2022 Generation Planning Process

Rate Advisory Committee Meeting – September 15, 2022

CPS ENERGY

CRA Charles River Associates

Agenda

- **Recap of Progress**
- Final Review of Planning Objectives and Metrics
- Review Results of ERCOT Market Scenarios
- Review of CPS Energy Resource Portfolio Definitions

CRA Integrated Resource Planning (IRP) Approach

The first three steps have been completed, setting up modeling and analysis over the next two months

Today's Update

Identify Planning Objectives

Agree on planning objectives and metrics to measure the performance of the plan against each objective

Develop Market Scenarios

Identify key sources of uncertainty and the potential range of future outcomes, and design internally consistent future scenarios

Develop Resource Portfolios

Design options for future resource plans, often based on different future scenarios and priorities

Portfolio Modeling and Analysis

Evaluate the performance of each resource portfolio against each future scenario, stochastic uncertainty, & extreme risk events

Select Preferred Plan

Identify trade-offs from each resource portfolio and select the preferred portfolio

Agenda

Recap of Progress

Final Review of Planning Objectives and Metrics

Review Results of ERCOT Market Scenarios

Review of CPS Energy Resource Portfolio Definitions

Generation Planning Objectives

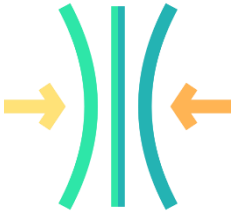
Six major planning objectives have been established, with System Reliability, Environmental Sustainability & Climate Resiliency, and Affordability scoring as most important by RAC members

Planning Objectives

Affordability
RAC: 12 (20%)

CPS Energy Financial Stability
RAC: 10 (17%)

Environmental Sustainability & Climate Resiliency
RAC: 13 (22%)



System Flexibility
RAC: 5 (8%)

System Reliability
RAC: 18 (31%)

Workforce Impact
RAC: 1 (2%)

RAC numbers represent "Dot Plot" vote tallies out of 59 total from August RAC meeting

Metrics

Metric measures have been refined based on RAC feedback, with more focus on near-term outcomes

Planning Objectives	Metrics	Measures
 Affordability	Bill Impact	Estimated monthly bills (Reference Case & scenarios)
	Revenue Requirements	Present value of revenue requirements between 2023 and 2030
		Present value of revenue requirements between 2023 and 2050
		Revenue requirements under extreme weather in 2030
 CPS Energy Financial Stability	CPS Energy Financial Metrics	Debt capitalization ratio in 2030
		Adjusted debt service ratio in 2030
		Days cash on hand ratio in 2030
 Environmental Sustainability & Climate Resiliency	Progress Towards City of SA Climate Action & Adaptation Plan (CAAP) Goals	The carbon intensity (CO_2 per MWh) of electricity generated by CPS Energy fleet in 2030 and 2040
		Reduction in CO_2 emissions from CPS Energy fleet in 2030, relative to 2016 baseline
		% reduction in electricity demand due to energy efficiency measures in 2030

Metrics

Metric measures have been refined based on RAC feedback, with more focus on near-term outcomes

Objectives	Metrics	Measures
System Flexibility	Market Purchases	% of CPS Energy electricity demand that is met through ERCOT market purchases in 2030
	Dispatchability	% of generating capacity in CPS Energy fleet that can have its output adjusted on demand in 2030
System Reliability	Diversity of Generation Capacity Mix	Pie chart of generation capacity in CPS Energy portfolio by fuel type (e.g. wind, solar, gas, coal, etc.) in 2030
	Capacity Headroom	Reserve Margin in 2030
		Market purchases in extreme weather in 2030
Workforce Impact	CPS Energy Workforce Impact	Number of CPS Energy Generation Employees in 2030
	Local Economic Impact	Total $ in capital expenditures for new generation capacity built in greater San Antonio area

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Recap of Progress

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Review Results of ERCOT Market Scenarios

Review of CPS Energy Resource Portfolio Definitions

Scenarios vs. CPS Energy Portfolios

Scenarios and portfolios are two distinct concepts. Scenarios are **external** factors, while **portfolios** are CPS Energy decisions

Focus of this section

- Demand
- Carbon Prices
- Commodity Prices
- Technology Costs

Scenarios

Future states of the world independent of CPS Energy resource decisions

- Reflect diverse, but possible, futures
- Include multiple linked and correlated key variables
- Independent of resources and resource plans

- Level/type of new capacity
- Capacity retirements
- Timing of new capacity
- Demand-side programs

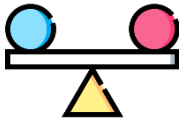
Portfolios

CPS Energy plans to meet customer requirements in the future

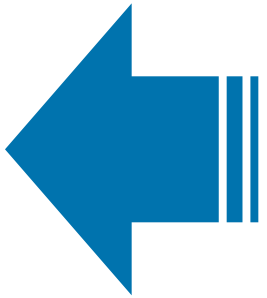
- A combination of decisions taken by CPS Energy to meet the challenges posed by the scenario or address other objectives
- Typically include decisions on new resources and retirements

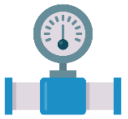
ERCOT Scenarios

CRA developed 4 ERCOT scenarios, which are designed to reflect diverse but possible future states of the world

	ERCOT Scenario	Narrative
	**Reference Scenario (REF)**	• Continuation of historical trends in demand growth, technological developments
	**Carbon-Based Economy (CBE)**	• Reduced environmental regulations and no federal or state-level carbon limits
	**Net Zero Carbon Economy (NZE)**	• Federal or state-level economy-wide net zero carbon targets by 2045
	**Volatile Market (VMA)**	• Geopolitical concerns drive policy decision-making

Key sources of uncertainty to incorporate into analysis.





Natural Gas Prices

Carbon Policies

Technology Costs

Demand Growth

Market Design

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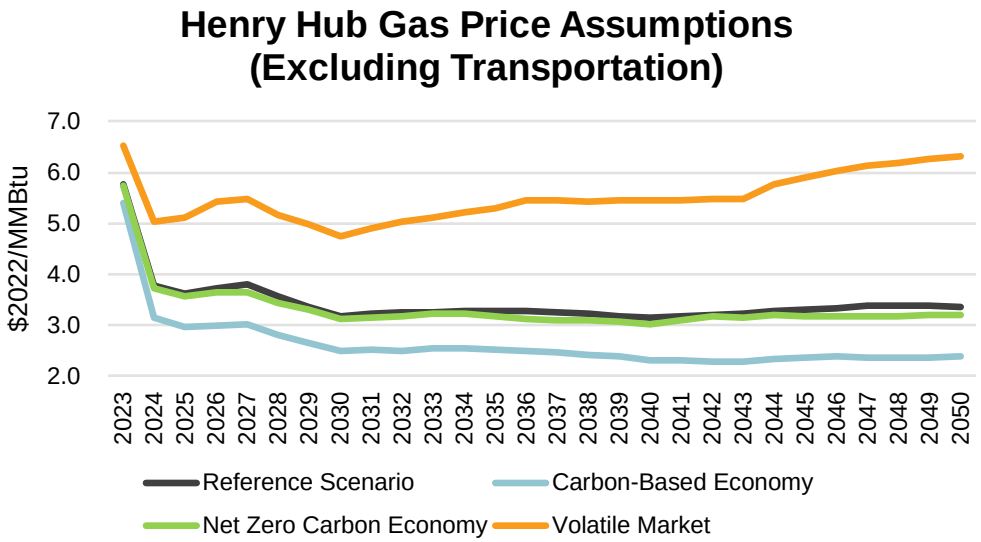
Key ERCOT Scenario Input Variables

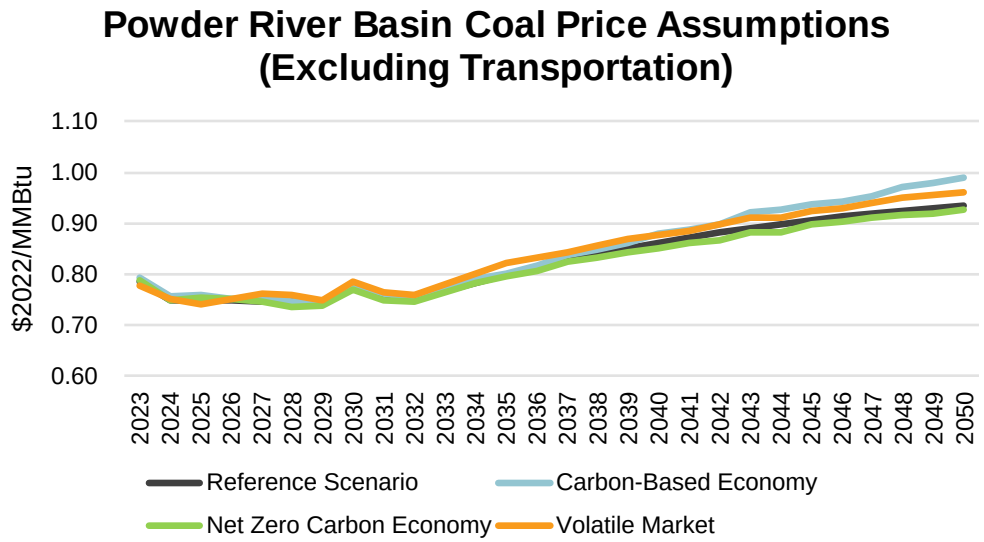
Each scenario comprises a combination of five input variables whose levels vary across the scenarios as shown below

ERCOT Scenario	Natural Gas Prices	Carbon Policies	Technology Costs	Demand Growth	ERCOT Market Design Change
Reference Scenario (REF)	Baseline	Baseline carbon price	Baseline	Baseline	Confirmed changes only
Carbon-Based Economy (CBE)	Low due to production increases	No carbon price	Baseline	High demand driven by low fuel and carbon prices	Confirmed changes only
Net Zero Carbon Economy (NZE)	Low due to electrification drive	High carbon price	Fast decline + Inflation Reduction Act Tax Credits*	High demand driven by electrification	Capacity market launched & seasonal reserve margins
Volatile Market (VMA)	High	No carbon price to alleviate inflation pressure	Slow decline + Inflation Reduction Act Tax Credits*	Low demand due to high natural gas prices	Confirmed changes only

**Note that all CPS Energy portfolio analysis will incorporate IRA tax credit provisions*

Fuel Price Scenarios

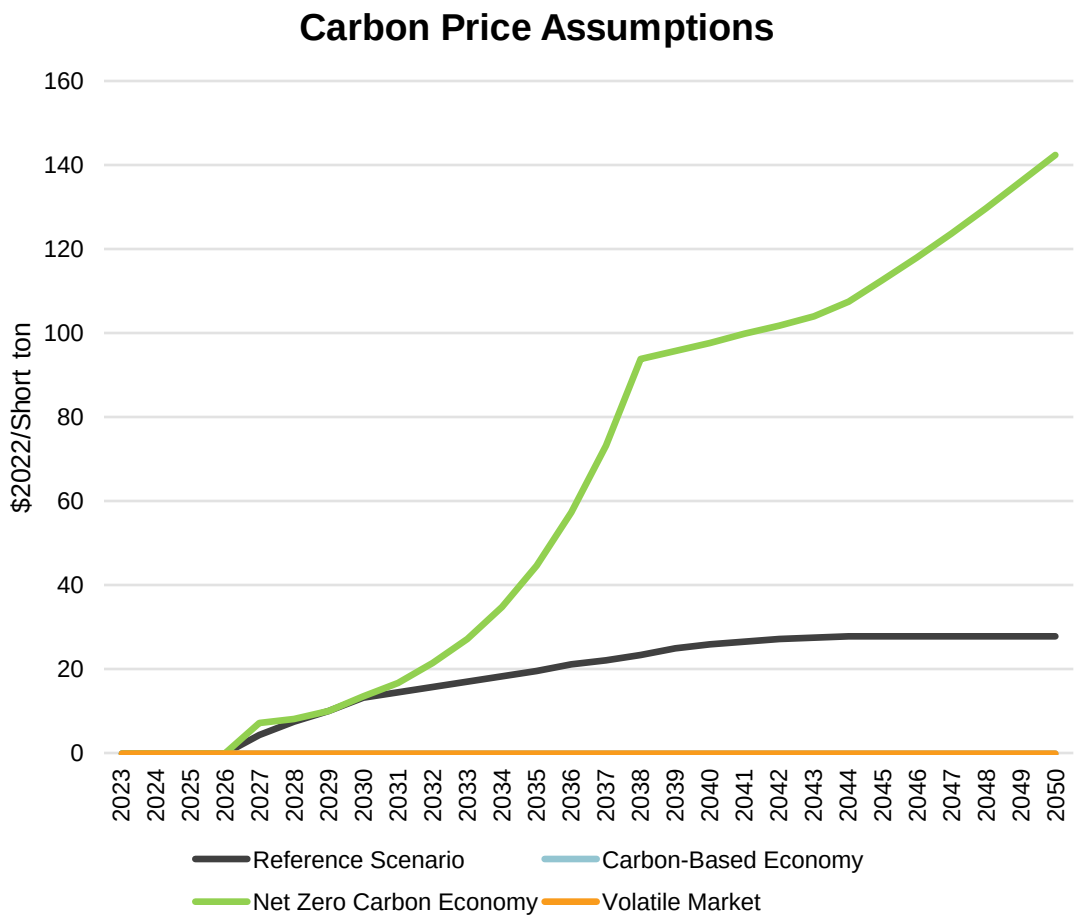




- Henry Hub gas price assumptions in 2050 across all scenarios range from $2.4/MMBtu to $6.3/MMBtu (**in today's real dollars**)
- The upper end is consistent with the level in Q2 of 2022, driven by geopolitical conflicts and high exports to Europe
- The lower end is consistent with the level observed in 2020 during the outset of the COVID-19 crisis.

- Powder River Basin ("PRB") price assumptions increase over time in all scenarios, reflecting rising marginal cost of production
- Historical PRB prices have had limited volatility, resulting in forecasts that are in a relatively tighter range compared to gas price forecasts

Carbon Policy Scenarios



- Carbon price assumptions in 2050 across all scenarios range from $0/ton to $142/ton of carbon dioxide emissions
- The $142/ton assumed for the Net Zero Economy (NZE) scenario in 2050 is consistent with the studies reviewed by CRA, which generally estimate carbon prices exceeding $140 per ton with sharp increases between 2045 and 2050 in order to reduce carbon emissions to a level that limits global temperature increase to 1.5 degrees Celsius

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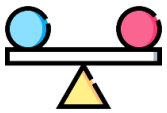
Technology Cost Scenarios

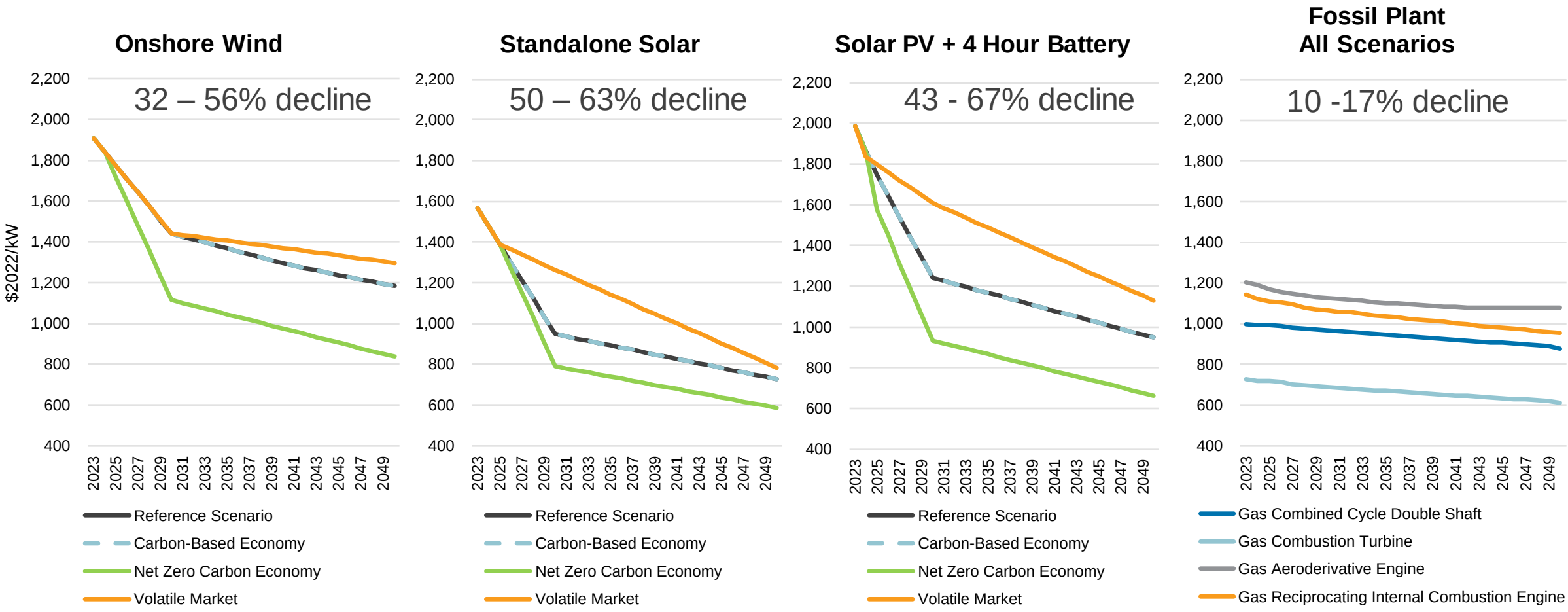
Technology cost assumptions were developed based on a combination of third-party sources and near-term market data

ERCOT Scenario	Level of Technology Costs Assumed for the Scenario
 **Reference Scenario (REF)**	Baseline
 **Carbon-Based Economy (CBE)**	Baseline
 **Net Zero Carbon Economy (NZE)**	Fast decline
 **Volatile Market (VMA)**	Slow decline

- Generation technologies are split into two categories: currently available technology ("CAT") and advanced emerging technology ("AET")
- CATs include wind, solar, battery storage (2, 4, and 8-hour durations), paired solar and storage, gas combined cycles, reciprocating internal combustion engines ("RICE"), and enhanced geothermal system
  - CRA sources CAT technology costs and performance assumptions for 2022 from EIA AEO 2022, other public sources for current technology and PPA prices, and CPS Energy market intelligence. CRA then applies technology cost and performance improvement rates that vary by scenario based on publicly available sources
- AETs include small modular nuclear ("SMR"), emerging long duration storage technologies (compressed air, flow battery, and pumped thermal), and hydrogen fuel use in turbines
  - CRA collates projections of AET technology costs and performance from various third-party sources. CRA then forms central, low, and high estimates of AET technology costs based on the data collected. AET technologies are generally not available for selection until at least 2030, reflecting current level of technology maturity

Technology Cost Scenarios – Renewable & Fossil

Technology cost assumptions were developed based on well-established third-party sources



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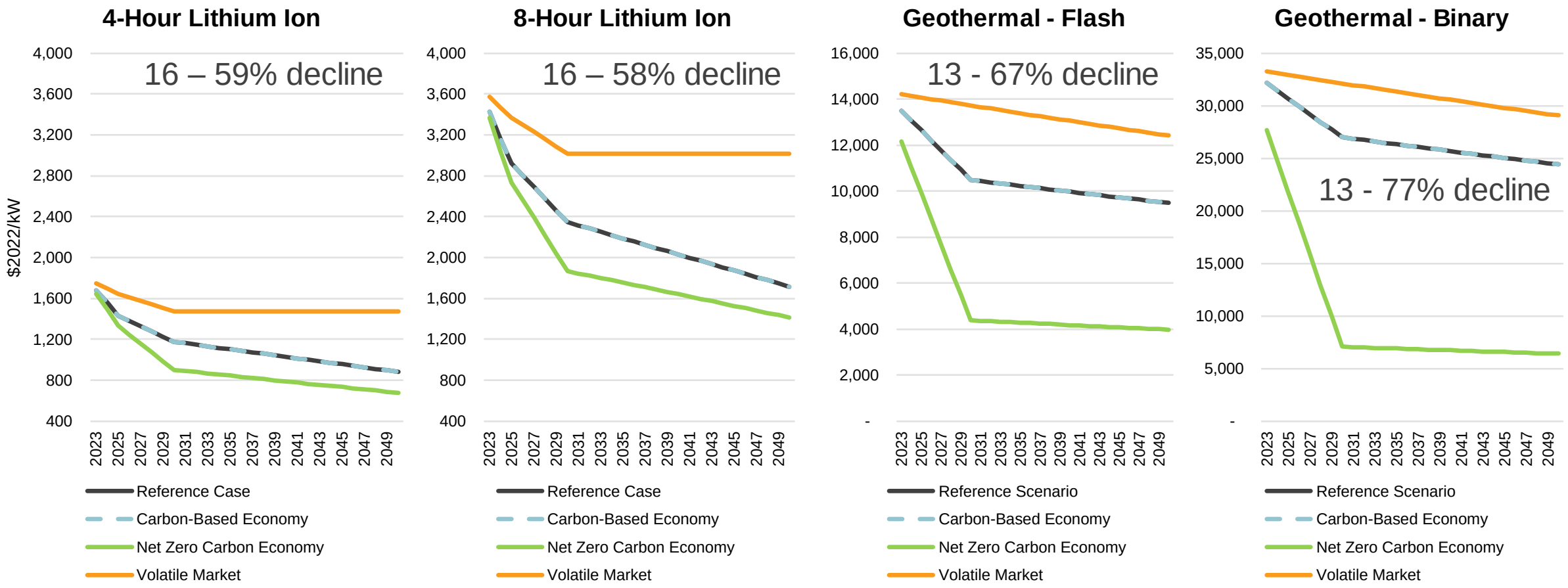
Technology Costs Scenarios – Lithium Ion and Geothermal

Technology cost assumptions were developed based on authoritative third-party sources



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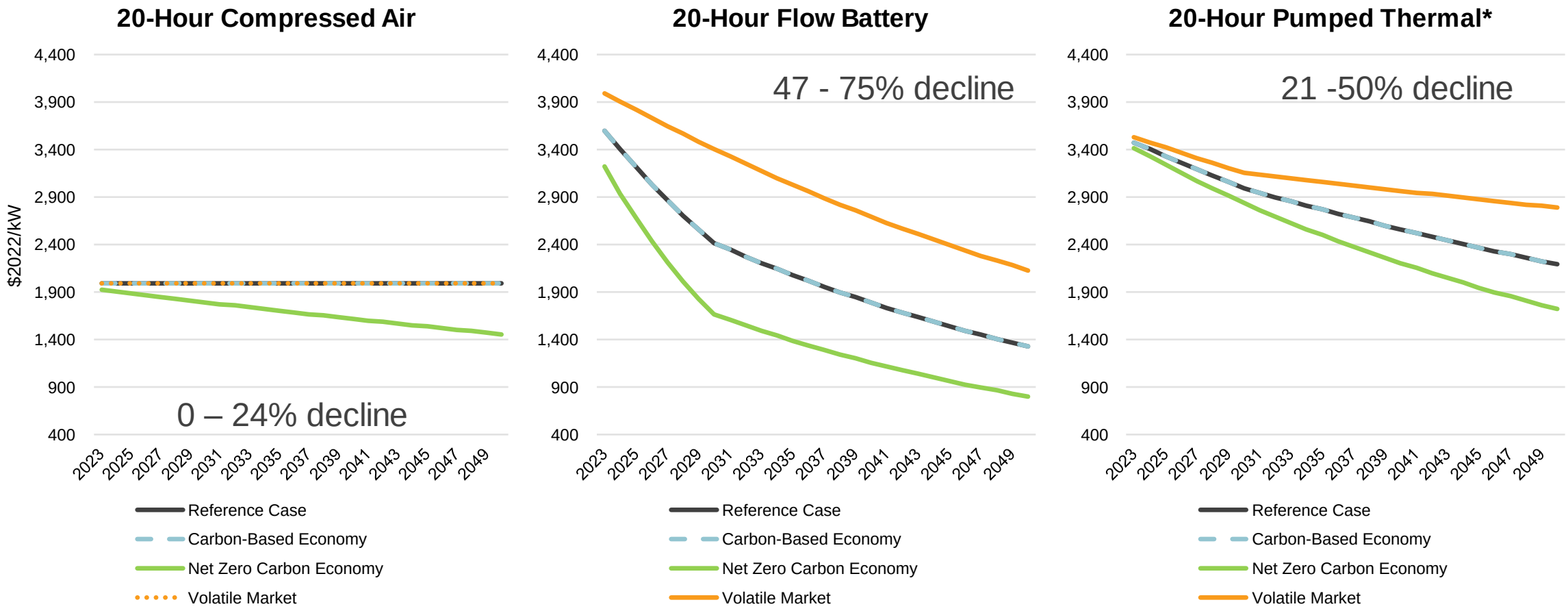
Technology Costs Scenarios – Long Duration Storage

Technology cost assumptions were developed based on authoritative third-party sources



*Note: *Pumped thermal uses electricity to drive a heat pump to store electricity as heat. When electricity is required, the heat is turned back into electricity using a heat engine.*

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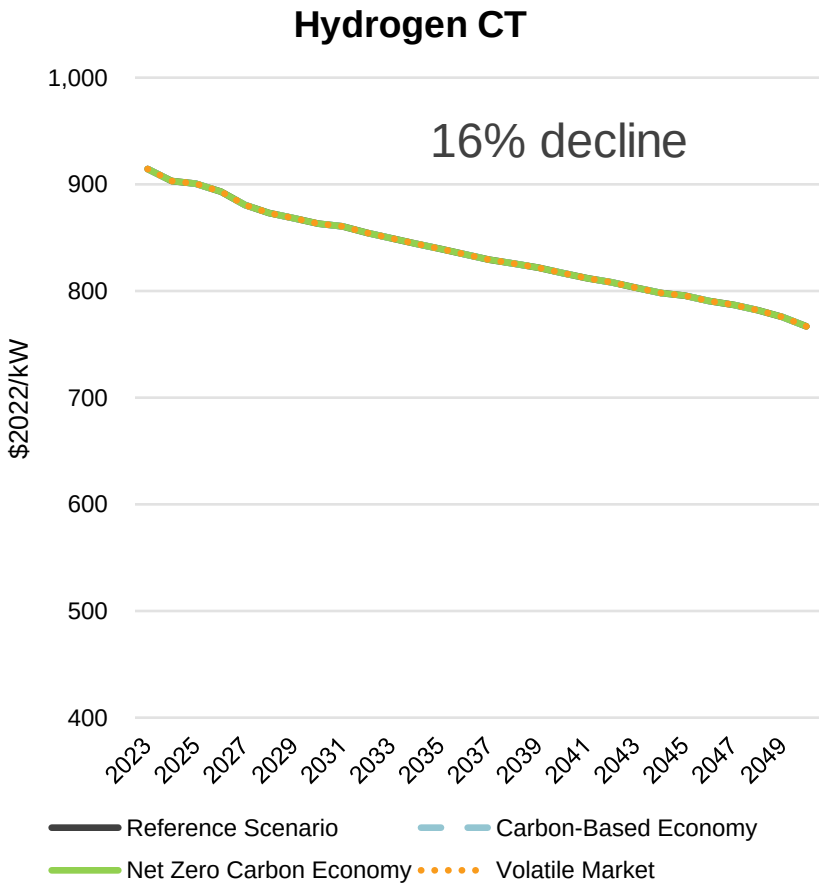
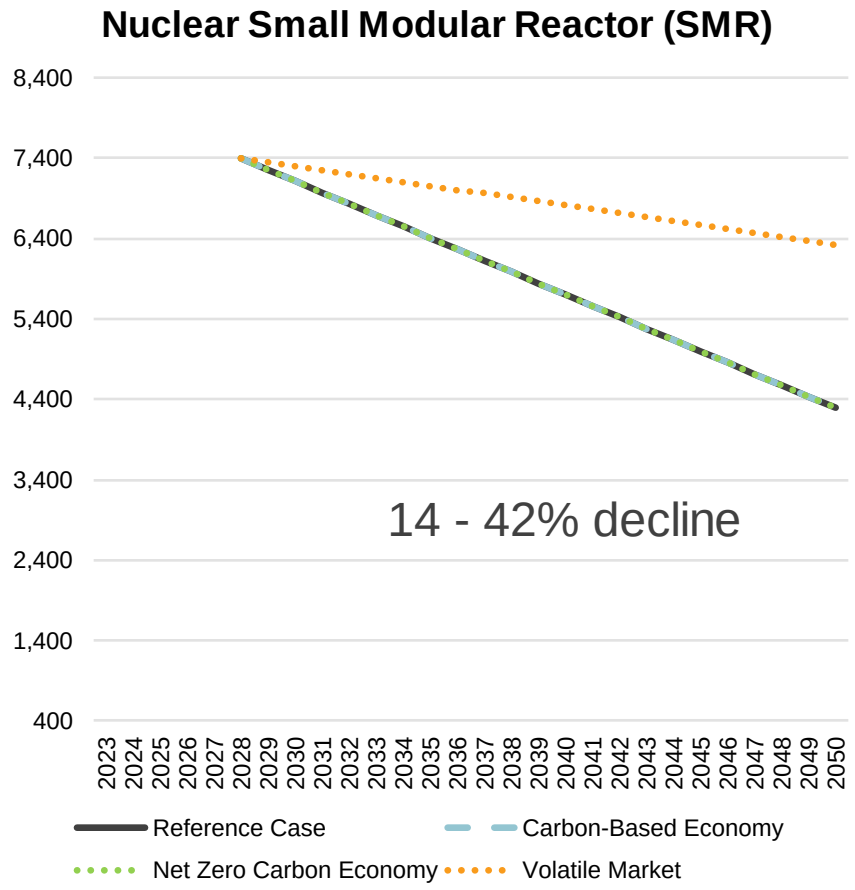
Technology Costs Scenarios – Hydrogen & SMR

Technology cost assumptions were developed based on authoritative third-party sources





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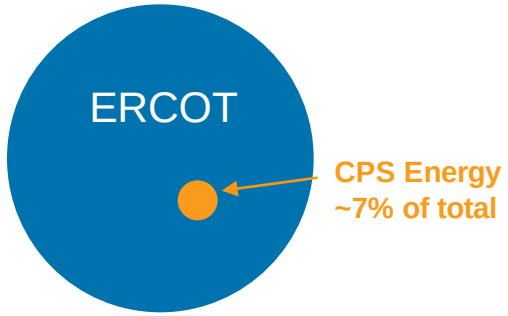
Key ERCOT Scenario Output Variables

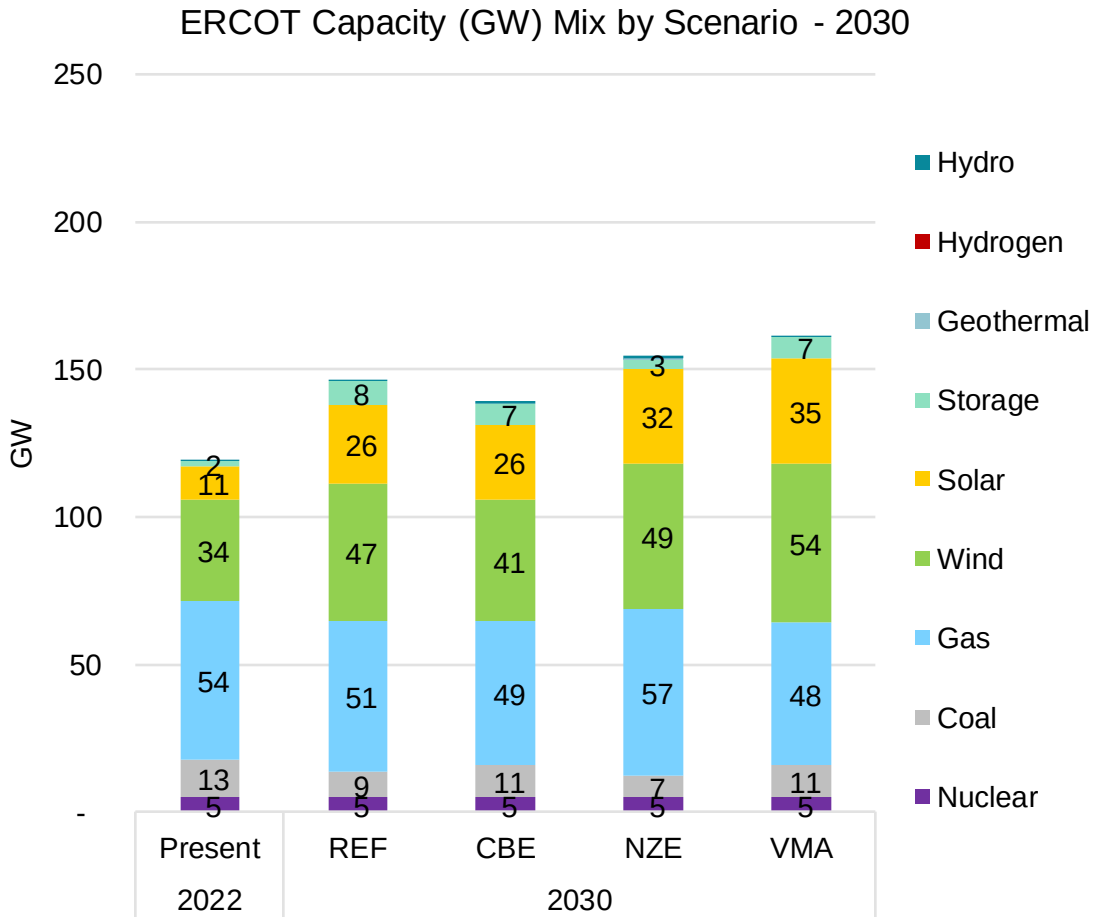
The scenario outputs summarize key ERCOT-wide outcomes, establishing a range of market conditions in which the CPS Energy system operates

- Each market scenario results in a fundamentally different view of ERCOT-wide resource additions and retirements
- The following key scenario output variables are relevant to the portfolio evaluation process:
  - Projected ERCOT market capacity mix (MW);
  - Projected ERCOT generation mix (MWh);
  - Projected ERCOT market emissions (Million tCO2); and
  - Projected ERCOT zonal electricity prices ($/MWh)
- Each portfolio will be analyzed within the framework of each scenario. Metrics will be calculated for each portfolio/scenario combination.



2030 ERCOT Market Capacity (GW) Mix

The model simulation optimizes a least-cost regional capacity expansion plan under each scenario's input drivers.

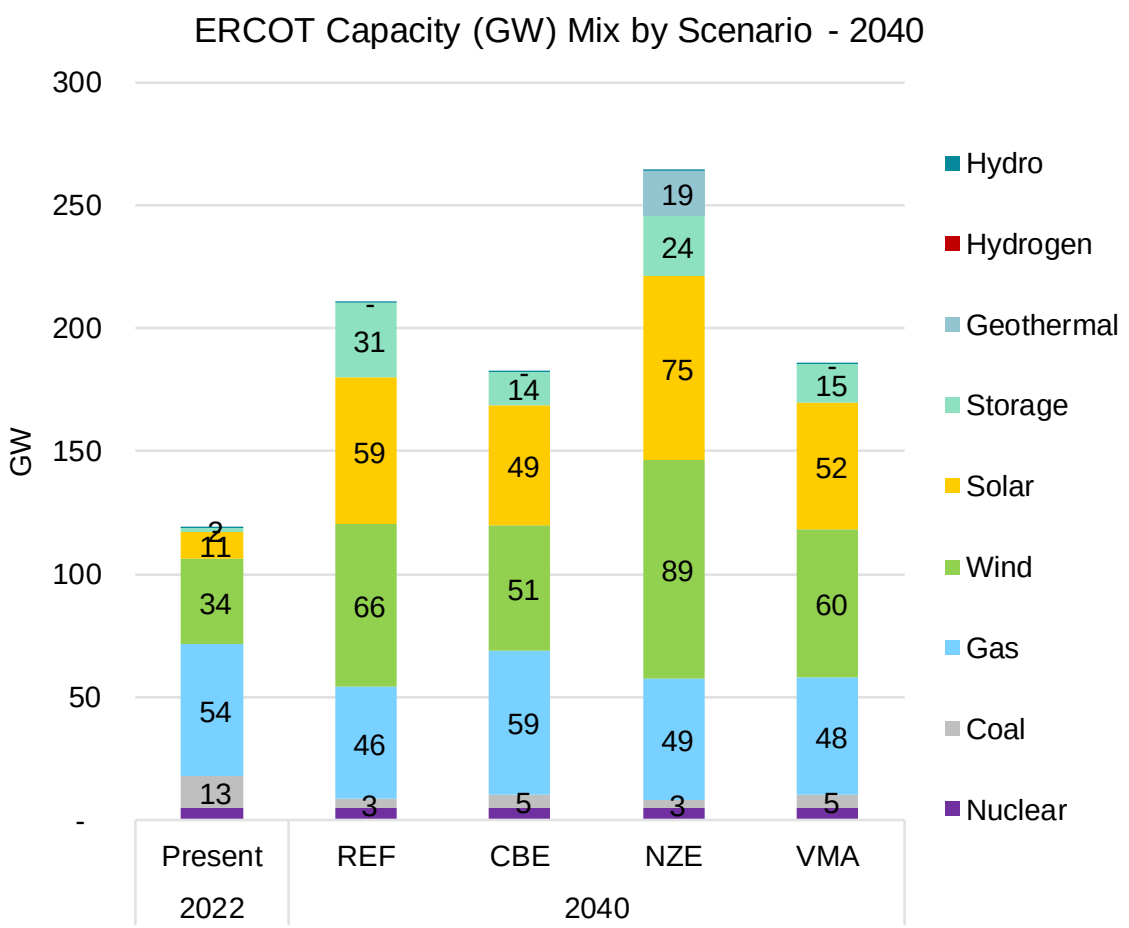


ERCOT Scenario	Commentary
Reference Scenario (REF)	• Increased wind and solar capacity displaces some coal and gas capacity • Additional storage capacity supports intermittency
Carbon-Based Economy (CBE)	• Lower commodity prices drive delayed coal and gas retirements and reduce renewable capacity additions relative to REF
Net Zero Carbon Economy (NZE)	• Earlier coal retirements as high carbon prices make coal generation uneconomic • New gas additions initially as battery costs remain higher than gas through 2030
Volatile Market (VMA)	• Accelerated renewable growth in late 2020s due to IRA tax credits • Delayed coal retirements due to high gas prices, making coal more competitive

*Note: There is limited hydro, hydrogen, and geothermal capacity.

2040 ERCOT Market Capacity (GW) Mix

The model simulation optimizes a least-cost regional capacity expansion plan under each scenario's input drivers.



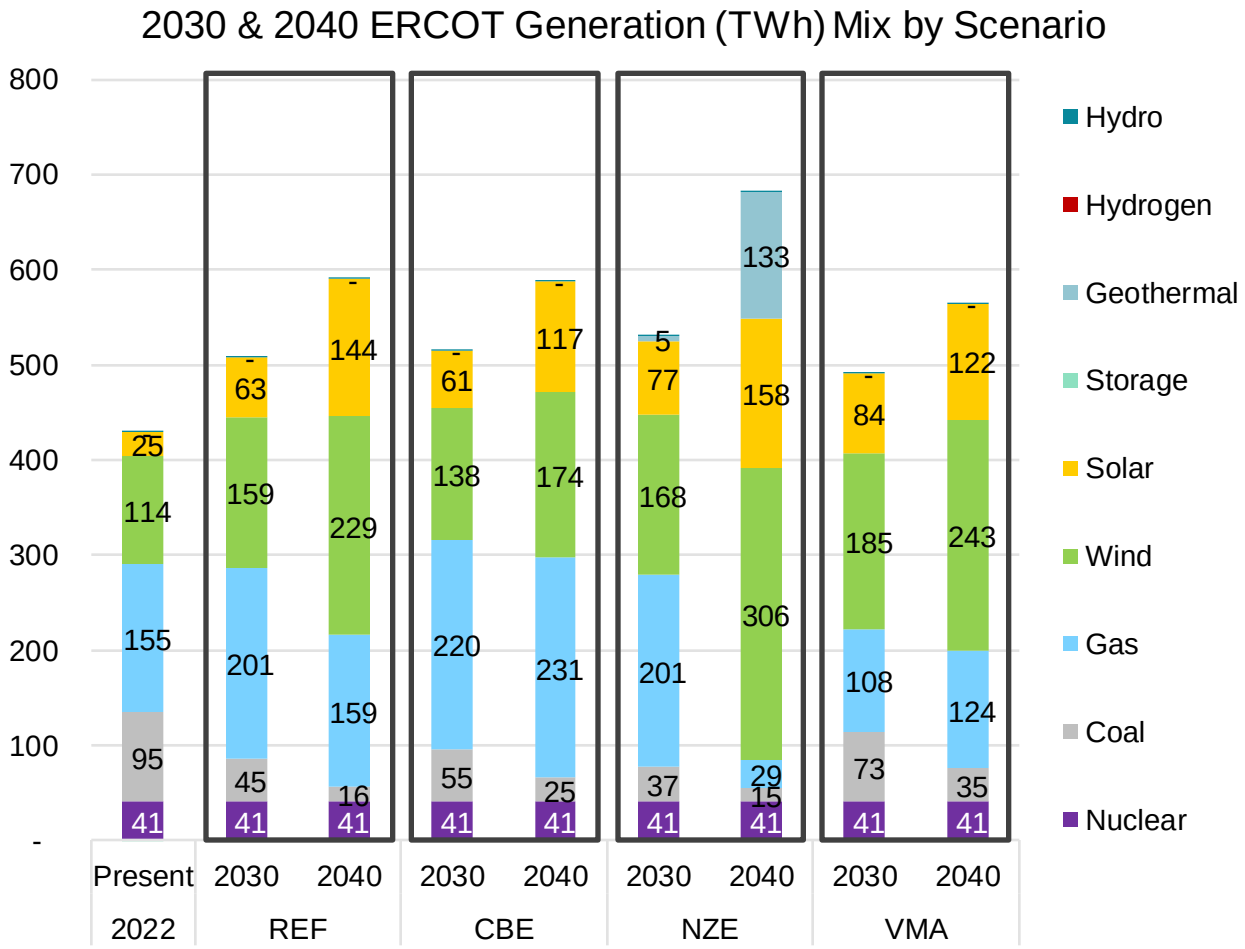
ERCOT Scenario	Commentary
Reference Scenario (REF)	• Further retirements of aging coal fleet • Continued growth in renewables, as well as storage to support higher intermittency • Gas remains to balance intermittency
Carbon-Based Economy (CBE)	• Low gas prices keep gas capacity competitive against renewables and storage for longer, leading to new gas additions
Net Zero Carbon Economy (NZE)	• Large capacity growth to meet electrification demand • Geothermal is selected for baseload needs • 20-Hr duration storage is selected to balance intermittency instead of new gas
Volatile Market (VMA)	• Slower wind & solar additions over the long-term • Gas capacity is retained to meet peak demand due to slow declines in battery costs

Notes:

1. There is limited hydro and hydrogen generation.
2. Geothermal is the low-cost resource option from a long-term capacity expansion perspective in NZE but could be representative of other "baseload" zero-emitting technologies.

2030 & 2040 ERCOT Market Generation (TWh) Mix

The share of renewable generation is expected to increase in all scenarios. Gas is projected to continue to play a significant role in the CBE scenario, while clean energy makes up the largest generation share in NZE.

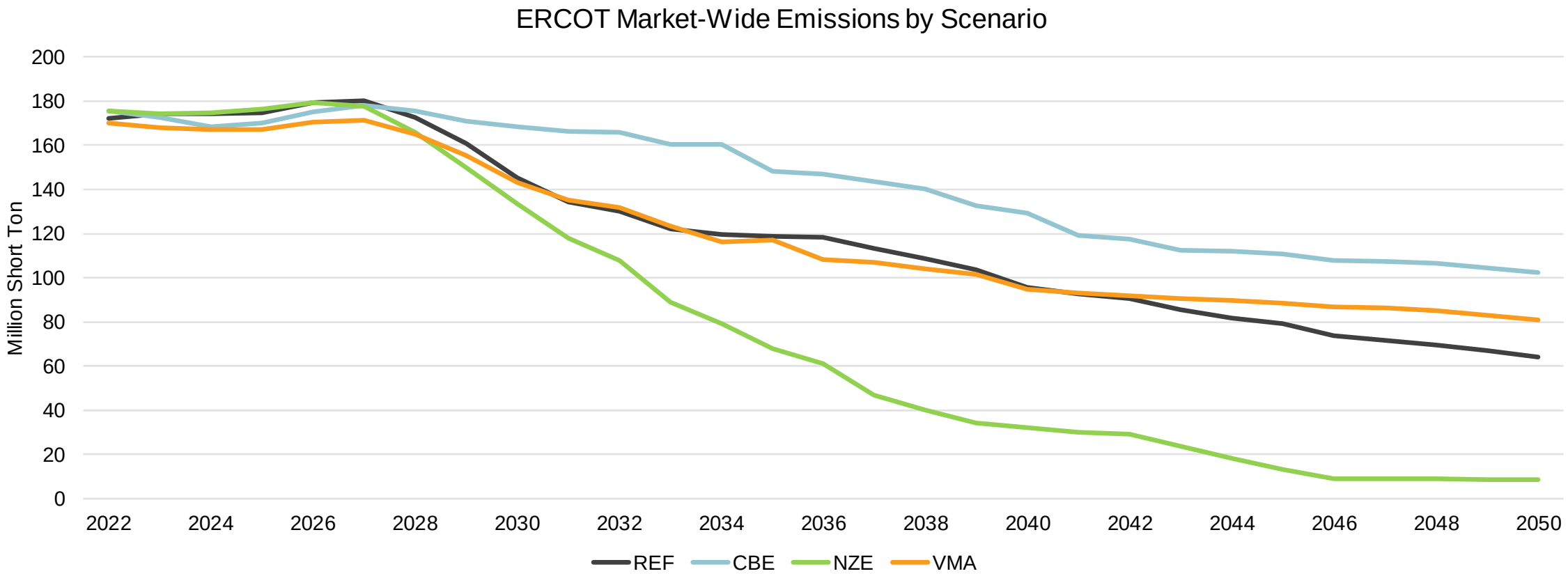


ERCOT Scenario	Commentary
Reference Scenario (REF)	• Further retirements of aging coal fleet • Continued growth in renewables, as well as storage to support renewables • Gas remains to balance intermittency
Carbon-Based Economy (CBE)	• Low gas prices keep gas generation competitive, leading to higher gas generation relative to REF
Net Zero Carbon Economy (NZE)	• High carbon prices make coal and gas uncompetitive against renewables, reducing capacity factors • Renewables have the largest generation share
Volatile Market (VMA)	• Higher coal generation than REF due to favorable coal prices relative to gas

Notes:
1. There is limited hydro and hydrogen generation.
2. Geothermal is the low-cost resource option from a long-term capacity expansion perspective in NZE but could be representative of other "baseload" zero-emitting technologies.
3. Storage capacity does not contribute positive net energy to the system and is thus not shown.

ERCOT Market Emissions

The NZE scenario is projected to reach near zero emissions as high carbon prices lead to fossil-fired plant retirements, while emissions in the CBE scenario are highest, as gas utilization remains high due to low natural gas prices.



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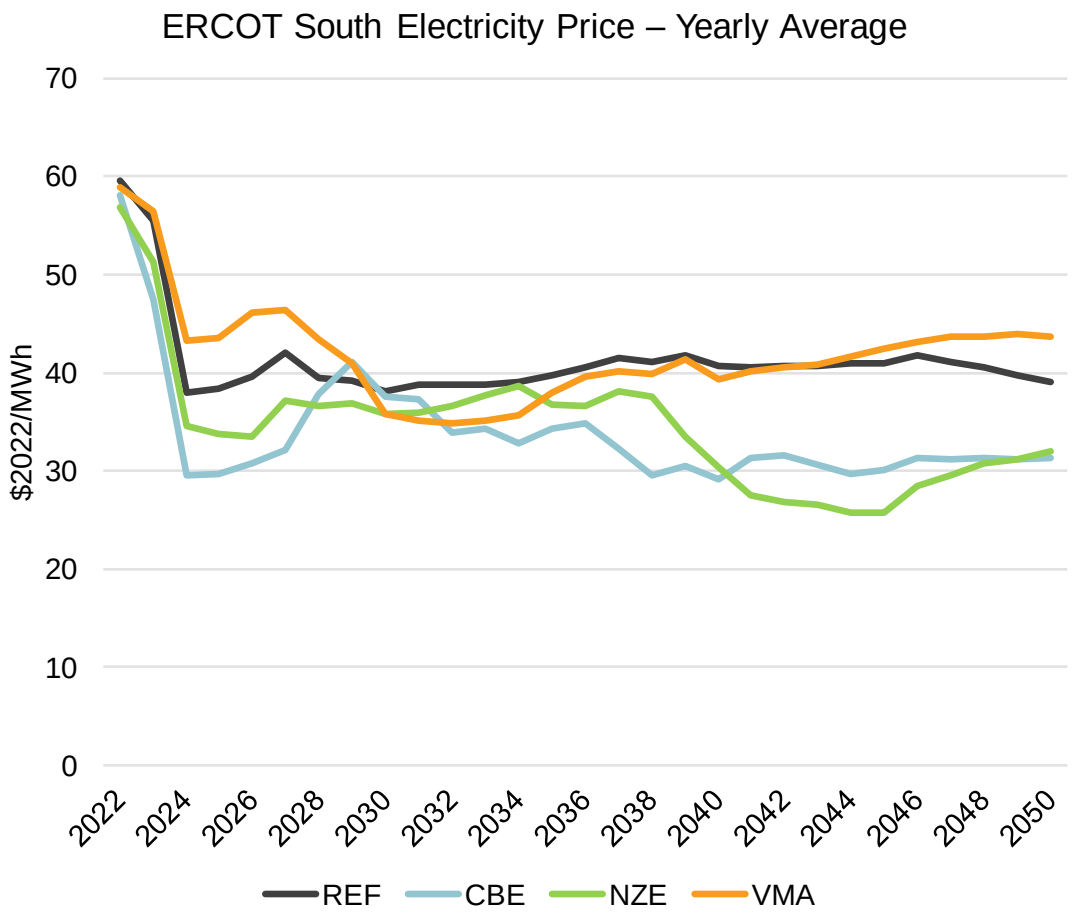
ERCOT South Electricity Price Projections

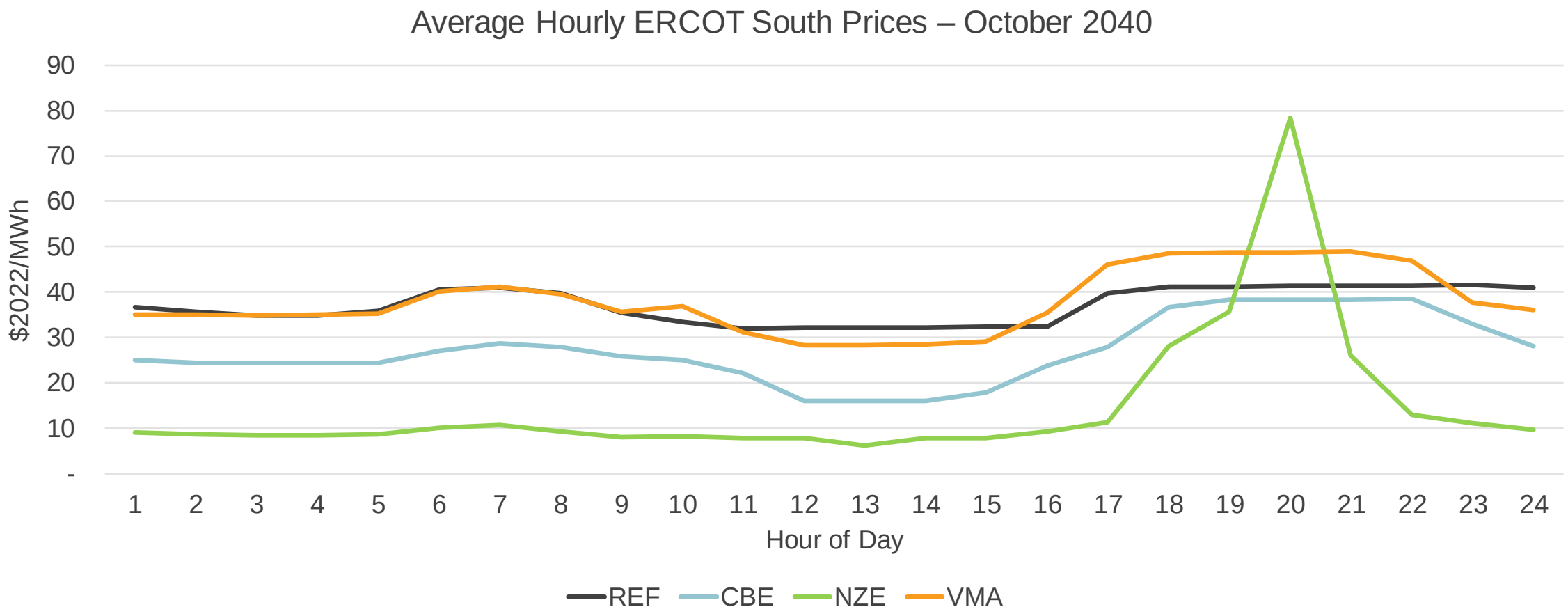
Power prices are driven by natural gas prices, carbon prices, and the level of renewable penetration in the market



ERCOT Scenario	Commentary
Reference Scenario (REF)	• Electricity prices track the price expectations for natural gas, which fall over the next few years
Carbon-Based Economy (CBE)	• Electricity prices fall further than the Reference Scenario due to sustained low commodity prices
Net Zero Carbon Economy (NZE)	• High carbon prices lead to faster renewable growth, suppressing long-term power prices • Beyond 2040, geothermal displaces coal and gas generation, further offsetting the impact of high carbon prices
Volatile Market (VMA)	• Higher prices in the 2020s than REF due to high gas prices • Price suppressed in early 2030s due to IRA-induced wind and solar growth • Prices track high gas prices in 2040s as coal is retired and renewable growth slows

High Intermittency in NZE Leads to Volatile Market Prices

High levels of clean energy reduce power prices during most hours of the day, but price spikes are likely during evening hours, particularly as solar generation declines



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Scenarios vs. CPS Energy Portfolios

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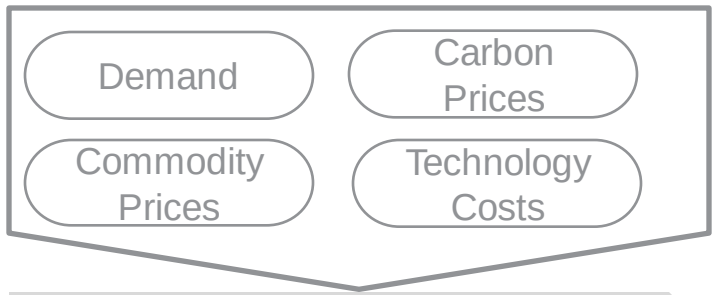
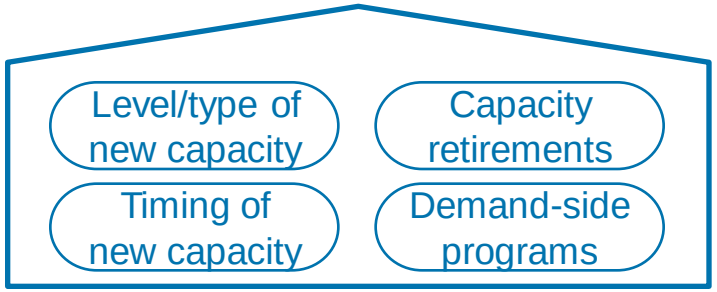


Scenarios
Future states of the world independent of CPS Energy resource decisions

- Reflect diverse, but possible, futures
- Include multiple linked and correlated key variables
- Independent of resources and resource plans

Focus of this section



Portfolios
CPS Energy plans to meet customer requirements in the future

- A combination of decisions taken by CPS Energy to meet the challenges posed by the scenario or address other objectives
- Typically include decisions on new resources and retirements

CPS Energy Portfolio Concepts

CRA is modeling 9 candidate portfolio concepts for CPS Energy (P1 – P9). Each portfolio concept is a combination of a retirement schedule and allowed technologies to meet capacity gaps

Portfolio	P1	P2	P3	P4	P5	P6	P7	P8	P9
Allowed Technology to Meet Capacity Gaps	Gas Only	Blend 1	Renewables	Blend 2	Renewables				
Existing Fleet Retirement Dates									
Spruce 1	Dec 2028		Dec 2028	Dec 2047	Mar 2025	Mar 2025	Mar 2025	Mar 2025	Mar 2028
Spruce 2	Convert to gas in Dec 2027 and retire in Dec 2065		Dec 2027	Dec 2065	Mar 2028	Mar 2028	Mar 2028	Convert to gas in Dec 2025 and retire in Mar 2035	Convert to gas in Dec 2028 and retire in Mar 2035
Braunig 1 - 3	Mar 2025		Mar 2025	Mar 2025	Mar 2025	Mar 2024	Mar 2024	Mar 2025	Mar 2025
Sommers 1	Mar 2027		Mar 2027	Mar 2027	Mar 2027	Mar 2026	Mar 2026	Mar 2027	Mar 2027
Sommers 2	Mar 2029		Mar 2029	Mar 2029	Mar 2029	Mar 2028	Mar 2028	Mar 2029	Mar 2029
Arthur Von Rosenberg	Dec 2047		Dec 2047	Dec 2047	Dec 2047	Mar 2030	Mar 2030	Dec 2047	Dec 2047
Rio Nogales	Dec 2049		Dec 2049	Dec 2049	Dec 2049	Mar 2030	Mar 2030	Dec 2049	Dec 2049
Milton B Lee 1 – 4	Dec 2039		Dec 2039	Dec 2039	Dec 2039	Mar 2035	Mar 2040	Dec 2039	Dec 2039
Milton B Lee 5 - 8	Dec 2045		Dec 2045	Dec 2045	Dec 2045	Mar 2035	Mar 2040	Dec 2045	Dec 2045
	CPS Energy Portfolios				**Proposed by RAC Member Belmares**				

Notes:

1. *All unit retirements require ERCOT approval.*
2. *When units retire, ERCOT may require transmission reliability upgrades to the grid, which typically take 4 to 5 years (i.e. estimated completion in the 2026 to 2027 timeframe).*
3. *New generation resources may not be available until 2026, so bridge purchases will be considered for P5-P8 as needed.*
4. *Spruce 2 gas conversion is likely not feasible before 2027, so bridge purchases will be considered in P8 as needed.*

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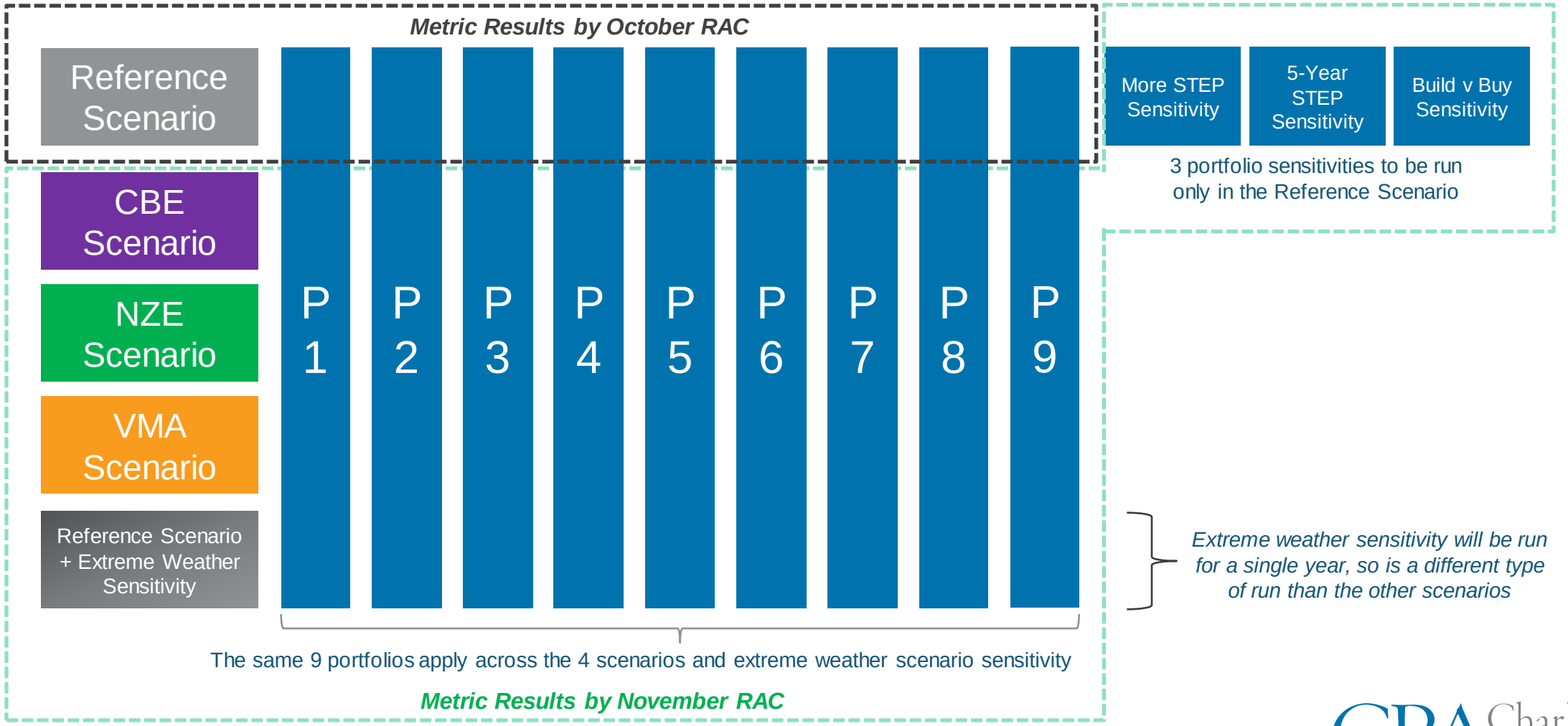
CPS Energy Portfolio Evaluation

CRA will generate up to 50 sets of results as part of the portfolio evaluation. The first set of metric results for the 9 portfolios will be for the Reference Scenario, the results of which will be provided during October RAC. The metric results for the remaining scenarios will be provided during November RAC.



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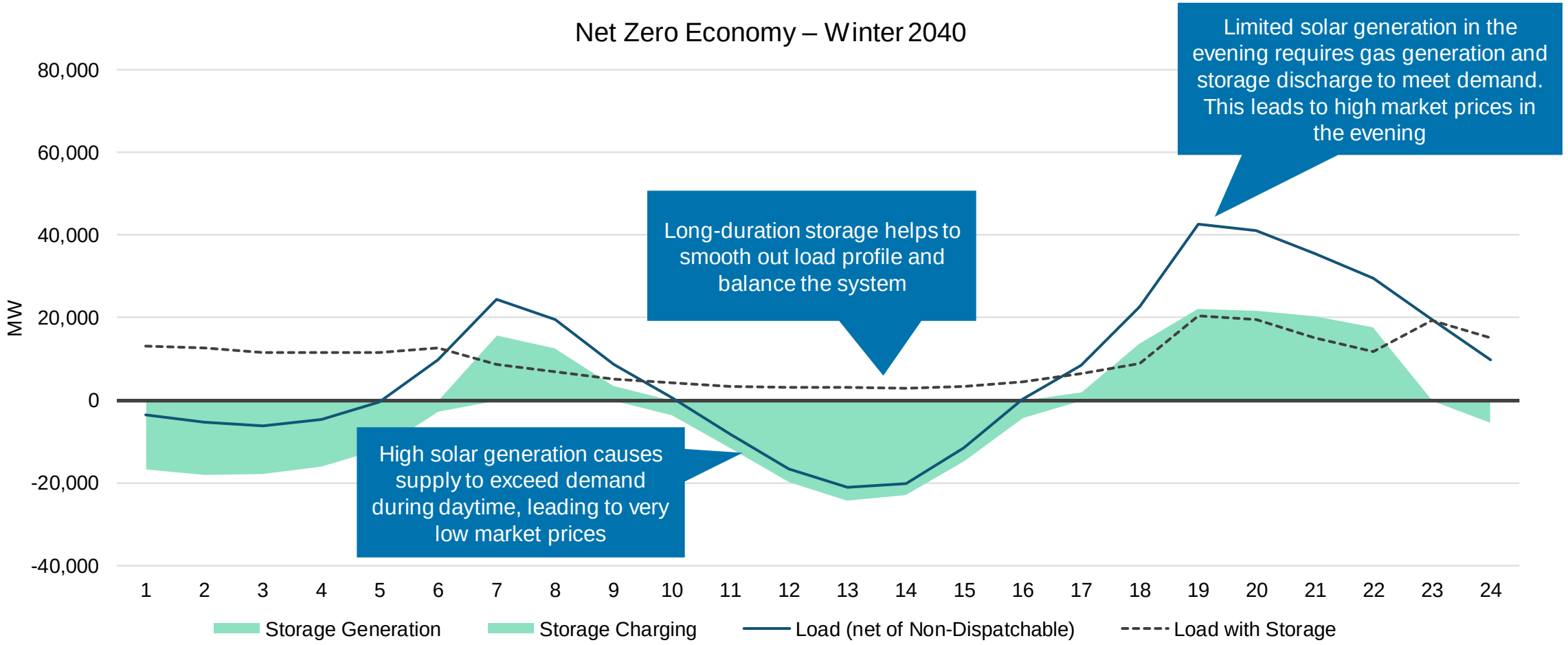
Next Steps

- Make adjustments based on feedback
- Refine all details for portfolios P1-P9
- Evaluate Portfolios P1-P9 within Reference Scenario conditions
- Engage with Peer Review Services consultant

Appendix

High Intermittency in NZE Leads to Volatile Market Prices

High solar generation suppresses prices during daytime, but leads to higher prices in the evening hours



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Timeline – Generation Plan Update

	Jun	Jul	Aug	Sep	Oct	Nov	Dec
RAC Agenda	Market & modeling intro (6/16)	CRA Process intro (7/21)	Dot plot / Scenario inputs / Process detail (8/18)	Scenario outputs / Portfolios (9/15)	Metrics – REF scenario (10/20)	RAC Q&A Mtg (11/3) Metrics – All scenarios/ Preferred Plan (11/17)	RAC Q&A Mtg (12/2) RAC Vote (12/6)
Public Input	RAC meeting date	RAC meeting date	RAC meeting date	Launch online survey & Press conference (TBD) Employee Townhall (9/13) RAC meeting date	1st Public Open House (a.m. & p.m.) (10/6) RAC meeting date	Public Virtual Town Hall (11/1) RAC meeting date	2nd Public Open House (a.m. & p.m.) (12/1) RAC meeting date
RAC & RAC Peer Review				Review inputs & ERCOT scenario outputs	Review portfolio REF results	RAC developing report to BOT	RAC reports to BOT (12/12)
CPS Energy Preferred Plan						CRA incorporates feedback	BOT/RAC process
Metrics		Draft Metrics		Final Metrics			
Scenario Development		Scenario narratives	Scenario parameters	Sensitivity parameters			
Portfolio Construction			Portfolio definition				
Portfolio and Financial Analysis				Populated Metrics – REF scenario	Populated Metrics – All scenarios		

Note: Updates from Aug RAC meeting highlighted in yellow.