America's Growing Disaster Liability, 2023 Update

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U.S. DISASTERS COST $120 BILLION PER YEAR

The National Centers for Environmental Information (2023) reports that the United States averages 14 to 18 floods, wildfires, and other natural disasters per year, each costing more than $1 billion. Figure 1 shows that the 3-year running average annual loss has reached $150 billion in inflation-adjusted 2023 US dollars. In 2022, the U.S. added $1.8 trillion in new construction (U.S. Census Bureau 2023a). Disasters effectively wipe out 8% of annual new construction, or about 1 month of every year's new construction.

LOSS GROWS 5X CONSTRUCTION GROWTH

A curve fit to the annual loss data shows an average annual increase of 6%, doubling every 11 years. That growth rate exceeds by five times the growth of inflation-adjusted construction spending (US Census Bureau 2023), so disasters are eating up an ever-growing portion of construction spending. Losses are also increasing more than twice as fast as real gross domestic product (Bureau of Economic Analysis 2023), and 10 times the population's 0.6% annual growth rate since 2010 (Macrotrends 2023). Growing productivity will not counter-balance the growth in disaster losses.

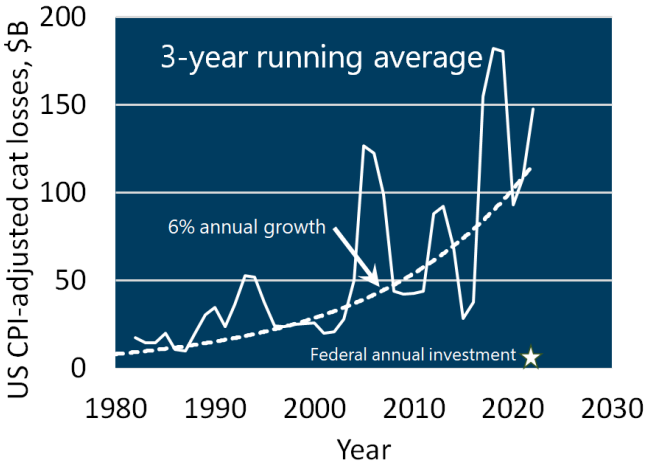

Figure 1. U.S. natural disaster losses grow 6% per year

WHY DISASTER LOSSES GROW SO FAST

New buildings *should* be more resilient than older ones. The National Institute of Building Sciences' *Natural Hazard Mitigation Saves* study estimates that one year of new buildings built to current code will suffer $13 billion less loss over their lifetime than if they had been built to 1990 era codes (Multi-Hazard Mitigation Council 2019). The federal government spends about $1 billion yearly to mitigate risk to existing buildings, preventing $6 billion in future losses (Federal Emergency Management Agency n.d.). Then why are losses growing at all?

DEMOGRAPHICS, CLIMATE PARTLY TO BLAME

The answer lies partly in *where* we build. Changnon et al. (2000) and Bouwer (2011) found that population growth and movement toward higher-hazard places are the major factors driving up losses from weather–climate extremes (e.g., Figure 2). Höppe and Grimm (2008) suggest climate change worsens the problem.

Figure 2. Hurricane Harvey caused $125 billion loss to Houston and southeast Texas. Houston's population is growing faster than all but two metropolitan areas. (Image: public domain)

FEDERAL SPENDING HELPS BUT NOT ENOUGH

Natural Hazard Mitigation Saves suggests two more factors. First, the existing problem dwarfs public mitigation budgets. Although the U.S. government invests $1 billion annually in mitigation, America's

Disasters destroy the equivalent of 1 month of new U.S. construction per year. Disaster losses double every 11 years, growing faster than construction spending, gross domestic product, and population. They will eat up an ever-larger fraction of annual construction. America is not fixing the problem.

resilience investment gap exceeds $520 billion. That is, the country could cost-effectively spend at least $520 billion to reduce its disaster liability by $2.2 trillion (Multi-Hazard Mitigation Council 2019). The Multi-Hazard Mitigation Council did not consider some high-value problematic building types such as older steel-frame buildings, so the $520 billion is a lower bound. The total investment gap and potential savings could be many times those figures.

NEW BUILDINGS NOT OPTIMALLY RESILIENT

Second, new construction adds to the liability. We design to assure life safety and to minimize initial construction cost without counting the later life-cycle costs. Doing so adds $16 billion annually to America's long-term disaster liability that could be cost effectively avoided by spending $4 billion for above-code design. This happens largely because initial owners and tenants enjoy only a small part of long-term resilience benefits but bear all the up-front cost. Without demand from owners, developers compete in a market with existing construction, so every $1 more cost means $1 less profit. Their profit motive favors code-minimum design, even though the rest of society and future generations subsidize that savings by 4:1.

7,500 SF ADDED PER 1,500 SF REMOVED

Even though code-minimum construction is sub-optimal from an economic perspective, *Natural Hazard Mitigation Saves* shows that new buildings are more efficient than those of 30 years ago, saving $11 in future losses per $1 in added construction cost. Shouldn't replacement of new buildings for old *reduce* the total liability? Yes, but only if each new building replaced one old one. But construction outpaces demolition by about 3 new houses per 1 demolished (Yun 2016). Those new houses are larger: 2,500 square feet on average versus 1,500 square feet 40 years ago (US Census Bureau 2023b). Assuming the same trends for non-residential buildings, America's disaster liability grows partly because we add 7,500 square feet of new safe but not optimally resilient buildings for every 1,500 square feet of old buildings demolished, and the newer ones tend to be in higher-hazard areas (Figure 3).

RESILIENCE OPTIONS AND INCENTIVES

Natural Hazard Mitigation Saves presents simple design improvements that minimize societal total cost of ownership. These vary by peril, but include greater strength, stiffness, and elevation, better detailing, and more fire-resistant materials. The National Institute of Standards and Technology (2019) is developing options to improve the speed with which some buildings can be re-occupied after earthquakes, but the goal is not explicitly aimed at reducing the growth in disaster losses or minimizing society's long-term ownership cost.

Figure 3. America adds about 7,500 square feet of new construction per 1,500 of old buildings removed (Images: top: D. Disponett, 2019, Pexels license; bottom: Porter)

Who will pay for the improvements, especially for existing infrastructure? The Institute for Catastrophic Loss Reduction is working with the National Institute of Building Sciences with Fannie Mae to design financial incentives that more equitably allocate resilience costs among building stakeholders who enjoy resilience benefits, including lenders, insurers, owners, tenants, and local, state, and federal governments. The process is called resilience incentivization; contact us to learn more.

CONCLUSIONS

U.S. natural disaster losses are growing about $7 billion per year, for at least four reasons: (1) people are moving to higher hazard areas; (2) public expenditures to reduce natural-hazard losses are small compared with the size of the problem; (3) the nation adds five times as much new building area as it removes; and (4) new buildings are not optimally resilient, adding $16 billion per year in future catastrophe losses that could be cost-effectively avoided. To reverse the growth of natural-hazard losses will require a change to one or more of these factors: development farther from high-hazard areas; greater investment to reduce disaster liability; more old property removed per new construction added; or more-resilient new construction. Code improvements and resilience incentivization could help to reverse the growth in America's disaster liability.

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About the author

Keith Porter, PE, PhD is chief engineer of the Institute for Catastrophic Loss Reduction and adjunct research professor at the University of Colorado Boulder and Western University. He served as principal investigator of *Natural Hazard Mitigation Saves* and led the engineering of the USGS's ShakeOut, ARkStorm, Tsunami, and HayWired scenarios. He helps people understand, measure, manage, and reduce risk from earthquakes, hurricanes, floods, fires, and other natural disasters.