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

Mitigation Saves: Private-Sector Flood Retrofit Saves $6 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.

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	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.

RETROFITTING PRIVATE-SECTOR BUILDINGS FOR FLOOD COULD SAVE SOCIETY $1.3 TRILLION

Recent code developments require new buildings to have up to 2 feet of freeboard—the difference between the elevation of the lowest floor and that of the floodwaters that have 1% probability of being exceeded in any given year (or just over 50% chance of being exceeded in 75 years). That means buildings that predate modern codes can be much more susceptible to flooding.

More than 1 million older houses currently stand in the 100-year floodplain and are more likely than not to be flooded during their economically useful life. A variety of retrofit measures could make these buildings safer and more efficient to own, meaning that a retrofit investment now would make their long-term cost of ownership lower. A combination of buyouts, elevation projects, and less-expensive modifications to basements, heating, and air conditioning equipment could save society almost $1.3 trillion at a cost of approximately $230 billion—a benefit-cost ratio of $6 saved per $1 invested.

Removing many of these houses from the floodplain and converting their land to open space could avoid almost $1.2 trillion in future losses at a cost of $180 billion—a BCR of over 6:1. It is practical to raise many of these buildings to have a taller foundation (called elevation retrofits). Doing so could save society $84 billion at a cost of $43 billion: $2 saved per $1 invested.

A less-expensive measure called wet floodproofing, which involves the removal of damageable finishes and contents from basements, could prevent $7.7 billion in future losses at a cost of $3.2 billion, saving over $2 per $1 invested. Elevating air conditioning equipment and ductwork above the 100-year flood elevation could save $1.1 billion at a cost of $700 million, a 2:1 benefit-cost ratio. And elevating heaters and furnaces could save $2.7 billion at a cost of $1.2 billion, another 2:1 BCR. Figure 1 shows the sources of these benefits, totaling over the five private-sector flood retrofit options considered here, and rounding slightly to avoid the appearance of excessive accuracy.

The total number of older buildings in the floodplain is uncertain. It could be much greater than 1 million, in which case the dollar figures presented here would increase in proportion.

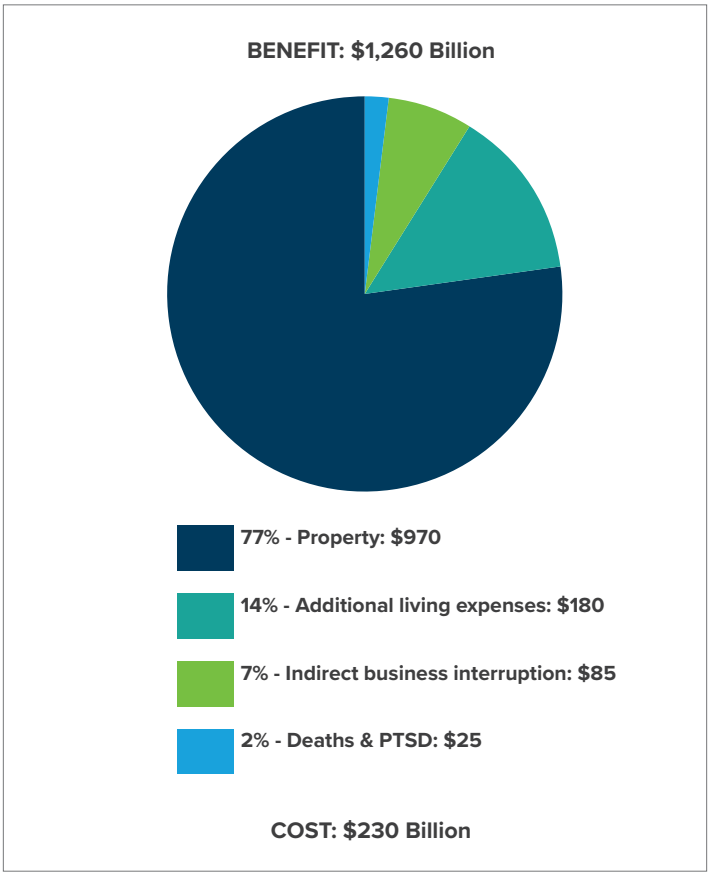

FIGURE 1. Total costs and benefits of private-sector retrofit options