Why Resiliency Matters

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President

Building Innovation 2018, Washington, D.C.

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Thornton Tomasetti

Contents

- What makes an Enduring/Resilient Organization
    - A little bit about Thornton Tomasetti
- Change, Innovation, Forward Thinking
    - Some illustrative projects
- The Case for Resiliency
- The Ostrich Paradox

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Our Core Ideology

1. Purpose…Why we exist
2. Values…How we pursue our purpose
3. Our Big Goal…What we aim to achieve
4. Our Envisioned Future…The firm we want to create
5. Our Enduring Organization…How we will get there

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Purpose

We embrace challenges to make lasting contributions.

Core Values

1. We are passionate about what we do.
2. We see opportunity where others focus on risk.
3. We look beyond the obvious to solve the real problem.
4. We challenge people to grow.

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Our Big Goal

To be the global driver of change and innovation in our industry

Our Envisioned Future

We are the trusted partner

We are small in our bigness

We are a learning organization

We are a team

We bet the farm on innovation

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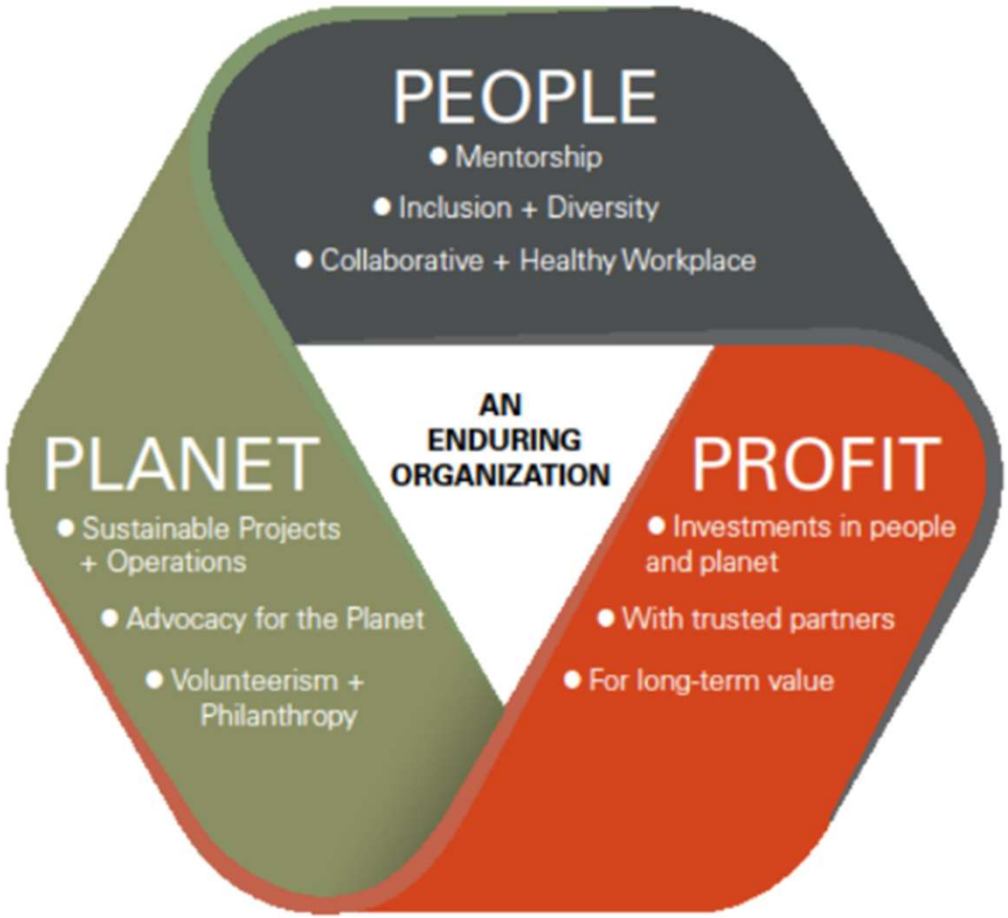
Our Enduring Organization



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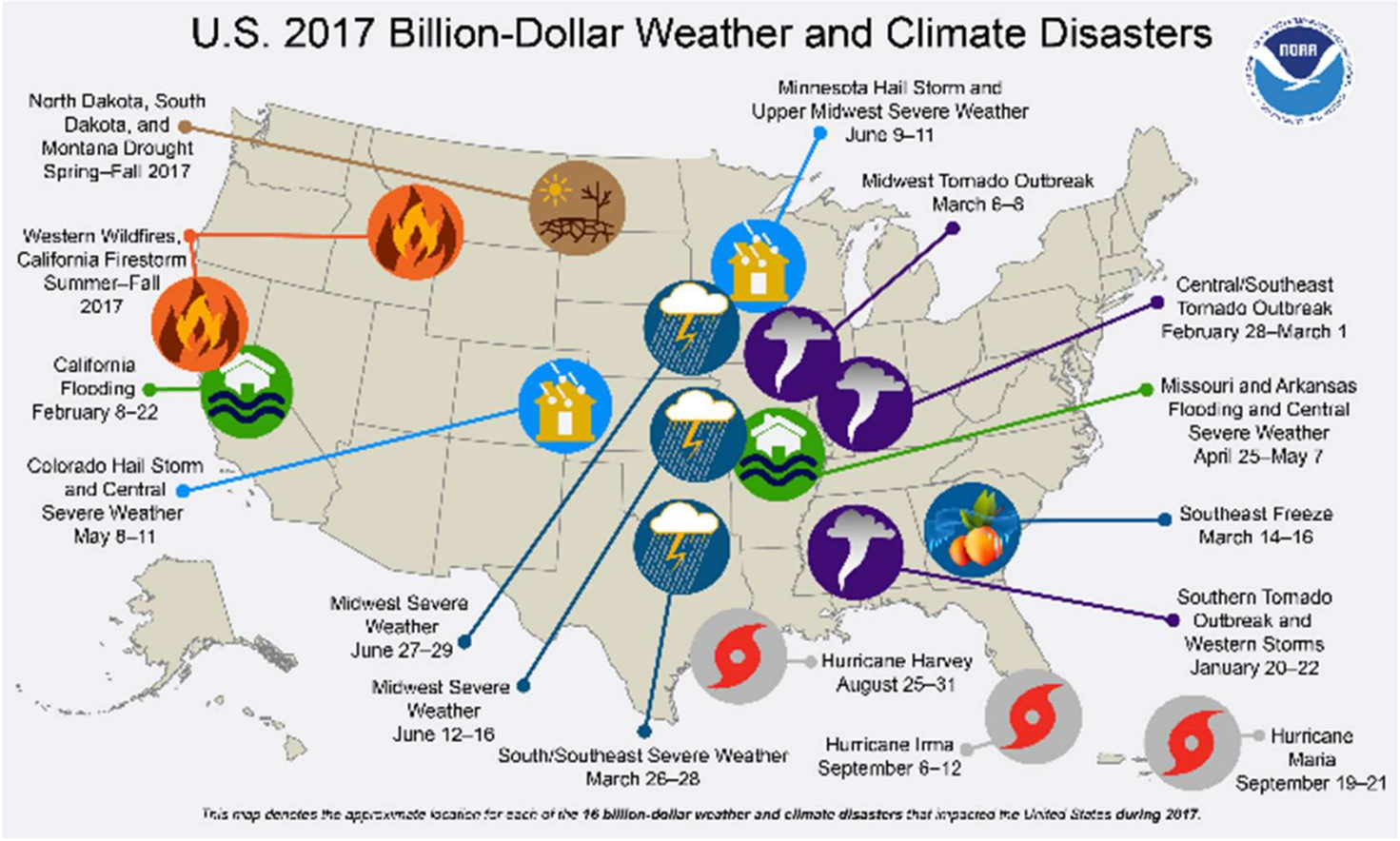

- In 2017, $306 billion in damage, 362 deaths
  - $265 billion from hurricanes, 251 deaths
  - $ 18 billion from wildfires, 54 deaths
- Since 1980, 219 U.S. disasters > $1 billion, totaling $1.5 trillion

Source: https://www.ncdc.noaa.gov/billions/

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Getty Center

Wildfires burn on a hillside near the Getty Center. Gene Blevins/Reuters

Getty Center

The New York Times | Source: Google Earth

A TRAVERTINE STONE was chosen to face all major walls, specifically because of its fire-resistant qualities.

B CRUSHED STONE, a fire-resistant material, covers each flat roof.

C OAK TREES that cover much of the grounds are regularly pruned, so that their canopies stay high off the ground.

D ACACIA SHRUBS were chosen for plantings closest to the building and on slopes, because they are fire-resistant and can hold plenty of water.

E A one-million gallon **WATER TANK** sits beneath the Getty's underground parking structure, to supply water for the irrigation system

F A network of **IRRIGATION PIPES** runs throughout the grounds. In case of fire, sprinklers can be used to soak the earth.

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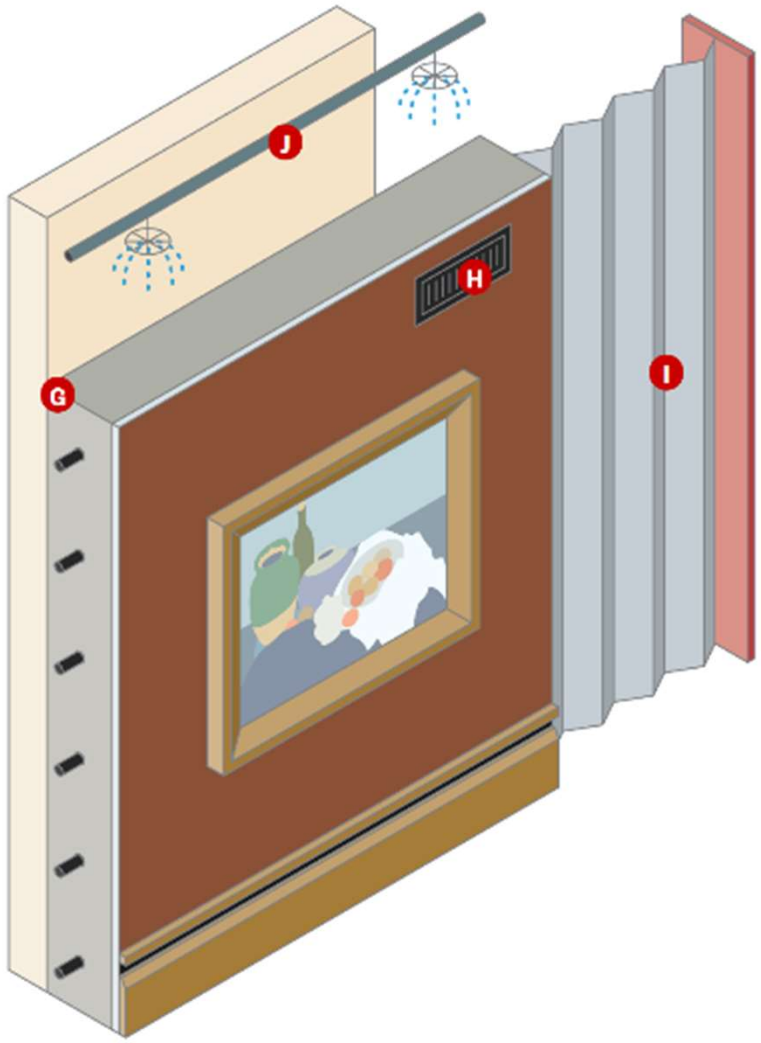
Getty Center



The New York Times | Source: Getty Center

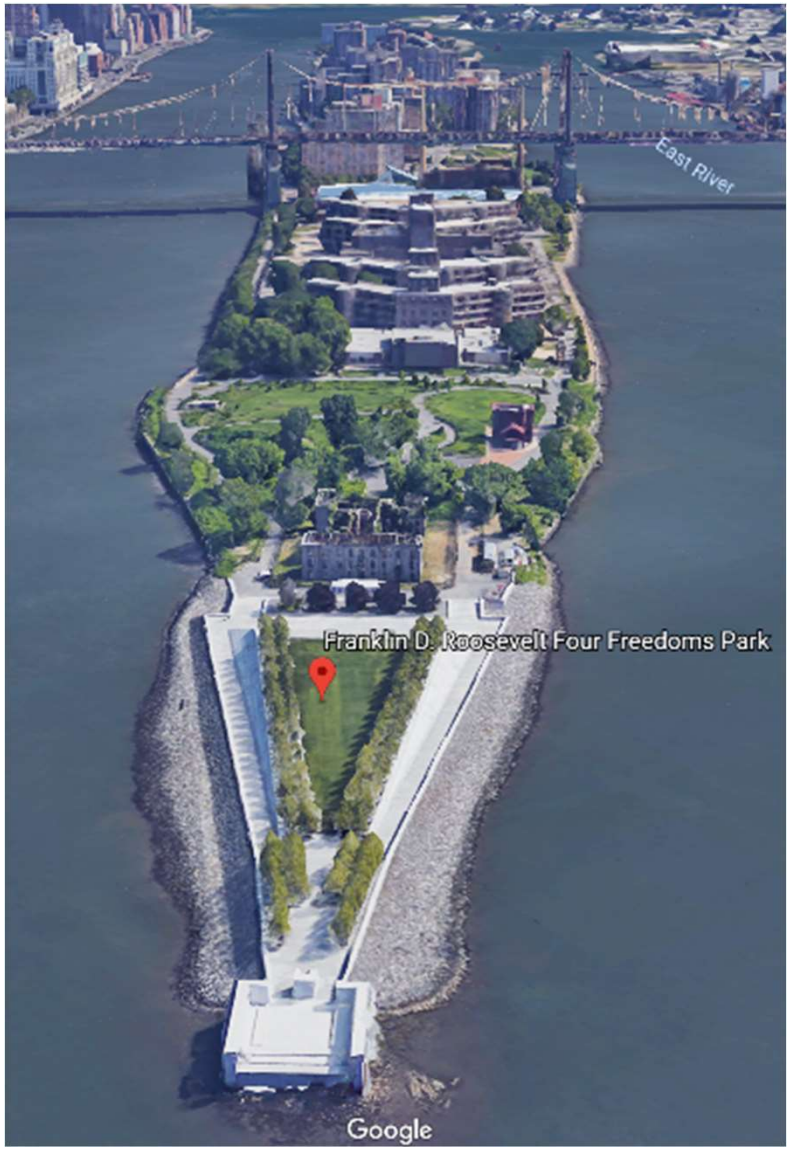
G **WALLS** are made of reinforced concrete, and have an outward facade of highly fire-resistant travertine stone.

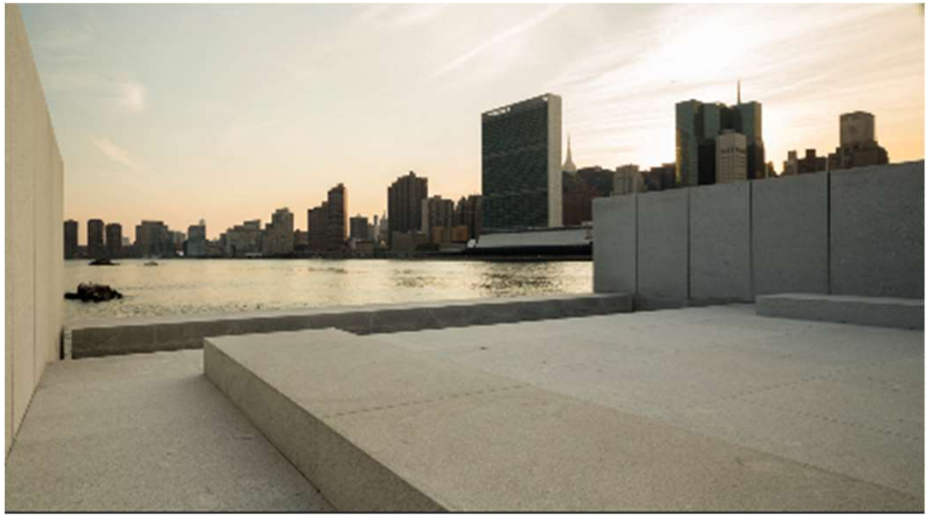
H **AIR SYSTEM** maintains a pressure flow to keep smoke from entering the building from outside. This air pressure can be increased if needed.

I Fire resistant **FOLDING DIVIDER WALLS** located between sections of the museum can be closed to seal off various areas in case of fire.

J **WATER SPRINKLERS** would only be used as a last resort. The pipes remain completely dry unless a fire is detected, so that they cannot accidentally drip water.

Four Freedoms Park





© Diane Bondareff / Four Freedoms Park

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Evolution in U.S. Embassy Design

© KieranTimberlake

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Goals of Test

- Evaluate the response of a unique curtain wall system subjected to a specified minimum blast load environment
- Validate mathematical models of the curtain wall system developed during the design phase
- Develop data to assist the community in future protective design efforts

Full Scale Field Test of Curtain Wall System

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Full Scale Field Test of Curtain Wall System

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Full Scale Field Test of Curtain Wall System

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Evolution in U.S. Embassy Design

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Scientific Method

- Bringing new concepts, new approaches to solve problems requires use of the scientific method
- *"Do whatever it takes to avoid fooling yourself into thinking something is true that is not, or that something is not true that is."* N. deGrasse Tyson

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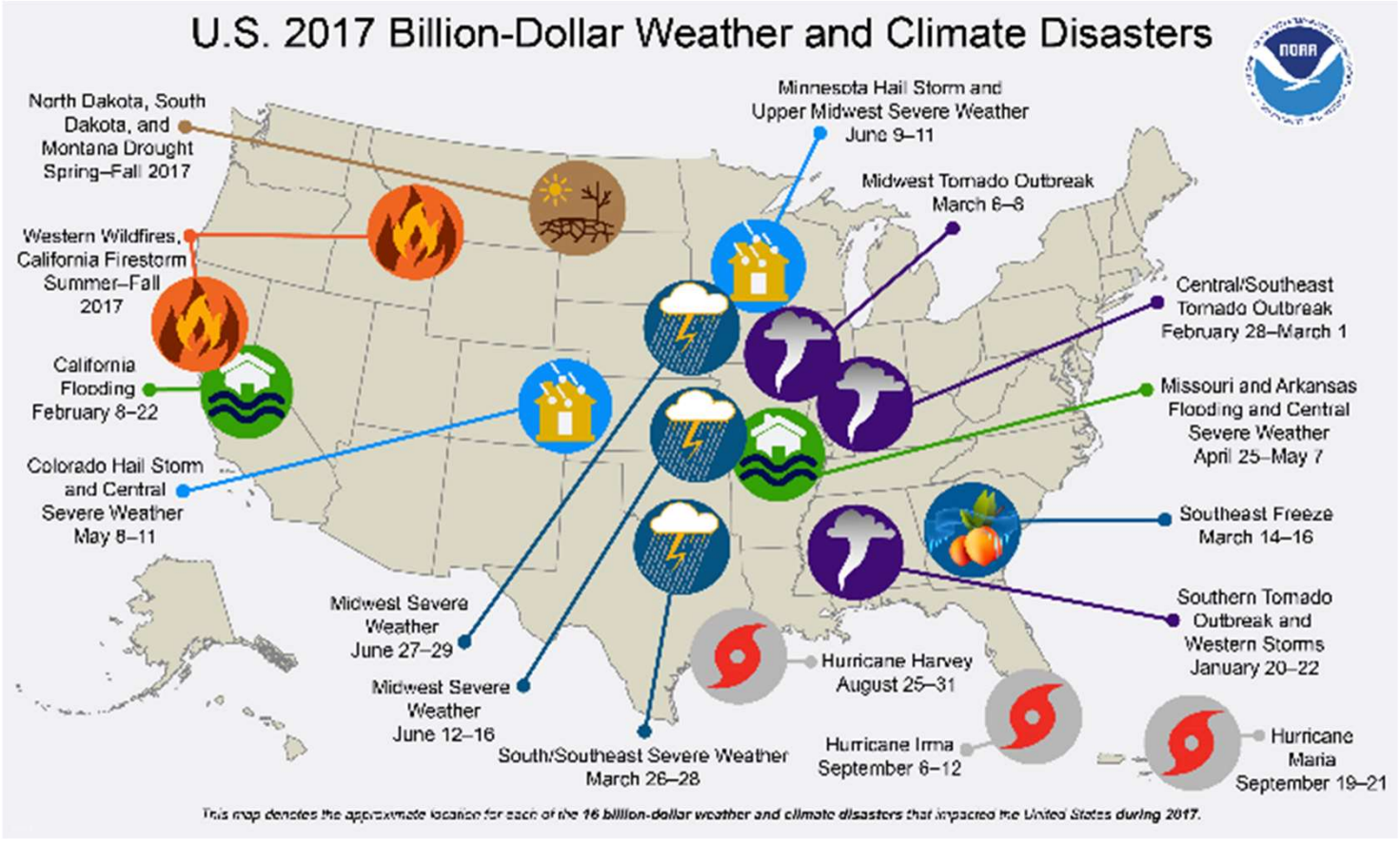

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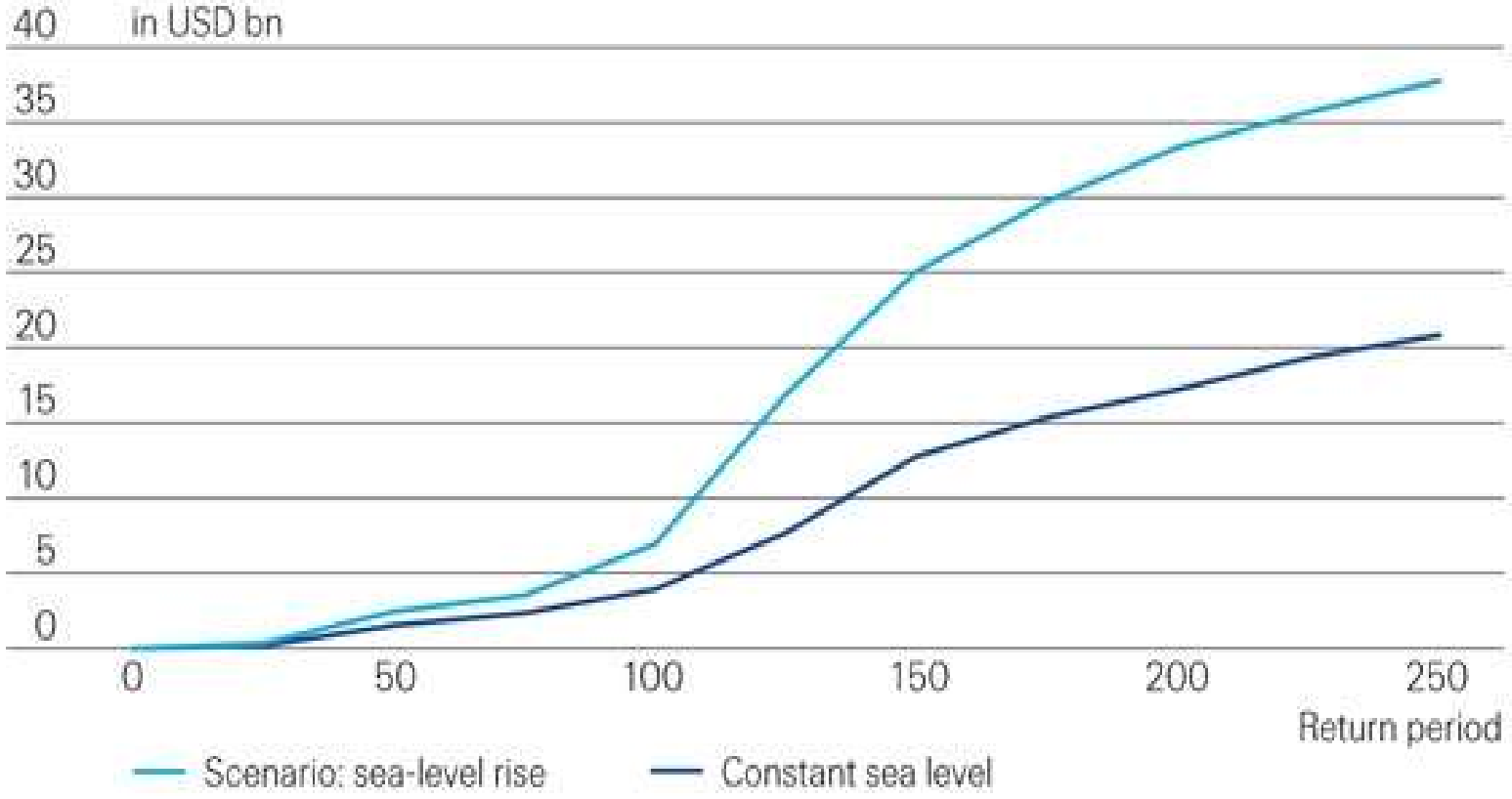
Why Does Resiliency Matter?

Increasing Exposure and Intensity of Disaster Events

A 10 inch rise in sea levels will increase insured losses for events that occur every 200 years from USD 17 billion to USD 34 billion



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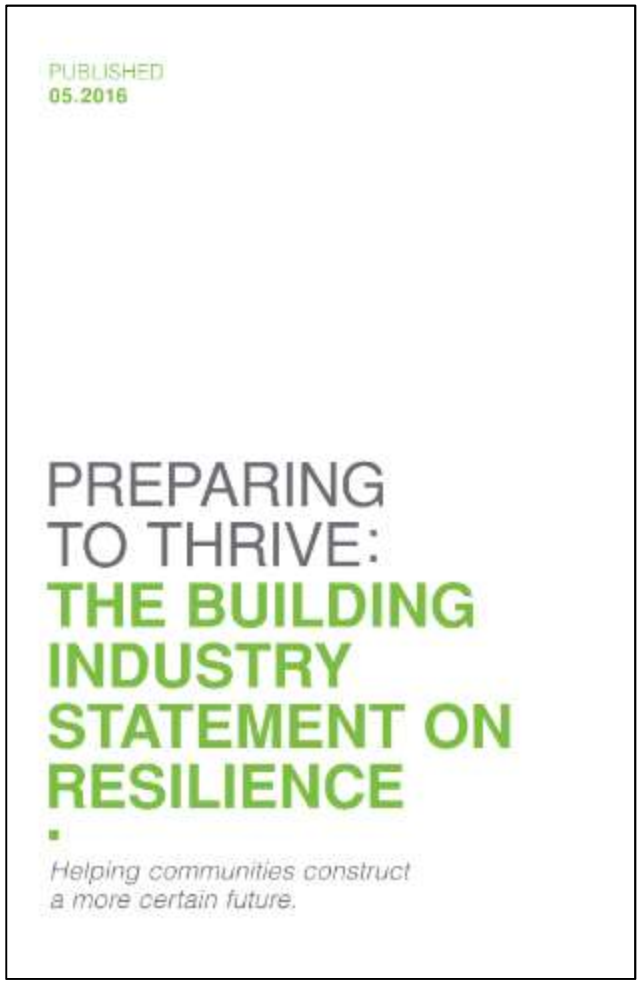
Statement on Resilience

NIBS, AIA, ASCE, ACEC, NSPE & 37 Industry Orgs



Represent the $1 trillion dollar design and construction industry

Prepare and plan for, absorb, recover from, and more successfully adapt to adverse events.

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.

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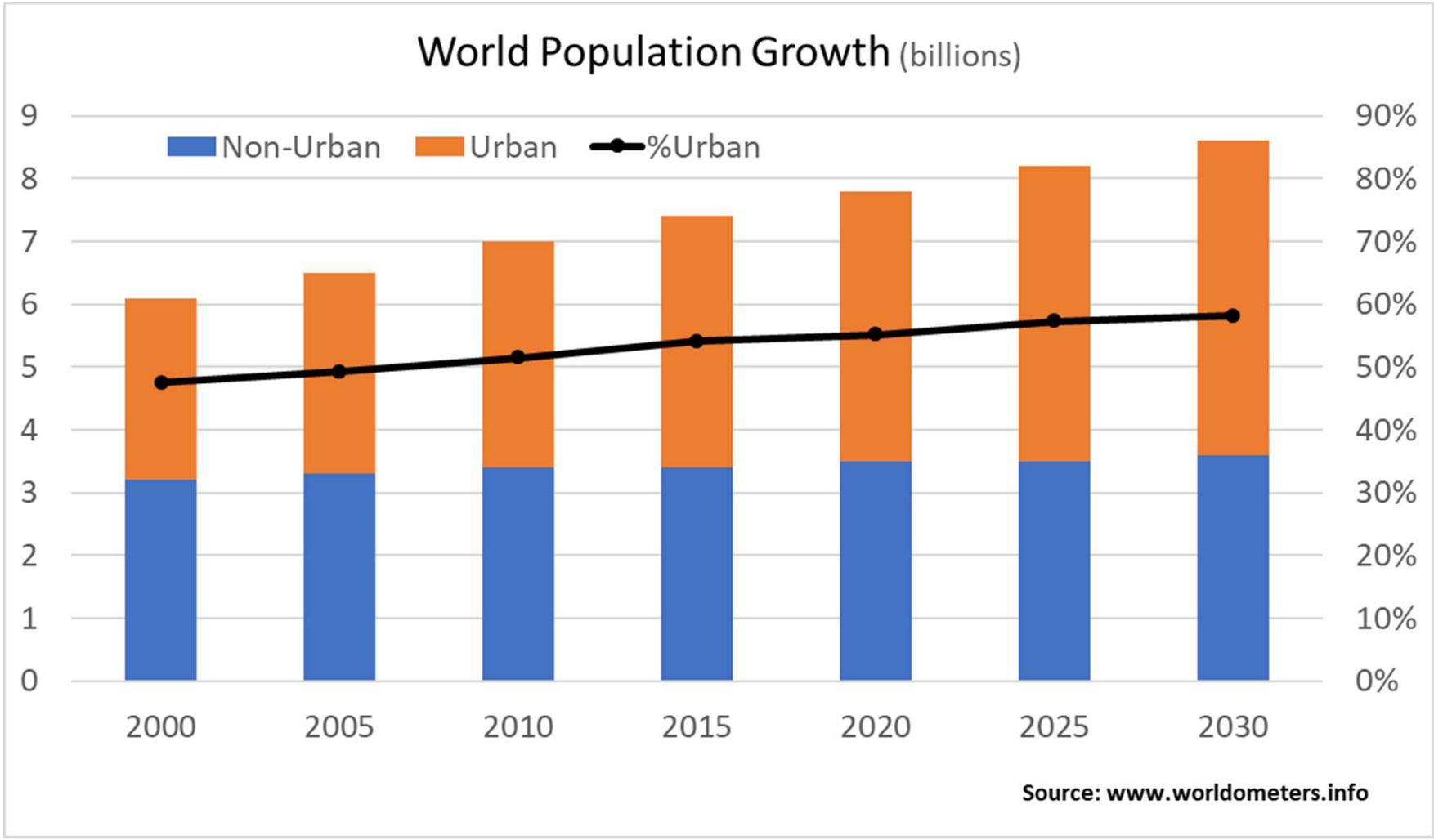
A Focus on Cities, Why?



Resiliency in an Urban Setting

What programs are available for guidance?

The importance of a holistic approach

Unique Challenges in an Urban Environment

Risk Assessment Process

- Hazards
- Performance
- Vulnerabilities
- Performance
- Options
- Risk Reduction

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City Resilience

What is City Resilience?

Definition: City resilience describes the capacity of cities to function so that the people living and working in cities – particularly the poor and vulnerable – survive and thrive no matter what stresses or shocks they encounter.

In the context of cities, resilience has helped bridge the gap between disaster risk reduction and climate change adaptation. It moves away from traditional disaster risk management, which is founded on risk assessments that relate to specific hazards. Instead, it accepts the possibility that a wide range of disruptive events – both stresses and shocks – may occur but are not necessarily predictable. Resilience focuses on enhancing performance of a system in the face of multiple hazards, rather than preventing or mitigating the loss of assets due to specific events.

A resilient city is one where there is:

1. Minimal Human Vulnerability
2. Diverse Livelihoods and Employment
3. Effective Safeguards to Human Health & Life
4. Collective Identity and Community Support
5. Comprehensive Security and Rule of Law
6. Sustainable Economy
7. Reduced Exposure and Fragility
8. Effective Provision of Critical Services
9. Reliable Communications and Mobility
10. Effective Leadership and Management
11. Empowered Stakeholders
12. Integrated Development Planning

City Resilience Framework,
Rockefeller Foundation

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100 Resilient Cities

100 RESILIENT CITIES

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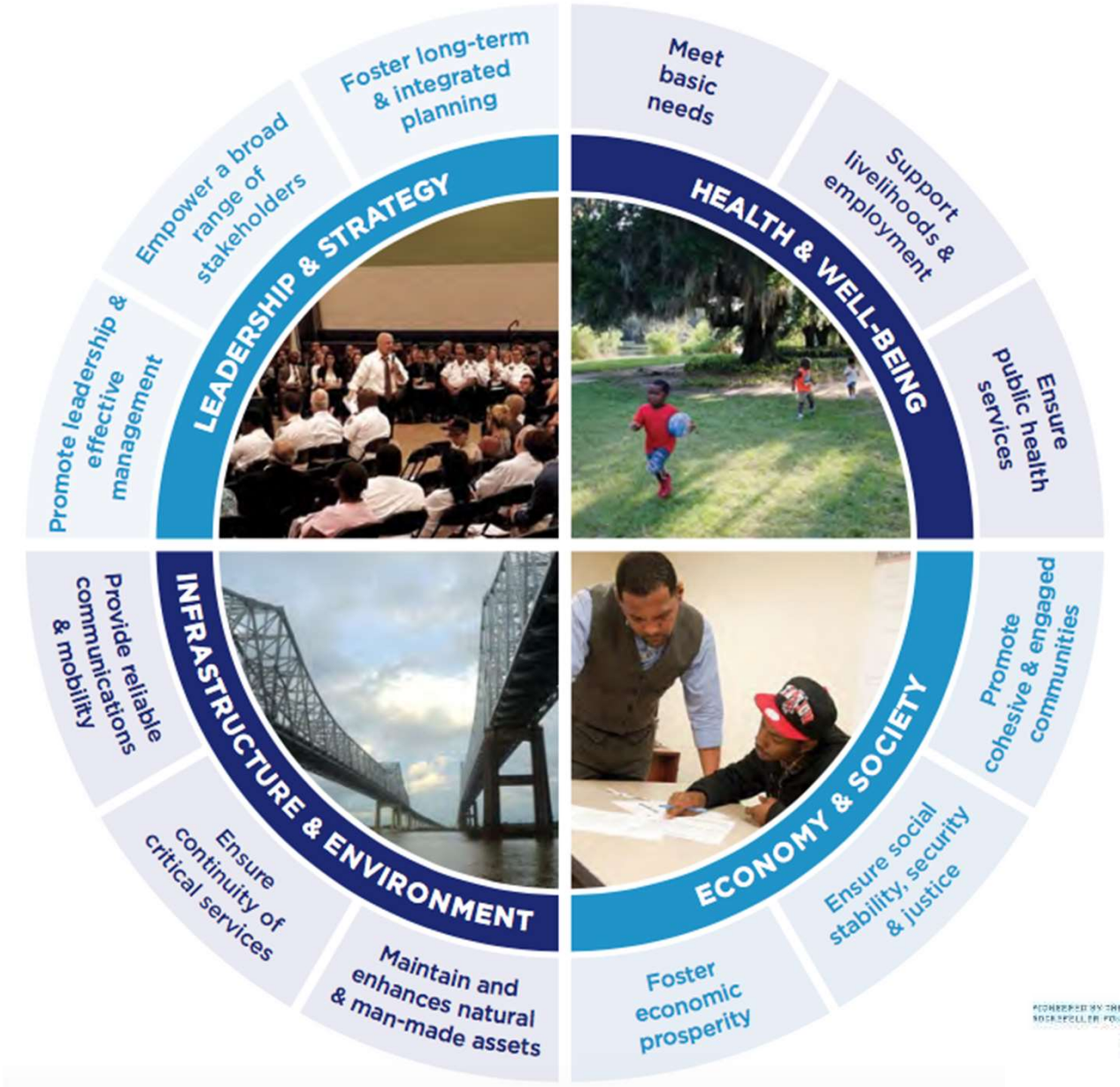
100 Resilient Cities



100 RESILIENT CITIES

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US Resiliency Council

MISSION

Establish and implement rating systems that describe the performance of buildings during earthquakes and other natural and man-made hazard events.

- Launched in 2015
- 75 certified rating engineers.
- Los Angeles City has committed to use the USRC Rating System to rate the 800+ buildings it owns.
- The USRC is initiating the development of rating systems for floods, hurricanes, tornadoes and blast.

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What is a USRC Rating?

A USRC rating identifies expected disaster performance of buildings in which you live, work or invest.

- The Rating considers the performance of:
  - Building's structure
  - Mechanical, electrical and plumbing systems
  - Architectural components such as cladding, windows, partitions and ceilings.

- Building performance affects:
  - Occupant safety
  - Cost and time to carry out repairs
  - When you can begin using the building again after the event

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USRC Rating Range for a New Code-Compliant Building (Depends on Structural System)

Safety

5★	Injuries and blocking of exit paths unlikely
4★	Serious injuries unlikely
3★	Loss of life unlikely
2★	Loss of life possible in isolated locations
1★	Loss of life likely in the building

Damage

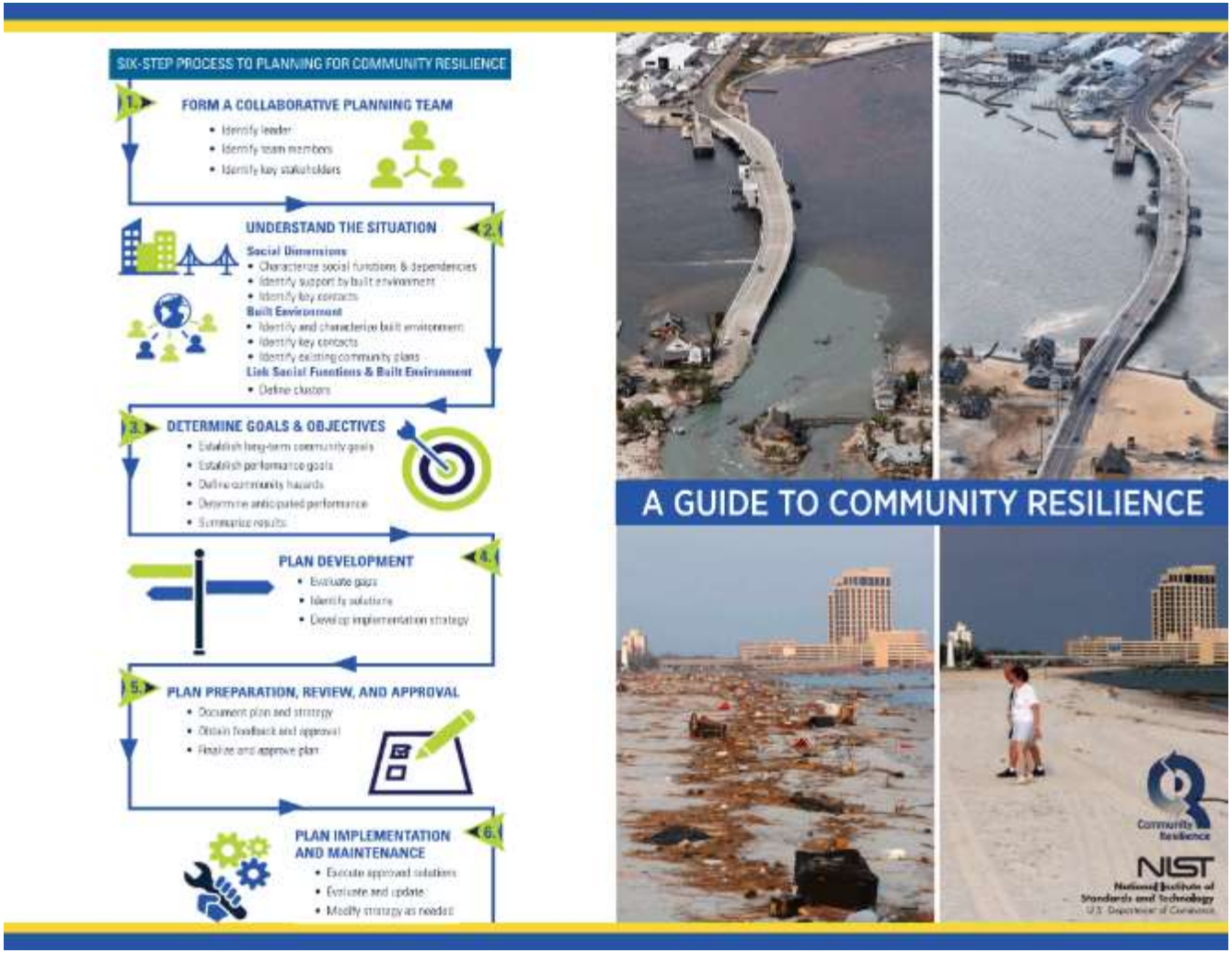
5★	Minimal damage (< 5%)
4★	Moderate damage (< 10%)
3★	Significant damage (< 20%)
2★	Substantial damage (< 40%)
1★	Severe damage (40%+)
NE	Not Evaluated

Recovery

5★	Immediately to days
4★	Within days to weeks
3★	Within weeks to months
2★	Within months to a year
1★	More than one year
NE	Not Evaluated

USRC Ratings Placards – All Satisfy Life Safety

NIST Guide Community Resilience



https://www.nist.gov/topics/community-resilience/community-resilience-planning-guide

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NIST Guide Community Resilience

HAZARD LEVELS FOR PLANNING

The ***CRPG*** encourages communities to define three hazard levels for planning purposes: routine, design, and extreme.

- ***Routine hazard:*** A high-frequency/ low-consequence event. It is expected to occur more often than the design hazard, but result in a stress on the built environment below the design level causing little/no damage or disruptions.
- ***Design hazard:*** The level designed for in the codes and standards for buildings, bridges, and similar infrastructure systems. Some disruption can be tolerated at this level.
- ***Extreme hazard:*** Low-frequency/ high-consequence event. It is expected to occur far less often than the design hazard, but produce shocks on the built environment far exceeding their designed capability.

10

HOW THE *ECONOMIC DECISION GUIDE* FITS INTO THE *RESILIENCE PLANNING SIX-STEP PROCESS*

EDG	CRPG
1 SELECT CANDIDATE STRATEGIES	1) Form a Collaborative Planning Team
2 DEFINE INVESTMENT OBJECTIVE & SCOPE	2) Understand the Situation
3 IDENTIFY BENEFITS & COSTS	3) Determine Goals & Objectives
4 IDENTIFY NON-MARKET (NON-ECONOMIC) CONSIDERATIONS	4) Plan Development
5 DEFINE ANALYSIS PARAMETERS	5) Plan Preparation, Review & Approval
6 PERFORM ECONOMIC EVALUATION	6) Plan Implementation & Maintenance
7 RANK STRATEGIES	

3

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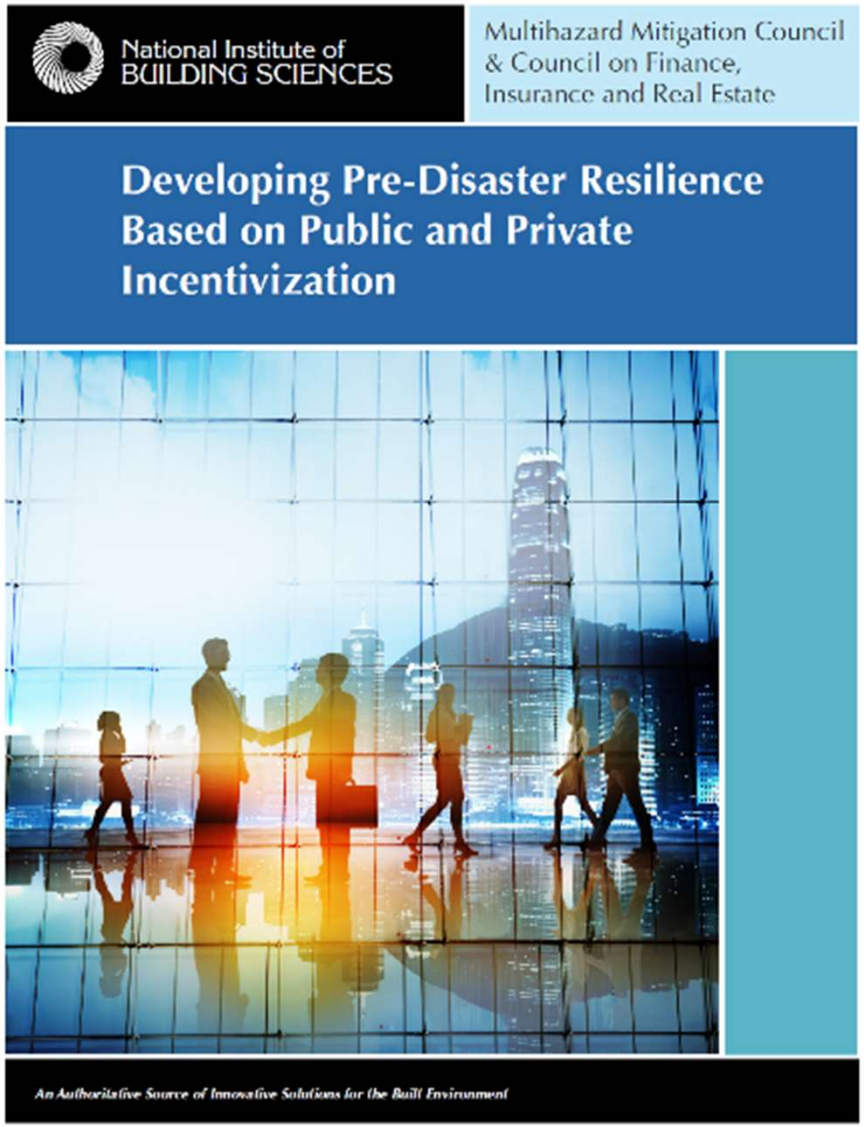
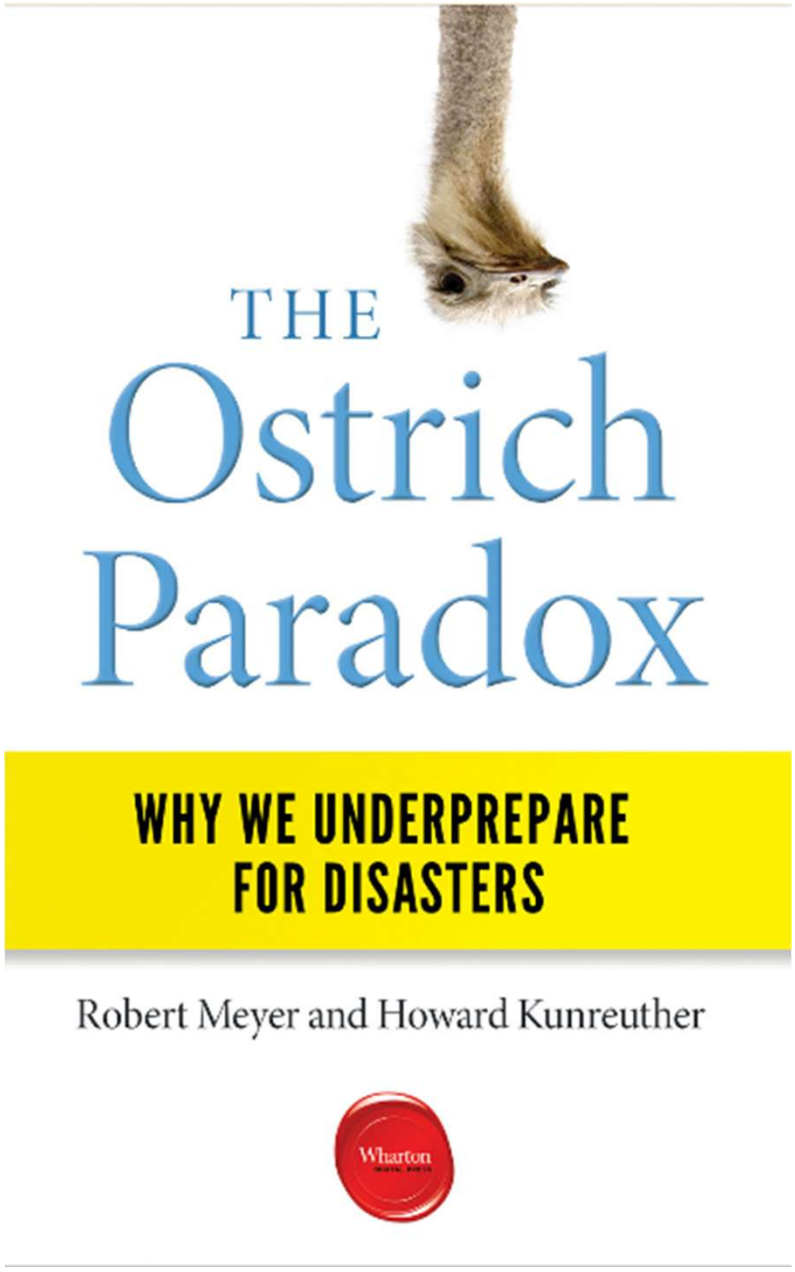
Developing Pre-Disaster Resilience Based on Public and Private Incentivization- NIBS



"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 funding of federal and state pre- and post-disaster mitigation efforts to create 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 codes and their application."

The Ostrich Paradox



Two Cognitive Systems

System 1: governs automated and instinctive thoughts

System 2: governs more controlled thoughts

“In most contexts, these two systems, working in concert, allow us to navigate our day-do-day lives with ease using simple intuitions and rules of thumb, freeing up mental resources for more taxing deliberative calculations if needed.”

They perform very poorly when dealing with problems that are ***unfamiliar, complex,*** *and* ***temporally distant***.

Meyer, Robert. The Ostrich Paradox: Why We Underprepare for Disasters, Wharton Digital Press.

Identified 6 Systemic Bias in How We Perceive Risk

Myopia, Amnesia, Optimism, Inertia, Simplification, and Herding

- **Myopia:** a tendency to focus on overly short future time horizons when appraising immediate costs and the potential benefits of protective investments;
- **Amnesia:** a tendency to forget too quickly the lessons of past disasters;
- **Optimism:** a tendency to underestimate the likelihood that losses will occur from future hazards;
- **Inertia:** a tendency to maintain the status quo or adopt a default option when there is uncertainty about the potential benefits of investing in alternative protective measures;
- **Simplification:** a tendency to selectively attend to only a subset of the relevant factors to consider when making choices involving risk; and
- **Herding:** a tendency to base choices on the observed actions of others.

Meyer, Robert. The Ostrich Paradox: Why We Underprepare for Disasters, Wharton Digital Press.

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What Can We DO?

- While we may not be able to alter our cognitive wiring, we may be able to improve preparedness by recognizing these specific biases and designing strategies that anticipate them

Meyer, Robert. The Ostrich Paradox: Why We Underprepare for Disasters Wharton Digital Press.

A Possible Solution

The Behavioral Risk Audit

- For well-known disasters and hazards (e.g., flood and storm risk), the audit provides a tool for identifying the tactical weak points of existing preparedness programs when they are put into practice.

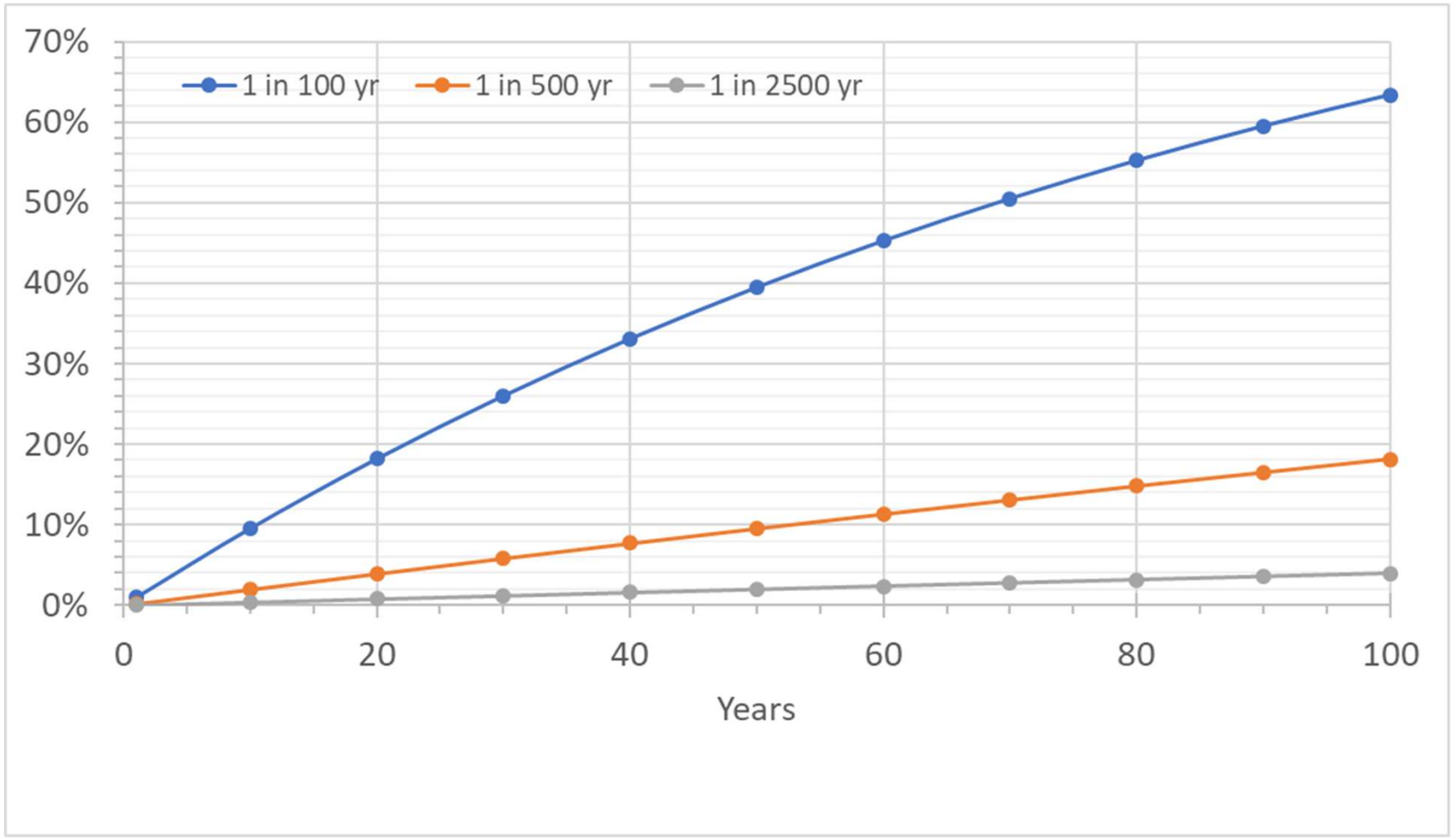
- For novel disasters and hazards for which no existing preparedness plans exist (e.g., new pandemics or cyberterrorism), the audit is a tool for anticipating the biases that can arise when people think about the personal risks these disasters and hazards pose to them, their community, and other stakeholders.

- Planners can then design preparedness plans that work with rather than against peoples' natural decision biases.

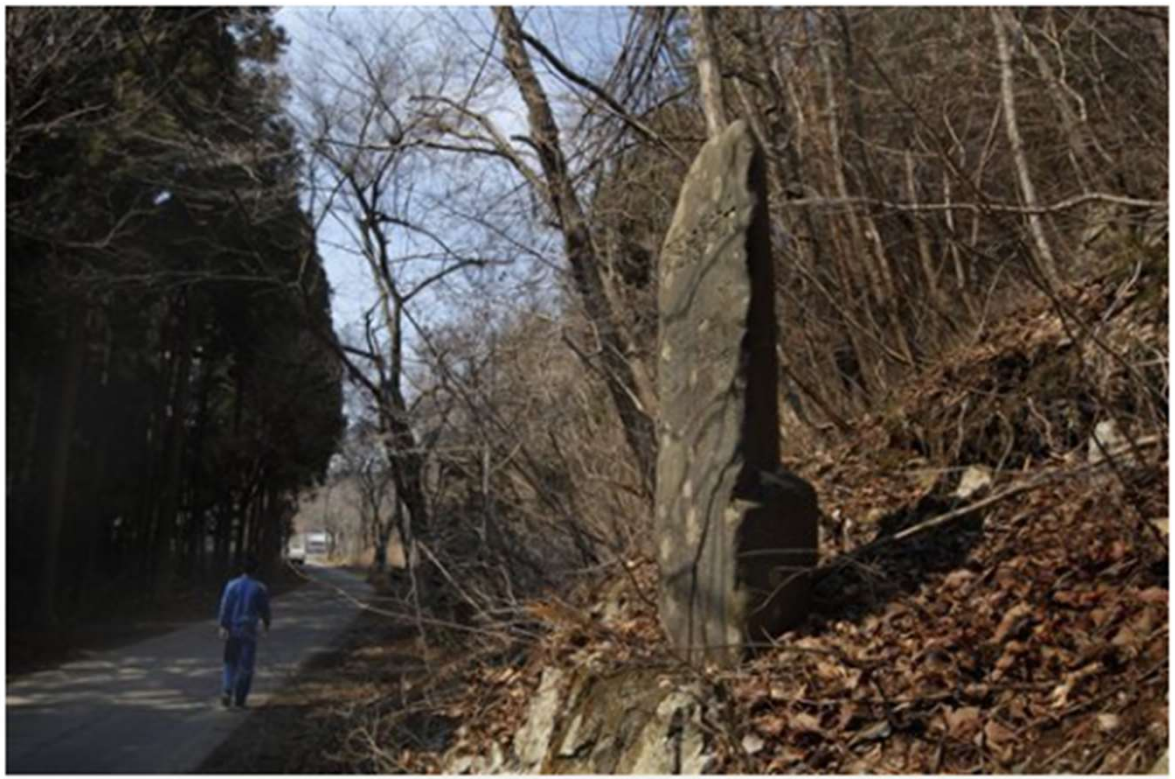
Meyer, Robert. The Ostrich Paradox: Why We Underprepare for Disasters. Wharton Digital Press

Bias	Impact on Beliefs	Manifestation in Preparedness	Remedy
Myopia: a tendency to plan over short future horizons	Focus on short-term horizons in evaluating flood loss mitigation options	Failure to invest in cost-effective measures due to high upfront costs	Couple long-term loans with insurance premium reductions to spread the upfront cost over time.
Amnesia: a tendency to base decisions on most recent experiences	Fading memory of past floods and resulting damage	Failure to renew annual flood insurance policy	Automatically renew multi-year policies with constant annual premiums.
Optimism: a tendency to underestimate the likelihood of personal harm	Underestimation of the probability of a flood	Tendency to see flood insurance and mitigation as overly expensive relative to benefits	Stretch time horizon so individual perceives the probability of a disaster to be closer to the scientific estimate.
Inertia: a tendency to choose default courses of action	A preference for the status quo in protective investments; for floods, doing nothing	Reluctance to purchase insurance or invest in existing loss-reduction measures (e.g., purchased storm shutters); procrastination in decision making	Make protection the default; make insurance a condition for obtaining a mortgage, or part of a bundled policy the resident can opt out of.
Simplification: a tendency to process only limited subsets of information	Limited consideration of information available about flood risk	Ignorance of the flood risk at a location; lack of knowledge of possible remedies	Implement communication programs that make it easier for residents to be aware of their flood risk, providing examples of the consequences of floods that dramatize impact.
Herding: a tendency to make decisions by social imitation	Tendency to base insurance decision on whether friends and neighbors have flood polices	Low rates of take-up at the community level	Implement communication programs that emphasize social norms of safety; offer seals of approval that enhance the social status of protective investments.

Addressing Optimism Bias



Addressing Amnesia Bias



© Vincent Yu, The Associated Press

"High dwellings are the peace and harmony of our descendants. Remember the calamity of the great tsunamis. Do not build any homes below this point." - Aneyoshi, Iwate Prefecture

Addressing Herding – e.g. USRC Ratings Placards

Protection in the Truly Long Term

Guiding Principles

1. Commit to long-term protective planning as a major priority.

2. Commit to policies that discourage individual and community actions that increase their exposure to long-term risks.

3. *Create policies that consider the cognitive biases that inhibit adoption of protective measures.*

4. Commit to addressing problems equitably.

Meyer, Robert. The Ostrich Paradox: Why We Underprepare for Disasters

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