2023 Proposed PSP and 2024-25 TPP Supplemental Analysis

October 20, 2023

California Public Utilities Commission

Background

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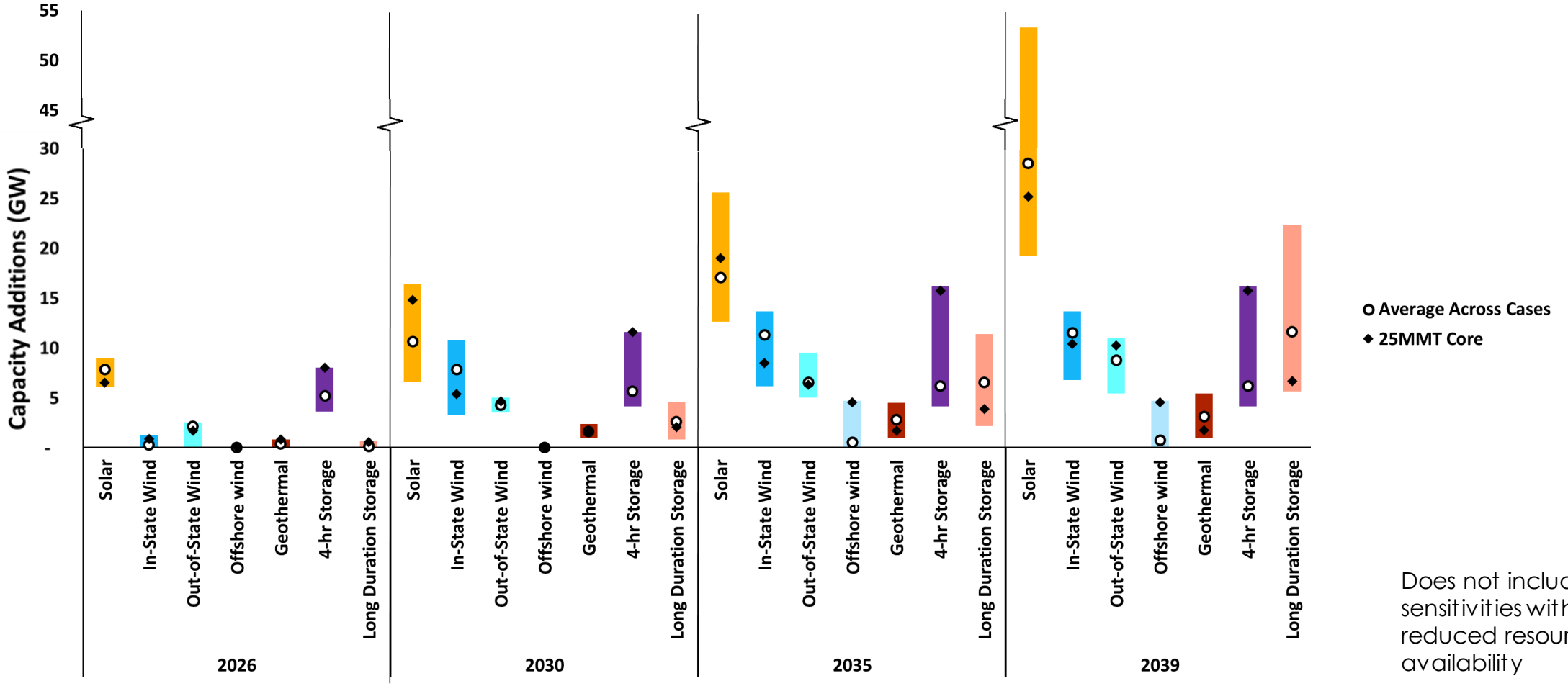
2023 PSP & 2024-25 TPP Analysis: RESOLVE Sensitivity Results

Overview of Included RESOLVE Sensitivities

Sensitivity Grouping	Description of Sensitivity	Sensitivity Cases New cases contained in this deck Cases Released with the PSP/TPP Ruling Materials
25 MMT Least-Cost	All sensitivities are compared to the 25 MMT Least-Cost case	
Cost	One or more resources have higher or lower costs than modeled in 25 MMT Least-Cost	1) High Battery 2) High Solar 3) High Land-Based Wind 4) High Solar PV, Battery 5) Low Offshore Wind 6) Low Offshore Wind & High Land-Based Wind, Solar PV, Storage 7) High Geothermal & Biomass 8) High Gas Fixed O&M
Demand	Annual load forecast varies from 25 MMT Least-Cost	1) High Electrification 2) 2021 ATE (Additional Transportation Electrification)
Resource Availability	Availability of resources (gas, imports, BTM PV) varies from availability in 25 MMT Least-Cost	1) Moderate Gas Retirement 2) High Gas Retirement 3) No Imports for Reliability After 2028 4) Low BTM PV
Long Lead-Time: Offshore Wind	Different competing resource costs and availability constraints are added	1) Reduced land-based clean resource availability 2) Significantly reduced land-based competing resource availability 3) Low offshore wind cost & reduced land-based clean resource availability 4) Low offshore wind cost & significantly reduced land-based clean resource availability 5) High land-based wind (resource and transmission) costs 6) High land-based wind, solar, and storage costs (resource and transmission costs) 7) Low offshore wind cost and high land-based wind, solar, and storage costs (resource and transmission costs)

Summary of Build Across all Sensitivities



Does not include sensitivities with reduced resource availability

Cost Sensitivities

Cost sensitivities explore how resource choices are/are not robust to changes in resource cost trajectories

Cost Sensitivities

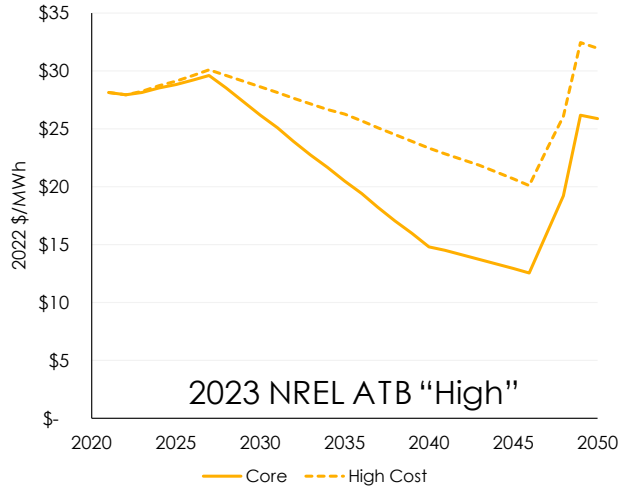
- Performing multiple cost sensitivities enables the consideration of different cost futures and their impact on optimal resource portfolio
- While near-term builds are more significantly impacted by current market trends, future costs are more uncertain and are driven by several factors including how supply chain of each technology evolves; therefore, the cost competitiveness between technologies is less predictable
- Cost sensitivities show if resource choices are, or are not, robust to differences in resource costs
- Higher cost sensitivities are considered for a more conservative approach and to evaluate delays in future cost reductions
- A lower cost sensitivity is considered for offshore wind to explore conditions at which offshore wind is economically reasonable in future portfolios

Cost Sensitivities

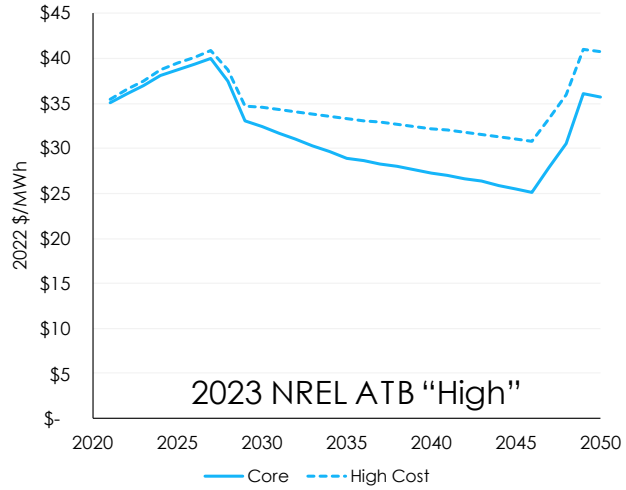
Cost Comparison for 25 MMT Least-Cost (Core) vs. Sensitivities

Levelized Fixed Cost

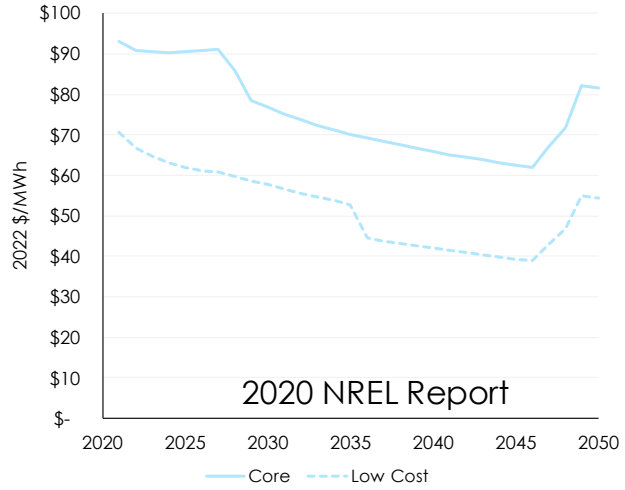
Solar - Tracking (33% CF)



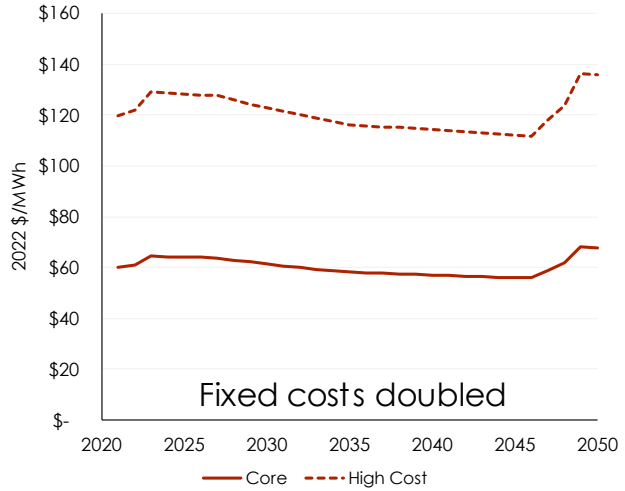
Land-Based (Onshore) Wind (35% CF)



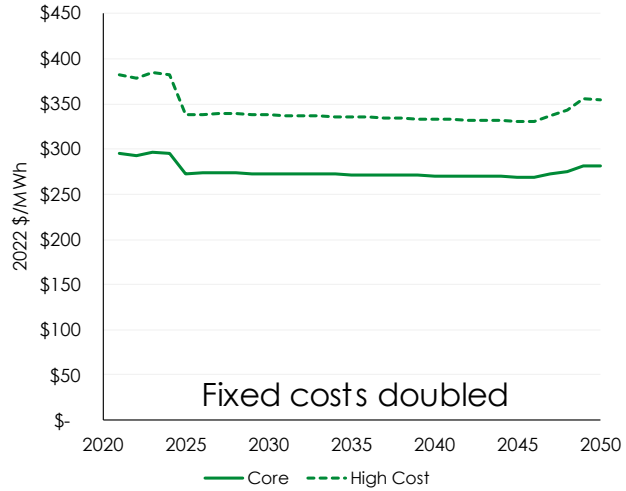
Offshore Wind - Morro Bay (49% CF)



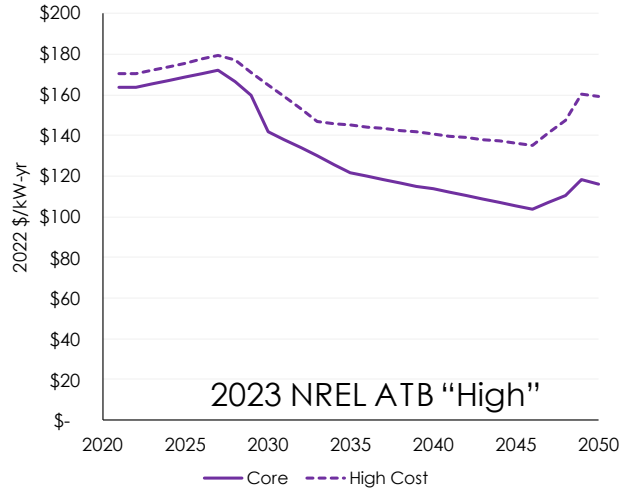
Geothermal (90% CF)



Biomass (85% CF)



Li-ion Battery (4-hr)



Cost Sensitivities

Definitions

New Cases
Cases included in PSP/TPP Ruling materials

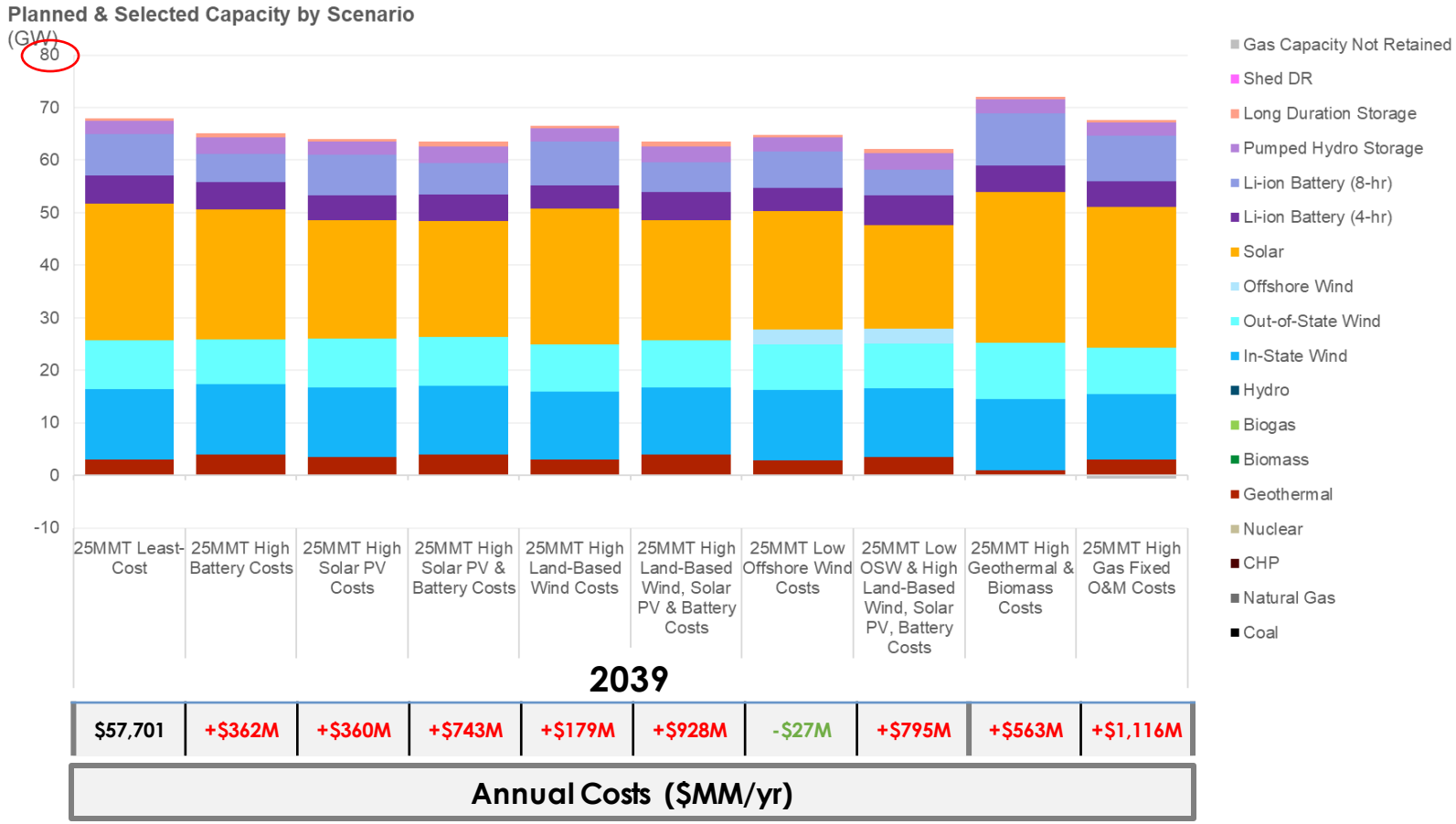
▲ Indicates cost increase
▼ Indicates cost reduction

	Battery	Biomass	Geo-thermal	Solar	In-State Wind	Out-of-State Wind	Offshore Wind	Existing Gas FO&M
25 MMT Least-Cost								
High Battery	▲							
High Solar				▲				
High Solar PV & Battery	▲			▲				
High Land-Based Wind					▲	▲		
High Land-Based Wind, Solar PV, Battery	▲			▲	▲	▲		
Low Offshore Wind							▼	
Low Offshore Wind & High Land-Based Wind, Solar PV, Storage	▲			▲	▲	▲	▼	
High Geothermal & Biomass		▲	▲					
High Gas Fixed O&M								▲

25 MMT Least-Cost vs Cost Sensitivities: 2039

Compared to the 25 MMT Least Cost Case:

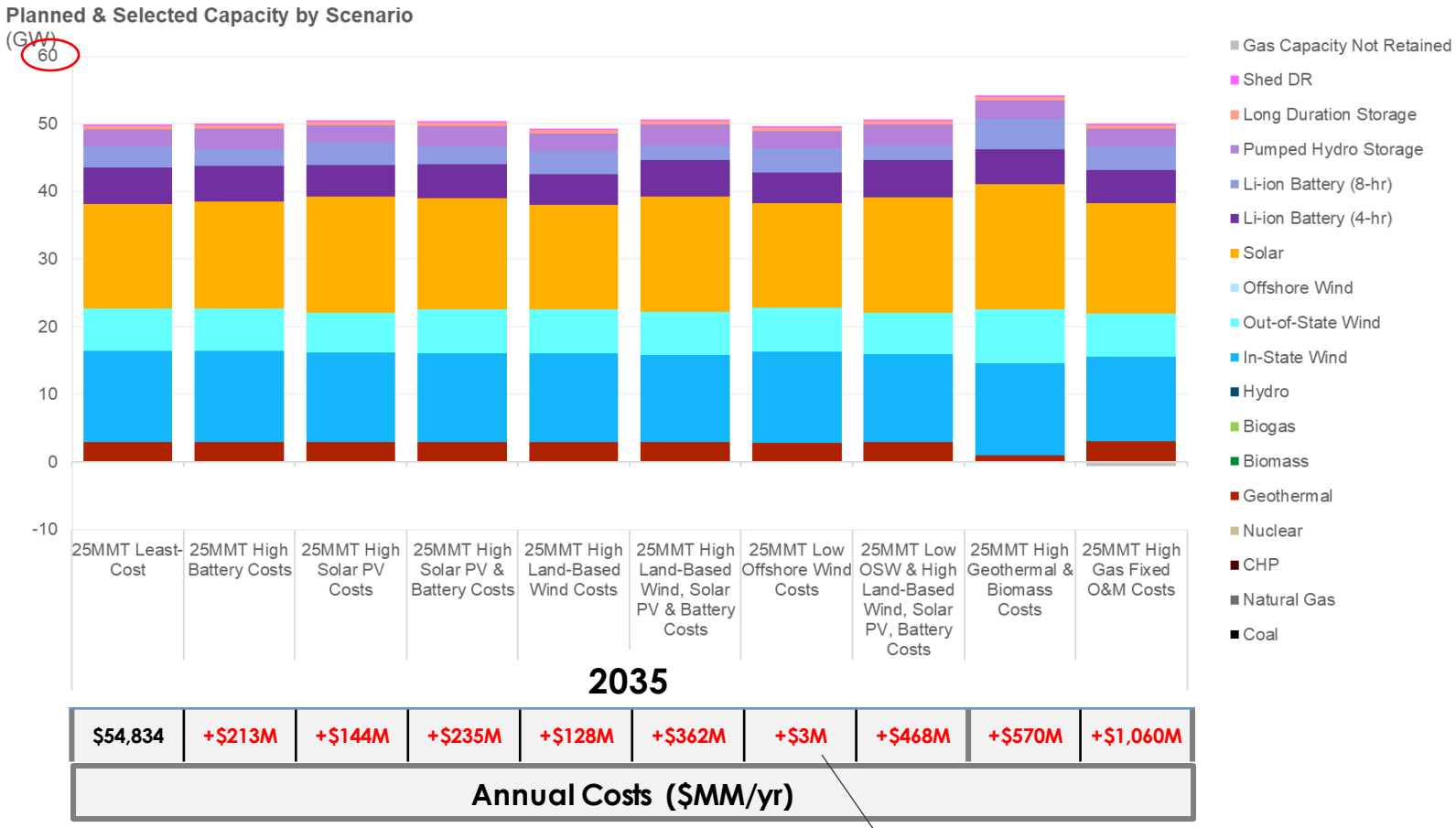
- High battery storage costs reduce 8-hr batteries in the portfolio more than they reduce the 4-hr battery builds and more pumped hydro is selected
- High solar and battery costs result in more geothermal build
- Higher land-based wind costs result in <1 GW wind replaced with 8-hr battery
- With lower offshore wind costs, offshore wind replaces a mix of geothermal, out-of-state wind, solar, and batteries in the portfolio and reduces the total system cost
- High biomass and geothermal costs result in additional wind, solar and 8-hr batteries and no additional geothermal gets selected after 2028
- Higher gas fixed costs increase the system costs substantially but result in <1 GW non-retained gas capacity



25 MMT Least-Cost vs Cost Sensitivities: 2035

- Portfolio composition is largely stable in response to cost changes
  - High geothermal costs reduce geothermal build by 2/3
  - High gas fixed O&M causes very slight increase in gas retirements

NPV of Total Resource Cost ($MM in 2022 Dollar Year, 2024-2065)	
25 MMT Least-Cost	$925,303 MM
25 MMT High Battery Costs	+$6,411 MM
25 MMT High Solar PV Costs	+$5,548 MM
25 MMT High Solar PV & Battery Costs	+$10,583 MM
25 MMT High Land-Based Wind Costs	+$1,833 MM
25 MMT High Land-Based Wind, Solar PV & Battery Costs	+$13,261 MM
25MMT Low Offshore Wind Costs	**-$797 MM**
25 MMT Low OSW & High Land-Based Wind, Solar PV, Battery Costs	+$10,461 MM
25 MMT High Geothermal & Biomass Costs	+$7,795 MM
25 MMT High Gas Fixed O&M Costs	+$16,829 MM



Negligible increase in annual costs ultimately becomes cost savings by 2039

Minor correction made to NPV & 2035 cost for High Geothermal & Biomass Costs case since slides released on 10/6/2023

Key Takeaways

- Resource choices are generally stable in response to differences in resource cost inputs, especially through 2035
  - Cost sensitivities result in minimal portfolio changes, even as portfolio costs increase/decrease
  - This result reflects other factors than cost in the resource selection process, such as resource potential limits, transmission limitations, etc.
    - Offshore wind is an exception, as is shown later in this presentation
- Minor portfolio changes are driven by cost differences as follows:
  - High geothermal costs leads to significant reductions in geothermal build
    - Geothermal is only selected to meet the MTR order requirements
  - Low offshore wind costs drive RESOLVE to include offshore wind build
  - High gas fixed O&M costs leads to marginally less gas retained but higher system costs
  - High solar/battery costs increase geothermal build

Demand Sensitivities

Demand sensitivities explore how resource choices are/are not robust to different demand forecasts

Demand Sensitivities

- Demand forecast is an input to the RESOLVE model
- In this set of sensitivities, loads higher than the 2022 IEPR Planning Scenario are modeled
- Performing multiple demand sensitivities enables the consideration of uncertainties in electrification and system peak levels and informs how resource portfolios change to meet increasing electric loads in the future
- Demand sensitivities explore whether resource portfolios are robust or not in respond to load growth

Demand Sensitivities

Definitions

Case	2026		2030		2035		2039	
	Annual Load (TWh)	Peak Demand (GW)	Annual Load (TWh)	Peak Demand (GW)	Annual Load (TWh)	Peak Demand (GW)	Annual Load (TWh)	Peak Demand (GW)
25 MMT Least-Cost	**252**	**54.9**	**280**	**58.3**	**319**	**64.0**	**352**	**68.7**
High Electrification (2022 IEPR Local Reliability Load Forecast)	**+3**	**+0.5**	**+12**	**+1.9**	**+27**	**+3.9**	**+35**	**+3.4**
2021 ATE (Near-Term Adjusted 2021 Additional Transportation Electrification)	0	0	**+1.6**	**+0.6**	**+14**	**+2.6**	**+45**	**+5.5**

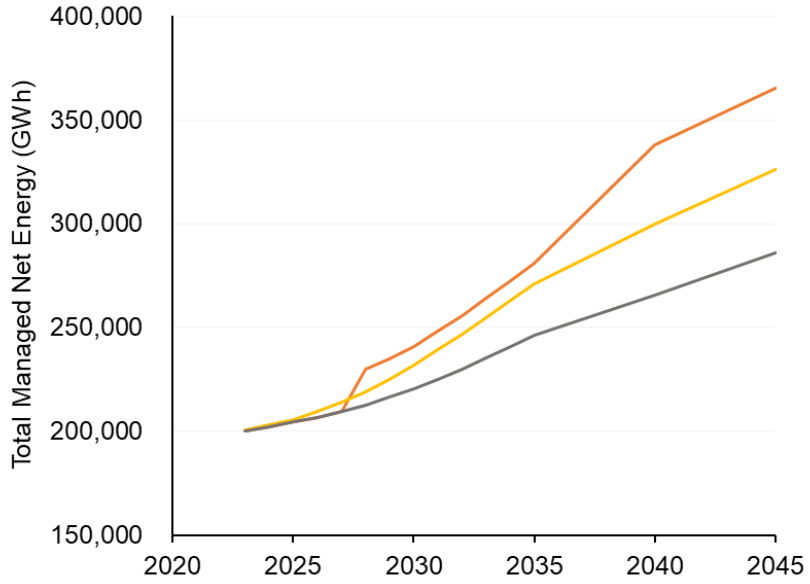
Red indicates an increase relative to 25 MMT Least-Cost

Case	Baseline Demand Case	Transportation Scenario	AAEE Scenario	AAFS Scenario	CARB SIP NOx Rules
25 MMT Least-Cost	Mid Case	AATE Scenario 3	Scenario 3	Scenario 3	Excluded
High Electrification (2022 IEPR Local Reliability Load Forecast)	Mid Case	Scenario 3	Scenario 2	Scenario 4	Included
2021 ATE (Near-Term Adjusted 2021 Additional Transportation Electrification)	Mid Case	2024-2027: Scenario 3 2028-2035: Policy	Scenario 3	Scenario 3	Included

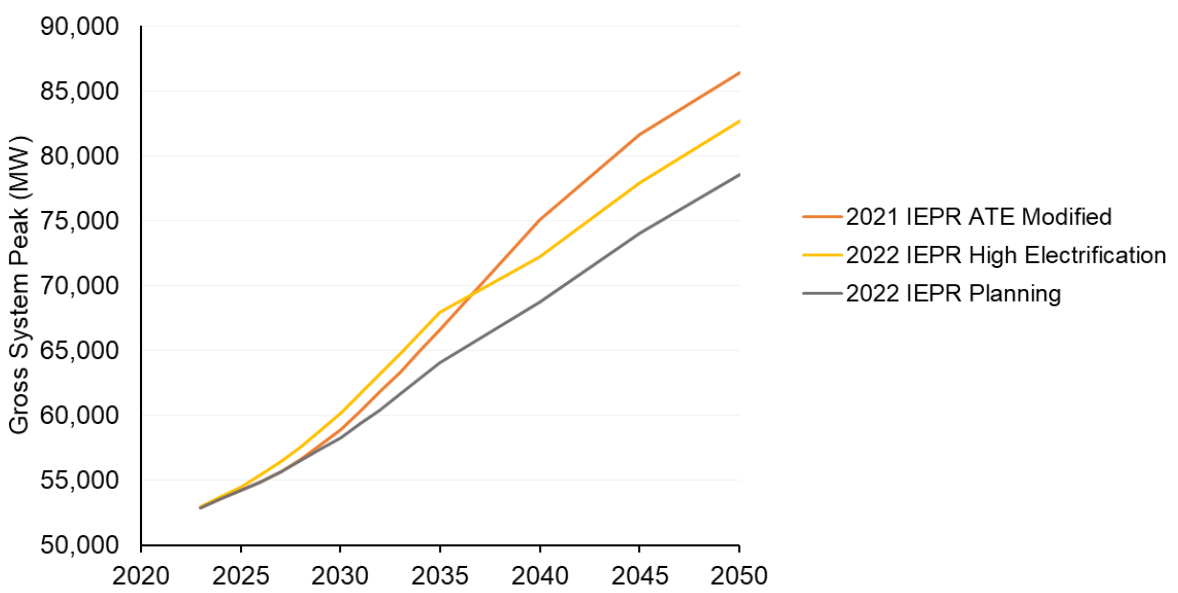
Load Forecasts

- The High Electrification scenario reflects the 2022 IEPR Local Reliability load forecast and has the highest near-term electric loads modeled in this set of sensitivities
- To avoid near-term divergence in demand between load forecasts, the 2021 IEPR ATE Modified Scenario has 2022 IEPR Planning Scenario loads through 2027, increasing to the 2021 ATE afterwards (as modeled in the 2023-2024 TPP analysis). In this set of sensitivities, The 2021 ATE load forecast has the highest loads in the long-run.

Annual Load



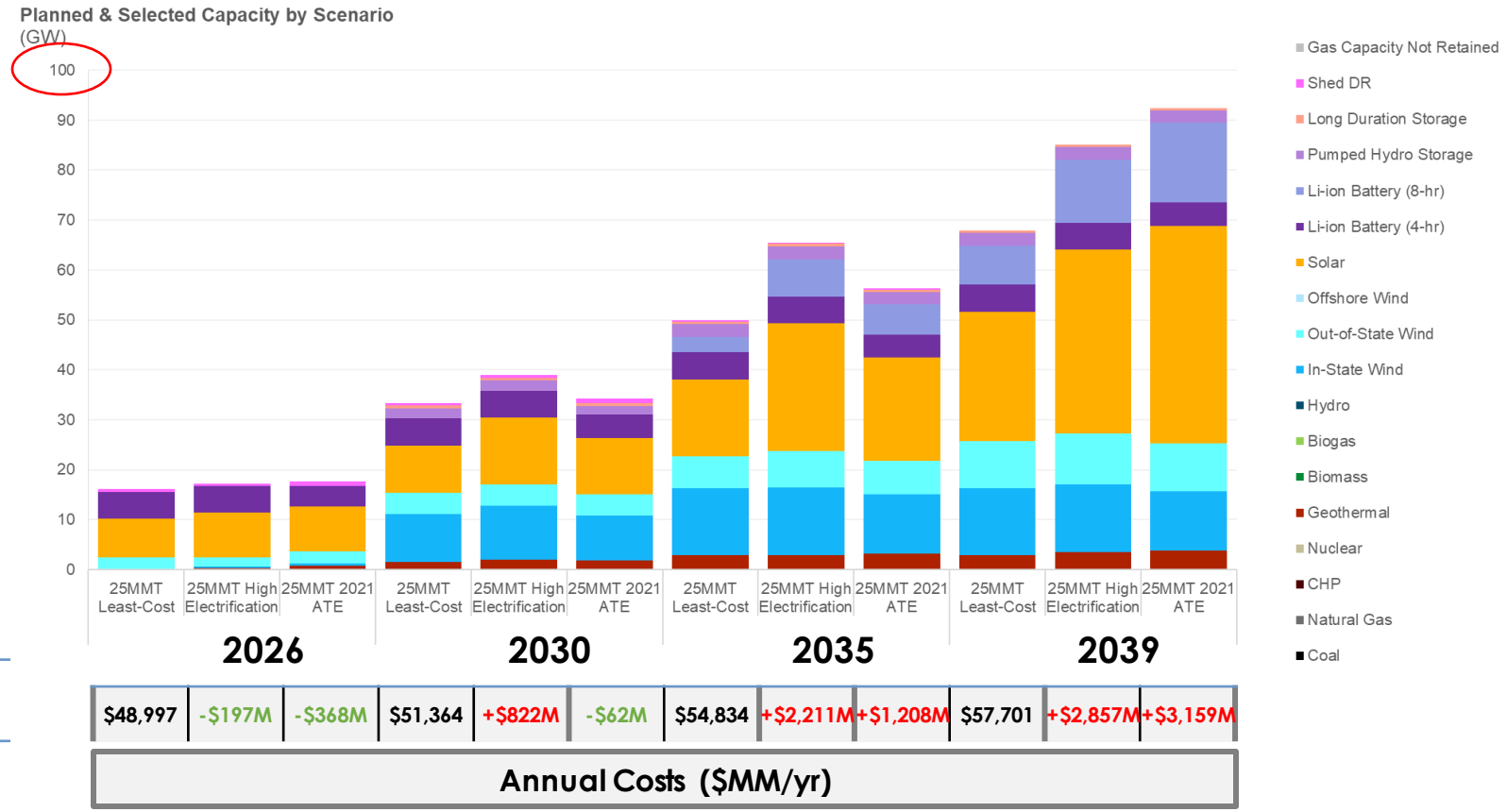
Annual Peak Demand



Demand Sensitivities

25 MMT Least-Cost vs Demand Sensitivities

- High electrification increases costs substantially by increasing solar, land-based wind, 8-hr battery and geothermal builds
- The modeled High Electrification Scenario reflecting the 2022 IEPR Local Reliability forecast assumes lower energy efficiency and higher electrification levels; therefore, it has much higher resource needs
  - Energy savings from energy efficiency measures are not optimized and are inputs to the model reflecting CEC's latest forecasts



NPV of Total Resource Cost ($MM in 2022 Dollar Year, 2024-2065)	
25 MMT Least-Cost	$925,303 MM
25 MMT High Electrification	+$31,293MM
25 MMT 2021 ATE	+$16,223MM

Demand Sensitivities

Key Takeaways

- Higher energy demand accompanied by increases in system peak demand increase the need for new resources
- Accelerated buildout of utility solar, out-of-state wind, and 8-hr batteries is needed to meet higher energy demands
- Cases with higher electrification show higher electric system costs meaning that customers would spend more on their electric bills; however, they would spend less on other energy costs (e.g., spending money on EV charging instead of gasoline)
- The net impact of these factors is not quantified here
- While total electric system costs increase with higher electrification, electricity rates may stay constant or even decrease depending on the ability to increase the utilization factor of fixed cost infrastructure (such as generation, distribution, and transmission capacity)

Resource Availability Sensitivities

Resource availability sensitivities explore how robust resource choices are to different resource availability assumptions

Resource Availability Sensitivities

- Resource availability sensitivities explore how changes in resource availability or retirements could impact portfolio selection
- Resource availability risk is not explicitly considered in each RESOLVE portfolio optimization
- Performing multiple resource availability sensitivities enables the consideration of resource availability risks as part of the portfolio development process

Resource Availability Sensitivities

Definitions

New Cases
Cases included in PSP/TPP Ruling materials

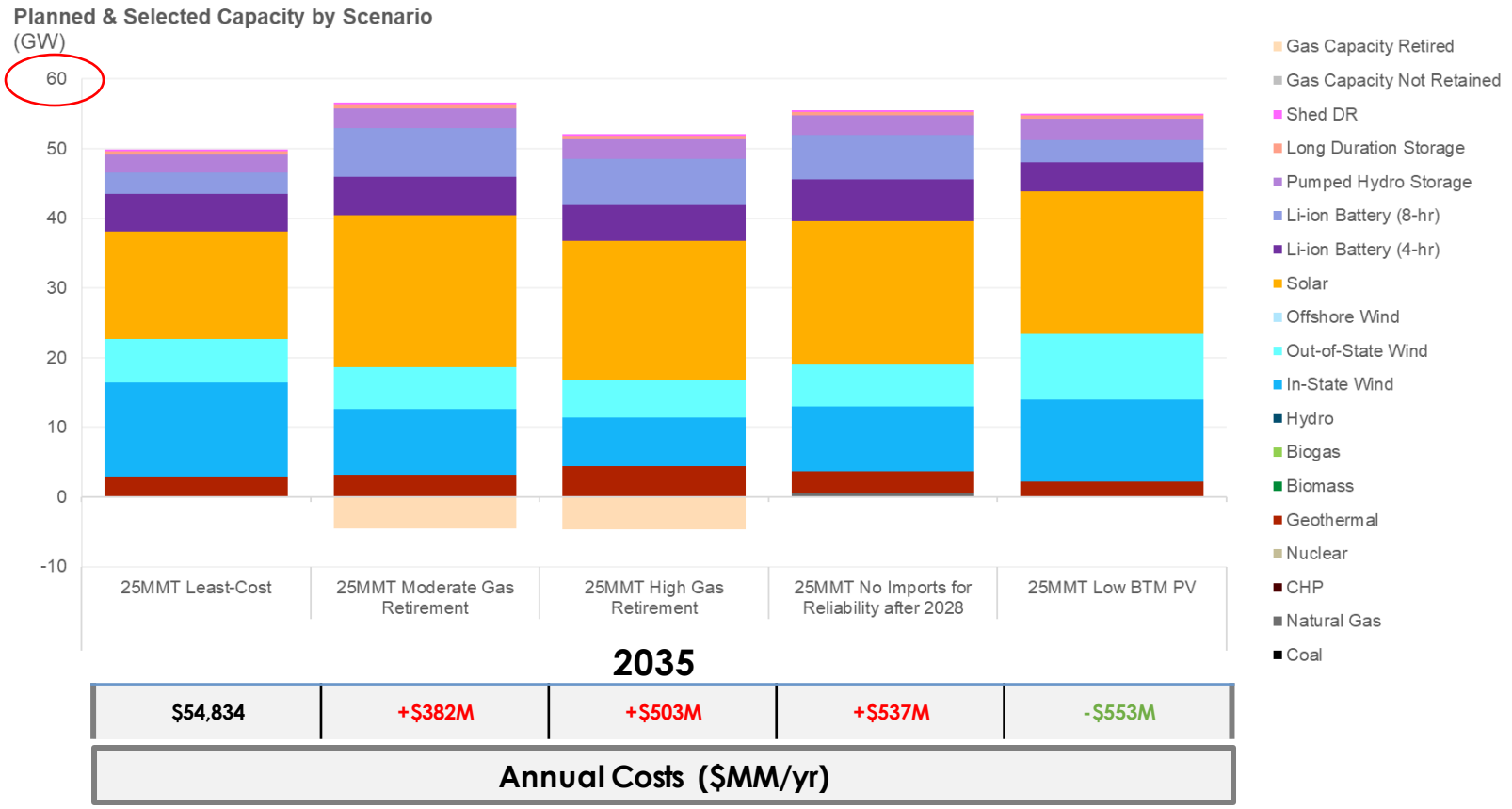
	Gas Capacity Retired by 2030	Gas Capacity Retired by 2045	Unspecified Imports Assumed for RA	BTM PV Capacity by 2045
25 MMT Least-Cost	0 GW	0 GW	4 GW	44 GW
Moderate Gas Retirement	4.2 GW	4.5 GW	4 GW	44 GW
High Gas Retirement	3.1 GW	12.1 GW	4 GW	44 GW
No Imports for Reliability after 2028	0 GW	0 GW	0 GW (after 2028)	44 GW
Low BTM PV	0 GW	0 GW	4 GW	31 GW

Red indicates a difference from 25 MMT Least-Cost

25 MMT Least-Cost vs Resource Availability Sensitivities: 2035

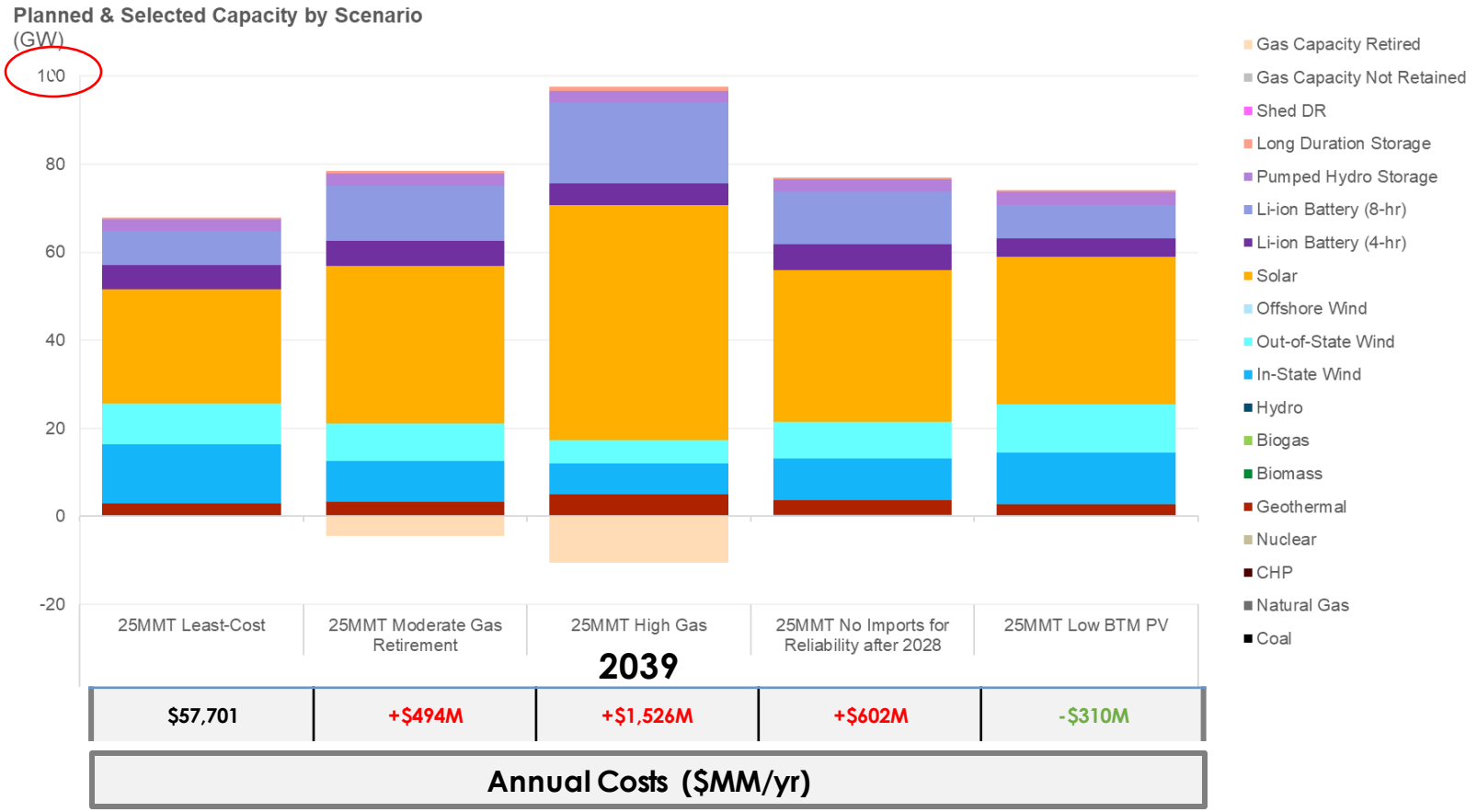
- In cases with higher gas retirement, gas (along with some wind) is replaced with solar and 8-hr battery storage
- No imports for reliability after 2028 also leads to more solar and 8-hr storage build, as well as 0.5 GW new gas
- Low BTM PV results in more utility-scale solar and 4-hour storage, as well as a shift from in-state to out-of-state wind
  - Cost savings shown for BTM PV include reduced customer costs for BTM PV

NPV of Total Resource Cost ($MM in 2022 Dollar Year, 2024-2065)	
25 MMT Least-Cost	$925,303 MM
25 MMT Moderate Gas Retirement	+$3,742MM
25 MMT High Gas Retirement	+$13,039MM
25 MMT No Imports for Reliability After 2028	+$5,469MM
25 MMT Low BTM PV	**-$5,073MM**



25 MMT Least-Cost vs Resource Availability Sensitivities: 2039

- Trends seen in 2035 are magnified in 2039
  - There is significantly more solar and 8-hr battery storage buildout in gas retirement and no import reliability sensitivities
  - Low BTM PV yields more utility-scale solar build



NPV of Total Resource Cost ($MM in 2022 Dollar Year, 2024-2065)	
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25 MMT No Imports for Reliability After 2028	+$5,469MM
25 MMT Low BTM PV	-$5,073MM

Key Takeaways

- Gas retirements provide little to no GHG emissions reductions benefits in these portfolios
  - While in-state gas generation goes down, it is replaced with imports (frequently gas plants in neighboring regions)
- Gas retirements increase costs, with higher levels of retirements increasing costs significantly more
- High gas retirement sensitivities and the no imports for reliability sensitivity lead to more solar and 8-hr duration battery storage build over time
- Gas retirement sensitivities were not analyzed to see if they would meet the local reliability requirements in LCR areas where gas generators are retired
  - Replacing firm capacity in local areas may be a challenge for the high gas retirements scenario
  - Long-duration storage may be able to replace some of the local capacity need
- BTM PV is largely replaced with utility-scale solar resources in the Low BTM PV sensitivity
  - Total resource costs are reduced as more expensive customer sited solar is replaced with lower cost utility scale solar

Long Lead-Time Sensitivities

Long-Lead Time sensitivities focus on offshore wind and explore how resource costs and availability impact offshore wind resource selection in the portfolio

Resource Availability and Cost Sensitivities

- Combinations of competing resource costs and resource availability are explored to identify major factors impacting offshore wind selection in the portfolio
- Given the high uncertainties in future costs and resource additions, this set of sensitivities explores situations where offshore wind selection in the portfolio is economically justified

Long Lead-Time Resource Sensitivities: Offshore Wind

Definitions

New Cases
Cases included in PSP/TPP Ruling materials

▲ Indicates cost increase
▼ Indicates cost reduction

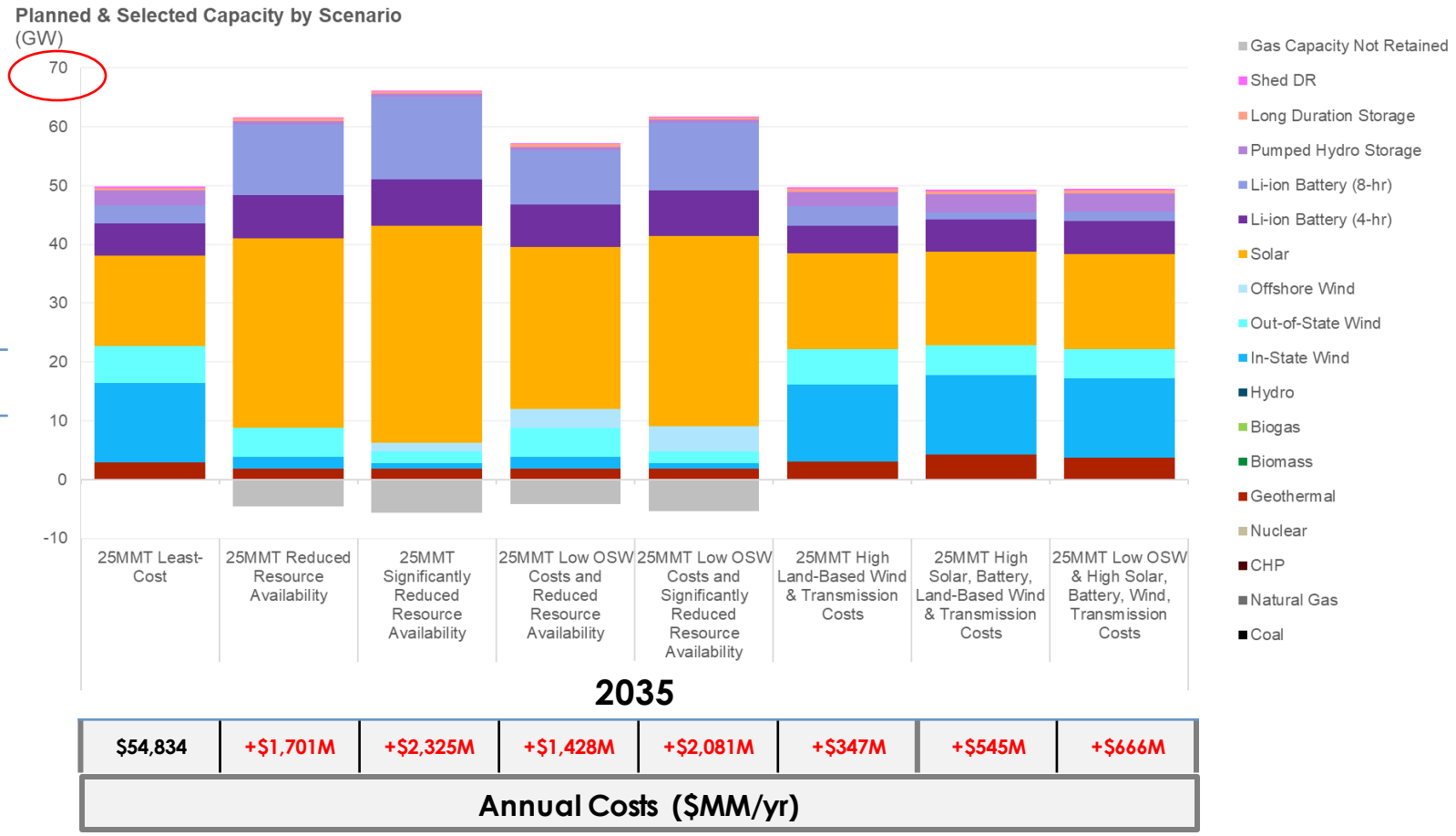
	Offshore Wind Costs	Land-Based Wind & Transmission Costs	Solar & Battery Costs	Land-Based Wind Resource Build Limits by 2035	Geothermal, Biomass & Pumped Hydro Resource Build Limits by 2035
25 MMT Least-Cost				**25.6 GW**	**9.7 GW**
Reduced Resource Availability (non-OSW resources)				**7 GW**	**3.5 GW**
Significantly Reduced Resource Availability (non-OSW resources)				**3 GW**	**3.5 GW**
Low OSW Costs & Reduced Resource Availability	▼			**7 GW**	**3.5 GW**
Low OSW Costs & Significantly Reduced Resource Availability	▼			**3 GW**	**3.5 GW**
High Land-Based Wind & Transmission Costs		▲		**25.6 GW**	**9.7 GW**
High Solar, Battery, Land-Based Wind & Transmission Costs		▲	▲	**25.6 GW**	**9.7 GW**
Low OSW & High Solar, Battery, Land-Based Wind, Transmission Costs	▼	▲	▲	**25.6 GW**	**9.7 GW**

Long Lead-Time Resource Sensitivities: Offshore Wind

25 MMT Least-Cost vs LLT Sensitivities: 2035

- With low offshore wind costs and significantly reduced resource availability (non-OSW resources), up to 4.3 GW offshore wind gets selected by 2035
- Higher competing resource costs alone do not result in offshore wind selection
- Reduced resource availability impacting land-based wind, geothermal, pumped storage and biomass, is resulting in substantially higher solar and 8-hr battery builds and non-retained gas

NPV of Total Resource Cost ($MM in 2022 Dollar Year, 2024-2065)	
25 MMT Least-Cost	$925,303 MM
25 MMT Reduced Resource Availability	+$17,146 MM
25 MMT Significantly Reduced Resource Availability	+$24,846 MM
25 MMT Low OSW Costs & Reduced Resource Availability	+$14,764 MM
25 MMT Low OSW Costs & Significantly Reduced Resource Availability	+$21,640 MM
25 MMT High Land-Based Wind & Transmission Costs	+$4,153 MM
25MMT High Solar, Battery, Land-Based Wind & Transmission Costs	+$17,433 MM
25 MMT Low OSW & High Solar, Battery, Land-Based Wind, Transmission Costs	+$14,784 MM



Long Lead-Time Resource Sensitivities: Offshore Wind

25 MMT Least-Cost vs LLT Sensitivities: 2045

- With low offshore wind costs and significantly reduced resource availability (non-OSW resources), up to 5.8 GW offshore wind gets selected by 2045
- Except for the case where offshore wind costs are low and other competing resource costs are high, no additional wind gets selected post 2039 through 2045

NPV of Total Resource Cost ($MM in 2022 Dollar Year, 2024-2065)	
25 MMT Least-Cost	$925,303 MM
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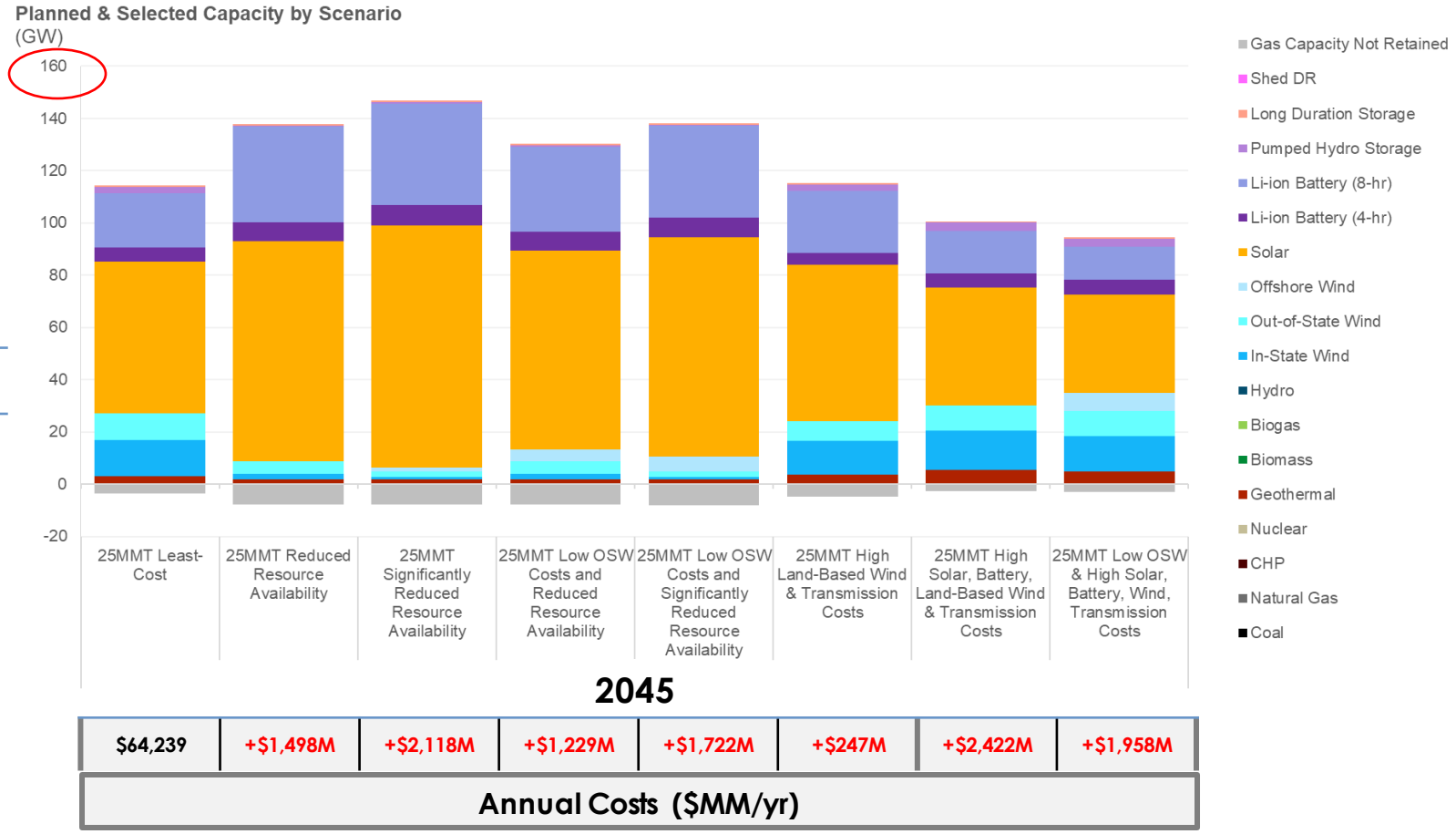

Long Lead-Time Resource Sensitivities: Offshore Wind

25 MMT Least-Cost vs LLT Sensitivities: 2039

- With low offshore wind costs and significantly reduced resource availability (non-OSW resources), up to 5.8 GW offshore wind gets selected by 2039
- Increased amount of storage, particularly 8-hr duration battery storage, leads to less gas capacity being retained relative to the least-cost portfolio

NPV of Total Resource Cost ($MM in 2022 Dollar Year, 2024-2065)	
25 MMT Least-Cost	$925,303 MM
25 MMT Reduced Resource Availability	+$17,146 MM
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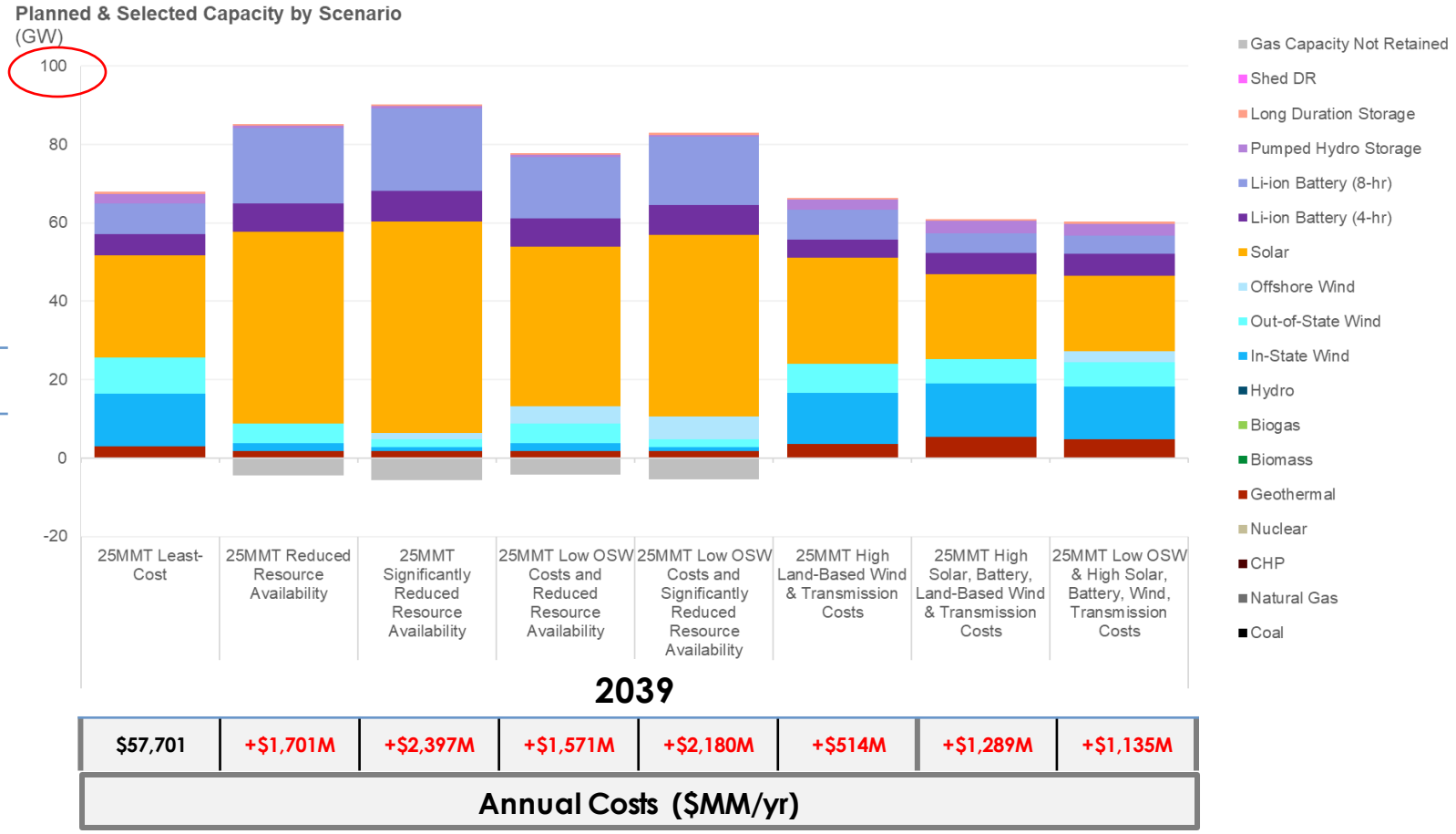


Key Takeaways

- High cost for competing resources alone does not result in offshore wind economic selection in the portfolio
- By reducing competing resource availability for land-based wind, geothermal, biomass and pumped storage, more solar and storage are selected, and more gas is not retained. However, the impact on the amount of offshore wind selected is minimal
  - The reduced resource availability (non-OSW resources) case does not have any offshore wind selection while the significantly reduced resource availability (non-OSW resources) has about 1.5 GW through 2045.
- Offshore wind selection is most sensitive to offshore wind costs
  - The most impact in the selection of offshore wind is seen when the cost of offshore wind is reduced
  - Even more offshore wind is selected when this is combined with other factors such as cost of competing resources and the availability of the competing resources

Detailed RESOLVE Results

25 MMT Least-Cost

Planned & Selected Capacity (GW)

Resource Category	2024	2025	2026	2028	2030	2032	2033	2034	2035	2039	2040	2045
Natural Gas	-	-	-	-	-	-	-	-	-	-	-	-
Geothermal	-	-	0.2	1.6	1.6	2.1	2.1	3.0	3.0	3.0	3.0	3.0
Biomass	-	-	-	-	-	-	-	-	-	-	-	-
In-State Wind	-	-	-	0.1	9.6	11.8	12.5	12.5	13.4	13.4	13.4	13.8
Out-of-State Wind	-	-	2.4	3.9	4.3	4.3	4.3	5.4	6.4	9.3	9.3	10.2
Offshore Wind	-	-	-	-	-	-	-	-	-	-	-	-
Solar	3.0	6.0	7.7	9.4	9.4	14.0	15.3	15.3	15.3	25.9	29.3	58.1
Li-ion Battery (4-hr)	4.1	4.4	5.4	5.4	5.4	5.4	5.4	5.4	5.4	5.4	5.4	5.4
Li-ion Battery (8-hr)	-	-	-	-	-	0.1	1.6	1.6	3.1	7.8	9.6	20.8
Pumped Hydro Storage	-	-	-	2.0	2.0	2.5	2.5	2.5	2.5	2.5	2.5	2.5
Long Duration Storage	-	-	-	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5
Shed DR	0.3	0.3	0.5	0.6	0.6	0.6	0.6	0.3	0.3	-	-	-
Gas Capacity Not Retained	-	-	-	-	-	-	-	-	-	-	-	*(3.6)*
Total	**7.4**	**10.7**	**16.1**	**23.5**	**33.4**	**41.3**	**44.9**	**46.5**	**49.9**	**67.9**	**73.1**	**110.8**

Detailed RESOLVE Results: Resource Cost Sensitivities

Resource Cost Sensitivity: High Battery Costs

Planned & Selected Capacity (GW)

Resource Category	2024	2025	2026	2028	2030	2032	2033	2034	2035	2039	2040	2045
Natural Gas	-	-	-	-	-	-	-	-	-	-	-	-
Geothermal	-	-	0.2	1.5	1.5	2.1	2.1	2.9	2.9	3.9	3.9	3.9
Biomass	-	-	-	-	-	-	-	-	-	-	-	-
In-State Wind	-	-	-	0.3	9.8	11.7	12.5	12.5	13.4	13.4	13.4	15.0
Out-of-State Wind	-	-	2.4	3.9	4.3	4.3	4.3	5.4	6.4	8.6	8.6	14.1
Offshore Wind	-	-	-	-	-	-	-	-	-	-	-	-
Solar	3.0	6.0	7.9	9.5	9.5	14.8	15.8	15.8	15.8	24.7	27.9	46.4
Li-ion Battery (4-hr)	3.9	4.3	5.2	5.2	5.2	5.2	5.2	5.2	5.2	5.2	5.2	5.2
Li-ion Battery (8-hr)	-	-	-	-	-	-	0.9	0.9	2.4	5.4	7.3	14.0
Pumped Hydro Storage	-	-	-	2.1	2.1	2.5	3.1	3.1	3.1	3.1	3.1	3.1
Long Duration Storage	-	-	-	0.5	0.5	0.5	0.5	0.5	0.5	0.9	0.9	0.9
Shed DR	0.5	0.5	0.7	0.7	0.7	0.7	0.7	0.3	0.3	-	-	-
Gas Capacity Not Retained	-	-	-	-	-	-	-	-	-	-	-	*(1.0)*
Total	**7.4**	**10.7**	**16.3**	**23.7**	**33.7**	**41.8**	**45.2**	**46.6**	**50.0**	**65.2**	**70.3**	**101.5**

Resource Cost Sensitivity: High Solar PV Costs

Planned & Selected Capacity (GW)

Resource Category	2024	2025	2026	2028	2030	2032	2033	2034	2035	2039	2040	2045
Natural Gas	-	-	-	-	-	-	-	-	-	-	-	-
Geothermal	-	-	0.4	1.5	1.5	2.1	2.1	2.9	2.9	3.5	3.9	3.9
Biomass	-	-	-	-	-	-	-	-	-	-	-	-
In-State Wind	0.0	0.0	0.0	0.0	7.9	11.9	12.3	12.3	13.2	13.2	13.2	13.8
Out-of-State Wind	-	-	1.8	3.3	4.3	4.3	4.3	4.8	5.8	9.3	9.3	11.7
Offshore Wind	-	-	-	-	-	-	-	-	-	-	-	-
Solar	3.0	6.0	9.0	12.9	12.9	14.7	17.2	17.2	17.2	22.5	24.6	46.0
Li-ion Battery (4-hr)	3.5	3.9	4.7	4.7	4.7	4.7	4.7	4.7	4.7	4.7	4.7	4.7
Li-ion Battery (8-hr)	-	-	-	-	-	0.1	1.4	1.8	3.2	7.7	9.1	19.1
Pumped Hydro Storage	-	-	-	2.1	2.1	2.6	2.6	2.6	2.6	2.6	2.6	2.6
Long Duration Storage	-	-	-	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5
Shed DR	0.8	0.8	1.0	1.1	1.1	1.1	1.1	0.3	0.3	-	-	-
Gas Capacity Not Retained	-	-	-	-	-	-	-	-	-	-	-	*(2.1)*
Total	**7.4**	**10.7**	**16.9**	**26.1**	**35.0**	**41.9**	**46.2**	**47.1**	**50.5**	**64.1**	**67.9**	**100.2**

Resource Cost Sensitivity: High Solar PV & Battery Costs

Planned & Selected Capacity (GW)

Resource Category	2024	2025	2026	2028	2030	2032	2033	2034	2035	2039	2040	2045
Natural Gas	-	-	-	-	-	-	-	-	-	-	-	-
Geothermal	-	-	0.3	1.5	1.5	2.0	2.0	2.8	2.9	3.9	3.9	3.9
Biomass	-	-	-	-	-	-	-	-	-	-	-	-
In-State Wind	-	-	-	-	8.0	11.7	12.2	12.2	13.1	13.1	13.1	15.0
Out-of-State Wind	-	-	2.5	4.0	4.3	4.3	4.3	5.5	6.5	9.4	9.4	17.2
Offshore Wind	-	-	-	-	-	-	-	-	-	-	-	-
Solar	3.0	6.0	9.0	12.6	12.6	14.6	16.4	16.4	16.4	21.9	24.6	36.1
Li-ion Battery (4-hr)	4.1	4.4	5.1	5.1	5.1	5.1	5.1	5.1	5.1	5.1	5.1	5.1
Li-ion Battery (8-hr)	-	-	-	-	-	-	1.2	1.2	2.5	6.0	7.9	11.7
Pumped Hydro Storage	-	-	-	2.1	2.1	2.7	3.1	3.1	3.1	3.1	3.1	3.1
Long Duration Storage	-	-	-	0.5	0.5	0.5	0.5	0.5	0.5	0.9	0.9	0.9
Shed DR	0.3	0.3	0.5	0.6	0.6	0.6	0.6	0.3	0.3	-	-	-
Gas Capacity Not Retained	-	-	-	-	-	-	-	-	-	-	-	*(0.2)*
Total	**7.4**	**10.7**	**17.4**	**26.4**	**34.7**	**41.7**	**45.4**	**47.0**	**50.4**	**63.5**	**68.0**	**92.8**

Resource Cost Sensitivity: High Land-Based Wind Costs

Planned & Selected Capacity (GW)

Resource Category	2024	2025	2026	2028	2030	2032	2033	2034	2035	2039	2040	2045
Natural Gas	-	-	-	-	-	-	-	-	-	-	-	-
Geothermal	-	-	0.2	1.6	1.6	2.1	2.1	3.0	3.0	3.0	3.0	3.0
Biomass	-	-	-	-	-	-	-	-	-	-	-	-
In-State Wind	0.1	0.1	0.4	0.8	10.5	12.1	12.1	12.1	13.0	13.0	13.0	13.0
Out-of-State Wind	-	-	2.5	4.0	4.3	4.3	4.3	5.5	6.5	8.9	8.9	9.9
Offshore Wind	-	-	-	-	-	-	-	-	-	-	-	-
Solar	3.0	6.0	7.0	8.7	8.7	13.8	15.5	15.5	15.5	25.8	29.6	55.5
Li-ion Battery (4-hr)	3.3	3.7	4.4	4.5	4.5	4.5	4.5	4.5	4.5	4.5	4.5	4.5
Li-ion Battery (8-hr)	-	-	-	-	-	0.4	2.0	2.1	3.5	8.4	10.2	22.5
Pumped Hydro Storage	-	-	-	2.0	2.0	2.5	2.5	2.5	2.5	2.5	2.5	2.5
Long Duration Storage	-	-	-	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5
Shed DR	1.0	1.0	1.2	1.3	1.3	1.3	1.3	0.3	0.3	-	-	-
Gas Capacity Not Retained	-	-	-	-	-	-	-	-	-	-	-	*(3.7)*
Total	**7.4**	**10.8**	**15.8**	**23.3**	**33.4**	**41.5**	**44.9**	**45.9**	**49.3**	**66.6**	**72.2**	**107.7**

Resource Cost Sensitivity: High Land-Based Wind, Solar PV & Battery Costs

Planned & Selected Capacity (GW)

Resource Category	2024	2025	2026	2028	2030	2032	2033	2034	2035	2039	2040	2045
Natural Gas	-	-	-	-	-	-	-	-	-	-	-	-
Geothermal	-	-	-	1.2	1.2	1.7	1.7	2.8	2.9	3.9	3.9	3.9
Biomass	-	-	-	-	-	-	-	-	-	-	-	-
In-State Wind	0.0	0.0	0.3	0.3	8.0	11.6	12.0	12.0	12.9	12.9	12.9	15.0
Out-of-State Wind	-	-	2.4	3.9	4.8	4.8	4.8	5.4	6.4	8.9	9.6	15.7
Offshore Wind	-	-	-	-	-	-	-	-	-	-	-	-
Solar	3.0	6.0	9.0	12.9	12.9	15.0	17.0	17.0	17.0	22.9	24.5	39.8
Li-ion Battery (4-hr)	4.1	4.4	5.4	5.4	5.4	5.4	5.4	5.4	5.4	5.4	5.4	5.4
Li-ion Battery (8-hr)	-	-	-	-	-	-	0.9	0.9	2.2	5.6	7.6	12.8
Pumped Hydro Storage	-	-	-	2.1	2.1	2.6	3.1	3.1	3.1	3.1	3.1	3.1
Long Duration Storage	-	-	-	0.5	0.5	0.5	0.5	0.5	0.5	0.9	0.9	0.9
Shed DR	0.3	0.3	0.5	0.6	0.6	0.6	0.6	0.3	0.3	-	-	-
Gas Capacity Not Retained	-	-	-	-	-	-	-	-	-	-	-	*(0.8)*
Total	**7.4**	**10.8**	**17.6**	**26.9**	**35.4**	**42.2**	**46.0**	**47.4**	**50.6**	**63.5**	**67.8**	**95.8**

Resource Cost Sensitivity: Low Offshore Wind Costs

Planned & Selected Capacity (GW)

Resource Category	2024	2025	2026	2028	2030	2032	2033	2034	2035	2039	2040	2045
Natural Gas	-	-	-	-	-	-	-	-	-	-	-	-
Geothermal	-	-	0.2	1.5	1.5	2.1	2.1	2.8	2.8	2.8	2.8	2.8
Biomass	-	-	-	-	-	-	-	-	-	-	-	-
In-State Wind	0.0	0.0	0.0	0.3	10.2	12.5	12.5	12.5	13.4	13.4	13.4	13.6
Out-of-State Wind	-	-	2.5	4.0	4.3	4.3	4.3	5.5	6.5	8.7	8.7	10.2
Offshore Wind	-	-	-	-	-	-	-	-	-	2.8	2.8	2.8
Solar	3.0	6.0	7.7	9.2	9.2	13.5	15.4	15.4	15.4	22.5	26.3	51.8
Li-ion Battery (4-hr)	3.3	3.7	4.5	4.5	4.5	4.5	4.5	4.5	4.5	4.5	4.5	4.5
Li-ion Battery (8-hr)	-	-	-	-	-	0.4	1.9	2.1	3.6	6.9	8.6	20.2
Pumped Hydro Storage	-	-	-	2.1	2.1	2.6	2.6	2.6	2.6	2.6	2.6	2.6
Long Duration Storage	-	-	-	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5
Shed DR	1.0	1.0	1.2	1.3	1.3	1.3	1.3	0.3	0.3	-	-	-
Gas Capacity Not Retained	-	-	-	-	-	-	-	-	-	-	-	*(3.7)*
Total	**7.4**	**10.7**	**16.2**	**23.4**	**33.6**	**41.7**	**45.1**	**46.2**	**49.7**	**64.8**	**70.2**	**105.2**

Resource Cost Sensitivity: Low Offshore Wind & High Land-Based Wind, Solar PV, Battery Costs

Planned & Selected Capacity (GW)

Resource Category	2024	2025	2026	2028	2030	2032	2033	2034	2035	2039	2040	2045
Natural Gas	-	-	-	-	-	-	-	-	-	-	-	-
Geothermal	-	-	-	1.2	1.2	1.7	1.7	2.9	2.9	3.4	3.9	3.9
Biomass	-	-	-	-	-	-	-	-	-	-	-	-
In-State Wind	0.0	0.0	0.3	0.3	7.9	11.7	12.2	12.2	13.1	13.1	13.1	13.8
Out-of-State Wind	-	-	2.0	3.5	4.8	4.8	4.8	5.0	6.0	8.6	8.6	16.4
Offshore Wind	-	-	-	-	-	-	-	-	-	2.8	3.8	5.5
Solar	3.0	6.0	9.0	13.0	13.0	14.7	17.1	17.1	17.1	19.8	19.9	30.9
Li-ion Battery (4-hr)	4.1	4.4	5.5	5.6	5.6	5.6	5.6	5.6	5.6	5.6	5.6	5.6
Li-ion Battery (8-hr)	-	-	-	-	-	-	0.7	0.7	2.2	5.0	5.5	7.6
Pumped Hydro Storage	-	-	-	2.1	2.1	2.5	3.1	3.1	3.1	3.1	3.1	3.1
Long Duration Storage	-	-	-	0.5	0.5	0.5	0.5	0.5	0.5	0.8	0.8	0.8
Shed DR	0.3	0.3	0.5	0.6	0.6	0.6	0.6	0.3	0.3	-	-	-
Gas Capacity Not Retained	-	-	-	-	-	-	-	-	-	-	-	-
Total	**7.4**	**10.8**	**17.4**	**26.8**	**35.5**	**42.1**	**46.2**	**47.3**	**50.7**	**62.0**	**64.2**	**87.6**

Resource Cost Sensitivity: High Geothermal & Biomass Costs

Planned & Selected Capacity (GW)

Resource Category	2024	2025	2026	2028	2030	2032	2033	2034	2035	2039	2040	2045
Natural Gas	-	-	-	-	-	-	-	-	-	-	-	-
Geothermal	-	-	-	0.9	0.9	0.9	0.9	0.9	0.9	0.9	0.9	0.9
Biomass	-	-	-	-	-	-	-	-	-	-	-	-
In-State Wind	0.0	0.0	0.0	0.5	10.2	12.8	12.8	12.8	13.7	13.7	13.7	13.8
Out-of-State Wind	-	-	2.5	4.0	5.0	5.0	5.0	7.0	8.0	10.7	10.7	12.0
Offshore Wind	-	-	-	-	-	-	-	-	-	-	-	-
Solar	3.0	6.0	7.7	9.8	9.8	16.2	18.5	18.5	18.5	28.7	31.9	58.5
Li-ion Battery (4-hr)	3.4	3.7	4.7	5.0	5.0	5.0	5.0	5.0	5.0	5.0	5.0	5.0
Li-ion Battery (8-hr)	-	-	-	-	-	0.4	2.5	3.0	4.6	9.9	11.9	23.6
Pumped Hydro Storage	-	-	-	2.2	2.2	2.7	2.7	2.7	2.7	2.7	2.7	2.7
Long Duration Storage	-	-	-	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5
Shed DR	1.0	1.0	1.2	1.3	1.3	1.3	1.3	0.3	0.3	-	-	-
Gas Capacity Not Retained	-	-	-	-	-	-	-	-	-	-	-	*(3.2)*
Total	**7.4**	**10.7**	**16.1**	**24.2**	**34.9**	**44.8**	**49.1**	**50.7**	**54.1**	**72.1**	**77.3**	**113.9**

Resource Cost Sensitivity: High Gas Fixed O&M Costs

Planned & Selected Capacity (GW)

Resource Category	2024	2025	2026	2028	2030	2032	2033	2034	2035	2039	2040	2045
Natural Gas	-	-	-	-	-	-	-	-	-	-	-	-
Geothermal	-	-	0.2	1.6	1.6	2.2	2.2	3.0	3.0	3.0	3.0	3.0
Biomass	-	-	-	-	-	-	-	-	-	-	-	-
In-State Wind	-	-	-	0.3	9.9	11.6	11.6	11.6	12.5	12.5	12.5	12.5
Out-of-State Wind	-	-	2.5	4.0	4.3	4.3	4.3	5.5	6.5	8.8	8.8	9.7
Offshore Wind	-	-	-	-	-	-	-	-	-	-	-	-
Solar	3.0	6.0	7.4	9.1	9.1	14.3	16.2	16.2	16.2	26.7	29.7	58.6
Li-ion Battery (4-hr)	3.7	4.2	5.0	5.0	5.0	5.0	5.0	5.0	5.0	5.0	5.0	5.0
Li-ion Battery (8-hr)	-	-	-	-	-	0.3	2.0	2.0	3.6	8.5	10.5	22.4
Pumped Hydro Storage	-	-	-	2.0	2.0	2.6	2.6	2.6	2.6	2.6	2.6	2.6
Long Duration Storage	-	-	-	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5
Shed DR	0.6	0.6	0.9	0.9	0.9	0.9	0.9	0.3	0.3	-	-	-
Gas Capacity Not Retained	*(0.6)*	*(0.6)*	*(0.6)*	*(0.6)*	*(0.6)*	*(0.6)*	*(0.6)*	*(0.6)*	*(0.6)*	*(0.6)*	*(0.6)*	*(5.4)*
Total	**6.8**	**10.2**	**15.2**	**22.7**	**32.8**	**41.1**	**44.7**	**46.0**	**49.5**	**67.1**	**72.0**	**108.8**

Detailed RESOLVE Results: Demand Sensitivities

Demand Sensitivities: High Electrification

Planned & Selected Capacity (GW)

Resource Category	2024	2025	2026	2028	2030	2032	2033	2034	2035	2039	2040	2045
Natural Gas	-	-	-	-	-	-	-	-	-	-	-	-
Geothermal	-	-	0.3	1.5	2.0	2.0	2.0	2.9	2.9	3.4	3.4	3.4
Biomass	-	-	-	-	-	-	-	-	-	-	-	-
In-State Wind	0.3	0.3	0.3	0.6	10.8	12.7	12.7	12.7	13.6	13.6	13.6	13.6
Out-of-State Wind	-	-	1.8	3.3	4.3	4.3	4.3	6.2	7.2	10.2	10.4	14.6
Offshore Wind	-	-	-	-	-	-	-	-	-	-	-	-
Solar	3.0	6.0	9.0	12.5	13.3	22.3	25.6	25.6	25.6	36.9	41.8	67.4
Li-ion Battery (4-hr)	4.0	4.4	5.3	5.3	5.3	5.3	5.3	5.3	5.3	5.3	5.3	5.3
Li-ion Battery (8-hr)	-	-	-	-	-	2.6	5.1	5.1	7.5	12.5	14.4	26.5
Pumped Hydro Storage	-	-	-	2.1	2.1	2.6	2.6	2.6	2.6	2.6	2.6	2.6
Long Duration Storage	-	-	-	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5
Shed DR	0.3	0.3	0.5	0.5	0.5	0.5	0.5	0.3	0.3	-	-	-
Gas Capacity Not Retained	-	-	-	-	-	-	-	-	-	-	-	*(3.3)*
Total	**7.7**	**11.0**	**17.2**	**26.3**	**38.9**	**53.0**	**58.7**	**61.1**	**65.5**	**85.1**	**92.1**	**130.6**

Demand Sensitivities: 2021 ATE

Planned & Selected Capacity (GW)

Resource Category	2024	2025	2026	2028	2030	2032	2033	2034	2035	2039	2040	2045
Natural Gas	-	-	-	-	-	-	-	-	-	-	-	-
Geothermal	-	-	0.8	1.8	1.8	2.4	2.4	3.2	3.2	3.8	3.8	3.8
Biomass	-	-	-	-	-	-	-	-	-	-	-	-
In-State Wind	0.3	0.4	0.4	0.7	8.6	11.0	11.0	11.0	11.9	11.9	11.9	12.8
Out-of-State Wind	-	-	2.5	4.0	4.3	4.3	4.3	5.8	6.8	9.7	9.7	15.7
Offshore Wind	-	-	-	-	-	-	-	-	-	-	-	-
Solar	3.0	6.0	9.0	11.4	11.4	17.4	20.0	20.0	20.5	43.4	52.1	71.7
Li-ion Battery (4-hr)	4.0	4.4	4.5	5.1	5.1	5.1	5.1	5.1	5.1	5.1	5.1	5.1
Li-ion Battery (8-hr)	-	-	-	-	-	1.0	3.1	3.7	5.8	15.8	18.9	26.8
Pumped Hydro Storage	-	-	-	1.8	1.8	2.4	2.4	2.4	2.4	2.4	2.4	2.4
Long Duration Storage	-	-	-	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5
Shed DR	0.3	0.3	0.5	0.6	0.6	0.6	0.6	0.3	0.3	-	-	-
Gas Capacity Not Retained	-	-	-	-	-	-	-	-	-	-	-	-
Total	**7.7**	**11.1**	**17.7**	**25.8**	**34.1**	**44.6**	**49.3**	**51.9**	**56.4**	**92.5**	**104.4**	**138.7**

Detailed RESOLVE Results: Resource Availability Sensitivities

Resource Availability Sensitivity: Moderate Gas Retirements

Planned & Selected Capacity (GW)

Resource Category	2024	2025	2026	2028	2030	2032	2033	2034	2035	2039	2040	2045
Natural Gas	-	-	-	-	-	-	-	-	-	-	-	-
Geothermal	-	-	0.0	1.4	2.2	2.4	2.4	3.2	3.2	3.3	3.3	3.3
Biomass	-	-	-	-	-	-	-	-	-	-	-	-
In-State Wind	-	-	-	-	7.5	8.4	8.4	8.4	9.3	9.3	9.3	13.4
Out-of-State Wind	-	-	1.5	3.0	3.9	3.9	3.9	5.0	6.0	8.5	8.5	9.7
Offshore Wind	-	-	-	-	-	-	-	-	-	-	-	-
Solar	3.0	6.0	8.3	10.4	10.4	17.3	20.2	20.5	21.8	35.8	40.9	55.2
Li-ion Battery (4-hr)	4.1	5.6	5.6	5.6	5.6	5.6	5.6	5.6	5.6	5.6	5.6	5.6
Li-ion Battery (8-hr)	-	0.4	0.4	0.4	0.4	2.8	4.6	5.0	6.9	12.5	14.4	20.5
Pumped Hydro Storage	-	-	-	1.8	2.3	2.8	2.8	2.8	2.8	2.8	2.8	2.8
Long Duration Storage	-	0.2	0.2	0.7	0.7	0.7	0.7	0.7	0.7	0.7	0.7	0.7
Shed DR	0.3	0.3	0.3	0.5	0.5	0.5	0.5	0.2	0.2	-	-	-
Retired Gas Capacity	*(2.6)*	*(2.6)*	*(3.5)*	*(4.1)*	*(4.2)*	*(4.5)*	*(4.5)*	*(4.5)*	*(4.5)*	*(4.5)*	*(4.5)*	*(4.5)*
Total	**4.8**	**9.9**	**12.8**	**19.7**	**29.2**	**39.9**	**44.5**	**47.0**	**52.1**	**74.1**	**81.0**	**106.7**

Resource Availability Sensitivity: High Gas Retirement

Planned & Selected Capacity (GW)

Resource Category	2024	2025	2026	2028	2030	2032	2033	2034	2035	2039	2040	2045
Natural Gas	-	-	-	-	-	-	-	-	-	-	-	-
Geothermal	-	-	0.1	1.8	2.4	2.4	2.4	3.5	4.4	5.0	5.0	5.0
Biomass	-	-	-	-	-	-	-	-	-	-	-	-
In-State Wind	-	-	-	-	7.0	7.0	7.0	7.0	7.0	7.0	7.0	7.0
Out-of-State Wind	-	-	2.4	3.9	4.1	4.1	4.1	5.4	5.4	5.4	5.4	5.4
Offshore Wind	-	-	-	-	-	-	-	-	-	-	-	-
Solar	3.0	6.0	8.1	9.3	9.8	17.6	20.0	20.0	20.0	53.3	64.2	78.2
Li-ion Battery (4-hr)	3.8	4.1	5.1	5.1	5.1	5.1	5.1	5.1	5.1	5.1	5.1	5.1
Li-ion Battery (8-hr)	-	-	-	-	-	2.7	5.4	5.4	6.7	18.3	22.2	28.2
Pumped Hydro Storage	-	-	-	1.8	2.3	2.8	2.8	2.8	2.8	2.8	2.8	2.8
Long Duration Storage	-	-	-	0.5	0.5	0.5	0.5	0.5	0.5	0.9	0.9	0.9
Shed DR	0.6	0.6	0.8	0.9	0.9	0.9	0.9	0.3	0.3	-	-	-
Retired Gas Capacity	-	-	-	-	*(3.1)*	*(4.0)*	*(4.7)*	*(4.7)*	*(4.7)*	*(10.5)*	*(12.1)*	*(12.1)*
Total	**7.4**	**10.7**	**16.5**	**23.2**	**28.9**	**39.0**	**43.4**	**45.2**	**47.4**	**87.2**	**100.4**	**120.4**

Resource Availability Sensitivity: No Imports for Reliability After 2028

Planned & Selected Capacity (GW)

Resource Category	2024	2025	2026	2028	2030	2032	2033	2034	2035	2039	2040	2045
Natural Gas	-	-	-	-	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5
Geothermal	-	-	-	1.4	2.3	2.3	2.3	3.2	3.2	3.3	3.3	3.3
Biomass	-	-	-	-	-	-	-	-	-	-	-	-
In-State Wind	-	-	-	-	7.5	8.4	8.4	8.4	9.3	9.3	9.3	13.2
Out-of-State Wind	-	-	1.9	3.4	3.9	3.9	3.9	5.0	6.0	8.5	8.5	9.7
Offshore Wind	-	-	-	-	-	-	-	-	-	-	-	-
Solar	3.0	6.0	8.5	10.3	10.3	17.6	19.3	19.7	20.6	34.3	39.3	55.0
Li-ion Battery (4-hr)	4.1	4.4	5.7	6.0	6.0	6.0	6.0	6.0	6.0	6.0	6.0	6.0
Li-ion Battery (8-hr)	-	-	-	-	0.0	2.1	3.9	4.4	6.4	11.8	13.7	20.8
Pumped Hydro Storage	-	-	-	1.8	2.3	2.8	2.8	2.8	2.8	2.8	2.8	2.8
Long Duration Storage	-	-	-	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5
Shed DR	0.3	0.3	0.5	0.6	0.6	0.6	0.6	0.3	0.3	-	-	-
Gas Capacity Not Retained	-	-	-	-	-	-	-	-	-	-	-	-
Total	**7.4**	**10.7**	**16.6**	**23.9**	**33.8**	**44.7**	**48.2**	**50.7**	**55.6**	**77.0**	**84.0**	**111.8**

Resource Availability Sensitivity: Low BTM PV

Planned & Selected Capacity (GW)

Resource Category	2024	2025	2026	2028	2030	2032	2033	2034	2035	2039	2040	2045
Natural Gas	-	-	-	-	-	-	-	-	-	-	-	-
Geothermal	-	-	0.8	1.6	1.6	2.1	2.1	2.2	2.2	2.8	2.8	2.8
Biomass	-	-	-	-	-	-	-	-	-	-	-	-
In-State Wind	0.3	0.4	0.4	0.7	8.8	11.4	11.7	11.7	11.7	11.7	11.7	13.2
Out-of-State Wind	-	-	2.5	4.0	4.3	4.3	4.3	7.0	9.5	10.9	10.9	10.9
Offshore Wind	-	-	-	-	-	-	-	-	-	-	-	-
Solar	3.0	6.0	9.0	13.4	13.4	17.5	20.5	20.5	20.5	33.5	36.3	65.2
Li-ion Battery (4-hr)	3.3	3.7	3.7	4.1	4.1	4.1	4.1	4.1	4.1	4.1	4.1	4.1
Li-ion Battery (8-hr)	-	-	-	-	-	0.1	1.5	2.0	3.2	7.6	9.6	20.7
Pumped Hydro Storage	-	-	-	2.0	2.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0
Long Duration Storage	-	-	-	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5
Shed DR	1.0	1.0	1.2	1.2	1.2	1.2	1.2	0.3	0.3	-	-	-
Gas Capacity Not Retained	-	-	-	-	-	-	-	-	-	-	-	*(2.8)*
Total	**7.6**	**11.1**	**17.6**	**27.6**	**36.0**	**44.3**	**49.0**	**51.3**	**55.0**	**74.2**	**78.9**	**117.6**

Detailed RESOLVE Results: Long Lead Time Sensitivities

LLT Sensitivity: Reduced Resource Availability

Planned & Selected Capacity (GW)

Resource Category	2024	2025	2026	2028	2030	2032	2033	2034	2035	2039	2040	2045
Natural Gas	-	-	-	-	-	-	-	-	-	-	-	-
Geothermal	-	-	-	1.8	1.8	1.8	1.8	1.8	1.8	1.8	1.8	1.8
Biomass	-	-	-	-	-	-	-	-	-	-	-	-
In-State Wind	-	-	-	-	2.0	2.0	2.0	2.0	2.0	2.0	2.0	2.0
Out-of-State Wind	-	-	1.3	2.8	4.3	4.3	4.3	4.3	5.0	5.0	5.0	5.0
Offshore Wind	-	-	-	-	-	-	-	-	-	-	-	-
Solar	3.0	6.0	9.0	10.2	18.8	24.7	28.2	31.7	32.3	49.0	54.3	84.3
Li-ion Battery (4-hr)	4.1	4.4	5.9	7.2	7.2	7.2	7.2	7.2	7.2	7.2	7.2	7.2
Li-ion Battery (8-hr)	-	-	-	-	2.4	6.5	8.4	10.1	12.1	19.2	20.7	36.5
Pumped Hydro Storage	-	-	-	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5
Long Duration Storage	-	-	-	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5
Shed DR	0.3	0.3	0.5	0.5	0.5	0.5	0.5	0.2	0.2	-	-	-
Gas Capacity Not Retained	*(0.4)*	*(0.4)*	*(1.8)*	*(3.9)*	*(3.9)*	*(4.4)*	*(4.4)*	*(4.5)*	*(4.5)*	*(4.5)*	*(4.5)*	*(7.6)*
Total	**7.0**	**10.3**	**14.9**	**19.6**	**34.1**	**43.6**	**48.9**	**53.8**	**57.1**	**80.7**	**87.5**	**130.1**

LLT Sensitivity: Significantly Reduced Resource Availability

Planned & Selected Capacity (GW)

Resource Category	2024	2025	2026	2028	2030	2032	2033	2034	2035	2039	2040	2045
Natural Gas	-	-	-	-	-	-	-	-	-	-	-	-
Geothermal	-	-	0.4	1.8	1.8	1.8	1.8	1.8	1.8	1.8	1.8	1.8
Biomass	-	-	-	-	-	-	-	-	-	-	-	-
In-State Wind	-	-	-	-	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0
Out-of-State Wind	-	-	-	1.5	2.0	2.0	2.0	2.0	2.0	2.0	2.0	2.0
Offshore Wind	-	-	-	-	-	1.5	1.5	1.5	1.5	1.5	1.5	1.5
Solar	3.0	6.0	9.0	12.8	24.0	28.1	31.6	35.2	36.8	54.0	59.8	92.7
Li-ion Battery (4-hr)	4.3	4.6	6.3	7.9	7.9	7.9	7.9	7.9	7.9	7.9	7.9	7.9
Li-ion Battery (8-hr)	-	-	-	-	4.7	7.5	9.3	11.1	14.0	21.1	22.5	38.8
Pumped Hydro Storage	-	-	-	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5
Long Duration Storage	-	-	-	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5
Shed DR	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.0	0.0	-	-	-
Gas Capacity Not Retained	*(0.5)*	*(0.5)*	*(2.1)*	*(4.0)*	*(5.6)*	*(5.6)*	*(5.6)*	*(5.6)*	*(5.6)*	*(5.6)*	*(5.6)*	*(7.7)*
Total	**6.9**	**10.2**	**13.7**	**21.2**	**37.0**	**45.3**	**50.7**	**55.9**	**60.4**	**84.7**	**92.0**	**139.0**

LLT Sensitivity: Low Offshore Wind Costs & Reduced Resource Availability

Planned & Selected Capacity (GW)

Resource Category	2024	2025	2026	2028	2030	2032	2033	2034	2035	2039	2040	2045
Natural Gas	-	-	-	-	-	-	-	-	-	-	-	-
Geothermal	-	-	-	1.8	1.8	1.8	1.8	1.8	1.8	1.8	1.8	1.8
Biomass	-	-	-	-	-	-	-	-	-	-	-	-
In-State Wind	-	-	-	-	2.0	2.0	2.0	2.0	2.0	2.0	2.0	2.0
Out-of-State Wind	-	-	1.3	2.8	4.3	4.3	4.3	4.3	5.0	5.0	5.0	5.0
Offshore Wind	-	-	-	-	-	2.8	2.8	3.2	3.2	4.4	4.4	4.4
Solar	3.0	6.0	9.0	10.2	18.6	20.7	23.4	26.4	27.5	40.7	45.7	76.1
Li-ion Battery (4-hr)	4.1	4.4	5.9	7.2	7.2	7.2	7.2	7.2	7.2	7.2	7.2	7.2
Li-ion Battery (8-hr)	-	-	-	-	2.4	4.4	6.1	7.4	9.3	15.7	17.6	32.8
Pumped Hydro Storage	-	-	-	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5
Long Duration Storage	-	-	-	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5
Shed DR	0.3	0.3	0.5	0.5	0.5	0.5	0.5	0.2	0.2	-	-	-
Gas Capacity Not Retained	*(0.4)*	*(0.4)*	*(1.8)*	*(3.9)*	*(3.9)*	*(3.9)*	*(3.9)*	*(4.2)*	*(4.2)*	*(4.2)*	*(4.2)*	*(7.6)*
Total	**7.0**	**10.3**	**14.9**	**19.6**	**34.0**	**40.7**	**45.2**	**49.3**	**53.0**	**73.6**	**80.5**	**122.6**

LLT Sensitivity: Low Offshore Wind Costs & Significantly Reduced Resource Availability

Planned & Selected Capacity (GW)

Resource Category	2024	2025	2026	2028	2030	2032	2033	2034	2035	2039	2040	2045
Natural Gas	-	-	-	-	-	-	-	-	-	-	-	-
Geothermal	-	-	0.3	1.8	1.8	1.8	1.8	1.8	1.8	1.8	1.8	1.8
Biomass	-	-	-	-	-	-	-	-	-	-	-	-
In-State Wind	-	-	-	-	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0
Out-of-State Wind	-	-	-	1.5	2.0	2.0	2.0	2.0	2.0	2.0	2.0	2.0
Offshore Wind	-	-	-	-	-	2.8	3.3	4.3	4.3	5.8	5.8	5.8
Solar	3.0	6.0	9.0	12.9	23.9	26.0	28.2	31.2	32.4	46.2	51.3	83.8
Li-ion Battery (4-hr)	4.2	4.5	6.2	7.7	7.7	7.7	7.7	7.7	7.7	7.7	7.7	7.7
Li-ion Battery (8-hr)	-	-	-	-	4.8	6.5	8.1	8.5	11.5	17.4	19.3	34.9
Pumped Hydro Storage	-	-	-	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5
Long Duration Storage	-	-	-	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5
Shed DR	0.2	0.2	0.3	0.3	0.3	0.3	0.3	0.1	0.1	-	-	-
Gas Capacity Not Retained	*(0.5)*	*(0.5)*	*(2.0)*	*(3.9)*	*(5.4)*	*(5.4)*	*(5.4)*	*(5.4)*	*(5.4)*	*(5.4)*	*(5.4)*	*(8.0)*
Total	**6.9**	**10.3**	**13.8**	**21.3**	**37.2**	**43.7**	**48.0**	**52.2**	**56.4**	**77.6**	**84.6**	**130.1**

LLT Sensitivity: High Land-Based Wind & Transmission Costs

Planned & Selected Capacity (GW)

Resource Category	2024	2025	2026	2028	2030	2032	2033	2034	2035	2039	2040	2045
Natural Gas	-	-	-	-	-	-	-	-	-	-	-	-
Geothermal	-	-	0.8	1.6	1.6	2.1	2.1	3.0	3.0	3.5	3.5	3.5
Biomass	-	-	-	-	-	-	-	-	-	-	-	-
In-State Wind	0.2	0.2	0.5	0.9	10.2	12.0	12.2	12.2	13.1	13.1	13.1	13.1
Out-of-State Wind	-	-	0.5	3.6	4.3	4.3	4.3	5.1	6.1	7.4	7.4	7.4
Offshore Wind	-	-	-	-	-	-	-	-	-	-	-	-
Solar	3.0	6.0	7.7	9.1	9.1	14.0	16.3	16.3	16.3	27.1	31.4	59.8
Li-ion Battery (4-hr)	3.3	3.6	4.5	4.6	4.6	4.6	4.6	4.6	4.6	4.6	4.6	4.6
Li-ion Battery (8-hr)	-	-	-	-	-	0.2	1.7	1.9	3.4	7.7	9.5	23.8
Pumped Hydro Storage	-	-	-	2.0	2.0	2.5	2.5	2.5	2.5	2.5	2.5	2.5
Long Duration Storage	-	-	-	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5
Shed DR	1.0	1.0	1.2	1.3	1.3	1.3	1.3	0.3	0.3	-	-	-
Gas Capacity Not Retained	-	-	-	-	-	-	-	-	-	-	-	*(4.7)*
Total	**7.5**	**10.8**	**15.2**	**23.5**	**33.6**	**41.5**	**45.5**	**46.4**	**49.7**	**66.4**	**72.5**	**110.5**

LLT Sensitivity: High Solar, Battery, Land-Based Wind & Transmission Costs

Planned & Selected Capacity (GW)

Resource Category	2024	2025	2026	2028	2030	2032	2033	2034	2035	2039	2040	2045
Natural Gas	-	-	-	-	-	-	-	-	-	-	-	-
Geothermal	-	-	0.8	1.4	1.4	2.0	2.0	3.4	4.2	5.4	5.4	5.4
Biomass	-	-	-	-	-	-	-	-	-	-	-	-
In-State Wind	0.0	0.0	0.3	0.3	7.9	11.7	12.7	12.7	13.6	13.6	13.6	15.0
Out-of-State Wind	-	-	-	2.8	4.3	4.3	4.3	4.3	5.1	6.3	7.1	9.7
Offshore Wind	-	-	-	-	-	-	-	-	-	-	-	-
Solar	3.0	6.0	9.0	13.0	13.0	14.8	15.9	15.9	15.9	21.6	23.2	45.0
Li-ion Battery (4-hr)	4.1	4.4	5.4	5.5	5.5	5.5	5.5	5.5	5.5	5.5	5.5	5.5
Li-ion Battery (8-hr)	-	-	-	-	-	-	0.7	0.7	1.1	5.1	6.8	16.3
Pumped Hydro Storage	-	-	-	2.1	2.1	2.5	3.1	3.1	3.1	3.1	3.1	3.2
Long Duration Storage	-	-	-	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5
Shed DR	0.3	0.3	0.5	0.6	0.6	0.6	0.6	0.3	0.3	-	-	-
Gas Capacity Not Retained	-	-	-	-	-	-	-	-	-	-	-	*(2.5)*
Total	**7.4**	**10.8**	**16.1**	**26.3**	**35.3**	**41.8**	**45.3**	**46.4**	**49.3**	**61.0**	**65.3**	**98.0**

LLT Sensitivity: Low OSW & High Solar, Battery, Land-Based Wind, Transmission Costs

Planned & Selected Capacity (GW)

Resource Category	2024	2025	2026	2028	2030	2032	2033	2034	2035	2039	2040	2045
Natural Gas	-	-	-	-	-	-	-	-	-	-	-	-
Geothermal	-	-	0.7	1.5	1.5	2.3	2.3	3.7	3.8	4.7	4.7	4.7
Biomass	-	-	-	-	-	-	-	-	-	-	-	-
In-State Wind	0.0	0.0	0.3	0.3	8.0	11.7	12.6	12.6	13.5	13.5	13.5	13.8
Out-of-State Wind	-	-	-	2.5	4.0	4.0	4.0	4.0	5.0	6.3	7.1	9.6
Offshore Wind	-	-	-	-	-	-	-	-	-	2.8	3.8	6.9
Solar	3.0	6.0	9.0	13.1	13.1	14.4	16.1	16.1	16.1	19.2	19.3	37.6
Li-ion Battery (4-hr)	4.1	4.4	5.6	5.6	5.6	5.6	5.6	5.6	5.6	5.6	5.6	5.6
Li-ion Battery (8-hr)	-	-	-	-	-	-	0.4	0.4	1.6	4.6	5.4	12.7
Pumped Hydro Storage	-	-	-	2.1	2.1	2.3	3.1	3.1	3.1	3.1	3.1	3.1
Long Duration Storage	-	-	-	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5
Shed DR	0.3	0.3	0.5	0.6	0.6	0.6	0.6	0.3	0.3	-	-	-
Gas Capacity Not Retained	-	-	-	-	-	-	-	-	-	-	-	*(2.9)*
Total	**7.4**	**10.8**	**16.1**	**26.2**	**35.4**	**41.3**	**45.1**	**46.2**	**49.4**	**60.3**	**63.0**	**91.6**

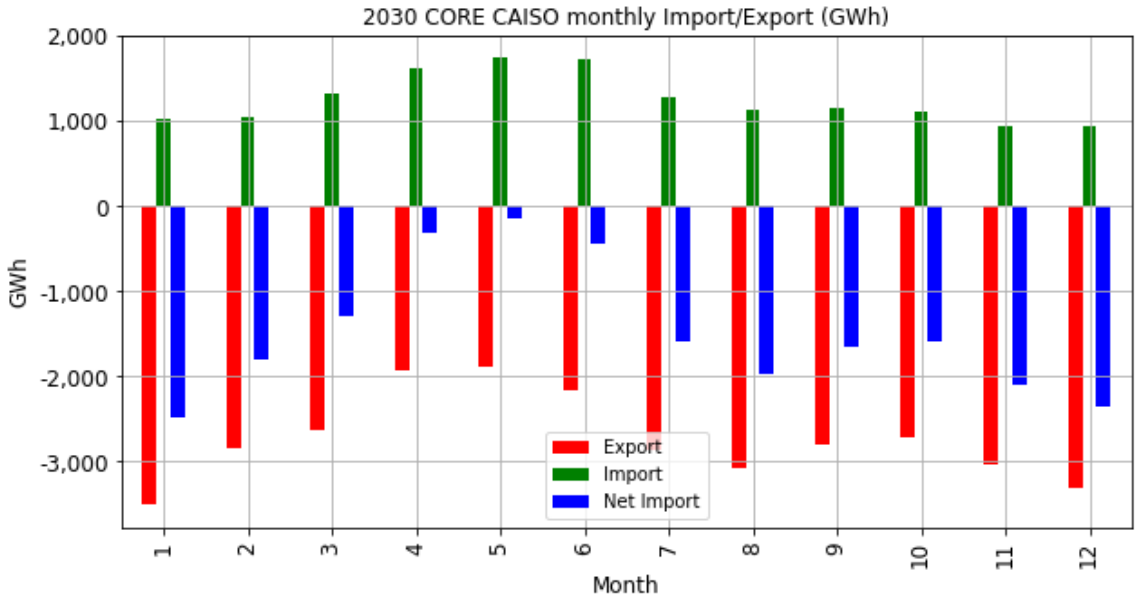
Imports and Exports

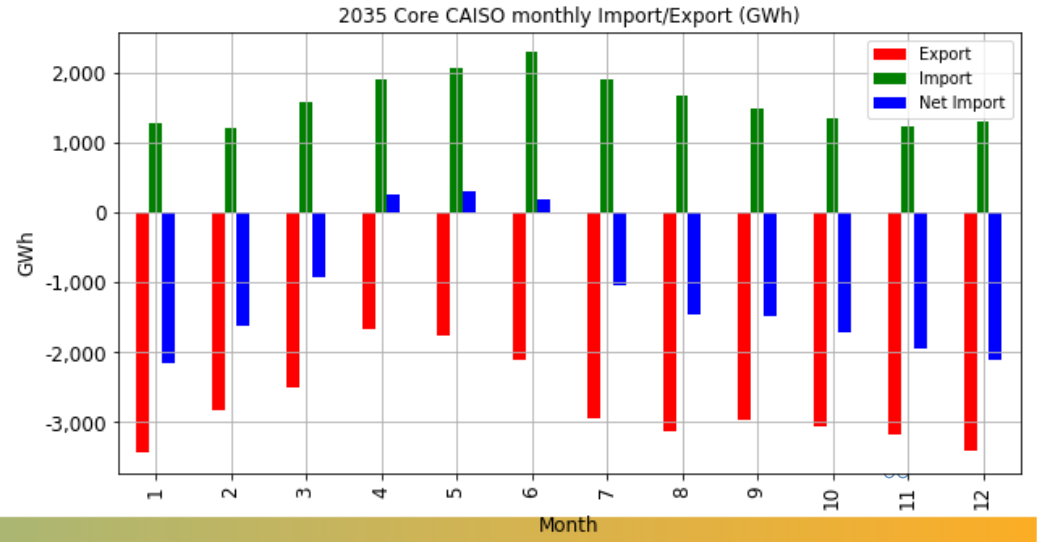
Background – import/export to CAISO regions

- Imports and exports have been calculated and analysed for all 6 studies (2026, 2030 and 2035 Core and Least Cost cases).
- Lowering the GHG target to 25MMT for the PSP analysis created a different resource portfolio, which led to changes in import and export patterns.
- The following slides show changes in future import/export patterns to CAISO.

Monthly Import/Export for 2030 and 2035 - Core Cases

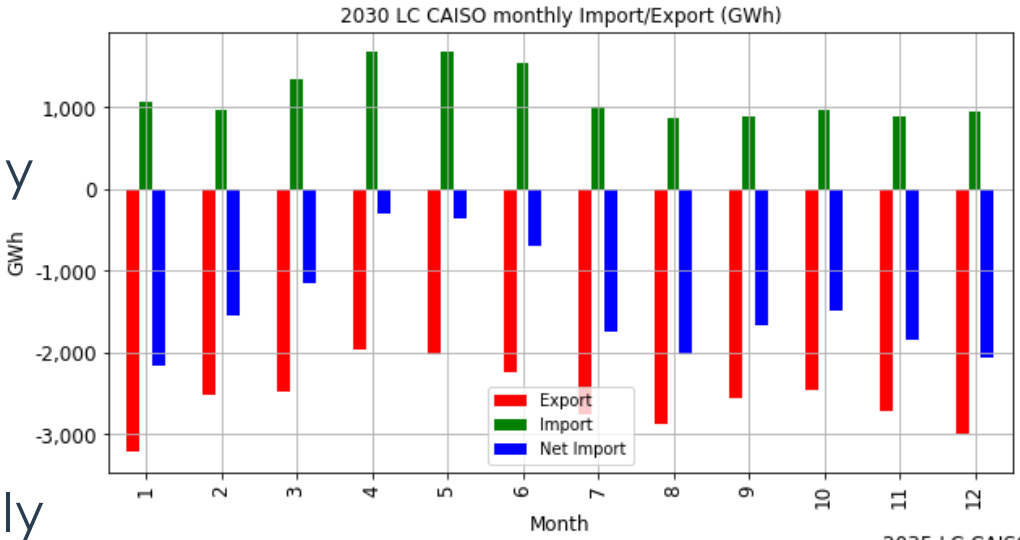
- Monthly exports in all months exceeds imports for 2030
- The analysis shows in 2030 CAISO will have mostly net exports
- This pattern changes in 2035 where the analysis shows net imports during months of April through June
- Highest imports happen between months of April to June in year 2030

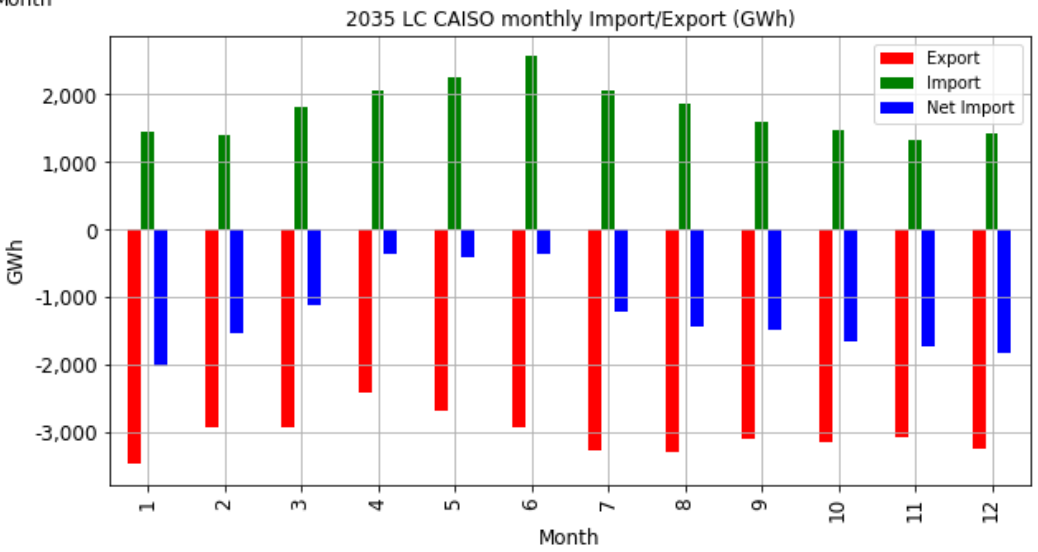




Monthly Import/Export for 2030 and 2035 - Least Cost Cases

- For all Least Cost cases, monthly exports in all months exceed imports
- The analysis shows that in 2030 and 2035 CAISO will have mostly net exports
- Highest imports happen during months of April to June.





Conclusions

- Monthly import/export results for both Core cases and Least Cost cases show an increase in imports during months of April to June compared to other months of the year. This trend can be seen in all study years.

- Most cases show a net export happening during all months of the year, though very small net export GWh during the spring, almost netting to zero in May and June.

- 2035 Core case shows that during months of April to June, net import is occurring, while in other periods interchange is net negative meaning net export is happening.