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October 24, 2022

VIA ELECTRONIC FILING

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

RE: In the Matter of: Duke Energy Progress, LLC, and Duke Energy Carolinas, LLC, 2022 Biennial Integrated Resource Plan and Carbon Plan, Docket No. E-100, Sub 179

Dear Ms. Dunston:

Please find enclosed for filing the Joint Brief and Partial Proposed Order of the North Carolina Sustainable Energy Association, Southern Alliance for Clean Energy, Natural Resources Defense Council, Sierra Club, Carolinas Clean Energy Business Association, Clean Power Suppliers Association and MAREC Action. By copy of this letter, I am serving a copy of the same on all parties of record by electronic delivery.

Under separate cover, the North Carolina Sustainable Energy Association, Southern Alliance for Clean Energy, Natural Resources Defense Council, and Sierra Club are also filing a separate partial proposed order.

Please do not hesitate to contact me if you have any questions.

Sincerely,

s/ Gudrun Thompson

Enclosures
cc: Parties of Record

BEFORE THE NORTH CAROLINA UTILITIES COMMISSION
DOCKET NO. E-100, SUB 179

	)	**JOINT POST-HEARING BRIEF**
	)	**OF THE NORTH CAROLINA**
In the Matter of:	)	**SUSTAINABLE ENERGY**
	)	**ASSOCIATION, SOUTHERN**
Duke Energy Progress, LLC, and	)	**ALLIANCE FOR CLEAN**
Duke Energy Carolinas, LLC, 2022	)	**ENERGY, SIERRA CLUB,**
Biennial Integrated Resource Plans	)	**NATURAL RESOURCES**
and Carbon Plan	)	**DEFENSE COUNCIL,**
	)	**CAROLINAS CLEAN ENERGY**
	)	**BUSINESS ASSOCIATION,**
	)	**CLEAN POWER SUPPLIERS**
	)	**ASSOCIATION AND**
	)	**MAREC ACTION**

The North Carolina Sustainable Energy Association (NCSEA), the Southern Alliance for Clean Energy (SACE), the Sierra Club, and the Natural Resources Defense Council (NRDC) (NCSEA, SACE, the Sierra Club, and NRDC, collectively, the Coalition of Low-Cost Energy And Net-Zero Intervenors or CLEAN Intervenors), the Carolinas Clean Energy Business Alliance, the Clean Power Suppliers Association, and MAREC Action respectfully submit this joint post-hearing brief in support of the near-term execution plan in their Joint Partial Proposed Order.

I. INTRODUCTION

N.C. Gen. Stat. § 62-110.9 (H951) sets clear deadlines for achieving its carbon-reduction requirements: a "seventy percent (70%) reduction in emissions of carbon dioxide (CO2) emitted in the State from electric generating facilities owned or operated by electric public utilities from 2005 levels by the year 2030 and carbon neutrality by the year 2050. .

. ."[1] Although the General Assembly empowered the Commission with significant discretion in planning to achieve the statutory reductions, that discretion has limits.

First, the Commission may extend the 70 percent reduction deadline to 2032 only where doing so would have a "more significant and material impact on carbon reduction."[2] Even if Duke had demonstrated a "more significant and material impact on carbon reduction" to warrant a two-year extension to comply with H951's interim emission reduction requirement—which it has not—any discussion of portfolios that extend the 70-percent reduction deadline beyond 2032 is entirely premature. The Commission may extend that deadline beyond 2032 only under specific, enumerated circumstances: "in the event the Commission authorizes construction of a nuclear facility or wind energy facility that would require additional time for completion due to technical, legal, logistical, or other factors beyond the control of the electric public utility" or "in the event necessary to maintain the adequacy and reliability of the existing grid."[3] The legislature's use of the phrase "in the event" makes clear that an extension pursuant to one of these triggering circumstances is to be granted only if ("in the event") such a circumstance arises—not prospectively, or at any rate not a decade or more prior to the extended compliance date proposed by the utility. Accordingly, the Commission should disregard any proposed portfolios that would not achieve the 70 percent reduction on time, because any argument that they have satisfied the statutory criteria required to justify a delay is simply untenable.

Further, in enacting H951, the legislature made clear its command that the law's carbon-reduction requirements be achieved at least cost. H951 explicitly admonishes the

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

Commission to "[c]omply with current law and practice with respect to the least cost planning for generation, pursuant to G.S. 62-2(a)(3a), in achieving the authorized carbon reduction goals and determining generation and resource mix for the future." N.C.G.S. § 62-110.9. That section of the General Statutes provides that resources for future growth include use of the "entire spectrum of demand-side options" and "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. . . ." N.C.G.S. § 62-2(a)(3a) (emphasis added).

Current law and practice with respect to least-cost planning focuses on two key considerations, cost and risk—both of which are typically borne by ratepayers. Although a key metric in least-cost planning is the present value of revenue requirements (PVRR)—the long-term system cost to ratepayers associated with a given resource or portfolio—the PVRR is not the only metric, nor should it be. One important question in the least-cost analysis is "least-cost for whom?" Answering this question requires consideration of how the costs of a portfolio are distributed across and within ratepayer classes.

In addition to cost considerations, risk is an important factor in least-cost planning. The Commission's IRP rules recognize the importance of factoring in risk when comparing combinations of resources (i.e., portfolios) in resource planning.[4] In the case of the Carbon Plan under development, these risks include (but are not limited to) fuel price risk, execution risk, stranded asset risk, and risk associated with non-commercial technologies. Depending how future conditions unfold, these risks have the potential to expose ratepayers

[4] NCUC Rule R8-60(g) (analysis must take into account sensitivity to "variations in future estimates of peak load, energy requirements, and other significant assumptions, including, but not limited to, the risks associated with wholesale markets, fuel costs, construction/implementation costs, transmission and distribution costs, and costs of complying with environmental regulation," as well as applicable "system operations, environmental impacts, and other qualitative factors.)

to billions of dollars in excess costs. A Carbon Plan that minimizes those risks will result in a path to compliance with H951's requirements that is not only least-cost, but also "least-regrets."

II. MODELING FOR COMMISSION CONSIDERATION FOR PLANNING PURPOSES

The Commission's statutory obligation in this proceeding requires the Commission to "take all reasonable steps" to achieve the 2030 carbon emissions reduction requirements of 70% emission below 2005 levels. Therefore, the Commission should only consider the models and portfolios presented that meet the 2030 interim emission reduction targets. To further guide its decision, the Commission should focus on portfolios that (1) rely on commercially available technologies for meeting that 2030 requirement; (2) are best positioned to take advantage of the cost savings that will be made possible by the policies in the Inflation Reduction Act; (3) meet the statutory requirements at least cost while maintaining system reliability; and (4) maintain operational flexibility by relying on modular resources that can be readily scaled up or down as necessary.

As with any modeling exercise, there are a wide range of reasonable choices and assumptions that can be made in capacity expansion and production cost modeling for the Carbon Plan. These various inputs and assumptions create a range of possible pathways for Commission consideration. The Commission need not, however, resolve all differences in inputs, assumptions, and other modeling decisions from the various portfolios before establishing a reasonable and prudent near-term execution plan over the next three years. Instead, the Commission should select as guideposts those models that would achieve the 2030 carbon emissions requirements (70% below 2005 levels by 2030).

As noted by several intervening parties, Duke has not made a showing that justifies the Commission extending achievement of the interim carbon- reduction requirement beyond 2030. See, e.g., September 9 Comments of Tech Customers on Non-Hearing Issues at 21 (noting that the "Companies have not presented any plan that would have a 'more significant and material impact on carbon reduction,' so section 62-110.9(4) does not permit an extension" and that the specific contingencies allowing for a two-year extension relating to wind or nuclear resources have not occurred); July 15 Comments of: CCEBA at 6-8 ("the adopted Carbon Plan *must* achieve the 70% reduction by 2030 *unless*" specific findings are made relating to contingencies that have not yet occurred); CLEAN Intervenors at 10-15 (the law requires meeting the 70% carbon reductions by 2030; the Commission retains "discretion with regard to the timing of compliance where implementation would have a 'more significant and material impact on carbon reduction'— in other words, would result in faster or deeper carbon reductions; enumerated and unmet contingencies allow for further delays only after the Commission has authorized construction of a nuclear or wind facility that faces delays due to specific factors); AGO at 7-13 ("the Commission may only include a portfolio that delays compliance with the [2030] statutory deadline in its final Carbon Plan if it determines that it provides 'more significant and material impact on carbon reduction'"); CEBA (asking the Commission to reject Duke's P2-P4 portfolios because they "significantly and unreasonably delay HB 951's statutorily mandated goal deadline of a 70% reduction in CO2 by 2030 and are therefore unreasonable for planning purposes"); EJCAN et al. at 21-24 (noting the "explicit restrictions to what may be taken into consideration and how long that extension may be granted" in H951); Redtailed Hawk Collective et al. at 26-30.

Even if planning for a delay in meeting the 2030 requirement was permissible at this stage, complying with the 2030 carbon reduction target is a priority for many intervening parties and should not be abandoned by the Commission in the inaugural Carbon Plan. See, e.g., July 15 Comments of: City of Asheville and County of Buncombe at 3-4 ("[t]he pathways in NCUC's final Carbon Plan should prioritize meeting the 2030 deadline of reducing emission by 70% compared to 2005 levels" and noting that the urgency of the climate crisis makes it "imperative that the 2030 target be met"); Durham County at 2-3 (calling on the Commission to meet the 2030 requirement given the urgency of addressing climate change); CEBA ("Duke needs to propose, or this Commission needs to independently develop and adopt, a Carbon Plan that is consistent with" the 2030 carbon reduction requirements).

The following portfolios submitted by intervenors in this proceeding meet the 2030 carbon emissions requirements and achieve the requirements of N.C.G.S. § 62-110.9 (H951) at projected lower relative costs to ratepayers than the Duke P1 or P1-Alt portfolios while relying on larger investments in commercially available renewable resources that are poised to become even more cost-competitive following the enactment of the IRA: the *Optimized* and *Regional Resources* portfolios modeled by Synapse Energy Economics, Inc. (Synapse) on behalf of CLEAN intervenors, the *Preferred* portfolio modeled by Gabel Associates (Gabel) and Strategen Consulting, LLC (Strategen) on behalf of the Tech Customers (Apple Inc., Google LLC, and Meta Platforms, Inc.), *SP-AGO* portfolio modeled by Strategen on behalf of the Attorney General's Office, and *CPSA3*, modeled by Brattle Group on behalf of Clean Power Suppliers Association (CPSA). It is reasonable

for the Commission to accept those portfolios as reasonable for planning purposes, and to rely most heavily on those portfolios when deciding on the near-term execution plan.

1. CLEAN INTERVENORS - SYNAPSE

Synapse modeled two scenarios: (1) the *Optimized* scenario, which allowed EnCompass to select an economically optimal portfolio based on revised model inputs and expanded availability of zero-carbon resources; and (2) the *Regional Resources* scenario, which built upon the *Optimized* scenario by also allowing the model to select imported Midwest wind resources via power purchase agreements (PPAs). Both of the resulting portfolios meet HB 951 carbon reduction mandates, maintain system reliability, and meet reserve margin requirements.

Synapse's updated modeling assumptions included: updated capital costs for new gas plants and small modular reactor (SMR) nuclear generators, using U.S. Energy Information Administration data (rather than internal Duke estimates); updated solar, solar-plus-storage, and wind costs (using government data from the National Renewable Energy Laboratory (NREL) rather than proprietary information from Guidehouse); more recent natural gas prices; industry references for projected hydrogen prices; and updated gas plant depreciation. Official Exhibits, vol. 24, Fitch Ex. 1, Carbon Free by 2050, Pathways to Achieving North Carolina's Power Sector Carbon Requirements at Least Cost to Ratepayers (Synapse Report) at 10-11. Synapse also used two 15-year planning horizons rather than the multiple 8-year and one 5-year planning segments used by Duke. *Id*. at B-16. In addition, Synapse noted the following key differences between its approach to using EnCompass and Duke's:

> Duke Energy over-rode EnCompass's ability to optimize for the most economic resource selections in three ways: First,

> Duke manually delayed the coal retirement dates that EnCompass identified as economically optimal. Second, it replaced several hundred megawatts ("MW") of battery storage with gas combustion turbines. And third, Duke manually added gas combustion turbines and small modular nuclear reactors based on supplemental resource adequacy analyses.

Tr. vol. 24, 138-39.

Synapse found that both the *Optimized* and the *Regional Resources* scenarios were less expensive to ratepayers than the *Duke Resources* scenario, while at the same time increasing the amount of renewable energy generation. The *Optimized* and *Regional Resources* scenarios do not select any new gas plants and reduce future reliance on speculative hydrogen, advanced nuclear, and SMRs.

Synapse's modeling shows that its scenarios would create significant savings for North Carolinians when compared to the *Duke Resources* scenario. The net present value of revenue requirement (NPVRR) is reduced in comparison to the *Duke Resources* scenario across the board, with the *Optimized* scenario saving $19.4 billion and the Regional Resources scenario saving $24.6 billion by 2050. Tr. vol. 24, 189.

Synapse's Optimized Portfolio included the following resource additions by 2030: 7,200 MW additional of additional solar; 5,600 MW of standalone storage; and 900 MW of onshore wind. Witness Fitch clarified that Synapse followed Duke's modeling choice to use a static dispatch curve for solar-plus-storage, which is why the Synapse portfolios did not select solar-plus-storage. Tr. vol. 24, 201-03. Witness Fitch testified that had the model allowed for dynamic dispatch, the Synapse portfolios would have selected more solar-plus-storage. *Id*.

2. TECH CUSTOMERS PREFERRED PORTFOLIO – GABEL ASSOCIATES AND STRATEGEN

The Tech Customers retained Gabel and Strategen to conduct EnCompass modeling to establish a "Preferred Portfolio" to yield a "preferred outcome as compared to Duke's proposed portfolio." Tr. vol. 25, 88. This Preferred Portfolio was presented in the Gabel/Strategen Report submitted on behalf of the Tech Customers. Gabel/Strategen also developed an "Adjusted Preferred Portfolio" that includes the same resources as the original Preferred Portfolio but allows the Belews Creek plant to retire later than originally projected. *Id*. at 90. The Preferred Portfolio achieves compliance with the 70-percent reduction in 2030, and has a lower NPVRR than P1, the only Duke portfolio that achieved 2030 compliance. *Id*. at 94.

Specifically, by 2030 the Preferred Portfolio adds 1,200 MW of onshore wind, 2,727 MW of standalone solar, 12,975 MW of solar-plus-storage, 3,075 MW of 4-hour batteries, 50 MW of 6-hour batteries, and 1,680 MW of pumped storage hydro. Official Exhibits, vol. 25, Gabel/Strategen Report at 10. Gabel/Strategen also conducted some sensitivity analyses in response to allegations by Duke witnesses that intervenors inappropriately modeled lower costs for renewables and energy storage and higher costs for thermal resources. In one of these sensitivities, Gabel/Strategen used Duke's resource cost assumptions with the Preferred Portfolio resource builds and still found that the Preferred Portfolio had a PVRR that was $2 billion less than Duke's P1 portfolio. Tr. vol. 25, 94.

3. ATTORNEY GENERAL'S OFFICE SP-AGO – STRATEGEN

The North Carolina Attorney General's Office ("AGO") originally retained Strategen to provide testimony and analysis of Duke's proposed Carbon Plan modeling.

After filing initial comments and as a component of Witness Burgess's direct testimony, Strategen conducted modeling in EnCompass to develop an additional Supplemental Portfolio, "SP-AGO." SP-AGO built upon Duke's SP5 portfolio to address several of the outstanding concerns which the AGO felt were not addressed by Duke or the Public Staff in the SP5 and SP6 portfolios. Tr. vol. 25, 234. The SP-AGO portfolio adjusted the SP5 portfolio by having 2030 set as the initial deadline, avoiding a "rush to judgement" on the need for new gas units in light of the Inflation Reduction Act, setting annual solar interconnections at the midpoint of Duke's initial P1 portfolio and "High Solar Interconnection" sensitivity of the Supplemental Portfolios and advanced by one year, and allowing the selection of resources that were initially excluded in SP5. *Id*. at 236.

These adjustments resulted in the SP-AGO portfolio meeting 2030 compliance with HB 951, achieving lower cumulative emissions than any portfolio proposed by Duke, and led to more solar-plus-storage being selected by EnCompass. *Id*. at 281. By 2030 the SP-AGO portfolio includes 6,126 MW of incremental solar (12,445 MW system total), 2,250 MW of onshore wind, 800 MW of offshore wind, 3,490 MW of incremental storage (both standalone and pumped hydro) 462 MW of incremental gas (CT) in 2028. Official Exhibits, vol. 25, Corrected Burgess Ex. 2. The SP-AGO portfolio also has a PVRR of $100 billion, which is lower than the other Duke portfolios that achieve 2030 compliance and also lower than Duke's SP5. Official Exhibits, vol. 25, Corrected Burgess Ex. 2.

4. CLEAN POWER SUPPLIERS ASSOCIATION – CPSA3

The Clean Power Suppliers Association retained the Brattle Group (Brattle) to conduct Carbon Plan modeling. Instead of using EnCompass, Brattle conducted its modeling with a house capacity expansion and generation dispatch optimization model

called GridSIM, which was developed by Brattle to model low-carbon utility systems. GridSIM optimizes capacity expansion and system dispatch in order to minimize the present value of system costs over the timeframe modeled, subject to meeting various constraints including hourly demand, seasonal capacity requirements, and CO2 limits. Tr. vol. 25, 434, 463. GridSIM focused the modeling timeframe on those years that are most relevant to the near-term execution plan and the 70% carbon emissions reduction requirement by 2030. *Id*. at 464.

Brattle followed Duke's modeling assumptions with regard to "load growth, gas prices, timing of coal plant retirements, and contribution of each type of resource towards meeting the seasonal resource adequacy requirements," but departed from Duke in several important respects. *Id.* Notably, Brattle assumed a higher maximum rate of solar interconnections than Duke in 2026 and 2027. In addition, Brattle turned to NREL's 2022 Annual Technology Baseline for generation and storage costs estimates, using conservative solar cost estimates, reevaluated potential interconnection capacity limits for solar, and assumed that nuclear SMRs were not available until after 2032, (*id*.) although Brattle performed two sensitivity analyses allowing for SMR selection in 2032 (neither of which resulted in the selection of SMRs in 2032). *Id*. at 440.

The results of Brattle's modeling simulations with higher solar interconnection limits were increased procurement of solar and lower overall costs to ratepayers. *Id*. Brattle modeled five portfolios for consideration (CPSA1-5), which modeled compliance dates in 2030 and 2032 using three different interconnection constraints (CPSA's proposed constraint, the "low solar" constraint used in Duke's P2-P4, and no constraint). The CPSA3 portfolio meets the 2030 carbon emissions reductions requirements and includes a

somewhat higher solar interconnection limit than that assumed by Duke in 2026 and 2027, although in 2028 and beyond it used the same interconnection constraint used by Duke in the P1 portfolio. *Id*. Brattle found that using Duke's lower solar interconnection limit would increase system costs in 2030 alone by about $860 to $930 million for 2030 compliance (based on conservative assumptions for future costs of solar that were 10% higher than Duke's estimates). *Id*. at 466. GridSIM also selected new gas, but not before 2029. *Id*. at 465; CPSA Comments, Ex. A at 30-34. By 2030, CPSA3 selects 7,500 MW of solar, 2,700 MW of BESS, 600 MW of onshore wind, and 400 MW of offshore wind. *Id*. at 465.

5. DUKE ENERGY – PORTFOLIO 1

As noted above, the P1 Portfolio is the only one submitted by Duke that would meet the 2030 carbon reduction requirement. Duke's P1 also included a higher cap on potential solar interconnection in later years than did its initial P2-P4 portfolios, allowing up to 1,800 MW per year in 2028 and later years (Duke used the same interconnection caps for 2026 and 2027 in all portfolios). Carolinas Carbon Plan, Chapter 3 Portfolios at 8 (May 16, 2022); Tr. vol. 8, 78. By 2030, P1 would install approximately 5,400 MW of new solar, 2,100 MW of battery storage, 600 MW of onshore wind, and 800 MW of offshore wind. As with all of Duke's portfolios, P1 would also add new gas resources: 2,400 MW of gas CCs and 1,100 MW of new gas CTs. Carolinas Carbon Plan, Executive Summary, Table 1 at 16 (May 16, 2022). Under Duke's modeling assumptions, the NPVRR through 2050 of Portfolio P1 is $101 billion. Duke's P1-Alt (no Appalachian gas) portfolio similarly selected 5,400 MW of solar by 2030, with an additional 1,800 MW added in 2030.

III. JOINT PROPOSED NEAR TERM EXECUTION PLAN

Considering all of the modeling that meets the 2030 interim carbon emissions requirements collectively, intervenors support the joint near-term execution plan set forth in Table 1. This near-term execution plan represents a no-regrets pathway, informed by the *Optimized* and *Regional Resources* portfolios modeled by Synapse on behalf of CLEAN intervenors, the *Preferred* portfolio modeled by Gabel and Strategen on behalf of the Tech Customers, *SP-AGO* portfolio modeled by Strategen on behalf of the Attorney General's Office, *Portfolios 1* and *P1-Alt* modeled by Duke Energy, and *CPSA3*, modeled by Brattle on behalf of CPSA. This no-regrets near-term execution pathway avoids the unnecessary risk of locking in reliance on new fossil-fuel plants or speculative and unproven technologies in later years. Just as importantly, this set of near-term actions is primed to take advantage of the financial incentives and policies enacted in the IRA. In addition, this near-term execution plan will keep the Commission's options open for flexible adaption in future IRP and Carbon Plan update dockets and draw most heavily from those portfolios that are projected to impose less costs on ratepayers than the Duke portfolios.

Table 1. Joint Near Term Execution Plan

RESOURCE	AMOUNT	PROPOSED NEAR TERM ACTIONS
Proposed Resource Selections		
Solar	2022 solar procurement of 1647 MW 2023 solar procurement of 1647 MW (with minimum 300 MW paired storage) 2024 Solar Procurement of 1947 MW (with minimum 450	• 440 MW of 2022 Procurement consists of third-party CPRE MW (to roll over to HB951 if unfulfilled) • If the RZEP are approved by the TPC, final DISIS cost allocations for RZEP will not be considered in bid evaluation, VAM calculation, or avoided cost cap compliance • Revisit Volume Adjustment Mechanism for 2023-24 procurements • Begin Stakeholder engagement on new contract language for solar-plus-storage, including properly valuing longer-duration storage, to be presented for NCUC approval before the 2023 procurement

	MW paired storage)	
Battery Storage	850 MW (total minimum procurement for 2023 & 2024)	• Finalize procurement strategy and initiate procurement activities to procure 850 MW minimum of stand-alone, battery-energy storage • Build-Own Transfer • Invest in operational capabilities for capitalizing on energy storage resources for grid services
Onshore Wind	900 MW	• Initiate competitive procurements of Carolinas onshore wind with target volumes of 300 MW in 2023, 300 MW in 2024, and 300 MW in 2025 with target in-service dates of 2026, 2027, and 2028 respectively • Begin necessary activities to support adding 450 MW of imported onshore wind in both 2027 and 2028 • Engage in inter-regional coordination with PJM for facilitating power purchase • Integrate Midwest wind import into short-term transmission planning
Offshore Wind	--	• Initiate study of costs of developing three distinct WEA leases
Pumped Storage Hydro	1,700 MW	• Conduct feasibility study for 1,700 MW, develop EPC strategy, and apply at FERC for re-licensing
Grid Edge-Energy Efficiency	1.5 percent of retail load	• Step-up utility energy efficiency savings target to 1.5 percent of eligible retail load by 2027 and 1.5 percent of total retail load by 2030
Grid Edge - Distributed Energy Resources	At least 1 GW by 2035	• Develop and support programs to empower customer-owned energy resources to accelerate contribution to grid needs
RZEP	--	• Begin construction in 2022 if approved by NCTPC

IV. COMMON CRITIQUES OF DUKE'S MODELING ANALYSIS

While there may be a range of reasonable assumptions and inputs in a complex modeling exercise like long-range decarbonization planning, certain modeling choices erode confidence that a given portfolio represents the most economically optimal set of resources. Manually changing resource selections made by the modeling software is a deviation from best practices. Among the intervening parties that conducted EnCompass modeling analysis, there are a number of common critiques of Duke's out-of-model adjustments to the resource portfolios economically selected by EnCompass.

- DELAY OF COAL UNIT RETIREMENT DATES

Duke's proposed portfolios relied on coal retirement dates that were determined outside the EnCompass model. Contrary to the Commission's Order in the 2020 IRP Docket No. E-100, Sub 165 (November 19, 2021), which required Duke to leverage the full functionality of the EnCompass production cost modeling and capacity expansion tools to select the optimal retirement dates for coal units endogenously, Duke did not include the endogenously selected retirement dates in its proposed carbon plan. Duke notes that it did in fact perform this required analysis, but made changes to the retirement dates ultimately included in its proposed Carbon Plan. The results of the endogenous analysis were only made available through discovery. AGO Strategen Report at 37.

The Gabel/Strategen Report prepared on behalf of Tech Customers, the AGO Strategen Report and the Synapse Report all highlight that Duke's proposed portfolios manually adjust the retirement dates for a number of its coal plants. Gabel/Strategen Report at 27; AGO Strategen Report at 37-39; Synapse Report at 29.

Duke's out-of-model steps modified its resource portfolios in ways that reduce transparency, distort the model results to be non-optimal, increase the portfolio's overall cost, and allow Duke to direct modelling toward its preferred outcomes. Tr. vol. 25, 257 – 259 (AGO witness Burgess). Regarding coal unit retirements specifically, Duke justified its manual changes to the model-selected retirement dates based on "limited professional engineering judgements" without further elaboration, indicating that Duke's coal unit retirement schedule may not align with the dates most optimal for reducing consumer costs. *Id*. at 284. Out-of-model steps used by Duke, including manual adjustments to the endogenously selected coal retirement dates, introduce bias to its results as they bypass

"the selection of resources based on both their cost and their potential carbon footprint as weighted by the optimization under a carbon emissions reduction target," calling the composition of the remaining portfolio into question as it may no longer be optimal. Tr. vol. 25, 101- 102 (Tech Customers witness Roumpani).

One of the key benefits of a tool like EnCompass is that it can evaluate the economically optimal mix of resources, including resources needed to replace uneconomic assets. CLEAN Intervenors witness Fitch testified that EnCompass retires a unit because the energy and capacity provided by the unit could more economically be provided by other resources. Tr. vol. 24, 172. Duke's decision to delay retirement of those units is not consistent with least-cost resource planning, and costs of continuing to run those uneconomic units will ultimately be borne by ratepayers. *Id*. at 172-73. While Duke asserts that delays to the coal unit retirement dates are necessary to address reliability concerns, retirement dates developed at the direction of the Commission for the Companies' 2020 IRPs were designed to accommodate construction of replacement resources and yet almost all the manual adjustments Duke made delay retirement beyond the "earliest practicable" schedule developed for the Companies 2020 IRPs. *Id.* at 174.

The Public Staff also expressed concerns with Duke's out-of-model steps that limited the endogenous selection of coal retirement dates, consistent with the concerns raised in the Synapse Report. Tr. vol. 21, 43 (Public Staff Witness Thomas). The Public Staff emphasized that maintaining the operation of plants beyond their economic life as proposed by Duke's manual out-of-model retirement date extension, is not advisable, but recognized that multiple considerations may need to be factored into retirement date selection, including impacts on transmission systems, coal inventory and fuel supply, and

maintaining system reserves to account for system abnormalities (such as unexpected extreme heat or cold weather). *Id*. at 117 (Public Staff Witness Metz).

Any delays to the economically optimal coal retirement dates will limit opportunities for ratepayer savings from securitization. Securitization under HB 951 and other refinancing benefits available under the recently passed Inflation Reduction Act will tend to increase ratepayer savings "in line with the size of the plant balances refinanced and duration of the refinancing period, with earlier retirements yielding larger consumer benefits." Tr. vol. 23, 236 (CLEAN Intervenor's witness Varadarajan). Therefore, the later a coal retirement occurs, the smaller the potential savings that can be derived from securitization." Tr. vol. 23, 235. As an example, RMI modeled securitization of 50 percent of all unrecovered balances following the retirement of all subcritical Duke coal plants by the end of 2022, which would yield an estimated $446 million in savings for ratepayers. Tr. vol. 23, 235. Similarly, Witness Varadarajan testified that the Inflation Reduction Act's Sec. 1706 loan program makes additional low-cost financing available for fossil asset transitions without H951's restrictions of 50% of the remaining net book value of subcritical coal units. Tr. vol. 23, 236.

Any delay from the optimal dates of early retirement of uneconomic coal plants makes reaching the carbon emissions reductions required under law much more difficult to achieve and reduces the opportunity for ratepayer savings from the securitization provisions of HB 951 as well as from the Section 1706 provisions of the IRA.

- BATTERY-CT OPTIMIZATION STEP

The Attorney General's Office, Tech Customers, CCEBA, and CLEAN Intervenors took issue with the "Battery-CT Optimization" step, in which Duke removed battery

capacity from its portfolios and replaced it with capacity from combustion turbine units. AGO Strategen Report at 33-34; Tech Customer Initial Comments at 11; Tr. Vol. 26, 251:7 – 252:4 (CCEBA Witness Ron DeFelice); Synapse Report at 30-32. Duke removes as much as 1600 MW to 2000 MW of battery storage from its portfolios and replaces it with 1500 MW to 1900 MWs of combustion-turbine units, to address concerns with the typical-day load shape. AGO Strategen Report at 33-34; Synapse Report at 30-32.

As discussed above with respect to coal unit retirement dates, Tech Customer's witness Roumpani testified that Duke's out-of-model steps, including replacing battery capacity selected by the model with combustion turbines, introduce bias to the results of the economically selected portfolios. Tr. vol. 25, 101. By definition, any manual changes to portfolios that deviate from the economically optimal portfolio identified by EnCompass are likely to result in increased costs to ratepayers. Tr. vol. 24, 140 (CLEAN Intervenor's Clean Intervenor's Fitch).

In addition to replacing economically selected storage with CT capacity, Duke limits the amount of four-hour battery storage that can be selected by the model over the planning horizon. Public Staff critiques Duke's capacity constraint and subsequent removal of at least 35% of the four-hour battery storage capacity selected (to be replaced with CT capacity), which may lead to an inflated need for dispatchable resources such as natural gas CT. Public Staff Initial comments at 128-130.

- LENGTH OF PLANNING HORIZON

Tech Customers and CLEAN Intervenors take issue with Duke's use of segmented planning horizons. Tr. vol. 25, 100; Tr. vol 24, 157-158. Duke uses three 8-year and one 5-year planning segments. Using shorter planning horizons prevents the model from

accounting for costs and emissions in years beyond that horizon. (Gabel/Strategen Report at 49; Synapse Report at B-16). As the Public Staff explains, were the model to select a gas CC in an earlier planning horizon, it would do so without considering the significant costs to convert that unit to 100% hydrogen combustion in 2047. Public Staff Initial Comments at 85.

In the context of the carbon plan, an 8-year planning horizon is too short of a term for the model to fully integrate long-term planning dynamics, such as the carbon reduction requirement. By contrast, Synapse used a 15-year planning horizon in its EnCompass analysis and Gabel and Strategen used one time horizon through 2050 in modeling its Preferred Portfolio. Tr. vol. 24, 158 (CLEAN Intervenor's witness Fitch); Gabel/Strategen at 50.

- SOLAR-PLUS-STORAGE CONFIGURATION AND ASSUMPTIONS

The AGO, Tech Customers, and Public Staff all raise concerns with Duke's use of a fixed storage output profile. By contrast, a flexible battery dispatch would allow the model to economically dispatch the storage resource, capturing the full value to the system of each additional solar-plus-storage resource that the model might select. AGO Strategen Report at 14-5. In addition to diminishing the value of solar-plus-storage, Tech Customers argue that using a fixed output profile diminishes the value of the model's economic optimization function, as the fixed output profile is developed external to the model. Gabel/Strategen Report at 45.

Duke's modeling did not include the full range of solar-plus-storage configurations available or the configurations likely to maximize the value longer duration batteries add to paired solar capacity. Duke's modeling also applies cumulative limits for solar-plus-

storage with a 50% battery ratio. AGO Strategen Report at 19- 20. Tech Customers point out that these limitations restrict the value solar-plus-storage resources can provide in reliability services, as well. Gabel/Strategen Report at 45. CPSA also criticized Duke for modeling an incomplete set of storage configurations and commented that Duke should be required to model a more complete set of scenarios which would include both 25% and 50% capacity ratios as well as 2-hour and 4-hour batteries, CPSA Comments at 25.

The Public Staff raised similar concerns over Duke's use of a predetermined storage output profile and the assumption that storage could only be charged from the coupled solar resource, as both restrictions unreasonably limit the flexibility of solar-plus-storage resources. The Public Staff ran additional modeling that suggests "the way Duke has modeled solar-plus-storage may be leading to material impacts on resource selection." Public Staff Initial Comments at 119-125.

CCEBA also criticized the assumptions used by Duke in modeling solar-plus-storage, including the use of only two potential configurations of solar-plus-storage, failure to acknowledge or model bidirectional grid charging of the storage element of a solar-plus-storage system, and the exclusion of AC-coupled solar-plus-storage systems as an option. CCEBA Initial Comments at 35-37. CCEBA further raised an issue with Duke's treatment of depth of discharge, noting that Duke's modeling appears to double-count the depth of discharge constraint, which is already built into the pricing of batteries by manufacturers, resulting in an inaccurate and uncompetitive valuation of battery resources in the Carbon Plan. *Id*. at 39-40.

While Synapse relied on Duke's fixed solar-plus-storage dispatch curves in its EnCompass analysis for consistency with Duke's method, witness Fitch supported the

Public Staff's recommendation to model dynamic dispatch for solar-plus-storage resources and to allow charging directly from the grid in order to better capture the contributions dynamic dispatch would provide. Tr. vol. 24, 165.

The cumulative effect of these solar-plus-storage assumptions and limitations likely reduced the amount of solar-plus-storage that the EnCompass model would have selected, had flexible battery dispatch, system configurations with larger batteries, and no cumulative limit on solar-plus-storage been utilized as assumptions. AGO Initial Comments at 21.

The capacity expansion modeling function of EnCompass tests thousands of potential portfolios with energy and capacity, reserve margin and reliability, and least-cost constraints to produce resource-neutral and economically optimal portfolios. By selectively overriding the resource selections made by the model or otherwise deploying manual constraints and "out of model adjustments," Duke's modeling produced non-optimal results that limit the utility of its portfolios.

V. ANALYSIS OF EXECUTION RISK

Section 62-110.9 set North Carolina on a journey to a non-carbon future and mandated that it be reached at least cost. It is the Commission's responsibility to select the pathway that ultimately gets North Carolina to the destination set by the General Assembly. Central to the analysis of any of the portfolios submitted to accomplish that goal is the concept of execution risk. But different parties have different understandings of what execution risk means.

For instance, Public Staff witness Thomas testified that in analyzing the execution risk of Duke's proposed portfolios, "the Public Staff is concerned that P1 is the most vulnerable to cost overruns related to delayed schedules and material price increases, as it relies heavily on aggressive additions of solar and storage, both of which are experiencing substantial near-term cost increases related to global inflation and supply chain issues." Tr. vol. 21, 41. On cross examination, he confirmed that "I think we were really focused on that enormous initial build-out as being potentially more risky in P1, because there is significantly more solar added in that portfolio." *Id*. at 241.

The Public Staff thus views P1, which is the only portfolio Duke proposed that aims to comply with the 70% CO2 reduction requirement by 2030, as riskier than three portfolios that do not because they concluded that "P1 has the highest exposure to cost overruns relative to other portfolios by that date." *Id*. The Public Staff does not, apparently, take into account that the other three proposed portfolios (and the supplemental portfolios prepared later) all rely, to a significantly greater degree, on unproven technologies.

This is a blinkered understanding of execution risk that fails to account for the *benefit* of the given course of action. The Public Staff's criticism of P1, and other high solar proposals from other parties, is that it spends more money before 2030 and is therefore more vulnerable to cost increases by that date. The benefit of achieving 70% reduction by 2030 is not considered. Nor does it account for other benefits of pursuing the more aggressive solar buildout, *even if it turns out to be unachievable.* CSPA witness Tyler Norris explained that earlier attempts to add larger amounts of solar will lead to earlier identification of needed upgrades, and therefore more time to address those upgrades and mitigate the risk that the costs of such upgrades will rise over time. Tr. vol. 26, 57.

Duke's approach to execution risk is similar. In discussing Duke's rationale for imposing a solar interconnection cap, witness Glen Snider confirmed that Duke set a constraint so that if the Encompass model economically selected solar as the most economic resource, but selected more than the constraint, the constraint would result in the selection of a more expensive, less economical resource. Tr. vol. 8, 74. This is inconsistent with the way Duke treats procurement of the excess CPRE megawatts, on which Witness Matt Kalemba conceded that it would be appropriate in that circumstance to take on greater execution risk if it were possible to capture greater cost savings for ratepayers. Tr. vol. 8, 108 ("it's a difference between just flat out saying we're gonna procure more than we can connect than saying we're gonna procure more than we can connect if it's economic to do so.") Nevertheless, in designing its Carbon Plan, witness Michael Quinto confirmed that Duke did not determine how much solar would have been selected without the cap or perform any sensitivities to determine the impacts of a higher cap. *Id.* at 77. Duke therefore looked at one risk, but ignored the benefits, and ignored the opportunity cost of its actions.

This approach by both the Public Staff and Duke results in overprotecting against risk in the short term while openly gambling on outcomes in the long term. They are both, for instance, quite willing to accept reliance after 2032 on the availability of Small Modular Reactors (SMR), despite both acknowledging that there is no currently commercially operating and interconnected SMR anywhere in the world. Tr. vol. 17, 183 (Chris Nolan – Long Lead Time Panel); Tr. vol. 21, 260 (Jeff Thomas).

Intervenors suggest a different approach that comprehends both the risks and the potential benefits of a course of action, and then compares potential courses of action comprehensively, rather than selectively.

For instance, while Duke and the Public Staff see known and certain execution risk of interconnection of solar and solar plus storage as more problematic, intervenors note that the unquantifiable risk of newer technologies poses a greater risk to the overall success of the Carbon Plan and costs to ratepayers. Where the Public Staff sees risk in locking in costs through earlier and larger procurement of solar and solar plus storage due to the chance that prices of those technologies may decline over time, the intervenors see greater risk in reducing deployment of mature technologies and planning to rely on the largely unknowable readiness and costs of SMRs or green hydrogen for long-term compliance with the mandates of G.S. § 62- 110.9. While Duke sees reliance in the near and mid-term on gas generation as enabling reduction of CO2 emissions and mitigating the operations risks posed by integration of renewables, the intervenors point out that recent gas price volatility and questions around the viability of planned new pipelines to North Carolina makes investment in new gas generation assets highly risky and cost sensitive.

The proposed Duke Carbon Plan trades quantifiable near-term execution risk for largely unquantifiable long-term reliance on uncertain potential resources. Should these long-term potential resources such as SMRs and green hydrogen come to fruition, then their integration into the power system in North Carolina can be accomplished at that time, and prior investments in more currently mature technologies such as solar and battery storage will have resulted in a more diversified resource portfolio. On the other hand, if near-term investments in more mature technologies are delayed or rejected based on reliance on the *hope* that currently speculative technologies will become commercially available and that hope ultimately does not bear out, then North Carolina would be left in an altogether different position. At that point, the path selected in 2022 would have failed,

but the failure will not be known until it is too late to react. In other words, the risk of the unknown outweighs the risk of the known.

Finally, one of the execution risks that must be contemplated in evaluating proposed portfolios and near-term execution plans is the very basic risk of non-compliance with the 2030 interim emissions reduction mandate in HB 951. In this regard, Duke portfolio P1 is the only portfolio proposed by Duke that could comply with the 2030 deadline. As noted above, several Intervenors propose plans that also would comply. While interconnection limitations and costs of solar pose some risk to the execution of those portfolios, portfolios P2 through SP6 have a 100-percent risk of noncompliance.

Therefore, in analyzing the execution risk of proposed portfolios and near-term execution plans, Intervenors ask the Commission to favor deployment of known and more mature carbon-free technologies, understanding the risk that interconnection constraints may result in short-term delays and that costs for such technologies may decline over time, over wagering on other technologies riding to the rescue after 2030.

VI. CONCLUSION

CLEAN Intervenors, CCEBA, CPSA and MAREC Action respectfully request that the Commission take this brief, joint near-term execution plan, and their joint partial proposed order into consideration when developing its Carbon Plan, and that the Commission adopt each of the ordering paragraphs in their joint partial proposed order.

Respectfully submitted, this the 24th day of October 2022.

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CERTIFICATE OF SERVICE

I hereby certify that all parties of record have been served with the foregoing JOINT POST-HEARING BRIEF OF THE NORTH CAROLINA SUSTAINABLE ENERGY ASSOCIATION, SOUTHERN ALLIANCE FOR CLEAN ENERGY, SIERRA CLUB, NATURAL RESOURCES DEFENSE COUNCIL, CAROLINAS CLEAN ENERGY BUSINESS ASSOCIATION, CLEAN POWER SUPPLIERS ASSOCIATION AND MAREC ACTION by email transmission.

This the 24th day of October, 2022.

/s/ David L. Neal