- Electric Retail Customers – 7.3 million
- Gas Customers – 500,000
- Market Cap – $57.5 billion
- Employees – 28,324
- Service Territory – 95,000 square miles
- Total US Generation Capacity – 57,500 MWs
- Transmission Lines – 32,400 miles
- Distribution Lines – 262,900 miles
- Duke Energy International owns, operates or has interest in approximately 4,900 MWs of generation
Policies Fostering Solar Growth

Source: SNL Energy
## Carolinas Installed Solar Capacity

<table>
<thead>
<tr>
<th></th>
<th>Current</th>
<th>Projected YE</th>
</tr>
</thead>
<tbody>
<tr>
<td>DEC</td>
<td>217 MW</td>
<td>350 MW</td>
</tr>
<tr>
<td>DEP</td>
<td>389 MW</td>
<td>800 MW</td>
</tr>
</tbody>
</table>

For Reference:
Dan River CC is 620 MW
Committed to Expanding Solar in North Carolina

September 2014
• Announced $500 million investment in solar
• 8 projects; 278 MW
• 3 projects, or 128 MW, owned/operated by Duke Energy
• Targeted in-service date for projects: Late 2015

January 2015
• Announced 13-MW solar project at Camp Lejeune
• Pending NCUC approval, to be owned/operated by Duke Energy
• Targeted in-service date for project: Late 2015
Act 236: The South Carolina Distributed Energy Resource Program Act of 2014

Signed into law by Gov. Nikki Haley on June 2, 2014

- Permits non-utilities and utilities to lease solar panels to homeowners and businesses.

- Requires the Public Service Commission of South Carolina to update solar power interconnection standards and the rate utilities must offer to a customer who installs solar panels at their home or business.

- Allows utilities to invest in or purchase solar power. If a utility adopts solar power, it must include an incentive program for customers who want to install solar at a home, business or a tax-exempt entity’s location.
Promoting Access to Solar in South Carolina

Large-Scale Solar Facilities
- Duke will seek Proposals for solar facilities (1-10MW)
- 1-10 MW solar PV; must be operational by 12/31/2016

Solar Rebate
- One-time rebate to customer upon completion of installation
- Residential rebate $1.00/watt DC and Non-residential $0.75/watt DC
- Customer may lease or purchase system; customer may net-meter or sell-all generation. Customer may install up to 1,000 kW and receive rebate

Shared Solar Program
- “Community Solar” is a bill-savings program offered by the utility in which multiple customers subscribe to and share in the economic benefits from one, large renewable energy facility.
- Available to all customers and marketed specifically to tax-exempt and low-income customers
Committed to Expanding Solar in Florida

- Duke Energy recently announced to invest in 500MW of renewable energy in its Florida service territory as part of its 10 year plan. One megawatt of large-scale solar is equivalent to about 200 typical residential rooftop systems.

- Since 2003, Duke Energy Florida has provided approximately $8 million for solar installations at K-12 schools and universities.

- Since 2011, Duke Energy Florida has funded more than $8 million to assist residential and commercial customers who install their own PV systems.

- We are leading several research projects in key areas of the state to evaluate impacts of DER on the system:
  - Battery storage projects in St. Petersburg to evaluate how to leverage storage in concert with PV
  - $1 million solar PV system at USF to manage and test integration
Most of the solar capacity installed in North Carolina consists of 1MW to 5MW sites.

Very little residential rooftop solar in NC currently. This is likely to change as solar installation and panel prices continue to decline or if regulatory policies change to permit 3rd party leasing of solar installations.
Impacts are being noted across most parts of Duke Energy’s business:

- Distribution
- Transmission
- System Operations
- Generation – Near Future
**Scope**

Document the current and planned state of distributed resource integration across all Duke Energy Jurisdictions. Document current operational impacts caused by the existing DER penetration level. Identify workable solutions to these current impacts. Project future operational scenarios that will emerge as DER penetration increases. Identify gaps in existing processes, technology, and tools. Prioritize impacts based on consequence, likelihood, and timing of occurrence. Propose solutions for the prioritized projected impacts.

**Representatives**

- System Operations
- Grid Management
- DER Operation Support
- DER Forecasting
- Grid Concept Evaluation
- Transmission Planning
- Distribution Planning
- Generation Dispatch and Operations
- Transmission P&C Engineering
- DPAC/DG
- Fossil/Hydro Operation
- System Fuels and Optimization
- Power Quality
- Solar site awareness and visibility
  - Physical/Circuit Location
  - Specifications
  - Data
  - Forecast and Contribution up to the System Level
- Masking of Actual Facility Loading
- Need for Better Meter Data
  - More Granularity
  - Near Real Time
- High Voltage During Light Load and Backfeed onto Transmission
- Impact on Load Shedding (Inadvertently Dropping Generation as Well as Load)
Long Term Plan – GIS and DMS will be the systems of record, the preferred visualization tool, and control for all these assets.

Working with Alstom on Distributed Energy Resource Management System (DERMS)
  - Project to enhance the functionality of the Alstom DMS to track capture impact of DER

Not quite there yet, so
Other Issues

- Limitations on “Self-Healing” Networks
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Limitations on “Self-Healing” Networks

- Substation A
  - Station Breaker
  - Recloser
- Open Point
- Recloser
- Substation B
  - Station Breaker
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- Substation A
  - Station Breaker
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- Open Point
- Recloser
- Substation B
  - Station Breaker
- Limitations on “Self-Healing” Networks
• Circuit Upgrades
  • Reconductor
  • Dedicated DER Feeders

• Integration of Battery Storage
  • Co-located with Solar
  • Distributed around Circuits

• Smart Regulator Controls
Load, Wind, Solar Profiles
April 2020

Duck Curve
DEP Winter Load Shape w/1700 MW of Solar
DEP Winter Load Shape w/1700 MW of Solar

[Graph with various energy sources and load shapes]
We Need More Storage

Bad Creek Pumped Storage

Batteries
Other Issues

- Operational Impacts of Customer Switching
  - Large Customer-Owned Transformers
  - Long Rural Circuits
  - Customer repeatedly energizing and de-energizing transformer during troubleshooting
  - Magnetizing inrush creating significant voltage drop
  - Nearby customers’ equipment mis-operates or shuts down
Other Work in Progress

- Continue DMS development
- Continue standardization efforts across geographic regions
- Work with NREL
  - Effects on regulators and capacitors, control strategies
  - Effects of smart inverter control
- Additional Studies and Simulations with Higher Solar Penetration in Future Years
- Integrating Energy Storage
Questions???