Resilient Retrofits Report
From ULI’s Urban Resilience Program

How can we prepare existing buildings for accelerating physical climate risks?

What role can real estate actors, designers, policymakers, and finance professionals play in the process?

Report includes:

- The business case for resilient retrofits
- A summary of design strategies for each physical climate risk
- A selection of public-sector policies influencing the retrofit context
- An array of financing solutions applicable to retrofits

Available Now on Knowledge Finder
A Few Housekeeping Announcements

- Participants will remain muted through the duration of the webinar
- Submit your questions through the Zoom Q&A function
- This webinar is being recorded and will be sent to registrants shortly, and uploaded to ULI’s Knowledge Finder platform
Speaker Introductions

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Founder & Principal
Public Square

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Risk & Resilience Practice Leader
Arup

Mary Witucki
Community Education and Outreach Program Lead
FEMA Region 9
Why is Resilience Important to CRE Facing Climate?

- Risks from extreme weather are here
- Resilience planning is urgent and a key component of risk management
- Risk information already includes climate related risks
- Climate change is already having an increasing impact on building values
- Resilience has become a competitive advantage
- Building owners that can have been implementing measures to mitigate flood and fire risk
- “Climate risks are investment risk.”
Resilience Program Roadmap

Year 1
- Establish resilience program goals and strategies

Year 2
- Perform portfolio risk assessments to understand portfolio risks

Year 3
- Perform additional onsite risk assessments for high-risk properties

Year 4
- Invest in fortification strategies. Ensure optimal operation practices

Year 5
- Make buildings more resilient and self-reliant. Resilient distributed energy systems

Year 6
- Public, Private, Partnerships. Seek Solutions that benefit the entire region
Resilience Risk Categories for Real Estate

We recommend assessing key portfolio risks through the following categories in alignment with the GRESB Real Estate Assessment and the Task Force for Climate Related Financial Disclosures (TCFD). A resilience risk assessment can help to identify and mitigate key physical, social and transition risks.

**PHYSICAL**
Reduce disruption to building operations in the case of extreme weather events or long-term shifts in climate patterns.

**SOCIAL**
Develop and operate buildings that are safe and promote the health and well-being of our building occupants and the livelihoods and prosperity of the local communities.

**TRANSITION**
Reduce the entity’s and building’s exposure to climate-related transition risks such as changes in energy costs and enhanced energy and emissions reduction and reporting laws.
ASSESS RISK & VULNERABILITY

• PERFORM RISK ASSESSMENTS
  physical, social and transition risks. Includes existing assets, new acquisitions, new developments & loan origination

• Budget for and PERFORM ADDITIONAL ON-SITE RISK ASSESSMENTS FOR HIGH-RISK ASSETS

• Due Diligence for New Acquisitions

MAKE A PLAN

• Develop & implement a RESILIENCE PLAN
  Establish goals and targets

• Evaluate risk assessment results

• INCORPORATE PRIORITY RESILIENCE MITIGATION MEASURES INTO ANNUAL BUDGETS

• UPDATE PROPERTY LEVEL EMERGENCY PLANS

• Check INSURANCE COVERAGE

IMPLEMENT RESILIENCE STRATEGY

• IMPLEMENT RESILIENCE MITIGATION MEASURES

• Educate stakeholders on the EMERGENCY PREPAREDNESS

• Track financial impacts of climate risks

• REPORT RESILIENCE PROGRAM PROGRESS and updates to GRESB, TCFD & Annual ESG reports

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## Plan: Resilience & Emergency Planning

<table>
<thead>
<tr>
<th>SITE</th>
<th>STRUCTURE</th>
<th>SYSTEMS</th>
<th>OPERATIONS</th>
<th>PEOPLE</th>
</tr>
</thead>
<tbody>
<tr>
<td>Create Cool Ground Surfaces</td>
<td>Use Cool Roofing</td>
<td>Create Resilient Heating, Cooling, and Ventilation Systems</td>
<td>Protect Records and Inventory</td>
<td>Plan for Building Occupant Needs</td>
</tr>
<tr>
<td>Flood proof Buildings</td>
<td>Enhance Building Insulation</td>
<td>Manage Heat Gain</td>
<td>Secure Interior Environment</td>
<td>Identify Mutual Aid Resources</td>
</tr>
<tr>
<td>Use Hazard Resilient Landscape Design</td>
<td>Manage Heat Gain</td>
<td>Prevent Wind, Water, Fire Damage</td>
<td>Train Building Owners for Resilience Upgrades</td>
<td></td>
</tr>
<tr>
<td>Provide Shade</td>
<td>Protect mechanical systems</td>
<td>Identify Resilient Water Systems</td>
<td>Protect Chemical Storage</td>
<td></td>
</tr>
<tr>
<td>Stabilize Slopes Susceptible to Erosion, Landslide, Fire</td>
<td>Prevent Wind, Water, Fire Damage</td>
<td>Extend Emergency Lighting and Services</td>
<td>Secure Potable Water</td>
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<tr>
<td>Use Soft/Green Infrastructure to Prevent Flooding</td>
<td>Protect mechanical systems</td>
<td></td>
<td></td>
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</tbody>
</table>

### Plan Components

- **SITE**
  - Flood-proof Building Site
  - Create Cool Ground Surfaces
  - Flood proof Buildings
  - Use Hazard Resilient Landscape Design
  - Provide Shade
  - Stabilize Slopes Susceptible to Erosion, Landslide, Fire
  - Use Soft/Green Infrastructure to Prevent Flooding

- **STRUCTURE**
  - Enhance Structural Elements for Extreme Loads
  - Use Cool Roofing
  - Enhance Building Insulation
  - Manage Heat Gain
  - Prevent Wind, Water, Fire Damage
  - Protect mechanical systems

- **SYSTEMS**
  - Ensure Back-Up Power and Systems
  - Create Resilient Heating, Cooling, and Ventilation Systems
  - Identify Resilient Water Systems
  - Extend Emergency Lighting and Services

- **OPERATIONS**
  - Have Emergency Plans
  - Protect Records and Inventory
  - Secure Interior Environment
  - Train Building Owners for Resilience Upgrades
  - Protect Chemical Storage
  - Secure Potable Water

- **PEOPLE**
  - Locate Vulnerable Populations
  - Plan for Building Occupant Needs
  - Identify Mutual Aid Resources
Top Building level Resilience Solutions in CRE

- **Backup Power** – solar, high ground generators, etc.
- **Building Electrification & Renewable Energy**
- **Emergency Management** – Property team training on using emergency systems and available backup systems
- **Record Protection** – Protect records and inventory
- **Backup** – Guarantee food & water availability
- **Flood Proof** – Protect building from flood including temporary flood barriers, sandbags & dewatering pumps
- **Resilient Power Availability** – Maintain high ground/protected from flooding
- **Safety** – Ensure compliance with the latest structural/fire codes
- **Emergency Command** – Establish emergency communications and command system
- **Structure** – Enhance structural elements for extreme loads
- **Transition Risks** – Consider future risks to asset value including reduction in capital availability and repricing of "brown" assets
- **Landscape** – Integrate hazard resistant landscape design

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Public Private Partnerships
To Protect Regional Coastal Areas

EXISTING  PHASE 1  COMPLETED

New York dry line project

Boston’s | Resilient Boston Harbor: Downtown

Oma’s Proposed Hoboken Waterfront

The Netherlands’s Sea Wall

Flood Map - Existing & potential

Rotterdam Storm Surge Barrier

SOURCE: PARKWAY PROPERTIES  © 2022 VERDANI, LLC / PROPRIETARY AND CONFIDENTIAL
Public Private Partnerships
Implemented Resilience Measures | Parkway & Hurricane Harvey


Cat 4 Hurricane Harvey

On Site Teams

Dewatering Pumps

Flood Gates

$125 billion in damage
No insurance claims for PKY

On site team prevented further damages during storm

Previously installed pumps ran full time as needed

Installed to protect underground spaces

SOURCE: PARKWAY PROPERTIES © 2022 VERDANI, LLC / PROPRIETARY AND CONFIDENTIAL
SEA-LEVEL RISE & FLOODING MITIGATION

- Developed in 2018, Pier 4 is a 13 story, LEED Gold, trophy asset in Boston’s dynamic Seaport District.
- The building is surrounded by three sides of waterfront exposure, located in Special Flood Hazard Zone AE.
- Mitigation measures were studied and implemented. Critical building services are located on the roof or mezzanine level.
- The property deployable flood mitigation protection barrier called FloodWall by AquaFence®.
- The four-foot-tall wall is designed for rapid deployment around the building within eight hours of a pending flood event and can be packed and stored in a minimal amount of space.
- The FloodWall has a protective shield designed to withstand impact from moving debris. Through annual emergency training, this wall is assembled to ensure all building staff can install the wall entirely around the premises of the property.
Insurance Institute for Business and Home Safety (IBHS) FORTIFIED™ is a national standard for resilient construction.

The standard indicates cost-effective measures that make homes more resilient.

For instance, “Continuous Load Path” standards reinforce attachment of roof to walls and walls to floors to reduce wind damage.

FORTIFIED™ Gold-rated houses are expected to withstand EF-0, EF-1, and many EF-2 tornadoes.

The cost of new home compliance with FORTIFIED standards ranges from zero to 3 percent of hard costs. Retrofits generally cost 18 to 24 cents per square foot.

- In Mississippi, it costs $3,000-5,000 more per 1,800 square foot home to build to FORTIFIED Gold.
- In Florida, where building codes require more resilient features, the additional effort to reach Gold costs $1,000 more per 1,800 square foot.

FORTIFIED homes have an average 7% increase in resale value.

Due to regulations in some states, insurance premiums are reduced for FORTIFIED homes.

- Alabama up to 55%; Oklahoma up to 42%; North Carolina up to 19%.
“For Every Dollar Invested in Climate-Resilient Infrastructure Six Dollars Are Saved”,
Secretary-General Says in Message for Disaster Risk Reduction Day

“The estimated cost of meeting the toughest 1.5C climate target is about $0.5tn over the next 30 years but will save the world $30tn in damages,”
Marshall Burke, assistant professor at Stanford University
Organizations ask us…

1. Which hazards should I be concerned with and how do we measure their impacts on my assets, people, and business?

2. Which physical and operational interventions should my organization prioritize?

3. How do I make a business case for investing in resilience?
Roadmap to Resilience

Evaluation of baseline risk

Prioritize actions + investment

Develop resilience strategies

Implementation
What is risk?

- Utility disruption
- Damage and repair costs
- Downtime and lost revenues
- Injuries and fatalities
- Inventory loss
- Health and wellness
- Climate migration
How do you calculate risk?

How likely is a hazard event to occur and what is the intensity?

What are the quantities, locations, values of exposed assets and people?

How damageable are the exposed assets and how vulnerable are the people?
What are the different types of risk analysis?

<table>
<thead>
<tr>
<th>Risk Assessment Classes</th>
<th>1</th>
<th>2</th>
<th>3</th>
<th>4</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>General Description</strong></td>
<td>High level risk screening assessment</td>
<td>Baseline risk analysis</td>
<td>Risk modeling</td>
<td>Advanced risk modeling</td>
</tr>
<tr>
<td><strong>Application</strong></td>
<td>Screening for Class 2 risk analysis Site selection / Due diligence Awareness</td>
<td>Screening for Class 3 or 4 risk modeling Site selection / Due diligence Risk-informed decision-making</td>
<td>Identification of components driving risk Component-specific risk mitigation Cost-benefit analysis and insurance optimization</td>
<td>Identification of components driving risk Component-specific risk mitigation Cost-benefit analysis and insurance optimization Resilience-based design of new buildings</td>
</tr>
<tr>
<td><strong>Recommended scale</strong></td>
<td>100's to 1,000's of buildings</td>
<td>10's to 100's of buildings</td>
<td>10's of buildings</td>
<td></td>
</tr>
<tr>
<td><strong>Accuracy / Confidence</strong></td>
<td>Low</td>
<td>Medium</td>
<td>High</td>
<td>Very High</td>
</tr>
</tbody>
</table>
Cost-benefit analysis workflow
(the quantifiable part of the business case)
Hazard data
Exposure data
Vulnerability data

Risk model

Risk Engine simulations

Existing building

Building deficiencies
Probabilistic risks/losses
Hazard data
Exposure data
Vulnerability data

Existing building
Risk model
Risk Engine simulations

Building deficiencies
Probabilistic risks/losses

Retrofit designs
Hazard data
Exposure data
Vulnerability data

Risk model
Existing building
Risk Engine simulations
Building deficiencies
Probabilistic risks/losses

Retrofit designs

Option 1: Baseline retrofit
Option 2: Enhanced retrofit
Option 3: Full renewal
Option 4: Replacement

Retrofit scope
- $ - $$$$ 
- Schedule
Hazard data → Exposure data → Vulnerability data → Risk Engine simulations → Retrofit designs

Retrofitted building → Risk model → Risk Engine simulations → Building deficiencies → Probabilistic risks/losses

Retrofit reduces vulnerability

Retrofit designs

Option 1: Baseline retrofit
Option 2: Enhanced retrofit
Option 3: Full renewal
Option 4: Replacement

Retrofit scope
- $ - $$$$  
- Schedule
Hazard data
Exposure data
Vulnerability data

Retrofit designs

Retrofitted building
Risk model

Risk Engine simulations

Building deficiencies
Probabilistic risks/losses

Retrofit impacts
• Reduced risk
• Asset life extension
• Disruption of operations

Option 1: Baseline retrofit
Option 2: Enhanced retrofit
Option 3: Full renewal
Option 4: Replacement

Retrofit scope
• $ - $$$$  
• Schedule

Retrofit scope

Re-assess risks
Hazard data
Exposure data
Vulnerability data

Retrofit designs

Retrofitted building
Risk model

Risk Engine simulations

Building deficiencies
Probabilistic risks/losses

Retrofit impacts
- Reduced risk
- Asset life extension
- Disruption of operations

Retrofit scope
- $ - $$$$ 
- Schedule

Cost-Benefit Analysis Engine

Outcomes:
- BCRs + payback periods
- Residual risks
- Prioritization strategy + optimized renovation per building

Option 1: Baseline retrofit
Option 2: Enhanced retrofit
Option 3: Full renewal
Option 4: Replacement
Welcome to the Arup Resilience Payback Calculator, a tool that enables building owners and developers to explore the benefits of investing in resilience. Please answer the following questions to discover whether extra investment in resilience can yield positive returns. Use of this tool should not take the place of detailed structural analyses and financial calculations.

1. Where is the building located?
   Earthquake hazard varies depending on location. Please select a location from the list below so we can more accurately determine the expected earthquake losses and downtime for the building.
   - Vancouver

2. What is the building occupancy?
   Please select the building’s primary occupancy from the list below. We will use this information to determine the value of the building and the cost of downtime. If desired, these values can be adjusted later.
   - Academic

3. How large is the building?
   Please provide the approximate gross area of the building in square feet.
   - 200000 sq ft
   - 800000 sq ft

The extra investment in resilience will pay for itself within 23 years.

Cost of standard building vs. resilient building over time (in millions)

- Standard building
- Resilient building
Real estate resilience framework | University of British Columbia resilience study

- Outlines tolerable risk targets and translates to building performance
- Specifies building performance objectives for new and existing buildings
- Specifies triggers for building retrofit and renewal

- Specifies design criteria to achieve policy objectives
- Specifies risk analysis criteria
FEMA listened to local practitioners across the United States.

- Approximately 30 practitioners from various communities.
- Best practices and strategies they use to design and implement building retrofit programs.
Common Challenges:

- Managing funding
- Understanding community perspectives
- Designing a program
- Supporting partnerships
- Communicating program goals
Managing Funding
“What funding is available? What is required?”

- Project Requirements
  - Cost of each retrofit
  - Time required for each retrofit
- Funding Requirements
  - Processes
  - Timelines
  - Commitments

- Scope accordingly based on requirements and team capacity.

“Build relationships with funding source contacts and communicate often. Work together to streamline program processes.”

ADVICE FROM A PRACTITIONER:
Learn from everyone around you. Talk to other communities and find out how they found and managed funding. Use all of your options for help.

— Laura Nelson, Senior Emergency Management Planner, Office of Emergency Management, Flagler County, Florida

Urban Land Institute
Understanding Community Perspectives

“We must work to understand the variety of factors and recognize how they overlap and intersect to affect an individual’s position, access, and resources.”

▪ Identify potential barriers
  ▪ Capability
  ▪ Motivation
  ▪ Opportunity

▪ EAST Framework
  ▪ Easy, Attractive, Social, Timely

“Who are the participants? What is important to them?”
Program/Policy Design

“Where to start? How to right-size?”

- **Goals**
  - Few & focused

- **Tips for effective policy**
  - Keep it simple
  - Communicate
  - Be flexible
  - Ensure stability and reliability
  - Elevate equity

- Establish clear design/construction standards that can be evaluated when each retrofit is complete.

“Programs centered on ensuring equity will help avoid unintentionally creating additional barriers that exclude or marginalize those who already have fewer resources and assistance available to them.”

ADVICE FROM A PRACTITIONER:
Reach out to other communities to see how they did their programs, and base new programs on those by tailoring it to your community needs. There is no need to reinvent the wheel and make more work for yourself than necessary.

— Tanya Davis-Hernandez, AICP, Director of Development Services, City of Lauderdale Lakes, Florida
Supporting Partnerships

“What partners are available to support the program?”

- Market Profile
  - Contractors/Inspectors
  - Materials suppliers
  - Insurance agents

- Community Partners
  - Associations/groups
  - Leaders

- Implementation Team
  - Planning/building departments
  - Communications/outreach
  - Training

“Retrofit programs are often administered by small teams in low-capacity departments. They survive by building strong partnerships with other city departments, agencies, and private sector businesses.”

ADVICE FROM A PRACTITIONER:
Don’t sit on payments. Get them out to your partners as soon as you can. If jurisdictions do not pay contractors in a timely manner, they may have had to front thousands of dollars to do the retrofit work for the homeowner. Contractors, especially small contractors, are not able to sustain this. This is one way that communities could lose good contractors. If they don’t get paid on time, the program might not be sustainable for them and they will drop out.

— Vicki White, Housing and Community Development Manager, City of Bradenton, Florida
Communicating Program Goals

“How to gather support, buy-in, and participation?”

- Program Engagement Lessons Learned
  - Start small
  - Be creative
  - Build trust
  - Rely on success

- Keep a service-oriented mindset
  - Providing high-quality service is integral for a sustainable and successful program.

“Take advantage of diverse expertise and create a cross-departmental agreement, where one department hosts the program and serves as a ‘one-stop shop’ and others provide services and assistance.”
Keys to Successful Programs:

- Meet people where they are
- Set clear expectations
- Build strong, diverse partnerships