Moving Forward:
Findings and Recommendations from the Consultative Council

An Authoritative Source of Innovative Solutions for the Built Environment
Introduction
The U.S. building industry is a dynamic and evolving industry and the challenges it faces have significant implications for the nation’s economy and citizens. Each year, the National Institute of Building Sciences, through its Consultative Council, brings together key stakeholders from across the building industry to examine the challenges and opportunities before both the industry and the nation. In turn, the Consultative Council compiles the most critical issues, along with strategies to address them, into a report to help the industry and the nation’s policymakers better deliver the high-performance buildings and communities that meet societal, governmental, owner and occupant goals.

The 2015 report, which follows, builds on the major themes previously identified in the 2014 Moving Forward Report. These three themes: resilience and a changing climate; aligning government and business to achieve a cost-effective, high-performance built environment; and the buildings-related workforce and productivity, continue to be important priorities. The 2015 findings and recommendations contained herein represent the collective input from the Council’s member organizations, industry thought leaders and the work of related Institute Councils and others working to advance the building industry.

I. Resilience and a Changing Climate
Communities are trying to become more resilient to disruptions from hazards, such as severe weather, floods, hurricanes and earthquakes, as well as man-caused threats. In the course of making a dramatic change in how federal, regional, state, tribal and local governments think about how they prepare for, absorb, recover from and adapt to adverse events, whether due to natural or human causes, leaders cannot afford to ignore the potential consequences of changing risks. Communities entrusted with the protection of the health, safety and welfare of their citizens have a duty to develop a comprehensive understanding of their assets and how they can reduce the risk and impact of disruptions to their building stock, infrastructure and social fabric.

In order to successfully mitigate these changing threats and risks, both public- and private-sector stakeholders need to understand the evolving effects of climate change and its potential impacts on their existing and new building stock; infrastructure; and social needs and systems. They should be aware that, in the future, to ignore the potential consequences and fail to plan for community resilience could be catastrophic at an individual, community and national scale. Communities need codes, standards, guidance and tools that will help them recognize their risks and prevent disruptive hazards from becoming disasters.

A proactive approach will improve community resilience and, more importantly, increase the public’s confidence in the construction of the environment where they live, work and play and in the fundamental services that they depend upon for quality of life. The most resilient outcomes will be generated from an approach that inoculates communities from potential disasters rather than responds to them in an emergency fashion. Communities need incentives that support them in developing and carrying out their resilience plans so that they will be able to establish performance and recovery goals for their social needs, built environment and principal hazards. Information on the true costs associated with various risks at the individual and community level can also help build awareness and drive action.
A. An Industry Statement on Resilience

To truly accomplish resilience at the community level requires the engagement, cooperation and coordination of numerous disciplines and stakeholders. In 2014, recognizing this need for collaboration and coordination, the building industry came together to issue a joint statement on resilience, committing to work to significantly improve the resilience of the nation’s buildings, infrastructure, public spaces and communities. The statement focuses on five specific aspects of the path forward where the buildings industry has the greatest opportunity to make a difference. Based on these priorities, the Consultative Council offers the following recommendations, several of which are discussed in greater depth elsewhere in this report:

1. **Research materials, design techniques, construction procedures and other methods to improve the standard of practice.**

   - Federal agencies that address climate-related issues (potentially under the auspices of the U.S. Global Change Research Program) and climate researchers should engage with members of the design, construction and operations disciplines to assess the performance of current buildings during catastrophic events and support the development of tools and information that incorporate the anticipated climate changes into codes, standards, guidance and industry practice.\(^1\)

2. **Educate our profession through continuous learning. Through coordinated and continuous learning, design, construction and operations professionals can provide their clients with proven best practices and utilize the latest systems and materials to create more resilient communities.**

   - As recognized in the March 19, 2015, Executive Order—Planning for Federal Sustainability in the Next Decade, it is essential that the design, construction and operations communities increase their capability to understand and incorporate climate-resilient principles into their work. The industry should develop, with the technical and financial support of related federal partners, the educational coursework necessary to build such capabilities.\(^2\)

   - Government leaders should work with facility owners; planning, design, construction and operations representatives; and resilience and disaster-preparedness professionals to establish common metrics and performance standards that can drive implementation of effective resilience strategies.

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\(^1\) The U.S. Government Accountability Office is in the process of conducting a study on current efforts relating to climate change and future opportunities. The National Institute of Building Sciences also has begun to undertake work in this area in response to a recommendation included in the *2014 Moving Forward Report*.

Industry Statement on Resilience

Representing more than 750,000 professionals, America’s design and construction industry is one of the largest sectors of this nation’s economy, generating over $1 trillion in GDP. We are responsible for the design, construction, and operation of the buildings, homes, transportation systems, landscapes, and public spaces that enrich our lives and sustain America’s global leadership.

We recognize that natural and manmade hazards pose an increasing threat to the safety of the public and the vitality of our nation. Aging infrastructure and disasters result in unacceptable losses of life and property, straining our nation’s ability to respond in a timely and efficient manner. We further recognize that contemporary planning, building materials, and design, construction and operational techniques can make our communities more resilient to these threats.

Drawing upon the work of the National Research Council, we define resilience as the ability to prepare and plan for, absorb, recover from, and more successfully adapt to adverse events.

As the leaders of this industry, we are committed to significantly improving the resilience of our nation’s buildings, infrastructure, public spaces, and communities.

- We research materials, design techniques, construction procedures, and other methods to improve the standard of practice.
- We educate our profession through continuous learning. Through coordinated and continuous learning, design, construction and operations professionals can provide their clients with proven best practices and utilize the latest systems and materials to create more resilient communities.
- We advocate at all levels of government for effective land use policies, modern building codes, and smarter investment in the construction and maintenance of our nation’s buildings and infrastructure.
- We respond alongside professional emergency managers when disasters do occur. Industry experts routinely work in partnership with government officials to survey damage, coordinate recovery efforts, and help communities rebuild better and stronger than before.
- We plan for the future, proactively envisioning and pursuing a more sustainable built environment.

The promotion of resilience will improve the economic competitiveness of the United States. Disasters are expensive to respond to, but much of the destruction can be prevented with cost-effective mitigation features and advanced planning. Our practices must continue to change, and we commit ourselves to the creation of new practices in order to break the cycle of destruction and rebuilding. Together, our organizations are committed to build a more resilient future.
3. **Advocate at all levels of government for effective land use policies, modern building codes and smarter investment in the construction and maintenance of our nation’s buildings and infrastructure.**

- Federal agencies should actively engage in the codes and standards development process, alongside industry stakeholders, to assure the consideration of federal priorities and the incorporation of federally supported research findings. Such engagement should include support for the existing private-sector-led development process and the importance of life-cycle costs and benefits in determining the overall code content.
- Federal agencies with an interest in building codes should work collaboratively to support the adoption of the latest codes at the state and local level through the provision of incentives, technical assistance and training of state and local leaders and code officials.
- The design, construction and management disciplines should work with owners and project developers (including within government) to develop and implement innovative approaches to procurement and delivery of a high-performance built environment, including public-private partnerships (design-build-finance-operate-maintain procurement), performance-based contracting and integrated project delivery. Where necessary, regulatory and policy barriers must be reviewed and changed to capture the benefits of such approaches.
- Beyond-code programs play an important role in providing consistency to owners, manufacturers and members of the design, construction and operations disciplines on the achievement of higher-performing facilities. Federal agencies (both as facility owners and subject matter experts) should participate in the development of such programs and use them.
- Federal, state and local mapping, emergency preparedness and geologic agencies should work to provide the public, community planners and project owners and members of the design, construction and operations community with the best available information to support land-use decision making.

4. **Respond alongside professional emergency managers when disasters do occur. Industry experts routinely work in partnership with government officials to survey damage, coordinate recovery efforts and help communities rebuild better and stronger than before.**

- Members of the design, construction and operations community have extensive building-related knowledge, which is valuable in responding to a hazard event. Such expertise should be utilized to the greatest extent practical without the fear of liability for licensed professionals. State and local governments should support passage of laws that open the door for professionals to participate constructively in response and recovery.
- Code officials are valuable resources to their communities, serving alongside police, fire and emergency medical services (EMS) in both mitigation and pre-event planning, as well as recovery after a disaster event. They play a valuable role in post-disaster assessments of structures and are a key asset in the rebuilding process. State and local government leaders should be prepared to take advantage of the capabilities of code officials and confirm that disaster management agencies are including code departments in their planning and recovery processes. The Federal Emergency
Management Agency (FEMA) also should develop coordinated training for code officials at the federal level—as is done for fire officials at the National Fire Academy.

5. Plan for the future, proactively envisioning and pursuing a more sustainable built environment.

- Members of the building industry, with the engagement of stakeholders—including lifelines—at the federal, state and local level, should work to develop guidance and tools that support increased resilience. Particular attention should be given to interdependencies across lifelines and infrastructure.

B. Addressing Drought and Water Use Concerns

Within the broad need to support the advancement of resilience, there are several specific topics of great concern. The nation must address the need to respond to increasing droughts and, in particular, the utilization of finite water resources. The economic impact of the persistent drought in California is estimated to have cost that state $2.74 billion and nearly 21,000 jobs. Reacting to Governor Brown’s edict to reduce potable water consumption by a minimum of 20%, California has rightfully undertaken efforts to adopt creative regulations to achieve that goal. However, some of the provisions that were ultimately enacted were ill-considered—specifically, flow-rate reductions on bathroom faucets below U.S. Environmental Protection Agency (EPA) WaterSense levels—which are creating an increased potential to result in dangerous unintended consequences relating to health and safety.

The recent legionellosis outbreaks in New York City, Chicago and Marin County, California, demonstrate the severe outcomes often associated with illnesses resulting from water-borne pathogens. In 2011, the Center for Disease Control and Prevention (CDC) reported that cases of legionellosis had increased 217% from 2000 to 2009. The CDC estimates that there are between 8,000 and 18,000 cases of legionellosis requiring hospitalization annually.

While it may seem that the issues of drought and the increase in legionellosis outbreaks are unrelated, they are in fact directly linked. As communities aim to reduce water use, transit times between the point of treatment at the water utility to the point of use in buildings are increasing due to water-efficiency measures enacted across the country. As a result, water is entering buildings with fewer residual disinfectant agents available to kill the pathogens that are thriving in the premises’ plumbing systems. While water resides in the premises’ plumbing systems, poor plumbing system designs, lower flow rates and lower hot water temperatures (required by plumbing codes to help prevent scalding incidents) are reducing scouring action and are increasingly providing an ideal incubator for the amplification of legionella.

The nation must continue on a path towards increased levels of water efficiency in buildings. The drought in California and elsewhere in the arid West is forecasted to be persistent, possibly lasting decades. Cities in those regions of the country will not be sustainable without being more efficient with potable water supplies and the intelligent, safe utilization of non-potable waters.

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4 Report - Morbidity and Mortality Weekly Report (MMWR), August 19, 2011 / 60(32); 1083-1086. See http://www.cdc.gov/mmwr/preview/mmwrhtml/mm6032a3.htm?s_cid=mm6032a3_w.
The nation needs the Federal Government to take the leadership role in the following areas in order to help ensure adequate water supplies, especially in regions of water scarcity, while addressing and mitigating the unintended consequences of water efficiency:

- Support plumbing research – Congress and the Administration should direct and fund the National Institute of Standards and Technology (NIST) to re-open its plumbing research facility. NIST leadership is needed to work with industry towards the development of new, statistically based models for calculating water-supply pipe sizing in buildings. Reducing the pipe size increases the scouring action of the water within the pipes, which helps to reduce biofilm growth, where pathogens like legionella grow and multiply. This effort would also carry the added benefit of decreasing construction costs and wait times for hot-water delivery, thus saving both water and energy usage throughout the life of the building.

- Develop a new statistical model for pipe sizing – The U.S. Environmental Protection Agency (EPA) should support the research and development of less-invasive water sub-metering technologies. The information obtained from sub-metering will result in a better understanding of complex water-use patterns associated with various building types.

- Better utilize alternate water sources – In order to help address water scarcity in times of drought, Congress and the Administration should direct the EPA, working with industry stakeholders, to develop uniform national non-potable water quality standards, along with permissible utilizations for all alternate water sources such as gray water, rainwater and storm water. Water quality standards that establish minimum water quality parameters are required to protect public health and safety. Where scientifically sound information is not yet available to set such standards, the EPA should undertake research to fill knowledge gaps.

- Engage with stakeholders in processes for energy and water savings – In support of understanding and addressing the water–energy nexus, the U.S. Department of Energy (DOE) should convene stakeholder meetings and hearings to develop widely accepted energy and water footprint guidelines for use by building owners and facility managers. At the same time, DOE should become more engaged in the development of consensus building, plumbing, mechanical and electrical codes to promote increased levels of energy and water efficiencies.

C. Code Development, Adoption and Enforcement Support

Building and related safety codes and standards are an essential part of public safety in the United States. The adoption and enforcement of building codes has an important impact on the lives of citizens and emergency responders, as well as on the cost of doing business. Safety codes address public health and well-being, as well as the protection of the built environment. The U.S. standardization system is market-driven and sectorial. In the construction area, the development of model codes and safety standards is a private-public partnership where the private sector subsidizes the development and maintenance of national voluntary consensus codes and standards but the authority to adapt, adopt and implement belongs to the state and local governments. A model code has no legal standing until it is adopted as law by the public entity having authority. This cooperative process allows all interests and stakeholders to have a voice, and ensures, to the extent feasible, harmonization between the private sector and the regulatory community.

The primary application of a building code is to regulate new construction. Building codes only apply to an existing building if the building undergoes renovation, reconstruction, rehabilitation or major alterations or if the occupancy of the existing building changes (e.g. from commercial to residential, or vice versa). However, the building code is the cornerstone of a complete system that includes other codes that cover property maintenance, zoning, sewage, sustainability, energy use, resilience and more.
Additional policies and initiatives can help address the need to improve energy performance or resistance to hazards beyond activities triggered under the code.

All aspects of the code development, adoption and enforcement process must work like a well-oiled machine in order to be successful. In the United States, this coordinated effort results in a stellar record of safety compared to other countries where building codes may exist but enforcement is lacking. The key to making facilities safe and able to resist natural disasters is the adoption of building codes based on science and technical knowledge, combined with proper design and construction practices and strong code compliance mechanisms. Properly enforced building codes also allow communities to quickly rebound from devastation caused by those disasters. Codes enhance economic development and ensure consistency among jurisdictions; yet adopting jurisdictions can make amendments that best fit their climatic, geographic and other local needs.

While the building community understands the importance of codes, for those outside the building community, the subject may be more abstract. It is important to continue to educate legislators, decision makers, home buyers and the public in general about how building codes and construction design affects each one of us every day in many ways. The general person walks in and out of homes, schools, offices, stores and places of worship without giving much or any thought to what has gone into creating that building or understanding how the building’s performance compares with current codes or standards of care. There are the traditional and obvious structural aspects of a building, as well as other aspects that are not necessarily seen or felt, such as in the quality of the indoor air or lighting, the noise level of all the operating systems, the comfort level of room temperature and more. It is building codes and standards that provide guidance on how to accomplish these benefits from the design stage, through construction and in the maintenance and operation of the buildings.

Building codes and their enforcement affect everyone. The subject should matter to the person building, buying or leasing the structure; to the institutions financing and insuring the project; and to the community as a whole.

Constructing homes and buildings to the most recent standards allows the builders to use the most cost-effective and safe methods available; provides the building owner and occupant the assurance that the building is built to the most resilient standards (addressing flood protection, seismic design and wind-bracing requirements) so the structure is safe, healthy and water and energy-efficient, creating a solid investment for the current and future owners. An appropriately zoned, well-designed, safely built and well-maintained community is a desirable place in which to live and attractive to successful businesses.

To support the development, adoption and enforcement of building codes, the Consultative Council makes the following recommendation:

- The U.S. Department of Homeland Security (DHS) /FEMA, Department of Housing and Urban Development (HUD) and DOE, working with industry partners, including insurance companies, should develop a collaborative program to support the adoption, administration and enforcement of the most currently available building codes. Such a program should focus on providing scientific and economic data associated with the effectiveness of building codes and their impacts on communities; education and training for code professionals; technical assistance; and evaluation tools for code department effectiveness.

D. Resilience and Green-Building Rating Systems
While codes provide an important means for setting baseline requirements at a community level, green-building rating systems provide a valuable resource for designers, contractors and owners going beyond
minimum levels. Nationally recognized green-building rating systems contribute to the awareness of environmental issues that may impact resilience. Owners and teams using rating systems have the opportunity to mitigate effects on buildings, humans and the environment as they consider pursuit of criteria related to using an integrated design process, selection of site, evaluation of building materials and use of sound construction practices. While code development activities are responding swiftly to address new environmental threats, rating systems are also evolving to support increased awareness.

The inclusion of criteria that encourages the use of integrated design processes to reward teams for setting performance goals and maintaining focus on those performance goals throughout the design and construction process helps drive achievement of high-performance goals. The criteria also encourage incorporation of community representatives where issues such as resilience and regional climate threats can and should be brought into the planning process.

The green-building rating systems also encourage a focus on evaluation of building materials for life-cycle assessment issues, which may result in teams selecting materials with lower carbon emissions, among other objectives. In addition to reducing environmental impacts, rating systems can help teams think through life-cycle cost and building service life or durability issues that may be impacted by regional climate threats. As these national rating systems continue to evolve, their stakeholders should strive to encourage owners and teams to use integrated design processes that involve broad community input; select sites with full consideration of regional climatic threats and resource capacity; evaluate building material durability and service life issues; conduct moisture control analyses to decrease water intrusion potential; and evaluate other opportunities through the use of rating systems to safeguard occupants and the long-term value of property during times of high-impact events.

II. Aligning Government and Business to Deliver a Cost-Effective, High-Performance Built Environment

Building owners and government agencies both aim to realize specific goals in the design, construction and operations of the built environment. Many of these goals are focused on similar ends—particularly around safety and security, and sustainability. Working collaboratively towards these goals will assure implementation of the most cost-effective strategies. Such strategies also can lead to increased industry productivity—a long-standing challenge for the industry.

A. Streamlining Regulatory Processes for Buildings and Infrastructure

High-performance, sustainable and resilient buildings and infrastructure require the consideration and integration of numerous systems and practices—which are often regulated by different government entities. Regulatory efficiency and compliance with modern construction codes and standards and other government regulations requires implementation of a system that supports streamlined approaches to compliance. Having regulatory agencies of federal, state and local governments work collaboratively, with the support of advanced information technology resources, can assure that regulatory requirements are met and that projects needed for economic, environmental and social benefits, such as resilience to disasters, can go forward in a timely and cost-effective manner.

The Alliance for Building Regulatory Reform in the Digital Age\(^5\) has begun work in this area. However, to assure the needs of all stakeholders are met will require engagement from all disciplines within the industry and government entities at the federal, state and local levels.

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\(^5\) Alliance for Building Regulatory Reform in the Digital Age. See [http://www.natlpartnerstreamline.org](http://www.natlpartnerstreamline.org)
At the national level, several different organizations are working on projects that will provide new tools to improve both the effectiveness and efficiency of the building regulatory process. Such projects include: increasing the use of digital signatures and seals; wider adoption and use of criteria to allow replicable buildings; and the digital representation and use of codes.

**Recommendation:**

- The White House, through the Office of Management and Budget (OMB) and with the engagement of DOE, EPA, HUD, DHS, the Access Board and U.S. Economic Development Administration (EDA), and working with industry stakeholders, should identify opportunities to align regulatory implementation and compliance requirements to support achievement of desired outcomes in the most cost-effective and efficient manner. The state and local levels should also conduct such a process and, ultimately, across all three levels of government.

**B. Utilizing Standards to Support Interoperability and Lower Transactional Barriers**

Standards have a direct relationship with the global macro economy. Data from the Organization for Economic Cooperation and Development and the U.S. Department of Commerce both show that standards and related conformity assessment (the process of checking that products and services measure up to implemented standards) have an impact on 80% of the world’s trade in commodities.  

Consistency in measurement standards at an international level helps to improve economic efficiency and provide the ability to accurately understand, interpret and benchmark property assets. In conjunction with emerging technologies, it also allows better data collection and predictive use of data.

In May 2013, the International Property Measurement Standards (IPMS) Coalition formed to develop and implement global standards for the measurement of real property. The Coalition today is comprised of more than 70 leading professional and standards-setting bodies. Members of the coalition include the World Bank, International Monetary Fund, Royal Institute of Chartered Surveyors (RICS) and Building Owners and Managers Association International (BOMA). In November 2014, the Coalition published IPMS for office buildings. The Coalition is expected to publish standards for other asset classes—residential, industrial, retail, and mixed use—in the next two years.

A separate coalition has been formed, the International Construction Measurement Standards (ICMS) Coalition, to address global standards for construction.

One central theme in construction and facility and asset management is decision-making. International standards and building information modeling (BIM), separately and jointly, improve decision-making. Standards also allow classifications to be developed for the productive use of technology. In the built environment, BIM and ‘big data’ promise much, but they have to overcome industry global challenges and fragmentation.

Various studies have shown that improving project performance is only possible by improving decision-making at each stage of the project life-cycle. In turn, decision-making can only be improved by providing the right information, in the right form, at the right time.

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Hence, developing standards for this information is crucial. Open data standards at an information technology (IT) technical level, along with standards for the professional work processes for those populating the BIM, are needed. To optimize BIM, the nexus between IT standards and professional standards must be considered.

Information needs to be defined in accordance with what decisions need to be made at each stage of the project life-cycle. Defining information needs is essential. Similarly, validation and checking of the information is easier with defined classifications and categories of information that can not only be automatically verified, but also compared on a project-by-project basis through benchmarking.

Technology needs professional standards and—in terms of data collection, use of predictive data and general relevance—professional standards need technology. As BIM advances and disruptive technologies affect land, property and construction, the need for international professional standards becomes greater.

Recommendations:

- The Administration should establish an inter-agency committee to engage with IPMS Coalition and ICMS Coalition in the consultive process and work towards the timely implementation of IPMS and ICMS across the public buildings stock—this includes use in BIM associated with renovations or new construction.

C. Innovative Solutions to Pressing Finance and Performance Needs

Numerous building industry and consumer groups have identified the current state of the nation’s infrastructure as a challenge to ongoing realization of economic goals. Several potential solutions have emerged, including a greater focus on life-cycle performance and total cost of ownership and utilization of innovative financing mechanisms.

1. Small Commercial Building Energy Retrofit Finance

As identified in a report by the Institute’s Council on Finance, Insurance and Real Estate, small commercial buildings offer a significant, yet untapped opportunity to improve energy performance. The retrofit market for small commercial buildings is conservatively estimated at $35.6 billion, assuming a 30% improvement in performance for buildings constructed before 1980. A market this size would create an estimated 424,000 job-years of full-time employment and reduce greenhouse gas emissions by 87 million metric tons a year. Small building retrofits would also improve the resilience of the nation’s built environment and would take pressure off the aging electric grid.

Despite this considerable opportunity, numerous market barriers are preventing meaningful financing and investment in retrofits for the small commercial building market. Small commercial buildings are less likely to be well-leased, well-located and occupied by strong-credit tenants. As a result, these buildings typically fall outside the investment parameters of institutional lenders and investors, making it more difficult to supply capital for energy retrofits.

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Recommendations

- Federal agencies should expand and deploy programs to facilitate state and local energy retrofit financing efforts.
  - Expand existing research, program development and technical assistance programs, including EnergyStar, and DOE’s the Commercial Building Energy Consumption Survey (CBECS) and Energy Efficiency and Renewable Energy (EERE) initiatives, which provide cost-effective approaches to market expansion.
  - The Federal Government is well-positioned to support research and deployment of control software and hardware for building performance tracking, reporting and analysis. Activities in this arena will enhance the measurement and verification of building energy performance and energy retrofit outcomes.
  - Federal credit enhancements and guarantees, such as those offered under the Small Business Administration (SBA) 7(a) and 504/Certified Development Company (CDC) programs, are a potent and well-tested way to attract substantial additional private financing to the small commercial building retrofit market. Development of a program that combines the small business financing expertise of the SBA and the energy-efficiency technical support of DOE would be ideal.
- Federal policymaking should encourage public-private energy retrofit approaches. To date, public-private ventures have been the most successful model for delivering energy retrofit financing to the small commercial building sector and have demonstrated the most potential to scale. Such initiatives should:
  - Leverage public credit enhancements, superior collection methods and sanctions to improve loan security and leverage significant private capital flows.
  - Use standardized administrative processes, legal documents and contractor training.
  - Bundle utility, federal, state and local tax incentives.
  - Aggregate small projects into larger energy-retrofit contracts.
  - Provide turnkey services to the property owner.
  - Promote cost-effective and readily deployed and replicated energy-conservation measures.
- Public policies and programs should be designed to anticipate the future aggregation of energy-retrofit loans into bonds and to provide the basis for appropriate loan documentation. Secondary markets, when appropriately controlled for risk, help to maximize financing opportunities and reduce financing costs.

2. Utilizing Innovative Procurement, Contracting and Financing Mechanisms

Building owners and policymakers are becoming increasingly interested in the performance of buildings. Whether driven by sustainability, resilience concerns or the desire to protect the investments of taxpayer dollars, government agencies are under increasing pressure to achieve performance-based requirements. These pressures are coming at a point when the budgets for new facilities, major capital improvements and long-term maintenance are shrinking. At the same time, there is greater public recognition of the need to incorporate a full life-cycle approach, increase sustainability, strengthen resilience and improve building performance. These challenges and requirements are spurring governments to look for new models to meet their long-term building performance goals.

Public-private partnerships (P3s) offer governments the opportunity to overcome challenges related to project financing while driving achievement of performance requirements. P3s have emerged as a potential procurement and finance model to engage the private sector in helping stretch public-sector
dollars, meet agency needs, introduce innovation and meet long-term performance goals cost-effectively. To date, in the United States, the utilization of P3s has largely focused on transportation infrastructure projects. However, other countries, including Australia, Canada and the United Kingdom, are making extensive use of P3s to fulfill needs for public buildings such as schools, hospitals, prisons and courthouses.

P3s for public buildings offer a number of potential benefits. They incentivize the use of high-performance building design to deliver the most cost-effective building that meets the agency’s needs over the facility’s life cycle. The P3 process often results in a faster delivery time for the project and incorporates a full life-cycle approach (as opposed to separate construction and maintenance processes that do not always align or fit with delivery schedules). P3s also can provide certainty in both cost and performance, reducing long-term risks borne by the government. Private-sector partners often bring increased innovation to projects. In addition, the public and private partners share the project risks based on which entity is in the best position to manage the specific risk.

P3s do not, however, eliminate all risk. They can add a layer of complexity to deals and pose challenges in procurement and execution. The structure of P3 financing may result in higher borrowing costs and a more narrow set of borrowing options. Across federal, state and local government, the policies for use of such a procurement and financing mechanism vary. More than 30 states have enabling legislation that addresses P3s at the state level, in a variety of models. Yet, a path forward for Federal Government utilization of P3s is currently unclear. The Institute and RICS Americas have undertaken an effort to help illuminate the road forward for enhanced utilization of P3s and other innovative procurement mechanisms.

Recommendations:

- Increase the focus on measured, actual performance through new and emerging contracting tools, codes, policies and practices. This will require the sharing of best practices, sample contracts and case studies, along with efforts to address industry concerns around liability for non-performance. Tax incentives and utility programs should incorporate requirements based on actual, measured reductions in energy use.
- Examine public-sector procurement models for opportunities to expand models that support life-cycle budgeting to optimize cost-effective performance. This includes examining Federal Acquisition Regulation (FAR) and Defense Federal Acquisition Regulation (DFAR) requirements and Office of Management and Budget (OMB) and Congressional Budget Office (CBO) scoring methodologies. Expand utilization of performance-based contract requirements9 and public-private partnerships/design-build-operate-maintain contracts.10
- Incorporate system-level requirements and operations-focused criteria into baseline codes and other policies to assure long-term performance and focus on diligent design, construction and operations in support of community goals and protection of subsequent owners of projects constructed for short-term investors.
- The building industry—with involvement of representatives from the legal, finance and insurance sectors—should conduct a dialogue on how to evolve the current state of fees, timelines and risk in furtherance of a systems-based approach to realize actual, measured performance results.

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10 Case Study: Governor George Deukmejian Courthouse (Long Beach Court Building). See http://www.wbdg.org/references/cs_longbeach.php.
• Establish a federal level body to help coordinate and provide guidance for both federal and state-level P3 efforts. This should include an educational component for policymakers and procurement officials.

D. Implementing Whole-Building and Performance-Focused Strategies
To date, strategies to reduce the impact of buildings on society or the environment largely have focused on design-based interventions or component-by-component strategies. While such strategies have resulted in some level of improvement in the built environment, it is becoming increasingly obvious that today’s goals require a new approach—one focused at the systems or whole-building level and the actual, measured achievement of performance goals.

Setting realistic performance goals requires supporting data. A number of efforts are already underway, including the emergence of benchmarking and disclosure requirements at the state and local level and CBECS. Such information should support aggregation to allow policymakers and members of the design, construction and operations disciplines to leverage multiple sources of information to set and then realize performance goals.

Recommendations:

• The U.S. Congress should consider a comprehensive approach to provide energy-efficiency incentives for buildings, including tax credits, deductions and depreciation schedules in developing tax reform measures. Tax incentives should be performance-based and linked to measurable energy savings; incentives might also be targeted to encourage retrofits that deliver substantial efficiency gains.

• Policymakers should leverage national CBECS data and the growing quantity of voluntary and mandatory benchmarking and disclosure programs to create more meaningful building performance databases. Better collection and dissemination of energy consumption and benchmarking data will support the design of more meaningful energy models and help owners, tenants, buyers, sellers, appraisers and banks to evaluate the performance of specific buildings and the interventions with the greatest return on investment.

• The building industry should develop and implement guidance, standards and other tools that focus at the systems and whole-building level, while including performance criteria. The General Services Administration (GSA) P-100 Facilities Standards for the Public Buildings Service, 11 and the private-sector National Performance Based Design Guide12 are examples of such tools.

1. A Holistic Incentivization Strategy for Resilience Investments
Resilience has come to occupy a place in public policy and programs across the United States. Yet, even in the face of growing losses and the deleterious effects of natural disasters, the nation’s capacity and appetite is waning for continued federal and state funding for pre- and post-disaster mitigation as part of efforts to promote resilience. A new approach is necessary—one focused on capturing all of the potential incentives provided by both the public and private sectors for pre- and post-hazard investment. The most cost-effective manner to achieve resilience is through a holistic and integrated set of public, private and hybrid programs based on capturing opportunities available through mortgages and loans; insurance; finance; tax incentives and credits; grants; regulations; and enhanced building

11 GSA P100 Facilities Standards for the Public Buildings Service. See http://gsap100.wbdg.org/
12 National Performance Based Design Guide. See http://npbdg.wbdg.org/
codes and their application. This focus on private/public sector opportunities to induce corrective action is called “incentivization.”

This approach calls for input, consensus, leadership and action from a broad spectrum of stakeholders that represent the entire U.S. incentivizing community and the regulatory and economic processes that need to be developed and coordinated to make incentivization part of the nation’s economic fabric. Such discussions need to occur at high enough levels in the public and private sectors to ensure enactment. Participants should include those who offer incentives, such as: insurance and finance-related companies, lenders and foundations, as well as forward-thinking communities and federal and state government agencies. It also needs to include homeowners, businesses, utilities and communities as decision-makers. The private sector will not undertake investment to support achieving resilience just because it is sensible, but because is economically prudent. Therefore, stakeholder offerers need a level of confidence that using incentives to implement mitigation strategies to achieve resilience will justify investments, underwriting and loan and grant programs. Decision-makers want the certainty that they can offset the cost of implementing mitigation strategies. In this win-win scenario, all stakeholders should experience the expanded benefits and co-benefits of resilience, including reduced losses and operational continuity. Once incentives start becoming the standard practice for leading private-sector stakeholders, the rest of the private sector should begin to follow.

Incentivizing property owners, lenders and securitizers to increase the use of mitigation standards should involve:

- The development and adoption of appraisal and bond underwriting standards that recognize the valuation benefits of building resilience, all other factors being equal. [Enhanced appraised values allow a borrower to leverage more mortgage financing for a given loan-to-value ratio. Conversely, for a specific loan amount, a more resilient building will be better collateralized (that is, have a lower loan-to-value ratio) than a less resilient comparable property. Similarly, bonds tied to more resilient properties would carry higher ratings, thus minimizing interest expense to the issuer.]
- The establishment of federal, state or local tax incentives for building owners participating in mitigation programs and grant programs to support participation in approved mitigation initiatives.
- Establish education and training programs for realtors and brokers to support expanded disclosure of building performance features, which could drive the marketplace to seek these resilience strategies.

Additional incentives strategies would be especially useful for residential properties:

- The expansion of federal home renovation programs to include mitigation improvements.
- Interest rate reductions for residential mortgages, provided, through Fannie Mae and Freddie Mac, on properties built to approved mitigation standards. This approach was recently introduced by Fannie Mae for mortgages on green-certified residential properties.

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Buildings owned by small businesses are likely to face special challenges implementing mitigation strategies for resilience. There is currently a significant market gap in supplying renovation financing for such properties. Closing the gap should include:

- Locally administered resiliency programs that would provide turnkey renovation services to participating property owners. Local property-assessed clean energy (PACE) programs are already providing such services for green building renovations.
- Federal SBA loans guaranteed by the federal government and made by private lenders or community development financial institutions, to finance building resiliency upgrades. SBA loans are already a key source of building acquisition and renovation financing for small businesses, although such loans lack specific resiliency requirements.
- Contractor-based financing, whereby a general contractor would develop turnkey resiliency programs for small buildings.
- Public-private solutions, combining PACE and SBA approaches with private capital and delivery of resiliency-based renovation programs at the local level.

Financial institutions are increasingly becoming involved in resilience discussions. Incentives for mitigation in resiliency programs could also be addressed through the capital markets:

- Corporate debt ratings, in appropriate cases, could recognize mitigation strategies. This approach would focus on companies whose assets are significantly concentrated in facilities or equipment in a single region or urban area prone to natural disasters, where such an event would have a profound effect on property loss and business discontinuity. Such companies would experience improved bond ratings, all other factors remaining equal, by adopting comprehensive mitigation strategies that achieve resilience. Similarly, municipal bonds linked to the construction of resilient facilities in regions prone to natural disasters could realize enhanced bond ratings, other factors being equal.
- Resilience-based real estate investment trusts (REITs), private equity funds and bond issuances could represent potential market innovations. In such cases, resiliency approaches could be combined with other environmentally-friendly approaches. Such investment strategies would address growing investor appetites for green investments, while resiliency strategies would reduce investment risk and improve portfolio operating performance.

E. Cybersecurity of Buildings and Critical Infrastructure

Building control systems with embedded communications technology, as well as those enabled via an Internet Protocol (IP) address, provide critical services that allow a facility to meet the functional and operational needs of users and occupants. Unfortunately, they also can be easy targets for hackers and people with malicious intent. Attackers can exploit these systems to gain unauthorized access to facilities; use as an entry point to traditional information technology (IT) systems and data; cause physical destruction of building equipment; and expose an organization to significant financial obligations to contain and eradicate malware or recover from a cyber-event. Cyber-attacks, such as the Target and Home Depot data hacks, have directed increased attention to the network connectivity of facility/building operations and maintenance vendors, an organization’s business IT systems and facility/building control systems.14

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14 Target data breach (2013) and Home Depot data breach (2014).
Facility/building control systems, such as building automation systems (BAS), energy management systems (EMS), physical security access control systems (PACS) and fire alarm systems (FAS), are now considered potential hacking points into an organization. Industrial Control Systems (ICS) are physical equipment-oriented technologies and systems that deal with the actual running of plants and equipment, including devices that ensure physical system integrity and meet technical constraints and are event-driven and frequently real-time software applications or devices with embedded software. These types of specialized systems are pervasive throughout the nation’s infrastructure and are required to meet numerous and often conflicting safety, performance, security, reliability and operational requirements. ICSs range from building environmental controls (heating/ventilation/air conditioning, lighting), to systems such as the electrical power grid. With the increasing interconnectivity of ICS to the internet, the ICS can be an entry point into the organization’s other IT systems.

In February 2013, the Obama Administration issued the Executive Order, Improving Critical Infrastructure Cybersecurity, which required the National Institute of Standards and Technology (NIST) to "lead the development of a framework to reduce cyber risks to critical infrastructure \(\text{the "Cybersecurity Framework".}\)"\(^{15}\) The Cybersecurity Framework will include a set of standards, methodologies, procedures and processes that align policy, business and technological approaches to address cyber risks. The Cybersecurity Framework shall incorporate voluntary consensus standards and industry best practices to the fullest extent possible.

While federal agencies have been required to meet stringent cybersecurity standards for traditional IT systems since the Federal Information Security Management Act (FISMA) was passed in 2002, the same level of protection and analysis is just beginning to be developed for building control systems. Buildings are becoming increasingly reliant on technologies that allow centralized monitoring and control of multiple building systems (building automation, fire and life safety, energy management, physical security, access control, etc.), to assist in accomplishing design and operational goals. Because of the unique operation and configuration of building control systems, traditional IT processes such as continuous monitoring, host-based scanning and automated patch management can cause building control systems to fail or become non-operational.

**Recommendation:**

- Members of the building industry, particularly facility managers, manufacturers and system technicians, should investigate and deploy existing federal and private-sector tools to assure the cybersecurity of building control systems. This includes training to recognize and address vulnerabilities.

### III. The Building Workforce

Across the building industry, concerns are growing about the availability of a workforce that can design, construct, operate and regulate the high-performance facilities being demanded by building owners and policymakers. These concerns focus both on the availability of skilled workers for the current and near-term, as well as into the future.

In particular, contractors have cited the impact the limited availability of skilled workers have on today’s projects. A recent Industrial Information Resources (IIR) survey found that between 30 and 60 percent of owners and contractors reported shortages in electricians, instrumentation technicians, combo welders, 

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millwrights, pipefitters and operators. A September 2015 survey by the Associated General Contractors (AGC) found that 86 percent of respondents reported difficulty in filling hourly craft or salaried professional positions. In a separate AGC survey from August 2014, a quarter of respondents reported passing on projects due to worker shortages.

The reasons for these shortages are multi-faceted. In general, the overall workforce is aging. In 2016, one-third of the construction workforce will be over the age of 50. Half of the current code official workforce is over the age of 55. In addition, the recent recession and down-turn in construction resulted in many construction workers leaving the industry for other sectors of the economy. Finally, quality training programs, particularly for hourly craft professionals, are lacking. School systems have dismantled public vocational and technical education programs, participation in union apprenticeship training is declining and high school programs have put an increased focus on college preparatory programs. Existing registered apprenticeship programs supported by the U.S. Department of Labor must expand at the state and local level, and the states must increase their focus on career and technical education opportunities. Veterans could be an important pool of talent to address short-term workforce challenges.

At the same time the industry is experiencing short-term labor challenges, it also is expecting to face a long-term need for new entrants into the field. According to the U.S. Bureau of Labor Statistics, the construction sector is projected to grow twice as fast as the average for all industries in the coming years, creating 1.6 million jobs between now and 2022. It will require a concerted effort from all building-related disciplines to assure that these positions are filled by workers with the skills and knowledge required to meet increasingly stringent performance demands. All industry participants should highlight the increasing utilization of technologies, such as BIM, sensors, controls and building management systems, and the growing collaborative nature of projects, as selling points to new entrants.

Increasing the productivity of current and new industry workers will help ease some of the pressure to engage new workers. Increased utilization of off-site construction techniques and technologies, along with tools such as BIM, can help. The National Institute of Building Sciences has undertaken an effort to advance productivity and the building workforce. An initial set of recommendations is due to be released in early 2016.

Recommendations:

- States and localities, with support from federal agencies and private sector representatives, should expand the availability of career and technical education programs, both at the high school and post-secondary education levels. State and local governments should enact legislation to permit the development of charter schools and construction career academies and give public school leaders the opportunity to establish construction career academies.

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16 IIR Labor Force Survey Results, July 2015.
17 AGC, 2015 Worker Shortage Survey Analysis. See https://www.agc.org/sites/default/files/Files/Communications/2015_Worker_Shortage_Survey_Analysis.pdf.
18 AGC, 2014 Worker Shortage Survey Analysis. See https://www.agc.org/sites/default/files/Files/Communications/Worker_Shortage_Survey_Analysis.pdf.
• All members of the building industry should serve as champions for the industry, by serving as mentors and advocating within the educational community and to parents, teachers, guidance counselors, students, business leaders and other decision makers to support technical/vocational curriculum that meet the needs of today’s workplace.

IV. Conclusion
The findings and recommendations included in this 2015 Moving Forward Report represent the latest thinking from the building industry on the tools, technologies, resources and policies necessary to achieve the goals established by policymakers, the public and the industry itself. These goals can be achieved with the engagement and collaboration of all industry stakeholders.
About the Consultative Council
The Consultative Council assembles high-level building community representatives to make recommendations on behalf of the building community directly to the executive and legislative branches of government to improve our nation’s buildings and infrastructure.

Council Members
ASTM International
American Institute of Architects
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