Reimagining the Power Grid

Puerto Rico Energy Bureau

Commissioner Ferdinand Ramos

October 2019 – ERIC Symposium

Puerto Rico – Quick Facts

- ✓ Land Area: 100 x 35 miles
- ✓ Population: 3.195 Million
- ✓ Mostly mountainous with large costal areas in the north and south
- ✓ Highest Elevation: 4,390 ft above sea level
- ✓ Subdivided into 78 Municipalities
- ✓ GDP (2018): $104 Billion

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History of Puerto Rico's Electric Power Sector

- ✓ Multiple Private Power Production Companies from 1893 up to 1941
- ✓ PR Government built a series of dams and hydroelectric generation
- ✓ Electric service was a by-product of the Irrigation service
- ✓ Nationalization of Private Electric System (Started 1937)
- ✓ Puerto Rico Electric Power Authority was created (May 1941)
- ✓ Mid 40's - Only 12% of Rural Communities had electricity
- ✓ PREPA built centralized generation (1950 – 2000)
- ✓ IPP built Coal (454MW / 2002) and LNG (540MW / 2000) power generation

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PREPA's SNAPSHOT

- ✓ PREPA is a Vertically Integrated Utility
- ✓ 1.5 Million customers
- ✓ $ 3.2 Billion Annual Revenues
- ✓ 2,478 Miles of Transmission Lines (230kV, 115kV, 38kV)
- ✓ 31,446 Miles of Overhead Distribution Lines (13.2kV, 8.32kV, 4.16kV)
- ✓ 1,723 Miles of Underground Distribution Lines
- ✓ 341 Substations
- ✓ 5.8 GW of installed capacity
  - ✓ 4.8 GW PREPA Owned (Thermal, Hydro)
  - ✓ 961 MW of Thermal IPP (Coal, Natural Gas)
  - ✓ 250 MW of Renewable IPP (Wind, Solar, Landfill Gas)

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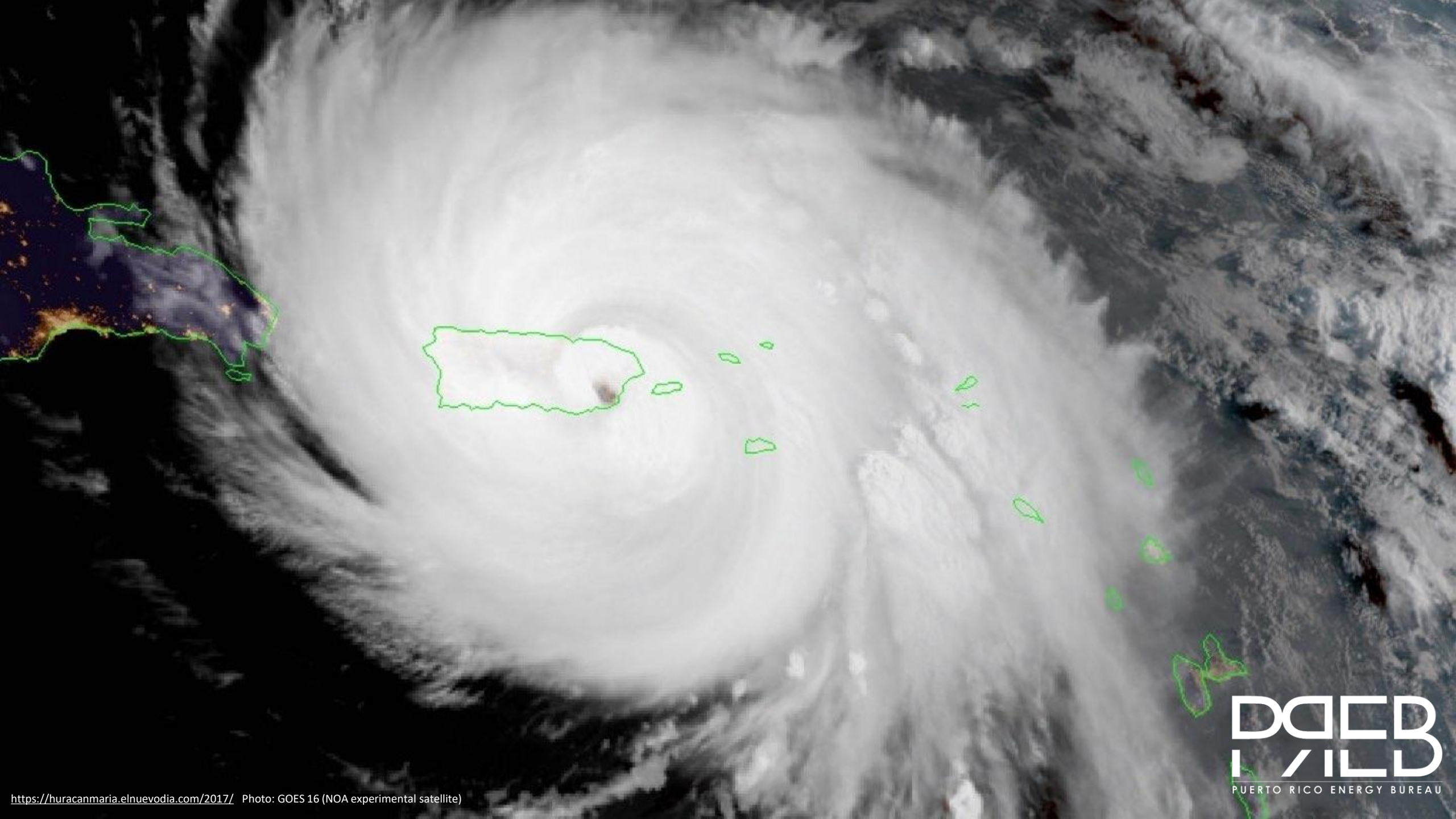
PREPA vs Largest Utilities (US) by Ownership Type

PREPA	Cooperative	IOU	Municipal / State / Federal
1.5 Million customers	334,000 customers	5.2 Million customers	1.43 Million customers
$3.2 B annual revenue	$563 M annual revenue	$15.5 B annual revenue	$3.6 B annual revenue



https://huracanmaria.elnuevodia.com/2017/ Photo: GOES 16 (NOA experimental satellite)

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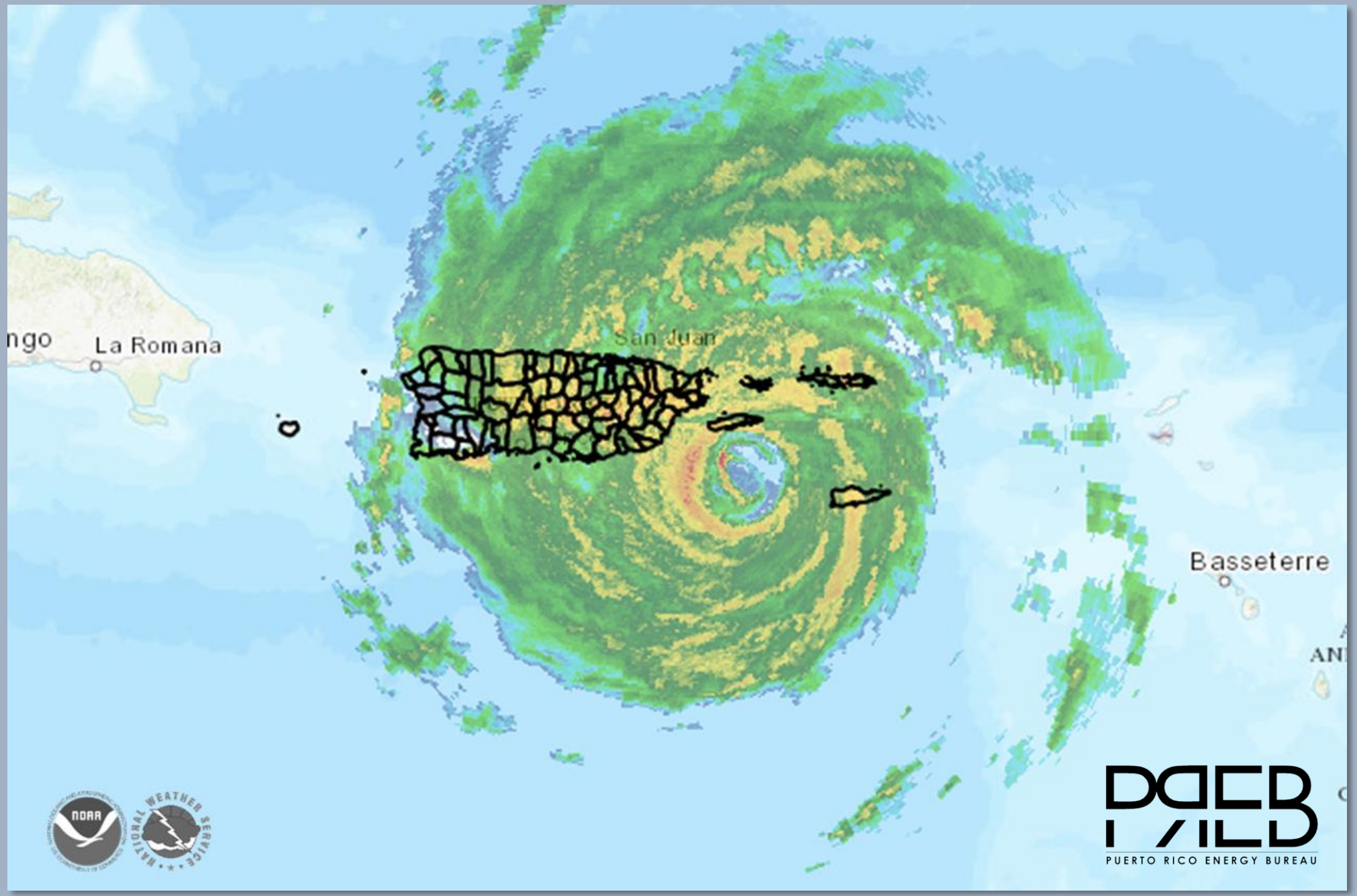
ngo
La Romana
San Juan
Basseterre
AN
NOAA
NATIONAL WEATHER SERVICE
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https://www.infobae.com/america/fotos/2017/09/21/las-imagenes-de-la-devastacion-tras-el-paso-de-maria-por-puerto-rico/

https://www.wired.com/story/photo-of-the-week-drone-captures-hurricane-marias-devastation-in-puerto-rico/

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https://sputniknews.com/us/201709301057839392-puerto-rico-mayor-criticizes-trump-hurricane-response/ AP Photo: Carlos Giusti

https://mundo.sputniknews.com/seguridad/201709211072542106-tormenta-maria-eeuu-seguridad-amenazas/

https://documents.recovery.pr/assets/documents/transformation-innovation-final.pdf

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https://spectrum.ieee.org/energy/policy/rebuilding-puerto-ricos-power-grid-the-inside-story Photo: Erika P. Rodriguez

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Before and After

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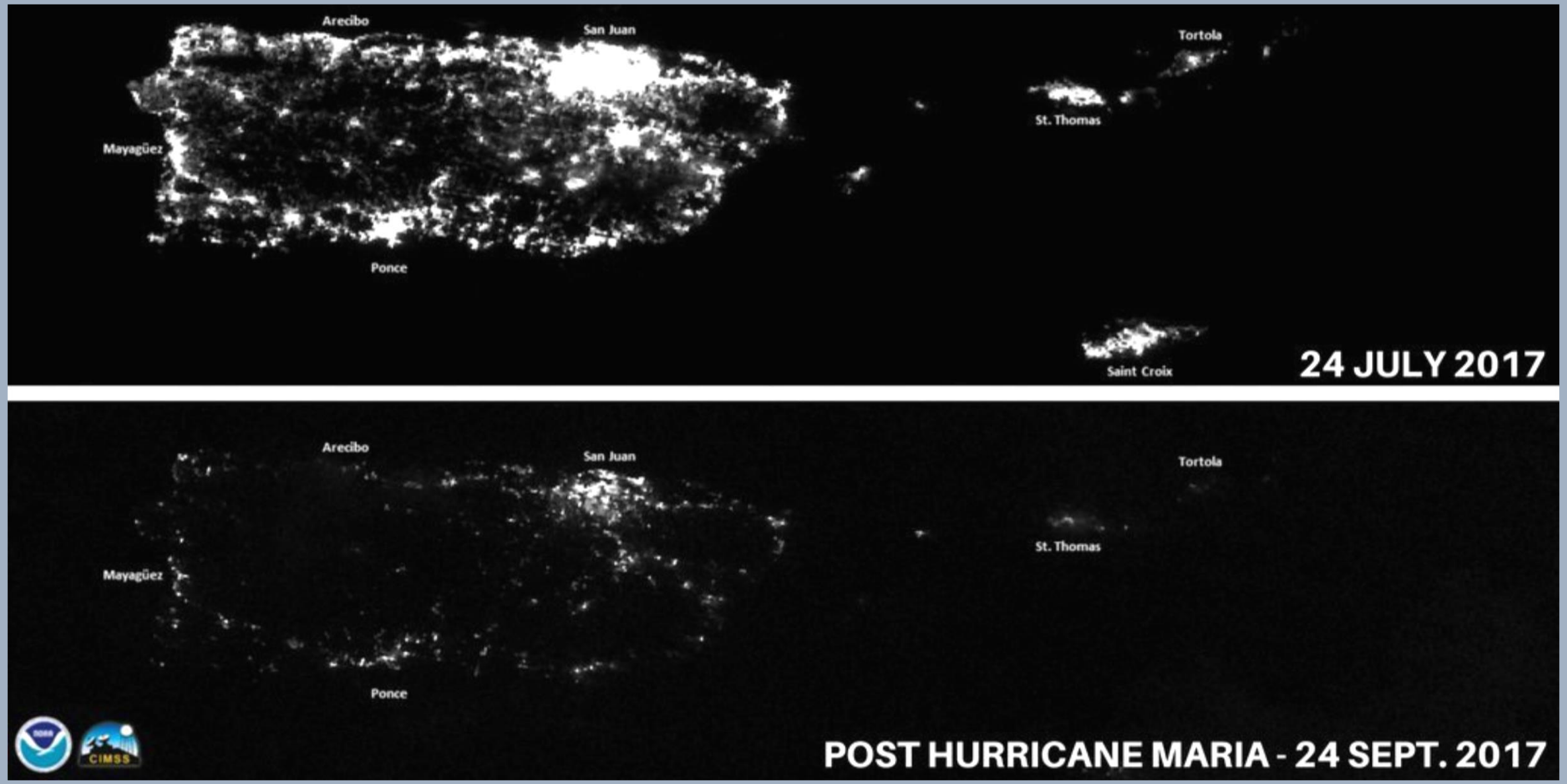

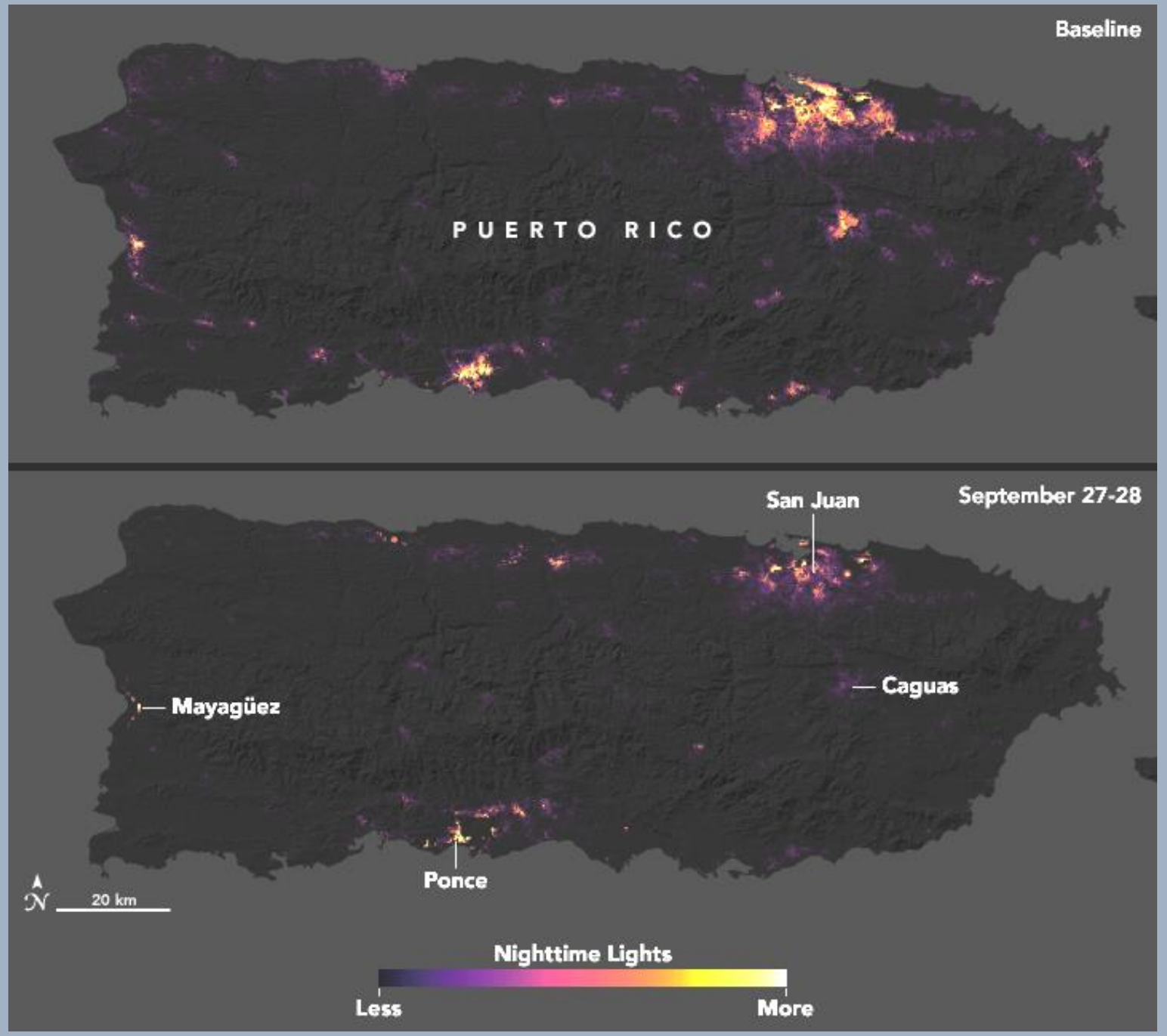

https://earthobservatory.nasa.gov/images/91044/pinpointing-where-the-lights-went-out-in-puerto-rico

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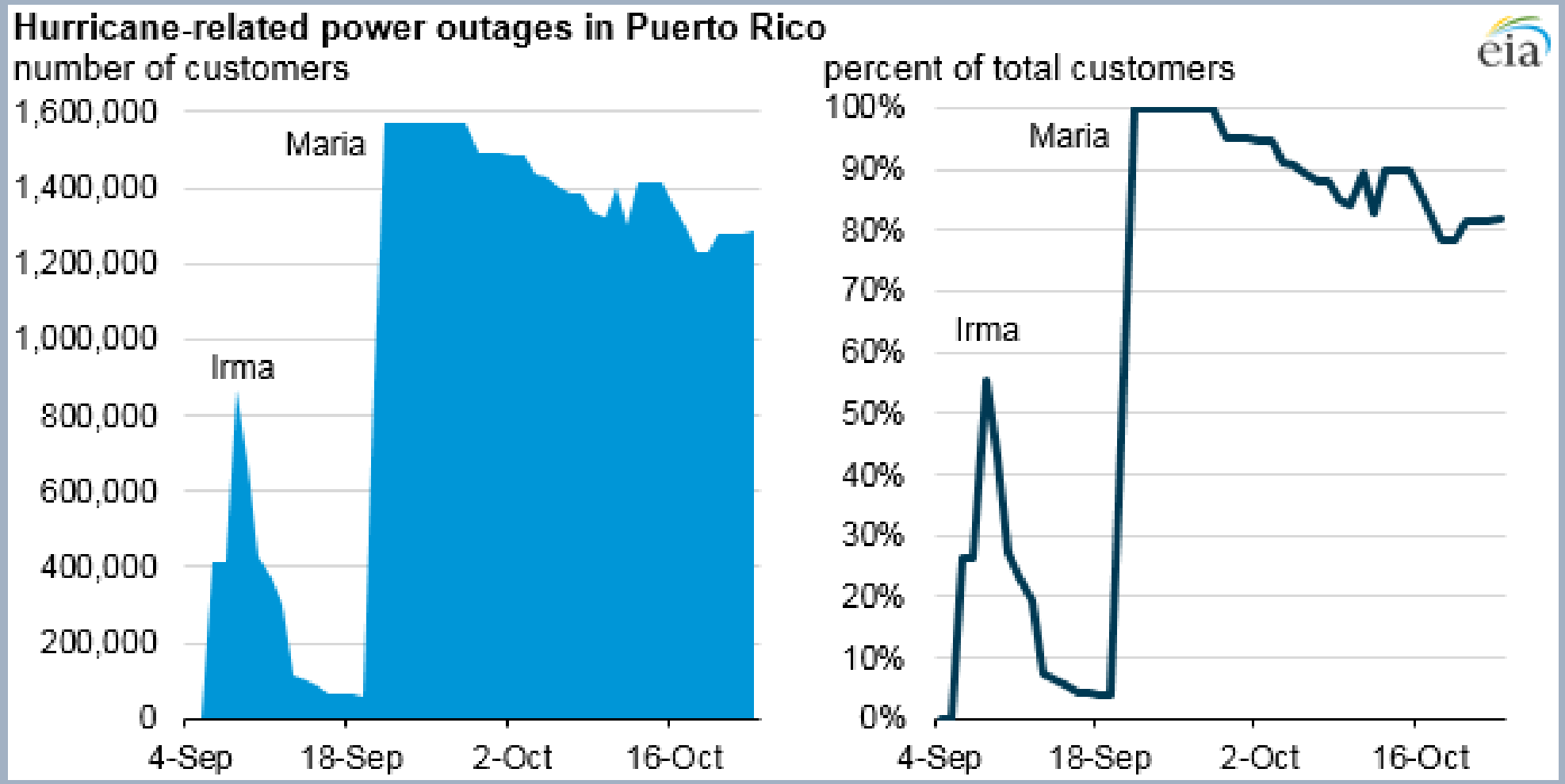
LONGEST AND MOST MASSIVE POWER OUTAGE



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RESTORATION EFFORTS

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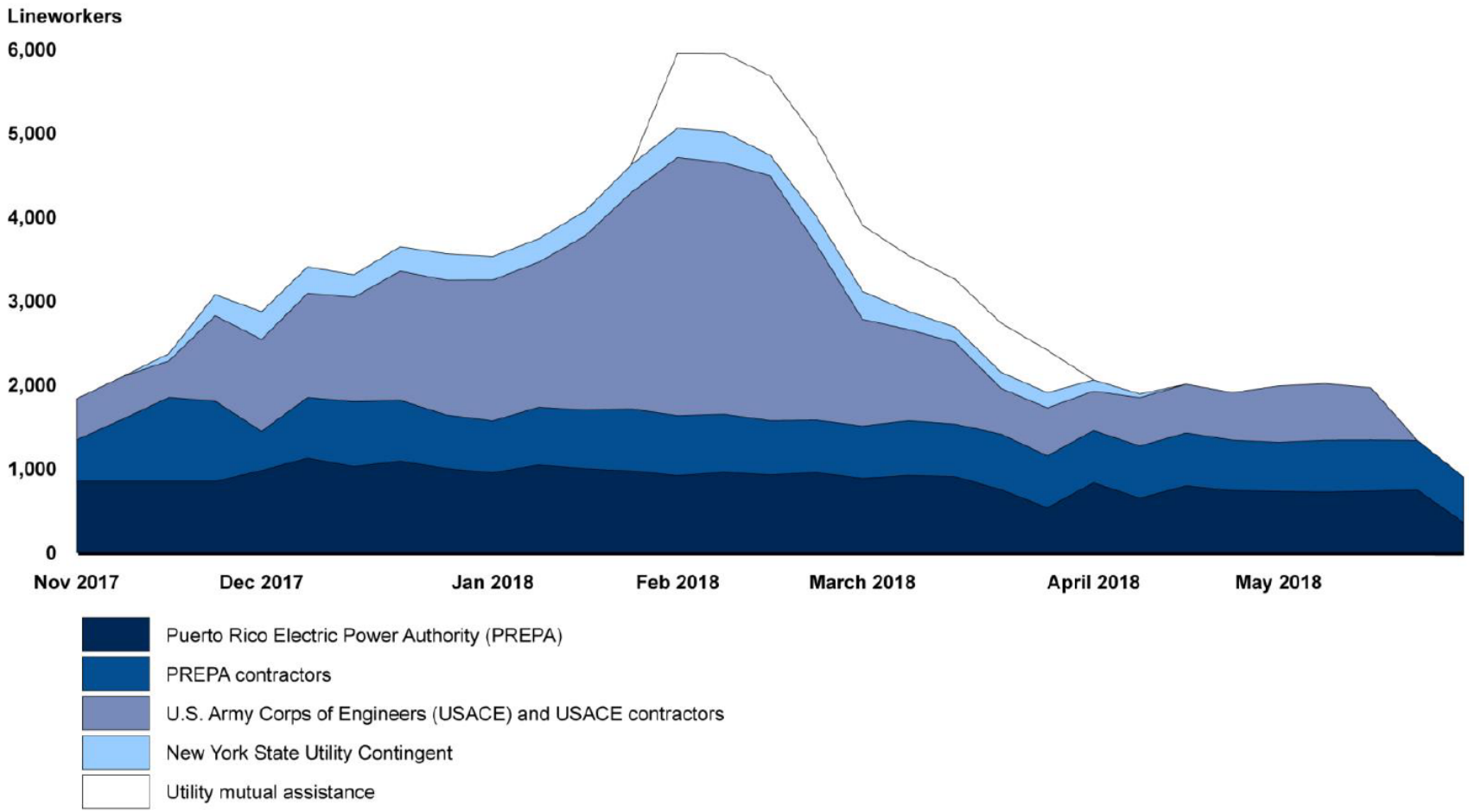

- ✓ 1,600+ Generators
- ✓ 9 Microgrids
- ✓ 61,000+ poles
- ✓ 8,400+ miles of wire
- ✓ 6,000 line workers @ the peak
- ✓ $5.4 Billion in Federal Aids for Emergency Power and Grid Restoration

RESTRUCTURED ELECTRIC SECTOR

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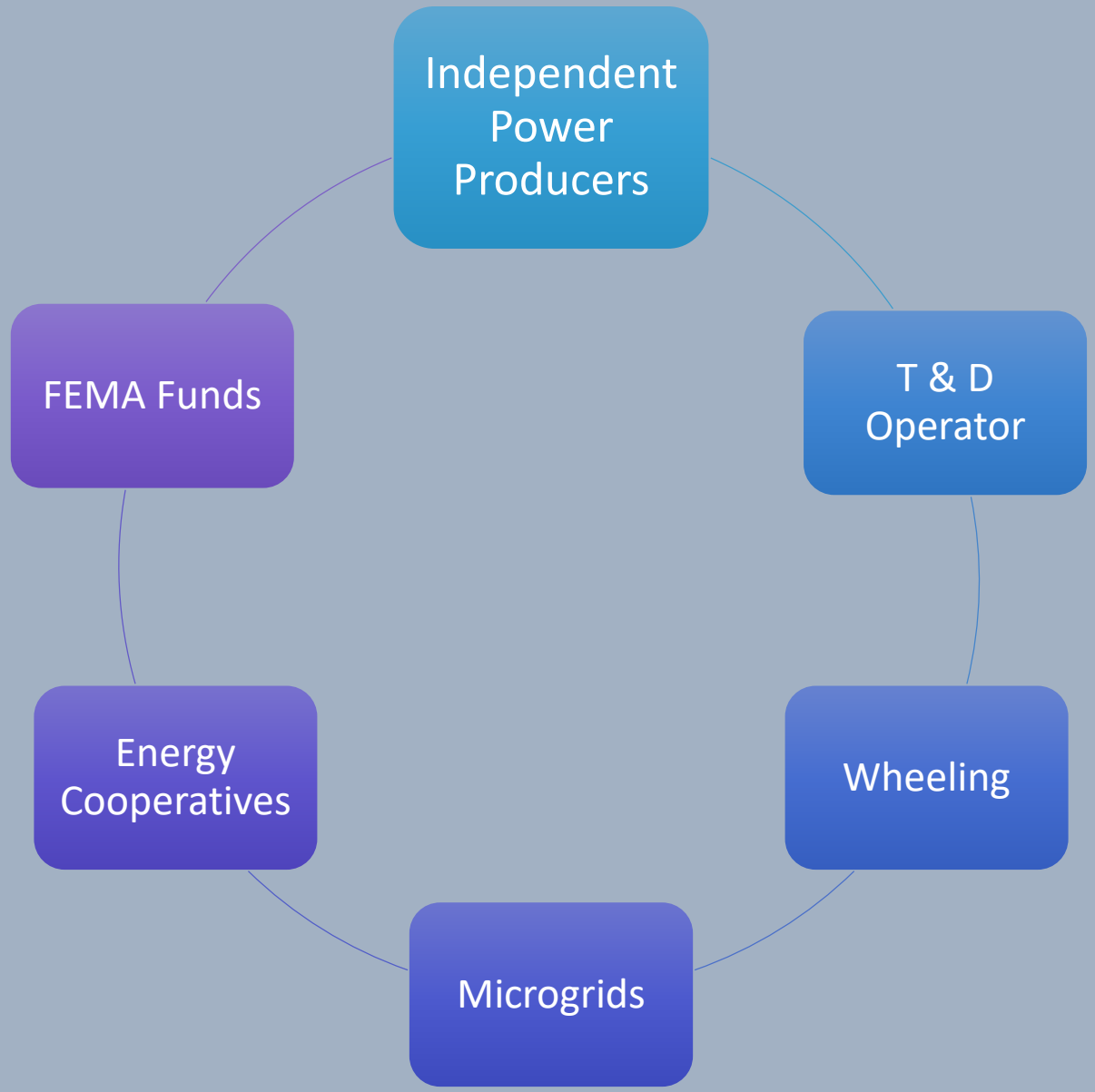

PUERTO RICO GRID PLANNING

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INTERGATED RESOURCES PLAN

20% - 2022 40% - 2025 60% - 2040 100% - 2050

GRID MODERNIZATION

RELIABILITY AND RESILIENCY

PERFORMANCE INCENTIVE MECHANISMS

ENERGY EFFICIENCY AND DEMAND RESPONSE PROGRAMS

INTERCONNECTION REFORM