

# Post-Hurricane Renewables Opportunity in Puerto Rico

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Transforming global energy use to create a clean, prosperous, and secure low-carbon future.

# The Puerto Rican power system was struggling before the storms

## Poor reliability

SAIFI, FY17

NA Median 1.0

PREPA 4.8

SAIDI, FY17

NA Median 1.9

PREPA 14.4

## Minimal renewables

RE generation %

2015 RPS 12%

2016 Actual 2%

2020 RPS 15%

2035 RPS 20%

## Expensive energy

Average rates, July '17 \$ / kWh

Res 0.19

Com 0.23

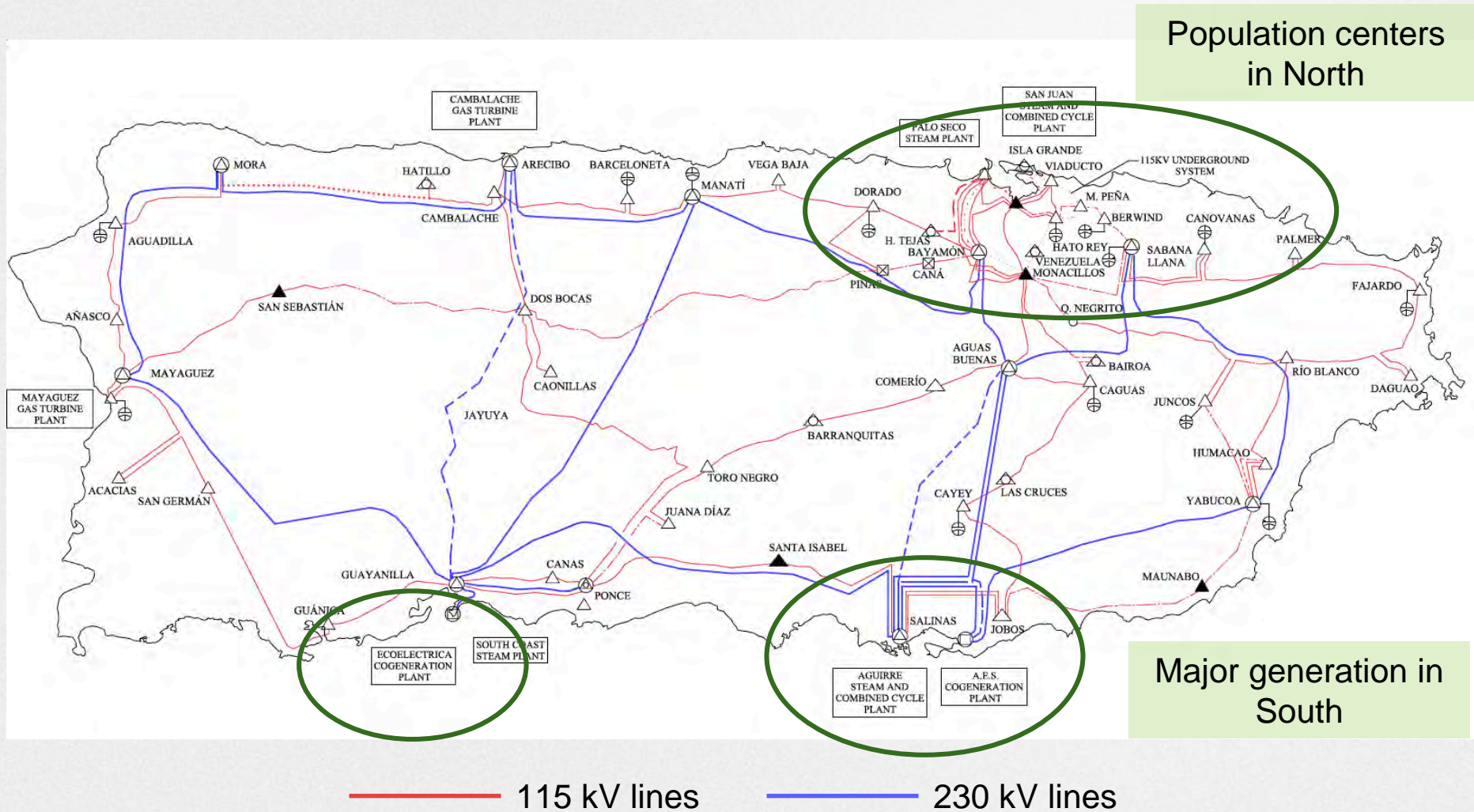
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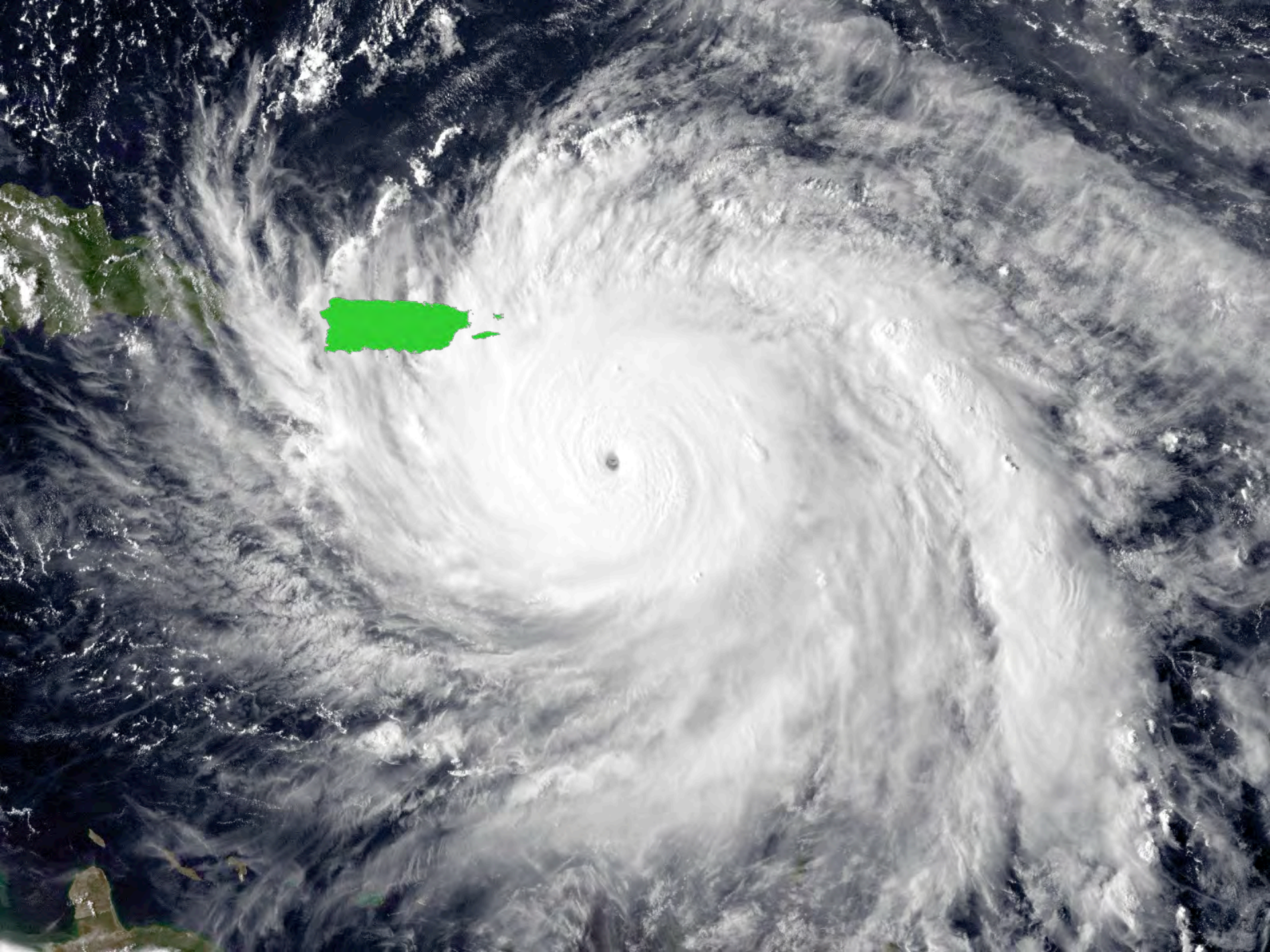
## Debt burden

**\$11.4 B**

Total PREPA liabilities

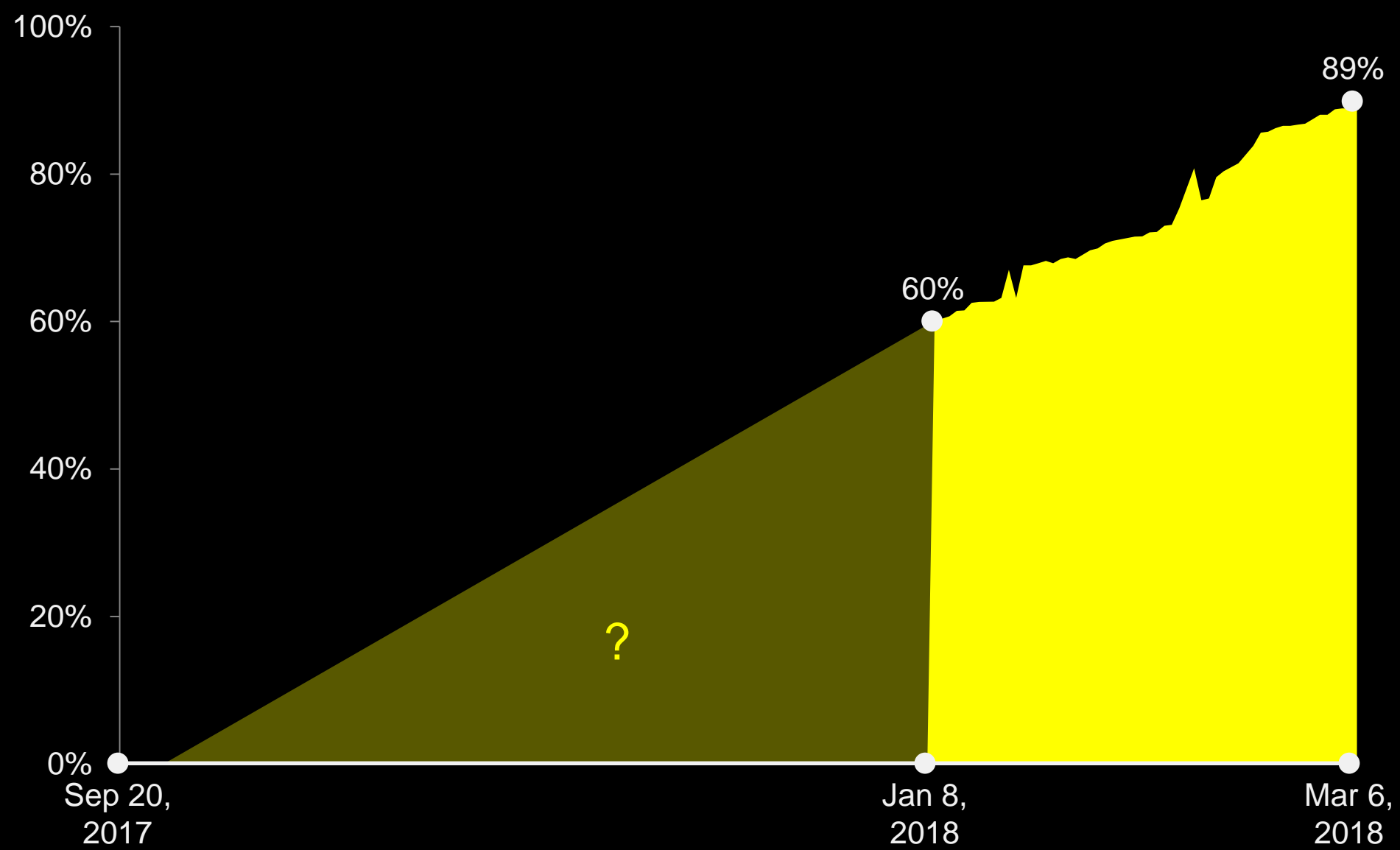
# Puerto Rico's electric grid relies heavily on North-South transmission over challenging terrain





# Puerto Rico Power Restoration Following Hurricane Maria

% of customers with grid power

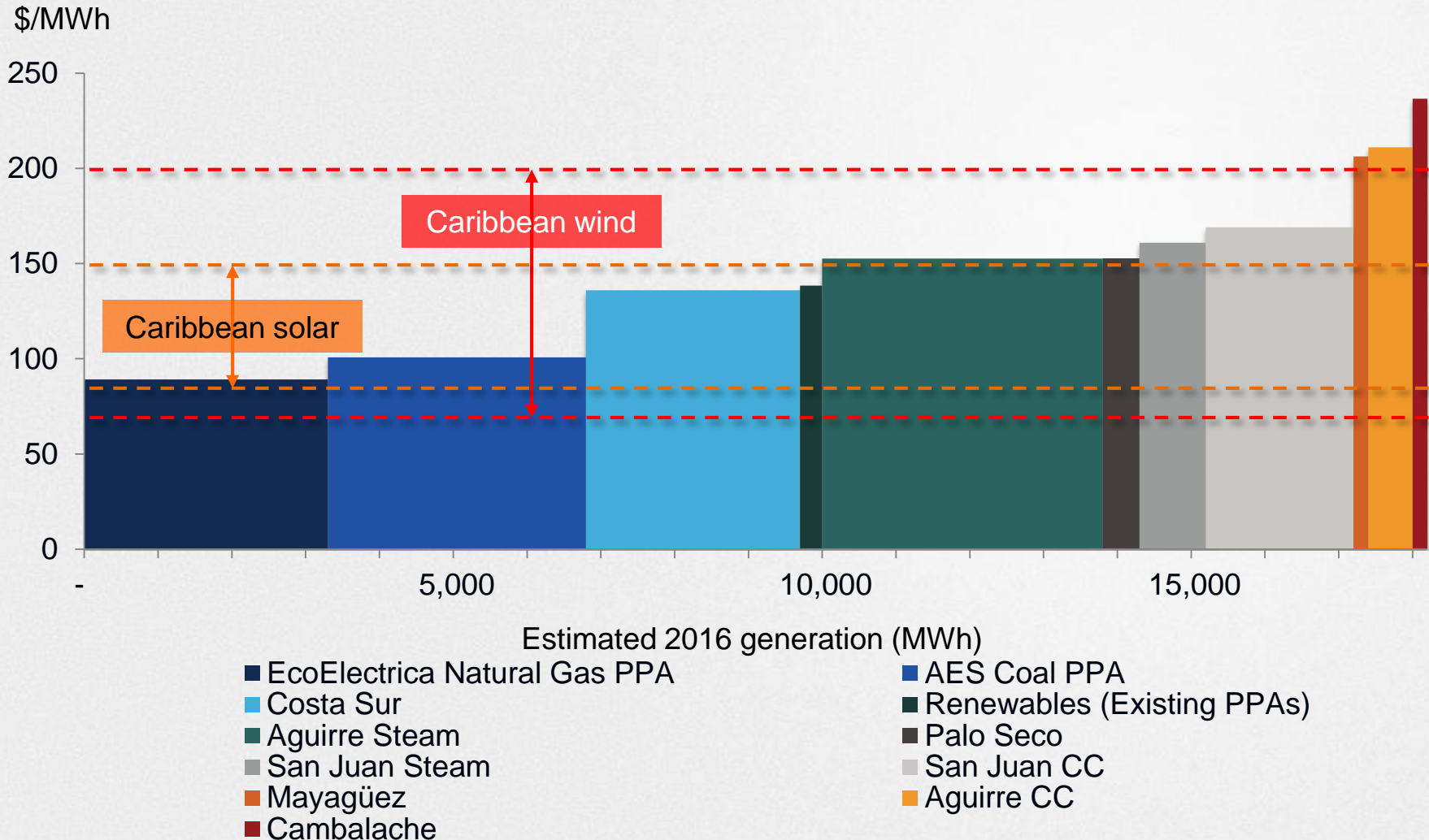


# Several plans are moving forward to drive Puerto Rico's energy transformation

- 1 Privatize the island's utility, PREPA
- 2 Implement new regulation enabling shared community microgrids
- 3 Resolve bankruptcy proceeding
- 4 Plan a new role for renewable energy and efficiency in a resilient grid

# Renewable energy is cost-effective for Puerto Rico

Operating cost of existing power generation in Puerto Rico, \$/MWh



Source: RMI analysis of PREPA data and benchmark PPA prices across Caribbean region

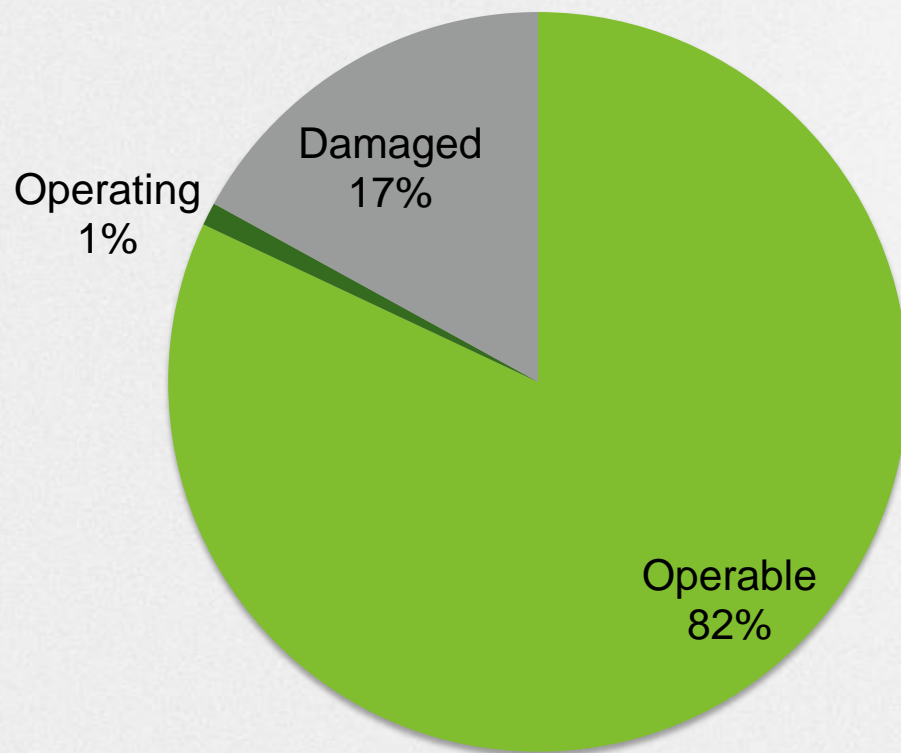


# Renewable generation is resilient

**Resilience**: how quickly and how well an electric system can recover from a widespread outage

Post-hurricanes status of utility-scale renewable energy in Puerto Rico

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75-95% of small scale / residential solar also ready to operate

Storm hardening can increase survival rates at approx. \$0.05 to \$0.15 per watt of installed capacity



Elsewhere in the Caribbean, some solar installations survived well while others experienced significant damage



# Necker Island, British Virgin Islands



# St. Thomas, U.S. Virgin Islands



# Turks and Caicos



# The larger of two wind farms survived without damage

101 MW Santa Isabel wind farm suffered no material damage

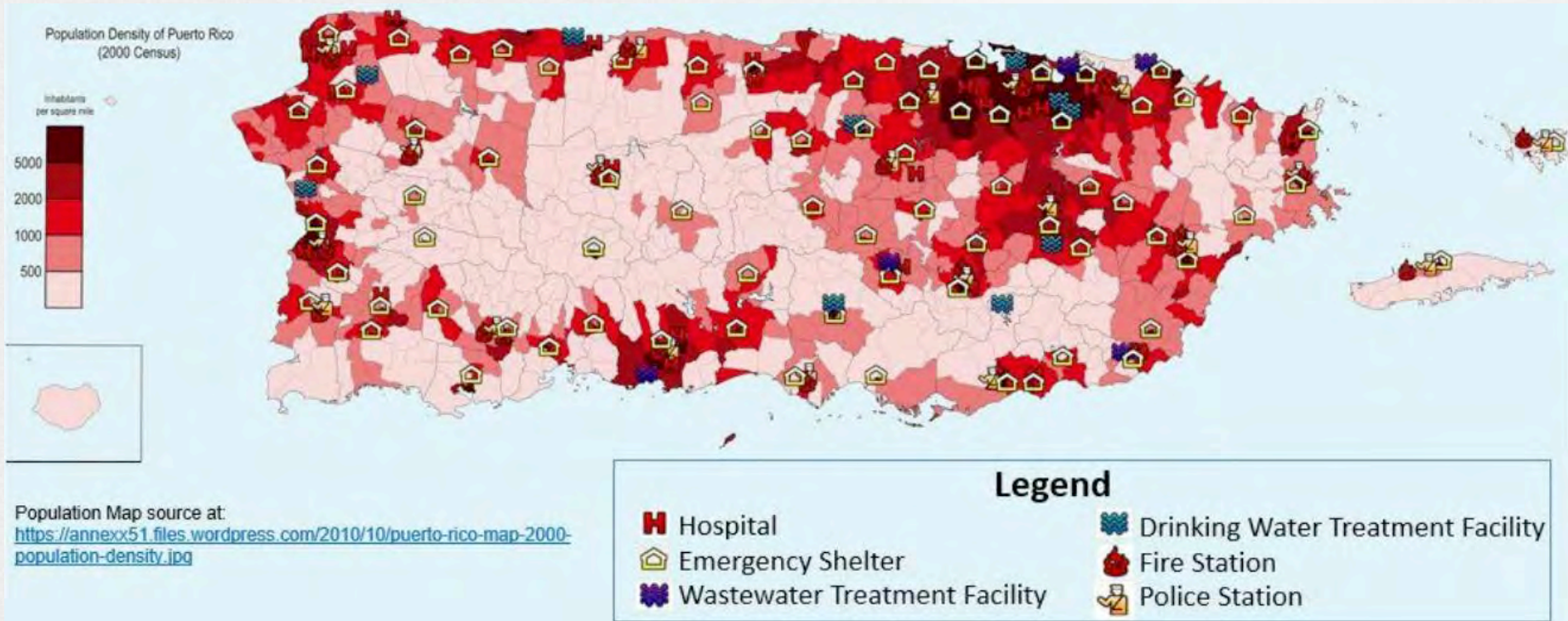


23 MW Punta Lima wind farm suffered extensive damage



# Microgrids can cost-effectively improve resilience

## Hypothetical islanding of critical infrastructure (NYPA)

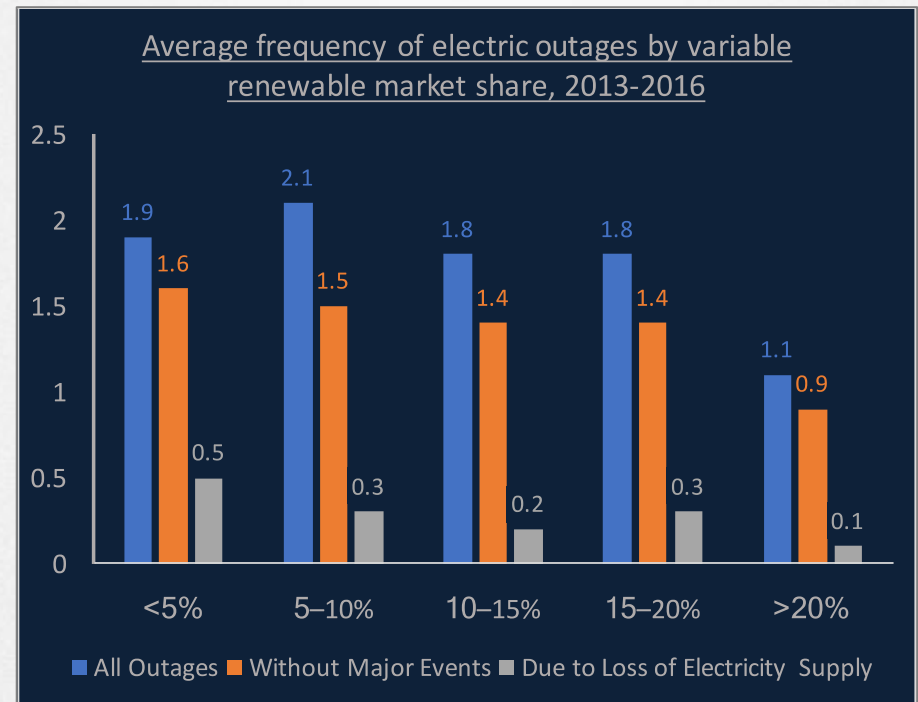
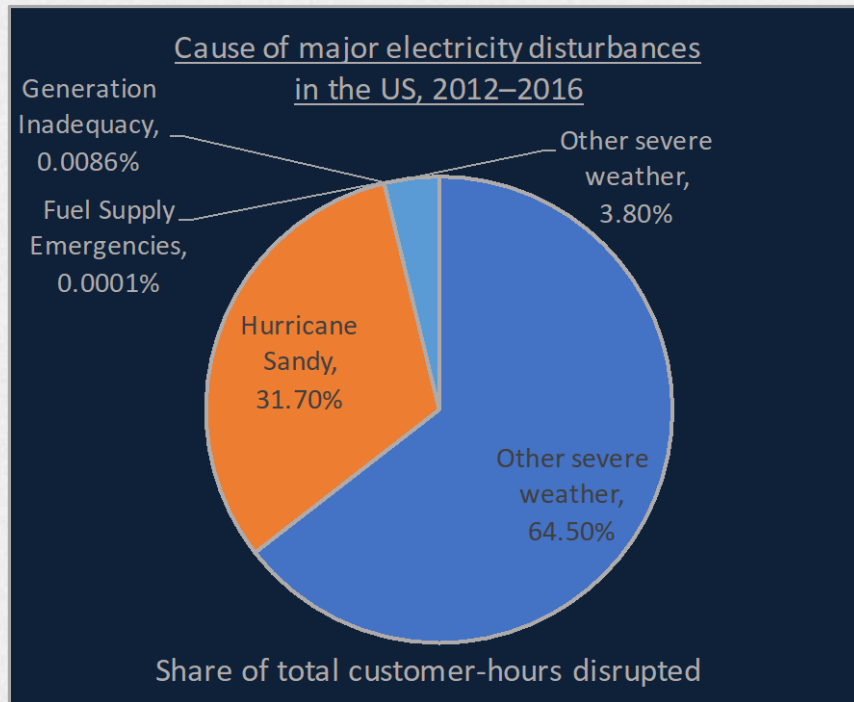


Costs may be less than storm-hardening remote communities and carry additional benefits:

- Minimized lost economic activity during outage
- Minimized land use and transmission requirements for central generation
- Deferred or reduced need for new plants
- Reduced dependence on imported fossil fuels

# Increased penetration of renewables in U.S. has not reduced reliability

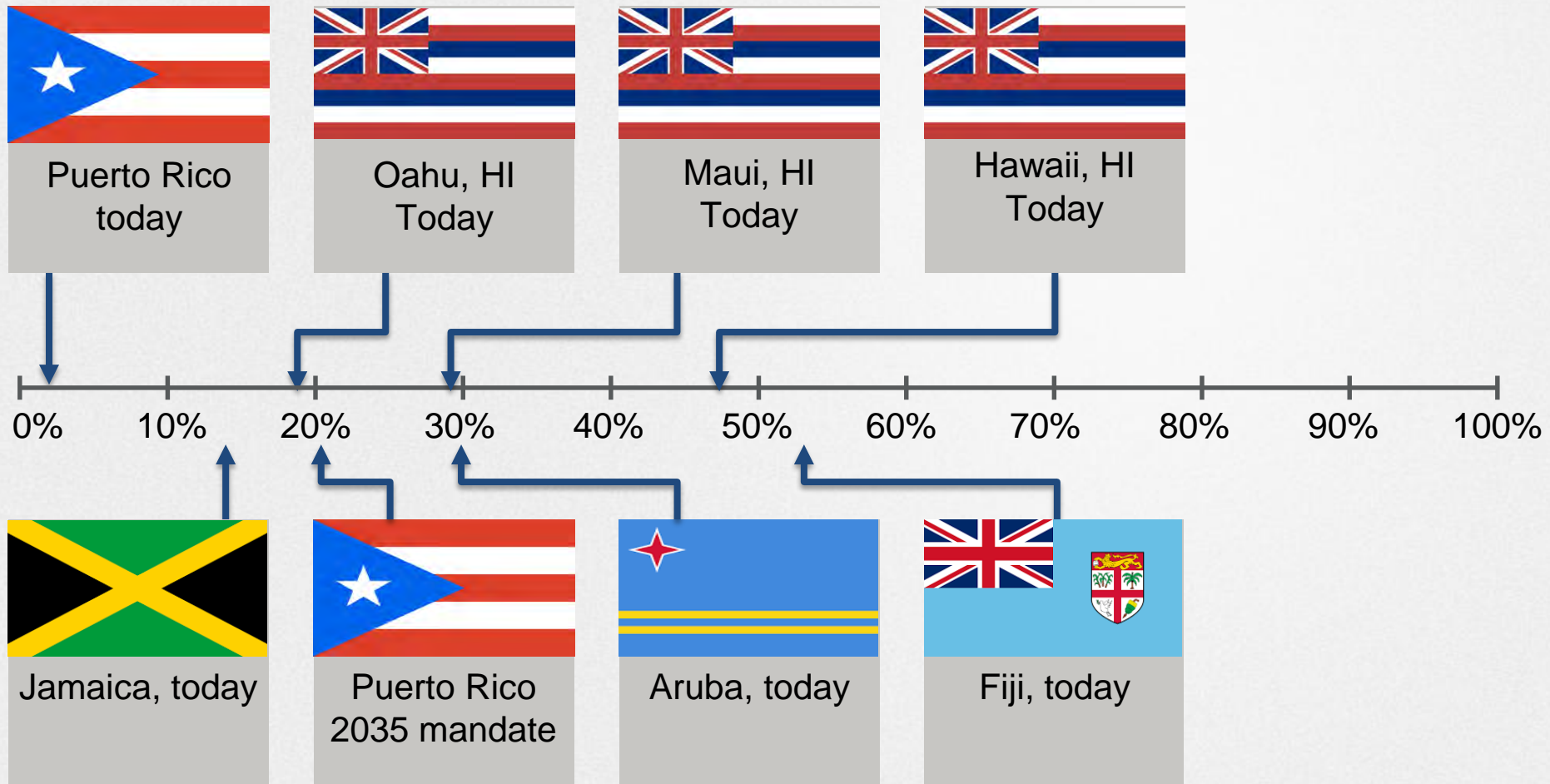
**Reliability:** the ability of generators and the grid to meet power requirements on demand, at all times



Balancing authorities with >20% renewables experienced the fewest, shortest outages, and less than .01% of all major electricity disturbances were caused by generation inadequacy

# Island systems are already operating at much higher renewable penetrations than Puerto Rico

Current and potential renewable energy penetration rates without loss to reliability





# What happens next?

## **Even as restoration continues to reach more customers, Puerto Rico is planning its energy transformation**

- Power restoration to last customers unknown, at least late May
- Integrated resource plan from PREPA by June 2018
- Legislation to enable PREPA privatization by summer 2018
- Updates to microgrids regulation

