 2016, A Better City coordinated the Commercial Real Estate Sector’s engagement with Climate Ready Boston. This involved hosting meetings with stakeholders to share information on climate projections and the vulnerability assessment, and conducting tenant and developer focus groups to obtain input on potential preparedness policies and programs at the building scale. The largest event hosted for the sector, [Boston’s Climate Vulnerabilities and Solutions Symposium](#), brought together over 325 participants to share the results of the Climate Ready Boston planning process, introduce building-scale interventions, and discuss private sector resilience actions and financing and policy options.<sup>9</sup> A Better City has also introduced climate preparedness into its signature sustainability program, the Sustainable Buildings Initiative, providing guidelines for property owners and tenants to assess climate hazards specific to their facility, identify vulnerabilities, evaluate options, and develop and implement a climate preparedness plan. Throughout these processes, the commercial real estate sector has requested additional guidance or standards for resilient design strategies for their portfolios.

The [Climate Ready Boston](#) report clearly demonstrated that the city, its businesses, and its residents need to take climate preparedness actions now. Business interruption impacts from sea-level rise are projected to total nearly \$250 million in annualized losses by the mid- to late-twenty-first century, in addition to \$1.4 billion in annualized physical damage, stress factors, and displacement costs. Downtown and South Boston will account for some of the biggest losses by neighborhood.<sup>10</sup> According to some Boston developers and property managers, the effects of climate change are already being felt today. They emphasize that resilience will require both building-level actions and a strong focus on infrastructure (i.e. drinking water, wastewater, electricity, heat, transportation, and telecommunications).<sup>11</sup> To help developers and building managers prepare their facilities for climate change, the resilience standards reviewed in this report offer a variety of approaches to and guidance for building-level preparedness.

## **AVAILABLE VOLUNTARY RESILIENCE STANDARDS**

The emerging standards reviewed here provide guidance for preparing buildings, infrastructure, and systems for climate-related effects. In its benchmarking, the research team found a crowded and wide-ranging landscape of available options. Each of the standards approaches resilience in a different way—varying in terms of hazards addressed, systems identified, and performance outcomes provided.

Below is a high-level overview of the eight standards identified that focus on commercial construction; this includes identification of the hazards addressed, the context and history, and relevance to Boston. The descriptions of the standards are replicated from the recent national voluntary resilience standards report<sup>12</sup> (see Acknowledgements for further details) that were developed after consultation and review by industry experts and the standard developers. Additional Boston-specific contextual information has been added to the description. The standards are listed in alphabetical order.

### **BUILDING RESILIENCE IN LA FRAMEWORK**

- **Hazards:** Requires existing facilities to assess their own hazards as part of the framework
- **Description:** The Building Resilience in LA (BRLA) project launched in 2015 as an initiative of the Los Angeles chapter of the US Green Building Council. The BRLA is a planning and operations framework focusing on capacity building and education for existing facilities to “survive and thrive in the face of stressors and shocks.”<sup>13</sup> The [Building Resilience Los Angeles: A Primer for Facilities](#), released in

October 2016, outlines a process for (1) incorporating resilience into operations and (2) initiating the institutional changes required to support preparedness planning. The BRLA's four core steps include forming a cross-functional resilience planning team, developing an understanding of vulnerabilities and risks, defining the facility's resilience goals, developing an actionable plan, and implementing and maintaining the plan's objectives. While the guide was developed in Southern California, it can be easily adapted for use in other regions as its focus is not on the specific hazards to which an area is vulnerable, but rather provides a framework to improve processes and planning. The facilities guidance and training developed by BRLA has been piloted by Los Angeles businesses, key community organizations, and nonprofits. The BRLA program is designed to build community-wide resilience, develop benchmarking methodologies, and create a peer to peer learning network for existing facilities<sup>14</sup>. It is one of the few standards reviewed with a specific focus on existing buildings.

- **Relevance to Boston:** The guide discusses BRLA's four-step planning process in detail, and is an appropriate reference tool for existing buildings in Boston with an interest in refining their operational planning. It can be utilized to assess internal capacity for responding to climate risks and fostering resilience and identify areas for process improvements.

## ENVISION

- **Hazards:** Sea level rise, extreme precipitation, storms, and extreme heat for infrastructure projects
- **Description:** Developed by the Institute for Sustainable Infrastructure and Harvard University's Zofnass Program for Sustainable Infrastructure, [Envision](#) is a rating system for public infrastructure projects of transportation, waste, water, energy, information systems, and landscapes. Envision provides guidance during project planning, design, construction, operation, and deconstruction, and offers a process and tools for evaluating and rating projects of different sizes and types based on their community, environmental, and economic benefits. The five credit categories are quality of life, leadership, resource allocation, natural world, and climate risks, and each credit has different levels of compliance or performance. The system encourages planning for short- and long-term hazards, as well as reducing emissions and environmental impacts and improving quality of life. The City of Los Angeles has adopted Envision for use in its infrastructure projects, and nearly 200 private sector engineering,

design, and planning companies have Envision-qualified professionals on their staff.

- **Relevance to Boston:** Throughout the Climate Ready Boston planning process, property developers stressed the importance of improving the resilience of buildings and infrastructure simultaneously. Envision could be used by local and regional agencies to better prepare infrastructure systems in parallel with some of the other standards for buildings profiled in this document.

## FORTIFIED: COMMERCIAL AND SAFER BUSINESS PROGRAMS

- **Hazards:** Wind caused by hurricanes, tornadoes, severe thunderstorms, hail, floods, earthquakes, wildfires, and severe winter weather
- **Description:** Developed by the Insurance Institute for Business and Home Safety, the FORTIFIED program offers a Commercial program and a Safer Business program. The [Commercial program](#) which is designed for new or existing buildings began in 2014. In hurricane-prone areas, it addresses hurricane and tropical storm hazards; in non-hurricane areas, it addresses high winds and hail.<sup>15</sup> The program offers three certification levels, which range from Bronze to Gold and address roof performance, building envelope protections, structural performance, and business continuity and operations. To address flooding, the standard requires electrical and mechanical systems to be protected at the Silver Level, and recommends, but does not require, that new construction take into account the flood zones designated by the Federal Emergency Management Agency (i.e., structures must be elevated three feet above the 500-year flood level). This designation is currently only available for buildings in Alabama.

[FORTIFIED for Safer Business](#) began in 2011 and is a code-plus program for small and mid-sized businesses constructing new facilities<sup>16</sup> (i.e., some of the program's performance requirements exceed the minimums set by the building code). Hazards included are floods, freezing weather, hail, high winds, hurricanes, water intrusion, wildfires, earthquakes, and interior damage from fire and water. The program offers process guidance, design criteria, and checklists for creating a compliant building, but the Insurance Institute does not currently offer certification levels or designations for these buildings and still considers the program to be in pilot phase.

The Insurance Institute's main program has been FORTIFIED Home, a program for new and existing construction focused on disaster protection from

hurricanes, high winds, hail, and severe thunderstorms. Alabama, Mississippi, Georgia, North Carolina, and South Carolina have adopted policies that provide (1) incentives to assist with retrofits and/or (2) insurance discounts for those who certify their homes.<sup>17</sup> Currently analogous incentives are not available for the commercial program, but could be a possibility in the future. The Insurance Institute for Business and Home Safety includes a research facility in South Carolina that can evaluate the resilience of residential and commercial construction materials, systems, and design for buildings up to two-stories in its testing chamber.

- **Relevance to Boston:** FORTIFIED programs focus on low- to mid-rise commercial buildings, which may be less applicable to the larger commercial buildings that comprise the majority of the Boston Green Ribbon Commission’s membership. Outside of these organizations, Boston has a significant number of low- to mid-rise multifamily and commercial buildings (under 60 feet in height), which could utilize FORTIFIED’s programming.

#### LEED PILOT CREDITS FOR RESILIENT DESIGN

- **Hazards:** Requires facility to determine hazards relevant to area and conduct an initial facility-level vulnerability assessment
- **Description:** Leadership in Energy and Environment Design (LEED) is a third-party verification system for green buildings of all scales, from private homes to large commercial buildings. LEED criteria can be applied to new or existing buildings, and the program offers four rating levels based on points gained for energy, water, waste, materials, transportation, human health, and other categories. The Boston Planning and Development Agency’s (BPDA) [Article 37](#) zoning code requires that building projects requiring a building or use permit achieve at least the “certifiable” level of LEED performance.<sup>18</sup>

Initiated in 2015, [the LEED pilot credits](#) on resilient design were developed to complement the existing LEED program; thus, are available alongside other LEED credits in the Building Design and Construction rating systems. There are three types of credits: the first requires a climate change assessment or emergency planning; the second requires design for the top three hazards relevant to an area (e.g. flooding, hurricanes, high winds, earthquakes); and the third requires [passive design for survivability](#), such as backup power, access to potable water, and/or thermal resilience.<sup>19</sup> Within particular hazard areas, the program offers limited specific guidance, but does offer the option to draw

on other standards to evaluate hazards, such as FORTIFIED for Safer Business and the Resilience-based Earthquake Design Initiative. The LEED pilot credits were under revision in 2016 and are anticipated to be re-released in the fall of 2017.

- **Relevance to Boston:** New or existing facilities in Boston could use the climate change assessment and emergency planning guidance to strengthen their preparedness. Additionally, the LEED pilot credits offer performance standards for passive survivability, which could be utilized by facilities with goals of minimizing operational losses or downtime during severe events.

#### PEER (PERFORMANCE EXCELLENCE IN ELECTRICITY RENEWAL)

- **Hazards:** Focuses on electrical system response to stressors, as opposed to specific hazards
- **Description:** Performance Excellence in Electricity Renewal ([PEER](#)) is a third-party certification program designed to measure and improve power system performance for campuses (including large buildings), cities and towns, and electricity supply projects.<sup>20</sup> It is administered by Green Business Certification Inc. (GBCI) and was developed by the Electric Power Research Institute (EPRI) and Motorola after the 2003 blackout in New York City. PEER helps energy professionals evaluate power generation, transmission, and distribution systems based on four outcome-based categories and associated credits: reliability and resilience; energy efficiency and environment; operational effectiveness; and customer contribution. Certification begins with an independent assessment of a project, which provides a roadmap and business framework for using PEER. PEER also offers a toolkit to enhance project development and design and foster continuous improvement. GBCI also oversees certification for the LEED green building program and the Sustainable SITES Initiative (below), two other resilience certification programs.
- **Relevance to Boston:** Power is critical for business continuity in many organizations. PEER can assist commercial real estate buildings or campuses in understanding the options for minimizing the risk of impact from power outages. Locally, PEER guidance was followed by the Boston Medical Center during the construction of its on-site combined heat and power project funded through the Community Clean Energy and Resilience Initiative.<sup>21</sup>

## REDI (RESILIENCE-BASED EARTHQUAKE DESIGN INITIATIVE)

- **Hazards:** Earthquake or other seismic hazards
- **Description:** The Resilience-based Earthquake Design Initiative ([REDi rating system](#)) was developed by Arup and is applicable to areas facing earthquakes or other seismic hazards, including coastal areas at risk for tsunamis.<sup>22,23</sup> The program focuses on beyond-code design, planning, and assessment to help facilities, organizations, and communities recover quickly after a seismic event. Current approaches to seismic preparedness prioritize occupant safety. REDi builds upon this framework, and also focuses on the adaptive capacity and recovery of the building and its operations. REDi's four main categories are (1) organizational resilience: contingency planning for utilities and the business community; (2) building resilience: using advanced design to minimize damage to a building's structure and equipment thus improving occupant safety; (3) ambient resilience: using site planning to reduce risks from external hazards during seismic events; and (4) loss assessment: evaluating direct financial losses and downtime.

REDi has silver-, gold-, and platinum-level objectives for resilient earthquake design, with ratings based on downtime after an event (i.e., time for reoccupancy and functional recovery), direct financial losses, and occupant safety. REDi utilizes performance-based criteria for achieving each of its certification-levels, which could be helpful for operational planning. Additionally, the standard also offers guidance on engaging stakeholders in planning and developing a formal resilience plan.

- **Relevance to Boston:** While REDi does not directly address climate-change induced hazards, some of its processes and methodologies can be applied to climate resilience planning for building systems and utilities. The standard's performance-based criteria more clearly articulate value to insurers. Some properties in California using REDi have been able to generate some competition between insurers for serving REDi-certified facilities, but this work is in an early stage and not yet scalable. However, the performance benchmarks could be adapted and leveraged by Boston-area facilities completing their own operational planning.

## RELI RESILIENCY ACTION LIST + CREDIT CATALOG

- **Hazards:** Sea level rise, storms, extreme temperatures, and extreme precipitation

- **Description:** The Resiliency Action List ([RELi](#)) was developed as a national consensus standard through an ANSI-approved process, and began piloting in 2015.<sup>24,25</sup> RELi provides a comprehensive process for incorporating resilience into new building design and planning. The program is structured similarly to LEED, using lists of credits and prerequisites that draw on existing standards. It can be applied to homes, buildings, infrastructure, districts, neighborhoods, and campuses. It is one of the most comprehensive new building standards reviewed, combining principles of resilience and sustainability at the building and community level.

The RELi pilot has more than sixty actions, addressing facility planning, design, operations, and maintenance. Other categories include site selection, emergency operations and planning (e.g. back-up power and thermal safety), and adaptive design based on a variety of specific hazards or groupings of related hazards. The actions range from planning for future risks (e.g. avoiding areas on the basis of projected sea-level rise) to adapting to or mitigating existing hazards and incorporating longer-term community cohesion, health, and economic vitality. The pilot credits are cross-referenced to and work with Envision, FORTIFIED, the LEED certification system, the Sustainable SITES Initiative, and other programs. Although RELi is still in testing phase, its current version requires action across multiple categories, encouraging a comprehensive approach to new buildings and their integration into the surrounding community.

RELi is also designed to be an underwriting standard, known as the Green and Resilient Property Underwriting and Finance Standard, which provides lenders with guidance on how much money can be safely loaned to a project and insurers with guidance on how to value the resilient and green attributes of a project. If adopted, it would amend the existing Green Building Investment Underwriting Standards that can currently be applied to commercial buildings.<sup>26</sup> RELi's standard quantifies the tangible value from resilience investments to reduce the costs of capital and financing and support underwriting for bonds and mortgages for resilience. The creators of the RELi standard are currently in discussions with insurance companies and lenders about applying the underwriting and finance standard, but it has not yet been put into use.<sup>27</sup>

- **Relevance to Boston:** The RELi standard provides guidance for a variety of different risks across the building cycle, including climate impacts anticipated to effect Boston's built environment such as sea-level rise and extreme heat. The RELi credit catalogue is publicly available and can be

used as a reference guide for property and facilities managers planning for resilience. The credit catalogue was designed for new construction projects, but some credits can be readily adapted for existing facilities.

green infrastructure planning tools developed by the Trust for Public Land (TPL), which identify areas of opportunity to address higher precipitation and heat. If a property is within opportunity zones identified by TPL’s tool, SITES can help with implementation guidance.<sup>30</sup>

### SUSTAINABLE SITES INITIATIVE

- **Hazards:** Sea level rise, extreme precipitation, and extreme temperatures
- **Description:** The Sustainable [SITES](#) Initiative offers a comprehensive rating system for developing sustainable landscapes.<sup>28</sup> The American Society of Landscape Architects Fund, the Lady Bird Johnson Wildflower Center at the University of Texas, Austin, and the United States Botanic Garden developed SITES. Because it focuses on projects from a land development perspective, SITES provides site guidance to facility and landscape architects and engineers, but does not address buildings. The system was tested through a two-year pilot program starting in 2009 and is administered by Green Business Certification Inc. (GBCI).<sup>29</sup>

SITES is designed to be pursued in conjunction with LEED certification. Like LEED, SITES has four certification levels, and categories for retail and office areas, and corporate campuses. Credit categories include pre-design assessment and planning; water, soil, and vegetation; materials selection; human health and well-being; construction, operations, and maintenance; and education and performance monitoring. Some of the SITES ratings categories overlap with other resilience standards, particularly in the realms of site selection and design, managing on-site precipitation, supporting social connections and site accessibility, providing on-site safety and food production, reducing heat island effects, and using appropriate plants.

- **Relevance to Boston:** The SITES standard can be used to help building owners or developers plan for and develop green infrastructure on their properties. SITES could be used in parallel with

### STANDARDS COMPARISON

The following analytical frameworks were developed from research completed for the national voluntary resilience standards report<sup>31</sup> (see Acknowledgements for further details). For consistency, the same analytical framework that was utilized nationally was applied to the subset of standards relevant to the commercial real estate sector.

The framework in Table 1 highlights key points of comparison between the standards. The framework draws on criteria across three categories: target audience, impact and scope, and standard development process. Within the target audience category, the framework compares standards based on facility type (e.g. residential, commercial, industrial, municipal), scale of focus (e.g. the facility or community level), the life-cycle phase at which the standard applies (e.g. new construction or retrofits), and whether the standard considers systems beyond the site level (e.g. communications or transportation).

Within the impact and scope category, the framework compares the hazards included within the standard (e.g. flooding, wind, earthquakes), performance goals (e.g. business continuity, passive survivability),<sup>32</sup> and whether the standard incorporates social vulnerability. Finally, the standard development process category compares the driver for the creation of the standard (e.g. community or industry), and the verification process (e.g. internal or external review).

Table 2 applies the framework outlined in Table 1 to each standard; symbols are explained in the legend below the table.

**TABLE I: Resilience Standards Evaluation Framework**

Target Audience	Impact and Scope	Standard Development Process
<ul style="list-style-type: none"> <li>• Facility type</li> <li>• Scale of focus</li> <li>• Building life cycle</li> <li>• Consideration of systems beyond the site</li> </ul>	<ul style="list-style-type: none"> <li>• Hazards included</li> <li>• Performance goals</li> <li>• Incorporation of social vulnerability</li> </ul>	<ul style="list-style-type: none"> <li>• Driver</li> <li>• Verification process</li> </ul>

**TABLE 2: Standards Comparative Framework**

STANDARD	TARGET AUDIENCE					IMPACT AND SCOPE				STANDARD DEVELOPMENT PROCESS			
	Facility Type	Scale		Life Cycle		Systems	Hazards Included	Performance Goals	Social Vulnerability	Driver		Verification	
		F	C	New	Retrofit					Industry	Community	Internal	External
BRLA	All	✓			✓	N	Holistic (planning framework)		●	✓	✓		
Envision	Infrastructure		✓	✓	✓	Y	Holistic		◐	✓		✓	✓
FORTIFIED	Commercial	✓		✓	✓	N	Wind, hurricanes, hail	Business continuity	○	✓			✓
LEED Pilot	Commercial	✓		✓		Y	Holistic	Passive survivability	○	✓			✓
PEER	Commercial, campus	✓		✓	✓	N	Power outage	Improving power performance	○	✓			✓
REDi	All	✓		✓		Y	Earthquakes	Building re-occupancy and recovery	○	✓		✓	
RELi	All	✓	✓	✓		Y	Holistic		◐	✓	✓	✓	
SITES	Commercial	✓		✓		N	Sea-level rise, flooding, temperature		○	✓			✓

Target Audience, Scale	F: facility-level; C: community level
Target Audience, Life Cycle	New: new construction; retrofit: existing buildings
Target Audience, Systems	Y: Includes systems beyond site; N: does not address systems beyond site
Impact, Social Vulnerability	<ul style="list-style-type: none"> <li>○ Impact on community cohesion and/or vulnerable populations not explicitly included within standards</li> <li>◐ Optional credits addressing community cohesion and/or vulnerable populations</li> <li>● Addressing community cohesion and/or vulnerable populations required as part of standard</li> </ul>

With regard to the target audience category, seven of the standards reviewed in Table 1 are applicable to commercial buildings and all, but one includes guidance for new construction. However, only half of the standards include guidance on resilience retrofits for existing buildings. Similarly, guidance for campuses, collections of buildings, and communities is limited.

Within the impact and scope category, half of the standards reviewed take a holistic approach to the hazards they cover, while the others are tailored to specific hazards. The more specific the hazards addressed by a standard, the more likely the guidance is to be technically focused. In contrast, holistic standards (i.e., those that address multiple hazards), tend to provide less in-depth coverage of approaches to resilience. For example, FORTIFIED and REDi are technically driven, performance-based standards, which offer detailed guidance specific to certain types of hazards. Other standards, such as RELi and the LEED pilot credits, offer a more holistic approach, providing building owners and managers with opportunities to assess facilities' resilience and prioritize plans accordingly.

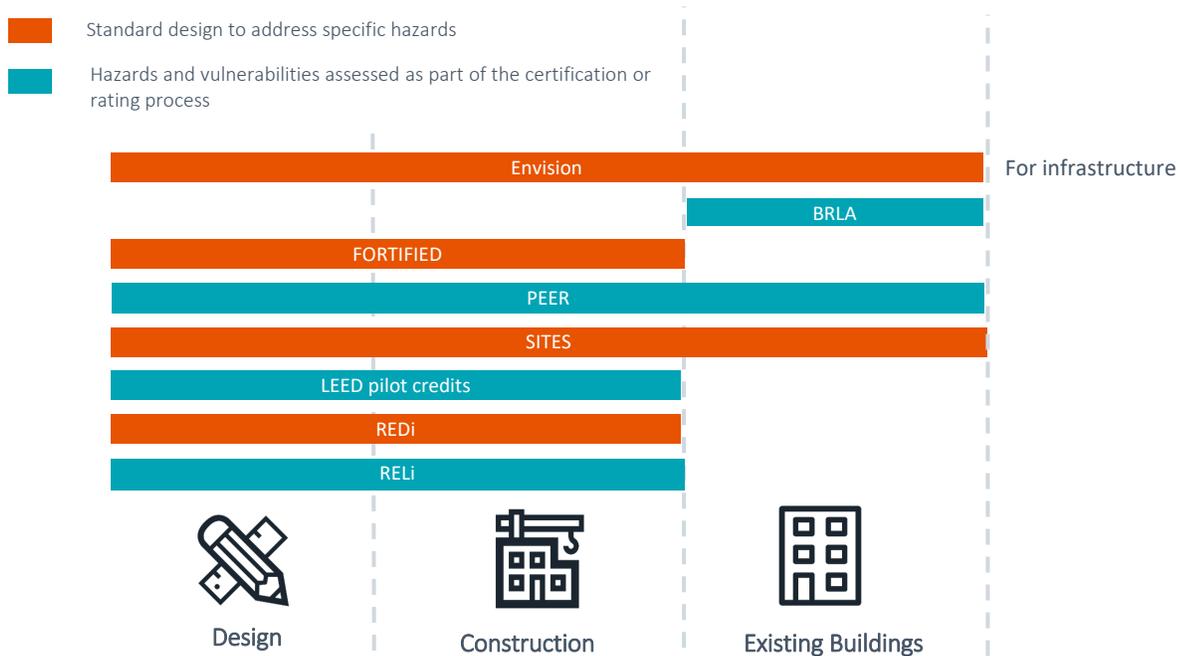
Several of the standards include performance measures, often related to the safety of the building occupants during and after an event and the ability to resume operations quickly after an event. Only a few of

the standards consider social vulnerability—that is, how the standard could improve outcomes for vulnerable populations during and after an event.

Finally, with regard to the standard development category, all of the standards were driven by the building industry (e.g. architects, engineers, developers, and existing certification providers). Most of the standards include external, third-party verification of compliance; a few rely on internal review.

Figure 1 provides a more detailed comparison of the standards, based on building life cycle.

**FIGURE I: Standards Compared by Building Life Cycle**



## CURRENT MARKET & OPPORTUNITIES FOR GROWTH

In interviews and focus group sessions, industry representatives expressed a need for general technical assistance, as well as help with conducting vulnerability assessments and developing action plans. At present, the resilience standards reviewed do not support such planning efforts or provide guidance on implementation for identified vulnerabilities. Moreover, some of the standards rely on historical data for hazard assessments, instead of incorporating current climate change projections.

In addition, qualitative research shows limited market awareness of voluntary standards and their intended purpose. Few interviewees or focus group participants were familiar with more than one standard; participants also indicated that major real estate industry associations, which are perceived as reliable resources, have not promoted information about resilient building techniques or the existence of standards. Focus group participants also shared that they have not received interest in resilience standards from their customers and tenants. Qualitative research conducted also showed that leading commercial real estate companies are evaluating their climate risks, but that these assessments have not translated into uptake of resilience standards.

Another factor contributing to the limited uptake in the use of resilience standards is the voluntary resilience market's limited support from the finance and insurance sectors. Currently, opportunities to monetize the value of investments are limited; insurers and lenders have not responded to resilience investments with adjusted rates. Interviewees noted that insurers have been hesitant to acknowledge benefits from projects without performance data from portfolios of completed projects. Similarly, lenders and financiers reportedly do not take climate change risks into consideration in their financing decisions.

This combination of characteristics—lack of industry outreach and unproven return on investment—has likely slowed adoption. Measuring the monetary value of resilience investments will be crucial to sustainable growth in the resilient design sector. Cost-benefit analyses—including avoided-costs estimates for both the technologies and design elements embedded within resilience standards—are necessary to bring insurers and financiers into the sector. Economic evidence, including performance metrics demonstrating returns, could drive insurance discounts or debt financing. With demonstrable cost savings, increased uptake, and scaled-up use of standards, lenders and insurers are likely to become more responsive.<sup>33</sup>

## RECOMMENDATIONS AND NEXT STEPS

As suggested by the volume of emerging standards, the resilient building market is in an early stage of development. At present, each set of standards addresses a market niche, and no one standard provides the guidance or technical support necessary to address all hazards—which is what facilities developers and owners have requested. New and existing facilities can, however, facilitate planning by using existing standards, some of which are directly compatible (e.g. LEED pilot credits combined with FORTIFIED, REDi, and RELi). Based on this research, preliminary recommendations are offered for the market segments below:

- **Existing buildings:** BRLA's guide for facilities managers and the first of the LEED pilot credits focused on planning both provide helpful frameworks for approaching resilience across organizational functions.
- **New construction:** In addition to leveraging LEED's planning frameworks, RELi's checklist for buildings can serve as a helpful guide for developers.
- **Low- to mid-rise buildings:** The FORTIFIED commercial standards are not currently designed to support high-rise facilities, which represent a significant portion of Boston's commercial building stock. But the standards do offer support for low- and mid-rise facilities across a number of different hazards.

Existing standards can support the BPDA's updating of preparedness checklists and other tools and incentives, as well as any future state-level financing tools and insurance policies.<sup>34</sup> In the absence of resilience considerations within existing codes and regulations, standards can offer an important bridge for policy makers and planners to create incentives for practices that move the market toward resilience.

The GRC and A Better City are committed to exploring options for scaling up resilience actions and providing up-to-date information to the commercial real estate sector. An important component of this work is continued outreach and education, in coordination with some of the industry associations (e.g. the Building Owners and Managers Association, the Greater Boston Real Estate Board, and the International Facilities Managers Association) to increase awareness of available resilience standards. Messaging can also be tailored to different audiences within commercial real estate; staff working on acquisitions, new buildings, and retrofits and existing building management will have different needs and concerns for resilience standards.

An additional next step will be to examine promising building resilience policies and practices of other states and cities for their applicability to Boston. For example,

in five states in the Southeast, homes in compliance with FORTIFIED's residential standards for hurricanes are eligible for insurance discounts or incentives.<sup>35</sup> Where the market has demonstrated the effectiveness and payback of investments, similar incentives could be tied to other resilience standards or technologies. Efforts being led by the National Institute for Building Sciences, RELi, and other entities to quantify the costs and benefits of resilience activities can support effective policy design and encourage investment. In the longer term, the creation of climate ready and resilient Boston building stock will require innovation, on the part of both the private and public sectors, in support of policy and code changes.

In addition to the actions profiled above, creating an enabling environment for resilience standards and investments will require participation from many stakeholders within the region and nationwide. Several key opportunities emerged through the research process, and are summarized in the chart below (see Figure 2).

The Commercial Real Estate Working Group is committed to tracking these work-streams, and informing the commercial real estate sector as relevant opportunities arise. The Working Group plans to utilize the U.S. Green Building Council's 2017 Greenbuild Conference in Boston as an important opportunity to spread awareness about the existence of resilience standards, and discuss needs and future opportunities for resilience planning for the built environment with the City and visiting experts from across the country. These discussions will lay a foundation for advancement of resilience standards in Boston.

**FIGURE 2: Next Steps for Supporting the Resilience Standards Market in Boston**

PRIMARY ACTORS	CITY OF BOSTON	REAL ESTATE INDUSTRY	A BETTER CITY
<b>Near Term (0-6 Months)</b>			
<p><b>Discuss standards in context of City’s resilience initiatives with BPDA and Environment Department staff</b></p> <p>The City of Boston has proposed many resilience initiatives as part of Climate Ready Boston.<sup>36</sup> These include an updated resiliency checklist, and the development of a resilience audit program for buildings. The criteria in the voluntary resilience standards could serve as an important guidance or framework for local buildings. The Boston Green Ribbon Commission’s Commercial Real Estate Working Group has already begun discussions about opportunities, and will continue to collaborate with Climate Ready Boston.</p>	✓		✓
<p><b>Coordinate with resilience activities from Greenbuild and Architecture Boston Expo in November 2017</b></p> <p>The U.S. Green Building Council is the creator of the LEED green building standard. Their national conference will be hosted in Boston, and will be co-located with the Architecture Boston Expo (ABX).<sup>37</sup> Resilience will be component of both conferences in conjunction with the re-release of the LEED Pilot Credits for Resilience. This will serve as an important opportunity to foster dialogue between local, regional, and national actors about the importance of voluntary programs in fostering resilience within buildings.</p>	✓	✓	✓
<p><b>Discussion with USGBC as LEED Pilot Credits are relaunched</b></p> <p>The LEED Pilot Credits for Resilience previously contained information to help facilities plan for resilience and design to performance standards, such as passive survivability. The credits were removed from the market for revisions based on stakeholder feedback. After the credits are made available again, the Commercial Real Estate Working Group can coordinate with national and local chapters of USGBC to understand relevant changes and promote the credits within the local commercial real estate sector.</p>		✓	✓
<p><b>Conduct outreach to other industry associations (BOMA, IFMA, BSA) and tenants on report findings</b></p> <p>The interviews and focus groups conducted as part of this research project suggest that there is limited industry awareness about the existence and content of the voluntary resilience standards. The Commercial Real Estate Working Group will include relevant information about the voluntary resilience standards in its outreach programs to support Climate Ready Boston and A Better City’s membership meetings.</p>		✓	✓
<b>Medium Term (1-2 Years)</b>			
<p><b>Develop resilience assistance for buildings through the Sustainability Buildings Initiative (SBI), Climate Ready Boston (CRB), and the upcoming resilience planning guide</b></p> <p>The standards by building lifecycle map (see Figure 1) indicates limited availability of guidance for existing buildings seeking to improve their climate preparedness. A Better City has integrated climate preparedness into its Sustainable Building Initiative</p>	✓		✓

PRIMARY ACTORS	CITY OF BOSTON	REAL ESTATE INDUSTRY	A BETTER CITY
<p>program. Climate Ready Boston has also included a resilience retrofit or audit initiative for existing buildings in its set of long-term resilience actions. The Commercial Real Estate Working Group will continue to conduct research to help fill gaps for existing buildings by utilizing relevant existing standards, and developing a guidance document for institutionalizing resilience planning and priorities in real estate organizations.</p>			
<p><b>Research on enabling policies to encourage resilience standard adoption and investments</b>  As aforementioned, several states in the Southeast have developed insurance incentive programs for FORTIFIED-certified properties. The Commercial Real Estate Working Group will research these and other policies, which enable resilience investments and examine which approaches might be relevant for the City of Boston and State of Massachusetts.</p>	✓		✓
<p><b>Develop case studies or interviews profiling facilities that have achieved resilience certification</b>  Across the United States, several properties are utilizing resilience standards for the first time or have recently been certified. The Commercial Real Estate Working Group will select a subset of these facilities for further examination. This research will enable us to pinpoint more appropriate applications for the Boston commercial real estate market, and update the recommendations provided within this document.</p>			✓
<b>Long-term (2.5-5 years)</b>			
<p><b>Encourage relevant pilots in Boston-area buildings</b>  Based on the available information from the case studies and other resilience initiatives, the Commercial Real Estate Working Group will identify resilience standards, which would be appropriate to pilot in a select group of facilities. These pilots will provide important lessons learned for the commercial real estate community’s planning, and the City of Boston’s resilience checklist and green building standard requirements.</p>	✓		✓
<p><b>Quantify cost-benefits of resilience investments</b>  Financiers and insurers have been hesitant to support resilience investments because there is limited data examining the costs and benefits of resilience technologies. Organizations, such as the National Institute for Building Sciences (NIBS), are actively trying to quantify the impacts of resilience investments. FORTIFIED, which was developed and supported by insurers continue to undertake testing to quantify the hazard mitigation impacts of certain technologies. Further research and data will be needed for lending and insurance products to enter the market to support the sustainable growth of resilience standards and investments.</p>		✓	

# ENDNOTES

<sup>1</sup> The Appraisal Institute. “Green Buildings and Property Value.” Available at:

<https://www.appraisalinstitute.org/assets/1/7/Green-Building-and-Property-Value.pdf>.

<sup>2</sup> These are the principal climate factors highlighted in the climate projections for the Climate Ready Boston report. Other non-climatic risks could include infrastructure disruption and terrorism.

<sup>3</sup> City of Boston. 2016. “Climate Ready Boston: Final Report.” Available at [www.boston.gov/environment-and-energy/climate-ready-boston](http://www.boston.gov/environment-and-energy/climate-ready-boston).

<sup>4</sup> Boston Planning and Development Agency. 2013. “Resiliency Policy.” Available at <http://www.bostonplans.org/planning/planning-initiatives/article-37-green-building-guidelines>.

<sup>5</sup> Alex Wilson. 2015. “How to Make a Hospital Resilient: A Tour of Spalding Rehab.” Resilient Design Institute. Available at <http://www.resilientdesign.org/how-to-make-a-hospital-resilient-a-tour-of-spaulding-rehabilitation-center/>. Interview with David Burson, Partners Healthcare.

<sup>6</sup> General Electric. 2016. “GE Details Plans for New Headquarters.” GE. Available at:

<http://www.genewsroom.com/press-releases/ge-details-plans-new-boston-headquarters-campus-283145>.

<sup>7</sup> Rupa Shenoy. 2015. “After Hurricane Sandy, a Redesign of Flood Protection.” NPR’s Marketplace. Available at <https://www.marketplace.org/2015/05/15/sustainability/aft-er-hurricane-sandy-redesign-flood-protection>; personal correspondence with Ben Myers, Boston Properties.

<sup>8</sup> A Better City. 2015. “Enhancing Resilience in Boston: A Guide for Large Buildings and Institutions.” Available at <http://www.abettercity.org/docs-new/resiliency%20report%20web%20FINAL.pdf>.

<sup>9</sup> A Better City. 2016. “Boston’s Climate Vulnerabilities and Solutions Symposium: Post-Symposium Summary.” Available at <http://www.abettercity.org/docs-new/10.11.16%20Climate%20Vulnerabilities%20Symposium-%20FINAL%20Recap.pdf>.

<sup>10</sup> City of Boston. 2016. *Climate Ready Boston: Final Report*, pp. 68–72. Available at [www.boston.gov/environment-and-energy/climate-ready-boston](http://www.boston.gov/environment-and-energy/climate-ready-boston).

<sup>11</sup> The need to focus on infrastructure was emphasized during a focus group with the commercial real estate sector on Climate Ready Boston and at a Green Ribbon Commission meeting in 2016.

<sup>12</sup> Meister Consultants Group and the Innovation Network for Communities. May 2017. “Voluntary Resilience Standards: An Assessment of the Emerging Market for the Built Environment.” Available online at: <http://www.mc-group.com/wp-content/uploads/2017/05/MCG-Voluntary-Resilience-Standards-Report.pdf>

<sup>13</sup> USGBC LA. 2017. “Resilience LA.” USGBC LA. Available at <http://www.resilience.la/#intro>

<sup>14</sup> Personal Correspondence with Heather Joy Rosenberg, Director, Building Resilience-LA. 2016–17.

<sup>15</sup> Insurance Institute for Business and Home Safety. FORTIFIED Commercial website. Available at <http://disastersafety.org/fortified/commercial/>.

<sup>16</sup> Insurance Institute for Business and Home Safety. FORTIFIED for Safer Business website. Available at <http://disastersafety.org/fortified/safer-business/>.

<sup>17</sup> Insurance Institute for Business and Home Safety. “Regulatory Framework for FORTIFIED Insurance Incentives.” Available at [http://disastersafety.org/wp-content/uploads/FORTIFIED-Home-Incentives\\_IBHS.pdf](http://disastersafety.org/wp-content/uploads/FORTIFIED-Home-Incentives_IBHS.pdf).

<sup>18</sup> Boston Planning and Development Agency. “Article 37 – Green Buildings.” Zoning Code. Available at: [https://www.municode.com/library/ma/boston/codes/redevelopment\\_authority?nodemd=ART37GRBU](https://www.municode.com/library/ma/boston/codes/redevelopment_authority?nodemd=ART37GRBU).

<sup>19</sup> Alex Wilson. 2015. “LEED Pilot Credits on Resilient Design Adopted.” Resilient Design Institute. Available at <http://www.resilientdesign.org/leed-pilot-credits-on-resilient-design-adopted/>.

<sup>20</sup> Green Business Certification Inc. 2015. “PEER Rating System Version 1.1.” Available at [http://peer.gbci.org/sites/default/files/resources/Rating%20System%20v1\\_1%20FOR%20DISTRIBUTION.PDF](http://peer.gbci.org/sites/default/files/resources/Rating%20System%20v1_1%20FOR%20DISTRIBUTION.PDF).

<sup>21</sup> Interview with Carl Spector, Commissioner of the Environment, City of Boston. February 8<sup>th</sup>, 2017.

<sup>22</sup> Main contributors to developing REDi included staff from ARUP, FEMA, LA Power and Water, San Francisco Public Works, San Francisco Seismic Safety, Stanford, UC Berkeley, SUNY Buffalo, Tischman Speyer, Tobin & Associates, and several independent advisors/consultants

<sup>23</sup> ARUP. 2013. “REDi Rating System: Resilience-based Earthquake Design Initiative for the Next Generation of Buildings.” Available at [http://publications.arup.com/publications/redi\\_rating\\_system](http://publications.arup.com/publications/redi_rating_system).

<sup>24</sup> Contributors to the development of RELi include Perkins + Will, Capital Markets Partnership, C3 Living Design, Perkins and Will, AREA Research, the University of Minnesota College of Design, the National Resilience Initiative Network: Upper-Midwest Hub, AIA Minnesota, and the Institute for Market Transformation to Sustainability.

<sup>25</sup> C3 Living Design Project. RELi + Resilient Design website. Available at [http://c3livingdesign.org/?page\\_id=5110](http://c3livingdesign.org/?page_id=5110).

<sup>26</sup> Capital Markets Partnership and the Institute for Market Transformation to Sustainability. 2012. “National Consensus Green Building Investment Underwriting Standards: Commercial Buildings.” Available at <http://mts.sustainableproducts.com/resiliency/CMP%20Commercial%20Green%20Building%20Underwriting%20Standard%20-%20Ver%202.2.pdf>.

<sup>27</sup> Interview with Doug Pierce, Perkins+Will, 2017.

<sup>28</sup> Green Business Certification Inc. 2014. “Sites Rating System for Sustainable Land Design and Development: v2.” Available online at <http://www.sustainablesites.org/certification>.

<sup>29</sup> The American Society of Landscape Architects Fund, The Lady Bird Johnson Wildflower Center at the University of Texas Austin and the United States Botanic Garden developed the rating system.

<sup>30</sup> The Trust for Public Land. 2017. “Climate-Smart Cities: Boston” Available at: [http://www.tplgis.org/Storymaps/CSC\\_Boston/cascade/index.html](http://www.tplgis.org/Storymaps/CSC_Boston/cascade/index.html)

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<sup>31</sup> Meister Consultants Group and the Innovation Network for Communities. May 2017. "Voluntary Resilience Standards: An Assessment of the Emerging Market for the Built Environment." Available online at: [http://www.mc-group.com/wp-content/uploads/2017/05/MCG-Voluntary-Resilience-Standards-Report\\_.pdf](http://www.mc-group.com/wp-content/uploads/2017/05/MCG-Voluntary-Resilience-Standards-Report_.pdf)

<sup>32</sup> Passive survivability refers to the ability to maintain critical life-support functions (such as electricity, temperature regulation, and access to water), during and after an event, often for a specified period. Alex Wilson. 2006. "Passive Survivability: A New Design Criterion for Buildings." BuildingGreen. Available at <https://www.buildinggreen.com/feature/passive-survivability-new-design-criterion-buildings>.

<sup>33</sup> Although it has yet to become an active driver of the uptake of resilience standards, the U.S. insurance industry has responded on a smaller scale by supporting standards such as the FORTIFIED program, which has a strong focus on technical specifications and evidence-based actions to protect homes and smaller-scale commercial buildings from hurricanes, high winds, and hail. Additionally, organizations

such as the National Institute for Building Sciences are attempting to assess the returns on specific technologies.

<sup>34</sup> Boston Planning and Development Agency. 2013.

"Resiliency Policy." Available at <http://www.bostonplans.org/planning/planning-initiatives/article-37-green-building-guidelines>.

<sup>35</sup> Insurance Institute for Business and Home Safety. 2014.

"Regulatory Framework for FORTIFIED Insurance Incentives."

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<sup>36</sup> City of Boston. 2017. "Climate Resilience Initiatives."

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[https://www.boston.gov/sites/default/files/imce-uploads/2017-01/crb\\_-\\_focus\\_area\\_ri.pdf](https://www.boston.gov/sites/default/files/imce-uploads/2017-01/crb_-_focus_area_ri.pdf)

<sup>37</sup> U.S. Green Building Council and Boston Society of Architects. 2017. "Greenbuild and ABX 2017" Available at:

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