DOE Electric Advisory Committee – Grid Resiliency

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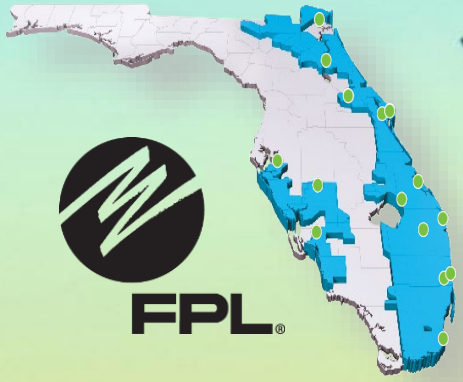
NEXTera® ENERGY



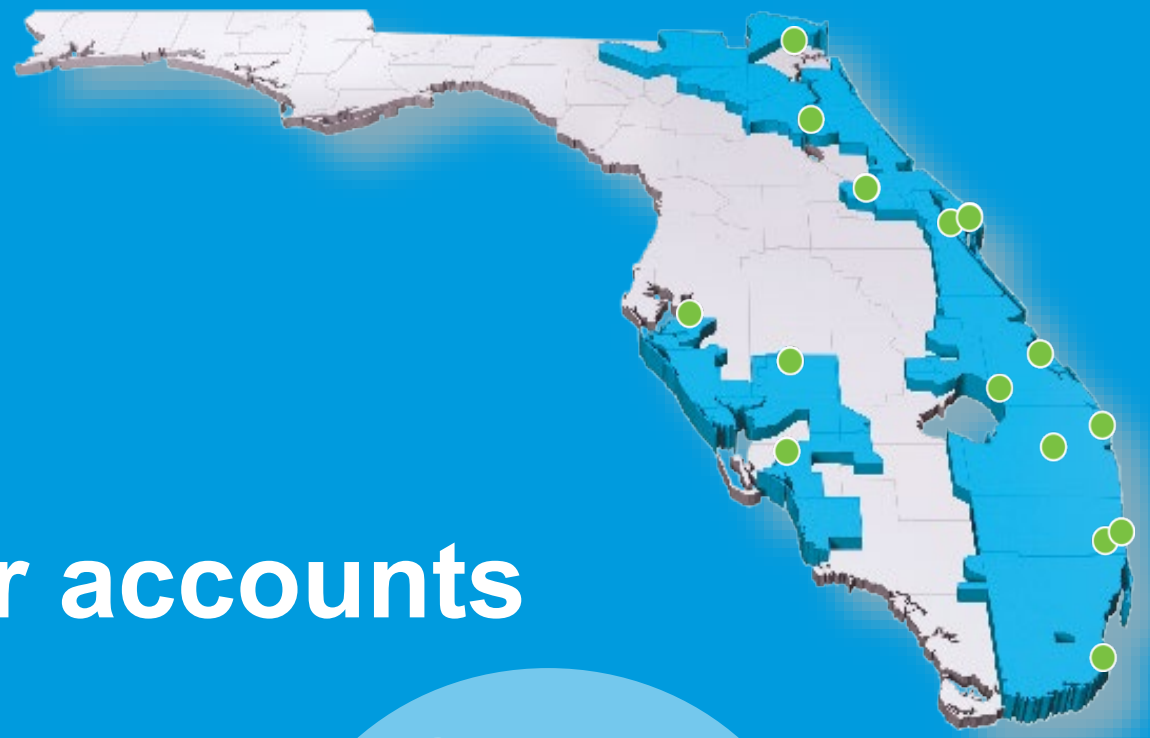
- Named one of Fortune's "World's Most Admired Companies" – ranked No. 1 in the electric and gas utilities industry
- Headquartered in Florida, operates in 33 states and Canada
- World's largest generator of renewable energy from the wind and the sun

FPL Service Territory

35 counties

27,000 square miles

4.9 million customer accounts



VAST MAJORITY OF CUSTOMERS
LIVE WITHIN 20 MILES OF COAST

Serving more than **half** of Florida

FPL Power Delivery Overview

600 substations

3,000 employees

75,000 miles of power lines

900,000 transformers

1.2 million poles and structures

Grid resiliency: the ability to bounce back, recover quickly, and go back into shape after being stretched - keep the lights on

Power grid **resiliency** and **reliability** are both frequently and often interchangeably referenced.

Grid preparedness initiatives ensure reliable operations of our most critical assets

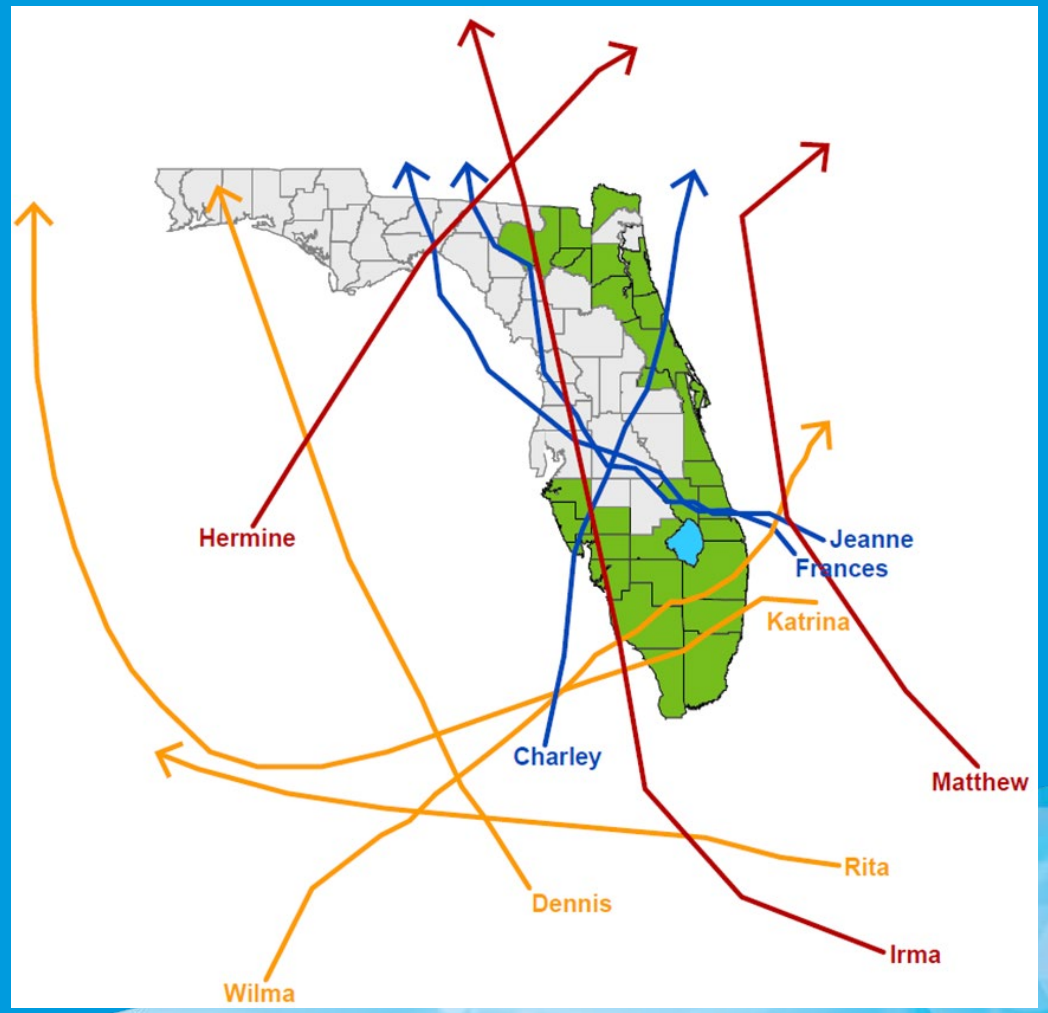
Readiness to respond to natural disasters stabilizes economies and normalcy

Ensures the ability to operate through any type of disruption

Engineering out vulnerabilities and building redundancy is critical to physical and cyber protection

Since 2004, Floridians have experienced numerous storms

Year	Storm	Customers	Restored
2004	Charley	874,000	13 days
2004	Frances	2,786,300	12 days
2004	Jeanne	1,737,400	8 days
2005	Dennis	508,800	3 days
2005	Katrina	1,453,000	8 days
2005	Rita	140,000	2 days
2005	Wilma	3,241,400	18 days
2016	Matthew	1,185,000	4 days
2017	Irma	4,454,000	10 days



Hurricane Wilma had the most significant impact during the 2004/2005 storm seasons

- **Transmission & Substation summary**
  - 227 of 235 substation outages caused by transmission line unavailability
- **Distribution summary**
  - 2,450 feeders out of service
  - 16,500 laterals affected
  - 11,371 distribution poles replaced
- **3.2 MM customers affected in 21 counties**
- **18 days to restore**
- **Community frustration peaked following Hurricane Wilma**

Storm preparedness and hardening initiatives

- **Pole Inspections – February 2006 – IOUs to implement 8-year cycle for wooden poles**
- **Storm Preparedness Initiatives – April 2006 – Ten initiatives established including a 3-year vegetation cycle for all distribution feeder circuits, a 6-year inspection cycle for transmission structures and a transmission hardening requirement**
  - Each IOU defined their own hardening initiatives and approach
- **Infrastructure Hardening – Each IOU files a storm hardening plan by May at least once every three years**

FPL

FPL developed a hardening tool kit that provides design flexibility for improving storm resiliency and strengthening infrastructure to withstand winds up to 145 MPH

- **Distribution pole hardening tool kit**
  - Replace with stronger poles
  - Add guy wires to add stability
  - Reduce distance between poles
  - Place some equipment underground
- **Transmission/Substation hardening tool kit**
  - Replace all poles with concrete or steel
  - Install flood monitors and storm resilient doors and windows in substations
  - Reduce distance between poles
  - Place some equipment underground
  - Introduce new equipment

50’/2 Wood

55’ IIIH Cast Concrete

The hardening toolkit provided design flexibility for improving storm resiliency of poles

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Our roadmap was prioritized and formed the basis of FPL's 2006 and 2007 FPSC filings

- **Hardening of FPL's infrastructure against future storms consists of 6 initiatives**
  - Harden existing distribution feeders serving critical infrastructure functions (CIF) to extreme wind loading (EWL)
  - Harden existing distribution feeders serving community needs to EWL (i.e., gas stations, pharmacies and grocery stores)
  - Design all new distribution facilities to EWL
  - Harden transmission structures with ceramic post insulators on square concrete structures (CPOCs)
  - Harden wood transmission structures by replacing with concrete or steel
  - Harden distribution poles crossing major roadways or utilized as "01" switches

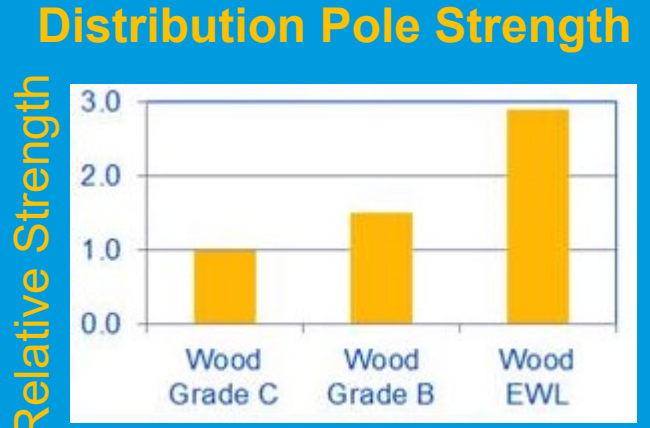
FPL developed a comprehensive strategy toward hardening the electric infrastructure while involving community and governmental partners

- **Providing incentive for overhead to underground distribution conversions**
- **Implementing a vegetation management program for all distribution circuits**
  - Maintain 3-year average trim cycle for feeders
  - FPL adopted a 6-year average trim cycle for laterals
- **Complying with the FPSC-mandated pole inspection cycles**
  - In 2006, FPL initiated an 8-year pole inspection program (PIP) for wood distribution poles
  - Transmission structures are inspected on a 6-year cycle

FPL

Florida standards based on NESC requirements, EWL

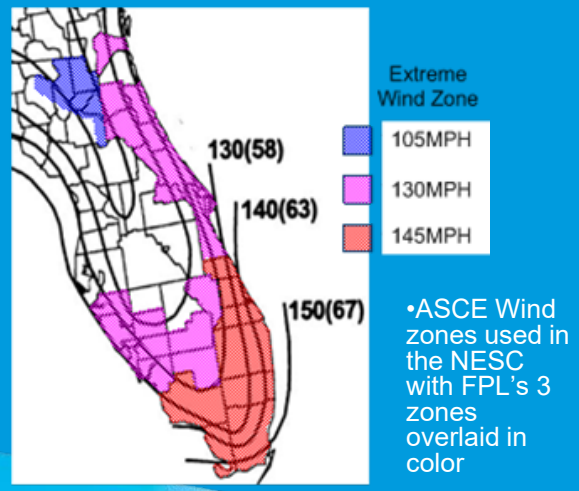
- **Florida Statute 366.04 and Florida Administrative Code 25-6.034 mandate that all electric facilities satisfy the requirements set by the National Electrical Safety Code (NESC)**
- **NESC requires facilities more than 60 feet high designed for extreme wind load (EWL)**
  - EWL is the minimum design load for buildings and other structures
- **NESC does not require EWL designs for facilities under 60 feet high, but incorporates additional load factors in different grades of construction**
  - Grade B is more resilient (50% stronger) than grade C (minimum standard for distribution facilities)
  - Until 2007, most FPL distribution facilities were designed to grade B construction
  - FPL adopted EWL for distribution facilities as a result of how well transmission facilities held up in the 2004-2005 storms



Since 2006, hardening has evolved into a comprehensive effort to strengthen and improve the distribution system

2006

- Focus on hospitals and ports
- Targeting critical pole locations such as 01 locations
- Pole replacements to meet extreme wind load



•ASCE Wind zones used in the NESC with FPL's 3 zones overlaid in color

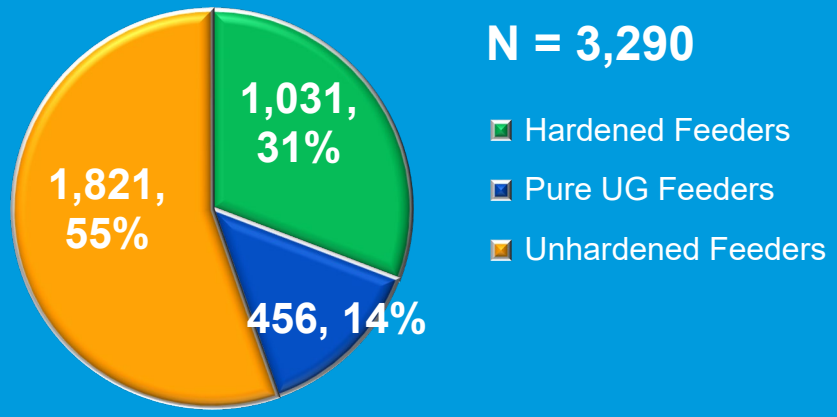
2007-2013

- Focus on top tier CIFs and community needs
- Hardening up to electrical boundaries
- Short-term reliability improvement
- Replacement of all transmission wood structures and CPOCs
- Lessons learned from Superstorm Sandy

2014-Present

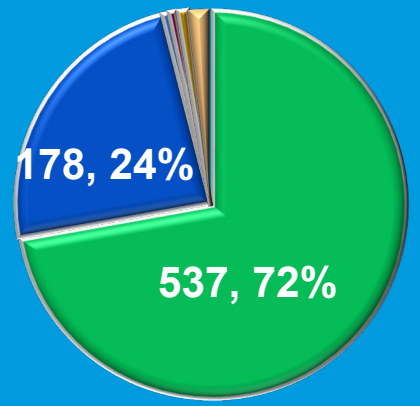
- Three-pronged strategy: prevent, mitigate, restore
- Expansion of reliability hardening
- Automated Feeder Switches (AFS) and Automated Lateral Switch (ALS) installations
- Evaluation of cost-effective undergrounding
- Introduction of lateral hardening

Our focus is on completing CIF and community feeders in 2018 and feeder hardening plan completion by 2024



N = 3,290

- Hardened Feeders
- Pure UG Feeders
- Unhardened Feeders

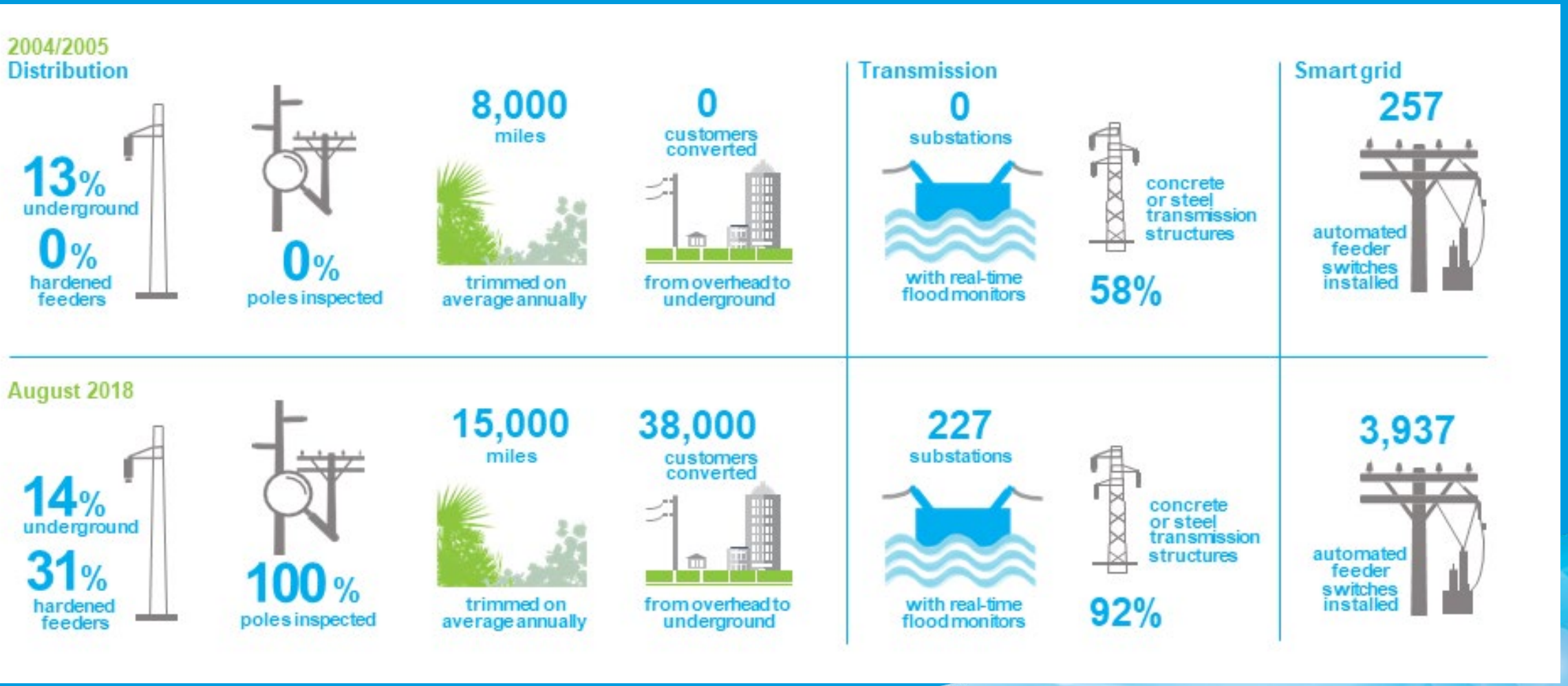


- CIF Hardened
- Community Hardened
- 4 - OH-UG Conv Pending
- 4 - Remaining 1-24%
- 2 - Remaining 25-49%
- 6 - Remaining 50-74%
- 13 - Remaining 75-99%

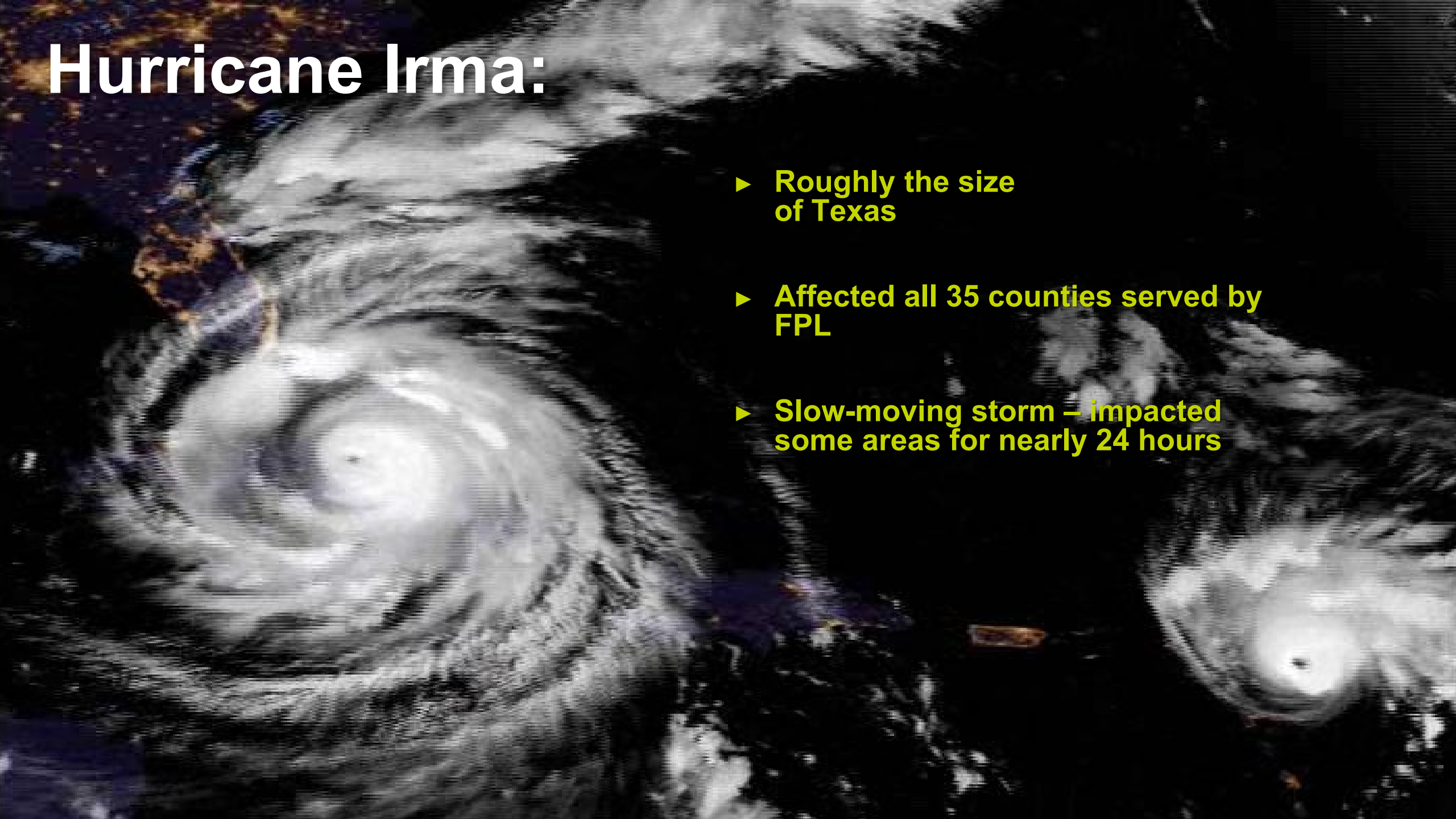
- **45 percent of all feeders hardened or undergrounded***
  - 1,031 overhead feeders hardened
  - 456 feeders undergrounded
- **96 percent CIF/Community feeders completed**
  - 537 CIF (95% complete)
  - 178 Community (98% complete)

*As of September 2018

Investments in a stronger system



Hurricane Irma:



- Roughly the size of Texas
- Affected all 35 counties served by FPL
- Slow-moving storm – impacted some areas for nearly 24 hours

Infrastructure Performance – Primary Outage Causes

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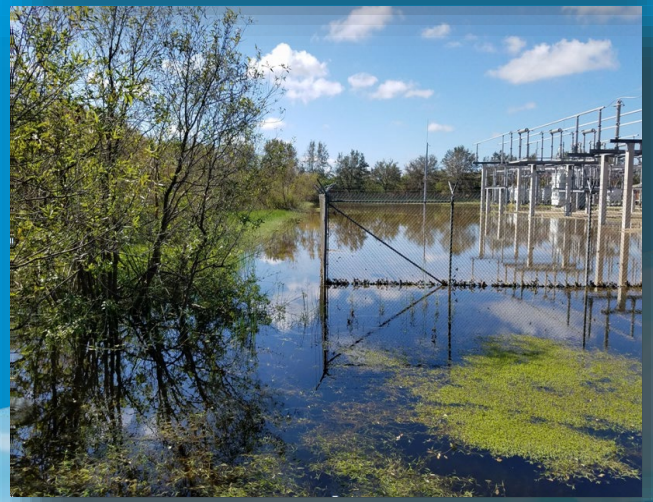
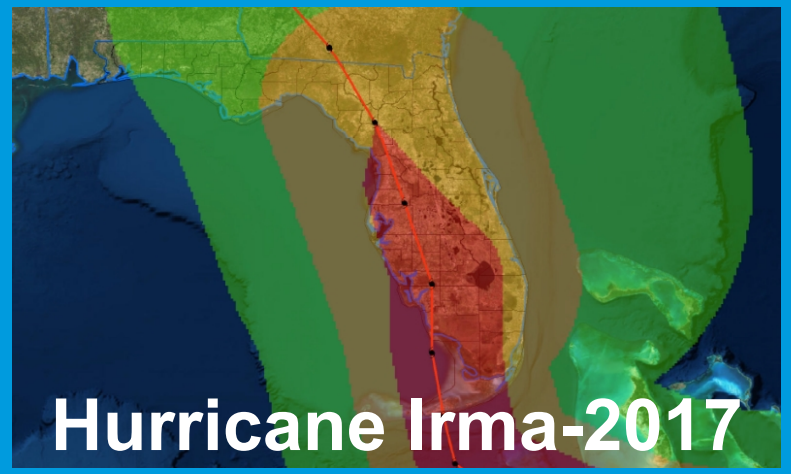


Wilma vs. Irma

Hurricane winds (74+ mph)

Strong tropical storm winds (55-73 mph)

Moderate tropical storm winds (39-54 mph)



Saffir-Simpson Scale	Category 3	Category 4
Cyclone Damage Potential Index*	2.8	4.3
FPL Counties Impacted	21	35
Customer Impacted	3.2 million	4.4 million
Poles Damaged	12,400	4,600
Substations De-energized/Time Restored	241 substations/5 days	92 substations/1 day

*Index developed by the National Center for Atmospheric Research that rates a storm's ability to cause destruction

FPL

Wilma vs. Irma Restoration

Customer Restoration	18 days	10 days
50% of Customers Restored	5 days	1 day
75% of Customers Restored	8 days	3 days
95% of Customers Restored	15 days	7 days
Average Customer Outage	**5.4 days**	**2.3 days**

Lessons learned from Hurricane Irma

Promoting Right Tree/Right Place Program

Building on proven hardening investments

Storm Secure Underground Program

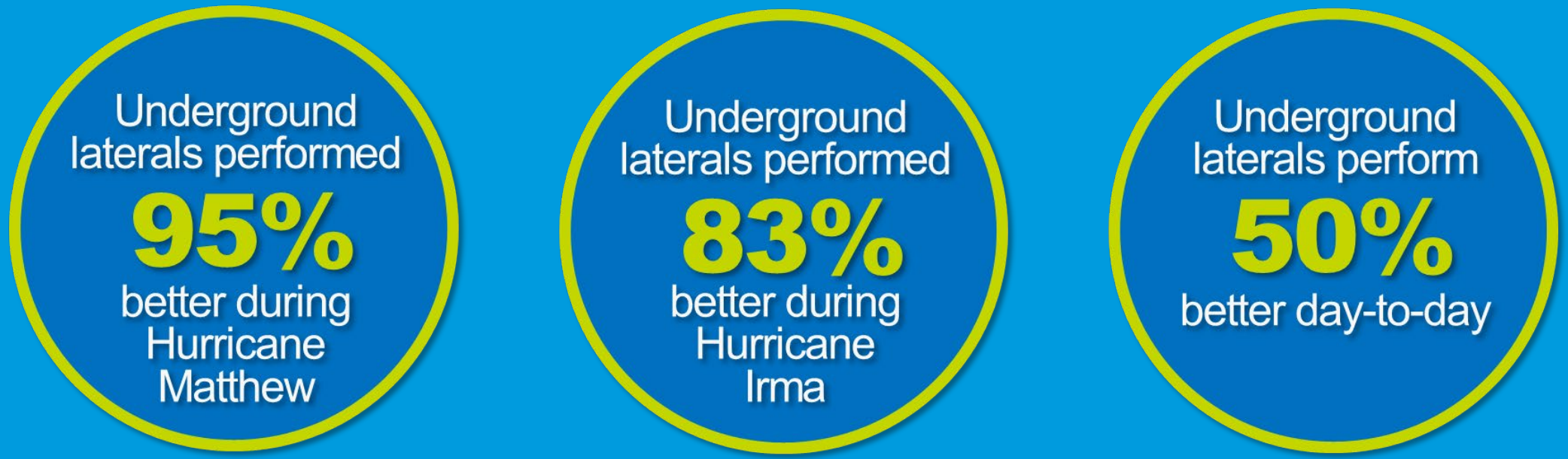
Storm Secure Underground Program Pilot

- **This initiative is exploring the benefits of undergrounding specific neighborhood power lines**
  - Pilot program started this year and has identified projects throughout our entire service area
  - Projects will begin construction in Q4 2018

Before construction

After construction

Undergrounding laterals provides significant benefits



- **Improved storm resiliency**
- **Improved day-to-day reliability**
- **Underground lateral life-cycle costs are now competitive with overhead life-cycle costs**
  - Reduction in storm restoration costs
  - Reduction in daily operation and maintenance expenses
  - Higher initial capital investment

We are on a journey to deliver superior performance by executing effective grid resiliency and reliability programs

1997
Reliability

2000
Improving the grid

2006
Storm Secure

Strengthening the grid

2010
Smart Grid

Modernizing the grid

2014
Customer momentary experience

Redesigning the grid

Grid2020
Continuous uninterrupted power

The Grid of the Future






The Grid of the Future – Hardened and Smarter

- Harden all feeders by 2024
- Harden laterals through pilot program
- Replace all transmission structures with concrete or steel
- Deploy automated self-healing grid technologies to prevent and mitigate any interruption of electric service
- Digitally connect the entire substation and feeder fleet
- Install smart sensors to enable real-time predictive equipment analytics and diagnostics
- Transform streetlights into a Smart Lighting fleet
- Emerging technologies including micro-grids and behind the meter