NC CLEAN PATH 2025: Update on Case Studies in Development

NC WARN Webinar
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Bill Powers, P.E. for NC WARN
NC CLEAN PATH 2025 Overview

- Clean, local, cost-effective, reliable power generation model.
- Rapid expansion of local solar and energy storage: homes, buildings, parking lots, vacant urban land.
- 25% of homes and commercial buildings with 100% solar by 2025 – rises to 50% by 2030.
- Displaces existing coal- and natural gas-fired power.
- Over 50% reduction in power generated for North Carolina by coal- and gas-fired plants by 2025.
- Net elimination of power from coal- and gas-plants by 2030.
- All customers benefit: no cross subsidies, pays for itself, stable rates.
Duke Energy: over next decade focused on expanding conventional infrastructure – big rate increases, do the minimum on green power

- Focused on maximizing shareholder value
- Transmission and distribution upgrades - $13 billion
- New gas-fired plants - $6 billion
- New pipelines - $2.5 billion
- Do minimum renewables, percentage decreases after 2025
$10s of billions Duke Energy plans to spend on reinforcing grid and adding gas-fired power plants is misdirected

- NC CLEAN PATH 2025 is based on rapid conversion to point-of-use solar with batteries on buildings as primary power system.
- Existing grid, and existing central station power plants, become backup systems.
- It is necessary to maintain these backup systems, but not to pay to reinforce and expand them.
NC CLEAN PATH 2025 focus is on generating solar power + batteries on homes and commercial buildings
Existing distribution grid can handle large flows of local solar power at little or no additional cost


- No significant cost hurdles to moving high levels of local solar over existing distribution grids in North Carolina.
- February 2018 California Public Utilities Commission report: no distribution grid upgrade costs if batteries included with solar.
Green Mountain Power – battery alternative to gas turbine peaker plants, 2,000 homes, $15/month

Investor-owned utility pro-actively pursuing local solar and battery storage as public benefit


Green Mountain Power CEO Mary Powell, September 2016:

- “We will empower our customers to control their energy use, keep costs low and increase reliability all year long.”

- “Leveraging the latest innovations like battery storage, we are working with customers to move away from the antiquated bulk grid, to a cleaner and more reliable energy system, where power is generated closer to where it’s used.”
50,000 home, 250 MW solar + battery project: Government of South Australia and Tesla


- 50,000 low-income and social housing units.
- All housing units equipped with 5 kW of solar panels and a 13.5 kWh Tesla Powerwall 2 battery storage unit.
- 250 MW discharge capacity, 650 MWh system.
- Follow-on to Tesla’s “built in 100 days” 100 MW discharge capacity, 129 MWh battery storage facility in (Jamestown) Australia.
- Twenty projects of this scale would meet the Clean Path 2025 target of 5,000 MW of distributed battery storage by 2025.
Local solar resource in North Carolina is low cost

NC net metering in 2018: local solar production cost is less than utility retail rate – net metering is now ready to ramp up in North Carolina


<table>
<thead>
<tr>
<th>Customer type</th>
<th>End of 2017 local solar installed cost ($/watt&lt;sub&gt;dc&lt;/sub&gt;)</th>
<th>Solar production cost range ($/kWh)</th>
<th>Average projected Duke Energy utility retail rate, 2018 ($/kWh)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Residential</td>
<td>2.50</td>
<td>0.08 – 0.11</td>
<td>0.12</td>
</tr>
<tr>
<td>Commercial</td>
<td>1.80</td>
<td>0.04 – 0.06</td>
<td>0.09</td>
</tr>
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</table>

Cost range represents cost of production if 1) cash purchase of system or 2) 100% financing.
Battery cost in 2016 was one-quarter cost in 2010, projected to be one-quarter of 2016 cost by 2030.

Green Mountain Power (GMP) is investor-owned private utility, like Duke Energy, and a leader in innovative distributed battery storage projects

- By aggregating Tesla batteries for peaking power and grid support, GMP reduces battery cost to customers from $7,000 to $1,500.

- If Duke Energy had battery program like GMP, the low battery cost would mean customers could add battery to net-metered solar systems and still produce power at less than Duke Energy retail rate in 2018.

- The addition of Tesla battery to residential solar system would add less than $0.01/kWh to rooftop solar cost-of-production.
Economics of battery storage with voluntary residential time-of-use rates (available 8/1/18 DEC, 1/1/16 DEP)

Duke Energy Executive: In 5 Years, Batteries Will Blanket the U.S.


- “There’s going to be a lot of excitement around batteries in the next five years.”
- “I would say that the country will get blanketed with projects.”
- “It’s a big opportunity for all of us to deliver what customers want.”
North Carolina implementation case studies:

- Duke University
- Brunswick Electric Membership Corporation (BMEC)
- City of Durham
- Apex, NC Municipal Utility
Case Study Candidates: Status of Climate Action Plans


<table>
<thead>
<tr>
<th>Case Study</th>
<th>Climate Action Plan (CAP) and Date</th>
<th>CAP Reduction Target</th>
</tr>
</thead>
<tbody>
<tr>
<td>Duke University</td>
<td>Yes, 2009</td>
<td>Carbon neutral by 2024, through biogas generation, reforestation, EE, and 4 MW of solar by 2012</td>
</tr>
<tr>
<td>BMEC</td>
<td>No</td>
<td>NC GreenPower participating utility <a href="http://www.bemc.org/content/nc-greenpower">http://www.bemc.org/content/nc-greenpower</a></td>
</tr>
<tr>
<td>Durham</td>
<td>Yes, 2007</td>
<td>Community: 30% by 2030 Local government: 50% by 2030</td>
</tr>
<tr>
<td>Apex Electric Utilities</td>
<td>No</td>
<td>NC GreenPower participating utility <a href="https://www.apexnc.org/237/North-Carolina-Green-Power">https://www.apexnc.org/237/North-Carolina-Green-Power</a></td>
</tr>
</tbody>
</table>
BMEC community solar w/batteries as option to onsite solar


- BMEC: 94,390 customer meters.
- 12 projects solar + battery projects in communities served by BMEC.
- 12 MW-hour of storage.
- Solar-plus-storage at communities in Brunswick, Columbus, Robeson and Bladen Counties.
- Reduces peak electricity costs and create dispatchable solar resources.
- Customer purchases output from subset of solar panels in community solar array. Option for customers with shaded rooftops.
Duke University: Clean Energy Alternatives Beyond Combined Heat & Power Plant Option


- 2018 installed solar capacity: <1 MW (at 3 locations)
- On-campus solar technical potential = 87 MW<sub>dc</sub>
- ~90 MW of solar power needed to completely displace fossil fuel component of Duke University power supply.
- In contrast to Duke University, Stanford University get ~50% of power from solar.
Duke University: ~36 MW\textsubscript{dc} of solar potential in on-campus parking lots, 51 MW\textsubscript{dc} on rooftops

sources: 1) J. Zhang, Increasing the Electricity Generation Capacity from Solar Resources at Duke University, April 27, 2018, p. 28.
The City of Durham produced hydropower at one reservoir in the 1920s, 1930s, and 1940s. Durham discontinued hydropower production when Duke Energy offered somewhat cheaper grid power. Durham does operate a landfill gas power project via a PPA.

2005 Addendum to Durham Franchise Agreement (expires 2020):

- **3. CITY AS INDEPENDENT POWER PRODUCER:** The City expressly reserves the right to engage in production of electricity.

- **4. DISTRIBUTION OF CITY-GENERATED POWER:** The City expressly reserves the right purchase of electricity for resale to service locations within the City and Company agrees to distribute the electricity through its facilities.
Paying for solar, battery, and energy efficiency under NC CLEAN PATH 2025
source: NC CLEAN PATH 2025, p. 93.

- **On-Bill Financing**
  - utility or private lender provides upfront cost of the upgrades
  - customer pays on electric bill over time
  - monthly savings exceed the monthly cost of upgrades

- **Property Assessed Clean Energy (PACE)**
  - municipal or private lender pays upfront costs
  - customer pays for upgrades on property tax bill over time
Innovators in clean energy transition are public utilities, not investor-owned utilities


<table>
<thead>
<tr>
<th>Utility Name</th>
<th>State</th>
<th>Rank</th>
<th>Watts per Customer</th>
</tr>
</thead>
<tbody>
<tr>
<td>City of Palo Alto Utilities</td>
<td>California</td>
<td>1</td>
<td>2753</td>
</tr>
<tr>
<td>Dominion North Carolina Power</td>
<td>North Carolina</td>
<td>2</td>
<td>1718</td>
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<tr>
<td>Farmers Electric Coop - Kalona</td>
<td>Iowa</td>
<td>3</td>
<td>1564</td>
</tr>
<tr>
<td>Ouachita Electric Cooperative Corporation</td>
<td>Arkansas</td>
<td>4</td>
<td>1282</td>
</tr>
<tr>
<td>Brunswick Electric Membership Corporation</td>
<td>North Carolina</td>
<td>5</td>
<td>1183</td>
</tr>
<tr>
<td>Rocky Mountain Power</td>
<td>Utah</td>
<td>6</td>
<td>847</td>
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<tr>
<td>City of Colton</td>
<td>California</td>
<td>7</td>
<td>800</td>
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<tr>
<td>Cobb EMC</td>
<td>Georgia</td>
<td>8</td>
<td>639</td>
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<tr>
<td>Roseville Electric</td>
<td>California</td>
<td>9</td>
<td>632</td>
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<tr>
<td>Pasadena Water and Power</td>
<td>California</td>
<td>10</td>
<td>545</td>
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Conclusions

- An energy strategy focused on local solar is clean, cost-effective and more reliable.
- A clean energy path can be done more cost-effectively than Duke Energy’s plan for new gas-fired plants and massive grid and pipeline investments.
- There are no economic or technical barriers to implementing large amounts of distributed energy in North Carolina.
- The standard investor-owned utility business model is not well adapted to implementing this strategy.
- Public utilities have been in the vanguard of the local solar model.