NC CLEAN PATH 2025: Update on Case Studies in Development

NC WARN Webinar

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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.

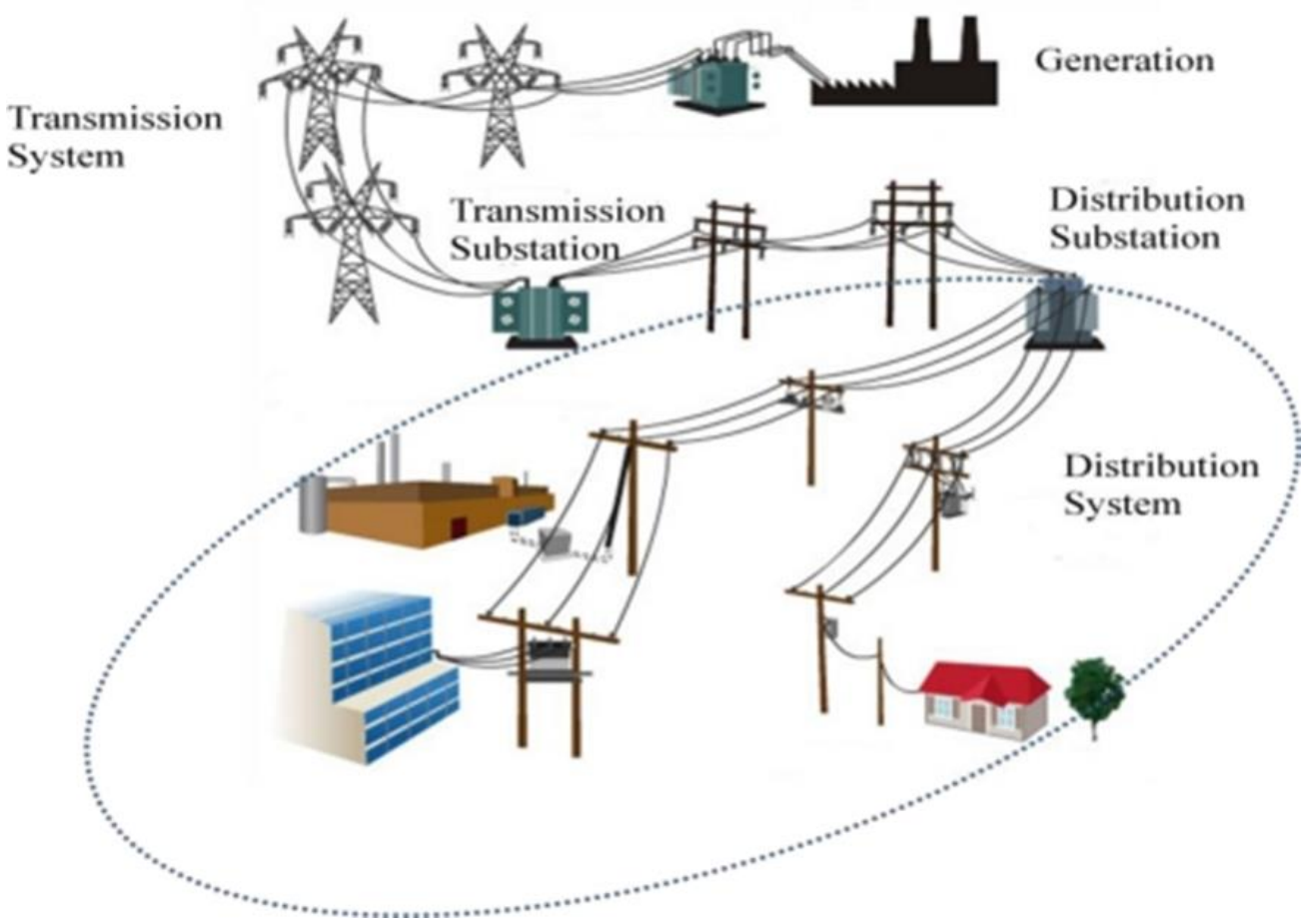
Duke Energy: over next decade focused on expanding conventional infrastructure – big rate increases, do the minimum on green power

- 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

sources: National Renewable Energy Laboratory, High Penetration PV Workshop, October 22, 2015 (various papers), 2) California Public Utilities Commission, *Residential Zero Net Energy Building Integration Cost Analysis*, February 1, 2018, p. xv.

- 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

sources: 1) New York Times, *Utility Helps Wean Vermonters from the Electric Grid*, July 29, 2017, 2) Bloomberg, *Tesla Powerwalls for Home Energy Storage Hit U.S. Market*, May 4, 2016.

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

sources: GMP press release September 14, 2016: http://www.greenmountainpower.com/press/green-mountain-power-suncommon-launch-first-vermont-solar-storage-partnership/

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."

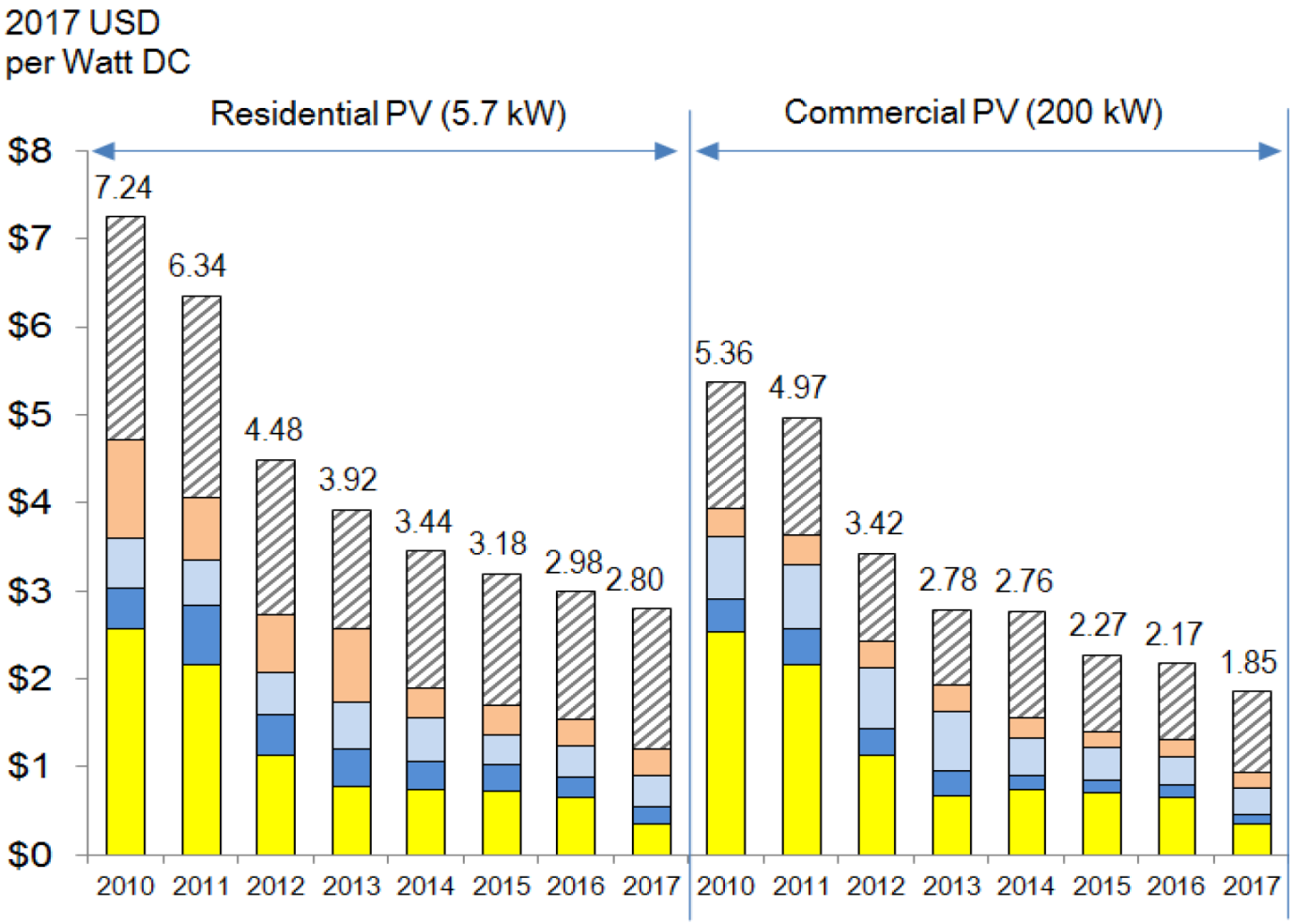
50,000 home, 250 MW solar + battery project: Government of South Australia and Tesla

source: www.teslarati.com, *Tesla's world's largest "virtual power plant" gets the green light in South Australia*, May 24, 2018: https://www.teslarati.com/tesla-virtual-power-plant-south-australia/.

- 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

see: *NREL, U.S. Solar Photovoltaic System Cost Benchmark: Q1 2017*, September 2017, p. vi.



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

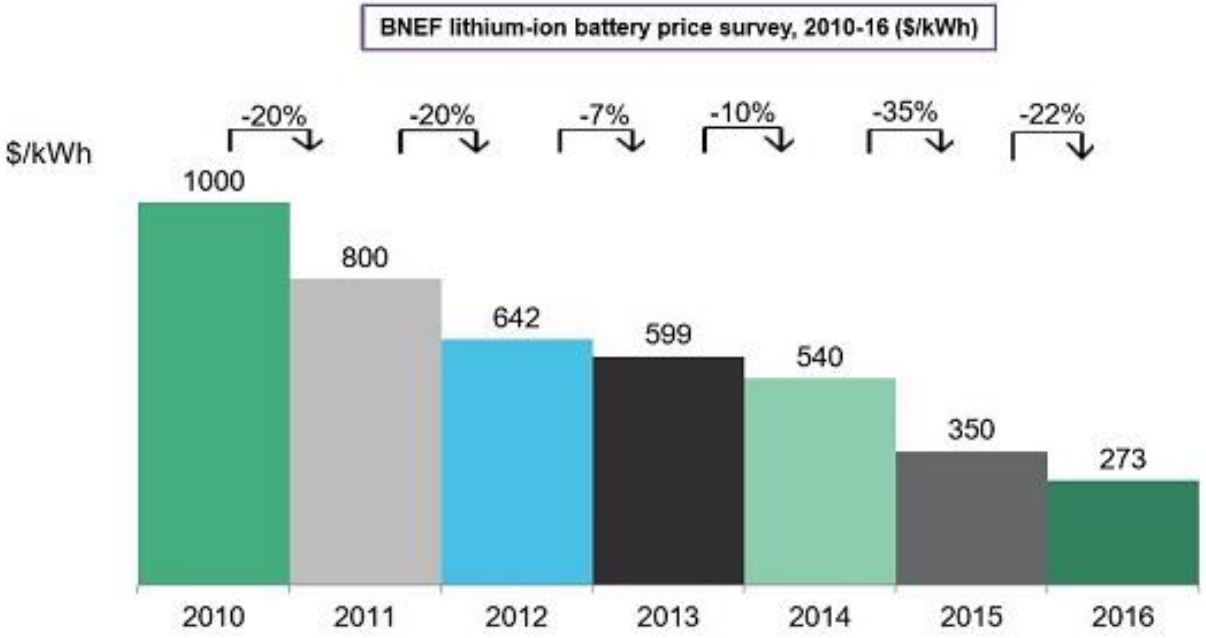
sources: 1) NREL, *NREL Report Shows U.S. Solar Photovoltaic Costs Continuing to Fall in 2016*, September 28, 2016, and 2) North Carolina solar industry representative, 3) Raleigh News & Observer, *Coal ash could raise your power bill: Duke Energy wants double-digit rate hike,* August 25, 2017.

Customer type	End of 2017 local solar installed cost ($/watt$_{dc}$)	Solar production cost range ($/kWh)	Average projected Duke Energy utility retail rate, 2018 ($/kWh)
Residential	2.50	0.08 – 0.11	0.12
Commercial	1.80	0.04 – 0.06	0.09

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

sources: 1) Bloomberg New Energy Finance, *Lithium-ion Battery Costs and Market*, PowerPoint, July 5, 2017, p. , 3) Bloomberg New Energy Finance, *How Big Will the Battery Boom Get? Try $548 Billion*, June 19, 2018. "Battery prices are expected to fall to $70 a kilowatt-hour 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)

sources: 1) SunRun, *3 Ways Solar Battery Storage Saves on Time-of-Use Rates*, June 15, 2018: https://www.sunrun.com/go-solar-center/solar-articles/3-ways-solar-battery-storage-saves-on-time-of-use-rates, 2) Duke Energy Carolinas, *Schedule RT (NC), Residential Service, Time-Of-Use,* effective August 1, 2018: https://www.duke-energy.com/_/media/pdfs/for-your-home/rates/electric-nc/ncschedulert.pdf?la=en.

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

source: Forbes, *In 5 Years, Batteries Will Blanket The U.S., Duke Executive Says*, October 22, 2017.

- "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."

NC CLEAN PATH 2025 Supplement, Fall 2018

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

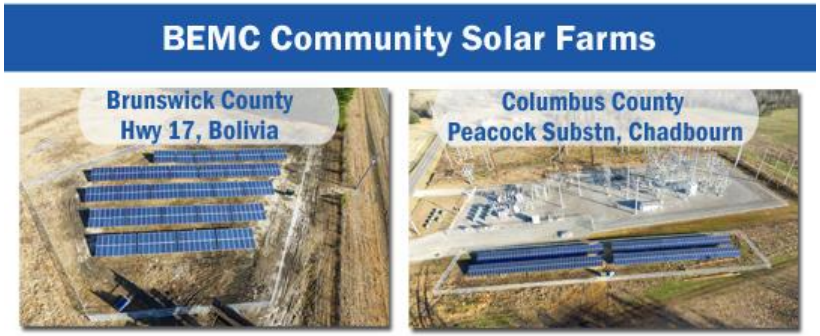
sources: 1) J. Zhang, *Increasing the Electricity Generation Capacity from Solar Resources at Duke University*, April 27, 2018, p. 12 & p. 15, 2) BMEC: http://www.bemc.org/content/nc-greenpower, 3) Durham: https://durhamnc.gov/263/Greenhouse-Gas-Emissions, and 4) Apex: https://www.apexnc.org/237/North-Carolina-Green-Power.

Case Study	Climate Action Plan (CAP) and Date	CAP Reduction Target
Duke University	Yes, 2009	Carbon neutral by 2024, through biogas generation, reforestation, EE, and 4 MW of solar by 2012
BMEC	No	NC GreenPower participating utility http://www.bemc.org/content/nc-greenpower
Durham	Yes, 2007	Community: 30% by 2030 Local government: 50% by 2030
Apex Electric Utilities	No	NC GreenPower participating utility https://www.apexnc.org/237/North-Carolina-Green-Power

BMEC community solar w/batteries as option to onsite solar

source: 1) Energy Storage News, *Cypress Creek's first solar-plus-storage projects take off with Lockheed's lithium*, March 27, 2018: https://www.energy-storage.news/news/cypress-creeks-first-solar-plus-storage-projects-take-off-with-lockheeds-li, 2) Brunswick Electric Membership Corporation webpage, November 1, 2017: http://www.bemc.org/content/community-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.



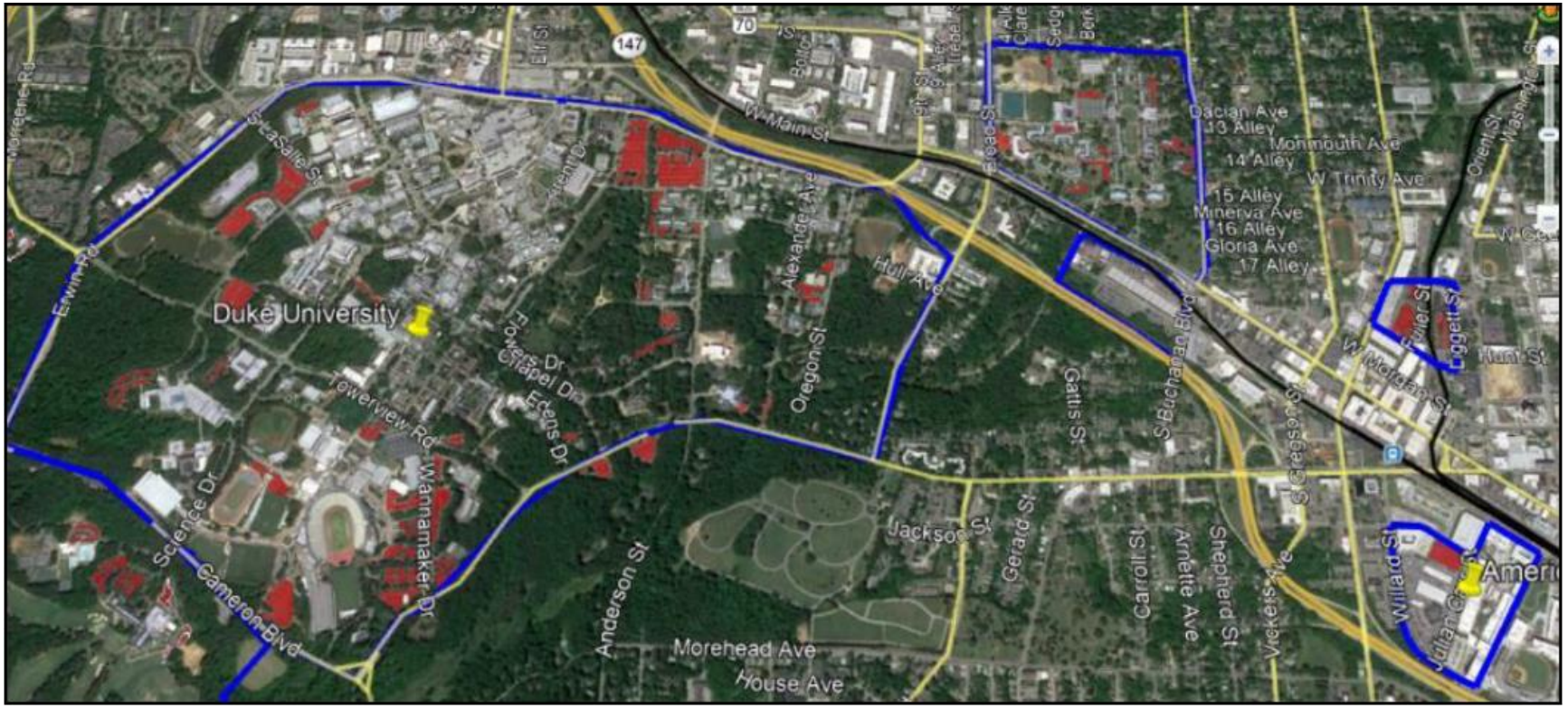
Duke University: Clean Energy Alternatives Beyond Combined Heat & Power Plant Option

sources: 1) J. Zhang, *Increasing the Electricity Generation Capacity from Solar Resources at Duke University*, April 27, 2018, p. 10 and p. 29, and 2) NC WARN, *NC WARN Letter to Duke University President on Proposed CHP Plant and Alternatives*, December 14, 2017, p. 2 and p. 5.

- Duke 2012 target for on-campus solar (in 2009 Climate Action Plan): 4 MW
- 2018 installed solar capacity: <1 MW (at 3 locations)
- On-campus solar technical potential = 87 MW_{dc}
- ~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_{dc} of solar potential in on-campus parking lots, 51 MW_{dc} on rooftops

sources: 1) J. Zhang, *Increasing the Electricity Generation Capacity from Solar Resources at Duke University*, April 27, 2018, p. 28.



2005 City of Durham Franchise Agreement with Duke Energy – potential model

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

see: Solar Power Magazine, *The Top Utilities of 2016 for Solar and Energy Storage*, April 26, 2017.

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

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.