

Building a Better Energy Grid in Puerto Rico


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Da' Vision and Strategies

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Grid Modernization – An Issue for Puerto Rico

- **Generation**
 - Old and unreliable
 - Frequent power plant outages (12 times more often than mainland U.S. averages)
 - High dependency on fuel oil and lack of incentives to diversity fuel mix (less than 4% of current supply is renewables and 45% is oil)
 - Principal generators located far from load centers with a poorly maintained T&D infrastructure susceptible to significant damages from hurricanes
-

Transmission and Distribution (T&D)

T&D System is poorly designed and operated

T&D Infrastructure has not been adequately maintained or upgraded

Very poor vegetation management and lack of rules and enforcement policies contributing to outages, energy losses, and power quality

Highly vulnerable to catastrophic events leading to reliability, power quality and resiliency issues



Severe Weather Recent Events

Hurricane Maria – Puerto Rico

- September 16 - October 2, 2017
- Worst natural disaster on record

Human Toll

The longest outage in U.S. history
(Sept 2017 – May 2018)

Lack of clean water

Tens of thousands of homes
damaged or destroyed

Surface transportation disrupted,
limiting access to medical
services

Official death toll: 2,975 (revised
in Aug. 2018)

Rebuilding

Army Corp. of Engineers – (testimony before Senate Energy Comm. May 2018)

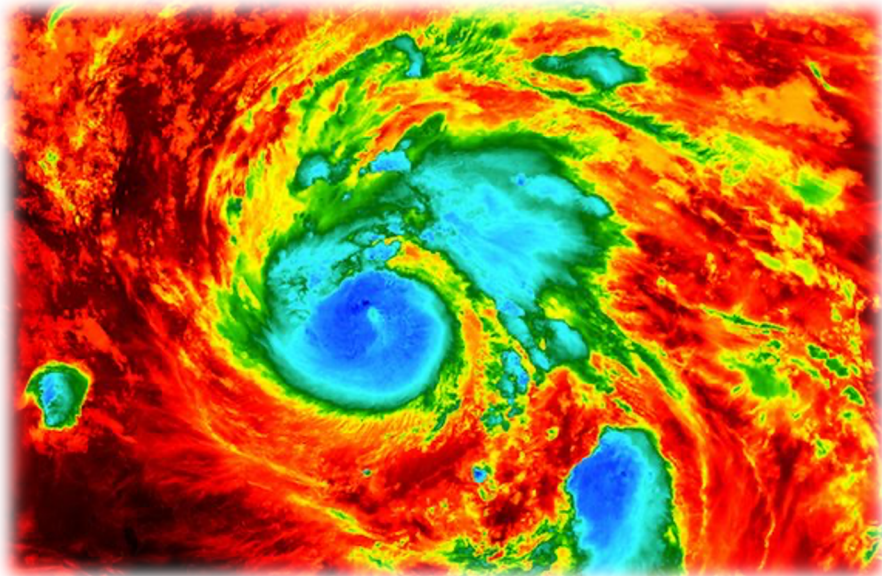
- Transmission – 79% rebuilt
- Distribution – 80% repaired and energized
- 22,900 customers still “out” (at the end of the line, in remote areas)

Federal money

- How much originally?
- September 2020 – FEMA released \$ 9.6 billion for grid rebuilding

- Traditional central station operating paradigm is extremely vulnerable!
 - ✓ Loads in the north, generation in the south
 - ✓ Reliance on transmission over the Cordillera Central mountain range
 - ✓ Storms tend to track southeast to northwest, terrain funnels winds on to transmission towers
 - ✓ Once down, transmission towers are remote and inaccessible – slows recovery
- Distributed resources have proven resilient
- A new kind of grid is needed – a Modern Integrated Grid
 - ✓ Support 2-way power flow while maintaining voltage & frequency (advanced sensors, high-speed communications, distributed control systems)
 - ✓ Customer-centric development & operation

Lessons Learned



Drivers- Grid Transformation

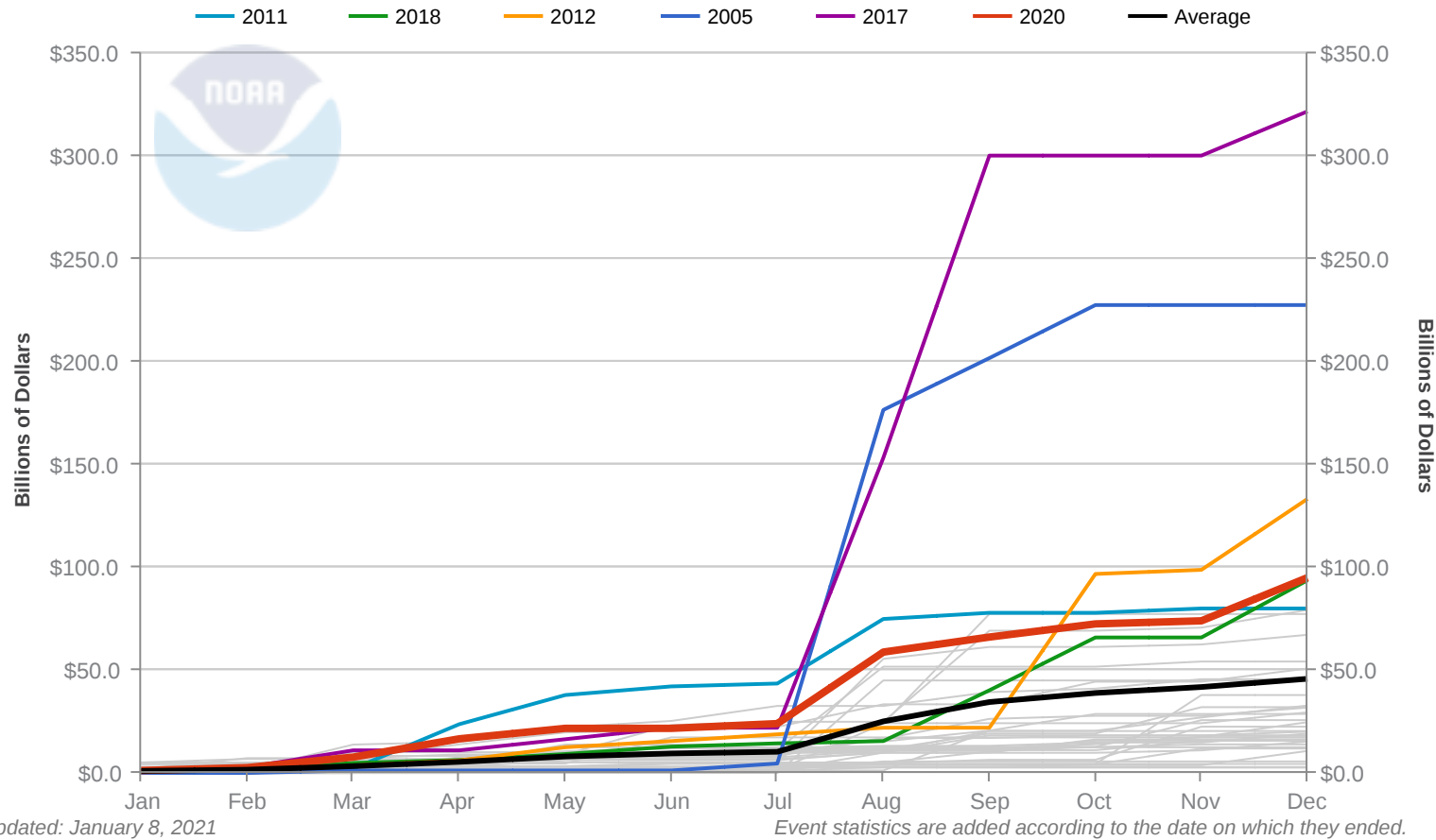
Changing Energy Sources

- Integrating clean energy, customer aggregation and demand response

Increasing Severe Weather Events

- Hardening the grid

1980-2020 Year-to-Date United States Billion-Dollar Disaster Event Cost (CPI-Adjusted)



Updated: January 8, 2021

Severe Weather Trends

Billion-Dollar Disasters BY THE NUMBERS (1980–2020)



DROUGHT



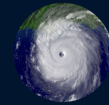
FLOODING



FREEZE



SEVERE STORMS



TROPICAL CYCLONE



WILDFIRE

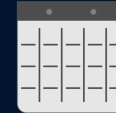


WINTER STORM

For more info:
www.ncdc.noaa.gov/billions/

1980 The year NOAA started tracking billion-dollar disasters

119 Number of billion-dollar events from 2010-2019



22 Number of U.S. billion-dollar disasters in 2020—the most on record



7.0 Average number of billion-dollar disasters per year since 1980

285 Number of billion-dollar disasters in the U.S. since 1980

\$1.875
TRILLION

Total cost of the 285 billion-dollar disasters



7 Number of billion-dollar tropical cyclones that struck the U.S. in 2020



15.1 Average number of billion-dollar disasters per year since 2015

50 Number of states that have had at least one billion-dollar disaster

124 Number of billion-dollar disasters that have impacted Texas since 1980—the most of any state



The Objectives of Puerto Rico's Energy Sector Transformation

CUSTOMER-CENTRIC



- Enable residents to choose how to best address their energy needs
- Enable consumers to become prosumers¹
- Increase customer engagement

AFFORDABLE



- Improve the cost of electric service to all customers
- Improve operational efficiency and financial stability

RELIABLE



- Establish best-in-class reliability of electric service, which is essential for customer well-being and economic development
- Establish best-in-class power quality that meets growing customer needs

RESILIENT



- Maintain ability to adequately withstand catastrophic natural events and other adverse conditions
- Continuously improve emergency preparedness capability

SUSTAINABLE



- Train and engage workforce with a strong safety culture
- Exact transparent regulatory framework
- Pioneer environmental leadership
- Drive economy and customer well-being

Following the Governor's Vision, PREPA's June 2019 Fiscal Plan is predicated on the implementation of an Energy Sector Transformation, leveraging private sector capital and operational expertise, to achieve the following objectives:

¹Prosumer is a person or legal entity who consumes and produces a product (e.g. a consumer using residential solar for partial electricity consumption)

The Transactive Electricity Grid



**Smarter
Energy
Infrastructure**

DRIVERS



1

Customer
Wants &
Needs

2

Environmental
Goals

3

Growth in
Distributed
Energy Resources

4

New
Technologies

BENEFITS



1

Enhanced
Reliability

2

Increased
Resiliency

3

Reduced Carbon
Emissions

4

Empowered
Customers

5

Flexible & Responsive
Energy Grid Platform

Smarter Energy Infrastructure

Grid Evolution Requires Increasing Investment

- Grid Technologies
- Digitization
- Data Analytics
- Distribution system sensing and monitoring
- Controls to enhance operational efficiency and to integrate new resources to improve reliability and grid resiliency, achieve power supply diversity and achieve evolving clean energy goals



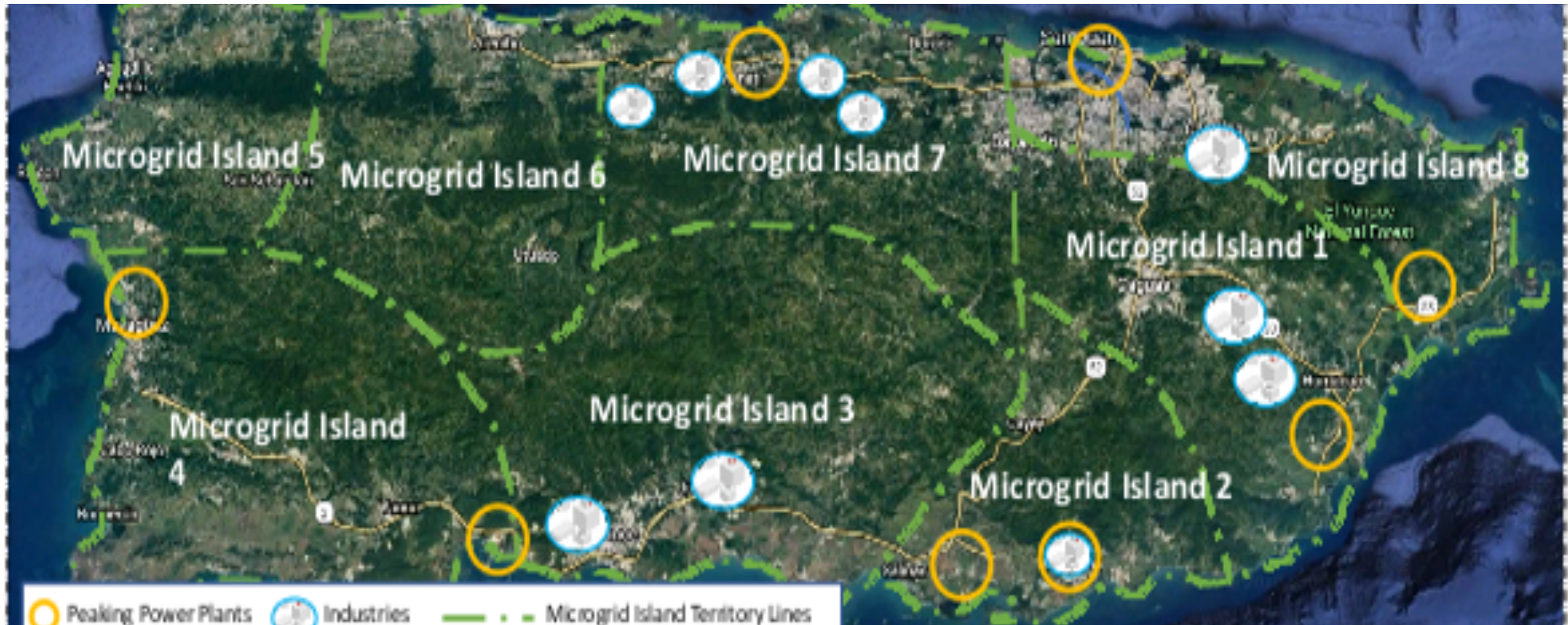
PREPA



Backbone Transmission System

Significant T&D investment and resilience improvements over 10 years*

Total expected T&D grid investment to be finalized subject to discussions with COR3. Estimates include many assumptions all of which materially impact results.



PREPA's Grid Modernization

Initiative presented are potential projects under current consideration on various stages of development. Inclusion here in should not be viewed as a guarantee of execution. Impacts of initiatives are indicative and intended for discussion purposes only. Values expressed are dependent on multiple factors – actual impacts may vary nationally.

Outsourcing the T&D System

- LUMA Energy gives a 15-year agreement for the management, repair, restoration and replacement of the Puerto Rico T&D System
- A Consortium Consisting of:
 - ATCO Ltd: Global Electric T&D and Natural Gas Operator
 - Quanta Services: leading infrastructure entity
 - Innovative Emergency Management: comprehensive emergency management and disaster recovery firm

Puerto Rico Is Moving to Deploy Renewable Generation

Aggressive Goals (Act 17- 2019)

- 40% on or before 2025, 60% on or before 2040, 100% on or before 2050 ✓ (Only about 2.5% today; the rest is oil, gas, coal)

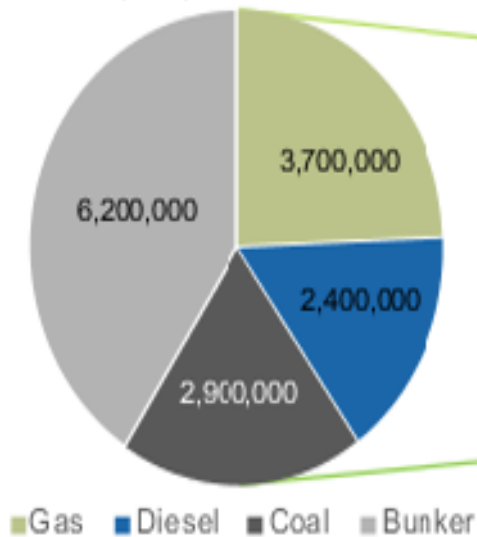
Utility-Scale Procurement (IRP – 2020)

- Puerto Rico Energy Bureau approves PREPA's plan to procure 3,750 MW of photovoltaic capacity and 1,500 MW of 4-hour battery storage capacity over a four-year period

Distributed Systems

- Act 17 – promote small-scale electric plants, facilitate interconnection of DGs ✓ January 7: Puerto Rico HUD RFP for a contractor to help distribute \$1.507 billion in US HUD block grant money to single family homeowners, businesses and/or public facilities to install PV systems with batteries

Tons of CO2 Produced 2017:
15,200,000 Tons Per Year



Tons of CO2 Produced 2028:
7,700,000 Tons Per Year



Increased renewable energy production coupled with natural gas-fired generation will improve air quality and reduce greenhouse gas emissions.

CO₂ reduced 49% in 10 years

PREPA's Carbon Reduction

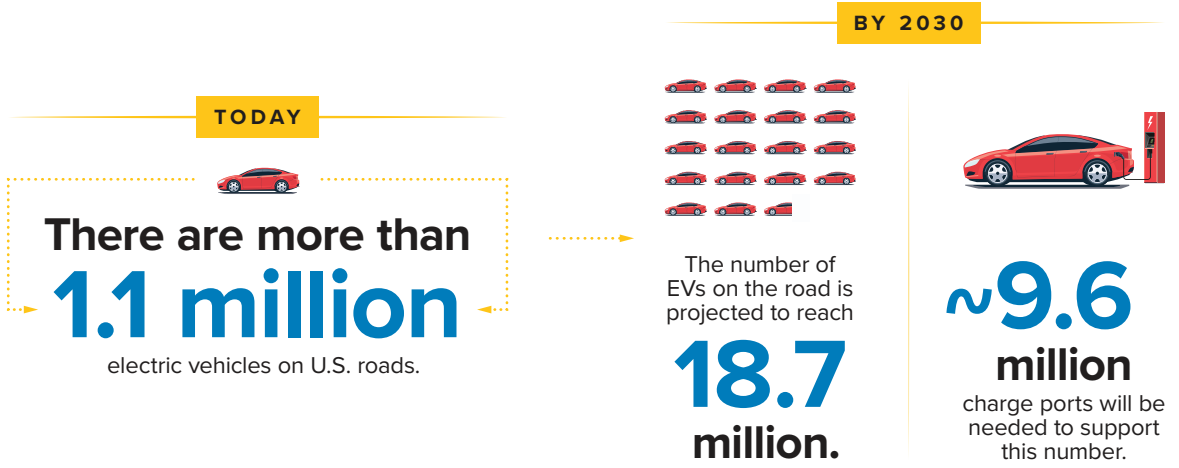
Puerto Rico – Current Status

- Ten-year rebuilding plan submitted to FEMA in process of implementation
- LUMA front-end transition ends June 1, 2021; Turning over the keys to LUMA to plan, maintain, rebuild, and operate T&D system as the GRIDCO.
- RFP issued for 1000 MW of renewables and 500MW of battery storage; over 150 developers have have expressed strong interest;
- RFP for operation and maintenance of legacy generation being finalized for development of a GENCO.

Biden Focus

Recovery, Renewal and Respect for PR

Create	Support	Invest	Provide	Expand
Create Federal Working Group to ensure Puerto Rico has resources and technical assistance for recovery	Support full recovery & infrastructure modernization-building back better	Invest in Puerto Rico's economic development and support for families	Provide relief for unsustainable debt	Expand access to education and workforce development.



Electrical Transportation Trends

Leading On Clean Energy



Changing U.S. Energy Mix

38%
CARBON-FREE



Increasing Investments

\$110 Billion+
PER YEAR IN SMARTER
ENERGY INFRASTRUCTURE

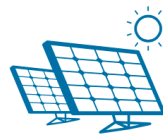


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Over the Past Eight Years,
More Than Half of New Electricity
Generation Capacity Was
WIND AND SOLAR



Investing
\$1.4 Billion+
TO DEPLOY
CHARGING INFRASTRUCTURE



Providing

67%
of the
SOLAR ENERGY
in the Country



Using
90%+
OF ALL
U.S. ENERGY STORAGE

Cutting Emissions

CO₂ ↓ ~30%
BELOW 2005 LEVELS
AS OF 2019
(preliminary)

NO_x ↓ 84%
BETWEEN
1990–2018

SO₂ ↓ 92%
BETWEEN
1990–2018

Texas Blackouts

Three back-to-back winter storms ravaged Texas on February 10-11; 13-17 and 15-20

Massive electricity power plant failures

Shortages of water, food, and heat

Over 4.5 homes and businesses without power

Frozen wind turbines and solar panels

Inadequately winterized natural gas equipment and frozen pipelines

Isolated grid from the Eastern and Western Interconnected Grids



Texas Blackouts – Reform the Grid and Electricity Markets

- Improve coordination between natural gas and electricity issues
 - Weatherize energy assets
 - Fix the market to address surges in wholesale market prices
 - Improve planning for climate change
 - Factor in renewables
 - Harness the cheapest energy including energy efficiency and demand response
 - Exercise controlled power outages
 - Link the Texas grid to other regions
 - Harmonize regulatory oversight over electricity and natural gas
 - Enhance transparency and communication with the public over major events.
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Conclusion

- Puerto Rico is transforming its electric system to be more reliable, resilient, clean and customer-focused to achieve economic growth and prosperity
- Modernizing the Electric Grid and transitioning to renewables with battery backup is an essential step in achieving this significant outcome