STATE OF NORTH CAROLINA
UTILITIES COMMISSION
RALEIGH

DOCKET NO. E-100, SUB 190

BEFORE THE NORTH CAROLINA UTILITIES COMMISSION

In the Matter of Biennial Consolidated Carbon Plan and Integrated Resource Plans of Duke Energy Carolinas, LLC, and Duke Energy Progress, LLC, Pursuant to N.C.G.S. § 62-110.9 and § 62-110.1(c)	)))))))	**DIRECT TESTIMONY OF GLEN SNIDER, MICHAEL QUINTO, THOMAS BEATTY, AND BEN PASSTY ON BEHALF OF DUKE ENERGY CAROLINAS, LLC AND DUKE ENERGY PROGRESS, LLC**

I. INTRODUCTION AND OVERVIEW

Q. MR. SNIDER, PLEASE STATE YOUR NAME, BUSINESS ADDRESS AND POSITION WITH DUKE ENERGY CORPORATION.

A. My name is Glen A. Snider, and my business address is 525 South Tryon Street, Charlotte, North Carolina 28202. I am currently employed by Duke Energy as Managing Director of Carolinas Integrated Resource Planning and Analytics.

Q. BEFORE INTRODUCING YOURSELF FURTHER, WOULD YOU PLEASE INTRODUCE THE PANEL.

A. Yes. I am appearing on behalf of Duke Energy Carolinas, LLC ("DEC") and Duke Energy Progress, LLC ("DEP" and together with DEC, "Duke Energy" or the "Companies") together with Michael Quinto, Thomas Beatty, and Ben Passty on the "IRP and Near-Term Actions Panel." Witnesses Quinto, Beatty, and Passty will introduce themselves.

Q. PLEASE DESCRIBE YOUR BUSINESS BACKGROUND AND EXPERIENCE.

A. With respect to professional experience, I have been in the utility industry for over thirty years. I started my career in 1989 as an associate analyst with the Illinois Department of Energy and Natural Resources, responsible for assisting in the review of Illinois utilities' integrated resource plans. In 1992, I accepted a planning analyst job with Florida Power Corporation and for more than twenty years have held various management positions within the utility industry. These

positions have included managing the Risk Analytics group for Progress Ventures and the Wholesale Transaction Structuring group for Arc Light Energy Marketing. Immediately prior to the merger of Duke Energy and Progress Energy, I was Manager of Resource Planning for Progress Energy Carolinas. I am currently the Managing Director of Integrated Resource Planning and Analytics for the Carolinas and have had the privilege to lead this team for the past ten years.

Q. WHAT ARE YOUR RESPONSIBILITIES IN YOUR CURRENT POSITION?

A. I am responsible for the supervision of the Integrated Resource Plans ("IRPs") for both DEC and DEP and am primarily responsible for development of the current 2023-2024 Carbon Plan and Integrated Resource Plan ("CPIRP" or "the Plan") filed with the Commission on August 17, 2023. In addition to the production of the IRPs, I am responsible for overseeing the analytic functions related to resource planning for the Carolinas region. Examples of such analytic functions include unit retirement analyses, the analytical support for applications for certificates of public convenience and necessity for new generating facilities, and analyses required to support the Companies' avoided cost calculations that are used in the biennial avoided cost rate proceedings.

Q. HAVE YOU PREVIOUSLY TESTIFIED BEFORE THE COMMISSION?

A. Yes. I have testified before the Commission on a number of occasions, including most recently in the 2022 Carbon Plan proceeding in Docket No. E-100, Sub 179 ("2022 Carbon Plan Proceeding").

Q. MR. QUINTO, PLEASE STATE YOUR NAME, BUSINESS ADDRESS AND POSITION WITH DUKE ENERGY CORPORATION.

A. My name is Michael Quinto, and my business address is 525 South Tryon Street, Charlotte, North Carolina 28202. I am the Director of IRP Advanced Analytics for Duke Energy.

Q. PLEASE BRIEFLY SUMMARIZE YOUR EDUCATIONAL BACKGROUND AND PROFESSIONAL QUALIFICATIONS.

A. I received a Bachelor of Science in Mechanical Engineering from the University of Cincinnati in 2014. I am a registered Professional Engineer in North Carolina.

Q. PLEASE DESCRIBE YOUR BUSINESS BACKGROUND AND EXPERIENCE.

A. I started my career with Duke Energy in 2011 in the cooperative education program while pursuing my engineering degree. I have been a full-time employee at Duke Energy since 2014 and have held a variety of engineering and leadership roles in IRP; Generation Resource Planning, Modeling, and

Analytics; and Regulated Generation Business Performance. I assumed my current position as Director of IRP Advanced Analytics in March 2023.

Q. WHAT ARE YOUR RESPONSIBILITIES IN YOUR CURRENT POSITION?

A. In my current position, I provide leadership and direction into the IRP modeling and planning process and financial analytics to support the Carolinas IRP functions. The team I lead supports the development and presentation of these analytics for DEC and DEP IRP filings, including the current 2023-2024 CPIRP. My team also develops business practices and analytic methods within the IRP process to inform how the Companies resource planning maintains reliability and prioritizes affordability in planning the Companies' power systems as DEC and DEP modernize and transition their generation fleets.

Q. HAVE YOU PREVIOUSLY TESTIFIED BEFORE THE COMMISSION?

A. Yes. I testified before the Commission in the Companies' 2022 Carbon Plan Proceeding. I also submitted pre-filed testimony in Docket No. E-7, Sub 1134 in support of DEC's application for approval to take control of the Lincoln County natural gas fired combustion turbine. Finally, I presented to the Commission as part of a technical panel on coal retirements in the Companies' 2020 IRP proceeding in Docket No. E-100, Sub 165.

Q. MR. BEATTY PLEASE STATE YOUR NAME, BUSINESS ADDRESS AND POSITION WITH DUKE ENERGY CORPORATION.

A. My name is Thomas Beatty, and my business address is 525 South Tryon Street, Charlotte, North Carolina 28202. I am a Senior Engineer on the Production Cost Modeling and Data Management team within Duke Energy's Enterprise Strategy and Planning Department.

Q. PLEASE BRIEFLY SUMMARIZE YOUR EDUCATIONAL BACKGROUND AND PROFESSIONAL QUALIFICATIONS.

A. I received a Bachelor of Science in Mechanical Engineering from North Carolina State University in 2015.

Q. PLEASE DESCRIBE YOUR BUSINESS BACKGROUND AND EXPERIENCE.

A. I began my career with Duke Energy in 2014 as an intern in the IRP group while pursing my engineering degree. I have been a full-time employee at Duke Energy since 2015, when I assumed my role as an engineer on the Production Cost Modeling and Data Management team.

Q. WHAT ARE YOUR RESPONSIBILITIES IN YOUR CURRENT POSITION?

A. In my current position, my primary responsibility is to perform modeling and analytics to support integrated resource planning for each of Duke Energy's regulated utilities, primarily focusing on the Carolinas (DEC and DEP). My team is responsible for the modeling performed by the Companies in support of the CPIRP.

Q. HAVE YOU PREVIOUSLY TESTIFIED BEFORE THE COMMISSION?

A. No.

Q. TURNING NOW TO YOU, MR. PASSTY, PLEASE STATE YOUR NAME, BUSINESS ADDRESS AND POSITION WITH DUKE ENERGY.

A. My name is Benjamin W. B. Passty. My business address is 525 South Tryon Street, Charlotte, North Carolina 28202. I am a Principal Load Forecasting Analyst for DEC and DEP.

Q. PLEASE BRIEFLY SUMMARIZE YOUR EDUCATIONAL BACKGROUND AND PROFESSIONAL QUALIFICATIONS.

A. I received a Bachelor of Arts degree in Economics and a Bachelor of Science Degree in Mathematics from Trinity University in 2002, a Master of Arts degree in Economics from Northwestern University in 2003, and a Doctor of Philosophy in Economics from Northwestern University in 2008.

Q. PLEASE DESCRIBE YOUR BUSINESS BACKGROUND AND EXPERIENCE.

A. I joined Duke Energy in July 2013 as a Lead Forecaster in the Load Forecasting Department. My current title is Principal Load Forecasting Analyst.

Q. WHAT ARE YOUR RESPONSIBILITIES IN YOUR CURRENT POSITION?

A. My primary responsibilities include developing the Companies' long-term electric load forecasts for the DEP and DEC service areas within North Carolina

and South Carolina. These forecasts and analyses are provided to departments throughout Duke Energy and are used for budgeting, generation planning, and regulatory filings, such as long-term forecast reports, integrated resource plans, and rate cases. In addition to my primary duties, I regularly support special projects, requiring statistical analysis and forecasting, including assessment of current and future economic conditions.

Q. HAVE YOU PREVIOUSLY TESTIFIED BEFORE THE COMMISSION?

A. No. However, I have previously testified before the Kentucky Public Service Commission ("Kentucky PSC") and submitted pre-filed testimony supporting Duke Energy Kentucky's and Duke Energy Ohio's load forecast to the Kentucky PSC as well as the Public Utilities Commission of Ohio, respectively.

Q. IS THE PANEL SPONSORING ANY EXHIBITS?

A. Yes. The Panel is sponsoring IRP and Near-Term Actions Panel Exhibit 1, which provides graphics and figures presented in our testimony in a larger, more readable format.

Q. MR. SNIDER, ON BEHALF OF THE PANEL, WHAT IS THE PURPOSE OF YOUR JOINT TESTIMONY.

A. This Panel's testimony sponsors IRP modeling and analytics used to develop the CPIRP as well the near-term actions resulting from the CPIRP modeling and analysis that the Companies support as the most reasonable, least-cost and least-risk path for executing the continued energy transition in the Carolinas. The

CPIRP builds on the Companies' analysis and planning performed to develop the initial proposed Carbon Plan filed in May 2022 in Docket No. E-100, Sub 179. In the intervening approximately 18 months since the initial proposed Carbon Plan was developed, the energy landscape has changed significantly, impacting the planning, analysis, and execution plans needed to ensure the CPIRP maintains or improves upon reliability of the system while achieving the State's emissions reduction targets established in N.C. Gen. Stat. § 62-110.9 and Session Law 2021-165 ("HB 951").

As further detailed in the Plan itself, the Panel's testimony highlights key issues and evolving planning inputs within the changing energy landscape as well as their impacts on the Companies' resource plan and describes how the Companies have met IRP and planning-related directives set out in the Commission's December 30, 2022 *Order Adopting Initial Carbon Plan and Providing Direction for Future Planning* issued in Docket No. E-100, Sub 179 ("Carbon Plan Order"). This Panel's testimony also supports the Companies' Execution Plan as the reasonable steps and near-term actions to be approved by the Commission to continue to progress execution of the Commission's initial Carbon Plan through 2026. The Companies have integrated updated input assumptions using new studies, market information, and forecasts, while also refining the modeling framework and approach to evaluate a wide range of planning possibilities and more accurately reflect their potential impact on the

resources needed. Additionally, the Companies have updated portfolio performance and risk analysis with financial, reliability, and risk considerations, and outlined the most reasonable execution steps over the near term to maintain reliability and achieve the emissions reduction targets of N.C.G.S. § 62-110.9(1) in a least cost manner. All of these factors are discussed generally in this Panel's testimony and in much greater detail throughout the sections of the CPIRP sponsored by the Panel.

Q. PLEASE EXPLAIN HOW THE REMAINDER OF THIS PANEL'S TESTIMONY IS ORGANIZED.

A. Section II of the Panel's testimony identifies the portions of the Plan this Panel sponsors and the associated Requests for Relief presented to the Commission for approval in support of the Plan.

Section III of the Panel's testimony supports the reasonableness of the Companies' modeling approach, including modeling framework, assumptions, and analytical steps, as presented in the Plan. Section III also explains how the Plan meets IRP-related directives from the Commission's Carbon Plan Order.

Section IV of the Panel's testimony provides an overview of the results of modeling analysis conducted in the CPIRP, including an overview of the CPIRP resource portfolios and a comparative evaluation of the Core Portfolios under each Energy Transition Pathway.

Section V of the Panel's testimony supports the Companies' reliance on

Energy Transition Pathway 3 ("Pathway 3") and recommended Core Portfolio P3 Base as the most reasonable, least cost, and least risk Pathway to reliably transition the system and prudently plan for the needs of customers. The Panel also supports how CPIRP Plan modeling was used as the basis for the development of the near-term action plan ("NTAP") proposed for execution in the Plan.

II. SPONSORSHIP OF THE PLAN

Q. MR. SNIDER, PLEASE IDENTIFY WHICH SECTIONS OF THE PLAN THE PANEL IS SPONSORING WITH ITS DIRECT TESTIMONY.

A. The Carolinas IRP team was integral to developing the proposed CPIRP and has primary responsibility for modeling inputs and assumptions, the modeling methodology and process, portfolio development and analysis, as well as using the outputs of the CPIRP modeling to inform the Companies' planned Execution Plan and proposed near-term actions presented in the Plan. The Panel is generally responsible for the development of the CPIRP, including the Executive Summary, Chapter NC, and Chapter SC, and specifically sponsors the following sections of the Plan, as presented to the Commission:

- Chapter 2, Methodology and Key Assumptions. This chapter describes the resource planning objectives, modeling approach and analytical framework, portfolio development, and detailed analysis performed in developing the CPIRP.

- Chapter 3, Portfolios. This chapter presents the Plan's portfolio development and performance analysis results supporting the Companies' recommended portfolio, P3 Base, along with other Pathway 3 portfolios, as the appropriate basis for the Companies Execution plan, balancing pace of transition and resource additions over time to achieve the emissions reduction targets discussed throughout the Plan.
- Chapter 4, Execution Plan, Table 4-2. This table presents the supply-side near-term action plan as the next reasonable steps in achieving the authorized emissions reduction targets while maintaining or improving reliability of the system.
- Appendix B, DEC and DEP System Information. This appendix presents required statistics and information on the Companies' current operating fleets in support of the Plan.
- Appendix C, Quantitative Analysis. This appendix describes the Plan's analytical process including the development and presentation of modeling set-up, key assumptions, portfolio development, and portfolio performance analysis, supporting the Companies recommended portfolio, P3 Base.
- Appendix D, Electric Load Forecast. This appendix describes the development of the load forecast and presents a forecast for the number of customers served, as well as seasonal peak load and total energy

needs for the systems. Included in this appendix are discussions of components of the load forecast and their impact on total system total system load.

- Appendix E, Screening of Generation Alternatives. This appendix discusses the screening of potential supply-side resource options including the current state of development of the technologies, applicability to the Companies' service territories, and appropriate inclusion of selectable resources in the Plan.
- Appendix F, Coal Retirement Analysis, pages 6-17. This Panel is sponsoring the Coal Retirement Analysis as part of the CPIRP's overall Analytical Framework through the Moving from Planning to Execution Section of the Appendix. The discussion and analysis include the impacts of the changing energy landscape on the updated coal retirement analysis and the planned retirement dates under each Energy Transition Pathway.

Q. PLEASE IDENTIFY THE REQUESTS FOR RELIEF PRESENTED IN THE COMPANIES' CPIRP PETITION AND BOWMAN EXHIBIT 1 THAT THE PANEL IS SUPPORTING THROUGH ITS TESTIMONY.

A. The Panel primarily supports CPIRP Request for Relief No. 1, requesting the Commission find that the Companies' 2023-2024 CPIRP modeling is reasonable for planning purposes and presents a reasonable plan for achieving

the State's authorized carbon dioxide ("CO_2") emissions reductions targets in a manner consistent with the requirements of N.C.G.S. § 62-110.9 and prudent utility planning. The Panel also supports the modeling and IRP inputs to all other Requests for Relief presented in the CPIRP for review and approval by the Commission.

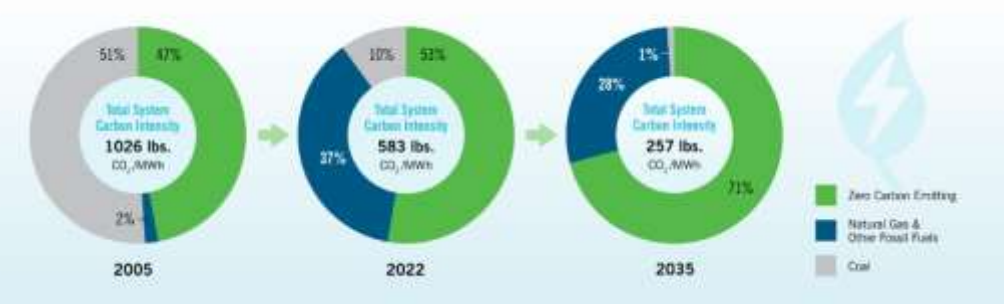
III. REASONABLENESS OF MODELING APPROACH, METHODOLOGY, AND KEY ASSUMPTIONS

A. Primary Changing Energy Landscape Drivers

Q. PLEASE DISCUSS THE RECENT CHANGING ENERGY LANDSCAPE AND HOW IT IS IMPACTING DEVELOPMENT OF THE PLAN.

A. The Companies have been in the process of transitioning the system for over a decade. As highlighted by Figure 1 below, the Companies have made substantial progress on transitioning the fleet since 2005. In this time the Companies have decreased generation from coal and increased carbon neutral generation resulting in a reduction in total system carbon intensity by more than 40%.

Figure 1: Combined DEC and DEP Energy Transition in Progress[1]



As the Companies continue to adapt to a changing energy landscape and plan to achieve the carbon emission reduction targets established by N.C.G.S. § 62-110.9, significant changes over the last 18 months are now shaping how the Companies plan the energy system going forward. The Commission recognized the changing energy landscape in the Carbon Plan Order, directing the Companies to continue to evaluate key inputs and assumptions in developing the CPIRP.[2] These directives included consideration realistic options for natural gas firm transportation services, the possibility of continued pressure on coal generation regulation and to evaluate the conversion of Belews Creek to a 100% natural gas fired unit, planning for robust utility-sponsored energy efficiency ("UEE") offerings and customer adoption to shrink the challenge of meeting Carbon Plan goals, and incorporating the impacts of the Inflation Reduction Act of 2022 ("IRA"), Infrastructure Investment and Jobs Act of 2021 ("IIJA"), and

[1] CPIRP Chapter 1 at 23 (Figure 1-1). Figure 1 is also replicated in IRP and Modeling Panel Exhibit 1.

[2] Carbon Plan Order at 47-48.

other future legislative changes, as well as other changing conditions, such as inflationary impacts to resource costs. In addition to each of these factors, which are discussed more in this testimony, the Companies have continued to integrate other planning assumptions that have a material impact on the Plan, including an increased load forecast and its impact on UEE savings goals, a new resource adequacy study with an increased target planning reserve margin, and proposed regulations for existing coal and new and existing natural gas resources. Each of these topics are detailed later in this Panel's testimony.

Q. MR. PASSTY, PLEASE BRIEFLY DESCRIBE THE CPIRP LOAD FORECAST AND HOW IT IS A KEY DRIVER IN THE DEVELOPMENT OF THE PLAN.

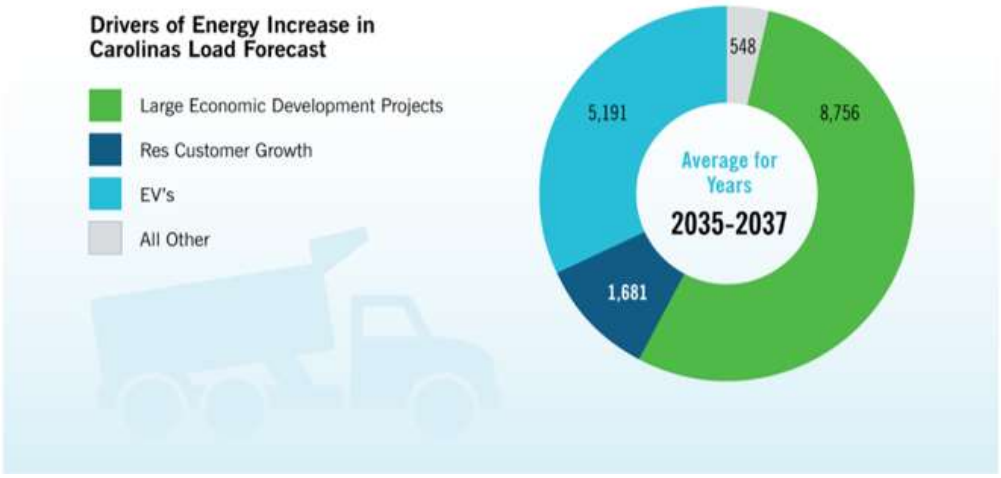
A. Appendix D, along with Chapter 2 and Appendix C, present detail related to the Companies' Electric Load Forecast, including forecasts for the number of retail customers, system energy, and demand at time of peak for customers in the DEC and DEP service territories.[3] Details concerning the procedures and methods underlying the final results are also provided in Appendix D to give insight into additional load growth scenarios.

As further described in the Plan, the Companies are projecting notably higher energy and peak demand needs relative to prior load forecasts with the growth in that demand accentuated in later years, particularly during 2031-

[3] CPIRP Appendix D; CPIRP Appendix C at 12-18; CPIRP Chapter 2 at 19-26.

2038. The Companies' analysis shows that much of this increase is driven by three factors: (1) economic development growth associated with several new large customer sites; (2) increasing growth in the number of residential customers; and (3) a surge in demand related to the energy that will power electric vehicles. Figure 2 displays the relative impacts these drivers have on the load forecast.

Figure 2: Composition of Level Changes in Peak Forecast (GWh)[4]



The strong impact of large sites on the forecast is based on information provided by the Companies' Large Account Management team who are seeing and projecting significantly more large projects in advanced stages of the development process than in previous forecast refresh cycles. While the overall load forecast process generally accounts for economic growth factors, the size

[4] CPIRP Appendix D at 23 (Figure D-9).

and development status of these known projects represents a marked increase over the base economic trajectory and supports the large site adjustment to the forecast. The strong economic development load growth is further discussed in Appendix D and included in developing the Plan.[5]

The second driver of the higher load forecast is the increase in residential customers. These have grown more than expected over the last several years.[6] This outperformance began before the disruptions due to COVID-19 and accelerated during 2020. The currently projected growth rate for residential customers reflects recent outperformance as well as continuing population growth in the region, an underlying economic factor to the load forecast.

The final key driver of the increased load forecast is the Companies' EV forecast. The current EV growth forecast has increased in comparison to historical EV projections, resulting in additional loading and energy requirements. For example, at the time the Companies developed their initial proposed Carbon Plan, EVs were projected to make up approximately 25% of new vehicle sales in 2030. That percentage has now increased to approximately 45% of new vehicle sales in 2030. This increase is due to multiple tailwinds such as higher than expected vehicle registrations in the near term, vehicle

[5] CPIRP Appendix D at 14-15 (including Table D-11).

[6] CPIRP Appendix D at 10-12.

manufacturer announcement updates and pledges for increased production of EVs, internal combustion engine vehicle ("ICEV") bans in certain states such as California, Washington, New York, Maryland which is resulting in forecasted increased vehicle model availability and purchases in North Carolina and South Carolina, and significant legislative initiatives such as the IRA. The Vehicle Analytics and Simulation Tool ("VAST") that is used for the EV forecast has included these variables, along with numerous others, to continually refine the forecast which is resulting in the increased load requirements.[7]

Q. HOW DOES THE COMPANIES' COMMITMENT TO PURSUE COST-EFFECTIVE UEE SAVINGS OFFSET THE INCREASED LOAD FORECAST DRIVERS EXPLAINED ABOVE WITH RESPECT TO THE COMISSION'S CARBON PLAN ORDER?

A. The Companies' base load forecast for the CPIRP utilizes an aggressive yet reasonable UEE load modifying forecast based on an updated annual minimum of 1% of eligible load (i.e., total retail sales less "opted out" customer load) that reduces the amount of load the Companies must serve. Because the UEE savings goals are a function of the load forecast, increases to the load forecast result in an increase to the amount of UEE savings necessary to meet the same 1% annual savings goal, as well represent an overall increased UEE forecast savings, using the same annual 1% of eligible load basis for the forecast

[7] CPIRP Appendix D at 17-19.

minimum. Furthermore, the impacts of the Commission's directed aspirational goal of 1.5% of eligible sales UEE forecast was evaluated as the high UEE forecast in the Plan.[8] Support for the development of the Companies' updated UEE forecasts and planning assumptions are presented by the Grid Edge and Customer Programs Witness Panel Testimony and in Appendix C and Appendix H (Grid Edge and Customer Programs).[9]

Q. PLEASE DESCRIBE HOW THE 2023 RESOURCE ADEQUACY STUDY IMPACTS THE NEED FOR NEW RESOURCES COMPARED TO THE INITIAL PROPOSED CARBON PLAN.

A. As previously mentioned, the Companies retained Astrapé Consulting to conduct a new resource adequacy study to support development of the biennial CPIRP Update. The study resulted in a 5% increase in the planning reserve margin from 17% to 22% compared to the initial proposed Carbon Plan. As further addressed in the 2023 Resource Adequacy Study, filed as Attachment I to the CPIRP and sponsored by the direct testimony of Witnesses Wintermantel and Benson, the increase in reserve margin was driven by a reduction in neighbor assistance, long-term economic load forecast uncertainty, and generator performance. Additional information can be found in Appendix C.[10]

[8] Carbon Plan Order at 133-34 (Ordering Paragraph 28); CPIRP Appendix C at 62-63.

[9] CPRIP Appendix H at 5-17.

[10] CPIRP Appendix C at 10-11.

B. CPIRP Pathway and Portfolio Development

Q. HOW DID THE COMPANIES DEVELOP THE PORTFOLIOS PRESENTED IN THE PLAN AND WHERE CAN THE COMMISSION FIND MORE INFORMATION ON THE DEVELOPMENT OF THE PORTFOLIOS IN THE CPIRP?

A. As explained in Chapter 2, the Companies constructed the CPIRP analysis using three Energy Transition Pathways to explore the critical planning consideration of the pace at which the energy transition should continue. Each Pathway contemplates a different pace for achieving a 70% reduction in CO_2 emissions relative to a 2005 baseline (the "Interim Target") in different years—from 2030 (Pathway 1) to 2033 (Pathway 2) to 2035 (Pathway 3)—with all reaching carbon neutrality by 2050.[11] The Companies developed a Core Portfolio under each Pathway using base case planning assumptions for all inputs, with the exception of the resource availability assumptions used to develop Pathway 1. Because it is not possible to achieve the Interim Target by 2030 using the Companies' already aggressive base case assumptions for new resource availability, P1 Base, the Core Portfolio corresponding to Pathway 1, shows new resources added to the Companies' electric system at a rate that exceeds the Companies' expectations for what will be feasible to connect without jeopardizing system reliability.

[11] CPIRP Chapter 2 at 7-9.

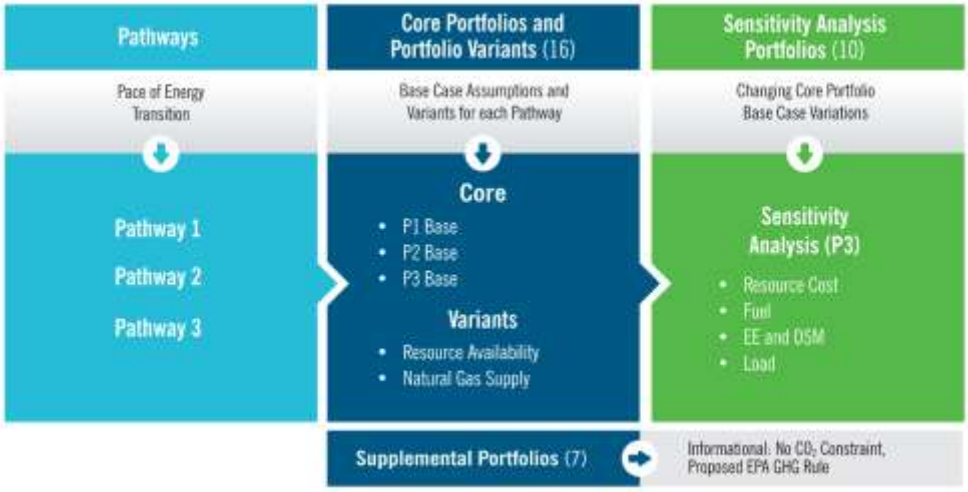
In addition to the Core Portfolio for each Pathway, the Companies developed 13 Portfolio Variants derived from the Core Portfolios to explore different assumptions for resource availability and gas supply, and 10 Sensitivity Analysis Portfolios derived from P3 Base to explore the impacts on portfolio composition and costs from changes to other input assumptions. Finally, the Companies developed several Supplemental Portfolios to explore potential impacts of the Environmental Protection Agency's ("EPA") Clean Air Act ("CAA") Section 111 Proposed Rule and to address planning scenarios identified for evaluation in the South Carolina 2020 IRP order.[12] These Supplemental Portfolios are included for informational purposes only.

Figure 3 shows the analytical framework of Energy Transition Pathways and the 33 portfolios developed as part of the Plan. Additional detail regarding development of the CPIRP portfolios is provided in Appendix C and a full list of the portfolios the Companies developed is presented in Chapter 2. [13]

[12] CPIRP Chapter 2 at 9.

[13] CPIRP Chapter 2 at 13-14 (Table 2-1).

Figure 3: Energy Transition Pathways and Portfolios[14]



C. CPIRP Analytical Process and Modeling Framework

Q. PLEASE SUMMARIZE THE COMPANIES' CPIRP MODELING FRAMEWORK AND DESCRIBE WHERE THE COMMISSION CAN FIND MORE INFORMATION ON ANALYTICAL PROCESS IN THE PLAN?

A. In Chapter 2 (Methodology and Key Assumptions) and Appendix C, the Companies describe the robust analytical process used to develop the Plan.[15] Figure 4 provides an overview of this process from the development of assumptions and modeling set up, to development and verification of the portfolios, to analysis of portfolio performance.

[14] CPIRP Chapter 2 at 8 (Figure 2-2). Figure 3 is also replicated in IRP and Modeling Panel Exhibit 1.

[15] CPIRP Chapter 2 at 14; CPIRP Appendix C at 2-3.

Figure 4: Carolinas Resource Plan Analytical Process Flow Chart[16]

As more fully detailed in Appendix N, the Companies also developed the CPIRP analytical process and modeling framework to meet the requirements of proposed Rule R8-60A.

Q. HOW HAS THE CHANGING ENERGY LANDSCAPE DESCRIBED ABOVE AND IN CHAPTER 1 OF THE CPIRP IMPACTED THE DEVELOPMENT OF CPIRP ASSUMPTIONS AND ANALYTICAL PROCESS USED IN PLANNING AND MODELING THE SYSTEM?

A. The Companies developed assumptions for the Plan based upon an updated "snapshot in time" that takes into account several significant changes since the initial proposed Carbon Plan reflecting the dynamic, changing energy landscape discussed in Chapter 1 and throughout the CPIRP.

[16] CPIRP Chapter 2 at 15 (Figure 2-3) and CPIRP Appendix C at 3 (Figure C-1). Figure 4 is also replicated in IRP and Modeling Panel Exhibit 1.

Impacts of IRA, the IIJA, and other changing conditions: Consistent with the Commission's Carbon Plan Order, the Companies have considered the impacts of the IRA, IIJA and other changing conditions into this biennial CPIRP update as discussed in Chapter 2.[17]

Load Forecast: As discussed previously, the Companies' projection of a significant increase in the load forecast, which is foundational to the development of portfolios and identifying the resources needed to maintain or improve system reliability, while meeting the emissions reduction targets, is a major driver of resource selection.

Resource Adequacy Study: Ensuring resource adequacy to maintain or improve reliability is also a key driver of the Plan. The Companies retained Astrapé Consulting to conduct the 2023 Resource Adequacy Study, which recommended an increased planning reserve margin relative to the initial proposed Carbon Plan.

Changing Macroeconomic Conditions Impacting Resource Cost and Availability: Since development of the initial proposed Carbon Plan, the industry has seen inflationary impacts to the cost of new resources and the availability of these resources. This is especially true for the onshore wind siting study and Wind Energy Areas ("WEA") evaluations conducted in response to

[17] Carbon Plan Order at 131 (Ordering Paragraph No. 4).

the Commission's Carbon Plan Order,[18] which are reflected in the updated assumptions used in the development of the Plan.

Natural Gas Fuel Supply and Transportation Service: As directed by the Carbon Plan Order,[19] the Companies have continued to work with the Public Staff to develop realistic assumptions regarding the availability of firm natural gas transportation, including transportation and deliverability sensitivities from both the Gulf and Appalachia regions.

Q. WHAT RESOURCE PLANNING MODELING CHANGES DID THE COMPANIES EVALUATE AND INTEGRATE INTO THE PLAN?

A. The Companies' modeling framework overall is very similar to the process utilized in the initial proposed Carbon Plan, which the Commission found reasonable for planning purposes. The Companies effectively "snapped the chalk line" in early summer after stakeholder engagement was completed to finalize development of the Plan. Foundational to the Carbon Plan framework, the Companies and the Commission will have the ability to continue to check and adjust every two years. The Companies implemented several modeling changes as directed by the Commission in this initial CPIRP update to the Carbon Plan.

[18] CPIRP Appendix I at 25-28.

[19] Carbon Plan Order at 132 (Ordering Paragraph No. 15).

Capacity Expansion Optimization: As directed by the Commission[20] and further discussed below, the Companies tested using longer optimization periods[21] in the EnCompass model. The assessment resulted in significant model run time increases, which if exclusively utilized, would be unworkable for conducting the significant number of modeling runs necessary to develop the Plan. As such, after the benchmarking and assessing the impact on extend model run times due to the longer optimization periods and considering which resources the model would optimize at the same time, the Companies completed the CPIRP modeling utilizing seven-year optimization periods. For purposes of modeling the 2023 CPIRP, this intentionally positioned the optimization period to (1) assess all resources needed for achieving the Interim Target by 2030; (2) included the evaluation of major investments such as offshore wind, advanced nuclear, and new hydrogen-capable CCs in the 2030s simultaneously within the same optimization period, and (3) allowed all but one year in the 15-year "Base Planning Period" to be used in the optimization of resources within two segments. Each of the Portfolios presented in the Plan were developed with this optimization period set up.

[20] Carbon Plan Order at 131 (Ordering Paragraph No. 5).

[21] The model's optimization period is a specified time horizon over which the resources costs and benefits are assessed through system simulations to determine resource selection. For optimization periods that are shorter than the planning horizon, each optimization period is a "segment" of a complete run over planning horizon.

Modeling Solar paired with Storage: The Companies integrated the Commission directed[22] modeling of dynamic dispatch of batteries and solar paired with storage resources, to optimize the utilization of the batteries in a changing energy system over time. Additionally, with the Companies' use of the updated EnCompass Version to 7.0.5, the Companies were able to leverage the model's capability to integrate bi-directional inverter capability, or "grid-charging" of the battery sharing an interconnection with solar sites.

Reduce Manual Adjustments of Storage Resources: The Companies reviewed and, where appropriate, reduced "manual adjustments" in the CPIRP modeling framework as directed by the Carbon Plan Order.[23] While the Companies continue to value utilizing the tools, modeling software, and analysis capable of ensuring cost effective resource selection for the benefit of customers, the Companies have not included the CT-Battery Optimization step in the development of this Plan. The proposed selected resources identified in the Plan are supported by robust analysis using a refined "typical day" structure in the capacity expansion model as described in Appendix C.

Additional discussion of each of these key modeling methodologies and assumptions is presented in Appendix C.

[22] Carbon Plan Order at 131 (Ordering Paragraph No. 6).

[23] Carbon Plan Order at 131 (Ordering Paragraph No. 7).

Q. HOW DID THE COMPANIES ASSESS THE FEASIBILITY OF UTILIZING LONGER OPTIMIZATION PERIODS WITHIN ENCOMPASS TO DEVELOP THE PLAN?

A. The Companies conducted 16-year optimization period capacity expansion runs on the base portfolios in each Pathway to assess the impacts of extended optimization periods on model run times. Table 1 presents a comparison of capacity expansion model run time results for the base portfolios as compared to the 16-year optimization period runs.

Table 1: Capacity Expansion Model Run Time base on Optimization Period Length

Capacity Expansion Model Run Time		
	7-YR	16-YR
P1	7.1	43.7
P2	9.0	228.4
P3	14.9	60.1

As demonstrated with the tests of longer optimization periods, run times increased by 400% to 2500%. With the development of 33 total portfolios, the model run time to complete all runs using a 16-year optimization period could have increased by 700%, making modeling the plan practically infeasible. In general, with increased modeling capabilities and possible complexities to capture, the Companies must carefully weigh additional model complexity with the incremental analytical benefit gained given the extended run times.

More information on the additional modeling advancements integrated into the CPIRP are discussed in Appendix C to the Plan.[24]

Q. DID THE COMPANIES RECONSIDER THE OPERATIONAL LIFE AND ACCOUNT FOR THE POTENTIAL CONTINUED OPERATION OF NATURAL GAS-FIRED GENERATION AFTER 2050?

A. Yes. The Carbon Plan Order found the Companies' use of 35-year operational lives of new gas assets was reasonable for planning purposes[25] but directed the Companies to continue to justify using the operational lives of new CCs and CTs if operating after 2050.[26] The Plan continues to use a 35-year operational life for new CCs and CTs based on the continued development of hydrogen production, transportation, storage, and utilization as well as the long-term potential for CO_2 offsets or carbon sequestration and beneficial reuse. The Commission found the Companies' plan for hydrogen fuel to replace natural gas and for the use of CO_2 offsets to be appropriate.[27] Since the initial proposed Carbon Plan, the momentum for the development of hydrogen as an energy source for power generation and the economy, as a whole, has continued to increase. The Companies continue to assume all new CCs and CTs are converted to operate on 100% hydrogen in 2050. This cost is considered by the

[24] CPIRP Appendix C at 6.

[25] Carbon Plan Order at 38 (Finding of Fact No. 25).

[26] Carbon Plan Order at 132 (Ordering Paragraph No. 17).

[27] Carbon Plan Order at 38 (Finding of Fact No. 24).

model in the selection of the resource. Additionally, instead of assuming the system reaches zero CO_2 emissions in 2050, the portfolios were developed consistent with at least 95% CO_2 emissions reduction by 2050, consistent with the allowable 5% offsets to reach carbon neutrality. The Companies modeled an economic dispatch penalty for CO_2 in 2050 emissions as a proxy for a CO_2 offset price to reduce the amount generation from remaining natural gas units beginning in 2050. Based on these considerations, the Companies use of a 35-year operational life for new CCs and CTs and natural gas-fired assets operating after 2050 is still appropriate.

Importantly, flexible hydrogen-capable CCs and CTs are needed to meet near-term load growth and provide reliable backstand for variable energy and energy limited resources to maintain the reliability of the system. How these units will operate over time will change, but their inclusion in the portfolio is critical to meeting the reliability needs of the system. More information on CC, CT, and hydrogen fuel modeling assumptions are included in Appendix C.[28] More information on the state of hydrogen and its use in dispatchable generation is included in the Dispatchable Generation and Fuel Supply Witness Panel Testimony and in Appendix K (Natural Gas, Other Low Carbon Fuels and Hydrogen).

[28] CPIRP Appendix C at 33-35.

D. Coal Retirement Analysis

Q. PLEASE DISCUSS THE COMPANIES' UPDATED COAL RETIREMENT ANALYSIS AND IDENTIFY WHERE THE COMMISSION CAN FIND MORE INFORMATION ABOUT THE DEVELOPMENT AND RESULTS OF THE ANALYSIS IN THE PLAN.

A. The Carbon Plan Order found the Companies' coal retirement analysis, as well as the planned unit retirement dates supported by that analysis, to be reasonable for planning purposes and appropriately focused on maintaining operational flexibility and reliability at a reasonable cost. The Commission also recognized that the planned coal unit retirements generally require replacement resources to maintain the resource adequacy of the system. The Carbon Plan Order directed the Companies to present a comprehensive analysis of the planned coal unit retirement schedule in this CPIRP Update.[29]

As discussed in detail in Appendix F, the Companies conducted an updated coal retirement analysis utilizing the same process the Commission found reasonable in the initial proposed Carbon Plan. The updated coal retirement analysis includes updated assumptions consistent with the development of the portfolios as discussed previously. Figure 5 below presents the Companies' coal retirement analysis process to determine the schedule of retirement for each pathway.

[29] Carbon Plan Order at 63-64.

Figure 5: Coal Retirement Analysis Process[30]

The Companies' initial modeling was used to develop costs to maintain the resources (including the benefits of securitization of 50% of remaining net book value of early retirement of subcritical coal as permitted under North Carolina law). This analysis then allowed the model to endogenously co-optimize the coal unit retirements with replacement resources while maintaining reliability of the system. Finally, the process assessed the modeling results and considered planning factors to determine the final retirement dates used for each Pathway. Table 2 below presents the final coal retirement dates for each unit as presented in Appendix F with the retirement dates in Pathway 3 aligning to the Companies recommended portfolio, P3 Base.

[30] CPIRP Appendix F at 7 (Figure F-1).

Table 2: Planned Coal Unit Retirements (effective by Jan. 1 of year shown)[31]

Unit	Utility	Winter Capacity (MW)	Effective Year by Pathway (Jan 1)		
			Pathway 1	Pathway 2	Pathway 3
Allen 1[1]	DEC	167	2025	2025	2025
Allen 5[1]	DEC	259	2025	2025	2025
Belews Creek 1	DEC	1,110	2030	2036	2036
Belews Creek 2	DEC	1,110	2030	2036	2036
Cliffside 5	DEC	546	2029	2031	2031
Cliffside 6[2]	DEC	849	2049	2049	2049
Marshall 1	DEC	380	2029	2029	2029
Marshall 2	DEC	380	2029	2029	2029
Marshall 3	DEC	658	2034	2032	2032
Marshall 4	DEC	660	2034	2032	2032
Mayo 1	DEP	713	2029	2031	2031
Roxboro 1	DEP	380	2029	2029	2029
Roxboro 2	DEP	673	2029	2029	2029
Roxboro 3	DEP	698	2030	2033	2034
Roxboro 4	DEP	711	2030	2033	2034

Note 1: Allen 1 & 5 retirements are planned by December 31, 2024. Retirements were not included in the Coal Retirement Analysis due to near-term planned retirement dates.
Note 2: Cliffside 6 is assumed to continue operating on 100% on natural gas beyond 2035 and was not included in the coal retirement analysis for the Carolinas Resource Plan.

More information on the Coal Retirement Analysis and how the schedules for each Pathway were utilized in portfolio development are contained in Appendix F and Appendix C.[32]

[31] CPIRP Appendix F at 9 (Table F-7). Figure 5 is also replicated in IRP and Modeling Panel Exhibit 1.

[32] CPIRP Appendix C at 47.

Q. HOW DID THE COMPANIES ADDRESS THE COMISSION'S DIRECTIVE TO INCLUDE JUSTIFICATION FOR DELAYS FROM THE INITIAL CARBON PLAN'S UNIT RETIREMENT SCHEDULE AND PRESENT ALTNERATIVES FOR REDUCING EMISSION THAT MAY RESULT FROM DELAYED RETIREMENTS? [33]

A. Chapter NC presents the retirement schedule for Pathway 3 compared to the retirement dates in the initial proposed Carbon Plan.[34] As discussed earlier in this Panel's Testimony, and discussed in Appendix F, the updated analysis factored in the base case assumptions used to develop the Core Portfolios, including the significant impacts of load and reserve margin on the Company's ability to retire coal resources while maintaining or improving reliability of the system.[35] The increased peak load forecast and planning reserve margin contributed to the updated coal retirement dates resulting in limited delays of certain unit retirement dates while still retiring all coal by 2035. The changing energy landscape considerations discussed in Section II(A) above, specifically including the Carolinas' growing energy requirements, requires certain of the Companies' coal units to remain online longer until additional replacement resources can be built. While the updated retirement analysis results in some coal capacity remaining online slightly longer than projected in the initial

[33] Carbon Plan Order at 63-64.

[34] CPIRP Chapter NC at 23 (Table NC-4).

[35] CPIRP Appendix F at 6.

proposed Carbon Plan, it does not necessarily mean the energy mix from coal will change measurably, as these resources are expected to be used on an increasingly limited basis as the Companies add additional carbon-free resources over time.

Q. DID THE COMPANIES RE-STUDY THE POTENTIAL COST AND BENEFITS OF FUTHER CONVERSION OF BELEWS CREEK TO OPERATE ON 100% NATURAL GAS AS AN ALTERNATIVE TO PLANNED RETIREMENT?

A. Yes. The Carbon Plan Order directed the Companies to re-study the costs and benefits of a further fuel source conversion at Belews Creek and provide the results as part of this CPIRP filing.[36] The Commission noted that the re-study should consider whether additional fuel source conversion at Belews Creek could serve as an interim measure until the Companies could bring fully-hydrogen-capable CT or CC generating units online as an alternative to investing in new natural gas generating units now and later incurring costs to convert those units to a zero-carbon fuel source. The Commission also asked for analysis regarding whether fuel source conversion would enable the Belews Creek units to provide additional, non-coal fired reserve capacity would be beneficial.[37]

[36] Carbon Plan Order at 65.

[37] *Id.*

For this analysis, the Companies obtained an estimate from the steam generator's original equipment manufacturer and internal engineering to develop costs and savings of converting and operating each of the 1,110 MW units to operate exclusively on natural gas. Furthermore, to ensure the generating units could be counted on as firm capacity, the Companies assumed additional expansion of the firm interstate transportation of natural gas delivered to the units. Removing the capabilities of coal combustion and the related firm fuel supply associated with onsite coal storage, the natural gas firm-transportation ("FT") costs in this scenario appropriately capture the cost to ensure continued firm fuel supply at the site. Overall, the conversion of Belews Creek to operation on 100% natural gas, and the extension of its operating life to 2041, when the unit could be replaced with hydrogen resources or other advanced carbon-free resources, did not result in sufficient production cost and resource deferral savings relative to the costs of conversion and required firm fuel supply. More discussion of the analysis and results can be found in Appendix C.[38]

E. Bad Creek II Economic Verification Analysis

Q. THE COMPANIES' ANALYTICAL PROCESS INCLUDES AN ECONOMIC VERIFICATION STEP FOR THE BAD CREEK POWERHOUSE II PROJECT. PLEASE EXPLAIN THE REASON FOR

[38] CPIRP Appendix C at 50-51.

THIS ANALYSIS AND WHERE THE COMMISSION CAN FIND MORE INFORMATION ON VERIFYING BAD CREEK II'S INCLUSION IN THE PORTFOLIOS.

A. Due to complexities that evaluation of long-duration storage introduces in the capacity expansion model, the Companies included the expansion of the Bad Creek pumped storage facility in all portfolios before the optimization of additional resource needs. However, the inclusion of this resource was supported by two different methods of economic verification. In the first method, the Companies re-optimized the P3 Base portfolio excluding Bad Creek II as a resource option. This portfolio was more expensive in PVRR terms than when Bad Creek II was included. In the second method, the Companies modeled the P3 Base portfolio with Bad Creek II as a selectable resource. Given the option, the capacity expansion model economically selected Bad Creek II for inclusion in the portfolio. These results confirm the inclusion of the Bad Creek II long-duration storage resource is economic. The Bad Creek II economic verification is described in greater detail in Appendix C.[39]

F. Portfolio Reliability Verification Analysis

Q. WHY DID THE COMPANIES CONDUCT PORTFOLIO RELIABILITY VERIFICATION AND WHERE CAN THE COMMISSION FIND MORE INFORMATION ON THE EVOLVING SYSTEM AND HOW THE

[39] CPIRP Appendix C at 66-67.

COMPANIES ARE ADDRESSING IMPACTS TO RELIABILITY IN THE PLAN?

A. The Companies have a unique responsibility for maintaining or improving the reliability of the grid as it executes the energy transition. To ensure the Core Portfolios maintain or improve upon the reliability of the system, the Companies conducted Portfolio Loss of Load Expectation ("LOLE") Reliability Verification analysis. The process was consistent with the Reliability Verification analysis performed as part of the initial proposed Carbon Plan, which the Commission deemed appropriate to validate the reliability of portfolios.[40] This analysis was conducted within the Strategic Energy Risk Valuation Model ("SERVM"). This modeling software, licensed through Astrapé Consulting, is the same modeling software used to develop the Resource Adequacy study and the recommended planning reserve margin used for the CPIRP. Each of the portfolios was assessed over thousands of combinations of weather and outage draws for maintaining an LOLE below the Resource Adequacy Study's benchmark. More discussion on the entire Reliability Verification process and other considerations of reliability are discussed in Appendix C, Appendix M and in the Reliability and Operational Resilience Panel's Direct Testimony.

[40] Carbon Plan Order at 55.

IV. MODELING AND ANALYSIS OF MOST REASONABLE, LEAST COST PLAN THAT MAINTAINS OR IMPROVES RELIABILITY

A. Portfolios and Analysis

Q. PLEASE SUMMARIZE FOR THE COMMISSION THE CORE PORTFOLIOS AND TRENDS IN RESOURCE SELECTION ACROSS PORTFOLIO VARIANTS AND SENSITIVITY ANALYSIS PORTFOLIOS?

A. Applying the CPIRP analytical process and modeling framework described in the Plan and addressed in section III above, the Companies developed three Core Portfolios, one corresponding to each Energy Transition Pathway. Chapter 3 includes a detailed discussion of the analytical results of the portfolio analysis, with additional information provided in Appendix C. Figure 6 and Figure 7 below show the energy and capacity mixes under each of the Core Portfolios as of 2033, the end of the Base Planning Period in 2038, and in 2050.

Figure 6: Modeled Energy Mix by Core Portfolio, Combined Carolinas System[41]

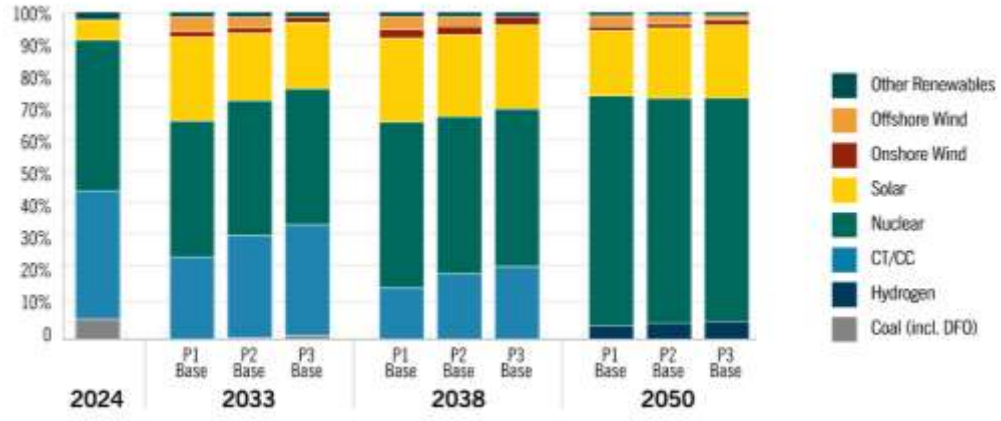
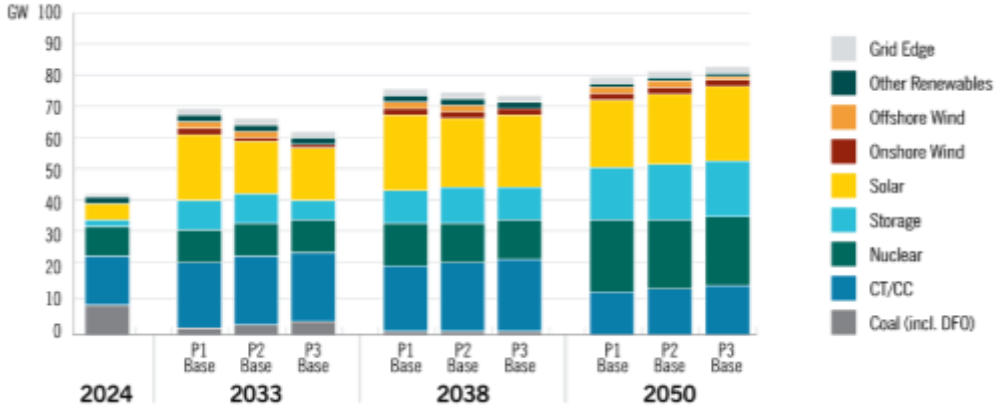


Figure 7: Nameplate Capacity Mix by Core Portfolio, Combined Carolinas System[42]



The resource mixes across all three Core Portfolios start to converge by 2038, in terms of both energy mix and capacity mix, and there is substantial alignment by 2050 when all three Core Portfolios reach carbon neutrality. As more fully explained in Chapter 3, the primary differentiation across the three

[41] CPIRP Chapter 3 at 5 (Figure 3-2).

[42] CPIRP Chapter 3 at 6 (Figure 3-3).

Core Portfolios is the pace, scope and scale of required resource additions in the near- and intermediate-terms that support different paces of continued energy transition.[43]

P1 Base, the Core Portfolio for Pathway 1, demonstrates the resources that would be needed to meet the Interim Target by 2030. Achieving this target while reliably serving growing customer load and replacing retiring coal generation with equally reliable resources requires an infeasible level of new resource additions and transmission upgrades.[44]

P2 Base and P3 Base, the Core Portfolios for Pathway 2 and Pathway 3, would meet the Interim Target by 2033 and 2035, respectively. These portfolios both also require unprecedented project development activity, but P2 Base would entail significantly more resource additions in the early 2030s than P3 Base, creating even more highly challenging siting, permitting, and construction needs, particularly for the execution of 1,600 MW of offshore wind and related transmission, as well as accelerated battery energy storage deployment. P3 Base carries lower cost and lower execution risk while still achieving the Interim Target by 2035 and keeping the Companies squarely on the path towards reaching carbon neutrality by 2050.[45]

[43] CPIRP Chapter 3 at 2-3.

[44] CPIRP Chapter 3 at 3.

[45] CPIRP Chapter 3 at 32-33.

The 13 Portfolio Variants and 10 Sensitivity Analysis Portfolios explore a wide range of alternative input assumptions including resource availability, fuel supply, resource cost, and load assumptions and forecasts that, together with the Core Portfolios, form a thorough and robust analysis. The results of this analysis support the Companies' all-of-the-above strategy for executing on the continued energy transition in the Carolinas to serve growing customer needs and reliably retire and replace coal-fired generating assets. Chapter 3 and Appendix C provide detailed results and conclusions of the full portfolio analysis, including:

- Significant sustained additions of carbon free solar resources over the next decade are called for in all portfolios with only small variations in annual additions and cumulative levels of solar across portfolios;
- Wind energy resources as a component of the transition provide valuable diversification of generation to complement the substantial amounts of solar generation that is envisioned across all Pathways;
- Offshore wind, while not identified as needed under P3 Base through the end of the Base Planning Period, is identified as needed to achieve carbon neutrality and is identified in several Pathway 3 Portfolio Variants and Sensitivity Analysis Portfolios as needed by 2035;
- The addition of significant levels of energy storage is an essential element of the Plan needed to accompany growing levels of intermittent

solar and wind generation providing a dispatchable resource to better align renewable output with customer demand;

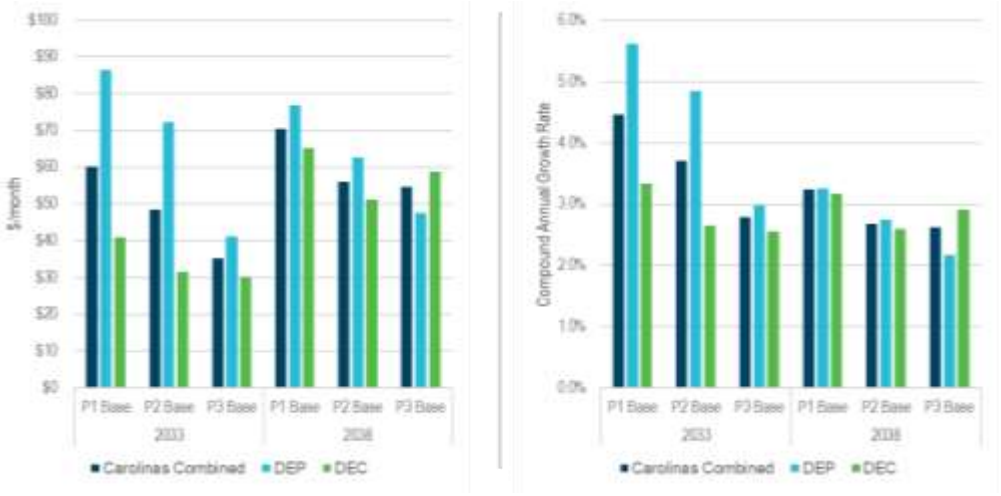
- A definitive need for new hydrogen-capable combined-cycle ("CC") and simple-cycle combustion turbine ("CT") generators is shown across all portfolios to backstand intermittent renewable generation, which is critical to the Companies' ability to maintain or improve reliability while retiring coal-fired generation; and
- Load growth above that envisioned in the base CPIRP forecast would require accelerated resource deployment even beyond the ambitious pace envisioned in P3 Base.

Q. HOW DO COSTS, CUSTOMER BILL IMPACTS, AND RISKS DIFFER ACROSS THE CORE PORTFOLIOS?

A. Developing a plan that reasonably balances costs, risks and the pace of energy transition while maintaining or improving reliability is at the center of the CPIRP analysis. Figure 8 below illustrates the present value of revenue requirements ("PVRR") for each Core Portfolio through 2038 and through 2050, and Figure 9 further below provides snapshots of the average monthly residential bill impacts and compound annual growth rates ("CAGR") in 2033 and 2038. These metrics are an important tool for comparing costs across portfolios, but reflect only costs considered in resource planning, and therefore are not intended or useful as estimates of "all in" costs.

Figure 8: PVRR by Core Portfolio, Calculated through 2038 and 2050[46]

Figure 9: Bill Impact Snapshots by Core Portfolio, 2033 and 2038[47]



As illustrated in the figures above, P3 Base represents the lowest cost of the three Core Portfolios in terms of both PVRR and bill impact. The slightly extended timeline for achieving the Interim Target allows for a more measured pace of capital investment that results in a lower CAGR for customer bills. P3

[46] CPIRP Chapter 3 at 26 (Figure 3-9).

[47] CPIRP Chapter 3 at 27 (Figure 3-10).

Base does not include offshore wind in what is already an ambitious set of resource additions in the early 2030s, which further mitigates cost impact, particularly for DEP customers. Importantly, the targeted pace of transition is a key determinant of cost and risk. Figure 10 below illustrates the pace of new resource additions for the three Core Portfolios.

Figure 10: Cumulative Supply-Side Resource Additions by 2038, Combined Carolinas System (beginning-of-year basis)[48]

Notably, all three Core Portfolios achieve the Interim Target by the mid-2030s and result in similar levels of new resource additions by the end of the Base Planning Period. The more measured but still ambitious pace envisioned in P3 Base provides the most reasonable balance of costs and execution risks while achieving CO_2 reduction targets and maintaining or improving system reliability. Chapter 3 provides an in-depth discussion of the tradeoffs across Energy Transition Pathways and the corresponding Core Portfolios.

[48] CPIRP Chapter 3 at 31 (Figure 3-14).

B. Supplemental Portfolio Analysis of Proposed EPA CAA Regulations

Q. DID THE COMPANIES CONSIDER THE IMPACTS OF THE UNITED STATES ENVIRONMENTAL PROTECTION AGENCY'S RECENTLY PROPOSED RULE CHANGES UNDER THE CLEAN AIR ACT SECTION 111 ("EPA CAA SECTION 111 PROPOSED RULE")?

A. Yes. The Companies' CPIRP modeling assesses compliance with or impacts of the EPA CAA Section 111 Proposed Rule. The Companies assessed performance of parts of the proposed rule on the Core Portfolios with respect to existing coal operational restrictions, existing CC capacity factors, new CT capacity factors and initial CO_2 emissions rate standards on new CC units. In general, these portions of the proposed rules were either met, or could be met with operational constraints. As Supplemental Portfolios, the Companies assessed impacts to resource requirements or Plan costs with respect to achieving the Phase II and Phase III requirements of the proposed rule with respect to capacity factor limitations or use of hydrogen for existing and new CCs. These Supplemental Portfolios, which carry significant uncertainty in finality of the rule and the availability to execute on the resources and hydrogen fuel supply, reflect increased costs and execution challenges, but does not necessarily result in the elimination of new gas generation as part of the least cost, least risk resource portfolio. These rules are still being reviewed by the industry and may be updated by the EPA in a final rule expected in Q2 2024.

More information on the assessments made by the Companies on the impact of the proposed rule are discussed in Appendix C.[49]

V. SUPPORT AND ALIGNMENT FOR NEXT REASONABLE STEPS FOR COMMISSION TO APPROVE

A. Recommended Core Portfolio P3 Base and Execution Planning in the Near-Term

Q. WHY IS P3 BASE THE COMPANIES' RECOMMENDED PORTFOLIO AND THE PRIMARY BASIS FOR THE PROPOSED RESOURCES FOR THE COMMISSION TO SELECT AS THE NEXT REASONABLE STEPS TO ACHIEVING THE EMISSIONS REDUCTIONS GOALS?

A. The Companies' Core Portfolio in Pathway 3, P3 Base, represents the most reasonable, least-cost and least risk plan that maintains or improves reliability and is appropriate for the Companies to use as a reference portfolio for other regulatory dockets, as a base planning assumption, and to support the next reasonable steps for the Commission to approve for execution in the near-term (2023-2026). As more fully supported in Chapter 3 and Chapter NC to the Plan, Pathway 3 and recommended Portfolio P3 Base most appropriately balance risk related to the transition of the fleet, while maintaining reliability and planning along a least cost path as discussed previously in this panel's testimony.[50]

[49] CPIRP Appendix C at 96-99 and 107-12.

[50] CPIRP Chapter 3 at 32-33; Chapter NC at 8-13.

Overall, the Companies believe the range of results across the Pathway 3 Core, Variant and Sensitivity Analysis Portfolios supports the actions discussed in Chapter 4 and Chapter NC as the executable near-term Carbon Plan to be approved by the Commission.[51]

B. Near-Term Action Plan as Next Reasonable Steps to Execute Carbon Plan through 2026

Q. HOW DID P3 BASE AND OTHER MODELING RESULTS INFORM DEVELOPMENT OF THE COMPANIES' PROPOSED NTAP?

A. In the Carbon Plan Order, the Commission concluded "that an approach focused on near-term activities comprised of a number of reasonable steps needed to achieve the mandated carbon dioxide emissions reduction, which are generally supported as "no regrets," is not only an appropriate course of action at this stage of implementation but is also well-supported by N.C.G.S. § 62-110.9, which contemplates review and adjustment of the Carbon Plan on an interim two-year basis."[52] Consistent with this conclusion and the requirements set forth by the Commission in their Carbon Plan Order, the Companies have developed a proposed NTAP and identified proposed resources to be selected by the Commission as the next reasonable steps based on the assessment of modeling results, risk analysis, planning factors, and execution considerations.

[51] CPIRP Chapter 4 at 8-9.

[52] Carbon Plan Order at 25.

As further explained in Chapter 4,[53] in developing the proposed near-term actions and selected resources the Companies considered the lead time necessary to execute on resources between the development of this CPIRP and when the Commission will update its Carbon Plan for the next cycle, by the end of 2026. This timeline allows the Companies to progress critical work to ensure the deployment of resources to meet the timeframes the resources are needed before any additional direction is provided by the Commission as they check and adjust every two years. For nearly every resource, including longer lead time resources, the Companies must begin early-stage project development, that may include site assessments, regulatory approvals, transmission studies, environmental permitting, and request for proposals for equipment, to stay on track for delivering these resources, should the Commission deem them reasonable, and maintaining optionality into the future for these resources. The proposed NTAP is generally consistent with P3 Base, is informed by the various other portfolios developed under Pathway 3, and further considers execution efficiencies and potential risk mitigation with respect to ensuring execution along a least cost path while maintaining or improving reliability through the transition. Companies' Witness Bowman presents a summary table of the supply-side NTAP as Bowman Exhibit 2 that reflects the proposed Commission

[53] CPIRP Chapter 4 at 3-5.

and Chapter 4 provides additional detail on the activities planned to be completed between now and 2026.

Bowman Exhibit 2 identifies the additional resources and volumes that are proposed for execution during the near-term through 2026. This aggressive near-term plan calls for a diverse set of resources that are necessary to reliably meet growing customer demand, replace retiring coal facilities while also staying on track to achieve target emissions reductions.

More information on identifying resources needed and translating the modeling results to Execution Plan including the proposed near-term actions and resources to be selected by the Commission for execution is contained in Chapter 3, Appendix C and Chapter 4.

Q. WITH RESPECT TO THE PRIMARY PLANNING REQUIREMENTS TO MAINTAIN OR IMPROVE RELIABILITY OF THE SYSTEM THROUGHOUT THE ACHIEVEMENT OF THE EMISSIONS REDUCTIONS TARGETS, HOW DOES THE COMPANIES' APPROACH TO "REPLACE BEFORE RETIRE" IMPACT THE PLANNED RETIREMENTS OF COAL UNITS?

A. The Companies discuss throughout the CPIRP that coal retirements are inextricably linked to reliable replacement capacity, otherwise discussed as the "replace before retire" approach. With the increase in the target planning reserve margin and the increase to the Companies' updated load forecast, the

Companies do not have adequate firm winter planning capacity to retire the Companies' remaining coal units without replacement resources. Translating the importance of the planning process to execution, future coal retirements will be contingent upon sufficient reliable replacement generation being placed in service. In order to maintain grid reliability, further changes in the customer demand forecast or changes in the availability or in-service date of reliable replacement generation may result in a need to adjust the coal retirement schedule presented in this Plan.

More information about the Companies' plan for exiting coal is contained with Chapter 4 and Appendix F.

VI. CONCLUSION

Q. MESSRS. SNIDER, QUINTO, BEATTY, AND PASSTY, DOES THIS CONCLUDE YOUR PRE-FILED DIRECT TESTIMONY?

A. Yes.

Figure 1: Combined DEC and DEP Energy Transition in Progress

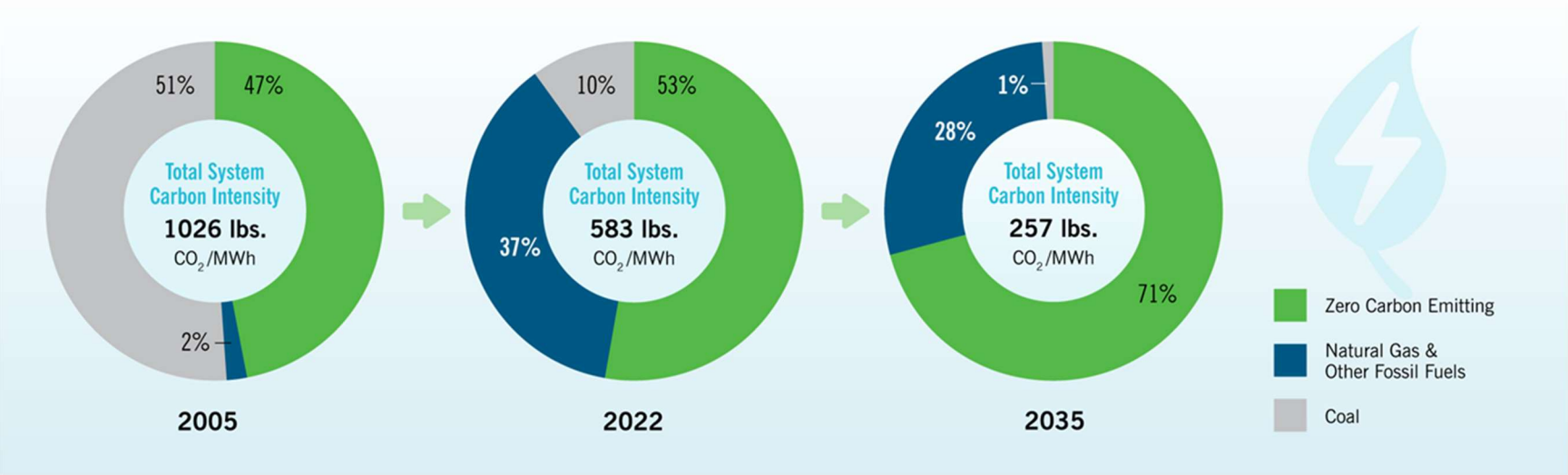


Figure 3: Energy Transition Pathways and Portfolios

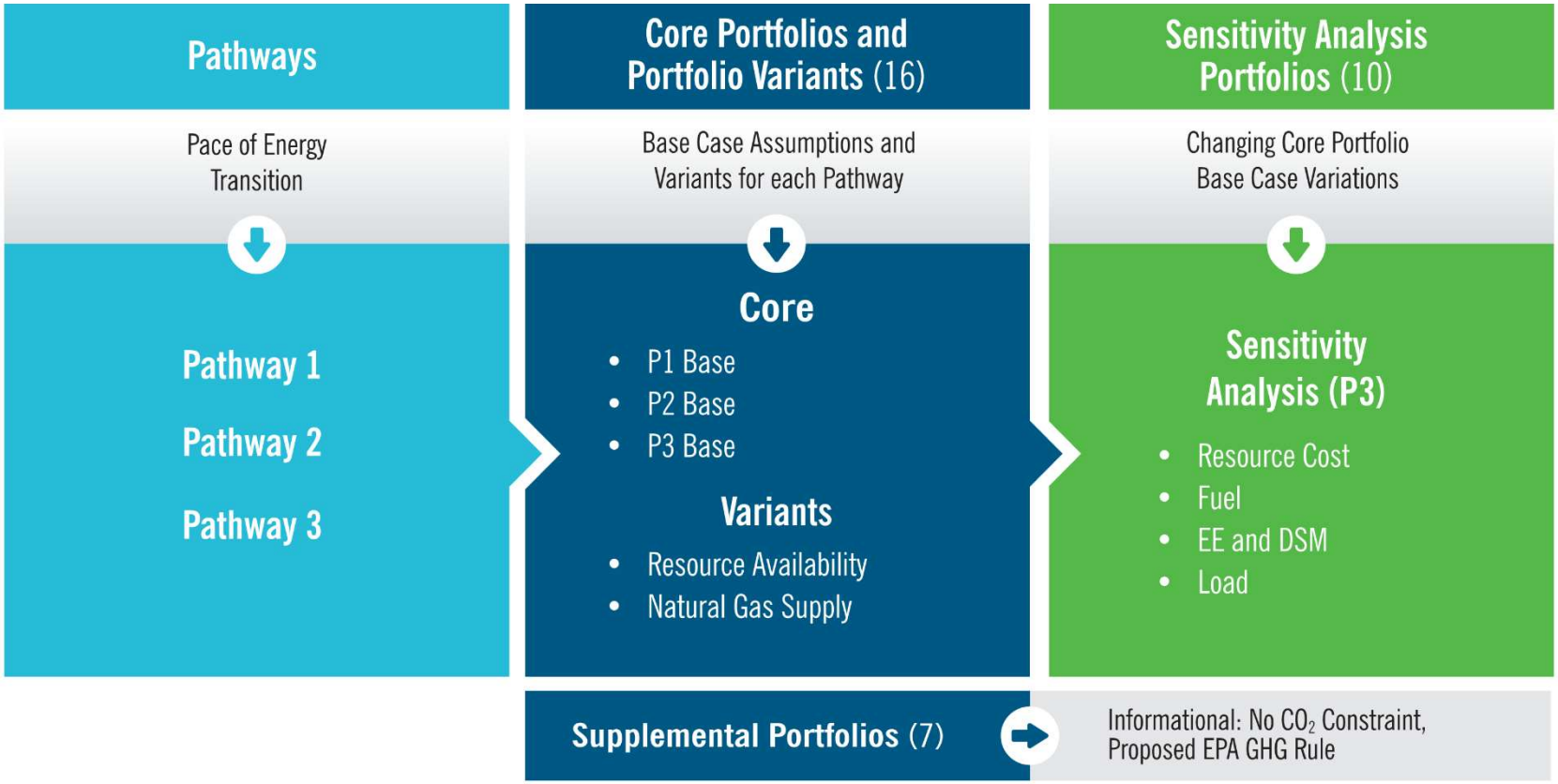


Figure 4: Carolinas Resource Plan Analytical Process Flow Chart

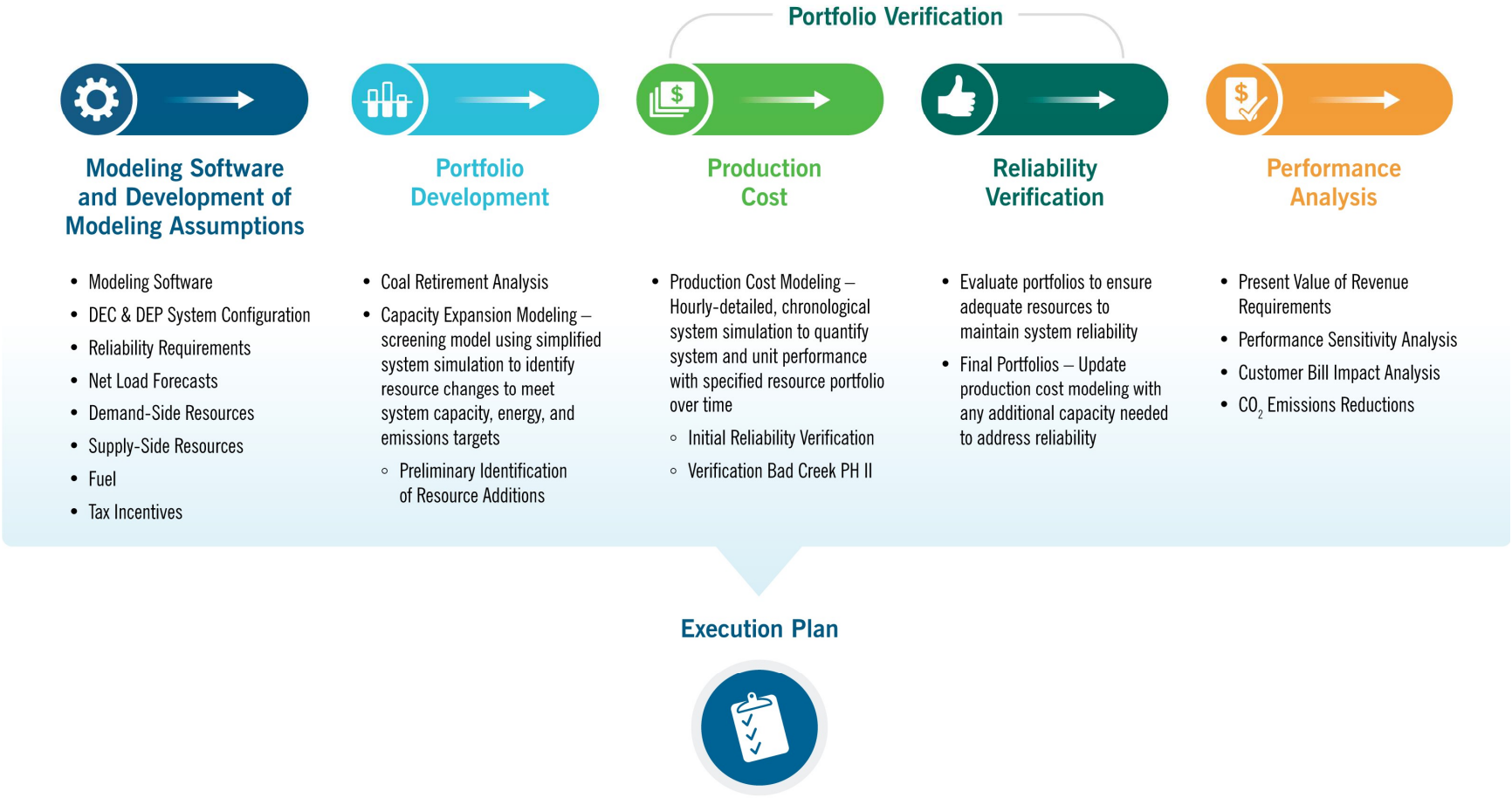


Figure 5: Coal Retirement Analysis Process