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November 26, 2019

Ms. Kimberley A. Campbell, Chief Clerk
North Carolina Utilities Commission
430 N. Salisbury Street
Raleigh, NC 27603

RE: Application for Certificate of Public Convenience and Necessity for Friesian Holdings, LLC to construct a 70-MW Solar Facility in Scotland County, North Carolina NCUC Docket No. EMP-105, Sub 0

Dear Ms. Campbell:

On behalf of Friesian Holdings, LLC, we herewith submit the pre-filed Direct Testimony and Exhibits of Rachel Wilson in the above-referenced EMP docket.

Pursuant to Commission Rule R1-28(e), the Company plans to deliver 16 copies of its testimony and exhibits on November 27, 2019.

Should you have any questions concerning this testimony or exhibits attached thereto, please do not hesitate to contact me.

Sincerely,

/s/ *Karen M. Kemerait*

Karen M. Kemerait

skb

CC: All Parties of Record
Enclosures

BEFORE THE

NORTH CAROLINA UTILITIES COMMISSION

RE: In the Matter of Application of Friesian Holdings, LLC for a Certificate of Convenience and Necessity to Construct a 70-MW Solar Facility in Scotland County, North Carolina	Docket No. EMP-105, SUB 0

Direct Testimony of
Rachel S. Wilson

PUBLIC VERSION

On Behalf of
Friesian Holdings, LLC

November 26, 2019

Table of Contents

I. INTRODUCTION AND QUALIFICATIONS

Q Please state your name, business address, and position.

A My name is Rachel Wilson and I am a Principal Associate with Synapse Energy Economics, Incorporated ("Synapse"). My business address is 485 Massachusetts Avenue, Suite 2, Cambridge, Massachusetts 02139.

Q Please describe Synapse Energy Economics.

A Synapse Energy Economics is a research and consulting firm specializing in electricity industry regulation, planning, and analysis. Synapse's clients include state consumer advocates, public utilities commission staff, attorneys general, environmental organizations, federal government agencies, developers, and utilities.

Q Please summarize your work experience and educational background.

A At Synapse, I conduct analysis and write testimony and publications that focus on a variety of issues relating to electric utilities, including integrated resource planning, resource adequacy, electric system dispatch, environmental regulations and compliance strategies, and power plant economics.

I also perform modeling analyses of electric power systems. I am proficient in the use of spreadsheet analysis tools, as well as optimization and electricity dispatch models to conduct analyses of utility service territories and regional energy markets. I have direct experience running the Strategist, PROMOD IV, PROSYM/Market Analytics, PLEXOS, EnCompass, and PCI Gentrader models, and I have reviewed input and output data for several other industry models.

Prior to joining Synapse in 2008, I worked for the Analysis Group, Inc., an economic and business consulting firm, where I provided litigation support in the form of research and quantitative analyses on a variety of issues relating to the electric industry.

I hold a Master of Environmental Management from Yale University and a Bachelor of Arts in Environment, Economics, and Politics from Claremont McKenna College in Claremont, California.

A copy of my current resume is attached as Exhibit RW-1.

Q On whose behalf are you testifying in this case?

A I am testifying on behalf of Friesian Holdings, LLC.

Q Have you testified previously before the North Carolina Utilities Commission?

A No. However, I was the principal author of a report entitled *North Carolina's Clean Energy Future: An Alternative to Duke's Integrated Resource Plan*, which was an exhibit to, and provided the basis for, comments submitted by the North Carolina Sustainable Energy Association on Duke Energy Carolina's ("DEC") and Duke Energy Progress's ("DEP," and collectively with DEC, "Duke Energy") Integrated Resource Plans in Docket E-100 sub 157. That report is attached to my testimony as Exhibit RW-2.

Q Have you testified previously before other state utility regulatory commissions?

A Yes. My experience as a witness in prior proceedings is summarized in my resume, which is provided in Exhibit RW-1.

Q What is the purpose of your testimony in this proceeding?

A The purpose of my testimony is to demonstrate that the least expensive long-term resource plan for North Carolina ratepayers is one that adds increasing amounts of solar and storage resources over the 15-year analysis period from 2019 to 2033. Ratepayers realize substantial savings relative to Duke Energy's proposed natural gas-dominated IRPs even when the likely long-term transmission investment costs necessary to incorporate increased penetrations of solar are included, and potential avoided transmission costs (transmission costs otherwise associated with gas capacity) are considered in resource plan costs.

Q Please identify the documents and filings on which you base your opinions.

A My findings rely primarily upon the analysis that I conducted and the report I prepared for the North Carolina Sustainable Energy Association, referenced above (Exhibit RW-2).

Q Are you sponsoring any exhibits with your testimony?

A Yes. I am sponsoring the following exhibits:

Exhibit Number	Contents
RW-1	Resume of Rachel S. Wilson
RW-2	*North Carolina's Clean Energy Future: An Alternative to Duke's Integrated Resource Plan*

II. SUMMARY OF CONCLUSIONS AND RECOMMENDATIONS

Q Please summarize your primary conclusions.

I conclude that a clean energy future that relies on a substantial buildout of renewable solar and battery storage resources is in the public interest for North Carolina ratepayers, notwithstanding the inclusion of approximately $223 million of network upgrades in DEP rate base. This type of generating resource portfolio is not only least-cost, saving ratepayer money, but also has benefits in the form of reduced air emissions and improved public health. Investments in solar projects in the near term, such as the one proposed by Friesian Holdings in this docket, are an essential part of realizing the sort of portfolio described above.

Q Please summarize your primary recommendations.

A I recommend that the Commission approve the requested CPCN for Friesian's proposed 70 MW solar facility.

III. NORTH CAROLINA'S LEAST-COST RESOURCE PLAN

Q Have you done any analysis that examines the economics of increased alternative energy penetration, including additional solar resources, in North Carolina?

A Yes. As noted, I was the principal author of the study entitled *North Carolina's Clean Energy Future: An Alternative to Duke's Integrated Resource Plan* previously filed with the Commission and included as Exhibit RW-2.

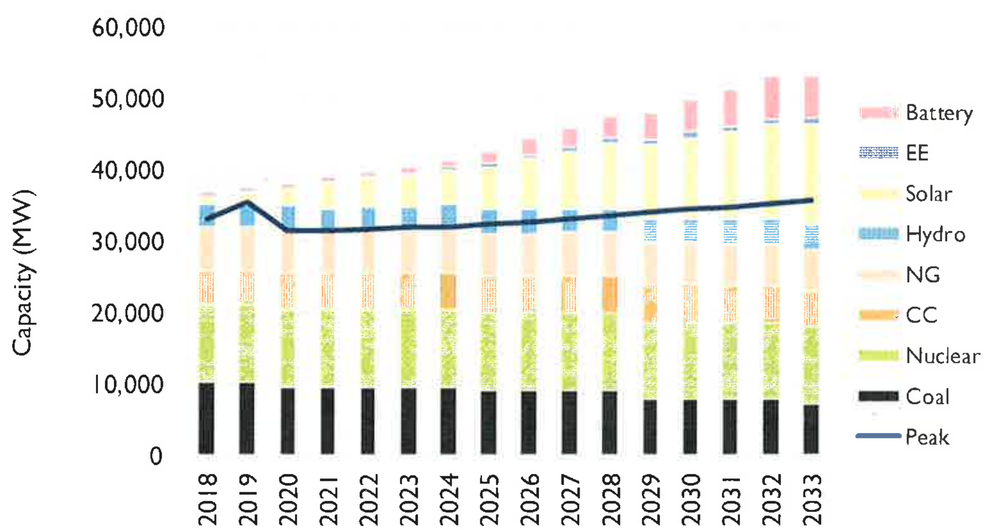
Q What did that study analyze?

A Synapse performed a rigorous, scenario-based analysis to evaluate an alternative clean energy future compared to the more traditional portfolio of fossil-fueled resource additions included in the Duke Energy 2018 IRPs. This report compares a Duke IRP scenario, which reflects the anticipated gas resource additions described in the 2018 IRPs, with an optimized Clean Energy scenario. In the Clean Energy scenario, resources such as solar, wind, energy efficiency, and battery storage were offered to the EnCompass electric sector model for selection of the most cost-effective future resource build to meet capacity and energy need. Synapse examined the benefits of this modeled clean energy future on the electric power system, emissions, public health, job creation, and electricity customer rates and bills. DEC and DEP were modeled as operating in a single Duke Energy service territory, but this does not assume the "capacity sharing" modeled by Duke in its IRPs as part of its Joint Planning scenario. Rather, the resource additions assumed by each utility in its individual IRPs are included and modeled as part of this scenario.

Q What volume of renewable resources is added in the Clean Energy scenario?

A The results show that renewable energy additions, in lieu of gas capacity, is the more economic choice for ratepayers. The Clean Energy scenario adds substantial amounts of solar and battery storage resources, both standalone and paired solar-plus-storage, through the duration of the study period, as shown in Figure 1. This volume of renewables is for the combined Duke Energy service territory in North and South Carolina. By 2033, there are 14 gigawatts (GW) of solar capacity and almost 6 GW of battery capacity in the Duke Energy service territory.

Figure 1. Annual capacity (MW nameplate), Clean Energy scenario



Note that the additions shown in Figure 1 are nameplate capacity and thus exceed the annual peak load requirement. The amount of firm capacity credit, or the portion of the nameplate capacity that contributes to the total reserves used to meet peak demands, given to solar and battery resources is lower than the nameplate value. If capacity were shown on a firm basis, it would track more closely with the annual peak value.

Incremental solar and battery additions in each year are shown in Table 1. Existing resources are included in year 2018 and incremental amounts include both those planned by Duke Energy and those added by the EnCompass model as part of its resource optimization.

Table 1. Incremental capacity additions (MW nameplate), Clean Energy scenario

Clean Energy scenario		
Year	Solar	Battery
2018	1,036	660
2019	620	12
2020	670	16
2021	1,150	28
2022	580	34
2023	420	34
2024	420	36
2025	1,120	696
2026	1,100	696
2027	950	400
2028	1,090	660
2029	1,090	660
2030	1,090	660
2031	960	660
2032	960	660
2033	810	0
Total	**14,066**	**5,912**

In contrast, the Duke IRP scenario has only 4 GW of solar and 232 megawatts (MW) of battery storage by 2033, relying instead on an additional 9 GW of new gas capacity in the form of combustion turbine and combined cycle units. In the 2019 IRP updates, the amount of new gas capacity increases to 12 GW.[1]

[1] Roselund, Christian. September 5, 2019. *Duke doubles down on fossils in 2019 long-term plan updates.* PV Magazine. Available at: https://pv-magazine-usa.com/2019/09/05/duke-doubles-down-on-fossils-in-2019-long-term-plan-updates/

Q How would you respond to the criticism that the grid cannot support the amount of solar called for in your report?

A The cumulative 14 MW of solar capacity called for in this report occurs over a 15-year period. While that amount of solar could not be integrated onto the grid as it exists today, technological innovation will certainly occur that will support larger volumes of renewables, both at the resource level and at the grid level. Duke CEO Lynn Good is relying on technological innovation to achieve its future goal of net-zero carbon dioxide emissions by 2050, stating that "Getting to net-zero carbon emissions, while ensuring energy remains reliable and affordable, will require new technologies. That's the very reason we need to act now. We must continue leveraging today's technologies while sustaining investment in innovation for this vision to become reality."[2] Getting to this point requires that Duke Energy start early, integrating the volumes of solar and battery storage that are currently possible, and providing the demonstrable benefits to current customers that are described in the next sections. Concerns over integration of 14 GW in the long term should not prevent North Carolina from moving forward with the first few GW of solar capacity in the near term.

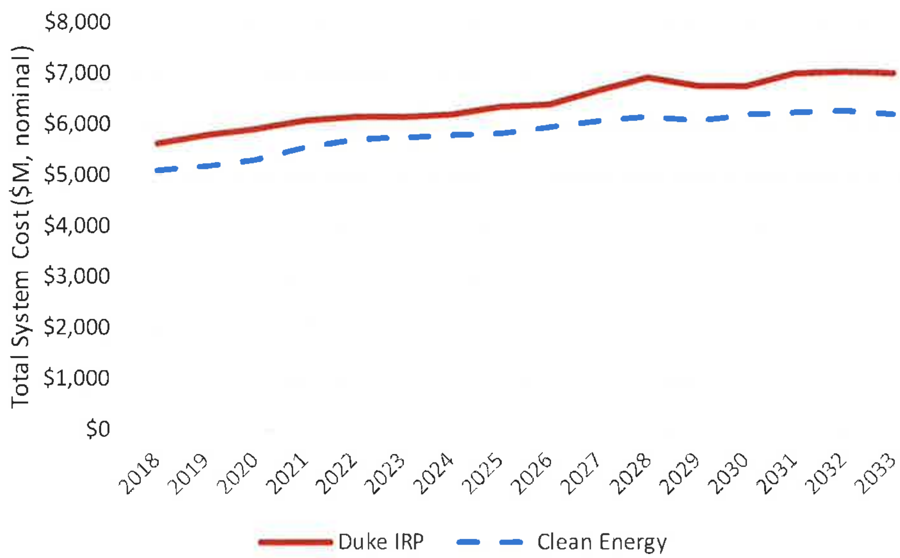
IV. RATEPAYER BENEFITS UNDER THE CLEAN ENERGY SCENARIO

Q What is the savings to ratepayers under the Clean Energy scenario?

A Figure 2, below, shows the total system cost under each scenario, which includes costs associated with new capital investment, the production cost for Duke's system (fuel and operations and maintenance costs), and incremental investments in new energy efficiency. The assumptions and methodology used to calculate these costs are discussed in Appendix A of the Synapse study, which begins on page 19. Under the Clean Energy scenario, ratepayers save an average of $584 million each year.

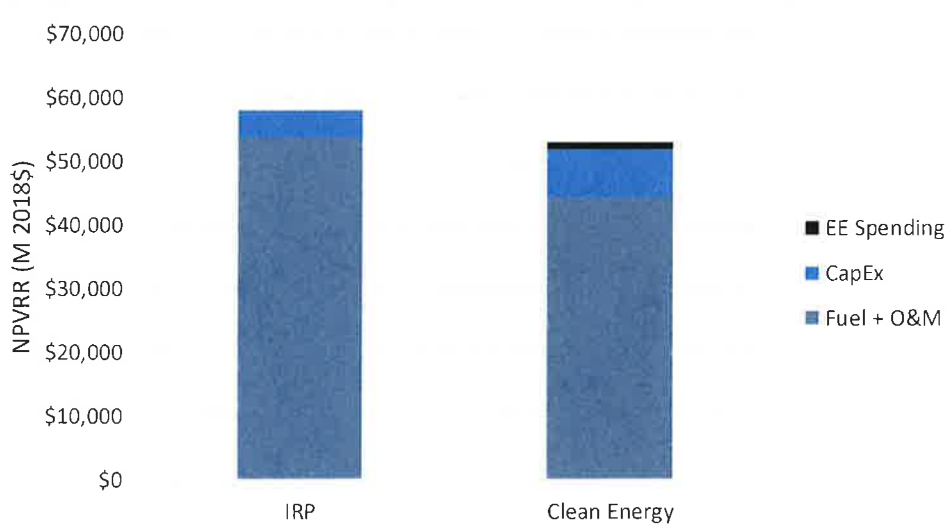
[2] Duke Energy. 2019. *Duke energy aims to achieve net-zero carbon emissions by 2050.* Available at: https://news.duke-energy.com/releases/duke-energy-aims-to-achieve-net-zero-carbon-emissions-by-2050

Figure 2. Annual system cost comparison



This represents a savings of almost $8 billion in terms of the net present value of revenue requirements over the entirety of the analysis period, as shown in Figure 3.

Figure 3. Revenue requirement of the Duke IRP and Clean Energy scenarios, North Carolina



I will note here that all new resources added by the EnCompass model are assumed to be utility-owned, and the costs shown in Figure 2 and Figure 3 include a rate of return to Duke Energy. The costs associated with the Clean Energy scenario are thus likely to be lower than what we have shown, to the extent that renewables are contracted for through Power Purchase Agreements (PPA) rather than acquired via utility ownership.

Q What does your analysis assume about the cost of solar capacity?

A The Synapse analysis relies on the *2018 Advanced Technology Baseline* published by the National Renewable Energy Laboratory (NREL). In the first year of the analysis period, our assumed capital cost is $1,778/kW in $2016, which NREL translates to a levelized cost of energy (LCOE) of approximately $45/MWh.[3] We assume a decline in the cost of solar in subsequent years.

V. TRANSMISSION UPGRADES ASSOCIATED WITH THE CLEAN ENERGY SCENARIO

Q Do the values shown in the above figures include the transmission upgrades that might be required to interconnect new resources?

A No. The costs of any new transmission, or upgrades to existing transmission, that might be required to interconnect either new gas or renewables generation resources are not included in the Synapse analysis.

A How would you estimate the benefits to ratepayers of the network upgrades associated with the Friesian project?

It is my understanding that the transmission upgrades associated with the Friesian project would support the addition of other solar projects that are behind this one in the interconnection queue. Without the upgrades, not only would the Friesian project not be built, those projects also could not be built, depriving ratepayers of cost savings demonstrated in the Clean Energy scenario and the additional benefits described in the next section. In Figure 2, above, I show that the average annual benefit of the Clean Energy scenario is $584 million. This represents the difference in capital and production costs (fuel plus O&M) between the scenarios.

[3] See *2018 ATB Cost and Performance Summary*, Available at: https://atb.nrel.gov/electricity/2018/summary.html.

In the early years, it is less expensive to add solar and battery resources to the system than to run the most expensive of Duke's existing units, resulting in customer savings under the Clean Energy scenario, even when the capital expenditures are considered. In the later years of the analysis, when new gas plants are built in the Duke IRP scenario, difference in benefits occurs because the capital and production cost associated with the Clean Energy scenario is lower than the same costs in the Duke IRP scenario. While not all of these savings would result from solar projects dependent on the Friesian upgrades, the development of these projects is beneficial for North Carolina customers.

Q How do these benefits compare to the cost of the transmission upgrades necessary for the Friesian project?

A The costs of the necessary transmission upgrades necessary to bring the Friesian project online have been estimated at $223 million.[4] Since Duke would have to ask the Commission for rate recovery of this investment in order for it to be included in customer rates, the costs would be recovered over the life of the asset. If we assume a depreciable life of 30 years for the transmission asset, a 52 percent equity ratio, and a cost of equity of 9.9 percent per year, the cost of the Friesian transmission upgrades plus a rate of return in the first year is just under $24 million. That value declines over time for the life of the asset.

VI. OTHER CUSTOMER BENEFITS FROM RENEWABLE RESOURCES

Q Does the Synapse study attached to your testimony examine other benefits associated with the addition of solar and battery resources?

A Yes. As part of the study, we examined the impacts of the Clean Energy scenario on air emissions from Duke Energy's resource portfolio and the effects on human health.

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[4] Appendix A of Large Generator Interconnection Agreement executed by DEP and Friesian on June 6, 2019.

Q What did the Synapse study find regarding emissions of carbon dioxide?

A The Clean Energy scenario leads to a reduction in emissions of carbon dioxide (CO_2), with total emissions being 59 percent less in 2030 under that scenario than in the Duke IRP scenario.

Q How did you calculate CO_2 emissions in each of the modeled scenarios?

A Emissions of CO_2 for Duke Energy service territory in each scenario are an output of the EnCompass model. I allocated emissions between North and South Carolina based on the proportion of sales in each state in 2030, which is based on historical data from the U.S. Energy Information Administration's (EIA) 861 dataset.

Q How did you calculate Duke Energy's portion of Governor Cooper's Clean Energy goal?

A The Clean Energy goal is to reduce emissions from the electric sector by 70 percent below 2005 levels by 2030.[5] The 2019 North Carolina Greenhouse Gas Emissions Inventory shows that emissions from electric power generation were 73.27 million metric tons of CO_2-e in 2005.[6] Thirty percent of those levels would set the goal at just under 22 million metric tons by 2030. I used data from the EIA's 861 dataset to calculate Duke's portion of sales relative to total sales in North Carolina. I then applied that percentage to the 2030 goal to arrive at 11.7 million metric tons.

Q Does the Clean Energy scenario get North Carolina to its goal under Governor Cooper's *Clean Energy Plan*, released in October 2019?

A Not quite, but progress towards that goal is demonstrably greater than under the Duke IRP scenario. The CO_2 emissions under the Duke IRP and Clean Energy

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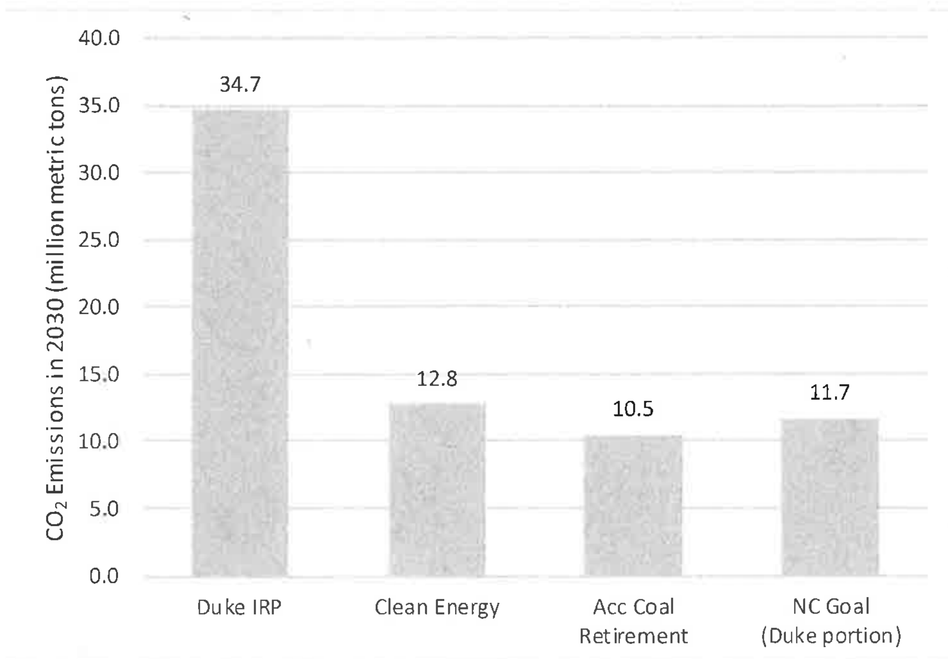
[5] North Carolina Department of Environmental Quality. 2019. *North Carolina Clean Energy Plan.* Available at: https://files.nc.gov/ncdeq/climate-change/clean-energy-plan/NC_Clean_Energy_Plan_OCT_2019_.pdf.

[6] North Carolina Department of Environmental Quality. 2019. *North Carolina Greenhouse Gas Inventory (1990 – 2030).* Available at: https://files.nc.gov/ncdeq/climate-change/ghg-inventory/GHG-Inventory-Report-FINAL.pdf.

scenarios, as well as an additional scenario that accelerates retirement of certain of Duke's coal units, are shown in Figure 4.

Figure 4. Comparison of North Carolina CO_2 emissions under modeled scenarios, 2030



Q What are the implications of the failure to meet Governor Cooper's Clean Energy Plan goal under the Synapse Clean Energy scenario?

A The Synapse modeling was completed six months prior to the release of the *Clean Energy Plan* and so our analysis did not consider Governor Cooper's emission reduction goal. Meeting that goal will require measures beyond those included in Synapse Clean Energy scenario. In our Accelerated Retirement scenario, Duke Energy's coal and gas combined cycle units run less than in the Clean Energy scenario, which enables the utility to meet its emissions goal. In the future, Duke might consider some combination of greater energy efficiency investment, additional coal retirements, or increased investment in renewables.

Q Are there other future resource portfolios that will meet the emission reduction goal with fewer additions of solar?

A There are likely other ways to meet the emission reduction goal. Duke has stated that it would need to accelerate the pace of coal plant retirements while "significantly increasing the Companies' mix of renewables (including wind generation), battery storage, energy efficiency, and combustion turbine (CT) generation." Potential illustrative scenarios provided by Duke show an additional 3,000 MW of additional solar resources over current amounts in the Base Case scenario, for a 51 percent reduction in CO_2. For a 60 percent reduction, an additional 669 MW of solar would be needed, while a 64 percent reduction would require an additional 2,100 MW of solar resources, or a total of more than 5 GW, as compared with the Base Case.[7]

Q What is the significance of the Friesian network upgrades to achieving Governor Cooper's emission reduction goal?

A As I show above, achieving that goal will require solar or other clean energy additions such as those shown in the Synapse Clean Energy scenario. It would be challenging to achieve this ultimate level of solar penetration if no additional solar resources can be interconnected in the areas dependent on the Friesian upgrades. From a resource development standpoint, southeastern North Carolina has been and remains the best location in the state for solar development because of favorable topography, higher insolation rates, low population density, and relatively inexpensive land costs, as discussed by Friesian witness Bednar in his Supplemental Direct testimony being filed on November 26, 2019.

In responses to discovery in this docket, Duke states that:

> Nevertheless, as stated in the Company's response to DR 2-7, substantial network upgrades will be needed to accommodate substantial amounts of new grid resources. The Friesian upgrades are representative of the types of upgrades that will be needed. The Friesian upgrades will, in fact, accommodate the interconnection of a substantial amount of solar resources which will introduce incremental renewable generation to the system that will, all things being equal, contribute to a reduction in CO_2.[8]

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[7] Duke Energy response to Friesian Holdings Data Request 2-8.

[8] Duke Energy response to Friesian Holdings Data Request 2-10.

Q What did the Synapse study find with respect to benefits to human health?

A Synapse used the CO-Benefits Risk Assessment (COBRA) tool[9] to assess the avoided health impacts in both North Carolina and South Carolina[10] due solely to the change in emissions associated with our modeled Clean Energy scenario. For this analysis, Synapse used modeled emissions (SO_2, NO_X, & $PM_{2.5}$) from the Duke IRP scenario as a baseline and compared them to modeled emissions from the Clean Energy scenario to arrive at an estimate of the health impacts **avoided** by the Clean Energy scenario.

In addition to physical health effects and the costs of associated medical treatment, illnesses related to air pollution impose other costs on society. These costs include lost productivity and wages if a person misses work or school and restrictions on outdoor activity when air quality is poor. Table 2 shows low and high estimates of the monetized value of these total avoided health impacts modeled in COBRA,[11] plus the value of restricted activity days and work loss days.

Table 2. Monetary benefits of all avoided health impacts under the Clean Energy scenario

Year	Total Health Benefits, Low	Total Health Benefits, High
2020	$196,778,415	$444,771,642
2025	$194,592,175	$439,830,666
2030	$161,291,821	$364,570,301
2033	$156,736,570	$354,274,856

[9] Developed for the U.S. Environmental Protection Agency (EPA) State and Local Energy and Environment Program, COBRA utilizes a reduced form air quality model to measure the impacts of emission change on air quality and translates them into health and monetary effects.

[10] Because the DEC and DEP IRPs do not specify the state in which proposed new gas generation would be sited, emissions, and thus health impacts, were modeled for the combined North and South Carolina territory.

[11] COBRA can estimate a number of detailed health impacts, including adult mortality, infant mortality, non-fatal heart attacks, respiratory hospital admissions, cardiovascular-related hospital admissions, acute bronchitis, upper respiratory symptoms, lower respiratory symptoms, asthma exacerbations, asthma emergency room visits, minor restricted activity days, and work loss days due to illness.

Q **Are all of these benefits attributable to the Friesian network upgrades?**

A No. These benefits result from implementation of the entire Synapse Clean Energy scenario. As with the cost savings to ratepayers, only a portion of these benefits are attributable to solar development that is dependent on the Friesian upgrades. But if only 20 percent of new solar development occurred in areas dependent on those upgrades, the annual health benefits would vastly exceed the annual cost of the upgrades.

VII. CONCLUSIONS AND RECOMMENDATIONS

Q **Please summarize your conclusions.**

A I conclude that a clean energy future that relies on a substantial buildout of renewable solar and battery storage resources is in the public interest for North Carolina ratepayers. This type of generating resource portfolio is not only least-cost, saving ratepayer money, but also has benefits in the form of reduced air emissions and improved public health. Investments in solar projects in the near term, like the one proposed by Friesian Holdings in this docket, and those that are dependent on the network upgrades associated with the Friesian project, are an essential part of realizing the sort of portfolio described in the Clean Energy scenario and meeting Governor Cooper's emission reduction goal. The public benefits of constructing those upgrades and thereby allowing the Friesian project and other solar project development in southeastern North Carolina to move forward likely exceed the cost of the upgrades by a wide margin.

Q **Please summarize your recommendations.**

A I recommend that the Commission approve the requested CPCN for Friesian's proposed 70 MW solar facility.

Q **Does this conclude your direct testimony?**

A Yes, it does.