2023 Integrated Resource Plan (IRP)

Public Stakeholder Meeting #2

April 29, 2022

Welcome

Stewart Ramsay
Meeting Facilitator
VANRY Associates

Meeting Guidelines

Principles to guide today's session

- Respectful dialogue
- Questions and comments are public
- Transparency of questions & answers
- Please limit questions and comments to IRP-related topics
- Email list is not being made public

Meeting Protocols

The value of this process is in your participation … please ask questions and offer comments!

1. Why are we using this format?
2. Use the **Q&A** for comments or questions during the presentation – we have a team of people helping to answer your questions
3. "**Raise Hand**" if you would like the chance to speak, we will get to you ASAP – we will open your mic when we can find the right spot

Note: we are not using the Chat function; it is disabled

Agenda

✔	Welcome
9:10	Opening Remarks
9:20	Introductions
9:35	Stakeholder Feedback
10:00	Santee Cooper Resource Position
10:20	Portfolio Evaluation Approach
11:00	BREAK
11:15	Update on Load Forecast
12:00	LUNCH BREAK
1:00	Update on DSM Plans
1:30	Major Assumptions
2:15	BREAK
2:30	Reserve margin, ELCC, and solar integration studies
3:30	Next Steps

Opening Remarks

Charlie Duckworth
Deputy CEO and Chief Planning and Innovation Officer
Santee Cooper

Introduction

Stewart Ramsay
Meeting Facilitator
VANRY Associates

Why are we here today?

Review major assumption methodologies to be used in 2023 IRP

- Review Santee Cooper resource need and IRP resource options
- Review IRP evaluation approach
- Status updates on Santee Cooper load forecast and DSM plans
- Discuss major assumption data sources and development approach
- Review of reserve margin, effective load carrying capability (ELCC), and solar integration studies being conducted by Astrapé
- Collaborate with stakeholders

To answer your questions and get your input

2023 IRP Stakeholder Meetings

Meeting #1

March 1, 2022

Stakeholder Process & Santee Cooper Resource Planning

Meeting #2

April 29, 2022

Resource Need, Resource Options, Evaluation Approach, Major Assumptions, Additional Studies

Meeting #3

June 2022

Review of Major Assumptions, Sensitivities, and Portfolios

Meeting #4

[TBD]

IRP Preliminary Results

Meeting #5

[TBD]

IRP Final Results

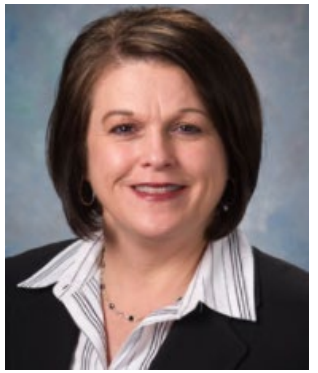
IRP Filing with Commission
May 15, 2023

Meeting content will be adjusted to reflect further discussions needed with stakeholders. The outline above is our starting point.

Today's Presenters

Eileen Wallace
Senior Manager, Resource Planning
Santee Cooper

Greg McCormack
Senior Manager, Financial Forecast
Santee Cooper



Patricia Housand
Manager, Program Development
Santee Cooper

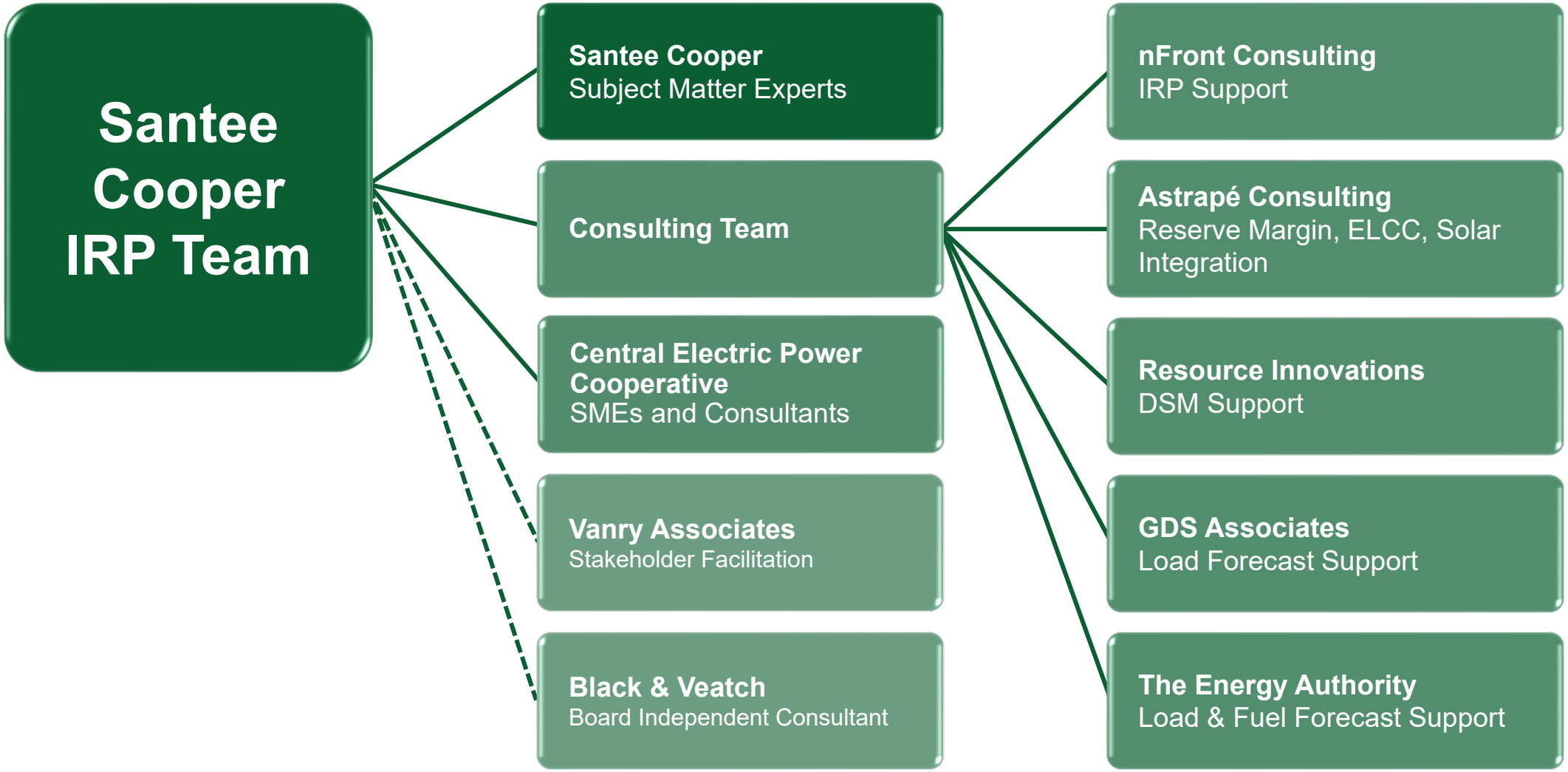
Stewart Ramsay
Meeting Facilitator
VANRY Associates

Bob Davis
Executive Consultant
nFront Consulting

John Hutts
Principal
GDS Associates

Nick Wintermantel
Principal
Astrapé Consulting

Santee Cooper IRP Support



Registered Stakeholders (April 28, 2022)

Individual Customers
A D Group
a TRC company
Adapture Renewables, Inc.
Avangrid
AVL-Microgrids
B&P, Inc.
Berkeley County Economic Development
Berkeley County Water and Sanitation
BrightNight Power
Burns & McDonnell
CCEBA Carolinas Clean Energy Business Association
Central Electric Power Cooperative
Century Aluminum Company
ChargePoint
City of Georgetown, SC
Coastal Conservation League
Conservation Voters of South Carolina
D.R. Horton
Duke Energy
E&E News
East Point Energy
ECSC Electric Cooperatives of South Carolina
Encore Renewable Energy
Energy Development Partners
Fox Rothschild LLP (on behalf of Alder Energy Systems, LLC)
Freedom Bicycles
GDS Associates
GE General Electric
Georgetown County Council
Gullah Geechee Chamber of Commerce
Honeywell
Horry County
Horry County Council
Horry County Schools
Horry Georgetown Technical College
International paper
J Miller Energy Consulting, LLC
J. Kennedy Associates
J. Pollock, Inc.
Longroad Energy
Messer North America
Nucor
PMPA Piedmont Municipal Power Agency
Qcells
R.E. Mason
RBC Resources LLC
Ridge Lake HOA
SACE Southern Alliance for Clean Energy
SC Department of Consumer Affairs
SC DHEC Dept of Health and Environmental Control
SC Office of Regulatory Staff
SELC Southern Environmental Law Center
Seneca Light & Water
Sierra Club
SMXB
Sofos Harbert Renewable Energy
Southeastern Wind Coalition
Southern Alliance for Clean Energy
Southern Company
Southern Current LLC
Swain Whitfield Utility Consulting
Telos Energy
Telos Energy (on behalf of SCCCL)
The Tiencken Law Firm
Thomas & Hutton
Town of Santee
Town of Surfside Beach
usedbooks4uto
Vance Florist
Vote Solar
Wärtsilä

Stakeholder Feedback

Stewart Ramsay
Meeting Facilitator
VANRY Associates

Summary of Post-meeting Survey Responses from Stakeholder Meeting #1

We learned there is interest in …

- the details of our 2023 IRP
- assumptions, sensitivity analysis, modeling output
- the respective roles, involvement and impact of the Central and Santee Cooper collaboration as this relates to the IRP
- slowing the pace of the presentations to allow for more interaction

Today we …

- plan to discuss each of the above as appropriate at this stage of the IRP process
- have built in time to answer more questions live in the sessions
- encourage you to use the *Q&A* or *raise your hand* functions within the meeting platform to have your questions and comments discussed today

New Stakeholder Feedback Forum

- Santee Cooper is introducing a new online forum that stakeholders can use to provide input and feedback on Santee Cooper's IRP
- The forum will provide an opportunity for stakeholders to submit comments, offer feedback, and post documents
- Information submitted to the forum and any responses from Santee Cooper can be viewed by all stakeholders
- The feedback forum can be found at www.santeecooper.com/IRP
- Santee Cooper will be posting feedback to the forum that was received from stakeholders prior to the start of the forum or was received through other means

Feedback Received from Stakeholders

Citations Provided through Q&A During Stakeholder Meeting #1

- Multiple references to web-based articles and reports on the following subjects
  - Benefits of 80% Clean Energy resource plans
  - Vehicle to grid (V2G) technology and pilot programs
  - Solar PV and energy storage cost trends (NREL, other sources)
  - Benefits of microgrids and distribution system automation

Input Received after Stakeholder Meeting #1

- Concerns regarding Santee Cooper's announced Proposed Shared Resource and IRP plans for combined cycle development and scope of resources to be evaluated and considered as part of the 2023 IRP
- Information on reciprocating internal combustion engines and the value such resources have in managing electric system operations
- Citation of studies for hydrogen use and conversion of generating resources
- Assumptions for utility-scale and distributed energy storage resources
- Suggestions for improving portfolio simulation approaches

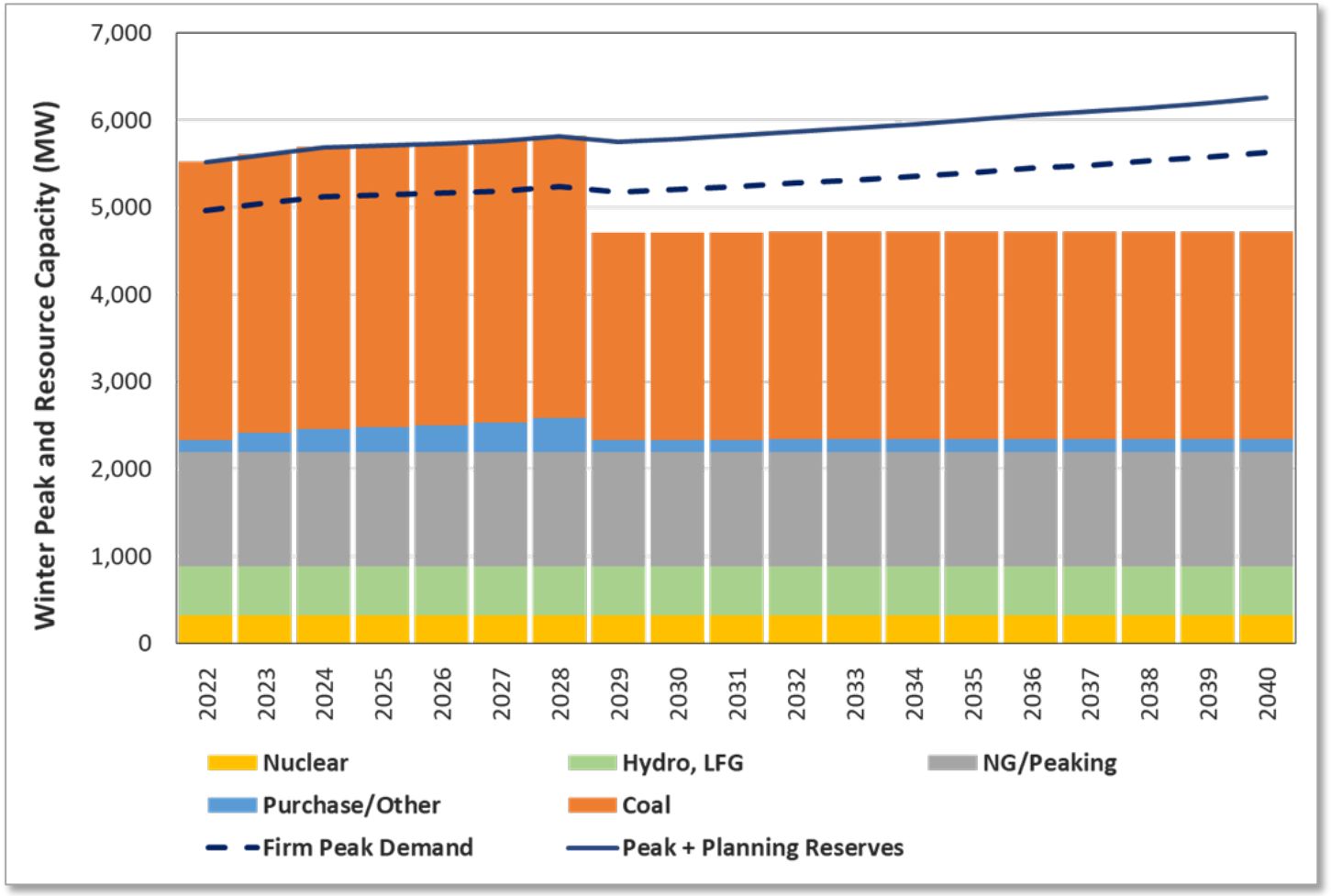
Stakeholder content and Santee Cooper responses will be posted on the Santee Cooper IRP Website www.santeecooper.com/IRP

Santee Cooper Resource Position

Eileen Wallace
Senior Manager, Resource Planning
Santee Cooper

Resource Planning Position
Supply / Demand Balance

- Winyah coal plant retirement in 2028 reduces available capacity by 1,150 MW
- Under last year's load forecast, 1,045 MW of capacity is needed by winter of 2029, increasing to over 1,500 MW by 2040
- Updated load forecast and reserve margin will impact forecasted capacity need



Resource Expansion Options

- Resource options studied for 2023 IRP
  - Santee Cooper resource additions
    - Combined cycle
    - Combustion turbine
    - Reciprocating internal combustion engine
    - Battery energy storage
    - Small nuclear reactors
  - Purchased power arrangements
    - Utility/developer power supply options
    - Solar PPA
    - Wind PPA
  - Hydrogen conversions of CC/CT/RICE
  - Projected low/medium/high sensitivity cases
    - Distributed generation
    - DSM
  - Stakeholder feedback / recommendations

Stakeholders, please share your thoughts on the following:

- Recommendations for additional resource options to consider
- Concerns with what's being proposed

Portfolio Evaluation Approach

Bob Davis
Executive Consultant
nFront Consulting

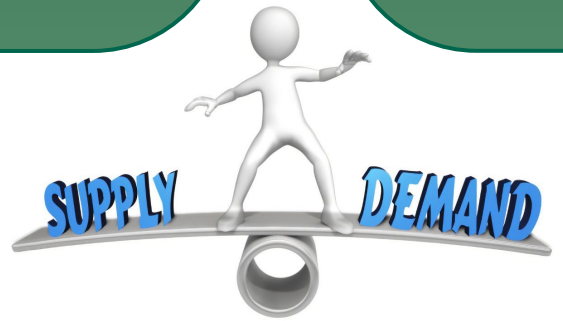
What are the goals of an IRP?

What is a Preferred Plan or Portfolio?

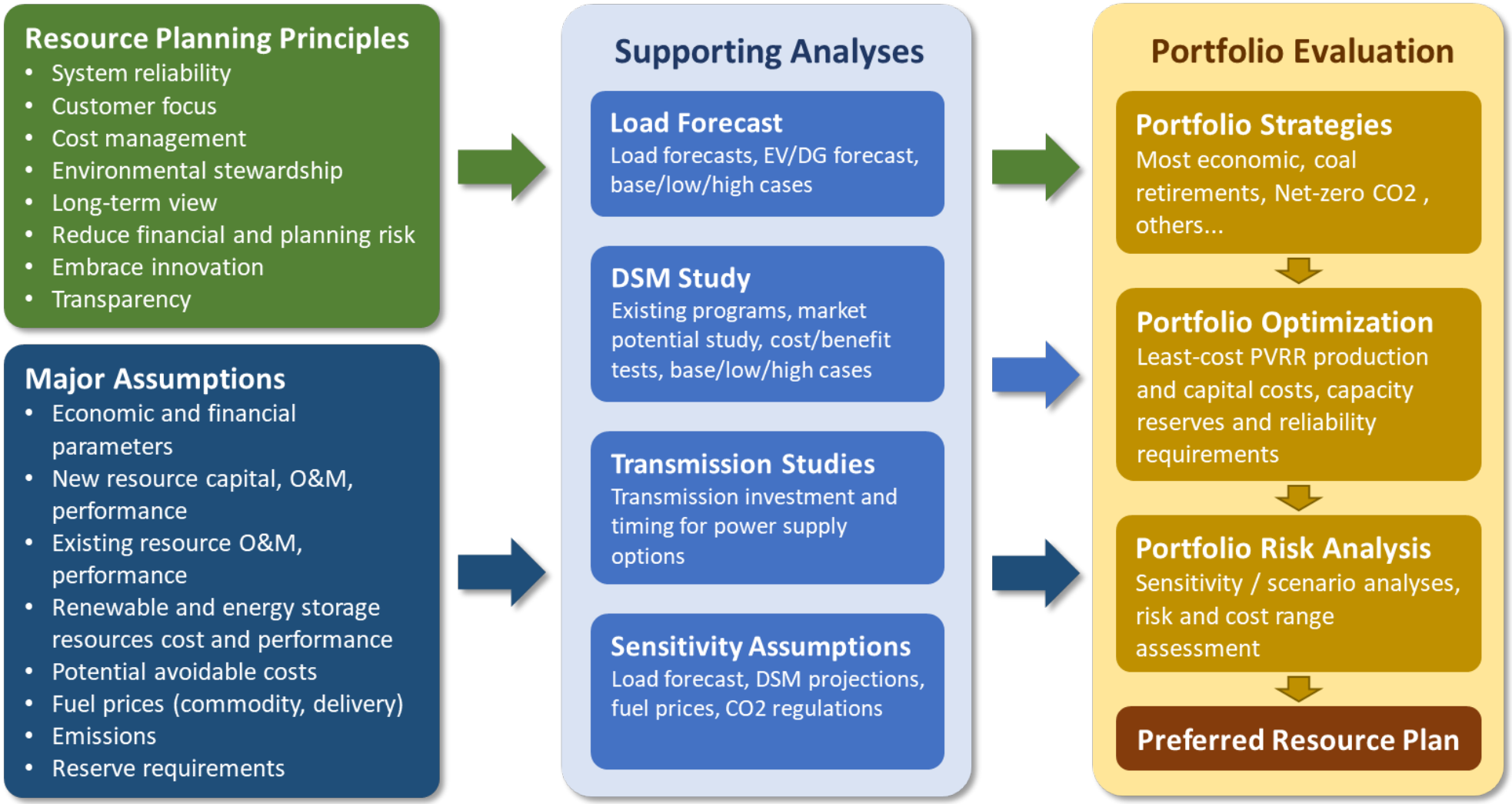
A *preferred resource portfolio* refers to the utility's selected long term supply-side and demand-side resource plans that safely, reliably, efficiently, and cost-effectively meets the projected load of its customers, considering environmental responsibility, risks and uncertainty.

An IRP should consider the following evaluation criteria:

- Resource adequacy and capacity to serve forecast demand requirements
- Power supply reliability
- Compliance with applicable state and federal environmental regulations
- Cost and affordability
- Assessment of risks
- Diversity of generation supply
- Other conditions the Commission determines to be in the public interest



IRP Process


Resource Planning Principles
• System reliability
• Customer focus
• Cost management
• Environmental stewardship
• Long-term view
• Reduce financial and planning risk
• Embrace innovation
• Transparency
Major Assumptions
• Economic and financial parameters
• New resource capital, O&M, performance
• Existing resource O&M, performance
• Renewable and energy storage resources cost and performance
• Potential avoidable costs
• Fuel prices (commodity, delivery)
• Emissions
• Reserve requirements
Supporting Analyses
Load Forecast
Load forecasts, EV/DG forecast, base/low/high cases
DSM Study
Existing programs, market potential study, cost/benefit tests, base/low/high cases
Transmission Studies
Transmission investment and timing for power supply options
Sensitivity Assumptions
Load forecast, DSM projections, fuel prices, CO2 regulations
Portfolio Evaluation
Portfolio Strategies
Most economic, coal retirements, Net-zero CO2 , others...
Portfolio Optimization
Least-cost PVRR production and capital costs, capacity reserves and reliability requirements
Portfolio Risk Analysis
Sensitivity / scenario analyses, risk and cost range assessment
Preferred Resource Plan

Portfolio Simulation

- Santee Cooper will utilize EnCompass simulation model to perform both
  - Resource expansion optimization simulation under multiple portfolio strategies
  - Detailed hourly generation production simulations of all portfolios and sensitivities
- Optimize resource expansion portfolio utilizing base case assumptions
- Evaluate portfolios across low / medium / high sensitivity assumptions
  - Fuel prices
  - CO2 prices
  - Load forecasts
  - DSM plans
- Santee Cooper will likely utilize a study period through 2060 for its IRP
  - Chapter 37 of the South Carolina Code of Law addresses multiple topics applicable to Santee Cooper that could affect the IRP study period, including: the definition of an IRP, reporting of study results, and requirements to evaluate a portfolio achieving net-zero CO2 by 2050
  - Santee Cooper intends to report on portfolio costs over multiple periods

Portfolio Cost Comparison Metrics

- Present Value Revenue Requirements (PVRR)
  - Comparison of the present value of capital and operating costs projected for each portfolio over the IRP study period
  - PVRR provides a convenient metric to compare and rank portfolios, identify significant (or insignificant) cost differences between portfolios
  - PVRR costs can also be used to evaluate differences in portfolio costs over multiple time periods, differences in major cost components, and changes in cost caused by changes in sensitivity assumptions
- Minimax regret analysis
  - PSC-ordered analysis of risk prepared by Duke and DESC for their IRPs
  - Analysis designed to measure the amount by which the costs for a given portfolio is higher compared to the lowest cost portfolio under the same assumptions (typically applied and compared across multiple sensitivity cases)
- Average customer bill impacts
  - Projected incremental changes to customer bills over time that could result under different portfolios and varying sensitivity assumptions

Resource Portfolios to be Studied

Economically optimized resource plan

- Consider all resource options

Future coal retirements

- Earliest practical retirement of all coal resources by mid-2030s

Net-zero CO2 by 2050

- Targeted CO2 emissions (mass) reductions
- Achieve specific percent reduction by 2030
- Allow for specific CO2 offsets

- Other stakeholder feedback/recommendations

Stakeholders, please share your thoughts on the following:

- Recommendations for additional portfolios that could be considered
- Concerns with what's being proposed

The results of these portfolios, along with sensitivity and risk analyses, will guide Santee Cooper toward a Preferred Portfolio

Net-zero CO2 Portfolio Approach

- Characteristics
  - Targeted CO2 emissions (mass) reductions
  - Achieve specific percent reduction by 2030
  - Allow for specific percent CO2 offsets
- Utility-scale technologies
  - Non-fossil generating resources
  - EE and renewable DG programs
  - Renewable natural gas (RNG)
  - Green hydrogen / other hydrogen with carbon capture
  - Carbon capture (generation)
- Potential CO2 offsets
  - Methane emissions reductions (wellhead/pipelines)
  - Carbon capture (non-generation)
  - Electric vehicles
  - Reforestation
  - Renewable energy credits
- Stakeholder suggestions

Stakeholders, please share your thoughts on the following:

- Approach
- Low/zero emitting technologies
- Level of reliance on CO2 offsets

Central Rights Under the Coordination Agreement – Impact on 2023 IRP

- Central's options regarding a Proposed Shared Resource (PSR) are defined by the Coordination Agreement between Santee Cooper and Central
- Central has an option to participate in the next resource implemented by Santee Cooper or to separately develop a resource to serve their load-ratio share
- On January 11, 2022, Santee Cooper issued a PSR (2x1 NGCC) to meet its contractual obligation
  - The resource commitment process can take up to 300 days and the PSR was issued to keep alive the option to implement an NGCC resource by 2028
  - Implementing the resource is subject to the outcome of the IRP process
- IRP evaluations may be impacted by Central decisions
  - Opt-in or joint participation in new resource(s)
  - Opt-out with Central developing its own non-shared resource

Update on 2022 Load Forecast

Greg McCormack
Senior Manager, Financial Forecast
Santee Cooper

John Hutts
Principal
GDS Associates

2022 Forecast Schedule and Process Update

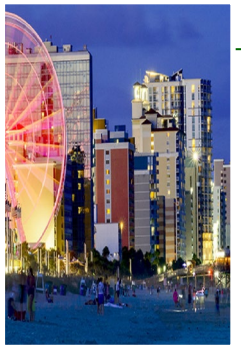
January - April
- Information gathering
- Analyze and prepare data

March - April
- Moody's Economic data is available
- EIA Annual Energy Outlook is available

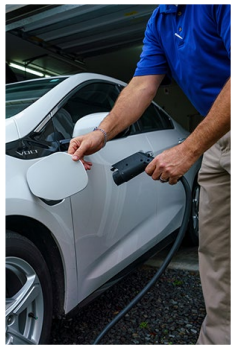
May
- Finalize base forecast

May - June
- Finalize sensitivities

Discussion Topics



Economic Data and SAE Results



Electric Vehicles

Rooftop Solar

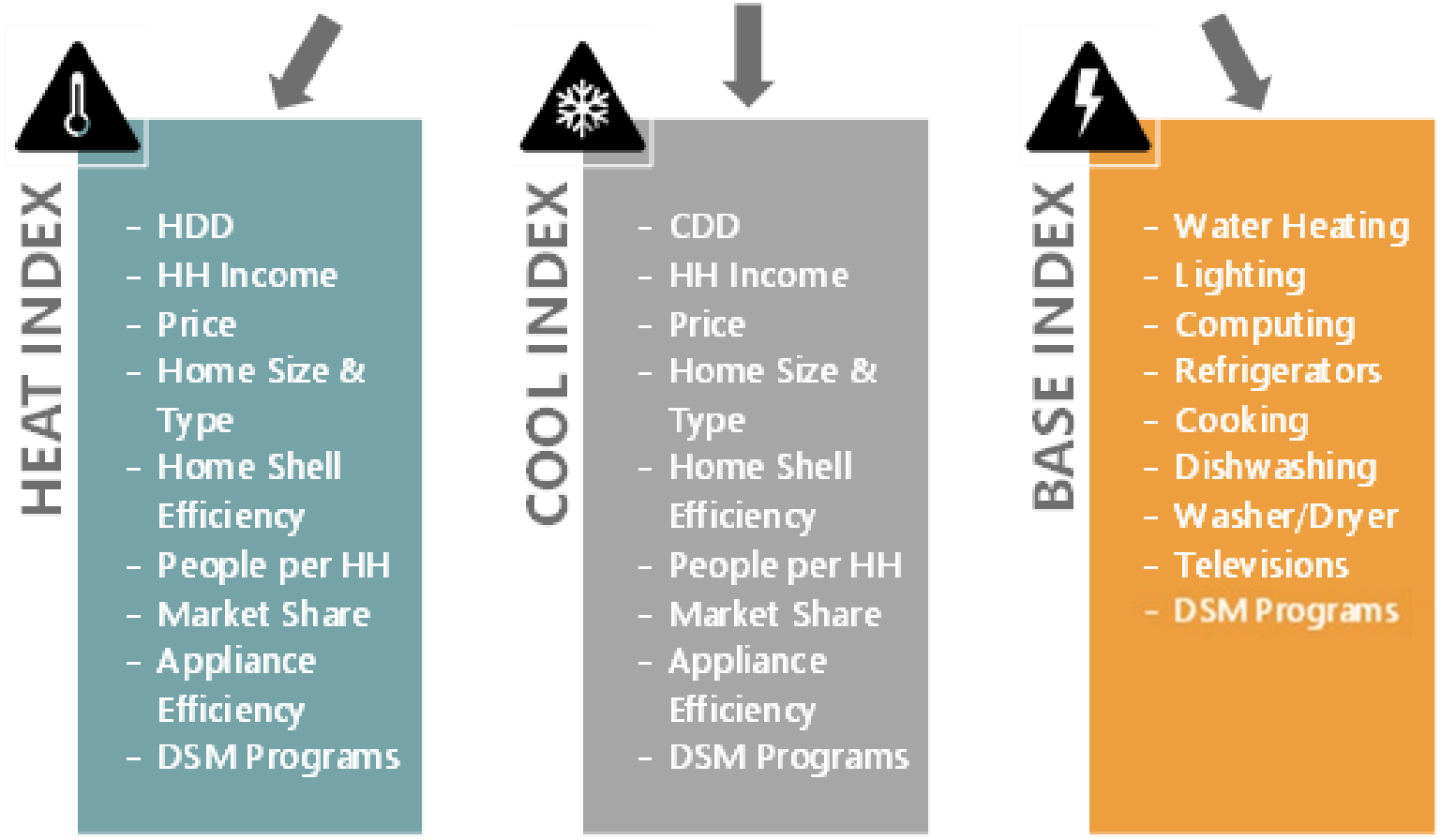
Sensitivity Scenarios

Direct Served Economic Data and Preliminary SAE Results

Econometric model does NOT contain future electric technologies or future rooftop solar

Statistically Adjusted End-Use Models

$$kWh = \beta_1 Heat_{Index} + \beta_2 Cool_{Index} + \beta_3 Base_{Index} + \varepsilon$$

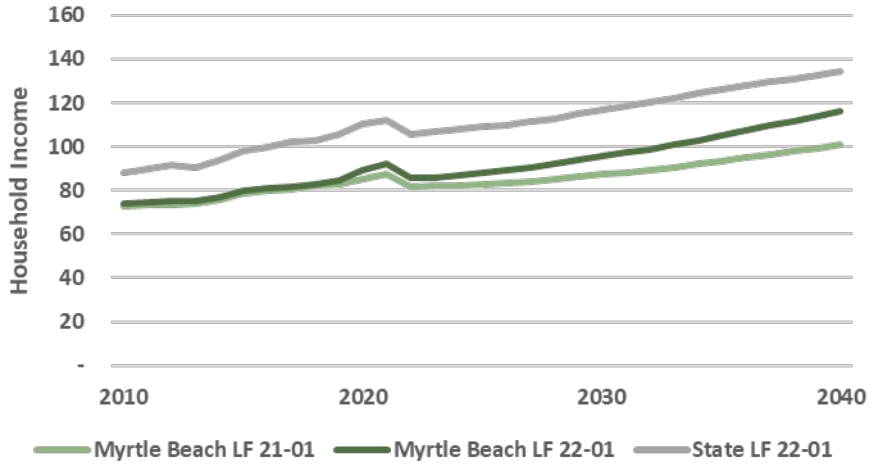


Forecast Assumptions

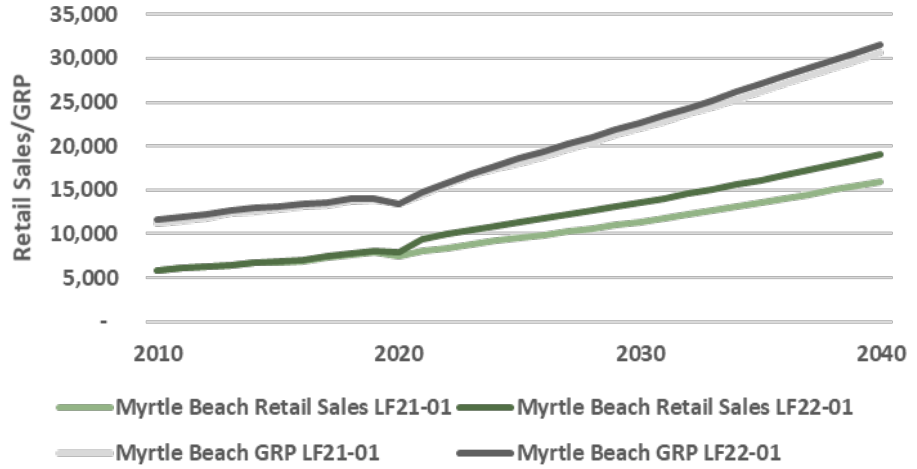
- Economic outlook
  - Moderate growth over the long term and similar to the previous forecast
  - Forecast reflects impacts of number of households, household income, employment, retail sales, and gross area product
- Equipment efficiency
  - Average operating efficiencies of Residential and Commercial equipment are based on the Energy Information Administration's (EIA) 2022 Annual Energy Outlook (AEO)
- Building characteristics
  - Forecast reflects changes home size, housing type, commercial square footage, building type, and structural efficiency

Moody's Economic Forecast

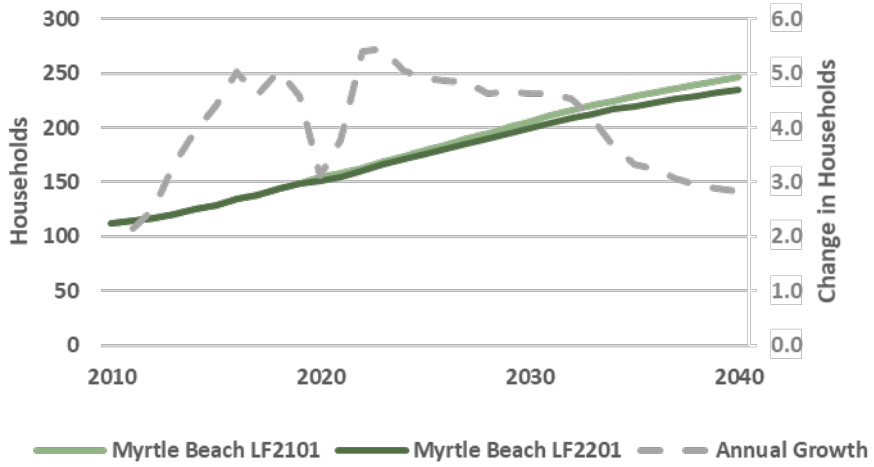
Average Household Income ($2012)



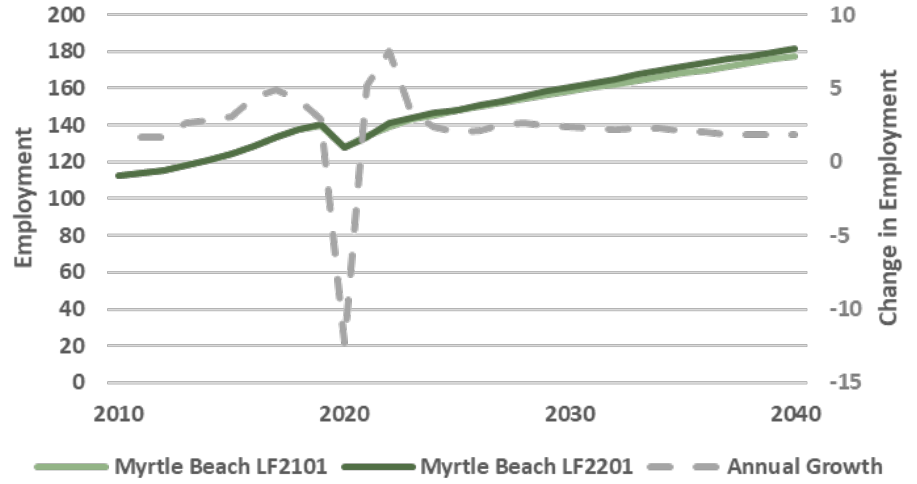
Gross Product & Retail Sales ($2012, Millions)



Number of Households (000s)



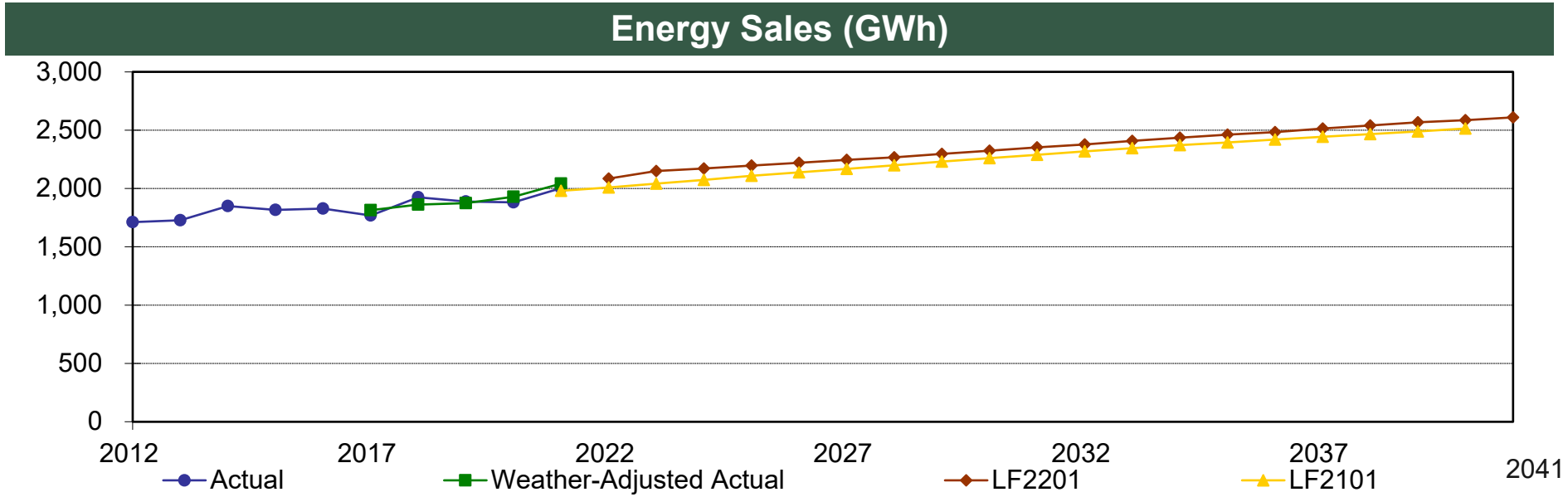
Employment (000s)

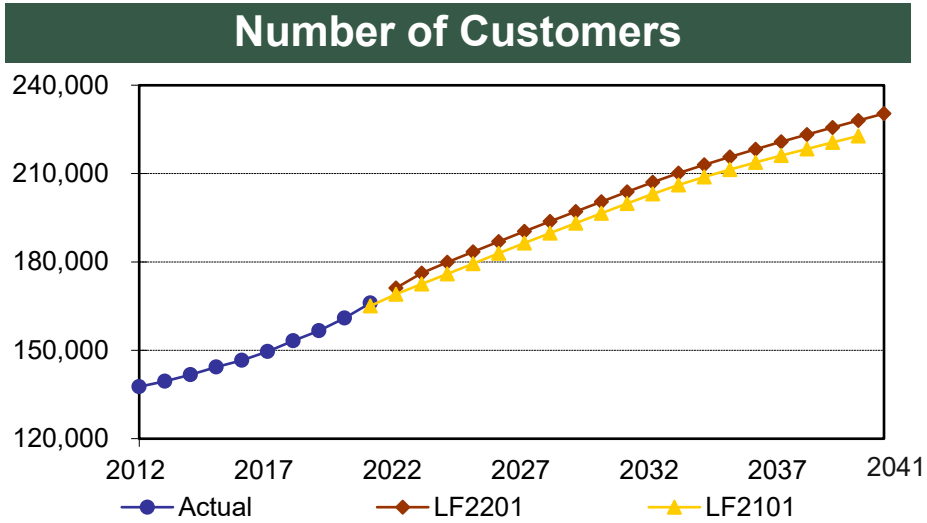


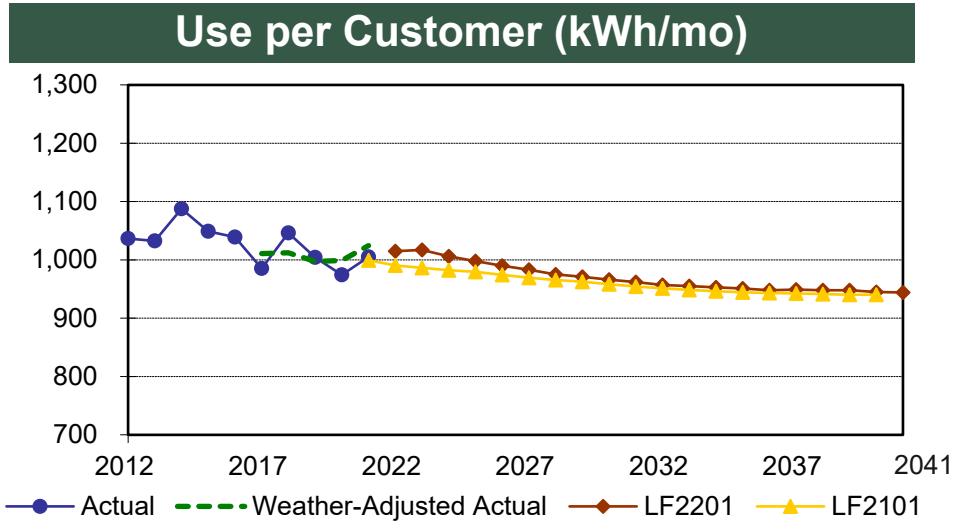
2022 Forecast Results (2022-2041)
Forecast Drivers

- Population growth is higher than the national average as migration to Horry County is strong
  - Energy sales growth in 2021 was nearly 5% reflecting strong customer growth and a rebound from COVID-19 related impacts in 2020
  - Horry County residential building permits are the highest since 2005-2006
- Continued declines in electric heating and water heating market share
- Results
  - Energy sales increase at approximately 1.4% over the next four years and 0.9% per year thereafter.
  - Summer and winter peak demands increase by just under 1% per year over the next 20 years.

2022 Forecast Results (2022-2041)
Residential Energy

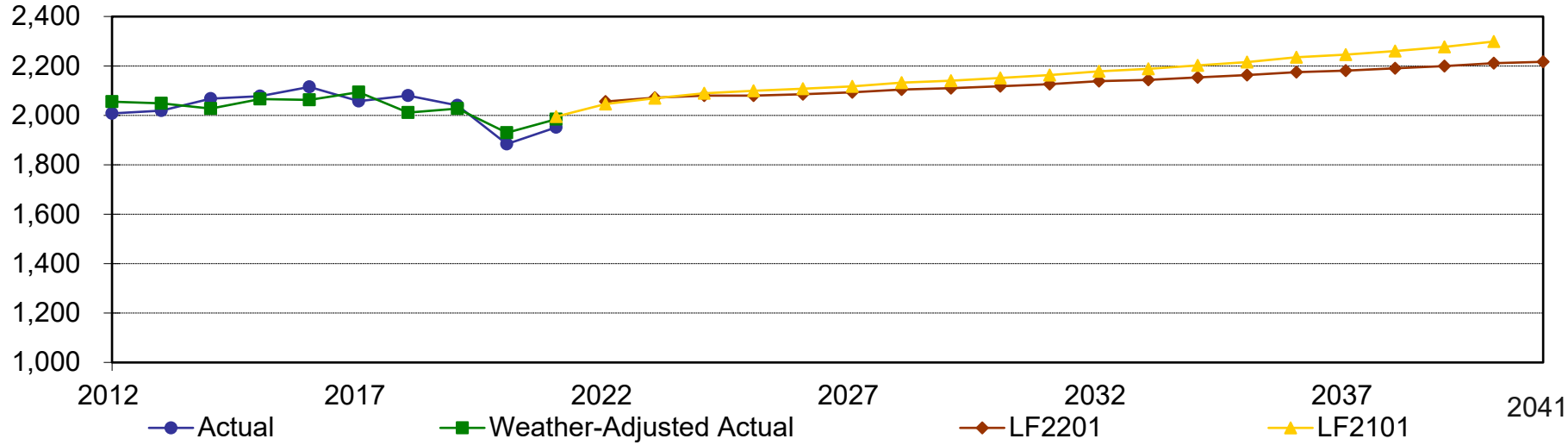




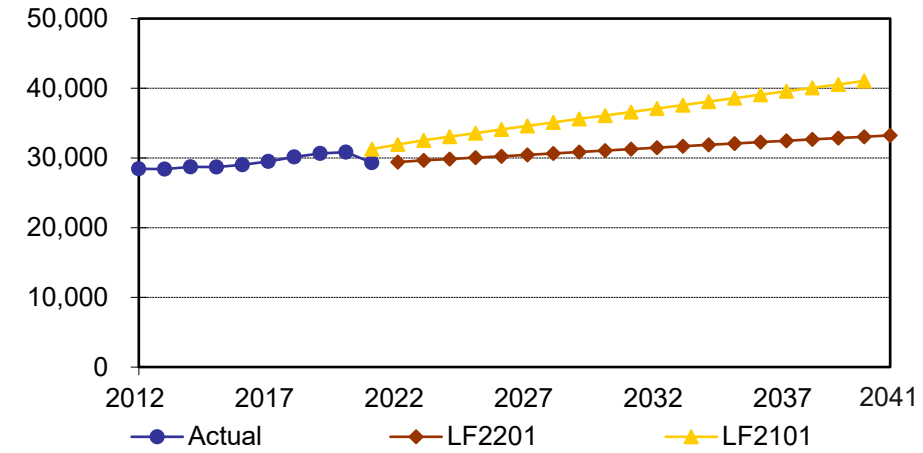


2022 Forecast Results (2022-2041)
Commercial Energy

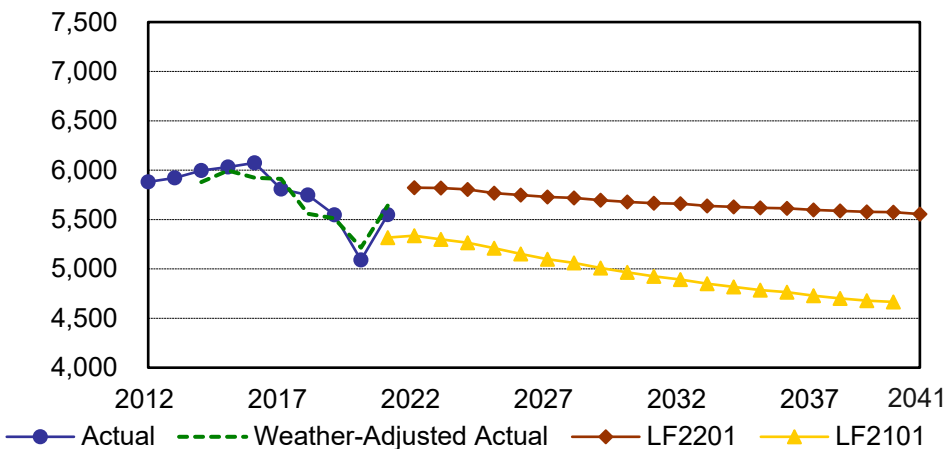
Energy Sales (GWh)



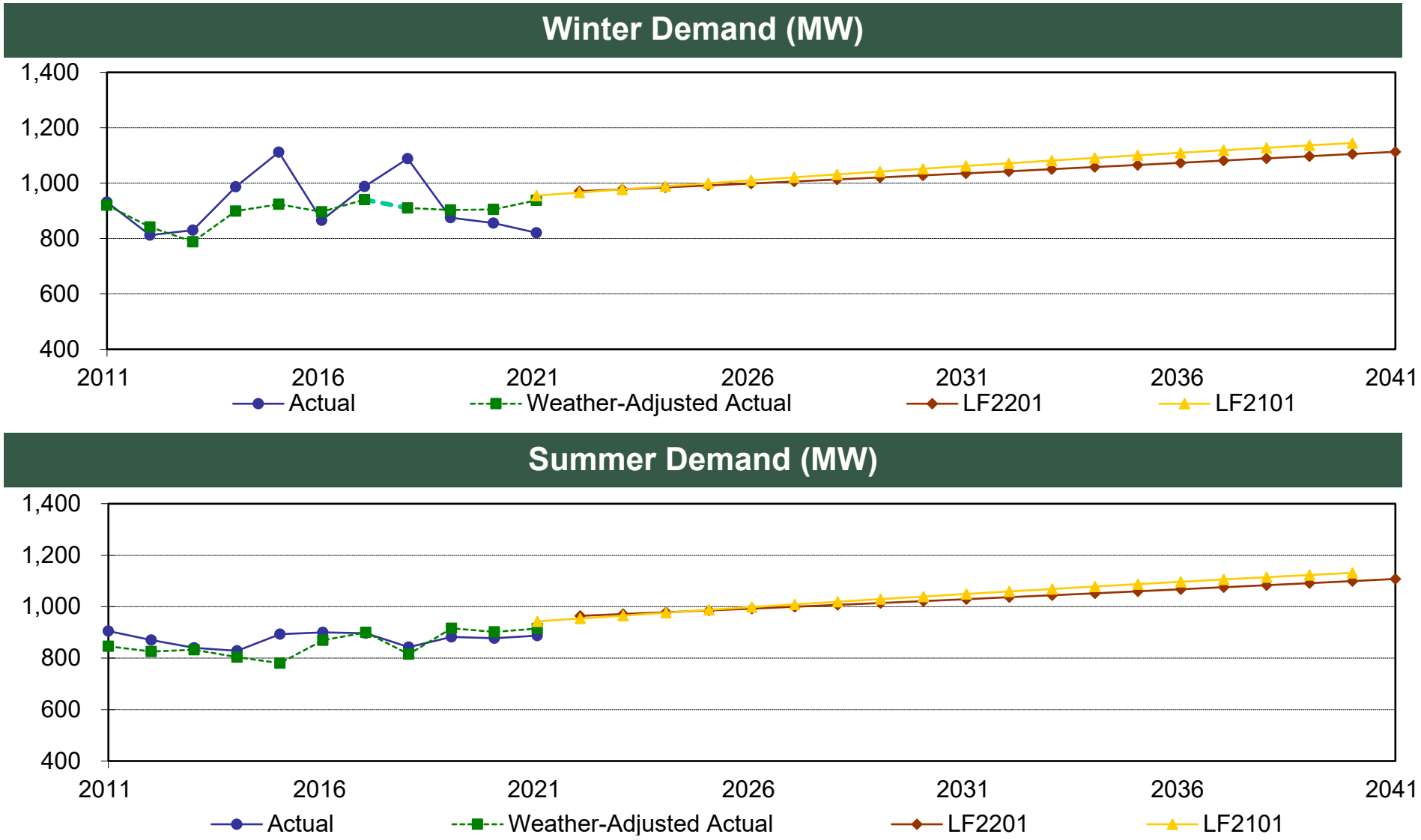
Number of Customers



Use per Customer (kWh/mo)



2022 Forecast Results (2022-2041)
Distribution Demand



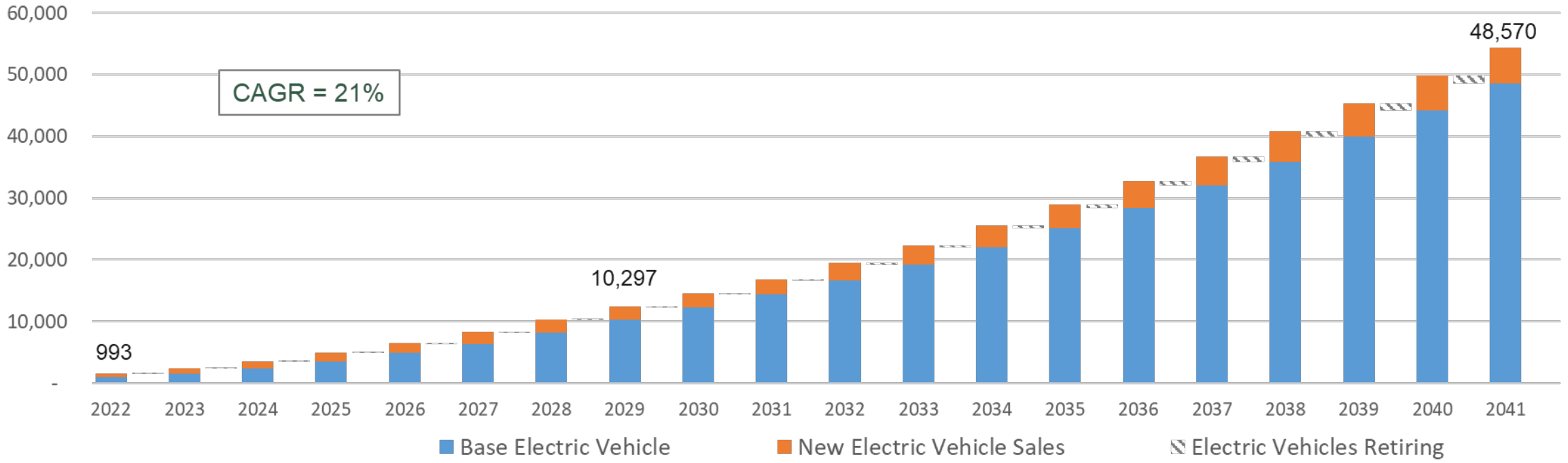
2022 Forecast Results (2022-2041)
Sensitivity Scenarios

- Sensitivities based on Monte Carlo simulations
  - Define distribution of possible input assumptions (e.g., household income, employment)
  - Account for correlations in input variables
  - Run multiple trials and record resultant load forecasts
  - Report percentile forecasts to generate various ranges of outcomes

Preliminary Electric Vehicle Forecast

Electric Vehicle Forecast:

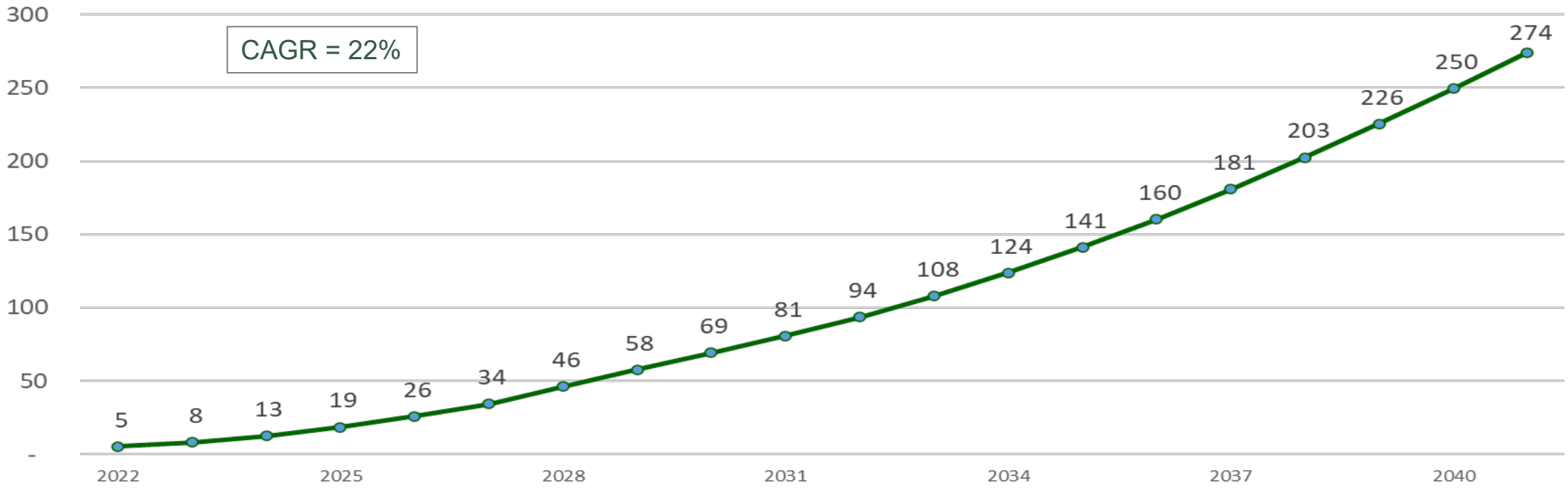
Number of Vehicles[1]



Variable	Source	Assumption
Hybrid vs Battery Electric Vehicle split	EPRI	~77% BEV by 2041
Percent of New Vehicle Sales that are Electric	EPRI	~27% EV market Share by 2041

1. *"Reprinted with permission of EPRI. Copyright © 2022 Electric Power Research Institute, Inc. All rights reserved."*

Electric Vehicle Forecast:
Total Energy (GWh)



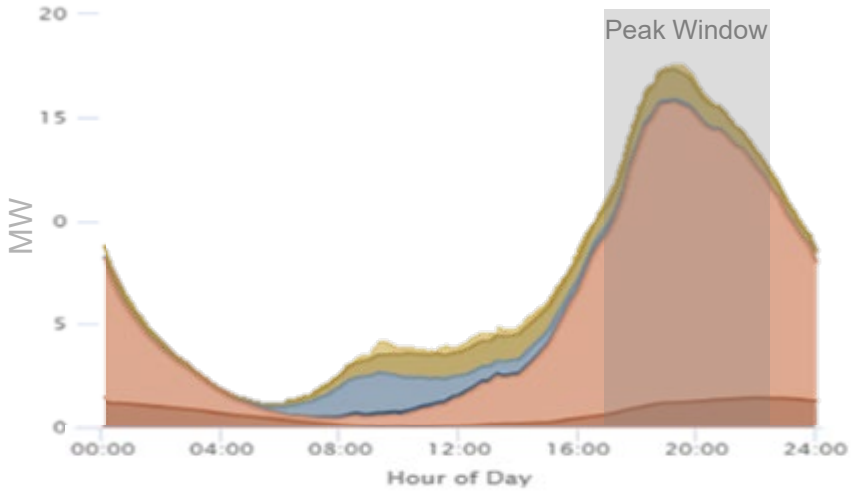
Variable	Source	Assumption
Average Daily Usage	Department of Energy	35 miles per car
Ratio of SUVs to sedans	Department of Energy	80% SUV / 20% sedan
Watt Hours / Mile	Department of Energy	450 SUV / 325 sedan[1]

1. *Adjustments made to account for seasonal battery performance*

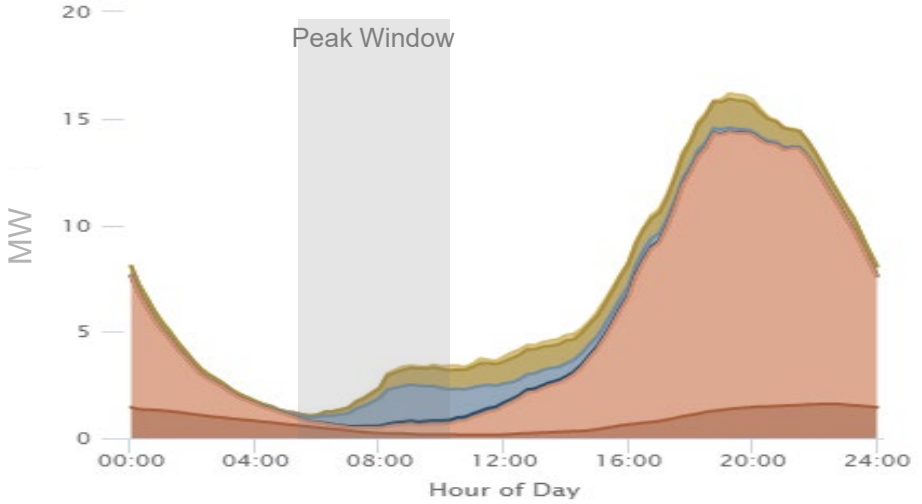
Electric Vehicle Forecast:

Daily Demand[1]

Summer[2]



Winter[3]

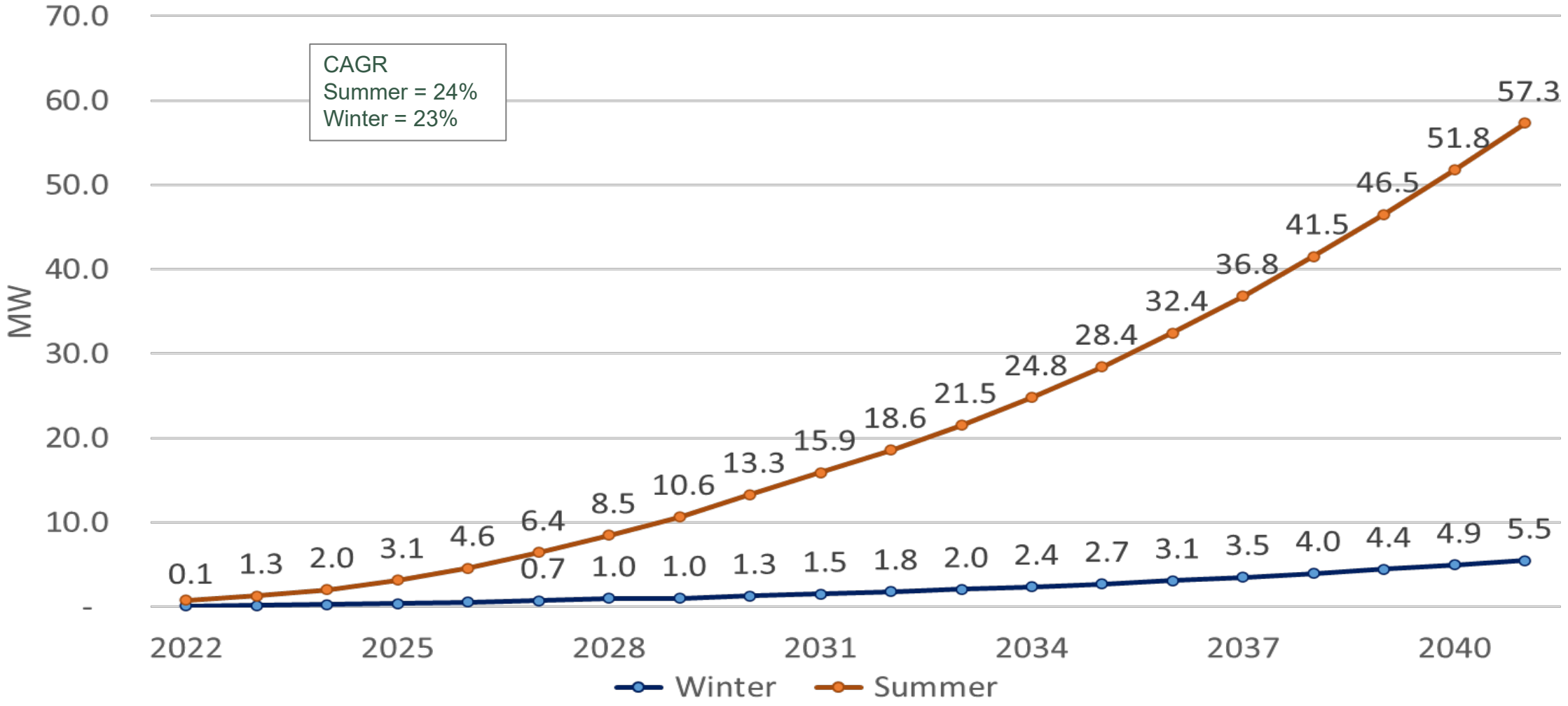


Variable	Source	Assumption
Charging Type	Department of Energy	80% Level 2
Home or Work Charging	Department of Energy	80% at home
Seasonal driving trends	St. Louis Federal Reserve	Monthly adjustment: 7.2-8.9%

1. *Source: US Department of Energy Alternative Fuels Data Center EVI-Pro Lite*
2. *Load shape at 86 degrees, per 10,000 electric vehicles*
3. *Load shape at 50 degrees, per 10,000 electric vehicles*

Electric Vehicle Forecast:

Total Demand – Prior to DSM Impacts



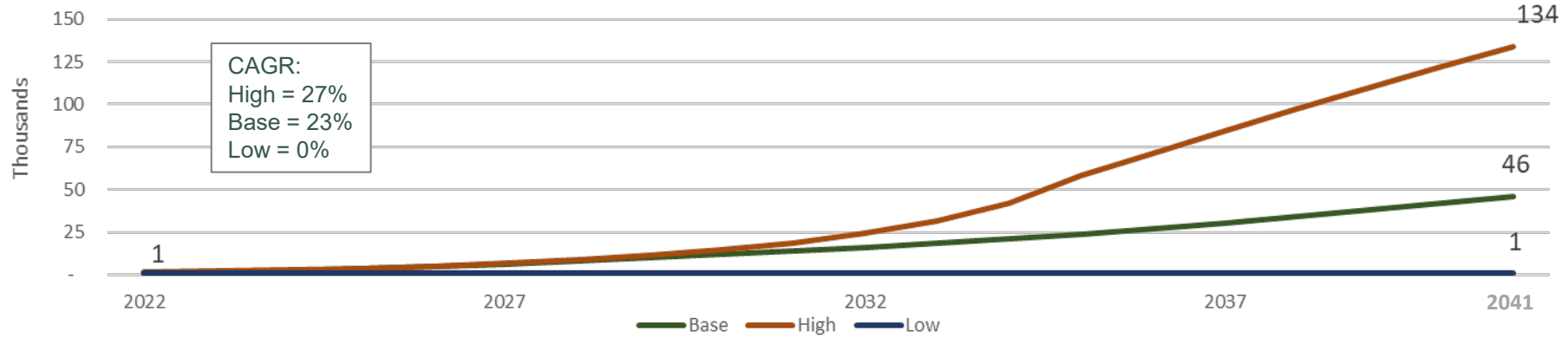
Electric Vehicle Forecast:
Sensitivity Scenarios

- High Case: Rapid Adoption
  - Updated EPA efficiency standards creates inflection point in 2026
  - 80% of new cars sold are plug-in electric by 2035
  - Horry County “moves up” adoption curve

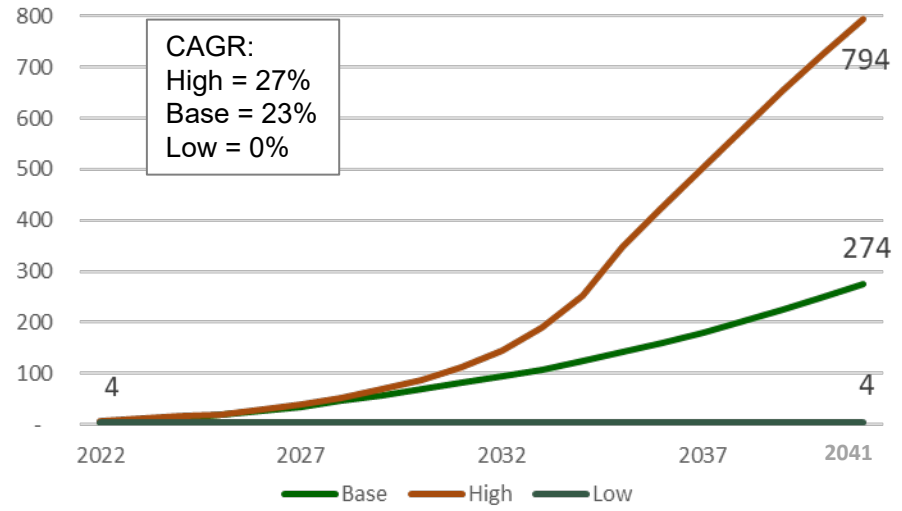
- Low Case: Plug-in Electric Vehicles remain niche technology
  - Plug-in electric vehicle adoption remains consistent with historical results

Electric Vehicle Forecast:
Sensitivity Scenarios

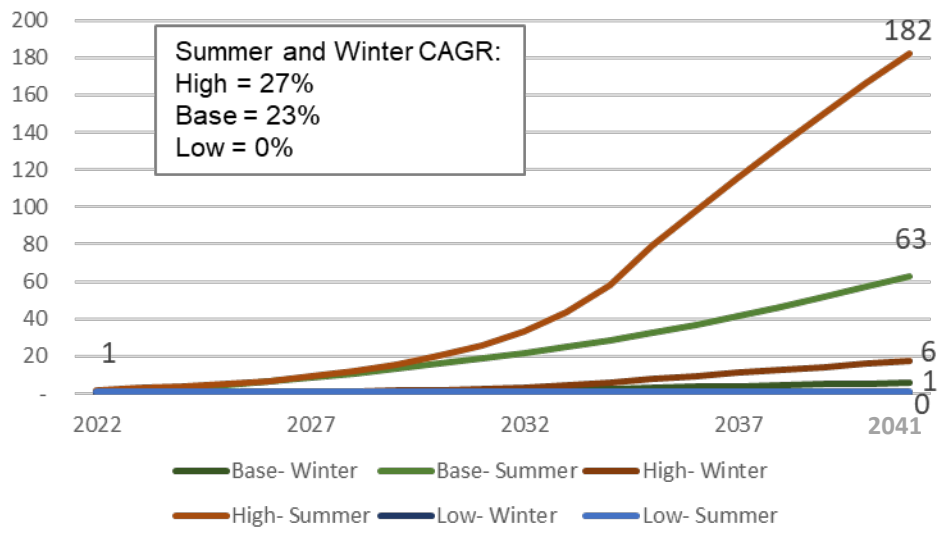
Number of Vehicles



Energy (GWh)

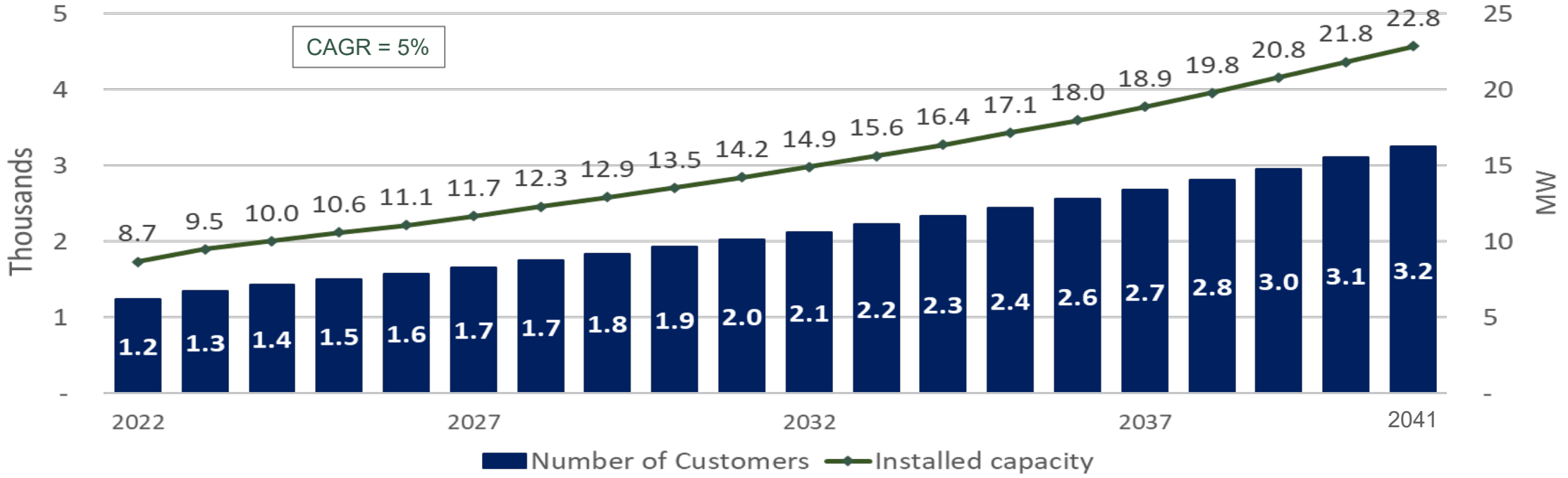


Demand (MW, prior to DSM Impact)



Preliminary Rooftop Solar Forecast

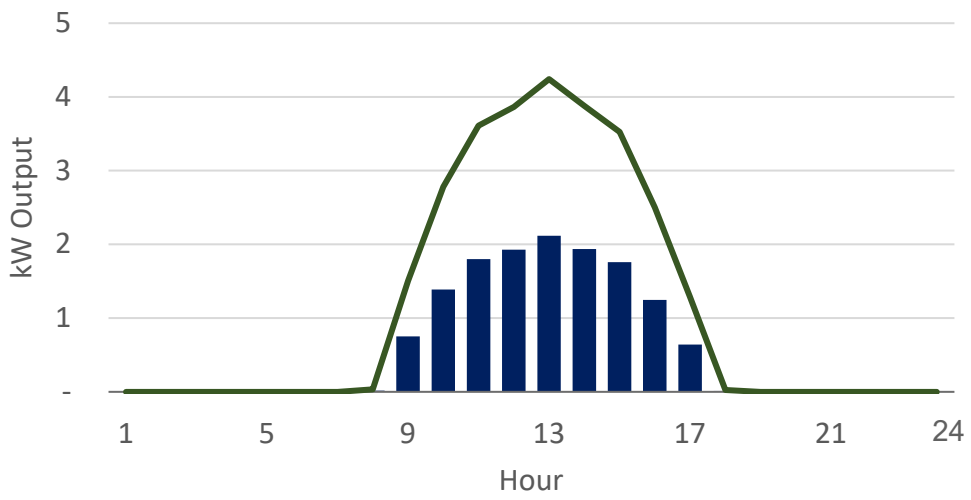
Rooftop Solar:
Customers and Installed Capacity



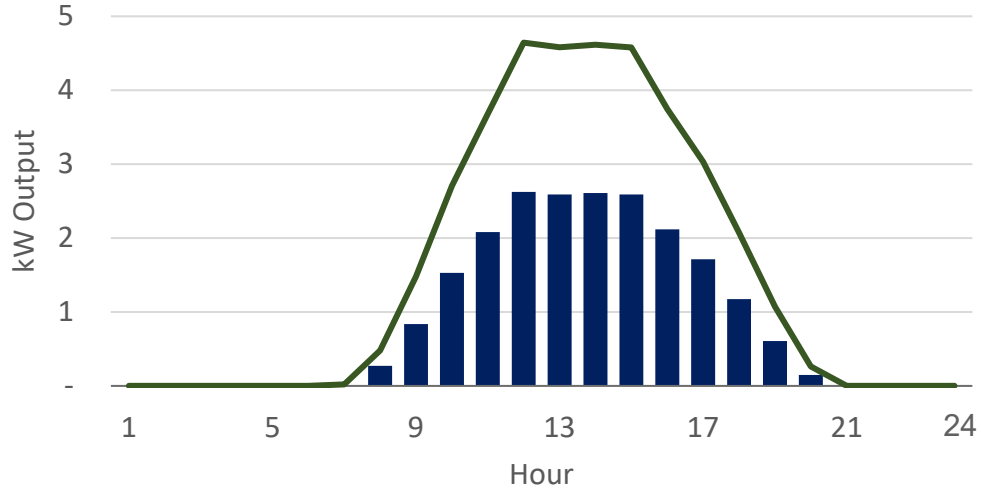
Variable	Source	Assumption
Installed Solar	AEO and internal	Forecasted national average
Number of Homes	AEO and internal	Forecasted national average growth rate
Installed Capacity	Current Average	7 kW

Rooftop Solar:
Production and Usage

Winter – 7kW System



Summer – 7kW System

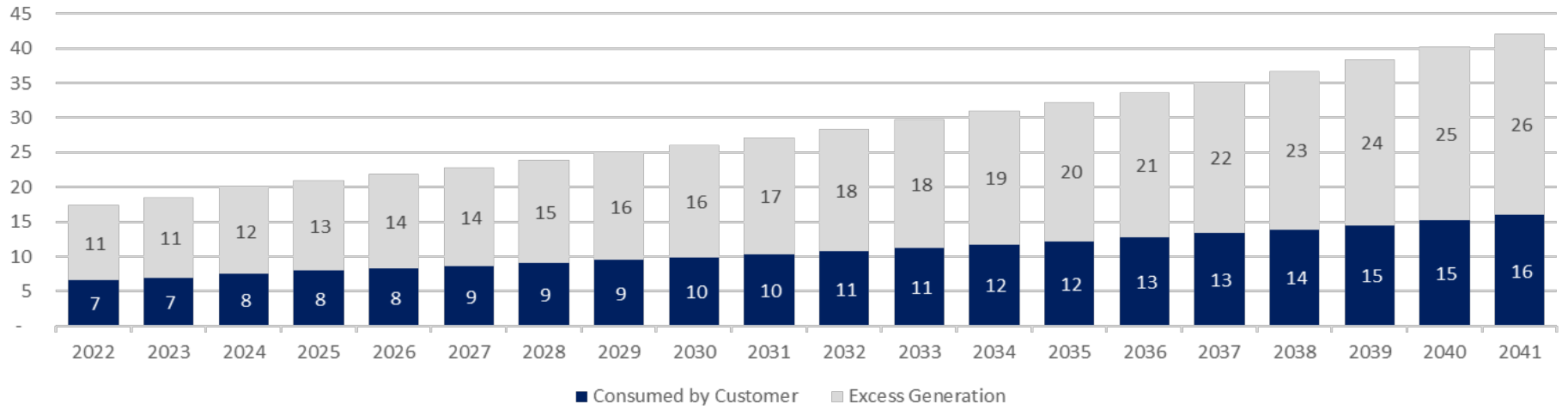


Consumed by Customer — Solar Generation

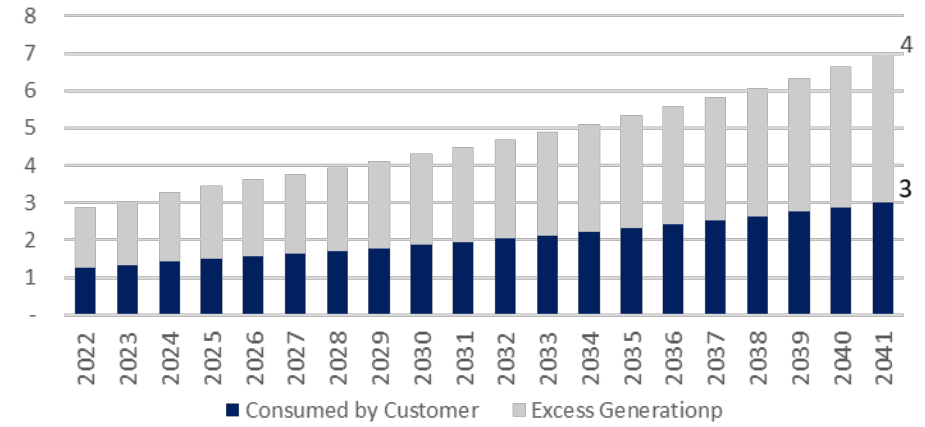
Variable	Source	Assumption
Solar Generation Curve	NREL	PV Watts Rooftop Calculator
Customer Consumption	Internal	Historical data

Rooftop Solar:
Energy and Seasonal Peak

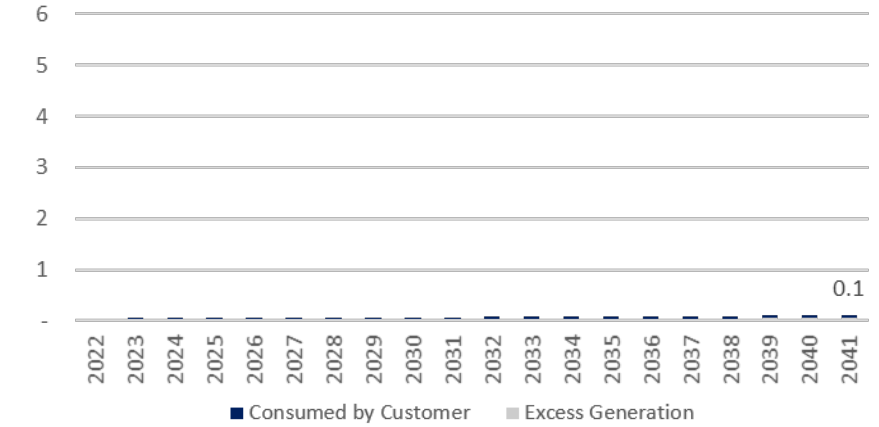
Energy (GWh)



Summer Demand (MW)



Winter Demand (MW)



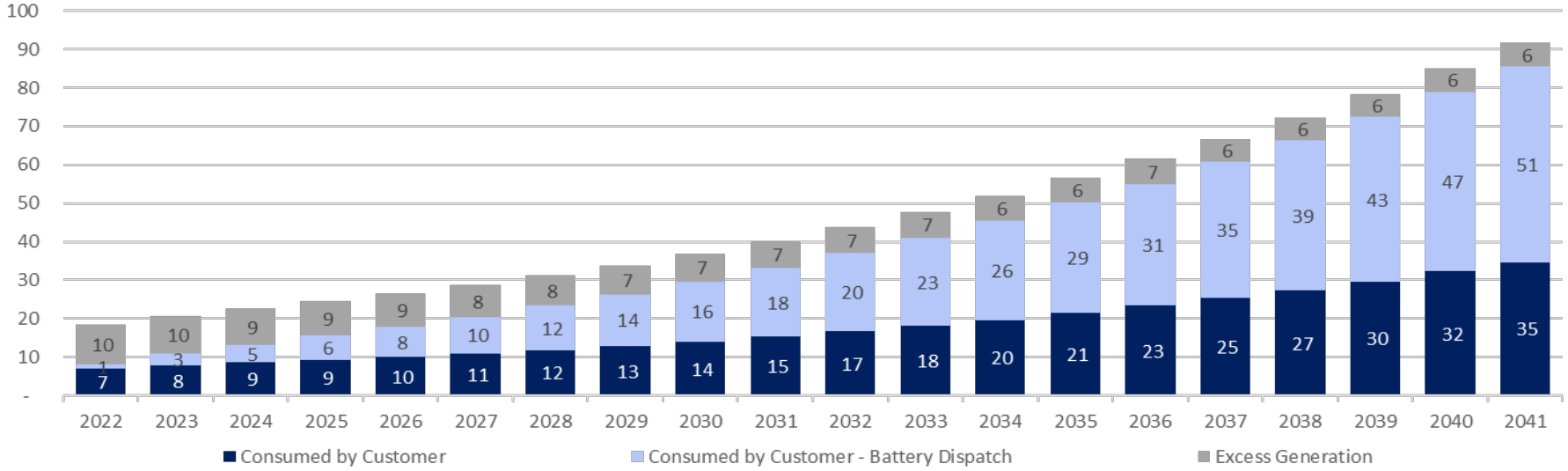
Rooftop Solar:
Sensitivity Scenarios

- High Case: Adoption and Battery Storage
  - 50% higher than EIA “Low Oil and Gas” case
  - Widespread adoption of 20 kW selectively dispatched battery storage
- Low Case: Zero growth
  - Unforeseen barriers prohibit any growth in solar technology and customer

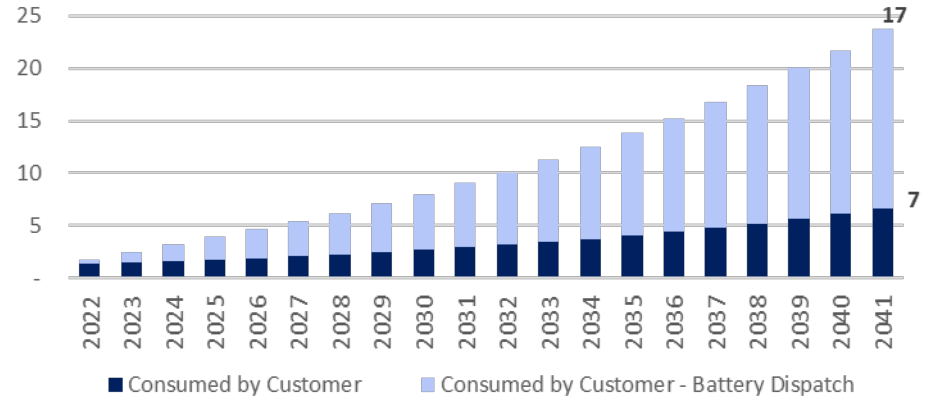
High Adoption and Battery Storage Assumptions		
Variable	Source	Assumption
Growth of Customers	EIA and Internal	~9% CAGR
Battery Size	NREL	5 kW, 4 Hours
Battery Adoption	Internal	100% adoption by 2041

Rooftop Solar:
High Adoption Energy and Demand

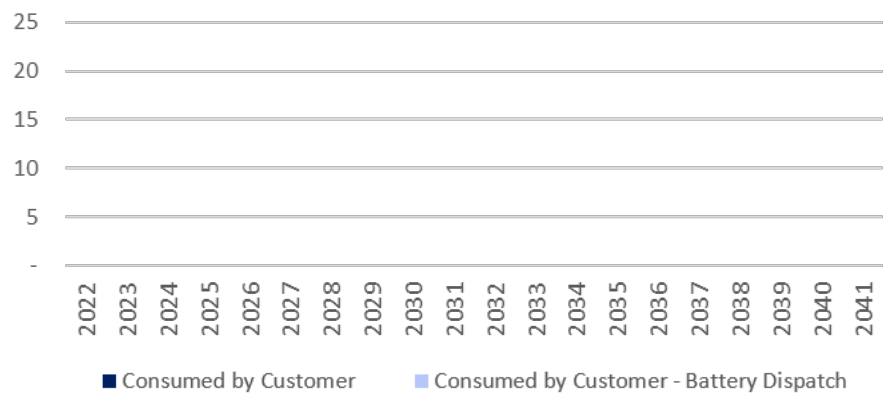
Energy (GWh)



Summer Demand – Prior to DSM (MW)

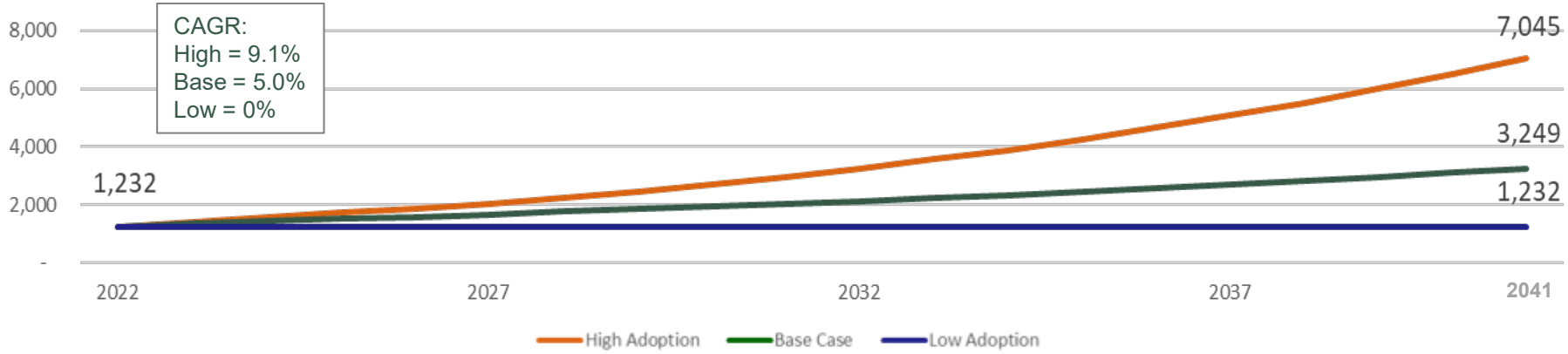


Winter Demand – Prior to DSM (MW)

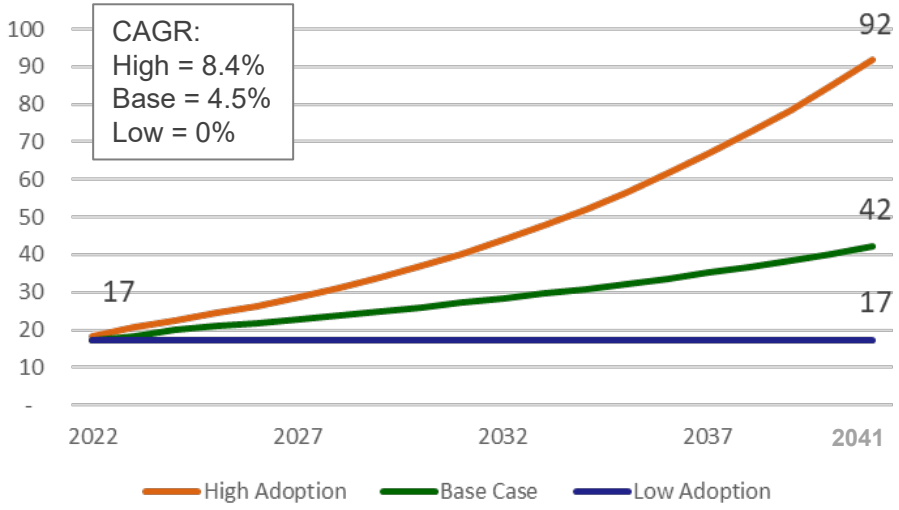


Rooftop Solar:
Sensitivity Scenarios

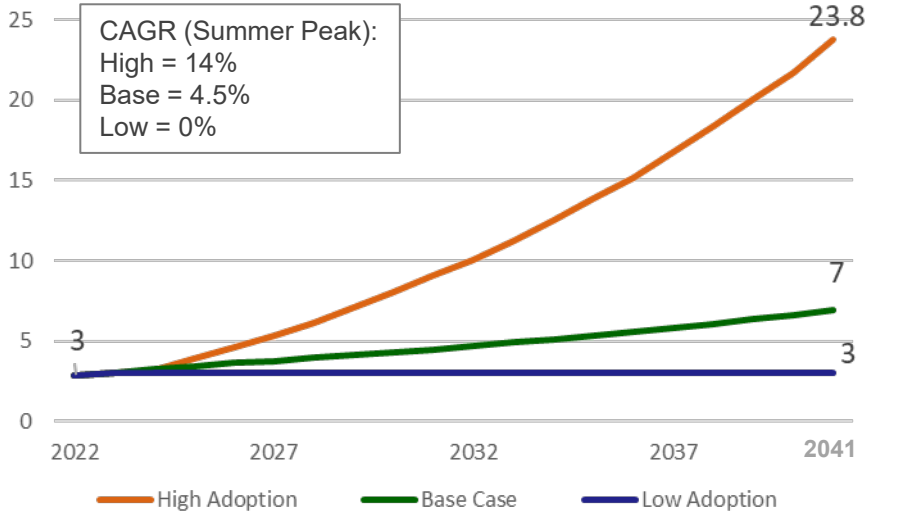
Number of Customers



Energy (GWh)



Demand – Prior to DSM (MW)



Update on DSM Plans

Patricia Housand
Manager, Program Development
Santee Cooper

Santee Cooper DSM Plans

The following section depicts activities currently being undertaken to update Santee Cooper's DSM plans. Central and its member systems separately develop projections and plans for DSM programs.

Demand Side Management (DSM)

Modifying How Customers Use Energy on Their Side of the Meter

EE

Energy Efficiency Programs: Objective is to reduce overall energy usage by encouraging customers to upgrade to higher efficiency equipment and/or install other energy-saving measures.

DR

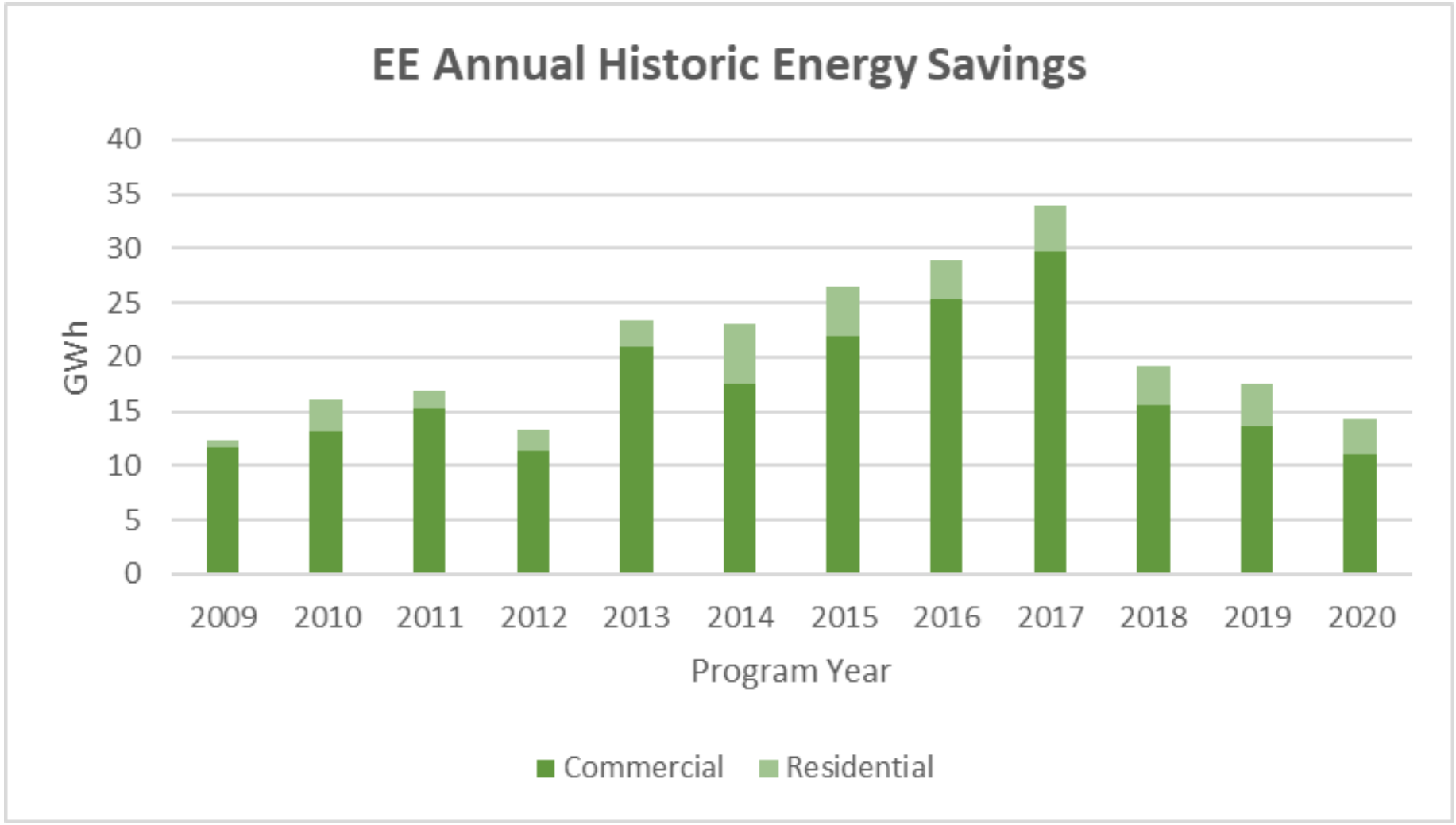
Demand Response Programs: Objective is to reduce participants' demand for electricity when Santee Cooper's system demand for electricity is at its highest.

BE

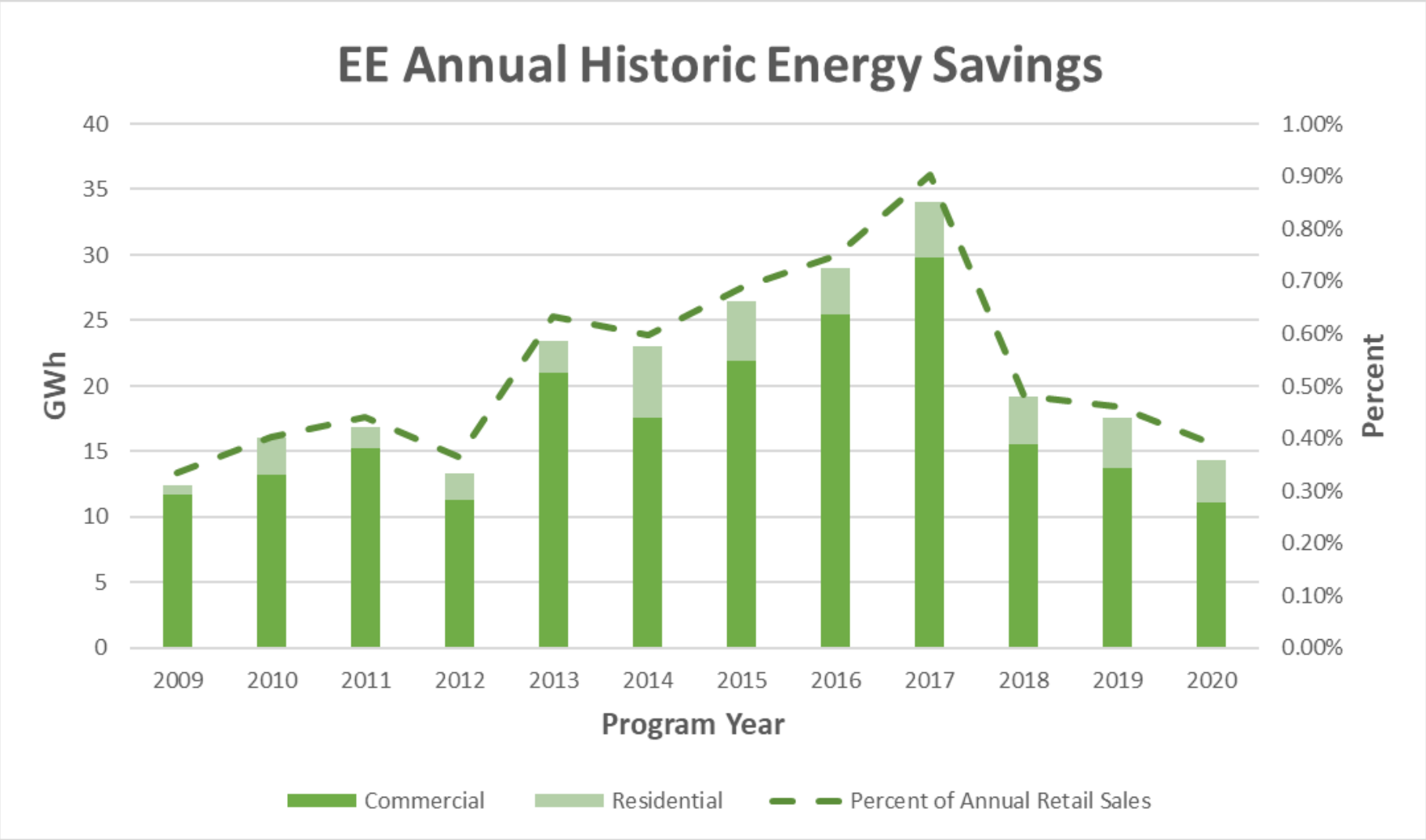
Beneficial Electrification Programs: Objective is to save consumers money over time; benefit the environment and reduce greenhouse gas emissions; improve product quality or consumer quality of life; or foster a more robust and resilient grid.[1]

1. *Beneficial Electrification League www.beneficialelectrification.com*

Energy Savings



Energy Savings

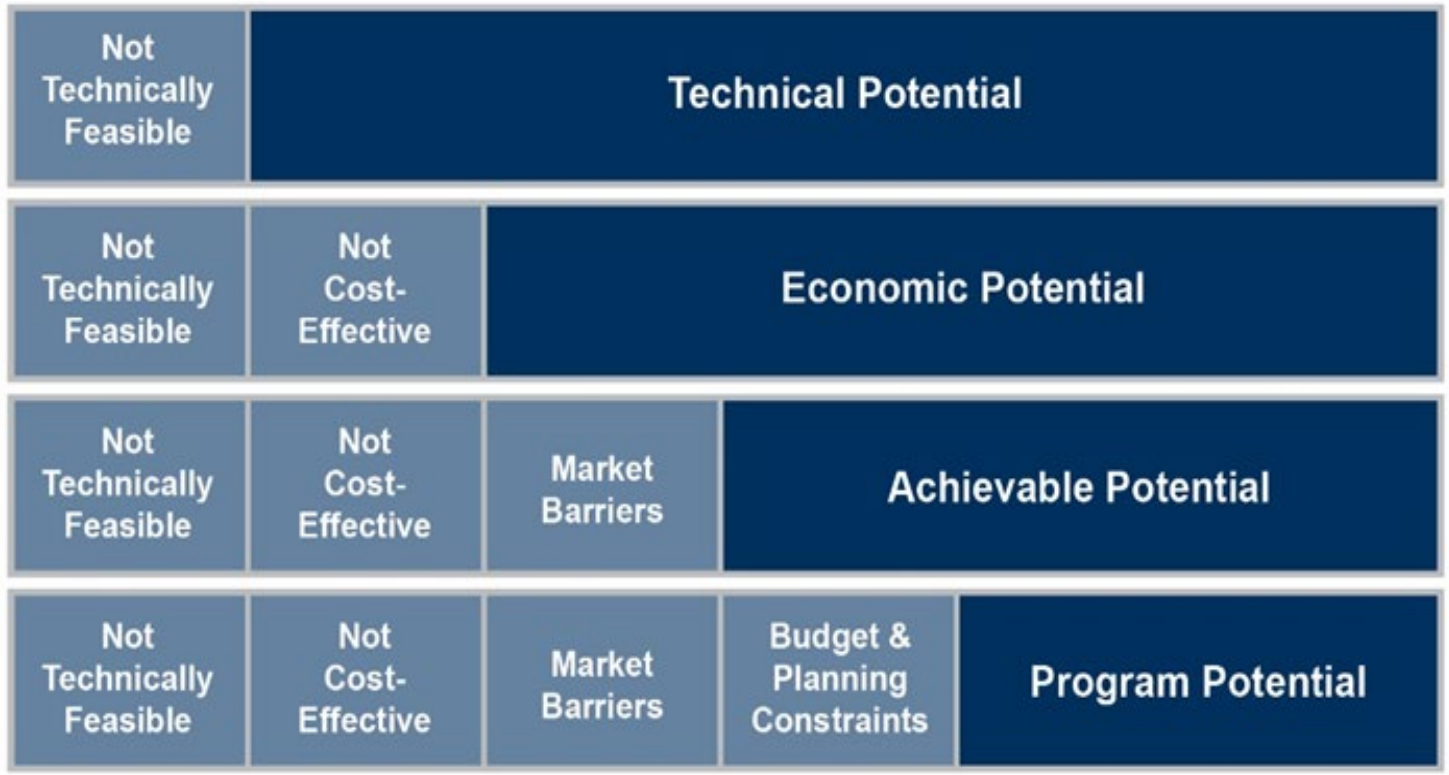


How is Santee Cooper's Marketplace Different?

- Santee Cooper's territory is largely a coastal, tourism-driven economy
  - High concentration of lodging, amusement, and restaurants
  - High percentage of economy is driven by seasonal activities
- 40% of Santee Cooper residential customers are non-permanent residents
    - occupy their properties only seasonally
    - rent their properties to vacationers
- High population of retirees
- Large percentage of homes built after energy codes established
- High proportion of renters

Energy Efficiency

Market Potential Study Approach

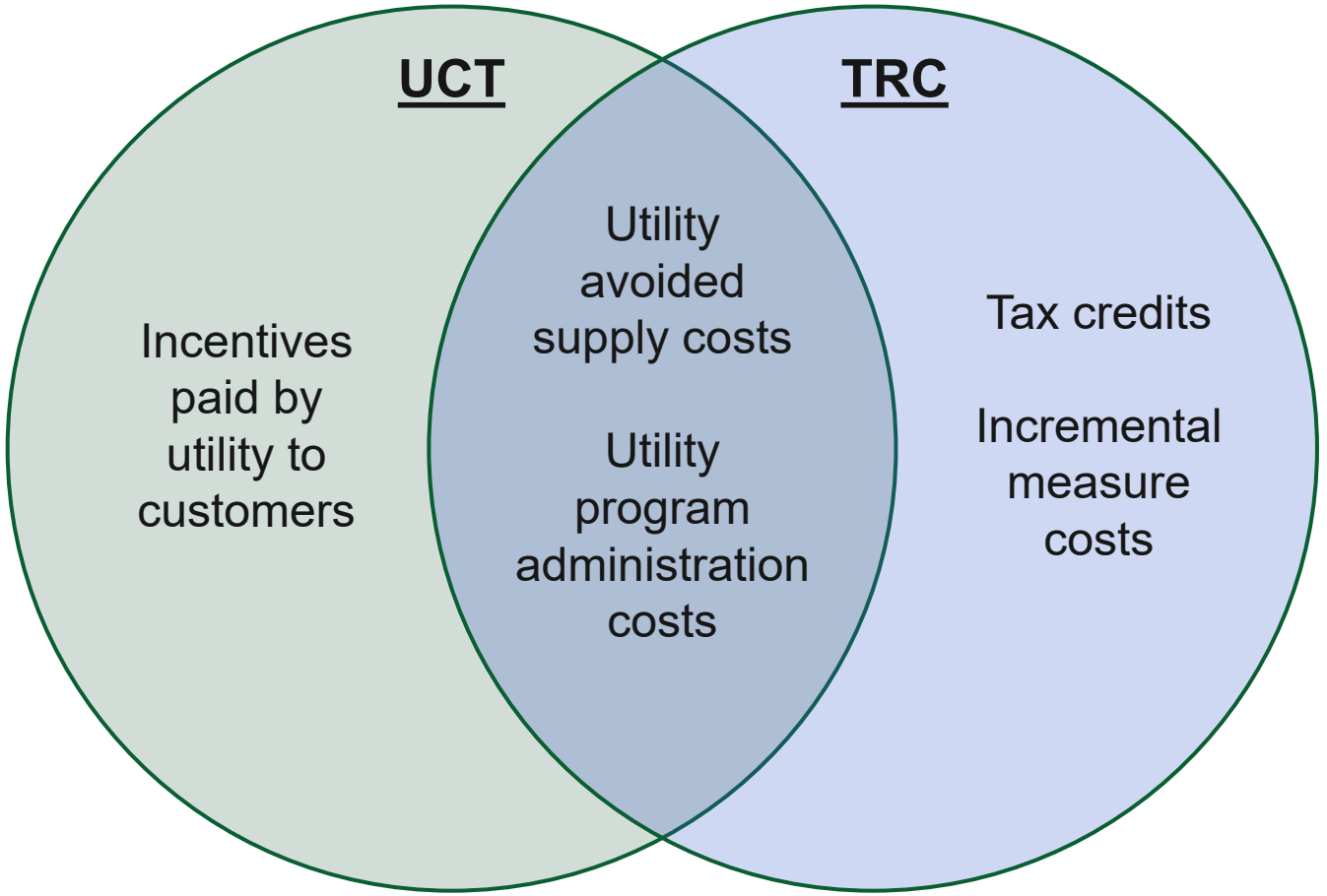


EPA – National Guide for Resource Planning

Energy Efficiency

Utility Cost Test (UCT) vs. Total Resource Cost (TRC)

- 2019 Market Potential Study evaluated measures using TRC test
- Resource Innovations is updating some assumptions of 2019 Market Potential Study and using UCT perspective
  - Consistent with PSC IRP Orders for DEC



Energy Efficiency

Market Potential Study Next Steps

Santee Cooper will evaluate the results of the 2022 Market Potential Study update

Santee Cooper is targeting to share results of the Market Potential Study update that uses UCT perspective at IRP Stakeholder Meeting #3

Electric Vehicles

Current Activities

Evaluate EV adoption scenarios

Rates and Pricing Area is working on developing and launching EV experimental rates

Continue to work with local, state, and regional stakeholder groups to refine and adjust EV initiatives to meet the evolving needs of customers and ensure Santee Cooper's system is prepared for the impacts of EV charging

Energy Efficiency and DSM

Tactics to Gain Higher Program Performance

- Increased customer awareness
  - We are working to educate our customers on how shifting their electricity usage to off-peak times will help manage the cost of electricity and reduce impacts to the environment
  - We will educate our customers about EVs with the goal of increasing customer interest in EVs and reducing their range anxiety
- Increased contractor awareness
  - Greater awareness of our DR and EV programs by our Trade Allies will help propagate this initiative
- Additional DER offerings to meet customer business cases
  - Program offerings that support DERs that customers are interested in will encourage adoption

Major Assumptions

Bob Davis
Executive Consultant
nFront Consulting

Major Assumptions

The following section depicts potential data sources, methodologies, and preliminary assumptions that may be used for Santee Cooper's 2023 IRP. Santee Cooper has made no final decisions on assumptions to be used in the 2023 IRP.

We encourage stakeholder feedback on the information presented.

Financing and Economic Assumptions

Assumption	Annual Rate
Santee Cooper weighted cost of debt	4.50%
Weighted cost of short-term commercial paper	2.75%
Santee Cooper discount rate	4.50%
General inflation rate	2.30%

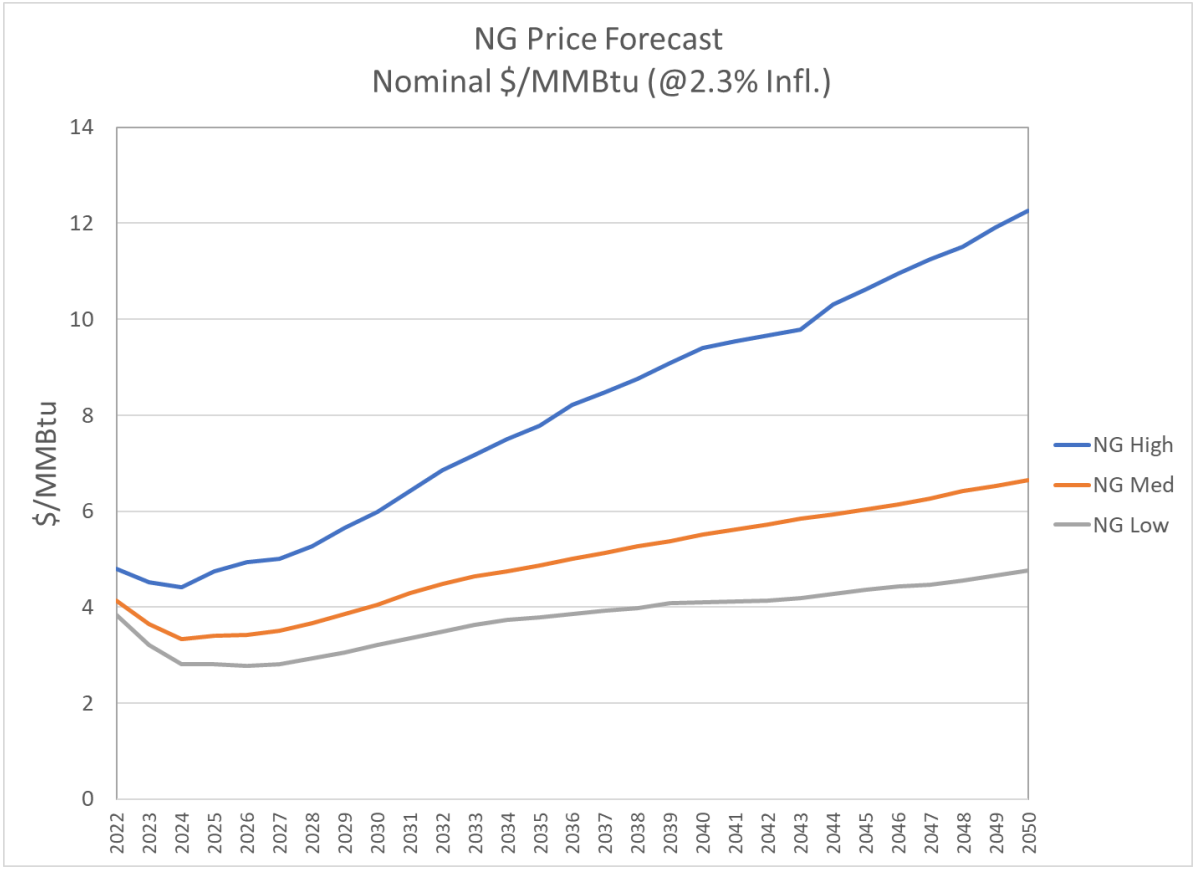
Fuel Prices

Fuel Price Forecast

- Adopting precedent established under Duke and Dominion IRP filings to use fundamental forecasts
- Santee Cooper proposing to use average of
  - EIA 2022 Annual Energy Outlook (AEO)
  - S&P Global Platts (fundamental forecast)
- Used for natural gas and coal price forecasts
- Fundamental prices modeled for entire study period

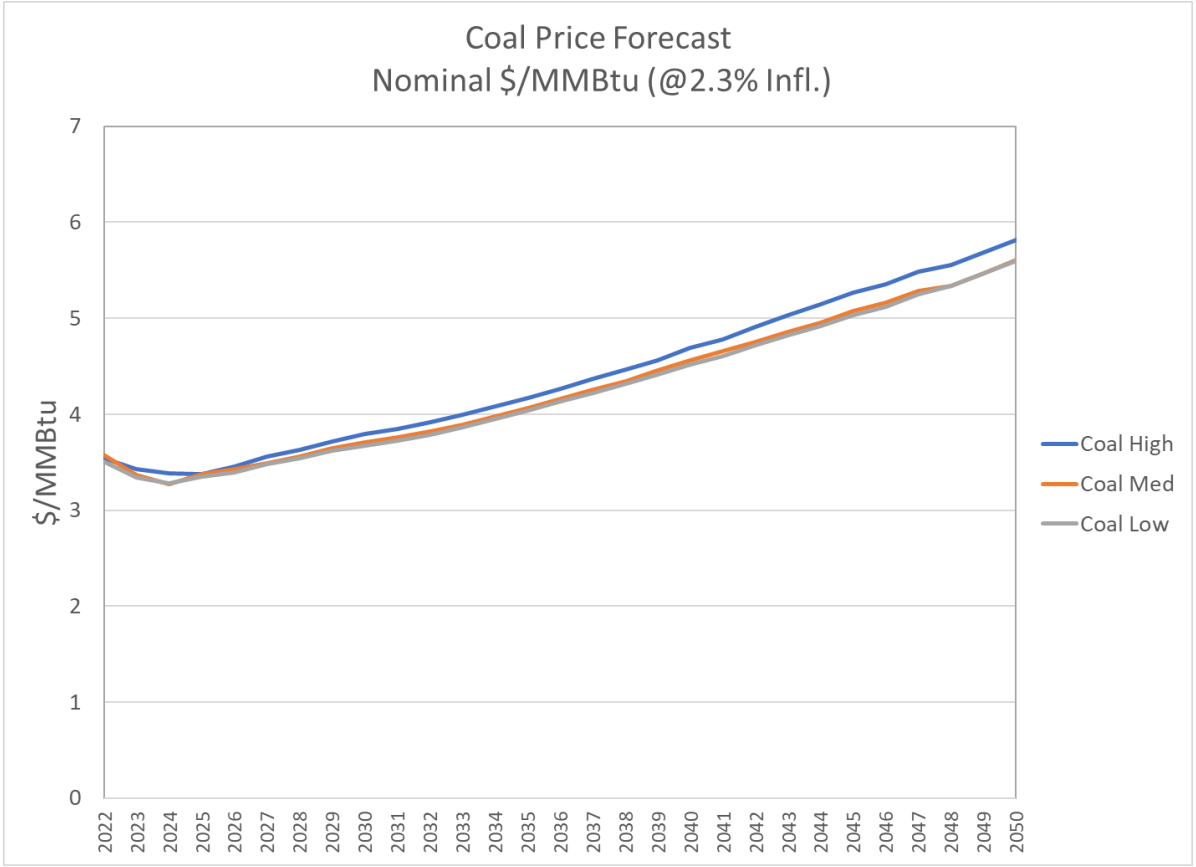
Natural Gas Price Forecast

- Henry Hub price forecast
  - Average of AEO Reference Case and S&P Global Platts
- Variable delivery charges based on existing pipeline fees from Gulf Coast area to South Carolina
- Relative monthly price patterns based on CME forward prices for Henry Hub
- Low and High sensitivity cases based on relative difference between AEO Reference Case and High and Low Oil and Gas Supply cases



Coal Price Forecast

- Coal basin prices for Central Appalachian, Northern Appalachian, and Illinois Basin
  - Average of AEO Reference Case and S&P Global Platts
- Forecast of coal rail delivery costs to South Carolina
- Low and High sensitivity cases based on relative difference between AEO Reference Case and High and Low Oil and Gas Supply cases



Fixed NG Transportation Pricing

- 2023 IRP will include costs of new firm NG service for new combined cycle resources
- Pricing will be based on preliminary discussions with pipeline companies
  - Estimates indicate firm reservation charges are approximately $2-3 per MMBtu (total over multiple pipeline systems)
  - Subject to further adjustment as information becomes available
- No escalation of firm NG reservation fees over study period

Other Fuels

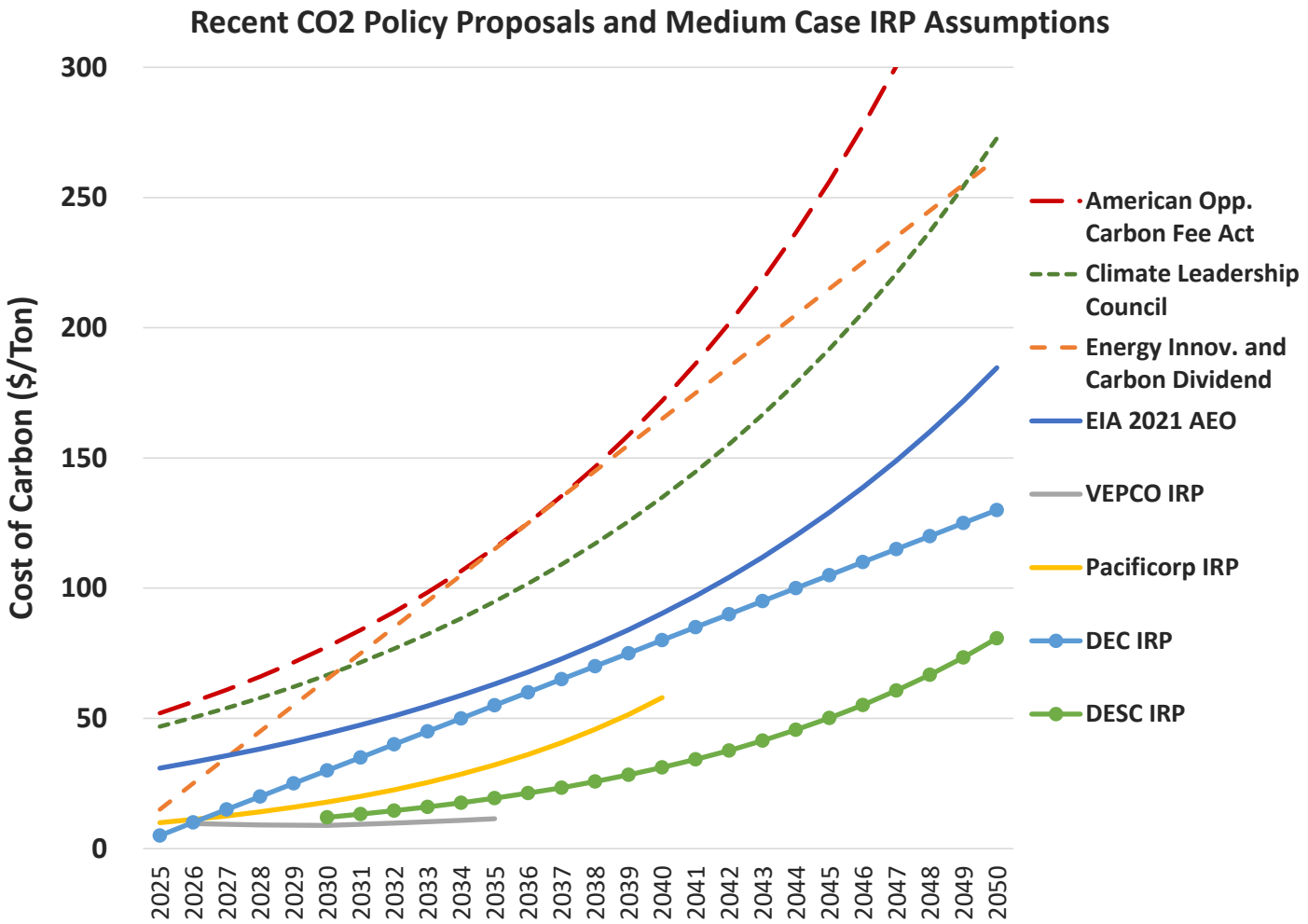
- Diesel fuel price
  - Average AEO and S&P forecasts
  - Adjustment for regional delivery costs
  - Sensitivities based on relative difference between AEO Reference Case and High and Low Oil and Gas Supply cases
  - Note: Minimal effect on IRP results

- Nuclear fuel price
  - Fuel price forecast provided by DESC

CO_2 Price

CO2 Price

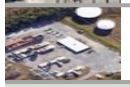
- Santee Cooper CO2 price assumptions for IRP are under development
- To be modeled as a CO2 tax
- Assumed tax rate to be based on a review of
  - CO2 tax rates assumed by Duke and DESC in IRPs
  - CO2 tax rates modeled by other utilities in recent IRP filings
  - Recent legislative proposals



Note: Data shown reflects the base or mid-range CO2 case.

Existing Resources

Santee Cooper Existing Resources

		Unit #	Service Date	Fuel Type	Technology	Winter Rating (MW)
Owned Resources:						
	**Cross** Pineville, SC	1 2 3 4	1995 1983 2007 2008	Coal Coal Coal Coal	ST ST ST ST	585 570 610 615
	**Rainey** Iva, SC	1 2A, 2B, 3-5	2002 2002 - 2004	NG NG	CC CT	520 630
	**Winyah** Georgetown, SC	1 2 3 4	1975 1977 1980 1981	Coal Coal Coal Coal	ST ST ST ST	280 290 290 290
	**Summer Nuclear Unit 1** Jenkinsville, SC	1	1983	Uranium	NUC	322
	**Jefferies,** Lake Moultrie **Spillway,** Lake Marion	1-4, 6 -	1942 1950	Water Water	Hydro Hydro	140 2
	**Landfill Gas** (multiple sites)	-	2001 - 2011	LFG	CT, IC	29
	**Myrtle Beach** **Hilton Head**	1-5 1-3	1962 - 1976 1973 - 1979	Oil/NG Oil	CT CT	65 100
Purchases:						
SEPA Hydro		-	-	Water	Hydro	305
Biomass		-	-	Biomass	ST	74
St. Stephens Hydro						84
Total Capacity						5,801

Note: As of the winter of 2021/2022, Santee Cooper has approximately 82 MW of nameplate solar capacity.

Existing Resource Characteristics

- Simulation of existing Santee cooper resources based on historical / known operating characteristics
  - Seasonal capacity ratings
  - Seasonal heat rates
  - O&M costs/rates
  - Planned maintenance
  - Forced outage rates
  - Other operating characteristics

New Resource Options

New Resource Options
CC, CT, RICE, and Small Nuclear

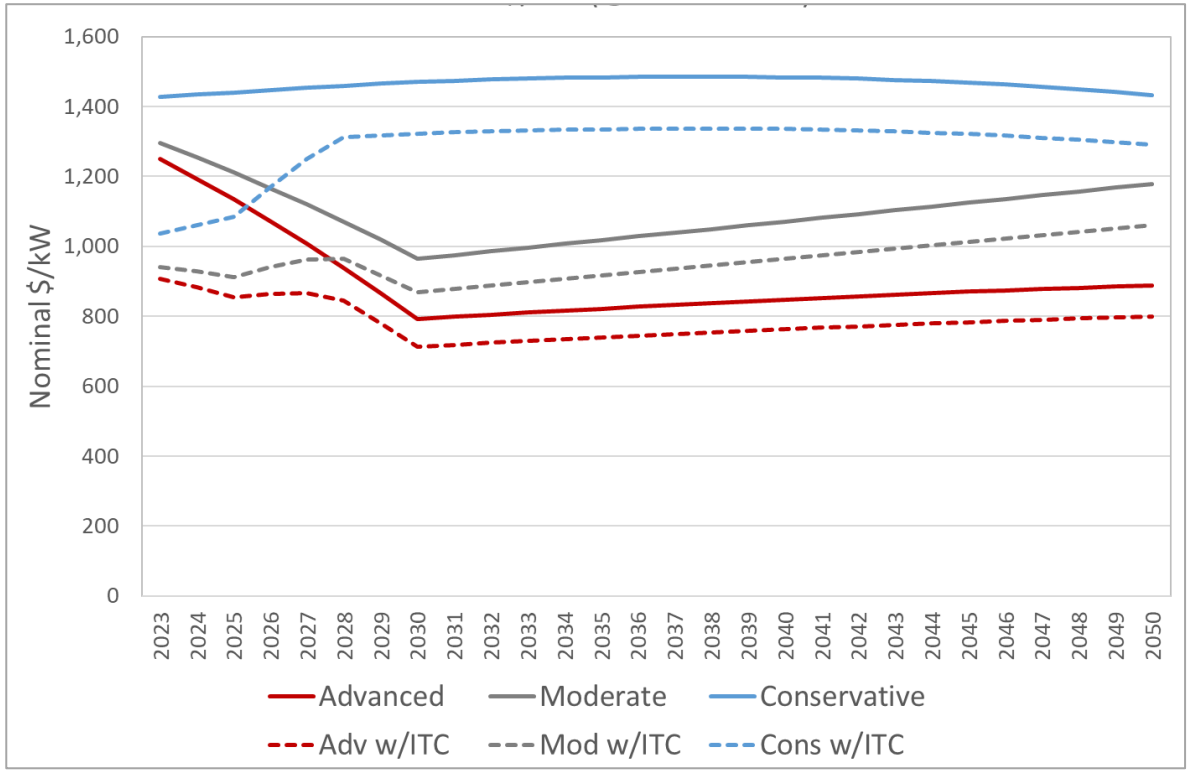
- Using EPRI TAGWeb in conjunction with other sources to develop assumptions for new CC, CT, RICE, and small nuclear resources
  - Capital and O&M costs based on EPRI TAGWeb with Santee Cooper specific adjustments for South Carolina
  - Capital and O&M cost escalation based on EPRI TAGWeb and NREL Annual Technology Baseline (ATB)
  - Heat rate assumptions based on EPRI TAGWeb and equipment vendor data
  - Operating characteristics based on EPRI TAGWeb with Santee Cooper specific adjustments for South Carolina

Purchased Power Options

- Near-term purchases to meet capacity sufficiency through 2028 based on price forecasts developed by The Energy Authority (TEA)
- Long-term PPA pricing based on tolling agreements for CC capacity and energy
  - Indicative pricing obtained from regional wholesale providers or neighboring electric utilities
  - Fuel costs simulated as heat rate tolling arrangement using fuel price forecasts consistent with those modeled for existing and new Santee Cooper resources
  - PPA arrangements may necessitate new transmission system upgrades following Winyah retirement

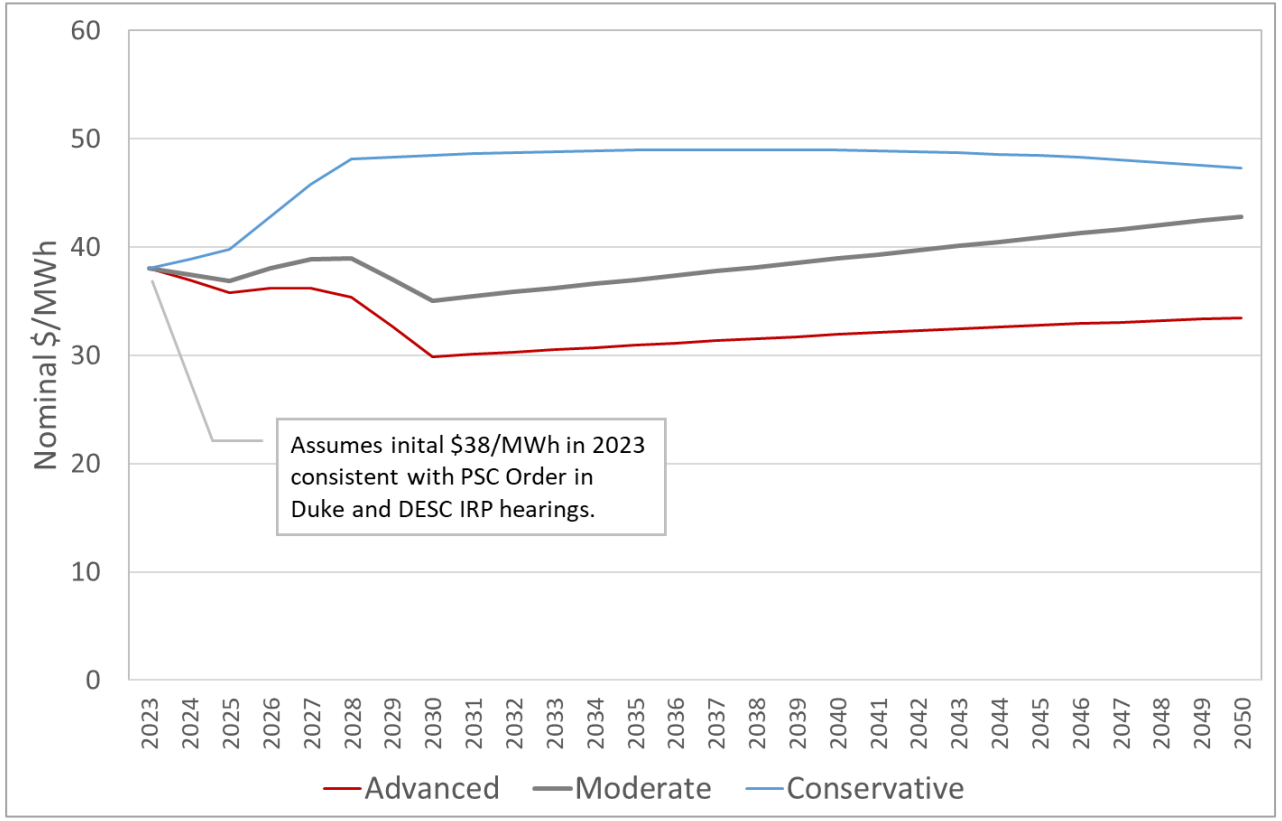
New Solar Resources

- Model as PPA resource
  - Allows Santee Cooper to capture benefits of investment tax credit (ITC) in pricing
- Technology cost trend
  - Utilize NREL ATB capital cost curve
  - Assumptions subject to change with updated ATB
- Simulation / resource expansion optimization
  - Simulate solar resource additions as expansion options in EnCompass
  - Develop diversified production profiles based on NREL System Advisor Model (SAM)
  - Include cost of integration based on results of Astrapé study



Solar PPA Price Forecast

- Santee Cooper is reviewing multiple potential sources to develop a starting price for solar PPAs
  - Santee Cooper RFP solicitation issued June 2020
    - With consideration of recent market trends and issues (e.g., inflation, constraints on supply chain, and anti-dumping trade investigations)
  - Duke and Dominion PSC orders to use specific solar PPA pricing within IRPs
    - Dominion ordered to use a low/med/high pricing from $38.94 to $34 per MWh
    - Duke ordered to use $38/MWh



New Energy Storage Resources

- Model energy storage as Santee Cooper-owned resources
- Simulate energy storage additions as expansion options in EnCompass
- Battery Energy Storage Systems (BESS)
  - Simulate 4-hour BESS resources
  - Capacity ratings for 4-hour BESS based on ELCC study
  - Model multiple capacity tranches of BESS resources with declining ELCC capacity ratings
- Other energy storage and long-duration BESS simulated as needed under net-zero CO2 portfolio

New Wind Resources

- Data on utility-scale wind resources for South Carolina is limited
- Santee Cooper is investigating assumptions to use in its IRP for both on-shore and off-shore wind resources
- Available data sources
  - Estimated equipment costs and other operating assumptions available from industry sources such as EPRI, NREL, EIA
  - Production profiles can be based on NREL SAM model
  - Review assumptions utilized by Duke and DESC in prior IRP filings
- Stakeholder feedback on data sources that include information specific to South Carolina (including citation of data/assumptions)

Hydrogen Conversion

- Ongoing Santee Cooper research efforts on use of hydrogen fuel in conventional natural gas-fueled resources
  - Review of vendor data for hydrogen operating limitations for new CC/CT/RICE resources
  - Estimation of equipment costs for modification/conversion to operation on higher levels of hydrogen fuel (industry sources: EPRI, NREL, DOE, etc.)
  - Adjustment of operating characteristics and emission rates for varying levels of hydrogen operation

Astrapé Resource Adequacy Studies

Nick Wintermantel
Principal
Astrapé Consulting

Santee Cooper Stakeholder Meeting
Resource Adequacy Studies

Presented By
Astrapé Consulting

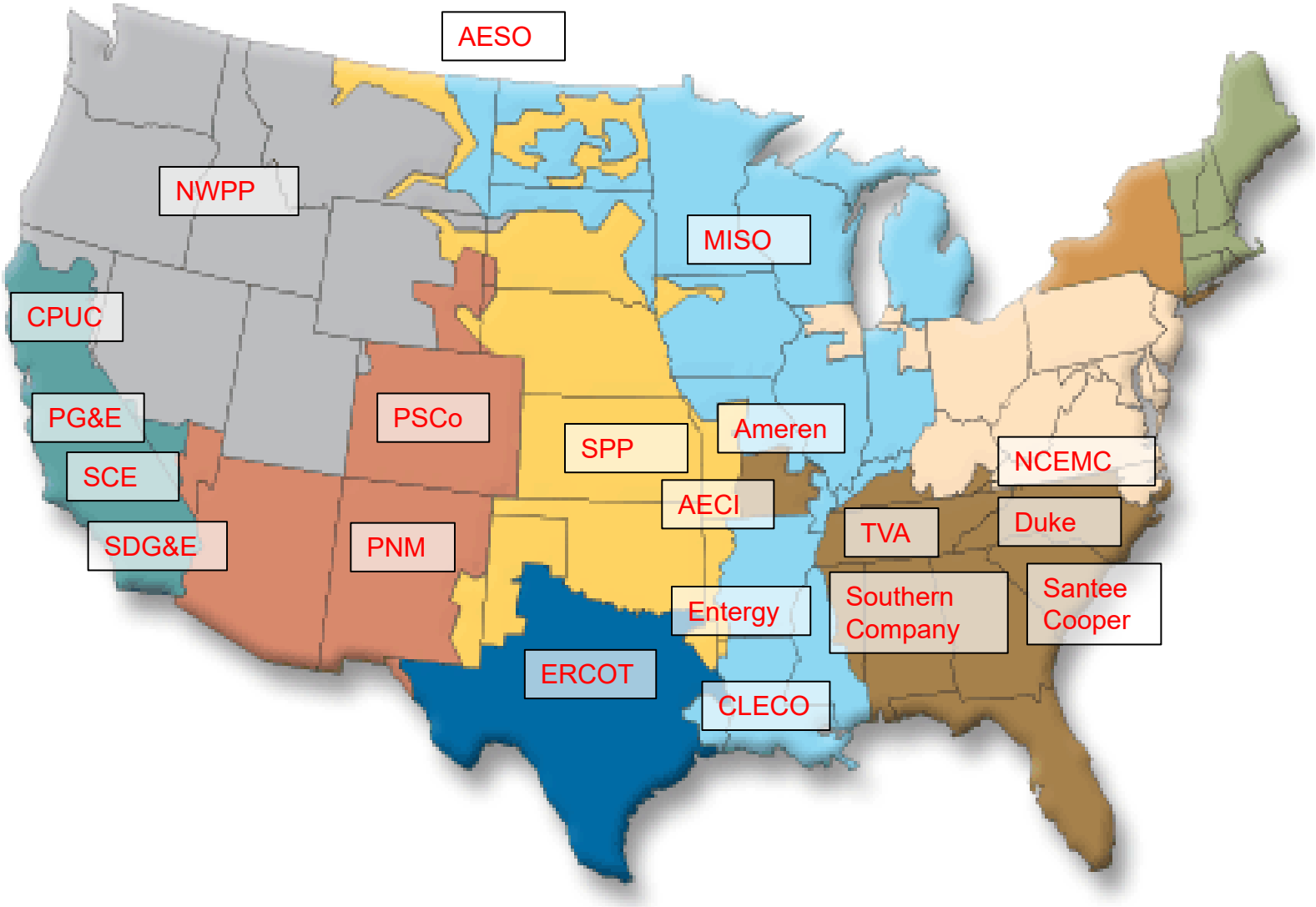
04-29-2022

ASTRAPÉ CONSULTING
innovation in electric system planning

Topics of Discussion

- **Planning Reserve Margin (PRM) Study Methodology**
- **ELCC Study Methodology**
- **Solar Integration Study Methodology**

Astrapé's SERVM Model has been utilized in the following areas across the U.S.



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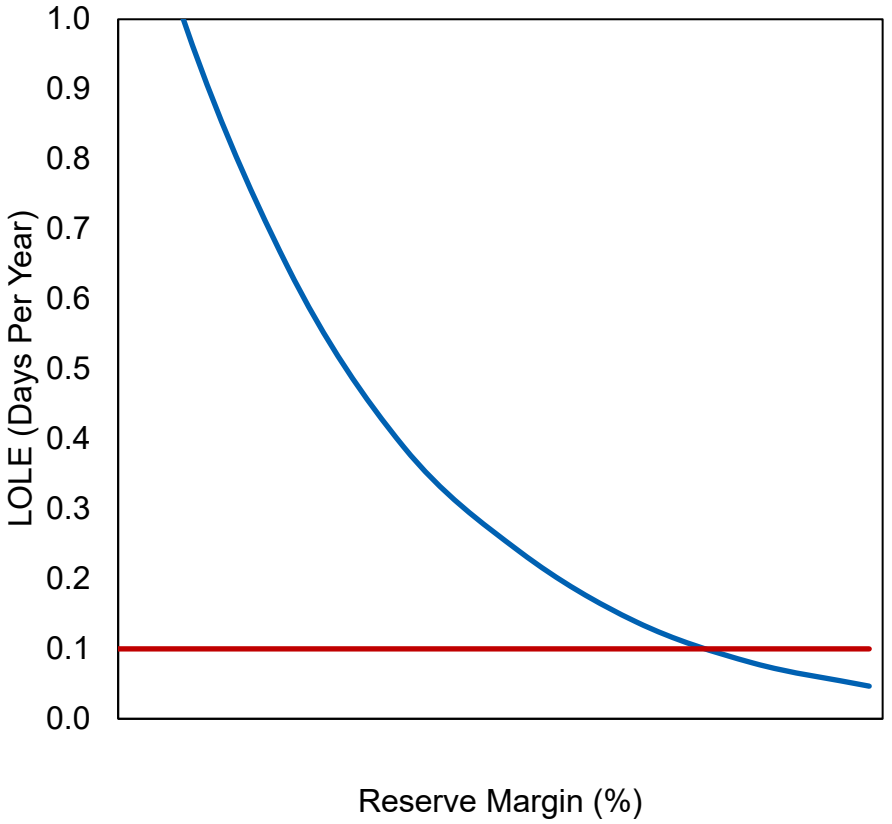
Planning Reserve Margin Study

PRM Study Methodology

- Planning Reserve Margin (PRM) - defined as the percentage by which the total capacity of system resources exceeds the forecasted peak load
- Loss of Load Expectation (LOLE) – number of days in a year that customer load is shed
- Methodology - Determine the reserve margin that achieves LOLE of 0.1 days/year; Also known as the 1 day in 10-year standard across the electric industry
- Perform sensitivities around key drivers



SERVM Framework

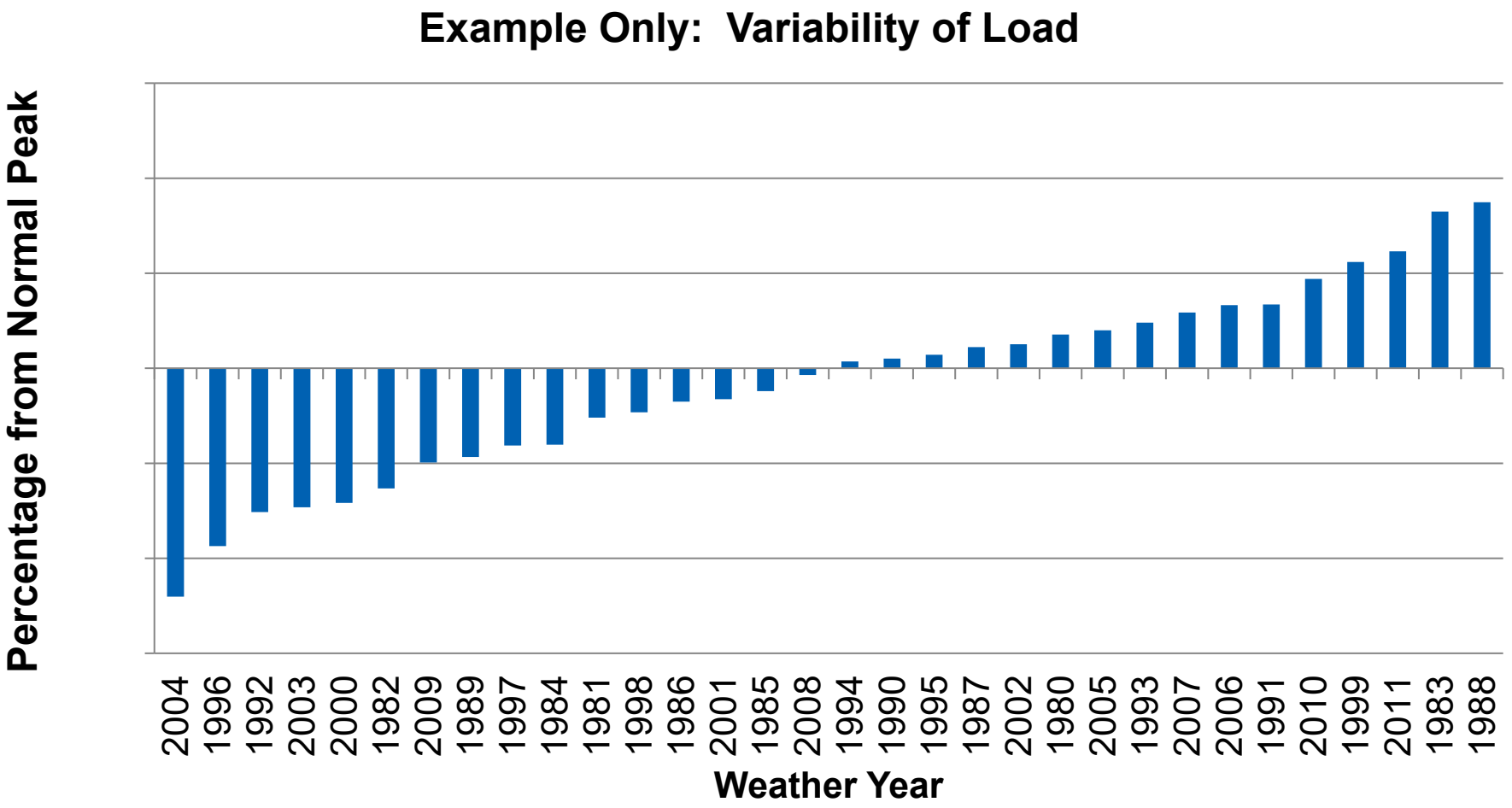
- **Capture Uncertainty in the Following Variables**
  - Weather: 41 years of weather history (1980-2020) with equal probability of occurrence
    - ➢ Impact on Load and Resources (hydro, wind, PV, temp derates on thermal resources)
  - Economic Load Forecast Error: Distribution of 5 points with varying probabilities of occurrence
  - Unit Outage Modeling (50+ iterations for each load scenario)
- **Multi-Area Modeling – Pipe and Bubble Representation**
- **Total Base Case Scenario Breakdown**

41 **Weather Years** (Equal Probability)	x	**5** **LFE Points** (Associated Probabilities)	=	**205** **Load Scenarios** (Associated Probabilities)
205 **Load Scenarios**	x	**50** **Unit Outage Draws**	=	**10,250** **8760 Hour Simulations**

Major Study Parameters

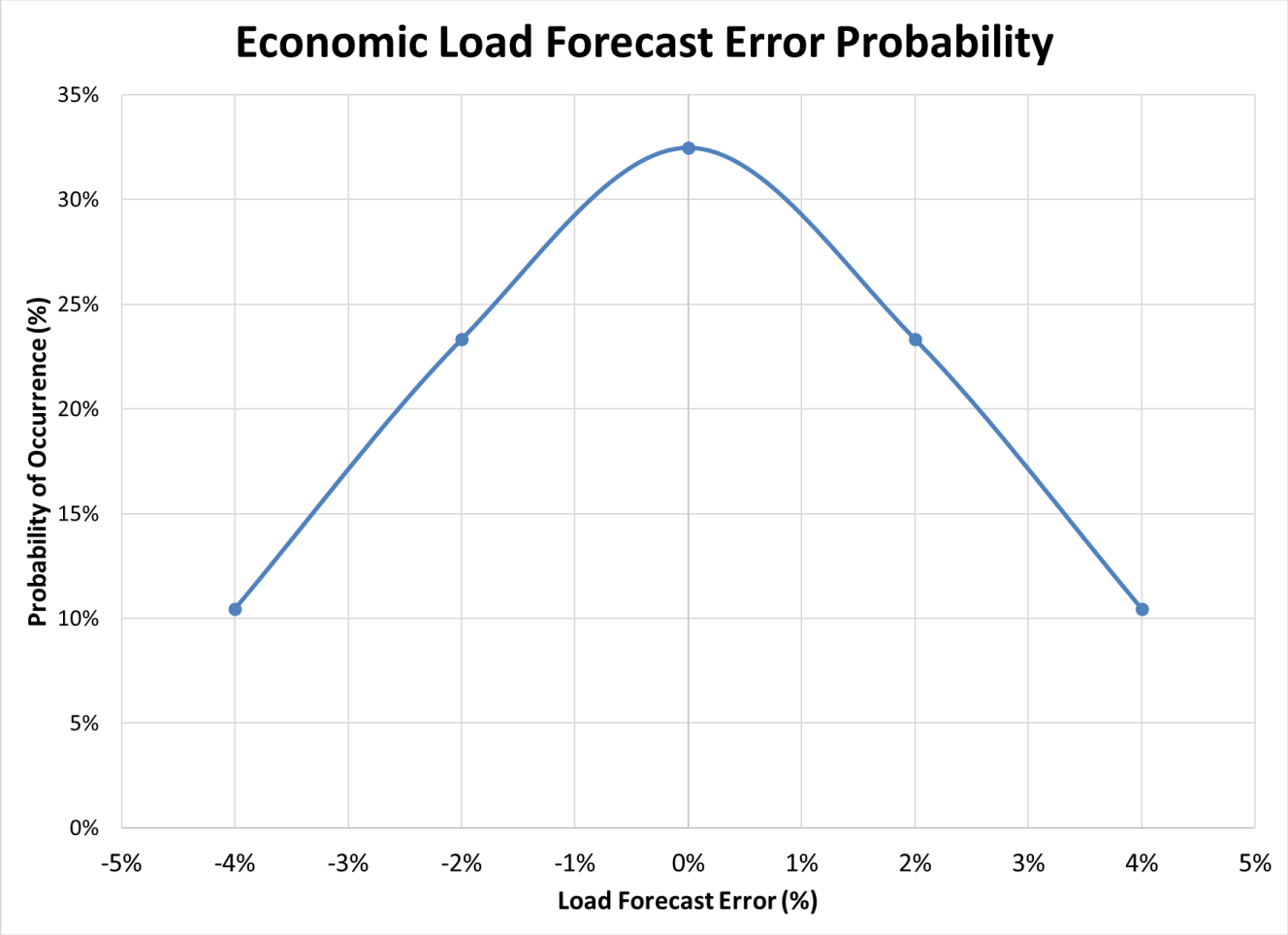
- **Study Years: 2026 & 2029**
- **Historical Weather Years: 1980-2020**
- **Regions (Balancing Authority Areas) Modeled**
  - Santee Cooper
  - SOCO (Southern Company)
  - Duke (Duke Energy Carolinas)
  - CPL (Duke Energy Progress)
  - SCEG (Dominion South Carolina)
- Maintain minimum regulating reserves of 100 MW during firm load shed events
- **Target LOLE:** 0.1 Days/Year = 1 firm load shed event in 10 years

Peak Summer Load Variability by Weather Year



Load Forecast Uncertainty and Forward Period

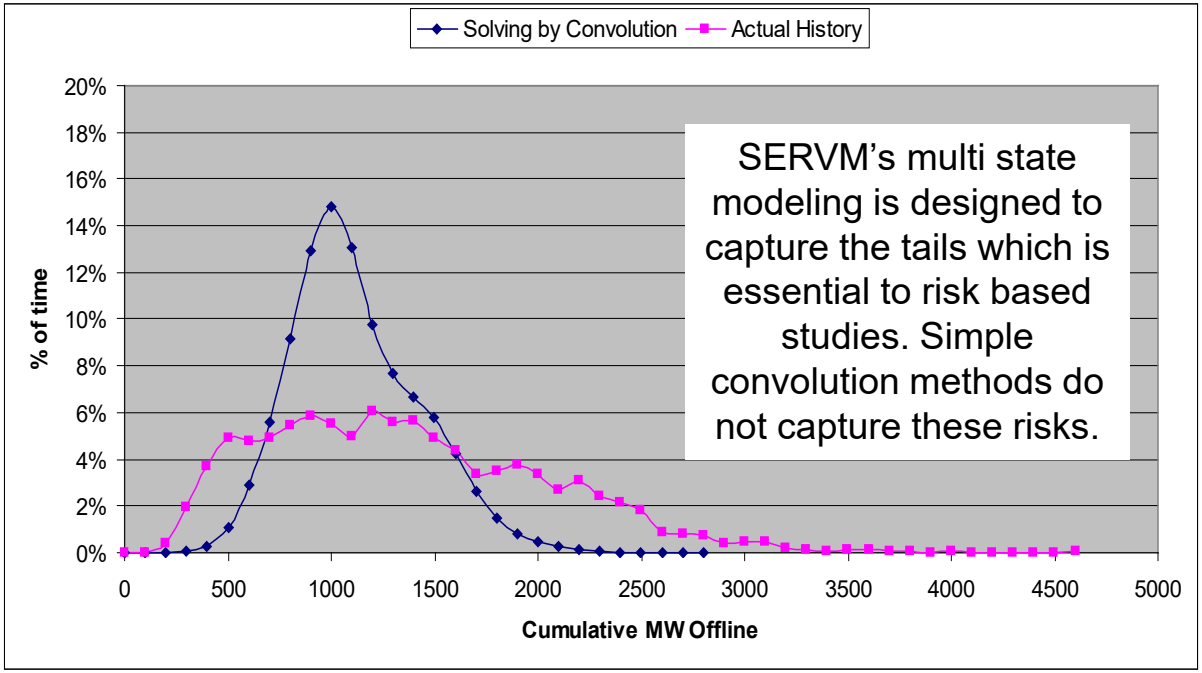
- Non-weather load forecast error increases with forward period
- Each weather shape simulated with each LFE and associated probabilities
- Represents 4 year ahead LFE because it generally takes 3-5 years to approve, permit, and build a new power plant.



Unit Outage Modeling

- **Full Outages**
  - Time to Repair
  - Time to Failure
- **Partial Outages**
  - Time to Repair
  - Time to Failure
  - Derate Percentage
- **Maintenance Outages**
- **Planned Outages**
- **Created Based on Historical GADS Data**

- Multi State Frequency and Duration Modeling vs Convolution



Hydro and Solar Modeling in SERVM

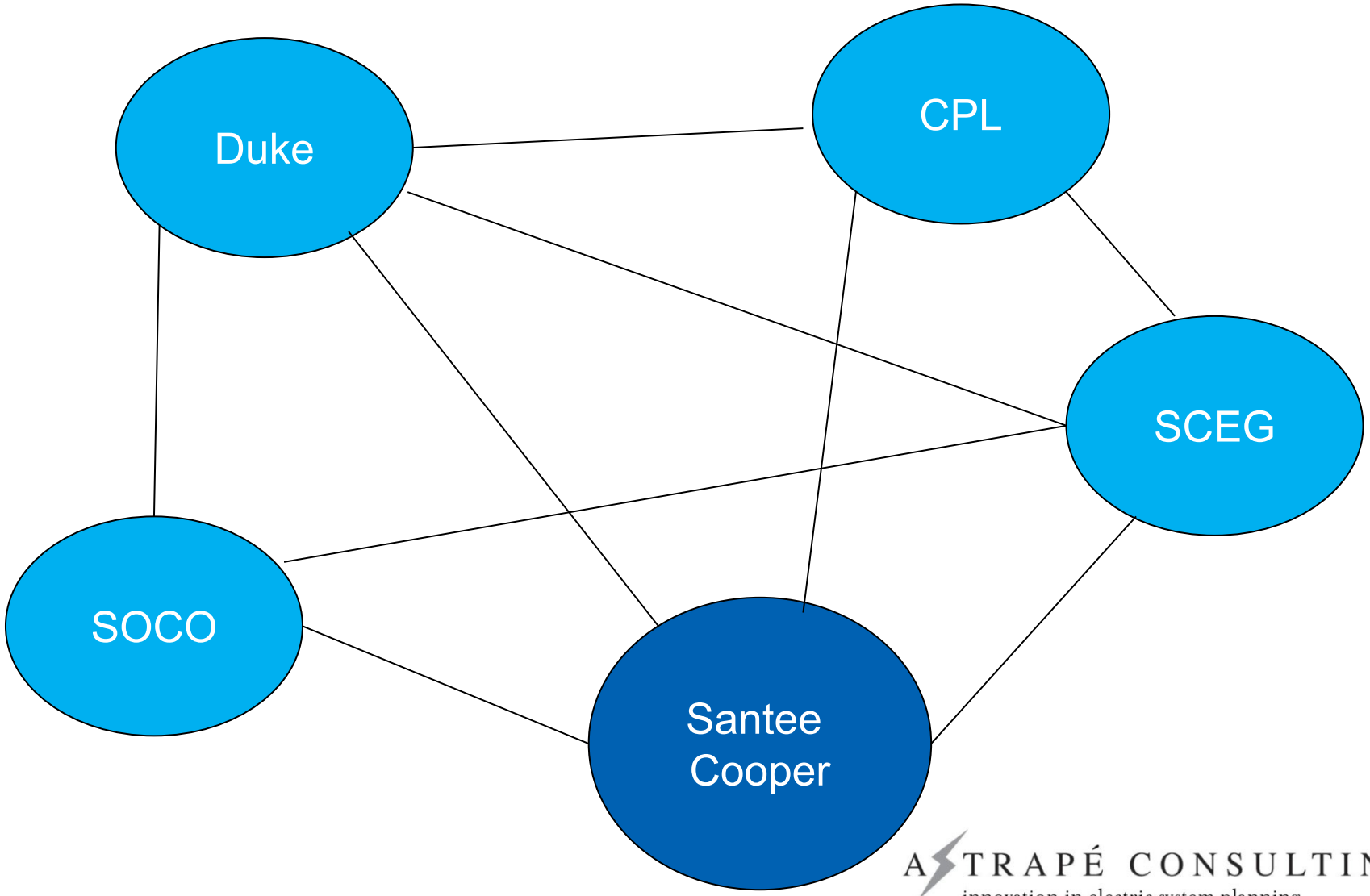
- **Hydro - Aggregate Hydro Units**
  - Weekly Peak Shaving with minimal daily scheduling
  - Inputs for each month for each historical weather year modeled

- **Solar – Model with Hourly Profiles**
  - Based on locations across the service territory, hourly irradiance data is pulled from the NREL database and profile development using SAM.
    - Data is available from 1998-current
    - Use daily solar data from 1998 to current profiles to fill in from 1980 – 1998 based on solar to load correlation.
      - Example: For January 1, 1980, determine closest matching load day from this day and the 1998 – 2020 period only examining Dec 31 – January 2 range of each year. Once this match is determined used that day's solar profile.

Demand Response

- **Modeled as resources with contract limits if they exist**
  - Hours per year
  - Hours per month
  - Hours per day
  - Dispatches per year
  - Dispatch Price

System Configuration



Climate Change Consideration

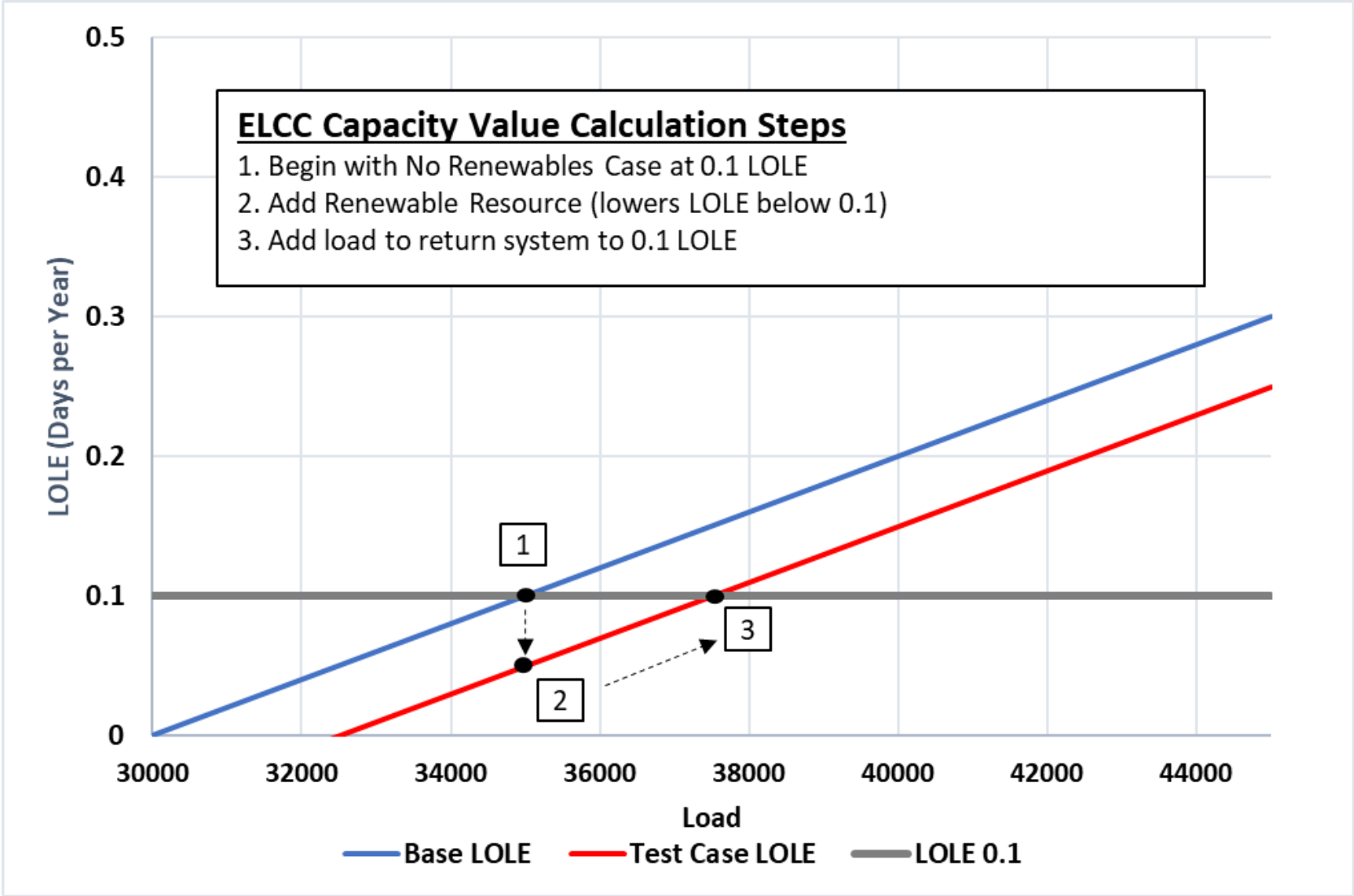
- Plan to utilize the 2020 NOAA Global Climate Report which states temperatures have increased 0.3°F/decade over the last 40 years.
- Climate Change Sensitivity
  - Increase historical temperatures by 0.3°F/decade
    - 1980 would increase by approximately 1.2°F
  - Redevelop loads using revised temperatures
  - Recalculate PRM per proscribed methodology

Other Sensitivities to consider

- Island Case
- High/Low Cold Weather Load Response Case
- Transmission Sensitivity

ELCC Analysis for Solar and Storage

ELCC Study Methodology



Note: Method will be modified per next slide to reflect seasonal targets.

Seasonal ELCC Methodology Details

- Start with System at approximately 0.1 LOLE with no renewable resources
  - Pull out Winter (Jan, Feb, Dec) LOLE and set as winter target
  - Pull out Summer (Jun-Sep) LOLE and set as summer target
- Add renewable tranche to system
- For each season, iteratively add load (negative perfectly available capacity) until that season's LOLE returns to target
- ELCC is the load added divided by the nameplate of the resource/portfolio

ELCC Portfolio Matrix to be Evaluated

Solar \ Battery 4hr	0	1,000	1,250	1,500	2,000
0					
0					
200				200\1,500	
400					400\2,000

Capturing solar and battery together will ensure any synergistic value of the two resources is considered

Solar Integration Study

SERVM Framework – Same as PRM Study

- **Base Case Study Year (2029) – Begin with PRM Study Database**
  - Simulate @ 5-minute increments
  - Weather (41 years of weather history)
    - Impact on Load
    - Impact on Intermittent Resources
  - Economic Load Forecast Error (distribution of 5 points)
  - Unit Outage Modeling (thousands of iterations)
    - Multi-State Monte Carlo
    - Frequency and Duration
  - Model SC With traditional capacity added to get to 0.1 LOLE Cap

- Base Case Total Scenario Breakdown: 41 weather years x 5 LFE points = 205 scenarios
- Base Case Total Iteration Breakdown: 205 scenarios * 50 unit outage iterations = 10,250
  - Exact iterations to be determined

Resource Commitment and Dispatch

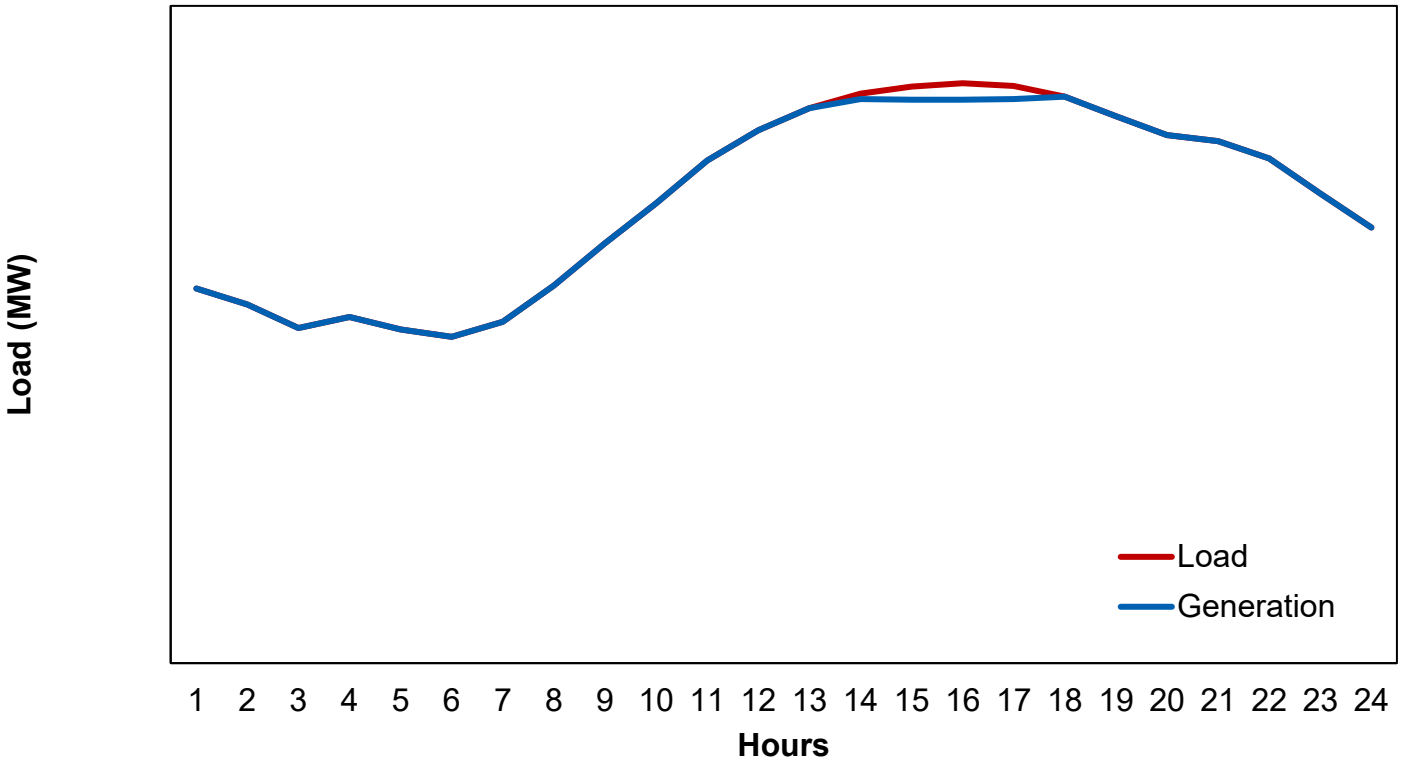
- **Chronological Commitment and Dispatch Model**
  - **Simulated at 5-minute dispatch increments**
- **Simulates 1 year allowing for thousands of scenarios to be simulated which vary weather, load, unit performance**
- **Respects all unit constraints**
  - Capacity maximums and minimums
  - Heat rates
  - Startup times and costs
  - Variable O&M
  - Emissions
  - Minimum up times, minimum down times
  - Must run designations
  - Ramp rates
- **Load and solar volatility modeled which removes perfect foresight**
  - **Based on historical datasets**

Ancillary Services

- **Ancillary services are input into SERVM**
  - Regulation Up/Down Requirement – served by units designated with AGC capability
  - Spinning Reserves Requirement – served by units who have minimum load less than maximum load
  - Load Following Up/Down Reserves – identical to spinning reserves; served by units who have minimum load less than maximum load
  - Quick Start Reserves – served by units who are offline and have quick start capability
- **SERVM commits resources to serve load and ancillary service requirements entered by user**

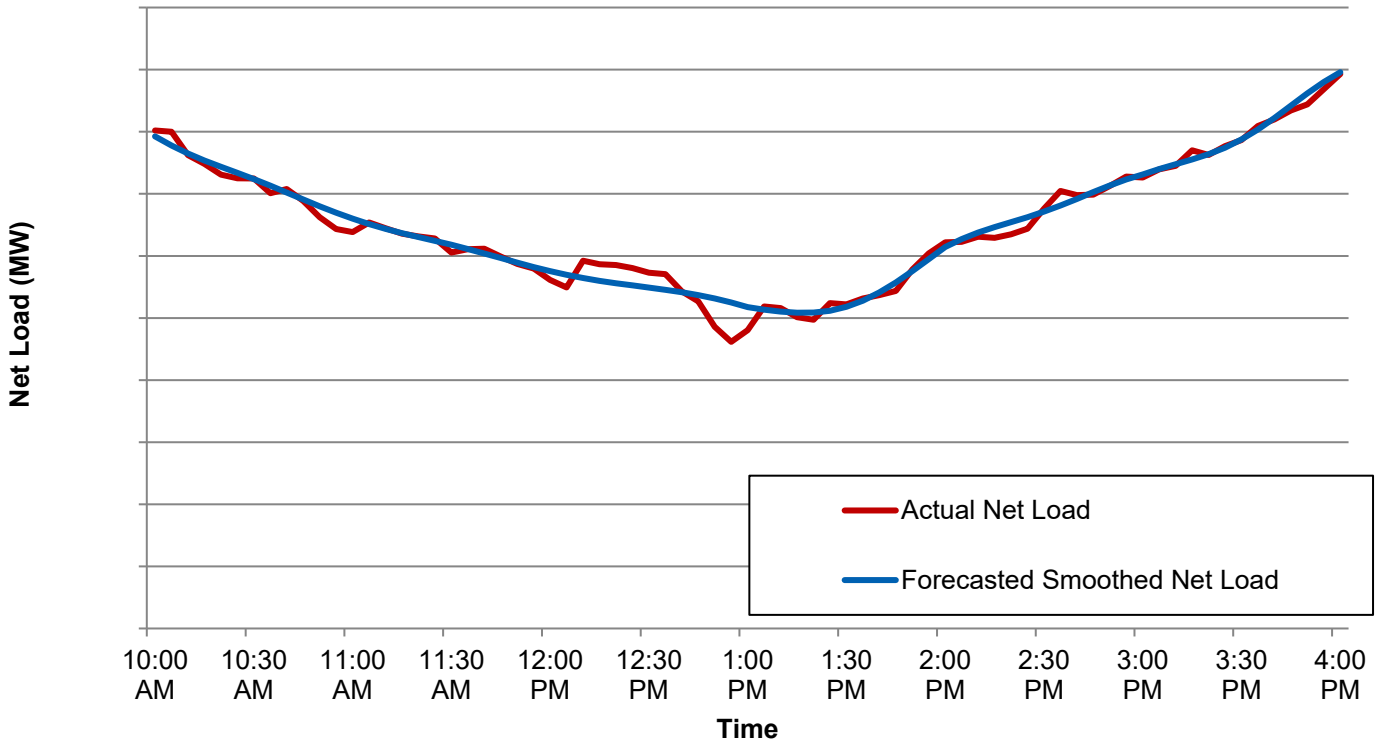
$LOLE_{CAP}$ – Example Only

- **$LOLE_{CAP}$:**
  - **Traditional LOLE; number of loss of load events due to capacity shortages, calculated in events per year.**
  - **Used for Reserve Margin Planning and Capacity Value of Resources**



Flexibility Violation – Example Only

- **Flexibility Violations:**
  - **Number of events where generators modeled in SERVM could not meet the next 5-minute net load. There was enough capacity installed but not enough flexibility to meet the net load ramps.**
  - **Resolved by adding online ramping capability to meet the volatility of additional solar**



Solar Integration Studies

- **Premise of the Study is to maintain the same amount of flexibility violations before and after solar is added**
  - Select Study Year –2029
  - Simulated different penetration levels of solar

	Santee Cooper Solar
Tranche 1 MW	500
Tranche 2 MW	1,000
Tranche 3 MW	1,500
Tranche 4 MW	2,000

- **Study Procedure**
  - Step 1:Run Base Case:
    - Simulate with reasonable operating reserves to determine flexibility violations without solar (e.g. no solar case produced 3 flexibility events per year)
  - Step 2: Add Solar:
    - As solar is added flexibility violations increase due to the increase in net load volatility
  - Step 3: Add Solar and Add ancillary services:
    - Add additional ancillary services in the form of load following to get back to the original number of flexibility violations
    - Target hours where flexibility violations occur
  - Step 4: Calculate the solar integration cost:
    - Calculate the cost increase of the additional ancillary services between Step 2 and Step 3. Then divide by the incremental solar generation to calculate the solar integration cost
  - Potential sensitivities analyzing different resource mixes

Next Steps

Stewart Ramsay
Meeting Facilitator
VANRY Associates

In closing…

Any questions we haven't answered today?

- Comments can be provided:
  - IRP Stakeholder Forum - provide comments, feedback, and post documents at www.santeecooper.com/IRP
  - stewart@vanry.com - for thoughts and input on meeting structure and engagement
  - Comments should be submitted by mid-May to be considered for the next stakeholder meeting
- Meeting summaries and other materials will be posted and made available at www.santeecooper.com/IRP

Next Steps

- Post Meeting Survey
- Stakeholder Session #3
  - Review of major assumptions, sensitivity assumptions, and portfolios to be modeled in 2023 IRP
  - Targeting June 2022

Thank you!

We would like to hear from you about your experience at this session.

Please complete our survey
that will appear in your browser as you leave the meeting

Appendix

Acronyms

- AEO: Annual Energy Outlook
- AGC: Automatic Generation Control
- AMEA: Alabama Municipal Electric Authority
- ASAI: Average substation availability index
- ATB: annual technology baseline
- BE: Beneficial Electrification
- BESS: battery energy storage systems
- BEV: battery electric vehicle
- CAGR: compound annual growth rate
- CC: combined cycle
- CDD: cooling degree day
- CO2: carbon dioxide
- Co-op: electric cooperative
- CT: combustion turbine
- DEC: Duke Energy Carolinas
- DER: distributed energy resources
- DERMS: distributed energy resource management system
- DESC: Dominion Energy South Carolina
- DG: distributed generation
- DOE: Department of Energy
- DR: demand response
- DSM: demand-side management
- EE: energy efficiency
- EIA: Energy Information Administration
- ELCC: effective load carrying capability
- EPA: Environmental Protection Agency
- EPRI: Electric Power Research Institute
- EV: electric vehicle
- GADS: generating availability data system
- GOFER: Give Oil for Energy Recovery
- GWh: gigawatt-hour
- HDD: heating degree day
- HH: household
- IC: internal combustion (engine)
- IRP: integrated resource plan
- ITC: investment tax credit
- kV: kilovolt
- kW: kilowatt
- kWh: kilowatt-hour
- LED: light-emitting diode
- LF: load forecast
- LFE: load forecast error
- LFG: landfill gas
- LOLE: Loss of Load Expectation
- mgd: millions of gallons per day
- MMBtu: 1 million British thermal unit
- MPS: market potential study
- MW: megawatt
- MWh: megawatt-hour
- NG: natural gas
- NGCC: natural gas combined cycle
- NOAA: National Oceanic and Atmospheric Administration
- NREL: National Renewable Energy Laboratory
- NUC: nuclear (resource)
- O&M: operations and maintenance
- PMPA: Piedmont Municipal Power Agency
- PPA: power purchase agreement
- PRM: planning reserve margin
- PSC: Public Service Commission
- PSR: Proposed Shared Resource
- PV: photovoltaic
- PVRR: present value revenue requirement
- QF: qualifying facility
- RECS: Residential Energy Consumption Survey
- RICE: Reciprocating Internal Combustion Engine
- RFI: request for information
- RFP: request for proposals
- RNG: renewable natural gas
- SAIDI: system average interruption duration index
- SAE: statistically adjusted end-use model
- SAM: System Advisor Model
- SEPA: Southeastern Power Administration
- SERVM: Strategic Energy & Risk Valuation Model
- SME: subject matter expert
- ST: steam turbine
- TEA: The Energy Authority
- TRC: total resource cost (test)
- UCT: utility cost test
- V2G: Vehicle to grid