Resilient Housing and Communities

Recovery & Resilience in Puerto Rico and the U.S. Virgin Islands

June 3, 2020

Materials will be available at: www.eesi.org/060320prusvi

Tweet about the briefing: #eesitalk @eesionline
Founded in 1984 by a bipartisan Congressional caucus.

Now an independent, bipartisan nonprofit with no Congressional funding.

We provide fact-based information on energy and environmental policy for Congress and other policymakers.

We focus on win-win solutions to make our energy, buildings, and transportation sectors sustainable and resilient.

Visit www.eesi.org to:

- View videos of our Congressional briefings.
- Sign up to receive our briefing notices, and fact sheets.
- Subscribe to our newsletters, including Climate Change Solutions.
Create opportunity for low- and moderate-income people through fit, affordable housing in diverse, thriving communities.
15 Years of Work in Housing Resilience, Recovery, Rebuilding
Disasters Impact Housing Security

- Hurricane Katrina
  August 23, 2005
  800K Homes

- Super Storm Sandy
  October 22, 2012
  650K Homes

- Hurricane Harvey
  Houston
  August 17, 2017
  135K Homes

- Hurricane Maria
  Puerto Rico/USVI
  September 20, 2017
  370K Homes

- Fires, California
  October 2017, 2018, 2019
  60K Plus
We have an Affordable Housing Crisis in the United States

- For the majority of states, between 10% and 15% of households are housing insecure. California and New York have the most housing insecurity; 20% of households face housing insecurity. Island communities
“The house is the place where both planning and community development impact upon the family and individual. Planning for housing must therefore take into account more than the physical structure and spatial requirements; it should consider the social, economic and psychological needs of the individuals and families who will occupy the housing. And housing must be considered within the community context.”

Lucilla Fuller Marvel
<table>
<thead>
<tr>
<th></th>
<th>Average</th>
<th>CSU Forecast</th>
<th>2019</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>TOTAL NAME STORMS</strong></td>
<td>12</td>
<td>16</td>
<td>18</td>
</tr>
<tr>
<td><strong>HURRICANES</strong></td>
<td>6</td>
<td>8</td>
<td>6</td>
</tr>
<tr>
<td><strong>MAJOR HURRICANES</strong></td>
<td>3</td>
<td>4</td>
<td>3</td>
</tr>
</tbody>
</table>

*Major Hurricane is Category 3 or higher*
THE SPREAD OF ILLNESS AND DISEASE IN THE WAKE OF NATURAL DISASTERS

Building Resilient Homes helps mitigate impacts to the health and well being of residents and communities facing extreme weather and natural hazard Risks. See Keep Safe for guidance.

- Untreated sewage after a flood can introduce bacteria, viruses and parasites
- Heavy rain and flooding can create conditions for mosquitos and other vectors that cause malaria and dengue fever
- Moisture after flooding leads to mold, which can cause asthma and other respiratory problems
- Particle pollution from fires can trigger asthma attacks, heart attacks and strokes
- Carbon monoxide from fires can lead to headaches, nausea, dizziness and, in high concentrations, premature death
- Extreme heat can lead to cardiovascular and respiratory disorders
- Earthquakes can create dust clouds that carry fungus spores, which can cause asthma
Call upon Diversity of Community Members to inform and define what resilience and mitigation planning is. Build Prototypes for peer to peer learning and sharing.

Jurisdictions identify how to leverage the Weatherization model to ensure homes are fortified in advance of storms with focus on Structural Risk (Roofs, Anchorage), Energy and Health Related Conditions.

Consider regional planning not just locality—especially in consideration of flood plain management and resource management.

Consider importance of non-profit sector in implementation of work.

Call to Action-Promoting Climate Resilient Islands
Models: Rapido Temp to Perm Housing Houston, Texas
OPPORTUNITY

- FEMA-BRIC
- HUD- CDBG, CDBG-DR, CDBG-MIT
- DOT
- USDOE
- Community Reinvestment Act
- ESG
Mitigation—Investment in Community Development

- Advance other community objectives
- Capital improvements, infrastructure protection, open space preservation, and economic resiliency
- A one-time cost for implementing a mitigation action often results in long-term savings to the community.
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.
MANTÉNGASE SEGURO
UNA GUÍA PARA EL DISEÑO DE VIVIENDAS RESILIENTES EN COMUNIDADES ISLEÑAS

KEEP SAFE
A GUIDE FOR RESILIENT HOUSING DESIGN IN ISLAND COMMUNITIES
Designing for the Future

SATELLITE DATA: 1993-PRESENT

Data source: Satellite sea level observations.
Credit: NASA Goddard Space Flight Center

RATE OF CHANGE

↑ 3.3
millimeters per year
THE GUIDE IS COMPRISED OF THE FOLLOWING CHAPTERS:

- Introduction
- Chapter 1: A Safer Site
- Chapter 2: Building Protection
- Chapter 3: Passive Habitability
PUTTING IT ALL TOGETHER

- Funding
- Contracting
- Building to Code
- Pulling Permits
- Insurance
- Design
Who is it for?

IS THIS GUIDE FOR ME?

Homeowner or Building Owner
As the owner of your home, be it a townhouse or a detached building, you wield the power to make decisions regarding your structure’s resiliency. You can choose to make major, permanent changes to your site and home to ensure safety before, during, and after a natural disaster.

Community leader
The community regards you as their representative. Your communication and organizational skills enable you to serve as a liaison between governmental/external efforts during times of distress. By taking on a leadership role to bring your community together in the face of an emergency, you are catalyzing a collaborative effort towards resiliency that can persist long after the disaster hits.

Tenant
Renting at a multifamily building may limit the actions you can take in terms of fortifying your home against natural disasters because you have limited ability to determine how the building is prepared, but you can still provide the authority with suggestions and key information found in this guide to improve your home.

Administrator
You may be an administrator of a housing program or are able to determine how to regulate a housing facility or home. This guide can help you determine ways to safeguard the building from hazards or set up a program to fund or support housing resilience.

Property Operator
You are the legal owner of a property which you rent out and you are responsible for ensuring it is safe and has emergency plans in place. Your tenants can certainly engage in some of the preventive and prescriptive measures included in this guide.

Construction Professional
As an architect, engineer, contractor, master builder, inspector, or other professional in the construction industry, the information included in the main corpus of this guide may seem basic to you. However, it is becoming increasingly important to bear these principles in mind.
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.

- c. You can add a natural fertilizer, like homemade compost, up to once a month. Keep track of the rain so you do not saturate the plants with water.

- d. For all techniques, hydroponic reservoirs are built of plastic, but other materials have been used, including concrete, glass, metal, vegetable solids, and wood. Containers should exclude light to prevent algae and fungal growth in the nutrient solution.

- e. With hydroponic farming, there are two types of watering systems: continuous flow or static. In continuous flow systems, water needs continuous circulation through the system and this requires a pump.
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.
ENERGY GENERATION + BACKUP
Strategies that provide critical needs for power when a facility loses power or other services

INTRO  Introduction

STRATEGY 15  Reduce your Energy Use

STRATEGY 16  Integrate Solar Electricity

STRATEGY 17  Integrate Solar Thermal Energy

STRATEGY 18  Install Energy Backup
WATER MANAGEMENT + STORAGE
Strategies that provide critical needs for water when a facility loses power or other services.

INTRO Introduction

STRATEGY 19 Reduce your Water Consumption

STRATEGY 20 Collect and Use Rainwater

STRATEGY 21 Improve Septic Waste Disposal System

STRATEGY 22 Prevent Wastewater Backflow in Homes
Keep Safe USVI
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.
Systems of a Community Resilience Center

COMMUNICATIONS
- Wi-Fi
- Solar phone
- Solar generator
- Wi-Fi access for social media/community branding with access for communication
- Community radio station
- Analog telephone line
- Oriented mesh systems allow testing and GPS without internet

STRUCTURAL
A professional structural engineer should be consulted to verify the building meets code requirements for seismic movement. Depending on location, ensure the structure can withstand forces caused by atomic surge produced by hurricanes or tornadoes events.

ENERGY STORAGE
Design a battery system that includes batteries for storing energy. Ensure that basic needs—light ventilation, emergency lighting, and electricity for essential equipment—are connected.

ENERGY GENERATOR
Have a backup energy generator for emergencies. Ensure that the generator is placed outdoors, at least 20 ft from the structure, and is protected from debris.

RAINWATER COLLECTION
Install a non-potable water collection system for non-potable water use, such as irrigation, flushing toilets, and cleaning. If polluted, water can be used for drinking. Rainwater storage tank could be located on the roof or ground.

SOLAR POWER
Install solar panels with batteries (some solar systems might also have a connection to the grid for selling power during low use or consuming power during high use and/or other forms of renewable energy. Other recommendations for the community center are individual house portable solar storage chargers the mobile phones, solar lamps, portable solar power generators, dedicated solar panels for critical & patients (for example, equipping dependency or respiratory, solar refrigerators, or hoop-up diesel generator)

SOLAR THERMAL HEATER
Use solar energy for hot water.

OPENINGS
Design using operable windows and doors. Long-term glass breezeways and ventilators. Maximize space by allowing the exterior area to be used. Make openings to reduce amount of air flow out and adjust the building.

VIBRATION
Use online regulators to improve we could mitigate seismic sunlight, reduce heat gain, and generate breezes, thereby reducing energy costs.

VENTILATION
Design a ventilation system in which air is always circulating through the inhabited spaces. This ventilation system could be passive with natural breezes or mechanical with active systems, such as air conditioning.

DIF (Design Flood Elevations)
If new construction, place the building above the Design Flood Elevations (DIF). If it is a new build, ensure equipment might be damaged with water is stored above the DIF.
Deployment Partners
PREPA
(Puerto Rico Electric Power Authority)
Integrated Seismic Energy Deposited by the Southwest Earthquake Activity of Puerto Rico from December 2019 to January 2020
PREPA
[ Puerto Rico Electric Power Authority ]
COVID-19 PANDEMIC
Changing the Energy Landscape in Adjuntas and Puerto Rico

#Autosuficiencia #InsurrecciónEnergética #50conSol

- Casa Pueblo Radio’s Solar Transmitter
- Solar Minimarkets: Strategically Located in 6 of Adjuntas’ Barrios
- Solar Barber Shop
- Solar Classroom in our Forest School
- 100% Solar Homes: 25 Fireflies
- Solar Cinema
- Casa Pueblo Radio: 100% Solar Powered
- Solar Refrigerators: 54 Units Throughout all of Adjuntas’ Barrios
- Restaurants: Vista del Río and El Campo es Leña
- Two Solar Hardware Stores and Other Small Businesses
- Comunidad El Hoyo: 10 Homes with Solar Energy Backup Systems
- 14,000 Solar Lamps: IluminandoPRconSol
- Workshops and Lectures on Renewable Energy
- Hybrid Biomass Energy Generation Systems
- 5 Permanent Systems for Dialysis Machines
- Cerro Mágico Ecotourism Project

Icons / The Noun Project
PUERTO RICO 2018

- Residential Consumption: 36.50%
- Commercial Consumption: 47.40%
- Industrial Consumption: 14.10%
- Public Lighting: 1.47%
- Agriculture: 0.15%
- Others: 0.31%
Los Cucubanos - Fireflies
Average energy consumption per home is 1.68 kWh.

Six 330 Wp solar panels per home can meet this consumption level.

This system, including batteries and installation, costs $8,000 per home.

Wherever electrical service is “stable”, the system can be installed without energy storage, thereby reducing the cost to $5,000 or less.

50%conSOL Residential equals $481 million in fossil fuel costs saved annually.

50%conSOL Residential equals NOT needing the Costa Sur power plant’s output, or one and a half times that of the San Juan power plant.

The use of solar water heaters should be maximized in order to minimize electrical consumption for this need.

It’s necessary to invest in energy efficiency in order to reduce household consumption and waste. This includes replacing light bulbs, air conditioning, and refrigeration systems with more efficient models, for example LED lights and “inverter” equipment/appliances.
Adjuntas
Pueblo
Solar
"Resilience is Community Strength"
Reneable energy for Puerto Rico

Puerto Rico is not prepared for another hurricane. A year ago, Hurricane Maria obliterated the island's electric grid, leading to the largest power outage in U.S. history. This disrupted medical care for thousands and contributed to an estimated 957 deaths. The hurricane caused over 650 billion dollars in damage to an island already in economic crisis. Although authorities claim that power was restored completely, some residents still lack electricity. Despite recovery efforts, the continued vulnerability of the energy infrastructure threatens Puerto Rico's future. But disruptions create opportunities to change. Hurricane Maria brought an opportunity to move away from a fossil-fuel-dominated system and establish a more resilient and sustainable one that can withstand future storms and other disasters.

Puerto Rico is representative of the Caribbean islands that rely heavily on fossil fuels for electric power: 90% of its electricity comes from imported fossil fuels (oil, natural gas, and coal), whereas only 8% comes from renewable sources (solar, wind, or hydroelectric). The distribution of 600 MW is challenging, requiring thousands of miles of transmission and distribution lines over the island's steep topography. This makes the island's central electrical grid vulnerable to hurricanes that are predicted to increase in severity because of climate change.

In Puerto Rico and the rest of the Caribbean, where sun, wind, water, and biomass are abundant sources of renewable energy, there is no need to rely on fossil fuel technology. Unfortunately, the government of Puerto Rico and the U.S. Federal Emergency Management Agency have been making decisions about the local power authority that are restoring the energy system to what it was before Hurricane Maria hit, perpetuating fossil fuel reliance.

Despite these decisions, a transformation has begun in communities across Puerto Rico. For example, in the mountain municipality of Adjuntas, local initiatives headed by Casa Pueblo, a self-reliant nonprofit community organization, has increased the installation of solar energy systems. Fortunately, the solar power-based infrastructure of Casa Pueblo was not affected by the hurricane, allowing Adjuntas to serve as the operation's center of operations for immediate local and regional response after the hurricane. Adjuntas became an oasis of power, where people got immediate assistance. Analogous solar-based energy systems were designed and installed by Casa Pueblo to supply the needs of numerous entities in the community: medical equipment, such as portable dialysis for homes with dialysis patients; a radio transmitter for a community radio station; and equipment for hardware stores, restaurants, and other businesses. Around the island, other examples of off-the-grid energy production, such as the resilience of small solar systems in rural communities, reveal significant potential to foster renewable energy production.

These new energy systems are changing the energy landscape of the municipality. But the majority of rural communities is still in need of sustained help.

At this juncture, when the opportunity to build a sustainable and resilient electrical system presents itself, moving away from dependency on imported fossil fuels should be the guiding vision.

"...moving away from dependency on imported fossil fuels should be the guiding vision."

Arturo Massol-Díaz is a professor in the Department of Biology at the University of Puerto Rico, Mayagüez, Puerto Rico, and a member of Clėncias Puerto Rico. arтурo.massol@upr.edu

Jennie C. Stephens is a professor of environmental science and policy at Northeastern University and director for Collaborative Research Initiatives at the Global Resilience Institute at Northeastern University. Boston, MA, USA. j.stephens@northeastern.edu

Jorge L. Colín is a professor in the Department of Chemistry at the University of Puerto Rico, San Juan, Puerto Rico, and a member of Clėncias Puerto Rico. jorge.colin@upr.edu

10.1126/science.aav5576

Published by AAAS
1 OCTOBER 2019 • VOL 365 ISSUE 6459 7
Arturo A. Massol-Deyá, “Our Energy for Our Country,”
Scenario Journal 07: Power, January 2020
https://scenariojournal.com/article/energy-for-our-country/

“Decolonization and building spaces for self-determination is an urgent need. We were raised on a political narrative that told us that we were weak because we are small, that we lack the natural resources to fuel a modern economy, that we are incapable of self-determination. Who needs oil, gas, or coal when we can embrace the renewable natural resources of the future? We have within our reach enough sun, wind, and water to power the Island and much more.”
autogestión comunitaria por
Puerto Rico y el Planeta Tierra

Para más información:

787.829.4842
Apartado 704
Adjuntas, Puerto Rico 00601
casapuebloreadjuntas@gmail.com

www.casapueblo.org
facebook.com/casapueblo
twitter.com/casapueblo.org

Radio Casa Pueblo
WOQI 1020 AM
y por el internet www.casapueblo.org/radio
móvil app tunein
Resilient Housing and Communities

Recovery & Resilience in Puerto Rico and the U.S. Virgin Islands

What did you think of the briefing?
Please take 2 minutes to let us know at:
www.eesi.org/survey

Materials will be available at: www.eesi.org/060320prusvi

Tweet about the briefing: #eesitalk @eesionline