North Carolina Utilities Commission

Docket No. E-100, Sub 165

Attachment 1

Direct Testimony of Tyler Fitch on behalf of Vote Solar, as submitted to the South Carolina Public Service Commission (Dockets 2019-224-E and 2019-225-E)

BEFORE

THE PUBLIC SERVICE COMMISSION

OF SOUTH CAROLINA

DOCKET NO. 2019-224-E
DOCKET NO. 2019-225-E

In the Matter of	)
	)
South Carolina Energy Freedom Act	)
(House Bill 3659) Proceeding Related to	)
S.C. Code Ann. Section 58-37-40 and	)
Integrated Resource Plans for Duke Energy	)
Carolinas, LLC and Duke Energy Progress,	)
LLC	)
	)
	)

DIRECT TESTIMONY OF

TYLER FITCH

ON BEHALF OF
VOTE SOLAR

FEBRUARY 5, 2021

BEFORE THE PUBLIC SERVICE COMMISSION OF SOUTH CAROLINA

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TABLE OF CONTENTS

LIST OF ATTACHMENTS

TF-1: Tyler Fitch *curriculum Vitae*

TF-2: Carbon Stranding: Climate Risk and Stranded Assets in Duke's Integrated Resources Plan

TF-3: Duke Energy 2020 Climate Report

TF-4: Duke Energy Carolinas and Duke Energy Progress Response to Vote Solar Data Request 2-10

TF-5: Con Edison 2019 Climate Change Vulnerability Study

TF-6: Duke Energy Carolinas and Duke Energy Progress Response to Vote Solar Data Request 2-7

"Climate change is an existential threat. Both the impact of climate change itself and policies to address it could have major impacts, creating stranded assets, generating large changes in asset prices, credit risks and so forth that could affect the financial system. These are very real risks." – Janet Yellen, Secretary of the Treasury[1]

I. Introduction and Summary

Q. Please state your name, title, and employer.

A. My name is Tyler Fitch. I am Regulatory Manager at Vote Solar.

Q. On whose behalf are you submitting this direct testimony?

A. I am submitting this testimony on behalf of Vote Solar.

Q. Please describe Vote Solar.

A. Vote Solar is an independent 501(c)3 nonprofit working to repower the U.S. with clean energy by making solar power more accessible and affordable through effective policy advocacy. Vote Solar seeks to promote the development of solar at every scale, from distributed rooftop solar to large utility-scale plants. Vote Solar has over 90,000 members nationally, including over 2,000 members in South Carolina. Vote Solar is not a trade organization, nor does it have corporate members.

Q. Please state your educational and professional experience.

A. I began work at Vote Solar in August 2018. As a regulatory manager, I conduct economic and regulatory policy research supporting a cleaner and more equitable energy system in the Southeast. My analysis and testimony has supported Vote Solar's regulatory interventions at public service commissions in South Carolina,

[1] Warmbrodt, Z. (2021, January). Yellen vows to set up treasury team to focus on climate, in victory for advocates. *Politico.* Retrieved at: https://www.politico.com/news/2021/01/19/yellen-treasury-department-climate-change-460408.

North Carolina, Georgia, Florida, New Orleans, Arizona, and Michigan. I provided testimony alongside James Van Nostrand on the incidence of climate risk on Duke Energy Carolinas' and Duke Energy Progress' assets and operations in the most recent rate case proceeding in North Carolina.

Prior to my work at Vote Solar, I was a Peter & Carolyn Mertz Fellow at the University of Michigan's School for Environment and Sustainability under Rosina Bierbaum, an internationally recognized leader in climate adaptation policy and implementation. I developed and published a novel community solar model for a non-profit in Highland Park, Michigan, and contributed to the Urban Energy Justice lab's research at the School. I received my Master of Science degree from the School in May 2018.

I worked as a consultant at ICF International from 2013 to 2016 on federal energy efficiency programs. As an analyst, I wrote data policy for the Department of Energy's Better Buildings Challenge and developed building energy efficiency scores for the EPA ENERGY STAR buildings program. I hold a Bachelor of Science degree from the University of North Carolina at Chapel Hill. My professional background is described in detail in my *curriculum vitae,* provided as Exhibit TF-1.

Q. Have you previously provided testimony to this Commission?

A. No, I have not.

Q. Have you previously testified before other regulatory commissions?

A. Yes. I have provided expert testimony to the Georgia Public Service Commission (Docket No. 42516, Georgia Power rate case), the North Carolina Utilities

Commission (Docket Nos. E-7, Sub 1214 and E-2, Sub 1219, Duke Energy Carolinas and Duke Energy Progress rate cases), and the Virginia State Corporation Commission (Case No. PUR-2019-00214, Virginia Electric and Power Company Application for approval to establish an experimental residential rate).

Q. What is the purpose of your testimony?

A. This testimony introduces climate-related risk as an emergent and material category of risks for Duke Energy Carolinas and Duke Energy Progress ("DEC" and "DEP," respectively, and collectively referred to as "The Companies"), and the families in the Carolinas that make up the Companies' ratepayers. I discuss the implications of climate-related risks for integrated resource planning generally, then evaluate the Companies' 2020 Integrated Resource Plans ("IRPs" or "Plans") in light of those risks. In particular, I assess the feasibility of meeting Duke Energy's carbon commitments while pursuing the Companies' base case with carbon policy scenario, and quantify the potential costs of pursuing this scenario and meeting carbon commitments. Finally, I provide conclusions of my evaluation and provide several recommendations to the Commission for managing climate-related risk exposure in the Companies' Plans and managing climate-related risks in resource planning in general.

Q. Please summarize the major conclusions of this testimony.

A. I reach the following conclusions:

- **Climate risks will shape the 21st-century economy.** Led by the financial sector, stakeholders across the economy are recognizing that climate-related risks are material today and slated to accelerate through the 21st century.

- **Climate risks are utility business risks—and should be treated as such.** Climate-related risks are a material business risk to the Companies today, and prudent business management would dictate that the Companies manage these risks just as they do all other business risks.
- **Integrated Resource Plans are designed to manage uncertainty and risk.** Since they were introduced in the 1970s and 1980s, integrated resource planning processes have been a powerful tool for managing uncertainty and risk in the utility sector. Any reasonable and prudent resource plan will demonstrate how it manages climate risks.
- **Duke Energy's 2020 IRPs ignores climate risks, at ratepayers' expense.** Duke Energy Carolinas' and Duke Energy Progress' Integrated Resource Plans do not adequately assess or manage climate-related risks.
- **Duke's Base Case exposes ratepayers to stranded asset cost risk.** The Companies' scenarios do not appear to implement Duke Energy's net-zero commitment, which could lead to reputational damage, cost-of-capital implications, or stranded carbon-emitting assets. According to my analysis, stranded asset costs to the Base Case with Carbon Policy alone could be $4.8 billion in 2020 dollars.
- **Best practices mitigate climate risk exposure.** The Commission and Company can use utility sector best practices to better inform and manage climate-related risks in future plans.

Q. Please summarize your recommendations to the Commission.

A. I make several recommendations to the Commission in Section V of my testimony. Below is a high-level overview of my recommendations:

- The Commission should find that climate-related risks are a material subset of business risks, and that prudent management of the Companies' businesses will necessarily entail assessment and management of those risks.
- The Commission should find that managing climate-related risks in consistent with the multi-decadal transition to a zero-carbon energy system is in the public interest and a necessary component of a reasonable and prudent integrated resources plan.
- Given that the Company has not adequately integrated climate-related risks, considered strategies to mitigate those risks, or included climate-related outcomes in its evaluation of the Plans, the Commission should reject the long-term portion of Duke Energy Carolinas and Duke Energy Progress's 2020 Integrated Resources Plans.
- The Commission should direct the Companies to make several corrections to its future plans, including: a systematic assessment of climate-related risks; adoption of more strategies to manage climate-related risks and drive direct incremental ratepayer benefits; explicit consideration of the Companies' anticipated zero-carbon transition; and evaluation of its Plans that fairly considers long-term costs.

- The Commission should direct the Companies to submit a revised short-term action plan that builds analytical capability and stakeholder input for assessing and managing climate-related risks.

Q. Please describe the structure of your testimony.

A. The testimony is divided into several sections.

In **Section II,** I introduce climate-related risks and their emergent relevance to resource planning in general and the Companies' Integrated Resource Plans in particular. I also describe at a high level how climate-related risk management can and should be integrated into utility regulation.

In **Section III**, I review the objectives of integrated resource planning and discuss the role of managing climate-related risks in determining a reasonable and prudent plan. It offers several pathways for evaluating integrated resource plans in light of climate-related risks.

I review the Companies' submitted Integrated Resource Plans in light of material climate-related risks in **Section IV**. Specifically, I assess whether the Companies a) adequately analyze climate-related risks in the formation of their scenarios; b) considered viable strategies that would mitigate climate-related risk and drive incremental cost benefits for ratepayers; and c) integrated climate-related risks into evaluation of the selected scenarios. I find that the Companies did not adequately perform any of these tasks and identify several specific oversights.

Finally, **Section V** presents my conclusions and recommendations to the Commission based on my review of the Plans.

II. Emergent Climate-Related Risks are Material to the Companies' Assets and Operations

A. *Introducing Climate-Related Risks*

Q. What are climate-related risks?

A. Climate-related risks are potential negative future impacts on an entity due to physical, social, or economic factors driven by climate change. These risks are incident across economic sectors and geographies, and they are observable at multiple scales, from the global financial system[2] to the individual firm[3] and even individual utility generation assets.[4] Climate-related risks encompass all of the risks that an entity might be exposed to due to physical climate changes and the societal and economic response to climate change, including the transition to a zero-carbon economy.

Importantly, firm-level climate-related risks are used to describe those potential negative impacts of climate change *to the firm itself*, rather than potential negative externalities due to carbon emissions. When Duke Energy Corporation presented a high-level estimation of climate-related risks to CDP (formerly the Carbon Disclosure Project) in 2020, for instance, it only calculated costs that would be directly sustained by Duke Energy, and did not include an estimation of social or

[2] US Commodity Futures Trading Commission ("CFTC") (2020). *Managing Climate Risk in the U.S. Financial System.* Retrieved at: https://www.cftc.gov/sites/default/files/2020-09/9-9-20%20Report%20of%20the%20Subcommittee%20on%20Climate-Related%20Market%20Risk%20-%20Managing%20Climate%20Risk%20in%20the%20U.S.%20Financial%20System%20for%20posting.pdf.

[3] *UtilityDive* (2020, November). Climate risks are accelerating. Here's what Duke, PG&E, and 16 other utilities expect to pay. Retrieved at: https://www.utilitydive.com/news/climate-risks-accelerating-heres-what-costs-duke-pge-and-16-other-utilities-expect/588860/.

[4] Bertolotti, A., Basu, D., Akallal, K., Deese, B. (2019, March). Climate Risk in the US Electric Utility Sector: A Case Study. Retrieved at: https://papers.ssrn.com/sol3/papers.cfm?abstract_id=3347746.

externality costs.[5] Climate-related risks therefore function as a specific dimension of business risks, and prudent management would dictate that these risks be assessed, disclosed, and managed just like any other business risk.

Climate-related risks are divided into two types: *physical* risks arise directly from physical phenomena related to climate change, while *transition* risks emanate from the economic, social, and political response to climate change and the transition to a decarbonized economy. Commonly accepted frameworks for discussing climate risks identify several specific dimensions:

- **Physical:** Impacts to assets and operations from climate-related changes to the physical environment.
- **Financial:** Impacts to cost-of-capital due to climate-related exposure and confidence in risk management.
- **Economic:** Risk of stranded assets or decreased sales due to increased viability of alternatives.
- **Regulatory:** Impacts to operating costs, capital expenditures, and firm and asset valuation due to changing regulations.
- **Reputational:** Potential loss of goodwill due to perceived response to climate change.

While these categories are useful for cataloguing the different ways that climate-related risks can impact a firm or entity, climate risks are closely interconnected.[6]

[5] Duke Energy Corporation (2020). Climate Change 2020 Submission to CDP ("Duke Energy 2020 CDP Submission"). Retrieved at: https://www.cdp.net/en.

[6] Task Force on Climate Related Financial Disclosures ("TFCD") (2017, June). Recommendations of the Task Force on Climate-Related Disclosures. P. 10. Retrieved at: https://www.fsb-tcfd.org/wp-content/uploads/2017/06/FINAL-2017-TCFD-Report-11052018.pdf.

Any strategy to manage climate-related risks should acknowledge this interconnection and pursue a holistic approach.

Q. How has awareness and management of climate-related risks evolved among the broader economic and financial community?

A. Today, the economic and financial climate risk landscape is almost unrecognizable compared to when the Companies last submitted full Integrated Resources Plans. Since then, the issue has transformed from an analytical exercise to a fundamental driver of the economic and financial landscape in the 21st century. In January 2020, the CEO of BlackRock (the second-largest single shareholder of Duke Energy) noted that climate-related risks are driving "a fundamental reshaping of finance."[7] During Secretary of Treasury Janet Yellen's confirmation hearing in January 2021, Yellen identified management of climate risk as a central priority for her position and the financial community:

> Climate change is an existential threat. Both the impact of climate change itself and policies to address it could have major impacts, creating stranded assets, generating large changes in asset prices, credit risks and so forth that could affect the financial system. These are very real risks.[8]

Charged with ensuring the stability of financial markets, the US Commodities Futures Trading Commission (CFTC), released a report titled "Managing Climate Risk in the US Financial System" in September 2020. The report concludes that "Promoting the transition to a net-zero emissions economy and safeguarding financial stability are consistent, mutually reinforcing objectives."[9]

[7] Fink, L. (2020). Larry Fink's 2020 Letter to CEOs. *BlackRock*. Retrieved at: https://www.blackrock.com/corporate/investor-relations/larry-fink-ceo-letter.
[8] Warmbrodt.
[9] CFTC., p. 2.

Together, these statements broadcast a clear message: Climate-related risks and opportunities are a critical concern to firms, sectors, economies, and even the global financial and economic system in the 21st century. For the U.S. electricity sector, an economic sector identified as particular exposed to these risks[10] and the first linchpin of a decarbonized economy,[11] the statements gain extra urgency. Recognition of climate-related risks by entities that wield influence on the global financial and economic stage, will doubtless drive new action on climate risk management. But they are also the product of transformative changes of how we perceive, discuss, and manage climate-related risks. Since Duke Energy Carolinas and Duke Energy Progress filed their last Integrated Resource Plans in 2018, climate risk management has reached a tipping point, moving from a theoretical exercise to a concrete responsibility. Several key developments are driving this transformation:

First, a common language exists for discussing climate-related risks. Concern about climate-related risks at all scales led the international Financial Stability Board to establish the Taskforce for Climate-Related Financial Disclosures ("TCFD") in 2015 to establish a universal framework and language for identifying, discussing, and ultimately managing climate-related risks.[12] Since the TCFD

[10] The Task Force on Climate-Related Disclosures identified the energy sector, including electric utilities, as one of four non-financial groups with "the highest likelihood of climate-related financial impacts." Task Force on Climate Related Financial Disclosures, (2017, June). Recommendations of the Task Force on Climate-Related Disclosures. P. 16. Retrieved at: https://www.fsb-tcfd.org/wp-content/uploads/2017/06/FINAL-2017-TCFD-Report-11052018.pdf.

[11] Mahajan, M. (2019, November). "How To Reach U.S. Net Zero Emissions By 2050: Decarbonizing Electricity." *Forbes.* Retrieved at: https://www.forbes.com/sites/energyinnovation/2019/11/12/how-to-reach-us-net-zero-emissions-by-2050-decarbonizing-electricity/#59f08aa649e7.

[12] Task Force on Climate-related Financial Disclosures, (2019, May). 2019 Status Report. p. 2. Retrieved at https://www.fsb-tcfd.org/publications/tcfd-2019-status-report/.

published its initial recommendations in 2017, the recommendations have become the international standard, adopted by almost 1,500 organizations and 110 regulators and governmental entities and representing over $150 trillion in global assets.[13] Duke Energy's 2020 Climate Report (the "Duke 2020 Climate Report") was built on the TCFD framework, underscoring the ubiquity of this language and the emerging relevance of climate-related risks.[14]

Second, physical, financial, economic, and regulatory climate-related risks are incident on the electricity sector today, and they will only continue to develop and accelerate. The highest-profile recent example of emergent and unexpected climate-related risks is the recent bankruptcy of Pacific Gas & Electric ("PG&E"), after a climate-accelerated wildfire burned much of its service territory. Covering the bankruptcy proceedings, the Wall Street Journal wrote that PG&E would be "The First Climate Change Bankruptcy, Probably Not the Last."[15]

Third, financial institutions and the broader public are aware of climate-related risks and expect firms to responsibly manage climate-related risks and transition to a zero-carbon economy. In a representative survey of American adults, 72 percent supported transitioning utilities to 100% clean energy by 2050, and 66 percent supported electric utilities meeting that standard by 2035.[16] Within the Plans, the

[13] Task Force on Climate-related Financial Disclosures, (2020, September). 2020 Status Report. P.3. Retrieved at: https://www.fsb.org/wp-content/uploads/P291020-1.pdf.
[14] Duke Energy (2020). Achieving a Net Zero Carbon Future ("Duke 2020 Climate Report"). P. 3. Retrieved at: https://www.duke-energy.com/_/media/pdfs/our-company/climate-report-2020.pdf?la=en.
[15] Gold, R., (2019, January), PG&E: The First Climate-Change Bankruptcy, Probably Not the Last. *Wall Street Journal.* Retrieved at https://www.wsj.com/articles/pg-e-wildfires-and-the-first-climate-change-bankruptcy-11547820006.
[16] Leiserowitz, A., Maibach, E., Rosenthal, S., Kotcher, J., Carman, J., Wang, X., Goldberg, M., Lacroix, K., Marlon, J. (2021, January). Politics & Global Warming, December 2020. *Yale Program on Climate Change Communication.* Retrieved at: https://climatecommunication.yale.edu/publications/politics-global-warming-december-2020/2/.

Companies note the growing interest from Environmental, Social, & Governance ("ESG") investors to understand the impact of transitioning the Companies' portfolio to net-zero carbon by 2050,[17] and one observer found that financial markets hit a 'tipping point' on climate risk in 2020.[18] Before Duke Energy set its net-zero by 2050 goal, twenty of the world's largest institutional investors, representing over $1.8 trillion in assets, sent a letter to Duke Energy and other electric utilities indicating that "As long-term investors, we view these [climate-related] risks as significant and material," and called on firms to set a net-zero by 2050 goal over the next six months.[19] Duke Energy published their net-zero goal seven months later, in September 2019.[20] To meet the investors' challenge, Duke Energy must demonstrate that it can and will comply with its net-zero commitment.

Fourth, cutting-edge analytical technology provides new precision in identifying climate-related impacts. Climate analytics firm Four Twenty Seven[*] completed a physical climate risk assessment of utilities on an asset-by-asset basis in January 2020 and found that Duke Energy's footprint was particularly exposed to sea-level rise and extreme weather events.[21] ConEd's climate vulnerability

[17] Duke Energy Carolinas (2020, September). Integrated Resources Plan 2020 Biennial Report ("DEC IRP Main Document"), South Carolina Public Service Commission Docket No. 2019-224-E, p. 93.
[18] Mackenzie, K. (2021, January). "The Financial Industry Passed a Climate Turning Point This Year." *Bloomberg Green.* Retrieved at: https://www.bloomberg.com/news/articles/2020-12-11/the-finance-industry-passed-a-climate-turning-point-this-year.
[19] California Public Employees Retirement System et al. (2019, February). *Institutional Investor Statement Regarding Decarbonization of Electric Utilities*. Retrieved at https://www.climatemajority.us/investorstatement-20190228.
[20] Duke Energy (2019, September). Duke Energy aims to achieve net-zero carbon emissions by 2050. Retrieved at https://news.duke-energy.com/releases/duke-energy-aims-to-achieve-net-zero-carbon-emissions-by-2050.
[*] Four Twenty Seven was acquired by credit rating analyst Moody's in July 2019.
[21] Morehouse, C. (2020, January). Ameren, Xcel, Dominion, Duke among most at-risk from changing climate: Moody's. *UtilityDive.* Retrieved at: https://www.utilitydive.com/news/ameren-xcel-dominion-duke-among-most-at-risk-from-changing-climate-mood/570789/.

assessment provides a model for modern climate-risk analysis, and their initial assessment released in December 2019 provides actionable recommendations.[22] The Duke 2020 Climate Report already identifies vulnerabilities to climate-related physical risks to its fleet in the Carolinas.[23]

Fifth, financial institutions are grappling with the risk of disorderly transitions and stranded assets. The Financial Stability Board, an international entity made up of the G20 economies, released a white paper in 2020 titled: "The Implications of Climate Change for Financial Stability." The report notes that a disorderly transition, caused by a delay in transition to a de-carbonization of the economy followed by sudden changes to markets or policies, could "have a destabilizing effect on the financial system."[24] The CFTC's report found that stranded economic assets will be a reality in any transition to a zero-carbon economy, but delaying action would double total stranded assets to $19.5 trillion by 2050.[25] The CFTC authors state: "In essence, transition risks arise when firms fail to prepare for or recognize broader market transitions. In a speedy transition to a net-zero economy, fossil-fuel industry assets might become stranded."[26] Stranded assets could, in turn, have broader impacts on the financial system and create feedback loops. A diagram of the interaction between physical risks, transition risks, and stranded assets is presented below as Figure 2-1.

[22] ConEdison (2019, December). Climate Change Vulnerability Study. Retrieved at: https://www.coned.com/-/media/files/coned/documents/our-energy-future/our-energy-projects/climate-change-resiliency-plan/climate-change-vulnerability-study.pdf?la=en.
[23] Duke 2020 Climate Report, p. 15.
[24] Financial Stability Board (2020, November). The Implications of Climate Change for Financial Stability. P. iv. Retrieved at: https://www.fsb.org/wp-content/uploads/P231120.pdf.
[25] CFTC, p. 104.
[26] CFTC, p. 25.

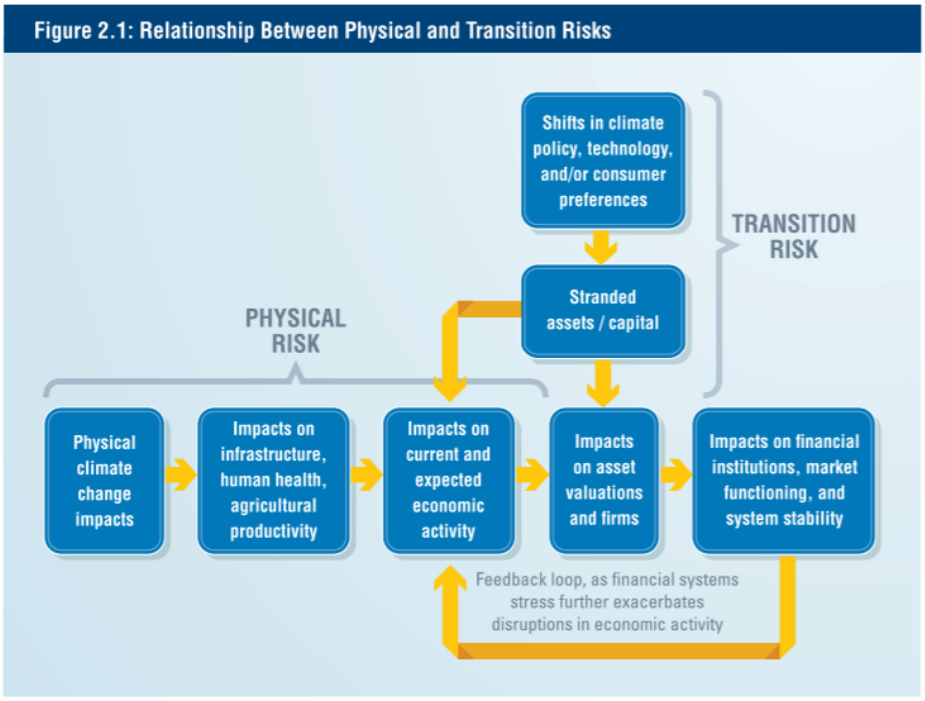

Figure 2-1. *Interaction of Physical and Transition Risks*[27]

Sixth, major financial institutions are asking that firms not just disclose their risk, but actively manage them by committing to zero emissions by 2050 and creating a credible plan to reach net-zero. In its November 2020 Financial Stability Report, the US Federal Reserve stated that it "[expects] banks to have systems in place that appropriately identify, measure, control, and monitor all of their material risks, which for many banks are likely to extend to climate risks."[28] BlackRock joined climate-conscious investment group Climate Action 100+ in December 2020, [29] and in CEO Larry Fink's 2021 letter to CEOs he notes the immediacy and magnitude of the transition:

[27] CFTC, p. 12.
[28] Board of Governors of the Federal Reserve System (2020, November). Financial Stability Report. P. 59. https://www.federalreserve.gov/publications/files/financial-stability-report-20201109.pdf.
[29] Holger, D. (2020, December). BlackRock Targets More Companies on Climate Change. *Morningstar.* Retrieved at: https://www.morningstar.com/news/dow-jones/202012102825/blackrock-targets-more-companies-on-climate-change.

> Given how central the energy transition will be to every company's growth prospects, **we are asking companies to disclose a plan for how their business model will be compatible with a net zero economy**"[30] [emphasis original].

Including BlackRock, the Climate Action 100+ now encompasses $52 trillion in assets under management that are expected to benchmark progress toward a net-zero economy in 2050. 2020 also saw Barclays,[31] Morgan Stanley,[32] JP Morgan Chase,[33] and TD[34] commit to net-zero financed emissions by 2050. Potentially as a result of these announcements, the investor-owned utility trade association Edison Electric Institute committed in January 2021 to 100% clean energy from its investor-owned utility members.[35]

To recap, there is a common understanding of climate-related risks; they are already substantially impacting firms in the US utility sector; investors and the public are taking those risks seriously; the tools exist to pinpoint climate risks; stranded asset risks are in focus; and actors (including Duke Energy) are converging on a net-zero by 2050 trajectory. These developments form a common foundation of

[30] Fink, L. (2021). Larry Fink's 2021 Letter to CEOs. *BlackRock*. Retrieved at: https://www.blackrock.com/corporate/investor-relations/larry-fink-ceo-letter.
[31] Barclays (2021). *Our ambition to be a net zero bank by 2050.* Retrieved at: https://home.barclays/society/our-position-on-climate-change/.
[32] Business Wire (2020, September). *Morgan Stanley Announces Commitment to Reach Net-Zero Financed Emissions by 2050.* Retrieved at: https://www.businesswire.com/news/home/20200921005255/en/Morgan-Stanley-Announces-Commitment-to-Reach-Net-Zero-Financed-Emissions-by-2050.
[33] JPMorgan Chase & Co. (2020, October). *JPMorgan Chase Adopts Paris-Aligned Financing Commitment.* Retrieved at: https://www.jpmorganchase.com/ir/news/2020/adopts-paris-aligned-financing-commitment.
[34] TD (2020). *TD Commits to Ambitious limate Action Plan and Targets Net-Zero Emissions by 2050.* Retrieved at: https://newscenter.td.com/us/en/news/2020/td-commits-to-ambitious-climate-action-plan-and-targets-net-zero-emissions-by-2050.
[35] Kuhn, T. (2021, January). America's investor-owned utilities: We can achieve a 100% clean energy future. *UtilityDive.* Retrieved at: https://www.utilitydive.com/news/americas-investor-owned-utilities-we-can-achieve-a-100-clean-energy-futu/593723/.

understanding and a call for action to firms and their regulators to seize the opportunity to manage climate risk.

Q. What climate-related risks are faced by the Companies and their Plans?

A. To evaluate the incidence of climate-related risks on the Companies and their 2020 Integrated Resource Plan, I conducted a wide-ranging assessment using publicly available material of the Companies' exposure to climate-related risks and analyzed potential stranded asset risk if the Companies pursue their base case with carbon policy scenario and continue to comply with their net-zero carbon commitment. As a fellow with the Energy Transitions Institute, I wrote a report titled "Carbon Stranding: Climate Risks and Duke's Integrated Resource Plan," that contains the results of my review and analysis of the Companies' Plans and their exposure to climate-related risks. The report is attached to this testimony as Exhibit TF-2. A survey of the Companies' climate risk exposure is provided in Section B of that report, and a table from the report is shown below as Table 2-1. I will further discuss the potential for stranded assets in the Companies' plans and costs for ratepayers in Section IV of this testimony.

Type of Risk	Duke Energy Exposure in Carolinas
Physical	2020 North Carolina Climate Science Report found that "large changes in North Carolina's climate, much larger than at any time in the state's history, are ***very likely.***"[1] A Moody's analysis found Duke among the most at-risk utilities to flooding.[2]
Financial	BlackRock, Duke Energy Corporation's third-largest shareholder, claims climate risks are driving a "fundamental reshaping of finance."[3] The firm voted against boards of directors 55 times during 2019-2020 due to lack of climate progress.[4] Increased focus on environmental, social, & governance (ESG) issues are driving Duke investor attention.[5]
Economic	Renewable energy technologies are outcompeting conventional fossil-fueled generation, even on a subsidy-free basis.[6] Expert analysis finds that portfolios of clean energy resources could economically out-compete existing fossil generation by the mid-2020s.[7]
Regulatory	North Carolina's Clean Energy Plan contemplates future policies to decarbonize the electric power sector, including accelerated coal retirements, market-based carbon reduction programs, clean energy standards, or a combination of these standards.[8]
Reputational	Duke Energy's existing decarbonization goals are a public commitment, and the corporation's reputation and social license could be damaged if the commitment is not upheld. In a recent survey, Deloitte found that "the math doesn't add up" for Duke's decarbonization plan.[9]

Table 2-1. *Selected climate-related risks to Duke Energy operating companies in the Carolinas.*[36]

To summarize the findings of the report, the Companies are exposed to climate-related risks of every type, and each of them are significant and likely to continue to accelerate through mid-century.

Q. Are there any developments related to climate-related risks since the finalization of the report that you would like to identify?

A. Yes, and in fact it is difficult to provide a single snapshot of climate risks because conditions continue to evolve, on an almost-daily basis. I will describe only a selection of recent relevant climate developments below:

[36] Fitch, T. (2021, January). Carbon Stranding: Climate Risk and Stranded Assets in Duke's Integrated Resources Plan. *Energy Transitions Institute.* Retrieved at: https://energytransitions.org/carbon-stranding. Footnotes indicated within the table correspond to footnotes in the Energy Transitions Institute report.

- **January 13, 2021.** A group of the country's largest bank and insurance trade groups published a draft version of a set of climate finance principles, including embrace of a carbon price.[37]
- **January 19, 2021.** A federal appellate court vacated and remanded the Affordable Clean Energy rule, opening possibilities for a larger scale and scope of federal regulation under Section 111(d) of the Clean Air Act.[38]
- **January 20, 2021.** The Biden administration signed an executive order that acknowledges climate risks and directed determination of a new, interim social cost of carbon in 30 days.[39]
- **January 21, 2021.** During Janet Yellen's confirmation hearing for Secretary of the Treasury, she said she would advise the Biden administration on achieving net-zero emissions by 2050 "based on the principle that polluters must bear the full cost of the pollution they are emitting."[40]

[37] Warmbrodt, Z. (2021, January). Banks, insurers move to shape climate debate as Washington crackdown looms. *Politico.* Retrieved at: https://www.politico.com/news/2021/01/13/banks-insurers-shape-climate-debate-459204.

[38] Richardson, N., Burtraw, D., Brennan, T. (2021, January). Striking Down the Affordable Clean Energy Rule Helps—But Does Not Guarantee—Ambitious Climate Policy. *Resources for the Future.* Retrieved at: https://www.resourcesmag.org/common-resources/striking-down-the-affordable-clean-energy-rule-helpsbut-does-not-guaranteeambitious-climate-policy/.

[39] White House (2021, January). Executive Order on Protecting Public Health and the Environment and Restoring Science to Tackle the Climate Crisis. Retrieved at: https://www.whitehouse.gov/briefing-room/presidential-actions/2021/01/20/executive-order-protecting-public-health-and-environment-and-restoring-science-to-tackle-climate-crisis/.

[40] Reuters (2021, January). Factbook: Yellen describes planned tax hikes, OECD negotiations, carbon pricing. Retrieved at: https://www.reuters.com/article/us-usa-biden-yellen-taxes-factbox/factbox-yellen-describes-planned-tax-hikes-oecd-negotiations-carbon-pricing-idINKBN29Q2Q4.

– **January 25, 2021.** The Biden administration signed an executive order that sets an aim for an emissions-free electricity sector by 2035 and directs agencies to eliminate subsidies for fossil fuels.[41]

– **January 27, 2021.** John Kerry made his assessment of status-quo development in the energy sector clear at the World Economic Forum, when he said: "If we build out a huge infrastructure for gas now and continue to use it as a bridge fuel… we're gonna be stuck with stranded assets in 10 or 20 or 30 years."[42]

The Biden administration's early activity on climate risk, combined with new statements from traditional business interests supporting economy-wide carbon pricing, signal a potential tipping point on carbon pricing. These developments underscore that the overview of climate-related risks presented here is only a partial view of climate risk exposure, and new developments could continue to change the landscape.

Q. Based on your review, is there reason to think that climate-related risks and opportunities will significantly impact the Companies' financial development, performance, and/or position?

A. Yes, and I believe these impacts merit careful review by regulators.

[41] White House (2021, January). Executive Order on Tackling the Climate Crisis at Home and Abroad. Retrieved at: https://www.whitehouse.gov/briefing-room/presidential-actions/2021/01/27/executive-order-on-tackling-the-climate-crisis-at-home-and-abroad/.

[42] Tobin, M. (2021, January). Kerry Warns of Stranded Asset Risk from Natural Gas Buildout. *Bloomberg Law*. Retrieved at: https://news.bloomberglaw.com/environment-and-energy/kerry-warns-of-stranded-asset-risk-from-natural-gas-buildout.

Q. Does this testimony represent a comprehensive evaluation of the Company's vulnerability to climate risks?

No. The purpose of my review of climate-related risks is not to quantify with precision the potential impact of these risks on the Companies' assets and operations; I relied on publicly available information for this analysis. A truly robust review of climate-related risks on the Companies' assets and operations would require substantial analytical and personnel resources and access to information and data that is private and/or confidential to the Companies. Nevertheless, I believe this overview is helpful for understanding the order of magnitude of climate-related risks and the substantial implications for the Companies' plans, assets, and operations in to the future.

Q. Does Duke Energy Corporation view climate-related risks as material to their business operations?

A. Yes. Starting with Duke Energy Corporation's 2017 report to shareholders,[43] Duke Energy Corporation has been proactively engaged in conversation around the role of climate-related risks and their relevance to Duke Energy Corporation's performance. During Duke Energy's first-ever ESG Day for investors interested in environmental, social, and governance issues, a member of Duke Energy's Board of Directors noted that climate issues are "central… to our business model and our future as a company."[44] The Duke 2020 Climate Report, released in May 2020,

[43] Duke Energy (2018, March). *Duke Energy's new Climate Report details the company's ability to adapt to a low-carbon future.* Retrieved at: https://news.duke-energy.com/releases/duke-energy-s-new-climate-report-details-the-company-s-ability-to-adapt-to-a-low-carbon-future.

[44] Duke Energy (2020, October). *Edited Transcript: 2020 ESG Investor Day.* P. 13. Retrieved at: https://www.duke-energy.com/_/media/pdfs/our-company/investors/news-and-events/2020/esg/2020-esg-day-transcript.pdf?la=en.

provides a high-level assessment of the corporation's climate-related risks and details its strategy for managing them at an enterprise level. The executive summary of the report reads, in part, "As one of the largest electric and gas utilities in the U.S., Duke Energy embraces its responsibility not only to power the communities where our customers live and work, but also to address risks from climate change."[45] Duke Energy Carolinas' 10-K report to shareholders has included disclosure of climate-related risks since at least 2001—twenty years ago.[46] To Duke Energy Corporation, climate-related risks are not just a material, but a central concern to the ongoing financial well-being of the organization.

Q. Based on your review of relevant climate-related risks, do you believe that climate-related risks are material to the Companies and their Integrated Resource Plans?

A. The Securities & Exchanges Commission defines a matter as material if "there is a substantial likelihood that a reasonable person would consider it important."[47] Based on my review of relevant material concerning the broader financial community, the utility sector, public opinion, and Duke Energy Corporation's own statements, I find that climate-related risks and opportunities are not only material but critical to the Companies' future financial performance. Public support for transitioning the energy sector to clean energy by mid-century suggests that a reasonable person would share this assessment. Therefore, I find that these risks are

[45] Duke 2020 Climate Report, p. 1.
[46] Duke Energy (2001). Form 10-K. Retrieved at: https://dukeenergy.gcs-web.com/static-files/dd45581e-7a0e-48d6-a0d7-c28d6d0298f0.
[47] US Securities & Exchanges Commission (1999, August). Staff Accounting Bulletin No. 99 – Materiality. Retrieved at: https://www.sec.gov/interps/account/sab99.htm.

material to the Companies' assets and operations, and given the Plans' clear impact on the Companies' net-zero transition, climate-related risks are material to the Plans as well. Confirming this conclusion, the Sustainability Accounting Standards Board's Materiality Map identifies several material concerns for electric utilities, including carbon emissions and "systemic risk management."[48]

Q. What is the role of ratepayers in sustaining climate-related risks and liabilities?

A. Simply put, the best way to secure low costs for ratepayers over the long-term is to sustainably and prudently manage climate-related risks. Like any other business risk, sustaining exposure or vulnerability to climate-related risks could have negative financial or economic impacts, which would in turn raise rates. Addressing climate-related risks does not impose a choice between environmental performance and affordability; instead, prudently managing climate-related risks is the best way to ensure affordability. Addressing climate-related risks to the Companies could also mitigate climate-related risks to ratepayers, such as the risk of losing power during extreme weather events. Because climate-related risks tend to impact our most vulnerable neighbors the most,[49] there is also a consumer equity elements to these risks.

For understanding the relationship between climate risk and affordability, the more relevant question is the relative amount of risk shared between ratepayers and

[48] Sustainability Accounting Standards Board ("SASB") (2021). SASB Materiality Map. Retrieved at: https://materiality.sasb.org/.

[49] Reames, T., Raimi, D., Wason, E. (2021, January). Defining, Measuring, and Addressing Energy Poverty, with Tony Reames. *Resources for the Future Resources Magazine.* Retrieved at: https://www.resourcesmag.org/resources-radio/defining-measuring-and-addressing-energy-poverty-with-tony-reames/.

shareholders. If, for example, an unforeseen future climate-related regulation increases the price of the Companies' gas supply and the Companies' systems rely heavily on gas-fired generation, then ratepayers are likely to absorb all of the negative impacts of any gas price increase. This example describes a perverse incentive, where Company management and shareholders are not exposed to the risks of their actions. The potential for these outcomes underscores the importance of public oversight of climate-related risk management.

Q. Please provide your conclusions from this section of your testimony.

A. Climate change and the transition to a low-carbon economy are setting into motion transformative changes for the electric utility sector in general and the Companies in particular. Just as these impacts materialize, however, new ways of discussing, analyzing, and managing these impacts are emerging. Climate-related risks are material to the Companies' bottom lines, and they will only accelerate as we move toward an increasingly decarbonized economy. In order to ensure that our electric utilities continue to act to further the public interest and provide just and reasonable service, the Companies—and their regulators—must actively assess and manage climate-related risks and opportunities.

B. Utility Regulators have tools to Integrate Material Climate-Related Risks

Q. In light of material climate-change risks to the Companies, what role does the Commission play in managing those risks?

A. According to South Carolina statute, the Commission's charge is to "supervise and regulate the rates and service of every public utility in this State and to fix just and

reasonable standards… of service."[50] Although I am not a lawyer and I do not propound a legal opinion in this testimony, based on my familiarity with utility regulation and a common-sense reading of the statute, I take the Commission's charge to 'supervise and regulate rates' and 'fix just and reasonable standards' to include oversight of the Companies' management of relevant business risks. Climate-related risks are a sub-set of business risks, and the previous section of this testimony demonstrates that they are relevant and material to the Companies' operations. The Commission should take the opportunity to treat them as such. As the Commission does for other risks, like commodity price risks, the Commission can and should assess the Companies' management of climate-related risks and intervene wherever appropriate in furtherance of the public interest.

Q. What tools are available to the Commission in integrated climate-related risks into its decision-making process?

A. The Commission could find that climate-related risks are material to the Companies' assets and operations, and direct the Companies to manage these risks across their operations in accordance with the prudent management of material risks. By making this affirmative finding, the Commission would increase regulatory certainty for all stakeholders in terms of the treatment of climate-related risks and contribute to a more efficient development and evaluation of future filings at the Commission.

The Commission could also consider a more prescriptive approach for directing utilities to disclose climate-related risks. As I discussed in the previous section, the

[50] South Carolina Code of Laws, § 58-3-140(A).

TCFD's recommendations provide a widely accepted, flexible, and clear framework for disclosing climate-related risks. The structure of the Duke 2020 Climate Report, for example, could provide an accessible template for requesting climate-related risk information from the Companies relevant to whatever matter is before the Commission. It is attached to this testimony as Exhibit TF-3. For more specific guidance to utilities, the Sustainability Accounting Standards Board has promulgated standards and specific metrics tailored to electric utilities (and notably includes performance against long-term targets as a metric).[51] Given the emerging nature of climate-related risks, the Commission would have an opportunity to lead the country in developing and promulgating utility risk disclosure standards.

Q. If the Commission were to integrate climate-related risks into its evaluation of utility business decisions, would they necessarily override other considerations for just and reasonable service?

A. No. Climate risks are one subset of business risk, and the Commission need not give undue priority to climate-related risks. Understanding trade-offs between these risks will be the critical work of the Commission going forward.

Q. What is unique about climate-related risks as opposed to other busines risks?

A. Although climate-related risks are a subset of business risks, all climate-related risks share two unique qualities: First, they unfold over much longer timelines than typical business risks; and second, climate-related risks are path-dependent.

[51] Sustainability Accounting Standards Board (2018, October). Electric Utilities & Power Generators Sustainability Accounting Standard. Retrieved at: https://www.sasb.org/wp-content/uploads/2018/11/Electric_Utilities_Power_Generators_Standard_2018.pdf.

Combined, these features underscore the importance of early action on assessing and managing climate-related risks.

Longer timescales are present not in just the physical phenomena of warming ambient temperatures, but also in the turnover rate of electric utility generation fleets and the pace of regulatory change. Because generation assets have multi-decadal lifetimes, reducing total emissions for a whole generation fleet must be a multi-decadal process. In a regulatory environment where 15-year integrated resource plans are the longest relevant timescale, multi-decadal transitions can present challenges to typical resource planning and evaluation.

Climate-related risks are path dependent because the ability to manage climate-related risks tomorrow is, in part, dependent on the decisions made today. This concept is most often invoked in the context of climate-related risks when discussing 'committed' emissions: If a carbon-emitting generation unit with a forty-year engineering lifetime is built today, then one can reasonably assume that (barring a zero-carbon retrofit) the system has 'committed' to a certain amount of emissions from that unit for the next forty years.[52] This concept helps to illuminate why investing in less carbon-intensive generation (e.g. transitioning from coal to gas) may not be a viable risk management strategy because it may 'commit' the system to an unsustainable level of future emissions.

Together, these features create a unique regulatory challenge: Decisions made today are difficult to hedge or reverse later, and the impacts of today's decisions

[52] Tong, D., Zhang, Qiang, Zheng, Y., Caldeira, K., Shearer, C., Hong, C., Qin, Y., & Davis, S. (2019, July). Committed emissions from existing energy infrastructure jeopardize 1.5 °C climate target. *Nature.* Retrieved at: https://www.nature.com/articles/s41586-019-1364-3.

may not be felt for years to come. As a result, prudent and clear-eyed regulation from the Commission is critical.

III. Resource Planning in the Public Interest Must Integrate Climate-Related Risks

Q. Please define integrated resources planning and discuss its purpose in utility regulation.

A. An integrated resource plan presents a long-term projection of future conditions for electricity service (including but not limited to load growth and demand patterns, resource adequacy concerns, and resource options), then proposes a set of resources that will most appropriately meet future needs. A robust integrated resources plan also integrates relevant stakeholder perspectives and performs uncertainty and sensitivity analyses that test the selected resource plan against several possible future environments.[53]

The practice emerged out of a tumultuous period in utility planning in the 1970s and 1980s, where cost over-runs, changes to market design, and increasing electricity prices led stakeholders to ensure that utilities plotted a course that would best serve the public interest.[54] Integrated resource plans provide an opportunity for utility planners and regulators to acknowledge the uncertainty and risk inherent in long-term planning and put forward a resource pathway that is most resilient to those risks and uncertainties. As the utility sector confronts a new set of

[53] Wilson, R., & Biewald, B. (2013, June). Best Practices in Electric Utility Integrated Resource Planning: Examples of State Regulations and Recent Utility Plans. Regulatory Assistance Project and Synapse Energy Economics. P. 51. Retrieved at: https://www.synapse-energy.com/sites/default/files/SynapseReport.2013-06.RAP_.Best-Practices-in-IRP.13-038.pdf.

[54] Kahrl, F., Mills, A., Lavin, L., Ryan, N., & Olsen, A. (2016, September). The Future of Electricity Resource Planning. Lawrence Berkeley National Laboratory. P. 8. Retrieved at: https://www.osti.gov/servlets/purl/1339559.

transformative challenges partway through the 21st century, the need for foresight and clarity in integrated resource planning is more clear than ever.

Q. What standard is used to determine whether an integrated resource plan best furthers the public interest?

A. Act 62 provides Commissioners with a flexible and powerful template for assessing the prudence of a proposed integrated resources plan. According to Act 62, the Commission "shall approve an electrical utility's integrated resource plan if the proposed resource plan represents the **most reasonable and prudent** means of meeting the electrical utility's needs" [emphasis added].[55] Act 62 directs the Commission to consider several factors in making its determination:

a. resource adequacy and capacity to serve anticipated peak electrical load, and applicable planning reserve margins;
b. consumer affordability and least cost;
c. compliance with applicable state and federal environmental regulations;
d. power supply reliability;
e. commodity price risks;
f. diversity of generation supply; and
g. other foreseeable conditions that the commission determines to be for the public interest.

In its December 2020 Order on Dominion's Integrated Resource Plan (the "Dominion IRP Order"), the Commission defined *reasonable* as "rational, logically

[55] South Carolina Code of Laws, § 58-37-40(C)(2).

consistent, and the result of sound judgment," and *prudent* as "[giving] due consideration to actual and foreseeable future conditions and risks."[56]

Q. How does the Commission incorporate risk management into its determination of a prudent and reasonable integrated resources plan?

A. As noted above, management of relevant and material risks has always been core to the integrated resource plan, and processes for reviewing any integrated resource plan are ultimately an exercise in risk management. As integrated resource planning has become more sophisticated and powerful software tools enable new types of analysis, it is easier than ever to optimize for least expected long-term costs given uncertain future conditions, rather than least-cost in the short term according to a base scenario.[57]

The need for risk-informed resource planning is even more clear in the context of vertically-integrated resource planning during a long-term transition to a decarbonized energy system. Long-term, material climate-related risks will have accelerating impacts on the Companies' resource decisions, and the long construction schedules and operational lifetimes of new generation assets increases exposure to risks. The Commission noted the need for risk-informed resource planning in its Dominion IRP Order:

> Such consideration [of reasonableness and prudence] should take into account the relative costs and benefits of avoiding potential future risks, such as regulatory, capital, or fuel risks. The Commission emphasizes that although cost is an important consideration, "reasonableness" and "prudence" do not require that

[56] Public Service Commission of South Carolina ("PSCSC") (2020, December). Order Rejecting Dominion's Integrated Resource Plan and Requiring Dominion to Make Modifications to its 2020 Integrated Resource Plan, Future Updates, and Future Integrated Resource Plan. Docket No. 2019-226-E. p. 12-13. Retrieved at: https://dms.psc.sc.gov/Attachments/Order/a4b59f43-e545-43bd-9f35-a846b7602c39.
[57] Kahrl *et al.*, p. 10.

> the utility simply select the least-cost resource plan given the inherent uncertainty of sensitivity assumptions for future conditions. For example, if two plans have nearly the same expected cost, it may be more reasonable and prudent to select the more expensive of the two, if consideration of the other statutory factors (e.g. commodity price risk or diversity of generation) strongly favors that plan.[58] [emphasis original]

The North Carolina Utilities Commission identified a similar dynamic specific to climate-related risks in its March 2020 Order on the Companies' 2019 IRP updates in North Carolina:

> The Commission observes that all parties agree that the near and intermediate term periods will be marked by rapid technological change accompanied and reinforced by potentially dramatic changes in the costs of new generating technologies and compounded by an increasing emphasis on reduction in greenhouse gas emissions from electric power generation. The Commission's view is no different. For this reason it is important when applying the principle of long-term least cost planning for generation assets that the Companies avoid near term investments in long-lived generating assets that may, due to market forces and technological change, become economically stranded over the course of the longer planning period.[59]

Q. How do climate-related risks incident to the Companies relate to their integrated resource plans?

A. Climate-related risks are a subset of material business risks, and as such should be treated in the same way: The Companies must take prudent actions to assess and manage climate-related risks as a part of ensuring a prudent and reasonable Plan. The Companies and the Commission should also acknowledge the unique qualities of climate-related risks, including their long time-scales, interconnectedness, and

[58] PSCSC, p.13.
[59] North Carolina Utilities Commission ("NCUC"), (2020, April). Order Accepting Filing of 2019 Update Reports and Accepting 2019 REPS Compliance Plans. Docket No. E-100, Sub 157. P. 11. Retrieved at: https://starw1.ncuc.net/ncuc/ViewFile.aspx?Id=86f15be3-7617-4910-aeae-d8568c4d0983.

path dependence, and integrate consideration of those qualities into their risk management strategy.

Q. Is there a tension between the traditional 15-year planning period for integrated resource plans and a longer timeline of analysis you propose here?

A. No. As with any plan, certainty on future circumstances decreases as the planning horizon moves further from the present. This is the principle behind the inclusion of a five-year, short-term action plans as a part of a broader, more comprehensive fifteen-year plan. Utilities and their regulators could add consideration of a long-term carbon transition plan to the IRP's current components.

As a statutory matter, the 15-year planning period is not explicitly prescribed. Act 62 defines an integrated resources plan, in part, as "a plan which contains the demand and energy forecast for ***at least*** a fifteen-year period…" [emphasis added].[60] I am not a lawyer and am not propounding a legal opinion in this testimony, but based on my reading there is no statutory reason for the Commission to exclude consideration of longer-term impacts on resource planning.

Q. Do you have any recommendations for integrated consideration of climate-related risks into the Commission's review of the Companies' Integrated Resource Plans?

Yes. I provide several high-level recommendations for how the Companies and Commission could integrate consideration of climate-related risks into their evaluation below.

[60] South Carolina Ann. Code § 58-37-10.

- The Commission should find that managing climate-related risks generally, and reconciling Plans with a transition to a net-zero system specifically, are in the public interest, and should be considered and balanced under South Carolina Code Ann. Section 58-37-40(2)(g).
- The Commission should find that carbon pricing is only one potential climate-related risk, and that carbon pricing sensitivity is not an adequate assessment of all climate-related risks in integrated resources planning.
- The Commission should find that assessing climate-related risks over a 15-year period is not adequate for insulating ratepayers from potential long-term climate liabilities. The Commission should direct future Integrated Resource Plans to disclose concrete long-term plans through 2050 for managing climate-related risks and transitioning to a net-zero system.

IV. The Companies' Integrated Resource Plans Do Not Adequately Assess or Manage Climate-related Risks

Q. Have you reviewed the Companies' Integrated Resource Plans?

A. Yes, I have.

Q. What role do climate-related risks and opportunities play in the Companies' plans?

A. Although the Companies do not use the TCFD terminology in their Plans, climate-related risks and opportunities are a clear driver of the Plans' development. The Companies explain, for example, that the Plans are "in alignment with the [Companies'] climate strategy."[61] The plans also acknowledge growing interest from the financial community in exposure to climate-related risks.[62] In testimony, Companies' Witness Santoianni explains that "For an electric utility company, greenhouse gas emissions are considered a 'material' ESG issue that impacts valuation,"[63] and that those material issues could impact valuation and cost of capital for customers.[64]

Q. Which components of the Plans and their review propounded by the Company are compatible with climate-resilient resource planning?

A. Several components of the Plans are designed to either mitigate or assess the incidence of climate-related risks on the Plan overall, and inclusion of the following

[61] DEC IRP Main Document, p. 5.
[62] *Ibid.*, p. 93.
[63] Direct Testimony of Duke Energy Carolinas, LLC, and Duke Energy Progress, LLC Witness Dawn Santoianni ("Santoianni Direct"), Docket No. 2019-224-E & 2019-225-E. p. 20, ll. 5-6. Retrieved at: https://dms.psc.sc.gov/Attachments/Matter/e3ec13ad-b59a-4591-8cd8-50d87e32b158.
[64] *Ibid.*, p. 19, ll. 10-11.

components of the Plans is consistent with best practices regarding climate-related risk management:

- **Scenario analysis.** Assessing multiple scenarios and possible pathways for transition is an established best practice in climate-related risk disclosure and management,[65] and the Companies' consideration of multiple pathways allows for weighing pros and cons between approaches.
- **Offshore wind planning.** Availability of wind resources in the Carolinas would provide a valuable additional zero-carbon resource that complements the solar generation resource,[66] and the Companies' inclusion of the resource in modeling is a step toward realizing wind capacity in the Carolinas.
- **Integrated Systems & Operations Planning (ISOP).** Distributed, zero-carbon energy resources will have a substantial impact on the grid in the future, and ISOP could maximize the short-term economic benefits and long-term carbon reductions of distributed energy resources.
- **Continued Use of Carbon Price Sensitivities.** Carbon price sensitivities allow for a straight-forward consideration of one component of climate-related regulatory risk.
- **Acknowledgement of mid-century transition timeline.** The 15-year planning horizon does not encapsulate the broader transition that is entailed in Duke

[65] TCFD (2017, June). The Use of Scenario Analysis in Disclosure of Climate-Related Risks and Opportunities. Retrieved at: https://assets.bbhub.io/company/sites/60/2020/10/FINAL-TCFD-Technical-Supplement-062917.pdf.

[66] Matsuda-Dunn, R., Emmanel, M., Chartan, E., Hodge, Bri-Mathias, Brinkman, G. (2020, January). Carbon-Free Resource Integration Study. National Renewable Energy Laboratory. P. viii. Retrieved at: https://www.nrel.gov/docs/fy20osti/74337.pdf.

Energy's net-zero by 2050 goal, and the Plans include at least some high-level discussion of the 2036-2050 timeline.

- **Stakeholder engagement.** Developing risk assessments, resource plans, and evaluation criteria alongside stakeholders can build regulatory certainty and manage regulatory and reputational climate-related risks. The Plans include several components requested by stakeholders.[67]

While the mere existence of these components is an improvement over their absence, there are several shortcomings to the Companies' approach. For example, ISOP is mentioned but not yet operational in these Plans. I will discuss other shortcomings of these components in other sections of this testimony.

Q. Based on your review of the Plans, do you believe that the Companies have adequately assessed or managed climate-related risks in the integrated resource plans?

A. Notwithstanding the components listed above, and based on my review of the Companies' Plans, Companies' witness testimony, the Companies' responses to discovery, and emerging utility and climate risk trends, I find that the Companies have not adequately assessed or managed climate-related risks in their plans. I find that they do not adequately account for climate-related risks in three ways:

First, the Companies did not assess material climate-related risks to their assets and operations or resource decisions made in the resource plans. The Companies neither conducted an explicit assessment of climate-related risks in the creation of the Plans, nor did they assess several consequential climate-related risks to the Plans.

[67] DEC IRP Main Document, p. 11.

Second, the Companies failed to consider several resource planning strategies that could mitigate climate-related risks while driving incremental cost benefits for ratepayers.

Third, the Companies' evaluation of the scenarios consistently emphasizes short-term costs while underplaying or ignoring additional investments or stranded asset costs incurred over the 21st century energy transition.

I provide support for each of these conclusions, in depth, below.

A. The Companies did not adequately assess climate-related risks in the formation of the Integrated Resource Plans.

1. The Companies did not conduct a systematic climate-related risk assessment.

Q. Did the Companies explicitly conduct a review of climate-related risks as it assembled its Plans?

A. The Companies state in discovery that they did not perform any systematic assessment of climate-related risks on the Companies' assets, operations, and/or earnings.[68] The response is attached to this testimony as Exhibit TF-4. Although the Duke 2020 Climate Report does include some discussion of climate-related risks faced by the Companies,[69] the Companies clarify that the Duke 2020 Climate Report "was not used in any way in the development of the 2020 IRPs."[70]

[68] Duke Energy Carolinas, LLC and Duke Energy Progress, LLC ("DEC-DEP") Response to Vote Solar Data Request 2-10(b).
[69] Duke 2020 Climate Report.
[70] DEC-DEP Response to Vote Solar Data Request 2-10(a).

Q. Do you believe that high-level, enterprise-level climate risk assessments such as the Duke 2020 Climate Report are adequate for determining exposure to and management of climate-related risks at the operating-company level?

A. No. Duke Energy's operating companies in Ohio, Indiana, Kentucky, Florida, and the Carolinas have different profiles of customers, different policy contexts and regulators, and—possibly most importantly—different physical environments.[71] The Duke 2020 Climate Report does not provide sufficient detail on any specific risk to provide granular, actionable information on an operating-company level.

Q. What are the potential impacts if granular climate-related risk information is not available on an operating-company level?

Company-specific climate-related risks are necessary for stakeholders in the Carolinas to better understand the Companies' operating conditions. In its October 2020 order initiating a proceeding on company-level climate risk disclosure, the New York Public Service Commission found that:

> "While disclosures at the holding company parent level serve to inform equity investors, these disclosures do not focus on climate-related risks relevant to the New York operating companies. Thus, given the issuance of debt at the operating company level, and to focus management and investor attention on climate-related risks in the state, the Commission believes that climate-related risk disclosures should be issued specific to the operating companies in New York."[72]

The same relationship between financers, climate risks, and operating companies is at play in the Carolinas. And, given that part of the remit of public utility

[71] Morehouse.
[72] State of New York Public Service Commission (2020, October). Order Instituting Proceeding. Case 20-M-0499. Retrieved at: http://documents.dps.ny.gov/public/Common/ViewDoc.aspx?DocRefId={0FFF1374-0511-41AC-8262-56BED5FAC8CC}.

commissioners is to supervise Companies' management of business risks, the same is true for regulators. Getting a 30,000 foot view on climate-related risks is not sufficient for the Commission to discharge its responsibilities to provide oversight of the Companies' risk management.

Q. Are there examples of jurisdictions that require climate-related risk disclosure at the operating company level?

A. Disclosure and management of climate-related risks, while increasingly common at the holding-company level, is just emerging at the operating-company level. As stated above, the New York Public Service Commission began its proceeding considering a decision to direct operating companies to disclose climate-related risks in October 2020.[73] California ordered its investor-owned utilities to begin reporting climate-related risks and adaptation measures in August.[74] Given the potential physical climate risks in South Carolina,[75] the operating-company-specific climate risk disclosure could be more important for oversight of relevant risks.

Q. What are the possible implications of not conducting this screen?

A. Without a systematic assessment and disclosure of climate-related risks, the Companies are not able to manage climate-related risks holistically, and as a result they expose ratepayers and shareholders to additional risk.

[73] *Ibid.*
[74] Whieldon, E. (2020, October). New York PSC is considering making utilities report climate change risks. *S&P Global*. Retrieved at: https://www.spglobal.com/marketintelligence/en/news-insights/latest-news-headlines/new-york-psc-is-considering-making-utilities-report-climate-change-risks-60765680.
[75] Morehouse.

Relevant regulatory and financial stakeholders—in this case public service commissioners and debt lenders to the Companies—also need a complete vision of material risks to perform their jobs efficiently and effectively. Operating without this information will lead to more uncertainty and volatility for all stakeholders.

Q. How might the Companies incorporate a systematic climate-related risk screen into their integrated resource planning process?

A. I recommend that the Commission direct the Companies to perform a systematic assessment and disclosure of climate-related risks incident on the Companies' assets and operations. Climate-related risk information is relevant not only for integrated resources planning, but also for any other matter before the Commission that concerns the Companies' long-term business plans. The Duke 2020 Climate Report provides a helpful template and implementation of the TCFD's recommendations, and frameworks and metrics provided by the Climate Disclosure Standards Board[76] and Sustainability Accounting Standards Board,[77] respectively, demonstrate even more specificity. For ease of administration, the Commission could direct Companies to submit their assessment on a quadrennial basis, as has been suggested in California,[78] or as a component of integrated resource planning filings.

[76] Climate Disclosure Standards Board ("CDSB") (2019, December). CDSB Framework for reporting environmental & climate change information. Retrieved at: https://www.cdsb.net/sites/default/files/cdsb_framework_2019_v2.2.pdf.
[77] SASB (2018).
[78] Whieldon.

2. The Companies did not incorporate foreseeable climate-related physical impacts into their Plans.

Q. Please provide a summary of potential physical climate-related impacts that could have significant impacts on development of an integrated resource plan.

A. Based on my review, there are two vectors for climate-related physical phenomena to impact development of an integrated resources plan: First, increases in ambient temperature and weather patterns could affect load forecast, peak load timing and magnitude, and resource adequacy concerns. Second, climate-related physical events such as extreme weather, flooding, or heat waves could have physical impacts on the Companies' physical assets, from transmission lines to generation assets.[79]

Q. Based on your review, are climate-related physical impacts likely to impact the Plans over the lifetime of new generation assets?

A. Yes. The North Carolina Climate Science Report (NCSSR), commissioned as a part of Governor Cooper's Executive Order 80, used state-of-the-art science and a NOAA-facilitated peer review process[80] to assess the current and future climate impacts to the physical environment in North Carolina.[81] I present a selection of the Report's conclusions below:

[79] *See:* Fonseca, F., Craig, M., Jaramillo, P., Berges, M., Severnini, E., Loew, A., Zhai, H., Cheng, Y., Nijssen, B., Voisin, N., & Yearsley, J. (2021, January). Effects of Climate Change on Capacity Expansion Decisions of an Electricity Generation Fleet in the Southeast U.S. Environmental Science & Technology. DOI: 10.1021/acs.est.0c06547.

[80] North Carolina Institute for Climate Studies (2020, September). *North Carolina Climate Science Website.* Retrieved at: https://ncics.org/programs/nccsr/.

[81] Kunkel, k., Corbett, D., Perry, L., Easterling, D., Dello, K., Robinson, W., Ballinger, A., Dissen, J., Stevens, L., Bililign, S., Lackmann, G., Stewart, B., Champion, S., Luettich Jr., R., & Terando, A. (2020, September). North Carolina Climate Science Report. North Carolina Institute for Climate Studies. Retrieved at: https://ncics.org/wp-content/uploads/2020/10/NC_Climate_Science_Report_FullReport_Final_revised_September2020.pdf.

- It is ***very likely*** that North Carolina temperatures will increase substantially in all seasons.
- It is ***virtually certain*** that rising sea level and increasing intensity of coastal storms, especially hurricanes, will lead to an increase in storm surge flooding in coastal North Carolina.
- It is ***very likely*** that some current climate design standards for North Carolina buildings and other infrastructure will change by the middle of the 21st century. This includes increases in design values for precipitation, temperature, and humidity. Several professional societies, however, are actively working on methods to incorporate climate change into national standards, and updated standards appropriate for use in a changing climate may be available in the near future.[82] [emphasis original]

While the NCCSR did not assess impacts to South Carolina, they are likely to be similar given the states' geographic proximity. The scope covered by the NCCSR was through the end of the 21st century, and short-term climate-related physical impacts can be difficult to pinpoint, but these impacts will become increasingly clear over the course of the next decades. Given the multi-decadal timeline of the potential investments considered in the Plans, the impacts to design standards are particularly relevant.

Duke Energy and the Companies have also discussed climate-related impacts to their operations and assets. Among several general climate-related risks to

[82] *Ibid.*

operations, the Duke 2020 Climate Report mentions the following specific physical climate-related impacts to the Companies' operating assets:

- Flood risks to the Brunswick nuclear station.[83]
- Water availability impacts to hydroelectric reservoirs for fossil and nuclear plants in the Carolinas;[84]
- Flood risks to the Sutton gas plant[85] (this plant was flooded during Hurricane Florence in 2018[86]).

Climate implications for integrated resource planning specifically are continuing to emerge. In January 2021, scientists at Carnegie Mellon University and the University of Michigan published the first capacity expansion model that explicitly incorporates physical impacts of climate change. Their study focused specifically on the Southeast U.S. and finds that "compounding climate-change impacts could result in a 35% increase in installed capacity by 2050" due to changes to demand and impacts to efficiency of thermal plants.[87]

These are material risks, today, and they will accelerate in the future. To the extent that they interfere with or affect a given generation unit's ability to perform as expected, these impacts should be included in integrated resource planning.

[83] Duke 2020 Climate Report, p. 12.
[84] Duke 2020 Climate Report, p. 13.
[85] Duke 2020 Climate Report, p. 14.
[86] Duke Energy (2018, September). *Sutton Plant Update: Conditions Remain Stable*. Retrieved at: https://news.duke-energy.com/releases/sutton-plant-update-conditions-remain-stable.
[87] Fonseca *et al.*

Q. Does the North Carolina Climate Science Report conclude that an increase in extreme cold events is likely?

A. No. The NCCSR finds that the annual number of such days has been above average for the last five years,[88] but concludes that "it is ***likely*** that the number of cold days and very cold nights will decrease."[89]

Q. How did the Companies integrate climate-related physical impacts into the development of their Plans?

A. The Plans do not present a systematic assessment of climate-related physical impacts, although some of the Companies' current practices integrate sensitivities that may incorporate climate impacts. The Plans included a 'high load' sensitivity,[90] and the resource adequacy included a 'climate' sensitivity.[91] In both examples these were sensitivity cases, rather than default conditions.

More notable is where the Plans did not include climate-related risks. The Companies did not assess climate-related physical risks to existing or planned generation assets, [92] despite the explicit mention of these risks in the Duke 2020 Climate Report. The load forecast uses a 30-year weather forecast, which assumes no trend in average temperatures.[93] Climate sensitivities were not included in transmission planning.[94] The picture of physical climate-related impacts on the

[88] Kunkel *et al.*, p. 53.
[89] *Ibid.*, p. 20.
[90] DEC-DEP Response to Vote Solar Data Request 4-4(e).
[91] Duke Energy Carolinas 2020 Integrated Resource Plan, Attachment III: Duke Energy Carolinas Resource Adequacy Study, Docket No. 2019-224-E. p. 16.
[92] DEC-DEP Response to Vote Solar Data Request 4-4(c).
[93] DEC-DEP Response to Vote Solar Data Request 4-4(a).
[94] DEC-DEP Response to Vote Solar Data Request 4-4(d).

Companies' assets and operations is piecemeal, at best, and does not reflect the full scale of impacts or the full scope of possible scenarios.

Q. What are the potential negative impacts of failing to integrate climate-related physical risks into the Integrated Resource Plans?

A. There are several potential impacts, ranging from chronic to acute. Chronic impacts might materialize as error in long-term load and demand projections, which could cause the Companies to make inefficient expenditures on resource adequacy needs. Acute impacts would include damage to assets that are not properly fortified against amplified flooding or extreme-weather risks. Without an in-depth review of the Companies' assets and operations with an eye toward physical climate risks, it is difficult to provide a comprehensive set of potential outcomes.

Q. Are there examples of investor-owned utilities that have conducted a robust climate vulnerability assessment?

A. Yes. In the aftermath of Hurricane Sandy, Con Edison and the New York Department of Public Service Staff convened a "Storm-Hardening and Resiliency Collaborative" for a diverse group of stakeholders to co-operatively devise a plan for assessing and responding to climate-related storm risks. As an output of the collaborative, Con Edison finished its first Climate Change Vulnerability Study in 2019.[95] The study is attached, in full, to this testimony as Exhibit TF-5. Because Con Edison is a re-structured utility, the study focused on the distribution system alone, but the same concepts could readily be applied to the Companies' vertically-integrated assets and operations.

[95] ConEd.

Q. How might the Companies integrate foreseeable climate-related physical impacts into their integrated resource planning process?

A. I recommend that the Commission direct the Companies to pursue a climate vulnerability study with a similar structure to the Con Edison report cited above and included as an attachment to this testimony. The study should use the best available climate science to characterize climate-related risks to the Companies' assets, then integrate those risks into its planning processes, from integrated resource planning to distribution planning and, ideally, the integrated concept envisioned by ISOP. Understanding holistic climate impacts across scales will allow the Companies to address them efficiently and effectively.

3. The Companies' reference carbon prices no longer provide an appropriate benchmark.

Q. Do the Plans include a reference carbon price in the development of their plans?

A. Yes. The Integrated Resource Plans use a 'base' reference carbon price that begins at $5 per ton of emissions in 2025, then increases at $5 per year. The 'high' carbon price begins at the same magnitude, but increases by $7 per year through the planning period.[96] The 'base case with carbon policy' scenario utilizes the base carbon price as an incentive for investment in zero-carbon generation.

Q. How do these reference prices compare to industry standards or actual federal bills under consideration?

[96] DEC IRP Main Document, p. 152.

A. The Companies' chosen carbon prices are lower than the reference policies that the Companies mention in their Plans as well as industry standards for carbon price projections. Figure 4-1, from the Carbon Stranding report, shows the Companies' base and high reference carbon prices versus proposed federal legislation mentioned in the Plans.[97]

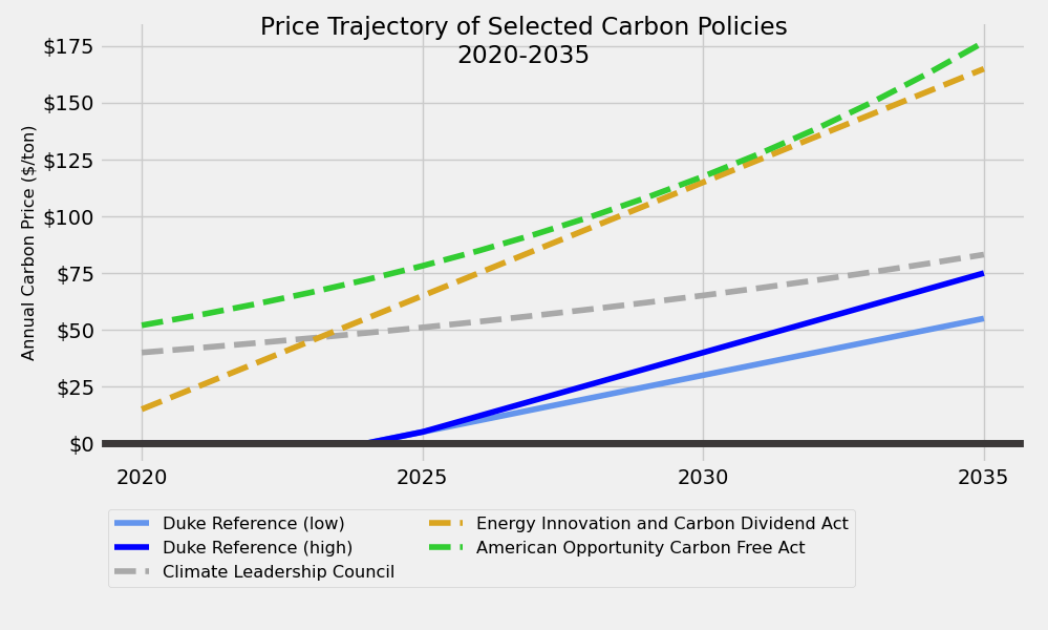

Figure 4-1. *Price Trajectory of Selected Carbon Policies and the Companies' reference price.*[98]

The graph shows that reference policies identified by the Company, specifically the Climate Leadership Council's policy, the Energy Innovation and Carbon Dividend Act, and the American Opportunity Carbon Free Act of 2019, each start at a higher point than the reference policies and (with the exception of the Climate Leadership Council proposal) escalate at a similar rate. It is worth noting that none of these bills were passed in 2020 and therefore they are not incident on the Companies, but

[97] DEC IRP Main Document, p. 152-153.
[98] Fitch, p. 21.

if they were passed any time in the next 5 years then the Companies' references would provide an under-estimate. Given the recent momentum toward carbon pricing discussed earlier in this testimony, any errors or variability in carbon pricing projections are particularly salient.

To better provide objective projections on the position of the energy economy in the United States, the US Energy Information Administration also includes carbon-pricing sensitivities in its Annual Energy Outlook (AEO).[99] US EIA's carbon pricing sensitivities in the 2020 EIA AEO are $15, $25, and $35 per ton of emissions, starting in 2021, increasing by 5% per year. Again, these values are significantly greater than the sensitivities used by the Companies.

Q. What role does a reference carbon price play in the Companies' plans?

A. The Companies explain that the prices were developed "to incentivize ZELFR technology in the 2030 and 2040 timeframes."[100] In response to questions about why the Companies declined to raise the reference prices, the Companies state that:

> The higher prices… would support a faster pace of coal and gas retirements and ZELFR technologies. However, the pace of CO2 reduction would be limited by the amount of renewables and storage that could be interconnected in a given year and the time needed for ZELFR technology development. The 5 and 7 $/ton escalator incentivized similar types of technologies but at a pace that could be implemented, provides time for technology development and provides much lower cost to customers on the path to net zero.[101]

Based on this response, the Companies appear to be approaching the use of a carbon pricing sensitivity backward. These responses suggest that the Companies are

[99] US Energy Information Administration (2020, March). *Annual Energy Outlook 2020: Alternative Policies.* Retrieved at: https://www.eia.gov/outlooks/aeo/section_issue_policies.php.
[100] DEC-DEP Response to Vote Solar Data Request 2-32(a).
[101] DEC-DEP Response to Vote Solar Data Request 2-32(b-c).

adjusting the inputs of their modeling to get a desirable output, rather than selecting realistic inputs and accepting the output of their model, notwithstanding the desirability of the outcomes.

Q. Has the Commission commented on carbon pricing risk?

A. Yes. The Commission found in the Dominion IRP Order that "It is in the public interest for the risk of potential carbon pricing to also be considered and balanced under [Act 62]." The Commission found problems with Dominion's carbon pricing scenarios of $0 and $25/ton, and that collectively with problems with gas pricing and future load, the current production cost modeling was "unreliable."[102]

Q. What are the potential negative impacts of failing to use an appropriate reference carbon price in research planning?

A. The Commission states the potential negative impacts of inadequate risk sensitivities in its Dominion IRP Order succinctly: "Poorly designed cost and sensitivity analyses can create skewed cost results that mislead decision-makers about which plan is most prudent."[103]

Q. How might the Companies better assess the regulatory risks of carbon pricing on their Plans?

A. To better manage climate-related regulatory risks, and specifically the risk of carbon pricing to the Companies and their Plans, I recommend that the Commission direct the Company to use the US EIA AEO carbon pricing sensitivities ($15, $25, and $35 in 2021, escalating at 5 percent per year) in its integrated resource plans.

[102] PSCSC.
[103] PSCSC.

These may be modeled as a carbon 'cap,' rather than a direct cost, to facilitate comparisons between sensitivities with zero and non-zero carbon prices.

B. The Companies did not consider strategies that would mitigate climate-related risks while driving incremental cost benefits

1. The Companies have not yet incorporated distributed energy resources (DERs) into integrated resource planning practices.

Q. What are distributed energy resources? What implications do their presence have for grid planning?

A. Distributed energy resources (DERs) are technologies connected to the electricity grid at the distribution level that are capable of interacting with, and providing value to, the grid. The technologies, and the services they are able to provide, are varied. Rooftop solar provides energy and capacity, while storage can increase capacity values and provide resilience benefits. Grid-connected water heaters act as a demand-side response measure, shifting energy usage from when energy is more costly to when it is less. Deployed intelligently, DERs could defer or avoid investment in distribution-level assets.[104]

The precipitous price decline in DERs, combined with widespread customer adoption, is re-shaping the grid.[105] Earlier this year, for example, utility Southern California Edison signed a contract Sunrun to utilize 300 distributed solar-plus-storage installations as a 'virtual power plant' to provide on-demand power to the

[104] Rhodium Group (2017, January). What's it Worth? The State of the Art in Valuing Distributed Energy Resources. Retrieved at: https://rhg.com/wp-content/uploads/2017/01/RHG_WhatsItWorth_Jan2017.pdf.
[105] GreenTechMedia (2018). How Distributed Energy is Reshaping the Energy Landscape. Retrieved at: https://www.greentechmedia.com/articles/read/how-distributed-energy-is-reshaping-the-energy-landscape.

grid.[106] The Federal Energy Regulatory Commission's Order 2222, issued in September 2020, officially recognizes the role of DERs and allows them to interact with the regional grid.[107]

Conventional integrated resources planning, however, has not included visibility into the distribution system. In order for the broader grid to best integrate the benefits of DERs, integrated distribution planning (IDP) capabilities are needed to provide visibility is needed at the distribution level during system planning.[108]

Q. How could DERs and integrated distribution planning impact the grid? Are there implications for climate-related risks?

A. With smart integration, DERs could have a truly transformative impact on the grid. Modeling from Vibrant Clean Energy using software that simultaneously models the bulk energy system and the distribution system found that decarbonizing the grid using DERs would be cheaper business-as-usual operations, and that savings could be as much as $473 billion across the country.[109] Distributed energy resources also provide resilience to the energy system, allowing continued function during climate-related weather events.[110]

[106] Gheorghiu, I. (2020, June). SCE, Sunrun partner on solar+storage virtual power plant pilot to drive down peak demand. *UtilityDive.* Retrieved at: https://www.utilitydive.com/news/sce-sunrun-partner-on-solarstorage-virtual-power-plant-pilot-to-drive-dow/579980/.
[107] St. John, J. (2020, September). 'Game-Changer' FERC Order Opens Up Wholesale Markets to Distributed Energy Resources. GreenTechMedia. Retrieved at: https://www.greentechmedia.com/articles/read/ferc-orders-grid-operators-to-open-wholesale-markets-to-distributed-energy-resources.
[108] NCUC (2021, January 12). Order Scheduling Technical Conference and Requiring Filing of Report. Docket No. E-100, Sub 165. Retrieved at: https://starw1.ncuc.net/ncuc/ViewFile.aspx?Id=630690ac-3dde-44b6-be9c-408ca902c51e.
[109] Clack, C., Choukulkar, A., Cote, B., McKee, S. (2020, December). Why Local Solar for All Costs Less. Vibrant Clean Energy. Retrieved at: https://www.vibrantcleanenergy.com/wp-content/uploads/2020/12/WhyDERs_ES_Final.pdf.
[110] Stout, S,. Hotchkiss, E., Lee, N., Holm, A., Day, M. (2018, April). Distributed Energy Planning for Climate Resilience. National Renewable Energy Laboratory. Retrieved at: https://www.nrel.gov/docs/fy18osti/71310.pdf.

Q. How have the Companies and other relevant stakeholders in the Carolinas responded to the opportunity presented by integrated distribution planning?

A. The Companies have noted the value and impact of integrated distribution planning, and have been developing what they call integrated systems & operations planning (ISOP) since at least 2019.[111] In the Plan documents, the Companies explain through ISOP and DERs "will increasingly create opportunities… to defer or potentially even avoid some traditional 'wires' upgrades, and in some cases, help to offset needs for building generation resources."[112] The Companies are committed to implementing the basic elements of ISOP in the 2022 IRPs in the Carolinas.[113] The North Carolina Utilities Commission (NCUC) has taken an interest in ISOP, requesting a recent report on integrated distribution planning best practices[114] and an update on the ISOP's development in March 2021.[115] In its scheduling order, the NCUC notes that:

> North Carolina is committed to address climate change and transition to a clean energy economy, as evidenced in its Clean Energy Plan and ongoing activities. The Commission believes that establishing comprehensive utility system planning processes that connect generation, transmission, and distribution planning in a holistic, iterative and transparent process are essential to honoring this commitment.[116]

[111] Duke Energy (2021). *ISOP Reference Information Portal.* Retrieved at: https://www.duke-energy.com/Our-Company/ISOP.
[112] Duke Energy Progress (2020, September). Integrated Resources Plan 2020 Biennial Report ("DEP IRP Main Document"), South Carolina Public Service Commission Docket No. 2019-225-E, p. 125.
[113] *Ibid.*
[114] Smart Electric Power Alliance (2020, September). Integrated Distribution Planning: A Framework for the Future. Submitted to NCUC Docket No. E-100 Sub 165. Retrieved at: https://starw1.ncuc.net/NCUC/ViewFile.aspx?Id=fa94eb54-c427-4c87-9ab6-f60fba42fa39.
[115] NCUC (2021, January 12).
[116] NCUC (2021, January 26). Order Granting Motions for Leave and Altering Start Time for Technical Conference. Docket No. E-100, Sub 165. Retrieved at: https://starw1.ncuc.net/NCUC/ViewFile.aspx?Id=fc22831e-549b-441b-abe9-34dc8b9415b2.

Q. Do the current Plans engage in integrated distribution planning?

A. No, they do not. The Companies' ISOP capabilities are not yet functional for integration into the integrated resource planning process. As mentioned above, the Companies anticipate that basic capabilities will be integrated in the 2022 IRPs.

Q. Are there examples of other integrated distribution planning initiatives in other states or with other utilities?

A. At least 17 states, are progressing with developing integrated distribution planning processes.[117] The Smart Electric Power Alliance's "Integrated Distribution Planning: A Framework for the Future" report, submitted to the NCUC, provides a helpful overview of ongoing integrated distribution planning processes.

Q. What actions can the Commission take to ensure that integrated distribution planning is effectively used in the public interest?

A. I provide the following recommendations to the Commission:

- The Commission should direct the Companies ensure that integrated distribution planning processes consider physical and transition climate-related risks, and include the benefits of managing those risks in their cost-benefit evaluations. To the extent found prudent, the Commission should request that the Companies provide regular updates on ISOP capabilities, assumptions, and results.
- While ISOP capabilities are being developed, the Companies should avoid moving forward with generation, distribution, or transmission investments that could be deferred or displaced by DERs if analytical capabilities were already

[117] Garcia, N. (2020, December). Top 10 Utility Regulation Trends of 2020. *GreenTechMedia.* Retrieved at: https://www.greentechmedia.com/articles/read/top-10-utility-regulation-trends-of-2020.

in place. The Commission should direct the Companies to develop a 'no-regrets' screen to ensure projects that could be cost-effectively displaced are avoided.

- To enhance collaboration between the Companies, Commission, and stakeholders and reduce regulatory and reputational risks (and to assist the Commission in implementing the above recommendations), the Commission should direct the Companies to embrace transparency with modeling software by procuring intervenor license for software modeling and sharing inputs, as recommended in the Dominion IRP Order.[118]

2. The Companies have declined to pursue beneficial regional coordination strategies, such as joint capacity planning or regional coordination beyond an energy exchange market.

Q. Please describe the role of regional energy coordination in managing climate-related risks.

A. Generally speaking, the ability for individual load-serving entities to participate in regional energy coordination constructs will enable a more affordable and efficient grid.[119] With access to a greater variety of generating resources over a larger

[118] Dominion IRP Order ordering paragraph 8.a. reads, in part, "[Dominion Energy South Carolina, or] DESC shall negotiate a discounted, project-based licensing fee that permits interested intervenors the ability to perform their own modeling runs in the same software package as DESC, and to direct DESC to absorb the cost of these licensing fees. Contemporaneously with the filing of each future IRP, DESC shall make available, without the need for a data request, the modeling inputs (including settings) and outputs, assumptions, any post- processing spreadsheets (e.g. to create the revenue requirements) in electronic spreadsheet format, and the model manual.

[119] Chen, J. (2020, March). Evaluating Options for Enhancing Wholesale Competition and Implications for the Southeastern United States. Duke Nicholas Institute for Environmental Policy Solutions. P.1. Retrieved at: https://nicholasinstitute.duke.edu/sites/default/files/publications/Evaluating%20Options%20for%20Enhancing-Wholesale-Competition-and-Implications-for-the-Southeastern-United-States-Final.pdf

geographic scope, regional energy coordination generally allows for better integration of variable, zero-carbon, zero-operating-cost resources.[120] A study from Energy Innovation examining the benefits of regional coordination through a regional transmission organization (RTO) in the Southeast found that the change to planning practices would reduce costs by 2.5 cents per kilowatt-hour and dramatically reduce carbon emissions.[121]

Q. How much regional coordination of energy and capacity do the Companies currently participate in?

A. Individual operating Companies are able to exchange energy through joint dispatch, but they only procure firm capacity for resource adequacy purposes from plants within their balancing area.[122] Companies are able to procure energy on a non-firm basis from neighbors, but this is generally the exception rather than the rule.[123] The Companies are not able to procure firm capacity for resource adequacy purposes from each other, nor from their neighbors.

[120] Chen, p. 26.
[121] Gimon, E., O'Boyle, M., McNair, T., Clack, C,. Choukulkar, A., Cote, B., McKee, S. (2020, August). Summary Report: Economic and Clean Energy Benefits of Establishing a Southeast US Competitive Wholesale Electricit Market. P. 1. Retrieved at: https://energyinnovation.org/wp-content/uploads/2020/08/Economic-And-Clean-Energy-Benefits-Of-Establishing-A-Southeast-U.S.-Competitive-Wholesale-Electricity-Market_FINAL.pdf.
[122] Duke Energy Carolinas 2020 Integrated Resource Plan, Attachment III: Duke Energy Carolinas Resource Adequacy Study. NCUC Docket No. 2019-224-E.
[123] Chen, P. 20.

Q. Are other configurations possible? What would be the benefits of an expanded pool for procuring firm capacity?

A. Yes, and in fact much of the United States uses regional planning for capacity planning in several different configurations.[124] I will describe potential capacity planning options, in rough order of increasing coordination, below:

- Joint capacity planning between the Companies in the Carolinas. This would allow the Companies to share firm capacity across their boundaries and potentially defer generation investment by utilizing each other's installed capacity.[125]
- An energy exchange market (EEM) would provide a central market for utilities to trade energy across the region. Generally speaking, exchanges on an EEM are voluntary, rather than relying on real-time optimization.[126]
- An energy imbalance market (EIM) coordinates dispatch across a region using a central optimization algorithm called security-constrained automatic dispatch (SCED).[127]
- A regional transmission organization (RTO) performs the same optimization as the energy imbalance market, but it also includes management for ancillary services in the short run and capacity and transmission planning in the long run.[128]

[124] Chen, p. 8.
[125] DEC IRP Main Document, p. 122.
[126] Butner, M. (2020, September). An Energy Imbalance Market in the Southeastern United States. Energy Transition Institute. P. 10-11. Retrieved at: https://energytransitions.org/energy-imbalance-market.
[127] Butner, p. 9.
[128] Butner, P. 3-4.

Q. Have the Companies examined increased regional coordination?

A. Yes. The Companies have considered joint capacity planning across the Companies' respective balancing areas since their merger, and included joint capacity planning as a sensitivity in their resource adequacy study.[129] The Companies generally note that joint capacity planning would likely lead to deferral of generation investments,[130] and although differences in reserve margin could lead to more cost-effective integration of zero-carbon generation[131] the Companies declined to assess the resource mix impacts of a lower reserve margin under joint capacity planning.[132] Duke Energy Carolinas' 2014 integrated resource plan notes in its short-term action plan that the Company will "Continue to examine the benefits of joint capacity planning and pursue appropriate regulatory actions."[133] The same phrase appears, verbatim, in the Carolinas 2020 IRP.[134]

The Companies also proposed a energy exchange market, branded as the Southeast Energy Exchange Market (SEEM).[135] The proposed platform would provide a

[129] Duke Energy Carolinas 2020 Integrated Resource Plan, Attachment III: Duke Energy Carolinas Resource Adequacy Study, p. 16. NCUC Docket No. 2019-224-E.
[130] DEC IRP Main Document, p. 109.
[131] Reimers, A., Cole, W., & Frew, B. (2019, February). The impact of planning reserve margins in long-term planning models of the electricity sector. *Energy* Policy. 125(2019), p. 1-8. Retrieved at: https://www.sciencedirect.com/science/article/abs/pii/S0301421518306797.
[132] DEC-DEP Response to Vote Solar Data Request 2-37.
[133] Duke Energy Carolinas (2014, September). Duke Energy Carolinas Integrated Resource Plan. P. 44. Retrieved at: http://starw1.ncuc.net/NCUC/ViewFile.aspx?Id=c3c5cbb5-51f2-423a-9dfc-a43ec559d307.
[134] DEC IRP Main Document, p. 122.
[135] Morehouse, C. (2020, December). Duke, Dominion, Southern file SEM proposal with state regulators, plan to file with FERC by end of year. *UtilityDive.* Retrieved at: https://www.utilitydive.com/news/duke-dominion-southern-file-seem-proposal-with-state-regulators-plan-to/592072/.

central platform for voluntary energy exchange.[136] The Companies state that they did not consider or analyze an RTO scenario in their Plans.[137]

Q. Have independent experts assessed regional coordination in energy markets in the Southeast?

A. Yes. Since the Companies' last integrated resources plan, a broad array of experts, including the Institute for Policy Integrity at NYU,[138] the Duke Nicholas Institute for Environmental Policy Solutions,[139] Energy Innovation,[140] and the R Street Institute[141] have examined the relative benefits of different regional coordination configurations in the Southeast.

Generally speaking, these experts find that increased levels of coordination lead to more benefits for ratepayers. The Institute for Policy Integrity analysis finds, for instance, that benefits from an EIM in the Southeast would result in tens if not hundreds of millions of annual benefits to ratepayers over an EEM.[142] R Street Institute experts conclude that "Based on what is known about the limited centralized control and governance of the Southeast Energy Exchange Market, it could be an improvement on the status quo, but will not reap most of the benefits of an EIM or RTO."[143]

[136] Duke Energy (2020, December). *Southeast electric providers to create advanced bilateral market platform.* Retrieved at: https://news.duke-energy.com/releases/southeast-electric-providers-to-create-advanced-bilateral-market-platform.
[137] DEC-DEP Response to Vote Solar Data Request 2-36.
[138] Butner.
[139] Chen.
[140] Gimon *et al.*
[141] Chen, J. & Bardee, M. (2020, August). How Voluntary Electricity Trading Can Help Efficiency in the Southeast. R Street Institute. Retrieved at: https://www.rstreet.org/wp-content/uploads/2020/08/No.-201-Energy-Trade-in-the-Southeast.pdf.
[142] Butner, p. i.
[143] Chen & Bardee, p. 10.

Q. What are the potential negative impacts of failing to consider all shared capacity options?

A. Based on my reading of the studies above, SEEM could provide some economic benefit to ratepayers, but the economic and emissions benefits are likely greater within an EIM or an RTO. Pursuing an EEM without due consideration of these configurations represents a missed opportunity. Joint capacity planning, however, presents a no-regrets approach to better coordination and economies of scale.

Q. Would there be any other benefits to pursuing joint capacity planning between the Companies?

A. Yes. Joint capacity planning could, with some regulatory changes,[144] allow the Companies to file a unified integrated resource plan, which would cut down administrative burden and provide a more efficient regulatory process.

Q. What actions can the Commission take to ensure that regional coordination is assessed and coordinated to mitigate climate-related risks and drive incremental direct benefits to ratepayers?

A. I recommend the following actions to the Commission:

- The Commission should direct the Companies to prepare an action plan for implementing joint capacity planning between the Companies. This plan should include any required changes to the joint dispatch agreement, any anticipated required regulatory approvals, and a projection of a realistic timeline for implementation.

[144] DEC-DEP Response to NCSEA Data Request 2-13.

- The Commission should direct the Companies to prepare an analysis comparing the benefits, including but not limited to direct ratepayer benefits and climate-related risk mitigation, of several regional coordination configurations, including but not limited to an EEM, and EIM, and an RTO. The analysis should be conducted by a third-party consultant that is mutually agreeable to the Companies, Commission, and the Office of Regulatory Staff.

3. The Companies embedded assumptions into model development that over-estimated the costs of transition to non-emitting generation

Q. Do you believe that all of the assumptions used by the Companies' capacity expansion and production cost models lead to the development of the most reasonable and prudent integrated resources plans?

A. No. I found several assumptions used by the Companies that may not be appropriate for precise and accurate modeling. Generally speaking, these assumptions tended to increase the costs of transition to a zero-carbon system while decreasing costs of status-quo development.

Q. Please discuss any specific assumptions that increase exposure to climate-related risks and provide recommendations.

A. Yes. I will list several assumptions that inappropriate and/or increase potential exposure to climate-related risks in the Plans below:

- The Companies' assumed costs of incremental transmission investment are, by their estimation, imprecise.[145] A range of transmission costs should have been

[145] *See* DEC IRP Main Document, p. 55; a*nd* DEC-DEP Response to NCSEA Data Request 2-25.

provided in present-value revenue requirement (PVRR) comparisons across scenarios.

- The Companies assumed that maximum solar deployment per year was the same as the historical average in the base case,[146] despite noting the potentiality of ISOP to accelerate interconnection,[147] citing increased pace of interconnection as a 'key element' for meeting zero-carbon goals,[148] and pursuing interconnection queue reforms outside of this proceeding.[149] Based on the Companies' stated intention on improving the pace of interconnection, Companies should increase the upper solar interconnection limit.

C. The Companies' evaluation of the selected scenarios consistently under-estimates the risks of status-quo resource planning while over-estimating the risks of transition to carbon-free resources.

1. At a portfolio level, the Companies did not adequately evaluate the risks of failing to meet long-term carbon commitments

Q. Describe the relationship between Duke Energy Corporation's net-zero-by-2050 commitment and the Companies' Plans.

A. The Integrated Resource Plans explain that the each of the scenarios within the Plans "keep Duke Energy on a trajectory to meet its near-term enterprise carbon-

[146] DEC-DEP Response to NCSEA 2-18.
[147] DEC IRP Main Document, p. 124.
[148] *Ibid.*, p. 132.
[149] Haggerty, J. (2020, September). Duke Energy, developers and regulators advance solar in the Carolinas with 'queue reform' and cluster studies. *PV magazine.* Retrieved at: https://pv-magazine-usa.com/2020/09/11/duke-energy-developers-and-regulators-advance-solar-in-the-carolinas-with-queue-reform-and-cluster-studies/.

reduction goal of at least 50% by 2030 and long-term goal of net-zero by 2050,"[150] and that the Plans are "complementary" with the net-zero-by-2050 commitment.[151] The Companies position each of the scenarios with the Plans as fully consistent with the net-zero-by-2050 goal.

Q. Describe the carbon trajectories achieved by the scenarios described in the Plan.

A. Based on the Companies' projections, each of the scenarios described by the Plans does, in fact, reduce annual carbon emissions over the 15-year planning period. In some scenarios, however, actual carbon emissions are modest. Figure 4-2 shows historic and projected annual DEC/DEP carbon emissions by IRP scenario.

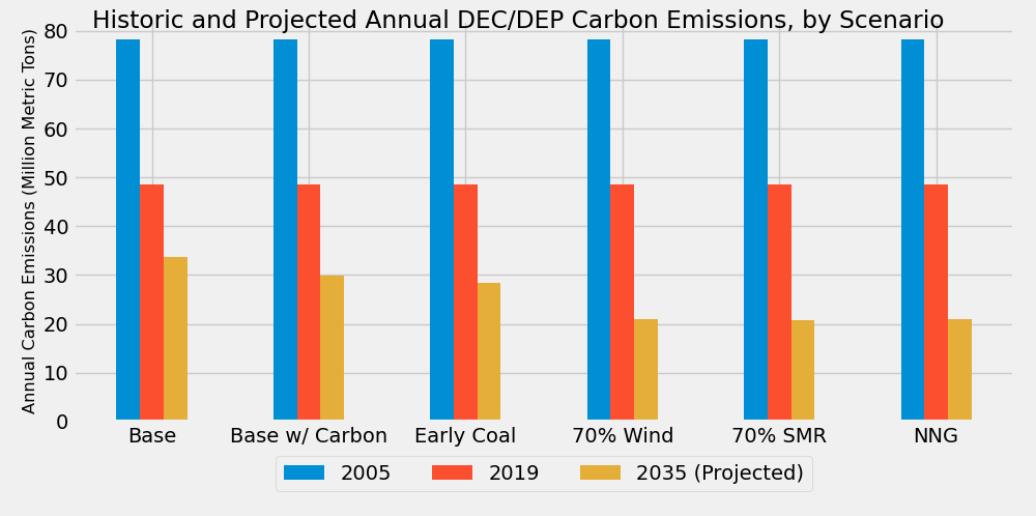

Figure 4-2. *Historic and Annual Projected Carbon Emissions, by Scenario.*[152]

In each of the scenarios, the blue and red bars show historical emissions in 2005 and 2019. The gold bar shows projected 2035 emissions for each scenario. Looking at emissions projections this way highlights important features of the Companies'

[150] DEC IRP Main Document, p. 6.
[151] DEC IRP Main Document, p. 8.
[152] *Figure is derived from values available in* DEC-DEP Response to North Carolina Sustainable Energy Association ("NCSEA") Data Request 7-21 *and* DEC IRP Main Document, p. 16, 135.

projected emissions trajectories. The first is that in each of the scenarios, a substantial amount of annual carbon emissions—over 20 million metric tons per year and about 40 percent of current emissions—remain.

The second is that the pace of emissions reductions 2019-2035 are all smaller in magnitude than the reduction achieved 2005-2019. By comparison, the carbon reductions projected in most of the scenarios appear relatively modest. The Base Case, Base Case with Carbon Policy, and Earliest Practicable Coal Retirements scenarios reduce less than half of the remaining system carbon emissions by 2035, leaving a larger amount to be reduced 2035-2050. Table 4-1, below, provides these values in table form.

Scenario	Base without Carbon Policy	Base with Carbon Policy	Earliest Practicable Coal Retirements	70% CO_2 Reduction: High Wind	70% CO_2 Reduction: SMR	No New Gas Generation
Carbon Reductions relative to 2020 Baseline *(%)*	**31%**	**38%**	**41%**	**57%**	**57%**	**57%**
Remaining Projected Carbon Emissions *(Million Metric Tons)*	**33.6**	**29.9**	**28.5**	**20.9**	**20.6**	**21.0**

Table 4-1. *Projected Carbon Reductions and Remaining Emissions, by Scenario*[153]

Q. Do the Companies present any analysis that would indicate that these plans are consistent with their net-zero-by-2050 commitment?

A. Beyond the statements provided above, the Companies did not conduct any specific analysis that demonstrates compatibility between the scenarios and the Companies'

[153] *Table is derived from values available in* DEC-DEP Response to North Carolina Sustainable Energy Association ("NCSEA") Data Request 7-21, DEC IRP Main Document, p. 16 and 135.

net-zero commitment,[154] and the Companies confirmed that they did not conduct any analysis for the IRP that contemplated generation resources needed to achieve carbon emissions 2036-2050.[155] Without further intervention, carbon reductions could even "stall and reverse before reaching 60 [percent] reduction."[156]

Q. Do the Companies track upstream emissions associated with the production and transportation of gas?

A. No,[157] despite acknowledgment of the carbon emissions implications of uncounted upstream emissions by the electric utility industry.[158] As a result, projected emissions are likely an undercount of full life-cycle emissions.

Q. Is Duke Energy's corporate commitment to net zero emissions by 2050 binding?

A. The Companies acknowledge that the commitment is not binding on Duke Energy leadership, and the Companies clarify that "the achievement of these goals is dependent upon a variety of factors."[159] The Plans generally stipulate a "need for supportive policies"[160] and technologies not currently in commercial operation[161] to actually achieve their commitment. Given that leadership has not made a binding commitment and the Plans concede that the Companies are either unwilling or unable to meet the commitment without further policy incentives or requirements,

[154] DEC-DEP Response to Vote Solar Data Request 2-12.
[155] DEC-DEP Response to Vote Solar Data Request 2-23.
[156] DEC IRP Main Document, p. 142.
[157] DEC-DEP Response to NCSEA Data Request 3-13.
[158] Kuckro, R. (2019, November). Utilities craft methane plan for gas supply chain. *EnergyWire*. Retrieved at: https://www.eenews.net/energywire/stories/1061525979.
[159] DEC-DEP Response to Vote Solar Data Request 2-10
[160] DEC IRP Main Document, p. 142.
[161] DEC IRP Main Document, p. 139.

it is not clear whether the Companies will achieve, or credibly pursue, their net-zero commitment without explicit direction from regulators.

Q. How do commitments such as Duke Energy's net-zero by 2050 commitment interact with climate-related risks?

A. Commitment like Duke Energy's function as a double-edged sword. On one hand, announcement of a commitment to decarbonization demonstrates corporate leadership and could generate reputational assets. If regulators believe that the Companies will achieve public policy objectives in the absence of regulatory action, regulators may be less likely to impose requirements on the Companies. Assuming firms follow through on them, corporate commitments provide insulation against reputational and regulatory risks.

If firms are not able or willing to comply with their corporate commitments, however, the commitment itself would become a liability. Stakeholders would be less likely to trust the firm, and policymakers could impose more sudden and strict regulations to meet policy goals. Climate risk experts note that acute policy changes would be more likely to lead to stranded assets and knock-on effects to the economic system.[162]

As demonstrated in Section II of this testimony, failing to comply with a net-zero by 2050 trajectory will increasingly be out of sync with the broader financial and economic community. The Companies could face sanction and material financial impacts if shareholders find that the Companies are not acting in line with shareholders' commitments and expectations.

[162] CFTC, p. 32.

Q. What have external observers and analysts concluded about Duke Energy's carbon commitment and the Companies' plans?

A. Management consultant firm Deloitte performed a survey of utility corporate carbon goals, including Duke Energy's in September 2020. The conclusion from its analysis was simple: "The math doesn't yet add up."[163] According to Deloitte, utilities simply are not retiring carbon-emitting assets like coal and gas, nor deploying zero-carbon generation like wind and solar, rapidly enough to meet their commitments. In the Sierra Club's January 2021 report comparing utility pledges to practices, they found that the Companies were in the top 15 operating companies in the country in terms of online coal capacity and planned gas capacity (and according to the report, Duke Energy Progress has the highest planned gas capacity buildout in the country).[164] When Synapse Energy Economics performed a similar review of carbon commitments from Duke Energy, Dominion Energy, and Southern Company, they found a similar lack of action and concluded that, "Utilities appear in some cases to simply be responding to state pressures or requirements rather than demonstrating the independent leadership needed to achieve ambitious decarbonization targets."[165] Among the recommendations in

[163] Porter, S., Thomson, J., & Motyka, M. (2020, September). Utility decarbonization strategies: Renew, reshape, and refuel to zero. Deloitte. Retrieved at: https://www2.deloitte.com/us/en/insights/industry/power-and-utilities/utility-decarbonization-strategies.html.

[164] Romankiewicz, J., Bottorff, C., & Stokes, L. (2021, January). The Dirty Truth About Utility Climate Pledges. Sierra Club. Retrieved at: https://www.sierraclub.org/sites/www.sierraclub.org/files/blog/Final%20Greenwashing%20Report%20%281.22.2021%29.pdf.

[165] Biewald, B., Glick, D., Hall, J., Odom, C., Roberto, C., & Wilson, R. (2020, March). Investing in Failure. Synapse Energy Economics. P. iii. Retrieved at: https://www.synapse-energy.com/sites/default/files/Investing-in-Failure-20-005.pdf.

Synapse Energy Economics report is a request to "align all actions," including integrated resource plans, "with CO_2 reduction trajectories and targets."[166]

Q. Has the Commission made any comment on the relevance of corporate net-zero goals to utilities' plans?

A. Yes. The Commission observed a similar set of circumstances play out in the Dominion IRP. In the Dominion IRP Order, the Commission observed that the proposed IRP "actually does not include any plan for making good on that commitment," and that it is "hopeful" that revised modeling will present at least some potential options for making good on its commitment.[167]

Q. Based on your analysis, do the Plans present a credible pathway toward a net-zero-carbon energy system by 2050?

A. No. As I mentioned earlier in this testimony, climate-related risks have two unique characteristics: Longer time scales and path dependency. While examining a single year's emissions provides a helpful snapshot of decarbonization progress, it is also important to look at the ability for a given portfolio of generation assets to reduce emissions in the future. When the Companies invest in a new carbon-emitting generation resource, one might reasonably expect that the asset would continue to operate over its lifetime and therefore continue to emit greenhouse gases into the future (barring zero-carbon retrofits, which will be discussed below). Experts call these expected future emissions from new investments "committed emissions."[168]

[166] *Ibid.*, p. 54.
[167] PSCSC.
[168] Shearer, C., Tong, D,. Fofrich, R., & Davis, S. (2020, September). Committed Emissions of the U.S. Ppower Sector, 2000-2018. AGU Advances 1(3). Retrieved at: https://agupubs.onlinelibrary.wiley.com/doi/full/10.1029/2020AV000162.

To better understand how committed emissions played out on the Companies' systems, I projected future carbon emissions, assuming existing and proposed carbon-emitting generation plants based on the Base Case with Carbon Policy scenario as a part of the 'Carbon Stranding' report. The results are shown in Figure 4-3. A further explanation of how this graph was constructed is available in section D of the report, attached here as Exhibit TF-2.

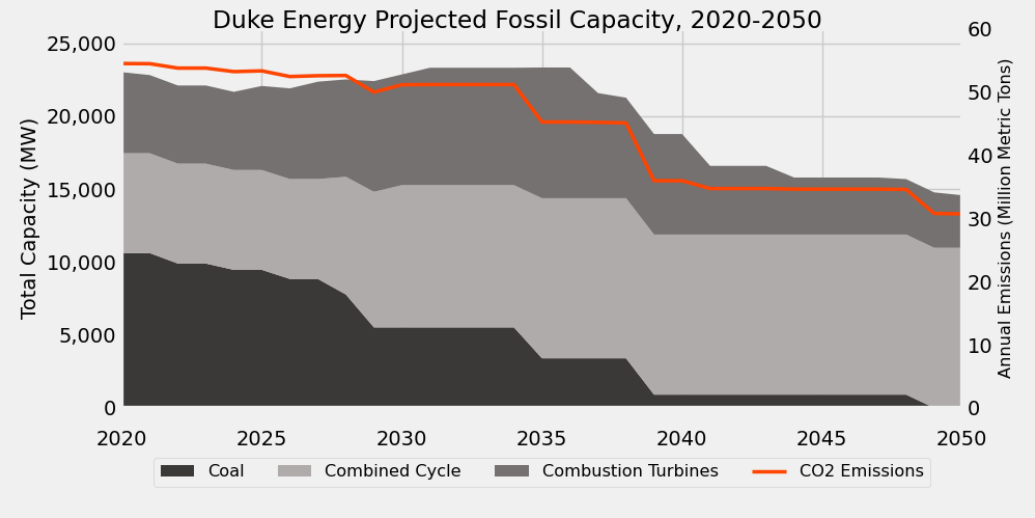

Figure 4-3. *Duke Energy Projected Fossil Capacity and Emissions, 2020-2050*[169]

The figure shows projected operating capacity (in stacked areas) of coal, gas combined-cycle, and gas combustion turbine units for the Base Case with Carbon Policy scenario, 2020-2050. Total operating capacity remains between 20,000 and 25,000 megawatts through 2035, but coal's share of capacity is largely replaced with combined-cycle capacity. Through mid-century, almost 15,000 megawatts of gas-fired generation assets are still online, made up of predominantly combined-cycle capacity. The red line shows projected carbon emissions each year, based on the amount of operating fossil capacity in that year. While emissions do decline as

[169] Fitch, p. 42.

a result of coal retirement through mid-century, about 30 million metric tons—60 percent of 2020 emissions—remain.

Notably, this graph shows what emissions pathway would result if these assets operate for their full engineering lifetime and the capacity factor of carbon-emitting assets is held at 2016-2018 levels. The Companies could change these expectations in the future, but no change to operating procedure or expected lifetime is contemplated in the Plans as written.

Q. Are the Companies credibly assessing or managing risks associated with failing to deliver on their corporate commitment?

A. No. The Companies have not provided any analysis demonstrating that base-case scenarios are compatible with Duke Energy's net-zero-by-2050 goal, and my analysis of the long-term emissions represented by investments in new generation shows a sustained high level of emissions through mid-century. In its 2020 submission to CDP, Duke Energy acknowledged the risk of stranded assets in the case of federal carbon regulation, but declined to calculate the potential costs: "[An estimation of the costs of carbon regulation] does not include any stranded costs that the company would seek to recover from customers associated with the possible premature shutdown of Duke Energy's existing power plant fleet."[170]

[170] Duke Energy 2020 CDP Submission..

Q. The Companies' corporate commitment by 2050 is to achieve net-zero emissions, implying the potential use of carbon offsets. What is the most appropriate way to account for offsets in long-term planning?

A. Duke Energy's net-zero commitment leaves open the possibility of using negative emissions technologies or carbon offsets to balance out any remaining emissions in Duke Energy's operating companies' system by 2050. Given that the last few percentage points of emissions are much more difficult to eliminate in decarbonization studies than the first,[171] this approach leaves a potentially important tool in the Companies' toolkit.

However, there is growing reason to be wary of reliance on carbon offsets. Recent reporting finds that even the most seemingly credible offset programs operating today are not successfully avoiding carbon emissions.[172] To compound the issue, many firms with net-zero commitments have announced their own plans to use offsets through 2050, creating a 'crowding out' effect by mid-century.[173] Given these concerns, offsets are best thought of as a last resort, rather than a central tool, in eliminating carbon emissions.

Q. What are the potential negative impacts of pursuing this trajectory?

A. As mentioned above, pursuing an investment plan that is not in alignment with Duke Energy's net-zero by 2050 commitment or a general strategy of

[171] Sergi, B., Hodge, B., Steinberg, D., Brickman, G,. Haase, S., Emmanuel, M., Fernandez, O. (2020, November). Duke Energy Carbon-Free Resource Integration Study. National Renewable Energy Laboratory. P. 20. Retrieved at: https://www.nrel.gov/docs/fy21osti/78386.pdf.
[172] Elgin, B,. & Mider, Z. (2020, December). The Real Trees Delivering Fake Corporate Climate Progress. Bloomberg Green. Retrieved at: https://www.bloomberg.com/news/features/2020-12-17/the-real-trees-delivering-fake-climate-progress-for-corporate-america.
[173] Mackenzie, K. (2021, January). Too Many Companies Are Banking on Carbon Capture to Reach Net Zero. Bloomberg Green. Retrieved at: https://www.bloomberg.com/news/articles/2021-01-15/too-many-companies-are-banking-on-carbon-capture-to-reach-net-zero.

decarbonization by 2050 will produce reputational damage, increase regulatory risk, and potentially impact the Companies' cost of capital.

Importantly, investment in new carbon-emitting assets without a clear plan to scrub carbon emissions also creates risk of a disorderly transition and stranded assets. By continuing to invest in a large carbon-emitting fleet, the Companies are exposed to market, economic, or regulatory changes intended to drive a transition to zero carbon by 2050. In this scenario, the Companies would need to radically change the operational role and lifetime of these assets in order to meet carbon expectations—with increased costs to ratepayers. Similarly to the fuel price risk discussed above, stranded asset cost risk would likely be borne by ratepayers rather than shareholders and therefore deserves special scrutiny.

Q. Have you assessed the magnitude of the potential for stranded assets?

A. Yes. Section D of the "Carbon Stranding" report, attached here as Exhibit TF-2, uses a high-level model of the potential for stranded assets as a result of the investment plan in the Companies' Base Case with Carbon Policy scenario. A full discussion of this analysis is presented in the report, but I will summarize it here. In this analysis, the model projects Companies' carbon emissions through 2050, then applies a carbon 'commitment' in the form of a straight-line interpolation between the Companies' emissions in 2020 and zero emissions in 2050. When projected emissions are greater than the carbon constraint, the model takes units offline—effectively 'stranding' them—until projected emissions are in line with committed emissions. The model uses a simple heuristic to prioritize removed units by technology (coal, then combined-cycle, then combustion-turbine for resource

adequacy concerns), then by carbon-intensity of generation (most carbon-intense first), then by age (oldest first). Figure 4-4 shows the Companies' carbon-emitting portfolio over time, when subject to the carbon commitment.

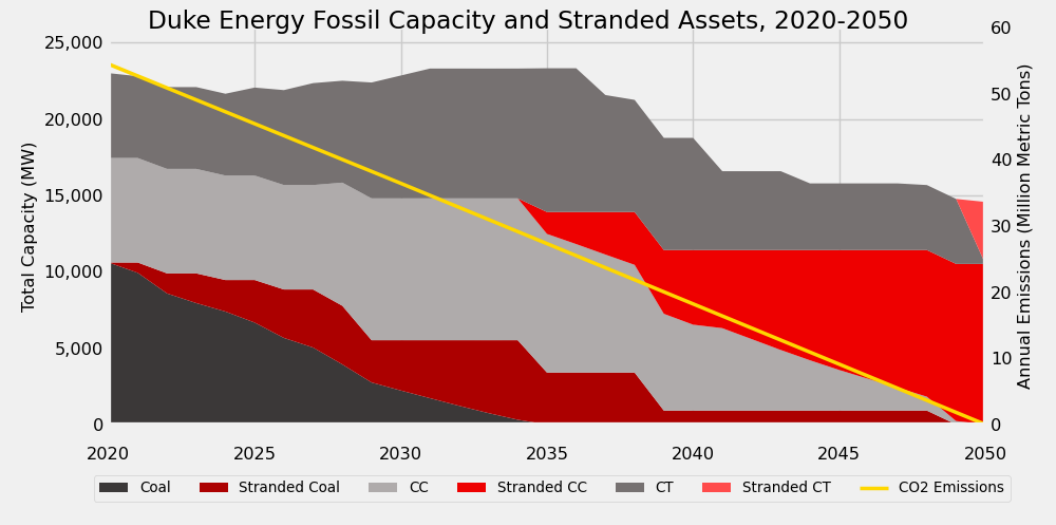

Figure 4-4. *Duke Energy Portfolio, with carbon stranded assets to meet climate commitments.*[174]

In Figure 4-4, areas shaded in red represent units and capacity that have been taken offline and 'stranded' in order to meet climate commitments. Additional carbon stranding occurs in every year, 2020-2050, with coal exiting the portfolio entirely in 2034 and a substantial amount of combined cycle assets are retired by 2040. Notably, no combustion turbines are retired until 2049-2050. This is because combustion turbines' capacity factors are very low—often below 5 percent—and therefore they contribute very little to total emissions.

[174] Fitch, p. 46.

Q. Did you calculate the potential cost for stranded generation assets?

A. It is difficult to provide a full accounting of the costs that would be incurred if the Companies were to be required to bring all of these units offline before the end of their engineering lifetimes. Maintaining service through this level of turnover would likely incur new investments and attendant costs in zero-carbon generation and transmission and implicate increases in operations and planning costs as a rapid transition occurs. Essentially, the scenario depicted above is one where the Companies continue to build out a carbon-emitting fleet, then are forced to retire these assets and build a zero-carbon replacement fleet.

The category of costs that does emerge clearly from this analysis is remaining asset value and return-on-investment for carbon-emitting resources that are removed from operation before the end of their engineering lifetimes. Assuming that the depreciation and return on investment are added to revenue requirements on a constant basis over the units' engineering lifetimes, substantial undepreciated value would remain on these units and the Companies' books when they are 'retired.' Without regulatory intervention, customers would be exposed to costs to pay for generation units that are only a decade old, but are nevertheless not used or useful. Figure 4-5 show the cost impacts of these stranded assets on customers, by year and by generation type.

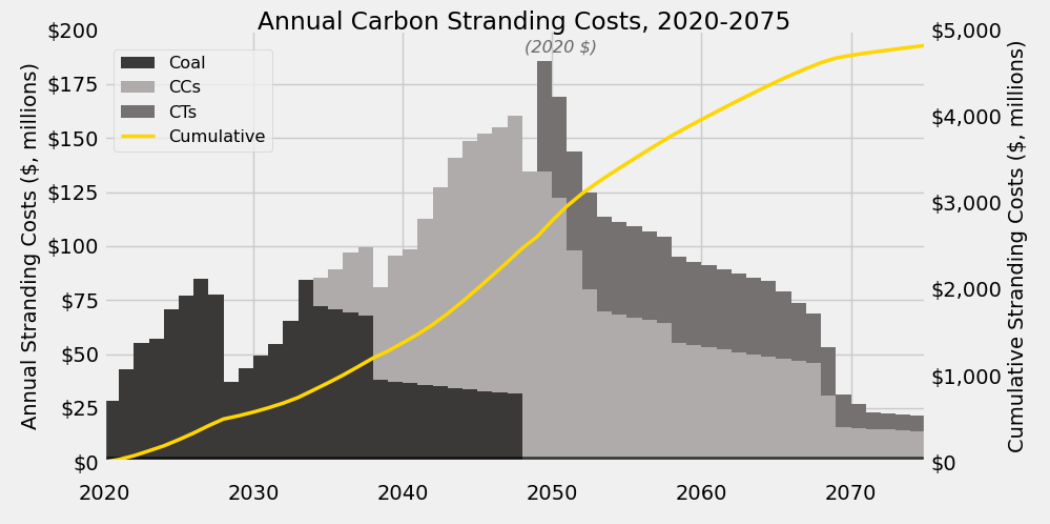

Figure 4-5. *Annual and Cumulative Carbon Stranding Costs, 2020-2075. All amounts in millions USD, adjusted for inflation.*[175]

Ratepayers would continue to pay off non-operational gas assets through 2075. Over the lifetime of all of these assets, carbon stranding costs would accumulate to about $4.8 billion in 2020 dollars, exceeding the total stranded investment cost to Duke Energy and Dominion Energy combined on the Atlantic Coast Pipeline by over $1 billion. Using a social discount rate appropriate for climate-related impacts, the present value of these stranded assets in the Base Case with Carbon Policy is $3.3 billion. This figure is equivalent to a $900 cost to each Duke Energy residential customer in the Carolinas, due today.

Q. Did the Companies incorporate an assessment of these risks into their Plans? Do you find this incorporation to be sufficient?

A. Although the Companies did not perform a stranding test on their existing gas fleet,[176] the Companies did conduct a 'stress test' using a 25-year operating life for new-build gas-fired assets. The sensitivity did find a very modest increase in PVRR

[175] Fitch, p. 48.
[176] DEC-DEP Response to Vote Solar Data Request 4-6(b).

costs through 2035[177] and some deferral of gas assets,[178] but the concerns raised throughout this testimony also apply to this stress test.

Even a 25-year operating life for new carbon-emitting generation, though, does not comply with Duke Energy's commitment or decarbonization by 2050. Table 4-2 presents each of the new-build gas assets envisioned in the Base Case with Carbon Policy, along with their pre-2050 lifetimes.

Plant	Planned First Year of Operation	Capacity (MW)	Operational Years before 2050
DEC Lincoln CT	**2025**	**402**	**25**
DEP Combustion Turbine 1	**2026**	**457**	**24**
DEP Combustion Turbine 2	**2027**	**457**	**23**
DEP Combined-Cycle 1	**2028**	**1,224**	**22**
DEP Combined-Cycle 2	**2029**	**1,224**	**21**
DEP Combustion Turbine 3	**2029**	**457**	**21**
DEP Combustion Turbine 4	**2029**	**457**	**21**
DEC Combustion Turbine 1	**2030**	**457**	**20**
DEC Combustion Turbine 2	**2031**	**457**	**19**
DEC Combustion Turbine 3	**2035**	**457**	**15**
DEC Combustion Turbine 4	**2035**	**457**	**15**
DEC Combined-Cycle 1	**2035**	**1,224**	**15**

Table 4-2. *Proposed New Gas Generation Assets with Operational Lifetime before 2050.*[179]

Among planned investments, 25 years is the *maximum* lifetime before Duke Energy's mid-century net-zero goal. Over a quarter of the proposed new-build

[177] DEC-DEP Response to Vote Solar Data Request 2-28.
[178] DEP IRP Main Document, p. 171.
[179] DEC IRP Main Document, p. 102-104 *and* DEP IRP Main Document, p. 104-106.

capacity in the Plans would come online in 2035, just 15 years before 2050. With this context, a 25-year operating lifetime might function better as a maximum lifetime than a 'stress test.' Although zero-carbon retrofits are possible for these units, retrofit costs are not included in the Plans and there are material concerns about their feasibility (these will be discussed in the next section of my testimony). Based on these flaws with the Companies' sensitivity analysis, I do not find the use a 25-year operating life sufficient or adequate for assessing or managing risks associated with the portfolio's planned transition to net-zero carbon by 2050.

Q. **How have other jurisdictions handled multi-decadal transitions?**

A. The Lawrence Berkeley National Laboratory's "Future of Electricity Resource Planning" study identified in 2016 the need for coherence between resource planning horizons and multi-decadal transitions.[180] The report did specifically identify Northern States Power's integrated resource planning practices as "beginning" to explicitly address longer-term transition issues.[181] I identify several practices from Northern States Power's integrated resources plan that would manage climate-related transition risk below:

- A 25-year timeline for capacity expansion modeling, with an acknowledgement that modeling results become increasingly subjective as outcomes extend into the future.[182]

[180] Kahrl *et al.*, p. 20.
[181] *Ibid.* p. 82.
[182] Northern States Power Company (2019, July). Upper Midwest Integrated Resource Plan. P. 107. Retrieved at: https://www.xcelenergy.com/staticfiles/xe-responsive/Company/Rates%20&%20Regulations/The-Resource-Plan-No-Appendices.pdf.

- Including 80% carbon emissions reduction from 2005 (Northern States Power's voluntary commitment) goals as an endogenous modeling constraint.[183]
- A practice of "strategic flexibility" which defers key resource planning decisions to allow for innovation and reassessment of technologies and costs.[184]

I do not present an overall judgment of Northern States Power's integrated resources plan here, but I do find that the above practices allow for better capability for managing long-term transition risks.

Q. What actions might the Companies take to manage this risk?

A. The Companies have several opportunities to incorporate these risks into plan development and evaluation. I recommend the Commission take the following actions to ensure integrated resource plans are in the public interest and protect ratepayers from climate-related risks:

- The Commission should direct the Companies to integrate a multi-decadal net-zero transition view explicitly into Plan development and selection. This could be accomplished through a quantitative or qualitative transition plan, committed emissions analysis, extended modeling timeline, explicit modeling constraint on emissions, 'strategic flexibility,' a combination of these practices, or other practices identified by the Commission.
- The Commission should direct the Companies to provide explicit projections of the operational role of existing and new-build carbon-emitting assets in the regular operation of the fleet, even if these are high-level. In particular, the Companies should describe the posture of the gas fleet preceding and after

[183] *Ibid.*, p. 115.
[184] *Ibid.*, p. 65.

midcentury. If shorter operational lifetimes and capacity factors are expected, this should be reflected in carrying and fixed operations and maintenance costs.

2. At an asset level, the Companies did not adequately evaluate the risk of stranding of new and existing carbon-emitting generation assets.

Q. Discuss the role of carbon-emitting assets in the Companies' Base Case with Carbon Policy.

A. As described above, carbon-emitting gas and coal assets continue to play a large part in the Companies' portfolio through the planning period. Over the course of the Plans, total carbon-emitting capacity (coal, gas combustion turbines, and gas combined-cycle plants) increases from 2020 to 2035. The Scenarios envision an addition of eight 457-MW combustion turbines and three 1,224-MW combined-cycle plants over the next fifteen years.

Q. Please describe climate-related risks incident on coal- and gas-fired generation investments.

A. These plants are exposed to climate-related risks through several vectors:

- *Physical*: Increased incidence of extreme weather can damage generation assets, and heat events can decrease cooling capability and operating efficiency.[185] Some plants in the Carolinas may be exposed to flooding risk.[186]
- *Financial:* Carbon emissions are a material concern for ESG investors,[187] and financers may have less appetite for exposure to carbon risks in the future.

[185] Bertolotti *et al.*
[186] Morehouse, (2020, January 22).
[187] Santoianni Direct, p. 20, ll. 5-6.

- *Economic:* Economically competitive, firm zero-carbon generation such as solar-plus-storage could out-compete these assets.[188]
- *Regulatory*: Future regulations could impact the cost and availability of fuel, or directly apply costs to plants.
- *Reputational:* Operation of these assets could undermine Duke Energy's zero-carbon commitment.

The transition risk to these investments is clear. As Duke Energy and the US electricity sector nears mid-century, risk exposure for generation assets that emit carbon will continue to increase. Ultimately, the Companies will likely be faced with a choice of incurring increased risk from additional emissions, shuttering these plants early, or investing in options that allow them to provide zero-carbon power.

Q. Have the Companies identified any pathways for decarbonizing gas-fired generation assets?

A. Yes. In their Plans, the Companies identify several technological options to de-carbonize existing gas-fired generation, including capturing and storing emitted carbon (often called carbon capture and storage, or CCS), sourcing and combusting zero-carbon renewable natural gas (RNG), and retrofitting the plants to burn zero-carbon hydrogen gas.[189]

Q. Are these technological pathways feasible in the short and long-term?

A. In the short-term, none of these options are feasible. Both gas substitution options would entail a regional or national build-out of supporting infrastructure to source

[188] BloombergNEF (2020, November). How PV-Plus-Storage Will Compete With Gas Generation in the U.S. Retrieved at: https://assets.bbhub.io/professional/sites/24/BloombergNEF-How-PV-Plus-Storage-Will-Compete-With-Gas-Generation-in-the-U.S.-Nov-2020.pdf.
[189] DEC IRP Main Document, p. 141.

and transport these materials. The Companies also found that "without a national strategy to transport CO_2, CCS is not applicable in the Carolinas."[190]

Long-term feasibility is more difficult to project with certainty. Credible estimates of RNG supply show that even with decades of investment, RNG could only supply a small fraction of current gas demand.[191] Although hydrogen supply and carbon capture and transport infrastructure development is possible, these networks would entail a major, national-scale investment, with attendant ratepayer costs and a need for coordination across multiple scales and partners.

Q. Has the Company integrated the potential for hydrogen or carbon capture into its Plans?

A. No. The Companies have not sponsored any analysis of the large-scale feasibility of either hydrogen[192] or carbon capture.[193] The Companies have not estimated the cost of these retrofits to any unit,[194] nor have they quantified impacts of implementation on PVRR.[195] Stated plainly, the Companies "[do] not expect to apply low carbon retrofits for hydrogen fuel, renewable natural gas, or carbon capture and storage."[196]

[190] DEC-DEP Response to Vote Solar Data Request 2-26.
[191] Saadat, S., Vespa, M., & Kesowik, M. (2020, July). Rhetoric Vs. Reality: The Myth of "Renewable Natural Gas" for Building Decarbonization. Earthjustice and Sierra Club. P. 2. Retrieved at: https://earthjustice.org/sites/default/files/feature/2020/report-decarb/Report_Building-Decarbonization-2020.pdf.
[192] DEC-DEP Response to Vote Solar Data Request 2-29(a).
[193] DEC-DEP Response to Vote Solar Data Request 2-30(b).
[194] DEC-DEP Response to Vote Solar Data Request 2-29(b) and 2-30(b).
[195] DEC-DEP Response to Vote Solar Data Request 2-29(d) and 2-30(d).
[196] DEC-DEP Response to Vote Solar Data Request 2-27.

Q. Does this represent a credible attempt to assess or manage climate-related risks to these assets?

A. No. The Plans go no further than mentioning theoretical possibilities for decarbonization. Even if these retrofits were feasible, the Companies have not assessed the costs or operational impacts of these retrofits—both critical information for integrated resource planning.

Q. What are the potential negative impacts of failing to insulate gas generating assets from climate-related risks?

A. Without any feasible technological decarbonization retrofit, the remaining recourse for the Companies would be pre-mature shutdown of these plants and assumption of stranded asset costs by either ratepayers or shareholders. The analysis provided above, showing a total stranded asset cost of $4.8 billion to the Companies, quantifies just one component of the costs associated with a disorderly transition away from the planned investments in the Base Case with Carbon Policy scenario.

Q. What actions could the Companies take to avoid these negative outcomes for ratepayers?

A. I recommend that the Commission take the following steps to account for climate-related transition risks on an asset basis for proposed new carbon-emitting generation:

- For any proposed or contemplated carbon-emitting generation investment, the Commission should direct the Company to present a lifetime plan for the asset, including how the asset fits into decarbonization strategy, anticipated operational lifetime of the asset, and timing and costs of zero-carbon retrofits

such as carbon capture or hydrogen substitution retrofits, even if cost estimates are high-level. In a credible, just, and reasonable integrated resource plans, all proposed carbon-emitting investments should have rigorous lifetime plans.

2. The Companies' evaluation of plan costs are not adjusted for risk and consistently under-emphasize long-term climate risks in favor of short-term cost.

Q. How do the Companies assess relative direct costs to ratepayers between the selected scenarios in their plans?

A. The Companies provide two principal methods for assessing relative direct costs to ratepayers between their scenarios: They provide a present-value revenue requirement (PVRR) for each scenario through 2050, and they provide an "Average Monthly Residential Bill Impact for a Household Using 1,000 kWh."[197]

Q. Do you believe these metrics provide a helpful and objective view of relative direct costs to ratepayers?

A. No. I find flaws regarding the assumptions made and costs estimated and included in these figures. These are addressed in the previous sections of my testimony. I also find flaws in the methods used to calculate these metrics. Generally, these flaws have the impact of over-emphasizing short-term costs while downplaying costs over the long-term.

Q. Please introduce the methodological flaws you find.

A. I find the following flaws:

[197] DEC IRP Main Document, p. 17.

- Both metrics mis-represent costs incurred by the Companies 2036-2050. The bill impact metric ignores these costs entirely, and the PVRR metric applies unrealistic assumptions to these costs.
- Use of a high discount rate for calculating PVRR over-emphasizes short-term costs and does not adequately represent ratepayers' perspectives.

Q. Please elaborate on the relationship between direct costs to ratepayers and the Companies' transition to net-zero emissions by 2050.

A. The Companies' scenarios each present different carbon emissions trajectories through 2035. Figure 4-6, below, presents one of the Companies' visualizations of each scenario's emissions trajectory.

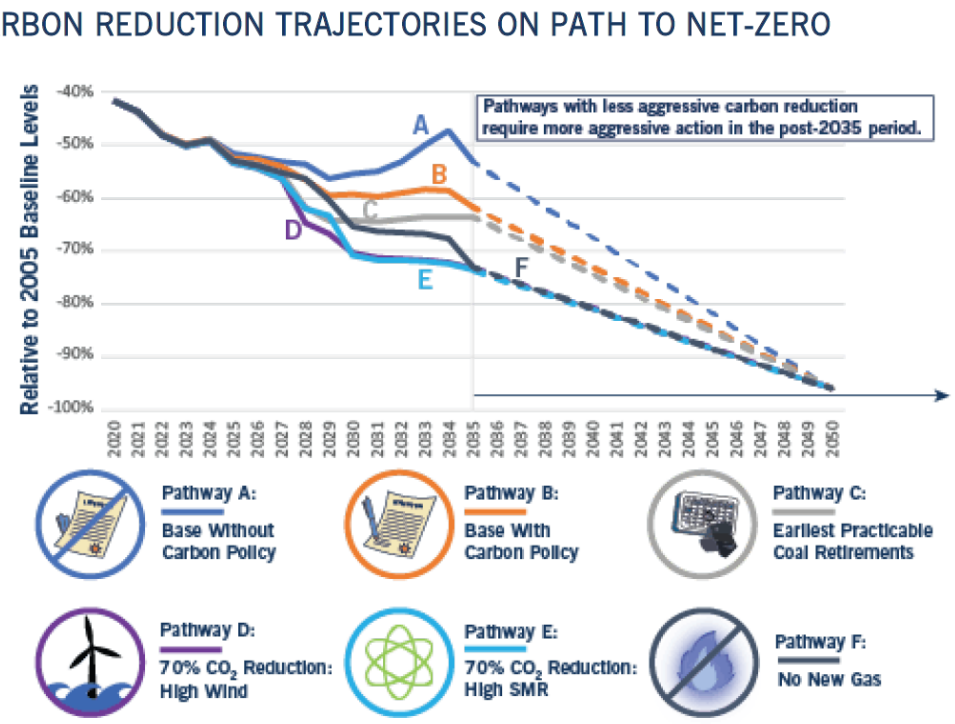

Figure 4-6. *Duke Energy Carbon Reduction Trajectories on Path to Net-Zero*[198]

[198] *Figure from* DEC IRP Main Document, p. 140.

Because the planning period for the IRPs is exactly halfway between 2020 and 2050, there is a mirror-image quality to the carbon reductions trajectories shown in the figure. Scenarios that reduce emissions little within the planning period are expected to reduce at a faster place in the 2036-2050 time frame. Conversely, scenarios that make larger reductions steps 2020-2035 have a less restrictive path 2036-2050.

Differences in 2036-2050 emissions trajectories will likely create differences in costs. The Plans explain that "[the] more aggressive portfolio transitions are more costly but… could position the portfolio well for future carbon policy by accelerating deployment of advanced technologies, requiring less aggressive action after 2035 to reach net-zero."[199] Although the Plans do not extend post-2035,[200] the Companies acknowledge that 2036-2050 zero-carbon investments would be required to address carbon reduction commitments.[201] Generally speaking, analysis on zero-carbon transitions suggest that delayed action will result in greater overall costs and the potential for stranded investments.[202] The carbon trajectories described in the Plans, therefore, run a spectrum between investing in a transition earlier to enable a smoother, lower-cost transition, or delaying action and risking a disorderly, costly transition 2036-2050.

[199] DEC IRP Main Document, p. 140.
[200] DEC-DEP Response to Vote Solar Data Request 2-23(b).
[201] DEC-DEP Response to Vote Solar Data Request 2-21(c).
[202] Network for Greening the Financial System (2020, June). Guide to climate scenario analysts for central banks and supervisors. P. 21. Retrieved at: https://www.ngfs.net/sites/default/files/medias/documents/ngfs_guide_scenario_analysis_final.pdf.

Q. How does the calculation of PVRR across scenarios account for these differences?

A. The Companies calculate a present-value revenue requirement (PVRR) through 2050 for each scenario through a combination of means. The costs through 2040 are calculated through use of PROSYM, a production cost model that incorporates planned generation capacity investments 2020-2035 as well as capital investments associated with coal retirement 2036-2040.[203] From 2040 onward, the Companies simply assume that costs in 2040 will escalate at a flat rate over 2041-2050.[204] Neither PROSYM outputs nor PVRR calculations account for different levels of investment (beyond timing of replacing Belews Creek coal capacity) across scenarios in the 2036-2050 timeframe.

This method has the perverse effect of actually *reversing* the dynamic discussed in the previous question. Portfolios that invest more in a transition to zero-carbon generation over the planning period have any increased carrying costs locked in 2036-2050, and even though the Company acknowledges additional generation investments will be required in less ambitious scenarios, ***lower carrying costs for those less ambitious scenarios are also locked in 2036-2050***. Especially in the case of the less ambitious carbon reduction scenarios, the assumptions embedded in PVRR calculations are not realistic or consistent with meeting a reasonable and prudent transition. The result is that delay is incentivized because necessary future investments are not accounted for, while prudent early investment does not entail any relative cost benefits in the later years.

[203] DEC-DEP Response to Vote Solar Data Request 4-1(b).
[204] DEC-DEP Response to North Carolina Sustainable Energy Association Request 2-44.

Q. How does the bill impact calculation across scenarios account for these differences?

A. There is no consideration of costs 2036-2050. The result is effectively ignoring investment requirements 2036-2050 to meet carbon commitments.

Q. Do you believe that transitioning to net-zero carbon by 2050 will necessarily result in additional long-run direct cost to ratepayers?

A. No, and nation-leading analysis demonstrates that deep reductions in carbon emissions in the electricity sector are feasible, with existing technologies, without additional costs to customers.[205] My concern here is how the Plans treat *timing* of different investments. As currently constituted, cost calculations used to evaluate these Plans disincentivize steady and controlled investment in favor of delay and incurring the risks of a hasty transition.

Q. Please discuss the second flaw you mentioned. What is the role of the discount rate in calculation of present-value costs and benefits?

A. The discount rate used in present-value calculations allows for an equivalent comparison of different costs and benefits across time. For firms, discount rates are helpful for considering whether the returns on a particular investment would be greater or less than their average cost of capital (this discount rate, often called the

[205] *See:* Aggarwal, S. & O'Boyle, M. (2020, June). Rewiring the U.S. for Economic Recovery. Energy Innovation. Retrieved at: https://energyinnovation.org/wp-content/uploads/2020/06/90-Clean-By-2035-Policy-Memo_June-2020.pdf?utm_referrer=https%3A%2F%2Fwww.2035report.com%2F; *and*
Larson, E., Greig, C., Jenkins, J., Mayfield, E., Pascale, A., Zhang, C., Drossman, J., Williams, R., Pacala, S., Socolow., (2020, December). Net-Zero America: Potential Pathways, Infrastructure, and Impacts. Princeton University. https://environmenthalfcentury.princeton.edu/sites/g/files/toruqf331/files/2020-12/Princeton_NZA_Interim_Report_15_Dec_2020_FINAL.pdf; *and*
Williams, J., Jones, R., Haley, B., Kwok, G., Hargreaves, J., Farbes, J., & Torn, M. (2021, January). Carbon-Neutral Pathways for the United States. AGU Advances. https://agupubs.onlinelibrary.wiley.com/doi/full/10.1029/2020AV000284.

"private" discount rate, is usually around 7 percent[206]). For policymakers, discount rates are used to reflect whether a given investment is likely to be socially beneficial, given the average rate of growth of the economy (this is often called the "social" discount rate and is typically around 3 percent,[207] although recent economic discussion has contemplated lower rates[208]).

Because climate-related costs and benefits often extend for decades and are subject to increased uncertainty and "tail" risks, discount rates for climate-related costs and benefits are a common and important topic of discussion.[209] Ranges for appropriate discounting of climate-related costs extend from 5 percent down to even 1 or 0.1 percent.[210] I am not making a judgment about whether such discount rates are appropriate in this proceeding, but these considerations are helpful context when discussing costs and benefits over multi-decadal timeframes.

Q. Functionally, what is the difference between a high and a low discount rate?

A. When subject to a higher discount rate, short-term benefits and costs are given much more weight in decision-making than long-term benefits and costs. Under a high discount rate, investments in the short-term to reduce costs in the long-term are generally avoided. Under a low discount rate, short-term benefits and costs are

[206] White House (2003, September). Circular A-4. Retrieved at: https://obamawhitehouse.archives.gov/omb/circulars_a004_a-4/.
[207] *Ibid.*
[208] Council of Economic Advisers (2017, January). Discounting for Public Policy: Theory and Recent Evidence on the Merits of Updating the Discount Rate. Retrieved at: https://obamawhitehouse.archives.gov/sites/default/files/page/files/201701_cea_discounting_issue_brief.pdf.
[209] New York State Department of Environmental Conservation (2020, December). Establishing a Value of Carbon: Guidelines for Use by State Agencies. P.13. Retrieved at: https://www.dec.ny.gov/docs/administration_pdf/vocfguid.pdf.
[210] New York State Energy Research and Development Authority and Resources for the Future (2020, October). Estimating the Value of Carbon: Two Approaches. Retrieved at: https://www.dec.ny.gov/docs/administration_pdf/vocmemo.pdf.

still weighted heavier than long-term costs, but the calculation is more amenable to investing now for long-term benefit.

Q. What discount rate do the Companies use in calculating their present-value revenue requirement?

A. The Companies use the after-tax weighted average cost of capital (essentially a "private" discount rate) for calculation of present-value revenue requirement.[211]

Q. Do you believe this discount rate is appropriate for the revenue requirement?

A. No. Different stakeholders in the IRP have different rates of time preference, and the Plans should reflect that.[212] The vast majority of ratepayers and, ultimately, the majority of revenue received by the Companies to satisfy the revenue requirement, are residential customers who are paying their bills, not commercial or industrial firms weighing how to best allocate funds.[213] As such, the appropriate rate of time preference would be the "social" discount rate, rather than the "private" one. Figure 4-7, from the National Energy Screening Project's National Standard Practice Manual, provides a helpful guide for thinking through appropriate discounting methods.

[211] DEC-DEP Response to Vote Solar 2-18.
[212] Duncan, J. & Burtraw, D. (2018, December). Does Integrated Resource Planning Effectively Integrate Demand-Side Resources? Resources for the Future. Retrieved at: https://media.rff.org/documents/RFF-Rpt-Burtraw-Duncan-2.pdf.
[213] US Energy Information Administration, (2020, October). Annual Electric Industry Report Form EIA-861, 2019. Retrieved at: https://www.eia.gov/electricity/data/eia861/.

Consideration	If the answer is "yes"
Time Preference Considerations:	
Does the regulatory perspective suggest the same time preference as utility investors?	Choose a discount rate equal to the utility WACC.
Does the regulatory perspective suggest placing a higher value on long-term impacts than utility investors?	Choose a discount rate less than the utility WACC.
Does the regulatory perspective suggest the same time preference as that of all utility customers?	Choose a discount rate that is represents all utility customers on average.
Does the regulatory perspective suggest the same time preference as that of society?	Choose a societal discount rate.
Does the regulatory perspective suggest placing a lower value on long-term impacts than society does?	Choose a discount rate greater than a societal discount rate, or at the high end of the range of societal discount rates.

Figure 4-7. *Considerations for determining a discount rate.*[214]

Q. What is the impact of using the private discount rate instead of the social discount rate?

A. Like the previous flaw I found with the Companies' evaluation of costs, using a private discount rate will unduly prioritize avoiding short-term costs, rather than minimizing costs over the long term. As a result, the Companies' development process will consistently select for Plans that do not have ratepayers, or their time preferences, in mind.

Q. Combined, what is the impact of these two flaws on consideration of costs in the Plans?

A. Combined, these flaws substantially and unduly emphasize short term costs, while either de-emphasizing or even ignoring investments that would be made 2036-2050. In the context of a transition to a net-zero energy system, these distortions are unacceptable for making an informed decision on reasonable and prudent planning.

[214] Woolf, T., Lane, C., Whited, M., Neme, C., Alter, M., Fine, S., Rabago, K., Schiller, S., Strickland, K., & Chew, B. (2020, August). National Standard Practice Manual For Benefit-Cost Analysis of Distributed Energy Resources. National Energy Screening Project. P. G-7. Retrieved at: https://www.nationalenergyscreeningproject.org/wp-content/uploads/2020/08/NSPM-DERs_08-24-2020.pdf.

Q. What are the potential negative outcomes of an inadequate evaluation of climate-related costs?

A. There is little doubt that climate-related risks will accelerate throughout the 21st century, from amplified physical phenomena to increasing social and economic momentum to transition away from carbon emissions. These evaluations systematically underplay these costs, to the potential detriment of ratepayers.

There is also a potential negative feedback loop embedded in the Companies' use of their weighted cost of capital as a discount rate. The Companies acknowledge in discovery that climate-related risks incident on the Companies' portfolio could have an impact on their cost of capital, which would in turn affect the relevant discount rate used in resource planning.[215] But if a high discount rate disincentivizes managing climate-related risks, which in turn increases the cost of capital and attendant discount rate, then the Company would only become *more* likely to avoid short-term costs in favor of long-term ones. This feedback of increased risk leading to increased short-termism would clearly not be in the interest of rate-payers. The relevant discovery question is attached as Exhibit TF-6.

Q. Do you have any other comments on the Companies' evaluation of costs across scenarios?

A. Yes. The testimony of Solar Business Alliance witness Kenneth Sercy in the Dominion Energy South Carolina Integrated Resource Plan proceeding provided a sophisticated discussion of incorporating risk into evaluation of integrated resource

[215] DEC-DEP Response to Vote Solar Data Request 2-7.

plans.[216] This testimony is compelling. The Commission's direction to Dominion Energy to implement cost ranges and minimax analysis are an effective way to integrate risk and uncertainty into cost evaluations, and a stakeholder process is an appropriate place to further refine evaluation of long-term risks, including climate risks.[217] I believe these changes should be incorporated, along with addressing the other flaws I find in this testimony, into the Companies' Plan evaluation.

Q. What actions might the Company take to avoid these outcomes?

A. The Companies have several opportunities to incorporate these risks into plan development and evaluation. I recommend the Commission take the following steps:

- The Commission should direct the Companies to, in all proposed scenarios, assume that generation investments consistent with achieving deep carbon emissions are deployed 2020-2050. Companies should avoid the outcome where an expansion in carbon-emitting assets is anticipated with no attendant investment that manage or displace those emissions deployed through midcentury.
- The Commission should direct the Companies include relevant context on cost timing whenever any bill impact calculation is presented.
- The Commission should direct the Companies to use a social discount rate for cost-optimization in integrated resource planning and sensitivity analysis.

[216] Direct Testimony of Kenneth Sercy on Behalf of the South Carolina Solar Business Alliance. Public Service Commission of South Carolina Docket No. 2019-226-E. Retrieved at: https://dms.psc.sc.gov/Attachments/Matter/c6cfec80-c3eb-46f8-b9fd-26b9a76ee9ca.
[217] PSCSC.

Q. Based on your overall analysis of the companies' assessment and management of climate-related risks, do you believe that the Companies have demonstrated that these plans best manage climate-related risks?

A. No. The Companies did not adequately assess climate-related risks to their assets or their Plans, they did not pursue strategies within the Plans that could mitigate these risks, and their evaluation of the Plans ignores or underplays substantial potential costs to ratepayers. The Companies have not demonstrated that they are prudently or reasonably managing climate-related risks.

D. Integrating Climate-Related Risks Moving Forward

Q. Please describe the role of the Short Term Action Plans included in the Companies' Plans.

A. The short-term action plan is a component of integrated resource plans required by the North Carolina Utilities Commission that "discusses those specific actions currently being taken by the utility to implement the activities chosen as appropriate per the [integrated resource plan main documents]."[218] The short-term action plans show how the Companies are acting to implement the Plans detailed in the document. They provide an opportunity for the Commission to make tractable recommendations that will result in changes in the short term, rather than steering the long-term course of the Plans.

[218] North Carolina Utilities Commission Rules, R8-60. Retrieved at: https://www.ncuc.net/ncrules/ncucrules.pdf.

Q. Please describe summarize the Companies' Short-Term Action Plans (STAPs).

A. The Companies describe several activities, including:

- Implementation of the Companies' EE and DSM plans, including a novel winter demand-side peak shaving program;
- Meeting renewable energy procurement requirements in compliance with state policy;
- Interconnecting more battery storage;
- Implementing Integrated Volt/VAR Control as a part of the Companies' Grid Improvement Program;
- Commissioning on a previously approved combustion turbine in North Carolina;
- Developing integrated systems & operations planning, for implementation in the 2022 IRPs; and
- Implementing competitive procurement of renewable energy (CPRE).[219]

Q. Are the Companies planning any other relevant actions in the short-term?

A. Yes. Duke Energy Progress intends to issue a request for proposals on a 457 MW combustion turbine in Q4 2021, in line with the Base Case with Carbon Policy scenario.[220]

[219] DEC IRP Main Document, Chapter 14.
[220] DEC-DEP Response to NC Public Staff Data Request 3-27.

Q. Which of these actions are relevant to climate-related risks?

A. The development of ISOP could have major implications for the Companies' exposure to climate-related risks. As discussed in Section IV(B)(1), integrating distribution-level dynamics and distributed energy resources (DERs) into system planning could have substantial impacts on the Companies' exposure to and management of climate-related risks. The ability for the Companies to do that is dependent on development of a robust toolkit within the ISOP process that implements the best practices of integrated distribution planning.[221]

Preparation of an RFP for a new 457-MW combustion turbine has clear climate risk implications. Given regulatory timelines, evaluations on these plans will be the last regulatory direction the Companies receive from the Commission before issuing the RFP.

[221] Smart Electric Power Alliance.

V. Conclusions & Recommendations

Q. Based on your review of the Companies' Plans, other matters in the docket, and emerging electric utility trends, what conclusions do you reach in this testimony?

A. I reach the following conclusions:

- **Climate risks will shape the 21st-century economy.** Led by the financial sector, stakeholders across the economy are recognizing that climate-related risks are material today and slated to accelerate through the 21st century. We have a common language for and an increasingly precise understanding of these risks, which are already incident on the US utility sector.
- **Climate risks are utility business risks—and should be treated as such.** Climate-related risks are a material business risk to the Companies today, and prudent business management would dictate that the Companies manage these risks just as they do all other business risks. As a part of its remit to supervise and regulate the Companies, the Commission has the charge and the opportunity to assess and manage climate-related risks to the Companies.
- **Integrated Resource Plans are designed to manage uncertainty and risk.** Since they were introduced in the 1970s and 1980s, integrated resource planning processes have been a powerful tool for managing uncertainty and risk in the utility sector. As the utility industry confronts relevant climate-related risks in the 2020s, managing climate-related risks is in the public

interest. Any reasonable and prudent resource plan will demonstrate how it manages climate risks.

- **Duke Energy's 2020 IRPs ignore climate risks, at ratepayers' expense.** Duke Energy Carolinas' and Duke Energy Progress' Integrated Resource Plans do not adequately assess or manage climate-related risks. They fail to apply any systematic consideration of climate risks, decline to consider resource planning strategies that would mitigate climate-related risks, and downplay or ignore relevant climate-related costs to these Plans each contribute to my assessment.
- **Duke's Base Case exposes ratepayers to stranded asset cost risk.** The Companies' scenarios do not appear to implement its net-zero commitment, which could lead to reputational damage, cost-of-capital implications, and stranded carbon-emitting assets. The proposed 'Base Case with Carbon Policy' scenario would expose the Companies to substantial climate-related risks as it continues to invest in carbon-emitting assets without a feasible path to decarbonization. The costs of retiring carbon-emitting plants alone, without considering rebuilding a zero-carbon fleet, sum to $4.8 billion 2020 dollars, or a present value of $900 per residential Duke Energy customer in the Carolinas.
- **Best practices mitigate climate risk exposure.** Best practices for managing climate-related risks in the utility sector generally and integrated resource planning specifically are emerging, and the Commission and

Company can use them to better inform and manage climate-related risks in future plans.

Q. Based on your review of the Companies' Plans, other matters in the docket, and emerging electric utility trends, what are your recommendations to the Commission?

A. I make the following recommendations:

1. The Commission should find that climate-related risks are a material subset of business risks, and that prudent management of the Companies' businesses will necessarily entail assessment and management of those risks.
2. The Commission should find that managing climate-related risks generally, and reconciling Plans with a transition to a net-zero system specifically, are in the public interest. Both of these matters should be considered and balanced in the Commission's evaluation under South Carolina Code Ann. Section 58-37-40(2)(g), beyond a narrow consideration of future carbon pricing regulations.
3. Given that the Company has not adequately integrated climate-related risks, considered strategies to mitigate those risks, or included climate-related outcomes in its evaluation of the Plans, the Commission should reject the long-term portion of Duke Energy Carolinas and Duke Energy Progress's 2020 Integrated Resources Plans.
4. The Commission should direct the Companies to do the following in its revised and future Plans:
    a. **Systematic Assessment:** Conduct a systematic assessment of climate-related risks to the operating company, including but not limited to

physical risks, financial risks, economic risks, regulatory risks, and reputational risks. The Companies should report these risks through a TCFD-compliant reporting template, such as the Sustainability Accounting Standards Board's Electric Utilities & Power Generators Sustainability Accounting Standard.[222]

b. **Physical Climate-related Risk Assessment:** Conduct a comprehensive climate vulnerability assessment, in line with industry best practices as represented by the 2019 Con Ed Climate Vulnerability Study (attached as Exhibit TF-5).

c. **Carbon Price Sensitivities:** Use the US Energy Information Administration 2020 Annual Energy Outlook's reference carbon prices of $15, $25, and $35 per ton starting in 2021, escalating at 5% per year.

d. **Model Transparency:** Procure an intervenor license for Encompass in future Integrated Resources Plans and provide comprehensive modeling inputs.

e. **Integrate Net-Zero Transition:** Integrate a multi-decadal net-zero transition view explicitly into Plan development and selection. This could be accomplished through a quantitative or qualitative transition plan, committed emissions analysis, extended modeling timeline, explicit modeling constraint on emissions, 'strategic flexibility,' a combination of these practices, or other practices as identified by the Commission.

[222] SASB (2018).

f. **Climate-informed planning for carbon-emitting resources:** For any proposed carbon-emitting resource, provide a lifetime plan that includes projected lifetime, capacity factor, and annual emissions. Adjust carrying cost and operating costs accordingly. If zero-carbon retrofits are contemplated or planned, include projected costs of any retrofit.

g. **Integrate 2036-2050 costs:** Include a factor in cost estimation that accounts for differences in carbon transition investment between scenarios. Contextualize any presentation of costs through 2035 with additional investments and carrying costs anticipated 2036-2050.

h. **Use a social discount rate for cost evaluation to ratepayers:** Use a social discount rate for PVRR evaluations and Plan development.

5. The Commission should direct the Company to do the following in its Short-Term Action Plan:

a. Continue to integrate stakeholder input as an important best practice of integrated resource planning.

b. Continue development of ISOP, ensuring that the capabilities developed are in line with integrated distribution plan best practices[223] and incorporate climate-related risks and benefits. The Companies should develop a 'no-regrets' screen to ensure that investments that could be deferred with ISOP-capable DERs are not made before ISOP is operational. To ensure analytical capabilities are being developed

[223] Smart Electric Power Alliance.

appropriately, the Commission could schedule regular technical ISOP conferences with the Company.

c. Coordinate with the Commission to engage a third party to analyze relative benefits (including climate-related benefits) of regional capacity planning through an EEM, RTO or EIM.

d. Develop a joint capacity action plan that included any anticipated required changes to the Companies joint dispatch agreement, anticipated required regulatory approvals, and projection of a realistic timeline for implementation.

6. Given the emergent nature of these risks and the challenges to the structure of the integrated resources plan itself, it may be appropriate to provide a dedicated venue to discuss and develop recommendations regarding integrating climate-related risks into integrated resources plans. If the Commission deems this step appropriate, I would recommend that the Commission develop a climate risk working group to consider the following issues:

a. Identification, assessment, disclosure, and management of climate-related risks to the Companies;

b. Commissioning a physical climate-related vulnerability study, similar to the 2019 ConEd vulnerability study (attached here as Exhibit TF-5);

c. Incorporating long-term, multi-decadal transition considerations into integrated resources planning and evaluation;

d. Best practices for evaluating long-term costs in integrated resources planning.

Q. Does that conclude your testimony?

A. Yes.