A Closer Look at the Solar Energy Cap in Duke Energy's Carolinas Carbon Plan

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I. INTRODUCTION

In 2020, electric power generation accounted for nearly 25% of total greenhouse gas emissions nationwide, with approximately 60% of that electricity generation coming from traditional fossil fuel facilities.[1] Seeking to reduce emissions from electricity generation, twenty-four states have enacted some form of greenhouse gas emissions legislation to achieve emissions reduction by 2030.[2] North Carolina joined this list in 2021 when the North Carolina legislature passed House Bill 951 and required the state's electric utility to reduce emissions by 70% by 2030.[3]

The passage of House Bill 951 is a critical step for North Carolina in its mission to create a cleaner energy future, but the inclusion of the competitive procurement provision limits the bill's effectiveness. This provision requires the electric utility to split the construction and ownership of new solar energy projects, incentivizing the electric utility to plan for fewer new solar projects so long as it is able to meet the bill requirements. The result is an untimely and costly plan to meet the emissions reduction requirements by 2030. For the bill to be successful in its mission to create a feasible, clean energy future, the competitive procurement provision involving solar energy projects must be amended to incentivize the electric utility to make decisions in accordance with the goals of the bill.

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[1] *Sources of Greenhouse Gas Emissions*, U.S. ENV'T PROT. AGENCY (Aug. 5, 2022), https://www.epa.gov/ghgemissions/sources-greenhouse-gas-emissions.
[2] *States Climate Action Map*, BERKELEY CAL.-CHINA CLIMATE INST. (Jan. 2022), https://ccci.berkeley.edu/states-climate-action-map
[3] Energy Solutions for North Carolina, North Carolina House Bill No. 951 § 1 (2021).

This article begins by taking a closer look at the content of House Bill 951, including its provisions for emissions reduction and energy transition and the implication of these provisions for the state's electric public utility, Duke Energy. The following section reviews Duke Energy's response to the legislation—the Carolinas Carbon Plan—with a focus on Duke Energy's decision to impose a cap on new solar construction in modeling its portfolio options. With Duke's proposals in mind, the paper then assesses the effect of the solar energy cap on the timeliness and cost efficiency of the Carolinas Carbon Plan. The paper concludes by arguing that the competitive procurement provision involving new solar energy projects must be amended to allocate a greater portion of ownership to Duke Energy, which will incentivize Duke Energy to make decisions that align with a timely and cost-efficient renewable energy system.

II. HB951 AND THE COMPETITIVE PROCUREMENT OF RENEWABLE ENERGY

In 2021, North Carolina joined the growing list of states with carbon dioxide emissions legislation with the enactment of HB951.[4] The bill sets emission reduction requirements for the electric generation sector and also includes policies to guide how new renewable energy infrastructure will be deployed to meet these requirements.[5] While the emissions reduction requirements are newly introduced in HB951, the policies guiding the transition to renewable energy infrastructure were originally introduced in 2017 via House Bill 859 and its Competitive Procurement of Renewable Energy (CPRE) provision and have been carried forward in HB951.[6]

A. HB951 outlines emissions reductions requirements to be met by 2030 and 2050.

HB951 establishes broad requirements pertaining to the reduction of carbon dioxide emissions from electric generating facilities that are owned or operated by the electric public

[4] *Id.*
[5] *Id.*
[6] *Id.*

utilities.[7] The act says that generators must reduce emissions from 2005 carbon dioxide levels by 70% by 2030 and must achieve carbon neutrality by 2050.[8] The act empowers the North Carolina Utilities Commission to "take all reasonable steps to achieve [these requirements]."[9] This includes the Commission tasking the electric public utilities, Duke Energy, with developing a Carbon Plan by the end of 2022 to achieve the emission reduction targets.[10] The Carbon Plan must take into account the reduction requirements, as well as additional factors like grid modernization and energy storage.[11]

B. The CPRE Provision establishes the ownership split of new solar energy projects under the plan to meet HB951 requirements.

In addition to the reduction requirements above, HB951 requires that the utilities achieve those reduction requirements consistent with the Competitive Procurement of Renewable Energy (CPRE) provision created in HB859.[12] The CPRE provision sought to ensure reliable and cost-effective service for customers amidst changes to the energy grid by forcing a certain level of competition and supplier diversification.[13] It aimed to do so by requiring that a portion of new renewable energy infrastructure be supplied by third parties and energy from those providers be purchased by the electric public utility.[14] However, the scope of the CPRE provision, as invoked in HB951, is narrow: It applies only to new solar, and it excludes wind, nuclear, and other forms of renewable energy.[15] This is made clear in HB951 with the explicit requirement that only new solar energy must be partially supplied by power purchase agreements with third parties.[16] Thus,

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[7] *Id.*
[8] Energy Solutions for North Carolina, *supra* note 3.
[9] *Id.*
[10] *Id.*
[11] *Id.*
[12] *Id.*
[13] Competitive Energy Solutions for NC, North Carolina House Bill No. 589 § 2 (2017).
[14] *Id.*
[15] Energy Solutions for North Carolina, *supra* note 3.
[16] *Id.*

under the CPRE provision, third parties must provide at least 45% of new solar energy infrastructure, while utility-owned or utility-operated infrastructure can supply no more than 55%.[17] Because Duke Energy generates revenue based on capital investments, as will be noted below, the CPRE provision affects Duke Energy's incentive structure by limiting the amount of solar energy infrastructure it can own. Duke Energy must abide by this solar energy split when developing the Carbon Plan to achieve HB951's emission reduction requirements.

III. DUKE ENERGY'S PROPOSED CAROLINAS CARBON PLAN

As laid out in HB951, the Utilities Commission tasked Duke Energy with creating a carbon plan to meet the proposed reduction requirements, and in response to this Duke Energy created the Carolinas Carbon Plan. The Plan consists of four different portfolio options, all of which aim to transition the current energy systems to a form that is capable of meeting the HB951 reduction requirements.[18] The first portfolio achieves the 70% reduction by 2030 through the additions of new offshore wind, new solar and battery storage, and accelerated retirement of two coal facilities.[19] The second portfolio meets the target reduction by 2032 and is similar to portfolio one but takes a slightly less aggressive pace when it comes to new solar additions.[20] Portfolio three takes a different approach by largely relying on new nuclear—small modular reactors—in the absence of offshore wind.[21] The reliance on new nuclear and the allowance of additional time for new solar means that the reduction requirements will not be met until 2034.[22] The fourth and final portfolio combines new nuclear and offshore wind to meet the reduction

[17] *Id.*
[18] *Carolinas Carbon Plan Executive Summary*, DUKE ENERGY (Dec. 17, 2022), https://desitecore10prod-cd.azureedge.net/-/media/pdfs/our-company/carolinas-carbon-plan/executive-summary.pdf.
[19] *Id.*
[20] *Id.*
[21] *Id.*
[22] *Id.*

requirements by 2034.[23] Again, the extended timeframe intends to accommodate the build out of new solar and battery storage capacity.[24]

Consumer watchdogs and energy policy experts have criticized Duke Energy's portfolio proposals based on the unambitious retirement timeline for existing coal facilities, extended timelines for portfolios two through four, and the overall cost to consumers.[25] At the heart of these outcome-based criticisms lies a more fundamental critique of Duke Energy's process: In modeling and creating its proposed energy portfolios, Duke Energy applied a solar cap.[26] The solar cap is a self-imposed assumption of the model that limits the amount of new solar that can be constructed in a given amount of time, and this assumption provides a foundation for the energy mix selected for each portfolio.[27] Duke Energy designed the solar cap in its models to allow for the addition of new solar in the amounts of 750 megawatts (MW) by 2027, 1,050 MW by 2028, and 1,350 MW beyond 2028.[28] Duke Energy cites technical challenges with transmission upgrades, interconnection, and battery storage as reasons for the imposed solar cap.[29] But studies by independent trade groups question the utility's reservations and call for more solar.[30] A study by Synapse Energy Economics suggests that 7,200 MW of solar energy

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[23] *Carolinas Carbon Plan Executive Summary*, *supra* note 18.
[24] *Id.*
[25] *The Dirty Truth About Utility Climate Pledges*, SIERRA CLUB (Dec. 17, 2022), https://coal.sierraclub.org/the-problem/dirty-truth-greenwashing-utilities.
[26] *Carolinas Carbon Plan Chapter 2: Methodology and Key Assumptions*, DUKE ENERGY (Dec. 17, 2022), https://desitecore10prod-cd.azureedge.net/-/media/pdfs/our-company/carolinas-carbon-plan/supplemental/chapter-02.pdf
[27] *Id.*
[28] *Id.*
[29] *Carolinas Carbon Plan Appendix I: Solar*, DUKE ENERGY (Dec. 17, 2022), https://desitecore10prod-cd.azureedge.net/-/media/pdfs/our-company/carolinas-carbon-plan/supplemental/appendix-i.pdf.
[30] Tyler Fitch et. al., *Carbon-Free by 2050: Pathways to Achieving North Carolina's Power Sector Carbon Requirements at Least Cost to Ratepayers*, SYNAPSE ENERGY ECONOMICS (July 20, 2022) (presentation by Synapse Energy Economics on the Carolinas Carbon Plan before the N.C. Utilities Commission), https://starw1.ncuc.gov/NCUC/ViewFile.aspx?Id=5815f0fe-8690-4aac-86f7-f2d752c73c9b; Michael Hagerty, et. al., *Duke Energy Resource Mix to Meet 70% CO2 Reduction by 2030 in NC: Review and Analysis of Draft Carbon Plan*, THE BRATTLE GROUP, INC. (presentation by The Brattle Group on the Carolinas Carbon Plan before the N.C. Utilities Commission), https://starw1.ncuc.gov/NCUC/ViewFile.aspx?Id=989d1f39-b185-4823-8058-2a353b584ff9.

should be added by 2030, dwarfing the solar cap limits set by Duke Energy.[31] This more aggressive solar plan combined with the retirement of existing coal facilities and the exclusion of additional gas combined-cycle and combustion turbines, would save a minimum of $700 million compared to Duke Energy's portfolio one proposal.[32] A second study by the Brattle Group suggests that removing the solar cap from Duke's modeling would yield portfolio options that include 9,500 MW of solar additions by 2030.[33] The Brattle Group takes their criticism of Duke Energy's Plan one step further by noting that Duke Energy has provided no quantifiable analysis to support their current solar cap assumption.[34]

IV. ANALYSIS

A. The solar cap incentives Duke Energy to minimize investment in solar and maximize alternative energy options.

While the technical challenges cited by Duke Energy are certainly valid challenges facing the introduction of new solar facilities, the lack of quantifiable justification for the solar cap suggests that Duke Energy's decision making is in direct alignment with the behavior incentivized by the CPRE provision described above. In determining the best adaptations to the Carolinas Carbon Plan, it is necessary to weigh the challenges behind the solar cap assumption, both technical and incentivized, against the benefit of a greater or lifted solar cap.

Understanding the interaction between Duke Energy's decision making and the solar energy split resulting from the CPRE provision is critical background for the environment in

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[31] Tyler Fitch et. al., *Carbon-Free by 2050: Pathways to Achieving North Carolina's Power Sector Carbon Requirements at Least Cost to Ratepayers*, SYNAPSE ENERGY ECONOMICS (July 20, 2022) (presentation by Synapse Energy Economics on the Carolinas Carbon Plan before the N.C. Utilities Commission), https://starw1.ncuc.gov/NCUC/ViewFile.aspx?Id=5815f0fe-8690-4aac-86f7-f2d752c73c9b.
[32] *Id.*
[33] Michael Hagerty, et. al., *Duke Energy Resource Mix to Meet 70% CO2 Reduction by 2030 in NC: Review and Analysis of Draft Carbon Plan*, THE BRATTLE GROUP, INC. (presentation by The Brattle Group on the Carolinas Carbon Plan before the N.C. Utilities Commission), https://starw1.ncuc.gov/NCUC/ViewFile.aspx?Id=989d1f39-b185-4823-8058-2a353b584ff9.
[34] *Id.*

which the Carolinas Carbon Plan was created. In the most basic sense, Duke Energy's ability to generate revenue comes down to their rate of return and rate base.[35] The rate of return is the percentage return that Duke Energy earns on their debt and equity investments.[36] The rate base is the value of the property on which Duke Energy makes a rate of return.[37] The rate base can also be thought of as the prudent capital investment by Duke Energy minus the accumulated depreciation expense.[38]

The solar energy split created by the CPRE provision greatly impacts the rate base portion of the calculation described above. This impact is best illustrated with the following hypothetical. Assume Duke Energy is planning on investing $20 billion in both new nuclear energy projects and new solar energy projects. Under the CPRE provision, Duke Energy will be able to invest, own, and rate base the entire $20 billion for the new nuclear energy projects. Assuming a seven percent rate of return and no significant depreciation, the resulting revenue would be $1.4 billion in the first year. However, under the solar energy split, Duke Energy is only able to rate base $11 billion of the new solar projects. Under the same assumptions as above the resulting revenue would be $770 million in the first year. The result in Duke Energy's decision making from this discrepancy seems to be clear; if the HB951 requirements can be met while introducing minimal new solar energy projects, then this is optimal for Duke Energy and its shareholders. This conclusion becomes evident after an analysis of Duke Energy's proposed Carolinas Carbon Plan.

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[35] Christopher J. Ayers, *Ratemaking Presentation*, NORTH CAROLINA UTILITIES COMMISSION (las accessed Dec. 17, 2022), https://files.nc.gov/pubstaff/documents/files/Ratemaking%20Presentation%20%283-18%29.pdf.
[36] *Id.*
[37] *Id.*
[38] *Id.*

B. The solar cap extends the timeline of the proposed Carbon Plan through the forced reliance on undeveloped energy sources.

The imposed solar cap has a direct impact on the carbon emission reduction timeline by altering the energy mix in Duke's proposals. A reduction in selected new solar means an increase in the selection of new offshore wind, new nuclear, new pumped storage, new combined cycle, and new combustion turbine.[39] While many of these alternative energy sources will play a critical role in the transition to net zero carbon emissions in the future, they are not far enough along in the development stage to meet the 2030 timeline required by HB951. Take new nuclear, small modular reactors (SMRs), for example. Currently the only approved SMR technology is by NuScale Power.[40] NuScale has yet to complete a project, and the estimated full plant operation date for their first projects, which began prior to 2020, is 2030.[41] While SMR technology may be available to reach the 2050 requirements, it is not feasible to include carbon emission reductions from SMRs toward the 2030 reduction requirements. Due to the reduction in the selection of new solar by the imposed cap, Portfolios three and four rely heavily on the selection of new SMR technology.[42] The solar cap makes the selection of a feasible energy mix extremely challenging when considering the 2030 reduction timeline.

The alternative carbon plans by Synapse Energy Economics and the Brattle Group, discussed briefly above, propose to solve this timeline problem with the removal or increase of the solar cap. While this would likely solve the timeline issue with a greater reliance on proven technology, it introduces a great amount of risk to the energy grid through the reduction in

[39] *Carolinas Carbon Plan Executive Summary*, *supra* note 18.
[40] *Projects*, NUSCALE POWER, LLC. (December 17, 2022), https://www.nuscalepower.com/en/Projects.
[41] *Id.*
[42] *Carolinas Carbon Plan Executive Summary*, *supra note* 18.

baseload power.[43] Baseload power demand is the amount of electricity that is constantly required regardless of the time or season.[44] Without major upgrades to storage and transmission systems, a variable renewable energy like solar energy cannot serve as a solution for baseload power demand.[45] These are the issues Duke Energy cited, but failed to quantify, for the imposition of the solar cap. The current baseload power options are traditional fossil fuel-based assets and nuclear power.[46] As discussed above, new nuclear is not a feasible option for the 2030 reduction timeline. This would suggest an optimal energy mix that includes new solar above the Duke Energy solar cap and a conservative retirement of fossil fuel-based assets while baseload power research and improvements are made via storage, transmission, and new nuclear development.

C. The solar cap increases energy costs to consumers by forcing the selection of more costly renewable energy options.

The introduction of HB951 is in many ways concerning for low-income customers. In 2019, 13.6% of North Carolina residents were living in poverty.[47] These families pay roughly 16% of their income towards their energy bills.[48] The proposed plan by Duke Energy estimates that the monthly bill will increase anywhere from $5 to $35 per month depending on the portfolio selected.[49] This bill increase makes an already challenging energy situation a crisis. The carbon plan designed to meet the reduction requirements by 2030 must do everything to maintain lower rates for consumers.

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[43] Stephen Arbogast, *Measuring Renewable Energy as Baseload Power*, KENAN INST. (March 2018), https://www.kenaninstitute.unc.edu/wp-content/uploads/2018/05/Kenan-Institute-Report-Measuring-Renewable-Energy-as-Baseload-Power-v2.pdf.
[44] *Id.*
[45] *Id.*
[46] *Id.*
[47] *Low-income Neighbors Need NC's Help With Energy Bill Burden*, SIERRA CLUB North Carolina (Oct. 20, 2021), https://www.sierraclub.org/north-carolina/blog/2021/10/low-income-neighbors-need-ncs-help-energy-bill-burden.
[48] *Id.*
[49] *Carolinas Carbon Plan Executive Summary*, *supra* note 18.

The cost of the new renewable energy options can be largely estimated and demonstrated through their respective levelized costs of electricity. The levelized cost of electricity is an indicator of how cost effective an energy source is.[50] It is the price at which the generated electricity should be sold for the system to break even at the end of its lifetime.[51] The unsubsidized levelized costs per megawatt hour for nuclear, coal, wind, and solar are $204, $152, $50, and $37, respectively.[52] It is clear that the imposed solar cap directly increases the levelized cost of electricity that will be passed on to the consumer. While the removal of the solar cap and an increase in new solar energy will not solve the energy cost challenges, it will provide the greatest chance of success for a cost-efficient energy transition.

D. The solar energy split could be amended to align Duke Energy's business incentives and the requirements of HB951.

The solar cap assumption implemented in Duke Energy's Carolinas Carbon Plan modeling could be increased in order to create a plan that will meet the 2030 reduction timeline in a cost-efficient manner. The technical justifications remain valid in determining the solar cap, but could be quantified to justify the precise level of feasible new solar. The lack of quantifiable analysis for the technical justifications suggests that the true rate limiting factor in the creation of the solar cap is the CPRE provision. The CPRE provision incentivizes Duke Energy to use the minimum amount of new solar energy as they strive to create an energy mix that meets the 2030 and 2050 requirements.

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[50] Michael Papapetrou & George Kosmadakis, *Resource, Environmental, and Economic Aspects of SGHE*, WOODHEAD PUBL'G SERIES IN ENERGY, 319, 319-353 (2022).
[51] *Id.*
[52] *Estimated Unsubsidized Levelized Costs of Energy Generation in the United States in 2021, by Technology*, STATISTA (Oct. 2021), https://www.statista.com/statistics/493797/estimated-levelized-cost-of-energy-generation-in-the-us-by-technology/.

One option to correct the misalignment between Duke Energy's business incentives and the emissions requirements of HB951 would require two steps. First, the optimum solar cap is calculated to ensure the proposed plan can meet the timeline requirements in a cost-efficient manner while accounting for the technical constraints. This calculation is a view of the solar cap without the bias introduced by the CPRE provision. After identifying the optimum solar cap, the 45/55 solar energy split is adjusted to ensure that it is in Duke Energy's interest to include the optimum amount of new solar energy in their proposed energy mix. This option would require the North Carolina legislature to amend HB951 and the CPRE provision. It is unreasonable to expect Duke Energy to make poor business decisions when they can fulfill the HB951 requirements with the use of less new solar energy. To create a successful energy plan and transition, the legislature could find a way to apportion a greater percentage of the solar energy split to Duke Energy to cooperatively align business incentives and timely, cost-efficient energy solutions.

V. CONCLUSION

In 2021, the North Carolina legislature enacted HB951 to establish requirements around the reduction of carbon dioxide emissions and included policies addressing the procedural aspects of the energy transition. The energy transition policies aimed at new solar energy, specifically the CPRE provision, misalign the business incentives of Duke Energy and the carbon reductions requirements in HB951. As a result, Duke Energy seeks and is able to create a Carbon Plan that meets the requirements of HB951 while minimizing the use of new solar energy, creating a plan that sacrifices timeliness and cost-efficiency to consumers. To truly satisfy the intentions of HB951 in creating a timely and cost-efficient renewable energy transition, the North Carolina legislature could amend the CPRE provision of HB951 to apportion a greater

percentage of new solar projects to Duke Energy to properly align business incentives and emission reduction goals.