DOCKET NO. E-100, SUB 179

Analysis of Duke Carbon Plan - Brad Rouse

BEFORE THE NORTH CAROLINA UTILITIES COMMISSION

DOCKET NO. E-100, SUB 179

In the Matter of: Duke Energy Progress, LLC)		
And Duke Energy Carolinas, LLC, 2022	**)**	**COMMENTS**
Biennial Integrated Resource Plans and	**)**	**OF BRAD ROUSE**
Carbon Plan	**)**	

Analysis of Duke Carbon Plan - Brad Rouse

I, Brad Rouse, a resident of Asheville, NC and Duke Progress, LLC ratepayer, am submitting these comments for consideration by the North Carolina Utilities Commission (Commission) as it reviews Duke's 2022 Carolinas Carbon Plan.

Summary:

Duke's carbon plan is welcome progress in that this is the first IRP or related plan that Duke shows a pathway to sharp reductions in carbon emissions by the next decade and 100% zero carbon by mid-century.

They have done a good job of presenting their process and some of the detail behind their plan.

For the most part I am in favor of the plan that they present for execution of "near-term actions", as presented in Chapter 4. The Commission should ask Duke to immediately start moving on some common aspects of all the plans, including enhanced energy efficiency (EE) and distributed energy (DER) programs, expansion of low-income programs, transmission upgrades, relicensing the existing nuclear fleet, pumped hydro expansion, battery systems development, onshore wind development, offshore wind development, expanding the flexibility of existing gas (and coal) plants, consolidating DEP and DEC operations, etc. The time frames are urgent, and Duke needs to begin urgent action to move ahead to meet the 2030 goal. The Commission can

ask Duke to proceed on these items even while it asks Duke to reconsider some of the aspects of the carbon plan to address the below concerns.

The Commission should ask for additional analysis before approving certain aspects of the plan. In my judgment, these aspects of the plan need substantial work before they can be approved:

- Duke's four scenarios are very similar in the later years: adding significant solar and moderate amounts of both onshore and offshore wind energy while greatly expanding nuclear and retaining large amounts of natural gas generation (which would be converted to hydrogen later). However, numerous academic studies are pointing to a future which includes far more solar, wind, and storage with a smaller (or zero) eventual role for nuclear and natural gas/hydrogen. Duke's carbon planning process seems to have ruled out such a scenario through its screening process. This screening process is to some degree a "black box". Indeed, other intervenors report having great difficulty in duplicating the results of this process as implemented through the EnCompass software. Duke needs to explicitly consider such scenarios in the latter stages of the process versus ruling them out early on. We all need to know more to reconcile what these academic studies are saying versus what Duke is saying. Further investigation is needed. Investments in new gas infrastructure and new nuclear should move slowly until this issue is fully understood.
- All the scenarios retire coal and replace it with a combination of natural gas and solar in the near term even though meeting the 2050 net zero goal requires the use of natural gas be eliminated. The ability of the plants to continue to operate using supposedly "green" hydrogen is presented as a justification for this choice, but a cost-effective "green" hydrogen market depends on future technology development and is an inherently inefficient means of producing electricity. It should be regarded as a substantial risk of this plan.
- The Commission should not approve the new gas units proposed in all four plan scenarios without first requiring Duke to develop a scenario which substitutes a combination of additional wind, solar, distributed energy resources, energy efficiency, even greater

expansion of low-income programs, batteries, and continuing to burn coal in some units to satisfy reliability requirements. Perhaps some short-term purchases could be used to bridge the gap. Perhaps the existing coal could only run during the expected winter peaking months. As shown in the report's Figures 3-6 through 3-9, gas units (existing plus new), burning hydrogen, will only produce 4% or less of total system energy by 2050. Duke clearly has in mind a future where the gas is not used much at all. Duke must explore the alternative that doesn't build this future barely-used-gas- capacity in the first place and present the results as part of an updated carbon plan, before any CPCN is granted for expansion of the gas system.

- Energy efficiency, low-income programs, and distributed energy resources (esp. rooftop solar) should be resources instead of assumed inputs. Duke may be dramatically understating the benefits and potential of even greater investments in these solutions. These programs have many added benefits to local communities such as local economic development and they come without as much need to expand the transmission system. Duke should include in its plans a greater commitment to the small scale and localized opportunities because of these additional benefits.
- The carbon report fails to incorporate a key implication of the recent IPCC report and other studies, which is that electric utilities will have a dominant position in the decarbonization of our entire energy system (which is required to solve the climate problem). Duke's load forecast only reflects a tepid energy system decarbonization by 2050. The Commission should require Duke to show a 2050 full electrification scenario with a much higher forecast of electricity demand by then. As discussed below, full electrification might lead to a 50% increase in energy requirements by 2050 versus the forecast in the Carbon Plan. And Duke should include as a goal of its plan the full decarbonization of society, even though that is not a specific requirement of the law.

The need for action to meet the 2030 carbon goal is very urgent. The NCUC should move expeditiously to approve of Duke's requests in most areas. However, some areas Duke's request for immediate action warrants additional investigation because they commit to investments of ratepayer money that may prove to be shortsighted. Burning coal needs to be minimized but

retiring coal plants in favor of building new gas plants may be premature and the Commission should consider options for replacing the need for those coal plants with solar, wind, and storage solutions before proceeding with new gas plants.

The following sections provide details on Brad Rouse's background plus additional details and support for the above points.

Brad Rouse background

My career has been spent in the fields of economic and financial analysis, with special focus on energy system planning. I received a BA in Economics from Yale and an MBA from the University of North Carolina at Chapel Hill (Kenan Flagler) with a focus on finance. After graduate school I was employed as an Economics Consultant for Data Resources Inc., advancing to manager of DRI's utility economics practice. My primary effort at DRI was to develop energy and demand forecasting systems for electric utilities in the Southeast. I led the development of Duke Progress's (then Carolina Power and Light) first long range economics based load forecasting system. In reading Duke's description of their load forecasting approach, I see that it still bears much similarity to the system I helped develop.

My career also includes a long period of time developing systems and performing analysis for utility long - range strategic planning. As a Vice President for Energy Management Associates, Inc. (EMA) in Atlanta, GA, I led the development of two premiere systems used to perform integrated resource plans – Proview and Strategist. Both Duke Energy and Carolina Power and Light used these systems as part of their development of integrated resource plans and I consulted extensively with Duke Energy system planning and financial departments for this purpose. At one time over 100 utilities were using these products worldwide, and there are still many users of one or more of these products today.

In addition to overseeing the development of these systems, I worked extensively with EMA consultants and industry planners, including at Duke Energy, to help apply these systems in the Integrated Resource Planning process. I presented expert witness testimony in Montana and

Pennsylvania, and more recently have testified as a member of the public before the Georgia Public Service Commission and the US Environmental Protection Agency.

After working with EMA, I advised individuals and businesses on financial planning strategy, receiving the Certified Financial Planner designation. I sold my financial planning advisory practice in 2013 to focus again on climate and energy planning issues.

I have been active in energy issues since moving to Asheville in 2015, including intervening before this Commission in DOCKET NO. E-2, SUB 1089 in 2016 and becoming deeply involved in the Asheville / Buncombe Energy Innovation Task Force, which later became the Blue Horizons Project. I co-founded a low-income energy efficiency non-profit in Asheville, NC, Energy Savers Network, which works under the auspices of the Green Built Alliance, and which is now a program of the Blue Horizons Project. In 2020 I wrote nine articles on the energy future for CleanTechnica, an online publication focused on the energy transition, and, in 2021, I published my first book, *Climate Warrior: Climate Activism and Our Energy Future* (see www.climatewarriorbook.com).

Near Term Action Plan

The Carbon Plan presents a dynamic staged process that reflects inherent uncertainty about the future. We don't know what the future will hold so we can only make informed and logical decisions and make our best estimate today based on what we know now. Duke's plan reflects that uncertainly as well as the need not to waste time. Duke should seek to avoid making decisions today that make future decisions to change direction more difficult. Capital expenditures to pursue one potential avenue, which might prove to be a waste of money when future information results in a changed direction, should be carefully considered.

Chapter 4 of the plan discusses the near-term actions that Duke asks the Commission to approve. The key word in this chapter is "preserve optionality". The Commission should approve of much of what Duke requests to do to "preserve" optionality. Some options need to begin early roll out because they take a long time to bring to maturity, and the option to "begin early" will be lost if they don't begin now. This includes expanding energy efficiency, on-tariff financing, net

metering, and "grid edge" programs. These are all great ideas and if anything should be emphasized to move with greater urgency from "pilot" stage to full on implementation. Programs to modernize the grid to allow more solar, to relicense the nuclear fleet, to expand the existing pumped hydro, to develop the transmission system to support wind energy, to consolidate operations between the two companies and more should all be approved by the Commission. This all represents a huge workload for one company, and it needs to get a green light ASAP so Duke can start working on it.

In addition to "preserve optionality", Duke should add the term "increase opportunity". Duke should not only work to secure the ability to implement the options it has presented, but also to explore alternative paths that the Commission should ask Duke to explore, and which will be discussed below, and preserve those options as well. One key alternative path is to explore a future development which does not expand the fleet of gas fired power plants as much or at all. This path should be informed by the academic work around designing future electric systems that incorporate much higher penetrations of wind, solar, and storage and which do not require new central generation to replace coal. Such an exploration should be added to the list of near-term actions that the Commission approves and directs Duke to take.

A major element of Duke's near-term and intermediate-term plans is to add 2.4 GW of gas combined cycle and .8 GW to 1.1 GW of gas combustion turbines. Lazard's 2021 report on generating plant options (https://www.lazard.com/media/451905/lazards-levelized-cost-of-energy-version-150-vf.pdf) estimates the midpoint cost of combined cycle at $1,000 per KW and combustion turbine at $812 per KW. From these estimates, we see that Duke's intermediate-term plan involves an investment of $2.4 billion in combined cycle gas plants and from $650 million to $880 million for combustion turbines, all to be recovered from ratepayers.

Lazard's report also shows that the levelized cost per MWH (LCOE) of combined cycle ($59.5) and combustion turbine ($173) gas plants are much higher than onshore wind ($38.5) and utility scale solar ($35.5) as of 2021. One must ask, why did the supposed "least-cost" modeling pick the gas CC and CT plants when wind and solar are so much less expensive. Was this result forced by Duke's modeling inputs? Duke will undoubtedly respond that solar doesn't contribute

at the peak winter hour and one must add the cost of storage into the mix. Perhaps, but one must also consider that the LCOE advantage of wind and solar may even be understated due to three key factors:

(1) LCOE critically depends on capacity factor and the capacity factors for gas will decline significantly during the 2030-2050 period as lower cost energy from solar, wind, and nuclear is preferred in utility operations and as Duke attempts to meet their carbon targets. A much lower capacity factor means a far lower LCOE.

(2) Gas prices have increased significantly over the last year and are not included in Lazard's comparison. Whereas fuel for wind and solar is zero cost, the fuel for gas capacity is high cost and is highly variable.

(3) Wind, solar, and storage technologies have been declining in cost at a rapid rate and this decline is likely to continue because of the build out of decarbonized energy systems worldwide. Technology tends to decline in price as a function of the cumulative implementation of the technology, and this is likely to continue based on the amount needed to meet the need for global decarbonization to achieve the goals of the Paris Climate Accords and either a 1.5 C or 2.0 C temperature pathway. The Commission should ask Duke to prepare a detailed comparison of a scenario that does not rely on this near-term gas build out to all of the four scenarios presented.

(4) Lazard's cost estimates include no subsidies from federal policy. If Congress extends wind, solar, and battery tax credits, or if they remove existing fossil fuel subsidies, then this will also increase the advantage of wind and solar versus gas CC and CT options.

Such a scenario will require a different near-term path likely, involving more storage, more solar, more commitment to energy efficiency, more demand management, and a more expanded use of wind energy in the near term. Such an option might also require a decision to rely upon imported wind energy from other regions, with the requisite transmission purchases. It also might require delaying the retirement of some of the coal units and instead reducing the utilization of the coal units and only retiring them when Duke and the Commission are sure that a reliable system can

be maintained without the coal capacity. One interim option could be for Duke to keep the coal units offline except for in the winter months when solar output is at a minimum in this scenario.

Preserving optionality for so many different options will require manpower and management attention from Duke. The benefit of wind, solar, storage, and energy efficiency options is that the lead times are shorter than for nuclear and some fossil opportunities. But these options do require immediate investment to begin scaling for a greater contribution than what Duke shows, Duke should ensure that the efforts to preserve optionality for the nuclear and fossil gas plants do not come at the expense of the build out of these shorter lead time options.

In summary, the Commission should not rely on the "black box" EnCompass calculations that say that all plans must include up to 3.5 GW of new gas. Instead, the Commission should ask Duke to do a full exploration of one or more options that include less or none of the combined cycle and combustion turbines and avoid the $3 billion plus capital investment, the likely underutilization of the gas units over the 2030-2050 period, and the risk that gas prices may be much higher than that used in Duke's current plan.

Carbon Plan Contradicted by Many Other Planning Studies

The carbon plan all the way out to 2050 continues to rely on central generating facilities, particularly nuclear plants. All four scenarios show a high reliance on nuclear for the energy requirements in 2050 when the system is at net zero. Solar growth seems to stall and wind energy has a miniscule share of energy in 2050. This result can be seen in Figures 3-6 through 3-9, energy mix box. The Commission is not being asked to approve of the specific units, but they are being asked to approve of the carbon plan in total. Not one of these plans presents the results of or consideration of an alternative that does not rely on nuclear power and / or does not rely on central station gas units replacing most of the capacity from retired coal units. This is despite the history during the last 10 years of dramatic declines in the cost of solar and wind and battery storage and the opinion among many prognosticators that these declines will continue.

Duke says that these options were considered in the screening process using the EnCompass optimization model, and that they did not make the final selection because the model chose the

options that are in Duke's plan. How can this result be explained given the current cost advantage of wind and solar and the rapid decline in expected future costs? Isn't the model supposed to pick the lowest cost option? What is going on in the modeling process that produces this result?

We do know that Duke has constrained the modeling to limit how much solar can be added in. Is solar the preferred choice but it is being blocked by limits imposed by Duke's modeling assumption? Are more renewables being blocked because Duke is using a "reserve margin" calculation to guide the EnCompass optimization combined with an assumption that solar plus battery plus wind do not contribute very much to reserves (through assumption of a low "ELCC")? And consider the "typical week" formulation in EnCompass, where a week which has both the seasonal minimum and the seasonal maximum in it is used. Such a week would seem to be anything but typical. Does this modeling technique somehow discriminate against solar plus wind plus batteries? Does it have to be this way? Is there a lower cost solution that we are not seeing? To me, there are too many questions to blindly rely on these modeling results to simply throw out the wind plus solar plus battery long term future, when these are known to be the lowest cost options.

Another consideration is the large body of evidence building up in academic studies that a renewables focused system can meet the demand for energy with a high level of reliability and low cost. Modeling studies are all we must go on since we can't point to many power systems that have yet achieved that desired for combination. Nevertheless, many analysts have used detailed hour by hour calculations to simulate such system. One such analysis is the work of a team led by Dr. Mark Z Jacobson, Director of the Atmosphere / Energy Program at Stanford University. Jacobson's team used an hourly multiyear production simulation of the state of North Carolina using public data and determined that a mix of solar, wind, and batteries could reliably meet the demand for a 2050 NC energy system at each hour without outages without using any fossil fuel or nuclear. The demand for energy in his forecast included the expansion of the electric system to assume electrification of all energy uses including 100% of transportation, 100% of energy, and 100% of residential and commercial heating. Obviously, the electric demands were much higher than what Duke is projecting now, but the startling result was that

overall spending on energy for consumers would be ½ of what that spending would be in the business-as-usual case before considering any climate or health benefits of less pollution. While Jacobson's work covers NC as a whole, which is not exactly the same as the DEP and DEC service territory, it's close. It would greatly inform the knowledge of all parties to understand why Duke's expensive carbon plan will work whereas Jacobson's much lower cost alternative won't work. One way to better inform our understanding would be to instruct Duke to come up with one or more additional scenarios which examine a future more like the scenario for NC in Jacobson's work. See: https://web.stanford.edu/group/efmh/jacobson/Articles/I/WWS-USA.html and the comparison to Jacobson's NC modeling below. There are many other studies from around the world that are forming a building body of evidence that are a counterpoint to the central station centric vision Duke presents. The following is a link to 70 such studies from 25 separate research groups that point to similar conclusions: https://web.stanford.edu/group/efmh/jacobson/Articles/I/CombiningRenew/100PercentPaperAbstracts.pdf

And here are some others that hopefully the Commission will review:

Ember think-tank – Europe: https://ember-climate.org/insights/research/new-generation/

David Suzuki Foundation – Canada: https://www.theenergymix.com/2022/05/27/canada-can-hit-100-zero-emission-electricity-by-2035-without-nuclear-ccs-report-finds/

University of California at Berkeley, "2035: The Report" - US: https://www.2035report.com/electricity/

National Renewable Energy Lab - US: https://www.nrel.gov/news/program/2021/the-challenge-of-the-last-few-percent-quantifying-the-costs-and-emissions-benefits-of-100-renewables.html

RethinkX – various US regions: https://www.rethinkx.com/press-release/2020/10/26/new-report-rethinking-energy-2020-2030-100-solar-wind-and-batteries-is-just-the-beginning

All of these studies point to a similar conclusion: There are robust pathways to 100% carbon free or very near to 100% carbon free electricity grids with costs close to or below the current cost of energy on the grid and all or almost all powered by renewables. Furthermore, a fellow Southeast

regional utility, Florida Power & Light, has announced that their utility operations will be at "real zero" carbon by 2045, using a portfolio that is 89% solar and 11% nuclear, and has stated that that is the lowest cost portfolio for them. https://www.nexteraenergy.com/real-zero.html

This is an issue that the Commission must investigate to make sure that Duke's analysis does not lead to a higher cost plan that also involves an unproven approach by requesting that Duke develop a scenario that relies on more efficiency, wind, storage, and solar and with no additional nuclear and gas beyond what already exists on the system.

Comparison of Duke Carbon Plan Scenario 1 to Jacobson Plan

As stated above, it is important that the Commission, and indeed, all stakeholders, come to an understanding of why the carbon plan does not choose more renewable energy when other studies show a strong advantage to such a path. In beginning the thought process toward such an understanding, it may be helpful to compare Duke's plan to the NC plan developed by Jacobson and understand the differences. The two plans are similar in that they provide an hour-by-hour analysis of the ability to meet the system demand by a portfolio of resources. In both plans, the resources available meet the required demand roughly 100% of the time. The Duke carbon plan is for the combined DEC and DEP service territories, whereas the Jacobson plan is just for NC. The hour-by-hour load matching is done for SERC as a whole, of which Duke is a part, due to robustness of publicly available hourly load data at that level. The electricity demand for the area served by Duke is about 20% more than the total for NC, so, in the table below, all of Jacobson's capacity and energy values are increased by 20%. The Duke numbers come from the carbon plan while the Jacobson numbers come from https://web.stanford.edu/group/efmh/jacobson/Articles/I/WWS-USA.html and can be obtained by clicking on the infographic link for North Carolina to access the pdf.

Here is the basic comparison for 2050, which the Duke Carbon Plan calls the "net zero year".

Comparison of Duke Carbon Plan to Jacobson WWS-NC Plan - 2050 Resource Mix			
	Duke Carbon Plan	Jacobson NC plan	Notes
2050 Energy Requirements (GWH)	206,160	300,643	Duke Numbers from Appendix E Table E19 page 19 scaled up to add NEM solar back in. Jacobson numbers from his NC 2050 forecast, scaled up 20% to reflect Duke territory larger than NC, due to portion in SC
Resource Mix %			
Hydro	0	1%	Duke Percentages read from chart in Chapter 3, Figure 3-6 Portfolio 1, Energy Mix subchart, "Net zero" column
Solar - Utility Scale	30%	49%	Jacobson numbers from NC 2050 Report
Solar - Net Metered	1%	22%	
Wind - Onshore	1%	10%	
Wind - Offshore	1%	18%	
Nuclear	63%	0%	
Gas / Hydrogen	4%	0%	Jacobson uses far more battery, thermal, and hydro vs. Duke using hydrogen for long duration storage
Sum	100%	100%	

These are obviously vastly different plans, but they share the characteristic that both claim to meet demand virtually 100% of the time. Jacobson's energy demand is much higher because he posits a plan that creates a zero-carbon total economy, so the additional GWH demand is due to

all other end uses being converted to electricity from direct use of fossil fuels. Duke has a much smaller vision of the ability of the economy to move away from fossil fuels. Duke relies on keeping their existing nuclear fleet in place and building a lot more, whereas Jacobson's analysis assumes nuclear is no longer in place by 2050. Compared to Jacobson, Duke's plan for wind and solar show very little ambition.

The interesting thing is that Duke claims that these changes will increase electric rates somewhat. Jacobson, on the other hand, takes advantage of 50% more electricity sales and the lower costs for wind and solar to show a rate projection that is very close to today's rate levels. When you consider the reduced demand for direct use of fossil fuels implied by Jacobson's forecast, the overall energy bill for consumers in Jacobson's analysis is roughly half of what they would be spending versus a "business as usual" scenario. Duke has not performed an analysis, to my knowledge, of the overall reduction in spending on energy that would result from the electrification of transportation, heating, and industry.

But how can one explain the stable electric rate in Jacobson versus the higher rates in the carbon plan? Duke supposedly has developed the "optimal" plan based on least cost, but clearly Jacobson is saying there is a much lower cost approach. Could it be that the installation of solar and wind reduces the costs while continuing to invest in new nuclear and gas drives rates higher? A comparison of the technology, using Lazard's study on levelized costs should be illustrative (https://www.lazard.com/media/451881/lazards-levelized-cost-of-energy-version-150-vf.pdf). Lazard's 2021 estimate of levelized cost in $/MWH for new build and without any subsidey, using 2021 fuel costs, is as follows (simplified to take the midpoint of the range from Lazard):

- Onshore wind - $41
- Offshore wind - $89
- Utility Scale Solar - $40
- Gas CC - $55
- Gas Peaking – $174
- Nuclear - $155

I do understand the challenges of using levelized cost numbers, but those challenges come from misestimating capacity factors. And by Duke's own admission, the capacity factors on gas CC and gas peaking will be lower than Lazard's assumptions in the later years, as gas (hydrogen) declines to meet only 4% of the load by 2050. These lower capacity factors will likely mean that the cost advantage of wind and solar will be even greater than shown above.

Of course, the wind and solar will require batteries as well, so their advantage may be reduced. Indeed, Jacobson shows an order of magnitude greater amount of storage in 2050 than the Duke carbon plan incorporates by 2035, in the range of 275 GW including pumped hydro, batteries, and thermal storage. It's almost as if Duke assumes a small amount of storage to get to the 2030 goal and then walks away from storage and renewables after that in favor of a central station nuclear dominated system.

I show these comparisons so the Commission can see how vastly different the Duke plan is from other plans, and not to advocate for the use of those plans in place of Duke's plan. It is likely, in my opinion, that the Commission will want Duke to continue to operate their existing nuclear fleet as the energy transition takes place, for example. However, Duke must show the Commission the implications of a plan that looks a lot more like Jacobson's plan, that is with less nuclear, less gas, more utility scale solar, more net metering solar, vastly more wind power, and vastly more storage. They must demonstrate the superiority of a nuclear dominated versus a wind-solar-storage dominated system, from the "least cost" perspective, and they must show it using a detailed analysis versus simply relying on the "optimization" technique used in the EnCompass software.

Natural Gas and Nuclear Investments carry risk

Duke acknowledges that the technologies it has chosen are not proven. No one has built a commercial small-scale reactor at this point, and it is not clear at all that current cost estimates will be able to actually be achieved. The cautionary tale is certainly the Vogtle units in Georgia which are years late and billions over budget.

Natural gas is risky due to price concerns, including the fact that market prices are much higher now than they were even a few months ago. Furthermore, the new natural gas units become part of the system in 2050 as hydrogen units. Hydrogen presents problems which add additional risk, including the risk that hoped for breakthroughs in low-cost electrolysis, hydrogen transport, and use of hydrogen in former natural gas plants will materialize. Based on the low use of hydrogen by 2050 in figures 3-7 through 3-10 in Chapter 4 of the Carbon Plan, its use is for peaking purposes only. However, it is possible that peaking will be more economically solved through some other method by then, at which point the new natural gas units' useful lives would be shortened and run the risk of being a stranded asset.

Duke Should Consider Central Role of Electricity in Energy Transition

Duke can lead our state in the energy transition. The likely path ahead for a low carbon energy system is through the complete transformation of the energy used to meet human needs such as mobility, heating, cooking, and products made through industrial processes. These human needs can be met through electricity from a carbon free electricity grid. Duke has incorporated some of this transformation in its thinking, but it should show the implications of such a transformation in terms of a series of alternate plans for a much greater transformation. The simple reworking of Jacobson's numbers suggest that this transformation will lead to electricity demand that is 50% greater than that in Duke's carbon plan. Duke, and the Commission, should begin to prepare for and encourage this transformation to a much greater degree than is shown in the existing plan.

Conclusion

Producing a carbon plan is one thing. Implementing the goals of the carbon plan is another thing. Getting the carbon plan exactly right in the near term is not as important as moving ahead with the things which we make basic sense, and which will provide the foundation for future progress. Based on the IPCC's climate report and the importance of the current decade, the Commission should thus approve of much of the near-term carbon plan, so Duke can get to work. It should also ask Duke's planning team to come back with more information and analysis for full approval of the plan.

The plan itself should be revised to incorporate more scenarios which seek to bridge the gap between the plan as it currently exists and the other plans which show a much greater role for solar, wind, and batteries. Duke should seek to explain why their estimates of future cost appear to be higher than Jacobson's and others. Duke should also develop a scenario for a much greater role for electricity in an overall scenario for complete decarbonization consistent with the goal of averting the worst of the impending climate crisis.

Respectfully submitted,

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VERIFICATION

I, Brad Rouse, verify that the contents or the foregoing Comments of Brad Rouse are true to the best of my knowledge, except for those matters stated on information and belief, and as for those matters, I believe them to be true.

Brad Rouse

Date: 7/12/22

Buncombe County, North Carolina

Sworn to and subscribed before me this day by Brad Rouse

This 12th day of July 2022.

Joshua R Robinson

Signature

Joshua R Robinson
NOTARY PUBLIC
BUNCOMBE COUNTY, NC
MY COMMISSION EXPIRES 11-25-23

JOSHUA R. ROBINSON, Notary Public

My commission expires: 11/25/2023