Better Buildings Residential Network Peer Exchange Call Series:

DISASTER! Resilience and Adaptation Pre- and Post-Disaster

September 26, 2019

Agenda and Ground Rules

- Agenda Review and Ground Rules
- Opening Poll
- Residential Network Overview and Upcoming Call Schedule
- Featured Speakers:
  - **Greg Hopkins**, Rocky Mountain Institute
  - **Erik Schmidt**, City of Chattanooga, TN
  - **Laurie Schoeman**, Enterprise Community Partners
- Open Discussion
- Closing Poll and Announcements

Ground Rules:

1. **Sales of services and commercial messages are not appropriate** during Peer Exchange Calls.
2. Calls are a safe place for discussion; **please do not attribute information to individuals** on the call.

The views expressed by speakers are their own, and do not reflect those of the Dept. of Energy.

Better Buildings Residential Network

Join the Network

Member Benefits:

- Recognition in media and publications
- Speaking opportunities
- Updates on latest trends
- Voluntary member initiatives
- One-on-One brainstorming conversations

Commitment:

- Members only need to provide *one number*: their organization's number of residential energy upgrades per year, or equivalent.

Upcoming Calls (2nd & 4th Thursdays):

- Oct 10: Why Good Contractors Are Hard to Find – The Green Workforce Shortage
- Oct 24: Health and Energy Efficiency Are Trending
- Nov 14: Window Treatments – The Undervalued Highly Efficient Energy Efficiency Measure

Peer Exchange Call summaries are posted on the Better Buildings website a few weeks after the call

For more information or to join, for no cost, email bbresidentialnetwork@ee.doe.gov, or go to energy.gov/eere/bbrn & click Join

Greg Hopkins

Rocky Mountain Institute

U.S. DEPARTMENT OF ENERGY

Introducing “Hours-of-Safety”

Greg Hopkins
Rocky Mountain Institute
September 26, 2019

Topics to cover

- Implications of extreme weather events
- Connecting home performance and resilience
- What are “Hours-of-Safety”?
- Potential use cases
- Next steps

Heat waves and polar vortexes continue to claim lives

More than 90 deaths now linked to heat wave in Quebec

Amid Heat Wave in New York, 50,000 Lose Electricity

U.S. • WEATHER

21 People Died in Weather-Related Incidents During the Polar Vortex

Sources: Woods, Allen, The Star, July 18, 2018; Watkins, Ali and Ashley Southall, New York Times, July 21, 2019; Gajanan, Mahita, TIME, February 1, 2019.

With extreme weather, power outages exacerbate risks

- Average power outages are between 8 and 20 hours, but can last multiple days
- Between January and June 2019, over 2.9M customers were out of power for a total of 684 hours as a result of severe weather
- Low-income households, elderly, children, and those with medical conditions are especially vulnerable to extreme temps

Source: “Polar Vortex death toll rises to 21 as US cold snap continues,” BBC, February 1, 2019

The critical question:

How long can a home maintain a safe temperature before conditions inside the home match the extreme conditions outside the home?

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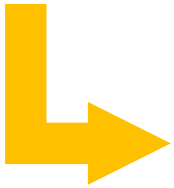
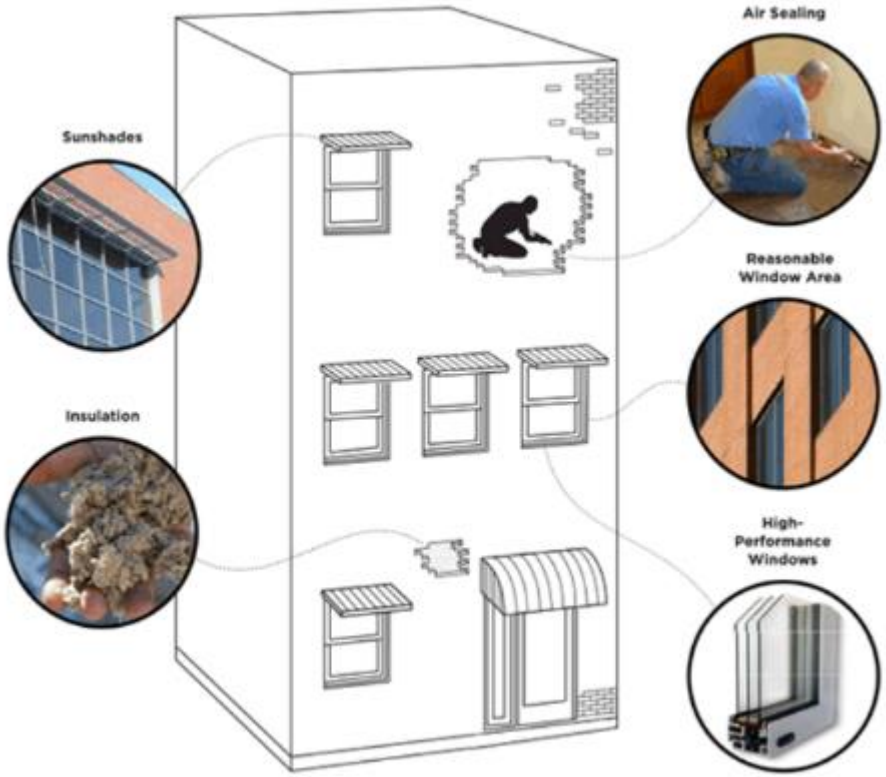
How long can a home maintain a safe temperature before conditions inside the home match the extreme conditions outside the home?



“Hours-of-Safety”
metric
(to be defined)

Resilience in homes often misses the ‘envelope factor’

- Resilience topics often refer to solar, storage, microgrids, etc
- But for most homes, key considerations in high △T situations come down to:
  - Insulation levels
  - Window types and WWRs
  - Infiltration
  - Ventilation
- Similar concepts exist (e.g. passive survivability) but no tangible metric has emerged



Design elements relevant to improving “hours-of-safety”

Graphic source: Leigh, Richard, et. al “Baby It’s Cold Outside”, Urban Green Council, 2014

HOS can unlock more interest/investment in home performance

Policymakers

- City, state and federal policymakers can use HOS to better plan for public health and safety (e.g. shelter-in-place vs evacuation)
- Can drive FEMA prevention dollars into home energy performance, improving the housing stock
  - Every $1 spent on prevention saves society $6 on emergency response

Consumers

- HOS can become a new ‘hook’ to understand why envelopes matter and care about / invest in EE (also true for policymakers)
  - Easier for many to grasp HOS concept than building science

Industry

- Can leverage the above to better pitch services / close sales to consumers and equip cities to be more strategically resilient

Next steps

- Modeling impacts of building envelope improvements on indoor temperatures in high △T scenarios to further develop concept
- Identify interest in and potential applications for this concept
- If you're working on a related topic and/or have ideas for collaboration, we'd love to hear from you!
  - Please reach out to Sneha at RMI: sayyagari@rmi.org
- Check out our recent blog on this topic: https://rmi.org/how-many-hours-of-safety-do-our-homes-have-in-extreme-weather/


Thank you! Questions?
Suggestions? Feedback?
Greg Hopkins
ghopkins@rmi.org
ROCKY MOUNTAIN INSTITUTE

Erik Schmidt

City of Chattanooga, TN

U.S. DEPARTMENT OF ENERGY

DISASTER! Resilience: Adjusting & Adapting Pre- and Post-Disaster

Strategies from a Mid-Sized City in the Southeast U.S.

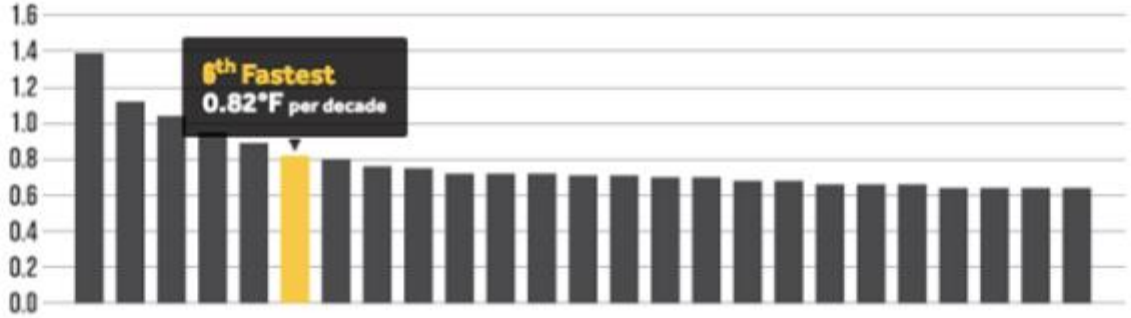
Setting the table: Resilience Challenges in the South

- Chattanooga is 6th fastest-warming city in the U.S. (4.11 degrees F, 1970-2018)
- Changing weather patterns that lean to the extremes (drought, fires, floods)
- Heat island effect in low-income neighborhoods + aging housing stock
- Regional income inequality despite some of the fastest rising incomes in U.S.
- Growing population adding stress to aging infrastructure and natural resources
- Federally-owned utility with no state-wide renewable portfolio standards

Hot and Getting Hotter

The top 25 hottest and fastest-warming cities

Which are the hottest? | Fastest-warming



STATES AT RISK

AMERICA'S PREPAREDNESS REPORT CARD

TENNESSEE

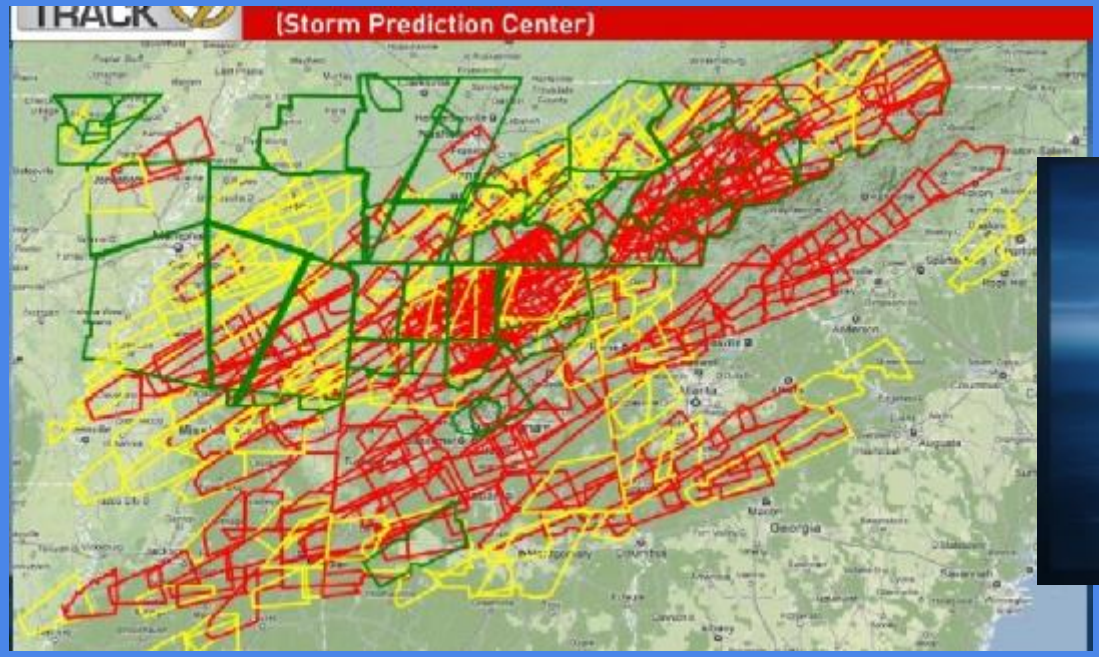
OVERALL GRADE:

C

OVERALL: C	
EXTREME HEAT:	C+
DROUGHT:	C+
WILDFIRE:	C+
INLAND FLOODING:	D
COASTAL FLOODING:	–

Tennessee faces considerable and significantly increasing threat levels from extreme heat, drought, wildfire, and inland flooding between now and 2050. Tennessee scores an overall grade of C on the Report Card, with grades ranging from a D for inland flooding to a C+ for extreme heat, drought, and wildfire. The grades are relative to other states, and relative to the magnitude of the climate threats themselves. Tennessee has taken ***strong action*** to address its current climate risks, including a comprehensive ***Hazard Mitigation Plan*** and threat-specific programs like Firewise (wildfire), Silver Jackets (inland flooding), and the ***Tennessee Drought Management Plan*** (drought). Tennessee has also taken ***limited action*** to assess its climate change vulnerabilities for the transportation sector. Tennessee has not assessed climate change vulnerabilities for other sectors, and it has taken ***no action*** to develop or implement an adaptation plan.

April 2011 Tornado Outbreak, Southeast U.S.



"The National Climate Assessment, released the day after Thanksgiving, projects a fourfold increase over the next 30 years in both the area burned by wildfire and suppression cost as forests dry out during longer and more prevalent droughts."

"In November 2016, a fire started by boys in the Great Smoky Mountain National Park raged across the scenic mountains. Fueled by a severe drought and winds topping 87 mph, the inferno quickly spread to the Gatlinburg area. Local officials and residents were caught off guard. Fourteen people died and nearly 2,500 structures were damaged or destroyed. That week, 50 major wildfires burned more than 100,000 acres across eight states. On one day, at least 53 active fires were simultaneously burning in Tennessee."

https://www.timesfreepress.com/news/local/story/2018/dec/09/devastating-wildfires-expected-be-more-commso/484589/

Water Security + Rising (Record) Temps

- TN American water main breaks late Thursday night, 09/12, leaving 35,000 customers with little or no water, affecting homes, businesses and government operations
- Repairs begin Friday, 09/13, when temperatures in Chattanooga reach a record of 103 degrees F; average high temps typically 84 F; 0.10” rain in September
- Water not fully restored to customers for 36 to 70 hours
- City, County, TNAW and other local partners come together to distribute over 800K bottles of water
- Ongoing investigation into how the break occurred, and how to prevent a similar incident from happening again
- Economic impact to be determined

FRED ECONOMIC DATA | ST. LOUIS FED

ECONOMIC RESEARCH

FEDERAL RESERVE BANK OF ST. LOUIS

MY ACCOUNT

Search FRED

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Categories > U.S. Regional Data > States > Tennessee > Counties > Hamilton County, TN

☆ Income Inequality in Hamilton County, TN (2020RATIO047065)

DOWNLOAD

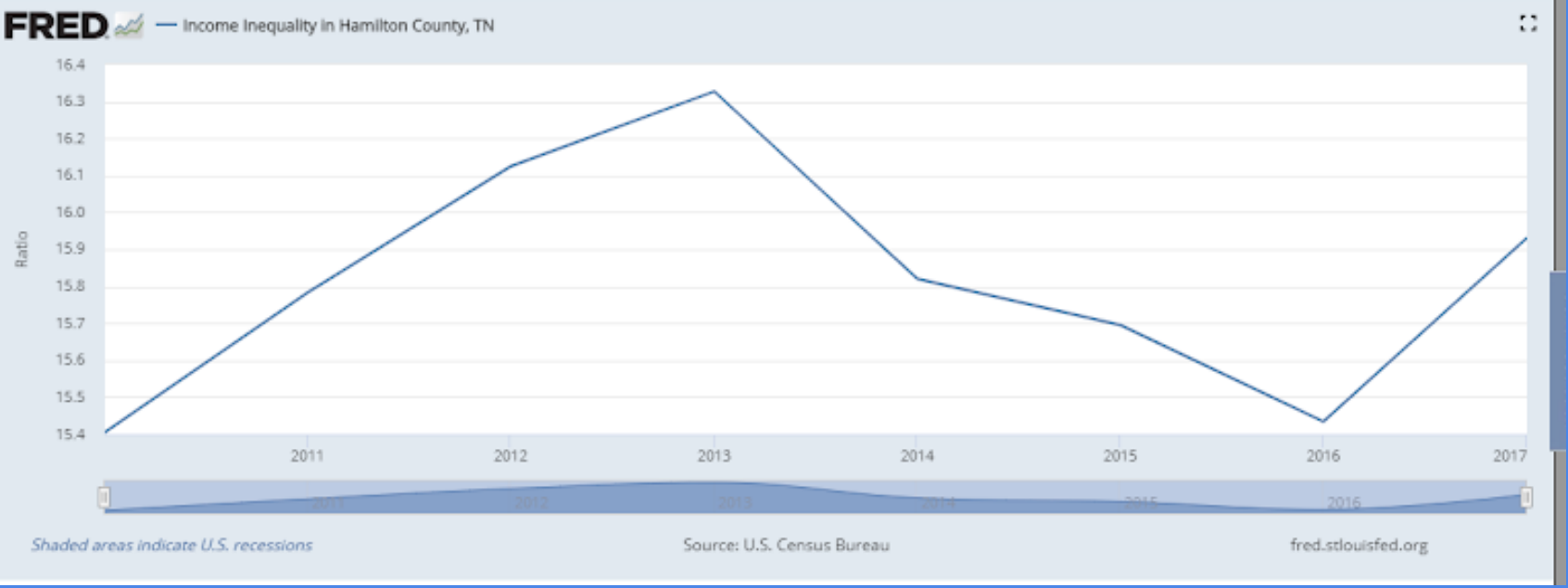
Observation: 2017: 15.93125 (+ more) Updated: Dec 7, 2018

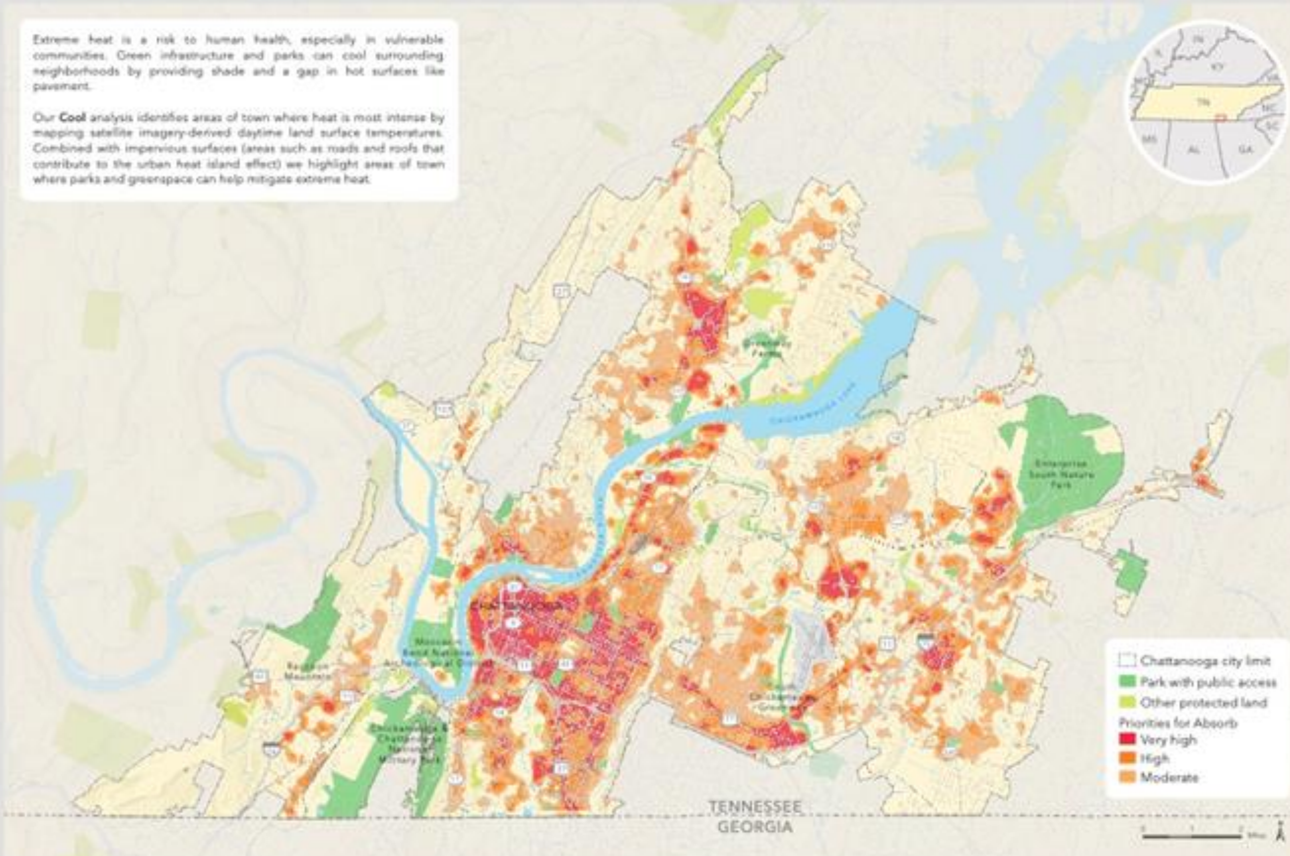
Units: Ratio, Not Seasonally Adjusted

Frequency: Annual

1Y | 5Y | 10Y | Max 2010-01-01 to 2017-01-01

EDIT GRAPH





Cool

HEALTHY CONNECTED CHATTANOOGA

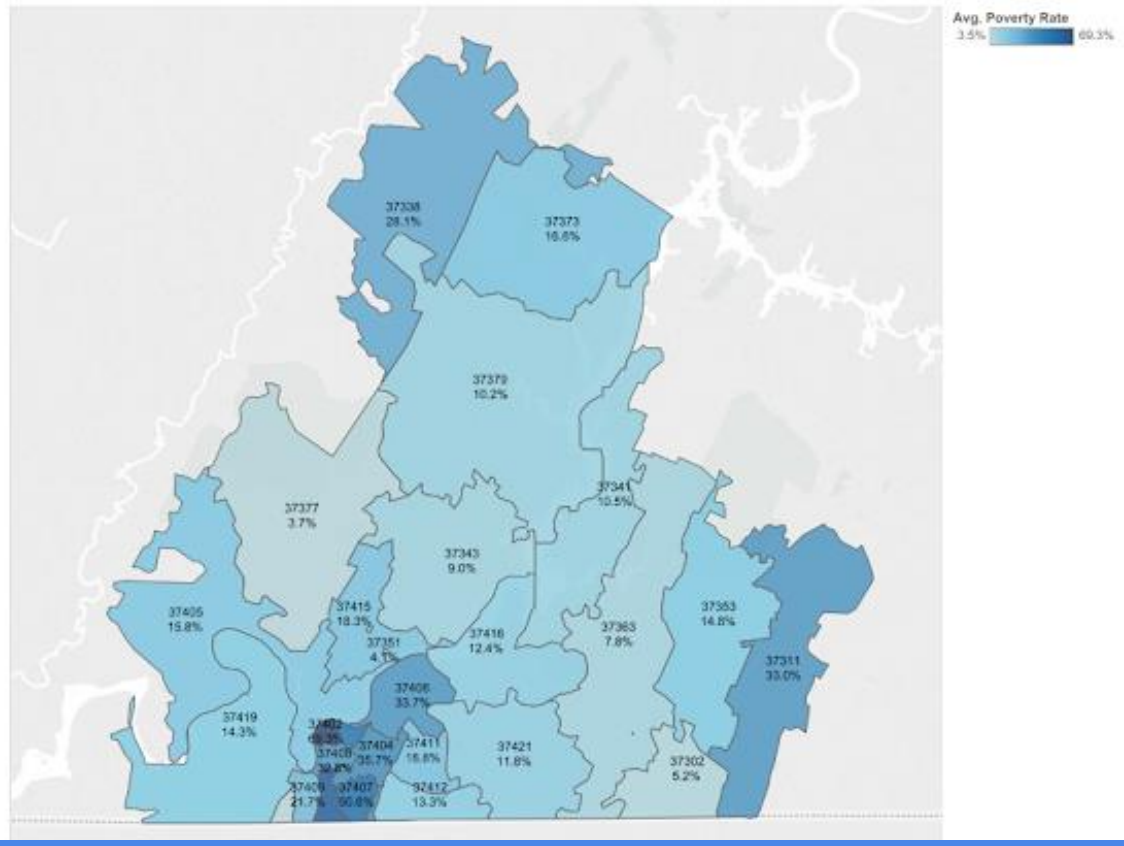
THE TRUST FOR PUBLIC LAND

Poverty's Effect on Power Usage in Hamilton County

Percentage of the population with incomes beneath the federal poverty line, by ZIP code.

Estimated number of households in poverty by ZIP code.

HEU's impact on impoverished homes in Hamilton County.

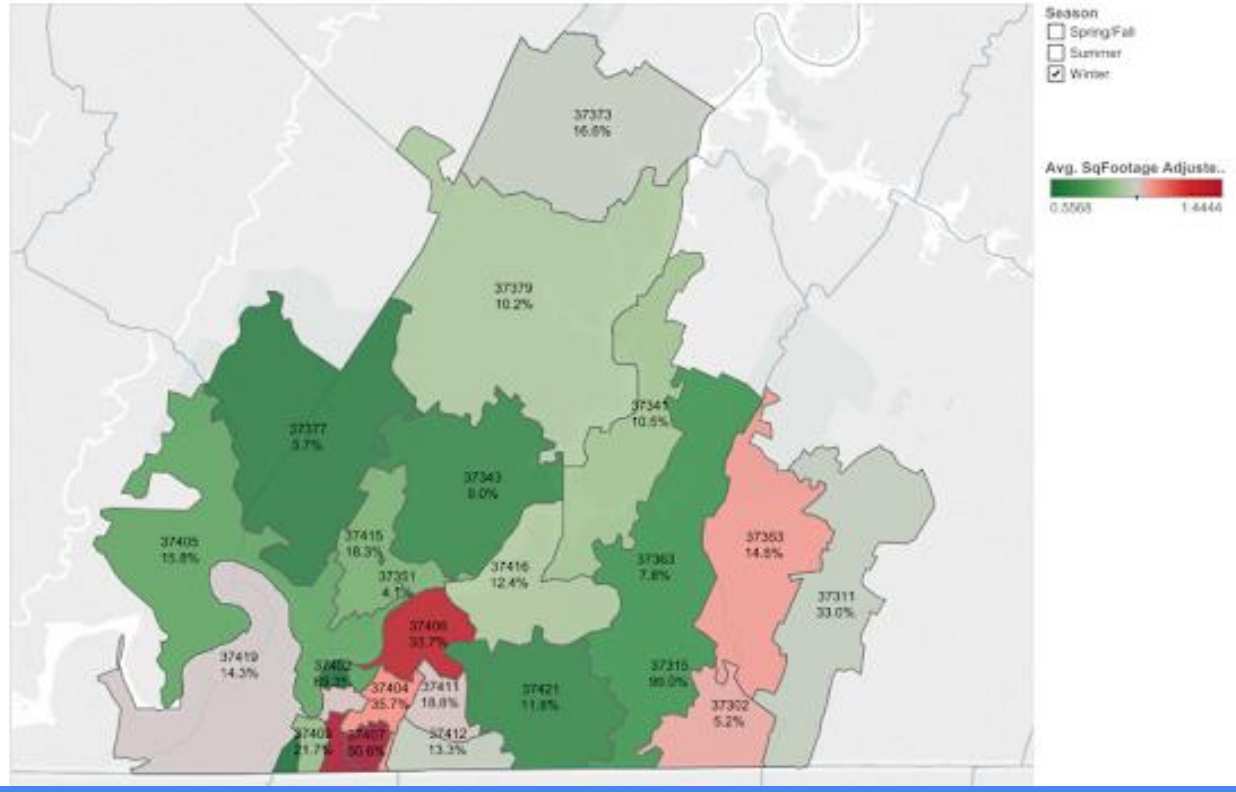


Poverty's Effect on Power Usage in Hamilton County

Percentage of impoverished households impacted by the HEU program by ZIP code.

Areas with higher % of population beneath the federal poverty line show higher monthly power usage. The effect is exacerbated in the winter. (Try different seasons on the right.)

Graphing % beneath poverty line vs. square footage-adjusted average monthly usage, we see a clear positive, significant trend. ($R^2 = 0.36$, p-valu..



Facing our Challenges: Resources and Strategies with an Integrated Approach

Government

City of Chattanooga

Hamilton County

Surrounding towns & counties

Federal Government

- U.S. Dept. of Energy
- ORNL
- HUD
- FAA

Utilities

Electric Power Board (EPB)

Tennessee Valley Authority (TVA)

Partners

University of Tennessee at Chattanooga

The Enterprise Center (Innovation District)

Local philanthropic

green|spaces

Southeast Sustainability Directors Network (SSCF)

Thrive 2055

City of Chattanooga

- Chattanooga municipal government buildings and regional WWTP achieved a 30% reduction in energy use intensity (EUI), 6 years ahead of schedule
- Achieved SolSmart Gold to facilitate adoption of solar within the city limits
- Building automation systems in 35+ facilities
- $1.4M, 61-facility LED retrofit for municipal facilities
- 3 megawatt PV solar array for Moccasin Bend Regional WWTP (October 2019)
- $5M for new HVAC and LED's for never-updated 1976 downtown library
- $2M+ in CDBG and ESG funds administered for neighborhood improvements
- 3 new all-electric CARTA buses; 6-9 more; all-electric downtown shuttle
- MLK Boulevard Smart Corridor
- First 100% renewable energy offset airport in the US
- Clear Chattanooga: Public Works sewer system rehabilitation program
- Regional Planning Agency: Tailored Area Land Use Plans

#ClearChattanooga

Local and Regional Utilities

- Tennessee Valley Authority (TVA) has reduced carbon footprint by 50+%
- The Electric Power Board (EPB) now boasts a ubiquitous fiber-optic network (Smart Grid) linking electrical infrastructure to 100% of homes and businesses with 10 gigabit capacity thanks to support from U.S. Department of Energy
  - 9,000 miles of fiber
  - 273,000 AMI smart meters
  - Over $800M in value to customers
  - 40% reduction in annual-minute interruptions; 56% reduction in outages
- 1st PEER certified local power company in the world
- Provided over 250 deep energy retrofits for homes in partnership with TVA
- EPB's 1.4megawatt community Solar Share in partnership with TVA
- Partnering with Chattanooga Airport and City of Chattanooga to establish microgrid capabilities at critical assets

Local Partners

- green|spaces
  - Empower: trained 2,000 residents with Basic Energy Workshops, averaging 100+ / month
  - Build it Green (B.I.G.) green collar jobs training for at-risk, low income residents
  - Green and Healthy Homes Initiative (GHHI)
    - 118 estimated people hospitalized in Chattanooga for asthma each year costing $3.9M annually
    - 1,435 estimated people visiting the ED for asthma each year costing $4.3M annually
    - EPB, TVA, Lifespring, GHHI, Erlanger Children's Hospital, and the City of Chattanooga to identify low-income patients with severe asthma, fund much-needed home improvements to improve air quality and energy efficiency, and then use health care savings to pay for those improvements. The team is currently piloting the project with 10-20 homes in 2019
  - Partnered with TVA & EPB to secure significant funding from Federal Home Loan Bank of Cincinnati to provide deep energy retrofits for homeowners w/ income of 50% AMI or less
  - Integrated Community Sustainability Plan

2019: Mayor Andy Berke announces 18 local city and county mayors have committed to developing a Regional Resiliency Plan

–regional–
RESILIENCY

Regional Resiliency Plan Focus Areas:

- Operational Response: How to best prepare for disasters before they occur to minimize impacts to businesses and residents
  - *Responsive emergency services*
  - *Development of a health facilities plan*
  - *Ensuring provision of critical services*
  - *Creating robust communication networks*
  - *Contingency planning across City government*
- Mitigation of future threats (through enhancement of the physical environment):
  - *Environmental stewardship, conservation and sustainability*
  - *Building preventive infrastructure*
  - *Effective land use planning*
  - *Enforcement of planning regulations*
  - *Developing financing structure for additional capital investments*

Questions?

Erik Schmidt, Director of Sustainability

Office of Mayor Andy Berke, Chattanooga, TN

eschmidt@chattanooga.gov

423.643.7822

Laurie Schoeman

Enterprise Community Partners

U.S. DEPARTMENT OF ENERGY

Enterprise: Who We Are

Create opportunity for low- and moderate-income people through fit, affordable housing in diverse, thriving communities.

How Enterprise Supports Communities

Policy

- CDBG-DR Standing Allocation
- National Flood Insurance Program
- Loca

Solutions

- Technical Assistance
- Developing Guidance Tools for Resilient Housing
- Piloting Housing Innovati

Capital

- Grants for Recovery
- Grants for Resilience
- Loan Capital
- Investment




“People who are already vulnerable, including lower-income and other marginalized communities, have lower capacity to prepare for and cope with extreme weather and climate-related events and are expected to experience greater impacts”

-National Climate Assessment 2019

To all Tenants of the Sea Horse RV Park:

We regret to inform you due to the severity of damage done by Hurricane Irma we must close the RV Park. We have a number of potential life safety issues and it is not safe to stay at the park.

Please remove all your belongings that have not been damaged by the hurricane and seek housing off the grounds. We recommend you contact FEMA using these contact numbers and websites, they can help you with temporary housing and financial assistance.

Call: 1-800-621-3362 FEMA – Federal Emergency Management Agency
By computer: DisasterAssistance.gov

Electricity service and water supply will not be returned to the park as the damage is too severe to allow it to be connected. Within the next week we will be removing damaged trailers and disassembling any [illegible] ups. If you own the trailer and it is capable of being


FEMA

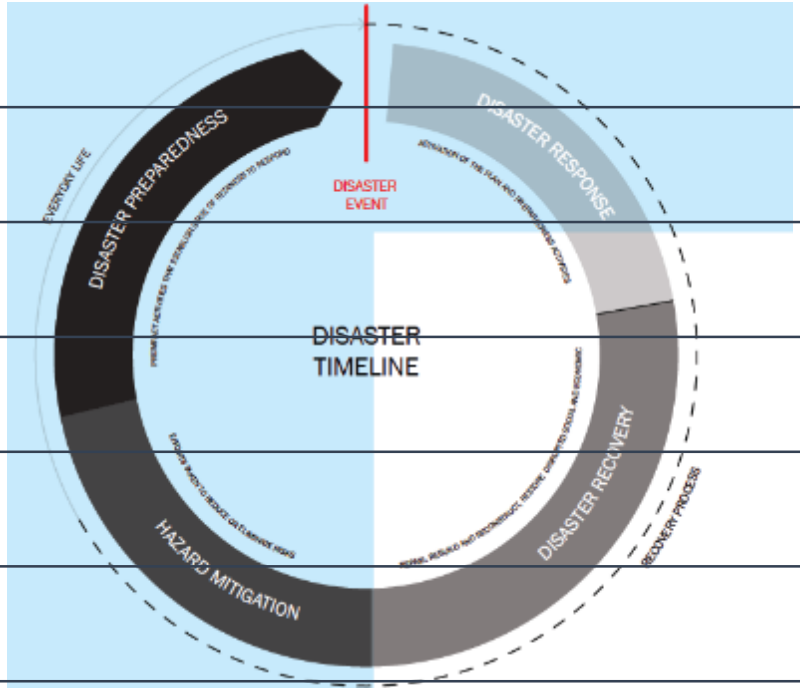
Resilience … to prepare, endure, adapt and thrive in a disruptive and changing world.

Faces of Resilience

 People	The extent of personal discomfort, harm, injury, or loss of life.
 Physical Assets	Loss or damage to structural and architectural building components, MEP and IT equipment, utilities, landscaping, contents.
 Operations	Disruption to building operations and functionality, occupancy, egress/ingress, critical systems, or lab activities.
 Revenue	Loss of revenue due to business interruption, specifically in relation to tenants.
 Reputation	Negative media attention or impact on industry reputation in the aftermath of an impactful shock or stress.

Supporting Life Cycle of Risk and Recovery

- Multifamily Housing Resiliency Toolkit
- Capital Needs Assessment
- Financial Lender Toolkit
- Resilience Guide For Island Communities
- Participatory Planning Mitigation Tool
- Capital and Grants
- Advocacy



Framework for Resilient Investments and Return Opportunities

More Efficiency in Operations and Asset management

Co-Benefits

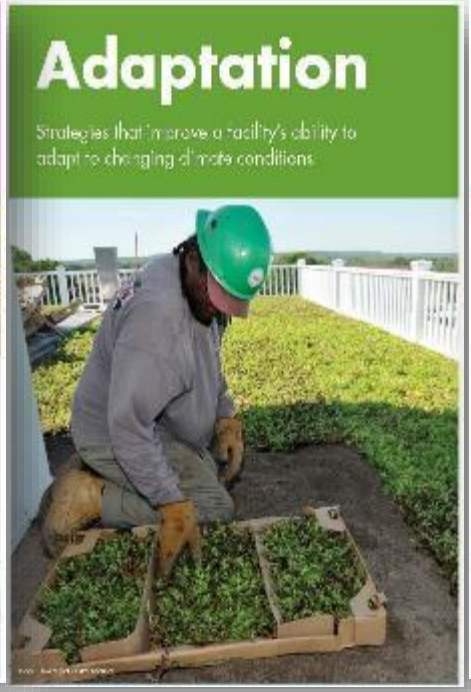
- Health
- Safety
- Co2 reductions
- Branding

Insurance and Risk Reduction

Utility Savings

Post Sandy Learning Collaborative for Housing Resilience

Strategies for Multifamily Housing Resilience



Enterprise

Determine your Resilience Strategies

Resilience Strategies
Decision Matrix

	Low to Mid-Rise walk up's	Small-Rise contemporary	Mid-rise contemporary	High-Rise contemporary	Estimated Cost	Related Strategies
Protection					**Protection**	
1 Wet Floodproofing	●	●	●	●	$$-$$$	6, 3, 9, 10
2 Dry Floodproofing	◉	◉	◉	◉	$$-$$$	3, 5, 6, 14
3 Site Perimeter Floodproofing	○	◉	◉	◉	$$-$$$	2, 6, 10
4 Resilient Elevators	◉	○	●	●	$$-$$$	2, 3, 6, 8, 13, 18
5 Backwater Valves	●	●	●	●	$	2, 6, 10
6 Sump Pumps	●	●	●	●	$	1, 2, 5, 8, 10, 13
Adaptation					**Adaptation**	
7 Envelope Efficiency	●	●	●	●	$$$-$$$$	11, 12
8 Elevated Equipment	◉	◉	●	●	$$$-$$$$	1, 7, 9, 12
9 Elevated Living Space	◉	◉	◉	◉	$$$-$$$$	1, 2, 8
10 Surface Stormwater Management	◉	◉	●	●	$$-$$$	2, 3, 5
11 Window Shading	●	●	●	●	$	7
12 Distributed Heating and Cooling	●	●	◉	○	$$	7, 8, 11
Backup					**Backup**	
13 Maintaining Backup Power to Critical Systems	●	●	●	●	$$-$$$	4, 6, 8, 15, 18
14 Emergency Lighting	●	●	●	●	$	13
15 Access to Potable Water	●	●	●	●	$	13
Community					**Community**	
16 Building Community Ties	●	●	●	●	$	17, 18, 19
17 Creating Community Resilience Spaces	◉	◉	●	●	$-$$	13, 15, 16, 18, 19
18 Developing an Emergency Management Manual	●	●	●	●	$	16, 17, 19
19 Organization for Community Resilience	●	●	●	●	$	16, 17, 18

Legend

Building Types*

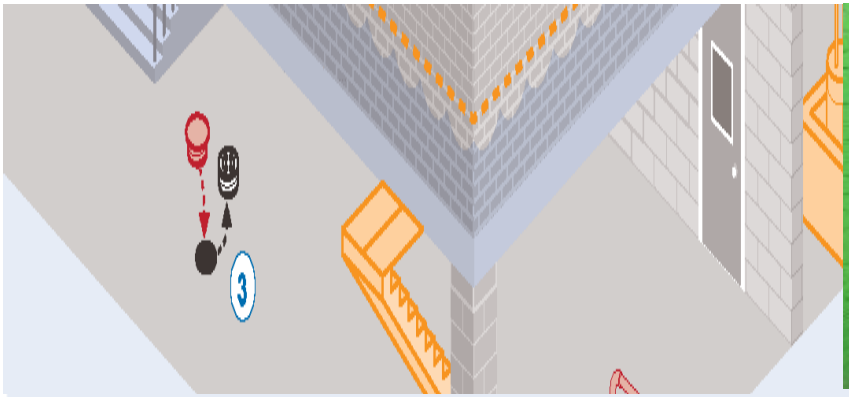
	Units	Floors	Year Built	Typical Building Construction	Elevator
Low to Mid-Rise walk up's	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
Small-Rise contemporary	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
Mid-rise contemporary	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
High-Rise contemporary	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]

Applicability

○ Minimally applicable ◉ Potentially applicable ● Applicable

Flood Prevention – High Cost

Dry Floodproofing



1. Seal cracks or openings in walls and foundation.
2. Install flood gates to prevent water from coming through entryways.
3. Install backflow preventers in floor drains.
4. Install a waterproof sidewalk hatch.
5. Protect against seepage by installing a sump pump.
6. Flood-proof equipment which cannot be elevated.
7. Flood doors are engineered to keep water out.

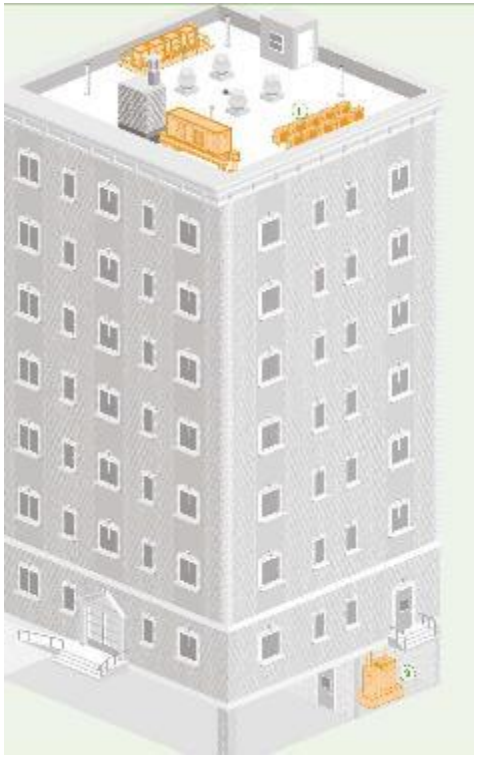
\+ *Strategies not pictured:*

Protect any electrical equipment with waterproof enclosures.

Only permitted in residential buildings with commercial on the first floor or non residential buildings. Egress must be maintained to the public way. Appendix G requires a flood emergency plan when dry floodproofing is installed in for a building. See Floodplain Zoning Regulations in the appendix of this presentation and Building Code Appendix G for additional requirements.

Flood Prevention – High Cost

Elevated Equipment



TECHNICAL ASSISTANCE MODEL
FLOOD HELP NYC

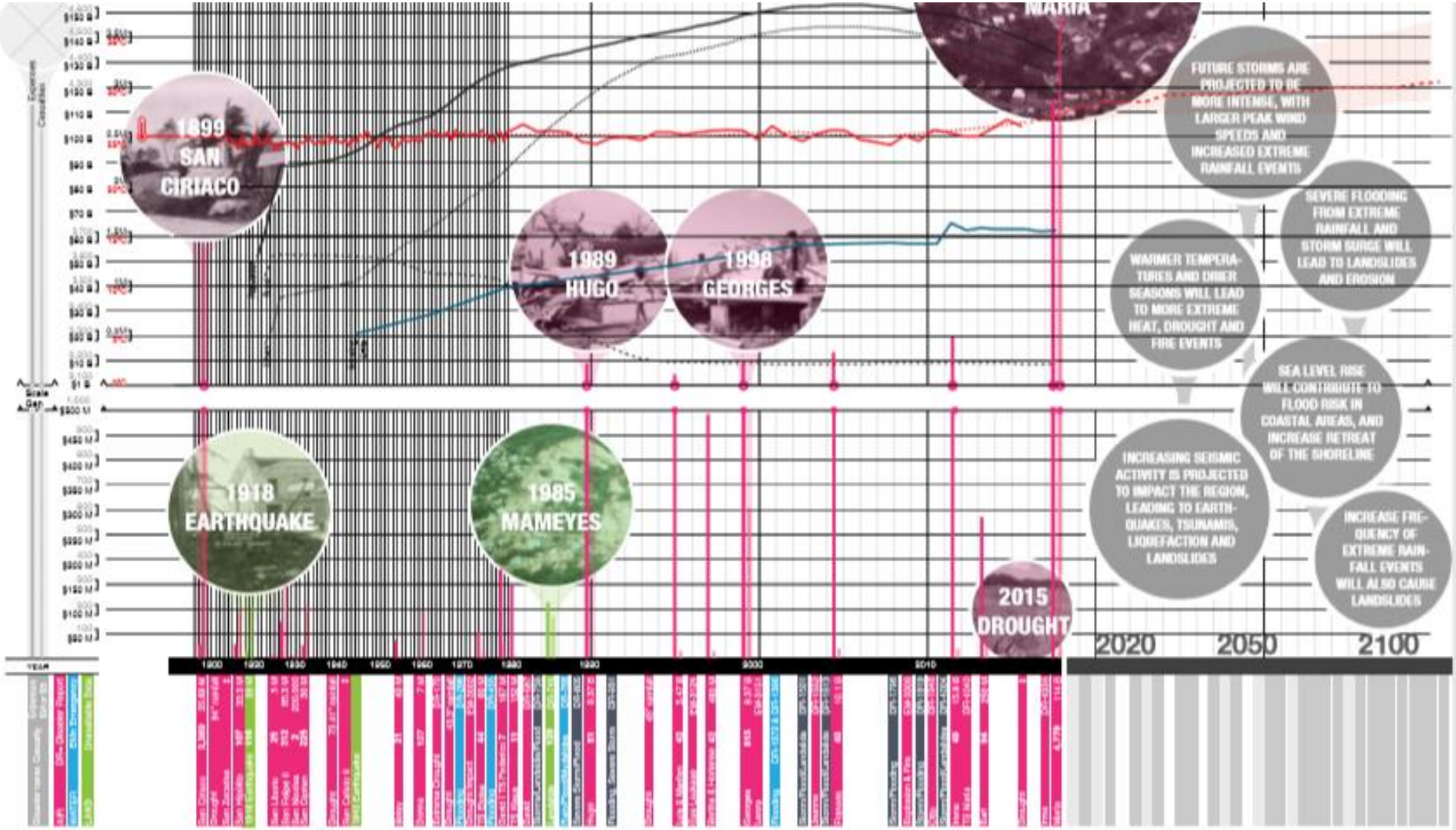

KEEPSAFE

KEEP SAFE

A GUIDE TO RESILIENT HOUSING DESIGN IN ISLAND COMMUNITIES

THE NEW YORK COMMUNITY TRUST NYCT

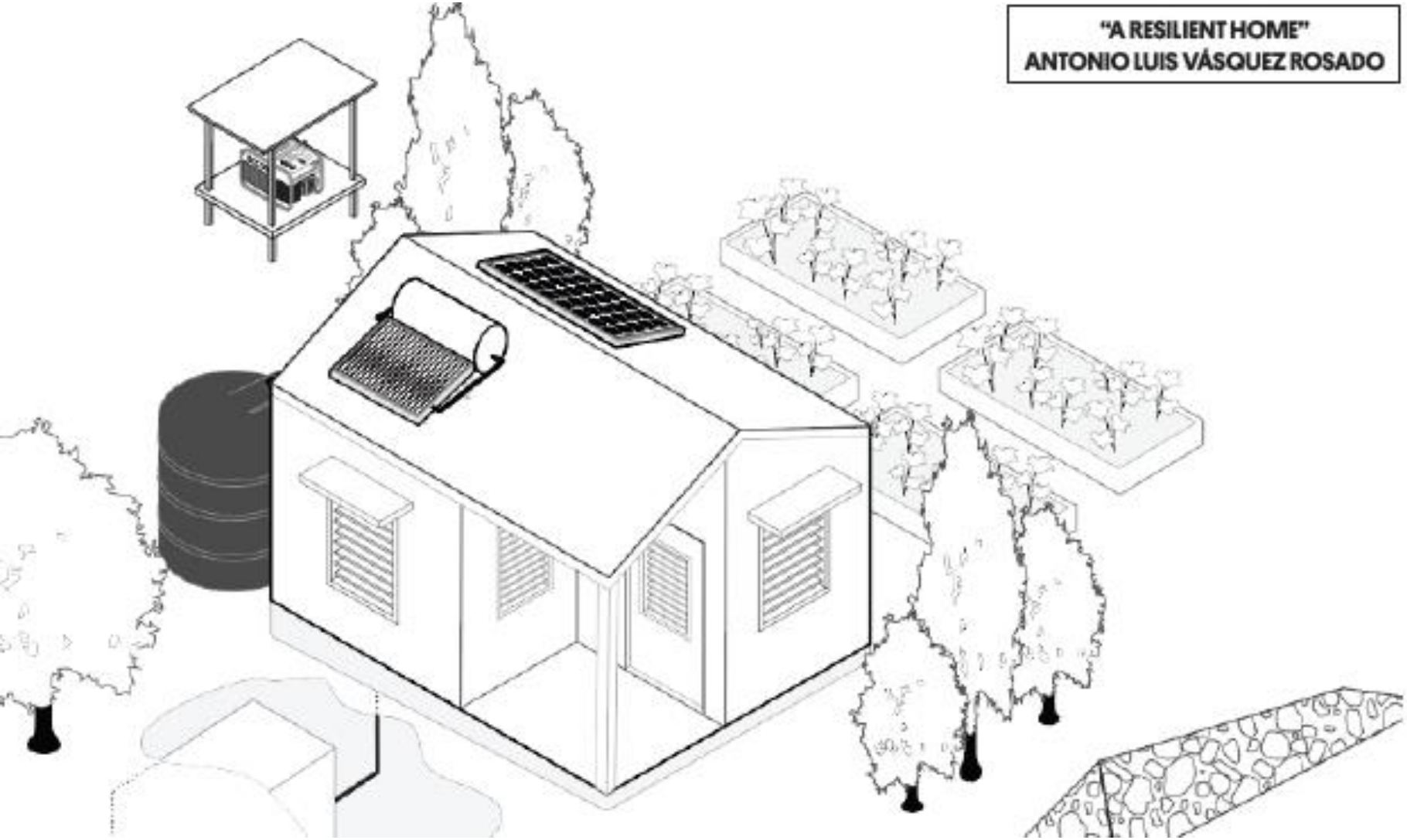
The Miami Foundation
For A Greater Miami


1899
SAN
CIRIACO
1989
HUGO
1998
GEORGES
MARIA
1918
EARTHQUAKE
1985
MAMEYES
2015
DROUGHT
FUTURE STORMS ARE PROJECTED TO BE MORE INTENSE, WITH LARGER PEAK WIND SPEEDS AND INCREASED EXTREME RAINFALL EVENTS
SEVERE FLOODING FROM EXTREME RAINFALL AND STORM SURGE WILL LEAD TO LANDSLIDES AND EROSION
WARMER TEMPERATURES AND DRIER SEASONS WILL LEAD TO MORE EXTREME HEAT, DROUGHT AND FIRE EVENTS
SEA LEVEL RISE WILL CONTRIBUTE TO FLOOD RISK IN COASTAL AREAS, AND INCREASE RETREAT OF THE SHORELINE
INCREASING SEISMIC ACTIVITY IS PROJECTED TO IMPACT THE REGION, LEADING TO EARTHQUAKES, TSUNAMIS, LIQUEFACTION AND LANDSLIDES
INCREASE FREQUENCY OF EXTREME RAINFALL EVENTS WILL ALSO CAUSE LANDSLIDES
1900
1920
1930
1940
1950
1960
1970
1980
1990
2000
2010
2020
2050
2100

HAZARDS AND STRATEGIES

HIGH WINDS	DROUGHT	FIRE	EXTREME TEMPERATURE	HEAVY RAINFALL	STORM SURGE	TSUNAMI	COASTAL EROSION	LANDSLIDE	EARTHQUAKE	SUBSIDENCE	LIQUEFACTION			
●	●	●	●	●	●	●	●	●	●	●	●	Strategy 1: Reinforce Your Site	Page 000	$-$$$$
●	●	●	●	●	●	●	●	●	●	●	●	Strategy 3: Plant an Edible Garden	Page 00	$
●	●	●	●	●	●	●	●	●	●	●	●	Strategy 4: Assess the Priorities for Your Home or Building Structural Condition Prior to Event	Page 00	$
●	●	●	●	●	●	●	●	●	●	●	●	Strategy 15: Reduce your Energy Use	Page 00	$-$$
●	●	●	●	●	●	●	●	●	●	●	●	Strategy 16: Integrate Solar Electricity	Page 00	$-$$$$
●	●	●	●	●	●	●	●	●	●	●	●	Strategy 17: Integrate Solar Thermal Energy	Page 00	$$-$$$
●	●	●	●	●	●	●	●	●	●	●	●	Strategy 18: Install Energy Backup	Page 00	$$-$$$
●	●	●	●	●	●	●	●	●	●	●	●	Strategy 19: Reduce your Water Consumption	Page 00	$
●	●	●	●	●	●	●	●	●	●	●	●	Strategy 23: Develop a Household Emergency Plan	Page 00	$
●	●	●	●	●	●	●	●	●	●	●	●	Strategy 24: Choose a Space to Keep Your Family Safe	Page 00	$
●	●	●	●	●	●	●	●	●	●	●	●	Strategy 25: Respond + Begin Household Recovery	Page 00	$
●	●	●	●	●	●	●	●	●	●	●	●	Strategy 26: Develop a Community Plan	Page 00	$
●	●	●	●	●	●	●	●	●	●	●	●	Strategy 27: Identify + Prepare Safe Community Shelter	Page 00	$-$$

HIGH WINDS	DROUGHT	FIRE	EXTREME TEMPERATURE	HEAVY RAINFALL	STORM SURGE	EARTHQUAKE			
○	●	●	●	●	●	●	Strategy 2: Reinforce Site with Vegetation	Page 000	$
●	○	○	○	●	●	●	Strategy 5: Build a Strong Foundation	Page 00	$$
●	○	○	○	●	●	●	Strategy 6: Build Stronger Walls	Page 00	$-$$
●	○	○	○	●	●	●	Strategy 7: Build a Sturdy Roof	Page 00	$$-$$$$
●	○	○	○	●	●	●	Strategy 8: Anchor, Seal and Protect Building Openings	Page 00	$-$$
○	○	○	○	●	●	○	Strategy 9: Flood Proof Home	Page 00	$-$$$
○	○	○	●	○	○	○	Strategy 10: Reduce Heat Gain	Page 00	$-$$$
○	○	○	●	●	●	○	Strategy 11: Increase Home Ventilation	Page 00	$-$$
○	○	○	●	○	○	○	Strategy 12: Benefit from Natural Light	Page 00	$-$$
○	●	○	○	●	●	●	Strategy 14: Manage Pests	Page 00	$-$$
○	●	●	○	●	●	●	Strategy 20: Collect and Use Rainwater	Page 00	$-$$
○	●	○	○	○	●	●	Strategy 21: Improve Septic Waste Disposal System	Page 00	$$-$$$
○	○	○	○	○	●	○	Strategy 22: Prevent Wastewater Backflow in Homes	Page 00	$


"A RESILIENT HOME"
ANTONIO LUIS VÁSQUEZ ROSADO

STATEGY 01

REINFORCE SITE WITH INFRASTRUCTURE

STEP 3 - IMPLEMENT GREY INFRASTRUCTURE ON SITE

- Consult a contractor, civil engineer, agronomist or the Agricultural Extension Service (SEA, by its Spanish acronym) to design gray infrastructure systems as outlined below.
- Be cautious when choosing where to deposit water. If water is contaminated with debris, do not deposit into a lake, river, or sea.
- Gray infrastructure may require special permits and a larger and more specialized professional team, can be more costly, and can be disruptive to the site if not properly designed and built.

RETAINING WALLS

Retaining walls are permanent barriers that prevent water from infiltrating the site. They are designed to contain the weight of the terrain on a steep slope that otherwise would collapse. Without a retaining wall, extreme rain might destabilize the exposed terrain and cause a landslide. These structures are beneficial in areas where erosion is inevitable or where critical infrastructure needs to be protected.

NATURAL HAZARDS IT PREVENTS

- Flooding
- Landslides
- Erosion
- Heat

WHAT YOU NEED TO KNOW

- - Built with reinforced concrete.
- - Usually shaped as an inverted T.
- - On the side of the terrain being stabilized, use a drain along the wall to keep water away from the structure.
- - The drain consists of a PVC pipe surrounded by gravel and fabric that

DRY WELLS

Dry wells are underground tanks, usually made of concrete, that store water to percolate or drain slowly to another site or sewer. Their design is similar to a pool.

NATURAL HAZARDS IT PREVENTS

- Flooding
- Erosion

WHAT YOU NEED TO KNOW

- A simple dry well is a 4'-6" deep and 3' diameter pit filled with gravel or aggregate covered with topsoil.

FRENCH DRAIN

A French Drain system slowly drains surface water and can consist of a PVC tube with holes, different grades of rock or similar materials that allow percolation of water through the soil and out to a desired area.

NATURAL HAZARDS IT PREVENTS

- Flooding
- Erosion

WHAT YOU NEED TO KNOW

- - Perforate a PVC tube and place into a trench.
- - Surround the tube with gravel and then cover with a permeable fabric.
- - Direct water to a sewer, dry well, or other method of disposal.

DITCH

Ditches are channels that are used to redirect water flow. Historically, common practice has been to "re-canalize" or "re-channel" rivers to avoid flooding but in recent years communities are adopting to "living with water," rather than channeling it off site, by allowing water to flow through sites.

NATURAL HAZARDS IT PREVENTS

- Flooding
- Erosion

WHAT YOU NEED TO KNOW

- A simple dry well is a 4'-6" deep and 3' diameter pit filled with gravel or aggregate covered with topsoil.

PERMEABLE SURFACES

Permeable surfaces consist of a paver, porous concrete, or other flooring system that allows water to pass through and percolate slowly into the soil, instead of solid pavement that reduces the area of the terrain that naturally percolates water.

- Usually made of asphalt, concrete, or planted surfaces.
- Areas with permeable pavement are usually utilized as an amenity for non-essential services like recreation.

NATURAL HAZARDS IT PREVENTS

- Flooding
- Heat

WHAT YOU NEED TO KNOW

- - For pavers, the terrain is flattened and prepared prior to placement.
- - The porous pavement or surface material is poured in place like regular concrete. Its porosity is a result of the permeable slab-like surface.
- -If pavement needs to bear "loads" such as vehicles, it will need to be validated for load bearing capacity in advance of placement.

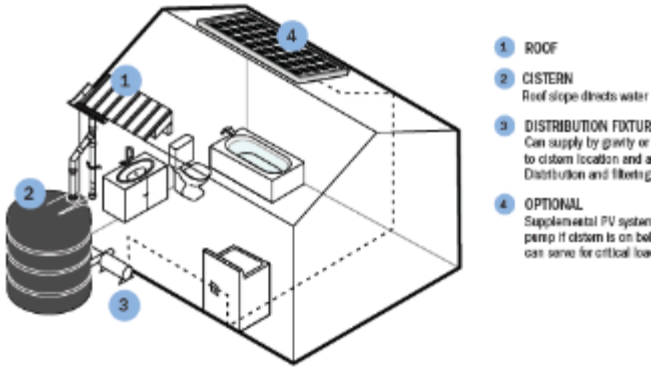
etween crop cycles to
nate soil

track of the rain so you
t saturate the plants with

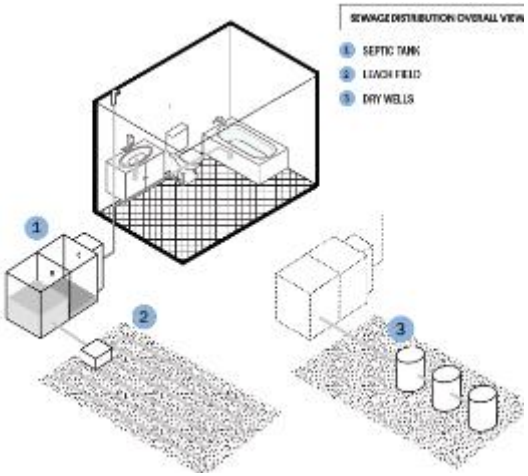
C. BEGIN THE PLANTING PROCESS

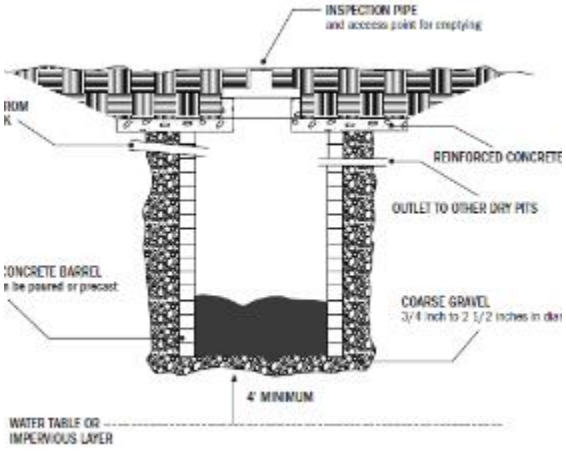
Hydroponic Gardening

- a. Hydroponics is a method of growing plants without soil by using mineral nutrient solutions in a water solvent.
- b. The nutrients used in hydroponic systems can come from an array of different sources; these can include, but are not limited to, byproduct from fish waste, duck manure, or purchased chemical fertilizers.
- d. For all techniques, hydroponic reservoir
built of plastic, but other materials have b
used, including concrete, glass, metal, veg
solids, and wood. Containers should exclu
to prevent algae and fungal growth in the
solution.
- e. With hydroponic farming, there are two
of watering systems: continuous flow or st
continuous flow systems, water needs con



1. ROOF
2. CISTERN
   Roof slope directs water
3. DISTRIBUTION FIXTUR
   Can supply by gravity or
   to cistern location and a
   Distribution and filtering
4. OPTIONAL
   Supplemental PV systen
   pump if cistern is on bel
   can serve for critical low





Safe Septic and Water

STATEGY
06

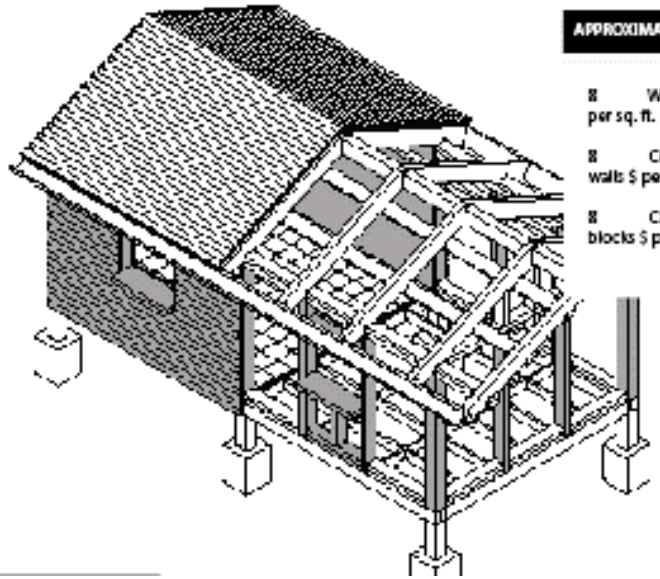
BUILD A STRONG FOUNDATION

STRATEGY IN ACTION

STEP 1 - WALL DESIGN PRINCIPLES

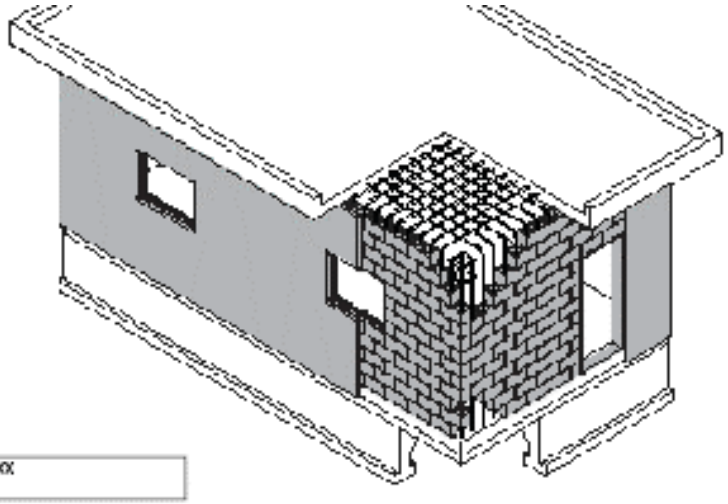
- Maintaining a continuous load path is like a chain that holds a home together from the roof to the foundation. A continuous load path is critical during an earthquake or hurricane because it holds a home together when ground forces or high winds try to pull it apart. Maintain a continuous load path by using vertical reinforcement, from the foundation to the roof, through the structural walls.

- Anchor interior partition walls into the structural frame for stability.



APPROXIMATE COST

- Wood frame with panels $ per sq. ft.
- Concrete columns with fill-in walls $ per sq. ft.
- Cast-in-place concrete with blocks $ per sq. ft.



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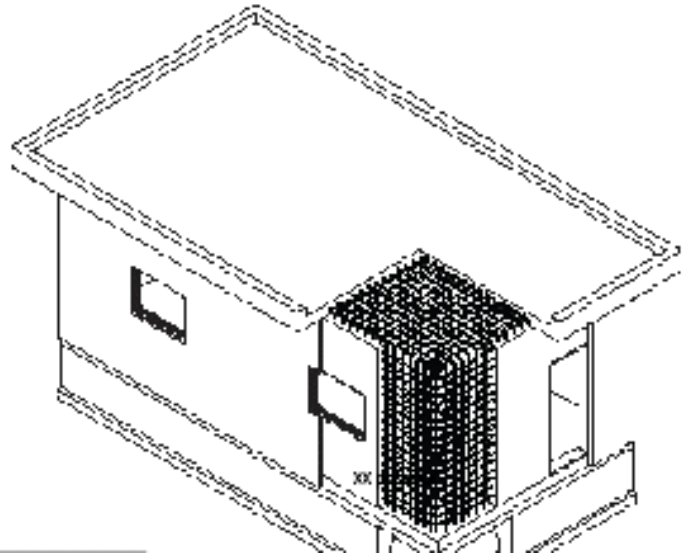
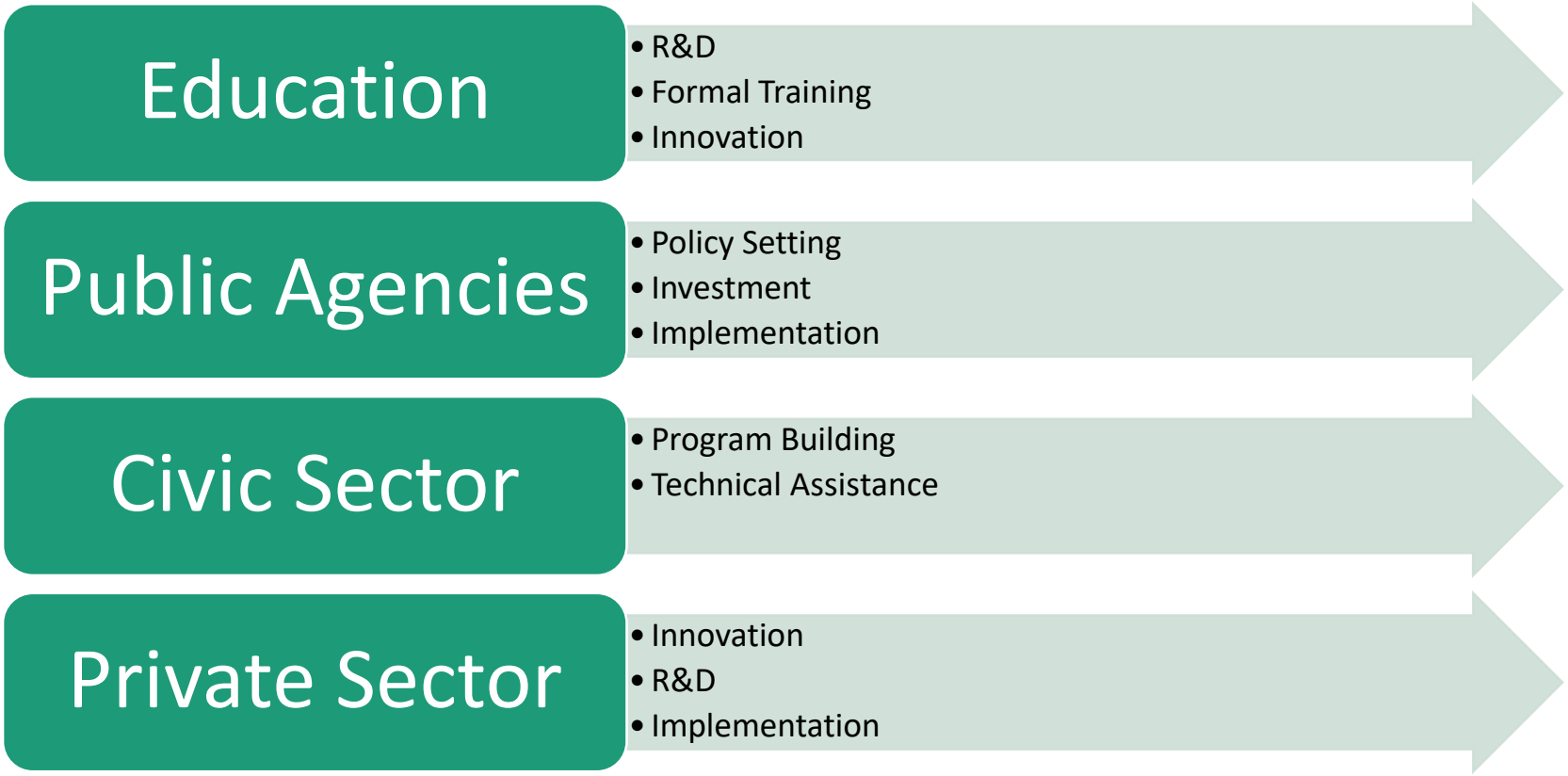


Creamos este recurso para ayudar a las comunidades a diseñar centros comunitarios resilientes para fortalecer la capacidad organizativa, promover la educación durante todo el año y poder enfrentar cambios climáticos, sociales y económicos. Ofrece sugerencias prácticas, incluido el desarrollo organización comunitaria, capacidad operativa y activos físicos relevantes para lograr resiliencia.

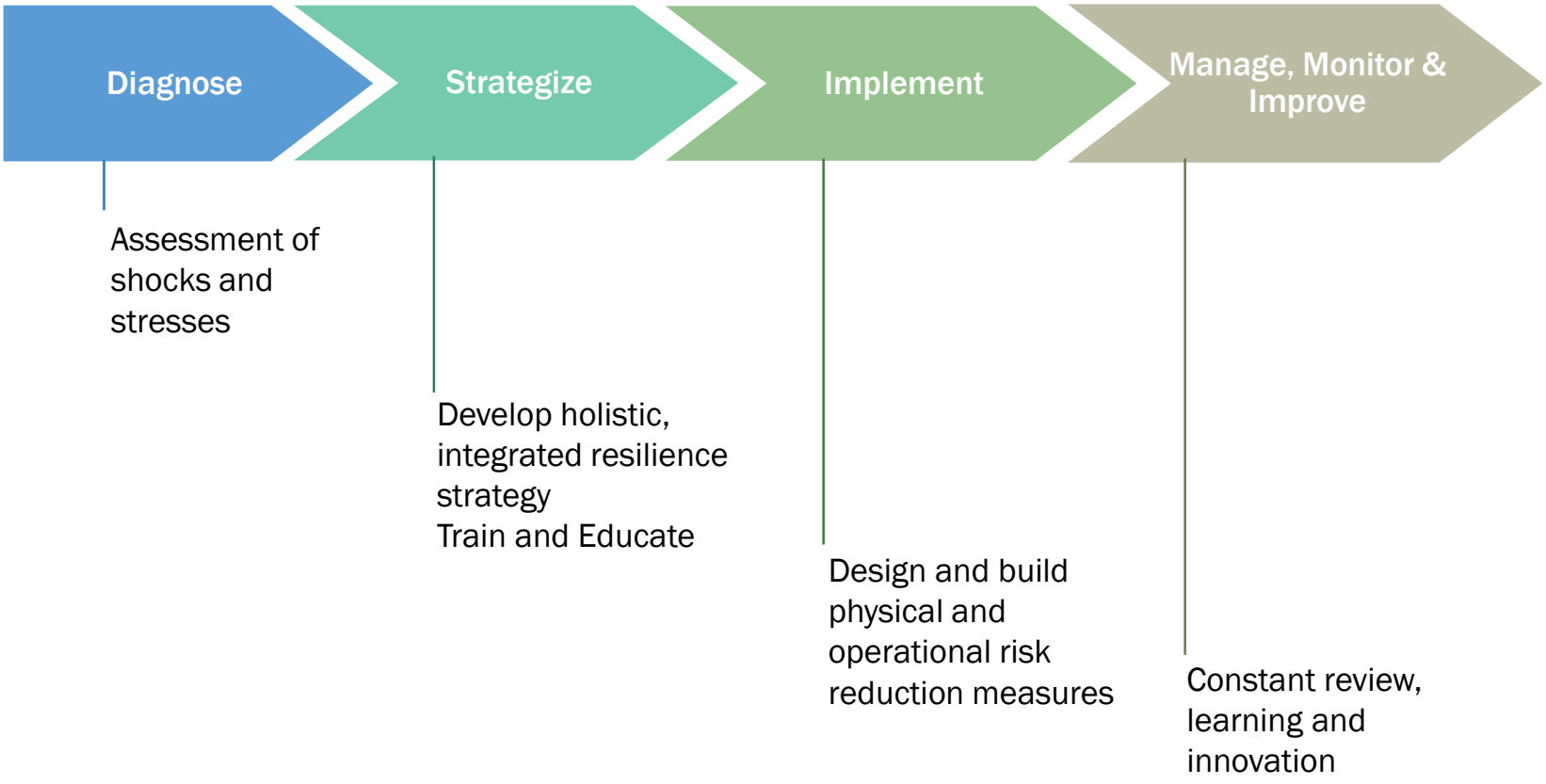
COMUNIDADES UNIDAS

GUÍA PARA EL DISEÑO DE CENTROS COMUNITARIOS RESILIENTES EN COMUNIDADES ISLEÑAS

Adoption of Resilience Guidance



Resilience Building Process



Opportunities to Collaborate

- A Housing Resiliency Standard
- Co-Benefits Defined
- Investment

Laurie Schoeman
Senior Program Director Resilience and Recovery
lschoeman@enterprisecommunity.org

Explore the Residential Program Solution Center

Resources to help improve your program and reach energy efficiency targets:

- Handbooks - explain *why* and *how* to implement specific stages of a program.
- Quick Answers - provide answers and resources for common questions.
- Proven Practices posts - include lessons learned, examples, and helpful tips from successful programs.
- Technology Solutions NEW! - present resources on advanced technologies, **HVAC** & **Heat Pump Water Heaters**, including installation guidance, marketing strategies, & potential savings.

https://rpsc.energy.gov

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