

ResilientSEE-PR: A multidisciplinary lens for rebuilding communities in Puerto Rico

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Perkins+Will*



resilient**SEE**™



HURRICANE MARIA LANDFALL
SEPTEMBER 20, 2017





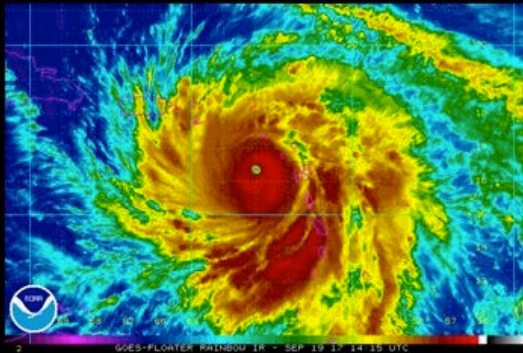




HURRICANE MARIA

PUERTO RICO & VIRGIN ISLANDS
11 AM AST TUE SEP 19 2017

Tuesday night into Thursday



WINDS: *Devastating to Catastrophic*

- 90 to 125 mph with gusts up to 175 mph
- **Impacts:** Widespread power outages. Impassible roads & bridges. Structural damage to buildings with complete wall & roof failure.

STORM SURGE: *Extensive*

- 6 to 9 feet
- **Impacts:** Large areas with coastal flooding. Structural damage to buildings, with several washing away. Roads washed out or severely flooded. Severe beach erosion. Damage to marina structures, as well as overturned or broken boats.

FLOODING: *Devastating to Catastrophic*

- 12 to 18 inches with isolated amounts of 20 to 25 inches
- **Impacts:** Rivers & tributaries ranging out of their banks. In mountain areas, runoff may rage down valleys while increasing susceptibility to rockslides & mudslides. Flood waters can enter numerous structures. Roads & bridges closures. Driving conditions become extremely dangerous.

MARINE CONDITIONS: *Dangerous*

- Seas of 20 to 30 feet with occasional seas of 40 feet or higher
- Life-threatening rip currents & surf conditions.

We're a global alliance committed to designing and rebuilding a resilient, sustainable Puerto Rico.

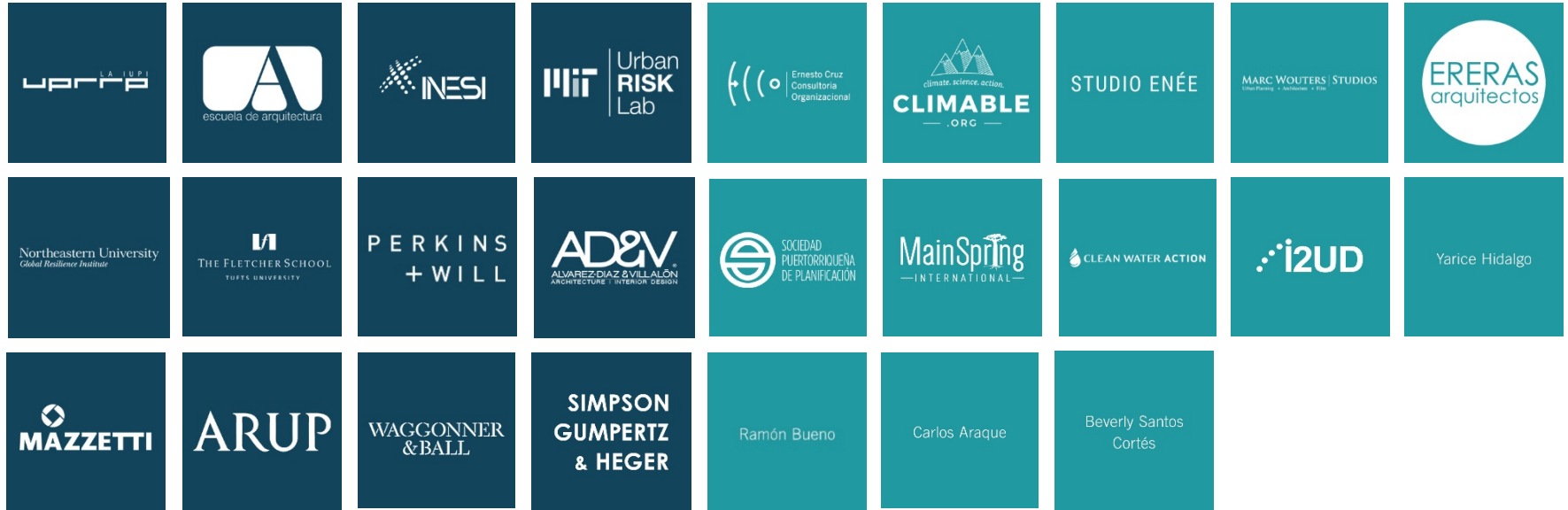


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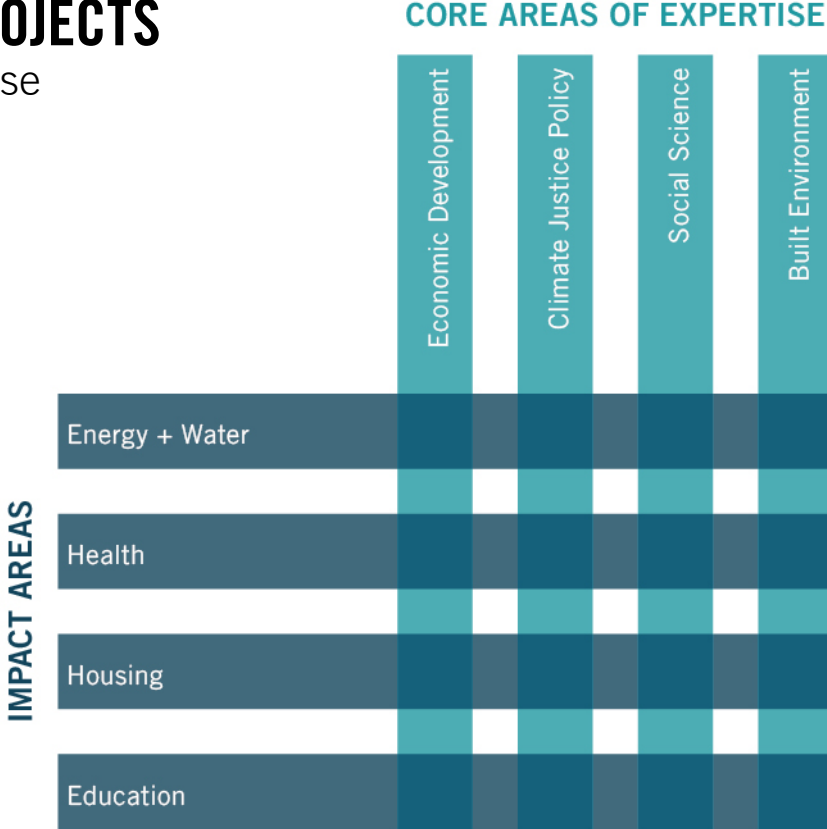
OUR GLOBAL ALLIANCE

Academic / Private Industry / Non-Profit Orgs



IDENTIFYING PROJECTS

Core areas of expertise



A HOLISTIC APPROACH TO RESILIENCE



SOCIAL RESILIENCE

Population health, environmental justice, social equity, community cohesion, and inclusivity of vulnerable populations



ENVIRONMENTAL RESILIENCE

Strategies to balance natural systems and man-made environments



ECONOMIC RESILIENCE

Business continuity, economic stability, developmental opportunity, benefit cost analysis



Education and community empowerment are, and will continue to be, critical components of a successful rebuilding strategy for Puerto Rico.

OUR COMMITMENT

We're in this together, for as long as it takes

We empower local communities

We design and build partnerships

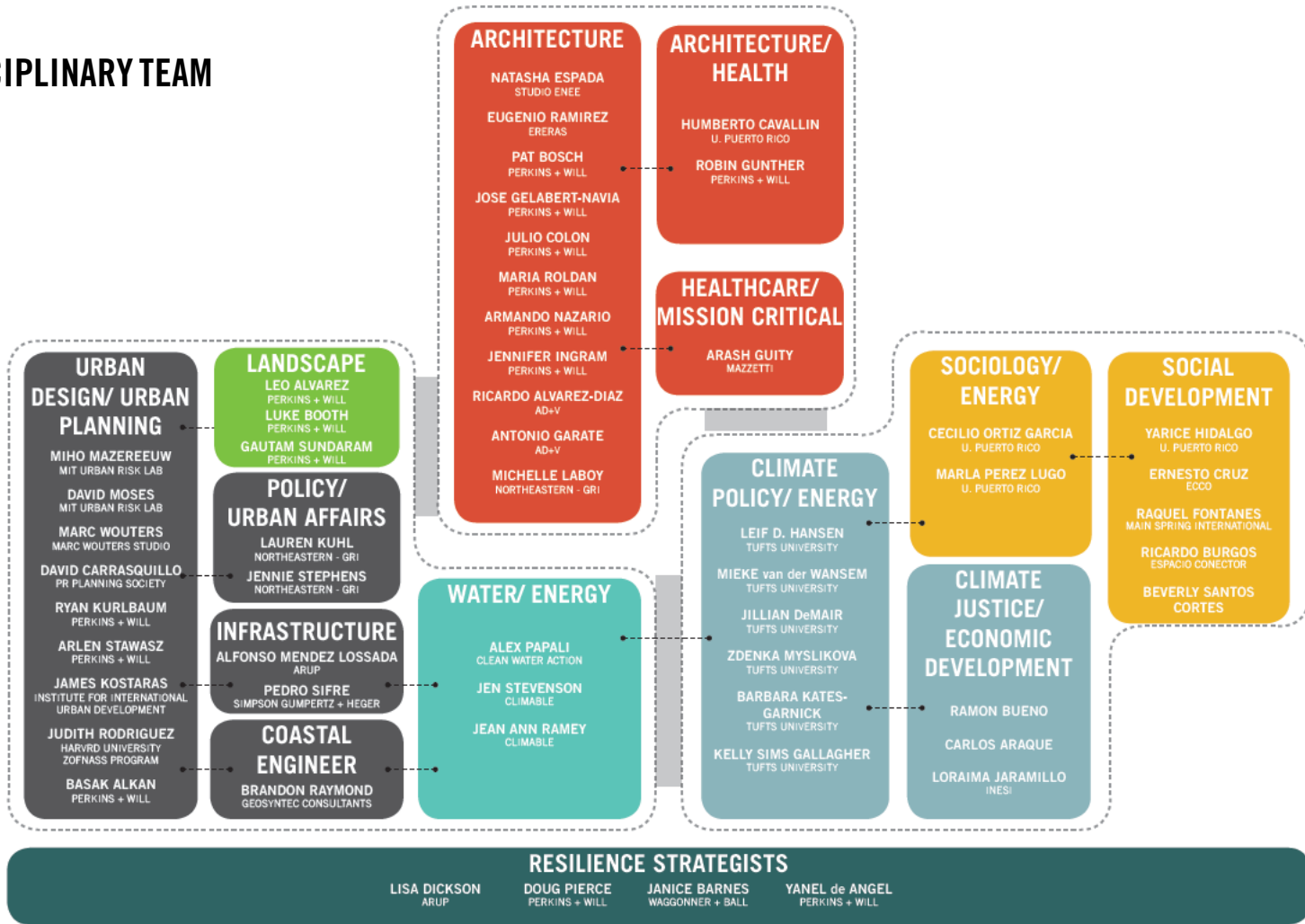
We see the whole-community perspective

We collaborate with policymakers

We support economic development

We grow together

MULTIDISCIPLINARY TEAM



Maria Puerto Rico Flood 9-20-2017

Hurricane path

112 mph wind gusts
10-15 in. rainfall
1-3 feet surge



Caribbean Sea

110 mph wind gusts
10-15 in. rainfall
4-7 feet surge

TOA BAJA MUNICIPALITY



Villas del Sol



Villa Calma

867

Villa Calma 1



Community Center



Iglesia Monte Hebron

INGENIO

Villa Calma 2

Pabellones

867

URBAN CAMP

TOA BAJA PILOT PROJECTS SCOPE

Ingenio Community, Toa Baja

- Villa Calma
- Villas del Sol

3 MAIN PROBLEMS

- Communities living in vulnerable floodplains
- Communities in need to rebuild in place with resilient design
- Lack of a community resilient hub



TOA BAJA PILOT PROJECTS SCOPE

SCOPE

- A Place of Unity – A Community Resilient Hub (Disaster Preparedness Center): services the Ingenio Neighborhood
- Villas del Sol – Resilient Framework Plan with special focus on:
 - Storm Water Management
 - Green Infrastructure
 - Electric Infrastructure



VILLAS DEL SOL



VILLAS DEL SOL



INGENIO COMMUNITY CENTER



INGENIO COMMUNITY CENTER





A CASE FOR CLIMATIC JUSTICE

10%

HIGHEST GLOBAL POPULATION DENSITY

55%

COASTAL MUNICIPALITY POPULATION

3.3'

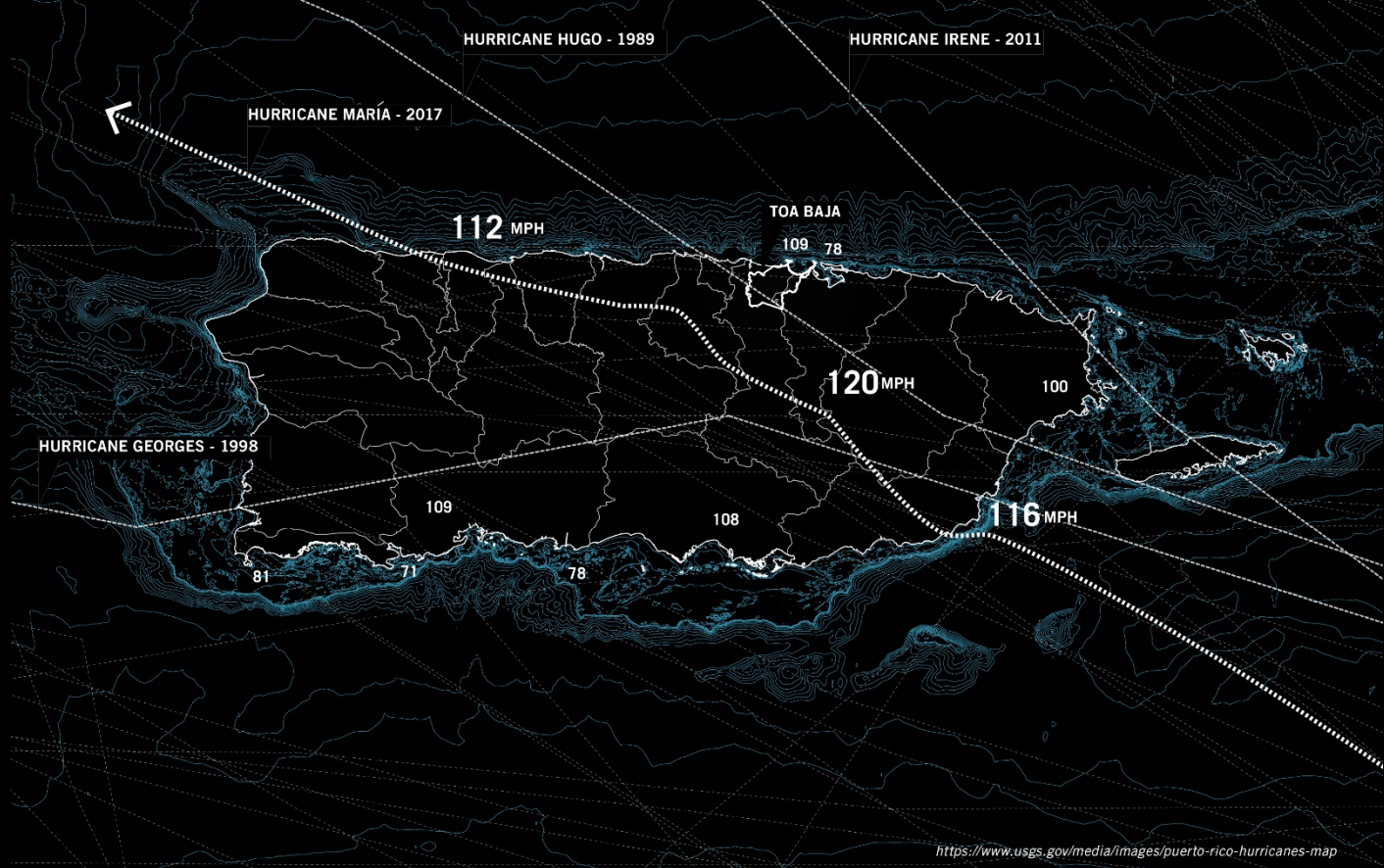
COASTLINE EROSION PER YEAR

INCREASED EXTREME RAINFALL EVENTS

INCREASE MEAN AND EXTREME TEMPERATURES

ISLAND // NATURAL RESOURCES

HISTORICAL STORM PATHS



MAJOR HURRICANE EVENT PATHS

HISTORICAL STORM EVENT PATHS

TOA BAJA //

TOA BAJA DISTRICTS

TOA BAJA

WHAT IS RELi

RELi (pronounced rely) is a project rating system that combines a holistic list of **resilient design criteria** with the latest in **integrative design process** for developing next generation neighborhoods, buildings, homes and infrastructure.



PERKINS+WILL



The Resilient Design Pattern

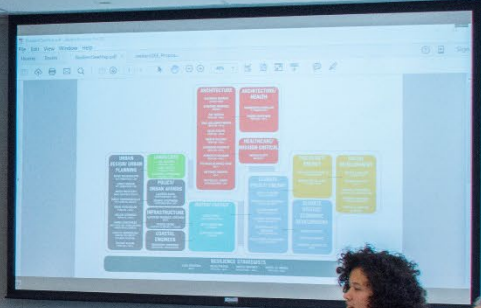
Resilient Design pursues buildings and communities that are shock-resistant, healthy, adaptable, and regenerative through a combination of diversity, foresight, and the capacity for self-organization and learning. Resilience is one of the five metapatterns that make up design inspired by ecology, sociology, and biology. We call this inclusive approach to problem solving and creative innovation, **Living Design**.

THE 5 INTERWOVEN LIVING DESIGN PATTERNS

01	02	03	04	05
Resilience	Restoration	Regeneration	Sustainability	Wellness
Adapt Shock-Resistant & Flexible	Repair Revitalize after Damage	Replenish Self-Reconstructing & Producing	Endure Maintain Capacity & Potential	Thrive Multi-Dimensional Vitality

Living Design has five metapatterns. Each pattern has its own area of focus. Each pattern embodies the other patterns.

WORK SESSION



Guest With Guest
Password Birkwood

PHASE 1: ANALYSIS
Infrastructure
Economic Development
Land / Asset Value
Site Research
Pre-Design / Program
Process!

PHASE 2: PLANNING
Regulatory Approvals
Concepts / Program of Work
Site Plan
Environmental
Architectural
Infrastructure Program
Cost Estimate

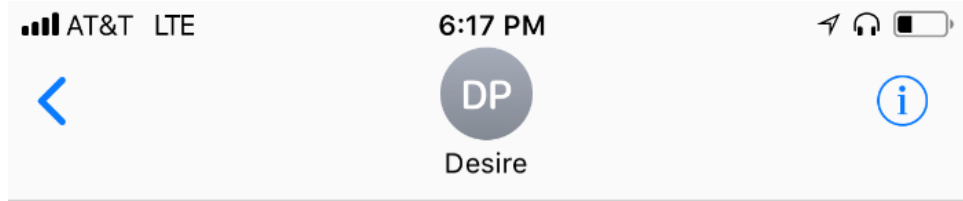
PHASE 3: DESIGN
Site Plan
Architectural
Infrastructure Program
Cost Estimate

PHASE 4: CONSTRUCTION
Construction Management
Construction Administration
Construction Management
Construction Administration
Construction Management
Construction Administration

REBUILDING IN PARTNERSHIP



Yanel de Angel and Bernardo (Betito) Marquez Garcia



Text Message
Today 5:51 PM

Dear Yanel, we..the people in Toa Baja will be eternally grateful for your attention and drive to help us move forward..I am proud to say ..I'm a puertorican woman with Orgullo Llanero....Bienvenida y tambien a tu equipo de trabajo que esta facilitando tu presencia y talento a nuestra patria querida....see you soon!..thank Ricardo too.

KEEP SAFE PUERTO RICO

Guide for Housing Resiliency

A Safer Site

Building Protection

Adaptive Design

Water Management

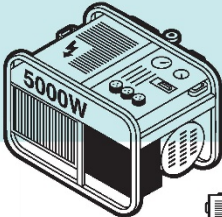
Power Generation + Backup

Household Preparedness And Response

Community Preparedness And Response

All combined, a total of 30 strategies!

CHAPTER
5



ENERGY GENERATION & BACKUP

It is important that a critical facility have a backup power source in the event of a power outage.

VI ENERGY GENERATION & BACKUP

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BACKGROUND ON THE SECTION

Energy generation and distribution systems are vulnerable to flooding from storm surge and precipitation as well as earthquakes, high winds and landslides which can threaten the stability of the power distribution network and the entire central power grid overall. When catastrophic events are anticipated throughout Puerto Rico, repeating damaged infrastructure and other regional facilities that lead to a high demand and damaged infrastructure.

Disseminated energy generation systems that are located as close to the user as possible improve the resilience to flooding. Consequently, repeatable damage prevention and mitigation strategies are needed to protect the grid.

As of 2018 in Puerto Rico, 90% of the power is generated by the public utility company, Enxer. The network is a mix of public and private utilities. The network is a mix of public and private utilities. The network is a mix of public and private utilities.

Plans to increase the capacity of the grid to support the growing demand for energy support a goal of 100% renewable energy.



VI ENERGY GENERATION & BACKUP

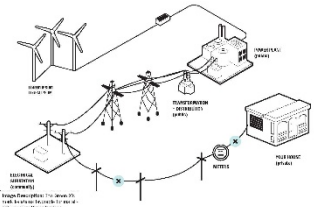
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STEPS TO DETERMINE YOUR ENERGY NEEDS

In order to assess your power needs, consider identifying your power demand and reduce.

TYPICAL ENERGY DISTRIBUTION

- Develop power systems to route emergency power to a load area that is not power source. In this case, backup power to the critical load area is provided by the generator. In this case, backup power to the critical load area is provided by the generator.
- There are several strategies that can ensure redundancy in power systems. The first step is to ensure that the power system is designed to be resilient to power outages.



VI ENERGY GENERATION & BACKUP

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STEPS TO DETERMINE YOUR ENERGY NEEDS

STEP 1: CALCULATE LOAD


Consider what a typical occupancy or load will be expected to be. The generator power capacity should be sized to meet the peak load. The generator power capacity should be sized to meet the peak load.

STEP 2: CALCULATE SITE

The load site is a critical factor in determining the generator power capacity. The load site is a critical factor in determining the generator power capacity.

MINIMUM ENERGY LOAD CONSIDERATIONS FOR HOUSING

LOAD TYPE	CONSIDERATIONS
RESIDENTIAL	Consider the number of occupants and the number of appliances. The generator power capacity should be sized to meet the peak load.
COMMERCIAL	Consider the number of employees and the number of equipment. The generator power capacity should be sized to meet the peak load.
INDUSTRIAL	Consider the number of machines and the number of equipment. The generator power capacity should be sized to meet the peak load.



VI ENERGY GENERATION & BACKUP

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STEPS TO DETERMINE YOUR ENERGY NEEDS

STEP 3 | CHOOSE TYPE OF GENERATOR

- **Know the size of your vehicle and how to drive it.** A generator that is too small or too large is inefficient and may be noisy.
- **Check the fuel tank capacity and how to fill it.** A generator that is too small or too large is inefficient and may be noisy.
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TYPES OF FUEL

FUEL TYPE	PROS	CONS
Gasoline	• Widely available • Easy to store and transport • Relatively clean-burning	• Short shelf life (up to 1 year) • Requires regular maintenance • Noisy operation
Propane	• Clean-burning • Long shelf life (up to 10 years) • Quiet operation	• Requires a propane tank • Propane tanks are expensive • Noisy operation
Diesel	• High energy density • Long shelf life (up to 10 years) • Quiet operation	• Expensive fuel • Requires a diesel engine • Noisy operation
Batteries	• Quiet operation • No emissions • No noise	• Limited runtime • Expensive • Requires a battery bank

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STEP 4 | OPERATIONS AND MAINTENANCE

- **Check the generator's operation and maintenance requirements.** A generator that is too small or too large is inefficient and may be noisy.
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STEPS TO DETERMINE YOUR ENERGY NEEDS

STEP 5 | CONNECTING THE GENERATOR

- **Check the generator's operation and maintenance requirements.** A generator that is too small or too large is inefficient and may be noisy.
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LOREN/PSUM

TWO TYPES OF TRANSFORMERS

ADDITIONAL INFORMATION

RECOMMENDATIONS

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RESILIENT COMMUNITY HUB

Set of Guidelines / Checklist

Operations

Physical Environment

Community Engagement

RE↑MAGINA
Puerto Rico

 Enterprise®



PERKINS+WILL



STUDIO ENÉE

WAGGONNER
& BALL