2022 Generation Planning Process

Rate Advisory Committee Meeting – August 18, 2022

CPS ENERGY

CRA Charles River Associates

Agenda

Generation Planning Objectives & Generation Preferences

Scorecard of Objectives & Generation Preferences

Generation Planning Metrics & Discussion

Portfolio Concepts & Modeling Process

Generation Planning Timeline of CPS Energy Deliverables & RAC Decision Expectations

Determining Generation Planning Objectives

Agreeing on key planning objectives early in the planning process will 1) give clarity and direction for the development of the preferred plan, 2) drive structured trade-off discussions, and 3) help validate and rationalize decisions

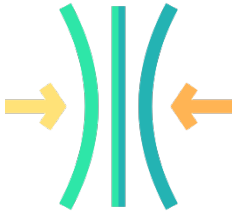
Examples of Planning Objectives

System Reliability

Affordability

Environmental Sustainability & Climate Resiliency

CPS Energy Financial Stability



System Flexibility

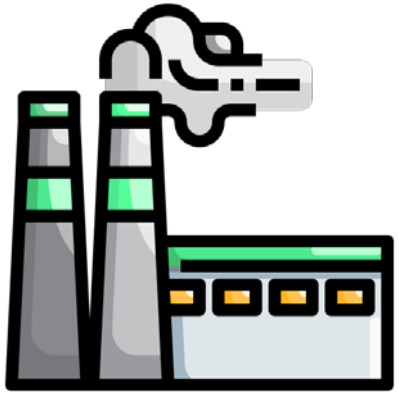
Workforce Impact

Criteria for Good Planning Objectives

- ✓ Discrete
- ✓ Measurable
- ✓ Specific
- ✓ Collectively exhaustive
- ✓ Balanced
- ✓ Reflects utility situation

Potential Portfolio Design

Three initial options being considered to meet needs over the next 5-6 years include portfolios where selected new generation resources are either, all-natural gas, all-renewables, or a blend of technologies



Gas

Generation needs to be met with gas technologies only, including combined cycles and reciprocating internal combustion engines ("RICE")

Blend

Generation needs to be met with available renewable, storage, and gas technologies

Renewables

Generation needs to be met with wind, solar, and storage technologies

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Turning Objectives into a Decision-Making Tool

Metrics can be identified for each objective to measure the performance of the resource plan against the objective

Potential Objectives	Potential Metrics	Potential Measures
System Reliability	Capacity Headroom	Margin between available capacity at peak demand hours and peak demand (Reserve Margin)
	Diversity of Generation Capacity Mix	Pie chart of generation capacity in CPS Energy portfolio by fuel type (e.g. wind, solar, gas, coal, etc.)
Affordability	Average Residential Bill Impact	Estimated monthly residential bills in 2030 and 2040
	Revenue Requirements	Range of present values of required revenues* from customers across scenarios between 2023 and 2050
Environmental Sustainability & Climate Resiliency	Progress Towards City of SA Climate Action & Adaptation Plan (CAAP) Goals	Reduction in CO_2 emissions from CPS Energy fleet in 2030, 2040, & 2050 relative to 2016 baseline
		The amount of CO_2 per MWh of electricity generated by CPS Energy fleet
		% reduction in electricity demand due to energy efficiency measures in 2030 and 2040

*Note: *Required revenues include fuel costs, operations and maintenance costs, depreciation charges, and financing charges*

Turning Objectives into a Decision-Making Tool

Metrics can be identified for each objective to measure the performance of the resource plan against the objective

Potential Objectives	Potential Metrics	Potential Measures
CPS Energy Financial Sustainability	CPS Energy Financial Metrics	Debt capitalization ratio, measuring CPS Energy's reliance on debt
		Adjusted debt service ratio, measuring the ability of CPS Energy to pay its loans
		Days cash on hand ratio, measuring the number of days CPS Energy can pay its expenses with its cash
System Flexibility	Dispatchability	% of generating capacity in CPS Energy fleet that can have its output adjusted on demand in 2030
	Market Purchases	% of CPS Energy electricity demand that is met through ERCOT market purchases in 2030 (annually or during specific peak hour times)
Workforce Impact	Local Economic Impact	Total $ in capital expenditures for new generation capacity built in greater San Antonio area
	CPS Energy Workforce Impact	Number of CPS Energy Employees in 2030

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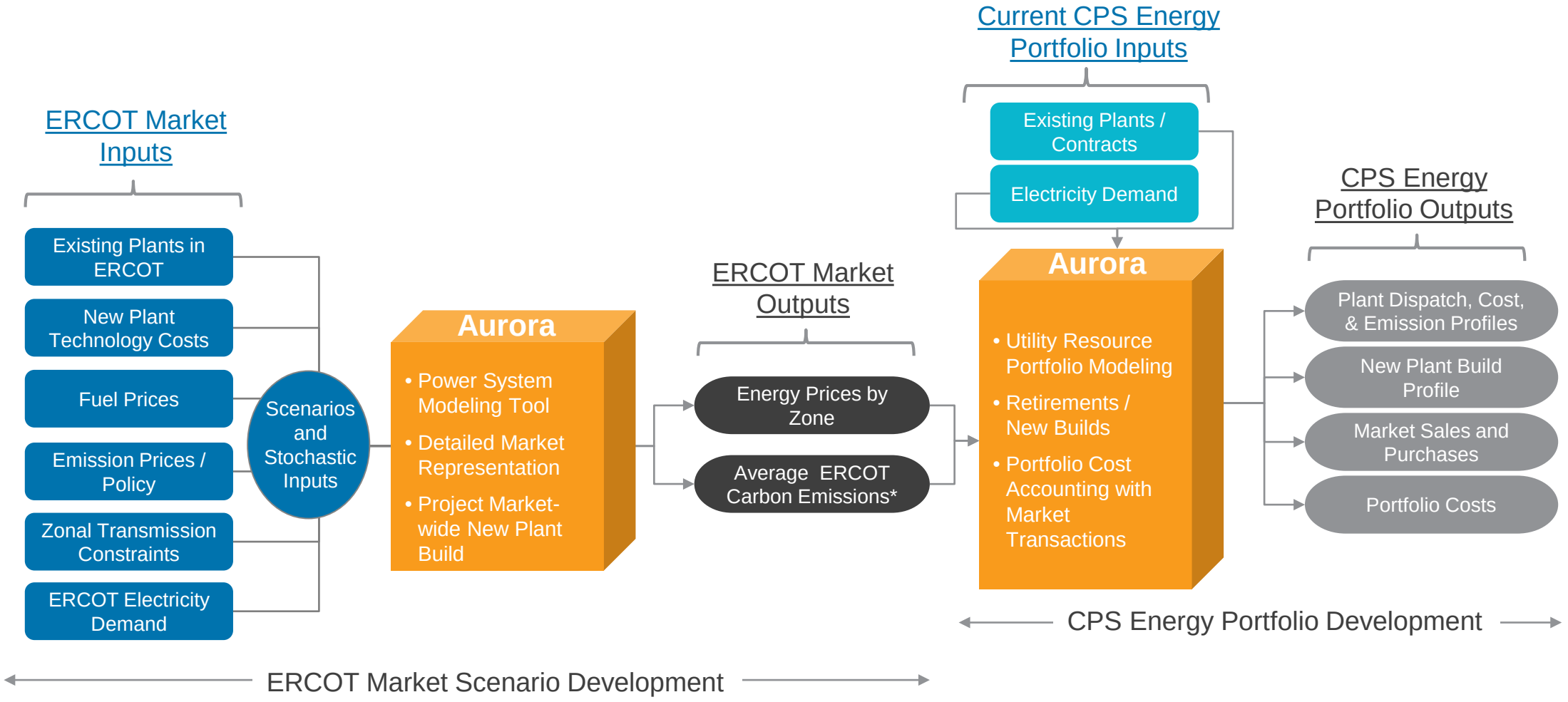
Overall Modeling Process

The modeling process includes ERCOT market analysis and CPS Energy-specific portfolio evaluation



Note: *This is used to measure carbon emissions from electricity purchases by CPS Energy

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

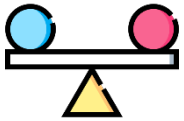
Portfolios

CPS Energy plans to meet customer requirements in the future

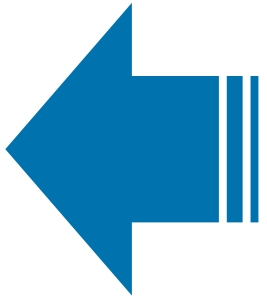
- A combination of decisions taken by CPS Energy to meet the challenges posed by the scenario or address other objectives
- Typically include decisions on new resources and retirements

Developing Market Perspectives

CRA and CPS Energy are evaluating major themes in the energy market that could inform scenario design and contribute to stochastic risk assessment.

	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.



Commodity Prices

Carbon Policies

Technology Costs

Demand Growth

Market Design

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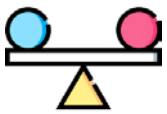
Scenario Design Considerations

CRA and CPS Energy are evaluating major themes in the energy market that could inform scenario design. The table below provides a preliminary view of scenario design.

ERCOT Scenario	Commodity Prices	Carbon Policies	Technology Costs	Demand	ERCOT Market Design Change
Reference Scenario (REF)	Baseline	Baseline	Consensus	Baseline	Confirmed changes only
Carbon-Based Economy (CBE)	Low	No Price	Consensus	High driven by low prices	Confirmed changes only
Net Zero Carbon Economy (NZE)	Low due to electrification drive	High carbon price	Fast decline	High driven by electrification	Capacity market launched & seasonal reserve margins
Volatile Market (VMA)	High	No price to alleviate inflation pressure	Slow decline due to trade restrictions	Low due to high energy prices	Confirmed changes only

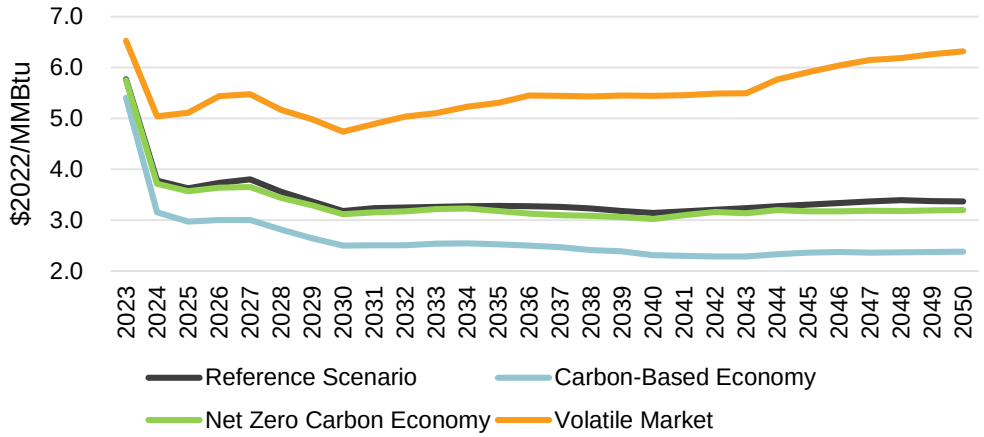
Commodity Price Scenarios

ERCOT Scenario		Commodity Price Level Assumed for the Scenario	Equivalent Scenario in AEO 2022
	**Reference Scenario (REF)**	Baseline	Reference
	**Carbon-Based Economy (CBE)**	Low	High Oil and Gas Supply
	**Net Zero Carbon Economy (NZE)**	Low	Low Economic Growth
	**Volatile Market (VMA)**	High	Low Oil and Gas Supply

- Commodity price assumptions can affect the economics between fossil-fuel and renewable technologies. The commodities considered include coal and natural gas, as these are used for power generation
- CRA relies on CPS Energy's commodity price forecasts for the Reference Scenario
- For other scenarios, CRA relies on commodity price scenarios in the Energy Information Administration ("EIA") Annual Energy Outlook 2022 ("AEO 2022"). CRA maps each ERCOT scenario to a similar scenario in AEO 2022
- CRA calculates the percentage differences in price forecasts between the relevant AEO 2022 scenarios and the AEO 2022 Reference forecasts
- CRA then applies the percentage differences to CPS Energy's commodity price forecasts to generate the forecasts for other scenarios

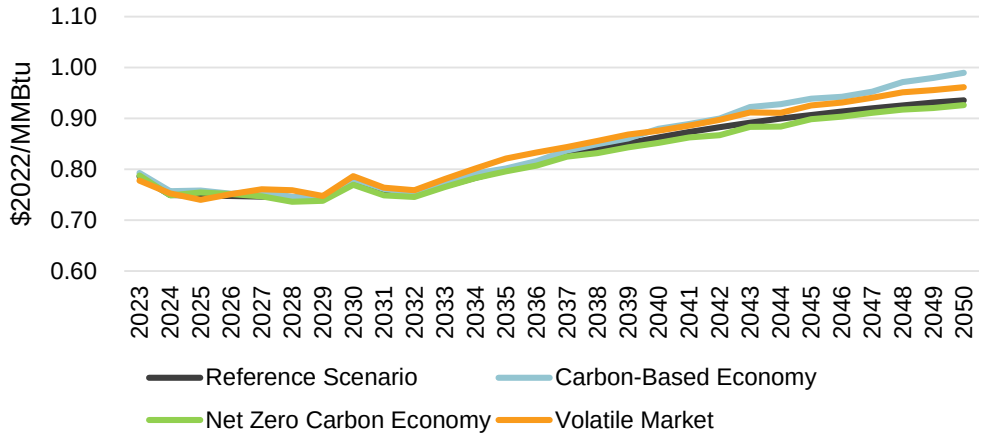
Commodity Price Scenarios

Henry Hub Gas Price Assumptions (Excluding Transportation)



- 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 COVID-19 crisis, resulting in a sharp decline in gas demand

Powder River Basin Coal Price Assumptions (Excluding Transportation)



- 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

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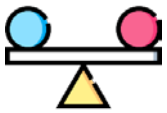
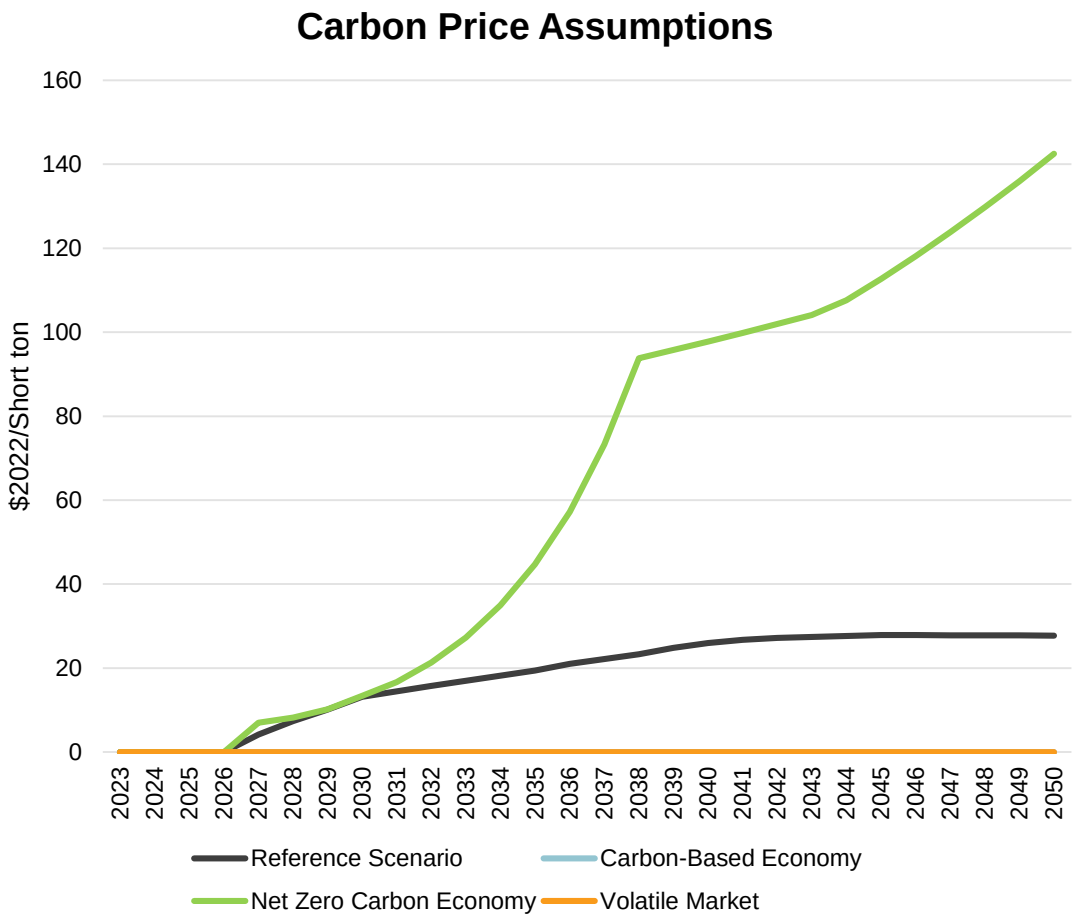
Carbon Policy Scenarios

ERCOT Scenario	Carbon Policies Assumed for the Scenario
 **Reference Scenario (REF)**	Baseline
 **Carbon-Based Economy (CBE)**	No Price
 **Net Zero Carbon Economy (NZE)**	High carbon price
 **Volatile Market (VMA)**	No Price

- Carbon policies could take many forms, including emission limits, carbon taxes, and other carbon pricing methods; separately, clean energy can be incentivized with subsidies or other standards
- CRA will model carbon policy with a cost applied to carbon emissions on a $/ton basis
- CRA relies on CPS Energy's carbon price forecasts for the Reference Scenario, and assumes zero carbon prices for the CBE and VMA scenarios
- For the NZE scenario with the high carbon price, CRA assumes carbon prices that are consistent with keeping global warming below 1.5 degree Celsius based on review of third-party studies
- The impact of the Inflation Reduction Act ("IRA") will be considered as part of the CPS Energy portfolio analysis

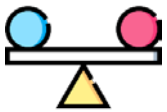
Carbon Policy Scenarios



- 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 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

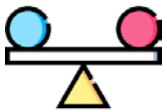
Technology Cost Scenarios

Technology cost assumptions are being 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)**	Consensus
 **Carbon-Based Economy (CBE)**	Consensus
 **Net Zero Carbon Economy (NZE)**	Fast decline
 **Volatile Market (VMA)**	Slow decline due to trade restrictions

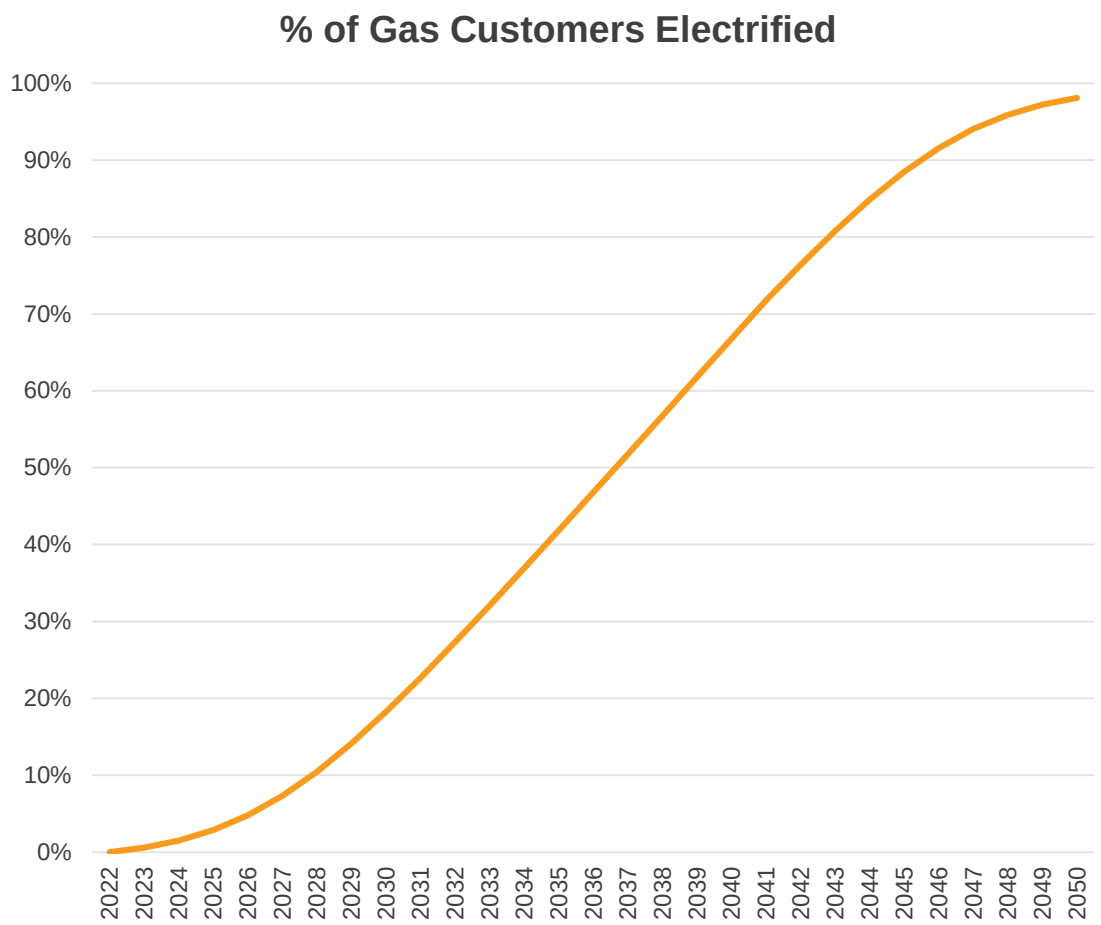
- Generation technologies are split into two categories: currently available technology (“CAT”) and advanced emerging technology (“AET”)
- CATs include wind, solar, battery storage (2, 4, and 8-hour durations), paired solar and storage, gas combined cycles, reciprocating internal combustion engines (“RICE”), and geothermal.
  - 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 turbine
  - 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

ERCOT Demand Scenarios

ERCOT Scenario	Demand Level Assumed for the Scenario	Equivalent Scenario in AEO 2022
 **Reference Scenario (REF)**	Baseline	Reference
 **Carbon-Based Economy (CBE)**	High driven by low prices	High Oil and Gas Supply
 **Net Zero Carbon Economy (NZE)**	High driven by electrification or buildings and transport	Low Economic Growth
 **Volatile Market (VMA)**	Low due to high energy prices	Low Oil and Gas Supply

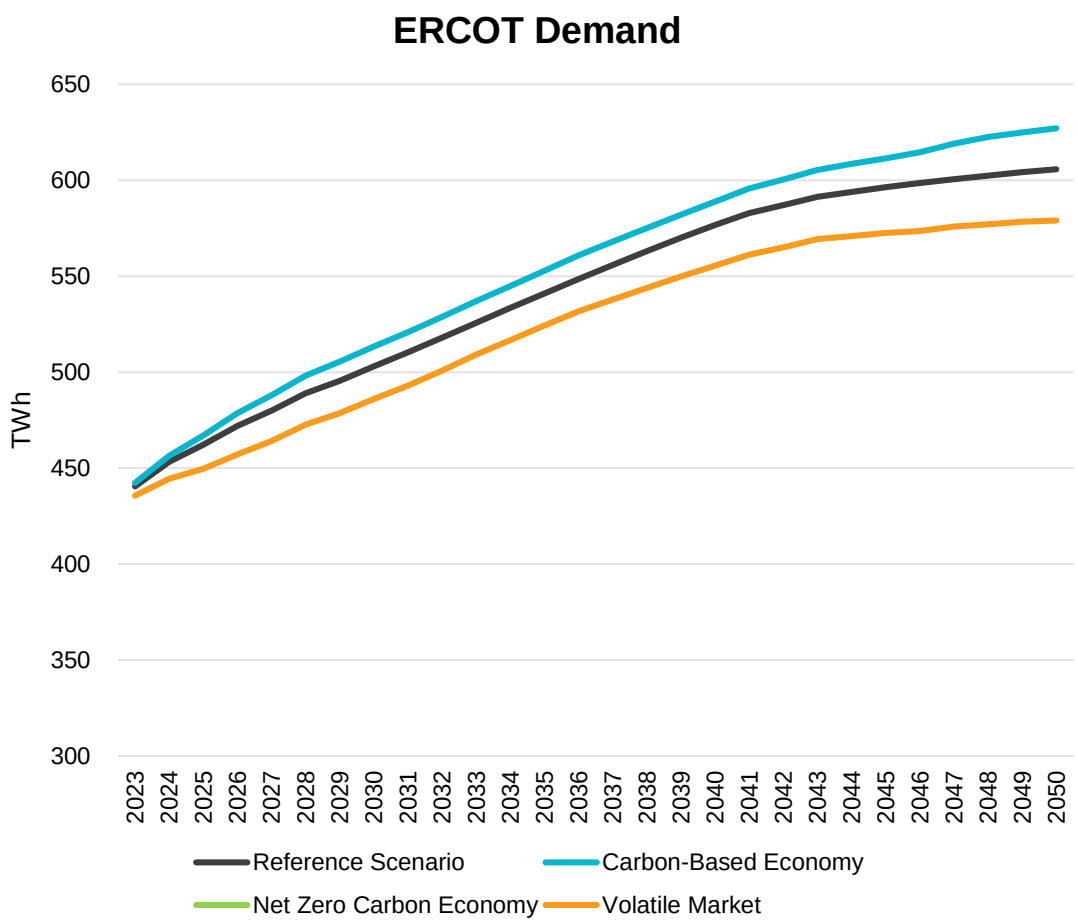
- ERCOT demand in the Reference Scenario is based on the 2022 ERCOT Peak Demand and Energy Forecast
- For the CBE and VMA scenarios, CRA relies on electricity demand scenarios in the AEO 2022
- CRA calculates the percentage differences in the demand forecasts between the relevant AEO 2022 scenarios and the AEO 2022 Reference forecasts and applies them to demand forecast in the Reference Scenario to generate the forecasts for other scenarios
- For the NZE scenario, CRA assumes that ERCOT demand growth corresponds to achieving 100% building electrification by 2050

ERCOT Demand Scenarios – NZE Scenario Electrification Forecast



- CRA develops a building electrification trajectory in the ERCOT footprint, assuming 100% of residential and commercial buildings in Texas will be electrified by 2050
- The trajectory assumes that there will be policies in place such that it will be economic for residential and commercial customers to switch from existing gas appliances to all-electric appliances
- The pace of electrification is based on the historical adoption pattern of distributed generation within Texas

ERCOT Demand Scenarios



- ERCOT demand presented is inclusive of electric vehicle charging and net of distributed generation and behind-the-meter storage
- In the Reference Scenario, ERCOT-wide demand is projected to grow by 1.2% per year, with the majority of the growth happening by 2040
- CBE has a faster growth rate due to lower energy prices and faster economic growth. Net load is projected to grow by 1.3% a year. By 2050, net load is 3.5% higher compared to REF
- VMA has a slower growth rate due to higher energy prices and slow economic growth. Net load is projected to grow by 1.1% a year. By 2050, net load is 4.4% lower compared to REF
- *NZE net load is currently under development*

Scenarios vs. CPS Energy Portfolios

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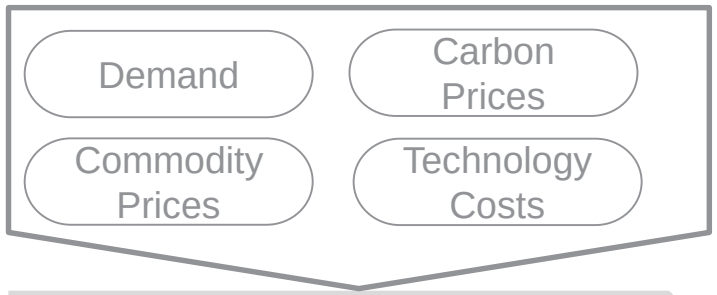
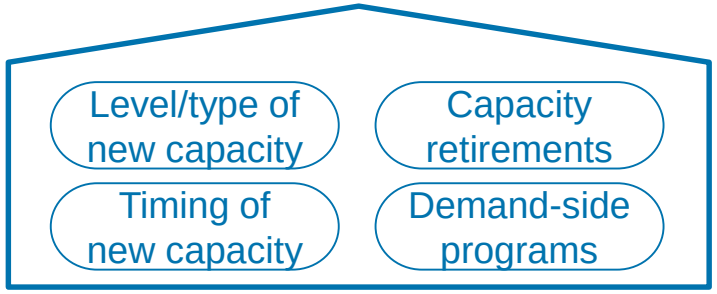


Scenarios

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



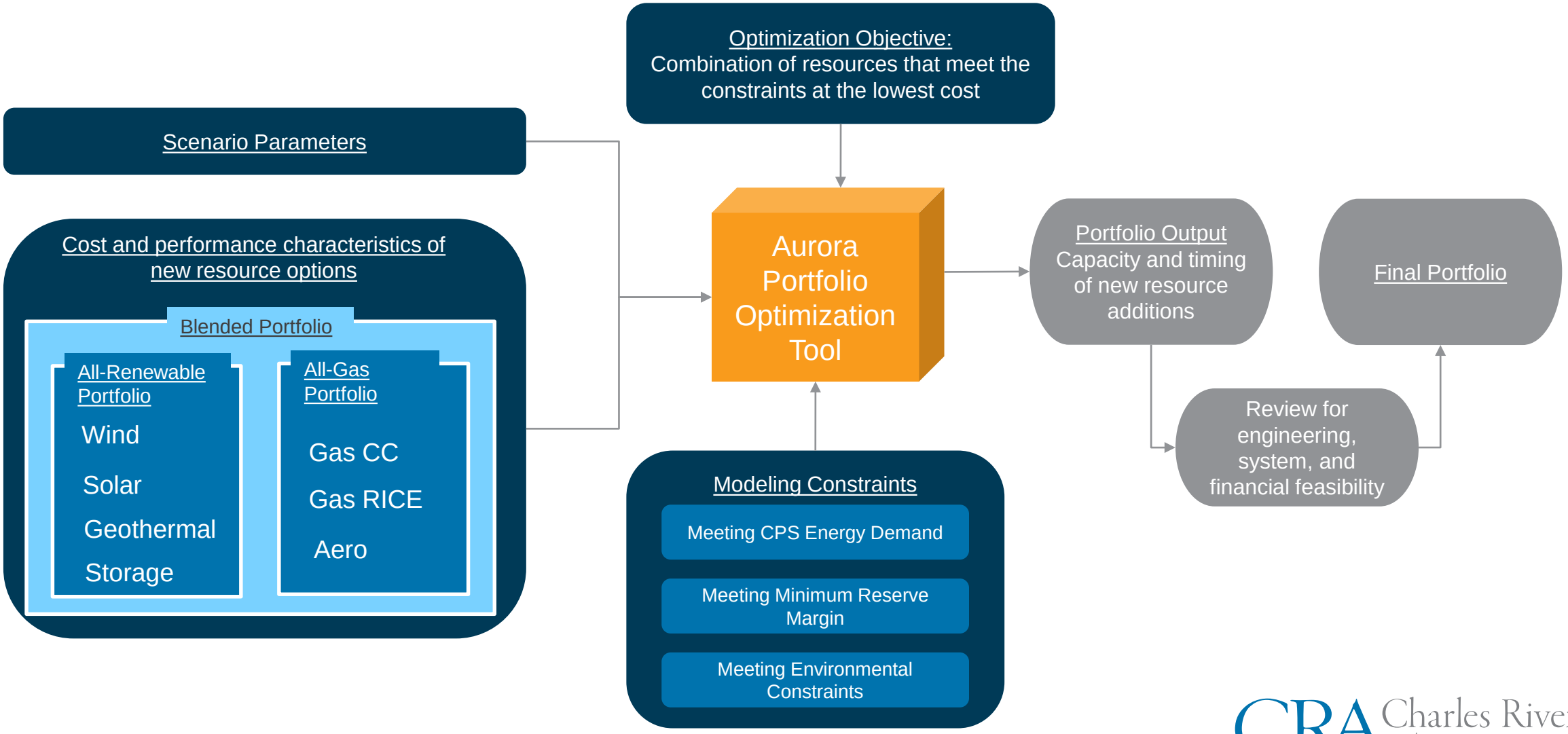
Portfolios

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

Approach to Selecting New Resources for Portfolios

Aurora is used as a tool to facilitate the selection of new resources for each portfolio



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Portfolio Concepts

CRA proposes to model nine portfolios. The first three portfolios will be based on retirement profiles provided by CPS Energy. The remaining six portfolios (P4 – P9) will be using retirement profiles proposed by Public Citizen

	P1	P2	P3	P4	P5	P6	P7	P8	P9
Retirement Profile	R1			R4	R5	R6	R7	R8	R9
Modeled Retired/Mothballed Capacity by 2030 (MW)	2,256			1,352	1,352	4,358	4,358	567	567
Allowed Technology to Meet Capacity Gaps	Gas Only*	Blend*	Renew-ables	Renewables					

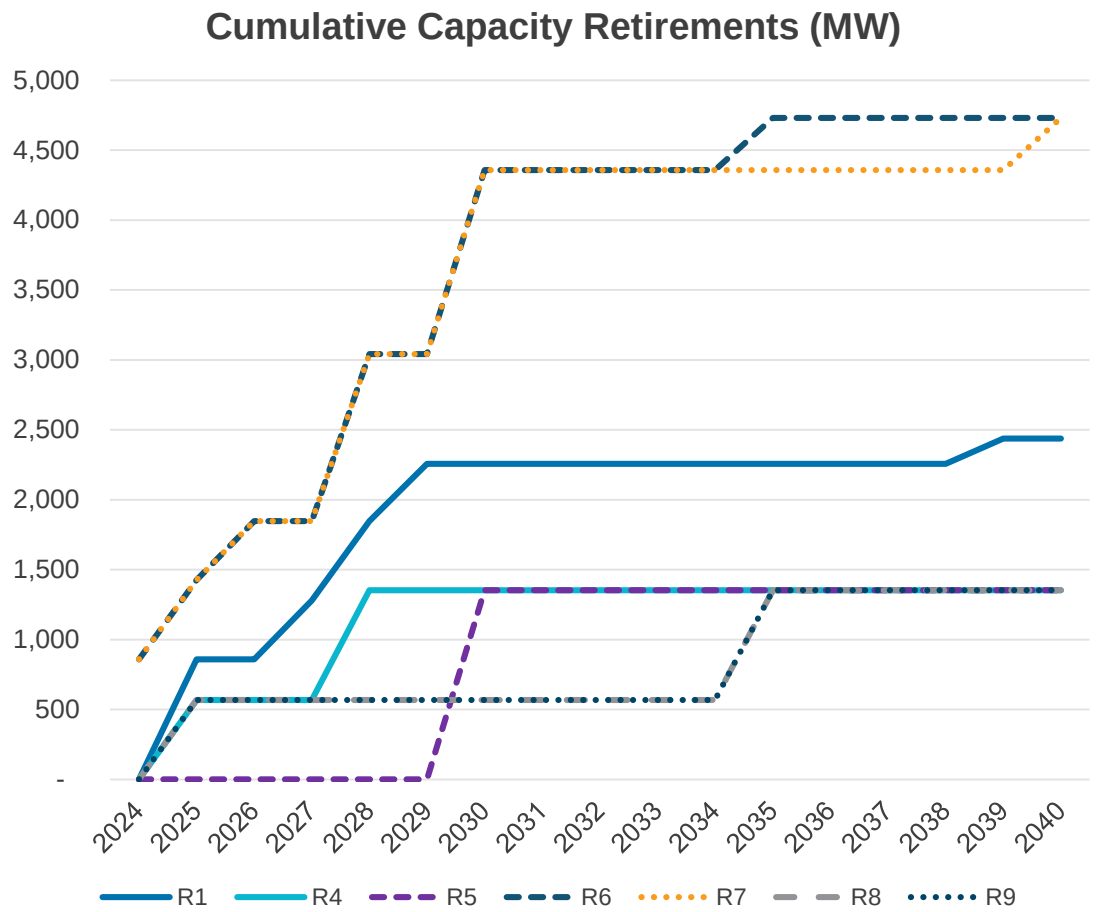
*Note: *Spruce 2 will be modeled as converted to gas by end 2027 in both gas-only portfolio (P1) and blend portfolio (P2)*

Portfolio Concepts

Retirement Matrix

Retirement Profiles

Plant	R1	R4	R5	R6	R7	R8	R9
Spruce 1	Mothball 2028	2025	2030	2025	2025	2025	2025
Spruce 2	Convert to Gas 2027	2028	2030	2028	2028	Convert to gas in 2025 and retire in 2035	Convert to gas in 2028 and retire in 2035
Braunig 1 - 3	2025			2024	2024		
Sommers 1	2027			2026	2026		
Sommers 2	2029			2028	2028		
Arthur Von Rosenberg	2047			2030	2030		
Rio Nogales	2049			2030	2030		
Milton B Lee 1 – 4	2039			2035	2040		
Milton B Lee 5 - 8	2045			2035	2040		



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Portfolio Sensitivities

In addition to the nine portfolios, CRA will perform three sensitivities on Portfolio 2 as shown below

	P1	P2	P3	P4-9
Retirement Profile	R1	R1	R1	R4-9
Allowed Technology to Meet Capacity Gaps	Gas Only	Blend	Renewables	Renewables
Sensitivity 1		Build vs Buy Sensitivity		
Sensitivity 2		Ending STEP in year 6		
Sensitivity 3		More STEP		
Sensitivity 4		Extreme Weather in 2030		

Next Steps

- Refine portfolio definitions based on RAC feedback
- Model portfolios
- Evaluate portfolios and develop the metrics

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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)	Metrics – All scenarios/ Preferred Plan (11/17)	
RAC & RAC Advisor Review				Review inputs & ERCOT scenario outputs	Review portfolio results	RAC reports to BOT	RAC reports to BOT
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		

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