

Review of Power Supply Study (Continuation from November 17 Meeting)

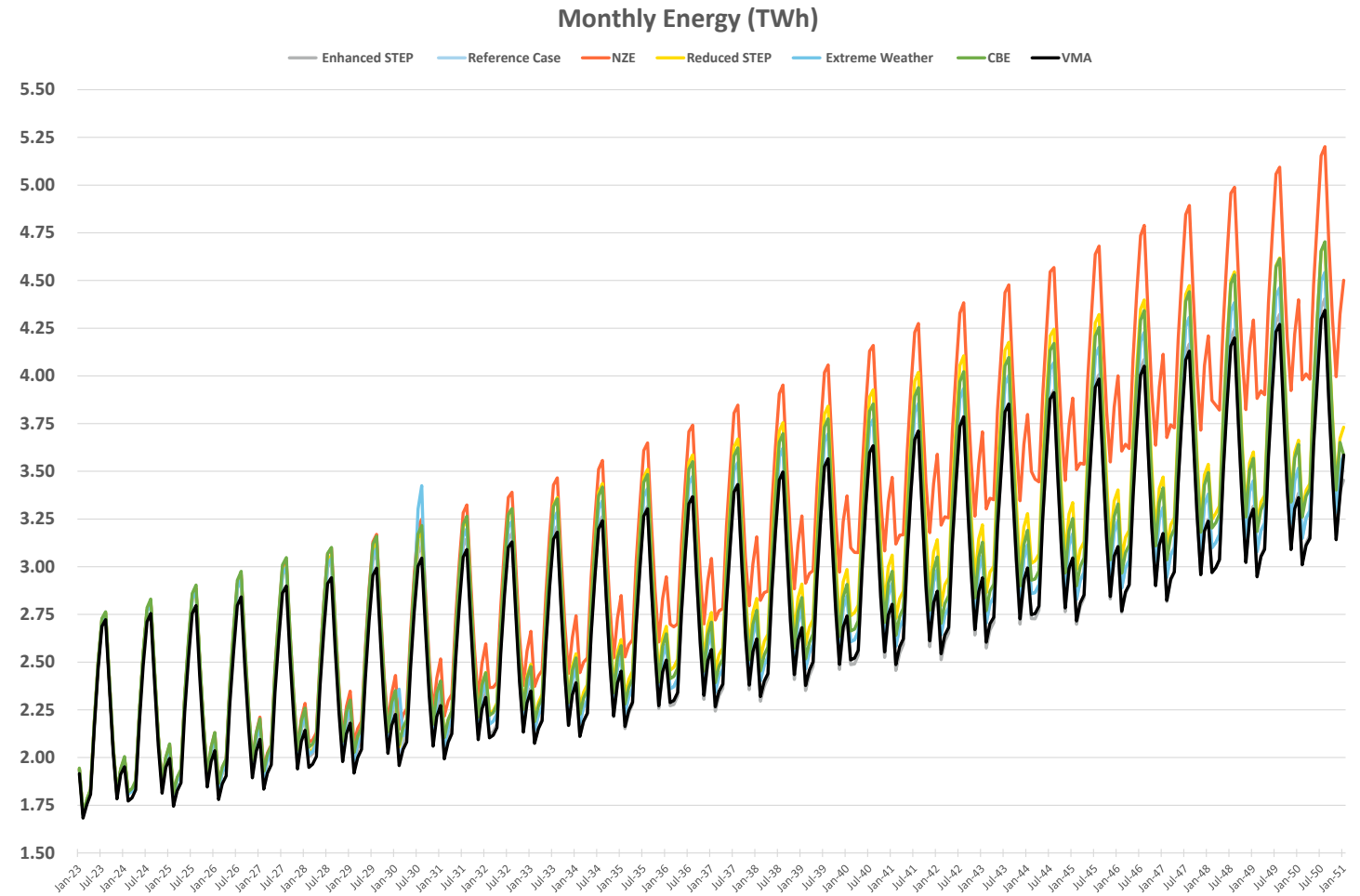
RAC of CPS Energy
December 6, 2022

Additional Assumptions and Results Review

Load Forecast for Other Scenarios & Sensitivities

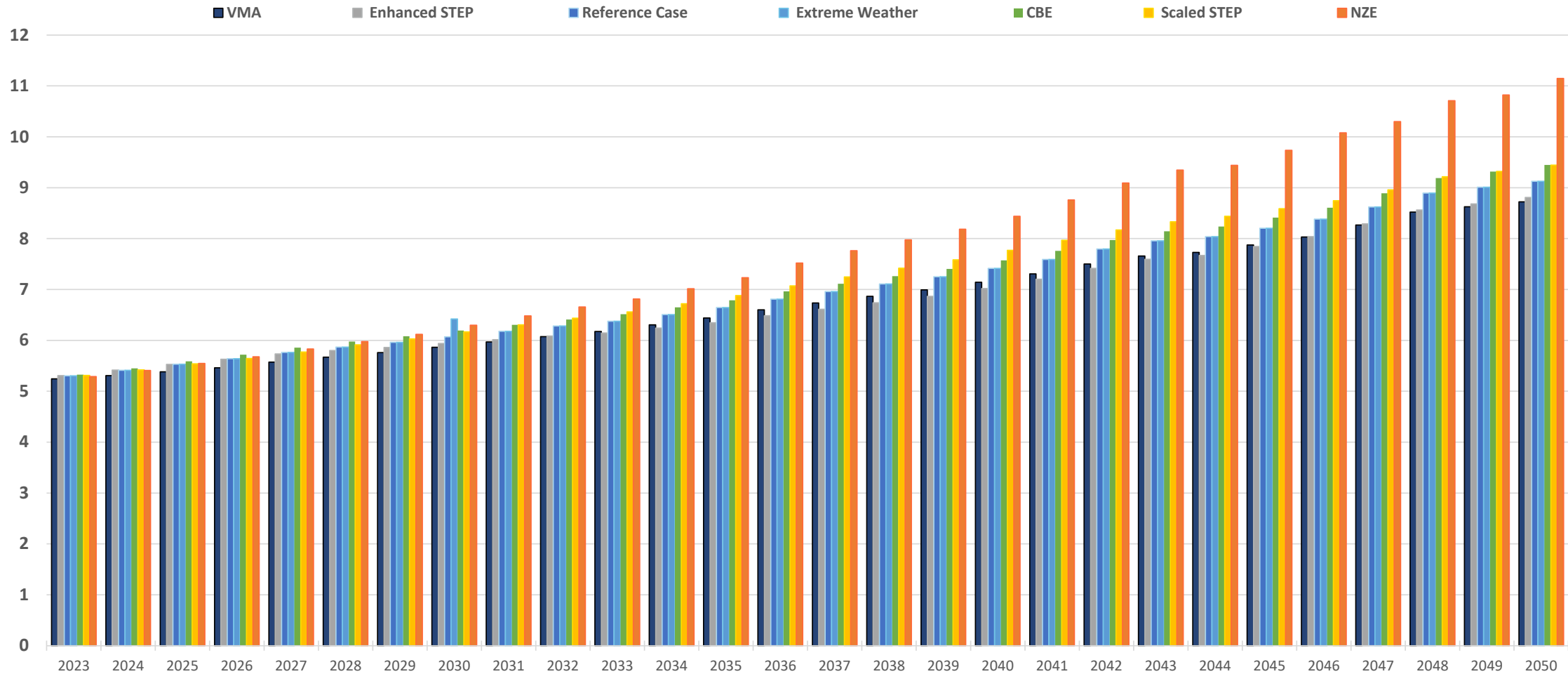


- Additional scenarios compared against the Reference scenario
- NZE Scenario, Enhanced STEP, and Scaled-back STEP sensitivities adjust component forecasts used in the Reference scenario
- Extreme Weather sensitivity, CBE and VMA scenario forecasts adjust the reference case results by a derived factor
- Scenario forecast results fall in-line with expectations



Load Forecast for Other Scenarios & Sensitivities

Annual Peak Demand (GW)



Load Forecast for Other Scenarios & Sensitivities

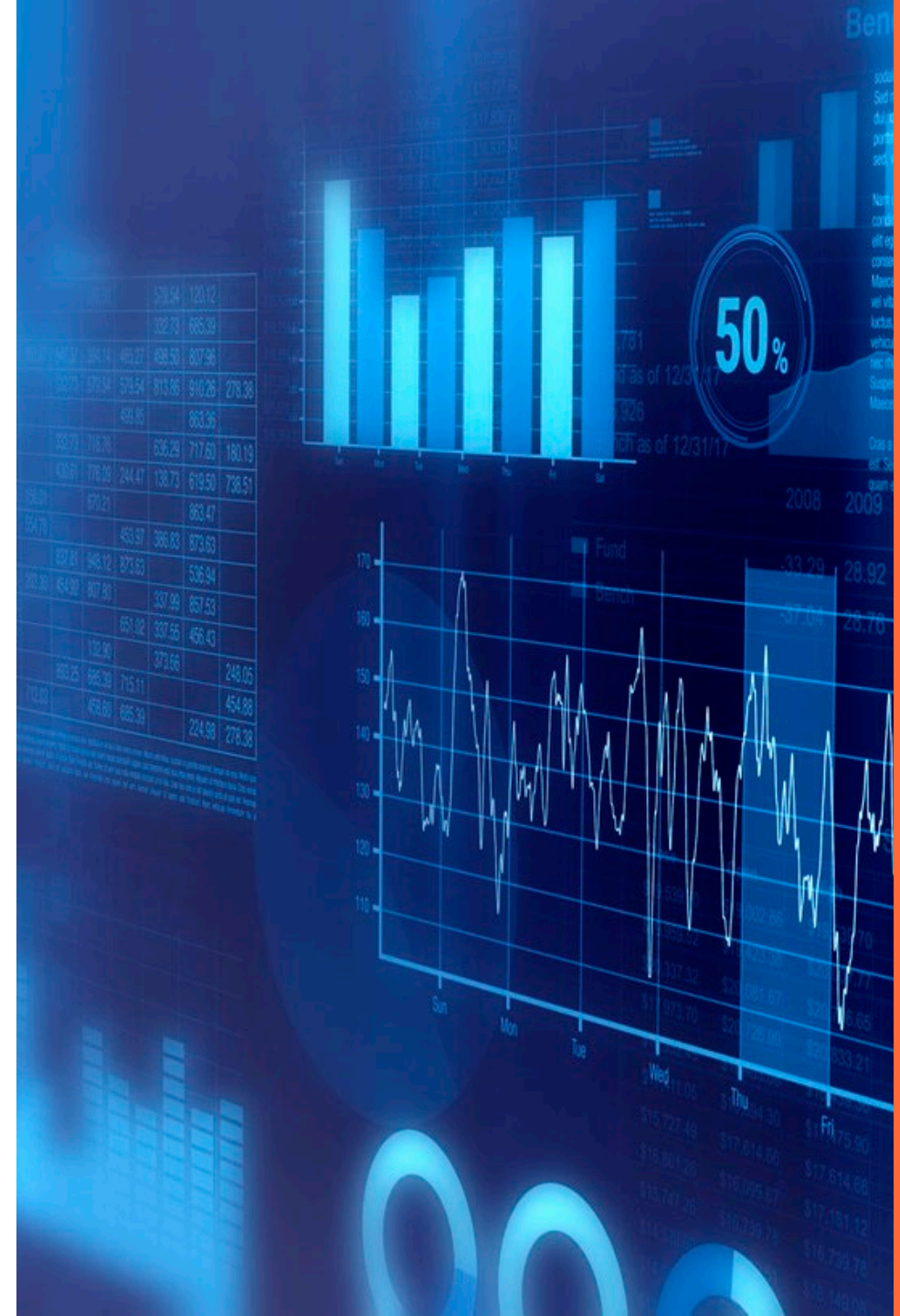
Annual Peak Growth Rate

Year	Reference Case	Enhanced STEP	VMA	Extreme Weather	CBE	Scaled STEP	NZE
2023	1.98%	2.02%	0.86%	1.98%	2.39%	2.05%	2.33%
2024	2.06%	2.00%	1.17%	2.06%	2.36%	2.05%	2.25%
2025	2.22%	2.13%	1.44%	2.22%	2.56%	2.21%	2.54%
2026	1.93%	1.77%	1.47%	1.93%	2.32%	1.93%	2.33%
2027	2.19%	1.88%	2.02%	2.19%	2.43%	2.22%	2.71%
2028	1.82%	1.16%	1.77%	1.82%	2.05%	2.44%	2.49%
2029	1.58%	1.04%	1.54%	1.58%	1.71%	2.01%	2.36%
2030	1.84%	1.33%	1.84%	7.74%	1.87%	2.29%	2.93%
2031	1.79%	1.26%	1.79%	-3.79%	1.81%	2.23%	2.96%
2032	1.66%	1.17%	1.74%	1.66%	1.67%	2.07%	2.65%
2033	1.52%	1.02%	1.68%	1.52%	1.59%	1.91%	2.41%
2034	2.06%	1.60%	2.09%	2.06%	2.07%	2.43%	2.95%
2035	2.09%	1.62%	2.15%	2.09%	2.12%	2.40%	3.09%
2036	2.51%	2.22%	2.52%	2.51%	2.56%	2.78%	3.97%
2037	2.20%	1.94%	2.02%	2.20%	2.13%	2.47%	3.22%
2038	2.14%	1.95%	1.95%	2.14%	2.09%	2.40%	2.75%
2039	1.99%	1.86%	1.85%	1.99%	1.99%	2.21%	2.60%
2040	2.25%	2.21%	2.11%	2.25%	2.26%	2.45%	3.14%
2041	2.38%	2.62%	2.32%	2.38%	2.44%	2.55%	3.78%
2042	2.70%	2.95%	2.66%	2.70%	2.76%	2.54%	3.78%
2043	2.06%	2.42%	2.10%	2.06%	2.18%	1.94%	2.81%
2044	1.07%	1.01%	0.91%	1.07%	1.15%	1.31%	1.01%
2045	2.02%	2.28%	1.90%	2.02%	2.10%	1.76%	3.13%
2046	2.19%	2.48%	1.99%	2.19%	2.35%	1.86%	3.51%
2047	2.88%	3.11%	2.94%	2.88%	3.27%	2.41%	2.20%
2048	3.14%	3.28%	3.05%	3.14%	3.38%	2.90%	3.97%
2049	1.29%	1.39%	1.21%	1.29%	1.37%	1.13%	1.06%
2050	1.28%	1.47%	1.16%	1.28%	1.40%	1.33%	3.01%
CAGR	2.03%	1.89%	1.90%	2.03%	2.15%	2.16%	2.80%

Key Results

- Expansion plan across portfolios
- Unit level information
- Portfolio generation mix
- Matching outputs to input assumptions
- Reserve margin
- Unit retirements
- Expected Capacity Factor (CF) for resource types
- Total emissions
- Fuel costs
- O&M costs
- Market purchases and sales

1898 & Co. Opinion: The model results are consistent with input assumptions and appear to be reasonable



Key Observations - Metrics

- **Five (5) Broad Categories**
 - **System Reliability**
 - **System Flexibility**
 - **Environmental Sustainability**
 - **Affordability**
 - **Work Force Impact**

1898 & Co. Opinion: The metrics used to evaluate portfolios and scenarios are consistent with typical long term power supply study



Key Observations – System Reliability (Resource Mix)

Portfolio Summary

- Resource mix and generation mix help assess system reliability for any portfolio
- Diverse mix of different technologies help offset any risk associated with any given technology
- Capacity mix – P6 and P7 have the most diverse capacity mix, but they also add the maximum resources (10 GW) by 2030. P1, P2 and P4 also have a diverse mix of resources and add the least amount of capacity by 2030. Amongst renewable portfolios, P9 adds the least resources by 2030
- Generation mix – P4, P6 and P7 have the most diverse generation mix. However, P4 is still reliant on coal and P6 and P7 add maximum resources by 2030. P1, P2 and P9 have a robust generation mix

Abbreviation	Allowed Technologies	Action on Existing Generating Fleet	2030 Generation Mix
P1 (Gas)	Gas	Spruce 1 shut down in 2028. Spruce 2 converted to gas in 2027.	
P2 (Blend 1)	All	Spruce 1 shut down in 2028. Spruce 2 converted to gas in 2027.	
P3 (Ren)	Renewables	Spruce 1 shut down in 2028. Spruce 2 shut down in 2027.	
P4 (Blend 2)	All	Both Spruce units run on coal beyond 2040	

Abbreviation	Allowed Technologies	Action on Existing Generating Fleet	2030 Generation Mix
P5 (Ren)	Renewables	Spruce 1 shut down in 2025. Spruce 2 shut down in 2028.	
P6 (Ren)	Renewables	Spruce 1 shut down in 2025. Spruce 2 shut down in 2028. All gas units shut down by 2035.	
P7 (Ren)	Renewables	Spruce 1 shut down in 2025. Spruce 2 shut down in 2028. All gas units shut down by 2040.	
P8 (Ren)	Renewables	Spruce 1 shut down in 2025. Spruce 2 shut down in 2025, and re-opened as gas unit in 2028	
P9 (Ren)	Renewables	Spruce 1 shut down in 2028. Spruce 2 converted to gas in 2028	

■ Nuclear	■ Geothermal	■ Coal
■ Gas	■ Gas Toll	■ Wind
■ Solar	■ Other	■ Storage
■ Hydrogen	■ Energy Efficiency	

Cumulative Capacity Additions Between 2023 and 2030 (MW)

Portfolio	P1	P2	P3	P4	P5	P6	P7	P8	P9
Allowed Technology	Gas	Blend 1	Renewables	Blend 2	Renewables				
Combined Cycle (CC) ¹	2,260	1,380	500	1,380	500	500	500	500	500
Reciprocating Internal Combustion Engine (RICE)	606	808	N/A	202	N/A	N/A	N/A	N/A	N/A
Wind ²	N/A	500	2,700	N/A	2,700	4,000	4,000	2,100	2,300
Solar ³	880	1,180	1,180	880	1,180	1,420	1,280	1,380	1,180
Short-Duration Storage ⁴	50	1,010	3,010	1,155	3,060	4,110	4,110	2,260	1,860
Long-Duration Storage ^{5,6}	N/A	50	100	-	100	100	100	100	100
Geothermal ⁶	N/A	-	60	-	25	275	275	-	-
Hydrogen ⁶	N/A	-	240	240	240	240	240	240	240
Nuclear – Small Modular	N/A	-	-	-	N/A	N/A	N/A	N/A	N/A
Total New Capacity	3,796	4,928	7,790	3,857	7,805	10,645	10,505	6,580	6,180
Spruce 2 Gas Conversion	785	785	Retire	Retain w/coal	Retire	Retire	Retire	785	785
Market Purchase 2026 ⁷	532	102	304	422	893	785	785	1,560	304
Market Purchase 2027 ⁷	N/A	N/A	253	N/A	947	20	20	1,771	606
Market Purchase 2028 ⁷	N/A	N/A	559	N/A	1,185	511	511	599	1,562
Market Purchase 2029 ⁷	N/A	N/A	917	N/A	913	N/A	N/A	600	750

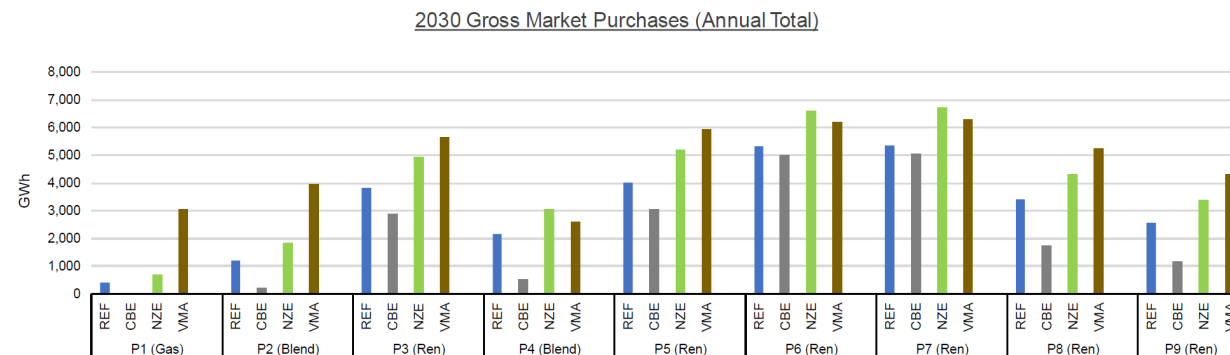
Notes: 1) Includes FlexPower Bundle 500 MW 10-year gas tolling contract; 2) Includes both coastal and west wind; 3) Includes FlexPower Bundle solar; 4) Includes FlexPower Bundle storage, and includes 2-hour, 4-hour, and 8-hour storage; 5) 20-hour storage; 6) Selected only in 2030 due to assumed technology availability; 7) Represents bridged capacity purchase for the year at 23% premium to hourly market price.

Key Observations – System Flexibility (Market Purchases)

- P1 relies least on market purchases in all scenarios except VMA
- Blend portfolios (P2 and P4) generally have lesser reliance on market energy purchases compared to renewable portfolios
- P6 and P7 rely more heavily on energy market purchases to meet load
- Of the renewable portfolios (P5-P9), P9 appears to rely less on market energy purchases.

Review of Portfolio Performance under Scenarios and Sensitivities

2030 Market Purchases – By Scenario and Portfolio



- Natural gas prices have a significant impact on market purchases:
 - Market purchases are generally lower in the CBE scenario because CPS Energy's natural gas plants are expected to dispatch more, reducing purchases from the market. The impact is more muted in P6 and P7 due to the closures of two combined cycle plants by 2030.
 - Conversely, market purchases are generally higher in the VMA scenario where natural gas prices are high. This is despite lower electricity consumption in the scenario. High natural gas prices put gas-heavy portfolios at a disadvantage relative to ERCOT market prices.
- The NZE scenario generally leads to higher market purchases in all scenarios. This is due to lower ERCOT market prices combined with higher electricity consumption resulting from significant electrification growth.

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Key Observations – Environmental Sustainability

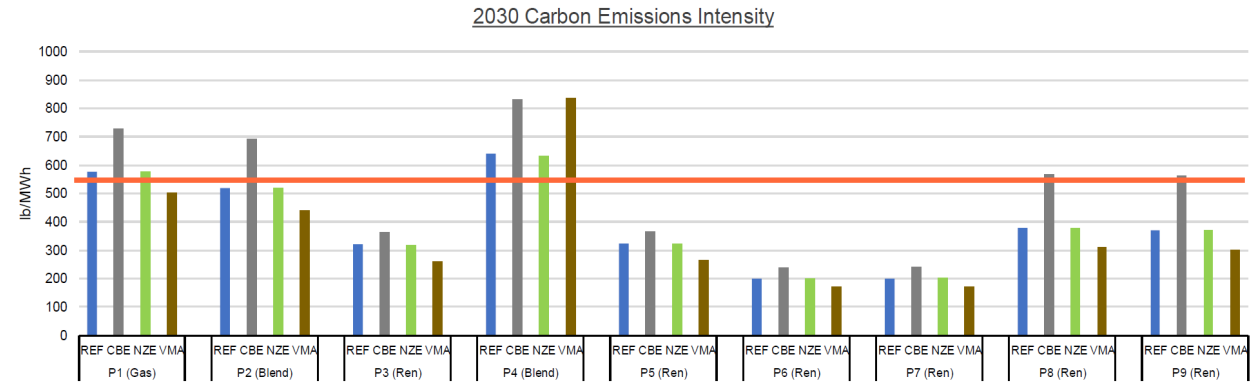
CAAP Goals & CPS Energy Carbon Intensity Metric		
Year	CAAP Goal Reduction (%)	CAAP Goal Carbon Intensity (lbs/mwh)
2016*	baseline	920
2030	41	543
2040	71	267
2050	100	0

*baseline year for the CoSA CAAP GHG Inventory is 2016

- For 2030, P4 appears not to meet the 2030 CAAP goals
- P6 and P7 have the lowest levels of emissions across all scenarios and exceed 2030 CAAP goals
- P1 is above CAAP goals for the CBE Scenario and is generally close to the CAAP goal for the REF and NZE scenarios. It exceeds CAAP goals under the VMA scenario
- Emissions for other portfolios generally fall in between

Review of Portfolio Performance under Scenarios and Sensitivities

2030 Carbon Emissions Intensity – By Scenario and Portfolio



- The CBE scenario generally results in the highest emission intensity for all portfolios (except P4). This is because low natural gas prices and no carbon prices lead to higher gas plant capacity factors.
- The VMA scenario generally has the lowest emission intensity across all portfolios (except P4). This is because high natural gas prices lead to lower gas generation and more market purchases. In P4, emission intensity is high because of higher coal generation from the two Spruce units, as coal is more competitive relative to natural gas.

Note: ERCOT-average CO2 emissions intensity in 2030 is projected to be 557 lb/MWh in REF, 650 in CBE, 504 in NZE, and 532 in VMA

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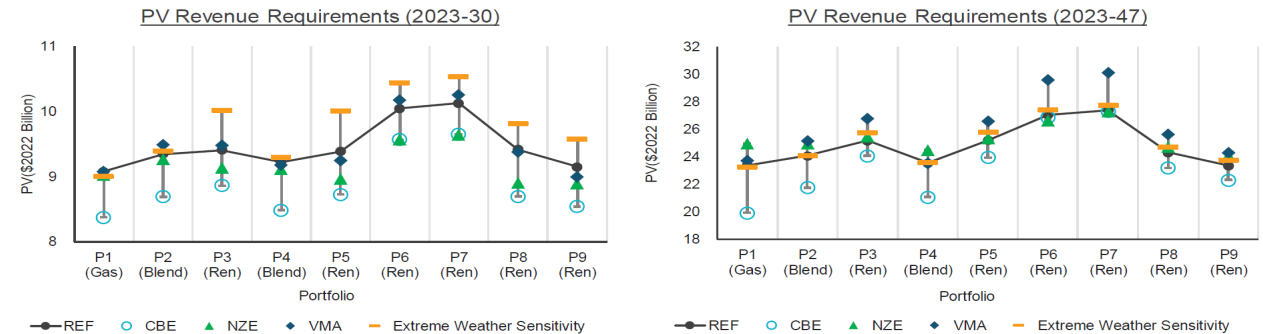
Key Observations – Affordability

	Affordability				
	Average Energy Cost (\$/MWh)				
	Reference Scenario (\$/MWh)	Carbon Based Economy (\$/MWh)	Net Zero Economy (\$/MWh)	Volatile Market (\$/MWh)	Extreme Weather (\$/MWh)
	2023 -2030	2023 -2030	2023 -2030	2023 - 2030	2023 - 2030
P1	\$58.07	\$52.33	\$56.89	\$59.85	\$57.30
P2	\$60.04	\$54.57	\$58.54	\$62.92	\$60.21
P3	\$60.58	\$55.95	\$57.71	\$63.08	\$65.07
P4	\$59.16	\$53.15	\$57.51	\$60.60	\$59.48
P5	\$60.47	\$55.09	\$56.57	\$61.53	\$65.03
P6	\$65.34	\$61.12	\$60.85	\$68.59	\$68.13
P7	\$65.96	\$61.71	\$61.40	\$69.23	\$68.81
P8	\$60.67	\$54.82	\$56.17	\$62.15	\$63.56
P9	\$58.64	\$53.58	\$55.94	\$59.38	\$61.70

Legend		
Less Favorable		More Favorable

Review of Portfolio Performance under Scenarios and Sensitivities

Present Value (PV) of Revenue Requirements – All Scenarios + Extreme Weather



- In the short term, gas and carbon prices drive the ranges of revenue requirements. Portfolios with more gas capacity benefit more from low gas prices in CBE. Portfolios with more renewable capacity benefit from the faster decline in renewable costs in NZE.
- Over the long term, the risks to revenue requirements are skewed higher for P6 and P7. This is driven by a slower-than-expected decline in renewable costs in VMA, and lower revenues from market sales as ERCOT market prices are suppressed by high renewable penetration in NZE. The risks are skewed lower for P1, P2, and P4 as these portfolios benefit from low gas prices in CBE.
- Both P1 and P4 face the highest cost increases in NZE due to the escalating carbon price, but P4 is hedged against high natural gas prices in VMA because it retains coal.

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- Average energy costs (2023-2030) is another measure to assess bill impacts and affordability
- P1 has the lowest average energy price range across scenarios and also has the least spread in costs across all scenarios indicating better price protection to customers
- P3 has the lowest energy cost in the CBE scenario, but also has the widest spread across all scenarios and extreme weather sensitivity indicating higher price volatility and associated risks
- P6 and P7 generally tend to have higher costs across all scenarios and the extreme weather sensitivity
- Amongst renewable portfolios (P5-P9) P9 tends to have a lower overall cost

Key Observations – Work Force Impact

Integrated Scorecard Summary

- In general, retiring fossil fuel based generating units with renewable energy resources can have impacts on the work force
- Renewable resources like wind and solar projects require less people to operate and maintain
- Renewable resources are likely to be more geographically dispersed
- P1, P2 and P4 will likely have the least impact on CPS Energy jobs due to continued operations of existing units or for adding new gas resources, which are expected to be local resources

Key Observations from Portfolio Metric Results

	Workforce Impact	
	CPS Energy Workforce Impact	Local Economic Impact
	# of Impacted CPS Energy Generation Employees	Capital expenditures for new generation capacity built in greater San Antonio area (\$Millions)
	2030	2023 – 2030
P1	155	2,758
P2	170	2,004
P3	345	1,310
P4	90	1,787
P5	355	866
P6	355	4,041
P7	355	4,041
P8	295	548
P9	295	548

Note:

1. Lighter shade means "more favorable."

Workforce Impact

• CPS Energy Workforce Impact

- P4 has the lowest impact on CPS Energy jobs, due to continued operations of both Spruce units and fewer capacity retirements by 2030. New gas plants allow CPS Energy to re-deploy employees from retired plants.
- P3, P5, P6, and P7 have the largest impact on CPS Energy jobs due to earlier retirements of CPS Energy-owned power plants.

• Local Economic Impact

- P6 and P7 have the highest capital expenditures in the local area, driven largely by new geothermal capacity.
- P1 and P2 include the most near-term gas additions, which are expected to be constructed in the local region.
- Although P5, P8 and P9 add significant renewable capacity, it is expected that most wind and solar would be sited outside of the greater San Antonio area.

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1898 & Co. Opinion: The metrics used to evaluate portfolios and scenarios are consistent with typical long term power supply study

Key Observations – Scorecard

- Color scheme used to highlight relative portfolio performance for each metric
- Individual portfolio performance for different scenarios not specifically mentioned
- Not aware of assigning weights and scoring of portfolios for individual scenarios
- Classification of risk for all portfolios and scenarios summarized as high, medium and low. However, classification guidelines are not clearly defined

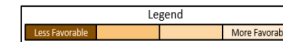
Integrated Scorecard Summary

Portfolio Metric Results

	System Reliability & Climate Resiliency				Environmental Sustainability			Affordability				System Flexibility		Workforce Impact		
	Diversity of Generation Mix	Capacity Headroom	Extreme Weather Exposure		Progress Towards City of SA CAAP Goals			Energy Cost (\$/MWh)		Present Value (PV) Revenue Requirements		Market Purchases	Dispatchability	CPS Energy Workforce Impact	Local Economic Impact	
	Generation Mix (MWh)	Expected Reserve Margin (%)	Rev. Req. Extreme Weather (\$Billion)	% of CPS Energy consumption that is met through ERCOT market purchases	% CO2 Intensity Reduction Relative to 2016 (Ref Scenario)	Emission Intensity (lb CO2/MWh)	% reduction in consumption due to STEP	Reference Scenario Average Cost (\$/MWh)	Range in Cost in all Scenarios (\$/MWh)	Ref Scenario (\$Billion)	Range Across all Scenarios (\$Billion)	% of CPS Energy consumption that is met through ERCOT market purchases	% of CPS Energy Capacity that is Dispatchable	# of Impacted CPS Energy Generation Employees	Capital expenditures for new generation capacity built in greater San Antonio area (\$Millions)	
	2030	2030	2030	2030	2030	2030 2040	2030	2023 - 2030		2023 - 2030	2023 - 2030	2030	2030	2030	2023 - 2030	
P1		13.7%	\$1.70	1.0%	37%	578	547	9.7%	\$58.07	\$52-60	\$8.58	\$7.87-8.58	1%	61%	155	\$2,758
P2		15.7%	\$2.04	3.1%	44%	518	350	9.7%	\$60.04	\$55-63	\$8.85	\$8.19-8.99	4%	57%	170	\$2,004
P3		14.5%	\$3.26	12.8%	65%	321	161	9.7%	\$60.58	\$56-63	\$8.90	\$8.36-8.98	13%	46%	345	\$1,310
P4		15.3%	\$2.02	6.1%	30%	641	361	9.7%	\$59.16	\$53-61	\$8.72	\$7.99-8.72	7%	63%	90	\$1,787
P5		15.0%	\$3.28	13.5%	65%	325	161	9.7%	\$60.47	\$55-62	\$8.88	\$8.23-8.88	13%	46%	355	\$866
P6		13.2%	\$3.27	19.6%	78%	200	31	9.7%	\$65.34	\$61-69	\$9.54	\$9.07-9.68	18%	39%	355	\$4,041
P7		13.1%	\$3.34	19.7%	78%	202	35	9.7%	\$65.96	\$61-69	\$9.63	\$9.14-9.76	18%	39%	355	\$4,041
P8		15.4%	\$2.79	11.2%	59%	378	160	9.7%	\$60.67	\$55-62	\$8.92	\$8.20-8.92	11%	48%	295	\$548
P9		14.6%	\$2.69	7.9%	60%	371	160	9.7%	\$58.64	\$54-59	\$8.65	\$8.04-8.65	9%	46%	295	\$548

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- Nuclear
- Geothermal
- Coal
- Gas
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- Wind
- Solar
- Other
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- Hydrogen
- Energy Efficiency



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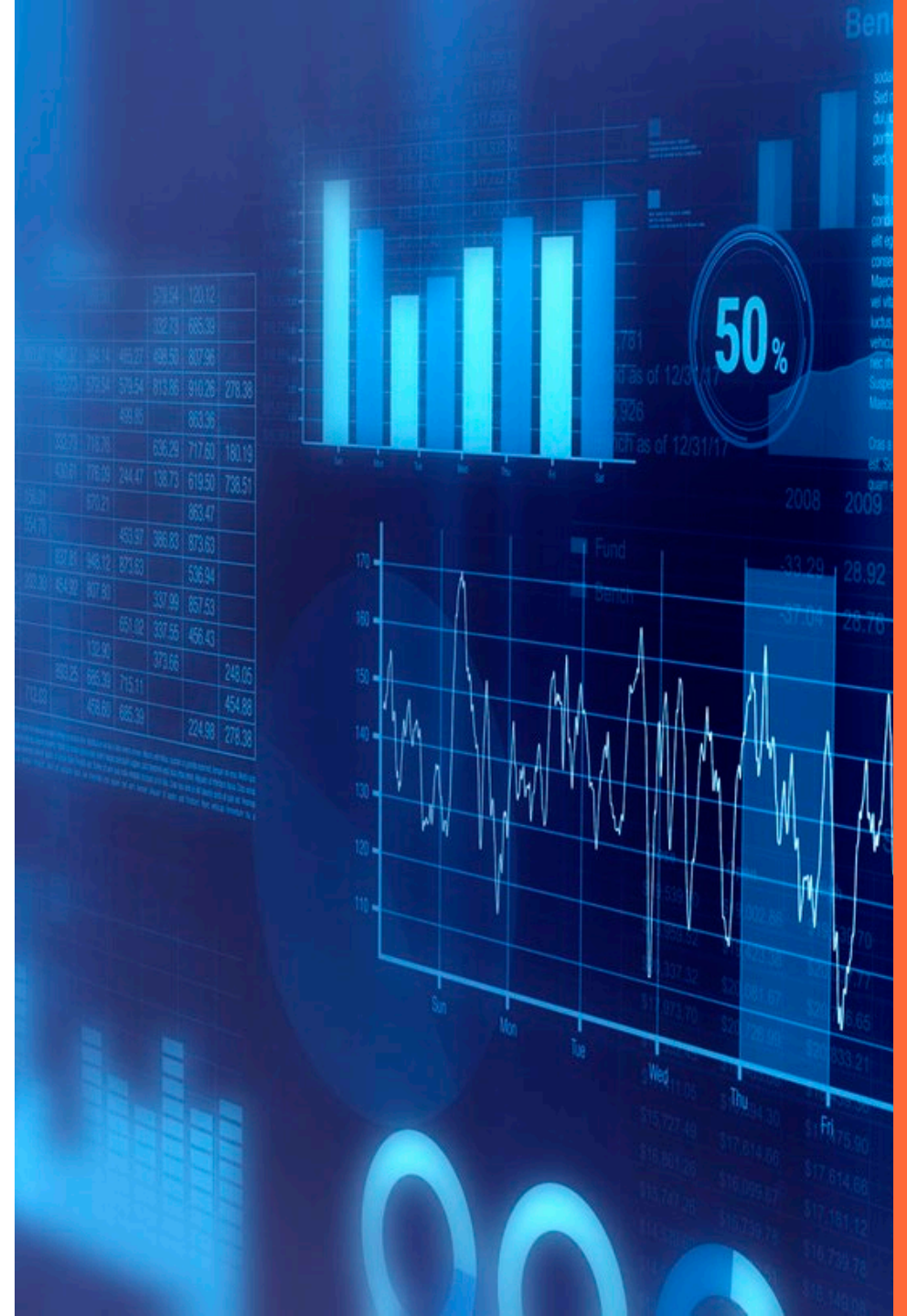
Key Observations

- The study approach seems reasonable
- The assumptions used in the analysis appear reasonable
- The capacity values of renewable resources appear reasonable
- The results of the scenario and portfolio analysis looks reasonable
- No single portfolio performs the best under all scenarios and sensitivities implying that there is a tradeoff between risk and cost and an optimum portfolio needs to be decided by weighing in all factors
- Replacing existing resources with new resources has a cost impact.. This shows up especially in P6, where all gas resources are shut down by 2035.
- P1 and P2 perform better across different scenarios and sensitivities compared to P6 and P7 and other renewable portfolios which indicate that CPS Energy gas and coal resources provide good value for CPS Energy portfolio
- Renewable portfolios have a lower emission profile compared to P1 and blend portfolios but are more costly
- Amongst renewable portfolios, P9 costs appear to be less volatile and hence has a lower risk profile



Recommended Portfolio

- No single portfolio performs the best under all scenarios and sensitivities implying that there is a tradeoff between risk and cost and an optimum portfolio needs to be decided by weighing in all factors
- Amongst all portfolios P1, P2, P4 and P9 generally appear to perform better compared to other portfolios across the five broad categories. Amongst these, P4 continues to rely on coal throughout the study period
- Based on the above 1898 & Co. recommends RAC members to consider P1, P2 and P9 for possible options for their recommendation



Next Steps and Additional Analyses



- This study handled solar generation as is typically done for planning studies. Generation profiles have been developed based on historical trends and correlated weather patterns. Generation profiles have also been modified for the extreme weather sensitivity. However, future renewable generation remains uncertain. It could be a good practice in the future to build in renewable generation variability over time that include more low generation event occurrences with longer durations based on historical information
- The assumptions in the extreme weather sensitivity case addresses the variation in renewable energy generation and capacity factors for 2030 only but in addition to that, the other critical risk around renewable generation is number of occurrences and occurrence durations for low generation events, especially for wind
- Assess the impact of recent capital cost inflation trends in the assumptions for new technologies, something that may not have been possible given the timing of the study