# VOLUNTARY RESILIENCE STANDARDS

## AN ASSESSMENT OF THE EMERGING MARKET FOR RESILIENCE IN THE BUILT ENVIRONMENT





Report Prepared for the Energy, Kresge and Barr Foundations

By Meister Consultants Group, Inc.

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# SECTION 1
# INTRODUCTION

## 1.1 OVERVIEW

Climate resilience, as defined by The Kresge Foundation, entails addressing "climate-change adaptation, climate-change mitigation, and social cohesion."[1] At the site and community levels, resilience requires investment in many different types of buildings, infrastructure, and community systems. The resilience of the built environment has emerged as a core area of interest for communities, including property owners. In the wake of disasters such as Hurricane Katrina and Superstorm Sandy, new guidelines have been developed to help communities prepare for both natural hazards (including those induced by climate change) and human-caused hazards. Throughout this report, such tools—which include certifications, benchmarking systems, planning frameworks, and design principles—will be referred to collectively as "resilience standards." These standards provide guidance for preparing buildings, infrastructure, and other systems for hazards and can also foster community cohesion.

Although the number of resilience standards has grown rapidly over the past few years, the standards vary in focus, and in the extent to which they include climate-change-induced risks. By increasing the resilience of the built environment, the standards' creators hope to encourage a shift toward resilience, much the way that the LEED (Leadership in Energy and Environmental Design) program fostered a move toward more sustainable facilities. Since the introduction of green building certifications, LEED standards have been incorporated into local ordinances, and the increased market value of LEED-certified makes the accreditations highly sought after.[2] In contrast, resilient buildings are at a much more nascent stage of development, in terms of both regulation and voluntary adoption.

This research project identified a crowded landscape of standards, varying in terms of which hazards they address, the scale of analysis, and performance outcomes. The purpose of this report is to provide an overview of the market for practitioners and property owners, suggest next steps to support market growth and development, and inform decision making for funders and policy makers.

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[1] The Kresge Foundation. 2014."Climate Resilience and Urban Opportunity Initiative: Frequently Asked Questions." n.d. Available at http://kresge.org/sites/default/files/Uploaded%20Docs/Climate-resilience-FAQs-063014.pdf.

[2] Appraisal Institute and Institute for Market Transformation. 2013. "Green Building and Property Value: A Primer for Building Owners and Developers." Available at https://www.appraisalinstitute.org/assets/1/7/Green-Building-and-Property-Value.pdf.

# 1.2 METHODOLOGY

The research team conducted desk research on the following voluntary resilience standards (for detailed descriptions of each standard, see Appendix A):

- Alliance for National and Community Resilience (ANCR). A nonprofit formed by the International Code Council with partners from the nonprofit and private sectors, ANCR is currently designing the Community Resilience Benchmarks system, a rating system for community resilience.
- Building Resilience—Los Angeles (BRLA). Developed by the US Green Building Council–Los Angeles, BRLA seeks to strengthen community resilience by positioning facilities preparedness in the context of resilience for the broader community. BRLA staff have started to deliver trainings, but benchmarking standards are still in development.
- Building Resilience Rating Tool (BRRT). The BRRT was created by the Insurance Council of Australia as a simplified version of insurance company hazard rating tools. Currently in beta testing, the tool provides a baseline assessment of risk from natural hazards faced by residential homes.
- Community resilience assessment methodology (CRAM). Developed by the National Institute of Standards and Technology, CRAM was designed to assess infrastructure preparedness to better understand overall community resilience. The methodology is currently in draft form.
- Enterprise Green Communities. The Enterprise Green Communities certification program is administered by Enterprise Community Partners, a lender to affordable housing projects, and is designed for new and existing affordable housing facilities. While focused primarily on green building design, the certification criteria incorporate resilient design components and are complemented by the Ready to Respond Toolkit. Both the certification program and the toolkit are available in the market.
- Envision. Developed by the Institute for Sustainable Infrastructure and the Zofnass Program for Sustainable Infrastructure at Harvard, Envision is designed to measure the sustainability of public works projects, with resilience as a key consideration. Envision is available in the market.
- FORTIFIED. The FORTIFIED standards are designed to build resilience to hurricanes, high winds, and hail, and can be applied to business, commercial, and residential properties. They were developed by the Insurance Institute for Business and Home Safety. FORTIFIED is available in the market.
- Interagency Concept for Community Resilience (ICCR). In 2016, the Mitigation Framework Leadership Group, an interagency working group co-led by the Federal Emergency Management Agency and the National Oceanic and Atmospheric Administration, released a draft of indicators identifying national-level measures that contribute to community resilience.
- LEED pilot credits. The LEED pilot credits on resilient design aim to build resilience at the facility level through the identification of hazards and the development of emergency preparedness procedures. They are designed to be pursued in conjunction with the LEED certification process.

The pilot credits are currently available through the Building Design and Construction rating system.

- Performance Excellence in Electricity Renewal (PEER). Developed by the Electric Power Research Institute and Motorola, the PEER standard addresses the reliability and resilience of electrical infrastructure. The standard is available in the market.
- Resiliency Action List (RELi). RELi was developed by the Capital Markets Partnership and the C3 Living Design Project in conjunction with Perkins+Will and several other collaborators as a national consensus standard. It aims to increase adaptability and reduce sensitivity to hazards for building occupants. RELi is currently being piloted by several facilities.
- Resilience-based Earthquake Design Initiative (REDi). The REDi rating system was developed by Arup as a standard for addressing seismic hazards. REDi is available in the market.
- Sustainable Sites Initiative (SITES). Administered by Green Business Certification, Inc., SITES is designed to build resilience by strengthening the ecosystem services of landscapes. SITES is available in the market.
- Unified Facilities Criteria (UFC). UFC was developed by the U.S. Department of Defense. The criteria incorporate sustainability principles and considerations for resilience to natural, climate-induced, and human-induced hazards. The criteria are used by U.S. military facilities.

The desk research identified areas of differentiation between the standards; the framework shown in Figure 1 highlights these points of comparison.

Figure 1: Resilience Standards Evaluation Framework


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, or 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 results category, the framework compares the hazards included within the standard (e.g., flooding, wind, earthquakes); performance goals (e.g., business continuity or passive survivability); and whether the standard incorporates social vulnerability. Within performance goals, passive survivability refers to the ability to maintain critical life-supporting functions such as regulation of temperature, access to water, and electricity, during and after an event occurs, often for a specified period of time.[3]

Finally, the standard development process category considers whether the creation of the standard was community or industry driven, and whether the standard is verified via internal or external review.

Figure 2 applies the framework outlined in Figure 1 to each standard. A legend appears at the bottom of the table. Standards that are in development, and for which only limited information was publicly available, were excluded from the table; however, all standards are described in detail in Appendix A.

In addition to desk research, the research team conducted twenty-two interviews with representatives from twenty organizations involved in the development of resilience standards, the deployment of resilience initiatives, or the management of facilities that incorporate resilience features. The team also held a four-person focus group consisting of an industry association representative and three members who 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.

[3] Wilson, Alex. 2006. "Passive Survivability: A New Design Criterion for Buildings." BuildingGreen. Available at https://www.buildinggreen.com/feature/passive-survivability-new-design-criterion-buildings.

Figure 1: Comparative Framework

| | Target Audience | | | | | Impact | | | Standard Development | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Standard | Facility Type | Scale | | Life Cycle | | Systems | Hazards Included | Performance Goals | Social Vulnerability | Driver | | Verification | |
| | | F | C | New | Retrofit | | | | | Industry | Community | Internal | External |
| BRLA | All – Planning Framework | ✓ | | | ✓ | N | Holistic | | ● | ✓ | ✓ | | |
| BRRT | Residential | ✓ | | | ✓ | N | Fire, Wind, Hail, Flood | Minimize damage during disaster | ○ | ✓ | | | |
| CRAM | Community – Planning Framework | | ✓ | | | Y | Holistic | | ● | ✓ | ✓ | | |
| Enterprise | Residential (Multifamily only) | ✓ | | ✓ | ✓ | Y | Holistic | | ● | ✓ | ✓ | ✓ | |
| Envision | Infrastructure | | ✓ | ✓ | ✓ | Y | Holistic | | ◑ | ✓ | | ✓ | ✓ |
| Fortified | Commercial | ✓ | | ✓ | ✓ | N | Wind, Hurricane, Hail | Business continuity | ○ | ✓ | | | ✓ |
| Fortified | Residential | ✓ | | ✓ | ✓ | N | Wind, Hurricane, Hail | | ○ | ✓ | | | ✓ |
| ICCR | Community - Planning Framework | | ✓ | | | Y | Holistic | | ● | ✓ | ✓ | | |
| LEED Pilot | Commercial | ✓ | | ✓ | | Y | Holistic | Passive survivability | ○ | ✓ | | | ✓ |
| PEER | Commercial, Campus | ✓ | | ✓ | ✓ | N | Power Outage | Improve power performance | ○ | ✓ | | | ✓ |
| REDi | All | ✓ | | ✓ | | Y | Earthquake | Building re-occupancy and recovery | ○ | ✓ | | ✓ | |
| RELi | All | ✓ | ✓ | ✓ | | Y | Holistic | | ◑ | ✓ | ✓ | | ✓ |
| SITES | Commercial | ✓ | | ✓ | | N | Sea level rise; Flood, Temperature | | ○ | ✓ | | | ✓ |
| UFC | Military Base | ✓ | | ✓ | | Y | Holistic | | ○ | ✓ | | | |

| Legend | | |
|---|---|---|
| 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 include interaction with systems beyond site |
| Impact, Social Vulnerability | ○ | Impact on community cohesion and/or vulnerable populations not explicitly included within standards |
| | ◑ | Optional credits addressing community cohesion and/or vulnerable population |
| | ● | Addressing community cohesion and/or vulnerable population required as part of process or standard |

# SECTION 2
# RESILIENCE STANDARDS

The following sections outline the findings from applying the comparative framework to the standards reviewed, introduce a market characterization for the resilience standards, and describe key emerging trends in the market.

## 2.1.1 DEFINING RESILIENCE

The standards differ in their approaches to increasing resilience. Specifically, some standards, such as FORTIFIED and REDi, are technically driven, performance-based standards, offering in-depth guidance for certain types of hazards. Others, such as RELi and the LEED pilot credits, take a more holistic approach, providing guidance for facilities to assess their own vulnerabilities and prioritize responses accordingly. Because of their broader scope, few of these standards offer the level of technical guidance provided by standards focused on specific hazards, and may instead refer readers to other resources.

These differences in approach are driven by two conceptions of resilience, which were evident throughout the interviews. Although not mutually exclusive, these conceptions have implications for how standards are designed and structured.

- Survival of shock and ability to perform better than similar buildings. This definition focuses on physical performance during or in response to an event—that is, it stresses the durability of an asset in comparison to similar buildings. Some interviewees noted that performance-based measures of resilience create a value proposition for external stakeholders; according to one respondent, resilience thus becomes "synonymous with functionality." FORTIFIED and REDi are among the resilience standards that use this definition; both focus on resilience measures designed to ensure functionality after specific events occur. The value of such standards may be more easily communicated to facility staff and operations personnel; moreover, performance criteria can be advertised to tenants or potential investors. Interviewees who support performance-based standards saw them as a key means of advancing the market.
- Survival and recovery of building and systems post-shock. This definition focuses on preserving key functionality during and after an event, but it takes a broader approach to systems on a campus- or community-wide scale. In practical terms, the emphasis is on (1) the preparedness of a facility, its surroundings, and interrelated systems (e.g., electricity, water, transportation) and (2) the facility's capacity to support occupants during an emergency. Thus, this definition focuses on the recovery element of resilience. The LEED pilot credits are based on this approach: though the credits focus on physical functions and on defining resilience at the facility scale, they also incorporate goals for critical functionality and emergency preparedness for the protection of occupants. Interviewees noted that the value of a survival and recovery focus is that it can be

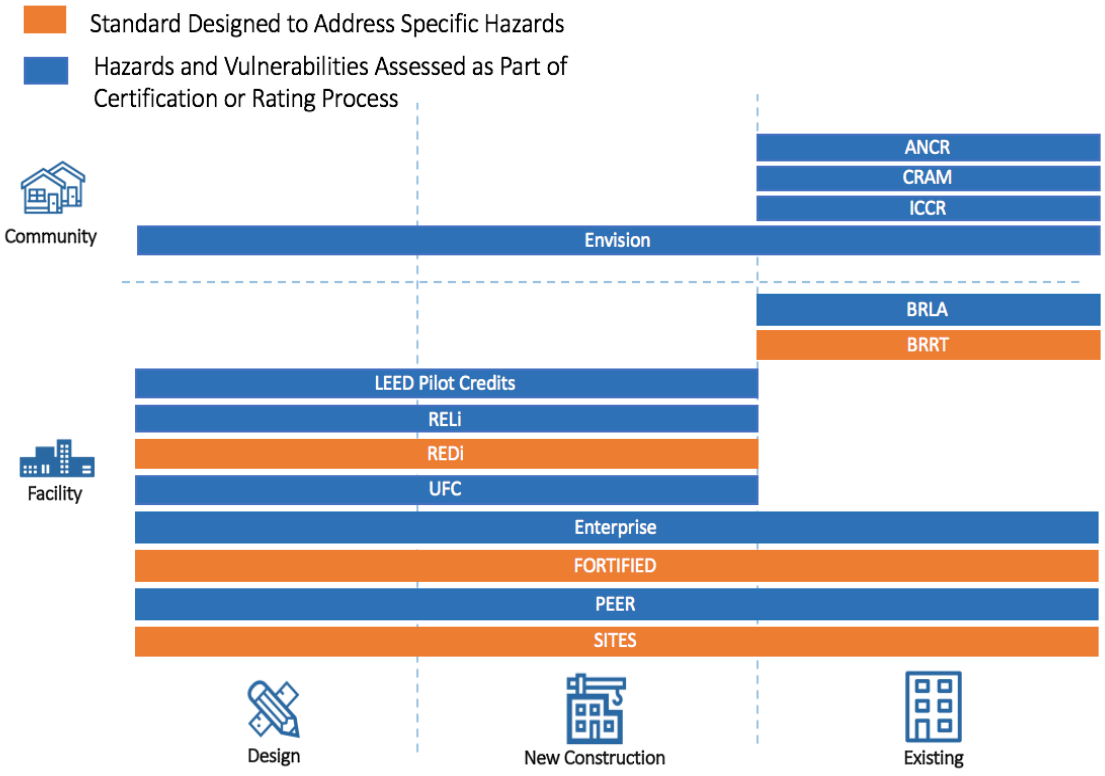
easily communicated to municipalities and public entities as a way of addressing systemic issues and vulnerabilities.

These definitions inform the overall design and goals of the standard. Interviewees understood resilience in one or both ways, and used definitions based on priorities of scale, hazards, and perceived market needs.

### 2.1.2 BUILDING LIFE CYCLE

The current market for resilience standards can be analyzed by the points of comparison listed in Figure 2. Within the category of target audience, the suitability of resilience standards can be analyzed with regard to facility type, scale of focus, building life cycle phase, or consideration of systems beyond the site (see Figure 3). An analysis filtered by building life cycle and scale shows that, at the facility level, design and new construction are better served by current standards than are existing facilities.

Figure 3: Market Characterization by Building Life Cycle and Scale




At the facility scale, building life cycle offers a way to determine whether a resilience standard is suitable for a given project. While some standards are intended to integrate resiliency into a certain part of a building's life cycle, others can be applied at different points in the cycle. Broadly, building life-cycle phases can be categorized as (1) design and new construction and (2) existing facilities.

- **Design and new construction.** Resilience standards for this category focus on increasing the resilience of new commercial or residential facilities or infrastructure. Often, such standards recommend construction materials or building techniques that will be responsive to specific hazards. REDi, for example, uses specific design elements to build resilience to seismic hazards.
- **Existing facilities.** Resilience standards within this category support retrofits of existing facilities to improve operations or increase resistance to hazards. As can be seen in Figure 3, few standards focus on existing facilities. Exceptions include the BRRT and BRLA. Currently in beta testing, the BRRT was developed by the Australian Insurance Council to provide homeowners with resilience scorecards and suggestions for retrofits, which may reduce premiums. The Los Angeles-based BRLA initiative provides guidance on integrating resilience into operations and delivers training programs for building staff. As part of its Enterprise Green Communities program, Enterprise Community Partners developed the Ready to Respond Toolkit, which includes guidance on resiliency for retrofits, but the toolkit has not been fully integrated into Enterprise Community Partners' certification program. Some programs designed for new construction can be partially adapted for existing facilities. For example, RELi recommends building maintenance and operations activities that can be adapted to existing buildings.

**REDi: 181 Fremont Tower**

181 Fremont is a 56-story, mixed-use building located in San Francisco. It is being marketed as the "most resilient tall condominium building on the West Coast." The tower was constructed in 2016, and has been certified Gold under the Resilience-based Earthquake Design Initiative (REDi). The REDi standard, administered by Arup, uses resilience-based design to go beyond-code for resilience to seismic events. The REDi standard provides a list of specific actions engineers can take to design a seismic-resilient building. The REDi standard requires building engineers and developers to establish goals for re-occupancy, full functionality and minimization of financial losses.

For a REDi Gold designation, applicants must include architectural components for seismic resilience, occupant safety considerations and design elements to protect critical systems of the building. As a REDi Gold building, residents of 181 Fremont should expect immediate occupancy after a seismic event, less than one month of functional recovery time for systems, and experience less than 5% in financial losses.

Sources: ARUP. 2013. REDi Rating System. Available at: http://publications.arup.com/publications/r/redi_rating_system
PR Newswire. 2016. "In a Global First, 181 Fremont in San Francisco Awarded New Earthquake-Resilience Rating." Available at http://www.prnewswire.com/news-releases/in-a-global-first-181-fremont-in-san-francisco-awarded-new-earthquake-resilience-rating-300339045.html

### 2.1.3 SCALE OF FOCUS

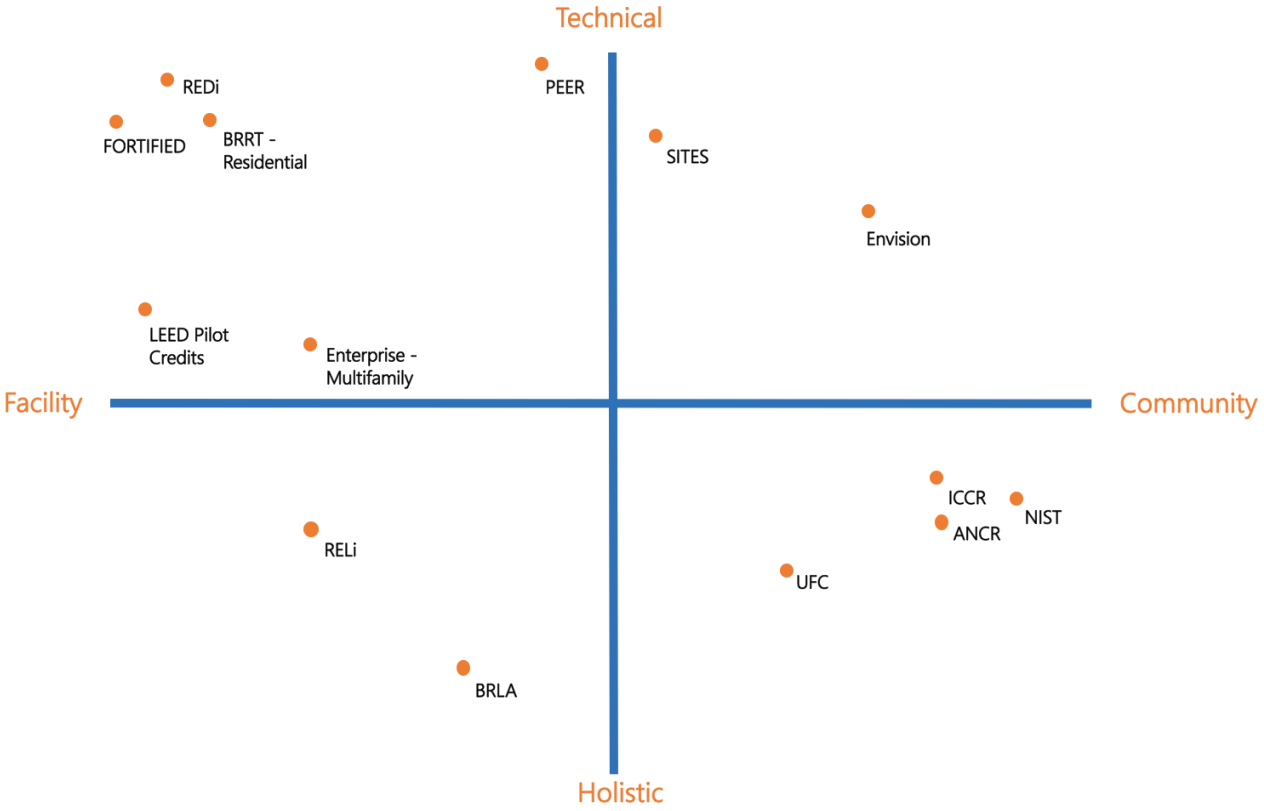
Many resilience standards are meant for specific types of systems, buildings, or infrastructure. For example, the PEER standard focuses on electrical grids, Envision on public works, and SITES on open-space design. Other standards are broader in scope, and consider facilities, neighborhoods, or communities holistically. Standards can therefore be categorized by the scale at which they address resiliency.

- Facility-scale standards. Standards at the facility scale address the resilience of one type of system, such as a single building or a campus-level electrical grid, and generally do not incorporate broader-scale context. For instance, FORTIFIED was created to harden residential or commercial buildings against high winds and hail. Risks are assessed at the building scale, and the program uses a facility-by-facility approach to certification.
- Neighborhood and community standards. Neighborhood and community standards address resilience at the district scale. These standards are nascent: instead of providing action steps for building resilience, they identify and assess the vulnerabilities of core community services and systems and offer guidelines for holistically addressing preparedness. One such standard, currently under development by ANCR, will provide a benchmarking tool to assess the vulnerabilities of systems such as buildings, waste, and transportation.

### 2.1.4 TECHNICAL VS. HOLISTIC STANDARDS

The suitability of a standard to a facility or community depends on the exposure of the facility or community to certain hazards and risks, including those associated with geographic location. As noted earlier, some standards focus on specific hazards and provide methods for addressing them, while others take a holistic approach to helping communities to assess and plan for hazards. Findings from the qualitative interviews and desk research undertaken for this project suggest that in addition to being categorized as facility or community focused, the standards can be positioned on technical and holistic axes, as shown in Figure 4.

Figure 2: Market Positioning of Standards[4]




- Technical standards. Standards with more of a technical focus provide in-depth guidance that is specific to certain hazards, but rarely offer a holistic approach to other aspects of community resilience. For example, the PEER standard, located in the upper-left quadrant of Figure 4, focuses on the reliability and resilience of electrical infrastructure. Many technically oriented standards focus on segments or subsegments of buildings, though a minority also consider campuses (e.g., PEER and SITES).
- Holistic standards. Holistic standards address multiple hazards or resilience challenges, offering guidance for the assessment of vulnerabilities and providing resources for improving preparedness. Vulnerability assessments are the cornerstone of many of today's resilience standards, including RELi, LEED pilot credits, and the Enterprise Green Communities certification. Standards that include a holistic assessment often include criteria for identifying hazards, such as geographic location and time frame.

Like community-scale standards, some facility-scale standards—such as RELi, BRLA, and the Enterprise Green Communities certification—envision buildings within their community context, and support vulnerable populations through community consultation and improvements to neighborhood

[4] Definitions for the acronyms used in Figure 4 are explained in Section 1.2.

infrastructure. For example, as part of evaluating and planning for preparedness for a given facility, BRLA requires engagement with the surrounding community and an assessment of vulnerabilities that may impact resilience.

Most facility-scale standards, however, address only physical assets. Many developers of standards noted during interviews that they were aware of and concerned about this gap, but they also acknowledged that social cohesion is not easily improved at the facility scale. The developers have faced challenges identifying pathways to address social vulnerabilities, while simultaneously creating standards that would reflect both the needs of facility owners and the market's receptiveness to the incorporation of additional voluntary measures.

In practice, facility managers and property owners surveyed were not aware of the current market landscape or found it challenging to begin resiliency planning. (Section 3 focuses on the scale of market adoption and industry's plans to scale up the sector.)

## 2.2 THE EMERGING MARKET: KEY TRENDS

The resilience standards market is still nascent, most of the standards are in pilot phases or with their first customers, and many organizations are involved. Moreover, interviews and focus group conducted for this project revealed that facilities managers, participants in the real estate sector, and coordinators of business associations and on-the-ground projects had little awareness of the standards.

Focus group participants 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. In addition, opportunities to monetize the value of investment in certification or resilience are currently limited. This combination of characteristics—lack of industry outreach and diffuse return on investment—has likely slowed adoption. For example, a major hospital invested in developing its own resilience checklist instead of using a number of resources and tools that were already available.

Interviews and focus groups identified the following stakeholders as being key to driving adoption forward:

- Insurance and reinsurance industry. Most interviewees consider the insurance and reinsurance industry a natural driver for the uptake of resilience standards. As an industry that stands to benefit from risk mitigation, the insurance industry could incentivize investment in standards. As evidenced by the BRRT, the industry is already beginning to play this role in Australia by making insurance industry risk assessment methods more transparent. Although it has yet to become an active driver of standard uptake, the insurance industry in the U.S. has responded on a smaller

scale by supporting the development of 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.

Because regulations are state driven, the role of insurance companies varies by state. In the case of FORTIFIED, five states—Alabama, Mississippi, Georgia, South Carolina, and North Carolina—have adopted either regulations requiring reductions in property insurance rates or incentives for homes that meet the FORTIFIED standard within certain counties.[5] In the case of other standards on the market, however, insurers have yet to evaluate the financial benefit of the resilience benefits and do not offer discounts or incentives for property owners. Most interviewees felt that the insurance and reinsurance industry can and should play a large role in the adoption of resilience standards. For this to happen, however, would require (1) evaluating returns on investment in certification and (2) pursuing changes to local statutes or state insurance regulations to encourage or require insurer involvement via pricing or incentive structures to recognize the value of resilience investments.

**FORTIFIED: Regulatory Incentives for Market Adoption**

The FORTIFIED Home standard is designed to make new and existing homes more resilient to hurricanes, high winds, and hail. Since 2009, five states have adopted various regulatory incentive programs encouraging the adoption of the FORTIFIED Home standard.

In Alabama and Mississippi, FORTIFIED Home properties are eligible for insurance discounts within certain coastal areas. The Strengthen Alabama Homes program also provides grant funding for retrofits of existing homes. In Mississippi, Georgia, and South Carolina, FORTIFIED Home properties receive wind-mitigation credits through the state's wind pool.

*Source:* Insurance Institute for Business and Home Safety. 2017."Regulatory Framework for FORTIFIED Insurance Incentives." Available at http://disastersafety.org//wp-content/uploads/FORTIFIED-Incentives1.pdf.

- Lenders and financiers. Opportunities for specialized financing to support resilience are currently limited. Lenders have also been largely unresponsive to resilience standards. One exception is Property Assessed Clean Energy (PACE) financing, which has been used to support energy efficiency and renewable energy systems; under the PACE program (which requires state legislation), owners can pay back loans through additions to their property tax bill. To date, PACE has been used for resilience projects only in Florida and California;[6] thus, PACE is unavailable in many areas where property owners may wish to invest in resilience. RELi, which was developed as

[5] Insurance Institute for Business and Home Safety. 2014. "Regulatory Framework for FORTIFIED Insurance Incentives." Available at http://disastersafety.org/wp-content/uploads/FORTIFIED-Home-Incentives_IBHS.pdf.
[6] PACENation. 2017. PACE in Florida. Available at http://pacenation.us/pace-in-florida/. San Francisco Department of the Environment. 2017. "Finance Your Energy-Saving and Water-Saving Home Upgrades." Available at https://sfenvironment.org/residentialpace.

an underwriting standard, was designed to encourage lenders to provide financial incentives to developers who use resilient design; RELi's creators are still in conversation with lenders to encourage industry uptake. Interviewees suggested many reasons that lenders may be wary of supporting resilience standards, including the need for case studies and demonstrated returns. Others indicated that regulation is a key driver for resilience financing, and some pointed to the need for political will to make regulatory changes.

In the case of residential properties, Federal Home Loan Banks can account for the value of resilience investments within appraisals by identifying where resilience increases property values. A study in Alabama, for example, found that FORTIFIED Gold homes, the highest level of residential certification available, had a 7% sale premium.[7] The commercial sector, however, does not have an equivalent structure. Appraisal systems and bond ratings have also been slow to respond to resilience investments and certifications, partly because of limited evidence of their effectiveness and financial impact.

- Regulators and state and local officials. Since there is a range of policy options that could spur adoption among developers and property owners, regulators and officials can be key sources of influence on resilient design. Interviewees noted that building codes can drive adoption, help create financing opportunities, and set performance baselines for communities. However, building codes have historically been slow to respond to new risks and emerging technologies. Moreover, not all local governments control their own building codes, so they cannot be universally used at the local level to influence development. Some interviewees noted, however, that local governments can encourage developers to incorporate resilience features through, for example, zoning review checklists used in the course of permit review or via zoning incentives.[8]
- Facility owners and operators. Facility owners and operators are interested in resilience standards as a means of increase the marketability of their facilities to investors and tenants, particularly in areas that have experienced recent natural disasters. They noted in interviews and the focus group, however, that market awareness of tools and standards is limited. One large commercial real estate owner developed its own vulnerability assessment methodology for the company's building portfolio—an example of failure to engage in outreach to the real estate sector creating inefficiencies in the market.

[7] S. Awondo, et al. "Estimating the Effect of FORTIFIED Home Construction on Home Resale Value." University of Alabama. Available at http://aciir.culverhouse.ua.edu/wp-content/uploads/2016/08/FORTIFIEDReport_V2-1.pdf

[8] Boston Planning and Development Agency. 2017. "Article 37—Green Buildings." Zoning Code. Available at https://www.municode.com/library/ma/boston/codes/redevelopment_authority?nodeId=ART37GRBU.

### 2.2.1 REMAINING FACILITY AND COMMUNITY NEEDS

Though the emerging market for resilience standards is crowded, unmet needs remain. As shown in Figure 4, few facility-scale standards apply to existing buildings; most are geared toward design and new construction. The extent to which current standards address climate hazards also varies. Much of the focus is on acute events such as hurricanes and floods, and standards tend to be oriented toward the shorter term; few standards incorporate long-term planning for climate hazards or employ climate projections, which are more appropriate for addressing risks like sea-level rise than historical records.

And while social vulnerability is an important element of resilience, most standards focus on physical assets: few incorporate features that would increase social resilience, such as by ensuring a backup food supply or sheltering and evacuations for vulnerable populations. Although some standards are attempting to address social vulnerability (e.g., there are credits geared to supporting systems such as telecommunications, human health, and emergency planning), such efforts vary from standard to standard, and none of the standards fully integrate social vulnerability.

# SECTION 3
# PATHWAYS TO SCALE

If the adoption of standards is to increase, many key stakeholders will need to take action. Both desk research and interviews undertaken for this project revealed parallels between the resilience and green building markets; many of the regulatory and incentive structures, stakeholders, and policies that supported improvements in building energy performance will also be crucial to the evolution of the resilience market. This section outlines next steps to consolidate and drive adoption of resilience standards.

- Streamline the market by increasing coordination among standards developers. Many facility owners, property managers, and local officials are unsure of how to navigate the existing market for resilience standards. One way to improve this situation would be to simplify the market by increasing coordination and outreach among developers and administrators of current tools and standards. Foundations could play a role in such an effort by convening and supporting conversations between developers, other experts, and representatives from industries or industry associations to discuss the state of the market—including barriers, opportunities, and areas that are ripe for collaboration. One possible outcome would be the formation of a working group, network, or other platform to facilitate an ongoing relationship between these stakeholders. Interviewees pointed to several nonprofits and industry associations as potential convening bodies, including the US Green Building Council, the Urban Land Institute, the Institute for Market

Transformation, the Building Owners and Managers Association International (BOMA), and the National Institute for Building Sciences.

Some standards developers have already started to streamline their tools by cross-referencing to other standards to avoid overlap and increase compatibility. RELi and LEED, for example, cross-reference FORTIFIED, REDi, and other standards. Some developers have expressed interest in collaborating not only to avoid overlap but to address gaps. Some interviewees suggested that an industry association might be a useful way to drive market adoption and address resilience to different hazards at different scales.

- **Develop pathways for shaping local policy.** State and local policy makers can use a range of policies to help drive market adoption of resilience standards and encourage market growth, including building codes, beyond-code policies, zoning and permitting, and incentive and financing programs.

  - **Building codes and policies** can drive market adoption and help open financial markets for resilience investments. Integrating resilience standards into building codes is particularly relevant for cities that have control over their own codes outside of statewide legislation. Los Angeles, for instance, has adopted the Envision framework for all new public works projects in the city.[9] If building codes are not under local control, or if state building code does not address resilience, voluntary standards can play an interim role by demonstrating what is possible, and by helping to identify minimum performance thresholds.
  - **Beyond-code policies** may enable local governments to take action on resilience, particularly in states where local governments do not control their building codes. Stretch codes, for example, are passed as enabling legislation at the state level and can be adopted by cities and towns to encourage local development standards that exceed those set by the state building code. They have been used to encourage energy efficiency and may lend themselves to resilience as well. Code councils and stakeholder groups will be critical to integrating resilience into current codes. Due to the cyclical nature of building code updates, however, building codes may be slow to respond to localized or short-term hazards, and to incorporate new technologies for building resilience.
  - **Revised zoning and permitting ordinances** can encourage resilience and help bolster the market by (1) drawing on the content of resilience standards and (2) requiring or offering incentives for certification. For example, local governments could provide development bonuses for resilience investments, require developers to demonstrate having taken

[9] Institute for Sustainable Infrastructure. 2016. "City of Los Angeles City Council Adopts Envision as City Policy." Available at https://sustainableinfrastructure.org/case-study/city-of-los-angeles-city-council-adopts-envision-as-a-policy/.

actions that are equivalent to obtaining resilience certification, provide zoning guidance for resilience, and provide or require preparedness checklists for facilities. Any standards, including checklists, should reflect local hazards and risks. Baltimore, Maryland, for example, developed the Disaster Preparedness and Planning Project (DP3 Plan), which includes resilience checklists for buildings, infrastructure, and public services.[10] States may support efforts to update zoning and permitting by providing technical assistance or informational resource development.

- Financing and incentive programs would address one of the principal gaps in the resilience standards market. Lenders and financiers are more likely to support investments that are required or recommended by local policy or industry best practice. Thus, nongovernmental organizations and building industry associations, such as BOMA and the NAIOP (Commercial Real Estate Development Association), could assist by developing case examples, model codes, and policies to encourage financing and incentives for resilient development. Incentive programs could include tax benefits, grants, lower development fees, or other financial incentives. The Strengthen Alabama Homes program, for example, is financed by insurance license fees and donations from the insurance industry, and provides progressively structured financing to help homeowners use the FORTIFIED standard to retrofit for resilience.[11] Some states and communities have successfully incorporated resilience investments into PACE financing, which could provide a near-term path for encouraging investments. To date, however, PACE has not been widely adopted for resilience and is limited to hazards such as hurricanes in Florida and drought and seismic threats in San Francisco.[12]

- Develop technical assistance programs and guidance for property owners and managers. Current standards do not provide clear pathways for facility-scale adoption by property owners and managers. While many standards provide methodologies for assessing risk, interviewees noted that guidance is needed for (1) assessing which risks to address on certain time scales and (2) addressing interdependent systems. Thus, technical assistance that would enable facilities managers to (1) identify and asses hazards and (2) select risk evaluation tools and standards could help spur the market. Enterprise Green Communities has made an effort along these lines through the Ready to Respond Toolkit, which is designed to support retrofits of multi-family

[10] City of Baltimore. 2013. "Disaster Planning and Preparedness Project: A Combined All-Hazards Mitigation and Adaptation Plan." Available at http://mitigationguide.org/wp-content/uploads/2013/07/Baltimore-HMP.pdf
[11] Insurance Institute for Business and Home Safety. 2017. "Strengthen Alabama Homes: Frequently Asked Questions." Available at https://strengthenalabamahomes.com/Content/Pdfs/SAHFAQs.pdf.
[12] PACENation. 2017. "PACE in Florida." Available at http://pacenation.us/pace-in-florida/. San Francisco Department of the Environment. 2017. "Finance Your Energy-Saving and Water-Saving Home Upgrades." Available at https://sfenvironment.org/residentialpace.

housing and also provides a resilience readiness assessment program for staff of existing facilities.[13] Technical assistance programs could be part of an offering from a forum or industry organization. Finally, technical resources could help address inequities, by supporting facilities that have limited capacity to address resilience.

**Process-based Approach to Resilience: Building Resilience- Los Angeles Project**

The Building Resilience Los Angeles Project, led by the USGBC-Los Angeles Chapter, began in 2015. The project aims to create a process-based approach to community resilience, by working with individual facilities to address their vulnerability. In 2016, the BRLA project released Building Resilience-LA: A Primer for Facilities, which created a process for identifying resilience goals and objectives at a facility-level, and creating and implementing a plan to address those goals.

The framework includes guidance on the formation of a project team, the identification of overlapping organizational and community goals, and identifies different potential tools that can be used to understand vulnerabilities and risks. USGBC-LA continues to develop the BRLA project, with specific focus on building capacity through training and developing tools and resources.

Source: Building Resilience-LA: A Primer for Facilities. 2016. USGBC-LA. Available at: http://www.resilience.la/#intro

Some of the interviewees believe that the path of least resistance is to integrate resilience into existing green building certifications and programs. LEED, for example, has enjoyed widespread adoption by marketing the co-benefits associated with green buildings, such as savings from energy efficiency.[14] Additional mechanisms, such as local regulations and incentives encouraging green building standards, have also helped move the market.

Despite the similarity of the two markets, however, barriers to entry may differ. Some interviewees noted that in the green building market, incentives for energy efficiency are split between landlords and tenants, based on utility payments and on the length of time a facility is owned or leased by the same parties. But because resilience is a life-safety issue and can be considered more essential to the mission of a facility, resilience standards could be less affected by split incentives. Thus, in geographic areas that have been subject to disasters and have a high risk of their recurrence, resilience may be valued among developers even with short-term ownership structures.

[13] Enterprise. 2017. Ready to Respond Tools for Resilience. Available at http://www.enterprisecommunity.org/solutions-and-innovation/green-communities/tools-and-services/ready-to-respond

[14] US Green Building Council. 2017. "The Business Case for Green Building: A Compilation of Citations." Available at http://www.usgbc.org/articles/business-case-green-building.

- **Demonstrate the return on investment (ROI) of resilience standards.** As awareness grows of the risks posed by extreme weather events and climate change, resilient design will become a higher priority for property developers and managers. At the same time, state and local regulations have made resilience challenging to scale: insurance regulations vary by state, and planning and zoning differ by jurisdiction.

  Interviewees consistently stated that the monetization of resilience investments is 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. Both economic evidence and performance metrics demonstrating returns could drive insurance discounts or debt financing. A few organizations have begun research to demonstrate performance-based outcomes for facility preparedness, including Enterprise Community Partners and FORTIFIED. FORTIFIED has created a testing facility to explore the effects of high winds and hail on residential and commercial buildings of up to two stories.

  Organizations such as the National Institute for Building Sciences are attempting to assess the returns on specific technologies. To help the market grow, standards developers and other stakeholders could collaborate, codevelop, fund, and consolidate existing ROI studies and apply them to a wider range of hazards and technologies. Such consolidation could create further consensus regarding the importance of these investments. Several interviewees also emphasized the opportunity to encourage the adoption of appraisal, loan, and bond underwriting standards that recognize the value of resilience (e.g., by offering improved bond ratings or lower interest rates for communities where resilience standards have been deployed). RELi was conceived as an underwriting standard, but in the absence of sufficient demand, lenders have been slow to react. Foundations could play a key role in spurring resilience research, by convening and fostering collaboration between stakeholders in the finance, underwriting, and insurance sectors.

- **Engage in outreach through industry associations.** Throughout the interviews and focus group session, practitioners working at the facility level and within the real estate industry shared that they had limited understanding of available resources, and requested assistance with resiliency planning. They also noted that trusted industry voices—such as BOMA and the International Facilities Managers Association—were not disseminating information on resilience planning. As noted earlier, such organizations could serve as natural conveners or trainers of property owners and managers. At a minimum, a summit meeting would increase outreach and awareness, mitigate the creation of standards with overlapping content, and possibly motivate resilience planning for property portfolios.

# 3.1 KEY IMPLEMENTATION PARTNERS FOR SUGGESTED STRATEGIES

Throughout the review of the market for voluntary resilience standards, key stakeholders surfaced as drivers for resilience. Figure 5 summarizes the roles of different stakeholder groups in market development.

Figure 5- Key Partners

| Strategy | Lender & Investor | Foundation | States | Local Jurisdictions | Facility Owner / Manager | Standard Developer | Insurance Sector |
|---|---|---|---|---|---|---|---|
| Streamline and unify resilience standards | | • | | | • | • | • |
| Explore code and insurance regulation | | • | • | • | | • | • |
| Adopt local policy options | | | | • | | | |
| Deliver technical assistance to facility managers and property owners | • | • | • | • | • | • | • |
| Demonstrate the ROI of resilience standards | • | • | | | • | • | • |
| Education and outreach | | • | | • | | • | |

# SECTION 4
# CONCLUSION

The voluntary resilience standards market is in its early stages and includes a large variety of standards, each of which is responsive to a market niche. The current standards apply to a variety of systems and can be applied on a range of scales, from the facility to the community level. While gaps remain in the market, there are several options available to facilitate near-term planning for both for new and existing facilities.

Meeting medium- and long-term needs, however, will require a concerted effort to (1) expand outreach and education about existing programs and (2) spur the movement of support sectors, such as the finance and insurance industries, to encourage market growth. The National Institute for Building Sciences, RELi, FORTIFIED, and other entities are leading efforts to quantify the costs and benefits of resilience, which can support effective policy design and encourage investment. Such research efforts could lead to more targeted, performance-based outcomes for resilient buildings, and a clear articulation of resulting monetary returns. These strategies represent initial steps toward strengthening the market. Improved resilience will be critical to successful adaptation to climate change and to the creation of stronger communities.

# APPENDIX A: RESILIENCE STANDARDS

Standards are listed in alphabetical order, and descriptions include links to each organization's website.

### 4.1.1 ALLIANCE FOR NATIONAL AND COMMUNITY RESILIENCE

The Alliance for National and Community Resilience (ANCR—pronounced "anchor") is a nonprofit formed by leaders from the International Code Council, the U.S. Resilience Council, and the Community and Regional Resilience Institute. The alliance's goal is to develop a community resilience benchmarking system that would lead to a three-tier certification program for communities with strong performance. The straw proposal uses a holistic approach to consider community resilience to several different stressors or risks. The initiative has several observers and partners from the nonprofit and private sectors (e.g., ICMA and Target). Working groups are being formed to develop criteria for various systems (e.g., the natural environment, food systems). The benchmarking system is still being developed, but the proposed process would allow communities to self-assess using ANCR tools, and seek recognition if their benchmarking results are strong. (Because the benchmarking system is still in development, it was excluded from the framework shown in Figure 2.)

### 4.1.2 BUILDING RESILIENCE RATING TOOL

The Insurance Council of Australia, an industry association of insurance providers, developed the web-based Building Resilience Rating Tool (BRRT) as part of its larger program on resilience. A simplified version of the hazard rating assessment used by insurers, the BRRT is now in its second beta release, and is available for testing by insurers and other interested parties. Relying on publicly available data sets and user-submitted information, the hazard rating tool focuses on minimizing damage to homes from natural disasters. It is currently limited to single-family homes. Risk is calculated based on building materials, location, and vulnerability to bushfires, cyclones, flooding, and hail. The tool provides an initial assessment of the home's vulnerability, calculates a resiliency score between 1 and 5, and offers homeowners guidance on improving their home's performance. Once the tool has been publicly released, resilience improvements will help reduce insurance premiums.

The BRRT could provide a useful model for education, outreach, and insurance industry partnership in the United States. In the first beta release, the Insurance Council of Australia was considering the addition of commercial properties, but neither alpha nor beta commercial software is currently available.

### 4.1.3 BUILDING RESILIENCE IN LA

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 focuses on capacity building and education for existing facilities. The Building Resilience Los Angeles: A Primer for Facilities Guide, 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 facilities guide and training developed by BRLA has been piloted by the Los Angeles business community, key community organizations, and nonprofits. The BRLA program is designed to build community-wide resilience, develop benchmarking methodologies, and create a community of practice for existing facilities. It is one of the few standards reviewed with a specific focus on existing buildings.

### 4.1.4 COMMUNITY RESILIENCE ASSESSMENT METHODOLOGY

In January 2016, the National Institute of Standards and Technology (NIST) released a concept paper for the development of a community resilience assessment methodology (CRAM). The goal is to assess community resilience by measuring the preparedness of different resource areas and infrastructure systems on which communities depend (e.g. communication and transportation). Built on research and stakeholder dialogues conducted to support the development of a disaster resilience framework, CRAM places a strong emphasis on the interconnection between infrastructure and social systems and complements NIST's ongoing effort to support community resilience planning.

CRAM outlines steps that communities can follow in order to select areas for analysis (e.g., security and safety), assess how well existing services are supporting whatever goal is under consideration, and identify ways to improve the performance of infrastructure or social systems in the event of disaster. CRAM will also include performance indicators, but the methodology is currently in development

### 4.1.5 ENTERPRISE GREEN COMMUNITES

Enterprise Community Partners, a financial lender to affordable housing projects, administers the Enterprise Green Communities Certification Program, which is designed for both new construction and existing buildings. The certification criteria were most recently updated in 2015 and are available to any facility with affordable housing units. As part of the certification criteria, the Enterprise Green Communities program requires adoption of a resilient design feature that improves performance in response to extreme weather events and power outages; it also includes an optional credit for conducting a vulnerability assessment, which must include consideration of climate projections.

To complement the certification program, Enterprise Community Partners has developed the Ready to Respond Toolkit, which focuses on resilience. The toolkit includes guidance for staffing and operating multi-family housing during disasters, as well as guidance on resilience retrofits for existing facilities. Enterprise Community Partners is also piloting a series of resilience-readiness assessments of existing multifamily facilities in New York City.

### 4.1.6 ENVISION

Developed by the Institute for Sustainable Infrastructure and the Zofnass Program for Sustainable Infrastructure at Harvard, Envision is a rating system for public infrastructure projects in the realms 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.

### 4.1.7 FORTIFIED

Developed by the Insurance Institute for Business and Home Safety, the FORTIFIED program offers three programs: FORTIFIED Home, FORTIFIED Commercial, FORTIFIED for Safer Business.

#### FORTIFIED HOME

The main program is FORTIFIED Home, which is designed for new and existing construction on focuses on protection from hurricanes, high winds, hail, and severe thunderstorms. Under the FORTIFIED Home program, developers of new construction projects or owners of existing homes complete a self-assessment, which is then reviewed by a third-party evaluator. Based on the results of the assessment, the developer or homeowner can undertake investments or retrofits as needed to achieve Bronze, Silver, or Gold designation. The designations are based on improving the resilience of different structural elements (e.g., roof, windows, doors). Alabama, Mississippi, Georgia, South Carolina and North Carolina have adopted laws or regulations that provide (1) incentives to assist with retrofits and/or (2) insurance discounts for those who certify their homes.[15] The Insurance Institute for Business and Home Safety has a research facility in South Carolina that includes a testing chamber capable of evaluating the resilience of residential and commercial construction materials, systems, and design for buildings of up to two stories.

#### FORTIFIED COMMERCIAL

The FORTIFIED 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. Certification levels 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). Currently, incentives are not available for the commercial program, but they could be a possibility in the future.

#### FORTIFIED FOR SAFER BUSINESS

FORTIFIED for Safer Business began in 2011 and is a code-plus program for small and mid-sized businesses constructing new facilities. 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 designations for these buildings and still considers the program to be in pilot phase.

### 4.1.8 INTERAGENCY CONCEPT FOR COMMUNITY RESILIENCE

The draft Interagency Concept for Community Resilience (ICCR) was created in response to President Obama's National Preparedness Goal, which focused on improving the ability of communities to mitigate and respond to hazards. The ICCR was developed by the Mitigation Framework Leadership Group, an interagency working group co-led by the Federal Emergency Management Agency and the National Oceanic and Atmospheric Administration. The draft released by the working group highlights indicators designed to align state and federal assessments of resilience and proposes national resilience metrics. It provides examples of community-level indicators that can signal the resilience level of community systems (e.g., housing, infrastructure). While the ICCR includes a number of indicators and data sources that could be helpful for planning, it does not identify performance thresholds or provide other guidance for communities that wish to use the indicators to self-assess resilience.

### 4.1.9 LEED PILOT CREDITS ON RESILIENT DESIGN

Leadership in Energy and Environmental 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.

Initiated in 2015, the LEED Pilot credits on resilient design were developed to complement the existing LEED program; thus, they 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. Within specific hazard areas, LEED draws on other standards for guidance, such as FORTIFIED for Safer Business and the Resilience-based Earthquake Design Initiative. New or existing facilities could use the climate change assessment and emergency planning guidance to strengthen their preparedness.

### 4.1.10 PERFORMANCE EXCELLENCE IN ELECTRICITY RENEWAL

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. It is administered by Green Business Certification Inc. (GBCI) and was developed by 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 Leadership in Energy and Environmental Design program and the Sustainable SITES Initiative, two other resilience certification programs.

### 4.1.11 RESILIENCE-BASED EARTHQUAKE DESIGN INITIATIVE

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. The program focuses on beyond-code design, planning, and assessment to help facilities, organizations, and communities recover quickly after a seismic event; this approach is in contrast to the traditional emphasis on protecting the lives of building occupants. 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; (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. The standard also offers guidance on engaging stakeholders in planning and developing a formal resilience plan. 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.

### 4.1.12 RESILIENCY ACTION LIST

The Resiliency Action List (RELi) was developed as a national consensus standard through an ANSI-approved process, and began piloting in 2015. 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 resiliency 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 Leadership in Energy and Environmental Design criteria, 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, if adopted, would amend the Green Building Investment Underwriting Standards currently applied to commercial buildings. 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.

### 4.1.13 SUSTAINABLE SITES INITIATIVE

The Sustainable SITES Initiative offers a comprehensive rating system for developing sustainable landscapes. 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 landscape architects, engineers, and architects but does not address buildings. The system is administered by Green Business Certification Inc. and was tested through a two-year pilot program starting in 2009.

SITES is designed to be pursued in conjunction with Leadership in Energy and Environmental Design (LEED) certification. Like LEED, SITES has four certification levels, and separate categories for commercial retail, 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.

### 4.1.14 UNIFIED FACILITIES CRITERIA

The Unified Facilities Criteria (UFC) is a planning framework for military installations. Originally developed by the U.S. Department of Defense in 2002, UFC was created to unify the design, construction, and operation of military properties. It offers guidance for operations, maintenance, and decommissioning, and could be used to inform civilian planning and construction as well.

The UFC is now administered by the US Army Corps of Engineers, the Naval Facilities Engineering Command, and the Air Force Civil Engineer Center. The Unified Facilities Guide incorporates several green building and sustainability principles, such as transit-oriented development and energy conservation. The UFC design criteria also include resilience to acute and longer-term hazards, such anti-terrorism construction standards, and planning construction above 100-year floodplains. The UFC encourages the use of reliable data sources for climate projections, and references the U.S. Global Change Research Office and National Climate Assessment.