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APPENDIX III

Dkt. No. E-100, Sub 190

Evaluation of the Temporal Deployment of Offshore Wind Generation and Advanced Nuclear Generation in the Duke Energy Carolinas Resource Plan

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1.0 INTRODUCTION

According to Duke Energy Carolinas, LLC, and Duke Energy Progress, LLC (collectively, "Duke" or the Companies"), the Carbon Plan and Integrated Resource Plan ("CPIRP" or the "Plan"), titled the *Carolinas Resource Plan* and originally filed in August 2023,[1] is designed to reliably meet current and future customers' energy needs over the next 15 years while also planning for the Companies' longer-term energy transition to achieve carbon neutrality by 2050. To meet customers' needs and navigate the complex and dynamic energy landscape of the future, the Plan presents three energy transition pathways. The Plan considers a robust portfolio of sensitivity analyses to inform the public and the North Carolina Utilities Commission ("NCUC" or "Commission") about its "all of the above" approach to prudently retire and replace 8,400 MW of coal-fired generating capacity. The Plan includes repurposing sites, where feasible, with equally reliable low emission resources to meet customer needs of the future. The August 2023 Plan was updated on January 31, 2024 (the "CPIRP Update").[2]

Notably, the CPIRP being evaluated in the present proceeding is far more comprehensive and represents an unprecedented assemblage of choices and changes than is generally encountered in a biannual integrated resource plan. In this case, the significant change in the mix of generation resources in the CPIRP is largely influenced by the significant new requirement to reduce existing and future carbon emissions by decommissioning the existing coal-fired generation fleet and deployment of low carbon generation sources to replace this large segment of the Companies' generation resources. This change is very significant. Under the Practice and Procedures of the Commission the Companies are required to model the various resource options available to fulfill these requirements.

> Modeling Resource Needs Over Base Planning Period and Carbon Neutrality Planning Horizon. — The CPIRP shall include, ***at a minimum***, a comprehensive analysis of all resource options (demand-side and supply-side) considered by the electric public utilities to serve native load requirements and firm planning obligations during the Base Planning Period and the Carbon Neutrality Planning Horizon in a manner that maintains or improves upon the adequacy and reliability of the existing grid as required by G.S. 62-110.9(3).[3]

Literature on modeling electric generation resources for a typical utility IRP shows that obtaining accurate and comprehensive results is challenging. However, the unprecedented level of change presented in the CPIRP clearly raises the level of difficulty in system modeling due to the large number of tradeoffs being calculated and the unprecedented paucity of reliable actuarial

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[1] *See Verified Petition for Approval of 2023-24 Carbon Plan and Integrated Resource Plans of Duke Energy Carolinas, LLC & Duke Energy Progress, LCC*, Dkt. No. E-100 Sub 190 (Aug. 17, 2023) [hereinafter, "Verified Petition"].

[2] *See Verified Amended Petition for Approval of 2023-24 Carbon Plan and Integrated Resource Plans of Duke Energy Carolinas, LLC & Duke Energy Progress, LCC*, Dkt. No. E-100 Sub 190 (Jan. 31, 2024) [hereinafter, "Verified Amended Petition"].

[3] NCUC Practice and Procedure, Rule R8-60A(d)(3) (emphasis added).

information concerning new generation technologies.[4] In order to fill the unavoidable actuarial data gap in the modeling results and go beyond the "minimum" information available, we have presented a substantial level of actuarial details concerning two major new generation resources that are unique to the Companies and the Commission. The information presented here will provide additional substance for the Commission's deliberations and decisions in this proceeding.

It is also important to recognize and consider that the CPIRP Update was the result of North Carolina's recent, unprecedented levels of economic development successes and resulting significant increases in the Companies' load forecast.[5] The CPIRP Update's stated goals are to "to inform the [Commission], customers, and stakeholders . . . the need for incremental resource additions to the Companies' proposed near-term actions plan ("NTAP") and updates to the longer-term resource plans."[6] The CPIRP Update includes a number of different options that have been considered in designing the orderly transition of electric generation resources to a mix of lower emission generation facilities. The list of various generation and energy storage assets considered in the CPIRP Update to lower carbon emissions include solar, battery storage, increased combustion turbines and additional natural gas generation sources, pumped storage hydro, advanced nuclear technologies, onshore wind, and offshore wind.

This report principally addresses two specific new electric generation technologies the Companies propose to deploy to lower carbon emissions from generation sources to levels set forth under North Carolina legislation HB 951: Offshore Wind ("OSW") electric generation and Advanced Nuclear technology and Small Modular Reactors (collectively, "New Nuclear"). These resources are classified as "long-lead generation assets," so named for the lengthy duration of time necessary to plan and deploy these generation assets. This report examines the timing for deployment of OSW and New Nuclear generation assets as proposed in the Plan and CPIRP Update. OSW technologies have never been utilized by the Companies and the New Nuclear technologies, while variations on existing nuclear technology, differ in many respects from the existing legacy nuclear generation technology already operating in the Companies' service territories. As such, neither of these proposed technologies have been previously deployed by the Companies, but both potentially offer significant benefits to the state's economy despite

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[4] Cole, et al., *Beginner's Guide to Understanding Power System Model Results for Long-term Resources Plans*, Golden, CO, NAT'L RENEWABLE ENERGY LAB. (Jan. 2024), https://www.nrel.gov/docs/fy24osti/87105.pdf.

[5] N.C. DEP'T OF COMMERCE, *Five Things to Watch in the 2023 North Carolina Economy* (Feb. 23, 2023), available at https://www.commerce.nc.gov/news/the-lead-feed/five-things-to-watch-2023-north-carolina-economy (discussing how North Carolina's economy has experienced strong growth in recent years, as evidenced by several key economic indicators: The state's GDP grew by 3.2% in 2022, reaching a total of $560 billion, and grew further in 2023 by 2.7%. In 2022 North Carolina ranked 9th among all U.S. states in terms of GDP growth. The state's economy has been buoyed by a thriving workforce, with North Carolina ranking 1st in the nation for workforce competitiveness according to CNBC. The state has attracted major business investments, including a $1 billion Apple facility in Research Triangle Park and a $458 million biomanufacturing plant by ProKidney. North Carolina has also seen robust job growth, with a net increase of around 190,000 jobs in 2022—the best year for employment growth in over 30 years. Major investments in manufacturing sectors like electric vehicles, semiconductors, and pharmaceuticals by companies like Apple, VinFast, Toyota, and Wolfspeed contributed to GDP growth.).

[6] *Chapter NC Supplement: 2023-2024 Carbon Plan and Integrated Resource Plan Supplemental Planning Analysis*, Dkt. No. E-100, Sub 190, 1 (Jan. 31, 2024).

potentially facing critical challenges to timely implementation. In the balance of this report, we review and describe those challenges and how they will be addressed in pursuing the legislative requirements for reducing carbon emissions set forth by the North Carolina legislature.

The CPIRP Update maintains the significant near-term actions and expenditures to implement the near-term material pursuit of the New Nuclear option, specifically the $75 million to be spent in this pursuit during 2024.[7] That $75 million expenditure was authorized by the Commission's final order for the Companies' Initial Carbon Plan.[8] However, material pursuit of OSW was set aside to be considered in the future pending further study. In the Commission's final order, it acknowledged that the Companies' proposed least costly portfolio, Portfolio P3, "foregoes offshore wind but utilizes SMR capacity to achieve the Interim Target by 2034."[9] In the Plan, as filed on August 17, 2023, OSW was not selected in the Companies' Preferred Portfolio, P3 Base, until 2038.

> As identified in the NTAP and addressed in the Executive Summary and Chapter NC (2023-2024 CPIRP Update), offshore wind was not selected in the Companies' recommended Core Portfolio P3 Base through the end of the Base Planning Period by 2038 (though needed for long-term carbon neutrality), and the Companies' near-term actions do not include obtaining a lease and proceeding with more significant initial development activities required to make offshore wind available in the Carolinas in the early 2030s.[10]

In the Supplemental filing made on January 31, 2024, the Companies amended the Plan to include 2.4 GW of new offshore wind generation by 2035.[11] However, regarding any material progress on the OSW option, the analysis supporting the Companies' supplemental portfolio P3 Fall Base—despite accelerating OSW by selecting 2.4 GW by 2035—does not request early development activities for OSW. Instead, the Companies' supplemental analysis recommends a new stakeholder proceeding by requesting the Commission issue an Acquisition Request for Information ("ARFI") to further study OSW deployment.[12] As discussed in the section on Near Term Planning, we do not agree that the ARFI, as proposed, efficiently collects and reports all the detailed information the Companies and Commission require regarding OSW procurement. Nor does the ARFI, as proposed, remedy the reported limitations of a similar RFI process

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[7] *See, Carolinas Resource Plan*, App'x J – Nuclear, Dkt. No. E-100, Sub 190, 18–19 (Aug. 17, 2023) (outlining Projected Costs (Through Year-end 2024) for New Nuclear in Table J-9 ($74.92 million) and Estimated Future Costs for New Nuclear in Table J-10 ($365 million).); *see also Supplemental Planning Analysis*, Dkt. No. E-100, Sub 190, 8 (Jan. 31, 2024) ("Importantly . . . all original Execution Plan activities presented in the Resource Plan, as filed in August 2023, continue to be needed.").

[8] *Order Adopting Initial Carbon Plan & Providing Direction for Future Planning*, Docket No. E-100, Sub 179, 95–96 (Dec. 30, 2022).

[9] *Id.*, at 16.

[10] *Carolinas Resource Plan*, Ch. 4 – Execution Plan, at 26.

[11] *Supplemental Planning Analysis*, at 8–9.

[12] *Id.*, at 53.

convened by DNV which yielded a report and conclusions only suitable for the selection of a "generic offshore wind resource."[13]

The Public Staff apparently shares these concerns. On April 17, 2024, the Public Staff filed a *Motion Requesting Issuance of Commission Order* urging the Commission to issue an order requiring the Companies to proceed with development of an offshore wind ARFI on an expedited basis.[14] The Commission issued an order requesting comments on the Pubic Staff's request,[15] and intervenors, including the N.C. Sustainable Energy Association ("NCSEA"), timely filed comments.[16] The Commission subsequently denied the Public Staff's motion determining that it is "premature to issue a decision on the Public Staff's Motion before receiving expert witness testimony at the expert witness hearing and considering all of the evidence in the record."[17]

In light of the Commission's order, we strongly recommend the Commission adopt the following requests, as described in NCSEA et al.'s comments:

1) Adopt a procedural schedule that requires interim updates from the Companies and the WEA leaseholders detailing the ARFI and its preliminary results, including written filings and/or convening a technical conference for the purposes of receiving presentations from the Companies and the WEA leaseholders on the ARFI and its preliminary results in the Fall of 2024 to inform the Commission's decision-making related to next steps for the development and procurement of offshore wind in this proceeding; and

2) Direct the Companies and the WEA leaseholders to jointly develop procurement schedules for each WEA, with achievable milestones through 2032, to guide the development of all, or a portion of, each WEA to achieve, at a minimum, the proposed 2.4 GW of offshore wind generation in the Companies' supplemental portfolio and analysis.[18]

The purpose of any ARFI the Commission approves should be expressly intended to enable the Companies and the WEA leaseholders to enter meaningful negotiations with the explicit goal of finalizing draft operative procurement procedures and realistic schedules for each WEA. Moreover, as described in this report, the WEA leaseholders are in possession of most of this

[13] *Public Staff's Motion Requesting Issuance of Commission Order*, Dkt. No. E-100, Sub 190, 6 (Apr. 17, 2024) (quoting Duke Response to Public Staff Data Request No. 31-18(h) (Attachment 1)).

[14] *Id.*, at 7.

[15] *Order Requesting Comments on the Public Staff's Motion Requesting Issuance of Commission Order,* Dkt. No. E-100, Sub 190, 3 (Apr. 22, 2024).

[16] *Comments Of NCSEA, The Southern Alliance for Clean Energy, Sierra Club, and Natural Resources Defense Council in Support of The Public Staff's Motion for Issuance of Commission Order*, Dkt. No. E-100, Sub 190. (Apr. 25, 2024).

[17] *Order Denying the Public Staff's Motion to Expedite Offshore Wind Acquisition Request for Information*, Dkt. No. E-100, Sub 190, 7 (May 6, 2024).

[18] *Comments of NCSEA et al.*, at 6–7.

information because they are currently negotiating with other states and utilities many of the same issues that are directly relevant and germane to the ARFI and the Commission's consideration, this knowledge transfer should be strongly encouraged. The presentation of the results of actual negotiation between the interested parties—i.e., the Companies and the WEA leaseholders—that recognizes the contemporary state of OSW development, rather than a quasi-academic information gathering, will provide actual contemporary evidence on how the potential for OSW will support the ratepayers and economy of North Carolina. The Companies' proposed ARFI will not fulfill this need in a timely manner, with any level of accuracy, without adopting the additional procedural steps and instruction recommended above. We strongly suggest that the Commission adopt these recommendations to modify the proposed ARFI to facilitate the acquisition of the data and information that is required for the Commission to make an informed decision on OSW procurement in the current CPIRP proceeding.

In addition to our recommendations regarding an amended ARFI with more process and structure, we recommend including the following early development activities and funding for OSW in the NTAP.

1) Authorize, for purposes of executing the CPIRP, early development activities for the deployment of OSW with the ability to incur an equivalent level of funding—approximately $75 million—committed to New Nuclear near-term development actions through 2026. These funds should be earmarked towards the necessary site assessment activities—like geophysical surveys using high resolution instruments to map the seafloor and geotechnical site investigation equipment needed to map out the areas 200 feet under the subsea bottom surfaces—to prepare and collect the site characterization data required for approval of the Kitty Hawk and Carolina Long Bay lease areas' Construction and Operating Permits (COP), as well as supporting early transmission planning for the OSW facilities in development;[19] and

2) Following the conclusion of the ARFI, convene a separate docket specifically for the purpose of receiving annual and/or regular updates to track the OSW procurement and development activities.

Importantly, these early development activities for the procurement of OSW can occur in parallel to the ARFI; which will help ensure that the procurement of OSW generation outpaces or meets the Companies' proposed timeline for OSW in Portfolio P3 Fall Base. These tasks are necessary undertakings for the timely deployment of OSW generation and are comparable to the functions that the Commission has already funded for New Nuclear technology.

In making these recommendations, we must not lose sight that the Plan, as initially filed on August 17, 2023, substantially defers and effectively postpones any early development activities necessary to facilitate the future deployment of OSW. By incorporating these recommendations, the Commission would be treating OSW in a manner consistent with the early deployment of New Nuclear and other long-lead generation resources. Without incorporating these

[19] These funds can also be directed towards funding the activities of staff in the interstate collaboration proposed in this report.

recommendations, it is our opinion that the Companies' proposal—both its initial Plan and CPIRP Update—will function to potentially eliminate OSW from the foreseeable future mix of electric generation in North Carolina. In effect, as discussed throughout this report, adopting the Companies' proposal ***creates a substantial execution risk that neither OSW nor the New Nuclear technologies are developed in a manner that will effectively and timely address the stated requirements of HB 951***.

We believe that postponing the early development of OSW deployment cannot be justified, especially when considering the significant actual and potential growth of the North Carolina economy, and the devastating impact that a shortage of electric generating capacity will have on the state's economy and promising economic growth into the future. Embracing diversity in generation technology development is a long-standing, conservative regulatory principle that we believe should be adopted by the Commission. This is particularly true because many of the core elements of the future CPIRP generation fleet are also new and are also subject to potential delays and/or deployment failures. There is no correlating delay proposed in the early development of the New Nuclear technologies—which share less actuarial history than OSW. The logic of foregoing any reliable, well-known, highly developed, and ubiquitously deployed generation technology—like OSW—constitutes a bold leap of faith in the belief that the other new or nascent technologies being developed will undoubtedly succeed. OSW has progressed significantly further through private investment by independent developers. Ultimately, forgoing early development of OSW may critically impede North Carolina's economic growth at a pivotal time for the state's future economy.

In the Plan, the NTAP and proposed early development schedule treats both OSW and New Nuclear as "second movers." As set forth in the Plan, the Companies' preference is that New Nuclear technology will not be deployed by the Companies until after a different utility goes forward with deployment.[20] Therefore, the Companies are second movers. In addition, the Plan's preferred portfolio declining to pursue OSW until some unspecified time in the mid-2030s also effectively further designates OSW as a "second mover" technology.[21] The lack of first mover status for either of these critical generation technologies may result in neither being developed in a timely manner. Our recommendation is that both technologies should be intentionally designated for early development in a simultaneous manner to assure that at least one of these long lead technologies will be successfully and effectively deployed by 2030.

In the Verified Amended Petition, the Companies requested authorization "to incur project development costs up to $75 million through 2024 plus an additional $365 million through 2026 for the development of advanced nuclear resources."[22] Likewise, for OSW the Companies are only asking for $1.4 million to develop and administer the proposed ARFI and no other authorizations to incur similar early development costs.[23] The costs of moving ahead

[20] *Carolinas Resource Plan*, App'x J – Nuclear, at 15.

[21] *Carolinas Resource Plan*, Ch. 3 – Portfolios, at 5 ("Offshore wind remains an important option for Pathway 3 in the mid-2030s, but the more measured pace of transition allows additional time to check and adjust the Plan with respect to this major investment.").

[22] *Verified Amended Petition*, at 32 (referencing request for relief 2(d)(v)).

[23] *Id.* (referencing request for relief 2(d)(iv)).

aggressively with the early development of OSW, on the same time frame as New Nuclear, are minimal compared to the economic costs of an electric generating capacity shortage if other technologies and deployments do not manifest as planned for any reason. The potential stranded costs imposed for early OSW development activity would be dwarfed by the negative economic impact on the state if other new development efforts are stalled.[24] Diversity in early development of generation technology development is a cost-effective means to address this critical vulnerability.

1.2 Statutory and Procedural History

On October 13, 2021, North Carolina Gov. Roy Cooper signed into law HB 951, codified as N.C. Gen. Stat. § 62-110.9, captioned "Energy Solutions for North Carolina." The principal near-term goal of this law is to achieve a 70% reduction in carbon emissions, by 2005 levels, from the state's electric generation facilities by the year 2030.[25] This would be primarily achieved through the retirement of the state's coal-fired generating facilities and implementation of a robust plan to build and operate alternative electric generation assets that produce low or no carbon emissions.

In response to HB 951, the Companies filed the 2022 Carbon Plan (the "Initial Plan") with the Commission on May 16, 2022, outlining the Companies' proposal on how to achieve the 70% reduction through several detailed portfolios of generation assets. The Commission issued its final order on the Initial Plan on December 30, 2022. Among its directives, the Commission found much of the Initial Plan "reasonable for planning purposes."[26] The Commission also ordered a new process for reviewing updates to the Initial Plan by combining the Carbon Plan and Integrated Resource Planning proceedings into the biennial CPIRP.

Pursuant to the Commission's Order, the Companies filed its updated plan in this CPIRP proceeding on August 17, 2023.[27] The Plan recommended changing the Companies mix of generation assets over time, including consideration and implementation of new technologies never previously deployed by the Companies. As in its Initial Plan, the CPIRP included detailed portfolios of generation assets to be developed over a lengthy period and provided the Companies' rationale for selecting their preferred portfolio—P3 Base portfolio—and the deployment schedule and process for the selected generation and supply side assets.

On November 30, 2023, due to a large surge in economic activity in North Carolina during 2023, the Companies announced it had updated its electric load forecast to account for a significantly

[24] Stranded costs occur when a technology is far along in deployment and becomes expectedly uneconomic. Any of these technologies being considered may be determined to be uneconomic and can be abandoned during development stage well before the stranded costs become excessive if the deployment does not prove to be viable. This determination can be made long before those stranded costs are substantial. Forgoing the minimal level of potential developmental stranded costs to pursue the conservative goal of establishing diversity in the eventual North Carolina generation fleet represents, in our opinion, resources well spent.

[25] N.C. Gen. Stat. § 62-110.9.

[26] *Order Adopting Initial Carbon* Plan, at 19, 38, 63, 78, 129.

[27] *See generally, Verified Petition*.

increased electric demand in the Companies' service territories.[28] Accordingly, as discussed above, the Companies filed updated modeling and the supplemental portfolio P3 Fall Base on January 31, 2024 (the "CPIRP Update"). The supplemental portfolio proposes changes for the significant reorganization of the Companies' electric generation assets, including changes to the deployment of long-lead generation resources like OSW and New Nuclear, to meet the updated electric load forecast while reducing carbon emissions from its electric generation facilities by 70% through 2035 and to become net-zero by 2050.

1.3 Basis for Deployment Determinations

This report constitutes a close and detailed examination of the important considerations for deployment of both the OSW and New Nuclear technologies, made on a relative basis using a representative objective taxonomy of concerns with detailed descriptions, to provide informed guidance on the optimal timing of deployment for each resource. The important aspects and concerns for the Commission to consider in determining the appropriate timing for the deployment of both OSW and New Nuclear long-lead generation assets are, in fact, similar. Both technologies represent large capital expenditures by the Companies that will be passed through to and paid for by the Companies' ratepayers. These generation resources both represent a substantial level of carbon free generation to the Companies' systems once they are deployed. ***They both involve technological and logistical aspects of deployment that may potentially cause delay in bringing either technology into operational generation status in the timely manner necessary.***

Our examination also concludes that OSW is equally as deployable as New Nuclear. That is not to say that either technology can be routinely or easily deployed in the Companies' electric generation mix. Both are somewhat new technologies, never previously deployed in North Carolina and the Companies' service territories and should be carefully implemented over an appropriate period of time. However, given the benefits and challenges that may arise during the implementation of these two technologies, our conclusion is that neither technology is any more advantageous for early deployment than the other. In other words, our analysis does not support the conclusion that the New Nuclear option is deployable significantly in advance of the OSW option as outlined in the Companies' preferred portfolio. The similarities in deployment risks and operational benefits strongly suggest that both resources should be deployed in the same timeframe.

Pursuing deployment diversity by initiating significant progress on both OSW and New Nuclear now also provides an additional element of redundancy and reliability to the CPIRP Update and resource planning, generally. If one technology is not deployed as planned, which is a distinct possibility with either technology, the other could make up for the absence of generation capacity that will be required to effectively power the quickly growing North Carolina economy. Because the near-term plans for New Nuclear are currently funded and active, we believe that the near-term plans for OSW should also be funded and initiated at this time. We view the Commission's

[28] *See Supp. Direct Testimony of Glen A. Snider on Behalf of Duke Energy Carolinas, LLC & Duke Energy Progress, LLC*, Dkt. No. E-100, Sub 190 (Nov. 30, 2023).

determination on the relative timing of the deployment of these technologies as critical to support the continued expansion of the North Carolina economy.

1.4 Purpose and Structure of this Report

The purpose of this report is to assist the Commission with its principal goal in this proceeding: to make rational and reasonable determinations for the best overall mix, use, and timing of several generation technologies that the Companies will deploy in pursuit of achieving HB 951's requirements. The Companies have put forward their proposal for the optimal mix and timing of deployment of generation technologies in their NTAP, which extends over the next few years through 2026, and the Intermediate Term, extending through 2032. This report, as stated, closely examines and compares the technical and financial feasibility risks affecting the timing of the deployment of both the OSW and New Nuclear long-lead technologies, and how they are treated in the NTAP. The results and information presented here are actuarial in nature and not the results of a modeling exercise.

We have framed our analysis of the objective stated criteria to reflect on a realistic and pragmatic basis, a direct comparison of the attributes and obstacles of deploying each technology. This report first comprehensively examines a parallel taxonomy of relevant characteristics of the OSW technology (Chapter 2.0) and the New Nuclear technology (Chapter 3.0) that are relevant to the decision-making process that we believe the Commission must undertake. In each chapter, the information is framed and organized into the following four broad, principal topical areas and significant subtopics of concern to examine each technology in a side-by-side manner. The principal topical areas are:

(1) the execution risks associated with each technology to promote an orderly transition from the current generation mix to the new mix of generation assets,

(2) the capability of the business models for each technology to effectively achieve the least-cost carbon reduction results and ratepayer equity,

(3) how each technology contributes to the most effective means of maintaining and/or improving system reliability, and

(4) the capability of each technology to promote the general welfare and well-being of the citizens and residents of North Carolina.

Chapter 4.0 is a comparative analysis, presented as a summary, discussing our analyses and conclusions of the four relevant areas of concern for the timely deployment of OSW and New Nuclear technologies. This chapter represents an "apples-to-apples," side-by-side comparison of a detailed taxonomy of critical considerations in the timing of the development and deployment of these two technologies. There, we attempt to form an objective basis for the Commission's determination of the optimal timing and development of the deployment of these two carbon free generation technologies. As a result, these direct comparisons carefully illustrate the relative risks and benefits for the deployment of the OSW and New Nuclear technologies.

2.0 OFFSHORE WIND GENERATION

2.1 Introduction

In the Plan, as filed on August 17, 2023, the Companies preferred generation portfolio, Portfolio P3 Base, regarding the long-lead time generation options, proposes to rely on the New Nuclear option and to defer the OSW option for future consideration.[29] In the CPIRP Update's supplemental portfolio, P3 Fall Base, although the Companies accelerate the deployment of OSW and propose to issue the ARFI ***in early 2025***,[30] it is our belief that the Companies continue to unreasonably defer the OSW option.[31] We believe the Companies' recommendation regarding the ARFI is misguided and we endorse the recommendations of NCSEA et al. in their comments in support of the Public Staff's motion to expedite the ARFI. Our full recommendations regarding OSW are clearly stated in Section 1.0 of this report.

While OSW is a relatively new technology to North Carolina and the Companies, OSW has been in use for decades with thousands of turbines in operation across the world.[32] OSW installations are ubiquitous globally in many regions (particularly in Europe, the United Kingdom, and Eastern Asia). Even in the United States there are currently at least four utility-scale OSW deployments on the East Coast of the United States that are well along in their deployment—two of which are now delivering power to their onshore clients.[33] These four deployments were initiated several years ago and considerable United States supply chain, regulatory, construction, and operational experience has been acquired during the process of these projects' development. In fact, some of that construction and operational experience in the United States is possessed by two parties to this proceeding: Avangrid (the Kitty Hawk Wind Energy Area ("WEA") leaseholder) and TotalEnergies (a leaseholder in the Carolina Long Bay WEA).[34]

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[29] *Carolinas Resource Plan*, Ch. 3 – Portfolios, at 3 (referencing Figure 3-1 which shows Advanced Nuclear affirmatively selected in P3 Base by January 1, 2035, and OSW was not); *see also, id.*, at 5 (describing OSW's role in Pathway 3).

[30] *Verified Amended Petition*, at 21.

[31] The intent of an ARFI is to obtain industry feedback early in the acquisition planning process to help develop an acquisition strategy that benefits both the government and industry. Not only has this process already occurred in concert with DNV, but as discussed in this report, we believe that direct input from industry acquired through a formal Request for Proposals and direct negotiations on an acceptable acquisition schedule is a far superior method to accomplish this goal.

[32] Musial, et al., *Offshore Wind Market Report: 2023 Edition*, U.S. DEP'T OF ENERGY at xii, 52 (Aug. 2023), https://www.energy.gov/sites/default/files/2023-09/doe-offshore-wind-market-report-2023-edition.pdf.

[33] The 800 MW Vineyard Wind 1 Project and the 132 MW South Fork Wind Project are in active construction or are completed and currently producing power. Two other offshore wind projects are under construction or in near-term preparation for construction—the 704 MW Revolution Wind Project and the 2.6 GW Coastal Virginia Offshore Wind Project. During the composition of this report substantial progress has been made on several additional OSW projects on the U.S. east coast that may not be fully represented in this report.

[34] Avangrid is pioneering the offshore wind industry in the United States, building the nation's first large-scale offshore wind project, the Vineyard Wind 1 Project, while pursuing a portfolio representing six gigawatts of clean power along the U.S. East Coast. TotalEnergies has been actively expanding its offshore wind business, with projects in the United States, the United Kingdom, France, and other countries.

Accordingly, both Avangrid and TotalEnergies can directly provide the detailed actuarial information sought through the ARFI, including updated pricing. As per our recommendations, the adoption of a procedural schedule for an expedited ARFI that requires the Companies and the WEA leaseholders to provide a substantive written record for the Commission by Fall 2024, of the meaningful negotiations for an acquisition schedule combined with a technical conference convened for the purpose of receiving presentations on the preliminary findings of the expedited ARFI process, will provide the Commission a strong basis for decisions on OSW's deployment by the end of 2024. Further, the joint development of negotiated procurement schedules by the Companies and leaseholders will assist the Commission and staff in successfully guiding the development of, at least, the 2.4 GW of offshore wind generation proposed in the CPIRP Update. Such an organized effort will also provide a basis for possible expansion of OSW deployments if the Commission should so choose.

Additionally, the other existing OSW deployments not under the purview of parties in this proceeding—particularly the OSW deployment commencing in Virginia—can serve as the educational sources necessary for the Commission and the Companies to consider. In particular, the Coastal Virginia Offshore Wind ("CVOW") project, which has already started construction activities, can inform the Commission and parties about implementing substantive early development activities to advance OSW deployment on the North Carolina Outer Continental Shelf ("OCS"). We believe that given the readily available details, knowledge, and economics—including alternative regulatory treatments—from first-movers of the existing large-scale deployments of OSW in neighboring states, North Carolina can learn a great deal.

Other, creative avenues to collect information on the deployment of OSW also exist. The existence of a formal Memorandum of Understanding (MOU) between the states of Virginia, North Carolina, and Maryland avails the Commission and its staff of resources developed to deploy OSW technology off the coast of these three participating neighboring states.[35] The Southeast and Mid-Atlantic Regional Transformative Partnership for Offshore Wind Energy Resources ("SMART-POWER") MOU has the explicit purpose of reducing administrative burdens, producing regulatory certainty, and sharing information to develop best practices for OSW deployment.[36]

The SMART-POWER MOU is specifically designed to promote, develop, and expand OSW electric generation and the accompanying industry supply chain and workforce along the Eastern Seaboard. The activities outlined in the SMART-POWER MOU include

(1) an interstate cooperative agreement to develop supply chain assets;

(2) to clarify, streamline and align state regulatory requirements for the construction and installation of OSW projects;

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[35] *See generally*, *Memorandum of Understanding among Maryland, North Carolina, and Virginia to Create the Southeast and Mid-Atlantic Regional Transformative Partnership for Offshore Wind Energy Resources SMART-POWER Partnership (SMART-POWER)*, available at https://files.nc.gov/governor/documents/files/SMART-POWER-MOU_FINAL.pdf.

[36] *Id.*

(3) to cooperate in the identification evaluation and promotion of vital infrastructure workforce;

(4) to coordinate university research activities and training programs;

(5) to promote the mid-Atlantic and Southeast United States as an OSW energy and industry hub and to share best practices in outreach and resource utilization;

(6) to coordinate federal communications with the Departments of Commerce, Defense, Homeland Security, and Interior; and

(7) to collaborate with OSW stakeholders including manufacturers, supply chain and industry representatives, along with nongovernmental organizations and other utilities and local governments.[37]

Under the SMART–POWER MOU, the participating states agreed to form a leadership team with representatives from each state, including a senior official authorized to represent the state by each state's governor. The leadership team meets quarterly and provides regular updates. We recommend the Commission invite representatives of the SMART-POWER MOU leadership teams to advise the Commission on the learnings of this multistate collaborative. It is our belief that, if approved, the same technical conference we recommend the Companies and WEA leaseholders present on the progress of the expedited ARFI in the Fall of this year would be an appropriate forum to receive this information. We believe that this proposed modified and expedited ARFI process provides a far more effective way to obtain relevant knowledge and will provide the Commission with the *de facto* information needed to render an informed set of decisions regarding the Companies' deployment of offshore wind generation. The developments and progress in neighboring states are articulable and available to the Commission for its *de facto* consideration rather than relying on the ARFI's *de jure* educational process that we believe will only further delay the availability of the significant benefits of OSW to the economy of North Carolina.

The more immediate deployment of OSW in North Carolina will create significant economic development benefits throughout the state. State agencies, including the North Carolina Department of Commerce and the Governor's NC Taskforce for Offshore Wind Economic Resource Strategies ("NC Towers Taskforce"), have made many of these benefits clear and have advocated for OSW development to spur the state's economy. North Carolina has a broad and robust manufacturing base capable of producing many of the OSW technology components and conducting highly technical elements of the OSW installations and services. The State's education system is already building capacity to take advantage of this capability and is currently expanding the relevant OSW workforce. Lastly, with construction of OSW facilities, the State's port facilities will be improved and expanded to accommodate OSW deployment and maintenance, spurring further economic growth. All this development will significantly benefit the citizens of the state in terms of improved general welfare and improved standards of living. As long as OSW deployment is delayed it will materially and unnecessarily deprive the state's citizens and economy of these significant benefits.

[37] *Id.*

2.2 EXECUTION RISK

2.2.1 Near Term Planning

As discussed in the conclusions of this report, we believe that OSW may be deployable before New Nuclear for reasons described in Section 3.0. However, this will require the Commission to authorize substantive material actions to commence planning and analysis for OSW generation as soon as practicable rather than relegating OSW for future consideration while actively pursuing the New Nuclear option. Both the OSW and New Nuclear options should proceed on parallel development tracks with equivalent importance and resources. If, for example, New Nuclear should face schedule challenges in deployment, then OSW generation may be available to provide increased supplies of low-carbon electric power to assist in adequately serving the energy needs of North Carolina's growing economy.[38] Accordingly, as previously stated, we believe that the Commission should authorize the following near-term and intermediate-term actions to achieve material advancement of OSW:

1) Adopt a procedural schedule that requires interim updates from Duke and the WEA leaseholders of the ARFI and its preliminary results, including meaningful direct negotiations, written filings and/or convening a technical conference for the purposes of receiving presentations from the Companies and the WEA leaseholders on ARFI and its preliminary results in the Fall of 2024 to inform the Commission's decision-making related to next steps for the development and procurement of offshore wind in this proceeding;

2) Direct the Companies and the WEA leaseholders to jointly develop, through direct negotiations, procurement schedules for each WEA, with achievable milestones through 2032, to guide the development of all, or a portion of, each WEA to achieve, at a minimum, the proposed 2.4 GW of offshore wind generation in the Companies' supplemental portfolio and analysis.

3) Authorize, for purposes of executing the CPIRP, early development activities for the deployment of OSW with the ability to incur an equivalent level of funding—approximately $75 million—committed to New Nuclear near-term development actions through 2026. These funds should be earmarked towards the necessary site assessment activities—like geophysical surveys using high resolution instruments to map the seafloor and geotechnical site investigation equipment needed to map out the areas 200 feet under the subsea bottom surfaces—to prepare and collect the site characterization data required for approval of the Kitty Hawk and Carolina Long Bay lease areas' Construction and Operating Permits (COP), as well as supporting early transmission planning for the OSW facilities in development; and

[38] *Carolinas Resource Plan*, Ch. 3 – Portfolios, at 16 (Duke validates this assertion, even before the increased load forecast, by stating "[a]dvanced nuclear *or* offshore wind is required to achieve the Interim Target by 2035. In the Portfolio Variant for Pathway 3 in which SMRs are not available for model selection until 2037, the model adds 1,600 MW of offshore wind by 2035 to achieve the target. The target is still met in 2035 . . . .").

4) Following the conclusion of the ARFI, convene a separate docket specifically for the purpose of receiving annual and/or regular updates to track the OSW procurement and development activities.

By initiating these planning and early development activities now, the actual construction of an OSW generation facility could begin within the three to four years it is expected to take to finalize, submit, and receive approval of the Construction and Operations Plan (COP). In the same three-to-four-year timeframe, the Companies can build their capabilities to operate and/or effectively monitor the production of electric power of an OSW generation facility to accommodate any acquisition structure.

2.2.2 Permitting & Licensing

The new Renewable Energy Modernization Rule issued by the Bureau of Ocean Energy Management ("BOEM") and the Bureau of Safety and Environmental Enforcement ("BSEE") on May 15, 2024, streamlines and modernizes the permitting process for offshore wind projects on the U.S. OCS.[39] The Renewable Energy Modernization Rule reduces administrative burdens, lowers costs, and increases regulatory certainty for offshore wind developers operating on the U.S. OCS. This regulation is effective on July 15, 2024, and is expected to facilitate the continued growth and deployment of offshore wind energy in the United States.

Specifically, the rule makes the following key changes to previous regulations:

1. Eliminates unnecessary requirements for the deployment of meteorological (met) buoys, increasing flexibility for developers;
2. Increasing survey flexibility to allow more time to complete the required geotechnical surveys and provide greater flexibility in designing projects;
3. Improves the project design and installation verification process, reducing administrative burdens;
4. Establishes a public Renewable Energy Leasing Schedule to provide more certainty and transparency around upcoming lease sales;
5. Reforms the renewable energy auction regulations to make the process more efficient;
6. Tailors financial assurance requirements and instruments to better fit the needs of the industry;
7. Clarifies safety management system regulations to enhance compliance; and
8. Finalizes all other technical corrections, the most significant of which are restructuring commercial lease terms into four periods tied to specific development

[39] Renewable Energy Modernization Rule, 89 Fed. Reg. 42,602 (May 15, 2024) (to be codified at 30 C.F.R. pts. 285, 585); *see also* Joshua V. Berliner, *US BOEM Proposes Modernized Offshore Wind Regulations*, MAYER BROWN LLP INSIGHTS (Jan. 17, 2023), https://www.mayerbrown.com/en/insights/publications/2023/01/us-boem-proposes-modernized-offshore-wind-regulations.

activities and allowing for regulatory departures before and after a lease or grant is issued to provide more flexibility.[40]

However, prior to the recent promulgation of the new rule summarized above, the developers leasing the three WEAs being considered by the Commission followed the previously existing procedures. For the Commission to consider the substantial efforts and significant expenditures already made by these developers, we summarize the previously required regulatory activities carried out, below. ***Importantly, the first two phases of the previous process have already been carried out by the WEA leaseholders.***

2.2.2.1 Previous Permitting Activities Carried Out by Current Lease Holders

Section 388 of the Energy Policy Act of 2005 provides the renewable energy authorization and permitting process that applies to the OSW facilities under consideration by the Commission. Principally conducted by the U.S. Department of the Interior under BOEM, the permitting process encompasses four main phases: (1) planning and analysis (approximately 2 years); (2) issuance of a lease or grant (approximately 1-2 years of planning and a one-year Preliminary Lease Term), (3) site assessment (a process inclusive of a five-year Site Assessment Lease Term), and (4) construction and operations (approximately 2 years of work with a 33-year Operations Term). The term of each phase of the leases enumerated above are updated and issued sequentially upon the completion of prior phase. The licensee may request renewal of the Operations Term which may be approved by BOEM to conduct substantially similar activities as were originally authorized under the lease or in an approved plan. If extended, the financial conditions of the lease may be modified.

A detailed SAP includes the proposed timelines for the construction, installation, and decommissioning of meteorological towers, meteorological buoys, and other installations that the lessee uses to assess what activities should be conducted on the leasehold. BOEM requires lessees to submit an SAP within 12 months of being granted the lease, with opportunities for necessary extensions.[41] During the site assessment phase, the lessee may also conduct site characterization surveys and studies to better understand how to mitigate the effects on avian and marine species. In addition, a conceptual decommissioning plan must include the nature, intensity, and duration of disturbances to the sea bottom, an evaluation of biological resources and potential impacts to them, impacts to water quality and benthic footprint, and environmental monitoring methods.[42]

A major component of the conduct of the SAP is the requirement for an Environmental Impact Statement ("EIS"), under the National Environmental Policy Act ("NEPA").[43] Potential

[40] Renewable Energy Modernization Rule, 89 Fed. Reg. at 42,603–04.

[41] Renewable Energy on the Outer Continental Shelf, 30 CFR § 585.601.

[42] U.S. DEP'T OF INTERIOR, BUREAU OF OCEAN ENERGY MGMT., *Guidelines for Information Requirements for a Renewable Energy Site Assessment Plan (SAP)* (June 2019), https://www.boem.gov/sites/default/files/renewable-energy-program/BOEM-Renewable-SAP-Guidelines.pdf.

[43] *See, e.g.*, U.S. DEP'T OF INTERIOR, BUREAU OF OCEAN ENERGY MGMT, *Vineyard Wind 1 Offshore Wind Energy Project Final Environmental Impact Statement, Vol. I* (Mar. 2021),

environmental impacts of OSW energy projects include, impacts on wildlife, avian, shellfish, finfish and benthic habitat; impacts on aesthetics, cultural resources, socioeconomic conditions; and impacts on air and water quality.[44] Beyond NEPA, other federal statutes have jurisdiction over specific ocean resources. Some of the most relevant authorities are the Endangered Species Act (ESA) 50 CFR Part 10, the Marine Mammal Protection Act (MMPA) 50 CFR Part 12, and the Migratory Bird Treaty Act (MBTA) 50 CFR Part 10. The agencies that administer those statutes do not have final authority over leasing decisions but are likely to be involved in the environmental review process leading to a final Department of Interior ("DOI") decision.

The COP is the actual plan and timeline for the construction, operation, and conceptual decommissioning of the OSW facility on the lease.[45] Once the COP is approved and the Facility Design Report and the Fabrication and Installation Report are approved by BSEE, the OSW generation facility may progress further toward construction. Two years before the expiration of the lease, the lessee is required to submit a decommissioning application to BSEE for approval. Decommissioning funds assurances are secured in stages after the Planning and Analysis phase to assure adequate financial resources availability.

In consideration of the process for OSW facilities being authorized for operation by the Commission, it is important to note, as previously discussed, that the first two phases of this process have already been carried out by the developers. The planning and analysis phase and the issuance of the leases have occurred for both the Kitty Hawk and Carolina Long Bay WEAs. For the Kitty Hawk WEA, Avangrid submitted its SAP in 2020 and its updated COP in September 2022 for the Kitty Hawk North Project.[46] The EIS for the Kitty Hawk North project has been submitted to BOEM and is awaiting publication in the Federal Register scheduled for July 11, 2025, and is scheduled for final agency action by May 18, 2026.[47] Accordingly, Avangrid is waiting for these agency actions to conclude to commence the construction and operation phase for the northern part of the WEA. Figure 1 is the timeline put forward by the federal government on the Permitting Dashboard which shows a projected final approval date for construction of Kitty Hawk North consistent with a 2028 commencement. The Kitty Hawk North generation facility is expected to interconnect to the PJM Interconnection, through Dominion Energy, at Virginia Beach, Virginia, and start generating power by October 2029.[48]

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https://www.boem.gov/sites/default/files/documents/renewable-energy/state-activities/Vineyard-Wind-1-FEIS-Volume-1.pdf.

[44] Vann, Adam (2023, Feb. 28) *Offshore Wind Energy Development: Legal Framework* (CRS Report No. R40175), https://sgp.fas.org/crs/misc/R40175.pdf.

[45] U.S. DEP'T OF INTERIOR, BUREAU OF OCEAN ENERGY MGMT., *Information Guidelines for a Renewable Energy Construction and Operations Plan (COP), Version 4.0* (May 27, 2020), https://www.boem.gov/sites/default/files/documents/about-boem/COP%20Guidelines.pdf.

[46] Schlenker, et al., *Offshore Wind in North Carolina: Updates on the Kitty Hawk Wind and Carolina Long Bay Projects* (Oct. 12, 2023), available at ehttps://safmc.net/documents/mcap_a6_offshorewindactivities-pdf/.

[47] PERMITTING DASHBOARD, FED. INFRASTRUCTURE PROJECTS, https://www.permits.performance.gov/proj/kitty-hawk-north-wind-project/environmental-impact-statement-eis (last visited May 23, 2024).

[48] AVANGRID RENEWABLES, *Kitty Hawk Offshore Wind Project, Site Assessment Plan – Public*, (Feb. 2, 2019), https://www.boem.gov/sites/default/files/documents/renewable-energy/state-activities/north-carolina/Avangrid-

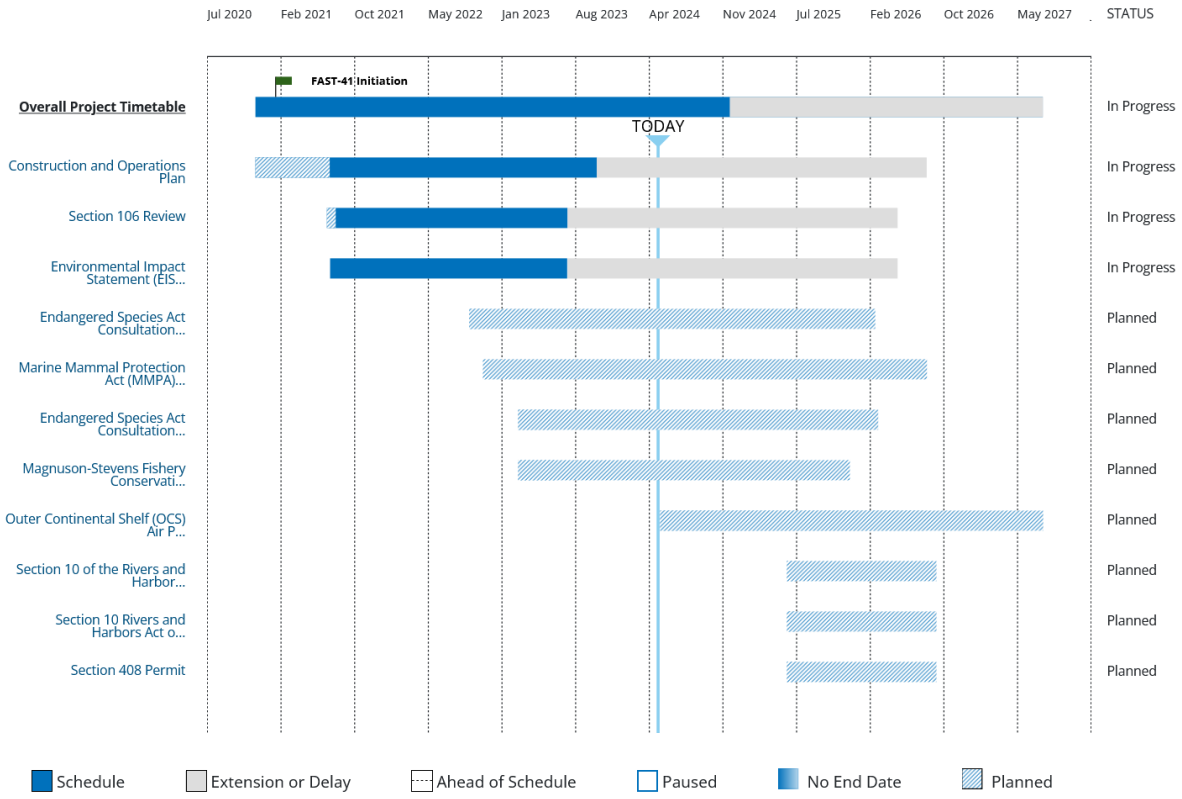

Figure 1. Kitty Hawk North projected timeline.[49]

For Kitty Hawk South, review of the COP has been in progress since May 3, 2022, and the state permitting processes have not yet begun. Construction for Kitty Hawk South is scheduled to start no earlier than 2028.[50] In estimating the remaining time available to put an OSW generating facility into operation in the northern portion of the Kitty Hawk WEA, the project can be operational within the next four to six years. Further planning will be required for the development of the remaining southern portion of the WEA.

TotalEnergies and Duke Energy, through its unregulated direct subsidiary Cinergy, have been conducting site assessment activities and have submitted draft information and extension requests concerning their proposed SAP activities for the Carolina Long Bay lease area. Consequently, the Carolina Long Bay lease areas are preparing their COP, most of which will progress with certainty should the Commission allow lessees to incur early development costs for the site characterization surveys. The purpose of site characterization surveys, like

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Kitty-Hawk-SAP.pdf; *see also Kitty Hawk North Wind*, TETHYS https://tethys.pnnl.gov/wind-project-sites/kitty-hawk-north-wind (last visited May 23, 2024).

[49] PERMITTING DASHBOARD, FED. INFRASTRUCTURE PROJECTS, https://www.permits.performance.gov/permitting-project/fast-41-covered-projects/kitty-hawk-south-offshore-wind-project.

[50] *Id.*

geotechnical exploration, "would be to assess the suitability of shallow foundation soils for supporting a structure or transmission cable under any operational and environmental conditions that might be encountered (including extreme events), and to document soil characteristics necessary for the design and installation of all structures and cables."[51] Since neither TotalEnergies nor Cinergy have submitted a COP to BOEM under the previous regulatory requirements, the estimated timeframe for initiating construction for the Carolina Long Bay lease areas may be longer than the timeframe for the Kitty Hawk lease areas.

2.2.3 Supply Chain/Interest Rates/Price Certainty

During 2021, the COVID-19 pandemic was elemental in constraining all major supply chains for production of goods and services in the global economy. Supply chain interruptions across the global economy have been closely related to inflation.[52] Inflation concerns have spurred central banks, including the U.S. Federal Reserve, to raise its rediscount rate causing retail interest rates to surge beginning in 2020. For all major energy projects—including OSW projects—carrying costs are highly sensitive to interest rates. Inflation went as high as 7% in the United States during that period, but since then has retreated to approximately 3.4%.[53] Consequently, several large OSW projects that negotiated offtake agreements prior to the global market distortions and slated to be constructed on the East Coast of the United States were terminated or put on hold to renegotiate the costs of the projects due to rising carrying costs and supply chain issues in 2023.[54]

Concerns over supply chains and inflation—although less of a concern now than during 2023—remain important considerations for the Commission in evaluating North Carolina OSW projects. The principal supply chains for the production of goods and services in the general global economy have been largely restored to their pre-pandemic state, despite residual uncertainty regarding any further future interruptions.[55] Moreover, since OSW projects are capital-intensive and the burden of high carrying costs due to the high residual commercial interest rate project financing, this issue has not reached final resolution. As a result, a high level of caution has been applied to consideration of all proposed and future generation projects, not restricted to OSW projects. In other words, the inflationary pressures that affect the funding and completion of

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[51] U.S. DEP'T OF INTERIOR, BUREAU OF OCEAN ENERGY MGMT., *Coastal Zone Management Act, Consistency Determination – Kitty Hawk Wind Energy Area Offshore the State of North Carolina*, 4 (using this document for the Kitty Hawk WEA to identify the purpose of site characterization activities and why they align with early development activities previously approved by the Commission.).

[52] Constraints on the supply of goods and services in the economy while demand has stayed elevated and increasing has been a major contributor to the rising cost of products in the marketplace. The result has been high inflation rates.

[53] *Consumer Price Index Summary*, U.S. BUREAU OF LABOR STATISTICS (May 15, 2024), https://www.bls.gov/news.release/cpi.nr0.htm.

[54] Ivan Penn, et al., *What Ails Offshore Wind: Supply Chains, Ships and Interest Rates*, NY TIMES (Dec. 11, 2023), https://www.nytimes.com/2023/12/11/business/energy-environment/offshore-wind-energy-east-coast.html.

[55] Laura Curtis, *Supply Chains Have Healed Yet Their Mark on Inflation to Endure*, BLOOMBERG (last updated Feb. 26, 2023), https://www.tbsnews.net/bloomberg-special/supply-chains-have-healed-yet-their-mark-inflation-endure-591110.

OSW projects apply to all major energy infrastructure projects—including all other projects being considered in the CPIRP. As such, inflationary pressures should not be used by the Commission to differentiate between the timeline for development of any of the more capital-intensive projects considered as part of this proceeding.

However, many of these costs and uncertainties for forthcoming OSW projects being considered by the Commission can be actively mitigated due to the extensive financial support provided by the Inflation Reduction Act ("IRA").[56] The IRA provides a tax credit for as much as 50% of the capital costs for OSW projects developed, pending the achievement of certain criteria. This legislation and the related federal subsidies, coupled with state carbon emissions mandates, are the prime reasons why, despite residual inflationary concerns, there are currently four OSW projects in the United States that are in, entering, or have completed the construction phase. The IRA is also a reason additional and recently terminated projects are being renegotiated and/or rebid into OSW procurement auctions. Supported by the IRA extending eligibility for the production and investment tax credits for projects that begin construction prior to January 1, 2025, the 800 MW Vineyard Wind 1 Project and the 132 MW South Fork Wind Project are in active construction and currently producing power.[57] Additionally, two other OSW projects are under construction or in near term preparation for construction: the 704 MW Revolution Wind Project and the 2.6 GW Coastal Virginia Offshore Wind ("CVOW") Project.[58] The CVOW is being constructed by Dominion Energy, the state's monopoly electric utility, due to the state of Virginia determining "[i]n order to meet the Commonwealth's clean energy goals . . . the construction or purchase by a public utility of one or more offshore wind generation facilities located off the Commonwealth's Atlantic shoreline or in federal waters and interconnected directly into the Commonwealth, with an aggregate capacity of up to 5,200 megawatts, is in the public interest."[59]

Since the termination events of 2023, a number of projects are being revived and new projects have been announced. This turnabout is a response to the continuing need of utilities and state authorities to pursue low- and no-carbon generation sources by nature of legislative mandates. Additionally, much of the confusion and misunderstanding of the mechanisms available to obtain

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[56] Natalia Luna, *Investment Conclusions from 2023's Clean Energy Sell-off*, COLUMBIA THREAD NEEDLE INVS., (February 2024), https://docs.columbiathreadneedle.com/documents/Investment%20conclusions%20from%202023%E2%80%99s%20clean%20energy%20sell-off.pdf?inline=true.

[57] Maria Gallucci, *The First Big US Offshore Wind Farm is Open – Here's What's Next*, CANARY MEDIA (Mar. 14, 2024), https://www.canarymedia.com/articles/wind/the-first-big-us-offshore-wind-farm-is-open-heres-whats-next.

[58] *See*, U.S. DEP'T OF INTERIOR, BUREAU OF OCEAN ENERGY MGMT., *Revolution Wind – Project Overview*, https://www.boem.gov/renewable-energy/state-activities/revolution-wind (last visited May 24, 2024) ("On November 17, 2023, the Bureau of Ocean Energy Management (BOEM) approved the Construction and Operations Plan (COP), as modified by the selected alternative in the Record of Decision, for the Revolution Wind Farm and Revolution Wind Export Cable Project."); *see also* U.S. DEP'T OF INTERIOR, BUREAU OF OCEAN ENERGY MGMT., *Coastal Virginia Offshore Wind – Project Overview*, https://www.boem.gov/renewable-energy/state-activities/CVOW-C (last visited May 24, 2024) ("On January 28, 2024, BOEM approved the Construction and Operations Plan for the Coastal Virginia Offshore Wind – Commercial (CVOW-C) Project.").

[59] VA. CODE ANN. § 56-585.1:11(B).

the financial benefits of the IRA continue to be addressed by federal authorities, which has improved developer confidence.

For example, in October 2023, after a third offshore wind solicitation in New Jersey, a special meeting was recently called to award OSW renewable energy credits. The New Jersey Board of Public Utilities ("NJPBU") chose the Leading Light project, a venture by Invenergy and energyRE for 2,400 MW capacity, at a price of $112.50 per MWh. The NJBPU also approved Attentive Energy 2**,** a 1,342 MW project by TotalEnergies and Corio Generation. With a future total nameplate rating of 3,772 MW, the awards are an effort by the State of New Jersey to get the state's ambitious renewable energy plans back on track after Ørsted's sudden withdrawal from its Ocean Wind 1 project on Oct. 31, 2023.[60]

Likewise, since New York declined to renegotiate its wind power purchase agreements with Ørsted, Equinor, and BP over their Sunrise Wind and Empire Wind 1 Projects,[61] Ørsted has rebid and was awarded an offtake agreement for its 924 MW Sunrise Wind project to replace the previous contract signed before the pandemic.[62] Norwegian oil group Equinor's 810 MW Empire Wind 1 since has received its COP and also was awarded an offtake contract in New York's fourth OSW solicitation.[63] Meanwhile, Equinor stated that the 1.2 GW Empire Wind 2 project "will be matured for future solicitation rounds" following the cancellation of its original contract.[64] Recently, it is also important to note that due to an equipment dispute regarding General Electric withdrawing plans for its 18 MW turbine design, New York has declined to approve conditional contracts for three other offshore wind projects with TotalEnergies, RWE and Britain's National Grid.[65] However, it is our understanding that these projects will also rebid into future New York OSW solicitations.

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[60] Kirk Moore, *New Jersey Energy Planners Award Two New Offshore Wind Bids*, WORKBOAT (Jan. 24, 2024), https://www.workboat.com/wind/new-jersey-energy-planners-award-two-new-offshore-wind-bids.

[61] Scott Disavino & Nichola Groom, *New York Rejects Orsted, Equinor, BP Requests to Charge More for Offshore Wind,* REUTERS (Oct. 12, 2023), https://www.reuters.com/sustainability/climate-energy/ny-will-not-change-offshore-wind-other-renewable-power-sales-contracts-2023-10-12/.

[62] *Ørsted and Eversource Win Bid for Updated Sunrise Wind. Project in New York*, ØRSTED (Feb. 29, 2024), https://us.orsted.com/news-archive/2024/02/orsted-and-eversource-win-bid-for-updated-sunrise-wind-project-in-new-york.

[63] *Empire Wind Project Hits Key Milestone with COP Approval*, EMPIRE WIND (Feb. 22, 2024), https://www.empirewind.com/2024/02/22/empire-wind-project-hits-key-federal-milestone-with-cop-approval/; *see also Empire Wind 1 Awarded Offtake Contract in New York's Fourth Offshore Wind Solicitation Round*, EQUINOR (Feb. 29, 2024), https://www.equinor.com/news/20240229-empire-wind-1-awarded-offtake-contract.

[64] Eduardo Garcia, *New York Lures Back Offshore Wind Builders Burnt by Cost Hikes*, REUTERS (Feb. 1, 2024), https://www.reuters.com/business/energy/new-york-lures-back-offshore-wind-builders-burnt-by-cost-hikes-2024-02-01/.

[65] Marie J. French, *Major Offshore Wind Projects In New York Canceled In Latest Blow To Industry*, POLITICO, (Apr. 19, 2024), https://www.politico.com/news/2024/04/19/new-york-offshore-wind-canceled-00153319.

There has been an ongoing debate in the wind power industry revolving around the push for larger wind turbines. Over the past several years the largest wind turbines have been in the 14 MW to 15 MW range. However, recently manufacturers have developed 10 MW sizes. In the New York dispute, GE declined to move forward with its

We list the trials and successes of deploying OSW in other states to exemplify that despite the objective challenges of deploying this resource, the OSW technology is maturing and expanding. Moreover, these projects are experiencing the costs of being the first movers of the OSW technology in the U.S. market. These deployments provide the Commission with valuable insights that Avangrid, TotalEnergies, and the Companies are learning without taking potentially costly prior actions toward the actualization of the North Carolina projects. As a second mover, the projects within the purview of this proceeding stand to benefit significantly from the experiences of others in the burgeoning U.S. OSW industry.

In addition to lessons learned regarding the deployment of the OSW technology, parties to this proceeding are witnessing the benefits OSW can produce throughout the economy to support the industry. New York has also committed $700 million to port infrastructure and manufacturing efforts for five wind ports including the Ports of Albany and Coeymans, as well as the South Brooklyn Marine Terminal.[66] The New Jersey Wind Port is also being subsidized and is expected to create substantial economic development in New Jersey as OSW projects are developed.[67]

North Carolina has several large ports that can be expanded for use in supporting OSW development and, further, can support more trade for the state both domestically and internationally. It should be recognized by the Commission that sending the appropriate market signals for the development of the existing WEAs in North Carolina can lead to the expansion of North Carolina ports to support manufacturing and construction activities in support of OSW development. This scenario represents a valuable economic development opportunity for the state. The North Carolina Department of Commerce performed a study and published a report on these benefits.[68] In particular, the ports of Morehead City and Radio Island are of particular interest.[69]

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18 MW version due to equipment production problems. Larger turbines, while able to deliver more power through fewer turbines in an installation, the vessels needed for the larger heavier turbines are not available. Many in the industry are recommending only using the 14 MW to 15 MW turbines until the equipment and installation vessel problems are resolved.

[66] Allegra Dawes & Sophie Coste, *Aligning Ambitions: State Strategies for Offshore Wind*, CTR. FOR STRATEGIC INT'L STUDIES, 2–3 (Sept. 2023), https://csis-website-prod.s3.amazonaws.com/s3fs-public/2023-09/230914_Dawes_Offshore_Wind.pdf?VersionId=BT3IMMZbGZjtgchreFhdxEOYrj1VzBgJ.

[67] *New Jersey Officials Break Ground on Multimillion Dollar Wind Port*, WASH. EXAMINER (Sept. 12, 2021), https://www.washingtonexaminer.com/news/1694599/new-jersey-officials-break-ground-on-multimillion-dollar-wind-port/ ("New Jersey's fiscal 2022 budget includes $200 Million allocated for the New Jersey Wind Port. Additionally, the New Jersey Board of Public Utilities is kicking in $13 million, and the New Jersey Department of Transportation is covering $44 million for dredging.").

[68] N.C. DEP'T OF COMMERCE, *Offshore Wind: Generating Economic Benefits In North Carolina - Economic Impact of a North Carolina Offshore Wind Farm*, https://www.commerce.nc.gov/nc-offshore-wind-energy-project-economic-impact-analysis-2-8-gw/download?attachment.

[69] BVG ASSOCS., *Building North Carolina's Offshore Wind Supply Chain*, 58–78 (March 2021), https://www.commerce.nc.gov/report-building-north-carolinas-offshore-wind-supply-chain/open.

Summary:

North Carolina has a strong supply chain focused on the onshore wind industry. North Carolina anchor companies form a strong basis for supply to the fast-growing offshore wind industry. Being a very business-friendly State, many strong companies are well represented, such as Nucor, Hitachi ABB, GE, and LS Cable.

The study included: (1) anchor company dialogues; (2) an economic development dialogue; (3) a workforce development dialogue and (4) a Tier 2 & 3 supply chain dialogue.

Prepare

- Actively support existing NC companies in the transition to OSW supply from North Carolina. [R15]
- Continue to promote and develop the NC Offshore Wind Supply Chain Registry. By the end of January, the new database had 42 sign ups. [R16]
- Consider the further integrating information about NC companies with wider US and global offshore wind databases, while keeping the platform accessible via North Carolina Department of Commerce website. [R22]

Facilitate

- Undertake further outreach and stakeholder activities especially with the companies in the NC Offshore Wind Supply Chain Registry. [R20]
- Evaluate establishing or being part of a more advanced database, possibly in collaboration with Virginia and Maryland. [R23]

Accelerate

- Assist existing and new anchor companies with access to market including securing appropriate sites, transport and port access. [R29]

It is also important to note that North Carolina will be a major supply chain participant in a growing OSW industry in the state. As pointed out in a table in the above-cited BVG Report the following in-state assets are available for participation in the OSW supply chain.[70]

The only clear means of stimulating the OSW-related economic development activities—including manufacturing opportunities for the multitude of small businesses in the state that have the capabilities, supply chains and transportation networks to manufacture the 80% of the non-Tier 1 parts needed for construction of OSW facilities—is for an appropriate market signal and support for the industry coming from the Commission by authorizing material progress towards the construction and operation of OSW facilities off the North Carolina coast. The North Carolina economy is poised and ready to take advantage of this opportunity. It must be emphasized that the process will not, and cannot, begin to materialize until the Commission acts to bring it to fruition. There are no inherent market mechanisms that can overcome a lack of regulatory clarity; that can only come from the Commission. To do otherwise may deprive North Carolina of an important source of carbon free electric generation and strong economic development that will result from the Commission's actions.

[70] *Id.*, at 44.

Inflation Adjustment Mechanisms

The projects, described above, that were terminated all negotiated their offtake agreements in a period of low inflation and low interest rates. Following the COVID-19 pandemic and subsequent period of high inflation, the OSW industry began including adjustment mechanisms in offtake agreements to deal with potential inflationary impediments to new projects. These mechanisms include a risk premium that is paid when the bid is made to mitigate potential project terminations. This trend is evidenced by the rise in LCOE for OSW projects which have been estimated to rise from $77.30/MWh in 2021 to $114.20/MWh in 2023.[71]

In Connecticut, a solicitation for proposals allows indexing prices to economic factors, such as inflation, up to 15%.[72] Three 25-year contracts for projects in New York (Attentive Energy One, Excelsior Wind and Community Offshore Wind) will include inflation adjustment mechanisms to recoup changes in construction costs until final investment decisions have been reached.[73] In New Jersey, Attentive Energy Two was also granted an inflation adjustment mechanism in its awarded contract.[74]

The essential hurdle that must be recognized and dealt with is that, like a regulated utility that builds a facility, developers of OSW generation facilities will seek to maintain a level of cost recovery. The inflation adjustment mechanism that has been proposed and negotiated by OSW generation developers, and ultimately accepted by regulators and the buyers of the electric generation, is an example of a reasonable cost recovery mechanism for these projects to go forward. A regulated electric utility is clearly allowed, in fact encouraged, to recover reasonable costs when inflation affects its costs of doing business. As discussed in the section on business models in this report, means of providing opportunities for cost recovery through regulatory mechanisms for the ultimate developers of the WEAs in North Carolina must be developed to ensure these projects are developed at a reasonable cost for developers and at a reasonable cost to ratepayers.

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[71] Atin Jain, *Soaring Costs Stress US Offshore Wind Companies, Ruin Margins*, BLOOMBERGNEF (Aug. 1, 2023), https://about.bnef.com/blog/soaring-costs-stress-us-offshore-wind-companies-ruin-margins/#:~:text=The%20US%20offshore%20wind%20industry,due%20to%20rising%20interest%20rates.

[72] CONN. DEP'T OF ENERGY & ENVTL. PROTECTION, *Request for Proposals for Offshore Wind Facilities – Revised Feb. 14, 2024 (Changes in Red)*, 19–20 (Feb. 14, 2024), https://www.dpuc.state.ct.us/DEEPEnergy.nsf/c6c6d525f7cdd1168525797d0047c5bf/5f3d7ee5480fdbb085258a5500500d7c/$FILE/Final%20RFP%20(2023%20OSW)_Revised%20V3.pdf.

[73] Adrijana Buljan, *New York's Three New Gigawatt-Scale Offshore Wind Projects to Bring USD 15 Billion in In-State Spending*, OFFSHOREWIND.BIZ, (Oct. 25, 2023), https://www.offshorewind.biz/2023/10/25/new-yorks-three-new-gigawatt-scale-offshore-wind-projects-to-bring-usd-15-billion-in-in-state-spending/ (referencing *United States: TotalEnergies Awarded a 25-year Contract to Supply 1.4 GW of Renewable Energy Electricity to New York*, TOTALENERGIES (Oct. 25, 2023), https://totalenergies.com/media/news/press-releases/united-states-totalenergies-awarded-25-year-contract-supply-14-gw.).

[74] *United States: TotalEnergies Awarded a 20-year Contract to Supply 1.3 GW+ of Renewable Energy Electricity to New Jersey*, TOTALENERGIES (Jan. 24, 2024), https://totalenergies.com/media/news/press-releases/united-states-totalenergies-awarded-20-year-contract-supply-13-gw ("The contract awarded by the NJBPU also includes a one-time inflation adjustment mechanism to compensate for changes in construction costs environment until the final investment decision.").

It can be anticipated that indexing of OSW generation power prices will now be part of any negotiation of a PPA, offtake agreement, or any other type of cost recovery mechanism or arrangement for an offshore power generation facility. Of course, as there can also be deflation, these mechanisms should be negotiated with the ratepayers in mind. A mix of regulatory and free-market economics must be recognized for the North Carolina economy to reap the well-established benefits of OSW projects. The Commission recognizing and stimulating these activities is a necessary condition for these projects and the resulting economic development.

Supply Chain Challenges

Significant expenditures will be required for the domestic manufacturing of OSW equipment and components, constructing and/or improving large marshaling ports, reserving and/or producing specialized vessels, and training a qualified labor force available to execute construction and operation of offshore facilities. In addition, some raw materials may be in short supply—such as steel, copper and aluminum. There is a global market for the goods and services necessary to provide the supply chain assets necessary for construction and operation of a healthy OSW industry in the U.S. Once the U.S. domestic supply chain begins to build, the international markets will respond and build those US markets into their purview, which in turn will grow support for the U.S. OSW construction market. The same logic applies locally; as North Carolina builds its OSW supply chain, the international markets will respond. It is also likely that as the North Carolina manufacturing community grows excess manufacturing capacity for OSW and renewable energy components, it will begin to serve the international export markets. This reciprocity will further increase in-state manufacturing and economic growth.

Regarding vessels, the United States's Merchant Marine Act of 1920, commonly referred to as the "Jones Act," requires vessels transporting merchandise between "coastwise points" in the United States—which includes classification of an OSW generating platform as a United States port—be constructed in the United States, owned by U.S. citizens, and crewed by U.S. citizens.[75] However, two types of construction vessels that are strictly required for the actual construction of a new OSW facility, the wind turbine installation vessels ("WTIV") and the heavy lift vessels ("HLV"), do not exist in the U.S. Jones Act fleet. Under current law, these two specialized vehicles do not need to be U.S. constructed, owned, or crewed provided they do not transport merchandise between two coastwise points—typically done by chartering specialized U.S.-made barges to shuttle components from ports to the WTIVs and HLVs.[76] The methodologies used to shuttle components do add to OSW construction costs, however, the most expensive vessels that will be needed will not be required to meet the obligations of the Jones Act in US waters.

There is a supply of WTIVs and HLVs being constructed internationally that will likely be available to provide the specialized vessels needed for the North Carolina OSW projects. In addition to the feeder barges, other vessels used to transport personnel and to transport

[75] Merchant Marine Act of 1920 § 27, as amended, 46 U.S.C. § 883.

[76] *Offshore Wind Market Report:* 2023 Edition, at 44 n. 21 ("foreign-flagged vessels can operate in U.S. waters in a Jones-Act-compliant manner. For instance, a foreign wind turbine installation vessel installing wind turbine components transported by a U.S.-built feeder barge. Vessels that transport cargo between U.S. ports need to be built and registered in the United States and owned and crewed by U.S. citizens or permanent residents.").

components from the shore to the site of the offshore construction site must be Jones Act vessels. These vessels, many with a lower level of specialization, can be expected to be available in time for the construction of North Carolina OSW generation facilities.

While there currently exists a need for those vessels to construct the OSW facilities that are entering the construction phase elsewhere, the construction phase for the North Carolina OSW facilities will likely begin 4 to 6 years from now. The same vessels currently reserved for several other U.S. projects will likely be available for construction of North Carolina OSW facilities at that time. If not, there is a pipeline of vessels being constructed internationally, and one WTIV being built domestically,[77] that will likely be available to provide the specialized vessels needed for the North Carolina OSW projects. However, again, the Commission authorizing material progress towards the construction and operation of OSW facilities off the North Carolina coast in this proceeding will send the appropriate signals to developers and allow the developers to reserve a space in the WTIV and HLV queues.

2.2.4 Inflation Reduction Act and Federal Subsidies

The Inflation Reduction Act of 2022 ("IRA") put in place extensions of the Production Tax Credit ("PTC") as well as the Investment Tax Credit ("ITC"). The PTC was first established in the Energy Policy Act of 1992 providing a per kilowatt hour tax credit for certain renewable electric production technologies. Generation of electricity using onshore wind energy has historically been the largest recipient of the PTC credits. The ITC was established in 2005 and provides tax credits based on a percentage of eligible equipment costs. Both the PTC and the ITC for many years have repeatedly lapsed and been subsequently renewed. The IRA put an end to this cycle by extending the existing PTC and ITC credits through the end-of-year 2024, and establishing technology neutral credits that will persist indefinitely until a high standard for phasing them out is attained.

OSW projects off the coast of North Carolina are eligible for both the PTC and ITC, among other financial incentives included in the IRA. The ITC for OSW projects is a basic 30% tax credit for OSW projects that begin construction before January 1, 2025. It is unlikely that an OSW facility off the coast of North Carolina will begin construction before that date. However, Section 48E of the IRA provided the new Clean Electricity Investment Tax Credit ("CEITC") and Section 45Y of the IRA provides the Clean Electricity Production Tax Credit ("CEPTC, collectively, the "Clean Electricity Tax Credits") for construction of OSW projects initiated after January 1, 2025. ***These two new Clean Electricity Tax Credits were designed to replace the previous tax credits and phase out on the later of 2032 or once greenhouse gas emission reduction targets are achieved (i.e., once electric power sector emissions fall below 25% of 2022 levels).***[78]

The CEITC provides as much as a 50% subsidy through federal tax credits for the construction of an OSW facility. The base subsidy is a 6% ITC, with a 24% increase—reaching 30% total—if

[77] *Id.*, at 44 (identifying the first U.S.-flagged WTIV currently being built in Brownville, Texas).

[78] *See* 26 U.S.C. § 45Y(d)(3); *see also* 26 U.S.C. § 48E(3) (adopting the same standard as in § 45Y(d)(3) by reference).

the project meets certain prevailing wage and apprenticeship requirements.[79] There are further incentives for projects that involve the inclusion of "energy communities," "low-income communities," and for domestic content, as well.[80] The combination of these incentives is how the magnitude of the CEITC can be as high as 50% of the capital cost of constructing an OSW generating facility. Incentives were also built into the Clean Energy Tax Credit structure to allow for monetization of these credits outside of the traditional tax equity markets. Under the CEPTC, an OSW project is eligible for $15 per MWh credit provided to the developer.[81] The industry is currently asking the IRS to clarify the tax benefits for the ITC so that they can include subsea cables and other interconnection systems that are critical for OSW projects.[82]

The incentives for development of an OSW supply chain also include advanced manufacturing tax credits for companies that domestically manufacture and sell clean energy equipment.[83] The IRA covers manufacturing of certain OSW components including distributed wind inverters, production of critical minerals, and construction of OSW vessels. Tax incentives include manufacturing of blades, nacelles, towers, fixed bottom and wind energy platforms.[84]

As stated, while the Clean Electricity Tax Credits are nominally set to expire 10 years after the IRA's enactment, the actual timeline for their expiration is the later of 2032 (the 10-year anniversary of the IRA) or when United States's electricity sector carbon dioxide emissions are equal to or below 25% of 2022 levels. Projections of when this expiration will occur have ranged from 2032 to ***as long as several decades after the initial passage of the IRA***.[85] The advanced manufacturing tax credits, however, do not include the same conditional provision as the Clean Electricity Tax Credits. The advanced manufacturing credits begin to phase out starting after 2030 and will entirely expire following December 31, 2032.[86] Accordingly, an appropriate

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[79] Comay, et al., (2022, Sept. 29) *Offshore Wind Energy Provisions in the Inflation Reduction Act*, at 2 (CRS Report No. IN11980), https://crsreports.congress.gov/product/pdf/IN/IN11980; *see also Prevailing Wage & Apprenticeship Initial Guidance Under Section 45(b)(6)(B)(ii)*, 87 Fed. Reg. 73,580 (Nov. 30, 2022) (amended in *Increased Credit or Deduction Amounts for Satisfying Certain Prevailing Wage & Registered Apprenticeship Requirements*, 88 Fed. Reg. 60,018 (Aug. 30, 2023)).

[80] INTERNAL REVENUE SERV., Notice 2023 – 38, *Domestic Content Bonus Credit Guidance Under Sections 45, 45Y, 48, and 48E* (May 23, 2023).

[81] INTERNAL REVENUE SERV., Notice 2022 – 51, *Request for Comments on Prevailing Wage, Apprenticeship, Domestic Content, and Energy Communities Requirements Under the Act Commonly Known as the Inflation Reduction Act of 2022*, at 8 n. 7 (Oct. 10, 2022); *see, generally,* INTERNAL REVENUE SERV., Notice 2022-49, *Request for Comments on Certain Energy Generation Incentives* (Oct. 10, 2022); *see also* U.S. DEP'T OF ENERGY, *Production Tax Credit and Investment Tax Credit for Wind Energy*, https://windexchange.energy.gov/projects/tax-credits (last visited May 25, 2024) (identifying that the Clean Electricity Tax Credits can be increased by as much as 20% under energy community and domestic content rules.).

[82] Heather Richards & Brian Dabbs, *Treasury Floats Tax Lifeboat for Struggling Offshore Wind*, EE NEWS, (Nov. 17, 2023) , https://www.eenews.net/articles/treasury-floats-tax-lifeboat-for-struggling-offshore-wind/.

[83] 26 U.S.C. § 45X.

[84] *Section 45X Advanced Manufacturing Production Credit*, 88 Fed. Reg. 86,844 (Dec. 15, 2023).

[85] Ryan Sweezey, *The Indefinite Inflation Reduction Act: Will Tax Credits for Renewables be Around for Decades?*, WOODS MACKENZIE, (Mar. 8, 2023), https://www.woodmac.com/news/opinion/IRA-tax-credits-for-renewables/.

[86] 26 U.S.C. § 45X(3).

market signal and support for the industry coming from the Commission in this proceeding by authorizing material progress towards the construction and operation of OSW facilities off the North Carolina coast can increase the likelihood that the state captures all available federal incentives for the OSW option—which may amount to hundreds of millions of dollars that will accrue to the benefits of the ratepayers.

In addition to the IRA, pursuant to the Infrastructure Investment and Jobs Act ("IIJA"), the U.S. Department of Energy ("DOE") expanded the Advanced Technology Vehicles Manufacturing Loan Program to include marine vessels, creating a lending authority of $17.7 billion that could help build low-emission OSW vessels by offering loans at low interest rates.[87] The IIJA also increased funding for the Maritime Administration's Port Infrastructure Development Program which will help grow OSW ports. Ports need investments in heavy-duty wharves, lay-down areas, manufacturing facilities, dredging, and other improvements before they can serve as staging areas for OSW projects. These federal incentives will have the corollary effect of significantly improving and expanding the North Carolina shipping port system.

2.2.5 Regulatory Support

The North Carolina coastline is among the most favorable regions for potential use of OSW generation throughout the East Coast of the United States.[88] However, other states with less potential for OSW are moving forward with the resource first. Neighboring Virginia has significantly advanced its endeavor to invest in OSW electric generation. The Virginia State Corporation Commission ("VSCC") has been diligently working towards OSW electric generation since 2020 and has already held extensive regulatory proceedings, including reports and hearings and conducting numerous economic analyses. The Virginia SCC subsequently approved construction of the first round of OSW electric generation to be installed off the coast of Virginia by Dominion Energy (d/b/a Virginia Electric & Power Co.).[89] It has also approved tariffs and riders to facilitate the use of OSW generation for its constituencies.

In contrast, the progress of regulatory consideration of OSW by the Commission is in a relatively nascent stage when compared to the progress that has been made in neighboring Virginia. The North Carolina executive branch has been supportive of OSW development. Governor Roy Cooper signed Executive Order 218 in June 2021,[90] setting a goal to develop 2.8 GW of wind generating capacity off North Carolina's coast by 2030, and 8.0 GW by 2040. Under the

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[87] *See* U.S. DEP'T OF ENERGY, *Advanced Technology Vehicles Manufacturing Loan Program*, https://www.energy.gov/lpo/advanced-technology-vehicles-manufacturing-loan-program-0 (last visited May 25, 2024).

[88] Musial, et al., *2016 Offshore Wind Energy Resource Assessment for the United States*, NAT'L RENEWABLE ENERGY LAB., Golden, CO (Sept. 2016), https://www.advancedenergy.org/wp-content/uploads/imported-files/66599.pdf (reviewing the report's appendices, North Carolina is repeatedly among the top for gross offshore wind potential across the metrics).

[89] *See Application of Va. Elec. & Power Co. for Approval & Certification of the Coastal Virginia Offshore Wind Commercial Project & Rider Offshore Wind*, Dkt. No. PUR-2021-00142 (VSCC Aug. 5, 2022).

[90] Exec. Order No. 218, (Cooper), (2021), *Advancing North Carolina's Economic and Clean Energy Future with Offshore Wind*.

Governor's direction, the Department of Commerce has made significant progress in developing programs to enhance workforce development in North Carolina to substantially contribute to the development of OSW generation infrastructure and assets.

The Governor's NC Towers Taskforce, which is overseen by the North Carolina Department of Commerce, is active in promotion of the State's OSW electric generation potential. The NC Towers Taskforce envisions utilizing the extensive manufacturing potential in North Carolina to support many OSW projects as they are developed along the East Coast of the United States. It is also coordinating many small- and medium-sized manufacturing facilities throughout the state to prepare many of the parts that will go into OSW facilities. The NC Towers Taskforce is coordinating with public education institutions including UNC Charlotte's Energy Production & Infrastructure Center and the CLEANCarolinas initiative. The CLEANCarolinas effort is coordinating efforts working with similar assets in South Carolina to establish a strong initiative in support of OSW generation across the Carolinas. Additionally, as described in Section 2.1, North Carolina is a signatory to the SMART-POWER MOU.

In addition to the efforts of the NC Department of Commerce, there are also a number of municipal and private commercial endeavors that are planning to support the utilization of North Carolina's ubiquitous manufacturing assets and highly skilled workforce to take advantage of the opportunities presented by OSW development.[91]

As previously stated, a strong level of support from the NCUC as evidenced in explicit actions is the key action required to strengthen and facilitate the efforts of other entities already underway in the state and promote the development of infrastructure assets and supply chain enterprises. As discussed in the economic development section of this report, the benefit of strong support from the NCUC is invaluable to the state's realization of those benefits.

2.2.6 Design Maturity

Offshore wind electric generation technology is a mature technology. As of the end of end of 2022, the total worldwide OSW power nameplate capacity was 59,009 MW from 292 operating projects and over 11,900 operating wind turbines. Most of the total installed capacity is in the following countries and account for more than 75% of the global installed capacity: China, the

[91] *See, e.g.,* Brad Rich, *County Residents Take Advantage of Opportunity to Learn More About N.C. Ports Authority Plan for Radio Island Property*, CARTERET COUNTY NEWS-TIMES (Sept. 30, 2023), https://www.carolinacoastonline.com/news_times/news/morehead_city/article_036e98f2-5d51-11ee-894f-af0d6147502d.html; Elizabeth Outz, *In N.C., Clean Energy Apprenticeship Program Set to Double this Summer*, ENERGY NEWS NETWORK (May 4, 2022), https://energynews.us/2022/05/04/in-n-c-clean-energy-apprenticeship-program-set-to-double-this-summer/; Kathy Blake, *Community Close-Up: Eastern North Carolina, Digging In*, BUS. NORTH CAROLINA (Apr. 1, 2022), https://businessnc.com/community-close-up-eastern-north-carolina-digging-in/.

United Kingdom, and Germany.[92] The global OSW generation deployment pipeline has expanded to over 700 GW.[93]

The OSW technology has evolved significantly, with turbines becoming larger and more efficient, capable of being installed in deeper waters and further from shore. For instance, the 3.6 GW Dogger Bank Wind Farm, the world's largest, is being constructed off the UK coast over 75 miles offshore and employing 13 MWe turbines.[94] The international OSW industry is, however, considering the standardization of OSW turbine installation sizes because instability of the OSW supply chain has arisen from the near constant push for larger and more powerful turbine installations. Vessels and ports that may be adapted to today's 13–14 MW turbines and tower sizes may become obsolete if the size and power of the equipment continues to grow. As a result, the 13–14 MW turbine size may become the industry standard allowing for interchangeable use of ports and equipment.

The DOE is pursuing further advances in deploying OSW generation technology including work on offshore substations and electric transmission equipment to increase reliable operations in harsh ocean environments. In its CONNECT initiative, DOE is facilitating and financing the development of and investment in transmission infrastructure solutions for large-scale OSW deployment and enhanced grid reliability and resilience through key partnerships, analysis, planning, R&D, and transmission infrastructure.[95]

As previously discussed, OSW electric generation technology has been widely employed outside of the United States and is maturing very rapidly, with significant advancements in the technology and equipment used in projects. The United States is poised for substantial growth in offshore wind generating capacity, supported by federal initiatives and policy support. As obstacles to deployment in the U.S. are addressed, offshore wind generation is anticipated to significantly increase in use. While challenges remain, the long-term prospects for offshore wind in the U.S. are growing, with the potential to significantly contribute to the nation's clean energy transition and decarbonization goals.

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[92] Musial, et al., *Offshore Wind Market Report: 2023 Edition*, at xii, 52; *see also* Mark Hutchinson & Feng Zhao, *Global Wind Report 2020*, GLOBAL WIND ENERGY COUNCIL (Mar. 27, 2023), https://gwec.net/wp-content/uploads/2023/04/GWEC-2023_interactive.pdf.

[93] Paliwal, et al., *2035 and Beyond: Abundant, Affordable Offshore Wind Can Accelerate Our Clean Electricity Future*, UNIV. OF CAL. BERKELEY (2023), HTTPS://2035REPORT.COM/OFFSHOREWIND/WP-CONTENT/UPLOADS/2023/07/GRIDLAB_2035-OFFSHORE-WIND-TECHNICAL-REPORT.PDF?HSCTATRACKING=91B037A2-3238-4547-9C2A-BFC94BDB61EB%7C885AF2B1-38AC-4A04-A700-C657679AF073.

[94] *World's Largest Offshore Wind Farm Dogger Bank Produces Power for the First Time*, EQUINOR (Oct. 10, 2023), https://www.equinor.com/news/202310-dogger-bank.

[95] *Advancing Offshore Wind Energy in the United States*, U.S. DEP'T OF ENERGY (Mar. 2023), https://www.energy.gov/sites/default/files/2023-03/advancing-offshore-wind-energy-full-report.pdf.

2.2.7 Overall Schedule

Figure 1 shows the federal government's projection of the timing for the process of beginning construction and operation of the Kitty Hawk North wind generating facility as proposed by Avangrid. Although many of the activities required for construction still must be undertaken, the timeline indicates that construction can start as soon as 2028. If this schedule holds, there would have been a nine-year gap between Avangrid submitting Kitty Hawk North's SAP to the start of construction. To expedite that process for Kitty Hawk South and the Carolina Long Bay WEAs, we recommend the Commission allow, for the purposes of executing the CPIRP, the Companies and the WEA lessees to incur initial project development costs to conduct geologic surveys. We also recommend the Commission direct the Companies and WEA lessees to engage in a modified ARFI that is more structured and streamlined, and includes direct negotiations between the Companies and the WEA leaseholders than the proposed ARFI. If these steps are taken in a straightforward manner, it is likely that construction of the first OSW facilities in the North Carolina will commence by 2032—prior to when the Clean Energy Tax Credits viability become conditional—and be in operation shortly thereafter.

2.3 POTENTIAL BUSINESS MODELS

2.3.1 Initial Arrangements and Regulatory Considerations

To comply with HB 951 the Commission is required to make a Carbon Plan to achieve a 70% reduction of carbon emissions ***using a least-cost approach***, which is to be developed in concert with stakeholders and utilities and will be revisited every two years. The legislation specifies that the carbon reductions can be achieved via use of technologies such as power generation, transmission and distribution, grid modernization, storage and energy efficiency measures, demand-side management, and the latest technological breakthroughs that meet the least-cost criteria. OSW is a principal pathway toward achieving the mandates of this legislation. To implement OSW, there are, at least, two potential business models that provide for the financeable construction and operation of OSW off the North Carolina coast for the benefit of the Companies' customers and to meet the emissions reduction mandates of HB 951.

In Virginia, the Coastal Virginia Offshore Wind ("CVOW") project is being directly constructed by Dominion Energy, which has many years of experience in the processes required to play a central role in the process of building and owning the project due to the CVOW demonstration project. The CVOW demonstration project is a 12 MW test facility that has been operating 27 miles off the Virginia coast since 2017. This facility has served as a test bed for the VSCC staff and Dominion Energy personnel to become familiar with the concepts and business relationships that are involved in the development of OSW generation.

Here, the Companies have no significant experience in the process of planning, permitting, constructing, and operating an OSW facility. As a result, we do not believe that the Companies are capable of playing a central role in the development of an OSW project as owner-operator and further that obtaining these capabilities would very likely take years to achieve. It is our belief that a partnership between the Companies and the WEA leaseholders (*i.e.*, Avangrid and TotalEnergies) will be the most cost-effective way to develop the states' first OSW generation facilities.

As a result, we believe the two best options for developing an OSW project—and ultimately operating the facility—are: (1) build and transfer arrangements in which the facility is constructed by an experienced and qualified OSW construction entity and then the construction entity transfers ownership to the Companies—which may contract with the construction entity and/or a third party to operate the facility; and (2) the Companies enter into offtake contracts with third party developers that construct, own, and operate the OSW generation facility and sell the electric power output to the Companies at the point of interconnection. Each business model is discussed below.

Build and Transfer

This option would facilitate the permitting, construction and operation of an OSW facility and would ultimately result in the facility being owned and operated by the Companies. The OSW generation facility would then be included in the Companies' rate base and be fully regulated by the Commission. This option, if the Commission determines that the Companies must own the OSW generation facility, may be preferrable as it caters to utilities without previous experience building and operating a specific generation technology. This option mitigates the risk of the facility not performing by contracting an independent power producer with direct experience in building and operating the relevant technology to develop the project. Then, after a period of time when the eventual utility-owner acquires the requisite knowledge of the facility, the facility will transfer ownership from the independent power producer to the utility. As we have recommended in this report, the Commission should direct the Companies and the WEA leaseholders to engage in a modified ARFI, with interim updates to the Commission, to bilaterally negotiate and discuss whether this arrangement is viable.

In any event, if this option is considered to be preferable to the offtake agreement option, it will be incumbent upon the Commission and the Companies to become fundamentally knowledgeable concerning all aspects of the planning, permitting, financing, and operation of the OSW facility that the Companies will ultimately own and operate. In addition, the Commission and the Companies will be responsible for developing and operationalizing a set of tariffs that will control the sale and distribution of power that is delivered to the Companies' customers.

Offtake Agreement with Appropriate Contract Provisions

An offtake agreement, or power purchase agreement (PPA), is the predominant arrangement for a regulated utility securing power supplied from an OSW facility. In a PPA, an independent power producer (an unregulated electric generation entity) constructs, owns, and operates the OSW generation facility, and sells the facility's electrical output to a regulated utility or state energy authority at a negotiated or market-set rate. In fact, the arrangement for the CVOW project, as described above, being owned and operated by the regulated utility is unique among OSW installations in the United States. In every other case, an offtake agreement is being, or has been, negotiated between the utility or state agency and the unregulated independent power producer is the owner and operator of the OSW generating facility.

In the offtake agreements there is typically a study conducted first of the projects Levelized Revenue of Energy ("LROE"). The LROE is the revenue needed by the independent power producer required to permit, construct, and operate the OSW facility. During the negotiation, a

number of adjustments are made to capture the costs of development—including, for instance, the IRA's Clean Electricity Tax Credits into the capital and/or operating costs, contingencies for material and component cost increases, and other contingencies built into the LROE. It is typical for the details of these offtake agreements to be kept confidential.[96] Numerous negotiations are currently underway involving several U.S. East Coast states and utilities pursuing PPAs with OSW developers that reflect the interests of all parties involved. It is incumbent that the Commission, the Public Staff, the Companies, and other interested parties learn the various aspects of the PPA negotiations through confidential agreements that will prepare parties to examine and scrutinize the results of negotiations by the Companies WEA leaseholders and advise the Commission on the prudence of any offtake agreement that is negotiated.

As discussed above, adjustments have been made in offtake agreements to deal with measures to mitigate developer risks that are not in the control of the developers—like inflation. Also, as previously mentioned, the first round of offtake agreements proved unable to adapt to extreme external market forces like those experienced throughout the COVID-19 pandemic, leading to the withdrawal from several contracts. Accordingly, owner-operators of OSW facilities that are selling power to a utility or state agency are seeking amendments to the standard offtake agreement that allow for adjustments to account for inflation or other market distortions affecting critical supply chain items during the construction phase. It has been reported that inflation indexing is a new and common component of most of the renegotiated offtake contracts that have been negotiated or are being renegotiated. Other types of adjustments such as hedging against the price of steel, concrete and other volatile materials have been discussed.[97] Although it is too early to make definitive statements regarding the substantive changes in the offtake agreements that are ultimately going to be disclosed when negotiations are finalized, it is known that offtake agreements are being amended to mitigate developer risks that are outside of the developer's control.

Another nuance for any arrangement involving the Companies is that North Carolina is not in the footprint of a Regional Transmission Operator/Independent System Operator (RTO/ISO). Meaning, the Companies are still vertically integrated utilities that own and control all its transmission and generation assets. In most of the world, including in most of the U.S., there are electric power pricing mechanisms such as Contracts for Differences or hedges based on Locational Marginal Pricing ("LMP") that allow for collars to be placed on the price of electricity that is purchased and sold under an offtake agreement that can be included as hedges to mitigate against those price risks. In addition, in many jurisdictions either generic Renewable Energy Credits ("REC") or Offshore Renewable Energy Credits ("OREC") are available to offset the cash price of purchasing power from an OSW generating station. In North Carolina there have not been measures put into place to establish OSW procurement targets as part of the state's Renewable Energy and Energy Efficiency Portfolio Standard ("REPS"), or other arrangements that would allow for meaningful RECs or ORECs to be used in an OSW related transaction. As a

[96] *See, e.g.,* Beiter, et al., T*he Vineyard Wind Power Purchase Agreement: Insights for Estimating Costs of U.S. Offshore Wind Projects*, NAT'L RENEWABLE ENERGY LAB., at v, 1 (Feb. 2019), https://www.nrel.gov/docs/fy19osti/72981.pdf.

[97] Eduardo Garcia, *New York Auction Highlights Jump in US Offshore Wind Prices*, REUTERS (Mar. 14, 2024), https://www.bankofamerica.com/smallbusiness/?page_msg=signoff&body=signoff.

result, there is no hedging ability put forward using LMP as it would be for instances for a utility in an RTO/ISO such as PJM. The Companies operate their own independent transmission organization without market-based pricing.

The combination of the lack of an ability to hedge against electric power price changes means that the entire price risk in electric power sales agreements must be allocated between the parties contractually in the offtake agreement. However, it may be possible to embody some "regulatory-type" provisions within the offtake contract that would allow for adjustments to be made by the Commission in the allocation of price risk between the Companies and the ratepayers. Perhaps the same type of price risk conditions that have been litigated before the VSCC and included in the CVOW regulatory process can be adapted to provide price risk allocation rules for inclusion in an offtake agreement for OSW in North Carolina.

For instance, for the CVOW, in Dominion's LROE there is a stated limit on construction costs for the overall facility above which the risks will be borne solely by the utility ($4,174/kW) and not the ratepayers. In addition, if the Net Capacity Factor performance of the OSW generating facility drops below 42%, the utility is responsible for covering the associated resulting rise in electricity costs, not the ratepayers. The utility is also obligated to receive the full and complete benefits of the IRA and make no elections that would reduce those benefits to customers.[98] There is much to be gleaned from the results of the ongoing offtake agreement negotiations for OSW. As stated, the Companies and WEA lessees have the means and time to successfully navigate these issues if our suggested actions are put into place in the near term.

It must be noted that the price risks are almost entirely present only in the construction phase of the OSW generating facility. The operation and maintenance costs for OSW facilities are not subject to the same level of influence of market conditions as that construction costs. The construction related risks have been negotiated in the case of the CVOW deliberations and certain parameters have been set and agreed to by all the parties and ordered by the VSCC. The same should be explored here.

2.3.2 Decommissioning and Financial Assurance

BOEM exercises authority over the decommissioning of any OSW installation immediately after the lease process is completed.[99] Within the SAP the applicant was required to provide a "conceptual decommissioning plan." However, the new modernization rule that has very recently gone into effect has eliminated the requirement for a separate SAP which has significantly reduced the need for a detailed conceptual decommissioning plan at the early site assessment stage. Instead, a more detailed decommissioning plan is required as part of the facility design report which must be submitted to BOEM and BESS before construction rather than requiring

[98] *Order on Reconsideration*, Dkt. No. PUR-2021-00142, Attachment A at 13 of 17 (VSCC Dec. 15, 2022), https://scc.virginia.gov/docketsearch/DOCS/7pj901!.PDF.

[99] Fernandez, Jr., et al., *Supporting National Environmental Policy Act Documentation for Offshore Wind Energy Development Related to Decommissioning Offshore Wind Facilities*, U.S. DEP'T OF INTERIOR, BUREAU OF OCEAN ENERGY MGMT., (Feb. 2022), https://www.boem.gov/sites/default/files/documents/renewable-energy/state-activities/Decommissioning%20White%20Paper.pdf.

them in the construction and operation plan. In addition, the modernization rule reduces the upfront capital costs by allowing incremental funding of financial assurance for decommissioning instead of having *a priori* funding before the project has even begun construction. It will also allow for the use of letters of credit as an acceptable financial assurance instrument.[100]

Before construction begins, the OSW operator must also present detailed decommissioning information and must include broad coverage of the construction site clearance activities to be undertaken as well as environmental impacts and potential mitigation measures. It must include plans for methods of removal and site clearance for all management systems and structures, platforms, shore connections and sea bottom apparatuses, and all bottom founded and installed structures. Chemical use and management and all potential discharges, benthic electrical systems and power requirements must also be made clear. Methods to clear the seafloor to a minimum depth of 15 feet below the mud line must be presented as well. All administrative and management costs incurred by BOEM to contract out the work must also be detailed and included.

These estimates assist in determining the amount of financial assurance requirements necessary to meet all the accrued decommissioning obligations on a case-by-case basis.[101] If the decommissioning activities do not go as planned BOEM will call for the forfeiture of the financial assurance provided. Even if the lease is revoked or terminated, the lessee is still liable for all removal disposal costs of any damage or injuries that might result from their failure to decommission.

Either two years before the expiration of the lease or as late as 90 days after its expiration the lessee must submit a detailed decommissioning application to BSEE for approval. The application must include identification and description of the facilities, cables, and/or pipelines designated for removal; a proposed decommissioning schedule; a description of the removal methods and procedures; and plans for the transportation and disposal or salvage of decommissioned materials. After approval, a separate decommissioning notice is required 60 days prior to the beginning of decommissioning activities. The lessee is given two years to remove all facilities, projects, cables, pipelines and other obstructions to clear the seafloor completely. If the lessee fails to decommission, BOEM will call for forfeiture of the financial assurance and make its own arrangements for decommissioning.

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[100] Renewable Energy Modernization Rule, 89 Fed. Reg. 42,602; *see also Renewable Energy Modernization Rule*, U.S. DEP'T OF INTERIOR, BUREAU OF OCEAN ENERGY MGMT., https://www.boem.gov/sites/default/files/documents/renewable-energy/Renewable%20Energy%20Modernization%20Rule.pdf (an agency fact sheet summarizing the Renewable Energy Modernization Rule.).

[101] *See Risk Management & Financial Assurance for OCS Lease and Grant Obligations*, 89 Fed. Reg. 31,544 (Apr. 24, 2024) (to be codified at 30 CFR pts. 550, 556, 590). (Effective on June 24, 2024, are new regulations to establish the financial requirements an OSW lessee on the OCS and in the Gulf of Mexico must provide to assure that decommissioning activities are undertaken, and most importantly, that sufficient financial resources are available to complete the decommissioning process.).

Alternatively, the lessee may request to have the facilities remain in place or converted to an artificial reef. If BOEM determines that the facility may remain in place, the former lessee remains liable for all future decommissioning requirements unless another entity has assumed responsibility and secured sufficient financial assurances for decommissioning.

2.3.3 Growth Potential

For the Kitty Hawk WEA, combining both Kitty Hawk North and Kitty Hawk South, is projected to support 2,488 to 3,500 MW of wind generating capacity.[102] Kitty Hawk South is projected to support 1,632 MW of generation capacity.[103] In the Carolina Long Bay WEA, Cinergy, formerly Duke Energy Renewables Wind LLC, projected that its lease area could support up to 1,600 MW of wind generation capacity.[104] For its Carolina Long Bay lease area, TotalEnergies projects that a total of 1,100 MW of wind generation could be developed.[105] These references indicate that over 7,800 MW of offshore wind generation could potentially be installed in the existing leases off the North Carolina coast. There exists a possibility that additional lease areas could be auctioned off the coast of North Carolina by the federal government. The proposed projects and any future WEA auctioned by the federal government already exceed the 2.4 GW of OSW the Companies propose in the CPIRP Update.

The Carolinas Transmission Planning Collaborative ("CTPC") was established to provide the Participants (Duke, North Carolina Electric Membership Corporation, ElectriCities of North Carolina), and other stakeholders an opportunity to participate in the local electric transmission planning process to expand transmission capacity for the areas of North Carolina and South Carolina served by the Participants. One of the objectives of the CTPC is to scope out the acquisition of new rights-of-way for 500 kV DC and AC lines necessary to import up to 1.6 GW of OSW energy.[106] This includes a significant investment, identified in the 2020-2030 plan, which outlines projects totaling over $804 million to improve the transmission infrastructure in North Carolina.[107]

Recently, NCSEA, jointly with other stakeholders, submitted a Public Policy Study Request to the CTPC requesting it assess the least-cost point of interconnection options for the two active

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[102] *Econ. & Fiscal Impact Kitty Hawk Wind Projects in Virginia*, CHMURA ECONS. & ANALYTICS, 1 (Mar. 1, 2024), https://www.kittyhawkoffshore.com/documents/30600168/0/Kitty+Hawk+Wind+Economic+Impact+Study_March+2024.pdf/6a0daede-2f54-48ef-5af9-1f01da9af914?t=1709784138879.

[103] *Id.*, at 4.

[104] *Duke Energy Secures Offshore Wind Lease for Carolina Long Bay,* DUKE ENERGY (May 12, 2022), https://news.duke-energy.com/releases/duke-energy-secures-offshore-wind-lease-for-carolina-long-bay.

[105] Jen Banks, *TotalEnergies NC TOWERS Meeting*, TOTALENERGIES, 3 (Aug. 4, 2022), https://files.nc.gov/nccommerce/2022-08-04-TotalEnergies-NC-TOWERS-Presentation.pdf.

[106] *Carolinas Resource Plan*, App'x L – Transmission System Planning and Grid Transformation, at 32.

[107] *Report on the NCTPC 2020-2030 Collaborative Transmission Plan*, N.C. Transmission Planning Collaborative, at 2, 24, 26 (Jan. 15, 2021), http://www.nctpc.org/nctpc/document/REF/2021-01-20/2020-2030_NCTPC_Report_01_15_2021_FINAL_REPORT.pdf.

North Carolina WEAs. The Public Policy Request further requests that to the extent an optimal point-of-interconnection ("POI") is established, whether it be the New Bern substation or another substation, it should also examine an alternative expansion of the POIs to accommodate both the OSW load and new solar generation at the 230 kV or 500 kV levels. The Public Staff also submitted a similar Public Policy Study Request asking the CTPC to identify multiple POIs to accommodate up to 4,800 MWs. The stakeholders made these requests in anticipation of future transmission needs for the growing OSW industry. The stakeholders that have submitted these requests are now working to incorporate these study requests into the new multi-value strategic transmission planning process at the CTPC for results prior to the next biennial CPIRP.

Like the CTPC, BOEM is anticipating the need to expand the transmission system to accommodate a growing number of interconnecting OSW facilities. In the final Renewable Energy Modernization Rule, BOEM noted it is "continuing to develop and implement a planned approach to transmission that includes the use of shared transmission infrastructure and corridors, meshed systems, and the development of an offshore grid, where approached."[108] Accordingly, it is expected that expanded opportunities for OSW generation beyond the 2.4 GW in the CPIRP Update will likely be available in the future to serve North Carolina's growing electric load.

2.4 RELIABILITY

2.4.1 Dispatch and Grid Services

If deployed without energy storage, offshore wind generation is not generally considered dispatchable. For the purposes of this report, we do not consider OSW generation implemented without energy storage a dispatchable resource. However, as identified in Appendix I of the Plan, as filed on August 17, 2023, the Companies admit,

> Offshore wind has an average annual capacity factor of approximately 40%-48%, dependent on factors such as location, weather and resource characteristics. It has its highest seasonal generation on winter mornings. As the peak planning hour has shifted to winter mornings, partially due to high solar integration, having capacity during those times is critically important, which is when offshore wind is consistently producing and peaking.[109]

The International Energy Agency further states that

> offshore wind projects have capacity factors of 40%-50%, as larger turbines and other technology improvements are helping to make the most of available wind resources. At these levels, offshore wind matches the capacity factors of efficient gas- and coal-fired power plants some regions—though offshore wind is not available at all times. Its capacity factors exceed those of onshore wind and are

[108] Renewable Energy Modernization Rule, 89 Fed. Reg. at 42,649.

[109] *Carolinas Resource Plan*, App'x I – Renewables and Energy Storage, at 29.

about double those of solar PV.[110]

OSW is a resource that improves the reliability of the Companies' electric grid operations even if it is not considered a dispatchable resource.

However, with support from energy storage technologies working in concert with OSW generation resources, OSW/Storage can be used to actively manage the electric grid with significant improvements in overall reliability. For example, results from tests at the onshore Tule Wind Farm near San Diego, California, demonstrated that wind resources combined with storage have the capability to accelerate the shift toward future electric grids with increased levels of renewable generation.[111] This is because pairing renewable generation with storage improves the dispatchability of all renewable energy. We find no reason to believe that the same results will not translate over to the dispatchability of OSW when combined with energy storage technologies in the Companies' systems.

Importantly, the Tule Wind Farm tests also demonstrated that modern wind power plants have the requisite controls in place to supply a full suite of grid reliability services. Smart inverter controls used in conjunction with offshore wind generation combined with energy storage can quickly detect frequency deviations and respond to load imbalances improving grid relatability and resiliency.[112] These and other studies have shown that, if fully integrated with storage and other advanced technologies, OSW can significantly improve the reliability of electric delivery in North Carolina.

2.4.2 Net Capacity Factor

Per Section 2.4.1, The National Renewable Energy Laboratory has calculated that the Net Capacity Factor ("NCF") for an offshore, fixed bottom wind generation facility off the United States coast will be 49%.[113] As previously discussed, the VSCC has ordered a minimum of 42% NCF for the Virginia OSW project, below which the ratepayers are not responsible.

2.4.3 External Events

The external event that can cause problems for an OSW generation facility is weather-related damage. Weather events off North Carolina's coast—which has been traditionally subject to significant hurricane risks—pose an adverse external event that may impact an OSW facility. These risks include extreme wind and wave conditions potentially causing monopile and column

[110] Cozzi, et al., *Offshore Wind Outlook, 2019*, INT'L ENERGY AGENCY, at 12 (Nov. 2019), https://iea.blob.core.windows.net/assets/495ab264-4ddf-4b68-b9c0-514295ff40a7/Offshore_Wind_Outlook_2019.pdf.

[111] Loutan, et al., *Avangrid Renewables Tule Wind Farm: Demonstration of Capability to Provide Essential Grid Services*, CAL. ISO & NAT'L RENEWABLE ENERGY LAB., 5 (Mar. 11, 2020), http://www.caiso.com/Documents/WindPowerPlantTestResults.pdf.

[112] *Id.*, at 47–48.

[113] Tyler Stehly et al, *2022 Cost of Wind Energy Review*, NAT'L RENEWABLE ENERGY LAB., 36 (Dec. 2023), https://www.nrel.gov/docs/fy24osti/88335.pdf.

damage, blade and turbine damage, substation damage, and subsea cable damage. While these risks are insurable, the loss of generation due to extreme post-event damage may present a risk to grid supply.

In the CPIRP Plan, the Companies worked with National Oceanic and Atmospheric Administration ("NOAA") hurricane information center and determined that for the potential OSW sites under the Commission's jurisdiction, there is less than a 2% chance that a Category 4 or stronger hurricane that would have a direct impact on the lease area locations based on over 170 years of hurricane tracking data.[114] Insurers also have access to highly advanced weather information and data that can be used to make accurate probability calculations of potential hurricane risks and resulting damage.[115]

Even if an external event does exceed design criteria, studies indicate that only a fraction of the turbines may be damaged. Studies on the impact of severe weather events on wind turbines have shown that structural damage to wind turbines experiencing damaging winds can be mitigated by incorporating nacelle yaw control in the design (*i.e.*, actively moving the nacelle to rotate to face into the wind).[116] Effective yaw control systems incorporate back up power for the yaw control motors when grid power is lost. Cable, blade, substation, and other system damage recovery will also be dependent on the robustness of design of those systems. Post event supply chain availability and costs will determine if any individually damaged turbines will be repaired, replaced or decommissioned.

A loss of a fraction of an overall OSW facility, which would be the probable impact from an extreme hurricane event, will be fully accommodated by the Companies reserve margin until recovery of the small lost OSW capacity can be restored. If adequate equipment and assets are available, any restoration will likely be accomplished in a timely manner. Importantly, the insurance industry has a great deal of experience in providing coverage for most or all occurrences, including severe weather, for OSW project construction and operations. The commercial insurance market is very well-positioned to support the emerging U.S. OSW industry, as it is done for many countries and developers moving into new locations.[117]

2.4.4 Operations and Management ("O&M")

OSW operations are carried out in challenging environments. While the equipment that is employed in these facilities is highly developed to withstand the severe weather that is encountered as well as the corrosive turbulent surrounding seas, to maintain economic

[114] *Carolinas Resource Plan*, App'x I – Renewables and Energy Storage, at 29.

[115] That weather data can also identify weather windows that allow for O&M tasks to be carried out with low weather-related risk.

[116] Hallowell, et al., *Hurricane Risk Assessment of Offshore Wind Turbines,* RENEWABLE ENERGY, (September 2018), https://www.sciencedirect.com/science/article/abs/pii/S0960148118302349.

[117] Tim Halperin Smith & Joao Amaro, *Navigating Risks in the U.S. Offshore Wind Industry: Insights into Insurance and Extreme Weather Challenges*, WIND POWER ENG'G & DEV. (Aug. 16, 2023), https://www.windpowerengineering.com/navigating-risks-in-the-u-s-offshore-wind-industry-insights-into-insurance-and-extreme-weather-challenges/.

performance, strong O&M practices must be in place. These practices include inspections of turbines, foundations, cables, and many other components as well as the ability to make repairs and replacements of various types of equipment. Overall general maintenance including "up tower" repairs (*i.e.*, repairs made directly to the equipment) and "down tower" remanufacturing processes (*i.e.*, fabricating new and replacement components) are important to maintain a low cost LCOE.

Modern O&M practices for modern OSW facilities are now highly refined due to the advanced nature of data management, automated visual inspections, diagnostics aided by artificial intelligence and the use of unmanned vehicles. As a result, the reliability of OSW generation has been significantly improved.[118]

Importantly, preventive maintenance can contribute substantially to the continued economic operation of OSW facilities. This is particularly true because conducting replacements of OSW equipment that has failed rather than subject to continuing maintenance can be costly in terms of production interruptions and lower net capacity factor. The continuing deployment of new OSW facilities and advances and O&M processes for existing facilities has led to quantum gains in the technologies and processes available to and used for O&M for new facilities including those that would be constructed off the North Carolina coast.

2.4.5 Useful Life

The issues surrounding the projected and potentially extended life of OSW facilities are a very active topic. Many windfarms that have been deployed for more than 20 years and are now seeking ways to extend their useful life. The main driver of this interest for new OSW facilities is how LCOE is calculated for a new facility. Since OSW uses no fuel and the only significant cost of operation is O&M, extending the useful life of an OSW facility beyond its original 25-to-30-year presumed lifetime, an extension of the anticipated useful life of a new OSW facility significantly decreases the projected LCOE. A major study conducted at the Department of Structural Integrity at the University of Strathclyde concluded that,

> Repowering can also be considered a type of decommissioning-cum-recommissioning with the installation of more powerful generation machines on existing structures or foundations while preserving the majority of the electrical systems (cables and substations), which substantially reduces the capital costs of the new project. The lifetime of foundations will depend on the type and the loads they receive and should last at least 100 years for gravity bases. Transmission cables can last more than 40 years, and the transformers 35 years.[119]

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[118] *Offshore Wind Farm Maintenance Optimal Engineering Strategies*, UTILITIES ONE, (Nov. 20, 2023), https://utilitiesone.com/offshore-wind-farm-maintenance-optimal-engineering-strategies.

[119] Pakenham, et al., *A Review of Life Extension Strategies for Offshore Wind Farms Using Techno-Economic Assessments*, ENERGIES, (Mar. 31, 2021), https://www.mdpi.com/1996-1073/14/7/1936 (citing Topham, et al., *Sustainable Decommissioning of an Offshore Wind Farm*. RENEW ENERGY, 102, 470–480 (2017), https://www.sciencedirect.com/science/article/pii/S0960148116309430).

The recognition of this means of improving the LCOE of electricity produced by new OSW facilities has led the UK's government in its new round of OSW licensing offers to make available a 60-year license which is up from 50 years previously. Given the projected 30-year life of OSW turbines, it is thought that this would allow two full project lifecycles which would substantially decrease the LCOE.[120] It has been estimated that the cost of the gravity base tower in OSW generation is approximately 26% of the overall original capital cost of the entire facility.[121] Of course, many site specific factors can affect the cost of particular components of an OSW facility, however the potential for substantially increasing the economic efficiency of an OSW facility is very significant. The potential for an extended useful life for an OSW facility is also enhanced by the new and highly automated O&M capabilities that will be applied to any new OSW facility. This will be a particularly significant consideration for installations off the North Carolina coast since all the leases have a term of 32 years and the leases can be extended for the same or similar use. Modeling should proceed to determine the likely effect of an extended useful life of an OSW facility in the Commission's decision-making process. To achieve a "least-cost" analysis of the LCOE for various generation technology alternatives, the Commission should be diligent in applying actual projected lifetimes of generation technologies rather than a simple 20- or 25-year projection, which may significantly overstate the resulting LCOE.

2.5 ECONOMICS & GENERAL WELFARE

2.5.1 Emissions

Because an operating OSW generation facility does not combust fuel, an OSW facility emits minimal carbon dioxide emissions from the production of electricity. The Environmental Protection Agency works together with BOEM to evaluate lifecycle air pollution emissions from OSW generation projects. Prior to construction, and offshore wind generation operator must obtain a permit from the EPA which covers both the construction and operational phases of the OSW generation facility. During construction the principal source of emissions are the vessels which are operating to construct the facility. Operational emissions are also emitted by engines on the turbines which operate for mobility as well as the continuing service by marine vessels that operate within 25 miles of the offshore wind generation facility.[122]

Ørsted has asserted, based on a study by Gamesa Siemens that wind generation facilities emit, generally, only 6 grams of carbon dioxide for every kilowatt hour of electricity produced. This conclusion includes the entire lifecycle of materials, manufacturing of the main parts, installation, operation, and maintenance. Further dismantling and recycling and disposal of the

[120] Elaine Maslin, *Extending Life in Offshore Wind*, MARITIME MAGAZINE, (Sept. 2022), https://www.maritimemagazines.com/offshore-engineer/202209/extending-life-in-offshore-wind/.

[121] *Renewable Energy Technologies: Cost Analysis Series*, INT'L RENEWABLE ENERGY AGENCY, (June 2012), https://www.irena.org/-/media/Files/IRENA/Agency/Publication/2012/RE_Technologies_Cost_Analysis-WIND_POWER.pdf.

[122] Lou Corio, *A Deeper Look at Offshore Wind Farm Air Emissions*, POWER ENGINEERS (May 26, 2022), https://www.powereng.com/library/a-deeper-look-at-offshore-wind-farm-air-emissions.

end-of-life non-salvageable components are included as are all the relevant transport activities in energy consumption included in the lifecycle calculation.[123]

A comprehensive literature review of the studies that have examined lifecycle emissions from offshore wind generating facilities concluded that the operational emissions of the facility were minimal and corresponded to approximately 3.5% of all lifecycle emissions.[124] However, other sources of emissions related to the manufacturing of the components were significant. For instance, extracting the raw materials for steel production accounts for 96% of the total emissions of the steel tower production process. Aside from the emissions from tower manufacturing—which accounts for 51% of the total emissions in the manufacturing stage of an OSW facility--significant emissions were related to the production of the foundation (~20%), the nacelle (~16%), and the blade (~10%).[125] Notably, the study surveyed indicated that the two principal sources of lifecycle emissions would be the extraction processes of the minerals and materials necessary and the potential for significant emissions during the process of decommissioning the facility. The studies surveyed also indicated that the recycling of materials from the decommissioning process would significantly reduce lifecycle emissions.[126]

2.5.2 Job Benefits

BVG Associates (BVGA), was commissioned by the North Carolina Department of Commerce to study the economic benefits for North Carolina from the initiation of development and construction of OSW generation facilities along the East Coast and more specifically of the North Carolina coast. Applying the best practices and lessons learned from the European Union, the study found that the OSW industry is expected to create a $140 billion supply chain and tens of thousands new manufacturing jobs in the United States by 2035.[127] North Carolina manufacturers are ready to address these needs and supply equipment for the entire U.S. East Coast market.

The study also found that North Carolina already possesses a very strong base of major manufacturing throughout the State and can attract additional manufacturers to locate in the State; further enlarging the existing industrial base enabling an acceleration effect on the wider North Carolina wind energy supply chain. The study found that North Carolina can use its existing manufacturing strength and its manufacturing-friendly regulatory environment to supply

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[123] A Clean Energy Solution – From Cradle to Grave, SIEMENS GAMESA RENEWABLE ENERGY S.A., 9–11, https://www.siemensgamesa.com/en-int/-/media/siemensgamesa/downloads/en/products-and-services/offshore/brochures/siemens-gamesa-environmental-product-declaration-epd-sg-8-0-167.pdf.

[124] Mello, et al., Wind Farms Life *Cycle Assessment Review: CO_2 Emissions & Climate Change*, SCIENCEDIRECT, Energy Reports 6, 216–217 (Nov. 14, 2020), https://www.sciencedirect.com/science/article/pii/S2352484720315298?via%3Dihub.

[125] *Id.*, at 217.

[126] *Id.*

[127] BVG ASSOCS., *Building North Carolina's Offshore Wind Supply*, at 19.

the physical supply chain and project-specific marine activities not only in North Carolina, but throughout the east coast wind energy markets.[128]

The North Carolina Department of Commerce found that the construction phase of an OSW project at the low range of the analysis will result in:

- The creation of 14,029 full-time jobs
- Earnings of nearly $1 billion
- Economic output of nearly $4 trillion

In the high range the results are:

- Creation of 28,208 full-time jobs
- Earning of over $2 billion
- Economic output of over $7.6 billion[129]

Studies by the Southeastern Wind Coalition ("SEWC") have also estimated large employment benefits from the Commission promoting active progress toward OSW development in North Carolina. The SEWC further calculated that during construction 27,621 to 30,990 job-years would be created and during O&M activities 923 job-years would be created.[130]

2.5.3 Public Opinion

Public opinion of OSW generation in North Carolina conducted in 2020 found that 71% of those surveyed strongly or somewhat strongly supported OSW generation in North Carolina.[131] Concerns have been raised by coastal residents principally having to do with the visual presence of turbines offshore. Some residents worry about the visual impact of wind turbines on the coastline, with preferences for wind developments, to be at least 24 nautical miles offshore.[132]

A Study by the National Centers for Coastal Science also conducted a survey of North Carolina coastal residents published in 2019 to measure public opinion on offshore wind development. The Study found that,

> Statistical modeling suggests that low awareness of local offshore wind energy development and high uncertainty of impacts from such development are

[128] *Id.*, at 2, 99-100.

[129] N.C. DEP'T OF COMMERCE, *Offshore Wind: Generating Economic Benefits In North Carolina - Economic Impact of a North Carolina Offshore Wind Farm*, at 5.

[130] Simmons, et al., *North Carolina Offshore Wind Cost-Benefit Analysis*, SE. WIND COALITION, 4 (Jan. 2022), https://sewind.org/wp-content/uploads/2023/01/NC_Offshore_Wind_Cost-Benefit_Analysis_FINAL.pdf.

[131] *NC Polls Toplines*, CLIMATE NEXUS POLLING (Nov. 2020), https://climatenexus.org/wp-content/uploads/2015/09/North-Carolina-Climate-Change-Poll-2020-Toplines.pdf (referencing Q8 where 33% "Strongly support" and 38% "Somewhat support" developing more OSW of the registered voters polled.).

[132] Celeste Gracia, *Coastal Residents Raise Concerns About North Carolina Offshore Wind Farms*, WUNC N.C. PUB. RADIO (Feb. 18, 2022), https://www.wunc.org/environment/2022-02-18/coastal-residents-raise-concerns-north-carolina-offshore-wind-farms.

predictive of support. While residents from households located closer to the shoreline are more likely to be opposed to local offshore wind energy development, more residents are supportive than opposed in this region of the coastal Carolinas. Unexpectedly, daytime views of the ocean do not predict support level. Perceived importance of marine mammal and sea turtle habitat drives opposition, while electricity affordability drives support for local offshore wind energy development. Results also suggest that residents living further inland from the shoreline are less likely to intend future action related to offshore wind energy development than residents living closer to the shoreline.[133]

[133] *Assessing Social Values Relative to Offshore Wind Energy Areas in North & South Carolina*, NAT'L CTRS. FOR COASTAL OCEAN SERVS. (Aug. 2019), https://coastalscience.noaa.gov/project/assessing-social-values-offshore-wind-energy-areas-north-south-carolina/.

3.0 NEW NUCLEAR

3.1 Introduction

The Companies have issued CPIRP request for relief 2(d)(v), for authorization to incur early development costs of up to $365 million through 2026 for New Nuclear (*i.e.*, SMR and AR) generation resources as necessary and reasonable steps for the execution of the CPIRP. In making this request for authorization to incur early development costs, the Companies made clear that it is their preference to not be first in developing and funding a New Nuclear project.[134] We agree with that posture. It is our experience that First-of-a-kind ("FOAK") projects face uncertainties in costs and timelines, limited access to traditional financing due to perceived risks, lack of historical data for accurate estimates, and the presence of unknown and knowable risks, that are hard to identify and mitigate. However, it is important to note that this will leave the timing of New Nuclear capacity in North Carolina in the hands of other developers and utilities and leave the Commission with significant uncertainty concerning deployment timing. The Companies cannot control the timing of others' efforts to develop the FOAK New Nuclear project.

We have comprehensively considered relevant industry history and data as well as the Companies' statements in the Plan. We have concluded that 2039 is the earliest likely Commercial Operation Date ("COD") of the first New Nuclear unit in North Carolina as opposed to the Companies' COD estimate of 2035—if the Companies are indeed a second mover in deploying a New Nuclear project. Using the same methodology, additional New Nuclear units at the first and second sites become later than the Companies' proposed schedule. We have estimated a realistic timeframe for a likely roll out for North Carolina New Nuclear generation facilities in the table below based on information available at this time.

Considering the contemplated addition of 900 MWe at Belews Creek and additional New Nuclear MWe's at other Company sites, evaluation of the potential licensing, cost and schedule benefits of one large new nuclear unit such as the AP- 1000 versus multiple SMR's appears to be a worthy of consideration in future CPIRP modeling.

Our suggested likely delay of New Nuclear deployment puts the consideration of earlier deployment of OSW generation in a clear perspective regarding the need to employ low-carbon generation and the curtailment of coal generation. It appears likely that OSW generation can be available before New Nuclear generation.

[134] *See, Carolinas Resource Plan*, App'x J – Nuclear, at 15 ("To significantly reduce both financial and regulatory risk, it is preferred to be a close follower of these [First-of-a-Kind] projects to resolve many of the initial design and construction risks.").

Table 1 – Schedule for Duke Energy New Nuclear builds based on industry data and Duke Supplemental Analysis – Advanced Nuclear paragraph.

Location	New Nuclear units	Total New Nuclear Supply (Mwe)	Likely COD Year	Total Number of New Reactors @ 300 Mwe
Belews Creek[1]				
	1	300	2039	1
	2	600	2040	2
	3	900	2041	3
Second Site[2]				
	1	1200	2046-2049	4
	2	1500	TBD	5
	3	1800	TBD	6
	4	2100	TBD	7
Unknown Site[3]				
	4	3300	TBD	11

Note 1 – Construction of the first two units at the first site assuming 2039 COD of the first unit.
Note 2 – The Second site construction begins after completion of the second unit at Belews Creek. With assumed construction time of 5-8 years (60 to 91 months).
Note 3 – The Supplemental Planning Analysis shows 11 reactors on Table SPA 2-11, at 28.

3.2 EXECUTION RISK

3.2.1 Near Term Planning

The near-term planning involves site selection, site control, development of a financial model, and sourcing funding for the development activities. The financial model defines thresholds for capital, O&M and fuel expenses and estimates of revenues for the project to meet financial objectives. Once site control is achieved and the financial model is approved by the developer, the regulatory approval application process commences; provided development funding is available.

In the Verified Amended Petition, the Companies have issued CPIRP requests for relief 2(d)(v), for authorization of development costs of up to $365 million through 2026 of New Nuclear generation resources as necessary and reasonable steps to execute the CPIRP. A request that the Companies have maintained from the Plan, as filed on August 17, 2023.[135]

[135] *Direct Testimony of Cliff Pompee, Steven Capps & Ben Smith on Behalf of Duke Energy Carolinas, LLC and Duke Energy Progress, LLC*, Dkt. No. E-100, Sub 190, 11, 12 (Sept. 1, 2023).

Witness Capps testified that in the Initial Carbon Plan, the Commission found that the Companies had demonstrated, "by a preponderance of evidence," that the decision to incur certain project development costs to pursue New Nuclear technologies was reasonable and prudent."[136] The Commission capped such project development costs incurred through 2024 at $75,000,000. The estimated future costs totaling $365 million related to advanced nuclear are provided in Table 4 of the Duke Energy's direct testimony.[137]

3.2.2 Permitting & Licensing

The U.S. Nuclear Regulatory Commission ("NRC") is the Federal agency responsible for protecting the health and safety of the public and the environment by licensing and regulating the civilian uses of radioactive materials. The New Nuclear applicant can follow one of two licensing protocols, the so called one step (10 CFR 52) licensing process that yields a combined construction and operating license ("COL") or the so called two step (10 CFR 50) licensing process which requires separate approval of construction and operation.[138] A proposed new advanced reactor licensing framework (10 CFR Part 53) which references many sections of PART 50 and PART 52 is in the development stage is also being considered. In addition, the nuclear Licensing Modernization Project is an industry-led initiative aimed at updating the regulatory framework for licensing advanced non-light water reactor designs.[139] Applicants utilizing already licensed reactor designs can reference a certified design or construction permit streamlining the NRC's review by focusing on site-specific and construction verification issues rather than re-reviewing the entire reactor design.[140]

In either licensing regime, the regulations allow for Early Site Permits ("ESP") to perform non-nuclear safety related work without making a nuclear technology/supplier selection. An ESP is based on an Environmental Impact Statement for heat rejection at the specific site. By issuing an ESP, the NRC approves one or more sites for a nuclear power facility, independent of an application for a construction permit or combined license. An ESP is valid for 10 to 20 years from the date of issuance and can be renewed for an additional 10 to 20 years. Any physical work performed under the ESP is at financial risk. The risk is not achieving regulatory approval and absence of continued validity of the financial model.

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[136] *Id.*, at 22.

[137] *Id.*, at 23.

[138] *Backgrounder on Nuclear Plant Licensing Process*, U.S. NUCLEAR REGULATORY COMM'N, https://www.nrc.gov/reading-rm/doc-collections/fact-sheets/licensing-process-fs.html (last visited May 26, 2024).

[139] *Industry-Led Licensing Modernization Project*, U.S. NUCLEAR REGULATORY COMM'N, https://www.nrc.gov/reactors/new-reactors/advanced/modernizing/rulemaking-and-guidance/industry-led-licensing-modernization-project.html (last visited May 26, 2024).

[140] *Id.*

3.2.3 Supply Chain/Interest Rates

Nuclear Fuel

SMR's based on light-water technology rely on the existing uranium suppliers and do not have a fuel supply issue. The weakest link in the nuclear supply chain for advanced reactors is nuclear fuel. The fuel is not needed until construction of a new reactor is substantially complete, approximately 8– to 10 years after project initiation. It is noted that there are limited domestic suppliers of high-assay low-enriched uranium ("HALEU") (fuel enriched to greater than 5% U-235) due to government and industry reliance on Russian suppliers. The DOE has recently issued a request for proposals to establish a reliable domestic supply of fuels for AR designs using HALEU.[141] The goal of the RFP is to support deployment of advanced nuclear reactors to spur the further development and deployment of advanced reactors in the United States. Currently, Centrus in Ohio and GNF's Wilmington North Carolina facility are licensed to enrich and fabricate HALEU.[142] This issue is being addressed through several ongoing DOE programs and initiatives in the IRA.[143]

Heavy Forgings

Managing the quality and capability challenges along the supply chain is crucial to securing a reliable and efficient supplier base. In Europe and North America, capability to manufacture safety-related components and systems has been eroded with the scarcity of New Nuclear projects since the 1980s. Emerging industrial countries' heavy forging vendors must upgrade their operations to meet the stringent requirements expected in the U.S. nuclear industry. Most of a new plant heavy forgings (reactor vessels for high pressure designs, steam generators, steam turbines and generators) will come from a range of international suppliers: China, Japan, South Korea, India, Canada and Europe.[144] Although Russia and the Ukraine have relatively advanced heavy forging capabilities, they have been removed from consideration due to the ongoing armed conflict. While there are several sources of heavy forgings, a 1- to 2-year lead time can be

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[141] U.S. DEP'T OF ENERGY, *DOE Announces Next Steps to Build Domestic Uranium Supply for Advanced Nuclear Reactors as Part of President Biden's Investing in America Agenda* (Jan. 9, 2024), https://www.energy.gov/articles/doe-announces-next-steps-build-domestic-uranium-supply-advanced-nuclear-reactors-part.

[142] *GE Vernova's Nuclear Fuel Business Receives Regulatory Approval to Manufacture Higher Enrichment Fuel*, GE VERNOVA (Feb. 14, 2024) https://www.ge.com/news/press-releases/ge-vernova-nuclear-fuel-business-receives-regulatory-approval-to-manufacture-higher-enrichment-fuel; *see also High-Assay Low-Enriched Uranium*, CENTRUS ENERGY CORP., https://www.centrusenergy.com/what-we-do/nuclear-fuel/high-assay-low-enriched-uranium/ (last visited May 26, 2024).

[143] *HALEU*, ORANO USA https://www.orano.group/usa/en/our-portfolio-expertise/advanced-reactors/haleu (last visited May 26, 2024) (indicating that due to its collaboration with DOE and AR developers, Orano is preparing to supply HALEU by 2030.).

[144] *Heavy Manufacturing of Power Plants*, WORLD NUCLEAR ASSOC. (Mar. 4, 2021), https://www.world-nuclear.org/information-library/nuclear-fuel-cycle/nuclear-power-reactors/heavy-manufacturing-of-power-plants.aspx.

anticipated.[145] This lead time must be fully integrated into the Companies project schedule to avoid unwanted project delays.

Transformers

Transformer lead times have been increasing for the last 2 years—from 50 weeks in 2021, to 120 weeks on average in 2024. Large transformers, both substation power, and generator step-up (GSU) transformers, have lead times ranging from 80 to 210 weeks, and some manufacturers have already announced plans to expand capacity to meet growing demand.[146]

Interest Rates and Inflation

Regarding interest rates, the New Nuclear carrying costs are subject to the same elevated commercial interest rates that affect OSW developers. Similarly, inflation of material and labor cost is applicable to any new energy project as concrete, steel, and copper are the materials used in significant quantities. Union labor is assumed for large energy construction projects including construction of nuclear power plants.

3.3.4 Federal Subsidies

Nuclear Fuel Suppliers

The Inflation Reduction Act invests $700 million to support the development of a domestic supply chain for HALEU through several HALEU Availability Program activities. The funding is available through September 30, 2026.[147]

Investment and Production tax credits (ITC, PTC) for developers

The IRA includes several tax incentives for clean energy technologies, including SMRs and ARs. A summary of the potential IRA benefits is provided in Duke Energy's *Carolina Resource Plan*. Note, that in addition to the other tax incentives cited, New Nuclear is also eligible for the Clean Electricity Tax Credits, like OSW.[148]

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[145] *Id.*

[146] Jacobs, et al, *Supply Shortages and an Inflexible Market Give Rise to High Power Transformer Lead Times*, WOOD MACKENZIE, (Apr. 2, 2023), https://www.woodmac.com/news/opinion/supply-shortages-and-an-inflexible-market-give-rise-to-high-power-transformer-lead-times/#:~:text=Transformer%20lead%20times%20have%20been%20increasing%20for%20the,plans%20to%20expand%20capacity%20to%20meet%20growing%20demand.

[147] 26 U.S.C. § 45J (Credit for production from advanced nuclear power facilities at a rate for 1.8 cents per kWh produced); *see also,* 26 U.S.C. § 45U (Credit for production from zero-emission nuclear power facilities at a rate for 0.3 cents per kWh produced, if the nuclear facility is not already receiving a credit pursuant to Section 45J); U.S. DEP'T OF ENERGY, *HALEU Availability Program*, https://www.energy.gov/ne/haleu-availability-program (last visited May 26, 2024) (the IRA invests $700 million, through 2026, to support the development of a domestic supply chain for HALEU through several HALEU Availability Program Activities.).

[148] *Carolina Resource Plan*, Appendix J – Nuclear, at 13–14 (referencing Table J-6).

Project developers will be able to choose from a technology-neutral production tax credit of $25 per megawatt-hour for the first ten years of plant operation or a 30% investment tax credit on new zero-carbon power plants placed into operation in 2025 or after.

Only one of these credits can be applied to a single facility but both include a 10% bonus if the power plant is built at a brown field site or a fossil energy community ensuring social and energy justice and a 10% credit if domestic content standards are met. Further, New Nuclear facilities are excluded from utilizing the Clean Electricity Tax Credits and other tax credits (*i.e.*, if the facility is using the CEPTC, it cannot also collect a credit pursuant to Section 45J.[149]

Above and beyond these credits, new and existing reactors can also leverage new production tax credits for up to ten years to generate clean hydrogen, which could expand market opportunities for current and future reactor technologies.[150]

Infrastructure Investment and Jobs Act of 2021

The Infrastructure Investment and Jobs Act of 2021 available to all applicants also appropriates $2.4 billion in key funding for microreactors, small modular reactors, and other advanced nuclear reactors, and enables an additional $3.2 billion through 2027.[151]

3.3.5 State and Federal Support

In 2021, North Carolina passed HB 951. Among the law's provisions, it allows the Commission discretion to delay the state's decarbonization requirements by two years, and more if it authorizes "construction of a nuclear facility or wind energy facility that would require additional time for completion."[152] The Commission in authorizing the ability to incur early development costs for New Nuclear, has demonstrated support for the resource as a "reasonable and prudent step in furtherance of the Carbon Plan."[153]

However, the NRC is the regulatory mandated lead agency for new reactor licensing. The NRC is a transparent yet ponderous regulator. The NRC is under pressure to show it can move expeditiously on a new nuclear technology, including New Nuclear designs, as many in the industry have advocated for deep reforms at the regulator.[154] Critics argue that the NRC must be willing to remove operational and organizational barriers that prevent rapid and efficient licensing and understand that time is of the essence to reduce emissions and solve energy

[149] 26 U.S.C. § 48E(b)(3)(C).

[150] *Inflation Reduction Act Keeps Momentum Building for Nuclear Powe*r, U.S. DEP'T OF ENERGY (Sept. 8, 2022), https://www.energy.gov/ne/articles/inflation-reduction-act-keeps-momentum-building-nuclear-power.

[151] *Biden Signs Infrastructure Bill Into Law*, NUCLEAR NEWSWIRE (Nov. 16, 2021), https://www.ans.org/news/article-3436/biden-signs-infrastructure-bill-into-law/.

[152] N.C. Gen. Stat. § 62-110.9(4).

[153] *Order Adopting Initial Carbon Plan*, at 29.

[154] Paul Day, *US Regulator Ready for Next Generation Nuclear, NRC Says*, REUTERS (Sept 1, 2023), https://www.reuters.com/business/energy/us-regulator-ready-next-generation-nuclear-nrc-2023-09-01/.

security issues. There are currently dozens of new reactor designs in the development stage, though only a handful have been submitted to the NRC initial review and none have gone through full regulatory scrutiny.[155] NRC uses technology-neutral and risk-informed approaches to assure safety objectives are being met which is a time consuming and meticulous process.

3.3.6 Design Maturity

There is little doubt that a variety of nuclear fission designs with a variety of coolants are capable of safe production of heat and electricity. Numerous conceptual designs exist on paper but are far from deployable until they are licensed, designed in detail, and constructed. While the conceptual reactor designs theoretically meet nuclear safety criteria, they are often simply far too underdeveloped or excessively expensive to construct. In an industry with consistent historical cost overruns, the issue of costs for New Nuclear is a daunting concern and must be deliberately and fully considered. The Companies' plan to be second for deployment of the selected nuclear technology is well advised as the history of FOAK design deployments in all industries and technologies has been wrought with uncertainty.

The World Nuclear Association provides a detailed methodology for determining New Nuclear design maturity.[156] The WNA guideline is informative for reactor developers and suggests 4 stages of design.

- Phase 1: Conceptual design.
- Phase 2: Plant-level engineering design
- Phase 3: System-level engineering design
- Phase 4: Component-level engineering design

No New Nuclear (*i.e.*, SMR or AR) design has been licensed for construction by the NRC. The NRC has recently docketed the construction permit application for Terrapower's Natrium reactor near a retiring coal plant in Lincoln County, Wyoming. Non-nuclear construction of that project is expected to begin in 2024. NuScale achieved NRC design certification with design completion to approximately Phase 4, but its site-specific COL efforts were stalled by lack of funding, customers, and staff.[157] Other New Nuclear SMR and AR designs, although promising, are in various design phases and in pre-application review with the NRC.

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[155] Matt Wald, *The State of Advanced Reactors*, NUCLEAR NEWS (Jan. 19, 2024), https://www.ans.org/news/article-5634/2024-the-state-of-advanced-reactors/.

[156] Allen Carson, *Design Maturity and Regulatory Expectations for Small Modular Reactors*, WORLD NUCLEAR ASSOC. (June 2021), https://www.world-nuclear.org/getmedia/23cea1aa-8b63-4284-947a-a0273327fce0/smr-design-maturity-report-FINAL-June.pdf.aspx.

[157] Lisa Stiffler, *Portland-Based Nuclear Reactor Company Nuscale Cuts 28% of Workforce, or 154 Employees*, GEEKWIRE (Jan. 8, 2024), https://www.msn.com/en-us/money/companies/portland-based-nuclear-reactor-company-nuscale-cuts-28-of-workforce-or-154-employees/ar-AA1mEf7b.

3.3.7 Overall Schedule

Licensing

Licensing a second of a kind New Nuclear facility would likely include the following assumptions.

- Design certification accomplished by the FOAK.
- Duplicate design with no substantial design or site-specific variations.
- ESP issued and physical non-nuclear work in progress.
- 10 CFR 50 or 10 CFR 52 review and approval process.[158]
- Combined Operating License Application (COLA) or Construction permit prepared and tendered.

The COLAs for VC Summer and Vogtle took approximately 4 years to achieve NRC approval (March 2008 – February 2012 for Vogtle and March 2008 – March 2012 for VC Summer).[159] In our opinion, it is possible that the COLA/construction permit approval for a future duplicate reactor design could be achieved in 30-36 months. The CPIRP Appendix J – Nuclear Figure J-4 assumes 30 months for the NRC to issue a COL or Construction permit (depending on which Licensing Pathway is chosen).

Construction

The International Atomic Energy Agency ("IAEA") compiles data in their Power Reactor Information System ("PRIS"). The PRIS database is a comprehensive source of data on all nuclear power reactors in the world. It includes specifications, performance history on operational reactors as well as reactors under construction or in the decommissioning process. In the 2022 IAEA report titled "Nuclear Power Reactors in the World" there is a graphic for the average construction time for reactors by yearly intervals. Notably the data for 34 reactor projects in the 2016 to 2021 period shows that the average construction time was 91 months.[160]

Although there are claims for much faster construction by various New Nuclear proponents, actual performance data is compelling. In fact, a planned construction duration of 91 months is more optimistic than the recent new reactor experience at Vogtle would indicate (Vogtle Unit 3 took 124 months and Vogtle Unit 4 took 125 months from start of nuclear construction).[161]

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[158] The 10 CFR 50 or 10 CFR52 review approval process may be chosen. For this report the overall schedule for licensing is assumed to be similar. The difference is with the Part 50 process the operating permit will be sought in parallel with construction.

[159] *See, e.g.*, *Issued Combined Licenses and Limited Work Authorizations for Vogtle, Units 3 and 4*, U.S. NUCLEAR REGULATORY COMM'N (Mar. 28, 2008), https://www.nrc.gov/reactors/new-reactors/large-lwr/col/vogtle.html#review.

[160] *Nuclear Power Reactors in the World*, INT'L ATOMIC ENERGY AGENCY, 87 (June 2022), https://1drv.ms/b/s!AoyAEUhQcUkojJFRAKq4HeDlWwnW1A?e=KGma6Q.

[161] *Commercial Operation Marks Completion of Vogtle Expansion*, WORLD NUCLEAR NEWS (Apr. 29 2024), https://world-nuclear-news.org/Articles/Commercial-operation-marks-completion-of-Vogtle-ex (Vogtle Units 3 & 4

Adding the licensing and construction history we estimate an optimistic schedule for a new second of a kind reactor could achieve commercial operation in 10 years from tendering a COLA or Part 50 construction permit (121 months (30 + 91 months)).

Other than NuScale there are no New Nuclear SMR or AR technology designs certified at present. Statements in the CPIRP are that a variety of reactor vendors are being evaluated and that evaluations will be completed in mid 2027.[162] Therefore, we assume the nominal 10-year schedule begins when a technology is selected, and that technology is then submitted for a COLA or a construction permit. Stated differently, ***if a design certified technology were chosen by Duke Energy in 2027 the optimistic commercial operation date (COD) for New Nuclear would be 2037***. However, that optimistic COD assumes no delays in the permitting and licensing for the construction of the selected technology. Since there has been a consistent pattern of delays in U.S. nuclear construction, for planning purposes it would be reasonable practice to add two years (20% schedule contingency) to the estimated completion date for the Companies' first New Nuclear facility (*i.e.*, a 2039 COD for long term nuclear base load generation planning).[163] Schedule contingency assumptions can be revised in the future as technology selection is completed and risks are mitigated.

Considering succeeding units of the same design, the Japanese advanced boiling water reactor ("ABWR") experience in the 1990's is useful as a reference. The best construction performance for the Japanese ABWR fleet was 54 months (Kashiwazaki-Kariwa).[164] We believe an assumption of 60 months construction duration provides a reasonable planning assumption for successive units of identical design for New Nuclear in North Carolina.[165]

The promise of New Nuclear as long term, carbon free baseload power is compelling. The learning gained from the first builds will certainly inform the succeeding builds provided the

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began nuclear construction in March 2013 and November 2013, respectively. Vogtle Unit 3 entered commercial operation in July 2023 and Vogtle Unit 4 entered commercial operation in March 2024.); *see also Vogtle Unit 3 Achieves its first Criticality, A Key Nuclear Commissioning Milestone*, FORO NUCLEAR (Mar. 14, 2023), https://www.foronuclear.org/en/updates/news/vogtle-unit-3-achieves-its-first-criticality-a-key-nuclear-commissioning-milestone/.

[162] *Carolina Resources Plan*, App'x J - Nuclear, at 10 (referencing Figure J-4).

[163] We have allocated 20% of the total project duration as a schedule contingency to accommodate risks such as unforeseen events, changes in scope, or unexpected challenges that may arise during construction. For instance, a qualified labor force will likely be engaged in distant Wyoming or Canada for the FOAK new nuclear project or engaged at the competing new nuclear Tennessee Valley Authority project.

See Structuring Nuclear Projects for Success: An Analytic Framework, World Nuclear Assoc., 9 https://world-nuclear.org/images/articles/Structuring%20Projects%20Report.pdf; *see also* Bent Flyvbjerg & Dan Gardner, HOW BIG THINGS GET DONE (2023).

[164] *Construction and Commissioning Experience of Evolutionary Water-Cooled Nuclear Power Plants*, INT'L ATOMIC ENERGY AGENCY, 3, 56 (April 2004), https://www-pub.iaea.org/MTCD/Publications/PDF/te_1390_web.pdf (referencing Table 1.2 and Table 5.2).

[165] *Study of Construction Technologies and Schedules, O&M Staffing and Cost, Decommissioning Costs and Funding Requirements for Advanced Reactor Designs*, U.S. DEP'T OF ENERGY, 11, 34–35, 56 (May 27, 2004), https://www.nrc.gov/docs/ML1018/ML101820632.pdf.

designs are substantially identical. The New Nuclear builds are however vulnerable to single causation issues such as licensing, supply chain, construction, opponents, or other barriers that have emerged in the global New Nuclear build projects. Taking the industry lessons learned and portions of the Duke Energy Supplemental Analysis - Advance Nuclear section into consideration from a planning perspective, we suggest the timing of New Nuclear capacity would likely be as provided in Table 1.[166]

There appears to be an inaccurate interpretation of the text in Duke Energy's Supplemental Analysis - Advanced Nuclear section in Tables SPA T-10 and SPA T-12.[167] The tables show 300 MWe addition every year from 2035 to 2038 for a total of 2100 MWe by 2038 (7 reactors), as shown in Table SPA T-10, copied below.

Table SPA T-10: DEC Winter Load, Capacity, and Reserves Tables (P3 Fall Base)

Line		2024	2025	2026	2027	2028	2029	2030	2031	2032	2033	2034	2035	2036	2037	2038
1	Gross System Peak Forecast	17,671	17,905	18,330	19,124	19,797	20,480	21,224	21,747	22,080	22,570	22,770	23,150	23,449	23,796	24,101
2	Cumulative EE Contribution at Peak	-7	-89	-172	-259	-343	-463	-545	-627	-705	-775	-821	-853	-875	-889	-893
3	Net System Peak Forecast	17,664	17,817	18,158	18,865	19,454	20,016	20,679	21,120	21,375	21,795	21,949	22,298	22,574	22,907	23,208
4	Existing Dispatchable Resources	20,609	20,627	20,678	20,751	21,005	20,287	20,348	19,825	18,499	18,494	18,491	18,488	16,266	16,266	16,266
5	Nuclear	5,650	5,650	5,650	5,650	5,650	5,657	5,680	5,703	5,699	5,699	5,699	5,699	5,699	5,699	5,699
6	CC	2,145	2,145	2,145	2,159	2,225	2,225	2,225	2,225	2,225	2,225	2,225	2,225	2,225	2,225	2,225
7	CT	3,249	3,651	3,651	3,707	3,717	3,717	3,717	3,717	3,717	3,717	3,717	3,717	3,717	3,717	3,717
8	Coal/DFO	6,119	5,693	5,693	5,693	5,693	4,933	4,933	4,387	3,069	3,069	3,069	3,069	849	849	849
9	Gas Boiler	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
10	Hydro	1,050	1,050	1,050	1,053	1,066	1,066	1,066	1,066	1,066	1,066	1,066	1,066	1,066	1,066	1,066
11	Pumped Storage	2,380	2,420	2,420	2,420	2,420	2,458	2,496	2,496	2,496	2,496	2,496	2,496	2,496	2,496	2,496
12	Standalone Battery	0	2	53	53	218	216	215	215	211	206	203	200	198	198	198
13	CHP	16	16	16	16	16	16	16	16	16	16	16	16	16	16	16
14	Existing Variable Resources	73	101	109	128	150	153	157	157	157	156	155	154	154	153	152
15	Solar	73	101	109	128	150	153	157	157	157	156	155	154	154	153	152
16	Purchases	323	313	315	314	315	315	311	311	301	299	301	302	304	305	307
17	Non-Renewable Purchases	178	178	180	181	182	182	183	185	186	188	189	191	192	194	195
18	Compliance Renewables	108	105	105	102	102	102	97	95	84	82	82	82	82	82	82
19	Non-Compliance Renewables	37	31	31	31	31	31	31	31	31	29	29	29	29	29	29
20	Undesignated Future Resources	0	0	0	100	604	2,178	3,115	4,486	5,986	7,518	9,432	10,361	10,878	11,485	12,093
21	Nuclear	0	0	0	0	0	0	0	0	0	0	0	600	900	1,500	2,100
22	CC	0	0	0	0	0	0	0	1,359	2,718	4,077	4,077	4,077	4,077	4,077	4,077
23	CT	0	0	0	0	0	1,274	2,124	2,124	2,124	2,124	2,124	2,124	2,124	2,124	2,124
24	Solar	0	0	0	0	13	25	36	48	57	66	74	82	89	97	104
25	Onshore Wind	0	0	0	0	0	0	0	0	0	0	0	158	206	206	206
26	Offshore Wind	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
27	Pumped Storage	0	0	0	0	0	0	0	0	0	0	1,742	1,742	1,742	1,742	1,742
28	Standalone Battery	0	0	0	100	394	488	487	487	477	467	459	453	448	448	448
29	Paired Battery	0	0	0	0	197	390	468	468	610	784	955	1,124	1,291	1,291	1,291
30	Production Capacity	21,004	21,042	21,103	21,292	22,074	22,933	23,930	24,779	24,942	26,467	28,378	29,305	27,601	28,209	28,817
31	Demand Side Management (DSM)	640	859	972	1,063	1,110	1,120	1,131	1,144	1,157	1,171	1,185	1,200	1,213	1,226	1,238
32	DSM	612	729	795	873	915	922	932	943	955	967	978	990	1,001	1,011	1,021
33	IVVC Peak Shaving	27	129	177	190	195	197	199	201	203	204	206	210	212	215	217
34	Total Firm Capacity	21,644	21,901	22,075	22,355	23,184	24,053	25,061	25,923	26,100	27,638	29,563	30,505	28,814	29,435	30,055
35	Total Reserve Capacity	3,980	4,084	3,917	3,490	3,730	4,036	4,382	4,803	4,725	5,844	7,614	8,207	6,240	6,527	6,847
36	Reserve Margin	22.53%	22.92%	21.57%	18.50%	19.17%	20.17%	21.19%	22.74%	22.11%	26.81%	34.69%	36.81%	27.64%	28.50%	29.50%

The Supplemental Analysis section "Advanced Nuclear" says "[t]his change further reduces the financial exposure of future units on the second site by performing the construction of the first two units at the first site over a three-year period before starting construction at the second site."[168] Using the companies COD assumptions (which we dispute as overly optimistic) of 2035

[166] *See Supplemental Planning Analysis*, at 27 (The text of this section addressing advanced nuclear is inconsistent with the Tables in the Supplemental Planning Analysis's Technical Appendix. The Advanced nuclear section talks about learning from the first unit and one year construction completion gap between the first and second unit. Later the section describes the first three units at Belews Creek. The section makes no mention of new nuclear units at the second site although the capacity additions could indicate 4 x 300 MWe units are planned at the second site.).

[167] *Supplemental Planning Analysis*, Technical App'x, at 11.

[168] *Supplemental Planning Analysis*, at 27.

for the first unit (300 MWe total new nuclear) and 2036 (600 MWe total new nuclear) for the second unit then starting construction of the next units in 2036, it is unclear how 2,100 MWe can be completed by 2038.

3.3 BUSINESS MODEL

3.3.1 Rate Treatment/Cost Certainty

In practice, New Nuclear investment is undertaken in broadly regulated markets largely via utility balance sheet financing where the operator can offset the risks of any given generating technology against those of other assets in their portfolio as well as shareholders. Any New Nuclear facility in the Companies' service territories will be included in the regulated rate base.

Cost Certainty

The costs of nuclear power plants fall into the following categories: Overnight Capital cost, interest rate during construction, and debt service, fuel cost, and O&M cost during operations.[169] The biggest unknown with new reactors is the overnight capital cost which is approximately 60% of total project cost.[170] Historical performance to cost estimate has been poor.[171] Since the construction time is lengthy, averaging 91 months, the interest rate on carrying costs during construction contribute heavily to the overall project cost (the sum of overnight capital cost and interest during construction are akin to the mortgage principal on a home).[172] Capital costs during operation are usually under 20% of the total operational costs.

The fuel cost in nuclear power has historically been a minor element in the total production cost. Fuel costs of New Nuclear plants are usually under 20% of the total operational costs. Fuel cost have historically been stable for light water reactors, however HALEU fuel costs are not as easily estimated and dependent on government programs as well as the extent of non-Russian industry mobilization of HALEU fuel manufacturing facilities like Centrus Energy Orano and others.

Operation and maintenance cost have been well quantified for the operating nuclear plants. Interestingly the physical security force is a significant portion of a nuclear plant's O&M budget. This is due to physical security requirements being added to nuclear plants following the 9/11 attacks. Physical security requirements will be designed into New Nuclear facilities as will

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[169] *Nuclear Costs in Context*, NUCLEAR ENERGY INST., December 2023, https://www.nei.org/resources/reports-briefs/nuclear-costs-in-context.

[170] Overnight' costs are exclusive of interest accruing during the construction period.

[171] David Schlissel & Bruce Biewald, *Nuclear Power Plant Construction Costs*, SYNAPSE ENERGY ECONS. INC., 7–9 (July 2008), https://www.synapse-energy.com/sites/default/files/SynapsePaper.2008-07.0.Nuclear-Plant-Construction-Costs.A0022_0.pdf (showing the average cost overrun for 75 large nuclear units was 207 percent.).

[172] *Economics of Nuclear Power*, WORLD NUCLEAR AGENCY, 16–17 (Sept. 29, 2023), https://world-nuclear.org/information-library/economic-aspects/economics-of-nuclear-power?source=content_type%253Areact%257Cfirst_level_url%253Aarticle%257Csection%253Amain_content%257Cbutton%253Abody_link.

revised emergency planning requirement that will likely hold the Emergency Planning Zone to the site boundary versus a 10-mile radius around the plant. Operations costs can potentially be lowered with the use of approved digital controls and AI administrative applications along with the acceptance of operating more than one unit from a single control room. We assume O&M cost will be 60% of the O&M cost (like the operating fleet) with opportunities for cost reduction as technological choices are made.

Considering the contemplated addition of 900MWe at Belews Creek and additional New Nuclear MWs at other Company sites, evaluation of the potential licensing, cost and schedule benefits of one large new nuclear unit such as the AP-1000 versus multiple SMR's appears worthy of consideration in future CPIRP proceedings.

3.3.2 Decommissioning

Before a nuclear power plant begins operations, the licensee must establish or obtain a financial mechanism – such as a trust fund or a guarantee from its parent company – to ensure there will be sufficient money to pay for the eventual decommissioning and used fuel management of the facility. The Nuclear Regulatory Commission (NRC) requires nuclear power plant licensees to establish or obtain a financial mechanism, such as a trust fund or a guarantee from its parent company, to ensure there will be sufficient money to pay for the eventual decommissioning of the facility.[173] The NRC estimates costs for decommissioning a nuclear power plant range from $280-$612 million and actual costs have proven to be higher. Licensees may demonstrate financial assurance for decommissioning by one or more of the following: prepayment, surety, insurance, or parent company guarantee method, or external sinking fund. The NRC requires nuclear power plant licensees to report to the agency the status of their decommissioning funds at least once every 2 years, annually within 5 years of the planned shutdown, and annually once a plant ceases operation.

3.3.3 Growth Potential

Existing nuclear and large brown-field retired coal plants are on large properties. The new reactor offerings typically need less than 16 acres for a single unit so expansion by multiple units of the same design in the future is possible on large sites provided all the licensing criteria are met for each reactor.

3.4 RELIABILITY

3.4.1 Dispatchability

Nuclear plants are designed to run at full power for the entire fuel or maintenance cycle. Reactor cold start up times are measured in days, as are planned shutdowns from full power. Nuclear plants are capable of load following, however, less than full load capacity load is uneconomic as the O&M costs do not reduce with load. All resources remain at full staff regardless of plant

[173] *Backgrounder on Decommissioning Nuclear Plants*, U.S. NUCLEAR REGULATORY COMM'N, https://www.nrc.gov/reading-rm/doc-collections/fact-sheets/decommissioning.html (last visited May 26, 2024).

load. Fuel costs are a small component of plant cost and do not justify less than full load operation.[174]

The interconnection for New Nuclear will be either at a brownfield retired coal plant, co-located at an existing Duke nuclear plant, or on a green field site all with strong transmission access. In other jurisdictions there are historic delays in securing interconnection agreements, however potential delays could be overcome with prudent planning and timely application to the Commission for interconnection.

3.4.2 Net Capacity Factor

The United States's nuclear plant capacity factors have been averaging above 92% since 2016.[175] The practices of the Companies in managing their nuclear facilities and the policies of the Institute of Nuclear Power Operations (INPO), which maintain fleetwide performance will be applied to any new reactor.

3.4.3 External Events

Nuclear plant design includes consideration of external events such as threats to physical security, hurricanes, earthquakes, floods, fire, cyber security, and airplane crashes. The external event designs and processes are reviewed by the NRC and included in the operating license.

3.4.4 O&M

Once constructed, the components of nuclear cost are: (1) nuclear fuel (~ 17%), (2) Capital improvements (~22%), and (3) O&M (~60%).[176]

3.4.4 Useful Service Life

A benefit of robust and high-quality construction is that nuclear plants, regardless of size, are initially licensed for 40 years. Nuclear units are eligible for up to two, 20-year Subsequent License Renewals (SLR) providing a possible total service life of 80 years.[177]

3.5 ECONOMIC & GENERAL WELFARE

3.5.1 Emissions Reduction

Nuclear is the largest base load low carbon power source in the United States. It generates nearly 800 billion kilowatt hours of electricity each year and produces more than half of the nation's

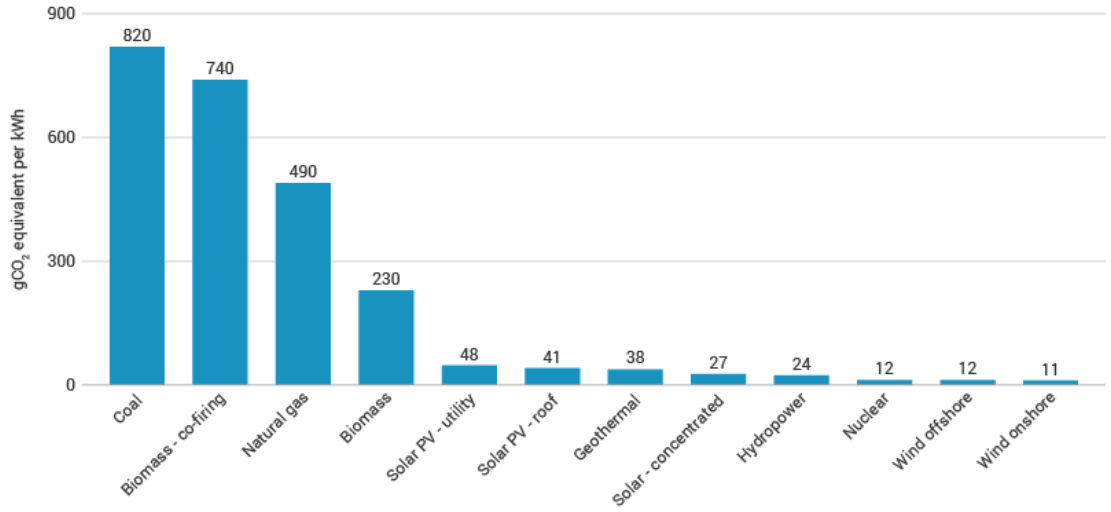
[174] *Nuclear Costs in Context*, NUCLEAR ENERGY INST., 6 (Dec. 2023), https://www.nei.org/resources/reports-briefs/nuclear-costs-in-context (noting fuel costs represent approximately 17 percent of the total generating cost).

[175] *U.S. Nuclear Industry Capacity Factors*, NUCLEAR ENERGY INST. (Mar. 2022), https://www.nei.org/resources/statistics/us-nuclear-industry-capacity-factors (last visited May 26, 2024).

[176] *Nuclear Costs in Context*, NUCLEAR ENERGY INST., at 6.

[177] *Backgrounder on Reactor License Renewal*, U.S. NUCLEAR REGULATORY COMM'N, https://www.nrc.gov/reading-rm/doc-collections/fact-sheets/fs-reactor-license-renewal.html (last visited May 26, 2024).

emissions-free electricity. This avoids more than 470 million metric tons of carbon each year, which is the equivalent of removing 100 million cars off of the road.[178] Nuclear power plants produce no greenhouse gas emissions during operation, and over the course of their life-cycle, nuclear power plants produce about the same amount of carbon dioxide-equivalent emissions per unit of electricity as wind, and one-third of the emissions per unit of electricity when compared with solar, per the graphic, below.[179]



3.4.2 Jobs/Other Benefits

The nuclear industry supports nearly half a million jobs in the U.S. and contributes an estimated $60 billion to the U.S. gross domestic product each year. U.S. nuclear plants can employ up to 700 workers with salaries that are 30% higher than the local average. They also contribute billions of dollars annually to local economies through federal and state tax revenues.[180] A strong civilian nuclear sector is essential to U.S. national security and energy diplomacy as the United States seeks to maintain its global leadership in this arena to influence the peaceful use of nuclear technologies.

In addition to the current economic impact of the nuclear industry in North Carolina, the economic impacts resulting from the construction and subsequent operations of a New Nuclear

[178] *Advantages and Challenges of Nuclear Energy*, U.S. DEP'T OF ENERGY (Mar. 29, 2021), https://www.energy.gov/ne/articles/advantages-and-challenges-nuclear-energy.

[179] *How can Nuclear Combat Climate Change?*, WORLD NUCLEAR ASSOC., https://www.world-nuclear.org/nuclear-essentials/how-can-nuclear-combat-climate-change.aspx#Nuclear%20Is%20Low-Carbon (last visited May 26, 2024).

[180] *Advantages and Challenges of Nuclear Energy*, U.S. DEP'T OF ENERGY (Mar. 29, 2021), https://www.energy.gov/ne/articles/advantages-and-challenges-nuclear-energy.

power plant in the State are estimated to be $1.8 billion for each one billion invested.[181]

3.4.3 Public Opinion

Commercial nuclear power is sometimes viewed by the general public as a dangerous or unstable process. This perception is often based on three global nuclear accidents, its false association with nuclear weapons, and how it is portrayed on popular television shows and films.

Many people view used fuel as a growing problem and are apprehensive about its transportation, storage, and disposal. DOE is responsible for the eventual disposal and associated transport of all commercial used fuel, which is currently securely stored at 76 reactor or used fuel storage sites in 34 states. For the foreseeable future, the used fuel can safely remain at these facilities until a permanent disposal solution is determined by Congress.[182]

One study found that households that live near existing nuclear facilities have an overwhelming positive opinion of their nuclear neighbor as the nuclear plants provide good jobs and support the local economy. Ninety-one percent of respondents, spanning demographic groups, have a favorable impression of the nearby plant, which is consistent with the trends seen in these national surveys since they began in 2005.[183]

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[181] von Nessen, et al., *The Economic Impact of the Nuclear Industry in the Southeast United States*, E4 CAROLINAS, 32–35 (Feb. 2024), https://d1aettbyeyfilo.cloudfront.net/senuclear/113083672585E4_Carolinas_Economic_Impact_Report_Final.pdf?kuid=37f73037-826c-473c-9f78-e5ee11e60786&kref=O6jM2tmKXUoQ.

[182] *Advantages and Challenges of Nuclear Energy*, https://www.energy.gov/ne/articles/advantages-and-challenges-nuclear-energy.

[183] Ann S. Bisconti, *Reverse NIMBY: Nuclear Power Plant Neighbors Say "Yes."*, BISCONTI RESEARCH, INC. (June 2022), https://www.bisconti.com/blog/9th-national-survey-of-nuclear-power-plant-neighbors.

4.0 COMPARATIVE ANALYSES

The preceding sections of this report have brought forward a number of facts that are relevant to the Commission regarding long-lead time generation assets. The fundamental question that this report addresses is the recommended relative timing for the deployment of both OSW technology and New Nuclear technology. We disagree with the Companies' proposal that OSW should be considered at some point in the future while New Nuclear is already being actively deployed. We believe and recommend that both technologies be undertaken in the near term. In order to present a reasonable comparative analysis of these two technologies regarding the question of relative timing for deployment, this analysis compares relevant objective areas of consideration in four important areas: (1) execution risk, (2) business models, (3) system reliability and (4) general welfare and well-being.

4.1 Execution Risks

We have not found any significant basis for distinguishing the substantive initiation of development between the two technologies on the basis of execution risk. Both technologies have their execution challenges.

For OSW there may be supply chain, permitting and construction issues that will arise. However, a number of different OSW projects are being constructed on the U.S. East Coast currently and over the next several years offer a great deal of experience before active construction of a North Carolina OSW project would begin.

The timely execution risk for New Nuclear will depend on the progress of the "first of a kind" projects being permitted and licensed by other entities since the companies have determined not to go forward first with such licensing and construction process. New Nuclear projects in North Carolina will not be initiated until those external processes are pursued and construction licensing completed. We have estimated that the earliest start date (COD) for New Nuclear will be in 2039. This estimate stands in stark contrast to the potential for the Kitty Hawk North project which may be starting construction in 2028-29 and could be operational by 2031-32.

Regarding permitting and licensing, no New Nuclear technology has been approved in an NRC licensing process except for NuScale, which is currently inactive due to financial constraints. On the other hand, BOEM has issued construction permits for several OSW facilities that are now operating or will be operating within 2-5 years.

It is not reasonable to distinguish between the timing of deployment of the two technologies on the basis of supply chain because both have some issues that we find to be manageable with reasonable planning.

Both technologies will receive significant financial support from the federal government under the Inflation Reduction Act and the Infrastructure Investment and Jobs Act.

Cost certainty for aspects of OSW and New Nuclear facilities are reasonably well established while other aspects such as OSW subsea and land-based transmission interconnects and construction cost may require more mature estimates. We recommend both technologies be pursued in parallel tracks. If one technology experiences execution difficulties, the other can

continue to support the State's economy and citizens. Since neither will constitute a significant portion of overall demand, the pursuit of both technologies will not result in economic inefficiency.

Federal Subsidies that are available for both OSW and New Nuclear are nearly identical, with neither technology having a significant advantage over the other.

Regulatory support is not the same for both technologies. Most of the regulatory support and oversight is Federal jurisdictional for New Nuclear, while the consideration and oversight of OSW is principally both Federal and state jurisdictional. However, both technologies are provided significant support by different authorities in North Carolina. The Commission has supported New Nuclear by authorizing the utilities the ability to incur early development costs for this resource but has not made any substantive decision on OSW. While OSW has received significant support through the executive branch of North Carolina as well as growing local support for OSW as it has already been substantially in place and functional elsewhere.

In consideration of design maturity, there is little doubt concerning the design maturity of OSW technology as it has been fully deployed and operational in many global regions. New Nuclear designs are tested; however, we anticipate significant progress as the FOAK developers make progress before the relevant regulatory bodies and utilities and actual construction cost and schedule data are realized. Once the New Nuclear FOAK designs are approved for construction, we anticipate that the Companies will move expeditiously to submit their applications to the relevant permitting and licensing authorities for approval. Accordingly, this ensures Duke is a second-mover for both OSW and New Nuclear.

There are well known processes available for both OSW and New Nuclear construction so there is no significant difference in construction risk.

Based on Execution Risk, there is no meaningful basis for the Companies to actively permit sites and select technology for New Nuclear to be actively pursued but wait to further consider OSW sometime in the future.

4.2 Business Models

We find the available business models for development of these two technologies constitute a reasonable basis for initiation of either technology. The business model for deployment of New Nuclear is one that's familiar to the Commission as well as the Companies. The costs of construction and operation of New Nuclear will be allocated to the regulated rate base to the extent that is reasonable and prudent, and those costs allocated to ratepayers.

For OSW, a number of projects have been canceled due to the weakness of a simple Power Purchase Agreement ("PPA") business model as a means to finance construction and operation of a significant OSW facility. As a result of those cancellations, developers have returned to negotiations with states and utilities that still have a need to address carbon reduction requirements.

Due to the financial weakness of a simple PPA, updated offtake agreements could be negotiated containing financial elements similar to how a regulated utility asset operates and is treated for

rate purposes. That is, there will be elements of cost recovery analogous to rate regulation. The offtake agreement would very likely include inflation adjustment mechanisms as applied in utility rate cases. Other mechanisms may be included in the offtake agreements with items that the Commission deems reasonable and prudent.

Both OSW and New Nuclear are subject to similar decommissioning procedures and financial assurance conditions for decommissioning. Both technologies can be expanded, New Nuclear by building additional units, and OSW by adding turbine capacity on the existing leases. The LCOE for both OSW and New Nuclear appear to be similar and does not serve as a factor to distinguish which of these technologies has an advantage over the other.

If by action of the Commission, the interstate collaboration between both the VSCC, MPSC and the Commission staff and the Companies and the Virginia Power operating units begin meaningful collaboration in an effort by the Companies to build a competent managerial capability to own and operate OSW facilities, then the regulatory model adopted by the VSCC can be implemented and the Commission can regulate the provision of the OSW low carbon generation in a traditional manner.

Both OSW and New Nuclear present significant opportunities for expansion options so that both could add additional generating capacity if needed. Both OSW and New Nuclear are also subject to exhaustive decommissioning and financial assurance requirements.

Based on the different business models there is no meaningful basis for the Companies to actively permit sites and select technology for New Nuclear to be actively pursued but wait to further consider OSW sometime in the future.

4.3 Reliability

We have found that there are different system reliability considerations to distinguish between these technologies' implementation timing. New Nuclear will likely operate at almost full net capacity factor for the lifetime of the facility. OSW facilities will likely operate between 40% and 49% overall net capacity factor.

New nuclear has no known vulnerability to external events such as weather. OSW facilities are subject to potential problems from extreme weather, particularly with hurricanes that have occurred frequently off the North Carolina coastline. However, studies have shown that design considerations can minimize the potential damage that high winds and wave action can impart on OSW facilities. In addition, the studies show that even a very severe hurricane will not damage the entire OSW facility, but rather parts of it. If that were to occur the structures and components can be replaced and the repairs would parallel the efforts to perform the original construction, which could take up to two years subject to equipment and vessel availability. We find that the reserve generation capacity on the Companies' system would be more than adequate to address the loss of that generation.

We do not believe that the operation and management ("O&M") of New Nuclear or OSW technologies indicates the need for a timing difference between initiating progress towards deployment of either technology. For new nuclear, O&M is straightforward, and the processes and costs are very well known. Similarly, O&M for OSW facilities services are conducted by

established service providers who have global reach. Real-time constant monitoring is conducted through remote operation centers and unmanned surface vessels, underwater vessels and drones with high tech visualization techniques and data collection capacity.

The measures of LCOE do not significantly differ regarding the ultimate cost of the electric power generated.

The useful life of OSW is 30 to 40 years and New Nuclear 80 years. Both technologies are subject to extensions through the permitting and licensing processes.

In terms of Operation & Maintenance, both New Nuclear and OSW preventive maintenance processes and procedures have been well established and will serve to maintain the performance of both technologies once deployed.

The useful service life for New Nuclear is initially licensed for 40 years, but life extension applications for the nuclear units make them eligible for two additional 20-year periods representing an accumulative useful life of 80 years. The useful life of turbines and OSW facility is 30 years, undersea cables have an estimated useful life of 45 years and while parts of an OSW facility have longer service lives. With high level maintenance and replacement of turbines and other parts that may fail, an OSW facility can operate for 60 years.

Based on the system reliability there is no meaningful basis for the Companies to actively permit sites and select technology for New Nuclear to be actively pursued but wait to further consider OSW sometime in the future.

4.4 Economic Development & General Welfare

Both OSW and New Nuclear are low carbon emitting technologies in the operational phase. In the construction phase and decommissioning phase there may be difference, but those differences have not been adequately articulated. A difference that has been voiced by interest groups may have to do with used (“spent”) fuel, however, the disposal of many components from the OSW decommissioned facilities may also pose a threat.

Both OSW and New Nuclear will provide substantial job growth.

Based on the different Economic Development and General Welfare considerations there is no meaningful basis for the Companies to actively permit sites and select technology for New Nuclear to be actively pursued but wait to further consider OSW sometime in the future.