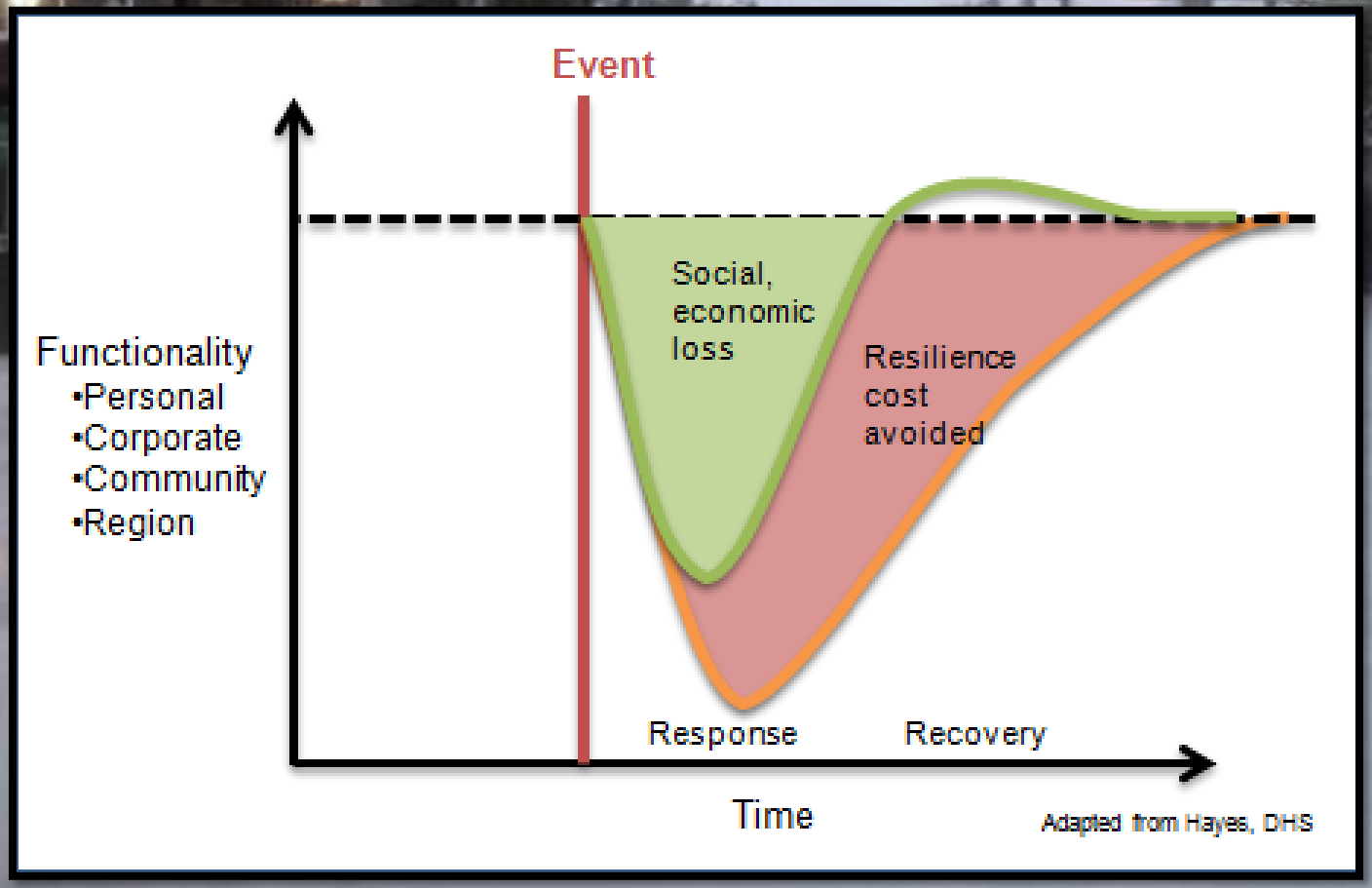
Resilience is the New Sustainability

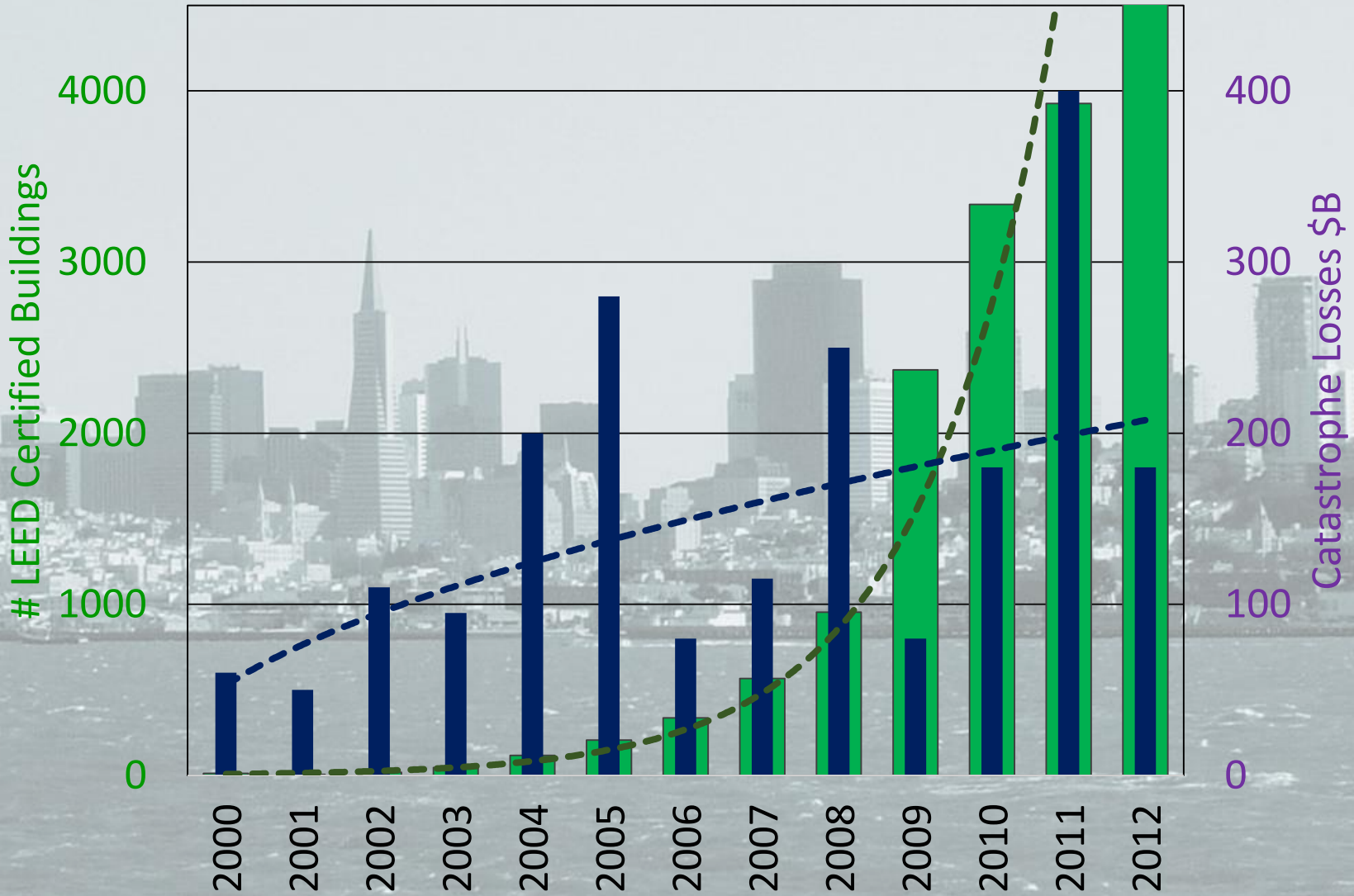
February 16, 2018

What is Resilience?

Resilience is a measure of how quickly a system recovers from shock



Is Green Design Delivering on the Sustainability Promise?



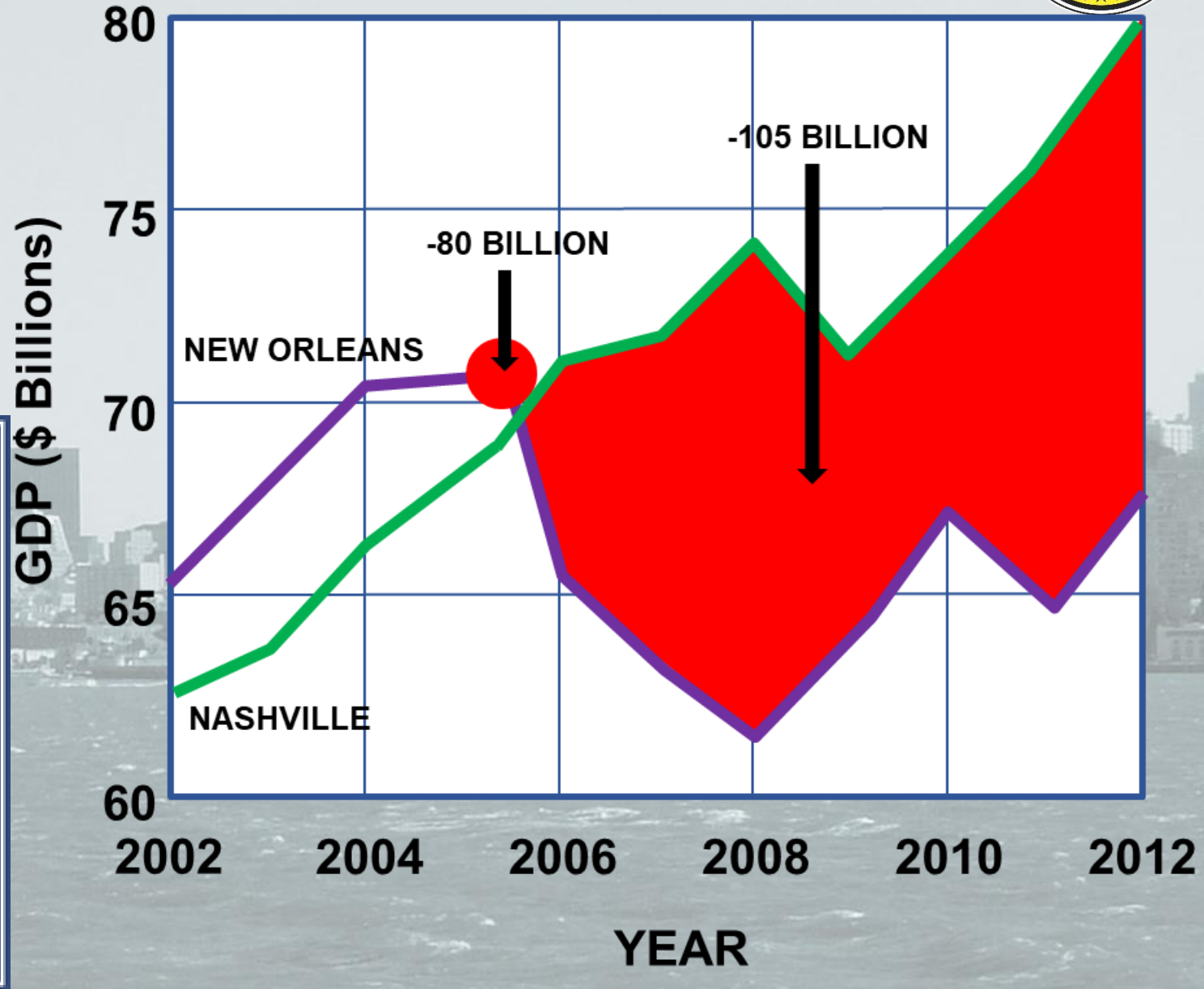
Resilience Is Different than "Green Design"

LEED certified buildings in Superstorm Sandy were designed to have a low impact on the environment…

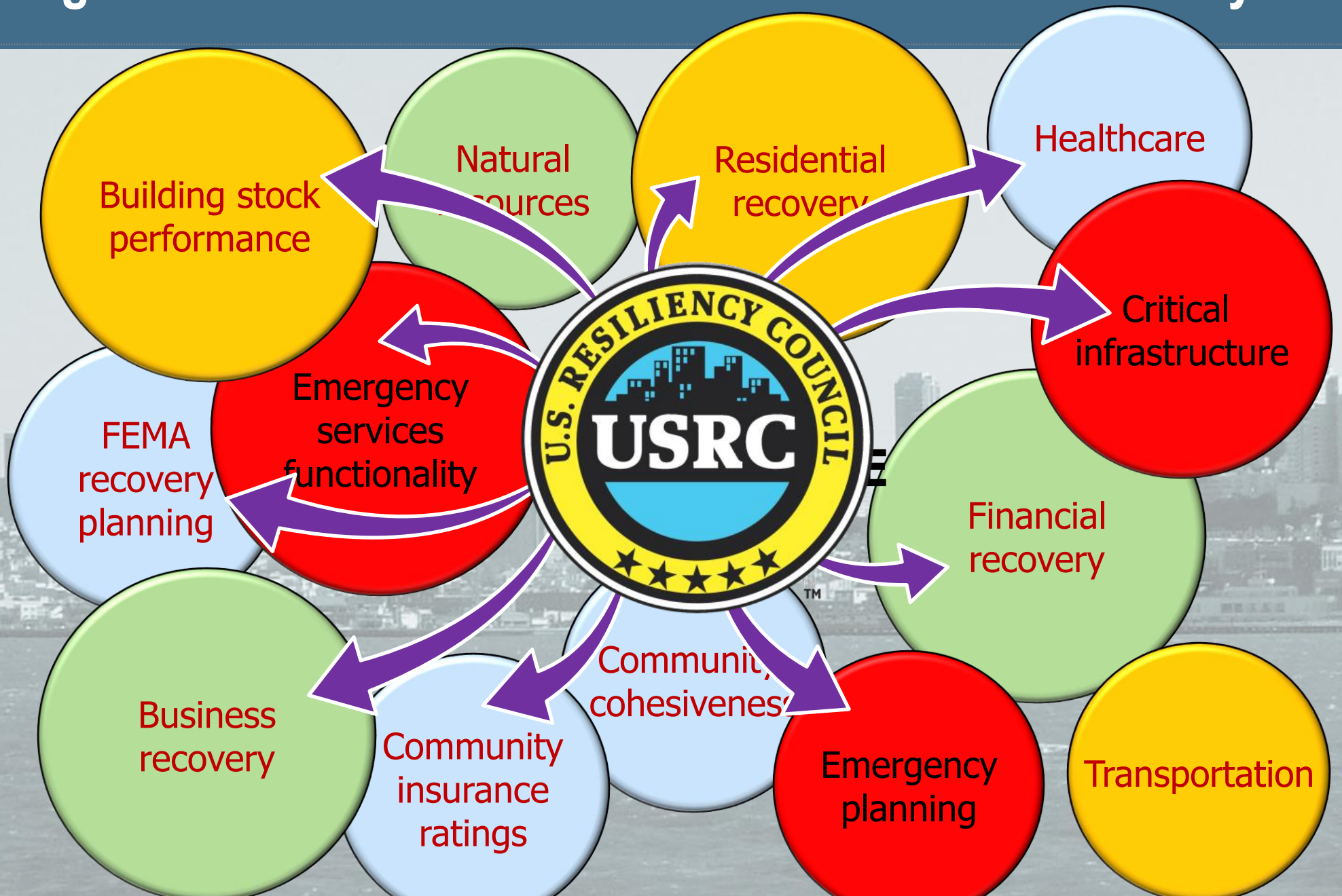
…but not for the environment to have a low impact on them.

Superstorm Sandy	
Deaths	>200 in 7 countries
Buildings damaged or destroyed	380,000 in NY, NY, CT
Estimated cost	$71 billion in NY & NJ.
Insured losses	$16 billion to $22 billion.
Estimated business losses	$25 billion
Homes without power	8.5 million
Debris generated	> 10 million cubic yards

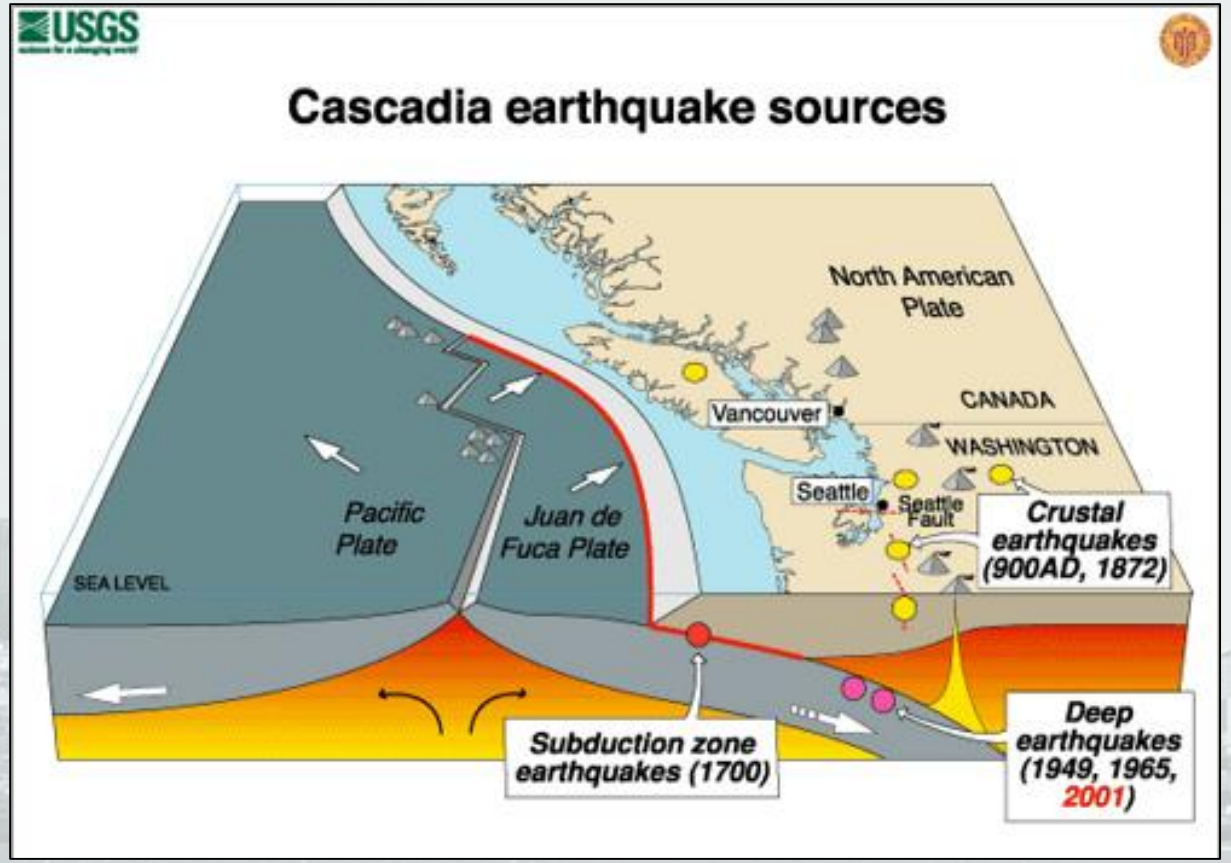
Trends Toward Resilience



Buildings As Part of A Resilient Community



Seismic Hazard



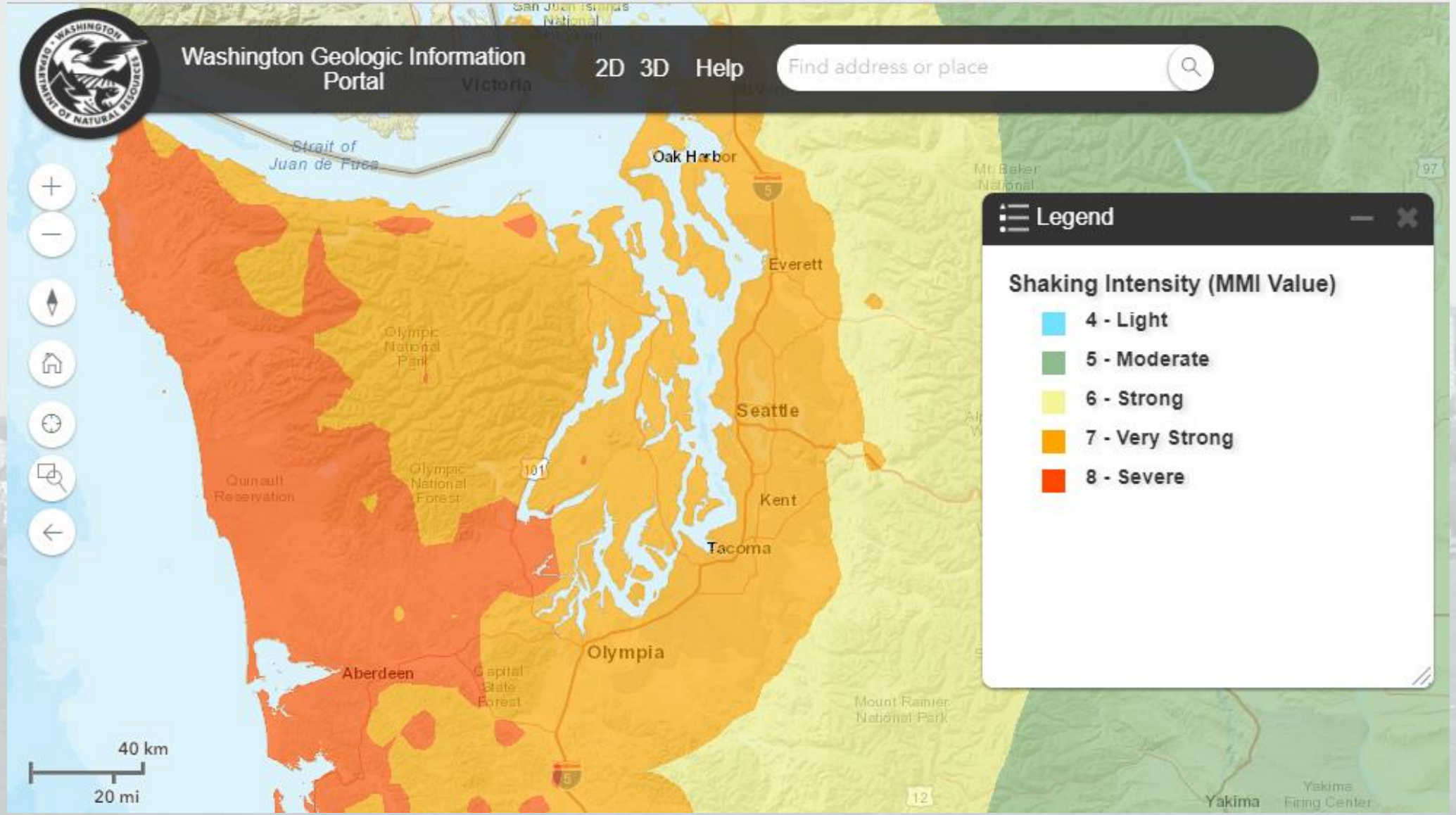
Average recurrence interval: ~430 years

Last CSZ event: 1700

Probability of M8 event over the next 50 years: one in three

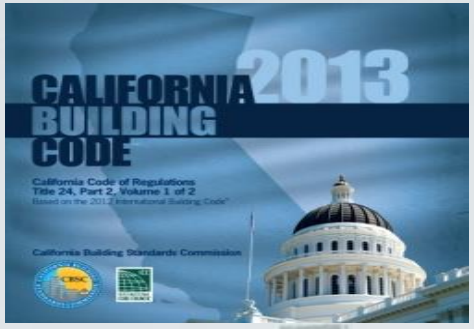
Probability of M9 event over the next 50 years: one in ten

Earthquake is Washington's Greatest Long Term Risk

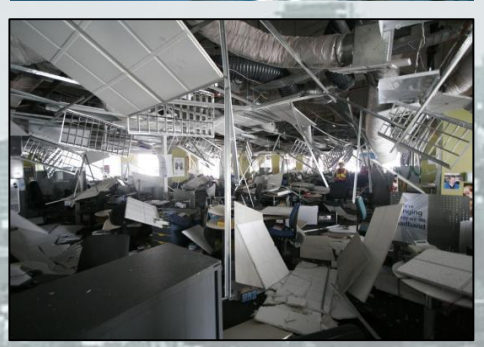


Misconceptions – Code vs. Reality

A code-compliant building is meant to prevent collapse, not to prevent injuries, limit damage or permit quick recovery.



Architectural and mechanical components can account for more than 70% of a building's property losses.



Lost revenue and business interruption costs can exceed the value of the building itself.

Consequences of Miscommunication

Christchurch Earthquake, NZ – 2010 & 2011

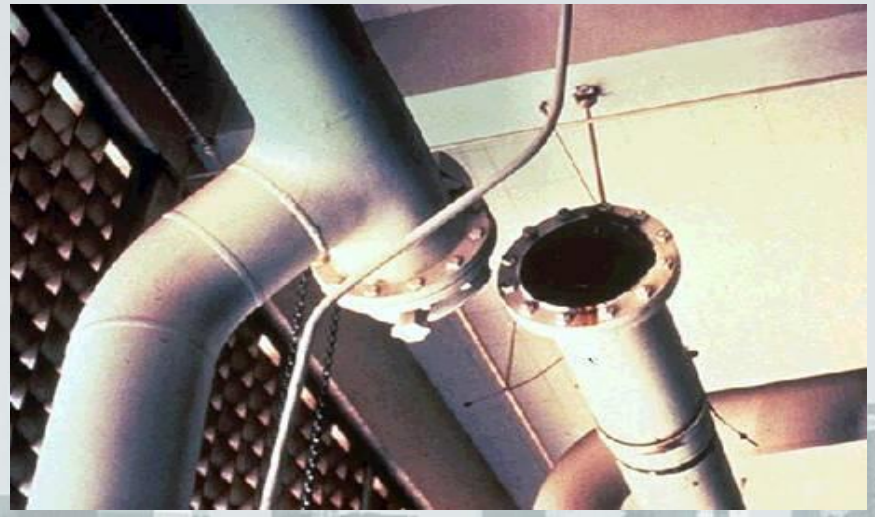
"Design Level and Max. Credible Events"

Only 2 buildings collapsed

>50% of buildings in downtown had to be demolished

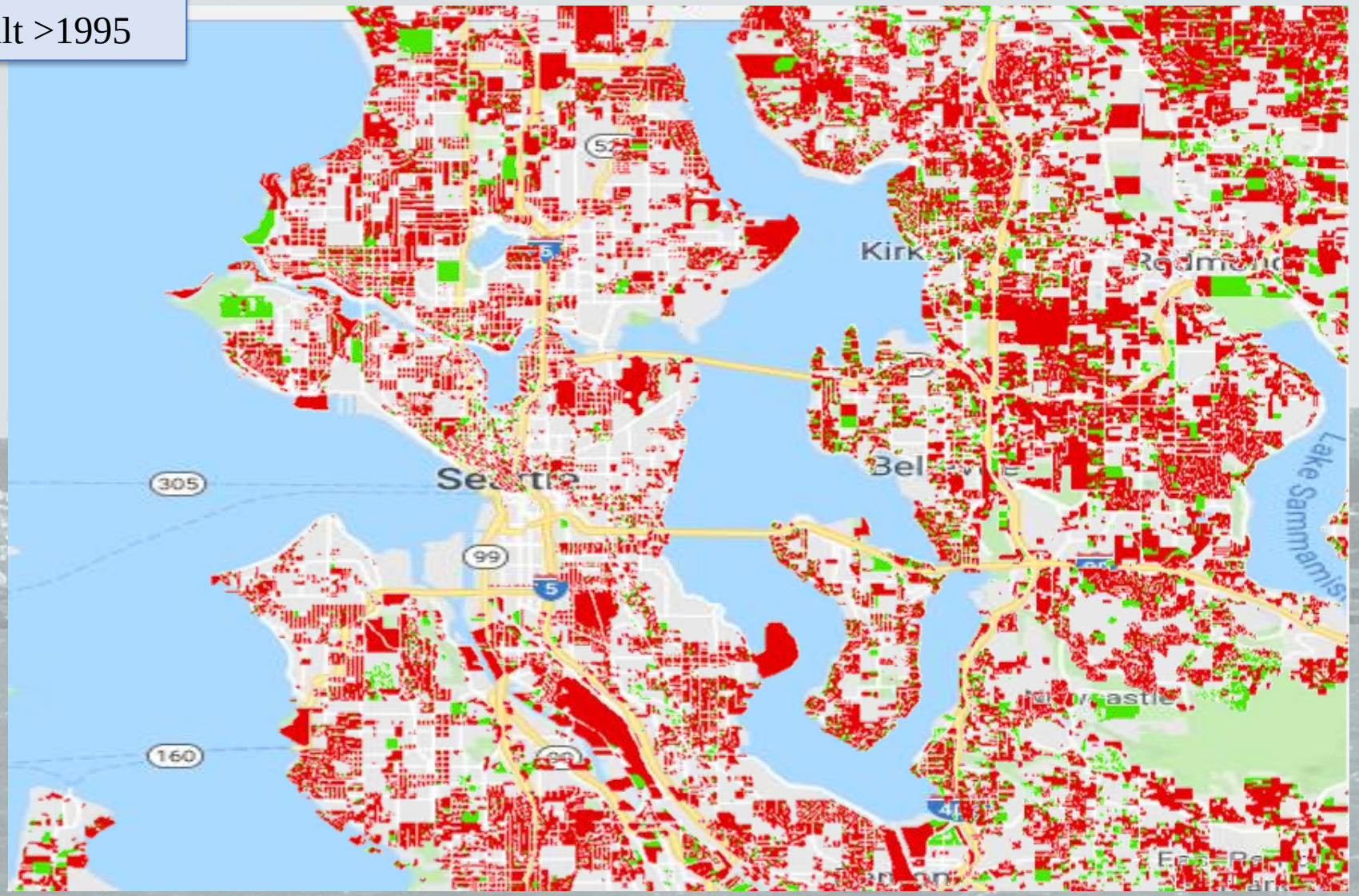
Were expectations met?
Depends on who you ask!

Non-Structural Damage



Modern Codes

Year Built <1995
Year Built >1995



Seattle, WA

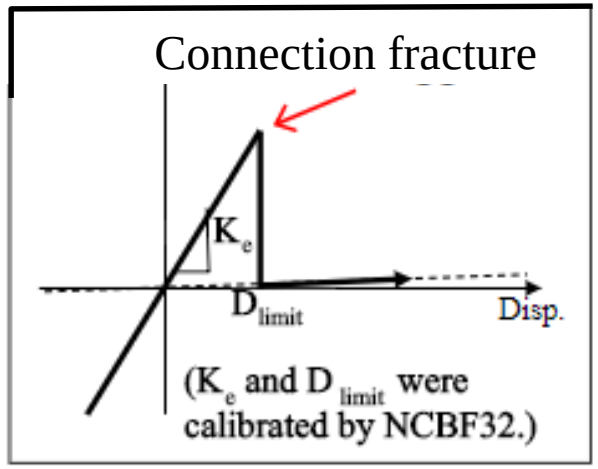
The Bullitt Center - Seattle

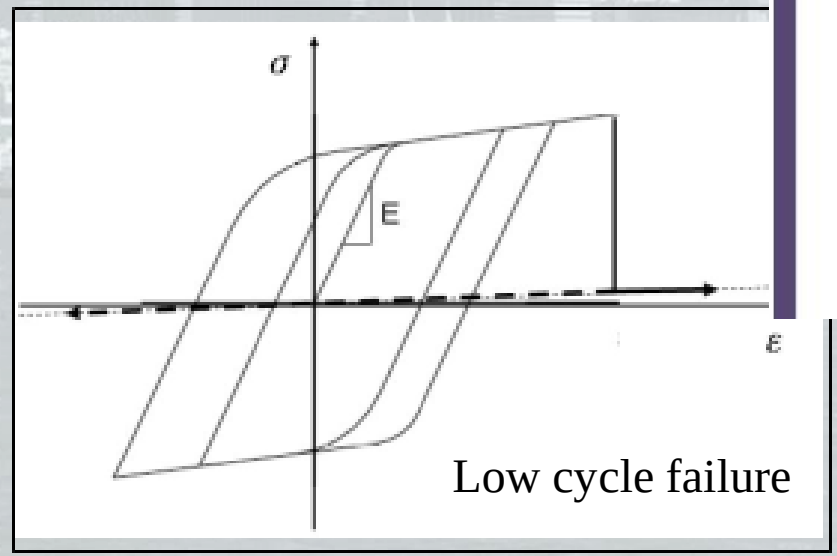
“THE GREENEST COMMERCIAL BUILDING IN THE WORLD”

“250 years: Lifespan of the building”

“The Bullitt Center is designed to show what’s possible, increasing the pace of change in the movement toward high performance green buildings and resilient cities.”

Seismic Performance of Braced Frames





Seismic Performance of Ductile Concrete

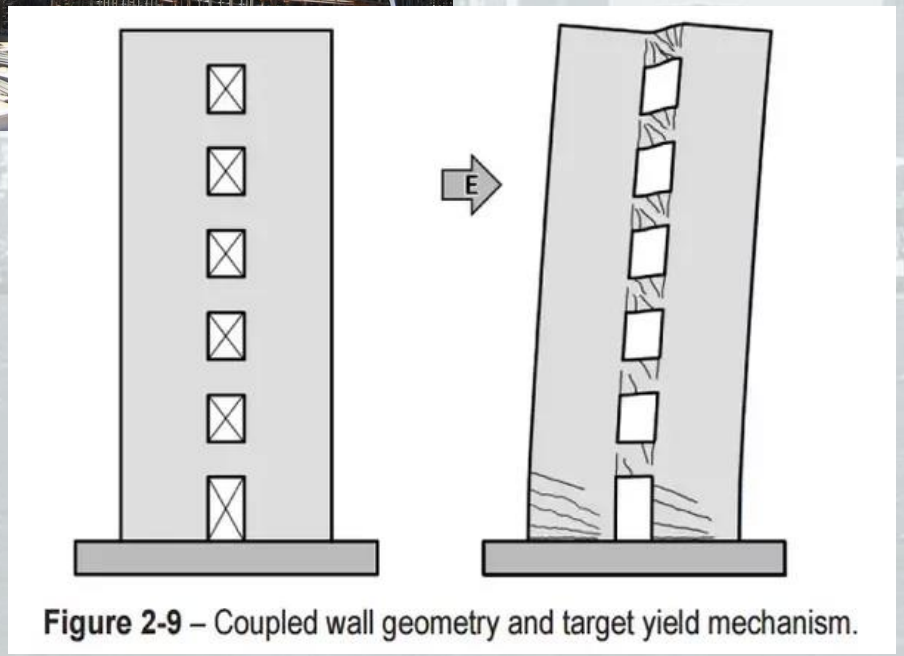
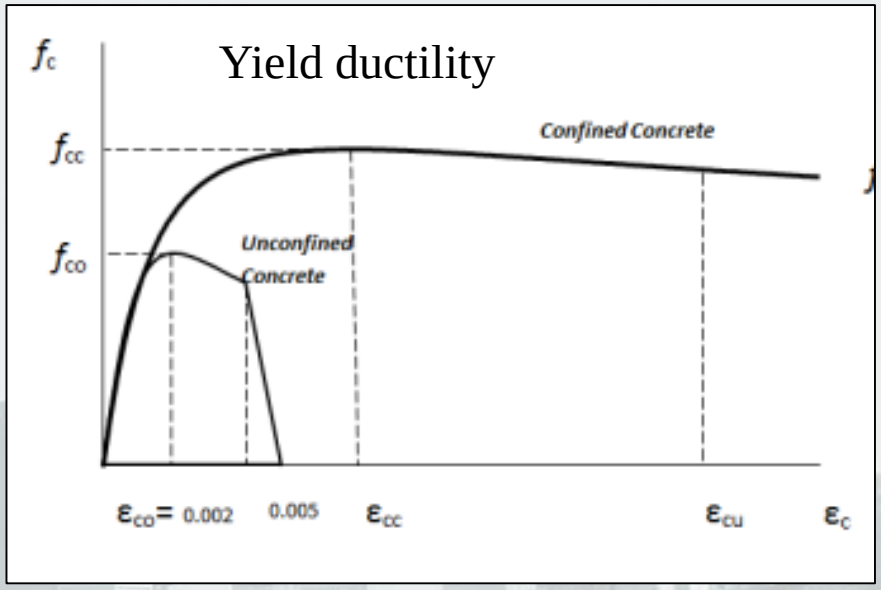
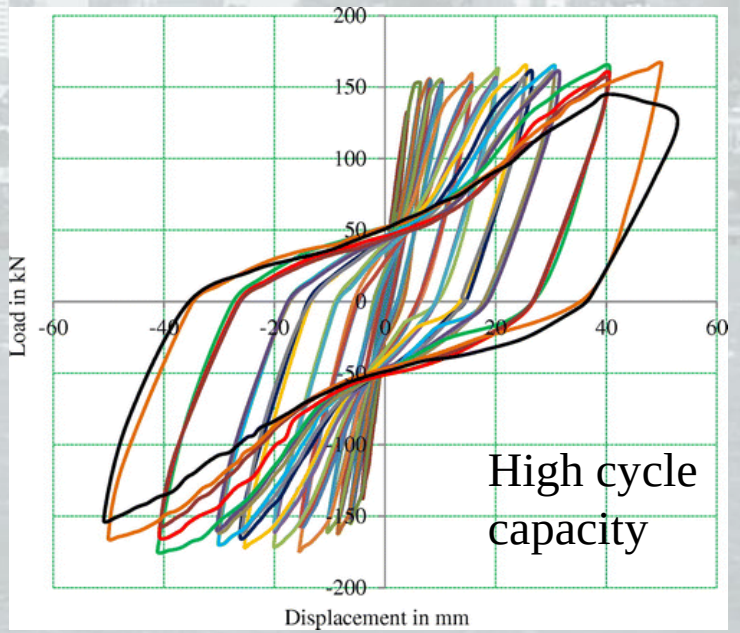
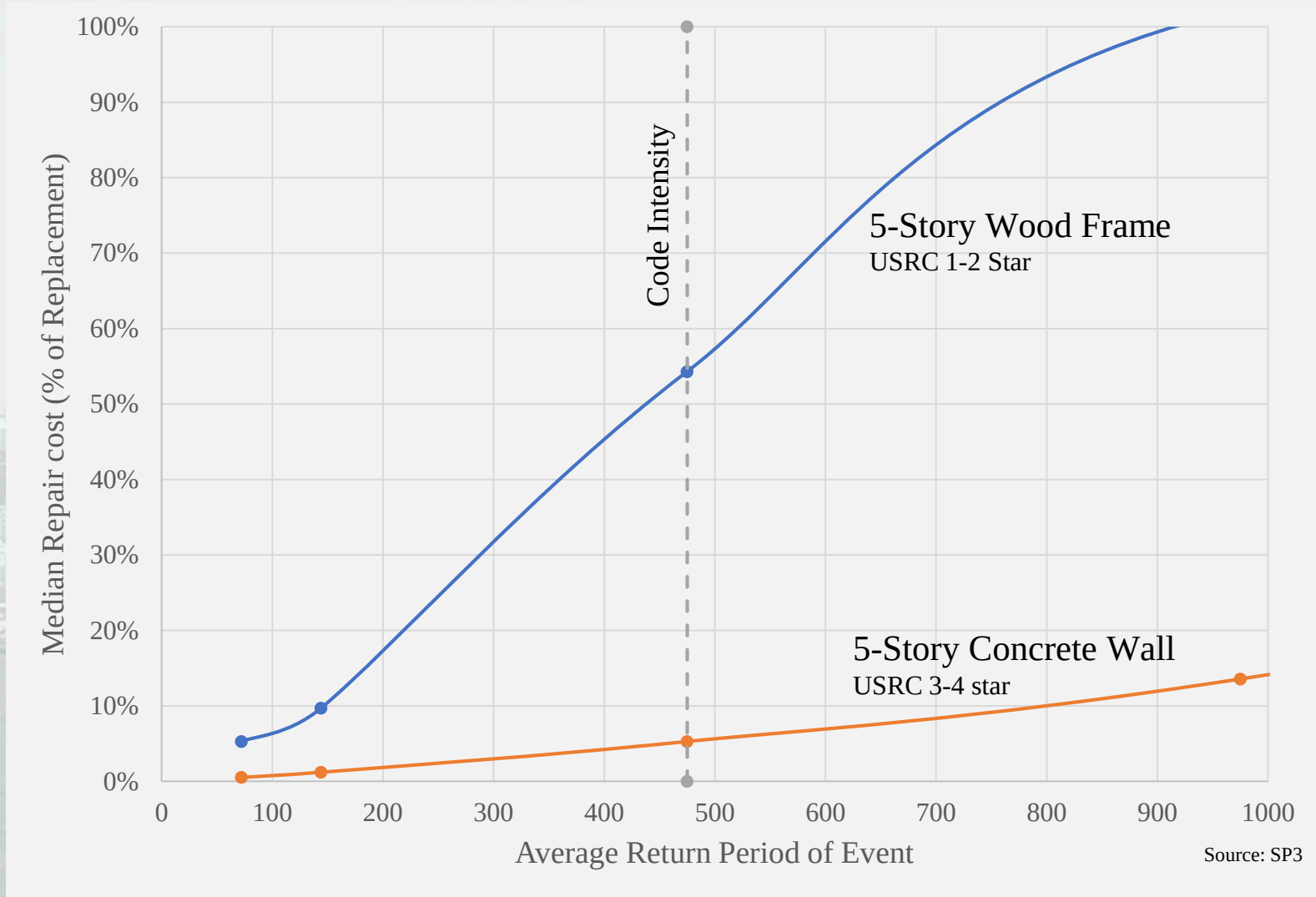


Figure 2-9 – Coupled wall geometry and target yield mechanism.

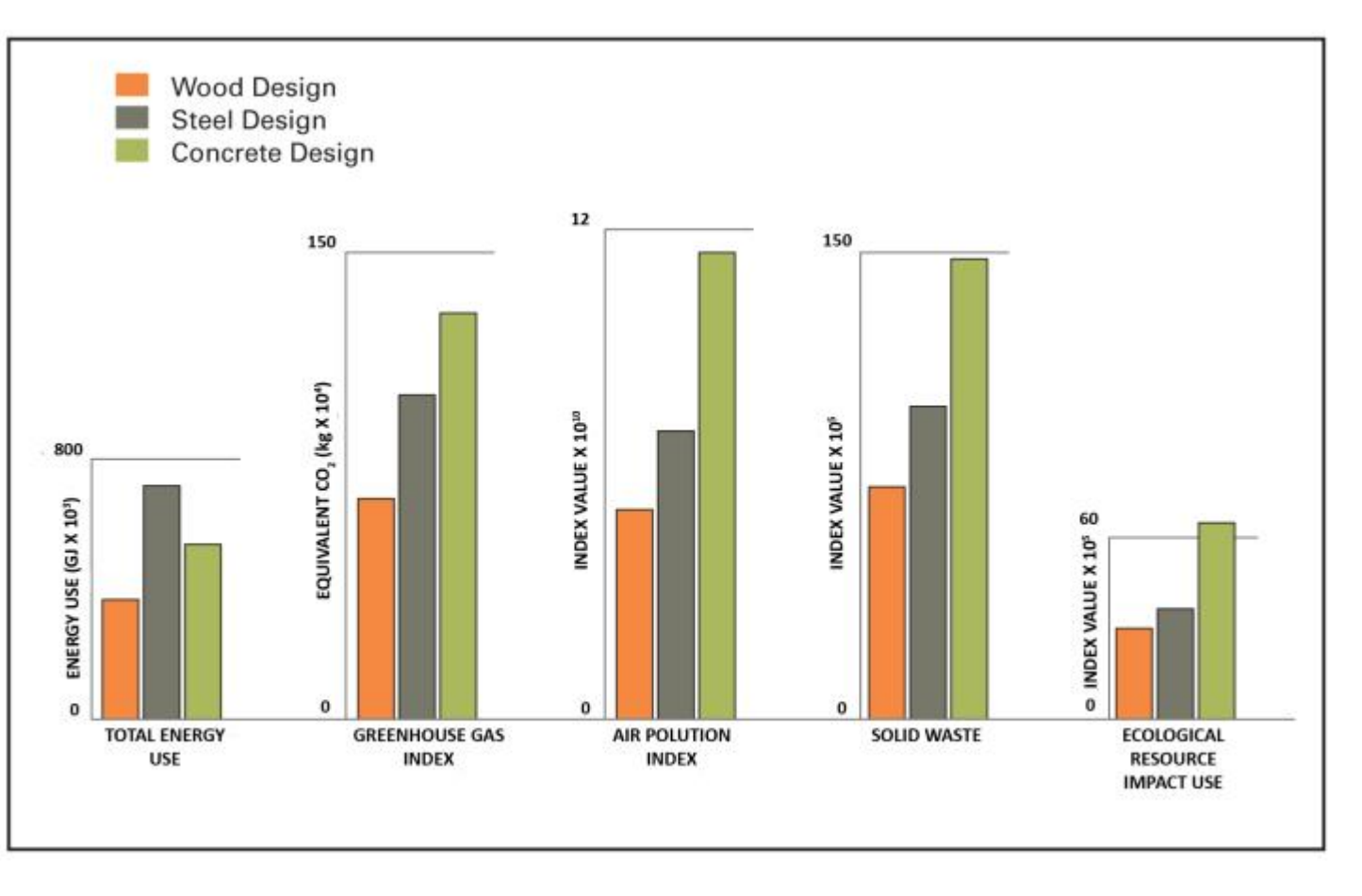




Performance Metrics



Embodied Energy



Source: Construction Materials, 2013

What is Resilience Based Design?

sustainable design…

…is well accepted by the building industry and many in the general public

…is explicitly required by many building owners

…is aspirational but not easily quantifiable

resilient design…

…is not well understood by the public

…is often taken for granted

…is measured by quantifiable metrics

US Resiliency Council

The US Resiliency Council

VISION -

A world in which people have the information they need about how buildings will perform in earthquakes (and other disasters.)

MISSION –

Educate, advocate, and organize to promote better tools for assessing and communicating building performance

Implement rating systems that describe the performance of buildings during earthquakes

ROLES AND RESPONSIBILITIES -

Educate the public to increase market demand for better performing buildings.

Develop consensus among diverse stakeholders and technical experts.

Promote integrity, stability, consistency and transparency of rating systems.

Communicating Performance

Preparation for College

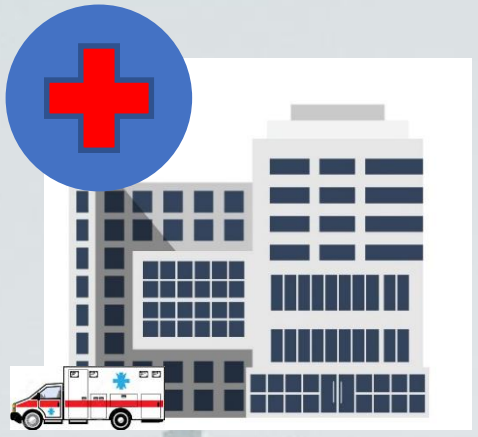
Cleanliness of Restaurants

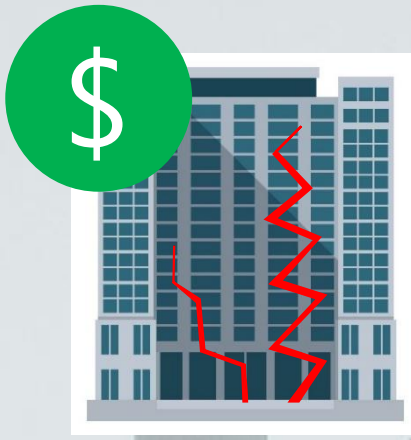
Car Safety

Financial Strength

US Resiliency Council Performance Metrics

USRC BUILDING RATING SYSTEM	SAFETY	DAMAGE	RECOVERY
★★★★★	Blocking exit paths unlikely	Minimal Damage (<5%)	Immediate to Days
★★★★	Serious injuries unlikely	Moderate Damage (<10%)	Within days to weeks
★★★	Loss of life unlikely	Significant Damage (<20%)	Within weeks to months
★★	Isolated loss of life	Substantial Damage (<40%)	Within months to a year
★	Loss of life likely	Severe Damage (40%+)	More than a year





CODE BASED DESIGN

RESILIENCE BASED DESIGN

+0-5% Cost

Modern Codes

What Factors Impact a Building Rating?

Higher Ratings

- Newer buildings
- Higher standards (e.g. hospitals)
- High performing structural systems (e.g. isolation)
- Use of ductile materials
- Distant from hazards
- Good building maintenance

Lower Ratings

- Older buildings
- Obsolete codes
- Low performing structural systems (e.g. unreinforced masonry)
- Use of non-ductile materials
- Near to hazards
- Poor building maintenance

Ratings as Part of Community Resilience

SAFETY ★
DAMAGE ★
RECOVERY ★

SAFETY ★★★
DAMAGE ★★
RECOVERY ★★

SAFETY ★★★★
DAMAGE ★★★
RECOVERY ★★★

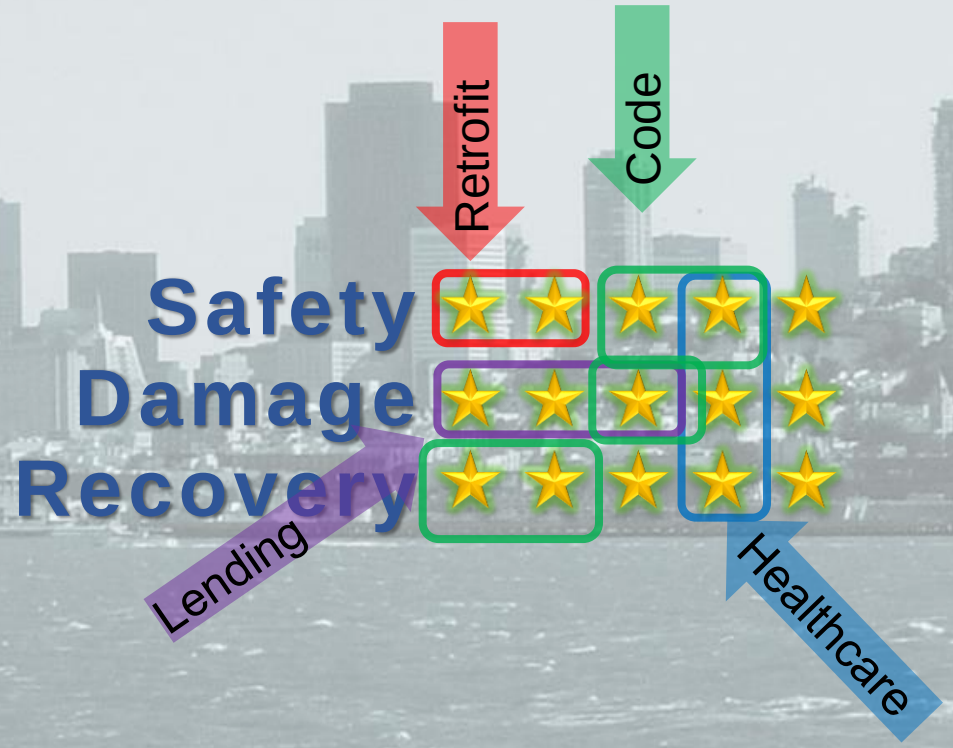
SAFETY ★★★★★
DAMAGE ★★★★★
RECOVERY ★★★★★

The Resilience Management Cycle

USRC Rating Programs

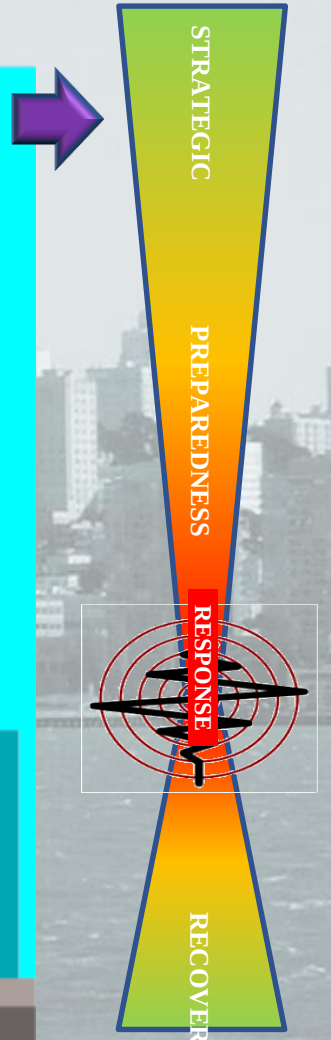
USRC Rating System used to develop community or corporate BUILDING RATING PROGRAMS

Use by	Dimension	Rating
Building Codes	Safety	3 to 4 stars
	Damage	3 stars
	Recovery	2 to 3 stars
Seismic Retrofit	Safety	2 stars minimum
Lenders	Damage	3 stars minimum
Healthcare	Safety	4 stars minimum
	Damage	4 stars minimum
	Recovery	4 stars minimum



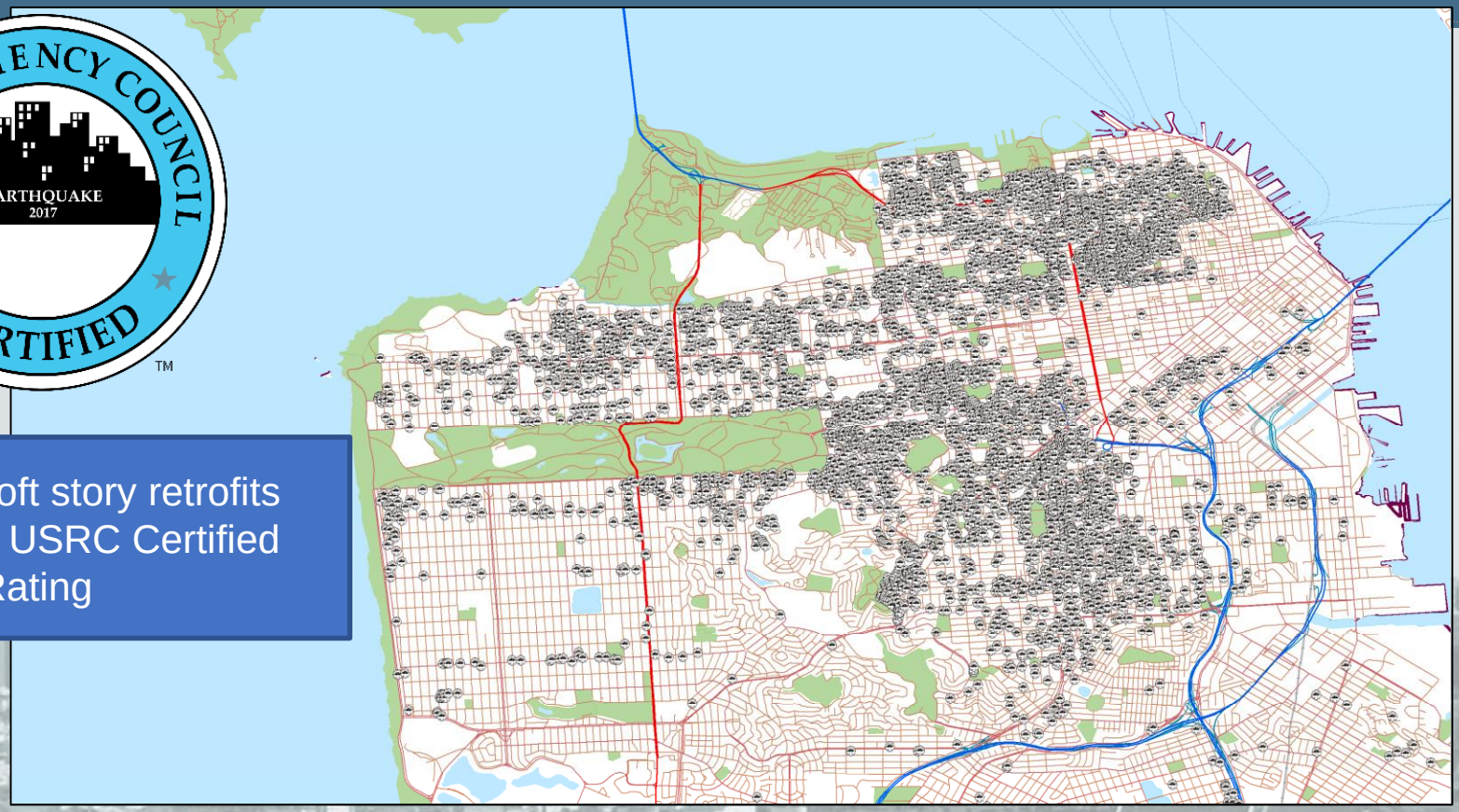
Different organizations have different needs

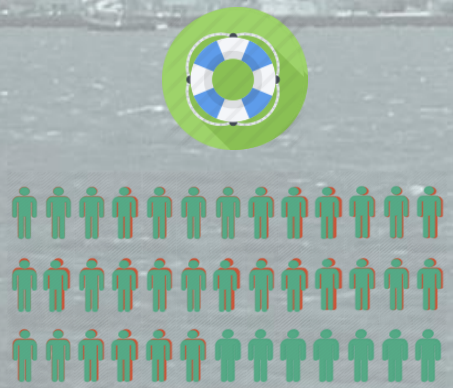
Developing Community Resilience Programs



Measurable Benefits of Retrofit Ordinances

Assuming soft story retrofits comply with USRC Certified Rating





Rating Systems Used to Set Design Objectives

USRC Gold/Platinum

Code Design

1-10%

4-Story Mixed Use Office Building

- **Risk Category III**
- **Precast concrete structural system and cladding is extremely durable**
- **PHMF provides self-righting performance after seismic event**

USRC Rating Results

USRC BUILDING RATING SYSTEM	SAFETY	DAMAGE	RECOVERY
★★★★★	Blocking exit paths unlikely	Minimal Damage (<5%)	Immediate to Days
★★★★	Serious injuries unlikely	Moderate Damage (<10%)	Within days to weeks
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★★	Isolated loss of life	Substantial Damage (<40%)	Within months to a year
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City and Statewide Performance Data

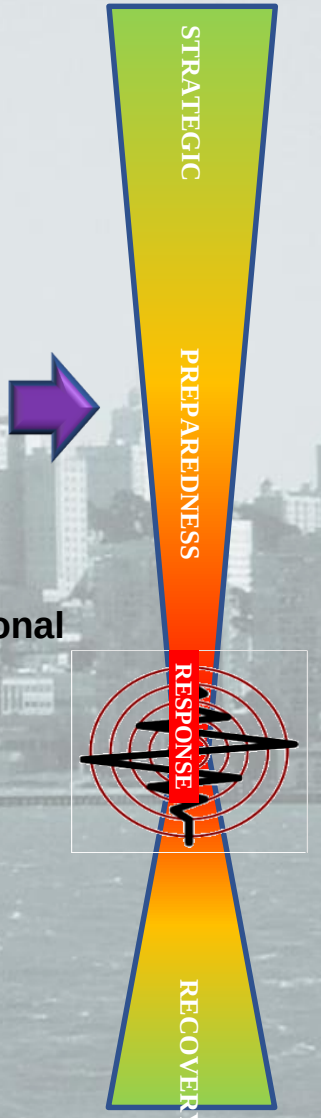
- Ratings for new buildings
- Performance criteria for new critical infrastructure
- Inventory of existing buildings
- Ratings provided in real estate disclosures

Housing

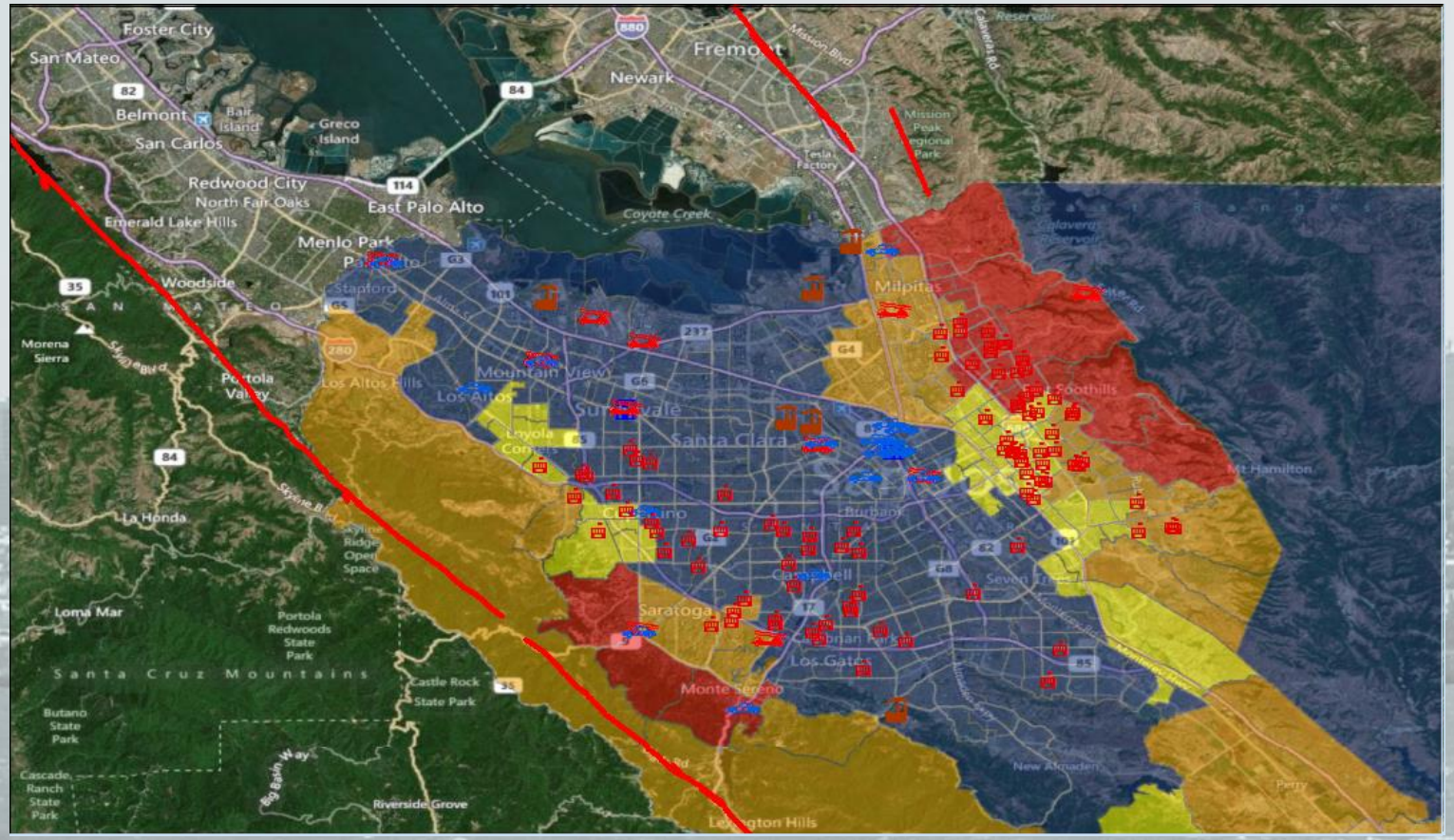
Food

Schools

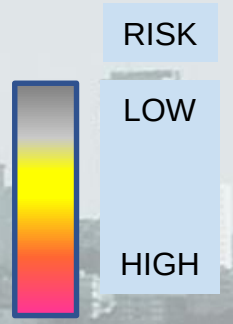
- Functional
- Not Functional

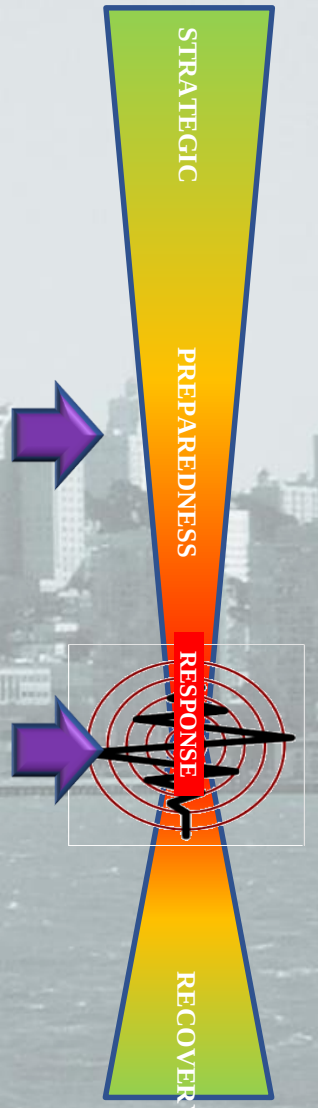


Disaster Response Planning

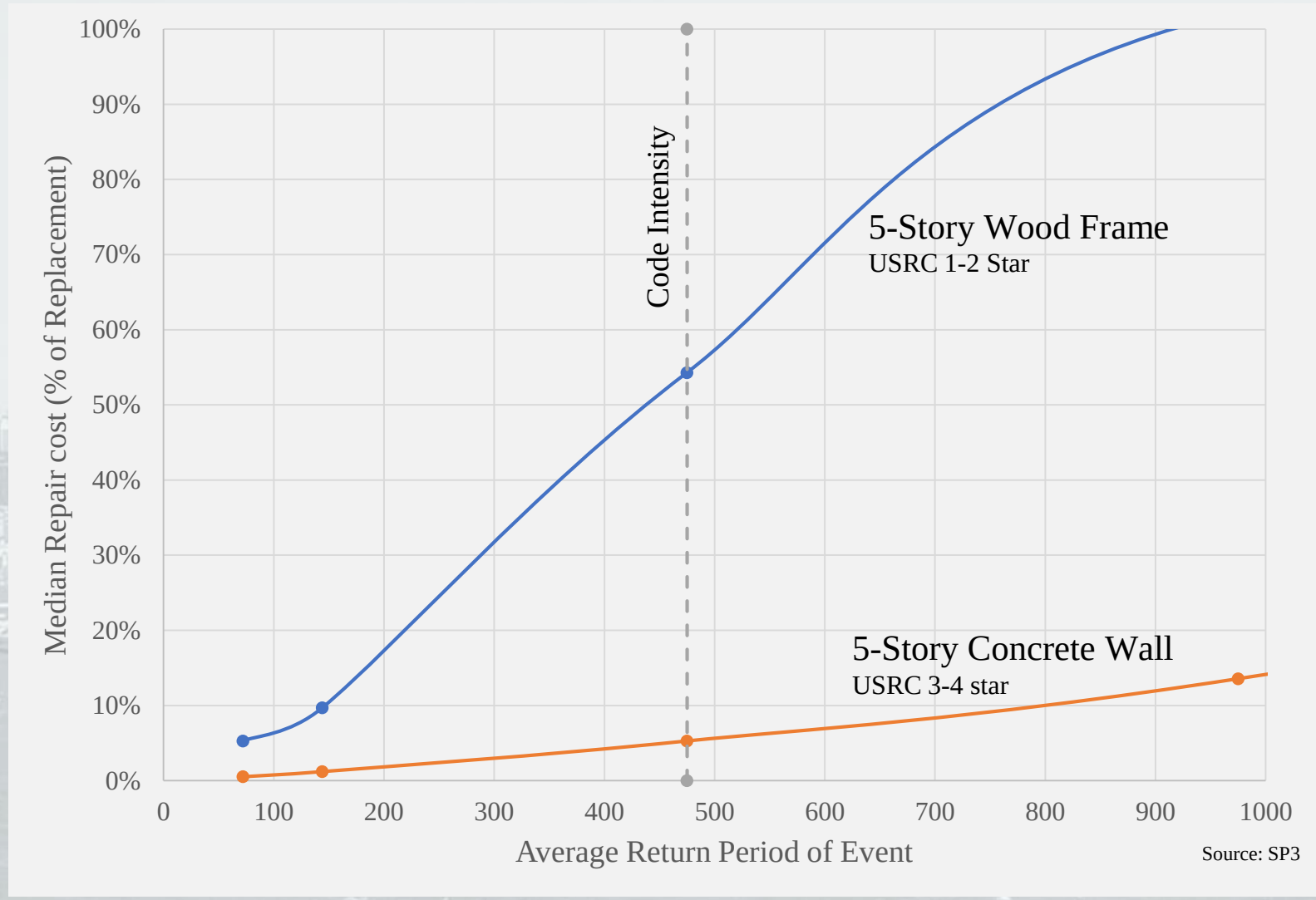


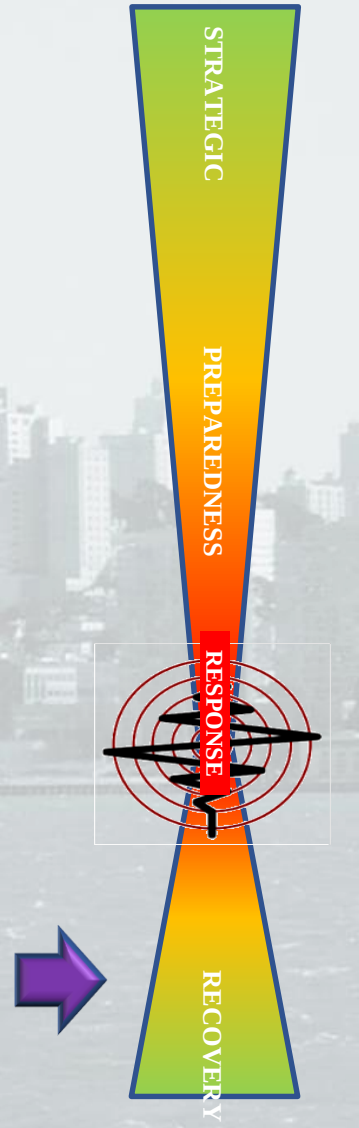
Essential Facilities – Earthquake Risk





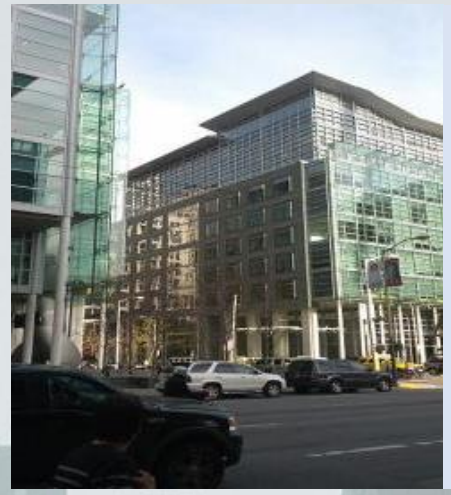
Performance Metrics





Increasing Market Demand for Better Performance

San Francisco



Tenants pay 0% for enhanced seismic designs, but will pay 15% to 20% more for modern systems, LEED rating, etc.

Tokyo

In Tokyo, 1970's buildings are being torn down, because new buildings with the latest anti-seismic features command rents 40% higher.

The Seismic Resilience Initiative

What is the Seismic Resilience Initiative?

The focus of SRI is to help cities identify buildings that could crumble or collapse under the massive ground force of a major quake.

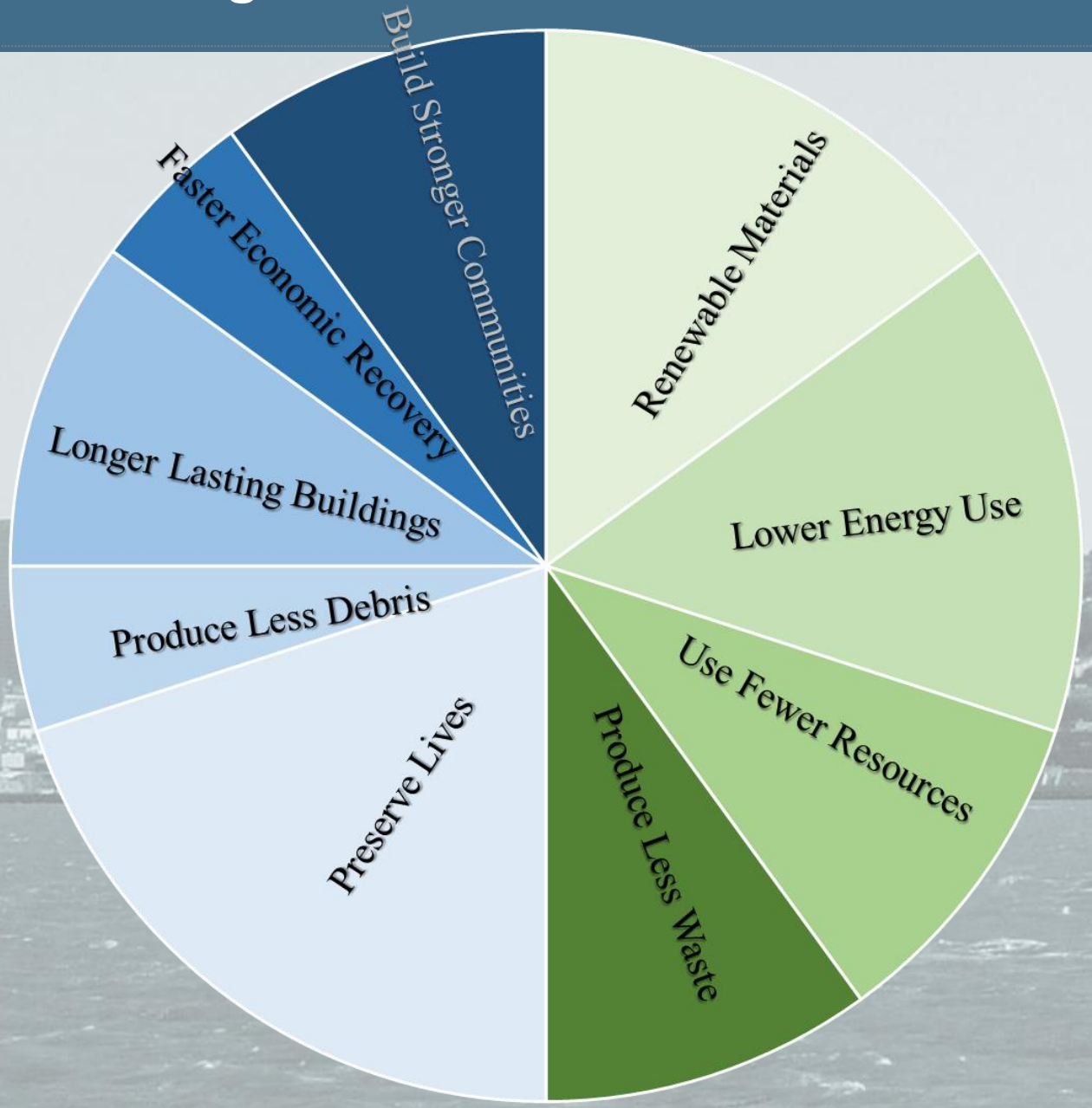
Soft-Story

Unreinforced Masonry

Nonductile Concrete & Steel Moment Frame

Older Tilt-Up

“Green” and Resilient Design are Two Sides of Sustainability



US Resiliency Council's Reach

- White House Summit on Resilient Building Codes
- Pew Trust signatory on flood ready standards
- AIA Industry Statement on Resilient Design
- Founding member – Alliance for National and Community Resilience
- Leading developer of earthquake performance rating systems nationwide
- Collaboration with Los Angeles, San Francisco, Portland and Seattle on resilience efforts

USRC Membership – An Opportunity to Demonstrate Your Support

Membership Category	Annual Membership Fee
Platinum	$20,000
Gold	$10,000
Silver	$5,000
Bronze	$3,000
Individual	$500

Thank You!

For more information on

The USRC, Ratings and Membership

www.usrc.org

www.usrc.org/membership