

North Carolina Clean Path 2025

Achieving an Economical Clean Energy Future

Prepared for NC WARN

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Bill Powers, P.E., Biography

Mr. Powers is a registered professional mechanical engineer in California with over 30 years of experience in energy and environmental engineering. He has written numerous articles on the strategic cost and reliability advantages of local solar power over large-scale, remote, transmission-dependent renewable resources, and frequently appears as an expert witness on alternatives to conventional power generation infrastructure. Mr. Powers is the author of the 2012 strategic energy plan, *Bay Area Smart Energy 2020*, for the San Francisco Bay region. The plan relies on rooftop and parking lot solar power, combined with accelerated energy efficiency measures and battery storage, as the template to reduce greenhouse gas emissions from power consumption in the Bay Area region by 60 percent by 2020. Mr. Powers served as an expert witness in a landmark proceeding in 2009 where the California Energy Commission denied a new peaking gas turbine power plant while determining that urban solar power could potentially serve as a cost-effective alternative to the proposed gas plant.



Mr. Powers began his career converting Navy and Marine Corps shore installation power plants from oil-firing to domestic waste, including wood waste, municipal solid waste, and coal, in response to concerns over the availability of imported oil following the Arab oil embargo. He has permitted numerous peaking gas turbine, microturbine, and internal combustion engine power plants. His home currently serves as urban off-grid test bed, including rooftop solar, battery storage, backup generation, and an electric vehicle, to demonstrate the cost-effectiveness and reliability of this power delivery approach. Mr. Powers has a B.S. in mechanical engineering from Duke University and an M.P.H. in environmental sciences from the University of North Carolina at Chapel Hill.

NC WARN

NC WARN is a 29 year-old, member-based nonprofit tackling the climate crisis – and other hazards posed by electricity generation – by watch-dogging Duke Energy practices and building people power for a swift North Carolina transition to clean, renewable and affordable power generation and increased energy efficiency.

In partnership with other organizations, and using sound scientific research, NC WARN informs and involves the public in key decisions regarding their health and economic well-being. Dedicated to climate and environmental justice, NC WARN seeks to address the needs of all of the public by intentionally including those often excluded from participation because of racism, sexism, classism, and other forms of oppression.

NC WARN commissioned this report in order to present a positive alternative to Duke Energy's long-term plan. See the full NC CLEAN PATH 2025 report and implementation plan at www.ncwarn.org/cp25/.

A note on updates: After this report was published, Duke Energy canceled plans for two new nuclear reactors at its Lee plant in Gaffney, SC. Thus, the \$20 billion nuclear price tag cited in the report no longer applies. Even without the nuclear plants, the NC CLEAN PATH 2025 plan remains far cheaper than Duke Energy's long-term plan. Follow updates regarding NC CLEAN PATH 2025 at www.ncwarn.org/cp25-updates.

Executive Summary

NC CLEAN PATH 2025 is an energy strategy focused on implementing local solar power,ⁱ battery storage, and energy efficiency measures to quickly replace fossil fuel-generated electricity and eliminate the resulting pollution, including greenhouse gases that are driving climate change.

This approach is cleaner, more reliable, and far less costly than the \$40 billion-dollar expansion of fracked natural gas, nuclear power, and transmission infrastructure being planned by North Carolina's dominant investor-owned (private) utility, Duke Energy. NC CLEAN PATH 2025 is also an economic engine that will create more jobs than the expansion plans proposed by the utility, and is based on available technology and proven, successful programs.

North Carolina has twice as much local solar potential as needed to retire all fossil fuel plants, and existing distribution lines can handle large flows of local solar at little additional cost.

Smaller municipal and cooperative utilities have been leaders in advancing local solar and battery storage in the United States, and may be best adapted to implementing NC CLEAN PATH 2025. However, there are no economic or technical barriers to its adoption by the large investor-owned utilities.

NC CLEAN PATH 2025 is an opportunity for North Carolinians to provide national leadership in the urgent challenge to slow climate change. NC CLEAN PATH 2025 will:

- Reduce power generated by coal- and natural gas-fired plants 57 percent by 2025.
- Reduce greenhouse gas emissions from electricity generation 100 percent by 2030. All coal-fired plants will be closed and gas-fired plants will be used only for backup supply.
- Maintain the current growth rate, 1,000 megawatts per year, of large-scale solar in North Carolina, but build it on vacant urban and suburban land, and on brownfields.
- Add 2,000 megawatts of solar power each year at homes, businesses, schools, and other buildings – and back it up with cost-effective battery storage, capitalizing on rapid progress by Tesla and other companies.
- Create financing options for local solar power, battery storage, and efficiency upgrades that allow everyone to benefit without financial burden.
- Accelerate energy-saving programs to reduce electricity usage 20 percent by 2025.
- Expand demand response programsⁱⁱ and energy efficiency upgrades to reduce peak summer cooling and peak winter heating loads 50 percent by 2025.
- Create 16,000 good jobs across the state in the first three years.

ⁱ Local solar can be on a residential, commercial, or institutional building's rooftop, covering parking areas, or ground-mounted next to the structure or on vacant urban land.

ⁱⁱ Demand response: Reducing or shifting consumers' electricity usage from peak demand periods to lower-demand periods by use of financial incentives.

An approach that beats the obsolete, high-cost, high climate impact utility model

North Carolina's investor-owned electric utilities (IOUs) are focused on building large power plants and additional transmission and distribution projects. The predominant utility, Duke Energy, supplies about 90 percent of the electricity in the state. Its 15-year plan is to expand conventional power generation and grid investments, resulting in large rate increases for customers.

Duke Energy's plan for North and South Carolina is to spend \$5 billion on new natural gas-fired plants, \$2.5 billion building the Atlantic Coast Pipeline, and possibly upwards of \$20 billion to build two nuclear units. Just in North Carolina, Duke Energy plans \$13 billion in transmission and distribution additions. Meanwhile, it plans to do the minimum to advance renewable energy; by 2031, only six percent of Duke Energy's total Carolinas generation would be from renewables.

NC CLEAN PATH 2025, in contrast, will make local solar with battery storage the backbone of the statewide electricity system. The cost of electricity will be lower for all customers due to the lower cost of solar compared to



NC CLEAN PATH 2025 will add 16,000 jobs spread across the state within three years of being adopted.

utility retail rates. The massive utility investments in large power plants and infrastructure will be avoided under NC CLEAN PATH 2025. Power bills will become stable and predictable instead of rising relentlessly to pay for largely unnecessary conventional utility expansion.

Financing comes from utilities or competitive lenders

Investments in solar, batteries, and efficiency upgrades can be facilitated by utilities – and possibly local governments and private lenders – which provide upfront capital and allow customers to pay for the upgrades on their electric bills over time (known as



Several companies now have battery systems on the market for use with local solar.

Tesla's Powerwall is shown storing a home's solar power for use when the sun isn't shining.

Source: Utility Dive.

Grid Expenditure Comparison, NC CLEAN PATH 2025 vs. Duke Energy

Cost Category	NC CLEAN PATH 2025	Duke Energy
Cost of electricity	Less than utility retail rate	Utility retail rate
Energy efficiency and demand response	\$450 million per year	\$120 million per year
Smart meters	\$0.5 billion	\$0.5 billion
Grid operations & maintenance	\$1 billion per year	\$1 billion per year
Grid upgrades	Less than \$1 billion (distribution grid upgrades)	\$13 billion over ten years (NC only)
New gas-fired power plants	\$0	\$5 billion (NC & SC)*
New nuclear plants	\$0	\$20 billion (NC & SC)*
Atlantic Coast Pipeline	\$0	\$2.5 billion (NC & SC)**

* Duke Energy electricity sales in NC are about four times those in SC. However, much of the proposed new gas-fired and nuclear generation will be located in SC.

** Shale gas transported on this pipeline will serve Duke Energy gas-fired generation in NC and SC.

on-bill financing). Customers' monthly bills will remain the same or be reduced. Electricity savings under NC CLEAN PATH 2025 will exceed the monthly payment for the upgrades.

Only minor improvements to the electricity transmission and distribution system will be necessary to realize NC CLEAN PATH 2025 targets. The cost will be passed through to utility customers in the same manner as operations and maintenance costs. Customers installing solar power and batteries will receive available federal tax benefits.

Abundant, low-cost local solar as backbone of the state's power supply

The North Carolina solar resource potential on rooftops, parking lots, and urban vacant land is about 130 million megawatt-hours (MWh) per year. This is nearly double the approximately 77 million MWh per year needed to displace North Carolina's coal- and natural gas-fired power. This local solar resource is distributed across small towns, larger communities, and urban areas close to where electricity demand is located.

Customers unable to use solar at their home, business, or other building can participate in community-based solar programs.

Electricity generated at large-scale "solar farms" is sold at the wholesale price of electricity and does not increase customer rates. The cost of local solar power in North Carolina, at homes and businesses, has fallen below the utility retail rate for Duke Energy customers in 2017. (Typically, retail rates for the cooperative and municipal utilities are higher.) Meanwhile, solar prices keep declining as utility rates keep rising. This means that homeowners, businesses, nonprofits, and governments save money by offsetting the retail electricity they currently purchase from the grid with solar panels on their rooftops, parking lots, or next to the building.

When excess power is generated from these net metered solar systems, it flows to neighbors who then pay the utility for the kilowatts. This arrangement, known as net metering, is now more cost-effective than grid power and is ready to ramp up in North Carolina. Net metering is an economic benefit to all utility customers, even those

without onsite solar, because it reduces the need to build large power plants and supporting transmission infrastructure, thus keeping rates from constantly rising.

Building on state success installing large amounts of solar

North Carolina is second in the nation in solar photovoltaic (PV) capacity, with approximately 3,000 MW now generating electricity. About 1,000 MW were installed in 2016 alone. Almost all of this was the result of large-scale projects greater than 1 MW in size on parcels of rural land.

NC CLEAN PATH 2025 will ramp up the solar installation rate to 3,000 MW per year by 2020, of which about 2,000 MW per year will be customer-sited rooftop, ground-mounted, or parking lot solar. The 1,000 MW annual installation rate of large-scale solar will be maintained, but with systems concentrated on vacant urban land and on brownfields (contaminated properties) closer to areas of electricity demand.

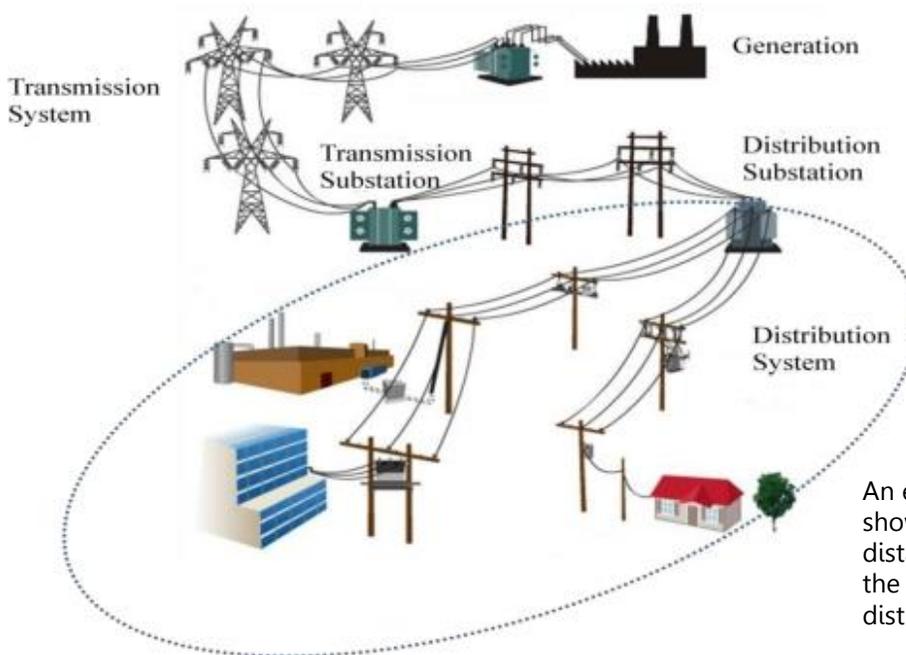
Local power lines can handle large flows of solar power at little additional cost

Low-cost distribution system upgrades carried out under NC CLEAN PATH 2025 will enable very high levels of solar power flow on existing distribution lines in local communities. Numerous studies by the U.S. Department of Energy and by utilities in states near North Carolina demonstrate that such upgrades should require a one-time cost of less than \$1 billion – spread out over several years – for a state the size of North Carolina. This is approximately the amount Duke Energy spends annually on operations and maintenance for the electricity grid in its North Carolina service areas.

Utilizing some existing generation and storage resources while retiring others

All coal-burning power plants will be phased out quickly under NC CLEAN PATH 2025. Existing hydroelectric plants and solar projects will continue to operate as reliable renewable resources. Existing nuclear plants will continue operating until current licenses expire in 2030 and beyond. The existing natural gas-fired power plants and transmission grid become backup systems over time.

Duke Energy's existing 2,140 MW of pumped storage hydroelectric plants (Bad Creek and Jocassee) can be readily integrated into the NC CLEAN PATH 2025 framework. They will serve



An example of a power grid, showing the high-voltage, long-distance transmission system and the lower-voltage local distribution system.

Source: [Lim et al.](#)

as large-scale batteries by absorbing over 2,000 MW of solar power in daytime hours, then dispatching the energy as hydroelectricity at night when solar power is not available.

Solar, batteries, and energy-saving measures offset high-usage periods

A key to transitioning from the current utility model is to provide a clean energy alternative to construction of natural gas-fired “peaker” plants to meet demand during periods of high electricity usage. Along with energy efficiency and demand reduction programs, NC CLEAN PATH 2025 does this by combining local solar power with battery storage, and allowing utilities to tap the power stored in local batteries during times of peak demand.

NC CLEAN PATH 2025 includes the addition of 5,000 MW of battery storage connected to onsite solar systems by 2025. Onsite battery storage is cost-effective in 2017, even more so when customers are fairly compensated by utilities for making their batteries available during periods of high customer usage.

Implementing battery storage at the point where power is used will increase reliability for all communities. It is a more economical and effective solution than Duke Energy’s existing proposal to build redundant backup transmission lines to meet vulnerable communities’ reliability needs.

Local solar power is now cheaper per kilowatt-hour than the retail rate customers are paying their utilities. On-bill financing helps customers benefit without upfront cost burden.

Heating, cooling, and other energy savings are key

Heating and cooling systems are key drivers of peak demand. Most antiquated, low-efficiency systems are beyond their useful design life and will be replaced over the next few years by far more efficient systems that will reduce electricity usage by substantial amounts.

Specifically, NC CLEAN PATH 2025 will achieve a 50 percent reduction in peak heating and cooling usage through comprehensive demand response programs and energy efficiency upgrades, and a 20 percent reduction in overall electricity consumption.

A statewide economic and employment engine

The new jobs necessary to fully develop this local solar and energy efficiency resource will be spread across the state in small towns and urban areas. New renewable investments will boost local economies through enhanced property value. NC CLEAN PATH 2025 will provide 50 percent more jobs than Duke Energy’s proposed build-out, in much less time, as shown in the table on the next page.



Jobs Generated by NC CLEAN PATH 2025

	NC CLEAN PATH 2025	Duke Energy
Direct new jobs	Solar approx. 14,000 <i>(7,000 per 1,000 MW per year installed solar capacity, increased by 2,000 MW per year)</i> Energy efficiency approx. 2,000 <i>(7 per \$1 million in annual output, increased by \$330 million per year)</i>	approx. 10,000 (grid modernization and new gas-fired capacity)
Period over which direct new jobs are added	3 years	10 years
Additional indirect new jobs (in the community)	approx. 16,000 (Duke Energy direct:indirect ratio approx. 1:1)	approx. 10,000

A net 100% reduction in greenhouse gases from electricity generation by 2030

Through a combination of local solar and battery storage systems, energy efficiency, and demand response programs, NC CLEAN PATH 2025 will reduce power generated by fossil fuel plants and associated greenhouse gas emissions 57 percent by 2025, and 100 percent by 2030.

Some natural gas-fired generation will be necessary even after 100 percent net reduction in greenhouse gases is achieved, primarily during extended periods of inclement weather when solar, hydropower, and existing nuclear generation, along with batteries and pumped storage, are insufficient to meet demand. At other times, especially spring and fall when heating and cooling demand are low, renewable power will be generated in excess of what is needed to meet in-state demand and can be exported to neighboring states.

Public utilities are innovators in the clean energy transition – investor-owned utilities can join them

Public utilities (municipal utilities and cooperatives) have been in the vanguard of

local solar and battery storage deployment in the United States. The typical utility business strategy has been resistant to implementing this innovative model. However, IOUs that commit to an explicit public benefit purpose – thus aligning shareholder interests with those of the public – can adopt a stable and profitable corporate structure that achieves a cleaner and less costly electricity supply for their customers.

At least one IOU, Green Mountain Power, has adopted the public benefit as an explicit corporate objective, balancing shareholder value with the public good. President and CEO Mary Powell expressed the nature of this public benefit obligation in the following terms:

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.