National Institute of BUILDING SCIENCES™
Innovative Solutions for the Built Environment

Mitigation Saves:
Earthquake Requirements Save $12 for Each $1 Invested

EVERY AMERICAN FACES NATURAL HAZARDS, AND THE RISK IS GROWING

U.S. disaster losses from wind, floods, earthquakes, and fires now average $100 billion per year, and in 2017 exceeded $300 billion—25% of the $1.3 trillion building value put in place that year. Fortunately, there are affordable and highly cost-effective strategies that policymakers, building owners, and the building industry can deploy to reduce these impacts. These strategies include adopting and strengthening building codes, upgrading existing buildings, and improving utilities and transportation systems. The benefits and costs associated with these mitigation measures have been identified through the most exhaustive benefit-cost analysis of natural hazard mitigation to date and documented in Natural Hazard Mitigation Saves. The study was funded by three federal agencies and four private-sector sponsors and produced by the National Institute of Building Sciences – the nation's Congressionally chartered convener of experts from the building professions, industry, labor, consumer interests, and government. For the report and accompanying fact sheets, see www.nibs.org/mitigationsaves. This fact sheet summarizes the study findings and significant savings associated with various mitigation measures.

- **Adopting the latest building code requirements is affordable and saves $11 per $1 invested.** Building codes have greatly improved society's disaster resilience, while adding only about 1% to construction costs relative to 1990 standards. The greatest benefits accrue to communities using the most recent code editions.
- **Above-code design could save $4 per $1 cost.** Building codes set minimum requirements to protect life safety. Stricter requirements can cost-effectively boost life safety and speed functional recovery.
- **Private-sector building retrofits could save $4 per $1 cost.** The country could efficiently invest over $500 billion to upgrade residences with 15 measures considered here, saving more than $2 trillion.
- **Lifeline retrofit saves $4 per $1 cost.** Society relies on telecommunications, roads, power, water, and other lifelines. Case studies show that upgrading lifelines to better resist disasters helps our economy and society.
- **Federal grants save $6 per $1 cost.** Public-sector investment in mitigation since 1995 by FEMA, EDA, and HUD cost the country $27 billion but will ultimately save $160 billion, meaning $6 saved per $1 invested.

National Institute of BUILDING SCIENCES™	ADOPT CODE	ABOVE CODE	BUILDING RETROFIT	LIFELINE RETROFIT	FEDERAL GRANTS
Overall Benefit-Cost Ratio	11:1	4:1	4:1	4:1	6:1
Cost ($ billion)	$1/year	$4/year	$520	$0.6	$27
Benefit ($ billion)	$13/year	$16/year	$2200	$2.5	$160
Riverine Flood	6:1	5:1	6:1	8:1	7:1
Hurricane Surge	not applicable	7:1	not applicable	not applicable	not applicable
Wind	10:1	5:1	6:1	7:1	5:1
Earthquake	12:1	4:1	13:1	3:1	3:1
Wildland-Urban Interface Fire	not applicable	4:1	2:1	not applicable	3:1

TABLE 1. Nationwide average benefit-cost ratio by hazard and mitigation measure. BCRs can vary geographically and can be much higher in some places. Find more details in the report.

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MEETING COMMON CODE REQUIREMENTS FOR EARTHQUAKE

Over the long term, building codes have gradually increased the required strength and stiffness of new buildings to resist earthquakes, along with numerous improvements to structural details. Building strength and stiffness increases on the order of 50% every 30 years in the higher-risk areas in the western United States. Thus, the average West Coast building built today to comply with I-Codes is about 1.5 times as strong and stiff as it would have been under the 1988 Uniform Building Code. The greater strength makes the building less likely to collapse or to be red-tagged in a large earthquake. The greater stiffness makes it less likely to suffer damage to many architectural elements such as walls and windows. These aspects of the 2018 I-Codes save $7 billion in the long term for every year of new buildings built to the code, at a cost of $600 million, producing a benefit-cost ratio of 12:1. Figure 1 shows the sources of these benefits. Figure 2 shows that benefit-cost ratios are highest in high-seismicity areas. Note that in much of the country, wind design forces exceed those for earthquake, so those areas are shown in gray, along with a small portion of Oklahoma where design forces have been raised to better protect people from seismicity associated with deep well injection of fracking waste fluid.

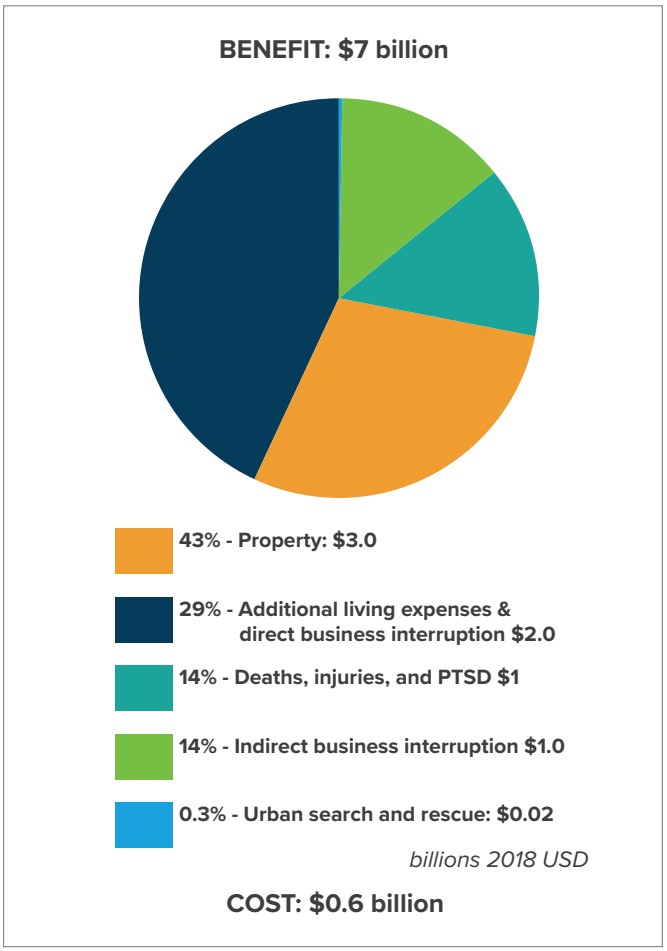

FIGURE 1. Total costs and benefits of new design to comply with 2018 I-Code requirements for earthquake, relative to 1990.

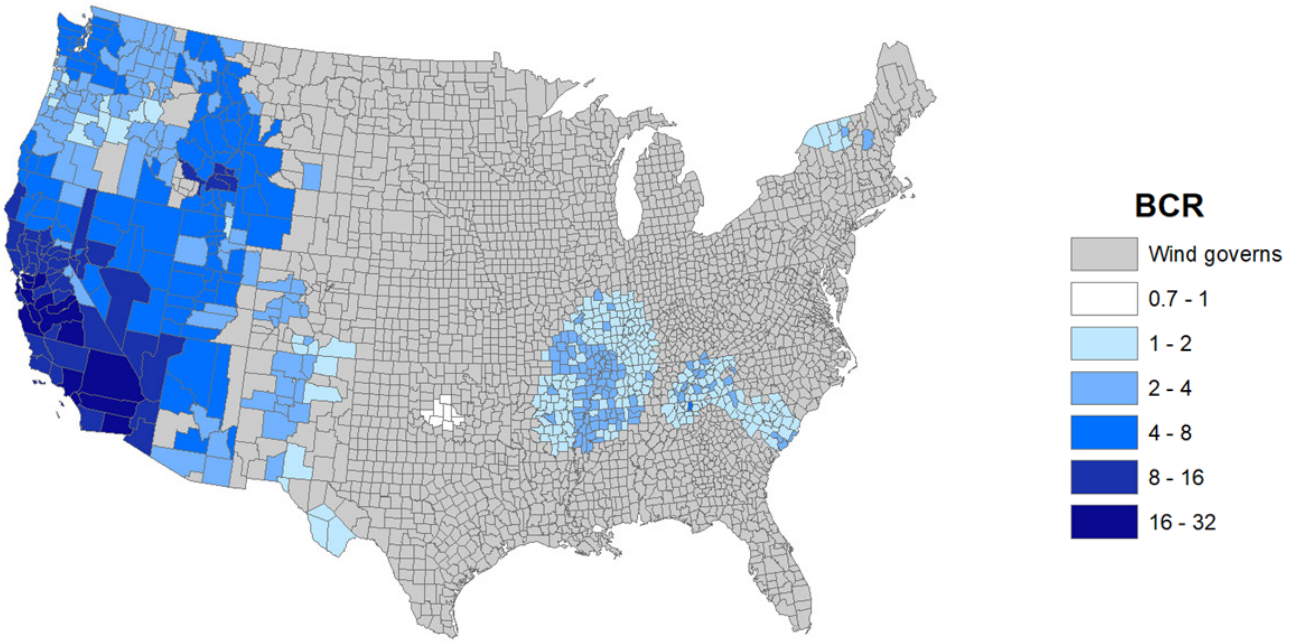

FIGURE 2. Benefit-cost ratios for seismic code compliance are highest in high-seismicity areas.