LEWIS & ROBERTS
PROFESSIONAL LIMITED LIABILITY COMPANY
ATTORNEYS AT LAW
3700 Glenwood Avenue, Suite 410
Raleigh, North Carolina 27612
Mailing Address
Post Office Box 17529
Raleigh, NC 27619-7529

Telephone (919) 981-0191
Facsimile (919) 981-0199

Richard M. Lewis **
James A. Roberts, III **
Winston L. Page, Jr.
Timothy S. Riordan
John D. Elvers **
Brian D. Lake

John H. Ruocchio
Paul C. McCoy**
Mallory E. Lidaka
Matthew D. Quinn
Melissa P. Woodard
Ashton L. Harrell, II

** NCDRC Certified Mediator

Matthew D. Quinn
Direct Dial: (919) 719-8538
Email: mdq@lewis-roberts.com

May 28, 2024

VIA ELECTRONIC FILING

Ms. Shonta Dunston, Chief Clerk
North Carolina Utilities Commission
4325 Mail Service Center
Raleigh, NC 27699-4300

Re: Duke Energy Progress, LLC and Duke Energy Carolinas, LLC's Biennial Consolidated Carbon Plan and Integrated Resource Plan
Docket No. E-100, Sub 190

Dear Ms. Dunston:

On behalf of The Environmental Working Group and NC WARN and pursuant to the North Carolina Utilities Commission's January 17, 2024 *Order Scheduling Public Hearings, Establishing Interventions and Testimony Due Dates and Discovery Guidelines, Requiring Public Notice, and Providing Direction Regarding Duke's Supplemental Modeling* and February 21, 2024 *Order Establishing Additional Procedures for Expert Witness Hearing* issued in the above-captioned proceeding, enclosed for filing please find the direct testimony of Grant Smith.

By copy of this letter, I am forwarding a copy to all parties of record by electronic delivery. Pursuant to the Commission rules, we will also be submitting for delivery by May 29, 2024, twelve three-hole punched paper copies of the testimony (including one single-sided copy).

Should you have any questions or concerns, please do not hesitate to contact me.

Sincerely,

Matthew D. Quinn

Enclosure(s)
cc: Parties of Record

{LH_Master.doc}

STATE OF NORTH CAROLINA
UTILITIES COMMISSION
RALEIGH

DOCKET NO. E-100, SUB 190

In the Matter of Biennial Consolidated Carbon Plan and Integrated Resource Plans of Duke Energy Carolinas, LLC, and Duke Energy Progress, LLC, Pursuant to N.C.G.S. § 62-110.9 and § 62-110.1(c)	))))))	**DIRECT TESTIMONY OF GRANT SMITH ON BEHALF OF THE ENVIRONMENTAL WORKING GROUP AND NC WARN[1]**

[1] NC WARN is presently a party to this docket. Contemporaneous with the filing of this direct testimony, petitions to intervene are being filed by the Environmental Working Group, Charlotte Mecklenburg NAACP, Down East Coal Ash Environmental and Social Justice Coalition, and Seeds of HOPE. To the extent that these organizations are permitted intervention, the present testimony is offered on their behalf.

TABLE OF CONTENTS

Q: **PLEASE STATE YOUR NAME, BUSINESS ADDRESS, AND CURRENT EMPLOYMENT POSITION.**

My name is Grant Smith. My business address is 1250 I Street NW, Suite 1000, Washington, DC 20005. I am currently the Senior Energy Policy Advisor at the Environmental Working Group.

Q: **WHAT ARE YOUR PRIMARY RESPONSIBILITIES AS SENIOR ENERGY POLICY ADVISOR FOR THE ENVIRONMENTAL WORKING GROUP?**

A: My responsibilities include: (1) co-authoring reports concerning Duke Energy and other utilities across the country, jobs in the renewables and energy efficiency sectors, hydrogen technology, energy and water; (2) highlighting trends and technological developments in the energy sector; and (3) authoring articles on energy policy and regulatory developments on topics such as utility rate structures, energy subsidies, renewable power, nuclear and coal-fired power, alternative utility models, and natural gas-fired power.

Q: **PLEASE BRIEFLY DESCRIBE YOUR EDUCATIONAL AND PROFESSIONAL BACKGROUND.**

A: I hold a Master of Arts in Teaching German in 1985 and a Bachelor of Arts in history and German in 1980 from Indiana University. I also attended the University of Hamburg, West Germany from 1978 to 1981. In 1982, I was a Max Kade Fellow at Indiana University. For nearly 40 years, I've been an energy, consumer, and environmental advocate. I have drafted reports, articles, and blogs on an array of energy policy issues. I also have 20 years' lobbying experience at the Indiana General Assembly on energy-related issues. Since 2017, I have worked at the Environmental Working Group. I've co-authored reports concerning Duke Energy and other utilities across the country, jobs in the renewables and energy efficiency sectors, hydrogen technology, energy and water. I've authored articles on energy technology trends, policy, and regulatory developments on topics such as utility rate structures, energy subsidies, renewable power, nuclear and coal-fired power, alternative utility models, and natural gas-fired power. Two of my articles were published in the energy sector trade periodical *Utility Dive*.

Prior to my role at EWG, from June 2011 – August 2017, I was Senior Energy Policy Advisor for the Civil Society Institute based in Newton, MA. For the Civil Society Institute, I conducted research and drafted white papers and topic briefs on various issues, including energy policy and the energy transition (including in Germany), the utility-sector assault on customer-owned solar, uranium mining, nuclear power, water policy (with respect to energy and agricultural impacts), frack sand mining, and energy market trends. I also worked with local organizations on the power sector and water related issues. From 1986 – 2011, I was employed at Citizens Action Coalition of Indiana, as a lobbyist, organizer, researcher and writer, and fundraiser. I became Executive Director in 2004. I worked on industrial toxics/industrial pollution prevention policy, alternative agriculture, telecommunications, and energy issues.

Q: HAVE YOU PREVIOUSLY TESTIFIED BEFORE THE NORTH CAROLINA UTILITIES COMMISSION?

A: No.

Q: HAVE YOU PREVIOUSLY PROVIDED TESTIMONY OR COMMENT AS AN EXPERT BEFORE ANY OTHER REGULATORY BODIES OR FORUMS?

A: Yes. I submitted comments in North Carolina Utilities Commission's (the Commission's) proceeding regarding Duke Energy's net metering program in March 2022 and in the Commission's proceeding regarding Duke Energy's carbon plan in July 2022.

Q: ON WHOSE BEHALF ARE YOU TESTIFYING IN THIS PROCEEDING?

A: I am testifying on behalf of the Environmental Working Group ("EWG").

Q: WHAT IS THE PURPOSE OF YOUR TESTIMONY IN THIS PROCEEDING?

A: The purpose of this testimony is to explain how Duke Energy Progress LLC and Duke Energy Carolinas LLC's (collectively, "Duke Energy") Carbon Plan and Integrated Resource Plan ("CPIRP") is flawed. This testimony will show (1) why electric system resiliency, properly vetted, should be the central concept around which to design Duke Energy's CPRIP and any future carbon plan, (2) the continuing and increasing impacts of climate change on North Carolina's power system leads to the conclusion that a much greater balance must be struck between utility-scale and distributed energy resource investments, (3) planned outages of central power plants will be increasingly difficult to schedule as every season currently harbors system disruptions from severe weather, and (4) without significant regulatory changes distributed energy resources ("DERs") will continue to be marginalized and risks and costs to electric system operations from climate change will escalate.

Q: HOW IS THE REMAINDER OF YOUR TESTIMONY ORGANIZED?

A: The remainder of my testimony is divided into the designated Issues for 2023-2024 CPIRP. First, I will discuss *Issue 1*: Planning Objectives in a Changing Energy Landscape. Second, I will discuss *Issue 9*: Near-Term Actions: Supply-Side Development and Procurement. Third, I will discuss *Issue 13*: Ensuring Reliability and Operational Resilience. Fourth, I will discuss *Issue 11*: Advancing Grid Edge and Customer Programs. Finally, I will offer my conclusions and recommendations.

1. ISSUE 1 - PLANNING OBJECTIVES IN A CHANGING ENERGY LANDSCAPE

Q: PLEASE SHARE YOUR PERSPECTIVE ON DUKE ENERGY'S CPIRP?

A: Duke Energy has adhered to an unchanged business plan for over a decade, emphasizing the need for increased natural gas capacity and reliance on existing nuclear plants. Despite acknowledging the impacts of climate change and the benefits of DERs, Duke Energy has opted for utility-scale investments, dismissing cheaper and more reliable alternatives such as virtual power plants (VPPs). This approach poses reliability and adequacy risks to the power system, compromises affordability and energy equity, and prioritizes profit over customer interests. Duke Energy's plan overlooks the integrated nature of reliability and resiliency, favoring utility-scale investments over distributed resources. This strategy violates statutes and fails to capture the benefits of VPPs and DERs, as recognized by state reports. To fully realize the benefits of DERs and VPPs, state mandates are necessary to ensure their incorporation into utility plans, using broader cost-effectiveness parameters.

Q: HOW HAS DUKE ENERGY'S BUSINESS PLAN HAS CHANGED OVER THE PAST DECADE?

A: Duke Energy's business plan has not changed for the better part of a decade, including its practice of shifting its business risk to customers and failure to account for the severe impacts of climate change. As shown in Table SPA 3-2 of the *Supplemental Planning Analysis*, Duke Energy's current CPIRP proposal relies heavily on additional natural gas capacity and existing nuclear capacity. This comports with Duke Energy's business plan for more than a decade in its IRPs, and new, non-existent nuclear capacity.[2] Duke Energy has emphasized natural gas-fired capacity additions and continued reliance on its aging, existing nuclear plants for

[2] Duke Energy, Supplemental Planning Analysis, NCUC Docket No. E-100, Sub 190 (Jan. 31, 2024), p. 39. https://starw1.ncuc.gov/NCUC/ViewFile.aspx?Id=bfb12788-90ea-4352-97d6-3f3a7134b5ad

more than decade.[3] The company has been touting its need for new "advanced" nuclear capacity since its 2019 annual report.[4]

Duke Energy does not address new technology, including VVPs or microgrids in its plan. Duke Energy's supplemental filings only add offshore wind as a potential energy source, but nuclear remains a dominant resource throughout the planning period and natural gas generation remains dominant until after 2038 – with the aim of burning only hydrogen in hydrogen-ready turbines by 2050.[5] The distributed energy programs remain the same from the initial filing, comprising a very small percentage of capacity and with no consideration of using customer-sited storage or EVs to supply power to the grid.[6]

Indeed, Duke Energy's alternative portfolios are essentially the same portfolio, except for the pace of implementation. As Duke Energy states, "[i]mportantly, all three Energy Transition Pathways employ similar base assumptions, but require a

---

[3] *See,* e.g., Smith, Grant, Walker, Bill, *Public Energy Enemy No. 1*. EWG (April 16, 2019). https://www.ewg.org/research/public-energy-enemy-no-1 and *Duke Energy's Epic Fails: $11.6 Billion in Scrapped Projects Since 2013*. EWG (Aug. 31, 2020). https://www.ewg.org/research/duke-energys-epic-fails-116-billion-scrapped-projects-2013

[4] Duke Energy Corporation, 2019 Annual Report and Form 10-K, p. 5. https://s201.q4cdn.com/583395453/files/doc_financials/2019/ar/2019-duke-energy-annual-report.pdf

[5] Planning Analysis, *supra* note149.

[6] Compare Duke Energy, *supra* note148, pp. 39,40 and Duke Energy, Duke Energy Carbon Plan Chapter 3 (Aug. 17, 2023), Table 3-2, p. 6 and Table 3-3, p. 7. https://starw1.ncuc.gov/NCUC/ViewFile.aspx?Id=0ae7fa49-ce8f-4df2-954d-0637b35e2f7b

different pace, scope and scale of resource additions to achieve the Interim Target."[7]

2. ISSUE 9 - NEAR-TERM ACTIONS: SUPPLY-SIDE DEVELOPMENT AND PROCUREMENT

Q: WHAT IS DUKE ENERGY'S STRATEGY FOR DISTRIBUTED ENERGY RESOURCES?

A: Duke Energy has a history of marginalizing DERs. EWG has published three reports that tracks Duke Energy's planning regimen and legislative initiates from the early 2010s through 2020. In terms of preferred generation resources and what it considered threats to it bottom line, the monopoly utility abandoned an offshore wind pilot and has no onshore wind; instead, embarking on a massive buildout of natural gas plants. Duke Energy also continually presses legislatures and regulators to shift its business risk to customers, with respect to undermining or eliminating energy efficiency programs, seeking extremely high fixed charges, pushing construction work in progress for construction of a coal gasification. plant and nuclear units and weakening customer-owned solar programs.[8]

[7] *Verified Amended Petition for Approval of 2023-2024 Carbon Plan and Integrated Resource Plans of Duke Energy Carolinas LLC and Duke Energy Progress LLC*, NCUC Docket No. E-100, Sub 190 (Jan. 31, 2024), pp. 14,15. https://starw1.ncuc.gov/NCUC/ViewFile.aspx?Id=6ca06ddb-b10a-4620-b69f-a718ccf9c9c1

[8] EWG, supra note 149 and Smith, Grant, Walker, Bill, *Tone Deaf: The Facts Behind Duke Energy's Low-Income Programs.* EWG (June 3, 2020). https://www.ewg.org/energy/tone-deaf-the-facts-behind-duke-energys-low-income-programs

Q: WHAT IS YOUR COST AND RISK ASSESSMENT OF DUKE ENERGY'S CPIRP?

A: Duke Energy's proposal is neither least cost nor low risk. Duke Energy's emphasis on utility-scale resources and small modular reactors ("SMRs") with no operational experience or definitive cost data makes Duke Energy's chosen portfolio neither a "lower cost" plan nor a plan with "lower execution risk,"[9] as Duke Energy claims. It may be the purported lowest cost among Duke Energy's chosen alternatives, but not an actual low-cost proposal. It may be low financial risk for Duke Energy, but not for ratepayers.

As shown, VPPs can provide the same services as utility-scale resources at a fraction of the price. Therefore, Duke Energy's proposal, heavily laden with utility-scale additions and minimal DER investment and with no portfolio option including VPPs or microgrids, cannot be the least costly.

Likewise, the plan is low risk for Duke Energy, as its shareholders are held harmless from any upfront initial development and R&D costs. Duke Energy recovers margin from the costs, and Duke Energy gets to keep those ratepayer dollars and their recovered margin even if the resources, such as SMR units, are not deployed.[10] In fact, Duke Energy seeks nearly $596 million upfront in this proceeding – on top

[9] Verified Amended Petition, supra note 154, p. 15.
[10] Verified Amended Petition, supra note 154, p. 22.

of the $75 million for SMR R&D from the previous carbon plan proceeding.[11] Once again, Duke Energy has been successful in shifting its business risk to ratepayers. Another weakness in Duke Energy's proposal is the utility's test to gauge the cost-effectiveness of energy efficiency programs. A recommendation in the NC DEQ's 2019 report is for utilities to expand the indices analyzed in arriving at cost effectiveness.[12] What the DEQ proposed was essentially the Societal Test that could consider, among other things, resilience, economic development, and public health. Importantly, there would be no argument for shifting costs among residential customers. Despite the state report's recommendation, nothing has been done to expand the cost-effectiveness test used by Duke Energy. The cost-effectiveness test expansion proposed by the DEQ would make VPPs look much better in terms of cost risk.

Q: HOW DOES DUKE ENERGY JUSTIFY ITS UTILITY-SCALE BIAS IN ITS CPIRP?

A: Duke Energy's justification of its continued over-investment in utility-scale resources boils down to this statement: "Although the electricity generation from wind and solar resources provides fuel-free electricity for the Companies' customers, this electricity is variable and not a replacement for baseload capacity."[13] Importantly, complete replacement of conventional power is not

[11] *Id.*, pp. 31, 32.
[12] NC Clean Energy Plan, supra note 124.
[13] Appendix J, *supra* note 209, p. 2.

currently technologically feasible. However, a renewables portfolio, which would include utility-scale wind, solar, and storage and coordinated DERs, can dramatically reduce conventional power generation and displace a good amount of existing conventional capacity.

Germany is proof of how renewables plus storage can systematically reduce reliance on conventional generation. Comparing Germany's energy mix in 1990[14] with 2023[15] is a clear demonstration. By 2023, natural gas generation rose by about 10 percent of total generation,[16] but has remained relatively flat since 2019.[17] However, all renewable generation exceeds the combined generation of coal, nuclear and natural gas power plants – with, in 2023, 39 percent of variable solar and wind (on- and off-shore) and 43 percent of conventional resource generation.[18] Germany has also launched a comprehensive green hydrogen program to decarbonize industry.[19]

---

[14] German Federal Environment Agency. Electricity Generation According to Energy Technology. Retrieved April 30, 2024, from https://www.umweltbundesamt.de/sites/default/files/medien/384/bilder/dateien/3_abb_bruttostromerzeugung-et_2023-11-24.pdf

[15] The Energy Supply Annual Report. German Association of Energy and Water Industries (Dec.18, 2023), pp. 30-31. https://www.bdew.de/media/documents/Jahresbericht_2023_Foliensatz_final_18Dez2023_V2.pdf

[16] Compare *supra* notes 230 and 231.

[17] Energy Supply Annual Report, *supra* note 211.

[18] *Id.*

[19] Germany's National Hydrogen Strategy. Clean Energy Wire (July 26, 2023). https://www.cleanenergywire.org/factsheets/germanys-national-hydrogen-strategy

Table 1. Comparison of German Energy Mix between 1990 and 2023*

1990	% of energy mix	2023	% of energy mix
Coal	59	Coal	26
Nuclear	27	Nuclear	1
Natural Gas	6.5	Natural Gas	16
Renewables	3.6	Renewables	53

Source: EWG, derived from the German Association of Energy and Water Industries and the German Federal Environment Agency. *Does not include energy efficiency investments

Additional issues Duke Energy deems problematic in forecasting solar output are clouds and precipitation.[20] However, SolarGIS maps show Germany, a world leader in distributed solar, to appear to have 30 percent *less* solar potential than North Carolina.[21] Germany's solar deployment started primarily with residential solar – from the bottom up, not top down. Indeed, in 2023, Germany nearly doubled its capacity that was installed in 2022 – half of which was on rooftops, according to

[20] Appendix M, supra note 160, p. 8.
[21] SolarGIS, Solar source maps and GIS data for 200+ countries. Retrieved April 30, 2024, from https://solargis.com/maps-and-gis-data/download/germany and SolarGIS, Solar source maps and GIS data for 200+ countries. Retrieved April 30, 2024, from SolarGIS, Solar source maps and GIS data for 200+ countries. Retrieved April 30, 2024, from https://solargis.com/maps-and-gis-data/download/north-america

Balkan Green Energy News.[22] Moreover, about 70 percent of solar buildings also include battery storage.[23]

Q: IN YOUR OPINION, HAS DUKE HAS COMMITTED TO OFFSHORE WIND?

A: No. Duke Energy is unsure about offshore wind investment, though offshore wind turbines have operational experience and hurricane-resistant offshore turbines are in development. Not only does Duke Energy ignore off-the-shelf VPP technology in its plan and rely heavily on the questionable future of SMR technology, but Duke Energy also seems to hedge on offshore wind technology, for which there is operating experience. Additionally, a turbine design is being developed by NREL, partnering with the University of Virginia, the University of Texas at Dallas, the Colorado School of Mines, to withstand hurricane-force winds.[24] The two-bladed, downwind turbine has been tested on land, with a smaller turbine, and modeled up to 25 megawatts, but not yet tested at scale.[25] Gulf Wind Technologies and Shell

---

[22] Spasic', Vladamir, "Germany adds record 14 GW of solar in 2023 – half is on households." Balkan Green Energy News (Jan. 9, 2024). https://balkangreenenergynews.com/germany-adds-record-14-gw-of-solar-in-2023-half-is-on-households/#:~:text=The%20Federal%20Network%20Agency%2C%20the,in%202022%20(7.5%20GW)

[23] *Id.*

[24] "Scientists develop wind turbines resistant to hurricanes." EcoWatch (June 23, 2022). https://www.weforum.org/agenda/2022/06/scientists-develop-wind-turbines-resistant-to-hurricanes/

[25] Simpkins, Kelsey, "Inspired by palm trees, scientists develop hurricane-resistant wind turbines." University of Colorado Boulder (June 15, 2022). https://www.colorado.edu/today/2022/06/15/inspired-palm-trees-scientists-develop-hurricane-resilient-wind-turbines

New Energies may demonstrate a hurricane-resistant turbine in the Gulf of Mexico this year.[26]

Duke Energy appears serious about offshore wind, but also indicates, in its Supplemental Planning Analysis, only the *possibility* of offshore wind development. Duke Energy plans to request information from vendors about pricing and acquiring the technology that Duke Energy says, "will shape and define a future *potential acquisition of an offshore wind generating facility*…"[27] (Emphasis added). The company has also asked for $1.4 million to develop and administer this wind development proposal[28] that Duke Energy can keep even if it doesn't invest in offshore wind.

Q: IN YOUR OPINION, HOW DOES DUKE ENERGY'S CPIRP IMPACT NATURAL GAS PLANT CAPACITY?

A: Duke Energy is planning for more climate-change vulnerable natural gas plant capacity. In terms of the vulnerability of natural gas plants, the Commission noted in its investigation of the outages during Winter Storm Elliott that "the Public Staff explained that even minor inadequacies in winterization efforts could have major consequences and gave the example of an inch-wide gap in insulation, difficult to

[26] "Gulf Wind Technology and Shell to Collaborate on Offshore Wind Technology and Workforce Development for the Gulf of Mexico." Gulf Wind Technology (March 13, 2023). https://gulfwindtechnology.com/news/gulf-wind-technology-and-shell-to-collaborate-on-offshore-wind-technology/

[27] Planning Analysis, supra note 149, p. 53.

[28] Verified Amended Petition, supra note 154, p. 23.

see because the gap was beneath a control box, that contributed to a plant derate."[29] The margin of error in weatherizing natural gas plants against extreme cold is 1 inch. This does not assure resiliency of these power plants, as combined-cycle plant operation could be disrupted, or power output curtailed from extreme heat, drought, or flooding.

Q: PLEASE EXPLAIN DUKE'S SUPPORT FOR SMR TECHNOLOGY.

A: Despite unknown costs and poor chances for wide deployment, Duke Energy continues to support SMR technology. Duke Energy is absolutely committed to SMRs – apparently initially raised in its 2020 Climate report[30] – asserting, in its January verified amended petition for approval: "For the avoidance of doubt, however, all Pathways and Portfolios rely on adding breakthrough advanced nuclear SMRs as fundamental to the Companies' execution of the energy transition in the mid-2030s and to ultimately achieving carbon neutrality by 2050."[31] The amended CPIRP is fundamentally the same as the initial CPIRP n from August 2023, except, that a portion of proposed capacity additions is shifted from nuclear capacity to offshore wind. Interestingly, Duke Energy appears certain that SMRs

[29] Order Making Findings and Directing Actions Related to Winter Storm Elliott, NCUC Docket No. M-100, Sub 163 (Dec. 22, 2023), p.18. https://starw1.ncuc.gov/NCUC/ViewFile.aspx?Id=59ef1f1c-74d7-4b83-b24a-ffc775304203

[30] Duke Energy Climate Report. (2021), p. 5. https://www.duke-energy.com/-/media/pdfs/our-company/climate-report-2020.pdf?rev=49bbf0609086481fb190e75d9c09a29a

[31] Verified Amended Petition, supra note 154, p. 21.

will become available but appears to be hedging on offshore wind, for which there is, at least, operational experience.

Q: IN YOUR OPINION, WHICH SMR TECHNOLOGIES IS DUKE LIKELY WAITING ON?

A: Duke Energy expects the first 300-megawatt unit to be deployed by early 2034.[32] There are two reactor designs: the GE-Hitachi BWRX-300 unit and the TerraPower sodium fast-reactor, or Natrium Reactor. The Department of Energy ("DOE ") has committed $2 billion in taxpayer funds towards the Natrium project, with a preliminary price tag of $4 billion.[33]

Q: WHAT ARE YOUR RISK CONCERNS OF THE TERRAPOWER REACTOR DESIGN?

A: The TerraPower project harbors many risks, mainly for taxpayers, and could very end up ultimately terminated like NuScale's attempt to license its SMR unit. Nuclear power developers have the option of using the current combined construction and operating license process or the original process[34] that allows the

[32] Supplemental Direct Testimony of Glenn Snider, Michael Quinto, Thomas Beatty, and Ben Passty on Behalf of Duke Energy Carolinas, LLC and Duke Energy Progress, LLC, NCUC Docket No. E-100, Sub 190 (Jan. 31, 2024) p. 31. https://starw1.ncuc.gov/NCUC/ViewFile.aspx?Id=35832f96-86b1-488c-a4f2-b6730812031d

[33] Gardner, Timothy, "US says Gates-backed reactor company's planned application needs work." Reuters (March 22, 2024). https://www.reuters.com/business/energy/us-says-gates-backed-reactor-companys-planned-application-needs-work-2024-03-22/#:~:text=The%20U.S.%20Department%20of%20Energy,environmental%20issues%20for%20the%20reactor.

[34] 10 CFR 50. https://www.nrc.gov/reading-rm/doc-collections/cfr/part050/full-text.html

developer to begin construction, prior to submitting more detailed safety data. The Nuclear Regulatory Commission's ("NRC's") approval of the safety data allows the developer to obtain an operating permit.

TerraPower chose the two-step process,[35] which requires a far less detailed Preliminary Safety Analysis Report. TerraPower will hone the design and the analysis of potential accidents during construction. An applicant that chooses this approach only does so because the design has insignificant deficiencies and incomplete technical justification.

As the NRC describes the process:

> Final design information and plans for operation are developed during the construction of the nuclear plant. The applicant then submits an application to the NRC for an operating license. The application contains a final safety analysis report and an updated environmental report. The safety analysis report describes the plant's final design, safety evaluation, operational limits, anticipated response of the plant to postulated accidents, and plans for coping with emergencies.[36]

As such, many aspects of the TerraPower project will be undefined at the construction permit phase. The problem with the two-step process is that it is a "design-as-you-build" approach. The NRC explains:

> An advantage of the 10 CFR Part 50 process is that it supports beginning the licensing process and, if the applicant wishes, starting construction earlier in the design process (at the preliminary design stage) than would be required by 10 CFR Part 52. While offering

[35] *Submittal of the Construction Permit Application for the Natrium Reactor Plant, Kemmerer Power Station Unit 1*. TerraPower (March 28, 2024), p 1. https://www.nrc.gov/docs/ML2408/ML24088A060.pdf

[36] *Nuclear Power Plant Licensing Process*. NRC (July 2004), p. 4. https://www.nrc.gov/docs/ML0421/ML042120007.pdf

> some advantages, the 'design-as-you-build' approach introduces some project risks in the regulatory arena if the NRC imposes additional requirements as a condition of receiving an OL. This approach also provides less finality before making a significant financial investment in plant construction.[37]

Indeed, this licensing regulation stipulates, to obtain an operating permit, "safety features or components, if any, which require research and development have been described by the applicant and the applicant has identified, and there will be conducted, a research and development program reasonably designed to resolve any questions associated with such feature or components."[38] This results in R&D on unresolved safety issues conducted during construction. Additionally, the construction permit regulations do not require the applicant to describe the operational and emergency response programs of the plant. Those issues are included in the operating license application.[39]

A critically important issue that remains unresolved is the extent of the corrosive nature of sodium coolant on plant components. In 2021, the Oak Ridge National Lab issued a report on this issue for the NRC, stating:

> Compatibility of structural materials with liquid sodium is one of the most important aspects of the safety and lifetime of sodium fast nuclear reactors (SFRs). This report reviews relevant and publicly available knowledge on the interaction between sodium chemistry and thermodynamics with structural materials… In general, there is a clear need for better predictive capabilities for sodium compatibility and long-term performance, which would avoid

---

[37] *A Regulatory Review Roadmap For Non-Light Water Reactors*. NRC (ML17312B567) (December 2017), p. 16. https://www.nrc.gov/docs/ML1731/ML17312B567.pdf

[38] 10 CFR 50.35. https://www.nrc.gov/reading-rm/doc-collections/cfr/part050/part050-0035.html

[39] NRC, supra note 180.

> extended experimental campaigns for new materials; design changes; and transient, off normal, or accident conditions.[40]

Notably, incessant redesign of the SMR unit, which led to surging costs and safety concerns, ultimately sunk the NuScale project.[41]

In terms of the licensing process, TerraPower submitted a report in August 2023 that proposed a methodology to determine the source term (understanding the amount of radiation that can be released from the reactor during each accident scenario) prior to submitting a construction license. In November, NRC staff found deficiencies in the report. TerraPower resubmitted an updated report in January. NRC plans to finish its analysis of the report by November 2024.[42] At the end of March, TerraPower submitted an application for construction.[43]

Q: WHAT ARE YOUR RISK CONCERNS OF THE GE-HITACHI REACTOR DESIGN?

[40] Romedenne, Marie, Pint, Bruce, *Corrosion in Sodium Fast Reactors*. Oak Ridge National Lab (TLR-RES/DE/CIB-CMB-2021-07) (May 2021), p. 45. https://www.nrc.gov/docs/ML2111/ML21116A231.pdf

[41] Smith, Grant, Lacy, Anthony, "Small size, big problems: Nuscale's troublesome small modular reactor plan." EWG (July 11, 2023.) https://www.ewg.org/news-insights/news/2023/07/small-size-big-problems-nuscales-troublesome-small-modular-nuclear#:~:text=NuScale%20has%20increased%20by%2050,catastrophic%20breakdown%20and%20radiation%20leak.

[42] Brusselmans, Roel, "Radiological Source Term Metho., Revision 1 (L-2023-TOP-0046)."
Received by George Wilson, March 7, 2024. https://www.nrc.gov/docs/ML2406/ML24067A069.pdf

[43] TerraPower, *supra* note 179.

A: The GE-Hitachi began the NRC licensing process for its BWRX-300 SMR unit in late 2019[44] and is in a licensing process in Canada. Nuclear expert M.V. Ramana, Simons Chair in Disarmament, Global and Human Security at the School of Public Policy and Global Affairs, University of British Columbia, is skeptical of the success of GE-Hitachi's design. He wrote in 2022, referencing the BWRX-300, that even if GE-Hitachi does not make changes in its SMR design during the Canadian licensing process "there will be the inevitable delays (and cost escalations) during construction."[45] _EWG also investigated the licensing process for the BWRX-300 unit. The Canadian and US licensing processes for the GE-Hitachi SMR are on parallel courses. Ontario Power Generation claims that it will have a unit online by 2029.[46] Tennessee Valley Authority is also planning to build a BWRX-300 reactor at the Clinch River site, which is projected to begin operation in 2032.[47]

---

[44] "GE Hitachi Nuclear Energy Begins NRC Licensing Process for BRWX-300 Small Modular Reactor." GE (Press Release) (Jan. 30, 2020). https://www.ge.com/news/press-releases/ge-hitachi-nuclear-energy-begins-nrc-licensing-process-for-bwrx-300-small-modular

[45] M.V. Ramana, "Slow deployment, safety hazards make SMRs a poor climate solution." NB Media Co-op. (Aug. 2, 2022). https://nbmediacoop.org/2022/08/02/slow-deployment-safety-hazards-make-smrs-a-poor-climate-solution/

[46] Ontario Power Generation, OPG's Darlington Small Modular Reactor project passes significant milestone. Retrieved May 1, 2024, from https://www.opg.com/stories/opg-darlington-small-modular-reactor-project-passes-significant-milestones/#:~:text=OPG%20has%20commenced%20site%20preparation,commercial%20operation%20starting%20in%202029

[47] Patel, Sonal, "TVA Unveils Major New Nuclear Program, First SMR at Clinch River Site." Power Magazine (Feb. 10, 202). https://www.powermag.com/tva-unveils-major-new-nuclear-program-first-smr-at-clinch-river-site/

Canada and the US signed an MOU "that allows the companies to coordinate efforts on the design, licensing, construction, and operation of SMRs. CNSC and USNRC are currently engaged in licensing and pre-application activities with OPG and TVA, respectively," and have signed several cooperative agreements.[48] The multinational design evaluation program was initiated in 2008 as an attempt to harmonize the licensing process between countries and to "improve the efficiency and the effectiveness of the design review process, aiming at increased convergence of regulatory practices."[49] Although each country relies on its own standards, the agreement is intended to prevent significant deviation of the design from country to country and to reduce duplication of technical reviews. This is important to US nuclear proponents and policymakers, who see the Darlington project as the first-of-a-kind BWRX deployment.

In 2019, GE initiated pre-application activities with the NRC around the BWRX-300 design. These activities involve meetings and submission of licensing topical reports ("LTRs"). Unlike safety topical reports, which focus on specific technical and safety approvals, the LTR seek approval of the licensing approach for the BWRX-300. NRC approval means the applicant has known methods, analysis, and

---

[48] *Joint Report on GEH BWRX-300 Safety Strategy White Paper: A Collaborative Review by the U.S. Nuclear Regulatory Commission and the Canadian Nuclear Safety Commission*. NRC (ML23135A151) (July 2023), p 1. https://www.nrc.gov/docs/ML2313/ML23135A151.pdf

[49] *Multinational Design Evaluation Programme 2008 Annual Report*. Nuclear Energy Agency (June 2009), p. 2. https://www.oecd-nea.org/mdep/annual-reports/MDEP-Annual-Report-2008.pdf

tests to demonstrate compliance with the appropriate safety regulations for licensing. These topical reports do not provide generic resolution of safety issues. The NRC has approved several topical reports, but there are many remaining.[50] In the US, GE-Hitachi is also expected to use the original licensing process,[51] applying for a construction license separately from the operating license. However, GE-Hitachi is still early in the NRC licensing process compared to Canada, where GE has submitted a construction authorization.[52] In 2023, GE requested a readiness assessment of a LTR to cover safety strategy.[53] It does not appear that GE has submitted the LTR for this topic. Given the progress in the Canadian licensing process and the hope of avoiding design changes at the NRC, it is my opinion the US government is content to wait for the design to be tested in Canada before attempting deployment in the US. Given the wait-and-see-approach and the typical

[50] U.S. NRC, Pre-Application review of Topical Reports associated with the BRWX-300 water cooled, natural circulation small modular reactor (SMR) with passive safety features. Retrieved May 1, 2024, from https://www.nrc.gov/reactors/new-reactors/smr/licensing-activities/pre-application-activities/bwrx-300.html

[51] U.S. NRC, *supra* note 179, p. 6.

[52] *Written Submission from Ontario Power Generation Inc. In the Matter of the Ontario Power Generation Inc: Applicability of the Darlington New Nuclear Project Environmental Assessment and Plant Parameter Envelope to Selected Reactor Technology.* Canadian Nuclear Safety Commission (CMD 24-H2.1) (Sept 18, 2023), p. 3. https://api.cnsc-ccsn.gc.ca/dms/digital-medias/CMD24-H2-1.pdf/object?subscription-key=3ff0910c6c54489abc34bc5b7d773be0

[53] Jardenah, Mahmoud, "Pre-Submittal Readiness Assessment Engagement Plan for Draft Safety Strategy LTR (NEDC-33934P)." Received by George Watkins (GE Vernova), Jesus Diaz-Quiroz (GE Vernova), June 15, 2023. https://www.nrc.gov/docs/ML2316/ML23166A876.pdf

delays in the licensing process and construction, the 2032 date projected by TVA for bringing its first BWRX-300 unit online seems extremely unlikely.

What this means for Duke Energy is if construction of the SMR in Canada, if constructed at all, is pushed into the mid-2030s that will also postpone Duke Energy's construction schedule. Provided, however, that Duke Energy adheres to the "pledge" it made in the 2022 carbon plan proceeding to be a "second mover" of SMR technology.[54]

Q: IN YOUR OPINION, SHOULD SMRS BE EXPECTED TO ADDRESS CLIMATE CHANGE AND BE COST-EFFECTIVE ADDITIONS TO DUKE'S SYSTEM?

A: No. SMRs fail the main argument for new nuclear units. Given the long lead-times, nuclear experts have found that SMRs will do nothing to address climate change, as the technology is too little, too late.[55] We find that, for SMRs generally, EWG's expert witness 2022 testimony for the previous carbon plan is still relevant:

> Based on a variety of factors, no reliance should be placed on SMRs and non-light-water advanced nuclear energy technologies to achieve the decarbonization goals of HB 951. They are costly; their schedules are likely to be delayed relative to the dates in Duke

---

[54] *Order Adopting Initial Carbon Plan and Providing Direction for Future Planning*, NCUC Docket No. E100, Sub 179 (Dec. 30, 2022), p. 95 https://starw1.ncuc.gov/NCUC/ViewFile.aspx?Id=7b947adf-b340-4c20-9368-9780dd88107a

[55] Makhijani, Arjun, M.R. Ramana, "Can small modular reactors mitigate against climate change?" Bulletin of Atomic Scientists (July 21, 2021). https://thebulletin.org/premium/2021-07/can-small-modular-reactors-help-mitigate-climate-change/

Energy's portfolios; and the risks and uncertainties involved are far too large to even put reliable upper limits on costs and delays.[56]

In addition, a 2015 analysis of the learning curves of various generation technologies found that nuclear power was the only technology where costs continually increased from generation to generation.[57]As for the expected costs of SMRs, an October 2023 analysis of SMR technology, including the BRWX-300, concluded:

> Based on a large-scale Monte Carlo analysis of potential net present values (NPVs) and levelized costs of electricity (LCOE), we find that SMR concepts do not seem to be an economic alternative to existing low-carbon technologies during our design lifetime simulation using the most favorable parameter values based on the literature. Even when using the *overly optimistic manufacturer-advertised construction costs* in the simulation, the majority of examined SMR concepts cannot deliver a positive NPV. The variance in the simulations can be in the largest part explained by the variance of the investment costs and the WACC, whereas the load factor and the electricity price play a minor role.[58]
>
> (Emphasis added).

In 2023, Wood McKenzie estimated the first of a kind SMR to be anywhere from $6,000,000 to $8,000,000 per megawatt – adding, "[w]e believe that FOAK costs

---

[56] Direct Testimony of Arjun Makhijani, PhD, on Behalf of Environmental Working Group, NCUC Docket No. E-100, Sub 179 (Sept. 2, 2022), p. 30. https://starw1.ncuc.gov/NCUC/ViewFile.aspx?Id=7d950a20-80ec-4d51-982d-11d5a881e9e9

[57] Rubin, Edward, Azevedo, Ines, Jaramillo, Paulina, Yeh, Sonia, *A review of learning rates for electricity technologies*. Energy (2015). https://www.sciencedirect.com/science/article/pii/S0301421515002293

[58] Steigerwald, Bjoern, Weibezahn, Jens, Slowik, Martin, von Hirschhausen, Christian, *Uncertainties in estimating the future costs of nuclear technologies: A model-based analysis of small modular reactors*. Energy (Oct. 15, 2023), pp. 9, 10. https://www.sciencedirect.com/science/article/pii/S0360544223015980

will be at the high end of this range, and could be even higher, as developers build out early-stage projects."[59] At this projected generic high end – and experience tells us that it costs will be much higher – Duke Energy's 300 megawatt BRWX-300 or the TerraPower unit, not counting the proposed molten salt storage system, would cost more than $2 billion plus profit margin – with no positive learning curve in sight. Duke Energy seeks a total of 3,600 megawatts of SMRs by 2043,[60] essentially tight 9-year buildout plan, costing billions more - equivalent to 3 large nuclear units that would take more than a decade or two to construct and bring online.

Q: CAN YOU DISCUSS HOW SMRS ARE VULNERABLE TO CLIMATE CHANGE IMPACTS?

A: SMRs are vulnerable to flooding.[61] They also use water to create steam to generate electricity,[62] so are vulnerable to periods of extreme heat and drought.

The Union of Concerned Scientists recently updated its SMR perspective, stating:

> *[T]he so-called passive safety features that SMR proponents like to cite may not always work, especially during extreme events such as large earthquakes, major flooding, or wildfires that can degrade the environmental conditions under which they are designed to operate.*

---

[59] *The Nuclear Option: Making nuclear power viable in the energy transition.* Wood MacKenzie (May 2023), p. 8. https://storage.pardot.com/131501/1683787920TDeRmpBv/Wood_Mackenzie_Thought_Leadership_Horizons_The_Nuclear_Option.pdf

[60] Supplemental Director Testimony of Snider et al, *supra* note 75, pp. 30, 31.

[61] *Lyman, Ed, Small Isn't Allows Beautiful: Safety, Security, and Cost Concerns about Small Modular Reactors.* UCS (Sept. 2013), p. 10. https://www.ucsusa.org/sites/default/files/2019-10/small-isnt-always-beautiful.pdf

[62] Natrium Cooling Water Availability: a TerrePower & GE-Hitachi technology. (2023). https://adamswebsearch2.nrc.gov/webSearch2/main.jsp?AccessionNumber=ML23345A038 and BRWX-300 small modular reactor. Retrieved April 30, 2024, from https://www.gevernova.com/nuclear/carbon-free-power/bwrx-300-small-modular-reactor

> And in some cases, passive features can actually make accidents worse: for example, the NRC's review of the NuScale, light-water design revealed that that passive emergency systems could deplete cooling water of boron, which is needed to keep the reactor safely shut down after an accident.[63]
>
> (Emphasis added).

SMRs will use substantial amounts of water if they manage to be deployed and operate on a consistent basis. A nuclear expert addressing SMRs has explained that "[a] single 300 MW reactor operating at 90 percent capacity factor would withdraw 160 million to 390 million gallons of water *every day*."[64] (Emphasis added).

Q: CAN YOU DISCUSS HOW DUKE ENERGY'S CPIRP IMPACTS THE STATE'S NUCLEAR POWER?

A: Duke Energy plans to sink more dollars into its climate-exposed, existing nuclear power plants. Duke Energy's plans for increasing the capacity of their existing nuclear power plants will also be highly costly to ratepayers. Duke Energy estimates these costs through 2031 to be more than $1.4 billion.[65]

---

[63] Lyman, Ed, "Five Things The "Nuclear Bros" Don't Want You To Know About Small Modular Reactors." UCS (April 30, 2024). Retrieved April 30, 2024, from https://blog.ucsusa.org/edwin-lyman/five-things-the-nuclear-bros-dont-want-you-to-know-about-small-modular-reactors/

[64] Makhijani, Arjun, PhD, M.R. Ramana, PhD, "Why small modular reactors won't help counter climate change." EWG (March 25, 2021). https://www.ewg.org/news-insights/news/why-small-modular-nuclear-reactors-wont-help-counter-climate-crisis

[65] Duke Energy, Carbon Plan *Appendix J Nuclear*, p. 8. https://starw1.ncuc.gov/NCUC/ViewFile.aspx?Id=ecc4438a-8a50-4c00-93b6-7331ff5c4c82

3. ISSUE 13 - ENSURING RELIABILITY AND OPERATIONAL RESILIENCE

Q: HOW DOES THE STATE OF NORTH CAROLINA TREAT RESILIENCY AND RELIABILITY?

A: North Carolina acknowledges the importance of electric system reliability and that DERs are key to achieving it. However, neither resiliency nor DERs have been lent the same level of importance as reliability within the Commission's regulatory regime. This is a fatal flaw in state policy that has led to continued emphasis on utility-scale options and that will leave the state unable to achieve "real reliability." As is historically the case, the State of North Carolina considers reliability and resiliency two distinct concepts, underscoring DERs to achieve resiliency and provide financial benefits to "all customers." In addition, reliability, in state statute, is front and center with respect to the Commission's regulatory authority while resiliency is relegated to a "may" provision for the Commission to consider in a limited context. Furthermore, the State Energy office, which has no jurisdiction over monopoly utilities, housed in the Department of Environmental Quality ("DEQ") was tasked with reporting on the concept of resiliency and surveying how the electric system is evolving.

In 2019, the DEQ's State Energy Office released the North Carolina Clean Energy Plan report. Importantly, the DEQ considers "decentralization" of the electric system as one of the "key drivers of power sector transformation."[66] The other key drivers - digitization, decarbonization, and (economic) "development"- all relate to decentralization.[67] Decentralization, in turn, is key to greater system resiliency, according to DEQ.[68]

Although the DEQ refers to VPPs only a single time in the report, the agency makes observations critical to elevating DERs as at least an equal partner with utility-scale resources that: (1) debunk the utility mantra that customers with solar and storage shift cost to those without, (2) tie DERs to enhance system resilience, and (3) urges expansion of cost-benefit analyses to include resilience, among other important benefits.

Q: COULD YOU PLEASE EXPLAIN WHY THE CONCEPT OF RESILIENCY HAS EMERGED AS CRITICALLY IMPORTANT FOR THE NORTH AND SOUTH CAROLINA ELECTRIC SYSTEMS?

A: Resiliency is the most important concept nationwide around which to design the electric grid. System reliability can no longer be a separate concept from system resiliency, as traditionally treated. To achieve a functional, more weather-resistant and affordable electric system, they must become inextricably intertwined as a matter of unavoidable reality. Climate change is the driving force behind this

---

[66] *North Carolina Clean Energy Plan: Transitioning to a 21st Century Electricity System.* State Energy Office, (Oct. 2019), p. 29 https://files.nc.gov/ncdeq/climate-change/clean-energy-plan/NC_Clean_Energy_Plan_OCT_2019_.pdf
[67] *Id.*, p. 29.
[68] *Id.*, p. 35.

necessity. If Duke Energy's business model continues to prevail in carbon plan proceedings, climate change has and will continue to exact outsized increasing economic impacts on the North and South Carolina economies and attendant rate impacts on ratepayers.

Currently, reliability and resiliency are treated as two separate concepts. Reliability is having an electric system stable enough to provide 24/7 service virtually all the time, including enough reserve margin to meet peak demand. Resiliency is the ability of the system to recover quickly after disruptions from, for instance, severe weather. The electric system must be designed to achieve reliability and resilience simultaneously, which requires that DERs be considered commensurate with utility-scale resources. This is important given the fragility of the bulk power system, including conventional, utility-scale power plants, to climate disruptions.

Q: CAN YOU PLEASE DESCRIBE DUKE'S APPROACH TO RESILIENCY AND RELIABILITY?

A: Duke Energy's approach to resiliency is to expand on its reliance on utility-scale resources that are vulnerable to climate change impacts. As noted, the sprawling transmission and interstate gas pipeline system are vulnerable to extreme weather and flooding. Duke Energy intends to add significant natural gas capacity to its system, rely on additional interstate pipelines, maintain its existing nuclear fleet, and wait on yet-to-materialize SMR technology.

Q: HOW HAS CLIMATE CHANGE MADE THESE CONCEPTS SO CLOSELY LINKED?

A: The impacts of climate change in terms of the costs of outages and threats to public well-being demonstrate that reliability cannot be achieved without a resilient power system. It is next to impossible to believe that the utility sector was unaware of the growing concerns of scientists with respect to the emerging negative impacts of climate change.

A much greater balance must be struck between utility-scale and distributed energy resource investments. Climate change has and will continue to impact the NC electric system, and the impacts are expected to worsen. Weather is expected to become less predictable from season to season, and the potential for severe weather becoming practically a year-round phenomenon will make planned outages for power plant maintenance and refueling more difficult to gauge. Specifically, the Brunswick Nuclear Plant poses a significant risk for severe accidents from hurricanes, given its proximity to the coast.

Q: DOES THE STATE OF NORTH CAROLINA RECOGNIZE CLIMATE CHANGE AS A THREAT TO THE OPERATION OF THE ELECTRIC SYSTEM?

A: Yes. The 2020 NC DEQ report on resiliency includes *Climate Hazards Facing North Carolina*,[69] all of which are or will impair the bulk power system.

The findings show that conventional fossil and nuclear plants will continue to be compromised during increasing drought, heavy precipitation, and hurricanes from

[69] NC DEQ, supra note 30, p. 1-3.

climate disruptions. Burying transmission lines to protect the system may be difficult due to projected increases in coastal and inland flooding. In our estimation, the Brunswick nuclear plant, due to expected increasing coastal flooding, erosion, storm surges, and saltwater intrusion, should be decommissioned within the next 10 years.

Specifically, the 2020 report listed the following climate hazards that will increase in severity over time:

- "More intense droughts in the future due to climate change are likely… which will lead to [stress] on thermoelectric plant cooling," which can cause derates or outages.
- "Heavy precipitation accompanying hurricanes and other weather systems is likely to increase" which subjects "[e]nergy infrastructure located along inland watersheds and coastal areas… to changes in river discharge and flooding from heavy precipitation events."
- "It is virtually certain that sea level along the North Carolina coast will continue to rise due to expansion of ocean water from warming and melting of ice on land" which "will lead to an increase in storm surge flooding in coastal North Carolina."
- "Intensity of the strongest hurricanes is likely to increase with warming of the oceans and atmosphere, leading to … flooding and precipitation."
- "Increases in extreme precipitation is likely to increase inland flooding in North Carolina."

- "Saltwater [i]ntrusion… due to sea level rise."
- "Higher average temperatures and more severe droughts will lead to an increased likelihood of conditions conducive to wildfires,"[70] which could impact solar generation as well as the transmission system.

Q: CAN YOU PLEASE DISCUSS THE CONTINUED IMPACTS OF CLIMATE CHANGE ON POWER SYSTEMS?

A: Duke Energy is aware of climate change; however, the company has continually suppressed the distributed energy market, focusing instead on utility-scale options. Climate change has had and will have continued impacts on the bulk power system, and such impacts are "growing in frequency, duration, or intensity…," according to Climate Central.[71] The Federal Reserve concurs.[72]

Indeed, Spencer Weart, a historian and retired director of the Center for History of Physics at the American Institute of Physics in College Park, Maryland, recently observed, "[s]cientists first began in 1988 to insist that real action should be taken."[73] In response to the growing concern with climate change, the UN created

---

[70] *Id.*, p. 1-3 – 1-6.

[71] *Surging Power Outages and Climate Change,* Climate Central, (Sept. 14, 2022), p. 1. https://assets.ctfassets.net/cxgxgstp8r5d/73igUswSfOhdo7DUDVLwK7/bb0a4e95e1d04457e56106355a1f74b9/2022PowerOutages.pdf

[72] Analyzing State Resilience to Weather and Climate Disasters. *Board of Governors of the Federal Reserve System.* Retrieved April 29, 2024, from https://www.federalreserve.gov/econres/notes/feds-notes/analyzing-state-resilience-to-climate-change-20230907.html

[73] Pester, Patrick, "When did scientists first warn humanity about climate change?" *Live Science*, (Dec. 12, 2021). https://www.livescience.com/humans-first-warned-about-climate-change

the Intergovernmental Panel on Climate Change, or IPCC that, at the time, predicted increasingly severe weather.[74] It has been established that ExxonMobil knew, through its own climate modeling, that global temperatures would increase but misled the public about the existence of climate change.[75] The predictions of the oil industry and climate scientists were decidedly accurate, with the bulk power system being particularly vulnerable to severe weather.

The National Centers on Environmental Information, housed at the National Oceanic Atmospheric Administration, or NOAA, puts an increasingly hefty price tag on weather-related events over the last 40 years. In its survey of billion-dollar weather events, NOAA shows increasing costs, adjusted according to the consumer price index, from climate change in the US from the 1980s through the 2010s, increasing steadily at $214.6 billion from 1980 to 1989 to $972.5 billion from 2010 to 2019.[76] The costs from severe weather in 2023 alone was $93 billion.[77] As early as 2012, the Congressional Research Service found that various studies estimated

[74] "Climate Change History." History.com, (June 9, 2023). https://www.history.com/topics/natural-disasters-and-environment/history-of-climate-change

[75] Rannard, Georgina, "Exxon Mobil: Oil giant predicted climate change in the 1970s – Scientists." BBC, (Jan. 12, 2023). https://www.bbc.com/news/science-environment-64241994

[76] Billion-Dollar Weather and Climate Disasters. *National Oceanic and Atmospheric Administration.* Retrieved March 29, 2024, from https://www.ncei.noaa.gov/access/billions/summary-stats/US/2000-2024

[77] *Id.* https://www.ncei.noaa.gov/access/billions/summary-stats/US/2023

the cost to the US economy of power outages was $20 to $55 billion annually.[78] The weather-related costs NOAA tracked include flooding, drought, freeze, severe storms, winter storms, hurricanes, and wildfires – all of which negatively impact the bulk power system. The 2022 Climate Central analysis shows a 78 percent increase in "weather-related power outages" in the previous decade compared to 2000 to 2010.[79] Besides hurricanes and drought-driven wildfires, the last decade has seen an escalation in severe winter storms and temperatures impacting the bulk power system, with 5 events in 11 years causing "unplanned cold-weather related outages…," according to the Federal Energy Regulatory Commission, or FERC.[80] Duke Energy has been referencing climate change at least since 2007 as a potential business risk – either considering it as a potential regulatory cost[81] or hemming and

---

78 Weather-Related Power Outages and Electric System Resiliency. Congressional Research Service, (August 28, 2012), Summary. https://crsreports.congress.gov/product/pdf/R/R42696

79 Climate Central, supra note 1, p. 3.

80 Inquiry into Bulk-Power System Operations During December 2022 Winter Storm Elliott: FERC, NERC, and Regional Entity Staff Report. Federal Energy Regulatory Commission and North American Electric Reliability Corporation, (Oct. 2023), p. 5. https://www.ferc.gov/news-events/news/ferc-nerc-release-final-report-lessons-winter-storm-elliott

81 Duke Energy Corporation, *2007 Form 10-K*, p. 30. https://www.sec.gov/Archives/edgar/data/1326160/000119312507044568/d10k.htm#tx92233_15

hawing over the future impacts.[82] Notably, not until its 2016 annual report did Duke Energy acknowledge the actual risks to its bulk power system.[83]

Q: CAN YOU PLEASE EXPLAIN WHAT GRID RESOURCES HAVE BEEN IMPACTED MOST SEVERELY BY CLIMATE DISRUPTIONS?

A: Hurricanes impact the bulk power system primarily with downed transmission and distribution system lines. Extreme winter weather impacts primarily conventional fossil generation.

Q: PLEASE DISCUSS HOW CLIMATE CHANGE IMPACTED THE CAROLINAS BULK POWER SYSTEMS.

A: In a report on resiliency funded by the federal government and published by the North Carolina Department of Environmental Protection, or DEP, the state noted that North Carolina is second in the country for "electric power service interruptions…"[84] On average, from 2009 to 2019, the report found that North Carolina had 3 hurricanes per year, 55 flooding events per year, 41 winter storms and extreme cold events.[85]

---

[82] Duke Energy Corporation, *2013 Annual Report and Form 10-K*, p. 57. https://www.annualreports.com/HostedData/AnnualReportArchive/d/NYSE_DUK_2013.pdf

[83] Duke Energy Corporation, *2016 Annual Report and Form 10-K*, p. 19 https://www.annualreports.com/HostedData/AnnualReportArchive/d/NYSE_DUK_2016.pdf

[84] *Bipartisan Infrastructure Law - SECTION 40101(d): Preventing Outages and Enhancing Resiliency of the Electric Grid (Proposed Program Narrative)*. North Carolina State Energy Office, (March 31, 2023), p. 1.

[85] *Id.*, p. 2.

From 1980 through 2023, North Carolina incurred $50 to $100 billion in damages from weather/climate-related severe weather in billion-dollar events, according to NOAA. Fifty percent of those damages occurred from 2010 to 2019 and more than 7 percent from 2019 through 2023.[86] Nearly 84 percent of damages from 2010 through 2023 were caused by hurricanes.[87] The Federal Reserve reports that weather and climate disaster costs accounted for more than 26 percent of cumulative state revenue for the Carolinas, essentially Duke Energy territory, from 2012 to 2021 – nearly 15 percent of state revenue for North Carolina and more than 11.5 percent of state revenue for South Carolina.[88]

Hurricanes, with attendant torrential rain and flooding, have also taken a toll on the bulk power system in the Carolinas. The more severe storms resulted in customers without power for weeks. A few examples of hurricane impact on the Carolinas includes:

- Hurricane Florence, 2018
    - Damages: $24 billion for the Carolinas[89]
    - Customers without power: 1.1 million in North Carolina[90]
- Hurricane Michael, 2018

[86] Billion-Dollar Weather and Climate Disasters. *National Oceanic and Atmospheric Administration*. Retrieved March 29, 2024, from https://www.ncei.noaa.gov/access/billions/summary-stats/NC/2010-2024
[87] *Id.*
[88] NOAA, supra, note 6.
[89] "Report: Hurricane Florence killed 122, caused $24 billion in damage." *AP,* (May 3, 2019). https://apnews.com/weather-general-news-a19e36ba2b2c49949d3e247cf7ea9896#
[90] *Id.*

- Damages: $22 million[91]
- Customers without power: 500,000[92]

- Hurricane Matthew, 2016
  - Damages: $4.8 billion[93]
  - Customers without power: 1.2 million in the Carolinas,[94] nearly 815,000 in North Carolina[95]
- Hurricane Dorian, 2019
  - Damages, $1.2 billion[96] (majority in North Carolina)
  - Customers without power: 200,000 in North Carolina[97]

---

91 Davis, Corey, "How Howling Hugo Became the Western Piedmont's Worst Hurricane." *North Carolina State Climate Office*, (Sept 23, 2019). https://climate.ncsu.edu/blog/2019/09/how-howling-hugo-became-the-western-piedmonts-worst-hurricane/

92 "Hurricane Michael caused 1.7 million electricity outages in the Southeast United States." *Energy Information Administration*, (Oct. 22, 2018). https://www.eia.gov/todayinenergy/detail.php?id=37332

93 *Overview of the Hurricane: Preparation, Response, and Recovery*. North Carolina State Energy Council, (Feb. 20, 2019), p. 21. https://www.deq.nc.gov/energy-mineral-and-land-resources/energy/energy-policy-council/epc-presentation-2-20-2019/download

94 "Utilities double efforts to restore power to thousands in NC." *WRAL News*, (Oct. 10, 2016.) https://www.wral.com/story/matthew-s-floods-close-north-south-lifeline-i-95/16102638/

95 Jamieson, Alistair, "500 rescued from North Carolina Floods as Matthew churns on." *CNBC*, (Oct. 9, 2016). https://www.cnbc.com/2016/10/09/500-rescued-from-north-carolina-floods-as-matthew-churns-on.html

96 *Effects of Hurricane Dorian in the Carolinas*. Wikipedia. Retrieved April 29, 2024, from https://en.wikipedia.org/wiki/Effects_of_Hurricane_Dorian_in_the_Carolinas#:~:text=The%20hurricane%20left%20%241.2%20billion,direct%20deaths%20in%20South%20Carolina

97 Nirappil, Fenit, Kaplan, Sahra, Berman, Mark, "Hurricane Dorian crashes into Outer Banks in North Carolina." Washington Post, (Sept 6, 2019).

- Hurricane Ian, 2022
  - Damages: We estimate between $2 to $4 billion range in the Carolinas[98]
  - Customers without power: 578,000 in North Carolina; 378,000 in South Carolina[99]

Indeed, as a recent North Carolina state report on climate risk notes: "Moody's, one of the big three credit rating agencies worldwide, has acquired a climate data company and recently identified Duke Energy as one of the nation's top utilities at risk from hurricanes due to climate change."[100] The North Carolina electric system is also susceptible to winter storms and extreme low temperatures. During Winter Storm Elliott in December 2022, Duke Energy experienced forced outages of nearly 1,600 megawatts of its North and South Carolina capacity due to unusually cold temperatures.[101]

---

https://www.washingtonpost.com/national/hurricane-dorian-crashes-into-outer-banks-in-north-carolina/2019/09/06/75a7936c-d0b3-11e9-87fa-8501a456c003_story.html

[98] Bucci, Lisa, Alaka, Laura, Hagen Andrew, Delgado, Sandy, Beven, Jack, National Hurricane Center Tropical Cyclone Report: Hurricane Ian. National Hurricane Center (AL092022) (April 3, 2023), pp. 13, 14. https://www.nhc.noaa.gov/data/tcr/AL092022_Ian.pdf

[99] *Id.*, p. 14.

[100] *Climate Risk and Resiliency Plan: Impacts, Vulnerability, Risks, and Preliminary Actions; A Comprehensive Strategy for Reducing North Carolina's Vulnerability to Climate Cha*nge. North Carolina Department of Environmental Quality, (June 2020). https://files.nc.gov/ncdeq/climate-change/resilience-plan/2020-Climate-Risk-Assessment-and-Resilience-Plan.pdf

[101] *Order Making Findings and Directing Action Related to Winter Storm Elliott*, Docket No. M-100, Sub 163 (Dec. 22, 2023), pp. 23-25. https://starw1.ncuc.gov/NCUC/ViewFile.aspx?Id=59ef1f1c-74d7-4b83-b24a-ffc775304203

That does not count the nearly 2,800 megawatts in forced outages not related to the storm and an additional 1,656 megawatts of planned outages, including the 759-megawatt Robinson nuclear plant.[102] In all, this more than 6,000 megawatts of power plant capacity not providing service when sorely needed represented nearly 20 percent of Duke Energy's entire power plant capacity in the Carolinas.[103]

The Alaska Beacon reports, with respect to Winter Storm Elliott, "[i]n North Carolina, where about 500,000 Duke Energy customers for the first time ever had service cut to save the broader electric grid, company executives told the state's public utility commission… that the company thought it had adequate reserve power to weather the storm."[104]

Q: IN YOUR OPINION, IS HARDENING THE BULK POWER SYSTEM ALONE A SOLUTION TO CLIMATE CHANGE IMPACTS?

A: No. The bulk power system infrastructure has proven itself highly vulnerable to hurricane-force winds. With respect to hurricanes in North Carolina, high winds

---

[102] Id., pp. 20, 21.

[103] "Duke Energy files updated Carbon Plan to serve the growing energy needs of a thriving North Carolina. Duke Energy," (Aug. 17, 2023). https://investors.duke-energy.com/news/news-details/2023/Duke_Energy-Energy-files-updated-Carbon-Plan-to-serve-the-growing-energy-needs-of-a-thriving-North-Carolina/default.aspx#:~:text=Duke Energy%20Energy%20Progress%20owns%2012%2C500,North%20Carolina%20and%20South%20Carolina

[104] Zullo, Robert, "How did renewables fare during Winter Storm Elliott." Alaska Beacon, (Jan., 30, 2023). https://alaskabeacon.com/2023/01/30/how-did-renewables-fare-during-winter-storm-elliott/

causing trees to damage power lines have been the predominant reason for outages.[105]

Flooding has also hampered restoring power to customers, as submerged powerlines pose electrocution threats.[106] Hardening the transmission system may prove increasingly ineffective as climate disruptions progress. For instance, Raleigh-based WRAL News reported that, among the transmission lines damaged by Hurricane Matthew, were those "built to sustain the high winds of a hurricane."[107] Burying power lines may help, but there are issues with that approach as well, as the buried lines are vulnerable to flooding and damaged lines may be more difficult to locate and repair.[108] Greater storm surges, which are expected to

[105] *See*, e.g., Davis, Corey, "Rapid Reaction: Michael Whips Up Winds and Widespread Damage." North Carolina State Climate Office, (Oct. 12, 2018). https://climate.ncsu.edu/blog/2018/10/rapid-reaction-michael-whips-up-winds-and-widespread-damage/ and WRAL News, supra note 24, and "Florida and Carolinas count the cost of Hurricane Ian." *DW*, (Oct. 1, 2022). https://www.dw.com/en/florida-carolinas-count-the-cost-of-hurricane-ian/a-63308308 and Stewart, Stacy R., Berg Robbie, National Hurricane Tropical Cyclone Report: Hurricane Florence. National Hurricane Center (AL062018) (Sept. 25, 2019), pp. 10-12. https://www.nhc.noaa.gov/data/tcr/AL062018_Florence.pdf

[106] "Duke Energy reports 96 percent of Hurricane Matthew outages restored; those who can receive power will be restored by Saturday night." *Duke Energy*. (Press Release) (Oct 14, 2016). https://news.duke-energy.com/releases/duke-energy-reports-96-percent-of-hurricane-matthew-outages-restored;-those-who-can-receive-power-will-be-restored-by-saturday-night

[107] WRAL News, *supra* note 24.

[108] Sharpe, John, "Buried lines helping to prevent outages during Carolina hurricanes." *Carolina Public Press*, (July 26, 2019). https://carolinapublicpress.org/29165/buried-lines-helping-prevent-outages-during-carolina-hurricanes/

worsen with climate-driven sea level rise,[109] also makes buried lines more vulnerable to corrosion from salt water.[110] As Ted Kury, director of energy studies at the University of Florida, told the Washington Post, "If you're in an area prone to flooding, a policy of putting everything underground doesn't make sense."[111] Cost is another issue. After a winter storm in North Carolina in 2002 that knocked a few million customers offline, the state decided to investigate burying power lines. The study found that the cost would be $41 billion over a 25-year period, doubling electric bills.[112] Nuclear power plants near the east coast are particularly vulnerable to storm surge.[113] The NRC requires shutdown of nuclear units prior to hurricanes striking, if the projected wind speeds of the storm require it.[114]

[109] "Multiple climate change-driven tipping points for coastal systems." *U.S. Geological Survey*, (July 30, 202). https://www.usgs.gov/publications/multiple-climate-change-driven-tipping-points-coastal-systems

[110] Brown, Dalvin, "Burying power lines isn't the only way to waterproof the grid." *Washington Post*, (Sept. 5, 2021). https://www.washingtonpost.com/technology/2021/09/04/weather-power-lines-climate-change/

[111] *Id.*

[112] *Id.*

[113] Shifflett, Shane, Sheppard, Kate, "How Rising Seas Can Sink Nuclear Plants Along the East Coast." *HuffPost*, (May 19, 2024). https://www.huffpost.com/entry/maps-rising-seas-storms-threaten-flood-coastal-nuclear-power-plants_n_5233306

[114] "Hurricane Matthew caused millions of customers to go without power on the east coast." *Energy Information Administration*, (Oct. 17, 2016). https://www.eia.gov/todayinenergy/detail.php?id=28372

This applies to Brunswick nuclear power plant.[115] Duke Energy shutdown the Brunswick nuclear power plant prior to the landfall of Hurricane Florence.[116] North Carolina's Robinson and Harris nuclear plants both lost grid power during Hurricane Matthew,[117] which causes nuclear plants to trip offline and fire up diesel generators to keep the core cool. Harris was offline for refueling, at the time.[118] In fact, a recent Government Accountability Office, or GAO, report categorized flooding hazards as "high" for every Duke Energy nuclear plant in the Carolinas.[119] Other power plants are also vulnerable to flooding. Floodwaters from Hurricane Florence also inundated a 625-megawatt natural gas plant, forcing it offline.[120] Although utility-scale solar can be impacted by flooding and other damage, solar arrays, deenergized directly prior to Hurricane Florence's landfall were powered up remotely,[121] unlike nuclear power plants that require large staff, the next day.

---

[115] HuffPost, *supra* note 43.

[116] Walton, Robert, "Duke Energy shuts down Brunswick nuclear plant ahead of Hurricane Florence." *Utility Dive*, (Sept. 13, 2018). https://www.utilitydive.com/news/duke-shuts-down-brunswick-nuclear-plant-ahead-of-hurricane-florence/532297/

[117] EIA, *supra* note 44.

[118] Id.

[119] *Nuclear Power Plants: NRC Should Take Actions to Fully Consider the Potential Effects of Climate Change*. U.S. Government Accountability Office, (GAO-24-106326) (April 2024), pp. 57, 59. https://www.gao.gov/assets/d24106326.pdf

[120] Dennis, Brady, Mufson, Steven, Eilperin, Julliet, "Dam breach sends toxic coal ash flowing into a major North Carolina river." *Washington Post*, (Sept. 22, 2018) .https://www.washingtonpost.com/energy-environment/2018/09/21/dam-breach-reported-former-nc-coal-plant-raising-fears-that-toxic-coal-ash-may-pollute-cape-fear-river/

[121] Merchant, Emma, "Clean Energy Players Weather Through Florence." *GreenTech Media*, (Sept 17, 2018). https://www.greentechmedia.com/articles/read/clean-energy-players-weather-hurricane-florence?utm_medium=email&utm_source=Daily&utm_campaign=GTMDaily#gs.WzbSXpA

North Carolina's sole wind farm was undamaged.[122] There was little damage reported with respect to rooftop solar.[123] The Brunswick nuclear units were down for about a week, and two crews were at the nuclear plant and had issues initially accessing the site due to flooding.[124] However, if transmission lines are down and substations damaged, even operating utility-scale wind and solar cannot deliver electricity to homes and businesses.

Q: CAN YOU DISCUSS HOW COLD WEATHER EXTREMES HAVE DAMAGED THE BULK POWER SYSTEM GENERALLY AND IN NORTH CAROLINA?

A: Severe winter storms and temperatures are a threat to the bulk power system. The Federal Energy Regulatory Commission ("FERC") noted in a 2023 report that winter storm Elliot "was the fifth in the past 11 years in which unplanned cold weather- related generation outages jeopardized grid reliability, and the fourth that triggered the need for a firm load shed."[125] The report continued, "[m]ultiple extreme cold weather event reports, including the 2021 Report issued less than two years ago, have detailed the same three primary causes of the unplanned generating

[122] Ivanova, Irina, "Hurricane Florence crippled electricity and coal – solar and wind were back the next day. *CBS News*, (Sept. 25, 2018). https://www.cbsnews.com/news/hurricane-florence-crippled-electricity-and-coal-solar-and-wind-were-back-the-next-day/
[123] GreenTech Media, *supra* note 51.
[124] Freebairn, William, "Duke Energy's two Brunswick units return to service after Hurricane Florence." *S&P Global*, (Sept. 24, 2018). https://www.spglobal.com/commodityinsights/en/market-insights/latest-news/electric-power/092418-dukes-two-brunswick-nuclear-units-in-north-carolina-return-to-service-after-hurricane
[125] FERC & NERC, *supra* note 10.

outages: Freezing Issues; Fuel Issues; and Mechanical/Electrical issues which are correlated with temperature, increasing in number as temperatures fall."[126]

Federal reports on Texas' winter storm in 2021[127] and winter storm Elliot[128] reveal that natural gas-fired and coal-fired power plants are the most vulnerable grid resources to severe winter storms. Outages during the Texas winter storm were attributed to primarily failures at the power plants or failure of the natural gas pipeline system, with 55 percent of natural gas plant capacity and 18 percent of coal plant capacity being knocked offline. Natural gas infrastructure failures caused 27.3 percent of all outages, derates and failures to start during the Event."[129]The storm impacted ERCOT (or the Electric Reliability Council of Texas)), the South/Central US – portions of MISO (or Midcontinent Independent System Operator) - and SPP (or Southwest Power Pool).[130] Natural gas capacity, at the time of the storm, comprised 52 percent of ERCOT generation, 61 percent of MISO South (the impacted portion of MISO), and nearly 39 percent of SPP generation.[131]

The FERC report notes:

---

[126] *Id.*, p. 15.

[127] *FERC, NERC Regional Staff Report: The February 2021 Cold Weather Outages in Texas and the South Central United States.* Federal Energy Regulatory Commission and North American Energy Reliability Corporation, (November 2021). https://www.ferc.gov/media/february-2021-cold-weather-outages-texas-and-south-central-united-states-ferc-nerc-and

[128] FERC & NERC, *supra* note 55.

[129] FERC, NERC, *supra* note 57, p. 16.

[130] *Id.*, p.10.

[131] *Id*, p. 22, 23.

> Of those outages, derates, and failures to start, 75 percent were caused by either freezing issues (44.2 percent) or fuel issues (31.4 percent) … Natural gas fuel supply issues caused the majority, 87 percent, of the 31.4 percent of outages and derates due to fuel issues, and caused 27.3 percent of all outages, derates and failures to start during the Event.[132]

Solar and nuclear power saw the least outages, at 1 percent and 2 percent of capacity, respectively.[133] Twenty-two percent of wind capacity experienced outages.[134] With respect to the 2023 FERC and NERC report regarding Winter Storm Elliott, gas and coal capacity comprised outages of 63 percent and 23 percent, respectively[135] – nearly 60 percent of fossil units experiencing unplanned outages and derates.[136] A mere 4 percent of wind and 1 percent of solar capacity experienced outages.[137] Nuclear outages were also very low, at 1 percent.[138] The storm also impacted generation resources in a huge area - from the Southeast to the Northeast and from the Midwest to the Plains States. Load had to be shed to maintain grid reliability by utilities in the Carolinas, Tennessee, and Kentucky.[139] In the impacted regions, natural gas comprised more than 41 percent of capacity,

[132] *Id.*, p. 15, 16.
[133] *Id.*, p. 16.
[134] *Id.*, p. 16.
[135] FERC, NERC, supra note 57, p. 17.
[136] *Id.*, p. 18.
[137] *Id.*, p. 17.
[138] *Id.*, p. 17.
[139] *Id.*, pp. 7,8.

followed by coal at 24 percent, at the time of the storm.[140] For Duke Energy Carolinas and Duke Energy Progress' combined operations in North and South Carolina, natural gas comprised 34 percent of capacity, followed by coal at nearly 25 percent and nuclear at 28.5 percent.[141] The utilities experienced 810 megawatts of forced outages at combined cycle natural gas plants, due to freezing and low natural gas pipeline pressures, and 768 megawatts of coal plant forced outages due to freezing.[142]

Duke Energy says that 1 megawatt for conventional power can power 800 homes.[143] Using Duke Energy's calculations for combined cycle and coal plant derates and home powered per megawatt, the lost power meant that those plants served the equivalent of nearly 1.2 million fewer homes. Although nuclear power plants experienced few outages or derates during winter storm Elliott, as noted, Duke Energy's 759-megawatt Robison nuclear plant was offline for a planned outage,[144] meaning the absent power generation was the equivalent of 607,200 fewer homes served. If we consider a home is equivalent to a residential customer,[145] the power available to the above plants with derates or outages could serve about 42 percent

---

[140] *Id.*, p. 25.
[141] *Id.*, pp. 25, 25.
[142] NCUC, *supra* note 31 pp. 21, 22.
[143] Duke Energy, supra note 33.
[144] NCUC, supra note 72, p. 21.
[145] 2022 Bundle Retail Sales – Residential. *EIA* (2022). https://www.eia.gov/electricity/sales_revenue_price/pdf/table_6.pdf

of residential customers in Duke Energy territory in the Carolinas during storm Elliot.

Q: IN YOUR OPINION, WHAT KIND OF SHIFT IN THINKING AND INVESTMENT PATTERN IN THE ELECTRIC SYSTEM DOES CLIMATE CHANGE NECESSITATE FOR NORTH CAROLINA?

A: Current and expected increasingly severe climate disruptions in North Carolina (and nationwide) indisputably demonstrates that bulk power system infrastructure and utility-scale power generation alone are not up to task to ensure reliability and resiliency for residential and business customers. This calls for rethinking the design of the electric system and points equally indisputably to the distributed grid paradigm, the centerpiece of which is the VVP. Other strategic considerations going forward, such as electrification of the grid grows are resource adequacy and affordability, which VPPs can also help achieve reliability. However, to ensure affordability, financial benefits must flow to ratepayers – not just to the utility.

Q: PLEASE EXPLAIN WHAT A VIRTUAL POWER PLANT IS.

A: VPPs are aggregated residential and/or commercial customers that essentially function as utility-scale power plants. VPPs are controlled by web-based signals to thousands of homes equipped with the necessary distributed energy technologies. These DER technologies are well-known and off-the-shelf, such as rooftop or community solar plus storage, EVs or smart thermostats "paired with electric heating, ventilation, and air conditioning systems (HVAC) such as heat pumps, electric water heaters, and C&I equipment."[146] This also includes energy efficiency investments.[147] These are all dispatchable resources or can be aggregated to benefit the electric system and customers. VPPs can reduce stress on the bulk power system or provide power to it. VPPs consist of various configurations. The most well-known and in place for decades is demand response[148] – where utilities control air conditioners or electric water heaters during peak demand to avoid overstressing the grid.

Q: IN YOUR OPINION, HOW CAN VPPS IMPROVE GRID RELIABILITY?

A: As the U.S. Department of Energy ("DOE") in its *Pathways* report: "[a]s simple as it seems to dial down or turn off electricity-consuming equipment, the critical role that demand response plays in ensuring grid reliability cannot be overstated."[149] In fact, demand response can play a significant role in maintaining grid stability – if customers are aggregated into a VPP. Brattle Group analysts observe that even "slight, infrequent adjustments to the temperature settings of a smart thermostat… can provide hundreds or even thousands of megawatts of peak demand

[146] *Pathways to Commercial Liftoff: Virtual Power Plants*. U.S. Department of Energy, (Sept. 2023), pp. 6,7. https://liftoff.energy.gov/wp-content/uploads/2023/09/20230911-Pathways-to-Commercial-Liftoff-Virtual-Power-Plants_update.pdf

[147] Kevin Brehm, Avery McEvoy, Connor Usry, and Mark Dyson, *Virtual Power Plants, Real Benefits*. RMI, (2023), p. 8. https://rmi.org/insight/virtual-power-plants-real-benefits/

[148] Hledik, Ryan, Peters, Kate, *Real Reliability: The Value of Virtual Power*. The Brattle Group, (May 2023), p. 10. https://www.brattle.com/wp-content/uploads/2023/04/Real-Reliability-The-Value-of-Virtual-Power_5.3.2023.pdf

[149] U.S. DOE, supra note 78, p. 19.

reduction…"[150] California serves as an example of the enormous potential of VPP demand response. California ratepayers voluntarily saved their electric system from collapse when requested by the state's governor to turn down their air conditioners in the summer of 2022.[151]

Wood McKenzie possesses a database of more than 500 US-based VPPs operating or in development[152] – mainly demand response programs. _California, New York, Massachusetts, and Texas are the leading states.[153] The largest VPP providers have accumulated enough aggregated megawatts to rival the larger independent power producers.[154] Key to the developments in these leading states is that they "offer aggregator-friendly standard offer for… DER resources."[155] Vehicle-to-grid with EVs remains in the "pilot phase."[156] However, the emphasis on simply demand response is "rapidly evolving to leverage the expanding mix of DER technologies," according to the Brattle Group.[157]

---

[150] Hledik, Ryan, Viswanathon, Kala, Peters, Kate, "Virtual power plants: Resource adequacy without interconnection delays." *Utility Dive,* (Opinion) (Aug. 17, 2023). https://www.utilitydive.com/news/virtual-power-plants-vpp-distributed-energy-resource-adequacy-der-distributed-energy/691135/
[151] Martin, Liza, Brehm, Kevin, "Clean Energy 101: Virtual Power Plants." *RMI,* (Jan. 10, 2023) https://rmi.org/clean-energy-101-virtual-power-plants/
[152] "California Dwarfs all other VPP markets in North America." Wood McKenzie, (Press Release) (March 29, 2023) https://www.woodmac.com/press-releases/california-dwarfs-all-other-vpp-markets-in-north-america/
[153] *Id.*
[154] *Id.*
[155] *Id.*
[156] *Id.*
[157] Brattle, *supra* note 80, p. 10.

There are examples of VPPs in the US at large commercial scale – or plans for them, including:

- Puget Sound Energy, or PSE, has partnered with Autogrid to create a 100-megawatt demand response VPP, consisting of nearly half of PSE's customers.[158]
- New York-based Sustainable Winchester plans to lease batteries, for demand response purposes, to 1 million people in the Hudson Valley, reaching potentially 45 municipalities.[159]
- During the 2020 heatwave in California, OhmConnect used smart devices and appliances to save enough power to take about 600,000 homes off the grid for an hour, "helping to avoid additional blackouts, according to the company.[160]
- By properly managing EV charging, California estimates that the cost for distribution grid investment to handle electrification could be as low as $15 billion compared to $50 billion without managing the flexible demand.[161]
- Texas found that demand response programs, utilizing managing demand with "smart meters, heat pumps, EV charging, water heaters, and other DERs could save customers $150 per year on average by 2030…"[162]

---

[158] Hering, Garrett, "'Call to action' on virtual power plants resonates across US grid." *S&P Global,* (Jan. 2, 2024) https://www.spglobal.com/marketintelligence/en/news-insights/latest-news-headlines/call-to-action-on-virtual-power-plants-resonates-across-us-grid-79649945

[159] Salazar, Christian, "Virtual Power Plants Offer a Climate-Forward Response to Increasingly Hot Summers." Next City, (Aug. 4, 2023). https://nextcity.org/urbanist-news/virtual-power-plants-offer-a-climate-forward-response-to-extreme-heat

[160] RMI, *supra* note 83.

[161] US DOE, supra note 78, p. 10.

[162] *Id.*, p. 10.

- New York estimates the costs of managing EV charging demand would reduce costs to customers 95% - $1.4 billion compared to $26.8 billion.[163]

Experts project that distributed resources will expand significantly by 2030, increasing the buildout potential for VPPs. Specifically, it is projected that by 2030, (1) about 1/3 of US homes are expected to have smart meters, (2) half of all homes are expected to have electric water heaters, (3) distributed battery capacity is expected to increase 14-fold, (4) residential rooftop top solar is expected to increase more than 3-fold, increasing rooftop solar to from about 5 percent to 14 percent of single-family homes[164] - in states with the enabling policies, and (4) 26 million EV's are expected to be on the road – up from 2 million last year.[165]

The Brattle Group observes: "[a]s decarbonization initiatives ramp up across the U.S., affordability and reliability are in the spotlight as the top priorities of policymakers, regulators, and utilities."[166] Expansive buildout of VPPs are key to achieving these priorities and others, including playing a prominent role in

---

[163] *Id*., p.10.

[164] The average size of residential solar systems is about 7 KWs. https://southern-energy.com/what-size-solar-system-do-you-actually-need/ and https://www.marketwatch.com/guides/solar/power-solar-panels-produce/ and https://www.statista.com/statistics/1421982/median-size-residential-solar-systems-united-states/ The 56 GW increase in residential capacity equates to about 8 million additional homes with rooftop solar. Given the current approximately 4.2 million solar homes, or about 5% of single-family homes, https://www.solarinsure.com/how-many-americans-have-solar-panels#:~:text=What%20Percentage%20of%20US%20homes,of%2084.69%20million%20eligible%20homes by 2030, using Brattle's estimated expansion of solar capacity, about 14 percent of single-family homes will have installed solar.

[165] Brattle, *supra* note 80, p. 9.

[166] *Id*., p. 32.

hardening the electric system against climate disruptions. A variety of analysts agree on the benefits of VPPs for the ratepayer and electric system and VPP capacity could grow substantially by 2030. Reports by the DOE, the Brattle Group, RMI and Vermont School of Law come to the same conclusions. VPP capacity could be expanded quickly and reduce electric system costs substantially. RMI estimates that VPPs could reach 60,000 megawatts by 2030[167] – equivalent to the power demand of 24 million homes[168] - and reduce costs of the electric system by $17 billion by avoiding or deferring utility-scale upgrades to the transmission and distribution systems and peaking natural gas power plants or reducing their use.[169] In fact, VPPs can provide the same services as utility-scale power plants – such as, ancillary services for reliability[170] – at 40 percent to 60 percent of the cost of utility-scale upgrades.[171] The Brattle Group, using RMI's 60-gigawatt projection, estimates savings of $15 to $35 billion over the next decade, excluding societal benefits.[172] DOE agrees with the cost-effectiveness of VPPs.[173]

Current VPP providers Voltus and Uplight are examples of the speed at which VPPs can be deployed. Voltus says that it can build out 500 megawatts (the size of a coal power plant unit) of demand response VPPs in 1 year; Uplight signed up 50,000

[167] RMI, *supra* note 83, p. 5.
[168] Next City, *supra* note 91.
[169] RMI, *supra* note 83, p. 5.
[170] US DOE, *supra* note 78, pp. 7,8.
[171] Brattle, supra note 80, p. 5.
[172] *Id.*, p. 25.
[173] US DOE, supra note 78, p. 3.

customers of a utility in 3 months," in a smart thermostat demand response program."[174] _Speed of capacity deployment is of the essence at this time. Regional transmission organizations keep sounding the alarm about the lack of "resource adequacy" as coal plants are retired. In addition, there is a 5-year backlog[175] of 100s of thousands of megawatts of battery and natural gas power plant capacity due to the lack of transmission to accommodate them.[176]

VPPs can compensate for this growing concern, as "VPPs not subject to the interconnection queue delays that are limiting deployment of large scale, i.e. utility-scale, resources," according to analysts at Brattle.[177] Unlike utility-scale resources, VPPs are scalable to need[178] because they are less expensive than grid resources; more quickly deployed; more cheaply and readily reduce transmission congestion; and, more readily utilize grid resources more efficiently – as they can shift peak load.[179] In terms of peak load reduction, the DOE's 2018 study of Northwest utilities showed that switching to managing heat pump water heaters from "uncontrolled resistance water heaters" could reduce evening peak demand 90

---

[174] Utility Dive, supra note 82.
[175] US DOE, *supra* note 78, p. 12.
[176] Rand, Joseph, Strauss, Rose, Gorman, Will, Steel, Joachim, Mulvaney Kemp, Julie, Jeong, Seonguen, Robson, Dana, Wiser, Ryan, *Queued Up: Characteristics of Power Plant Seeking Transmission interconnection as of the End of 2022*. Lawrence Berkeley National Laboratory, (April 2023), p. 3. https://emp.lbl.gov/sites/default/files/queued_up_2022_04-06-2023.pdf
[177] Utility Dive, *supra* note 82.
[178] "The Emerging Trend of Virtual Power Plants in Electric Utilities." *Evans,* (Dec. 11, 2023). https://www.evansonline.com/blog/the-emerging-trend-of-virtual-power-plants-in-electric-utilities
[179] See generally, US DOE, *supra* note 78 and RMI, *supra* note 83.

percent,[180] a growing necessity as the penetration of solar increases and shifts peak demand more into the evening hours.

VPPs are also a critical component in enhancing grid resiliency against climate disruptions.[181] A significant advantage of VPPs over utility-scale power plants and transmission lines is that they improve resiliency by being local resources, which "integrate multiple small-scale energy resources, improving grid resilience and reducing the impact of a single point of failure."[182]

Q: PLEASE EXPLAIN HOW VPPS RELATE TO THE CONCEPTS OF RESILIENCY AND RELIABILITY.

A: In the context of VPPs, the concepts of resiliency and reliability are presented practically as interchangeable. The DOE presents reliability and resiliency as closely linked concepts. It references the increasing storm damage we're experiencing in its subsection titled reliability and resilience under "value proposition" of its report. DOE doesn't mention reliability, only resiliency, stating:

> Several potential characteristics of VPPs can further increase resilience: a geographically diverse footprint of generation sites, a higher number of storage assets, and the ability to 'island' sections

[180] Metzger, Cheryn, Technology Integration: Heat Pump Water Heaters (HPWH). Office of Energy Efficiency and Renewable Energy, US DOE. https://www.energy.gov/eere/buildings/articles/technology-integration-heat-pump-water-heaters

[181] Jones, Keven, PhD, Franco, Mary, Mashke, Kim, Pardee, Sarah, *How Virtual Power Plants Can Advance Electrification and Mitigate Infrastructure Needs As We Race to Meet Our Climate Challenges*. San Diego Journal of Climate and Energy Law, (2022), p. 143 https://digital.sandiego.edu/cgi/viewcontent.cgi?article=1108&context=jcel

[182] Evans, *supra* note 110.

of the grid into microgrids in response to adverse events such as extreme weather and other threats.[183]

As noted by the DOE, another advantage of VPPs is that microgrids can be created within VPPs, such as islanding critical infrastructure like hospitals when necessary. DOE also describes the benefits of reliability and resilience in its report as "avoided outages, shortened outages, and reduced number of end users impacted by outages."[184] RMI links the concepts in a similar way, explaining "VPPs are already helping provide resilience when the grid is down, and offer numerous other unique reliability benefits that traditional power plants do not."[185] Other benefits of VPPs include the ability to accommodate electrification of the grid and expanding deployment of renewables.[186] VPPs are also a means to achieve energy equity, such as the DOE conditional loan to jumpstart Sunnova's Project Hestia to provide VPP access to disadvantaged communities.[187]

What is critical to working towards electric bill affordability is that ratepayers benefit, or should, financially from VPPs. DOE states, "[a]cross VPPs generally, the primary operational costs are participant incentives; in other words, most of the money spent on VPPs flows to electricity consumers (households and

---

183 US DOE, supra note 78, p. 11.
184 *Id.*, p. 53.
185 RMI, *supra* note 83.
186 Brattle, supra note 80, p. 27.
187 Kennedy, Ryan, "Virtual power plants roll out across the U.S." *PV Magazine*, (June 16, 2023). https://pv-magazine-usa.com/2023/06/16/virtual-power-plants-roll-out-across-the-u-s/

businesses),"[188] which would reverse the national trend over the last decade in legislative and regulatory attempts and actions by utilities to substantially curtail ratepayer financial benefits from their own rooftop solar and energy efficiency investments at the behest of monopoly utility companies – if properly implemented. There are societal benefits as well. The Brattle Group refers to these as reduced emissions and resiliency, estimating that these benefits add an additional $20 billion in savings to the $15 to $35 billion in savings in its report.[189] Resiliency is generally not included in utility cost-effectiveness tests,[190] which greatly undervalue VPP proposals. The Brattle Group refers to VPPs as "real reliability" for good reason, namely, because the bulk power system doesn't provide it. Indeed, DOE refers to its 2023 report as "an urgent call to action for a diverse range of stakeholders to accelerate VPP liftoff."[191]

Q: PLEASE DISCUSS DEQ'S PERSPECTIVE ON SYSTEM RESILIENCE AND SAVINGS.

A: The DEQ begins early on in its report with the observation that "[i]intelligently managed DERs could offer a vision of a world where demand may be easily dispatchable as supply – which, as noted, they already do… providing services that

---

[188] US DOE, supra note 78, p. 24.
[189] Brattle, supra note 80, p. 5.
[190] Sverivastava, Rohini, Garfunkel, Emily, Wood, Amber, *Valuing Resiliency Benefits in Building Retrofit Programs*. American Council for an Energy Efficient Economy, (March 2024), p. vi. https://www.aceee.org/blog-post/2024/03/ignoring-resilience-benefits-limits-growth-energy-efficiency-programs
[191] US DOE, supra note 78, p. 4.

benefit both the customer and the utility."[192] The DEQ recognizes the myriad benefits of DERs, such as enhanced resilience, the ability to provide ancillary services, and reducing costs of the electric system, at various points in its report. Here are examples:

In a well-designed system, DERs can provide positive net value to the grid, *such as avoided infrastructure investments, improved resilience, and increased integration of clean energy*. Through these capabilities, customers can help mitigate or in certain cases, reduce electricity cost when they offer services to the utility. For example, customers who choose EE measures that shape their load to complement grid resource availability are contributing to *keeping costs down for all customers*..."[193] (Emphasis added).

DEQ also states, "[d]istributed energy resources, including EE, demand-side management, solar, and storage have the potential to provide valuable services to the electricity grid and lower costs on the system while providing customers with cleaner power and more control over their energy usage."[194] Notably, VPPs are mentioned only a single time in the context of energy storage and resiliency, providing improved resilience and reducing "the need for peaker power plants,"[195] among other ancillary benefits.

---

[192] NC DEQ, supra., p. 21.
[193] *Id.*, p. 37.
[194] *Id.*, p. 83.
[195] *Id.*, p. 33, 34.

DEQ acknowledges that energy efficiency and demand response "decrease overall electricity demand from the grid, which in turn, avoids the cost of building new generation and transmission lines, saves customers money, and lowers pollution from electric generation." [196] However, benefits to customers – that is, working towards affordability – cannot be achieved unless customers benefit financially. This is discussed briefly in the context of utility-scale storage, in that there was "no mechanism (at the time) to pay market participants…"[197] For DER's, savings are mentioned generally but not payments or bill credits specifically for participating ratepayers. DEQ also notes that DERs, including information technology, represent "economic development opportunities in urban and rural areas of the state."[198] In addition, DER's, according to DEQ's report, can be deployed to disadvantaged areas, creating more energy equity and resilience against severe weather.[199]

Q: PLEASE EXPLAIN HOW A COST-BENEFIT ANALYSIS IMPACTS DISTRIBUTED ENERGY RESOURCES.

A: Critically important for North Carolina to achieve "real reliability," is to properly assess the costs and benefits of DERs. DEQ urges expansion of currently used cost-benefit analysis. Here are examples of what DEQ suggested that, if implemented

[196] *Id.*, p. 33.
[197] *Id.*, p. 35.
[198] *Id.* p. 11.
[199] *Id.* p. 78.

properly, would make VVPs (and microgrids) equal partners with utility-scale resources:

- Increased system resilience, reliability, and safety
- Reduced customer cost, especially for low-income, disadvantaged communities
- Health impacts
- Increased customer flexibility and choice
- Enhanced social equity or environmental justice
- Environmental benefits, such as avoided GHG emissions
- Economic development benefits, such as job growth[200]

DEQ also recommended "comprehensive utility planning processes" … to "[s]trengthen resilience and flexibility of the grid."[201]

Q: IN YOUR OPINION, WHAT ARE THE WEAKNESSES IN DEQ'S REPORT?

A: Notably, the Commission is not involved in the DEQ report. The Commission, with regulatory authority over utilities, should be the lead agency in these analyses. The DEQ discusses Duke Energy's existing nuclear fleet as a non-carbon emitting technology,[202] but does not discuss the nuclear power's vulnerability to severe drought, flooding, and hurricanes. Similarly, the DEQ discusses the expansion of

[200] *Id.* p. 78.
[201] *Id.* p. 82.
[202] *Id.* p. 23.

natural gas-fired power and anticipated increasing carbon emissions from the additional capacity[203] but neither their vulnerability to severe weather, nor the vulnerability of the transmission system to severe weather.

What is disconcerting is that in its latest report, DEQ seems to marginalize the critical services DERs can provide to all customers. DEQ's follow-on report in 2020, "Climate Risk Assessment and Resilience Plan," underscores the 2019 report's emphasis on DERs emphasizing "[t]he plan (the Clean Energy Plan report from 2019) calls for requiring utility companies to develop projects focused on distributed energy resources, community solutions, and microgrids… to enhance resilience."[204]

However, in a discussion of administering a grant program to enhance resiliency funded by the federal government, DEQ, after all the proclamations of the benefits of DERs, weakens its tone of necessity. The agency states, "[a]s recommended by the CEP, modernizing the grid *may* include greater deployment of energy storage, use of clean energy, greater use of demand-side resources, and enhanced grid operation for more flexibility and reduced response time."[205] (Emphasis added). Given the DEQ's emphasis and discussion of DERs in its 2019 report, one would have expected that grid modernization at least "should", not "may," include greater deployment of the resources listed, particularly DERs.

---

[203] *Id.*, pp. 24, 25.
[204] DEQ, *supra* note 30, p. 5L-3.
[205] State Energy Office, *supra* note 14, p. 6.

4. ISSUE 11 - ADVANCING GRID EDGE AND CUSTOMER PROGRAMS

Q: IN YOUR OPINION, HOW HAVE STATE STATUTES LIMITED RESILIENCE AND DERS?

A: State statutes marginalize resilience and DERS by eroding the ability of DERs to gain traction in relationship to utility-scale resources.

First, the only mention of resiliency or resilience and DERs appear in state statute is in performance-based rates provisions.[206] These are concepts that the Commission "may" consider approving utility requests for performance-based rates.[207]

Second, state statute did stipulate that if a utility filed for a certificate of need for a coal or nuclear power plant, it would have to first demonstrate that "energy efficiency measures; demand-side management; renewable energy resource generation; combined heat and power generation; or any combination thereof, would not establish or maintain a more cost-effective and reliable generation system."[208] However, that provision was repealed in Senate Bill 678 in 2023,[209] seemingly to clear the way for Duke Energy's bid to construct small nuclear reactors proposed in a previous carbon plan. Since coordinated DERs are cheaper

---

[206] NC Stat. § 62-133.16. (d)(2)(i).
[207] *Id.*
[208] Senate Bill 678, NC Stat. § 62-110.1(e) https://www.ncleg.gov/Sessions/2023/Bills/Senate/PDF/S678v6.pdf
[209] *Id.*

than utility-scale investments and more quickly deployed, Duke Energy would have had a tough time justifying construction of a new nuclear design. In addition, in this same provision, state statute stipulates that a proposed power plant is part of a "least cost" approach to achieve state mandated carbon goals and "will maintain or improve the adequacy and reliability of the existing grid."[210]

Notably, "adequacy" is not defined in statute. In Commission rules, adequate or adequacy, although not defined outright, appears to apply mainly to quality of service: the expertise to deliver service, whether the electric power system is maintained and available for operation, enough fuel supply, and enough generation (power capacity) and wires capacity to serve all ratepayers.[211] But, resiliency is not mentioned in Commission rules and DERs are only in the context of planning and constrained by Duke Energy's cost-effectiveness test and location.[212] In fact, in its mission statement, the Commission does not mention resiliency; only that it must "promote adequate, reliable, and economical utility service."[213] In essence, state policy excludes resiliency and DERs from an aspect of service utilities must provide – despite the state's recognition that these resources can provide improved resiliency, lower costs of the overall system, and provide benefits to all ratepayers as well as the necessity of improving system resiliency.

---

[210] *Id.*
[211] See generally, Rules and Regulations. North Carolina Utilities Commission. https://www.ncuc.gov/ncrules/rulstoc.html
[212] NC, Rule R8-60A(d)(iii) https://www.ncuc.gov/ncrules/Chapter08.pdf
[213] NC Utilities Commission. Retrieved April 29, 2024, https://www.ncuc.gov/Aboutncuc.html

Q: HOW DOES DUKE TREAT DISTRIBUTED ENERGY RESOURCES IN ITS CPIRP?

A: Duke Energy continues to marginalize distributed resources. There is no change in its Grid Edge minimal capacity from the initial carbon plan proposal to the supplemental proposal, as well as distributed resources not providing power to the grid.

Instead, Duke Energy relegates VPPs to a minimal pilot that could last 10 years, the timing of which happens to coincide with Duke Energy's initially planned SMR unit coming online.[214] As a comparison, Brattle Group estimates California's VPP potential to be nearly 7,500 megawatts by 2035.[215] North Carolina should conduct a similar analysis. Experts in VPP potential and technology raise concerns with never-ending pilots and suggest pilots may not be needed at all, with the assumption up front if implemented they will be successful.[216]

---

[214] Penrod, Emma, "Duke Energy pilot could open door to VPPS at vertically integrated utilities, SELC attorney says. Utility Dive (Jan. 29, 2024). https://www.utilitydive.com/news/duke-energy-virtual-power-plant-vpp-PowerPair-selc-battery-solar/705812/

[215] Hledik, Ryan, Peters, Kate, Edelman, Sophie, California's Virtual Power Potential: How Five Consumer Technologies Could Improve the State's Energy Affordability. The Brattle Group (April 2024), p. 5. https://www.brattle.com/wp-content/uploads/2024/04/Californias-Virtual-Power-Potential-How-Five-Consumer-Technologies-Could-Improve-the-States-Energy-Affordability.pdf?utm_medium=email&_hsenc=p2ANqtz-8wshqIJvstNWYtq2M4ipQfajg8UGoELRB-U3tAami4aAwnxSKIom6Djxdp_B2dOBSmqBAI3e2yCeGmRS6iCaUxO4B-jg&_hsmi=302284747&utm_content=302284747&utm_source=hs_email#:~:text=We%20focus%20on%20five%20commercially,commercial%20buildings%20and%20industrial%20facilities.

[216] Utility Dive, supra note 82.

Duke Energy also postponed its vehicle-to-grid pilot for one year – until 2025 - claiming supply chain issues as the reason.[217] However, Duke Energy's claim is suspect. For example, Cox Automotive reports record sales of EVs in 2023, reaching 1.2 million and capturing more than 7.5 percent "of the total US vehicle market."[218] Similarly, Car Edge reports that Ford's overall EV sales rose 114 percent during March of this year – mainly its Mustang EV[219] - electric truck sales increased 52 percent in 3 weeks, over the same month.[220]

Q: IN YOUR OPINION, HOW ROBUST ARE DUKE'S ENERGY EFFICIENCY PROGRAMS?

A: Not very. The most recent American Council for an Energy Efficient Economy ("ACEEE") report on utility efficiency programs shows that Duke Energy's programs come nowhere near the flagship programs in the country with respect to low-income spending, net savings, spending, peak savings, lifetime savings.[221] The

---

[217] Order Extending Starting Date of Pilot Program and Modifying Reporting Requirements, NCUC Docket No. E-7, Sub 1275 (Dec. 11, 2023), p. 3. https://starw1.ncuc.gov/NCUC/ViewFile.aspx?Id=9e2b7728-f8de-4903-bcb7-0744f6838c57

[218] "A Record 1.2 Million EVs Were Sold in the US in 2023, According to Estimates from Kelley Bluebook." Cox Automotive (Jan. 9, 2024). https://www.coxautoinc.com/market-insights/q4-2023-ev-sales/

[219] "Ford's EV Sales Are Rising. Tesla Chargers and Price Cuts Fuel Surge." (2024). https://caredge.com/guides/ford-ev-sales-2024

[220] *Id.*

[221] Specian, Mike, Berg, Weston, Subramanian, Sagarika, Campbell, Kristin, *2023 Utility Energy Efficiency Scorecard*. ACEEE (Aug. 2023), p. 51-52, 54-55, 58-60, 65-66. https://www.aceee.org/sites/default/files/pdfs/U2304.pdf

Southeast, according to ACEEE, is the worst region in the country for utility energy efficiency programs.[222]

Table 2. Comparison of Duke Energy EE Programs in the Carolinas to Top Utility Programs 2021

Category of Savings/Spending	**Duke Energy Average in the Carolinas**	**Range of Top 10 Utilities**
Low-income Spending as % of Total EE Spending	4.4%	9.74% to 59.21%
Savings as % of Sales	0.76%	1.74% to 3.00%
Spending as % of Revenue	2.1%	3.25% to 11.99%
Net Lifetime Savings as % of Sales	5.7%	20.54% to 47.02%

Source: EWG, data derived from ACEEE.

To further justify its utility-scale laden business plan, Duke Energy uses testimony of James B. Robb, President and Chief Executive Officer of the North American Electric Reliability Corporation, before Congress. However, Duke Energy leaves out important observations by Robb. Duke Energy states the following in September 2023 testimony in this proceeding – ignoring the IEEE initiative - with respect to issues with inverter-based technologies:

[222] *Id.*, p. 38-39.

> Consistent with Mr. Robb's testimony, *Appendix M* acknowledges that operating experience across the United States underscores the need to purposefully manage the pace of the energy transition to identify and address new challenges before they materialize into broad-based risks to the power system. For example, a key challenge to maintaining grid reliability is ensuring that new resources added to the grid have predictable performance characteristics so as to ensure grid stability. As evidenced by continued major grid disturbances, new IBR-based technologies have the potential to respond to grid events unreliably. *Until improved national standards are available to dictate, model, and validate performance capabilities, accelerated reliance on these (IBR-based) technologies presents System Operators with increasing, unknown risks.*[223]
>
> (Emphasis added).

However, Robb also raised the potential for distributed resources to add to resiliency and reliability, emphasizing that resource adequacy isn't enough in providing power 24/7:

> [W]e need to better understand the impact on the bulk power system from the dynamic performance associated with inverter based resources (IBRs) and distributed energy resources (DERs). These understandings can then be balanced against the potential for demand side management (both energy efficiency and demand response) to support reliability and resilience. . . Resource adequacy (capacity) does not guarantee energy sufficiency. We must shift focus to 24x7 energy planning, not just capacity plus a reserve margin.[224] *Finally, due to the changing fuel mix, the dynamics associated with DERs, and the potential for demand side management to support reliability*, we must shift the planning focus. Whereas resource planning traditionally focused on having enough generation capacity during peak demand conditions ("capacity on peak"), *the focus must be broadened to include the need for sufficient energy at all times* ("energy 24x7").[225]
>
> (Emphasis added).

---

[223] Direct Testimony of Samuel Holeman III and Patrick O'Connor on Behalf of Duke Energy Carolinas, LLC and Duke Energy Progress, LLC, NCUC Docket No. E-100, Sub 190 (Sept 1, 2023), p. 19.
[224] *Id.*, p. 9.
[225] *Id.*, p. 3-4.

Q: IN YOUR OPINION, HOW DOES DUKE ENERGY VIEW UTILITY-SCALE INVESTMENT?

A: Despite Duke Energy recognizing that "weather extremes, particularly wide-spread and prolonged cold and heat patterns, increase demand and place added load and stress on the electric system"[226] and that summer and fall also "pose reliability and resilience challenges" from extreme heat and hurricanes,[227] Duke Energy lists only its utility-scale generation assets in addressing resilience issues going forward:

- "Ensuring power-plant resilience by reviewing operating experience during periods of extreme cold weather and high loads, reviewing weatherization enhancements, and re-baselining plant performance as necessary to properly account for generator availability risks in the resource planning and reliability processes."
- "Reviewing outage planning strategies to minimize risks from overlapping and/or over- concentrated planned outages on key generating units."
- "Resilience and reliability risks are not isolated to periods of cold and winter weather, and the timing of planned outages is an essential component of year-round reliability."
- "Continued assessment of fuel security, resilience, and adequacy for the Companies' supplies of natural gas and coal. A critical need for system resilience

---

[226] Duke Energy, Carbon Plan Appendix M (Aug 17, 2023), p. 24. https://starw1.ncuc.gov/NCUC/ViewFile.aspx?Id=cb70dc63-f81b-42cd-bf4b-ee63e0ae2693
[227] *Id.*, p. 22.

is adequate firm gas transportation and fuel flexibility, including ensuring adequate coal supply through retirement.

- "Continued improvements to cross-functional organizational awareness and communication during periods of tighter system conditions and heightened risks."[228]

The reality is that that resiliency is now a year-round challenge. Duke Energy does not mention VPPs or microgrids, proven to improve resilience, among other things, in *Appendix M Reliability and Operational Resilience.*

Q: IN YOUR OPINION, DOES DUKE ENERGY ADEQUATELY ADDRESS RESILIENCE RISKS OF CONVENTIONAL POWER PLANTS?

A: Not in any serious manner. Duke Energy begins *Appendix M Reliability and Operational Resilience* raising reliability issues with respect to renewables increasing "operational complexity,"[229] using this argument to justify more gas capacity, in the near- to mid-term, and claiming that weather-dependent renewables will exacerbate reliability and resiliency risks to the grid during extreme weather events.

Duke Energy goes as far as to focus in on having to repair damaged rooftop solar roofs in the wake of storms[230] - notwithstanding the fact that, if prioritized, it is highly unlikely that tens of thousands (or more) of rooftop solar systems would all

[228] *Id.*, p. 24.
[229] *Id.*, p. 1.
[230] *Id.*, p. 22.

be rendered incapacitated while outages of a few large, centralized power plants could potentially cause blackouts.

Duke Energy also emphasizes that the smoke from growing wildfire threats due to climate change would likely reduce solar panel output,[231] but the recent Government Accountability Report on nuclear plant vulnerabilities noted that all of Duke Energy's nuclear power plants in the Carolinas are vulnerable to wildfires, categorizing that risk as "high/very high."[232] The GAO states: "Wildfires pose several risks to nuclear power plants, including increasing the potential for onsite fires that could damage plant infrastructure, damaging transmission lines that deliver electricity to plants, and causing a loss of power that could require plants to shut down."[233]

Noting standards are forthcoming,[234] Duke Energy also raises the disruption caused in Texas by utility-scale solar inverters, as a cautionary note in terms of pace of deployment.[235] However, IEEE developed standards for interconnecting inverters to the grid[236] that garnered overwhelming support of participating stakeholders.

[231] *Id.*, p. 22, 23.
[232] GAO, *supra* note 49.
[233] *Id.*, p. 16.
[234] Duke Energy, *supra* note 149, p. 19.
[235] *Id.*, p. 18
[236] IEEE 2800-2022: Standard for Interconnection and Interoperability of IBR Interconnecting with Transmission Systems. ERCOT Inverter-Based Resources Task Force (March 18, 2022). https://www.ercot.com/files/docs/2022/03/21/EPRI_IEEE%202800-2022_Overview_for_ERCOT_IBRTF_2022__03_18.pdf

Q: IN YOUR OPINION, DOES DUKE ENERGY DISCUSS THE UTILITY SECTOR SUPPORT FOR NEW STANDARDS TO SMOOTH UTILITY-SCALE IBRS INTEGRATION?

A: No. According to IEEE, in April 2022:

> The IEEE Stands Association… working group that drafted the new standard had more than *175 participants representing stakeholder groups including IBR equipment manufacturers, project developers, transmission planners, grid operators, researchers, regulators and others. The draft standard was later reviewed and balloted by more than 450 subject matter experts across the industry. The standard's high approval rate of more than 90%* at the end of the IEEE SA balloting process documented, for the first time in North America and beyond, a broad consensus for the technical minimum requirements for the interconnection, capability, and performance needed for reliable integration of IBRs into the bulk power system. Similar consensus requirements have existed in Europe and Australia for some years."[237]
>
> (Emphasis added).

ERCOT (the Texas RTO) was in the process of adopting standards based on IEEE 2800-2022 in 2023, to accommodate solar farm owners' cost objections that replacing existing inverters the IEEE standard would have, in their and ERCOT's view, required.[238] The standard provides for viable inverter capabilities, such as ride-through capability, frequency response, and reactive power voltage control.[239]

---

[237] Addressing Grid Reliability As Renewable Energy Integration Speeds Up. IEEE (April 26, 2022). Retrieved April 30, 2024. https://standards.ieee.org/beyond-standards/addressing-grid-reliability-as-renewable-energy-integration-speeds-up/

[238] ERCOT, Inverter-Based (IBR) Ride-Through Requirements. Nodal Operating Guide Revision Request, No. 245, (June 22, 2023).

[239] Hoke, Andy, PhD, PE, *IEEE 2800-2022 Overview and Roadmap to Adoption.* ESIG/NAGF/NERC/EPRI Generation Interconnection Workshop (Aug. 11, 2022).

Q: WHAT CONCLUSIONS DO YOU DRAW FROM YOUR RESEARCH?

A: Duke Energy's business strategy has remained stagnant for over ten years, emphasizing the expansion of natural gas capacity and the extension of existing nuclear plants' lifetimes. Despite acknowledging climate change's impacts and the potential benefits of DERs, Duke Energy has favored utility-scale investments over distributed technologies, dismissing their cost-effectiveness and reliability advantages. This approach has led Duke Energy to ignore viable alternatives, such VVPs, which could enhance reliability and resiliency while reducing costs.

Duke Energy's reluctance to embrace distributed resources is evident in its continued dismissal of VPPs, opting instead for utility-scale investments that compromise both financial and energy security for its customers. By exploiting weaknesses in North Carolina statutes, Duke Energy prioritizes reliability and adequacy over resiliency, disregarding the integrated nature of these concepts in the face of climate disruptions. This narrow focus on reliability serves to bolster Duke Energy's profit margins at the expense of customer affordability and equity, as well as the state's overall economic stability.

State reports highlight Duke Energy's vulnerability to climate change and stress the importance of DERs, particularly VPPs, in enhancing system resilience and reducing costs. To fully harness the benefits of DERs and accelerate their deployment, state mandates are necessary to ensure their incorporation into utility

---

https://www.esig.energy/download/ieee-2800-2022-overview-and-roadmap-to-adoption-andy-hoke/

plans, using broader cost-effectiveness parameters. By mandating VPPs and microgrids as essential services and incorporating them into the CPIRP, the state can address Duke Energy's narrow focus and better serve the interests of its customers and the broader community.

Q: IN YOUR OPINION, HAS DUKE ENERGY THOROUGHLY PRESENTED THE COMMISSION THE POTENTIAL TECHNICAL CHALLENGES AND OPERATIONAL PROBLEMS ASSOCIATED WITH ITS CPIRP?

A: No.

Q: WHAT WOULD YOU RECOMMEND THE COMMISSION DO WITH DUKE'S PROPOSED CPIRP?

A: The Commission should reject Duke Energy's proposed and supplemental CPIRP. The proposed supplemental CPIRP by Duke Energy fails to meet statutory requirements, as it neglects to prioritize least-cost solutions and overlooks vital elements for maintaining or enhancing grid reliability and adequacy. Notably absent from the plan are virtual power plants (VPPs) and microgrids, which are recognized as highly effective tools for achieving cost-effectiveness and improving system resilience. Given the escalating impacts of climate change and the inherent benefits of VPPs, the Commission should broaden the cost-effectiveness criteria, as recommended by state reports and DEQ, to encompass these crucial factors, along with any other relevant benefits or costs.

As climate change impacts will escalate and VPPs possess inherent cost-effectiveness and systemwide benefits, the Commission should expand the too narrow cost-effectiveness test now used by Duke Energy according to parameters recommended by DEQ and any other benefit or cost the Commission deems reasonable.

In line with NCWARN's recommendations, the Commission should prioritize the statutory mandate for solar capacity deployment on residential and commercial rooftops and offer direct financial incentives to program participants. Additionally, efficiency measures for existing loads should be progressively increased, with targeted incentives and standards to ensure compliance, particularly focusing on expanding programs for low- and moderate-income households.

Given the inevitability of escalating climate risks, particularly along coastal areas, proactive planning should commence for the decommissioning of the New Brunswick nuclear plant within a decade. Furthermore, recognizing the current and future threats of flooding and wildfires to Duke's nuclear fleet, the Commission should initiate a docket for planning the decommissioning of these plants within the next 30 years. Additionally, expedited action is warranted for the VPP pilot program, with a shortened timeline of two years, aiming to achieve full-scale implementation within three to five years. Likewise, initiatives for scaling up vehicle-to-grid (V2G) programs should commence within the next five years to maximize their benefits.

Q: DOES THIS CONCLUDE YOUR TESTIMONY?

A: Yes.

CERTIFICATE OF SERVICE

I hereby certify that I have this day served a copy of the foregoing document upon all counsel of record by email transmission.

This the 28th day of May, 2024.

/s/ Matthew D. Quinn

Matthew D. Quinn