North Carolina Energy Policy Council
Agenda
10:00 a.m. Wednesday, February 19, 2020
Ground Floor Meeting Room, Archdale Building
Raleigh, North Carolina 27699
Discussion of Grid Modernization and Grid Operations Planning (70 mins)

DEC and DEP’s Grid Improvement Plans Filed with the NC Utilities Commission (40 mins):
Mr. Jay Oliver, Duke Energy General Manager, Grid Strategy and Asset Management Governance:

Recent EMC Distributed Energy Resources (DER) Initiatives (30 mins):
Mr. Charles Bayless, NC Electric Membership Corporation Vice President, Senior Regulatory Counsel Raleigh-Durham Area
DEC and DEP’s Grid Improvement Plans Filed with the NC Utilities Commission
(40 mins):

Mr. Jay Oliver, Duke Energy General Manager, Grid Strategy and Asset Management Governance:
Grid Improvement in North Carolina
N.C. Energy Policy Council

February 19, 2020
DYNAMIC DRIVERS FOR GRID IMPROVEMENT

Environmental Trends → Customer Expectations

Distributed Technologies → Customer Expectations

Threats to Grid Infrastructure → Customer Expectations

Impacts of Weather Events → Customer Expectations

Grid Advancements → Customer Expectations

Concentrated Growth → Customer Expectations
North Carolina has faced major weather events, with Hurricanes Matthew (2016) and Florence (2018), and most recently Michael (2018) illustrating the magnitude of the challenge the grid faces today from weather.
What is happening?

- Broad pressure internationally to reduce carbon emissions
- Corporations making commitments and demanding renewable options
- States and cities setting goals for renewables, low carbon transportation, and energy efficiency

**Contracted Capacity of Corporate Power Purchase Agreements, Green Tariffs, and Outright Project Ownership**

- **2013**: 0.32 (5)
- **2014**: 1.20 (8)
- **2015**: 3.12 (32)
- **2016**: 1.61 (18)
- **2017**: 2.78 (28)
- **2018 YTD**: 1.96 (19)

- **Microsoft**
- **Google**
- **Amazon** (4)
- **Facebook**
- **Procter & Gamble** (2)
- **Apple**
- **General Motors**
- **Walmart**
- **Dow Chemical**
- **Equinix** (2)
- **Owens Corning** (2)
- **Iron Mountain** (2)
- **Avery Dennison**
- **Salesforce**
- **Solvey**
- **Kaiser Permanente** (2)
- **Switch** (2)
- **Apple** (2)
- **Amazon** (4)
- **Johnson & Johnson**
- **Digital Realty** (2)
- **General Mills**
- **LinkedIn**
- **Target**
- **T-Mobile**
- **Adobe**
- **Switch**
- **Ingersoll Rand**
- **Brown-Forman**
- **General Mills**
- **Nike**
- **Gruppo Bimbo**
- **Kohler**
- **T-Mobile**
- **Google, J&J, Target, Walmart** (2)
- **Facebook** (3)
- **Microsoft**
- **AT&T** (2)
What is happening?

- Solar PV is becoming increasingly competitive
- Spending on energy storage solutions forecasted to increase at annual rate of 18% over next 10 years in North America
- DER expected to grow 8x faster than new centralized generation in the next 10 years globally
In summary, evolving megatrends will have implications on our customers and the state.
Grid Improvement in North Carolina

Building a smarter grid for YOU

- Improve Reliability to avoid outages and speed restoration
- Strengthen the grid against physical and cyber impacts
- Give more options and control over energy use and tools to save money
- Expand solar and innovative technology across a two-way, smart-thinking grid

Grid Improvement in North Carolina
HARDENING
Improvements that lower system risk and prevent outage events from occurring

RESILIENCY
Improvements that minimize event impacts and improve ability to recover rapidly

Outage Prevention

Rapid Recovery
Expanding solar and innovative technologies

Private Solar

Microgrids

Battery storage

EV Charging

DUKE ENERGY®
Transmission new construction
Targeted Reliability improvements
Grid improvement plan
Distribution new construction
Vegetation Management

Improved customer experience
NORTH CAROLINA GRID IMPROVEMENT PLAN

Megatrends

causing...

Implications

requiring...

Grid Capabilities

Value to Customers

creating by...

leading to Duke's strategy...

North Carolina Grid Improvement Plan

Protect

Modernize

Optimize

Improvement Programs

generating...

Value to Customers

causing...

Grid Improvement Plan

creating by...

Implications

requiring...

Grid Capabilities

Value to Customers

causing...

Duke's strategy
### DUKE ENERGY’S NC GRID IMPROVEMENT PLAN FRAMEWORK

#### OPTIMIZE

Optimize the total customer experience

<table>
<thead>
<tr>
<th>Energy Storage</th>
<th>EV Charging</th>
<th>Hardening and Resiliency [T]</th>
<th>Hardening and Resiliency [D]</th>
<th>Integrated Volt-Var Control</th>
<th>Long Duration Interruptions</th>
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<tbody>
<tr>
<td>Oil Breaker Replacement</td>
<td>Self-Optimizing Grid</td>
<td>Targeted Undergrounding</td>
<td>Transformer Retrofit</td>
<td>Transformer Bank Replacement</td>
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</table>

#### MODERNIZE

Leverage enterprise systems and technology advancements

<table>
<thead>
<tr>
<th>Smart Meters (AMI)</th>
<th>DER Dispatch Tool</th>
<th>Distribution Automation</th>
<th>Enterprise Applications</th>
<th>Enterprise Communications</th>
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<tbody>
<tr>
<td>Customer Data Access</td>
<td>Integrated System Operations Planning</td>
<td>Power Electronics</td>
<td>Transmission System Intelligence</td>
<td></td>
</tr>
</tbody>
</table>

#### PROTECT

Reduce threats to the grid

- Physical & Cyber Security

#### MAINTAIN

Serve customers in a manner that meets industry safety, reliability and environmental standards

<table>
<thead>
<tr>
<th>Line Extensions</th>
<th>Capacity Expansions</th>
<th>Substation Additions</th>
<th>Outage Follow-up</th>
<th>Pole Replacements</th>
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</thead>
<tbody>
<tr>
<td>Vegetation Management</td>
<td>End-of-life Asset Replacement</td>
<td>Equipment Inspection &amp; Maintenance</td>
<td>General System Protection</td>
<td></td>
</tr>
</tbody>
</table>

1. Maintain base work not included in NC Grid Improvement Plan
Benefits from Improving the Grid

Societal
- Lower impact to global environment
- Avoided water impacts
- Avoided land impacts
- Reduced blackouts (security & well-being)
- Improved quality of life
- Improved access to data
- Better customer experience

Indirect
(indirect parties)
- Increased competitiveness for the state
- Increased employment for the state
- Increased global DER enablement
- Increased transportation electrification enablement

Indirect Value
(risk reduction)
- Increased system redundancy
- Improved power quality
- Improved system stability
- Avoided ancillary services
- Improved employee safety
- Reduced chance of environmental incident
- Reduced remediation costs
- Increased public safety

Direct value
(captured by customer)
- Avoided business revenue loss
- Avoided equipment damage
- Avoided spoilage
- Avoided ancillary costs (hotel, generator, lost work)
- Increased customer-owned DER enablement
- Decreased energy use or use off peak

Direct value
(captured by utility)
- Avoided transmission capacity
- Avoided transmission losses
- Avoided distribution capacity
- Avoided distribution losses
- Avoided generation capacity
- Avoided fuel costs
- Deferred capital cost
- Avoided power purchase
- Lower restoration costs
- Theft reduction
- Improved utility operations (i.e., lower O&M)
- Avoided CO₂
- SO₂ emission reduction
- NOₓ emission reduction
- Hg emission reduction
- Particulate matter emission reduction
MEGATRENDS

1. Rise and sophistication of threat of physical and cyber attacks on grid infrastructure
2. Rapid advancement and impacts of technology of renewables and distributed energy resources (DERs)
3. Rapid advancement and new capabilities / functionalities of devices and systems that operate and manage the T&D grids
4. Shifts in customer expectations and use of the grid from generations past
5. Increases in environmental commitments from the international, and customer communities
6. Significant increase in number, severity and impact of weather events
7. Heavily concentrated population and business growth in urban and suburban areas

Portfolio Methodology

NC Grid Improvement Plan
to begin addressing all 7 megatrends
### Influence of Stakeholder Input

#### Grid Improvement Plan Carolinas (NC) 2020-2022

<table>
<thead>
<tr>
<th>Category</th>
<th>Dollars in (000's)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Compliance: Cost Effectiveness Justified</td>
<td>$134</td>
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<tr>
<td>Physical Security</td>
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<tr>
<td>Cyber Security</td>
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<tr>
<td>Cost Benefit &amp; Cost Effectiveness Justified</td>
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<td>SOG</td>
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<td>IVVC</td>
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<td>Incremental Transmission H&amp;R</td>
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<td>TUG</td>
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<td>Rapid Technology Advancement: Cost-Effectiveness</td>
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<tr>
<td>Power Electronics for volt/var control</td>
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**Total: $2.3 billion**

#### Previous

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<tr>
<td>Cyber Security</td>
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**Total NC: $13 billion**

**Note:** The percentages indicate savings or changes from previous estimates.
Recent EMC Distributed Energy Resources (DER) Initiatives (30 mins):

Mr. Charles Bayless, NC Electric Membership Corporation Vice President, Senior Regulatory Counsel Raleigh-Durham Area
POWERING EVERYDAY LIFE FOR 2.5 MILLION

24% of the population

45% of the land mass
A Brighter Energy Future

Businesses:
- Declaring sustainability goals
- Need to be “green”

Consumers:
- Environmentally aware
- Focused on saving money

➢ Driven by service to our members
➢ Inspired to be a leader
Transforming Utility Grid

- **Resources** are moving to the distribution system
- **Communication** between the TO and DO is needed

Distributed Energy Resources

**NC Electric Co-ops: 400+ MW of DER**

- 18 community solar sites - 2MW
- 260 MW Utility Scale Solar
- 13 MW other Renewables
- 50 MW Conservation Voltage Reduction
- 75 MW Customer-Owned Generation
- 2 battery storage locations
- 4 MW connected thermostats and water heaters
NCEMC Microgrids

NCEMC Consumer Microgrid
Butler Farms

NCEMC System Microgrid-Ocracoke

Heron’s Nest Project: Brunswick EMC

Rose Acre Farms

What’s New
- CahiT GridMind (site controller) will integrate with DERMS
- GridPort (distributed sensor) on individual devices

Current Status
- Site grading is complete, wrapping up permits
- NEC, battery purchase order, solar equipment on the way after Brunswick County permit approvals
- Over half of the 33 homes have contracts

Project Timeline
- Energize battery and solar by December 2019

What’s New
- Designing optimal control of distributed, back-up diesel generation to balance against solar + storage

Project Timeline
- CDD of Q2-2020

Microgrid resources
- 2 MW Solar + 2 MW / 4 MWh Storage
- Served by express feeders
- Control connection to diesel generation to manage transient stability

NC Electric Cooperatives
Your Business Energy Cooperatives
26
NCEMC DER Projects

NCEMC Solar and Storage Projects

- 5 MW Solar/10 MWh battery
- 2 MW Solar/4 MWh Battery
- 500 kW Solar/1 MWh Battery (6 projects)

Distributed Power Supply Resources

- Smart Thermostats
- Water Heater Controls
- Residential Batteries
NCEMC Device Deployment

Member consumers who choose to participate in the demand response program will receive:

- Up to 2 thermostats per home (Ecobee5 Lite or Google Nest E) at $25 per device
- Option to upgrade to premium thermostat(s) (Ecobee Smart or Google Nest Learning Thermostat) at $105 per premium thermostat (limit 2 per home)
- Option to add-on a FREE Carina water heater control device with the purchase of any smart thermostat

Plus FREE professional installation of all devices

Customer eligibility
- Electric heating and air conditioning
- Electric water heating (to be eligible for Carina water heater control device)
- Co-op member in good standing

Members cannot be currently participating in their electric cooperative’s smart thermostat, net metering, or time-of-use rate programs.

21,000 Thermostats – 25MW
8,000 Water Heaters – 5MW

Member Consumer Enrollment Incentives

- Thermostat participants will receive a $50 prepaid gift card each year on their enrollment anniversary date
- Water heater control participants will also receive a one-time $50 prepaid gift card following enrollment

Consumer Journey

High level overview
- Distribution co-op will be featured in branding and marketing of the program
- Enroll via website (Domain is TBD)
- Installation scheduled within 45 days of program enrollment
- ~2 hr appointment for professional installation/consultation
- Participants will be asked to complete a satisfaction survey following installation
- 24/7 customer support will be available

Program design:
- Up to 48 demand response events per year
- No more than 2 DR event opt-outs per year in order to be eligible for enrollment incentives
- 3 year commitment to the program
- Program availability through Dec. 31, 2021
- Thermostats will not be adjusted more than 3 degrees during DR events
- DR event window no longer than 4 hours
- Generally, winter events will be from 6am-8am and summer events will be from 4pm-6pm
Distribution Operator

The DO is the entity responsible for and facilitates

- System operation
- Reliability
- Market activities at wholesale and retail levels
Distribution Operator Platform

Platform Aggregation

- Service offerings meet consumers where they are
- Involvement level: Aggregator or Virtual Power Plant (VPP)
- Aggregation brings resources to scale

Source: Modernizing transmission / distribution interface coordination for a high-DER future Lorenzo Kristov
The Individual Impact of Solar

Partly Cloudy  Overcast  Sunny

Source: NCEMC Community Solar output

25 EMCs:  > 120 MW of Renewable DER today
> 400 MW including CVR, COG, DR
The VPP through our DERMS platform:

- Aggregate solar output is smoother than individual sites
- Short-term variability is managed best by aggregating sites
- Operational challenges persist with individual sites
DER Positioning

- Coordination is key with higher penetration of DER
- Aggregation brings resources to scale
- Service offerings meet consumers where they are
DO and the Wholesale Interface

- DO-TO communication creates upstream value
- Potential to Defer new investment in transmission and generation
- Provides ancillary services and support grid stability