M Natural Gas

Natural gas-fired generation is a proven and cost-effective dispatchable technology that has a long history of reliably serving Duke Energy Carolinas, LLC's ("DEC") and Duke Energy Progress, LLC's ("DEP" and, together with DEC, "Duke Energy" or the "Companies") customers with the ability to provide baseload, intermediate and peaking energy needs in a flexible manner. The flexibility and reliability of the technology also aids system operators in ensuring a reliable system by providing ramping and dispatchability to support greater integration of intermittent renewable resources, as discussed further in Appendix Q (Reliability and Operational Resilience Considerations). Combustion turbine technology will continue to serve the system in the future, whether it is fired with natural gas or another lower- or non-carbon emitting fuel, such as hydrogen, as discussed further in Appendix O (Low-Carbon Fuels and Hydrogen).

Dispatchable natural gas-fired resources continue to be an important part of maintaining low customer costs and high reliability of the Carolinas system. The Companies continue to consider advanced technology combined cycle ("CC") units as excellent options to meet a portion of future demand. The improving efficiency and reliability of CCs coupled with a large domestic resource base of natural gas make this resource very attractive. As coal facilities are retired and the proportion of delivered energy from variable renewable resources (solar and wind) increase, CC units will play an important role in the Companies' future diverse portfolio by maintaining system stability as a dispatchable resource available 24/7.

The Carolinas Carbon Plan (the "Plan" or "Carbon Plan") portfolios demonstrate that a diverse mix of resources is needed to meet growing system demand and to replace the energy and capacity from retirements of older less efficient units. Planning for a mix of complementary new low- or no-carbon resources and reliable and proven dispatchable technologies, such as natural gas, is critically important for ensuring reliability and de-risking the transition to a carbon-neutral future as compared to a transition that relies on a single or narrow scope of technologies.

With the significant capacity of variable, low-carbon generation (mostly solar and wind) that will be needed to reach Session Law 2021-165's ("HB 951") 70% CO_2 emissions reductions target, it will also be important to have sufficient peaking resources such as combustion turbines ("CT"). These units are normally dual-fuel.

Introduction to the Companies' Natural Gas Fleet

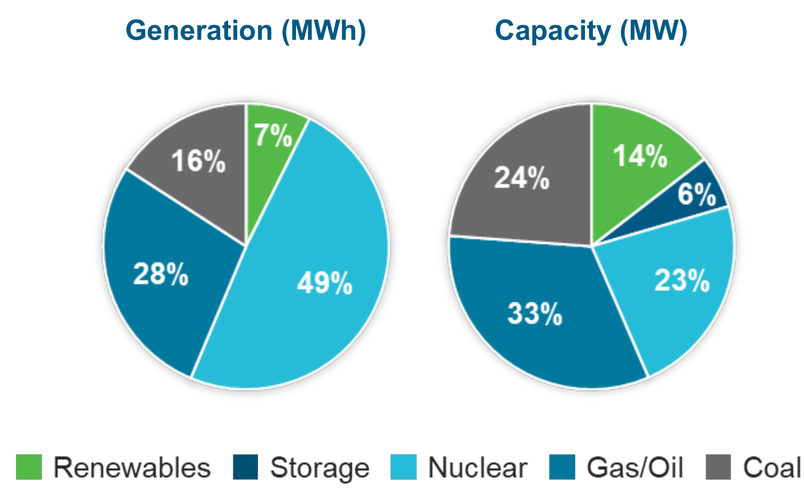
As of year-end 2021, the Companies' current CT/CC fleet consists of 55 standalone CTs, nine CCs, and one combined heat and power ("CHP") unit, as summarized in Table M-1 below. The Companies have over 50 years of operational excellence with their CT/CC fleet. The oldest operating units date back to 1970 and the Companies completed their latest CC at the Asheville plant in 2020. Across the fleet, the Companies operate four variations of CCs: 1x1s, 2x1s, 3x1, and CHP. Of the nine CCs, six are dual-fuel, which means they have the ability to run on either gas or ultra-low sulfur diesel.

Table M-1: Summary of Duke Energy Natural Gas Assets

Gas Asset Type	Number of Units	Capacity MW (winter)
Combustion Turbines (CTs)	55	6,147
Combined Cycles (CCs)	9	5,828
Combined Heat & Power (CHP)	1	15.5
Total	65	11,990.5

In 2021, the Companies' gas fleet comprised one-third (33%) of the total Carolinas capacity and generated 28% of the overall Carolinas generation (MWh), as illustrated in Figure M-1 below.

Figure M-1: Carolinas' Generation and Capacity as of December 31, 2021



Types of Natural Gas Generation

Appendix H (Screening of Generation Alternatives) outlines the types of generation assets that are considered for modeling. For CTs and CCs, the assets considered are shown in Table M-2 below.

The model of CT chosen, whether in simple cycle or combined cycle mode, will depend on the needs of the specific portfolio. Choices generally include F, G, H and J classes. The Advanced Class (J/HA) would have the most turndown and ramping flexibility and are the largest units. In fact, Duke Energy has partnered with Siemens to develop a state-of-the-art Advanced Class CT in demonstration and testing stage at the Lincoln station. This large CT (over 400 MW of capacity) will become Lincoln Unit 17 when the unit completes testing and is transferred to Duke Energy in 2024.

Configuration of CCs would likely either be 1x1 (like Asheville) or 2x1 (like Richmond, Sutton, Buck, Dan River and WS Lee). Newer technologies will be more adaptable for future hydrogen use. All three major Original Equipment Manufacturers ("OEMs") have stated they expect their machines will be 100% hydrogen capable by 2030. Any new gas assets will be designed with hydrogen (or other carbon-neutral fuel) in mind. The Companies will incorporate in their design, or make provisions for, features that will assist in the future hydrogen transition.

Table M-2: CT/CC Assets Considered for the Plan Modeling

Duty	Asset Description	Comment
Baseload	Combined Cycle F-Class	All of Duke Energy's combined-cycle fleet in NC is currently F-Class
	Combined Cycle J/HA-Class	Duke Energy's future CCs will likely be this most efficient class
	Combined Cycle with carbon capture and sequestration ("CCS")	CCS is not currently deemed viable for the Carolinas region from both geology and economic perspectives
Peaking/Intermediate	Aeroderivative Combustion Turbine	Aeros are typically used in fast start applications; Duke Energy has numerous aero units
	F-Frame Combustion Turbine	Duke Energy has many "F" frames on its system
	J/HA-Frame Combustion Turbine	Lincoln 17 will be the first advanced class on the system
	Reciprocating Engine	Duke Energy does not currently have any reciprocating engines on its system

Natural Gas Generation in the Plan

The Plan demonstrates and plans for integrating renewable energy resources, such as solar and wind, to become necessary to transition to a carbon-neutral future; however, these intermittent resources are simply unable to reliably meet customer demand each hour of each day of the year in a manner that dispatchable natural gas resources can. Planning to rely solely on renewable resources without high capacity factor dispatchable natural gas resources capable of following net-of-solar loads puts the system at risk of having insufficient energy to serve customer demand; the system must be supplemented with complementary, dispatchable resources to ensure energy adequacy and reliability failures in times when renewables do not or cannot produce (rainy/snowy days, dense cloud cover, etc.), as discussed in detail in Appendix Q (Reliability and Operational Resilience Considerations). Therefore, it is imperative that some amount of CT/CCs be added to maintain system reliability and compliance with NERC standards.

Today, coal-fired generation is critical during periods of high customer demand to provide the "essential reliability services" of regulating and load following on the Duke Energy Balancing Authorities ("BA"). If this generation is not replaced by generation that can provide these same essential reliability services, Duke Energy's system operators will be significantly challenged to comply with NERC's BAL Reliability Standards, and reliable electric service for its customers will be threatened.

In March of 2021, NERC President and CEO James Robb emphasized for the United States Senate Committee on Energy and Natural Resources ("U.S. Senate E&NR Committee") the critical role that gas generation has today for ensuring the reliability, resiliency and affordability of electric service in the United States and, going forward, will fulfill to reliably integrate more solar and wind generation resources as the Companies transition to lower CO_2 emissions. Robb explained:

> Natural gas is essential to a reliable transition. As variable resources continue to replace other generation sources, ***natural gas will remain essential to reliability***. In many areas, natural gas-fueled generation is needed to meet energy demand during shoulder periods between times of high and low renewable energy availability. On a daily basis in areas with significant solar generation, the ***mismatch between the solar generation peak and the electric load peak necessitates a very flexible generation resource to fill the gap. Natural gas generation is best positioned to play that role***. The criticality of natural gas as the "fuel that keeps the lights on" will remain unless or until very large-scale battery deployments are feasible or an alternative flexible fuel such as hydrogen can be developed.[1]

As shown in Table M-3 below, each of the four portfolios indicate the need for dispatchable CT and CC near-term assets. The range is 800-1,200 MW of CTs and 2,400 MW of CCs through the 70% interim target, with total new gas assets ranging from 3,600-4,000 MW through 2035. The ability to permit and construct these new assets and secure fuel supply will directly correlate with the ability to retire coal facilities and achieve the associated carbon reductions. The gas units are vital to maintaining system reliability with the transition from dispatchable resources to intermittent resources. Determining optimal project locations and configurations and then seeking new interconnection service for new natural gas resources is another critical path item for executing the Plan. Recognizing

[1] James R. Robb, North American Electric Reliability Corporation, Testimony Before United States Senate Committee on Energy and Natural Resources, Full Committee Hearing On The Reliability, Resiliency, And Affordability Of Electric Service, at 9, 10 (March 11, 2021) (emphasis added), *available at* https://www.energy.senate.gov/services/files/EB1D7E02-BC93-4DFF-A6A9-002341DA34CF.

that by 2035, all portfolios plan for at least 1,200 MW of new CTs and 2,400 MW of new CCs to be placed into service, the Companies plan to submit interconnection requests into the Definitive Interconnection System Impact Study ("DISIS") interconnection process to evaluate the interconnection costs at their preferred sites.

Table M-3: Portfolios 1-4 CT/CC Units and MW Needed in P1-P4 Through Compliance Period

Portfolios	New Advanced Class CTs, #, MW	New Advanced Class 2x1 CCs #, MW
P1: 70% by 2030 *With Offshore Wind*	3 1,200 MW	2 2,400 MW
P2: 70% by 2032 *With Offshore Wind*	3 1,200 MW	2 2,400 MW
P3: 70% by 2034 *With Small Modular Reactors*	3 1,200 MW	2 [2,400 MW
P4: 70% by 2034 *With Offshore Wind and Small Modular Reactors*	2 800 MW	2 2,400 MW

Execution and Risk Management

Delivering on the 70% interim target will require expanding the flexibility of the Companies' existing natural gas fleet in the Carolinas as well as building additional dispatchable natural gas resources. The detailed near-term actions and procurement activities that will be required around both the existing and new natural gas resources are discussed in Chapter 4 (Execution Plan). The actions that are required come with significant execution risks, which are discussed in detail in the remainder of this section, including some of the mitigation strategies to address these risks.

Pipelines: New gas interstate pipelines have been increasingly challenged through every permit approval required. The ability to bring additional gas supply to the Carolinas via pipelines is important to the success of the Companies' clean energy transition. More details on fuel supply and associated risks are addressed in Appendix N (Fuel Supply). The Companies have many years of successful experience of brownfield replacement of coal facilities with natural gas assets, but adequate gas supply is the largest risk. This risk can be somewhat mitigated with sufficient oil backup to cover fuel needs over sharp winter peaks.

Tightening Permitting standards: On April 21, 2022, the U.S. Environmental Protection Agency ("EPA") issued a whitepaper titled "Available and Emerging Technologies for Reducing Greenhouse Gas Emissions from Combustion Turbine Electric Generating Units." The white paper surveys control approaches or technologies that can be used to reduce greenhouse gas ("GHG") emissions from CT/CCs. In the paper, EPA states that while it is not currently establishing any binding requirements, the technologies and measures discussed may be relevant for permit development or future standard setting. EPA has indicated that they plan to propose revised GHG emission standards for new gas-fired CT/CCs around July 2022. Therefore, there are risks that EPA could alter the GHG requirements for future CT/CCs, which could mandate modifications of proposed designs. To address this risk, the Companies will be including provisions for initial hydrogen capability and/future expansion of those capabilities in our CT/CC designs as discussed further in Appendix O (Low-Carbon Fuels and Hydrogen).

Executive Orders on Social Cost of GHG ("SC-GHG"): On January 7, 2022, N.C. Governor Cooper issued Executive Order 246, *North Carolina's Transformation to a Clean, Equitable Economy*. Section 6 of the Executive Order discusses the Social Costs of Greenhouse Gas Emissions, which is published by the federal Interagency Working Group (IWG). Specifically, it directs:

> Within ninety (90) days of the publication of the IWG's updated SC-GHG estimates, the Governor's Office shall begin releasing guidelines for including and considering these estimates in specifically identified Cabinet agency decisions and actions, which the agencies shall follow within the timeframe provided by the guidelines and consistent with applicable law.
>
> Within sixty (60) days of any future IWG updates, the Governor's Office shall revise its SC-GHG guidelines to account for the IWG's latest SC-GHG estimates. Wherever feasible, agencies are encouraged to incorporate the IWG's SC-GHG estimates into agency decision-making processes that impact GHG emissions, even if guidance has not yet been issued for that decision-making context. Non-Cabinet agencies, the North Carolina Utilities Commission and other boards and commissions, universities, local governments, businesses, and other entities in North Carolina are encouraged to incorporate the SC-GHG into their decision-making processes. Consistent with applicable law, Cabinet agencies shall actively support such actions.[2]

It is too early to know what the effect of Section 6 may be on the North Carolina Utilities Commission or permit review agencies like the North Carolina Department of Environmental Quality. Notably, Duke Energy's Carbon Plan modeling includes 3,600-3,900 MW of economic gas resources (along with 4,000-6,000 MW of economically included energy storage) to enable retirement of 8,400 MW of coal generation and integrate 12,700-17,200 MW of renewables subject to interim CO_2 reduction targets consistent with HB 951.

Conclusion

Natural gas will continue to play a role into the future, with a growing need for dispatchable resources to support the integration of large amounts of renewables. HB 951 directs the Commission to issue a

[2] Exec. Order No. 246, North Carolina's Transformation to a Clean, Equitable Economy, Section 6 (January 7, 2022).

Plan that makes all reasonable efforts to achieve 70% CO_2 emissions reductions by 2030 at least cost while maintaining or improving system reliability. To retire coal facilities and maintain system stability, a foundational amount of dispatchable gas units will be required as outlined in the four portfolios presented above in Table M-3.[3] These new CT/CC assets will likely be located at brownfield sites to take advantage of existing infrastructure, permits and Duke Energy's talented and experienced workforce. Looking toward 2050, Duke Energy expects the eventual transition of natural gas units from baseload to resilience assets with fewer hours of use and more aligned with complementing storage use. Any new CT/CC assets will be designed for high flexibility (ramping, turndown, cycling ability) needed with a high renewables presence and also with a future hydrogen transition in mind. Hydrogen blending with natural gas and eventually 100% hydrogen use will lower any future CT/CC's carbon footprint over time.

[3] *See also* Appendix E (Quantitative Analysis) and Appendix Q (Reliability and Operational Resilience Considerations).