STATE OF NORTH CAROLINA
UTILITIES COMMISSION
RALEIGH

DOCKET NO. E-100, SUB 179

In the Matter of:	)	
Duke Energy Carolinas, LLC, and Duke	)	INITIAL COMMENTS OF
Energy Progress, LLC, 2022 Integrated	)	ENVIRONMENTAL WORKING
Resource Plans and Carbon Plan	)	GROUP
	)	

Pursuant to the North Carolina Utilities Commission's ("Commission") *Order Requiring Filing of Carbon Plan and Establishing Procedural Deadlines* entered on November 19, 2021 in the above-referenced docket, as extended by the Commission's *Order Granting Extension of Time* entered on November 29, 2021, the Environmental Working Group ("EWG"), through undersigned counsel, hereby respectfully submits its Initial Comments concerning Duke Energy Carolinas, LLC ("DEC") and Duke Energy Progress, LLC's ("DEP") (collectively, "Duke Energy" or the "Companies") Verified Petition for Approval of Carbon Plan (the "proposed Carbon Plan") filed on May 16, 2022:

SUMMARY

The Commission must reject Duke Energy's proposed Carbon Plan in the above-referenced docket. The Carbon Plan proposed by Duke Energy fails to comply with the requirements of Section 1 of House Bill 951 ("HB 951"), North Carolina's first-of-its-kind legislation codifying requirements for the electric utility sector to reduce and eventually achieve net-zero carbon emissions.

EWG retained several experts to review Duke Energy's proposed Carbon Plan: Dr. Arjun Makhijani ("Dr. Makhijani"), who has extensive experience in

nuclear engineering, electrical engineering, and renewable energy, analyzing the economics and efficiency of various renewable energy sources; Dr. M.V. Ramana ("Dr. Ramana"), a physicist, professor, and author focusing on nuclear power and climate change; and Grant Smith ("Mr. Smith"), an energy, consumer, and environmental advocate with over thirty (30) years of experience, who serves as the current Senior Energy Policy Advisor for EWG.

Following a detailed review, Dr. Makhijani, Dr. Ramana, and Mr. Smith have determined that Duke Energy's Carbon Plan is deficient in at least the following respects:

- Duke Energy's portfolios are substantially similar, thereby limiting the Commission's ability to objectively develop a least cost path that meets or exceeds present grid reliability levels.
- Duke Energy's Carbon Plan does not adequately consider the latest technological breakthroughs and other approaches to achieve the least cost generation and resource mix, such as optimizing deployment of distributed energy resources ("DERs").
- Duke Energy's Carbon Plan does not evaluate the social costs of carbon in comparing the costs of its four portfolios and related emissions reduction targets.
- Duke Energy's plan to procure about half its hydrogen requirements for combined cycle and combustion turbine electricity generation in the year 2050 from a putative "green hydrogen market" in all four portfolios is

unrealistic and speculative; it introduces significant uncertainties as to cost and whether the 100% decarbonization target can be achieved in that year.

- Duke Energy's Carbon Plan likely underestimates demand growth due to electrification of transportation and of non-electric energy uses in the residential and commercial sectors.
- Duke Energy's Carbon Plan fails to adequately capture requirements for maintaining or increasing grid reliability and resilience.
- Duke Energy's Carbon Plan does not include an analysis of the economic risks and reliability considerations associated with new and existing nuclear technology.
- Duke Energy's option to put hydrogen in existing pipelines may increase indoor air pollution, disproportionately impacting residential and commercial users of natural gas.

These findings demonstrate that Duke Energy's Carbon Plan fails to comply with the mandates of HB 951 and other applicable North Carolina law and public policy. EWG therefore respectfully requests that the Commission reject Duke Energy's proposed Carbon Plan.

Finally, pursuant to the Commission's *Order Establishing Additional Procedures and Requiring Issues Report* entered on April 1, 2022, EWG offers the following list of substantive issues that it believes should be subject to an expert witness hearing:

1. Whether Duke Energy has underestimated the costs, risks, and reliability of its proposed new nuclear technology and nuclear generation?

2. Whether Duke Energy has failed to adequately consider grid modernization, storage, energy efficiency measures, and the latest technological breakthroughs to achieve the least cost mix?

3. Whether Duke Energy has adequately assessed demand needs for DEP and DEC customers?

4. Whether Duke Energy's proposed portfolios are varied enough to enable the Commission to objectively evaluate and adopt a least cost path to achieve compliance with the carbon reduction goals of HB 951?

5. Whether Duke Energy has adequately taken into account the social costs of carbon?

6. Whether Duke Energy has addressed potential nitrogen oxide emissions and related air pollution in the context of any of its four portfolios and its possible disproportionate impact on customer classes?

7. Whether Duke Energy adequately considers the potential technical challenges and operational problems associated with its proposed advanced nuclear reactors?

8. Whether Duke Energy has demonstrated that greater 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 than adding its proposed new nuclear technology?

INDEX OF ATTACHMENTS

EWG submits the following attachments filed contemporaneously with these Initial Comments.

Attachment A - Part I: **A. Makhijani: Review and Comments on Duke Energy Carolinas, LLC and Duke Energy Progress, LLC's 2022 Proposed Carbon Plan.**

Attachment A - Part II: **A. Makhijani & M.V. Ramana: Review and Comments on Duke Energy Carolinas, LLC and Duke Energy Progress, LLC's 2022 Proposed Carbon Plan.**

Attachment B: **G. Smith**: **Duke Energy's Unreasonable, Imprudent Carbon Plan: High Bills and More Boondoggles Proposed for Duke Ratepayers**

DISCUSSION

Session Law 2021-165 ("S.L. 2021-135"), also known as HB 951, enacted N.C. Gen. Stat. § 62-110.9, clearly directs the Commission—not Duke Energy exclusively—to develop a Carbon Plan with utilities and stakeholders that takes all reasonable steps to reduce carbon dioxide emissions in North Carolina from electric public facilities owned or operated by electric public utilities, such as Duke Energy, by 70% from 2005 levels by 2030 and to achieve carbon neutrality by 2050.

Duke Energy's proposed Carbon Plan, as presented to the Commission, fails to comply with two primary directives of HB 951, which first, requires the Commission to develop a Carbon Plan that complies with current law and practice with respect to least-cost planning for generation,[1] and second, ensures that any generation and resource changes maintain or improve upon the adequacy and reliability of the existing grid.[2]

Large portions of these Initial Comments draw from the reports prepared by Dr. Makhijani, Dr. Ramana, and Mr. Smith, which provide additional details and supporting citations and are herein incorporated in their entirety by reference.

I. Duke Energy's Nearly Identical Portfolios Prevent an Objective Cost Comparison, Limiting the Commission's Ability to Achieve the Least Cost Path Consistent with HB 951 and Current Law and Practice.

[1] N.C. Gen. Stat. § 62-110.9(2).
[2] N.C. Gen. Stat. § 62-110.9(3).

Section 1 of HB 951 directs the Commission to develop a plan to: "achieve the authorized reduction goals, which may, *at a minimum*, consider power generation, transmission and distribution, *grid modernization*, storage, energy efficiency measures, demand-side management, and *the latest technological breakthroughs* to achieve *the least cost* path consistent with this section to achieve compliance with the authorized carbon reduction goals."[3] Section 1 further instructs the Commission to develop a Carbon Plan that complies with "current law and practice with respect to the least cost planning for generation, pursuant to G.S. 62-2(a)(3a)."[4]

Section 62-2 of the North Carolina General Statutes codifies the governing principles that guide the Commission's decision-making with respect to rates, services, and operations of public utilities in the state. Section 62-2(a)(3a) declares that the policy of North Carolina is:

> To assure that resources necessary to meet future growth through the provision of adequate, reliable utility service include use of the entire spectrum of demand-side options, including but not limited to conservation, load management and efficiency programs, as additional sources of energy supply and/or energy demand reductions. To that end, to require energy planning and fixing of rates in a manner to result in the least cost mix of generation and demand-reduction measures which is achievable, including consideration of appropriate rewards to utilities for efficiency and conservation which decrease utility bills[.]

In its Verified Petition for Approval of Carbon Plan, Duke Energy asserts that its proposed plan "assesses a range of portfolios that will . . . result in further carbon dioxide ('CO_2') emissions reductions through a prudent, orderly, and cost-effective

[3] N.C. Gen. Stat. § 62-110.9(1) (emphasis added).
[4] N.C. Gen. Stat. § 62-110.9(2).

energy system transition."[5] The reality belies this assertion. Instead, the portfolios within Duke Energy's proposed Carbon Plan neglect to include various options for the purpose of assessing the least cost path towards carbon neutrality. Duke Energy's four portfolios are substantially similar, omit advanced technology and potentially lower-cost options, contain higher cost elements, and do not contain enough variation of technologies and approaches to enable the Commission to perform a cost comparison. In light of these statutory failings, the Commission must reject Duke Energy's Carbon Plan.

A. The differences between the four portfolios are marginal.

A summary of the final resource additions for each proposed portfolio for target year 2050 in Duke Energy's Proposed Carbon Plan is illustrated by the table below.[6]

Table E-71: Final Resource Additions by Portfolio [MW] for 2050

	Coal Retirements	Solar[1]	Onshore Wind	Battery[2]	CC	CT	Offshore Wind	New Nuclear[3]	PSH
P1	-9,300	19,900	1,800	7,400	2,400	6,800	800	9,900	1,700
P2	-9,300	18,200	1,700	5,900	2,400	6,400	3,200	9,900	1,700
P3	-9,300	19,000	1,800	6,400	2,400	7,500	0	10,200	1,700
P4	-9,300	18,100	1,800	6,100	2,400	6,800	800	10,200	1,700

Note 1:Includes solar capacity both standalone and paired with battery.
Note 2: Includes battery capacity both standalone and paired with solar.
Note 3: Includes SMR and advanced nuclear with integrated storage.

Part I of Dr. Makhijani's Report highlights the major similarities and minor differences between Duke Energy's four portfolios and makes the following observations: Combined cycle capacity and Pumped Storage Hydro ("PSH")

[5] Duke Energy Company & Duke Energy Progress Verified Petition for Approval of Carbon Plan ¶ 4, Docket No. E-100, Sub 179 (May 16, 2022).
[6] Duke Energy, Carolinas Carbon Plan, Appendix E, Table E-71 at p. 77 (May 16, 2022) [hereinafter Carolinas Carbon Plan].

across all portfolios are exactly the same; proposed onshore wind is almost identical across all portfolios, with only about a 6% difference between the lowest (P2) and highest capacity portfolios (P1, P3, P4); the highest solar capacity portfolio (P1) is approximately 9% greater than the lowest solar capacity portfolio (P4); the highest nuclear capacity portfolios (P3, P4) is approximately 3% greater than the lowest nuclear capacity portfolios (P1, P2) with no consideration of the uncertainties in cost and construction time of new nuclear technology such as small modular reactors ("SMRs") and uncertified non-light water reactor designs, as further discussed in Section III below; and the difference between the highest battery capacity portfolio (P1) is approximately 24% greater than the lowest battery capacity portfolio (P2).

Furthermore, Duke Energy's efficiency assumptions are the same in every portfolio at 1% of eligible load, yet, despite Duke Energy's assertion that this is a "very ambitious target,"[7] there is a much wider range of efficiency achievements across the country. For example, 15 states achieved efficiency gains of more than 1% in 2020, with the highest being 2.34%.[8] Since efficiency is often considered the lowest cost energy resource, without a wider range of efficiency assumptions—including more ambitious targets and investments to offset costly supply side investments—there is no reasonable way to evaluate whether Duke Energy's Carbon Plan meets the least cost mandate.

B. <u>Duke Energy's four portfolios do not consider lower cost approaches and advanced technologies</u>.

[7] Carolinas Carbon Plan, Appendix G at p. 5.
[8] Attachment A, Part I, Makhijani Report at p. 8.

There are various elements that could significantly lower costs that are not included in Duke Energy's Carbon Plan, even though they are recognized within the Plan. The following discussion is not meant as a conclusive cost analysis. Instead, it is meant to show the Commission that other advanced technological approaches can achieve the low-cost mandate and clean energy future envisioned by HB 951.

Duke Energy's Carbon Plan assumes that by the year 2050, a large amount of hydrogen will be produced from new and existing combustion turbines ("CT") and combined cycle ("CC") power plants to reduce and eventually eliminate carbon dioxide emissions. Duke Energy briefly considered, but rejected, fuel cells in the context of baseload technologies, indicating that it did not evaluate the option of using low-cost light duty fuel cells or medium duty fuel cells as a means of replacing CC and CT power plants for peak and intermediate load applications. Fuel cells would be beneficial because they would eliminate air pollution attributable to CT and CC generation. To aid the Commission's adoption of a least cost approach, the Carbon Plan should include fuel cells of varying costs, durability, and efficiencies so that a reasonable least cost comparison can be made.

Another example of potentially lower cost technological innovations that could have a major role in a future decarbonized grid is Vehicle-to-Grid technology ("V2G"), which is far better developed than the putative "green hydrogen market" or uncertified nuclear technologies that Duke Energy has included. V2G enables two-way transfer of power between electric vehicles ("EV") and the electrical grid. Consideration of such technology in any of the four portfolios is notably absent

from Duke Energy's Carbon Plan. This innovative technology can help the energy grid supply electricity during peak hours and, provided reasonable and prudent investments are made and suitable infrastructure is built, has the potential to displace a significant amount of conventional infrastructure such as gas turbines.

For example, as Dr. Makhijani illustrates in Part I of his Report, if the approximately 55,000 parking spots across all of North Carolina's major airports can accommodate V2G, the potential capacity, at 8 kW and 40 kwh per spot, would be over 400 MW and over 2,000 MWh. Furthermore, if this technology were added in other locations with significant capacity, such as school bus and transit bus depots, and in units of the "Self-Optimizing Grid," it has the potential to displace much of the combustion turbine resources proposed by Duke Energy's Carbon Plan. Other benefits to this approach could include lowering electricity and transportation costs for participating consumers.

C. Duke Energy's Carbon Plan does not consider the social costs of carbon.

The carbon mitigation trajectories in all four portfolios are substantially the same. However, they do differ in terms of cumulative CO_2 emissions, due to the varying dates for achievement of the 2030 target of HB 951. Duke Energy claims that the higher emission portfolios with extended timelines are estimated to be the lower cost options (P3 and P4). The supposed cost advantage attributed to P3 and P4 are illusory when considering the range of social costs related to carbon from the added emissions in these portfolios. Dr. Makhijani notes in Part I of his Report that the Environmental Protection Agency has published various estimates related to the social cost of carbon—ranging from $14 - $270 per metric ton. If considering

even a $60 per metric ton scenario, the added social cost of carbon imputed to P3 and P4 would be approximately $4.4 billion more, relative to P1. Therefore, should this well-recognized social cost of carbon increase overtime, the costs associated with P3 and P4 would significantly rise compared with the P1 and P2 portfolios, wiping out much, most, or even all the supposed cost advantages of P3 and P4.

For these reasons, EWG respectfully requests that the Commission reject Duke Energy's Carbon Plan until a plan is developed that includes consideration of the social costs of carbon and advanced new technologies that could significantly lower costs and improve the electrical grid's reliability and resilience. The inclusion of such elements would further aid the Commission in performing an objective cost comparison to meet the least cost planning for generation mandate of HB 951 and N.C. Gen. Stat. § 62-2(a)(3a).

II. Duke Energy's Carbon Plan Underestimates Demand, and Will Not Maintain or Improve Upon the Adequacy and Reliability of the Existing Grid.

HB 951 requires the Commission to "[e]nsure any generation and resource changes maintain or improve upon the adequacy and reliability of the existing grid."[9] By underestimating the electrification of transportation and omitting consideration of large-scale electrification of natural gas uses in buildings, Duke Energy's Carbon Plan severely underestimates demand growth, thereby undermining the reliability and adequacy of the existing grid. Further contributing to future uncertainties for the electric grid is Duke Energy's reliance on relatively long lead-time nuclear, as further discussed in Section III. Because of Duke

[9] N.C. Gen. Stat. § 62-110.9(3).

Energy's failure to comply with its statutory obligations, the Commission must reject Duke Energy's proposed Carbon Plan and adopt a plan that adequately addresses these issues.

A. Duke Energy's Carbon Plan contains a low projection of electric vehicle deployment.

Duke Energy's assumption about transportation electrification rely on targets set by major automakers and the Biden Administration's goal for half of all new passenger vehicle sales in the United States to be electric vehicles by 2030. This assumption fails to capture the uncertainty and variety of targets that have been adopted domestically and internationally which will have global impacts, not to mention shifts in consumer demand for electric vehicles. As Dr. Makhijani explains:

> The Duke Energy portfolios present a very narrow view of currently available major targets that should be considered, since the automotive market and automotive technologies are largely globalized. There are a variety of corporate and national plans and targets that are far more ambitious than the assumptions made by Duke Energy; even if not fully realized, these more ambitious plans would greatly alter Duke Energy's projection for transportation demand.[10]

If the transportation sector is electrified at a faster pace than Duke Energy's projection, the estimates for transportation load in 2035 in Duke Energy's Carbon Plan would be short by thousands of gigawatt-hours. This substantial underestimation of demand could lead to reliability problems, including peak demand growth, and missed opportunities for V2G infrastructure, as discussed above.

[10] Attachment A, Part I, Makhijani Report at p. 24.

B. Duke Energy's Carbon Plan does not consider electrification of residential and commercial spaces.

Duke Energy's electric load forecast does not include major initiatives for conversion of fossil fuel dependent structures in the residential and commercial sectors, particularly with respect to space and water heating. Significant load growth beyond Duke Energy's projections will occur should a large-scale conversion of existing buildings take place over time. Other implications for failing to include demand growth due to conversion of natural gas uses in buildings include:

- Underestimation of generation and storage;
- Increased costs for transportation and delivery of natural gas for power generation due to lower demand for natural gas in the residential and commercial sectors; and
- Underestimation of opportunities for efficiency investments and demand response aggregation.

C. Duke Energy's Carbon Plan undermines the reliability of the electric grid.

A number of factors, including those discussed above and Duke Energy's reliance on relatively long lead-time nuclear, as further discussed in Section III, may cause reliability in the existing grid to deteriorate. Maintaining reliability and service in the future, as required by HB 951, requires resilience planning, including quantitative criteria that go beyond the Loss of Load Expectation, Loss of Load Hours, and Expected Unserved Energy as presented in Duke Energy's Carbon Plan.

Duke Energy's Carbon Plan refers to the development of a "Self-Optimizing Grid" ("SOG") program, which aims to integrate distributed solar and battery resources. Although the SOG is a suitable framework for resiliency planning, Duke Energy has not translated this program into resilience requirements and design criteria for distributed solar generation and other distributed resources. For example, the number of self-islanding microgrids that would be required to maintain continuity of essential services has not been specified. In fact, microgrids are not discussed in Duke Energy's Appendix on generating resources (Appendix E); are mentioned only in passing in Duke Energy's Appendix on Reliability and Operational Resilience Considerations (Appendix Q); and referenced in Appendix G without any quantitative detail linking it to the proposed Carbon Plan.

Another significant omission from Duke Energy's Carbon Plan in the context of power system reliability and resiliency is an analysis of black-start capability and requirements, which is the process of restoring system power after a complete blackout. A detailed consideration of black-start capability is important for the development of a least cost framework since it may change the mix of resources relative to those in the proposed Carbon Plan portfolios.

Finally, assessing the reliability and resiliency of the electric grid necessitates an evaluation of the availability of water resources, given the climate crisis and its impacts on water supply. Such a consideration is notably absent from Duke Energy's Carbon Plan. Although Nuclear Energy Technology and its related risks are further discussed below, it is worth noting that since Duke Energy's proposed new nuclear generation capacity will increase its existing capacity in

North Carolina by about 130%, this will significantly increase cooling water requirements. As global temperatures rise, high water temperatures may result in de-rating of thermal generation capacity during summer peaks; a least cost plan that maintains or improves reliability therefore necessitates an analysis of the vulnerabilities associated with the water resource challenges ahead.

III. Duke Energy's Proposed Nuclear Technology and Reliance on Existing Nuclear is Not a Reasonable and Prudent Step in Executing the Carbon Plan.

Duke Energy's heavy reliance on nuclear energy generation is misplaced and patently unreasonable. Duke Energy claims that "[n]ew advanced nuclear plants such as small modular reactors ("SMRs") and advanced reactors will be critical to achieving carbon neutrality by 2050 as required by HB 951," and that modeling performed identifies the need for at least 570 MW of new nuclear by 2035[11] and about 10,000 MW by 2050, with only slight (300 MW) differences between portfolios.[12] The incorporation of new nuclear reactor designs, for which certification applications have not even been submitted, much less been built and operated under commercial conditions, is far from a reasonable and prudent step towards achieving the carbon emissions reductions target of HB 951. For these reasons, the Commission must reject Duke Energy's Carbon Plan.

A. Nuclear power is not economically competitive and presents great risks.

The high costs associated with nuclear power from both large and small reactors imply that a path through nuclear toward a low-cost, low-carbon future is

[11] Carolinas Carbon Plan, Chapter 4 at p. 18.
[12] Carolinas Carbon Plan, Appendix E, Table E-71 at p. 77.

unlikely—especially when other low carbon alternatives are available. While nuclear costs have *increased* over time, the cost of electricity for solar and wind have declined and will continue to do so. As detailed in Dr. Makhijani and Dr. Ramana's Report (Attachment A, Part II), in a 2021 annual cost report, Lazard, an asset management and investment firm, estimated that:

> [T]he levelized cost of electricity from new nuclear plants will be between $131 and $204 per megawatt hour, whereas the corresponding cost from newly constructed utility-scale solar and onshore wind plants are between $26 and $50 per megawatt hour; offshore wind is estimated to produce electricity at somewhere between $66 and $100 per megawatt hour.[13]

Additionally, the number of unprofitable nuclear plants that have been prematurely retired continues to rise due to high operating and maintenance costs. In its proposed Carbon Plan, Duke Energy claims that its existing reactors will operate reliably beyond the currently licensed 60 years for another 20 years. Even France, a country that is dependent on nuclear power with reactors that are less than 60 years old, has had significant problems recently. Dr. Makhijani and Dr. Ramana highlight that "less than 30 GW of the 61.4 GW capacity of the French nuclear power fleet was online at the end of April 2022" in part due to the discovery of "stress corrosion cracking in the pipes of the emergency core cooling system of some reactors towards the end of 2021."[14] Duke Energy's Carbon Plan projects a similar reliance on nuclear power to that of France, and such issues make it imperative that the Commission reject the current plan and consider low-cost and lower risk energy alternatives.

[13] Attachment A, Part II, Makhijani & Ramana Report at p. 43.
[14] Attachment A, Part II, Makhijani & Ramana Report at p. 45.

B. The historical delays in nuclear deployment will make it unlikely for Duke Energy's Carbon Plan to meet the emission reduction targets of HB 951.

Duke Energy has not included an analysis of the historical large cost overruns and delays in commissioning nuclear power plants, nor of the common impacts of cancellations of both planned and under-construction reactor projects. Another element of uncertainty associated with nuclear power generation is the great economic risk associated with project cancellation or delays, as demonstrated by the "failed nuclear renaissance." As further detailed in Dr. Makhijani and Dr. Ramana's Report (Attachment A, Part II), "[t]hat proposed renaissance was propelled by the Energy Policy Act of 2005 that offered various guarantees and incentives to nuclear power." What followed was a series of cancellations and no additional nuclear capacity. In fact, only two projects during this time even reached the construction stage. One was abandoned after $9 billion was spent, and the other project, set to build units 3 and 4 at the Vogtle Plant in Georgia, was originally estimated to cost $14 billion. That projection has since increased to over $30 billion, and construction remains incomplete. The projected start dates of these two units were 2016 and 2017, but those dates were pushed back. The current scheduled start date is set for 2023.

These high costs and delayed timeframes are demonstrative of a longstanding pattern associated with nuclear power plants. As Dr. Makhijani and Dr. Ramana's Report (Attachment A, Part II) explain, "one study examined 180 nuclear projects and a mere five met anticipated cost and time targets. The

remaining 175 took, on average, 64% more time than projected, and had final costs that exceeded the initial budget on average by 117%."[15]

This longstanding history is critical to the Commission's evaluation of whether Duke Energy's proposed nuclear plans will have an impact on the decarbonization schedule of its portfolios and whether they will meet the ultimate target set by HB 951.

C. Small Modular Nuclear Reactors are an economically impractical alternative and do not provide a suitable complement to wind or photovoltaic (solar) power.

Large reactors offer economies of scale; however, as the name suggests, Small Modular Nuclear Reactors, or SMRs, produce relatively small amounts of electricity and have low economic value. Additionally, the significant cost overruns and schedule delays detailed above also extend to modular construction. SMRs will cost more than large reactors for each megawatt of generation capacity, and, as Dr. Makhijani and Dr. Ramana explain, "unless the problem of lost economies of scale is fully overcome, the higher cost per unit of capacity will make electricity from small reactors more expensive than large reactors."[16]

SMR proponents argue that savings from modularity and factory manufacturing would compensate for their low economic value. However, in the United States and France, costs have increased as more nuclear plants have been built. According to Dr. Makhijani and Dr. Ramana, even under optimistic assumptions, SMRs would have to be manufactured by the hundreds, if not thousands, to compensate for the loss of economies of scale. Additionally, the cost

[15] Attachment A, Part II, Makhijani & Ramana Report at p. 48.
[16] Attachment A, Part II, Makhijani & Ramana Report at p. 50.

of electricity from SMRs have only shown high estimates. For example, As Dr. Makhijani and Dr. Ramana point out, "in its 2019 Integrated Resource Plan ("IRP"), Idaho Power estimated a cost of $121 per megawatt hour for a NuScale plant operating at a 90% capacity factor."[17]

Furthermore, due to their high fixed (capital) costs and low variable (fuel) costs, nuclear power does not provide a suitable complement to renewable resources such as wind or photovoltaic (solar) power because they are not economically suitable for responding to variability. As Dr. Makhijani and Dr. Ramana explain, responding to variability would mean operating at partial load for much of the time, which would raise costs per unit of electricity. For example, "the cost per unit of electricity from a NuScale SMR would rise by about 20 percent if the capacity factor is reduced from 95% to 75%."[18]

In addition to two proposed SMRs, Duke Energy's Carbon Plan also lists two other reactor designs scheduled to be built and in commercial operation by the end of this decade. These advanced reactors include non-light water reactors. Further details regarding the status and potential problems and vulnerabilities with each proposed design are included in Dr. Makhijani and Dr. Ramana Report in Part II of Attachment A.

Given the poor economic prospects for SMRs, and because Duke Energy's portfolios contain almost the same amount of nuclear capacity, the Commission must reject Duke Energy's Carbon Plan until more varied portfolios are presented to enable a least cost comparison.

[17] Attachment A, Part II, Makhijani & Ramana Report at pp. 50-51.
[18] Attachment A, Part II, Makhijani & Ramana Report at p. 51.

IV. Duke Energy Should Not Be Permitted to Bypass Other Opportunities for Regulatory Oversight.

In its Verified Petition for Approval of Carbon Plan, Duke Energy boldly asks the Commission to make a premature blanket determination outside the scope of the appropriate proceedings that its proposed Carbon Plan is reasonable and prudent. This attempt by Duke Energy to circumvent the inquiry typically required for future cost recovery is in violation of law and must be rejected by the Commission.

In its Verified Petition for Approval of Carbon Plan, Duke Energy repeatedly uses the terms "reasonable" and "prudent" and declares its plan as both "reasonable and prudent."[19] Duke Energy then unabashedly asks this Commission to make the express determination that "engaging in initial project development activities for [the activities summarized in Table 3, including new nuclear and natural gas dependent generation,][20] **is a reasonable and prudent** step in executing the Carbon Plan to enable potential selection of these generating facilities in the future."[21] Furthermore, Duke Energy requests approval of its Carbon Plan "in its entirety,"[22] including the statement that "the Carbon Plan represents prudent long-term electronic resource planning that complies with current law and practice. . . ."[23] Duke Energy is therefore asking the commission to preauthorize cost recovery and that project development costs relating to risky, unproven SMRs

[19] The term "reasonable" is used six times and the term "prudent" is used six times in the Petition for Approval of Carbon Plan with similar frequency in the Executive Summary (ES). The phrase "reasonable and prudent" is used six times in the Petition for Approval of Carbon Plan and three times in the ES.
[20] Carolinas Carbon Plan, Table 3 at p. 23.
[21] *Id.* at 29 (emphasis added).
[22] *Id*. at 27.
[23] *Id*. at 2.

and other elements of its Plan be recoverable through base rates in the future, even in the event that those sources are not needed for energy generation (or are not least cost as required by statute). In short, Duke Energy is attempting inappropriately to adjudicate whether any of its proposed portfolios are reasonable and prudent under the regulatory requirements set forth in N.C. Gen. Stat. § 62-110.1 (Certificate for Construction of Generating Facilities), and N.C. Gen. Stat. § 62-133 (How Rates Fixed) using the Carbon Plan as a backdoor around those statutes' independent requirements.

The Carbon Plan cannot act in this backdoor fashion. HB 951 does not preempt the requirement under N.C. Gen. Stat. § 62-110.1(e) for Duke Energy to show that other energy efficiency and generation resources cannot provide a more cost-effective and reliable generation system than the nuclear facility development the producer wishes to pursue. N.C. Gen. Stat. § 62-110.1(e) expressly requires that, prior to the construction of a new coal or nuclear facility, Duke Energy must demonstrate that:

> [E]nergy 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 and that the construction and operation of the facility is in the public interest.[24]

Duke has made no attempt at such a demonstration, and the Commission should not accept Duke Energy's invitation to ignore these statutory requirements.

The statute also requires a showing that costs incurred were reasonable and prudent and provides that, if the construction is canceled, then costs

[24] N.C. Gen. Stat. § 62.110.1(e).

previously determined to be reasonable and prudent may be recovered in rates.[25] The Carbon Plan process may not be used as a blanket stamp of approval that any measure that falls within the umbrella of Duke Energy's suggested portfolio is reasonable and prudent.

Further, N. C. Gen. Stat. § 62-133 provides that, to be included in rates, costs must not only be reasonable and prudent, but must be, with only limited exception, for property "used and useful, or to be used and useful within a reasonable time."[26] Duke Energy again asks this Commission in these Carbon Plan proceedings to ignore these fundamental ratemaking principles and to determine now that all costs relating to the development of each of the resources identified in Table 3 of its Executive Summary, including expensive and unreliable SMRs and volatile natural gas dependent resources, are deemed reasonable and prudent, even if those resources are ultimately determined not to be least cost or even necessary.

Finally, preapproval of Duke Energy's plans as reasonable and prudent displaces the financial burden of incorporating unproven technologies like SMRs from the stockholders onto the ratepayers. As noted elsewhere and in the attached expert reports, Duke Energy's proposed Plan gifts short shrift to renewable and energy conservation technologies with demonstrated efficacy as well as advanced technologies like V2G and instead favors problematic, costly, and risky technologies like SMRs. The SMR design that has advanced furthest through the Nuclear Regulatory Commission approval process is plagued by certification

[25] N.C. Gen. Stat. § 62-110.1(f1).
[26] N.C. Gen. Stat. § 62-133(b)(1).

hurdles, delays, and cost overruns. Imposing these known problems on ratepayers is anything but reasonable or prudent.

Further details regarding Duke Energy's impermissible attempt to obtain blanket approval for its proposed portfolios as reasonable and prudent are included in Mr. Smith's Report in Attachment B.

CONCLUSION

Duke Energy's proposed Carbon Plan and accompanying portfolios must be rejected as noncompliant with HB 951 and other statutory and regulatory requirements. As a means of addressing several of the issues discussed above, among others, Part I of Dr. Makhijani's Report concludes with a recommendation of well-differentiated Carbon Plan portfolios that take into account cost, reliability, and resilience needs to enable the Commission to perform a cost comparison and determine a least cost approach.

Respectfully submitted this 15th day of July, 2022.

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CERTIFICATE OF SERVICE

I hereby certify that I have on this day served a copy of the foregoing *Initial Comments of Environmental Working Group* upon each of the parties of record in these proceedings or their attorneys of record by electronic service.

This the 15th day of July, 2022.

LAW OFFICE OF F. BRYAN BRICE, JR.

By: /s/ Andrea C. Bonvecchio

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