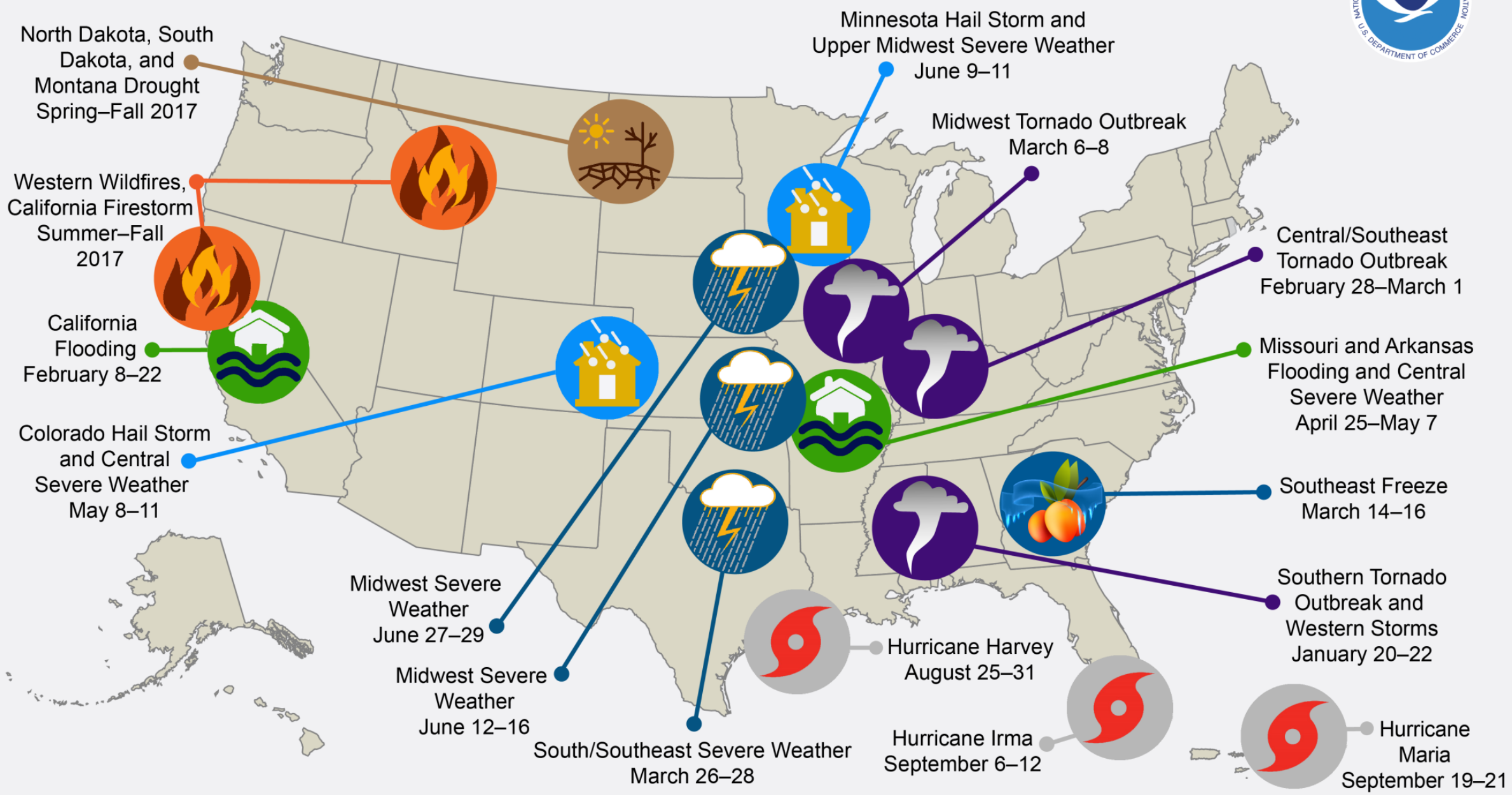
Extensive flooding from Tropical Storm Harvey in southeast Texas on Aug. 31, 2017. Air National Guard

Barranquitas, Puerto Rico, October 9, 2017 -- Aerial view of a damaged home in the mountainous area of Barranquitas, Puerto Rico. After Hurricane Maria, many homes, businesses, roads, bridges and government buildings suffered major damages due to strong winds and heavy rain. Photo by Andrea Booher / FEMA

Tubbs Fire, ABC News

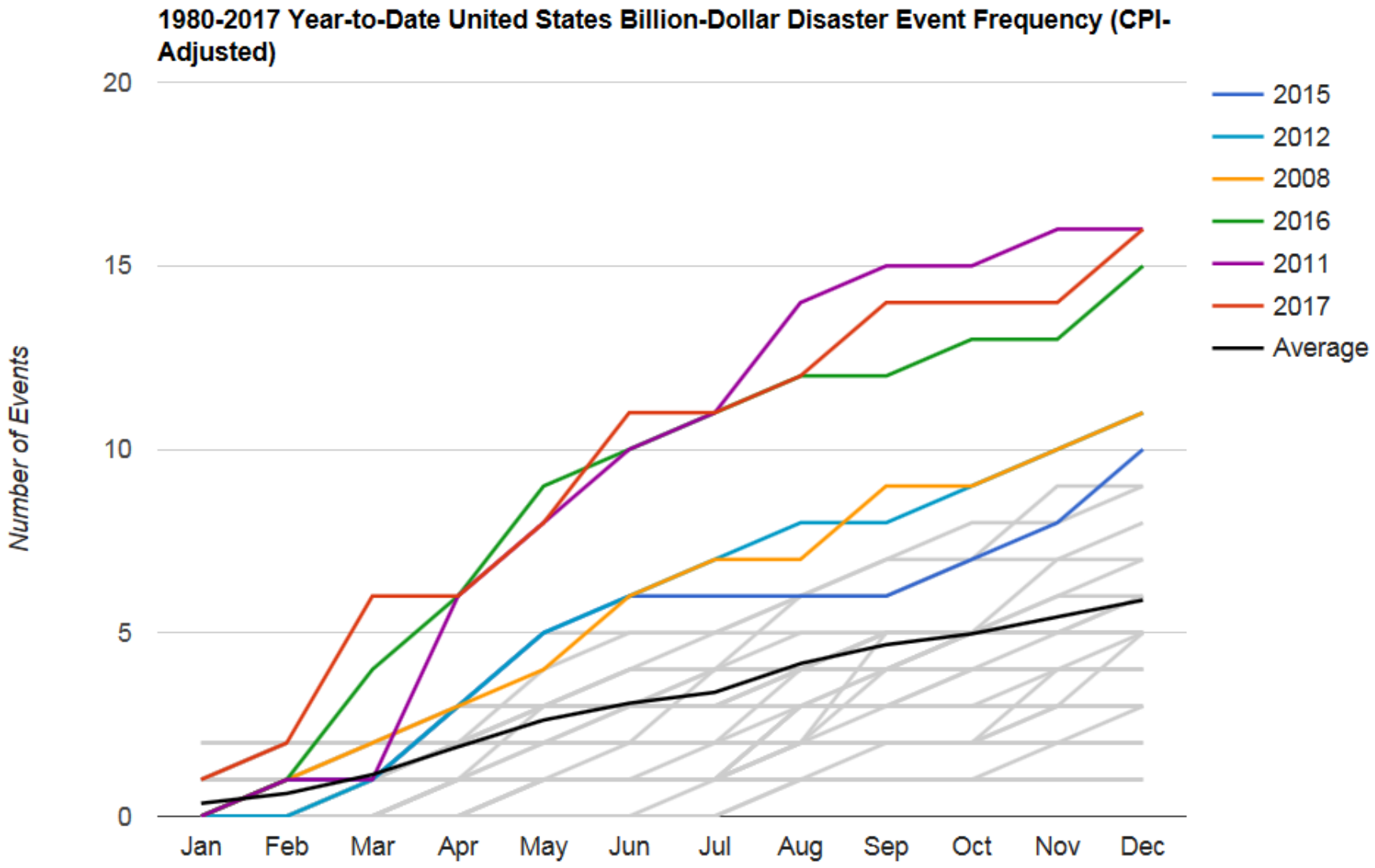

Carolina. . .
We've Got A Problem
Chip Somodevilla

U.S. 2017 Billion-Dollar Weather and Climate Disasters



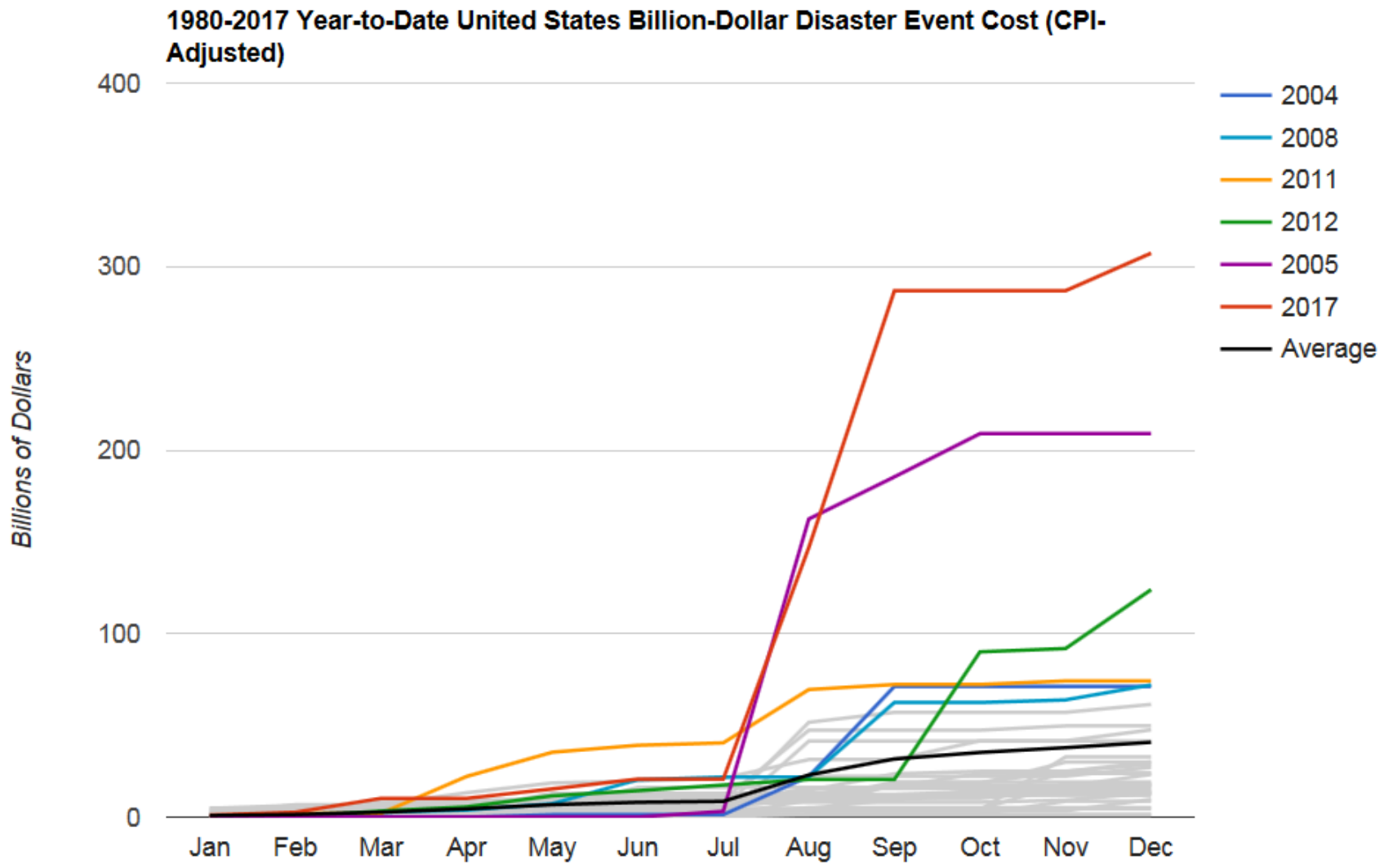
*This map denotes the approximate location for each of the **16 billion-dollar weather and climate disasters** that impacted the United States **during 2017**.*

Frequency of Natural Disasters



Event statistics are added according to the date on which they ended.

Cost of Natural Disasters



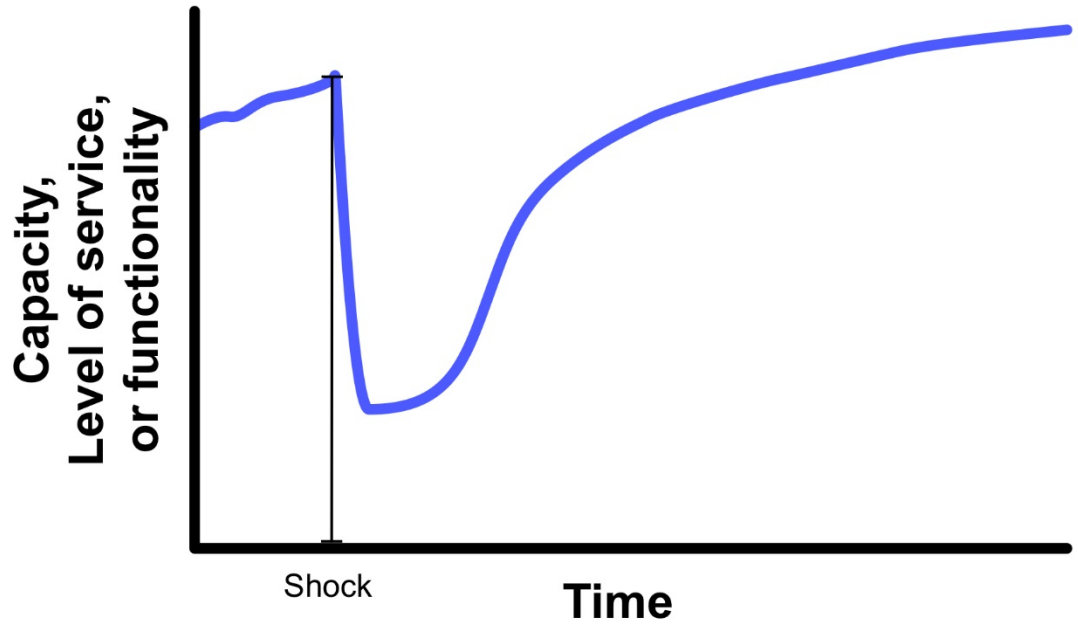
Event statistics are added according to the date on which they ended.

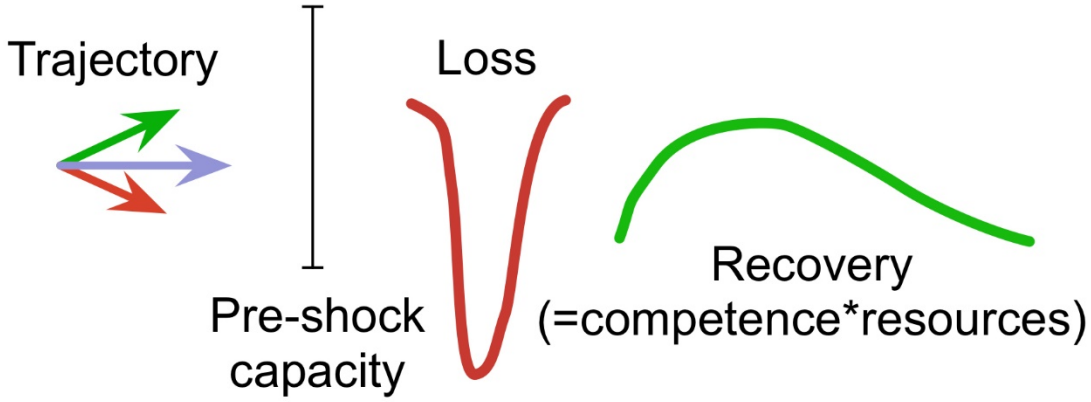
What is Resilience?

According to the National Academy of Sciences:

Resilience is the ability to prepare and plan for, absorb, recover from, and more successfully adapt to adverse events.

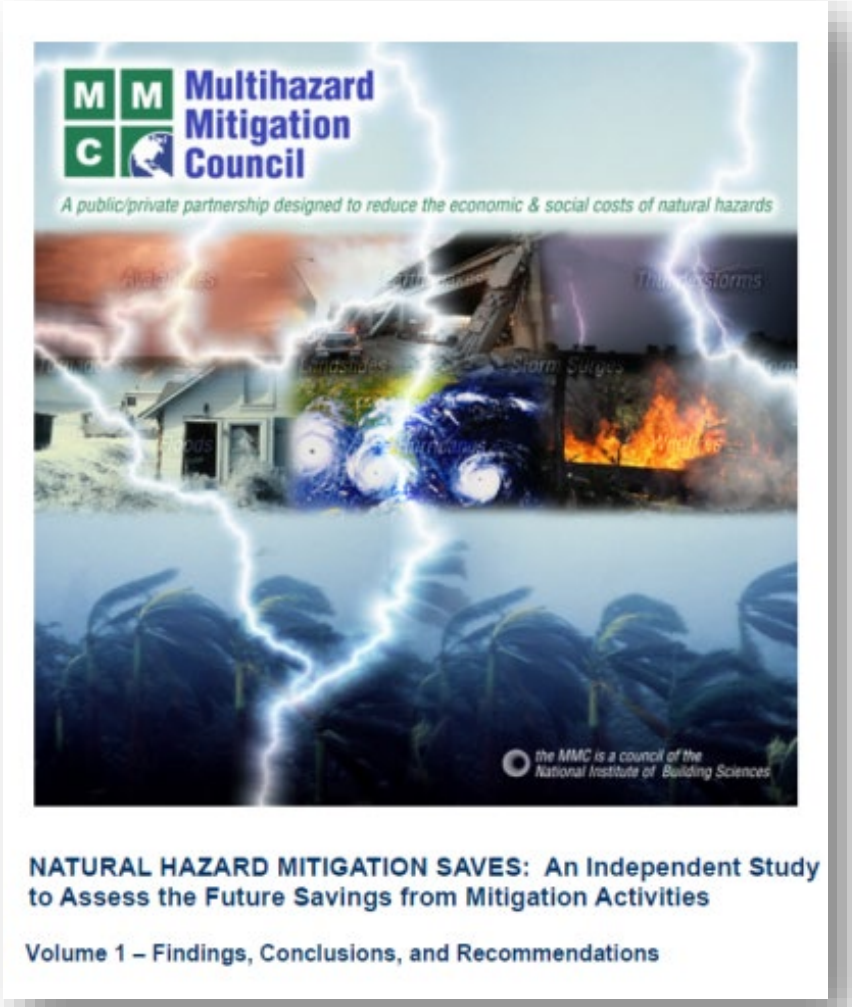
Resilience





Adapted from UK Department for International Development

Natural Hazard Mitigation Saves:
An Independent Study to Assess the Future Savings from Mitigation Activities (2005)



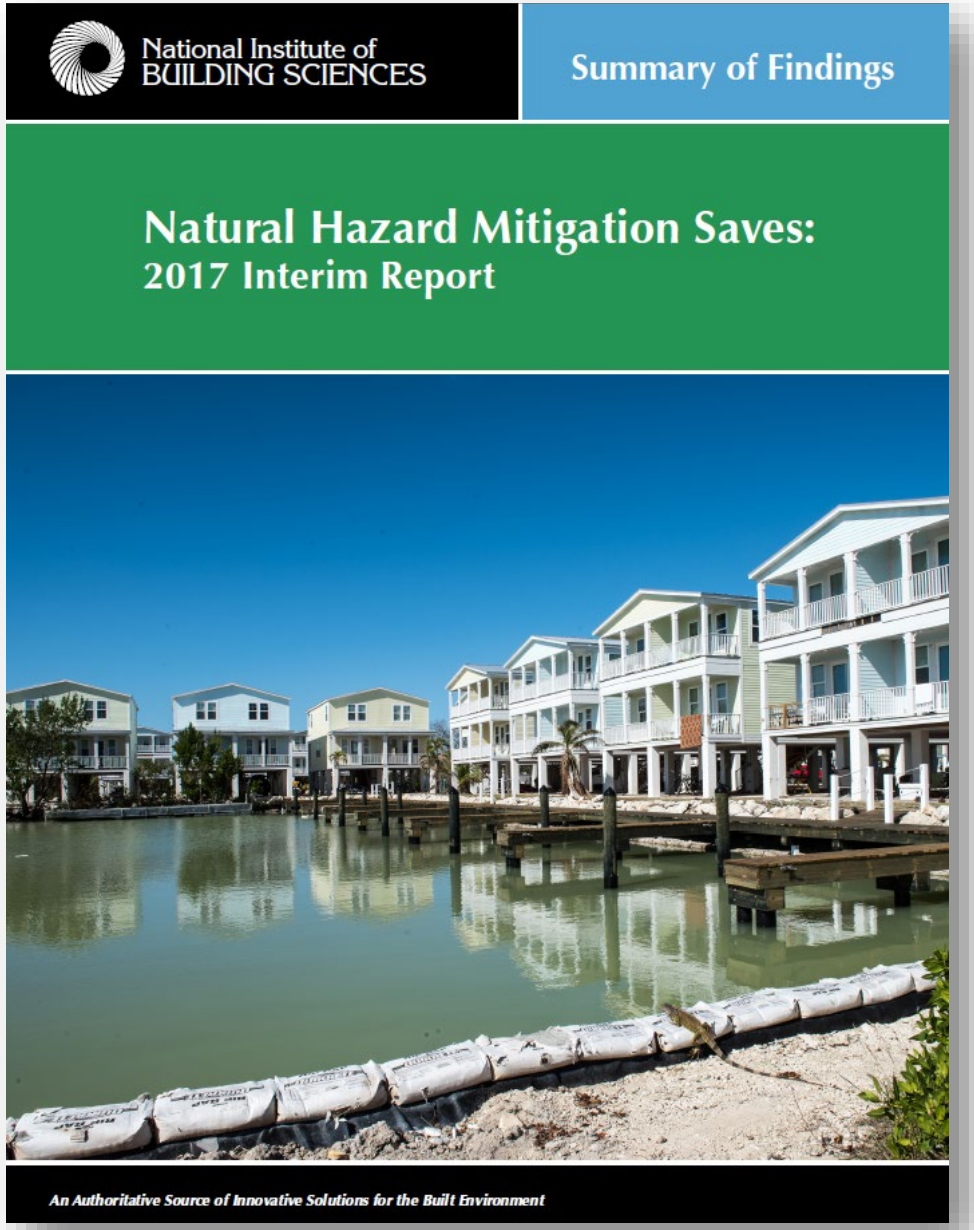
"Money spent on reducing the risk of natural hazards is a sound investment. On average, a dollar spent by FEMA on hazard mitigation provides the nation about $4 in future benefits."

A Valuable Contribution . . . But Questions Remained

Private Sector Initiatives

Building Codes

Lifelines



Premier Plus Sponsor

Premier Sponsors

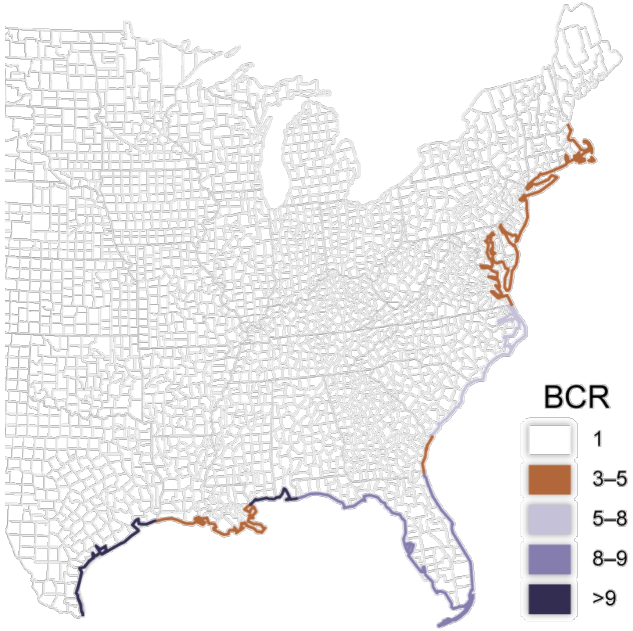
Lead Sponsor

Sponsors

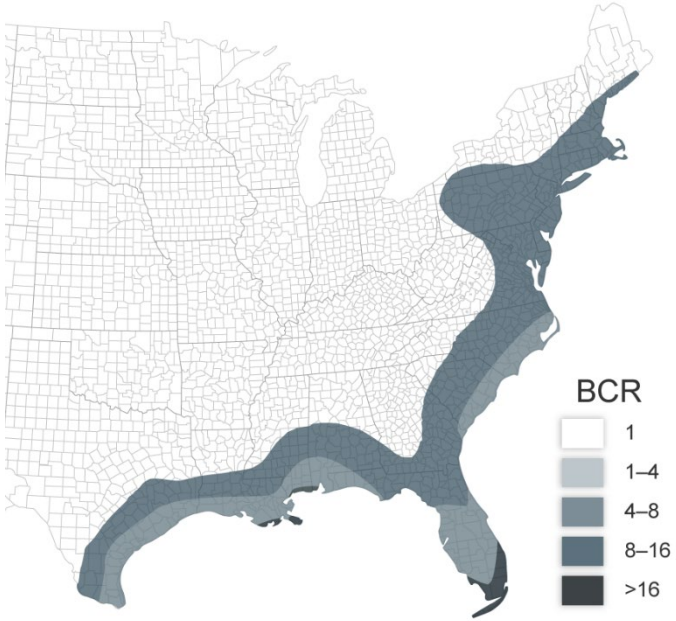
Supporter

Benefit Cost Ratios by Hazard and Mitigation Measure

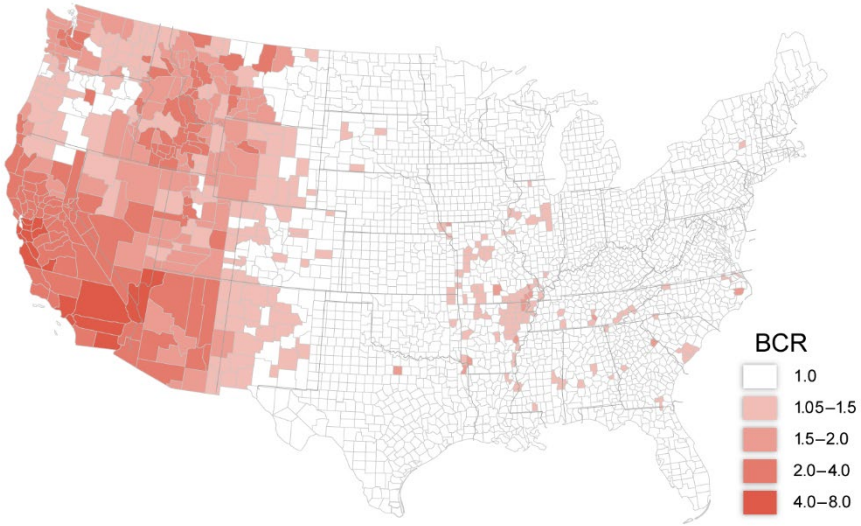
National Benefit-Cost Ratio Per Peril *BCR numbers in this study have been rounded	Federally Funded	Beyond Code Requirements
Overall Hazard Benefit-Cost Ratio	6:1	4:1
Riverine Flood	7:1	5:1
Hurricane Surge	Too few grants	7:1
Wind	5:1	5:1
Earthquake	3:1	4:1
Wildland-Urban Interface Fire	3:1	4:1



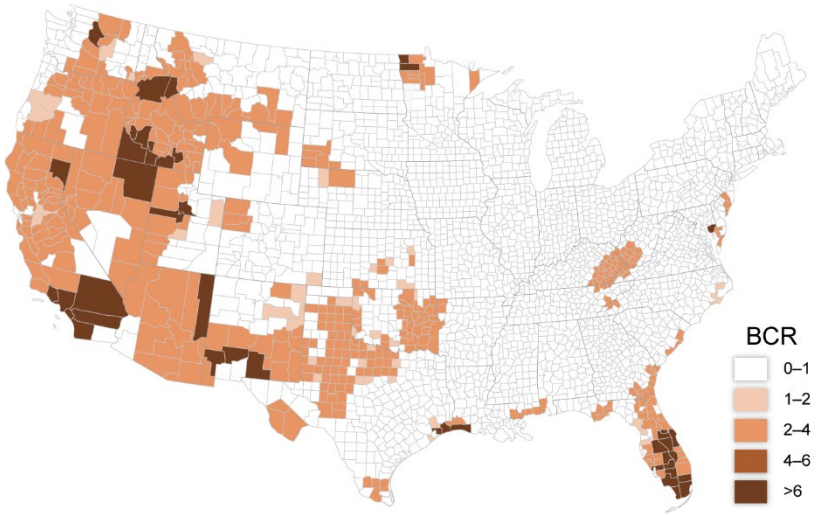
BCR for Coastal Flooding Mitigation



BCR for Hurricane Wind Mitigation

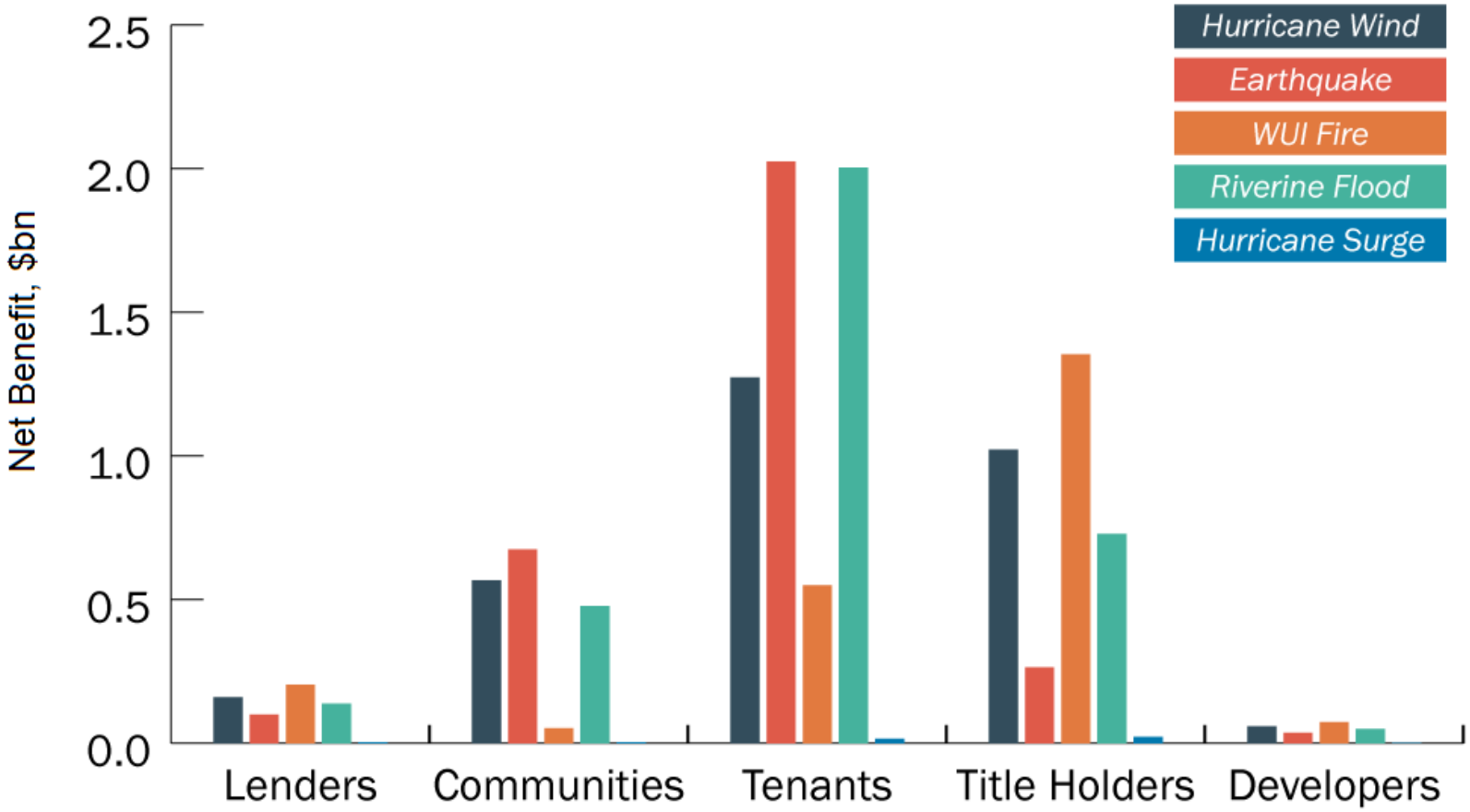


BCR for Earthquake Mitigation



BCR for Wildfire Mitigation

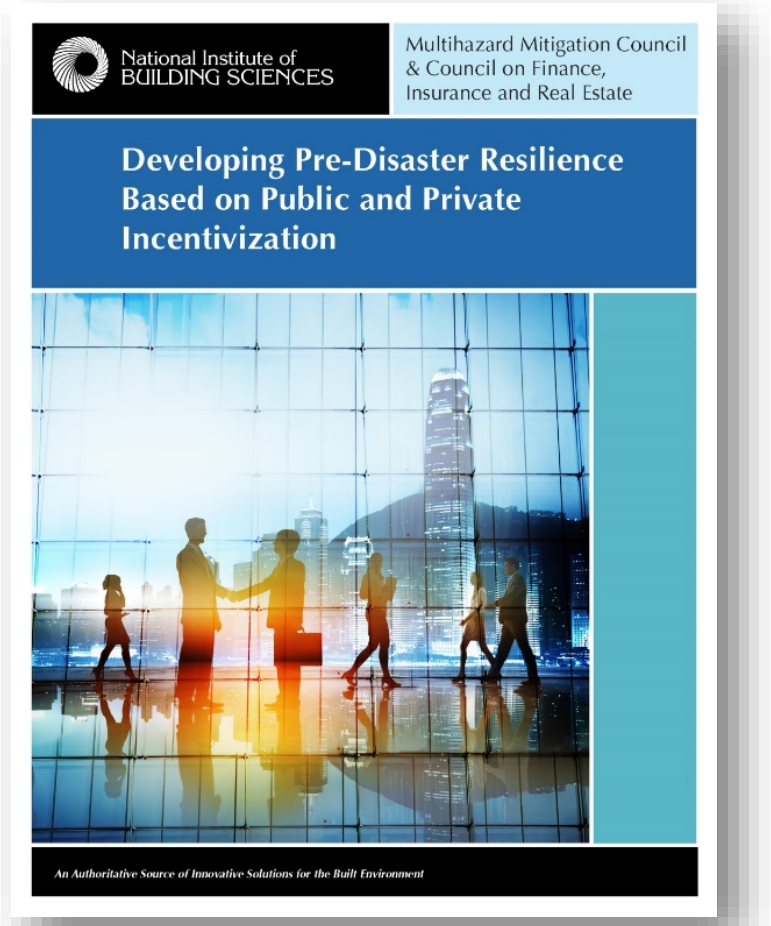
All Stakeholders Benefit from Exceeding Select 2015 I-Code Provisions



Mitigation Measures Studied

- **1 - Overall framework and integration of subsequent modules**
- **2A – Design and build new buildings to exceed code minima**
- **2B – Adopt and enforce building codes** (← late October)
- **3 - Retrofit of existing facilities** (← early 2019)
- 4 - Business continuity planning and disaster recovery
- **5 - Utility and transportation infrastructure mitigation** (← late October)
- **6A - Federal mitigation grants and loans** (← sole focus of MSv1)
- 6B – Non-building specific activities by federal agencies to mitigate hazard

Pre-Disaster Resilience Based on Public and Private Incentivization

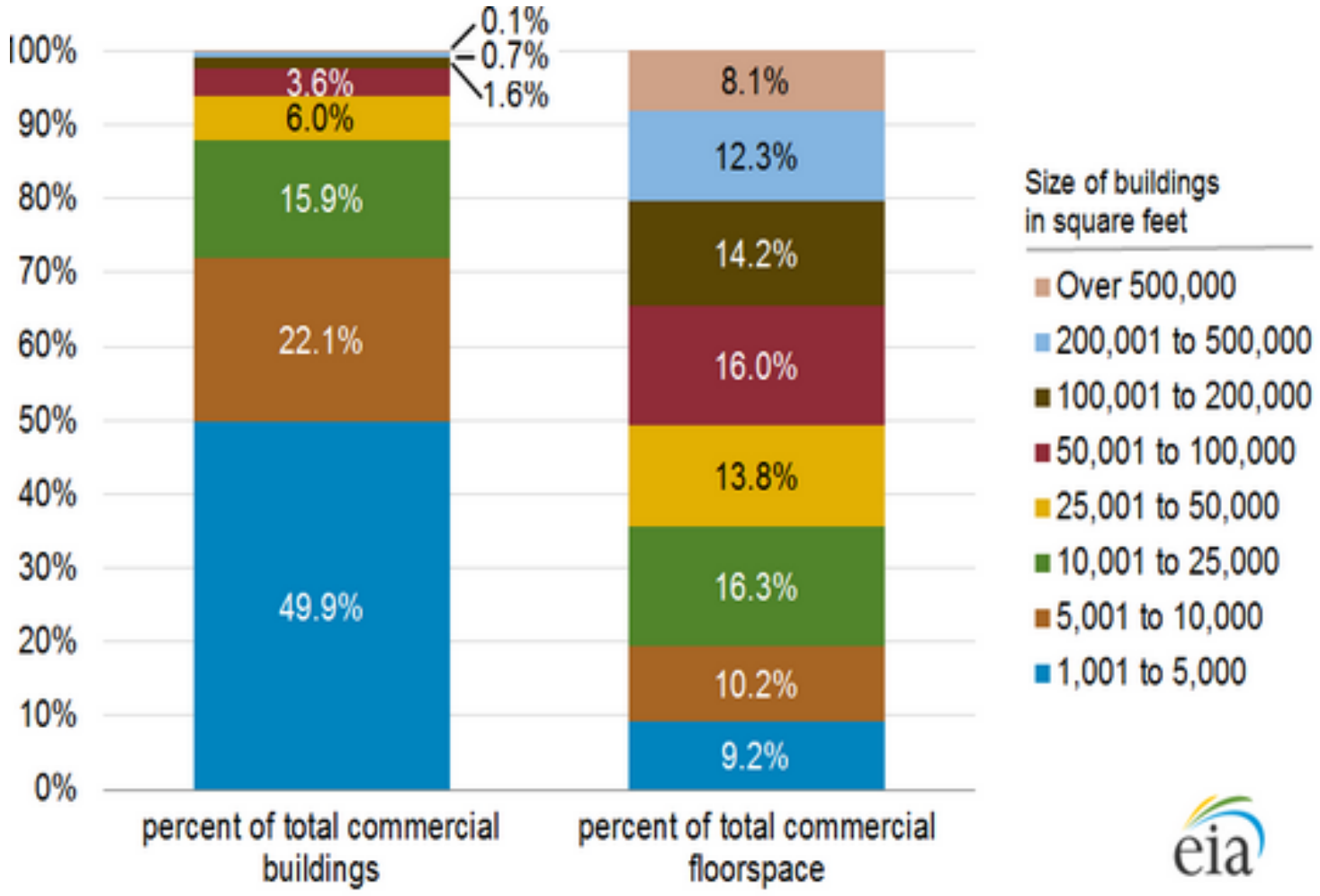


The most cost-effective manner to achieve resilience is through a holistic and integrated set of public, private and hybrid incentivization programs including mortgages, insurance, finance, tax incentives and credits, and grants

Layered Incentive Strategies

Refinance Model for an Existing Commercial Building Retrofitted for Resilience				
Finance		**Offsets**		
Finance Source	Payback Source	Insurance	Finance	Tax Incentive
Refinancing	Building Owner	Premium discount	Reduced equity requirement	Property tax reduction
		Reduced deductible	Interest rate reduction	State tax deduction
				Disaster Savings Account deduction

Small Building Domination

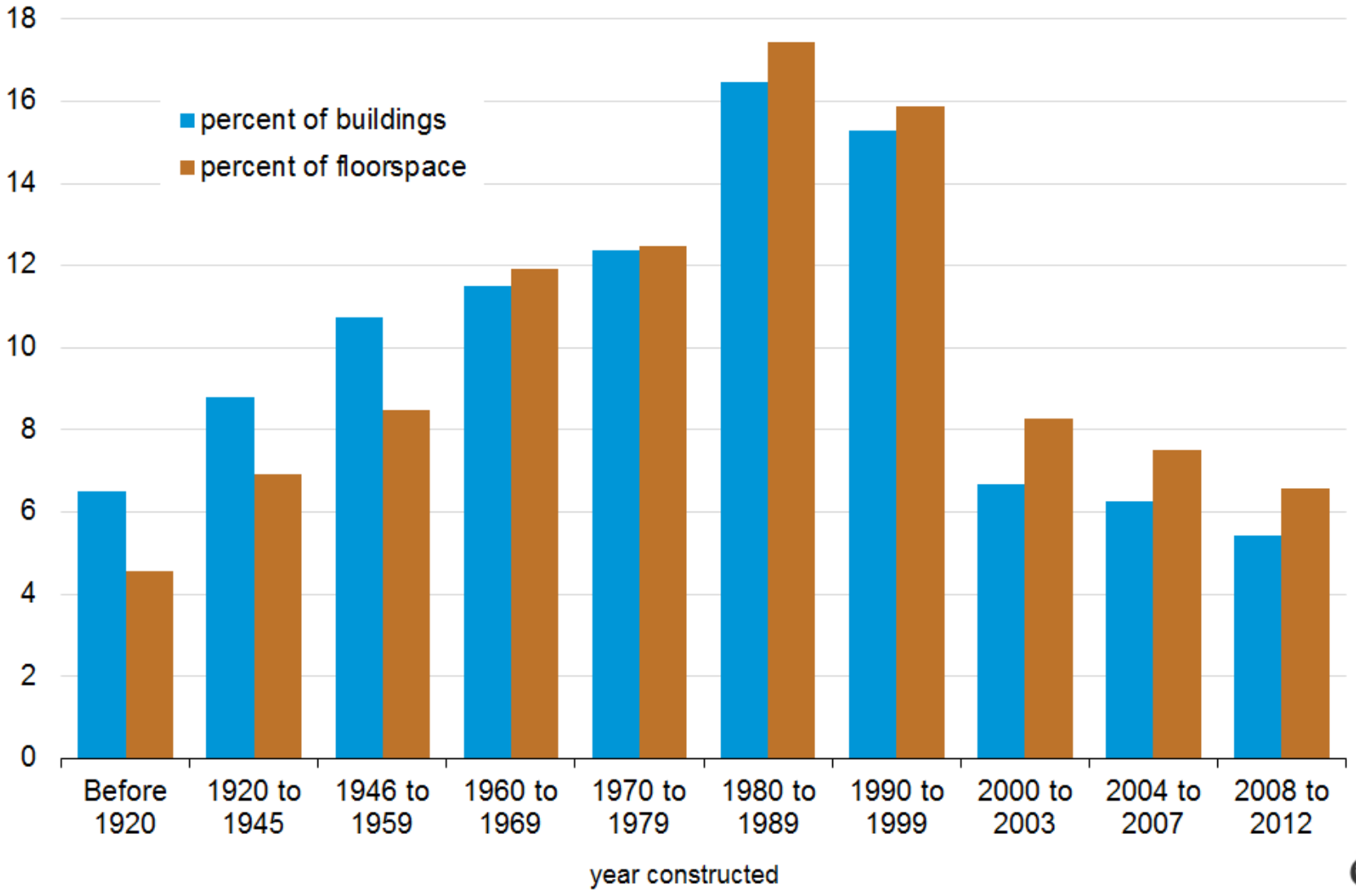


≤ 50k sq.ft.

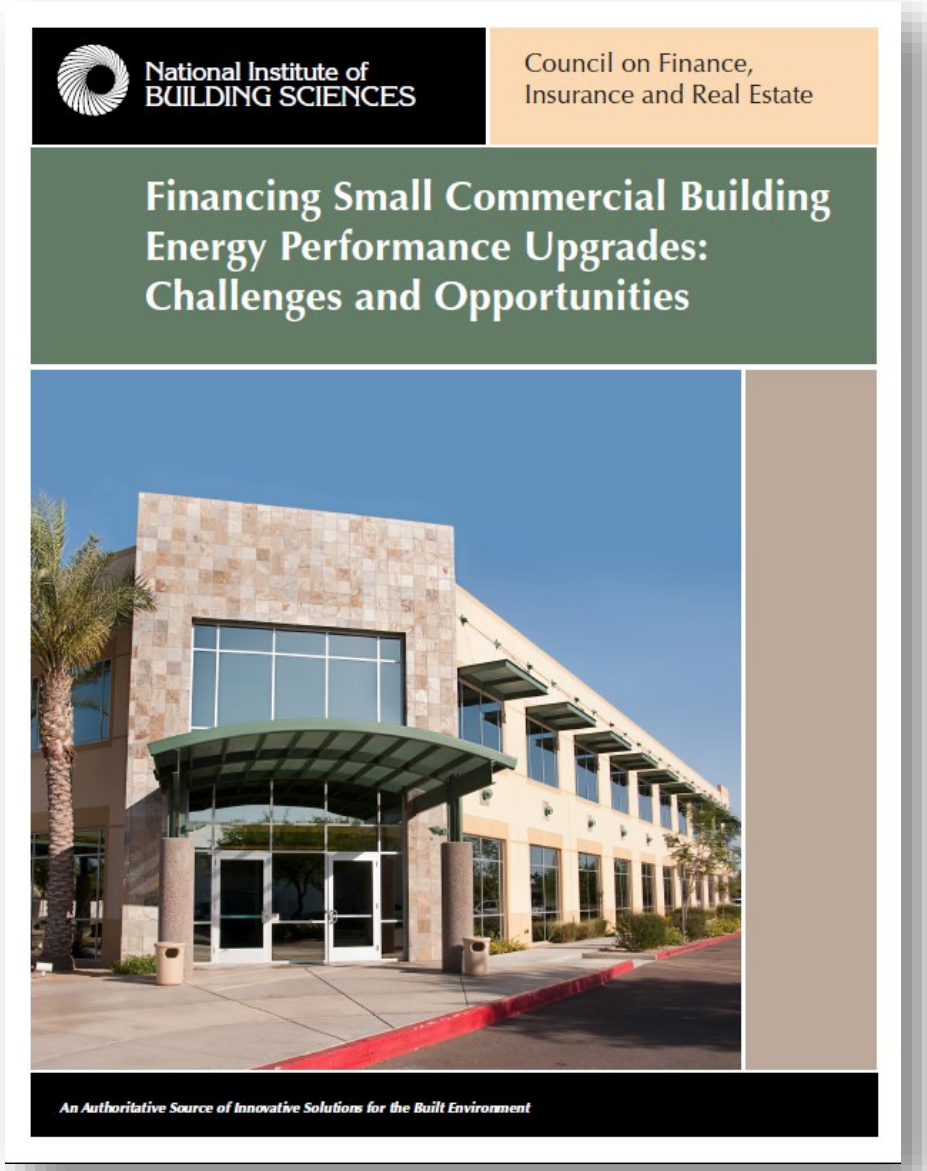
Structures	**93.9%**
Square Footage	**49.5%**

Source: Energy Information Administration, "2012 CBECS Preliminary Results," June 2014, http://www.eia.gov/consumption/commercial/reports.cfm

Variations in Today's Building Stock



Source: U.S. Energy Information Administration, 2012 Commercial Buildings Energy Consumption Survey



Estimated Energy Retrofit Market Opportunity

	Total	Commercial Buildings	Small Commercial Buildings[1]
Investment ($billion)	$279	$72	$35.64
Energy Savings (trillion BTUs)	3033	848	419.76
Energy Savings (10 years, $ billion)[2]	1000	$279.6	$138.4
Cumulative Job Years (thousand FTEs)	3305	857	424.2
GHG Reductions (million metric tons CO_2/year)	616	175	86.6

Sources:
Fulton Mark, et al., *United States Building Energy Efficiency Retrofits, Market Sizing and Financing Models*, DB Climate Change Advisors, Deutsche Bank Group, March 2012, pp. 3, 7
U.S. Energy Information Administration, "2012 CBECS Preliminary Results," June 2014, http://www.eia.gov/consumption/commercial/reports.cfm

Notes:
1. Small commercial building share estimated at 49.5% of commercial building share, per 2012 CBECS preliminary results.
2. Commercial energy savings in dollars derived from the ratio of commercial Btu savings to total BTU savings.

National Institute of Building Sciences Council on Finance, Insurance and Real Estate. 2015. "Financing Small Commercial Building Energy Performance Upgrades: Challenges and Opportunities." https://www.nibs.org/resource/resmgr/CC/CFIRE_CommBldgFinance-Final.pdf.

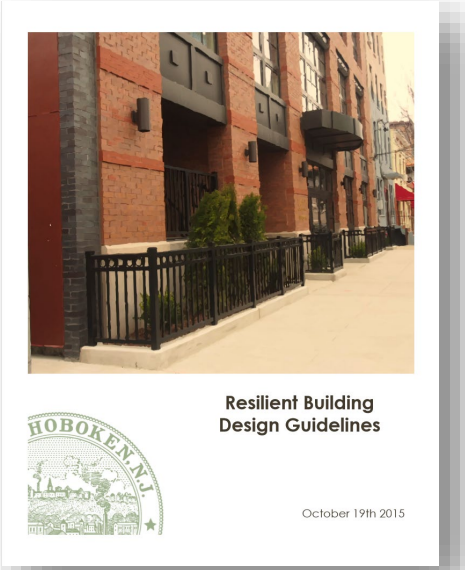
The Intersection of Energy Efficiency & Resilience

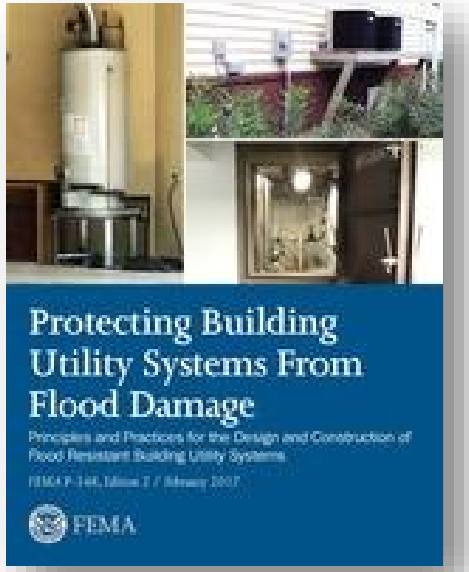
Table ES1. Resilience benefits of energy efficiency

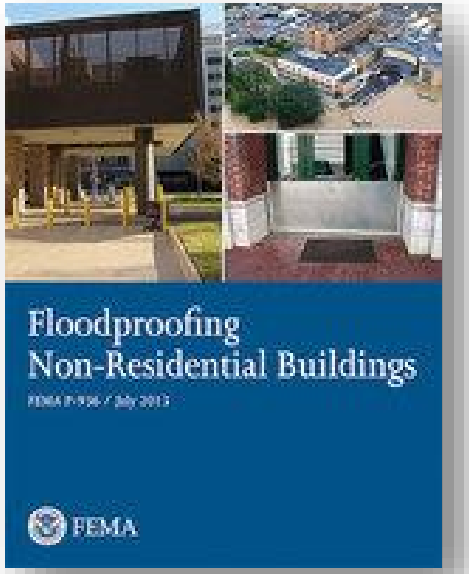
Benefit type	Energy efficiency outcome	Resilience benefit
Emergency response and recovery	Reduced electric demand	Increased reliability during times of stress on electric system and increased ability to respond to system emergencies
	Backup power supply from combined heat and power (CHP) and microgrids	Ability to maintain energy supply during emergency or disruption
	Efficient buildings that maintain temperatures	Residents can shelter in place as long as buildings' structural integrity is maintained.
	Multiple modes of transportation and efficient vehicles	Several travel options that can be used during evacuations and disruptions
Social and economic	Local economic resources may stay in the community	Stronger local economy that is less susceptible to hazards and disruptions
	Reduced exposure to energy price volatility	Economy is better positioned to manage energy price increases, and households and businesses are better able to plan for future.
	Reduced spending on energy	Ability to spend income on other needs, increasing disposable income (especially important for low-income families)
	Improved indoor air quality and emission of fewer local pollutants	Fewer public health stressors
Climate mitigation and adaptation	Reduced greenhouse gas emissions from power sector	Mitigation of climate change
	Cost-effective efficiency investments	More leeway to maximize investment in resilient redundancy measures, including adaptation measures

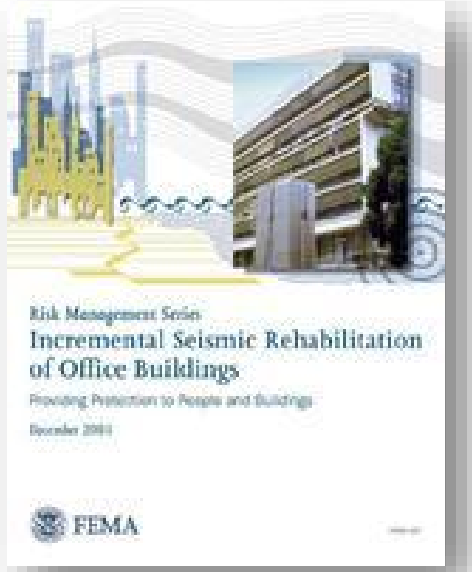
ACEEE, *Enhancing Community Resilience through Energy Efficiency*, 2015

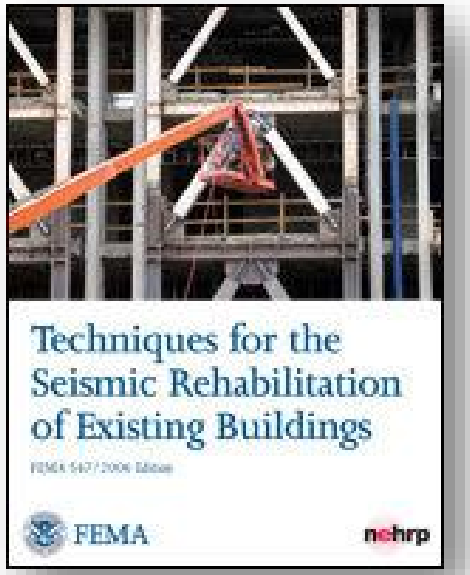
Existing Resources



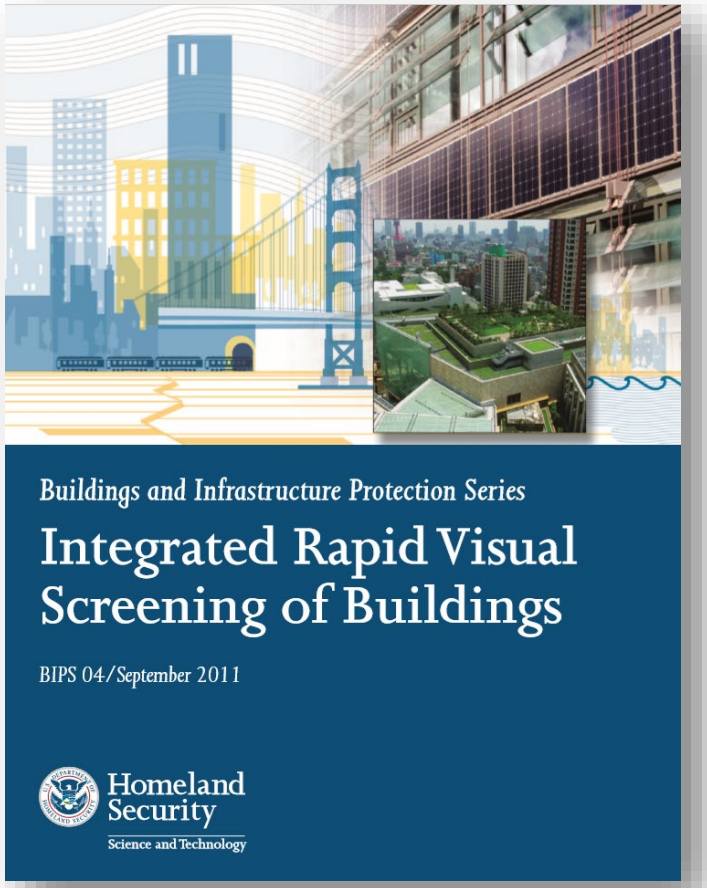






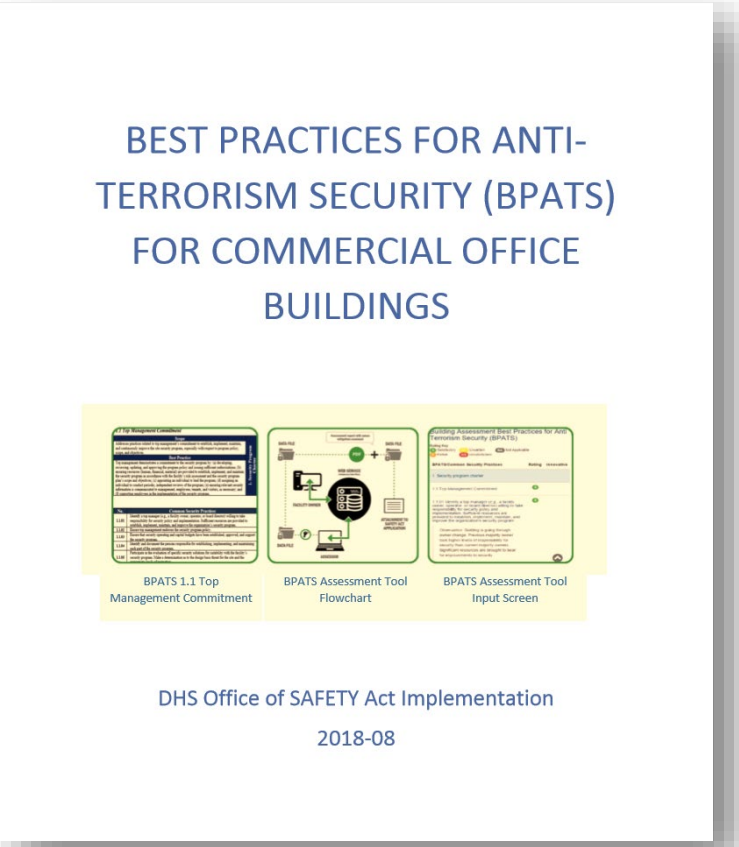


Tools to Assess Risk, Identify Recommendations



- Allows the prioritization of inventories of facilities based on risk, resilience and potential resource needs
- A convenient way to test mitigation measures implemented or planned
- Can support other more thorough assessments
- Dramatic reductions in facility assessment costs, time, and expertise constraints
- Expected to save millions of dollars to the public and private sectors

Tools to Assess Risk, Identify Recommendations



- Best Practices for Anti-Terrorism Security (BPATS) for commercial office buildings
- Evaluate various components of building security including access control, risk awareness, physical security, IT security and more.
- The guide spans seven categories, 411 best practices and approximately 60 associated common practices.

High-Performance Buildings Defined

High-Performance building means a building that integrates and optimizes on a life-cycle basis all major high-performance attributes, including energy [and water] conservation, environment, safety, security, durability, accessibility, cost-benefit, productivity, sustainability, functionality, and operational considerations.

-Energy Independence and Security Act of 2007 §401 (PL 110-140)

Public Law 93-383
93rd Congress, S. 3066
August 22, 1974

An Act

To establish a program of community development block grants, to amend and extend laws relating to housing and urban development, and for other purposes.

Be it enacted by the Senate and House of Representatives of the United States of America in Congress assembled. That this Act may be cited as the "Housing and Community Development Act of 1974".

Housing and Community Development Act of 1974.
42 USC 5301 note.

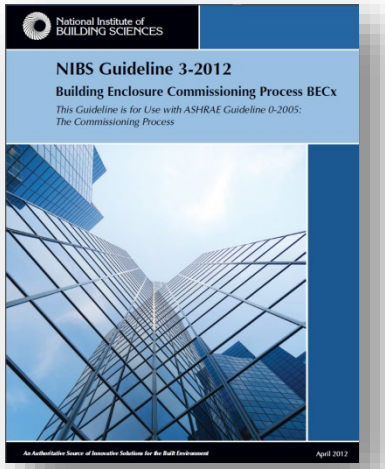
NATIONAL INSTITUTE OF BUILDING SCIENCES

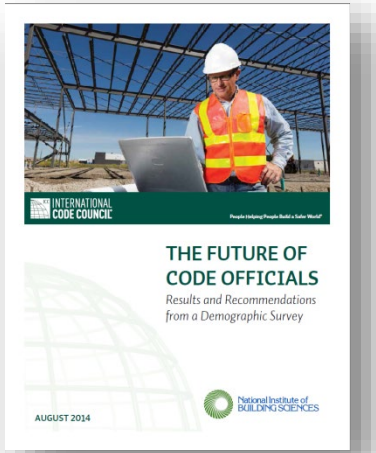
12 USC 1701j-2.

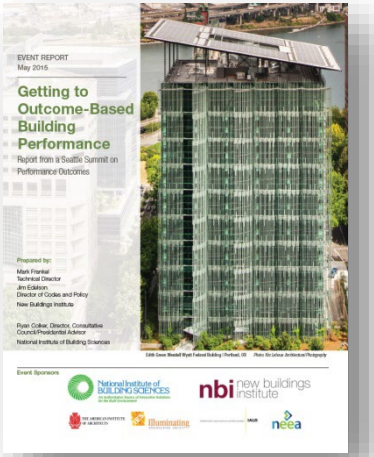
SEC. 809. (a)(1) The Congress finds (A) that the lack of an authoritative national source to make findings and to advise both the public and private sectors of the economy with respect to the use of building science and technology in achieving nationally acceptable standards and other technical provision for use in Federal, State, and local housing and building regulations is an obstacle to efforts by and imposes severe burdens upon all those who procure, design, construct, use, operate, maintain, and retire physical facilities, and frequently results in the failure to take full advantage of new and useful developments in technology which could improve our living environment; (B) that the establishment of model buildings codes or of a single national building code will not completely resolve the problem because of the difficulty at all levels of government in updating their housing and building regulations to reflect new developments in technology, as well as the irregularities and inconsistencies which arise in applying such requirements to particular localities or special local conditions; (C) that the lack of uniform housing and building regulatory provisions increases the costs of construction and thereby reduces the amount

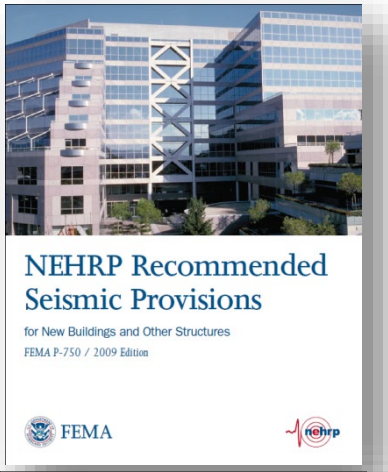
National Institute of BUILDING SCIENCES

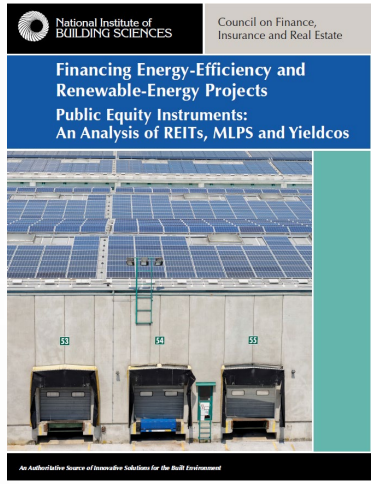
An Authoritative Source of Innovative Solutions for the Built Environment





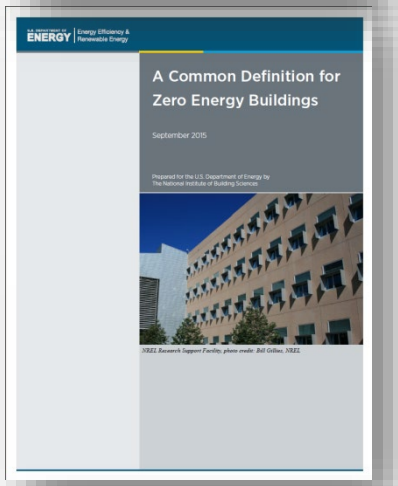




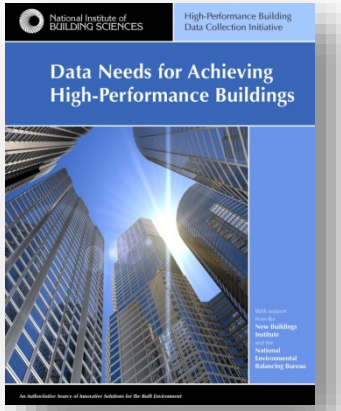


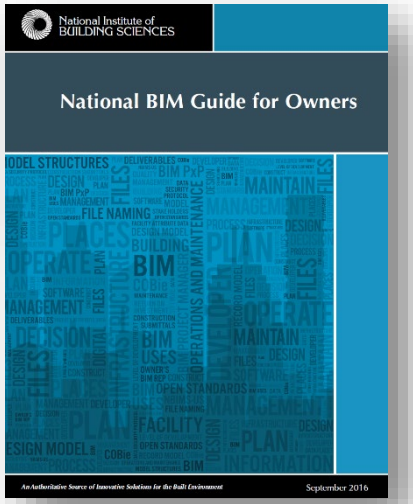
COBie

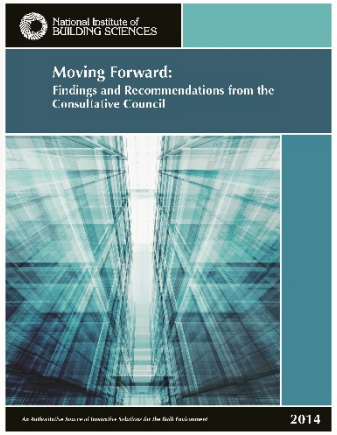
BUILDING INNOVATION 2016
National Institute of BUILDING SCIENCES CONFERENCE & EXPO
ACHIEVING A RESILIENT FUTURE

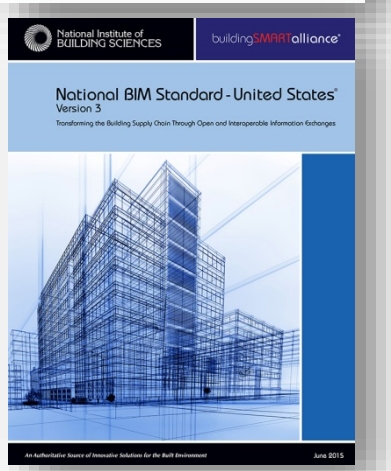


WBDG
WHOLE BUILDING DESIGN GUIDE









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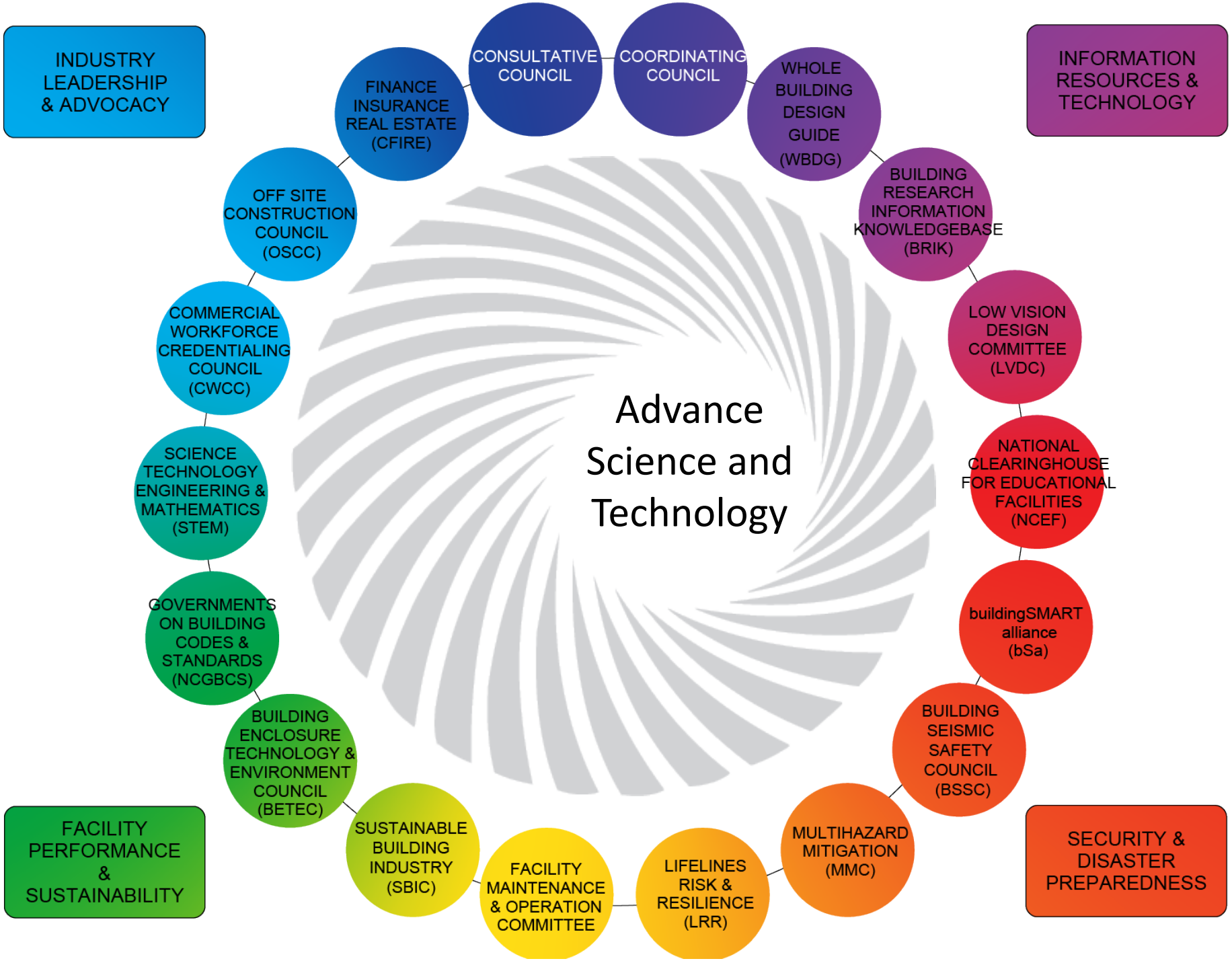
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OFF SITE CONSTRUCTION COUNCIL (OSCC)
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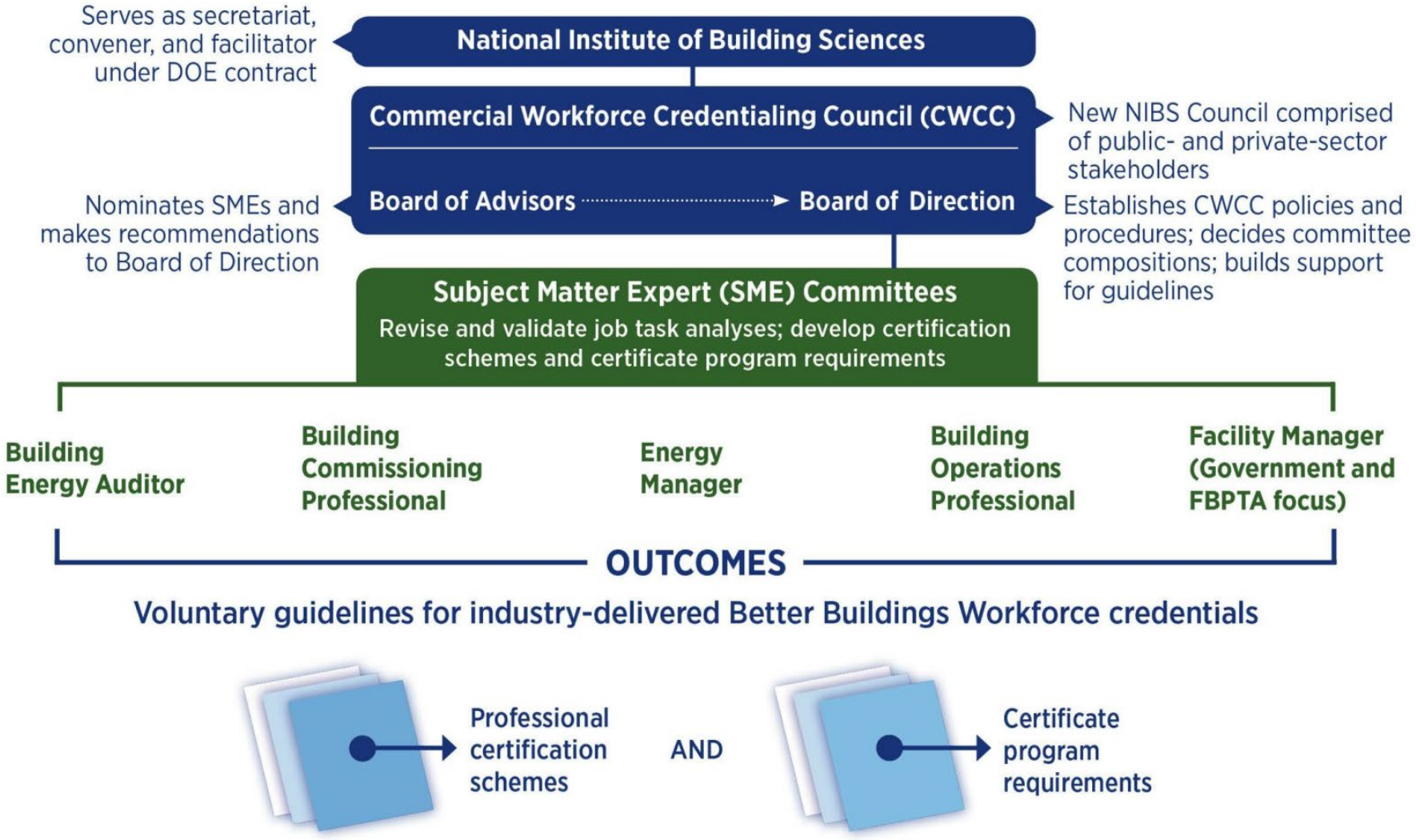
BUILDING RESEARCH INFORMATION KNOWLEDGEBASE (BRIK)
LOW VISION DESIGN COMMITTEE (LVDC)
NATIONAL CLEARINGHOUSE FOR EDUCATIONAL FACILITIES (NCEF)
buildingSMART alliance (bSa)
SECURITY & DISASTER PREPAREDNESS
BUILDING SEISMIC SAFETY COUNCIL (BSSC)
MULTIHAZARD MITIGATION (MMC)
LIFELINES RISK & RESILIENCE (LRR)
FACILITY MAINTENANCE & OPERATION COMMITTEE
SUSTAINABLE BUILDING INDUSTRY (SBIC)
BUILDING ENCLOSURE TECHNOLOGY & ENVIRONMENT COUNCIL (BETEC)
GOVERNMENTS ON BUILDING CODES & STANDARDS (NCGBCS)
FACILITY PERFORMANCE & SUSTAINABILITY

Developing a Competent Workforce



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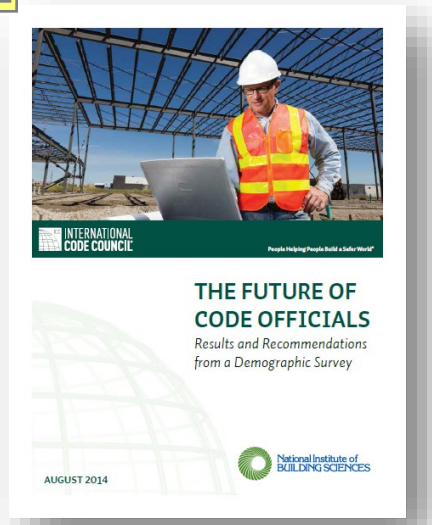
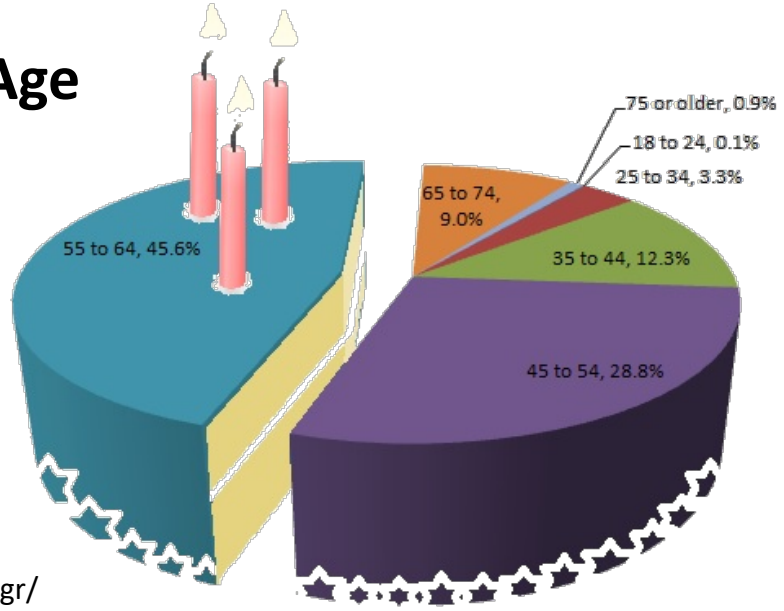
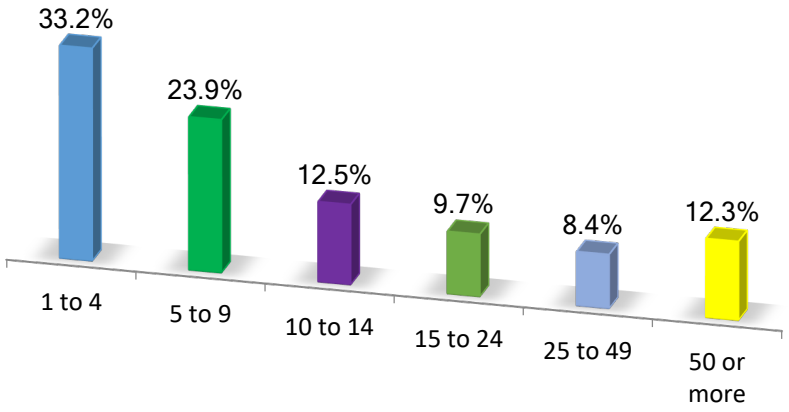


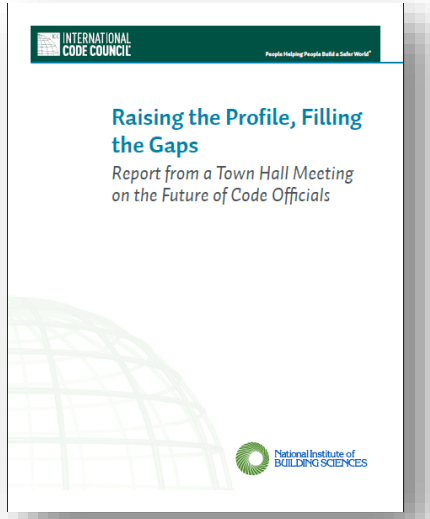
http://www.nibs.org/resource/resmgr/ncgbcs/future-of-code-officials.pdf

Age



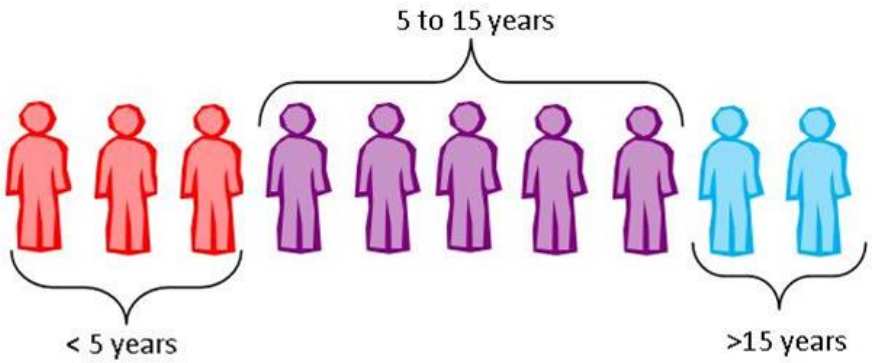
Department Size



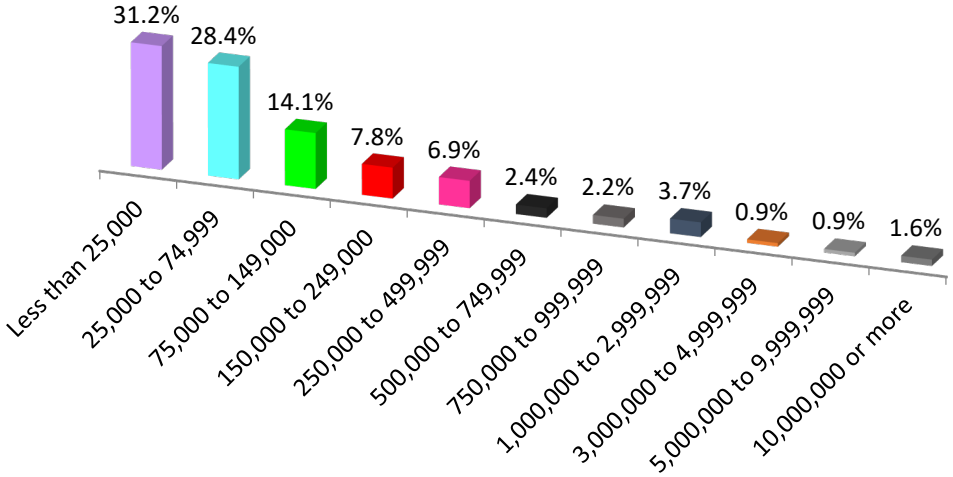


http://www.nibs.org/resource/resmgr/Docs/Final_Rprt_Future_of_Cde_Off.pdf

Retirement Plans



Community Size



Advancing Resilience

U.S. RESILIENCY COUNCIL
EARTHQUAKE 2009
Safety ★★★★★
Damage ★★★★★
Recovery ★★★★★
PLATINUM

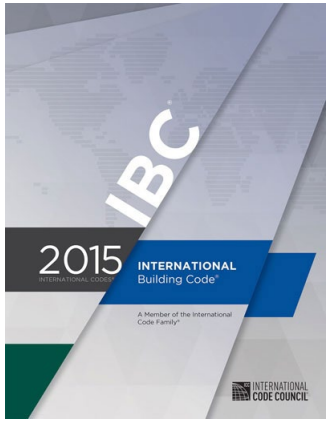
FORTIFIED for Safer Living®

LEADERSHIP IN ENERGY & ENVIRONMENTAL DESIGN
LEED

Alliance for National & Community Resilience

PERFORMANCE EXCELLENCE IN ELECTRICITY RENEWAL

RELi



RESILIENCE-BASED DESIGN INITIATIVE
REDi

ENVISION™

The Importance of Community-Level Resilience Illustrated

Galveston Texas, Post-Ike

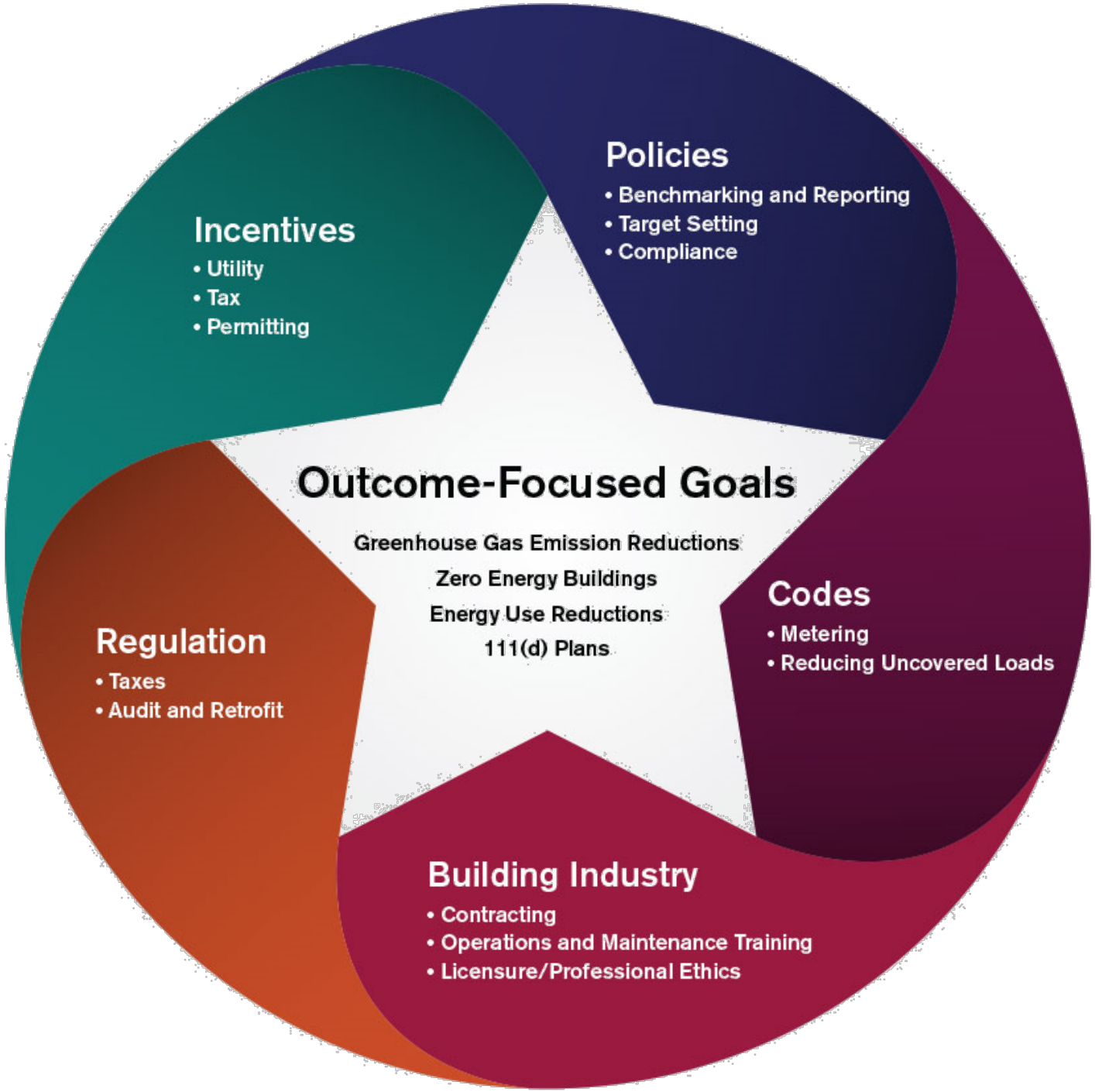
NYC, Post-Sandy

Functions in Communities

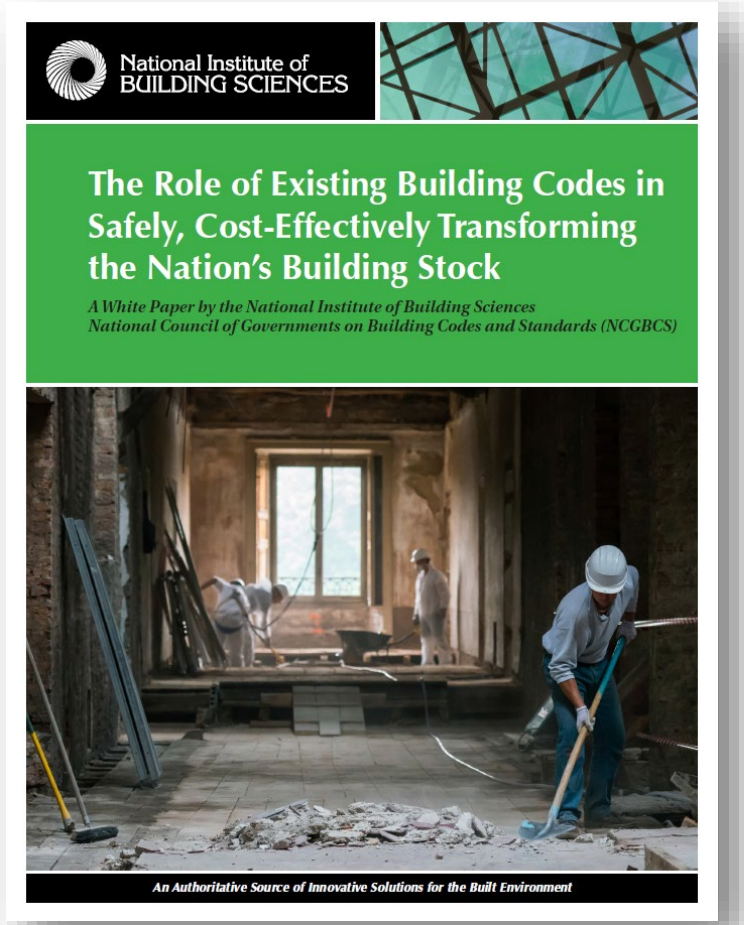
Social
Neighborhoods; Communications; Culture and Recreation; Education and Training

Infrastructure
Natural Environment; Transportation; Water; Energy; Solid Waste; Food; Buildings; Communications Infrastructure

Organizations
Local Government; Public Safety and Security; Public Health and Healthcare; Business; Finance; Governance


Policies
• Benchmarking and Reporting
• Target Setting
• Compliance
Incentives
• Utility
• Tax
• Permitting
Outcome-Focused Goals
Greenhouse Gas Emission Reductions
Zero Energy Buildings
Energy Use Reductions
111(d) Plans
Codes
• Metering
• Reducing Uncovered Loads
Regulation
• Taxes
• Audit and Retrofit
Building Industry
• Contracting
• Operations and Maintenance Training
• Licensure/Professional Ethics

The Role of Existing Building Codes



Existing buildings define the main streets and the skylines of the nation's communities. Yet, as these communities evolve to address changes in their economy and populations, they don't always have the mechanisms in place to assure the safety and security of their citizens while providing building owners and developers a cost-effective means for updating the existing building stock to meet changing needs. Existing building codes provide just such a mechanism.

Traditional vs. Performance Based Procurement

	PLANNING	RFP	DESIGN	CONSTRUCTION	OPERATIONS
Current practice	Little or no interaction	Respond to RFP Prepare contracts	Design building, fit energy utilization into design	On-site inspections	Program incentive paid
Energy performance-based procurement	Concept modeling Establish energy requirements Prepare RFP	Interact with A&Es to ensure RFP compliance Respond to RFP Prepare contracts Review submittal	Build RFP requirements into design Review design team submittals	On-site inspections Conduct measurement & verification on site Compare to RFP requirements	Program incentive paid Realize high performing building

Seventhwave, Accelerate Performance, http://www.seventhwave.org/accelerateperformance/about

WBDG a program of the National Institute of Building Sciences
WHOLE BUILDING DESIGN GUIDE

ABOUT | SITE MAP | CONTACT | CREATE ACCOUNT | LOG IN | SEARCH WBDG

DESIGN RECOMMENDATIONS | PROJECT MANAGEMENT - O & M | FEDERAL FACILITY CRITERIA | CONTINUING EDUCATION | ADDITIONAL RESOURCES

RESOURCE PAGES / OUTCOME-BASED PATHWAYS FOR ACHIEVING ENERGY PERFORMANCE GOALS

OUTCOME-BASED PATHWAYS FOR ACHIEVING ENERGY PERFORMANCE GOALS

by Ryan M. Colker
Sustainable Buildings Industry Council
Updated: 10-31-2017

INTRODUCTION

Policymakers and the public are increasingly interested in reducing energy use. Whether due to a desire to reduce costs, greenhouse gas emissions, or imported energy, achieving these goals will depend on actual and measurable results. Numerous approaches exist to reduce energy use. Model energy codes provide baseline requirements (where adopted). Green building programs provide additional guidance. Benchmarking and companion operations and maintenance practices along with ongoing commissioning also support achievement of performance goals. (See also Meet Performance Objectives; Optimize Energy Use; Building Commissioning; Optimize Operational and Maintenance Practices.)

WITHIN THIS PAGE

- Introduction
- Additional Resources

MODEL ENERGY CODES AND PERFORMANCE

Current model energy codes and standards only provide criteria prescribing how buildings are to be designed and constructed. The provisions in virtually all energy codes and standards are based on a number of prescribed criteria that must be satisfied by specific products, materials and components of a building. Unfortunately, many of those criteria do not account for the application of new technologies such as innovative window materials or creative design approaches such as passive solar, building form and shape, and orientation. Current codes also do not cover all the energy consuming functions in a building, even though these functions contribute to the overall energy use and influence the energy use of equipment covered under the code. Plug and process loads, and elevators and escalators generally are not included. In California, for instance, plug loads account for about 40% of overall energy use in buildings—closer to 65% in hospitals and restaurants.[1]

The closest these documents come to actual performance of a building is a simulation of how a building as designed is expected to perform compared to the same identical building but assumed to just meet the provisions in the code. In effect, this creates a custom energy budget for

National Institute of BUILDING SCIENCES

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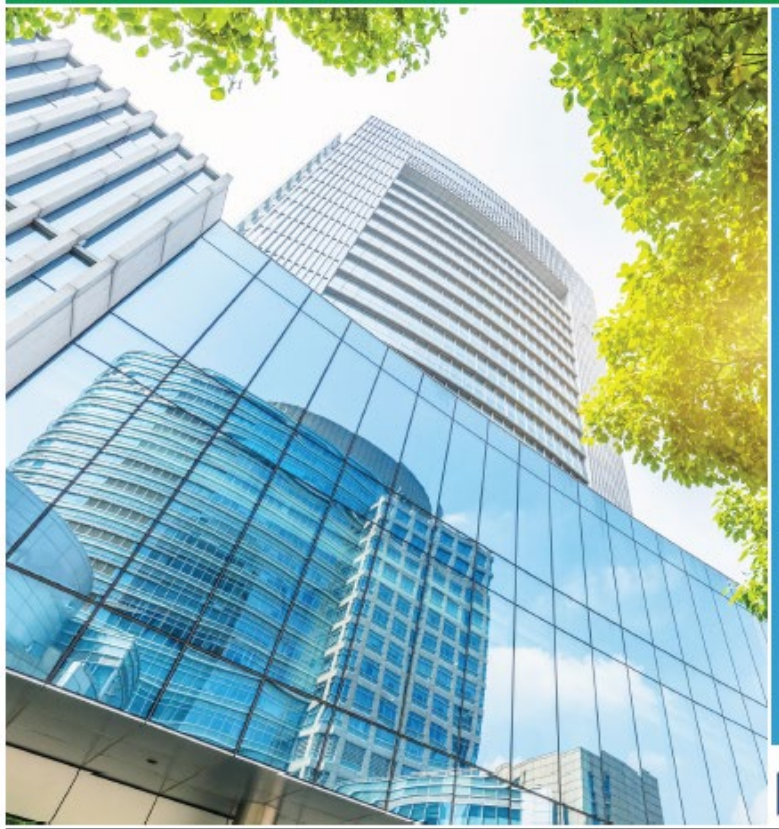
Implementing an Outcome-Based Compliance Path in Energy Codes: Guidance for Cities



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October 2017

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RESOURCE PAGES / BUILDING SYSTEMS EFFICIENCY

BUILDING SYSTEMS EFFICIENCY

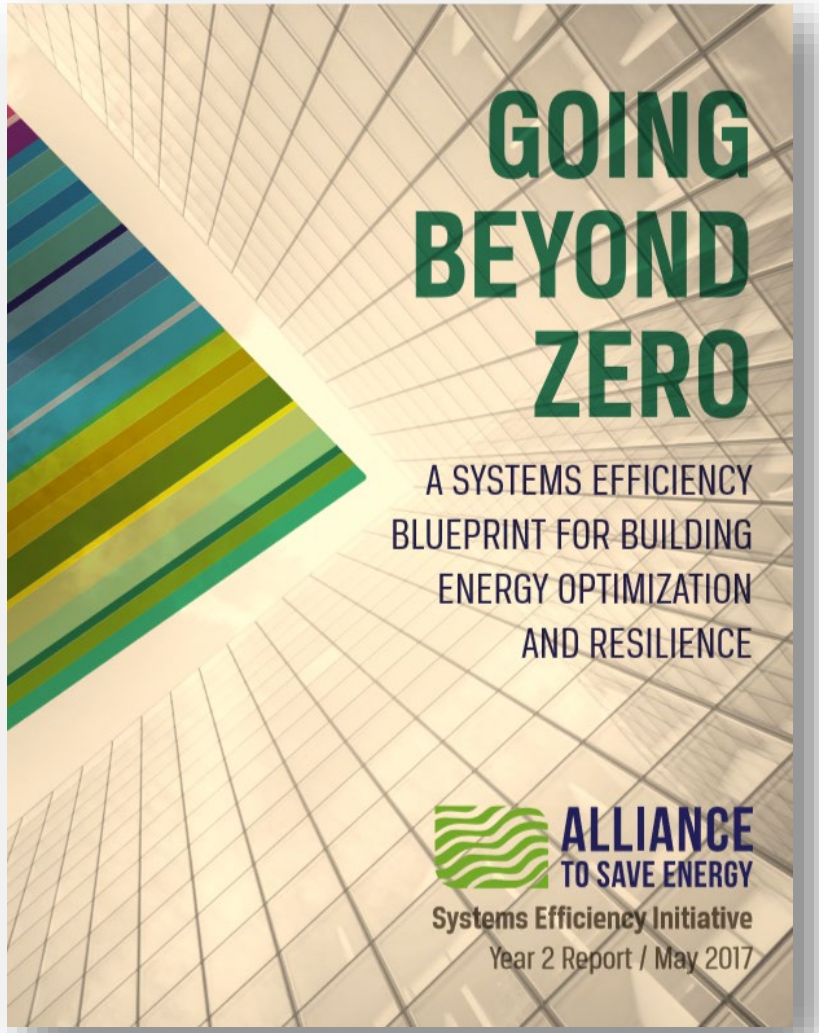
by the Alliance to Save Energy
Updated: 03-29-2018

INTRODUCTION

Much progress has been made on improving building energy efficiency over the past decades by focusing on the efficiency of individual building components (i.e., appliances and equipment) and, more recently, the efficiency of the building as a whole. As a middle ground between component and whole-building efficiency, a building systems approach considers the interactions of components within and among building systems, as well as interactions among multiple buildings, and between the building and the electric grid. Adopting a systems perspective will become increasingly necessary to achieve meaningful and cost-effective future energy savings within the built environment.

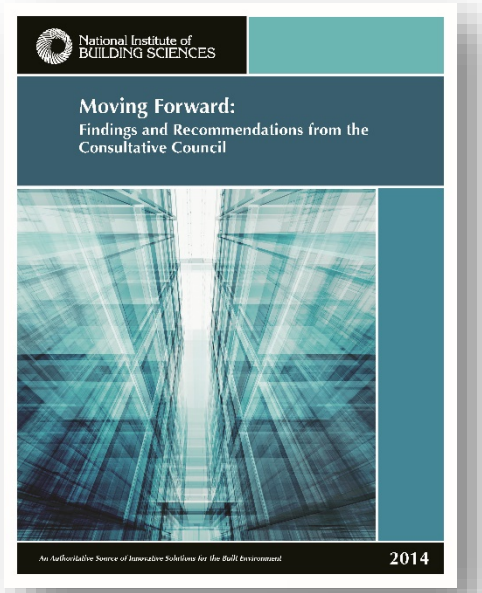
WITHIN THIS PAGE

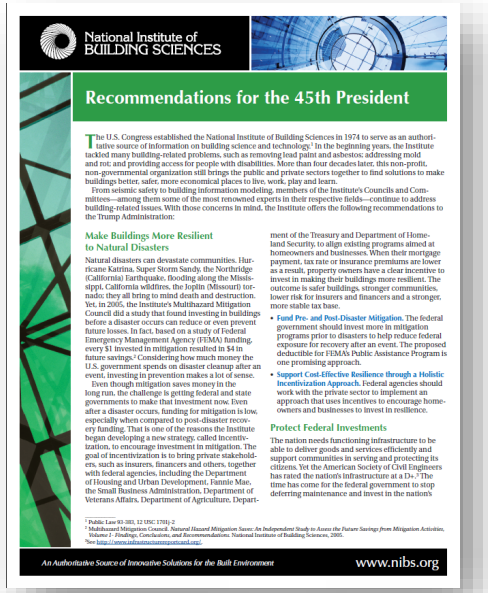
In addition to improving energy performance, a systems approach has the potential to achieve significant non-energy benefits: reduced carbon emissions (commercial buildings alone account for about 18 percent of direct and indirect greenhouse gas emissions), improved grid reliability, water savings, and extended equipment life and increased occupant comfort and productivity. The quantifiable non-energy benefits have been estimated to range from 25 to 50 percent of the total benefits of energy efficiency across all sectors.

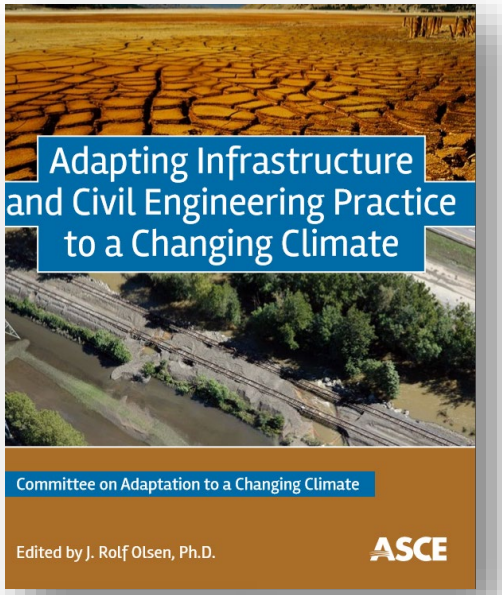


An Emerging Resilience Issue

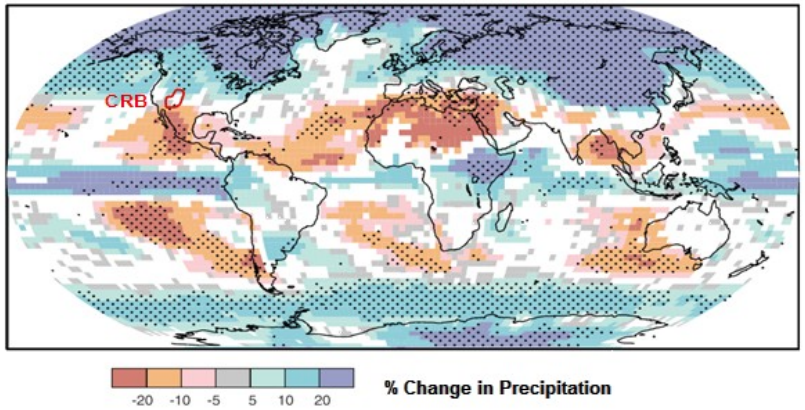
Designing for Future Risks

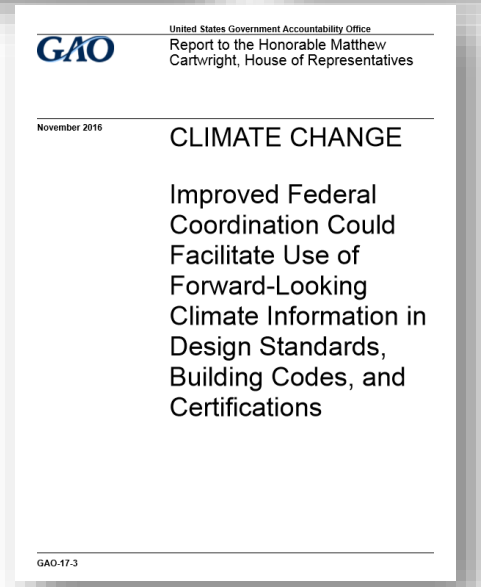


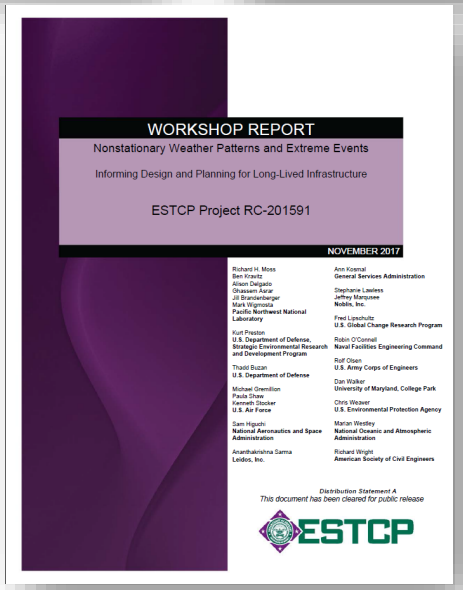




Multi-model projected patterns of precipitation changes







Retrofit for Resilience: Preparing Communities for Hazards

RETROFIT Conference 2018
Charlotte

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