



# 2026 RESOURCE PLAN

COLUMBIA WATER & LIGHT  
APRIL 2026



# Agenda

- **Introductions**
- **Load and Power Forecasts**
- **Resource Options**
- **Existing Summer/Winter Load Balance**
- **Base Case**
- **Scenarios**
- **Discussion and Questions**

# INTRODUCTIONS

TEA  
THE Energy Authority



**JIM MYERS**  
Resource Planning Strategist, Sr



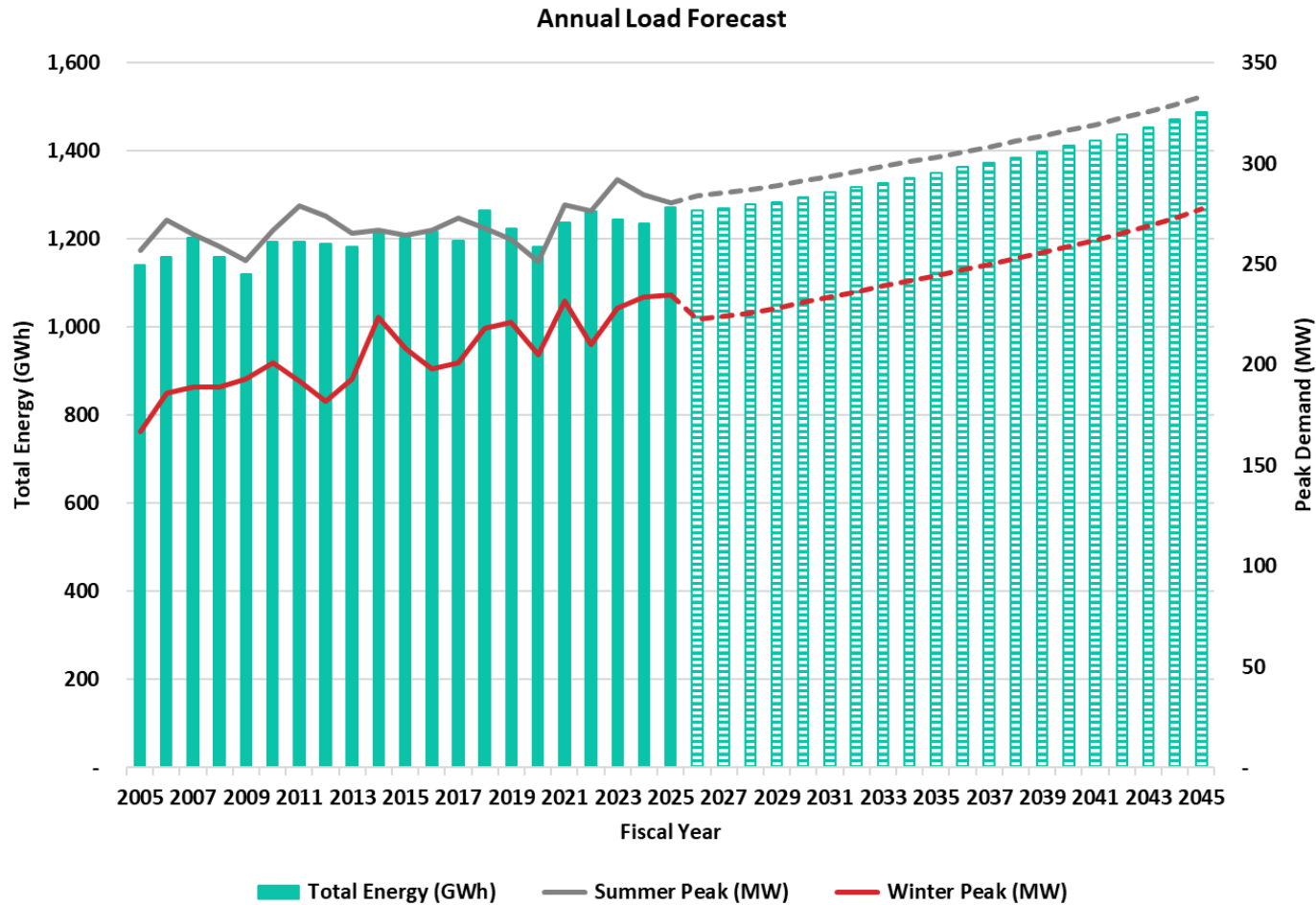
**MARQUEES KIMMEY**  
Portfolio Analyst



# Project Team

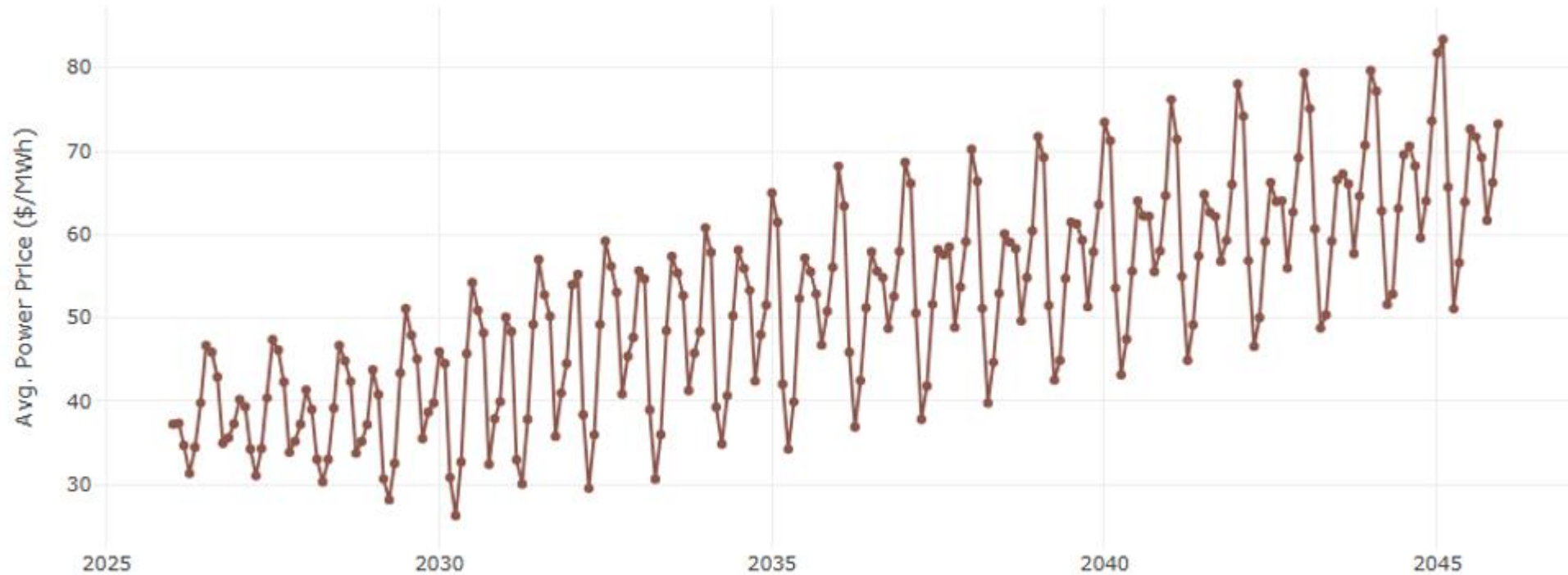
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	Ron Wyble
	Erin Keys
	Eric Worts
	Dawn Jennings
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	Brandon Williams
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	Damir Domazet
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# 2026 Annual Load Forecast



Fiscal Year	Total Energy (GWh)		Summer Peak Demand (MW)		Winter Peak Demand (MW)	
	History & Forecast	YoY Change (%)	History & Forecast	YoY Change (%)	History & Forecast	YoY Change (%)
2015	1,203	-1.6%	264	-1.0%	208	-7.1%
2016	1,216	1.1%	267	1.0%	198	-4.9%
2017	1,197	-1.6%	273	2.1%	201	1.6%
2018	1,265	5.7%	268	-1.8%	218	8.5%
2019	1,225	-3.2%	262	-2.1%	221	1.4%
2020	1,182	-3.5%	251	-4.2%	205	-7.2%
2021	1,238	4.7%	279	11.2%	232	13.2%
2022	1,262	2.0%	276	-1.1%	210	-9.5%
2023	1,244	-1.5%	292	5.6%	228	8.6%
2024	1,236	-0.6%	284	-2.6%	234	2.6%
2025	1,272	2.9%	281	-1.3%	235	0.3%
2026	1,265	-0.6%	284	1.1%	223	-5.2%
2027	1,270	0.5%	285	0.5%	224	0.7%
2028	1,278	0.6%	287	0.5%	226	0.7%
2029	1,285	0.5%	289	0.7%	228	1.1%
2030	1,295	0.8%	291	0.8%	231	1.3%
2031	1,306	0.9%	294	0.8%	234	1.2%
2032	1,319	0.9%	296	0.8%	236	1.0%
2033	1,328	0.7%	299	0.9%	239	1.2%
2034	1,339	0.8%	301	0.8%	242	1.1%
2035	1,350	0.8%	303	0.8%	245	1.1%
2036	1,363	1.0%	306	0.8%	247	1.1%
2037	1,373	0.7%	308	0.8%	250	1.1%
2038	1,385	0.9%	311	0.9%	253	1.1%
2039	1,398	0.9%	314	0.9%	256	1.2%
2040	1,413	1.1%	317	0.9%	259	1.3%
2041	1,424	0.8%	319	0.8%	262	1.2%
2042	1,438	1.0%	323	1.0%	266	1.4%
2043	1,454	1.1%	326	1.0%	269	1.4%
2044	1,473	1.3%	330	1.1%	273	1.5%
2045	1,489	1.0%	333	1.1%	278	1.6%

# Power Price Forecast - Average Monthly Pricing



- Increase in monthly average price swings over time, driven by growth in solar and wind generation across the MISO footprint.
  - Depressed average power prices during spring months, due to higher wind generation across MISO.
  - Peak in average pricing shifts from summer to winter months beginning in 2034.

# Resource Options

## Solar

Renewable generation sourced from utility-owned or contracted solar facilities.



## Natural Gas

Reliable, dispatchable, and flexible capacity and energy using gas turbines or internal combustion engines.



## Small Modular Reactor

Advanced nuclear technology for flexible energy generation.



## Wind

Renewable energy self-generated or purchased from wind farms.

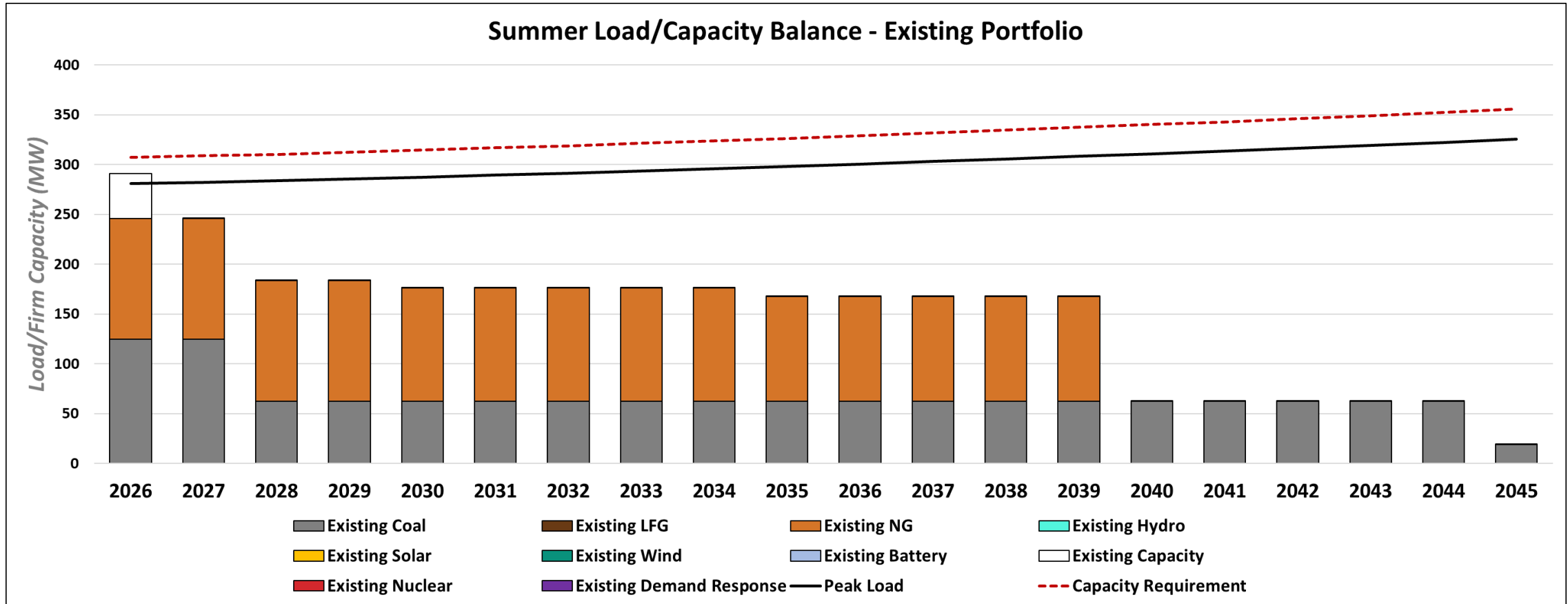


## Battery Storage

Storage operated by the utility to provide capacity and energy when needed.

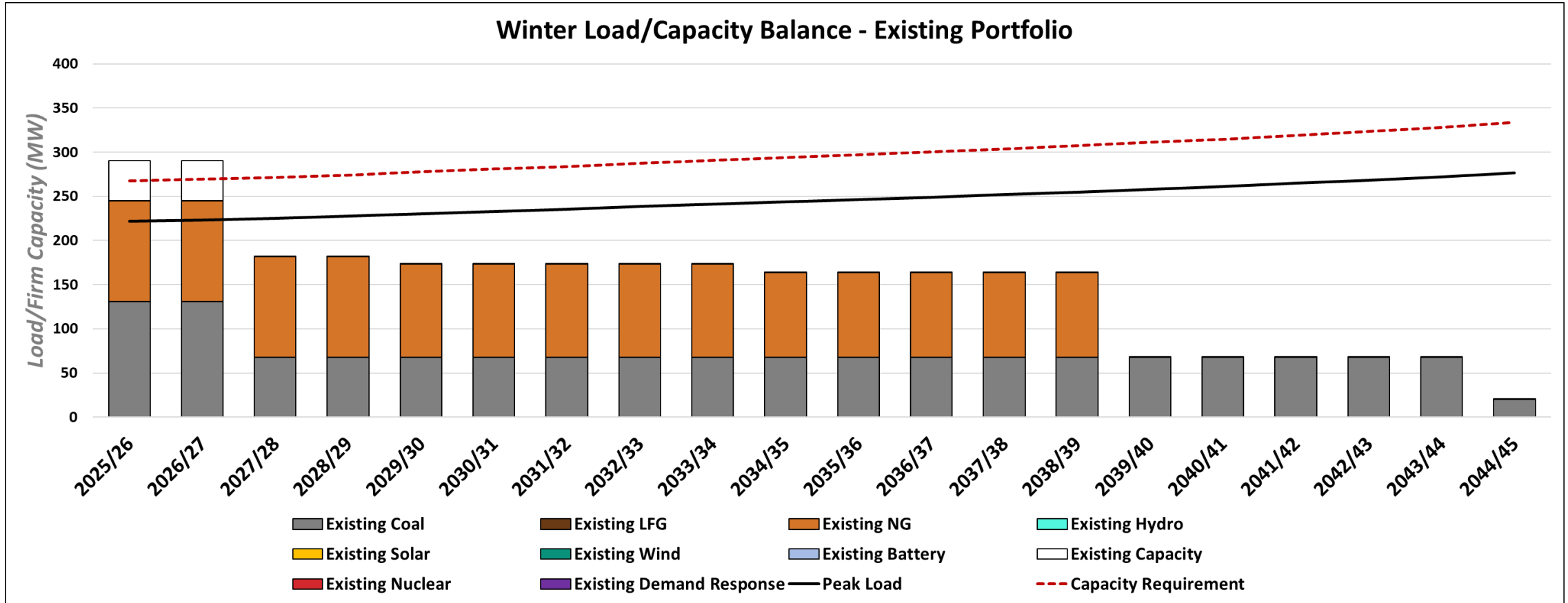


# Summer Load Balance



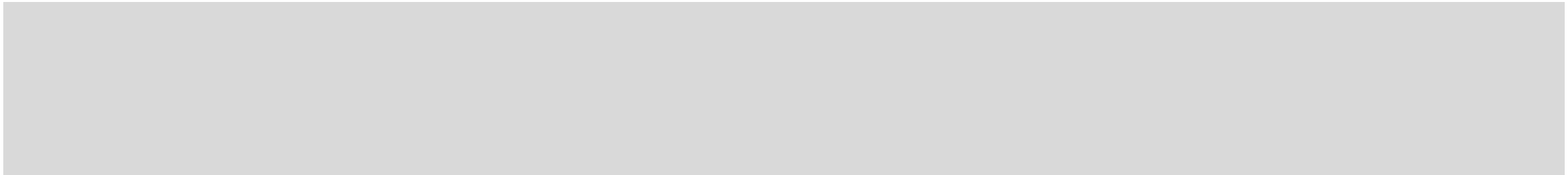
- Dynegy Capacity set to expire in 6/1/2027
- Sikeston set to retire in 2028
- CEC 1-4, D6, and D8 set to retire in 2039
- Coal contracts have no retirement date

# Winter Load Balance

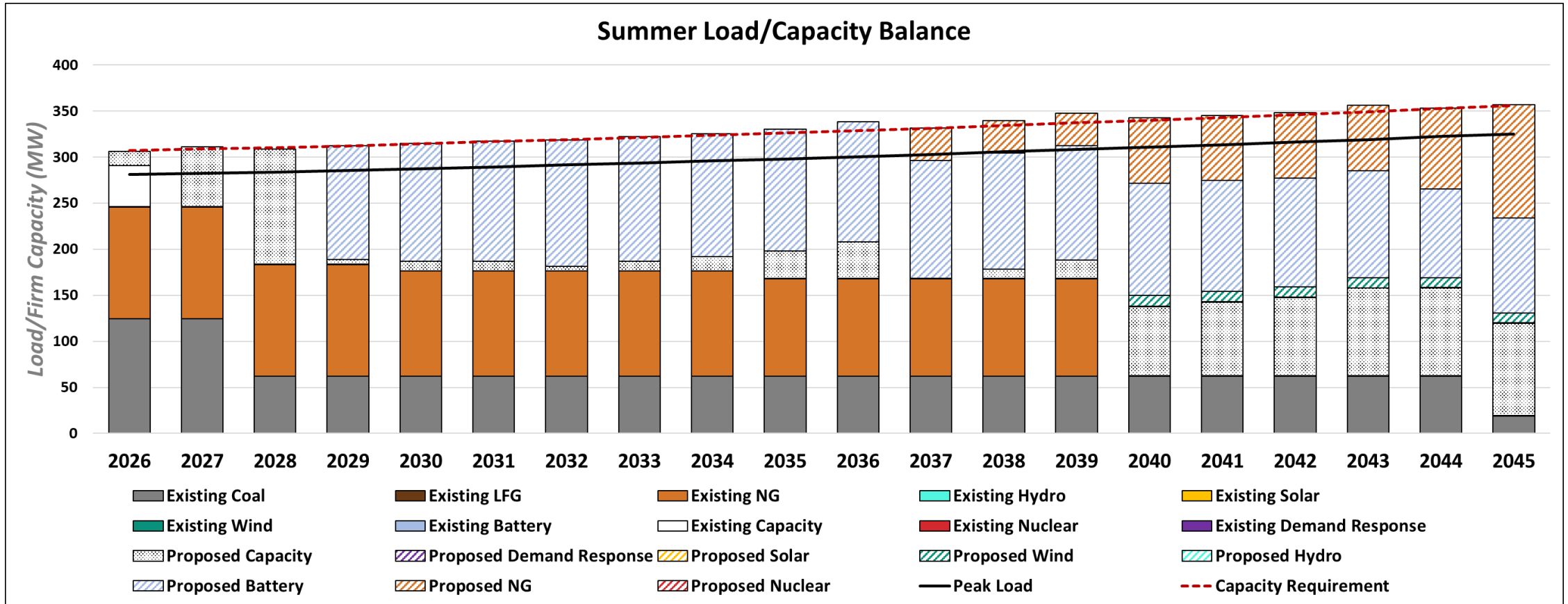


- Dynegy Capacity set to expire in 6/1/2027
- Sikeston set to retire in 2028
- CEC 1-4, D6, and D8 set to retire in 2039
- Coal contracts have no retirement date

# BASE CASE

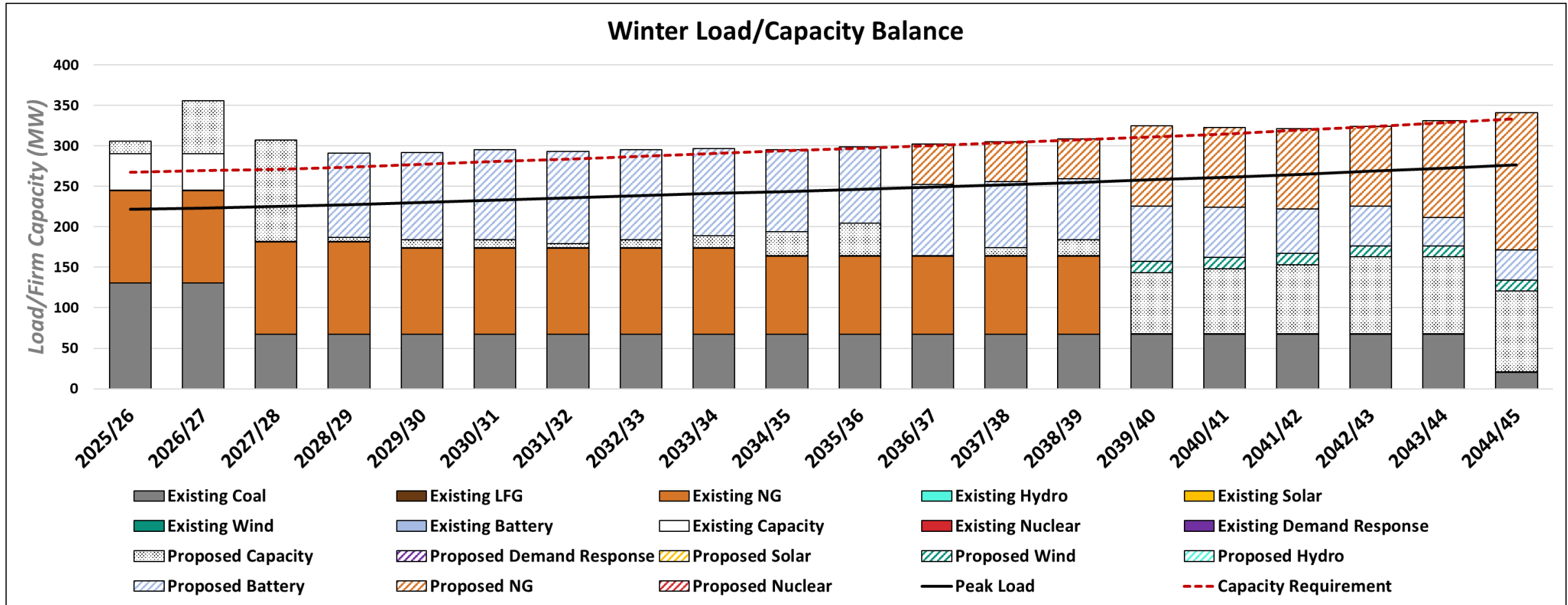


# Base Case - Summer Load Resource Balance



- Base Case build out with no restrictions consists of bilateral capacity, 4-hr batteries, wind, solar, and thermal (CC/CT)
- 120 MW of self build wind and 40 MW of self build solar to fulfill 40% carbon free requirement by 2040

# Base Case – Winter Load Resource Balance



- Base Case build out with no restrictions consists of bilateral capacity, 4-hr batteries, wind, solar, and thermal (CC/CT)
- 120 MW of self build wind and 40 MW of self build solar to fulfill 40% carbon free requirement by 2040

# Base Case - Annual Cost Table

Costs And Revenues (\$M)	2026	2027	2028	2029	2030	2031	2032	2033	2034	2035	2036	2037	2038	2039	2040	2041	2042	2043	2044	2045
Existing Fixed Costs	\$ 31.00	\$ 30.15	\$ 20.87	\$ 20.86	\$ 21.17	\$ 21.62	\$ 22.13	\$ 22.53	\$ 23.01	\$ 23.49	\$ 24.06	\$ 24.50	\$ 25.02	\$ 25.55	\$ 23.83	\$ 24.33	\$ 24.90	\$ 25.48	\$ 26.15	\$ 7.76
Existing Variable Costs	\$ 31.37	\$ 31.86	\$ 15.68	\$ 15.69	\$ 15.77	\$ 16.20	\$ 16.60	\$ 16.93	\$ 17.26	\$ 15.01	\$ 15.40	\$ 15.66	\$ 15.97	\$ 16.28	\$ 9.85	\$ 9.99	\$ 10.16	\$ 10.33	\$ 10.54	\$ 8.12
Existing Fuel Costs	\$ 0.29	\$ 0.29	\$ 0.29	\$ 0.07	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -
Existing Emission Costs	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -
<b>Total Existing Costs</b>	<b>\$ 62.66</b>	<b>\$ 62.29</b>	<b>\$ 36.83</b>	<b>\$ 36.62</b>	<b>\$ 36.95</b>	<b>\$ 37.82</b>	<b>\$ 38.73</b>	<b>\$ 39.46</b>	<b>\$ 40.27</b>	<b>\$ 38.51</b>	<b>\$ 39.46</b>	<b>\$ 40.16</b>	<b>\$ 40.99</b>	<b>\$ 41.83</b>	<b>\$ 33.69</b>	<b>\$ 34.32</b>	<b>\$ 35.06</b>	<b>\$ 35.81</b>	<b>\$ 36.69</b>	<b>\$ 15.89</b>
Proposed Capital Costs	\$ -	\$ -	\$ -	\$ 8.43	\$ 8.70	\$ 8.97	\$ 9.50	\$ 9.50	\$ 9.50	\$ 9.50	\$ 9.50	\$ 17.13	\$ 17.13	\$ 17.13	\$ 49.71	\$ 49.71	\$ 49.71	\$ 49.71	\$ 55.99	\$ 65.13
Proposed Fixed Costs	\$ 1.14	\$ 7.84	\$ 16.60	\$ 5.65	\$ 6.47	\$ 6.59	\$ 6.24	\$ 6.86	\$ 7.43	\$ 9.24	\$ 10.57	\$ 7.30	\$ 8.64	\$ 10.04	\$ 24.26	\$ 25.48	\$ 26.65	\$ 28.57	\$ 28.77	\$ 31.92
Proposed Variable Costs	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -	\$ 0.99	\$ 0.95	\$ 1.18	\$ 2.43	\$ 2.08	\$ 2.16	\$ 2.56	\$ 2.67	\$ 4.63
Proposed Fuel Costs	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -	\$ 8.45	\$ 8.05	\$ 10.14	\$ 21.15	\$ 18.03	\$ 18.71	\$ 22.06	\$ 22.77	\$ 39.74
Proposed Emission Costs	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -
<b>Total Proposed Costs</b>	<b>\$ 1.14</b>	<b>\$ 7.84</b>	<b>\$ 16.60</b>	<b>\$ 14.08</b>	<b>\$ 15.17</b>	<b>\$ 15.56</b>	<b>\$ 15.74</b>	<b>\$ 16.36</b>	<b>\$ 16.93</b>	<b>\$ 18.74</b>	<b>\$ 20.08</b>	<b>\$ 33.88</b>	<b>\$ 34.77</b>	<b>\$ 38.50</b>	<b>\$ 97.55</b>	<b>\$ 95.30</b>	<b>\$ 97.23</b>	<b>\$ 102.90</b>	<b>\$ 110.20</b>	<b>\$ 141.43</b>
<b>Gross Generation Costs</b>	<b>\$ 63.80</b>	<b>\$ 70.13</b>	<b>\$ 53.44</b>	<b>\$ 50.70</b>	<b>\$ 52.11</b>	<b>\$ 53.38</b>	<b>\$ 54.47</b>	<b>\$ 55.82</b>	<b>\$ 57.20</b>	<b>\$ 57.25</b>	<b>\$ 59.53</b>	<b>\$ 74.04</b>	<b>\$ 75.76</b>	<b>\$ 80.33</b>	<b>\$ 131.24</b>	<b>\$ 129.61</b>	<b>\$ 132.28</b>	<b>\$ 138.72</b>	<b>\$ 146.89</b>	<b>\$ 157.32</b>
Gross Market Energy Revenues	\$ 49.03	\$ 49.20	\$ 27.82	\$ 33.35	\$ 34.36	\$ 37.35	\$ 39.59	\$ 38.86	\$ 40.22	\$ 30.82	\$ 31.78	\$ 44.07	\$ 43.89	\$ 47.31	\$ 74.63	\$ 71.87	\$ 75.09	\$ 80.33	\$ 83.62	\$ 95.71
<b>Net Generation Cost</b>	<b>\$ 14.77</b>	<b>\$ 20.93</b>	<b>\$ 25.62</b>	<b>\$ 17.34</b>	<b>\$ 17.75</b>	<b>\$ 16.03</b>	<b>\$ 14.88</b>	<b>\$ 16.96</b>	<b>\$ 16.99</b>	<b>\$ 26.43</b>	<b>\$ 27.75</b>	<b>\$ 29.97</b>	<b>\$ 31.87</b>	<b>\$ 33.02</b>	<b>\$ 56.61</b>	<b>\$ 57.74</b>	<b>\$ 57.20</b>	<b>\$ 58.39</b>	<b>\$ 63.27</b>	<b>\$ 61.61</b>
Load																				
Gross Market Energy Costs	\$ 47.49	\$ 48.10	\$ 47.62	\$ 54.61	\$ 57.15	\$ 62.43	\$ 67.29	\$ 66.89	\$ 71.00	\$ 73.42	\$ 76.16	\$ 78.70	\$ 80.67	\$ 83.79	\$ 86.55	\$ 89.03	\$ 93.02	\$ 96.14	\$ 99.23	\$ 104.03
Charges for Unmet/Unserved	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -
Total Load in GWh	1,257	1,262	1,269	1,275	1,285	1,294	1,304	1,313	1,323	1,333	1,346	1,355	1,367	1,379	1,394	1,403	1,416	1,430	1,448	1,460
<b>Gross Load Cost</b>	<b>\$ 47.49</b>	<b>\$ 48.10</b>	<b>\$ 47.62</b>	<b>\$ 54.61</b>	<b>\$ 57.15</b>	<b>\$ 62.43</b>	<b>\$ 67.29</b>	<b>\$ 66.89</b>	<b>\$ 71.00</b>	<b>\$ 73.42</b>	<b>\$ 76.16</b>	<b>\$ 78.70</b>	<b>\$ 80.67</b>	<b>\$ 83.79</b>	<b>\$ 86.55</b>	<b>\$ 89.03</b>	<b>\$ 93.02</b>	<b>\$ 96.14</b>	<b>\$ 99.23</b>	<b>\$ 104.03</b>
Net Costs to Serve Load	\$ 62.26	\$ 69.03	\$ 73.24	\$ 71.96	\$ 74.90	\$ 78.46	\$ 82.17	\$ 83.85	\$ 87.99	\$ 99.86	\$ 103.91	\$ 108.67	\$ 112.54	\$ 116.81	\$ 143.16	\$ 146.77	\$ 150.21	\$ 154.53	\$ 162.50	\$ 165.64
<b>Net Cost to Serve Load (\$/MWh)</b>	<b>\$ 49.52</b>	<b>\$ 54.69</b>	<b>\$ 57.72</b>	<b>\$ 56.43</b>	<b>\$ 58.29</b>	<b>\$ 60.63</b>	<b>\$ 63.01</b>	<b>\$ 63.85</b>	<b>\$ 66.51</b>	<b>\$ 74.92</b>	<b>\$ 77.22</b>	<b>\$ 80.19</b>	<b>\$ 82.32</b>	<b>\$ 84.71</b>	<b>\$ 102.73</b>	<b>\$ 104.61</b>	<b>\$ 106.07</b>	<b>\$ 108.04</b>	<b>\$ 112.25</b>	<b>\$ 113.45</b>
NPV of Net Cost to Serve Load (\$)	<b>\$1,435,816,973</b>																			
Levelized Cost of Energy through 2045 (\$/MWh)	<b>\$75.76</b>																			

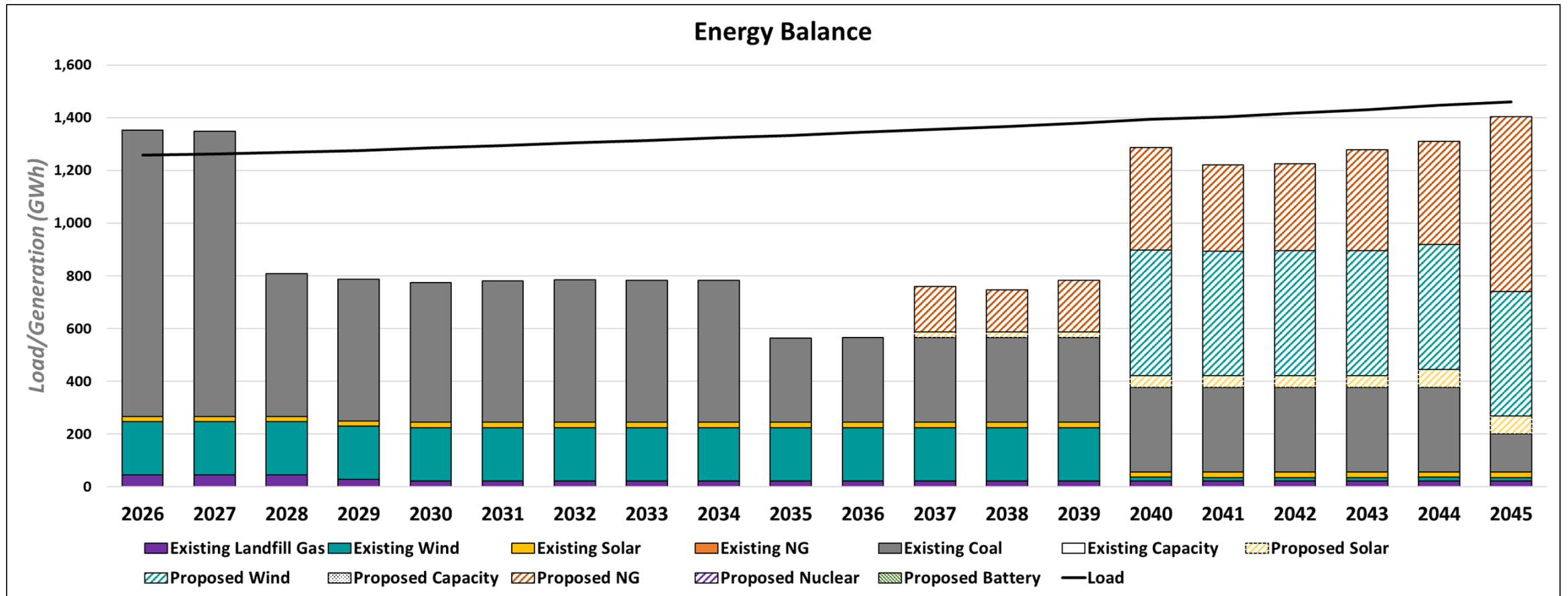
- Base Case build out with no restrictions consists of bilateral capacity, 4-hr batteries, wind, solar, and thermal (CC/CT)
- 120 MW of self build wind and 40 MW of self build solar to fulfill 40% carbon free requirement by 2040

# Base Case - Solution Build Out

Base Case Portfolio - Summer Firm Capacity (MW)																					10-yr NPV (\$M)	20-yr NPV (\$M)	20-yr LCoE (\$/MWh)		
Scenario	Resource Type	26	27	28	29	30	31	32	33	34	35	36	37	38	39	40	41	42	43	44				45	
Base	Coal	125	125	62	62	62	62	62	62	62	62	62	62	62	62	62	62	62	62	62	19	\$644	\$1,435.82	\$75.76	
	Natural Gas	121	121	121	121	114	114	114	114	114	106	106	141	141	141	71	71	71	71	88	123				
	Nuclear																								
	Hydro																								
	Wind	0.4	0.4	0.4	0.4	0.4	0.4	0.4	0.4	0.4	0.4	0.4	0.4	0.4	0.4	0.4	12	12	11	11	11				11
	Solar													0.3	0.3	0.3	0.5	0.5	0.4	0.4	0.6				0.6
	Battery Storage				124	128	131	137	136	134	132	130	128	126	124	122	120	118	116	96	103				
	Bilateral Capacity	60	65	125	5	10	10	5	10	15	30	40		10	20	75	80	85	95	95	100				
	Demand Response																								
<b>Total</b>		<b>306</b>	<b>311</b>	<b>309</b>	<b>313</b>	<b>315</b>	<b>317</b>	<b>319</b>	<b>322</b>	<b>325</b>	<b>330</b>	<b>338</b>	<b>332</b>	<b>340</b>	<b>348</b>	<b>342</b>	<b>345</b>	<b>348</b>	<b>356</b>	<b>353</b>	<b>357</b>				

- Base Case build out with no restrictions consists of bilateral capacity, 4-hr batteries, wind, solar, and thermal (CC/CT)
- 120 MW of self build wind and 40 MW of self build solar to fulfill 40% carbon free requirement by 2040

# Base Case – Energy Balance

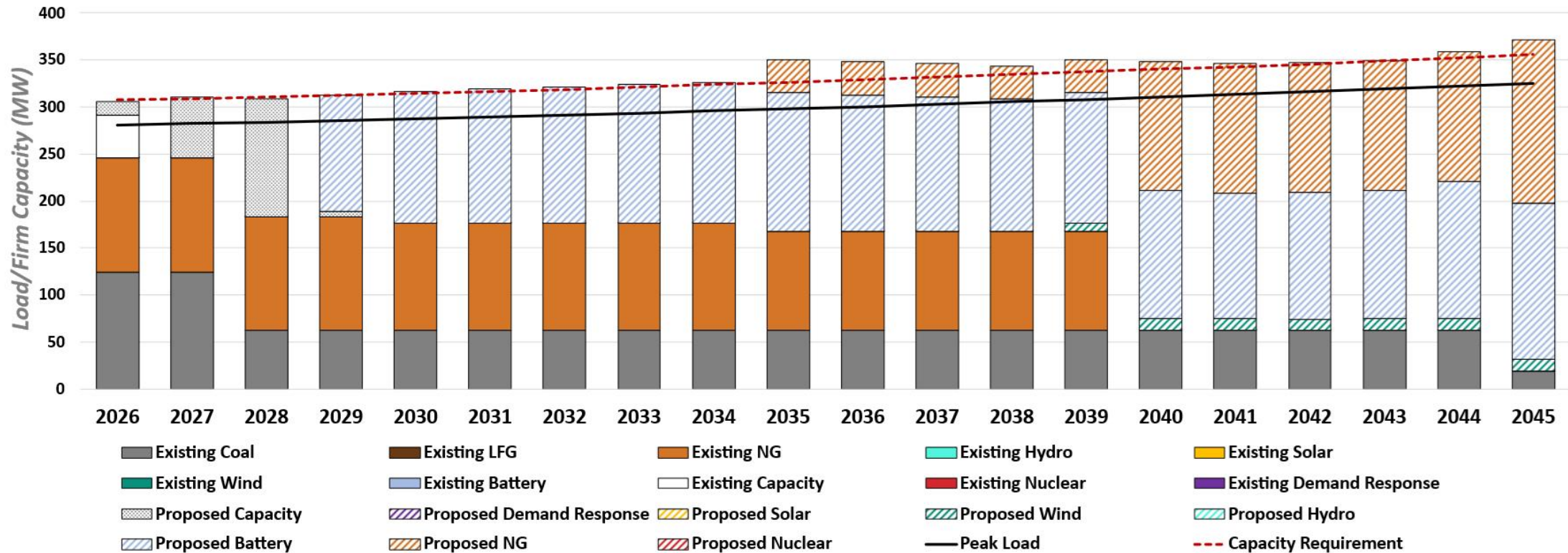


- Portfolio is energy short after Sikeston retirement in 2028 - model assumes excess load would be served by market
- Less short in the later years once thermal resources and self build wind begin to ramp up
- Existing thermal still available to ramp up, model just did not dispatch it in this iteration

# SCENARIOS

# Scenario 1a - Focus Thermal Resources

Summer Load/Capacity Balance



- Limits bilateral capacity and focuses on building out thermal resources after batteries ramp up
- Model selects self build 4-hr batteries, self build wind, and thermal (CC/CT)
  - 150 MW of self build wind to fulfill 40% carbon free requirement by 2040

# Scenario 1a - Focus Thermal Resources

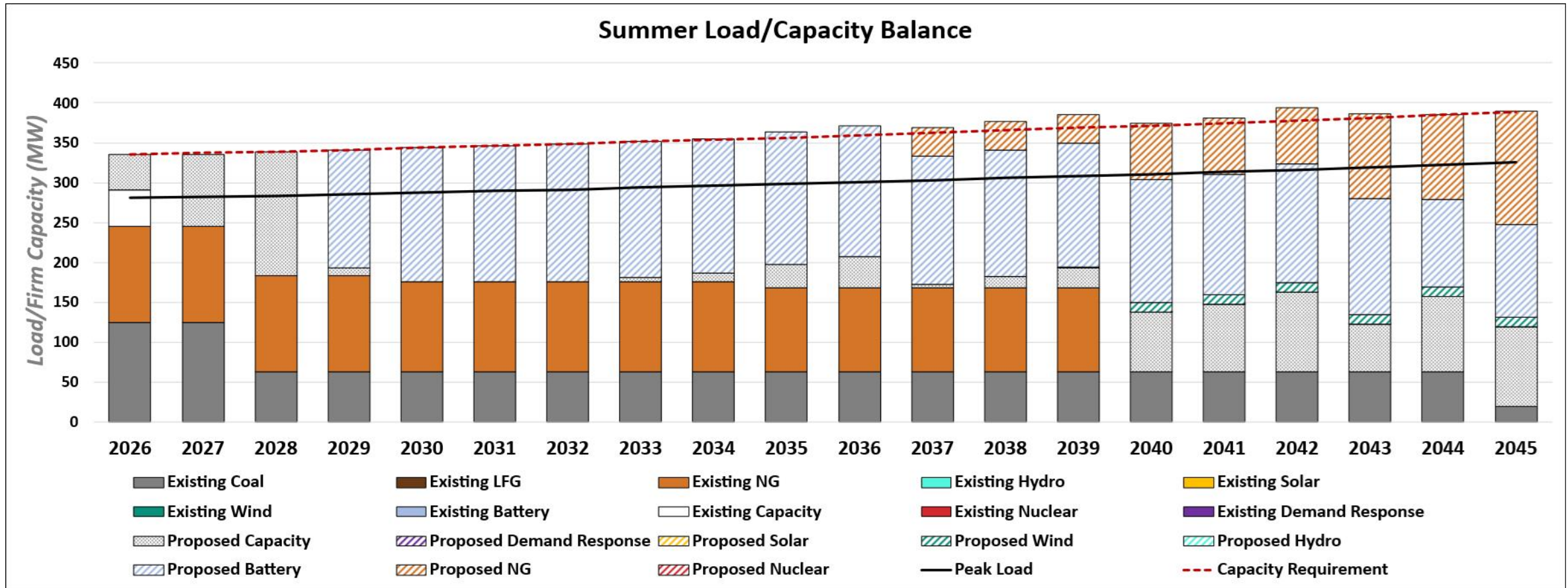
Solution Comparison																					10-yr NPV (\$M)	20-yr NPV (\$M)	20-yr LCoE (\$/MWh)		
Scenario	Resource Type	25	26	27	28	29	30	31	32	33	34	35	36	37	38	39	40	41	42	43				44	
Scenario 1: Focus Thermal Resources (MW)	Coal	125	125	62	62	62	62	62	62	62	62	62	62	62	62	62	62	62	62	62	19	\$647	\$1,454	\$76.74	
	Natural Gas	121	121	121	121	114	114	114	114	114	141	141	141	141	141	138	138	138	138	138	174				
	Nuclear																								
	Hydro																								
	Wind	0.4	0.4	0.4	0.4	0.4	0.4	0.4	0.4	0.4	0.4	0.4	0.4	0.4	0.4	9	13	13	12	13	13				13
	Solar																								
	Battery Storage				124	140	143	145	147	149	147	145	143	140	138	136	134	135	136	146	166				
	Bilateral Capacity	60	65	125	5																				
	Demand Response																								
<b>Total</b>		<b>306</b>	<b>311</b>	<b>309</b>	<b>313</b>	<b>317</b>	<b>319</b>	<b>322</b>	<b>324</b>	<b>326</b>	<b>350</b>	<b>348</b>	<b>346</b>	<b>344</b>	<b>350</b>	<b>349</b>	<b>346</b>	<b>348</b>	<b>349</b>	<b>359</b>	<b>372</b>				

Scenario 1 (MW) - Difference from Base Case																					10-yr NPV (\$M)	20-yr NPV (\$M)	20-yr LCoE (\$/MWh)		
Scenario	Resource Type	25	26	27	28	29	30	31	32	33	34	35	36	37	38	39	40	41	42	43				44	
Scenario 1 less Base Case Summer Firm Capacity (MW)	Coal																					\$3	\$18.55	\$0.98	
	Natural Gas										35	35				67	67	67	67	50	50				
	Nuclear																								
	Hydro																								
	Wind														9	1	1	1	2	2	2				
	Solar													-0.3	-0.3	-0.3	-0.5	-0.5	-0.4	-0.4	-0.6				-0.6
	Battery Storage					12	12	8	12	15	15	15	15	14	14	14	14	17	20	50	63				
	Bilateral Capacity					-10	-10	-5	-10	-15	-30	-40		-10	-20	-75	-80	-85	-95	-95	-100				
	Demand Response																								
<b>Total</b>						<b>2</b>	<b>2</b>	<b>3</b>	<b>2</b>	<b>0</b>	<b>20</b>	<b>10</b>	<b>14</b>	<b>4</b>	<b>3</b>	<b>6</b>	<b>1</b>	<b>-1</b>	<b>-7</b>	<b>6</b>	<b>15</b>				

- Major NPV driving factor is the added constraint of limiting bilateral capacity after 2029
- Limits bilateral capacity and focuses on building out thermal resources after batteries ramp up
- Model selects self build 4-hr batteries, self build wind, and thermal (CC/CT)
  - 150 MW of self build wind is needed to fulfill 40% carbon free requirement by 2040

# Scenario 1b - Focus Thermal Resources with +10% Higher PRM



- Scenario limits build out to thermal resources and 10% increase to annual PRM
- 4 combined cycles, self build 4-hour batteries, and bilateral capacity compose most of the capacity resources build out
- 130 MW of self build wind and 20 MW of self build solar are needed before 2040 to meet 40% carbon free requirement

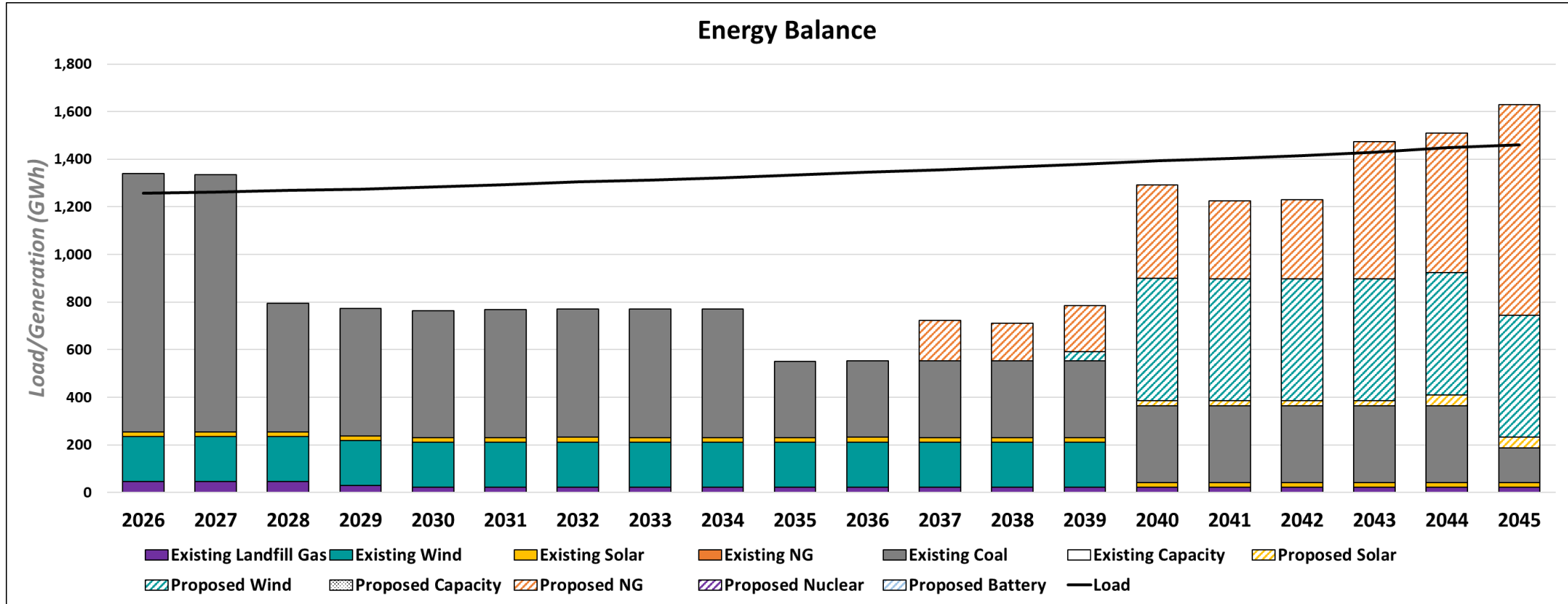
# Scenario 1b - Focus Thermal Resources with +10% Higher PRM

Solution Comparison																						10-yr NPV (\$M)	20-yr NPV (\$M)	20-yr LCoE (\$/MWh)	
Scenario	Resource Type	25	26	27	28	29	30	31	32	33	34	35	36	37	38	39	40	41	42	43	44				
Scenario 5: Focus Thermal resources w/ 10% higher PRM (MW)	Coal	125	125	62	62	62	62	62	62	62	62	62	62	62	62	62	62	62	62	62	19	\$667	\$1,489	\$78.54	
	Natural Gas	121	121	121	121	114	114	114	114	114	106	106	141	141	141	71	71	71	106	106	142				
	Nuclear																								
	Hydro																								
	Wind															1	12	12	12	12	12				12
	Solar																0	0	0	0	0				0
	Battery Storage				148	168	170	172	171	168	166	163	161	158	156	153	151	149	146	110	116				
	Bilateral Capacity	90	90	155	10				5	10	30	40	5	15	25	75	85	100	60	95	100				
Demand Response																									
<b>Total</b>		<b>336</b>	<b>336</b>	<b>338</b>	<b>341</b>	<b>344</b>	<b>346</b>	<b>349</b>	<b>352</b>	<b>354</b>	<b>363</b>	<b>371</b>	<b>369</b>	<b>376</b>	<b>385</b>	<b>374</b>	<b>381</b>	<b>394</b>	<b>387</b>	<b>385</b>	<b>389</b>				

Scenario 5 (MW) - Difference from Base Case																						10-yr NPV (\$M)	20-yr NPV (\$M)	20-yr LCoE (\$/MWh)	
Scenario	Resource Type	25	26	27	28	29	30	31	32	33	34	35	36	37	38	39	40	41	42	43	44				
Scenario 5 less Base Case Summer Firm Capacity (MW)	Coal																					\$23	\$52.71	\$2.78	
	Natural Gas																		35	19	19				
	Nuclear																								
	Hydro																								
	Wind	-0.4	-0.4	-0.4	-0.4	-0.4	-0.4	-0.4	-0.4	-0.4	-0.4	-0.4	-0.4	-0.4	-0.4	0.6	0.6	0.5	0.5	0.5	0.5				0.5
	Solar													-0.3	-0.3	-0.3	-0.3	-0.2	-0.2	-0.2	-0.2				-0.2
	Battery Storage				24	40	40	35	35	34	34	33	33	32	32	31	31	30	30	13	13				
	Bilateral Capacity	30	25	30	5	-10	-10	-5	-5	-5				5	5		5	15	-35						
Demand Response																									
<b>Total</b>		<b>30</b>	<b>25</b>	<b>30</b>	<b>29</b>	<b>30</b>	<b>29</b>	<b>30</b>	<b>30</b>	<b>29</b>	<b>34</b>	<b>33</b>	<b>37</b>	<b>37</b>	<b>37</b>	<b>32</b>	<b>36</b>	<b>46</b>	<b>31</b>	<b>32</b>	<b>32</b>				

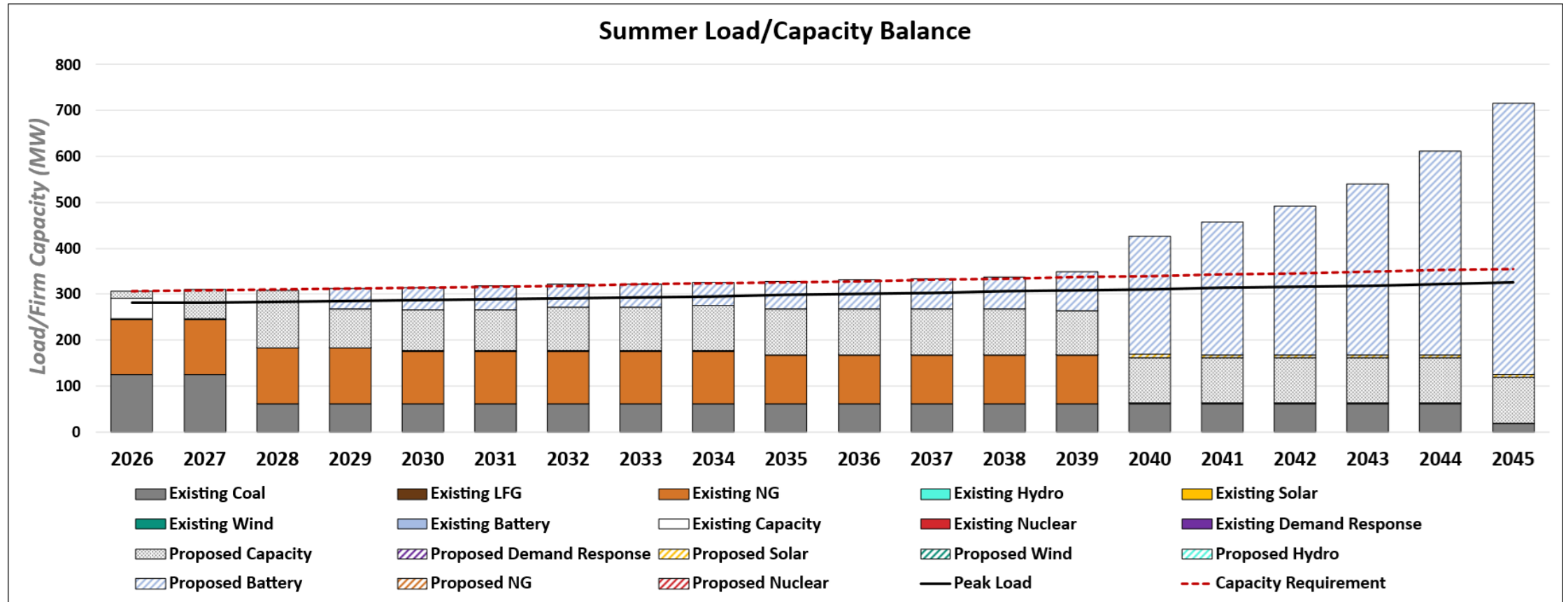
- Scenario limits build out to thermal resources and 10% increase to annual PRM
- 4 combined cycles, self build 4-hour batteries, and bilateral capacity compose most of the capacity resources build out
- 130 MW of self build wind and 20 MW of self build solar are needed before 2040 to meet 40% carbon free requirement

# Scenario 1b - Focus Thermal Resources with +10% Higher PRM



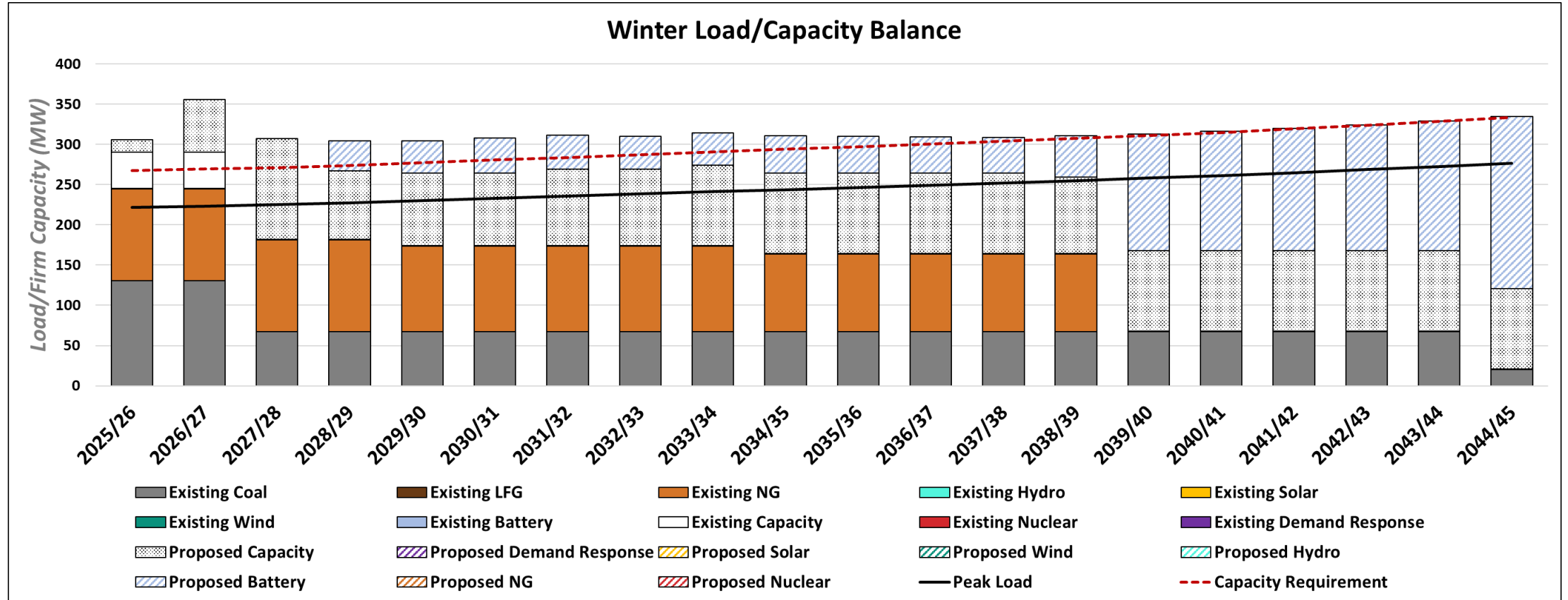
- Scenario limits build out to thermal resources and 10% increase to annual PRM
- 4 combined cycles, self build 4-hour batteries, and bilateral capacity compose most of the capacity resources build out
- 130 MW of self build wind and 20 MW of self build solar are needed before 2040 to meet 40% carbon free requirement

# Scenario 2 - Limit Resources to PPAs & Capacity



- Limits all resources to only self build batteries and bilateral capacity
- After 2040, ELCC for battery resources suffer in the winter causing significant overbuild to meet Winter PRM
- 230 MW of solar PPA is needed to meet 40% carbon free energy requirement
  - ELCC accreditation for solar is extremely low in the later years of the study

# Scenario 2 - Limit Resources to PPAs & Capacity



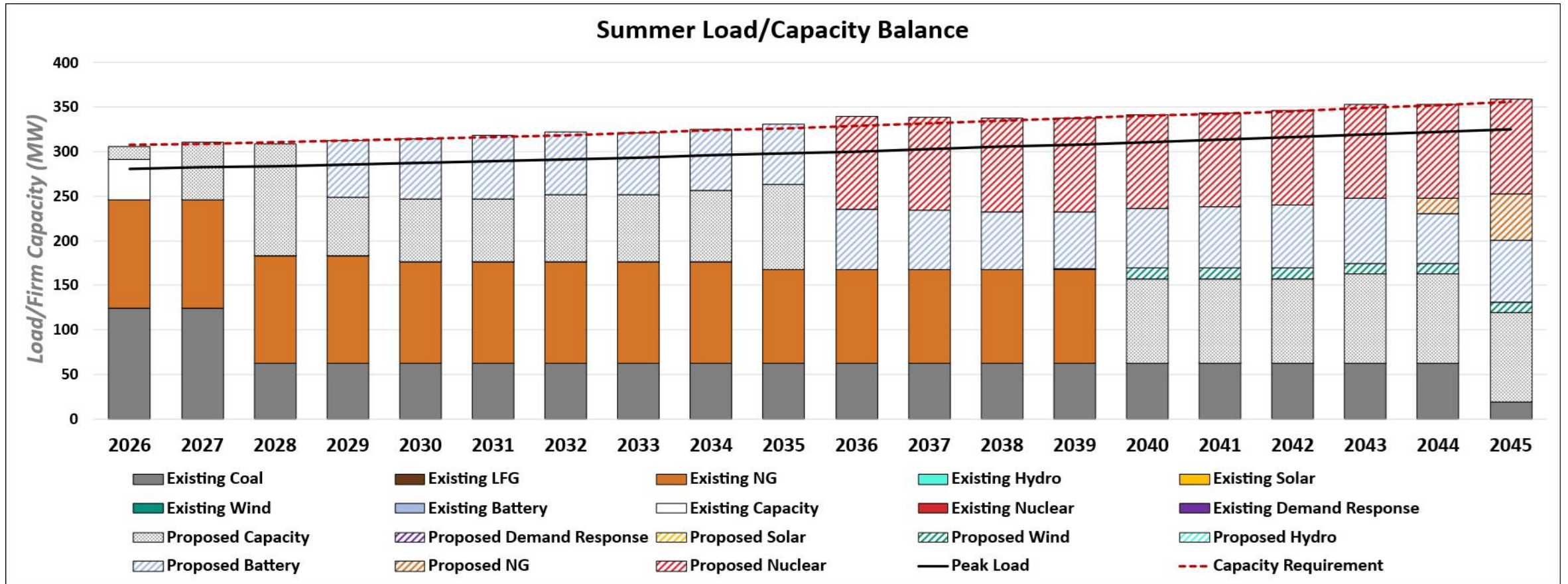
- Limits all resources to only self build batteries and bilateral capacity
- After 2040, ELCC for battery resources suffer in the winter causing significant overbuild to meet Winter PRM
- 230 MW of solar PPA is needed to meet 40% carbon free energy requirement
  - ELCC accreditation for solar is extremely low in the later years of the study

# Scenario 2 - Limit Resources to PPAs & Capacity

Solution Comparison																						10-yr NPV (\$M)	20-yr NPV (\$M)	20-yr LCoE (\$/MWh)		
Scenario	Resource Type	25	26	27	28	29	30	31	32	33	34	35	36	37	38	39	40	41	42	43	44					
Scenario 2: Limit resources to capacity & PPAs (MW)	Coal	125	125	62	62	62	62	62	62	62	62	62	62	62	62	62	62	62	62	62	19	\$672	\$1,627	\$85.82		
	Natural Gas	121	121	121	121	114	114	114	114	114	106	106	106	106	106											
	Nuclear																									
	Hydro																									
	Wind	0.4	0.4	0.4	0.4	0.4	0.4	0.4	0.4	0.4	0.4	0.4	0.4	0.4	0.4	0.4	0.4	0.4	0.4	0.4	0.4				0.4	
	Solar																6	6	5	5	5				5	
	Battery Storage				44	48	51	51	50	50	60	63	66	68	85	258	288	324	372	445	591					
	Bilateral Capacity	60	65	125	85	90	90	95	95	100	100	100	100	100	95	100	100	100	100	100	100				100	
	Demand Response																									
<b>Total</b>		<b>306</b>	<b>311</b>	<b>309</b>	<b>313</b>	<b>315</b>	<b>318</b>	<b>323</b>	<b>322</b>	<b>326</b>	<b>328</b>	<b>331</b>	<b>334</b>	<b>337</b>	<b>348</b>	<b>427</b>	<b>456</b>	<b>492</b>	<b>539</b>	<b>612</b>	<b>715</b>					
Scenario 2 (MW) - Difference from Base Case																						10-yr NPV (\$M)	20-yr NPV (\$M)	20-yr LCoE (\$/MWh)		
Scenario	Resource Type	25	26	27	28	29	30	31	32	33	34	35	36	37	38	39	40	41	42	43	44					
Scenario 2 less Base Case Summer Firm Capacity (MW)	Coal																					\$28	\$190.75	\$10.06		
	Natural Gas													-35	-35	-35	-71	-71	-71	-71	-88				-123	
	Nuclear																									
	Hydro																									
	Wind																	-12	-11	-11	-11				-11	-11
	Solar														-0.3	-0.3	-0.3	5	5	5	4				4	4
	Battery Storage				-80	-80	-79	-86	-85	-84	-72	-67	-62	-58	-39	136	168	206	256	349	488					
	Bilateral Capacity				80	80	80	90	85	85	70	60		90	75	25	20	15	5	5						
	Demand Response																									
<b>Total</b>							<b>1</b>	<b>4</b>	<b>0</b>	<b>1</b>	<b>-2</b>	<b>-7</b>	<b>2</b>	<b>-3</b>	<b>0</b>	<b>84</b>	<b>111</b>	<b>144</b>	<b>183</b>	<b>259</b>	<b>358</b>					

- NPV driving factor is from significant overbuilding of PPA batteries to meet Winter PRM and shift from self build
- After 2040, ELCC for battery resources suffer in the winter causing significant overbuild to meet Winter PRM
- 230 MW of solar PPA is needed to meet 40% carbon free energy requirement
  - ELCC accreditation for solar is extremely low in the later years of the study

# Scenario 3a - Force 30% Nuclear PPA



- Forces 30% of the PRM obligation to be met by nuclear PPAs
- Nuclear PPAs have a 10-year lead time with the first resource being built in 2036
- 130 MW of self build wind is needed to meet 40% carbon free requirement

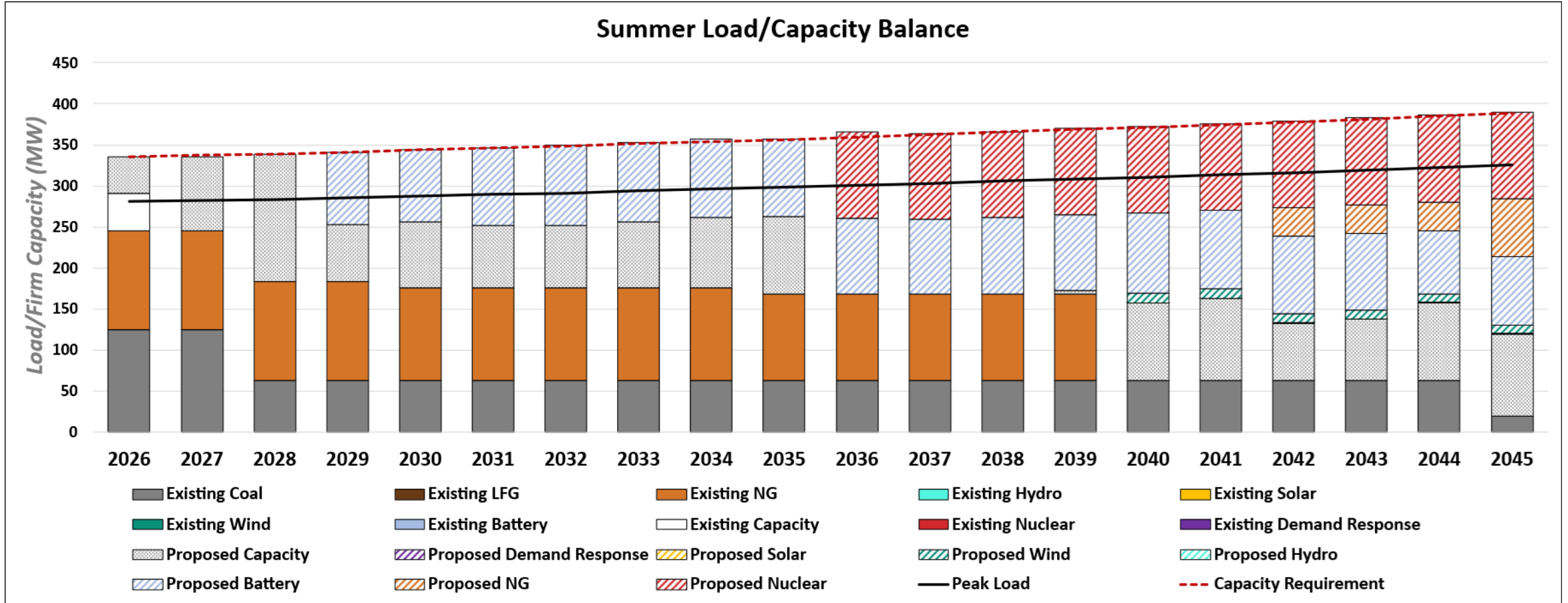
# Scenario 3a - Force 30% Nuclear PPA

Solution Comparison																						10-yr NPV (\$M)	20-yr NPV (\$M)	20-yr LCoE (\$/MWh)	
Scenario	Resource Type	25	26	27	28	29	30	31	32	33	34	35	36	37	38	39	40	41	42	43	44				
Scenario 3: Force 30% Nuclear PPA (MW)	Coal	125	125	62	62	62	62	62	62	62	62	62	62	62	62	62	62	62	62	62	19	\$624	\$1,628	\$85.92	
	Natural Gas	121	121	121	121	114	114	114	114	114	106	106	106	106	106					17	52				
	Nuclear												105	105	105	105	105	105	105	106	106				106
	Hydro																								
	Wind	0.4	0.4	0.4	0.4	0.4	0.4	0.4	0.4	0.4	0.4	0.4	0.4	0.4	0.4	1	13	13	12	12	12				12
	Solar																			0.2	0.2				0.2
	Battery Storage				64	68	71	71	70	69	68	67	66	65	64	66	69	71	73	56	70				70
	Bilateral Capacity	60	65	125	65	70	70	75	75	80	95					95	95	95	100	100	100				100
	Demand Response																								
<b>Total</b>		<b>306</b>	<b>311</b>	<b>309</b>	<b>313</b>	<b>315</b>	<b>318</b>	<b>322</b>	<b>321</b>	<b>325</b>	<b>331</b>	<b>340</b>	<b>339</b>	<b>338</b>	<b>338</b>	<b>342</b>	<b>344</b>	<b>346</b>	<b>353</b>	<b>353</b>	<b>359</b>				

Scenario 3 (MW) - Difference from Base Case																						10-yr NPV (\$M)	20-yr NPV (\$M)	20-yr LCoE (\$/MWh)		
Scenario	Resource Type	25	26	27	28	29	30	31	32	33	34	35	36	37	38	39	40	41	42	43	44					
Scenario 3 less Base Case Summer Firm Capacity (MW)	Coal																					-\$20	\$192.57	\$10.16		
	Natural Gas													-35	-35	-35	-71	-71	-71	-71	-71					
	Nuclear													105	105	105	105	105	105	106	106				106	
	Hydro																									
	Wind															1	1	1	1	1	1				1	
	Solar															-0.3	-0.3	-0.3	-0.5	-0.5	-0.4				-0.2	-0.4
	Battery Storage				-60	-60	-59	-67	-66	-65	-64	-63	-62	-61	-60	-56	-51	-47	-43	-40	-33				-33	
	Bilateral Capacity				60	60	60	70	65	65	65	-40			-10	-20	20	15	10	5	5					
	Demand Response																									
<b>Total</b>							<b>1</b>	<b>3</b>	<b>-1</b>	<b>0</b>	<b>1</b>	<b>2</b>	<b>7</b>	<b>-2</b>	<b>-10</b>	<b>-1</b>	<b>-1</b>	<b>-2</b>	<b>-3</b>	<b>0</b>	<b>2</b>					

- 10-year NPV driving factor is shift to bilateral capacity over self build batteries for more flexibility to build SMRs (Small Modular Reactors) by 2036
- 20-year NPV driving factor is force build out of SMR PPA which is not as economic vs base case
- Nuclear PPAs have a 10-year lead time with the first resource being built in 2036
- 130 MW of self build wind is needed to meet 40% carbon free requirement

# Scenario 3b - Force 30% Nuclear PPA with +10% Higher PRM



- Forces 30% of PRM obligation to be served by nuclear PPAs when available in 2036 and increases annual PRM by 10%
- Nuclear PPAs have a 10-year lead time with first resource being built in 2036
- 130 MW of self build wind and 20 MW of self build solar are needed to meet 40% carbon free requirement by 2040

# Scenario 3b - Force 30% Nuclear PPA with +10% Higher PRM

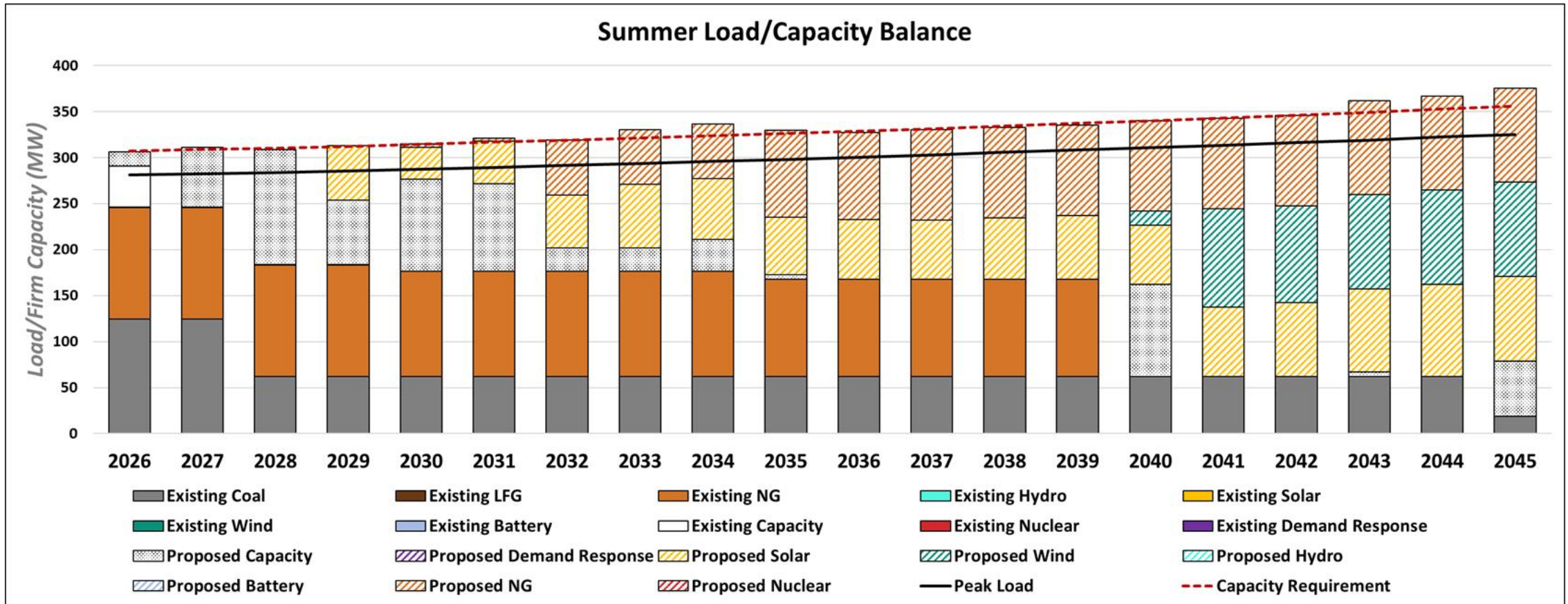
Solution Comparison																						10-yr NPV (\$M)	20-yr NPV (\$M)	20-yr LCoE (\$/MWh)	
Scenario	Resource Type	25	26	27	28	29	30	31	32	33	34	35	36	37	38	39	40	41	42	43	44				
Scenario 6: Force 30% Nuclear PPA w/ 10% higher PRM (MW)	Coal	125	125	62	62	62	62	62	62	62	62	62	62	62	62	62	62	62	62	62	19	\$645	\$1,677	\$88.47	
	Natural Gas	121	121	121	121	114	114	114	114	114	106	106	106	106	106			35	35	35	71				
	Nuclear												105	105	105	105	105	105	105	105	105				
	Hydro																								
	Wind																12	11	11	11	11				11
	Solar																0.5	0.7	0.7	0.6	0.6				0.8
	Battery Storage				88	88	95	98	97	96	94	93	91	94	92	98	96	95	93	76	83				
	Bilateral Capacity	90	90	155	70	80	75	75	80	85	95				5	95	100	70	75	95	100				
Demand Response																									
<b>Total</b>		<b>336</b>	<b>336</b>	<b>338</b>	<b>341</b>	<b>344</b>	<b>346</b>	<b>349</b>	<b>353</b>	<b>357</b>	<b>357</b>	<b>365</b>	<b>364</b>	<b>366</b>	<b>370</b>	<b>372</b>	<b>376</b>	<b>379</b>	<b>382</b>	<b>385</b>	<b>390</b>				

Scenario 6 (MW) - Difference from Base Case																						10-yr NPV (\$M)	20-yr NPV (\$M)	20-yr LCoE (\$/MWh)	
Scenario	Resource Type	25	26	27	28	29	30	31	32	33	34	35	36	37	38	39	40	41	42	43	44				
Scenario 6 less Base Case Summer Firm Capacity (MW)	Coal																					\$2	\$240.93	\$12.71	
	Natural Gas												-35	-35	-35	-71	-71	-35	-35	-52	-52				
	Nuclear												105	105	105	105	105	105	106	106	106				
	Hydro																								
	Wind	-0.4	-0.4	-0.4	-0.4	-0.4	-0.4	-0.4	-0.4	-0.4	-0.4	-0.4	-0.4	-0.4	-0.4	-0.4	-0.4	-0.4	-0.4	-0.4	-0.4				
	Solar												-0.3	-0.3	-0.3		0.2	0.2	0.2		0.2				
	Battery Storage				-36	-40	-36	-39	-39	-38	-38	-37	-37	-32	-32	-24	-24	-24	-23	-20	-20				
	Bilateral Capacity	30	25	30	65	70	65	70	70	70	65	-40		-10	-15	20	20	-15	-20						
Demand Response																									
<b>Total</b>		<b>30</b>	<b>25</b>	<b>30</b>	<b>29</b>	<b>30</b>	<b>29</b>	<b>30</b>	<b>31</b>	<b>31</b>	<b>27</b>	<b>27</b>	<b>32</b>	<b>27</b>	<b>22</b>	<b>30</b>	<b>30</b>	<b>31</b>	<b>27</b>	<b>33</b>	<b>33</b>				

- Forces 30% of PRM obligation to be served by nuclear PPAs when available in 2036 and increases annual PRM by 10%
- Nuclear PPAs have a 10-year lead time with first resource being built in 2036
- 130 MW of self build wind and 20 MW of self build solar are needed to meet 40% carbon free requirement by 2040

# Scenario 4 - High Gas & Power Prices



- Higher gas and power prices are assumed throughout study
- Renewables highly encouraged by model with both PPAs and self build options
- Thermal resources start in 2032 with RICE and CCs

# Scenario 4 - High Gas & Power Prices

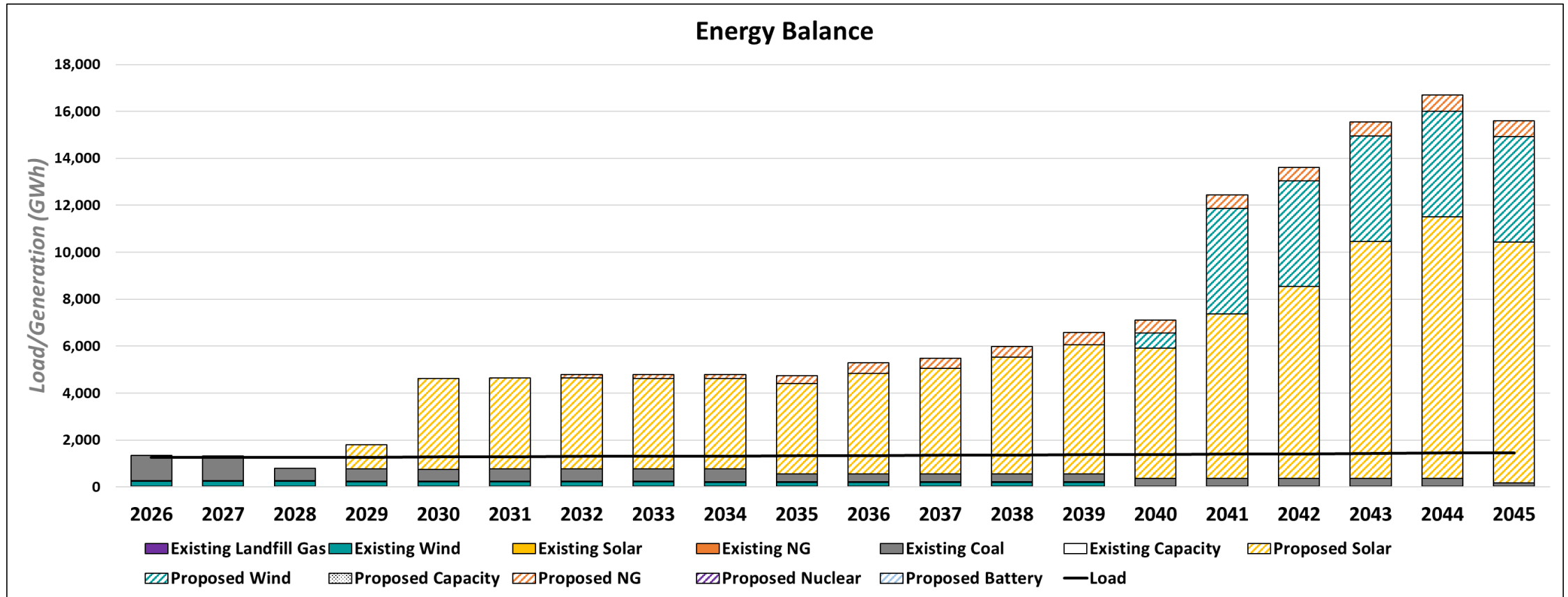
Solution Comparison																						10-yr NPV (\$M)	20-yr NPV (\$M)	20-yr LCoE (\$/MWh)	
Scenario	Resource Type	25	26	27	28	29	30	31	32	33	34	35	36	37	38	39	40	41	42	43	44				
Scenario 4: High Gas & Power Scenario (MW)	Coal	125	125	62	62	62	62	62	62	62	62	62	62	62	62	62	62	62	62	62	19	\$759	\$1,373	\$72.43	
	Natural Gas	121	121	121	121	117	117	174	173	173	200	200	204	204	204	98	98	99	102	102	102				
	Nuclear																								
	Hydro																								
	Wind	0.4	0.4	0.4	0.4	0.4	0.4	0.4	0.4	0.4							15	107	105	103	103				103
	Solar				59	35	46	58	69	66	62	65	64	67	69	64	75	80	90	100	92				
	Battery Storage																								
	Bilateral Capacity	60	65	125	70	100	95	25	25	35	5					100			5		60				
Demand Response																									
<b>Total</b>		<b>306</b>	<b>311</b>	<b>309</b>	<b>313</b>	<b>315</b>	<b>321</b>	<b>319</b>	<b>330</b>	<b>336</b>	<b>330</b>	<b>327</b>	<b>330</b>	<b>333</b>	<b>335</b>	<b>340</b>	<b>343</b>	<b>346</b>	<b>362</b>	<b>367</b>	<b>375</b>				

Scenario 4 (MW) - Difference from Base Case																						10-yr NPV (\$M)	20-yr NPV (\$M)	20-yr LCoE (\$/MWh)	
Scenario	Resource Type	25	26	27	28	29	30	31	32	33	34	35	36	37	38	39	40	41	42	43	44				
Scenario 4 less Base Case Summer Firm Capacity (MW)	Coal																					\$115	-\$63.13	-\$3.33	
	Natural Gas					3	3	60	59	59	95	95	63	63	63	28	28	28	31	14	-21				
	Nuclear																								
	Hydro																								
	Wind										-0.4	-0.4	-0.4	-0.4	-0.4	-0.4	3	95	93	91	91				91
	Solar				59	35	46	58	69	66	62	65	64	67	69	64	75	80	90	99	91				
	Battery Storage				-124	-128	-131	-137	-136	-134	-132	-130	-128	-126	-124	-122	-120	-118	-116	-96	-103				
	Bilateral Capacity				65	90	85	20	15	20	-25	-40		-10	-20	25	-80	-85	-90	-95	-40				
Demand Response																									
<b>Total</b>					<b>0</b>	<b>0</b>	<b>4</b>	<b>0</b>	<b>8</b>	<b>11</b>	<b>0</b>	<b>-11</b>	<b>-2</b>	<b>-7</b>	<b>-12</b>	<b>-2</b>	<b>-2</b>	<b>-2</b>	<b>6</b>	<b>14</b>	<b>18</b>				

- Higher gas and power prices are assumed throughout study
- Renewables highly encouraged by model with both PPAs and self build options
- Thermal resources start in 2032 with RICE and CCs

# Scenario 4 - High Gas & Power Prices



- Higher gas and power prices are assumed throughout study
- Renewables highly encouraged by model with both PPAs and self build options
- Thermal resources start in 2032 with RICE and CCs

# Discussion and Questions



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