Docket No. E-100, Sub 179

Public Staff Report
Duke Energy "Carolinas Carbon Plan"
Stakeholder Meeting 1 (January 25, 2022)
9 am – 4 pm

GENERAL OVERVIEW

The first stakeholder meeting, which was moderated by third-party facilitator Great Plains Institute, primarily consisted of presentations by Duke Energy technical experts on the topics listed below. One hour was set aside for discussion, during which participants were asked to share their criteria for a successful carbon plan. In addition, a chat box was used by stakeholders to ask questions (some of which were answered by presenters during the meeting) and make comments. Many questions remained unanswered due to time constraints. Duke Energy indicated that the stakeholder meetings will become more interactive as the process moves forward.

Participating Stakeholders: *See Attachment 1*

Agenda: *See Attachment 2*

Duke Presentation: *See Attachment 3 for presentation slides*

- *Welcome and Introductions*
  - Duke's Carbon Plan proposal will cover both North Carolina and South Carolina.
  - The Carbon Plan must be least cost while not compromising system reliability.
  - Purpose of stakeholder meetings is to receive input from stakeholders, in particular customers and communities impacted by the clean energy transition.
  - The process will be more interactive in the next two stakeholder meetings.
  - Duke Energy has withdrawn its motion for a joint proceeding with South Carolina.

- *Stakeholder engagement process and objectives*
  - Stakeholder Meeting 2 scheduled for February 23, 2022.
  - Stakeholder Meeting 3 scheduled for March 22, 2022.
  - Duke will file its Carbon Plan proposal on May 16, 2022.

- *Introduction to Resource Planning and Decarbonization in the Carolinas*
  - Duke has engaged Guidehouse to help with the process.
  - Decarbonization must balance (1) sustainability, (2) affordability, and (3) reliability – need to examine how each resource fits into the broader resource portfolio.
  - Decarbonization involves (1) reducing and modifying load, (2) adding carbon-free resources, and (3) ensuring reliability.
  - The 2050 net-zero target allows for the last remaining percentage points to be met through offsets.
  - The Carbon Plan will begin with available technologies, then move to deployment of new resource types, and then look at emerging technologies.
  - Over time, there will be more information on costs and emerging technologies, and the Carbon Plan will be updated – the immediate Carbon Plan will be based on the best knowledge we have at this time.

- *Road to 70% Emissions Reduction and Net-Zero Future*
  - Discussion regarding HB951 requirements.
  - CO_2 emissions data to inform 2005 baseline CO_2 emission levels, most recently reported CO_2 emission levels, and the required, 2030 CO_2 emission levels under HB951 will be obtained from EPA eGRID database (uses actual measurements of CO_2 in stack emissions); where actual emissions data is not available, Duke will use EIA reported fuel data to estimate emissions.
  - 2005 CO_2 emissions baseline of 76 million short tons; 2019 CO_2 emissions were 47 million short tons; target for 2030 is 23 million short tons.
  - Discussion of decarbonization replacement resources, with timeline of expected availability of each.
  - Demand-side resources will be important to reduce demand and avoid emissions.

- *Introduction to Modeling*
  - Duke will be using a modeling tool called EnCompass, which can model all constraints simultaneously.
  - EnCompass will be used for capacity expansion modeling and production cost modeling; ancillary reserve requirements are modeled in-house.
  - Duke uses the SERVM tool to ensure it does not exceed 1 loss of load event per 10-year period.
  - Encompass inputs: new generation, existing generation, load forecast, fuel cost and supply, and constraints.

- *Economic Coal Retirements Modeling Methodology*
  - Focus on when coal is retired and with what it is replaced.
  - 2020 IRP Order directs Duke to utilize endogenous retirement; Duke may also provide supplemental analysis, such as the sequential method proposed in 2020 IRP.
  - Seeking stakeholder input on coal retirement analysis with certain key considerations (transmission impacts, simultaneous consideration of all units, co-optimized replacement resources, multiple replacements possible).
  - Optimal retirements determined by net exchange in investment, maintenance, and operations cost of system.

- *Load Forecast: Key Drivers*
  - EE/DSM assumptions – various levels of penetration based on market potential study, 1% of load per year in EE target.
    - Potentially need structural modifications and mechanisms to remove market barriers to program participation or to enhance cost effectiveness of new programs.
    - Duke is considering proposing an expanded EE/DSM definition, which would include “reducing consumption from the grid.”
  - Behind the meter solar forecast – feedback solicited on types and sources of projection scenarios to be used.
  - EV forecast – proposed base case (historical trends) and high case with Biden administration goal of 40-50% of new vehicles by 2030.
    - Soliciting feedback on charging usage profiles, projections of adoption.
    - Bi-directional Vehicle to Grid charging currently not modeled.

- *Other Key Modeling Assumptions: solar interconnection forecast; technology forecasts, natural gas price methodology forecast*
    - Considering annual solar interconnection limits of 500 MW, 750 MW, potentially more in an "enhanced transmission policy."
        - To meet 2030 targets, solar must be procured by 2026 to accommodate transmission upgrades.
        - Soliciting feedback on scenario development – potential value in an unrestricted interconnection sensitivity.
    - Technology cost and operational characteristics derived from Burns & McDonnell, Guidehouse, and EPRI.
        - Stakeholder interest in other sources, such as NREL ATB.
        - Relative to EIA, Duke's internal estimates are more aggressive for offshore wind, tracking solar PV, and battery storage.
    - Gas price forecast proposed: 5 years market, 3 years blend, fundamentals afterwards (using average of multiple fundamental forecasts).
        - Multiple fuel price sensitivities will be utilized.

- *Next Steps*
    - Presentation slides, an anonymized transcript of the chat box, and a recording of the presentation will be made available.
    - www.duke-energy.com/carolinascarbonplan has information regarding the stakeholder process.
    - Duke has heard the stakeholders' request for a working group on transmission issues, in addition to other potential working groups, and will take that request under consideration.

General feedback from participants regarding process:

- Requested receipt of presentation materials in advance of stakeholder meetings.
- Requested smaller working groups, with a specific request for a working group focused on transmission planning.
- Requested the ability to review the data and assumptions used in Duke's modeling of the Carbon Plan throughout the process.
- Requested open and transparent modeling tools; some stakeholders asked which parties intended to obtain an EnCompass license.
- Noted the absence of any female presenters.
- Expressed the desire for the stakeholder group to achieve consensus on as many issues as possible prior to Duke's filing of the proposed Carbon Plan.

ISSUES ON WHICH THERE IS CONSENSUS

- Rooftop solar, demand-side management, and energy efficiency should be pursued first to reduce and shift the load forecast.
- Multiple key model sensitivities should be tested – fuel, EE/DSM, capital costs, coal retirement schedule, and solar interconnection limits, at a minimum.

ISSUES IN DISPUTE

The list below captures broad themes of questions and comments made during the stakeholder meeting. The issues below are not necessarily in dispute at this time, nor is this an exhaustive

list of points raised. In addition, the items below are attributable to one or more participants, and do not represent the views of the group as a whole. The Public Staff does not take a position on any of the issues listed below at this time.

Carbon Plan, Generally

- Recommendations and analyses from related processes such as the development of the Clean Energy Plan (particularly the A1 process) and the Low-Income Affordability Collaborative should be incorporated into the Carbon Plan.
- The Governor's Executive Order No. 246 should be incorporated into the Carbon Plan
- Consider regional coordination.
- Must consider future transmission needs and siting of resources.
- Question of whether Duke has any plans to combine its DEP and DEC balancing areas in order to achieve efficiencies and meet its carbon plan requirements, or, alternatively, to allow facilities located in DEP's service territory to serve DEC load.

Emissions Targets, Generally

- Carbon reduction targets should be based on CO_2 equivalents, not just CO_2 emissions.
- Out-of-state emissions should be included in the calculation of Duke's emissions.
- Duke's emissions reductions should be more aggressive than prescribed in HB951.
- Must keep the 2050 goal in mind as we seek to meet the interim 2030 goal.
- Duke should not use the siting of high-emitting sources in South Carolina as an end-run around its HB951 emissions targets.
- Make sure we are measuring real emission reductions (e.g., swine biogas gets too much credit compared to its contribution to emission reductions).
- Methane emissions and leakage from upstream gas production should be taken into consideration.
- Importance of electrification (e.g., vehicles, heating, industrial load) in order to solve the economy-wide emissions problem.

Affordability

- On-bill financing should be part of the Carbon Plan.
- Must maintain fair and affordable rates for at-risk households and communities.
- Must consider and decrease the impact of the Carbon Plan on low- and moderate-income customers.

Environmental Justice and Communities

- There should be support for communities impacted by the transition away from coal.
- The Carbon Plan should be intentional about the siting of new facilities, avoiding areas already disproportionately impacted by energy generation and other industrial facilities.

Renewable and Carbon-Free Resources

- Disagree with Duke's assumptions about the availability and timing of offshore wind resources.
- Concern that proven technologies are being lumped together with emerging technologies or technologies still in research and development.
- Support for an aggressive storage scenario.
- Solar+storage should be considered as a resource.
- With respect to renewables, reliability and variability must be distinguished– renewables are variable, but in a predictable way, which makes them reliable.

- Need transparency and a common understanding around R&D investments versus investments in more mature technologies.
- Want to see transparency around Duke's perceived regulatory risk with regard to different resources (e.g., offshore wind regulatory approval process).
- Desire to pursue a "no regrets" renewable procurement and interconnection strategy.
- Hydrogen should only be included in the Carbon Plan if its production is carbon-free.

Modeling and Inputs

- Need transparency on pricing; avoid using confidential inputs as much as possible.
- Would like to see the plan reduce methane emissions upstream before selecting gas as a new resource.
- Model a scenario with a very high level of distributed resources and all currently available mechanisms for those resources to shift demand out of peak periods.
- Avoid precluding resource decisions down the road that might have better cost outlooks.
- Avoid building gas plants that will not survive their useful life and that will become stranded assets.
- Modeling should take into account fuel supply constraints.
- Modeling should take into account natural gas capacity constraints in Transco Zone 5.
- It is unclear whether DSM/EE will compete against other resources to meet future load requirements, or if it is only being used to develop the load forecast.
- Modeling should take into account the securitization of coal plants.

Docket No. E-100, Sub 179 **ATTACHMENT 1**

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Participating Stakeholders

350 Triangle
Advance Carolina
Alder Energy Systems
Alliance to Protect Our People and the Places We Live
Ameresco
APCO Worldwide
Apex Clean Energy
API
API SE Region
Appalachian State University
Appalachian Voices
Atrium Health
Audubon North Carolina
Bailey & Dixon, LLP
Baldwin Consulting Group, LLC
Bank of America
BP
BrightNight Power
Brooks, Pierce, McLendon, Humphrey & Leonard, LLP
Brubaker & Associates, Inc.
Buncombe County
Carolina Industrial Group for Fair Utility Rates
Carolina Utility Customers Association, Inc.
Carolinas Clean Energy Business Association
Carrboro Climate Action Team
Central Electric Power Cooperative, Inc.
Ceres
Charles River Associates
Charlotte Business Journal
Charlotte Pipe and Foundry
Charlotte-Mecklenburg NAACP
Chatham County
City of Asheville
City of Charlotte
City of Greensboro

City of Greenville
City of Salisbury
Clean Energy Buyers Association
CleanAIRE NC
Clemson University
Clemson University Facilities
Climate Action North Carolina
Coastal Conservation League
Conservation Voters of South Carolina
Consultant
Continental Tires the Americas, LLC
Core Solar, LLC
Corning Incorporated
Cypress Creek Renewables
Department of the Navy
Department of the Navy - NAVFAC
Dominion Energy, Inc.
Draughon Farms, LLC
Duke Energy
Duke University
Duke University / DUHS
Durham Climate Reality Project
Durham County Government
East Point Energy
Eckel & Vaughan
Ecoplexus
Ed Ablard Law Firm
Electric Cooperatives of South Carolina
Electric Power Research Institute
Electric Power Research Institute, Energy & Environmental Analysis Program
ElectriCities of North Carolina, Inc.
Energy and Policy Institute
Environmental Defense Fund
Equinor Renewables
ESS Tech, Inc.
Facebook
Fayetteville Public Works Commission
Fox Rothschild
Gaia Herbs
GE Power
Geenex Solar LLC
Good Solar Organization
Google, LLC

Great Plains Institute
Green Built Alliance / Energy Savers Network
Greensboro Solar Power Now Coalition
Guidehouse
Haywood EMC
HDR Inc.
Interfaith Creation Care of the Triangle
Invenergy
JB Pudlo Consulting
JLL
Kairos Government Affairs
Kimberly-Clark Corporation
KTS Strategies LLC
Lockhart Power Company
Longroad Energy
McGuireWoods LLP
Members of the public
Messer
Michelin North America
Milliken & Company
Mitsubishi Power Americas
MountainTrue
National Council of Structural Engineers Associations
Natural Resources Defense Council
NC WARN
NCUC - Public Staff
New Belgium Brewing
North Carolina Black Alliance
North Carolina Clean Energy Technology Center
North Carolina Conservation Network
North Carolina Department of Commerce
North Carolina Department of Environmental Quality
North Carolina Department of Justice
North Carolina Division of Air Quality
North Carolina Electric Membership Corporation
North Carolina General Assembly
North Carolina Interfaith Power and Light
North Carolina Justice Center
North Carolina League of Conservation Voters
North Carolina State University
North Carolina Sustainable Energy Association
North Carolina's Electric Cooperatives
Nova Energy Consultants, Inc.

Orsted
PactivEvergreen
Palladium Energy
Parkdale Mills
Parker Poe
Person County Commissioner
Piedmont Environmental Alliance
Pine Gate Renewables, LLC
Regulatory Assistance Project
RMI
Robinson Consulting Group
Rutherford Electric Membership Corporation
RWE Renewables
Sands Law, PLLC
Santee Cooper
Savion
ScottMadden, Inc.
Siemens Energy
Sierra Club
Sierra Nevada Brewing Co.
Smart Electric Power Alliance
Soltage, LLC
Solterra Partners, LLC
South Carolina Coastal Conservation League
South Carolina Department of Commerce
South Carolina Department of Consumer Affairs
South Carolina Office of Regulatory Staff
Southeast Sustainability Directors Network
Southeastern Wind Coalition
Southern Alliance for Clean Energy
Southern Current LLC
Southern Environmental Law Center
Southern Renewable Energy Association
State of North Carolina
Strata Clean Energy
Strategen Consulting
Sunrun Inc.
Synapse Energy Economics
TerraPower
The Nature Conservancy
The State Media Co./ McClatchy
Town of Boone
Town of Chapel Hill

UNC School of Law
Upstate Forever
UTILICOM
Vestas North Americas
Vote Solar
Wartsila
WaterFurnace
North Carolina Manufacturers Alliance

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Duke Energy – Carolinas Carbon Plan Stakeholder Meeting 1

January 25, 2022 9:00am – 4:00pm ET

Agenda

Part 1: Overview and Key Considerations

9:00am	Welcome and Introductions
9:15am	Stakeholder Engagement Process and Objectives
9:45am	Introduction to Resource Planning and Decarbonization in the Carolinas
10:15am	Road to 70% Emissions Reduction and Net-Zero Future
10:45am	BREAK
11:00am	Discussion
12:00pm	LUNCH BREAK

Part 2: Modeling Inputs and Assumptions

1:00pm	Introduction to Modeling
1:30pm	Economic Coal Retirements Modeling Methodology
2:00pm	Load Forecast: Key Drivers
2:30pm	BREAK
2:45pm	Other key modeling assumptions: solar interconnection forecast; technology forecasts; natural gas price methodology forecast
3:45pm	Next Steps
4:00pm	Adjourn

Duke Energy Carolinas Carbon Plan Stakeholder Meeting 1

Virtual Meeting – January 25, 2022

**Please note, this meeting is being recorded. Presentations will be posted on the Carolinas Carbon Plan website, and discussion portions will be kept for internal purposes only to ensure accuracy of meeting notes.*

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Today's Approach

Part 1: Overview & Key Considerations

The morning session will be focused on introductions, process, level-setting and core objectives of the Carolinas Carbon Plan.

Part 2: Inputs & Assumptions

The afternoon session will provide an opportunity to provide feedback to the technical inputs and assumptions that drive the modeling underlying the Carbon Plan

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Great Plains Institute (GPI)

Doug Scott,
Vice President, Electricity & Efficiency

Trevor Drake,
Senior Program Manager

Alissa Bemis,
Meeting & Administrative Coordinator

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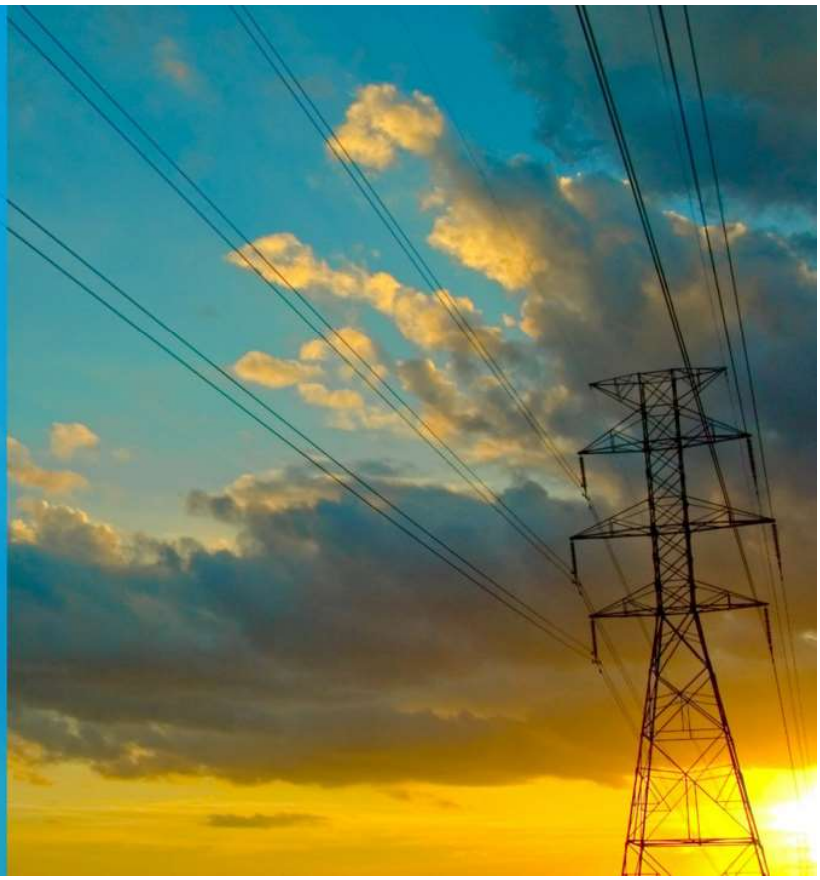
Related GPI Work

- Integrated Resource Planning
- Power Plant Host Community Impacts
- Time-Varying Rate Designs
- Electric Vehicle Investments and Programs
- Distribution System Planning
- Load Flexibility and Demand Response Programs
- Utility Performance Metrics



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Duke Welcome

Stephen De May
State President, North Carolina

Mike Callahan
State President, South Carolina

Stakeholder Process Objectives

1. Ensure the Carolinas Carbon Plan is informed by input from a wide range of stakeholders.

2. Enable a transparent conversation about how to plan an energy transition that prioritizes affordability and reliability for NC and SC customers.

3. Build on areas of agreement, clarify areas of disagreement, and seek opportunities for collaboration in advance of filing the Carolinas Carbon Plan.

Stakeholder Process Timeline

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Meeting Ground Rules

- **Respect each other:** Help us to collectively uphold respect for each other's experiences and opinions, even in difficult conversations. We need everyone's wisdom to achieve better understanding and develop robust solutions.

- **Focus on values and outcomes:** Today's discussion is about what stakeholders value in the energy future, and how the Carolinas Carbon Plan can align with those values. Pending legal issues are outside the scope of this conversation.

- **Chatham House Rule**: Empower others to voice their perspective by respecting the "Chatham House Rule;" you are welcome to share information discussed, but not a participant's identity or affiliation (including unapproved recording of this session).

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Meeting Ground Rules

- **Respect the time:** Our time together is limited and valuable, and we have a large group, so please be mindful of the time and of others' opportunity to participate.
- **Use the chat:** Please submit your comments and questions in the chat. GPI staff will monitor the chat to pull out questions for Q&A portions. Please be respectful and focus on issues, not people.
- **Raise your hand:** During dedicated Q&A portions of the meeting, use the "Raise Hand" feature to indicate you would like to voice a question or comment.

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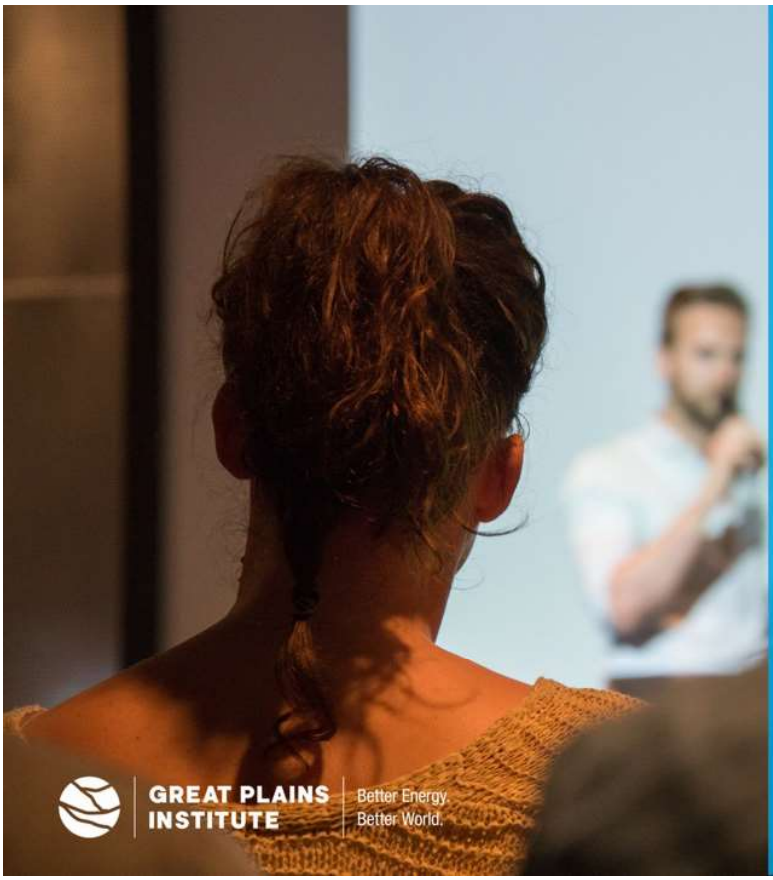

Meeting Dates

1. **Tuesday, January 25th**
2. **Wednesday, February 23rd**
3. **Tuesday, March 22nd**

Future meeting agendas will be based on feedback received today

Additional Participation

Meeting materials/recordings will be uploaded to the website:

www.duke-energy.com/CarolinasCarbonPlan

Information/feedback can be sent to:

DukeCarbonPlan@gpisd.net

Meeting recordings (Q&A portions of meetings will be removed to adhere to the non-attribution rule) and meeting summaries will be uploaded to the website for participants to access.

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Today's Agenda

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2:00pm	Load Forecast: Key Drivers
2:45pm	BREAK
3:00pm	Other Key Modeling Assumptions:
	• Solar Interconnection Forecast
	• Technology Forecasts
	• Natural Gas Price Forecast
3:45pm	Next Steps
4:00pm	Adjourn

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Introduction to Resource Planning and Decarbonization in the Carolinas

Glen Snider, Managing Director, Carolinas Integrated Resource Planning

JANUARY 25, 2022

DUKE ENERGY®

BUILDING A SMARTER ENERGY FUTURE®

Guiding Principles for Decarbonization: Sustainability, Affordability, Reliability

Sustainability

- Carbon reduction targets
  - 70% reduction 2030
  - Net zero by 2050
- Continually reducing environmental impact to ensure
  - Cleaner air
  - Cleaner water
  - Cleaner land

Affordability

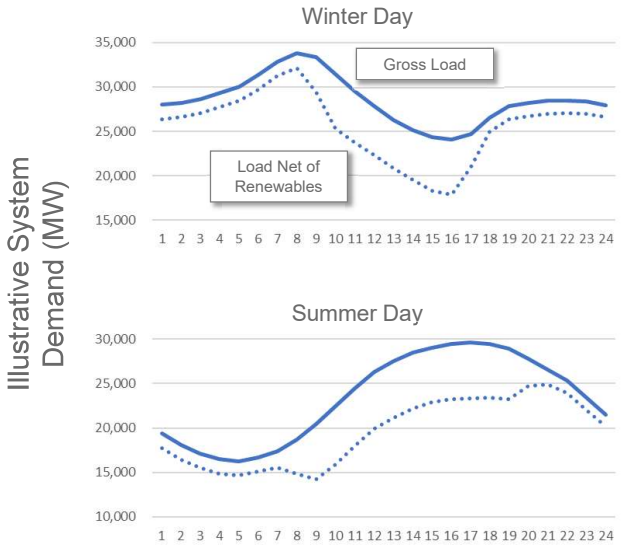
- Capital, land, operations and maintenance (O&M), and fuel costs vary by resource type
- Cumulative costs over time represented as present value of costs
- Evaluation of forecasted annual bill impacts shows costs & benefits at snapshots in time

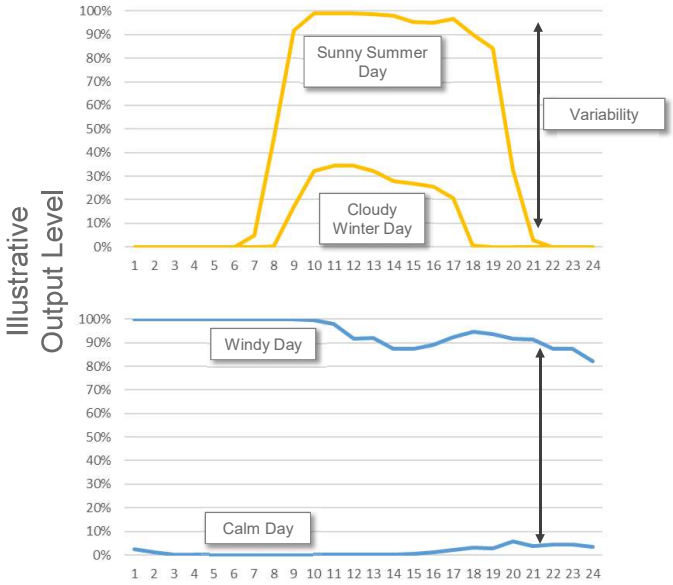
Reliability

- Serve customer demand that varies year-to-year, month-to-month, hour-to-hour, and minute-to-minute
- Maintain adequate long-term reserves to meet customer needs during peak demand periods
- Maintain adequate system flexibility to respond to changing real-time operating conditions

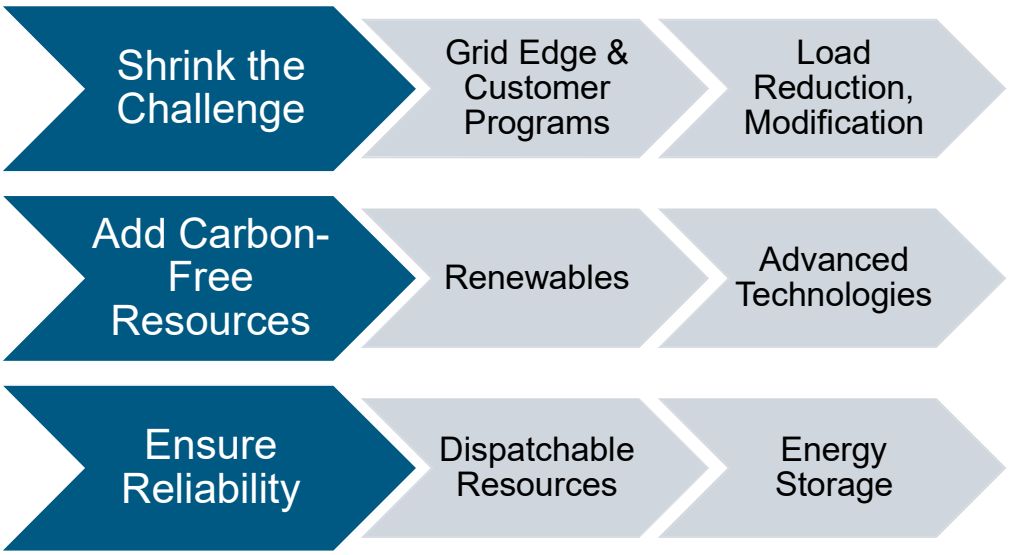
Reliability Requires Responding to Variability

- Variable generation compounds challenges of variable load, increasing importance of resources able to rapidly increase or decrease output to balance supply and demand in real time





Elements of Decarbonization



Executing a Plan Within a Plan

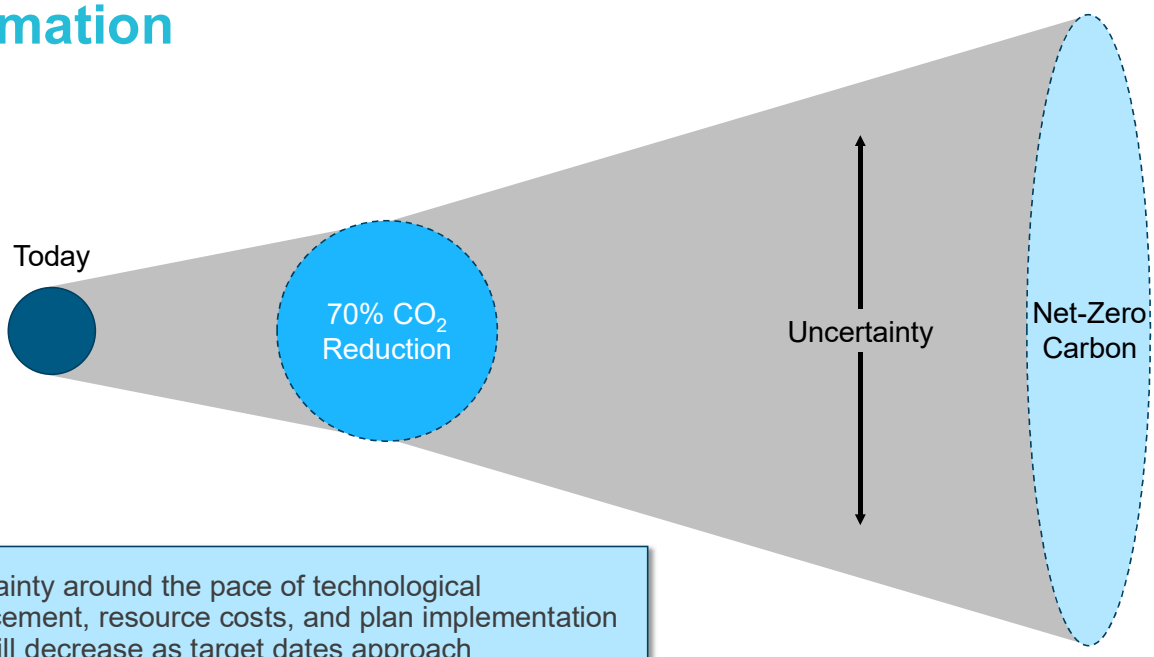
70% CO_2 Reduction → **Carbon Neutrality**

- Available Technologies
- Near-term Execution
- Supporting Actions to Enable Implementation

- Deployment of New Resource Types
- Advanced Nuclear
- Offshore Wind

- Emerging Technologies
- Preparation for Future Action
  - Research & Development
  - Technology Pilots
- Signposts Indicating Pace of Advancement

Periodic Carbon Plan Updates Will Incorporate New Information



Uncertainty around the pace of technological advancement, resource costs, and plan implementation risks will decrease as target dates approach

Road to 70% Emissions Reduction and Net-Zero Future

Mark McIntire, Director, Government and Environmental Affairs

Mike Quinto, Integrated Resource Planning, Lead Engineer

JANUARY 25, 2022

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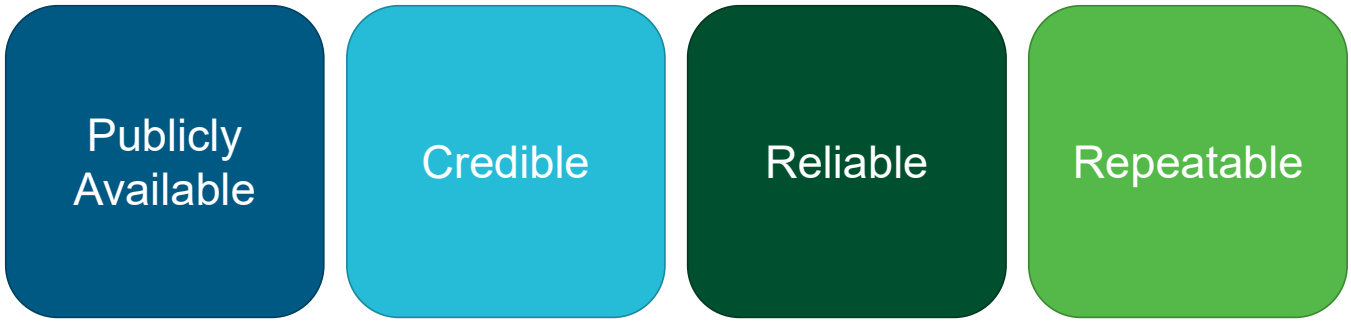
Requirements for CO_2 Emissions Reduction

- ✓70% Reduction in Emissions
- ✓Of Carbon Dioxide (CO_2)
- ✓Emitted in the State (NC)
- ✓From electric generating facilities owned or operated by (or on behalf of) electric public utilities
- ✓From 2005
- ✓Carbon Neutrality by 2050

CO_2 Emissions Data Considerations



EPA eGRID

- Environmental Protection Agency (EPA) Emissions and Generation Resource Integrated Database (eGRID)

"The Emissions & Generation Resource Integrated Database (eGRID) is a comprehensive source of data on the environmental characteristics of almost all electric power generated in the United States. The preeminent source of emissions data for the electric power sector, eGRID is based on available plant-specific data for all U.S. electricity generating plants that provide power to the electric grid and report data to the U.S. government" – eGRID Technical Guide

- Used for environmental disclosures, emission inventories, and RPS and RECs Tracking
- Used by Federal Government, state and local governments, the EPA, National Labs, ISOs, non-governmental organizations, academia, and companies

eGRID Emissions Data Sources

- eGRID uses EPA's Clean Air Market Division (CAMD) Power Sector Emissions Data
  - Data reported to EPA by electric generating units to comply with the regulations in 40 CFR Part 75 and 40 CFR Part 63
    - Emissions data primarily uses Emissions Tracking Systems (ETS)/Continuous Emissions Monitoring Systems (CEMS)
      - Actual measurements of CO_2 in stack emissions
    - Where CEMS data is not available, eGRID uses EIA reported fuel data (EIA-923) to estimate emissions
      - Estimates emissions based on fuel consumed and standard emissions based on fuel type

CO_2 Emissions included in Baseline and Reduction Goals

Owned

Operated by

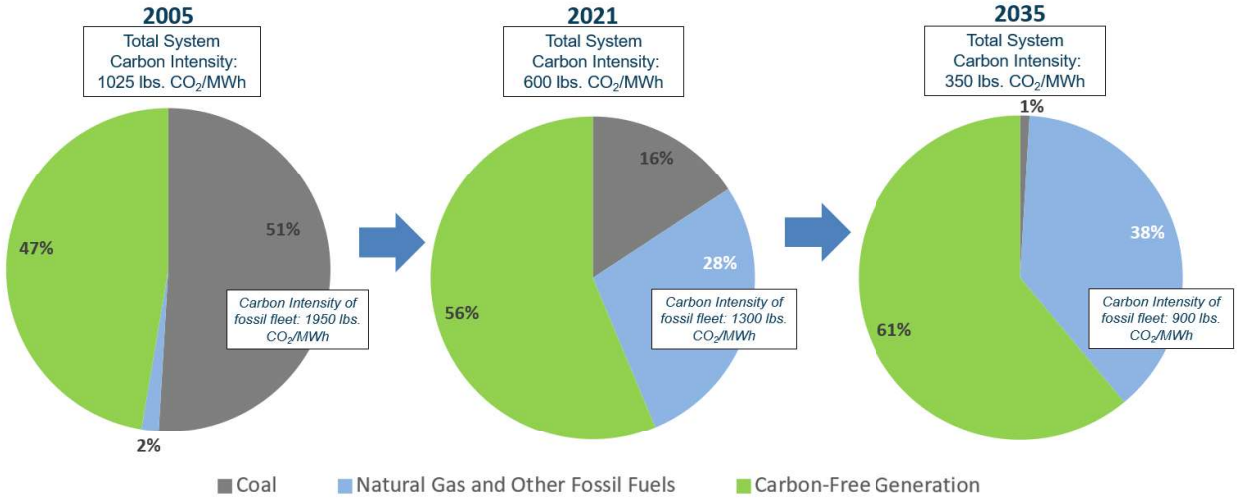
Operated on behalf of

CO_2 Emissions included in Baseline and Future Actual Emissions

Owned	Operated by	Operated on behalf of
Stack emissions associated with the ownership share of electric generation facilities located in North Carolina owned by DEC/DEP	Stack emissions associated with electric generating facilities located in North Carolina operated by DEC/DEP	Stack emissions associated with electric generating facilities located in North Carolina not owned or operated by DEC/DEP, but contracted to sell electrical output to DEC/DEP

Carolinas Combined Fleet Transition Progress

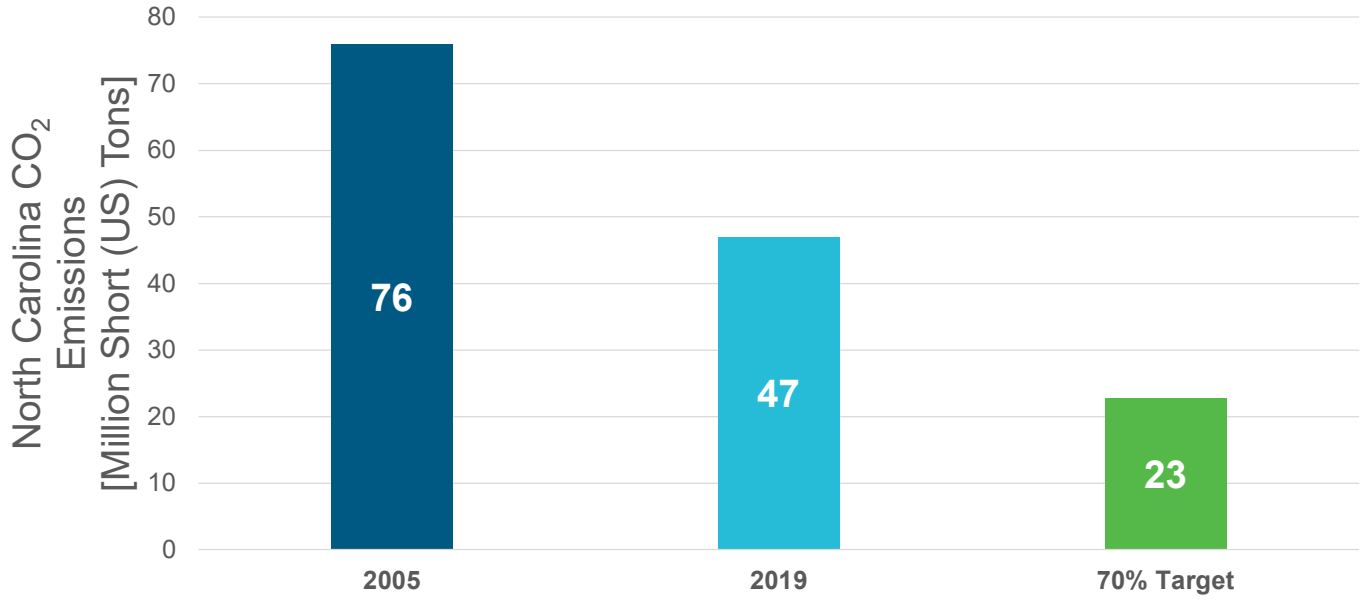
The combined DEC/DEP fleet is a national leader in low carbon intensity energy, with a current rate 37% lower than the industry average of 957 lbs. CO_2/MWh[1]



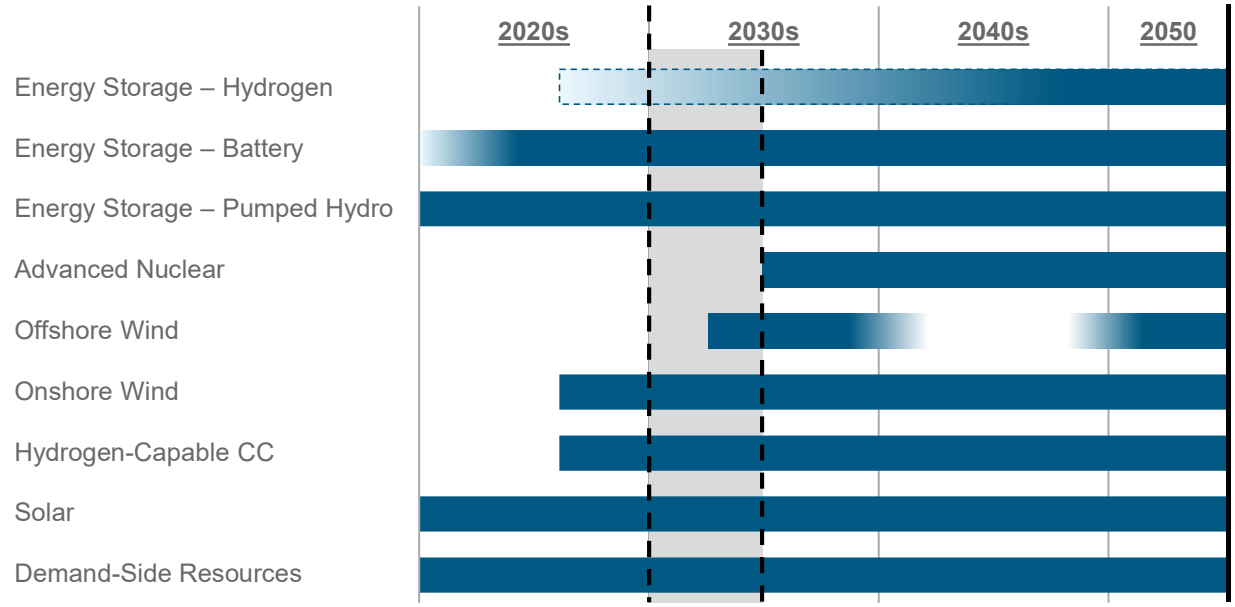
1Source: MJ Bradley, "Benchmarking Air Emissions of the 100 Largest Electric Power Producers in the United States" – July 2020, p. 30

Note: 2021 and 2035 energy mix and carbon intensity projections are based on the 2020 IRP Base w/ Carbon Policy

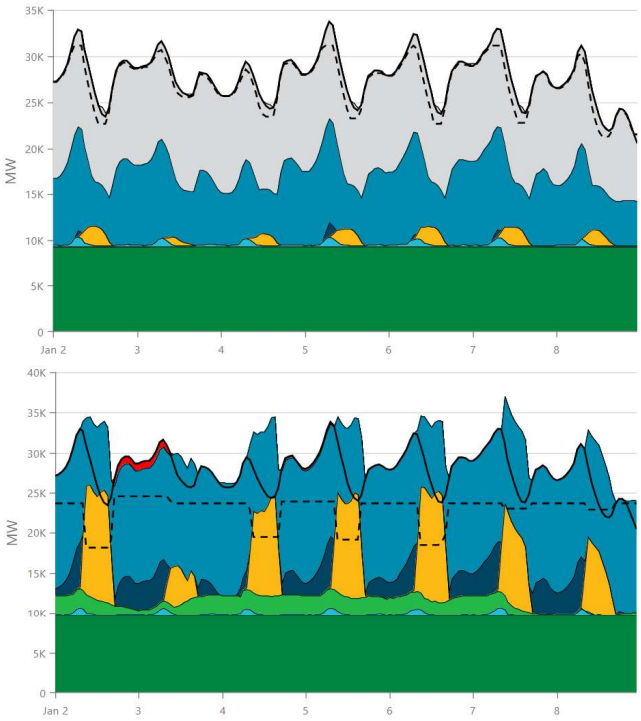
CO_2 Emissions Baseline, Progress, and 70% Reduction Target

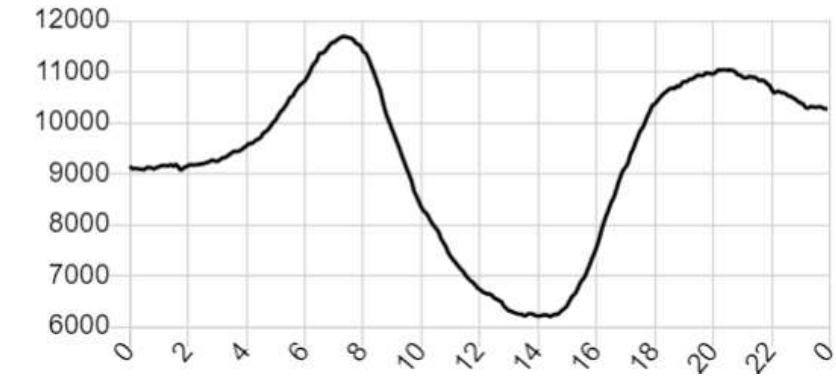


Decarbonization Replacement Resources



The NC/SC System Must be Built Preserving Reliability





- Net Load
- Load (2018)
- Curtailment
- Unserved
- New Demand Response
- Imports (Fossil)
- Coal
- Gas
- Storage
- Solar+Storage
- Solar
- Wind
- Hydropower
- Nuclear

Break

Please return at 11:05AM.

Clarifying Questions

What information would help you better understand the content presented this morning?

Discussion:

What are your criteria for a successful carbon plan?

Lunch Break

Please return at 1:00PM.

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Introduction to Modeling

Bobby McMurry, Director, Production Cost Modeling & Analytics





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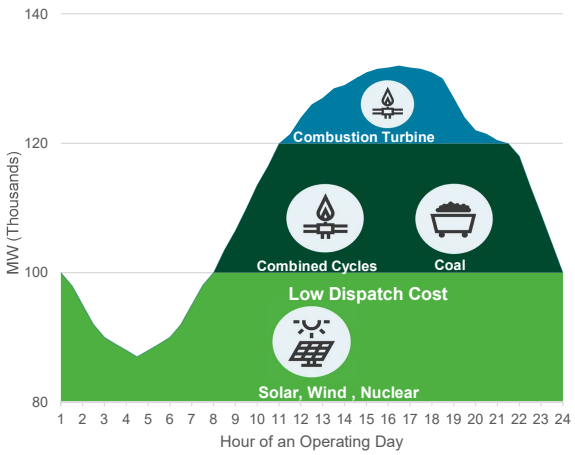
Models, Inputs and Assumptions

In-depth Modeling Simulates the Power System Operations Over Time

- Capacity expansion modeling optimizes the set of resources between existing and new generation sources over long timeframe
  - Expansion tools consider the fit of resource to the type of demand: Is it needed every hour? Is it needed occasionally over the year? Is it only needed as load goes above a certain level?
- Production cost modeling optimizes the use of resources in hourly, seasonal, and annual complexities of actual power systems

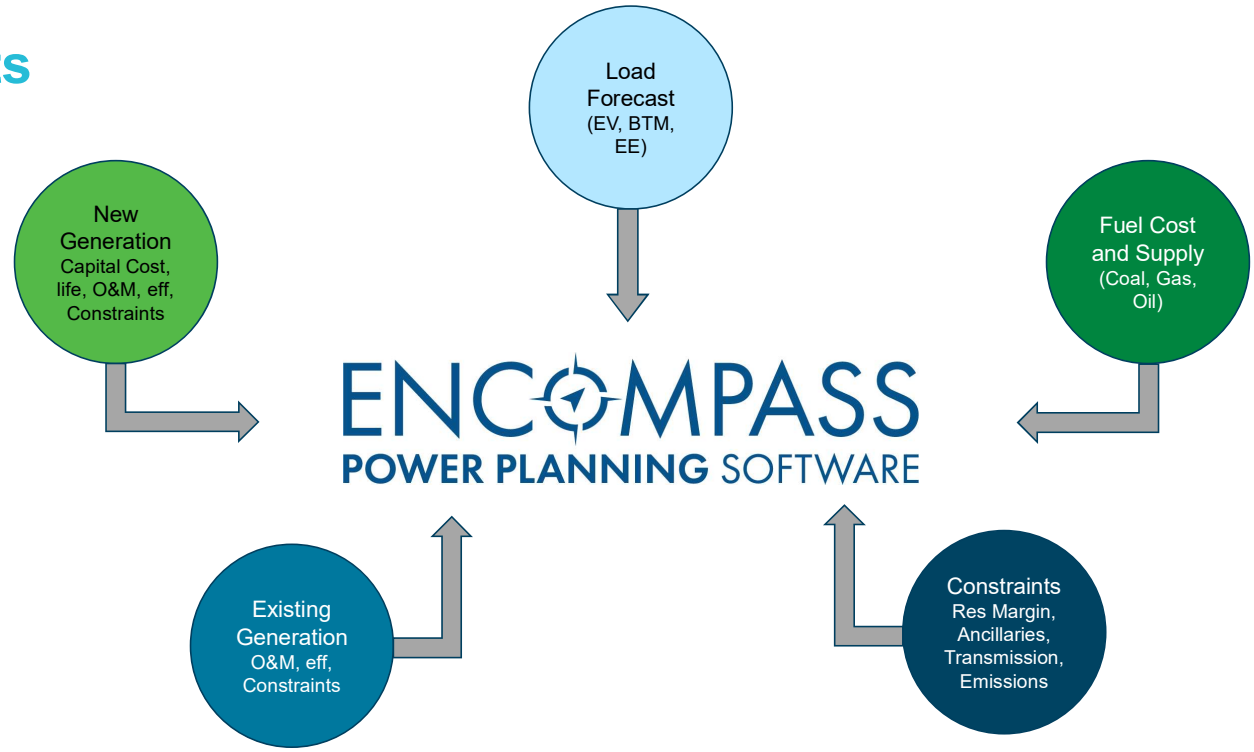


Models

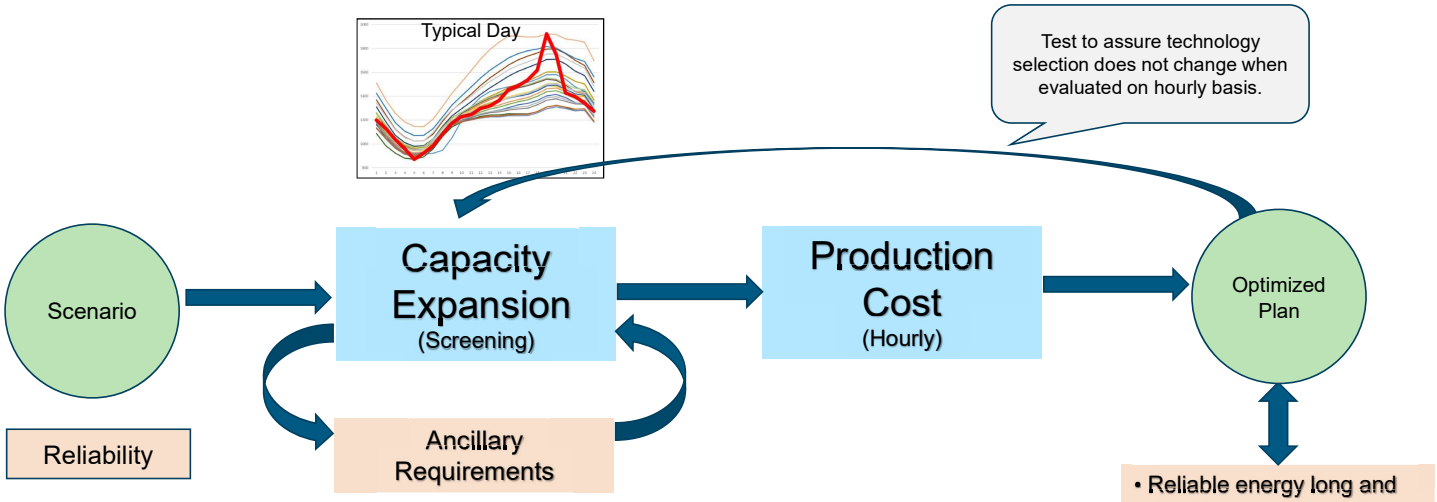
- EnCompass Power Planning Software
  - New Capacity Expansion, Production Cost and Regional Power Flow Model
    - Integration – 2020 and 2021
    - Advantages
    - Mixed Integer Linear Programing – model all constraints at the same time
      - Unlimited Ancillaries
      - Emission Caps
      - Specific Renewable Requirement
      - Reserve margin – monthly
      - Advanced storage logic
      - Dual Fuel Optimization
      - Economic Retirement

- Reliability
  - Regulating & Balancing Reserves (Ancillaries) – Provides reserves needed to account for day ahead forecast changes and inter-hour volatility
  - SERVM – Reliability check to assure portfolios will not exceed 1 loss of load event per 10-year period
    - SERVM = Strategic Energy & Risk Valuation Model

Inputs



Reliability & Affordability Require Detailed Modeling



Optimized Plan – Each portfolio will be evaluated over a range of sensitivities in selection of the optimized plan.

- Load, Fuel, Emissions cap, Technology Cost, Financial impact

Q&A

Coal Retirements Modeling Methodology

Mike Quinto, Integrated Resource Planning, Lead Engineer

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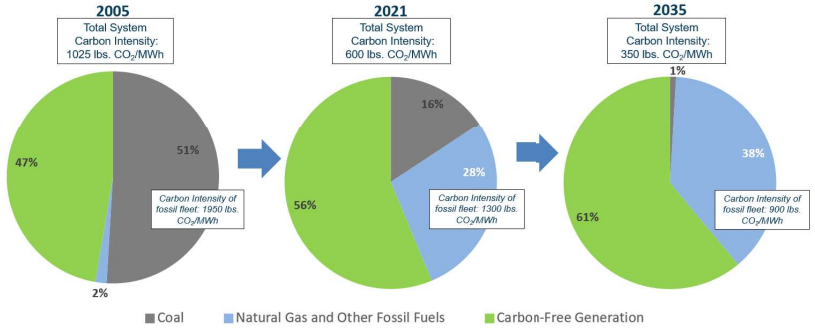
Coal in the Carolinas (as of 2020 IRP)

- Coal assets in the DEC and DEP fleet have provided reliable capacity and energy to customers for decades
- Remaining coal assets continue to provide year-round dispatchability that is especially critical during high load winter conditions
- As the industry landscape changes and market forces drive down costs of replacement resources, it is important to develop a transition plan that recognizes where replacement resources become more economic and carry less risk for customers

The combined DEC/DEP fleet is a national leader in low carbon intensity energy, with a current rate 37% lower than the industry average of 957 lbs. CO_2/MWh[1]



1Source: MJ Bradley, "Benchmarking Air Emissions of the 100 Largest Electric Power Producers in the United States" – July 2020, p. 30

*2021 and 2035 data reflects projections from 2020 DEC/DEP IRP Base Case with Carbon Policy – 2022 Carbon Plan will update this analysis

Coal Retirement Analysis Background

- Previous IRPs utilized the retirement dates of coal units consistent with DEC/DEP's most recently approved depreciation study
- Economic coal retirement analysis was performed as a part of the 2020 IRPs
- Coal retirement analysis methodology was a topic in the NCUC's Second Technical Conference in the 2020 IRP
- Analysis in the 2020 IRPs and the methodologies presented in the Second Technical Conference lay the foundation to refine retirement analysis in support of carbon reduction targets in the new legislation
- Coal retirement analysis will be refined and incorporated into Carbon Plan

Retirement Analysis

Existing Capacity Costs:
- Incremental Maintenance CapEx
- Ongoing Fixed O&M
- Environmental Compliance CapEx
- System Production Cost Value

Replacement Capacity Costs:
- New Generation CapEx
- New Fixed O&M
- Retiring & New Generation Transmission CapEx
- System Production Cost Value

When a unit is retired and **what** it is replaced can change the inputs and balance of this equation

DEC/DEP Coal Fleet Statistics

Unit	Fuel Capabilities	Maximum Natural Gas Co-firing Capability	Unit Capacity (Winter)	Unit Capacity (Summer)	In-Service Date	2020 IRP Economic Coal Retirement Analysis Retirement Date (YE)	Current Depreciation Study "Probable Retirement Year" (YE)
Allen 1	Coal		167	162	1957	2023	2024
Allen 5	Coal		259	259	1961	2023	2026
Cliffside 5	Coal/Gas	40%	546	544	1972	2025	2032
Roxboro 3	Coal		698	694	1973	2027	2033
Roxboro 4	Coal		711	698	1980	2027	2033
Roxboro 1	Coal		380	379	1966	2028	2028
Roxboro 2	Coal		673	668	1968	2028	2028
Mayo 1	Coal		713	704	1983	2028	2035
Marshall 1	Coal/Gas	40%	380	370	1965	2034	2034
Marshall 2	Coal/Gas	40%	380	370	1966	2034	2034
Marshall 3	Coal/Gas	50%	658	658	1969	2034	2034
Marshall 4	Coal/Gas	50%	660	660	1970	2034	2034
Belews Creek 1	Coal/Gas	50%	1,110	1,110	1975	2035+	2037
Belews Creek 2	Coal/Gas	50%	1,110	1,110	1975	2035+	2037
Cliffside 6	Coal/Gas	100%	849	844	2012	2035+	2048

Stakeholder Feedback for Coal Retirement Analysis

- General Comments on Coal Retirement Analysis
  - **Magnitude** and **complexity**
  - **Modeling limitations**
  - **Transparency** in results
  - Straight-forward, **standard methodology**
  - Remove **objectivity** from analysis

- Key Considerations for Coal Retirement Analysis
  - **Retirements** should be **considered simultaneously**, timing and order determined by model endogenously
  - Replacement resources should include the option of **multiple resource to fill resource gap**
  - **Retirements** should be **co-optimized with replacement resources**
  - Retirements determined by **net exchange** in investment, maintenance, and operations **cost of the system**
  - Impacts to the transmission system
  - Recognize investment decreases as generating units approach retirement
  - Need for retirement dependency and capturing shifting costs
  - Sunk costs should be excluded, only avoidable costs should be considered

Carbon Plan Coal Retirement Analysis Approach

- Endogenous economic selection of coal retirement in Encompass's capacity expansion model
  - Leverage dynamic cost modeling tool
  - Model determination of order and timing of retirements
  - Co-optimization of retirements and replacement resources
  - Captures net cost differences in investment, maintenance, and operations cost of system

- Still evaluating capabilities of model to handle complexity of analysis

- Option to also evaluate coal retirements in sequential process in detailed production cost model

- Retirements are dependent on replacement resources and may be shifted slightly in execution to support orderly transition of the fleet or to maintain the reliability of the system

Q&A

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Load Forecast Drivers

Brian Bak, Manager, DSM Analytics
Tim Duff, General Manager, Retail Customer and Regulatory Strategy
Matt Kalemba, Director, Distributed Energy Technologies Planning & Forecasting

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Energy Efficiency (EE) Forecasting

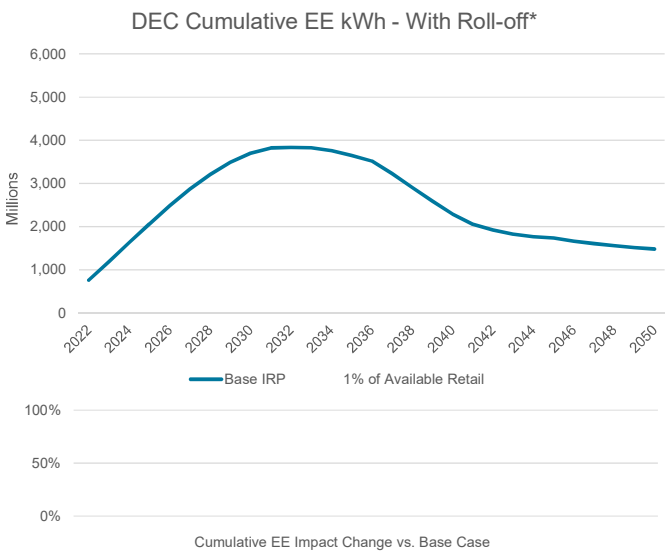
Market Potential Study (MPS)

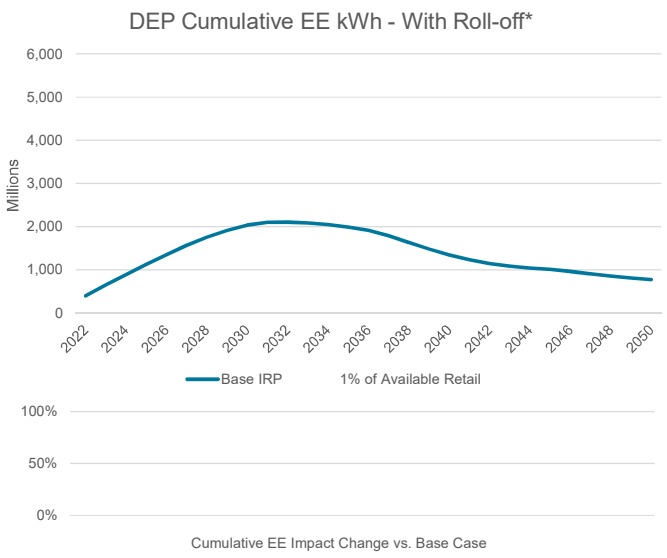
- Performed by third party expert consulting firms
- Used to inform our EE portfolios as well as IRP EE forecasts
- Provide a comprehensive assessment of EE/DSM potential using the best data available at the time to support the study with results specific to the service territory and customer base
- Include all currently known technologies, estimated costs, and energy and demand reduction impacts for these EE and DSM measures

EE Potential Level Estimates

- **Technical** - Maximum savings possible, regardless of cost. Assumes 100% customer adoption
- **Economic** - All cost-effective measures, again with *100% customer adoption*
- **Achievable** - Potential of cost-effective measures based on *realistic customer adoption assumptions*, unlimited program budget and rate rider impact.
- **Program** - Potential of cost-effective measures based on *realistic customer adoption assumptions and reasonable program budgets and rate rider impacts*

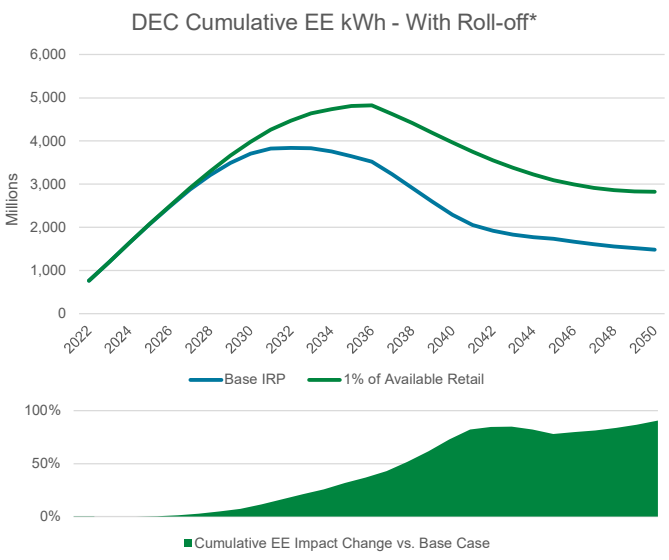
Forecast – Base Case

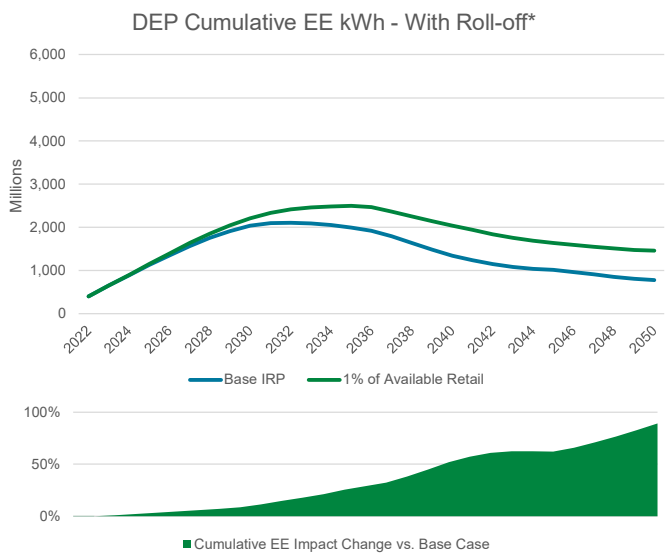




* Roll-off:
- Energy saving impacts no longer represented in our EE forecast as measures reach “end of life”
- Ongoing savings are accounted for in the load forecast.

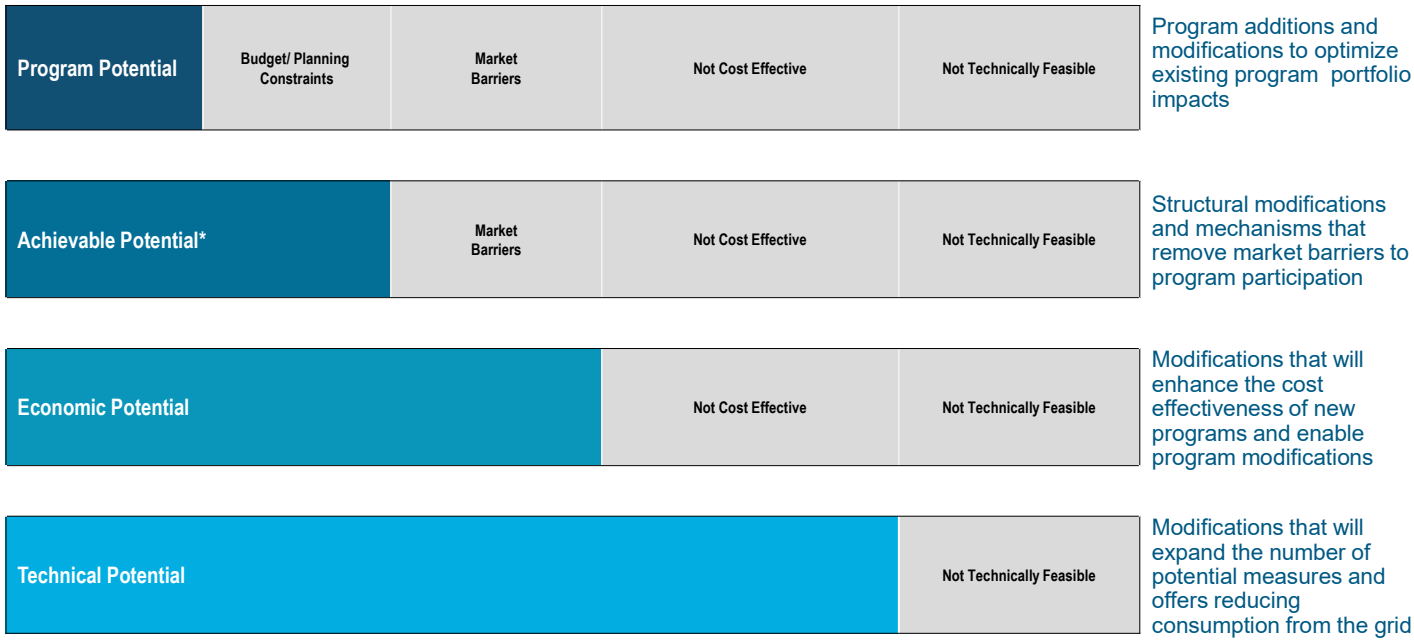
Forecast – 1% of Available Retail Load





* Roll-off:
- Energy saving impacts no longer represented in our EE forecast as measures reach “end of life”
- Ongoing savings are accounted for in the load forecast.

Moving Beyond the Carolinas’ Base EE/DSM Forecast



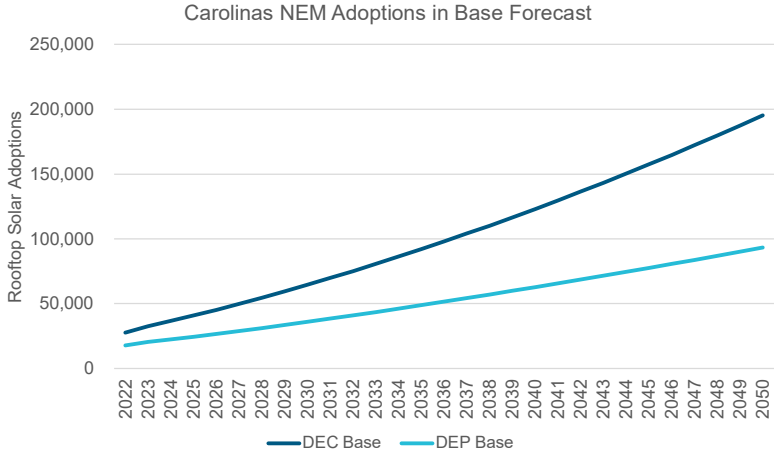
Potential Enablers for Delivering More EE/DSM in the Carolinas

Structural modifications and mechanisms that remove market barriers to program participation	
On-Tariff Financing	Establishing an on-tariff financing program and the necessary recovery mechanism consistent with HB951 to reduce upfront capital costs and credit barriers to undertaking energy efficiency
Marketing enhancements	AMI and other customer data allows better target marketing of programs to customer with high energy savings potential from specific measures
Modifications enhancing the cost effectiveness of new programs and enabling program changes	
Recognition of the value of carbon	A financial value recognizing the value of avoided carbon emissions from energy efficiency programs in cost effectiveness evaluation (UCT).
As Found Energy Savings Recognition	Currently energy savings only recognize savings versus a device's efficiency standard despite the fact true carbon reduction is the energy reduction versus the actual device replace
Recognition of localized customer programs values	Identify overloaded circuits/substations and target localized customer programs to offset specific required high T&D spend
Modifications expanding the potential measures and offers reducing consumption from the grid	
Utility Codes and Standards Program	Currently advancement of building codes and appliance standards reduces potential savings. Creating opportunity for attribution associated with code advancement and compliance
Customer owned assets that reduce grid consumption	Opportunity to incentivize customers to adopt assets like rooftop solar that reduce energy consumption and carbon emissions from the utility grid.not currently shown as potential
Development of energy efficiency programs for new electrification loads	Currently electrification adds load to the forecast, but little to no energy efficiency opportunities associated with load that actually reduces non-utility carbon emissions
Modifications to Non-Residential Customer Opt Out	Currently energy and carbon savings associated with efficiency potential for industrial and customers using over 1,000,000 KWH not able to be achieved through utility programs
Expand EE Programs to wholesale customers	Opportunity to expand potential EE savings and carbon savings to include potential from customers that take generation from the Duke Carolinas' system.

Carolinas Net Metered (NEM) Solar Forecast

NEM Projections

- Base Case projections use currently approved tariffs in North Carolina and South Carolina
- Other suggested NEM Projections?
  - Aggressive price declines
  - 30% ITC
  - **Other options?**



Jurisdiction	Base NEM as % of Total System Energy
2023	
Duke Energy Carolinas	0.5%
Duke Energy Progress	0.6%
2025	
Duke Energy Carolinas	0.6%
Duke Energy Progress	0.7%
2030	
Duke Energy Carolinas	0.9%
Duke Energy Progress	1.0%

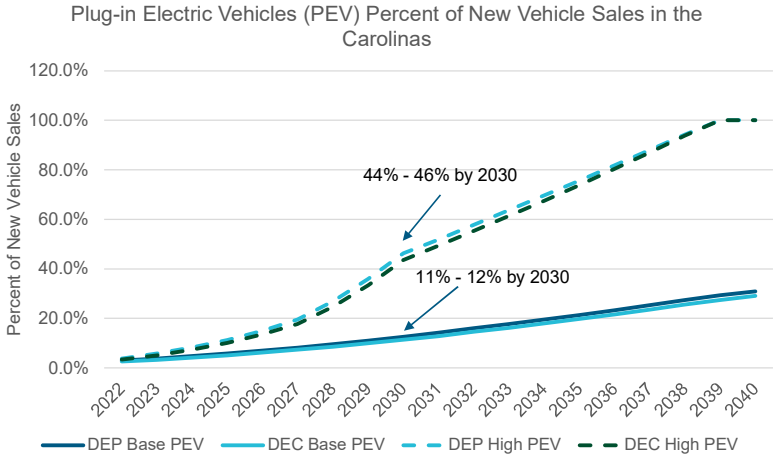
Electric Vehicle Adoption Assumptions for the Carolinas

Base EV Projections

- Base projections based on mid-2021 data shows continued steady adoption of EVs across the Carolinas
- Includes projections for light duty (LD), medium duty (MD), and heavy duty (HD) EV adoption

Alternative Projections

- Updated Base Scenario accounting for increased commitments from EV manufacturers and accelerated adoption in 2021
- High Case: Achieve President Biden's goal of PEVs making up 40% - 50% new vehicle sales by 2030
- **Other suggested forecasts?**



Jurisdiction	Base EV Energy - % of Total Energy	High EV Energy - % of Total Energy
2023		
Duke Energy Carolinas	0.1%	0.1%
Duke Energy Progress	0.1%	0.1%
2025		
Duke Energy Carolinas	0.2%	0.4%
Duke Energy Progress	0.3%	0.5%
2030		
Duke Energy Carolinas	1.4%	3.2%
Duke Energy Progress	1.6%	3.9%

Break

Please return at 3:05PM.

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Solar Interconnection Forecast

Matt Kalemba, Director, Distributed Energy Technologies Planning & Forecasting





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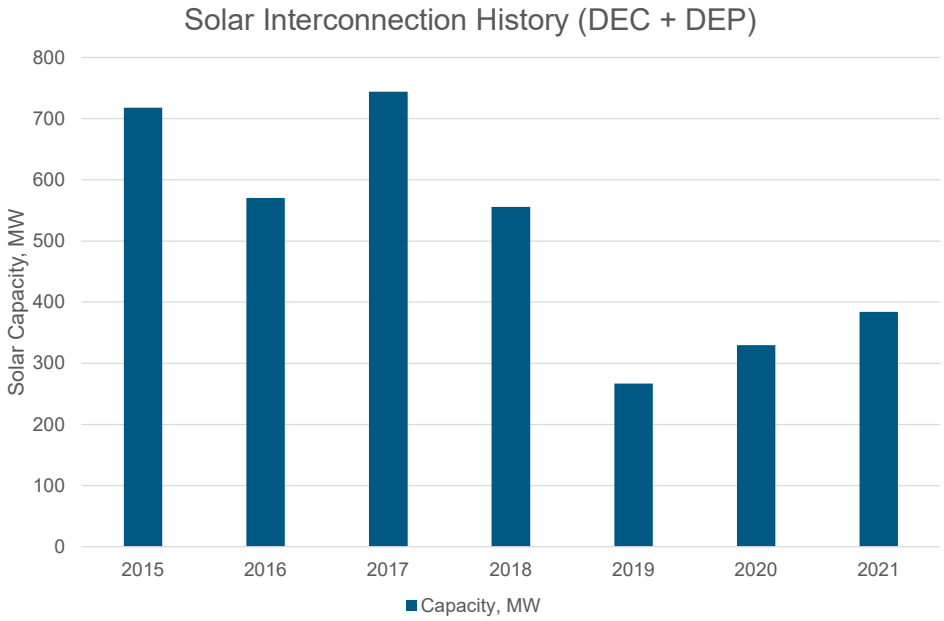
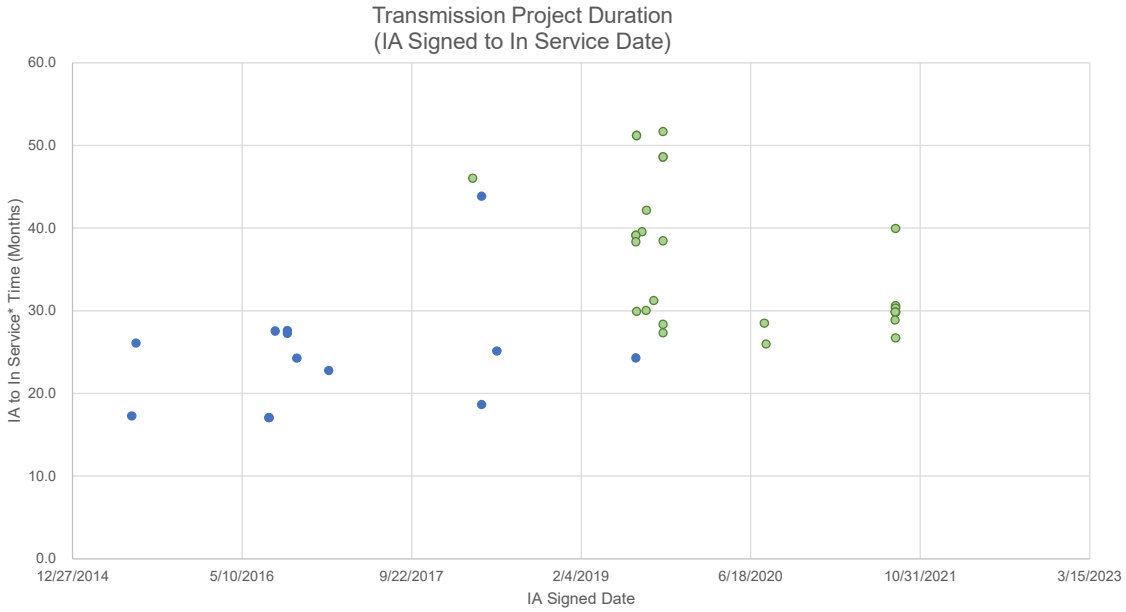
Annual Solar Interconnection Capability - History

- Average about 510 MW/year of solar interconnections since 2015
- Average approximately 9 transmission interconnections annually



Annual Solar Interconnection Capability – Time to Interconnect Trends



*For "Not Connected" projects, the "In Service" date is the currently estimated in service date.

Annual Solar Interconnection Capability – Model Sensitivities

- Land availability, supply chain, increasing transmission reliability and resiliency upgrades, and other resource additions / retirements are headwinds to increasing annual solar interconnections
- Shift from smaller, distribution tied solar to larger transmission projects may increase efficiency
- No regrets, proactive strategic transmission investments would enable shorter interconnection timelines

Range of Interconnection Capability Sensitivities

(Annual Nameplate MW Interconnections)

	2026	2027	2028	2029	2030	Potential Connected Solar by 2030
Transmission Constrained	*up to* 500	500	400	400	400	~9,400
Progressive	*up to* 750	750	750	750	750	~11,000
Enhanced Transmission Policy	*To Be Determined*					*TBD*

- *Transmission Constrained* – Decreasing land availability in unconstrained transmission areas increasingly restricts growth opportunities
- *Progressive* – Land availability less constraining than expected, cluster study process leads to more efficient interconnections as upgrade costs are shared among more participants, and / or shift to larger solar facilities leads to steady solar interconnections at historically high levels
- *Enhanced Transmission Policy* – Proactive strategic transmission investments lead to more efficient solar interconnections and increased possibility of larger solar projects

Technology Forecast

Adam Reichenbach, Generation Technology, Lead Engineer





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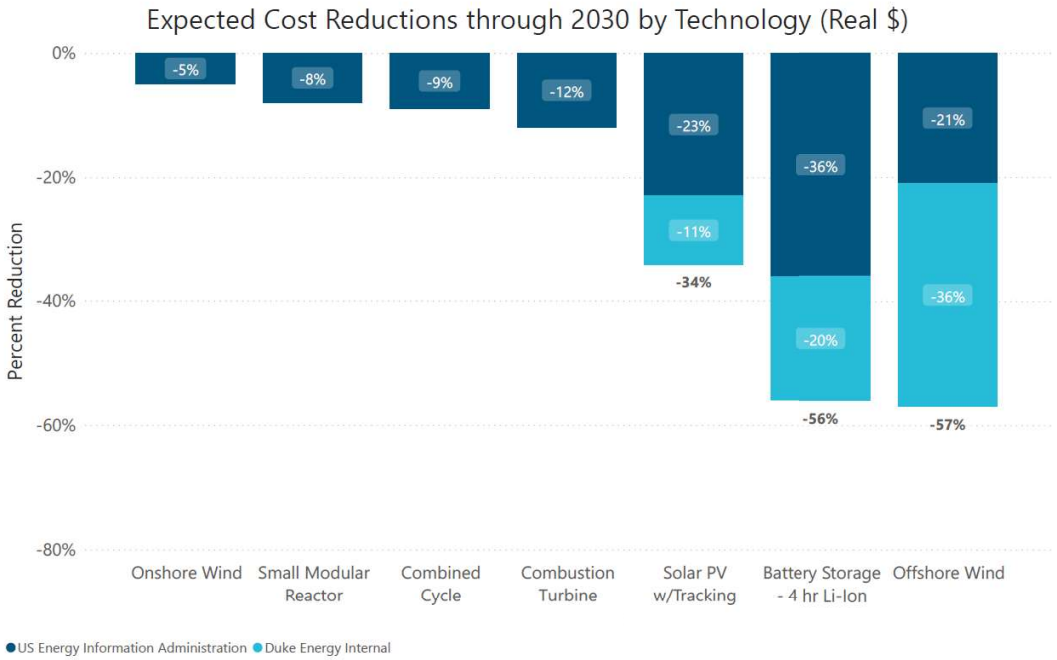
Technology Information

Technology[1]	Role	Dispatchability	Annual Capacity Factor
Solar PV with Tracking	Variable	Partial	25-30%
Offshore Wind	Variable	Partial	40-45%
Onshore Wind	Variable	Partial	20-30%
Battery Storage	Storage/Peaking	Full	15-25%
Pumped Hydro Storage[2]	Intermediate	Full	25-35%
Advanced Nuclear	Baseload	Partial/Full	60-95%
Combined Cycle[3]	Baseload	Full	40-80%
Combustion Turbine[3]	Peaking	Full	< 25%

- This table represents existing technologies or near-term emerging technologies that we believe will be available within the planning horizon.
- Duke's Emerging Technology Assessment Team (ETAT) is actively looking at other potential energy solutions

Note 1: Sources of data for Duke modeling are Burns & McDonnell, Guidehouse, and EPRI.
Note 2: Pumped Hydro Storage has both pumping and generating capabilities.
Note 3: Hydrogen is under consideration as an emergent fuel source.

Technology Learning Curves



Natural Gas Price Forecast

Bobby McMurry, Director, Production Cost Modeling & Analytics

JANUARY 25, 2022

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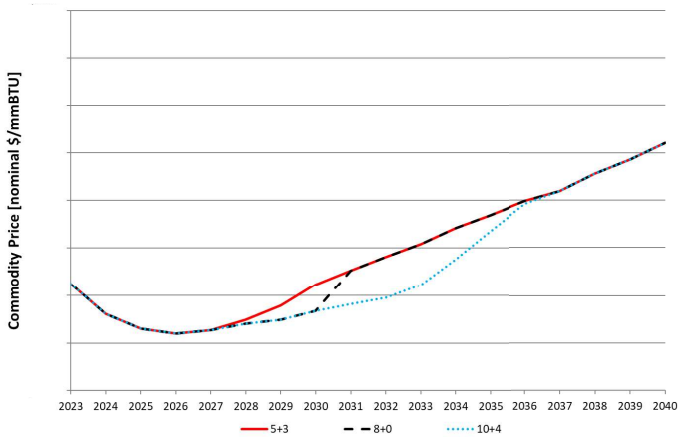
Natural Gas Forecasting Methodology

- Historically
  - Use of 10 years of market gas with 5 years blend to 100% fundamentals
  - Fundamentals - Provided by IHS biannually
  - Avoided Cost (NC) – Use of 8 years Market and 100% fundamentals year 9.
- Proposed Change of Methodology
  - Use of 5 years of market gas w/ 3 year blend to fundamentals
    - Coal and gas on the same blending basis
  - Fundamentals – Use an average of EIA, EVA, IHS and Wood MacKenzie.
    - Decrease volatility in fundamental fuel price from one year to another.



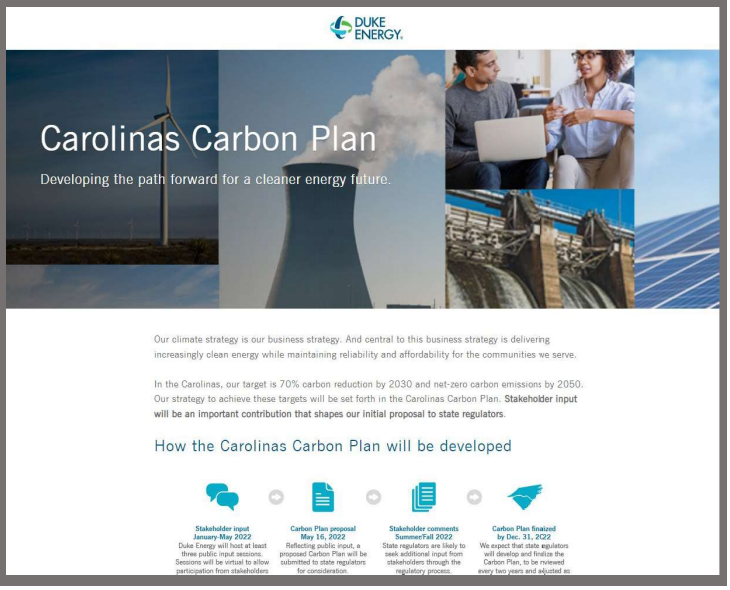
Q&A

Next steps:

- Information/feedback can be sent to DukeCarbonPlan@gpisd.net
- The next meeting will take place on Wednesday, February 23rd. GPI will be sending out an email later this week with the link to register.

Meeting materials/recordings will be uploaded to the website:

www.duke-energy.com/CarolinasCarbonPlan



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