TEA
THE EnergyAuthority

CMWL LONG-TERM LOAD FORECAST

DECEMBER 10TH, 2025

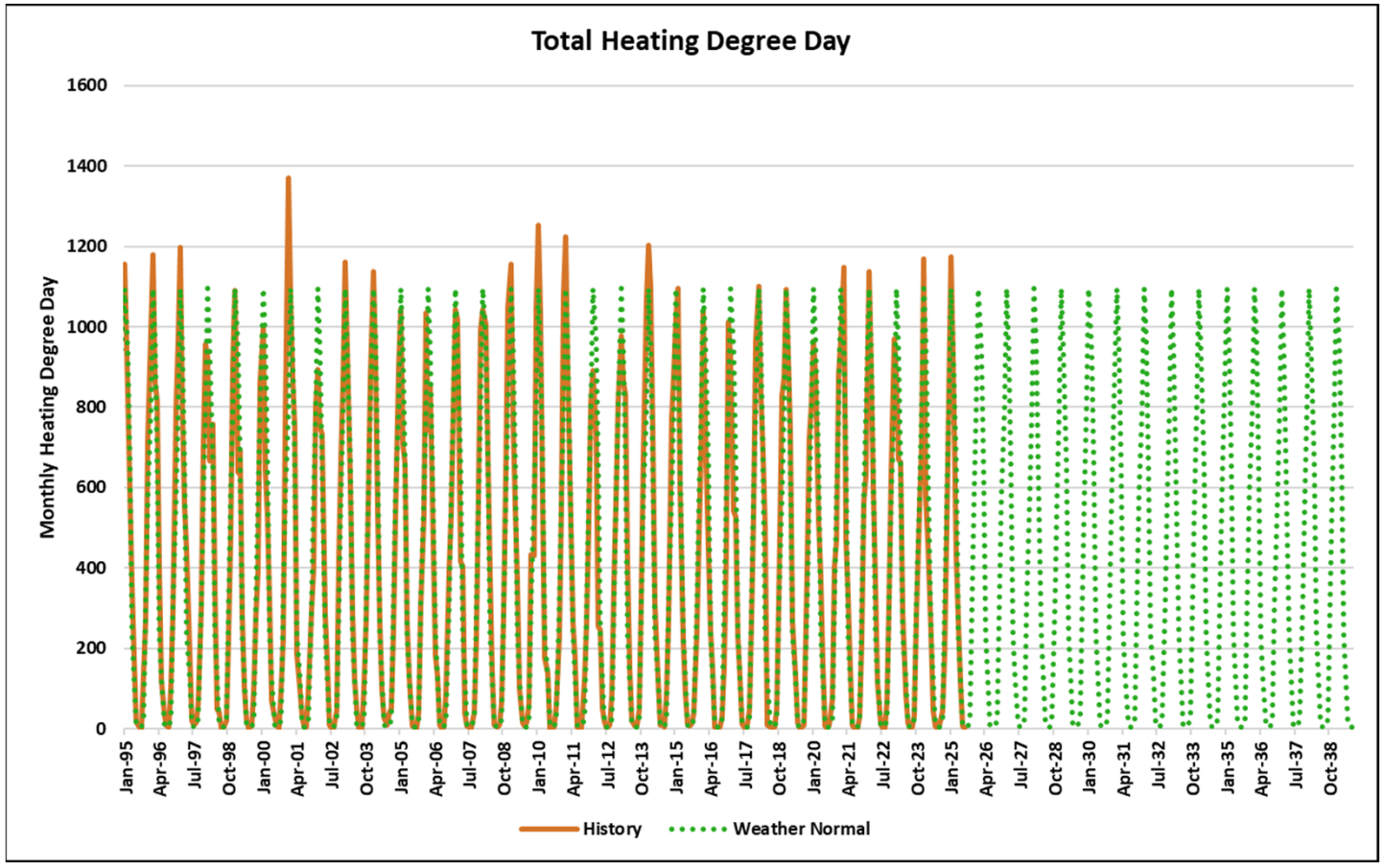
AGENDA

- Monthly load forecasting process
  - Total energy & peak demand
- Additional considerations
  - Energy efficiency, electric vehicle charging, BTM generation
- Forecast results
  - Net and gross load projections
  - Prior year comparison
- Coincident peak demand forecast

MONTHLY FORECAST

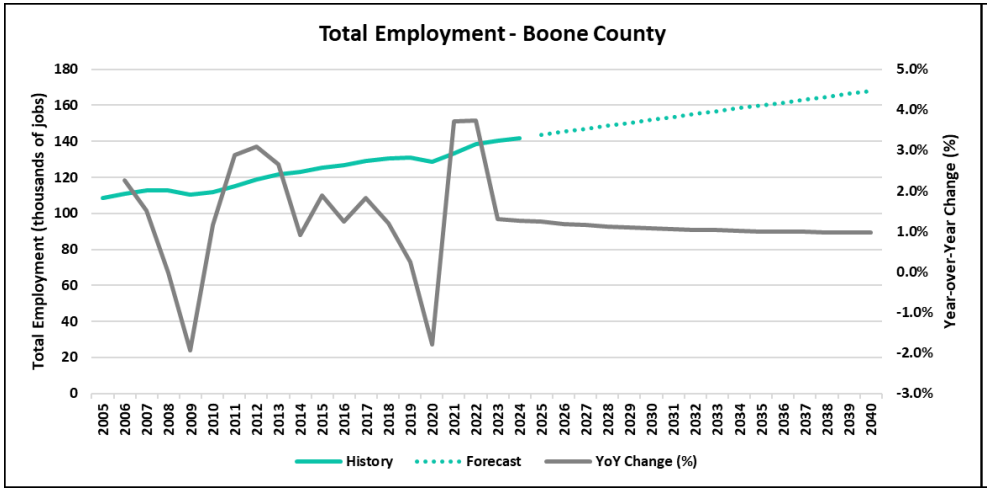
- Linear regression model
- Inputs
  - CMWL monthly total energy & peak demand history for January 2005 – July 2025.
  - Monthly historical weather data for January 1995 – July 2025.
    - Model selected between different combinations of weather variables to find the best fit.
  - Woods & Poole economic data for Boone County.
    - Model was allowed to choose between 6 different economic indicators and find which one fit best to load history.
- Outputs
  - Monthly system total and peak load for CMWL.
    - Separate model utilized for each season (Winter, Spring, Summer, Fall).

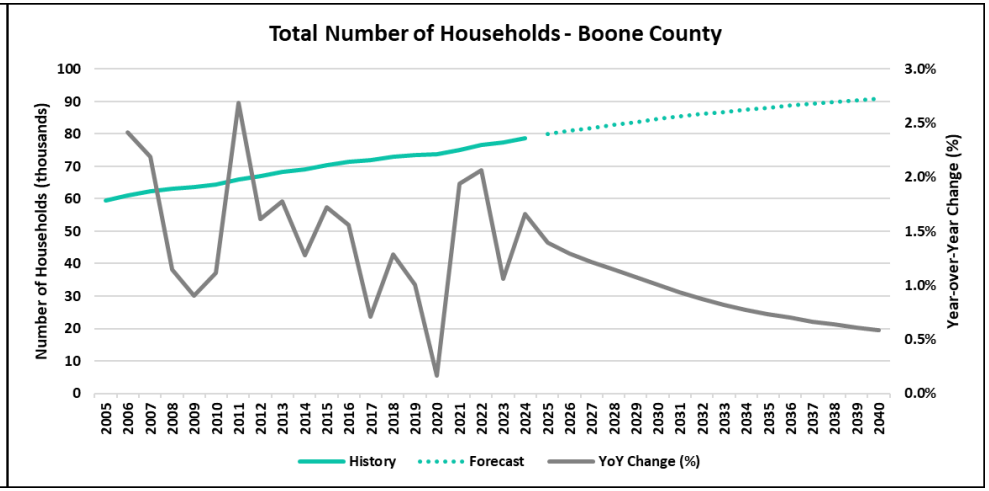
WEATHER NORMALIZATION



- Different combinations of feature features tested for monthly total energy and peak demand.
  - Total cooling/heating degree days
    - Total cooling/heating degree days squared
  - Max cooling/heating degree days
    - Max cooling/heating degree days squared
  - Min/max temperature
  - 3-day & 5-day maximum cooling/heating degree days
- 50/50 weather normal forecast, meaning 50% of the time weather will realize more extreme or milder than normal.

ECONOMIC DRIVERS





Selected Economic Growth Variable		
Season	**Total Energy**	**Peak Demand**
Winter	Total Number of Households	Total Number of Households
Spring	Total Employment	Total Employment
Summer	Total Employment	Total Employment
Fall	Total Employment	Total Employment

- 6 economic growth variables for Boone County tested using data from Woods & Poole.
  - Total population
  - Total employment
  - Total personal income
  - Gross regional product
  - Number of households
  - Total retail sales

ADDITIONAL CONSIDERATIONS

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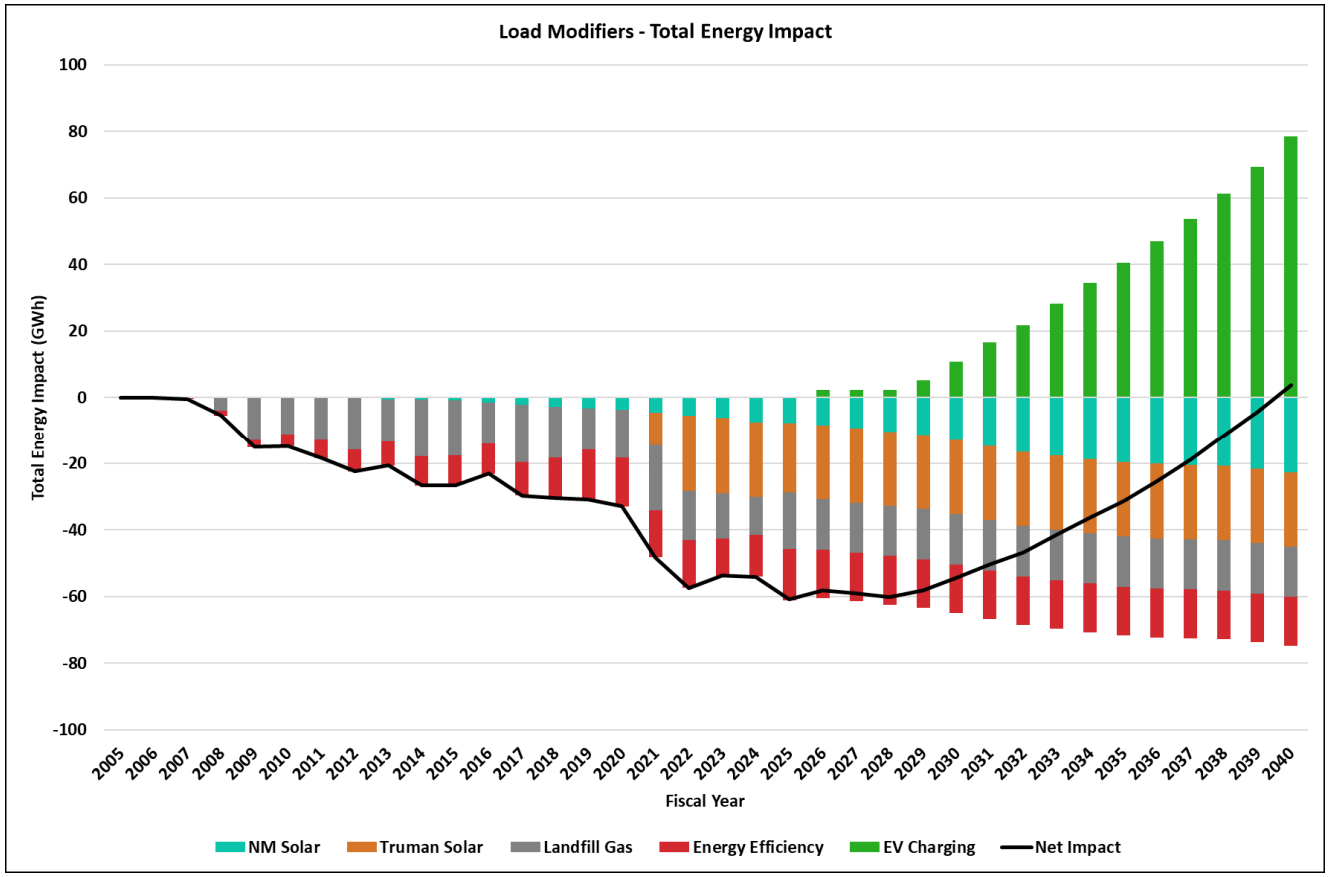
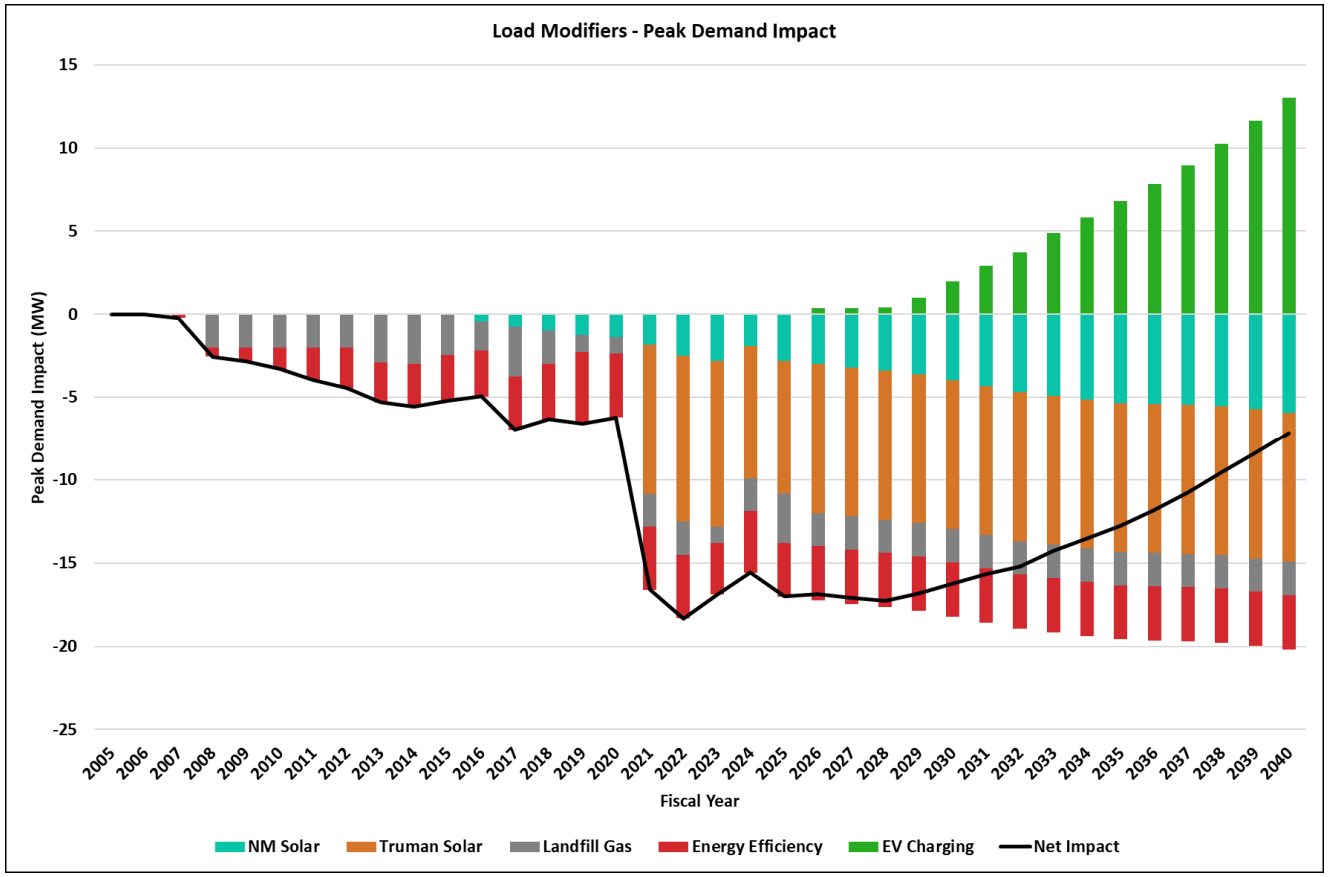
- Energy Efficiency
  - Updated existing data from CMWL using annual-level efficiency savings.
- Electric Vehicles
  - Developed vehicle count forecast using a combination of Woods & Poole economic growth predictions and EIA 2025 annual energy outlook forecasts.
  - Used Electric Vehicle Infrastructure (EVI-Pro) tool from NREL to derive an hourly charging shape given the vehicle count forecast.
- BTM Generation (Columbia LFG, Truman Solar, & NM solar).
  - Utilized historical generation data for Columbia LFG and Truman Solar.
  - For net-metering solar, utilized the National Renewable Energy Laboratory's ReEDS model.

LOAD MODIFIERS – TOTAL ENERGY IMPACT



- Projected growth in BTM generation is expected to more than offset electric vehicle charging impacts through 2039.
  - Electric vehicle charging growth accelerates from the early 2030s onward.

LOAD MODIFIERS – PEAK DEMAND IMPACT



- Projected growth in BTM generation is expected to more than offset electric vehicle charging impacts through the forecast duration.
  - Electric vehicle charging has a lower impact on peak demand relative to total energy, due to lower charging during afternoon hours (summer peak periods).

FORECAST RESULTS

NET VS GROSS LOAD

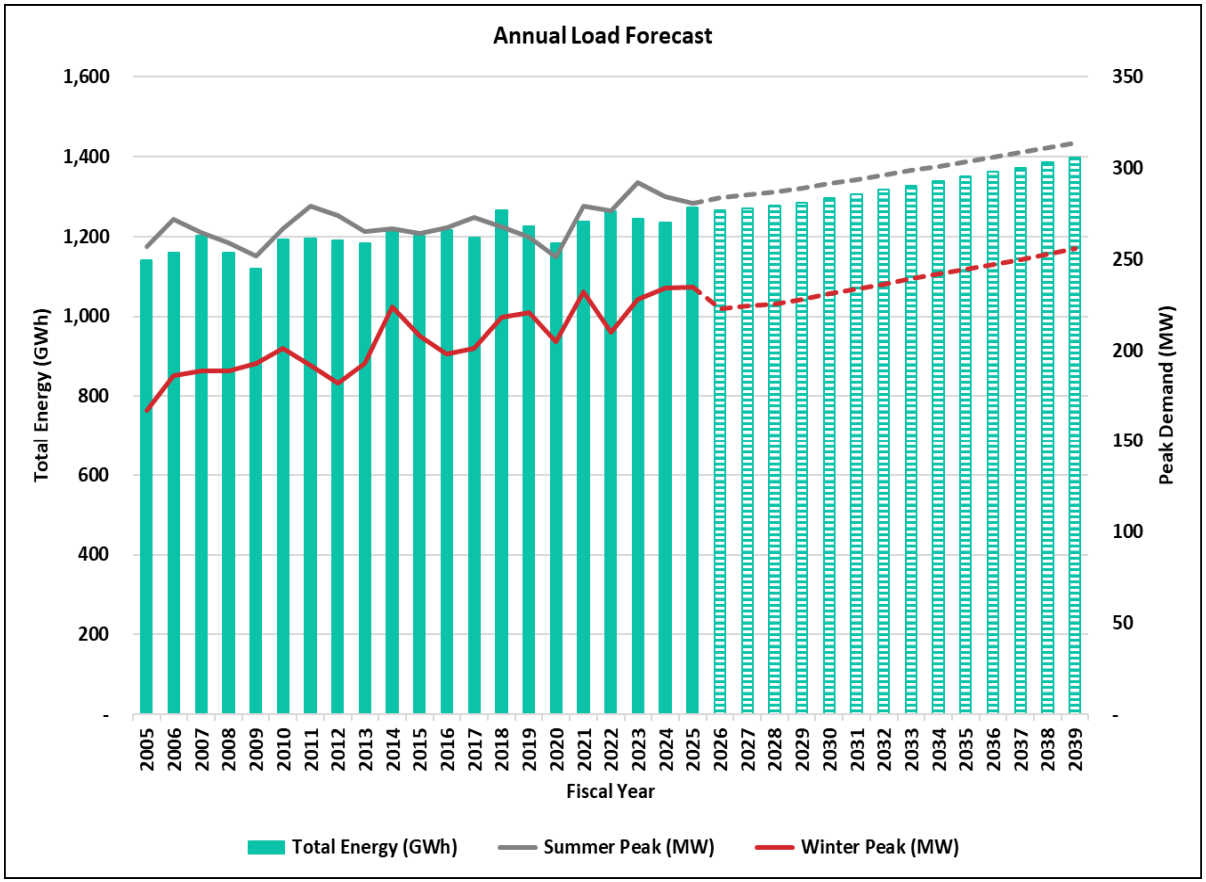
- Gross Load
  - Used in MISO resource adequacy submittal.

$$Gross\ Load = Base\ Load + Energy\ Efficiency + Electric\ Vehicles$$

- Net Load
  - For reference or budgeting.

$$Net\ Load = Base\ Load + Energy\ Efficiency + Electric\ Vehicles + BTM\ Generation$$

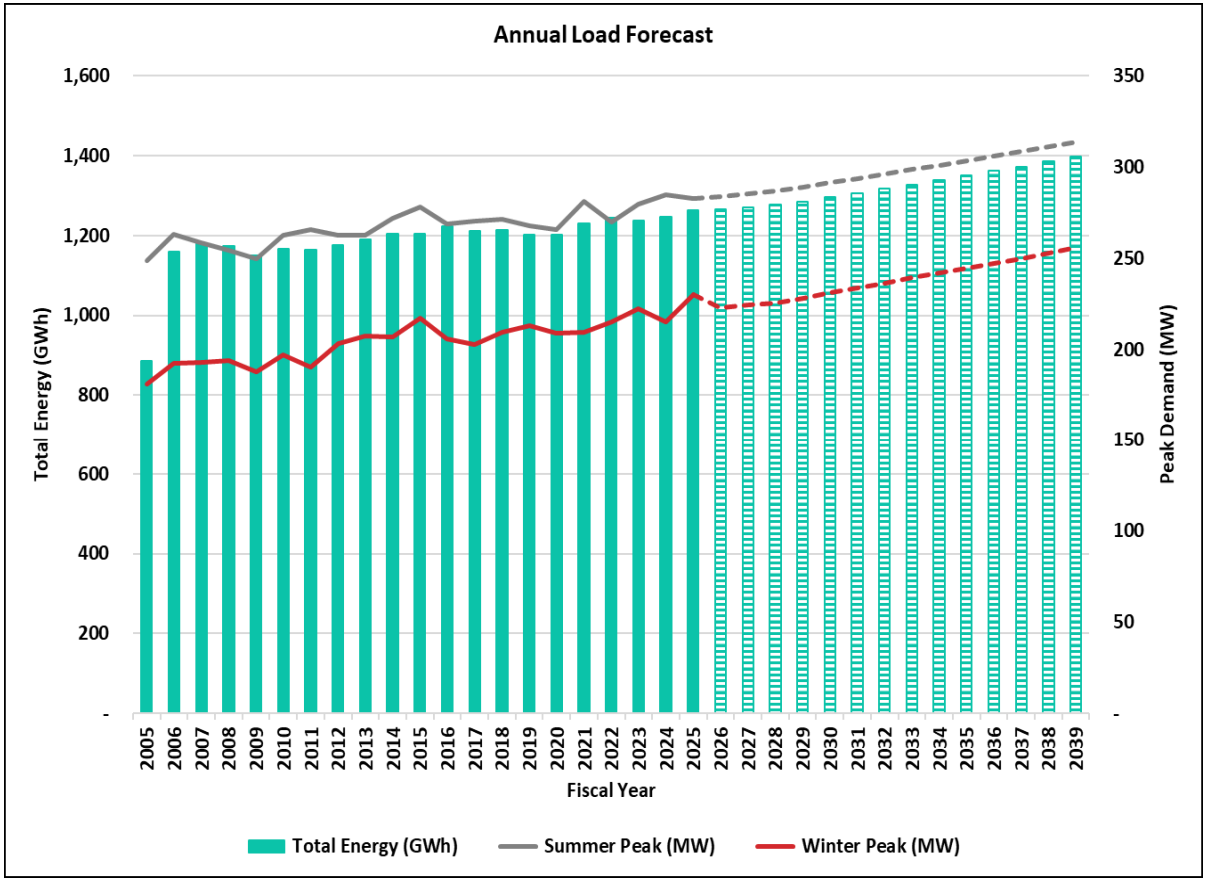
GROSS FORECAST – ACTUAL HISTORY



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%

Annual Growth Rate (%) - Actual History & Forecast			
Metric	Total Energy	Summer Peak Demand	Winter Peak Demand
20 Year Historical Average	0.4%	0.5%	1.2%
10 Year Historical Average	0.3%	0.8%	1.9%
10 Year Forecast Average	0.7%	0.7%	1.0%

GROSS FORECAST – WEATHER NORMAL HISTORY



Fiscal Year	Total Energy (GWh)		Summer Peak Demand (MW)		Winter Peak Demand (MW)	
	Weather Normal History & Forecast	YoY Change (%)	Weather Normal History & Forecast	YoY Change (%)	Weather Normal History & Forecast	YoY Change (%)
2015	1,204	0.0%	278	2.2%	217	4.9%
2016	1,224	1.7%	269	-3.4%	206	-5.2%
2017	1,213	-0.9%	270	0.6%	203	-1.3%
2018	1,213	0.0%	272	0.5%	210	3.2%
2019	1,202	-0.9%	268	-1.5%	213	1.6%
2020	1,201	0.0%	266	-0.7%	209	-1.9%
2021	1,230	2.3%	281	5.8%	209	0.3%
2022	1,245	1.3%	270	-4.0%	215	2.7%
2023	1,238	-0.6%	280	3.6%	223	3.4%
2024	1,248	0.8%	285	1.8%	215	-3.3%
2025	1,263	1.2%	283	-0.7%	230	7.0%
2026	1,265	0.1%	284	0.3%	223	-3.3%
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%
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2037	1,373	0.7%	308	0.8%	250	1.1%
2038	1,385	0.9%	311	0.9%	253	1.1%
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Annual Growth Rate (%) - Weather Normal History & Forecast

Metric	Total Energy	Summer Peak Demand	Winter Peak Demand
20 Year Historical Average	0.4%	0.7%	0.9%
10 Year Historical Average	0.4%	0.3%	1.3%
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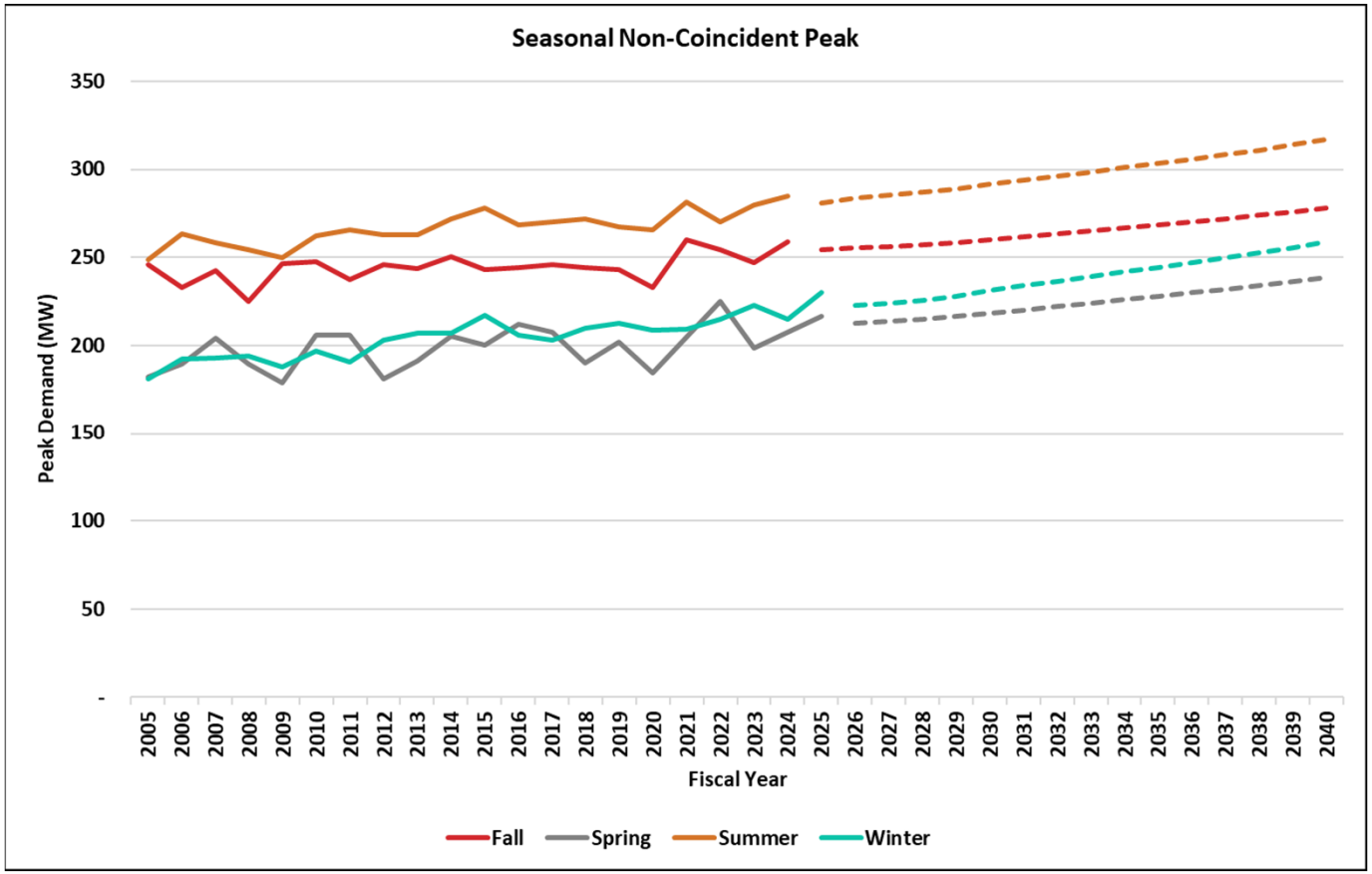
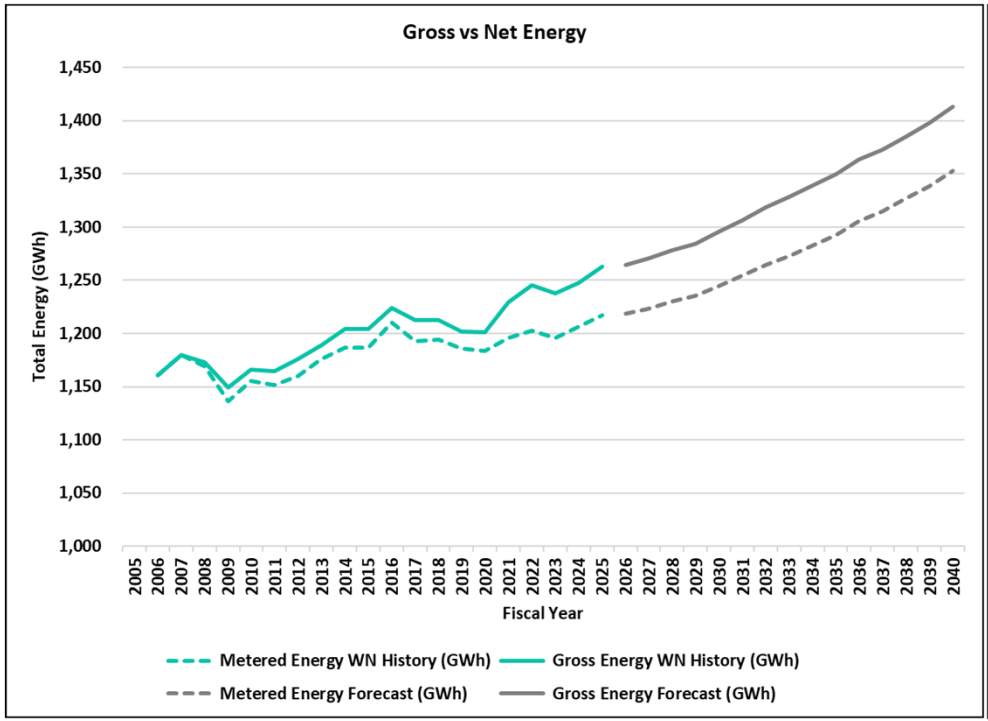
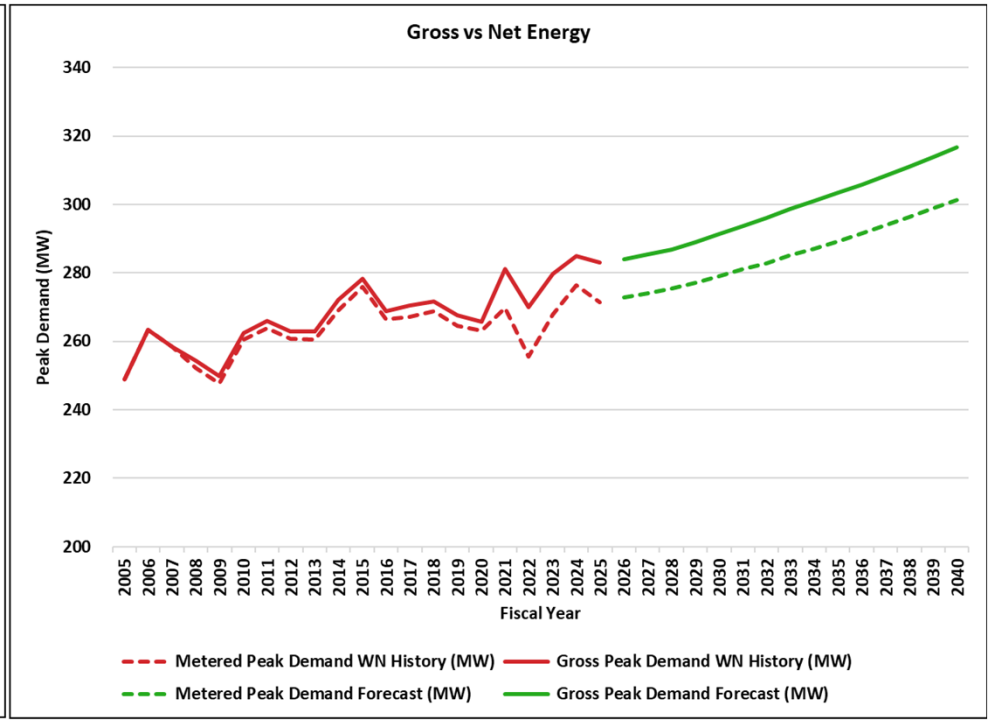
GROSS FORECAST – SEASONAL PEAK DEMAND



- Solid lined representing weather-normal history, while dashed lines reflect forecast.
- Higher rate of growth for winter peak demand due to larger volume of electric vehicle charging occurring during peak hours (7 PM).

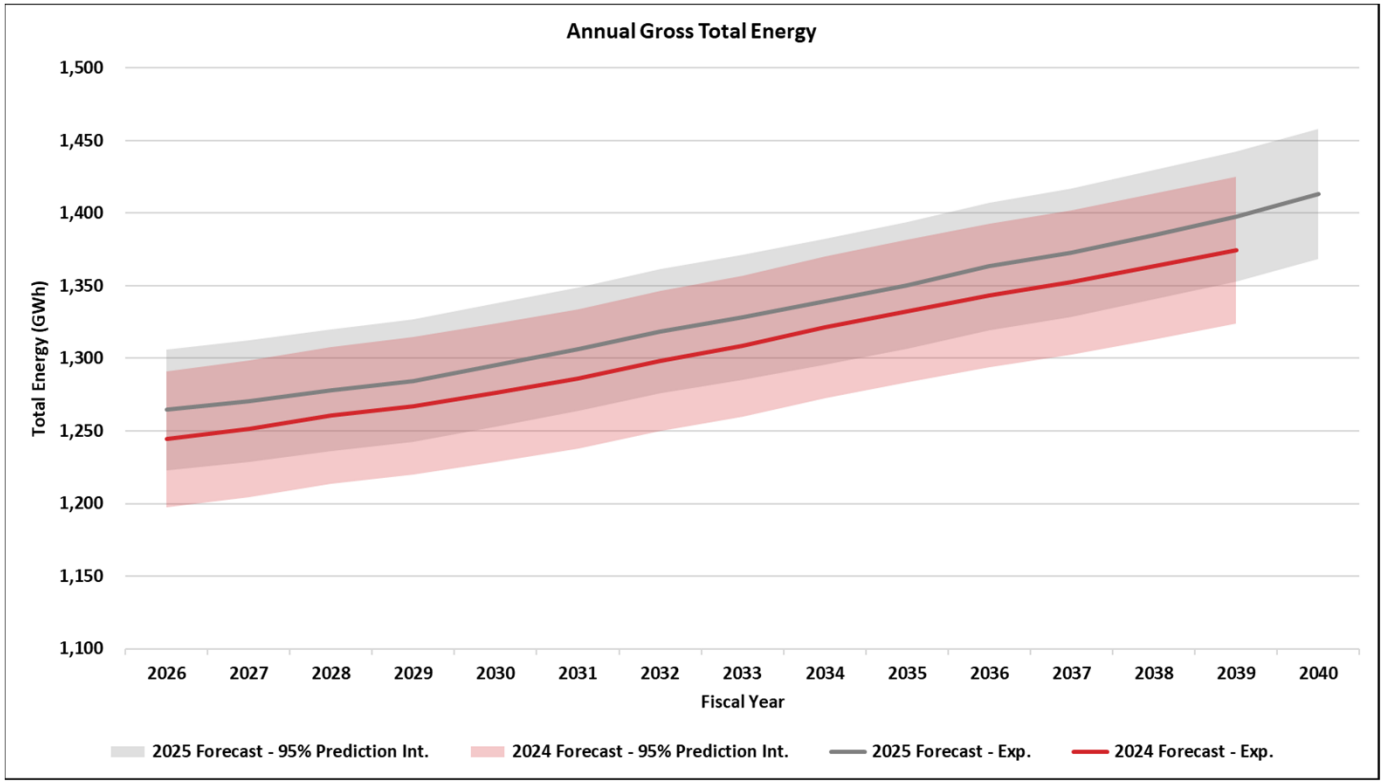
ANNUAL SUMMARY – TOTAL ENERGY





- Separation between net and gross energy driven by Truman solar and net-metering solar growth.

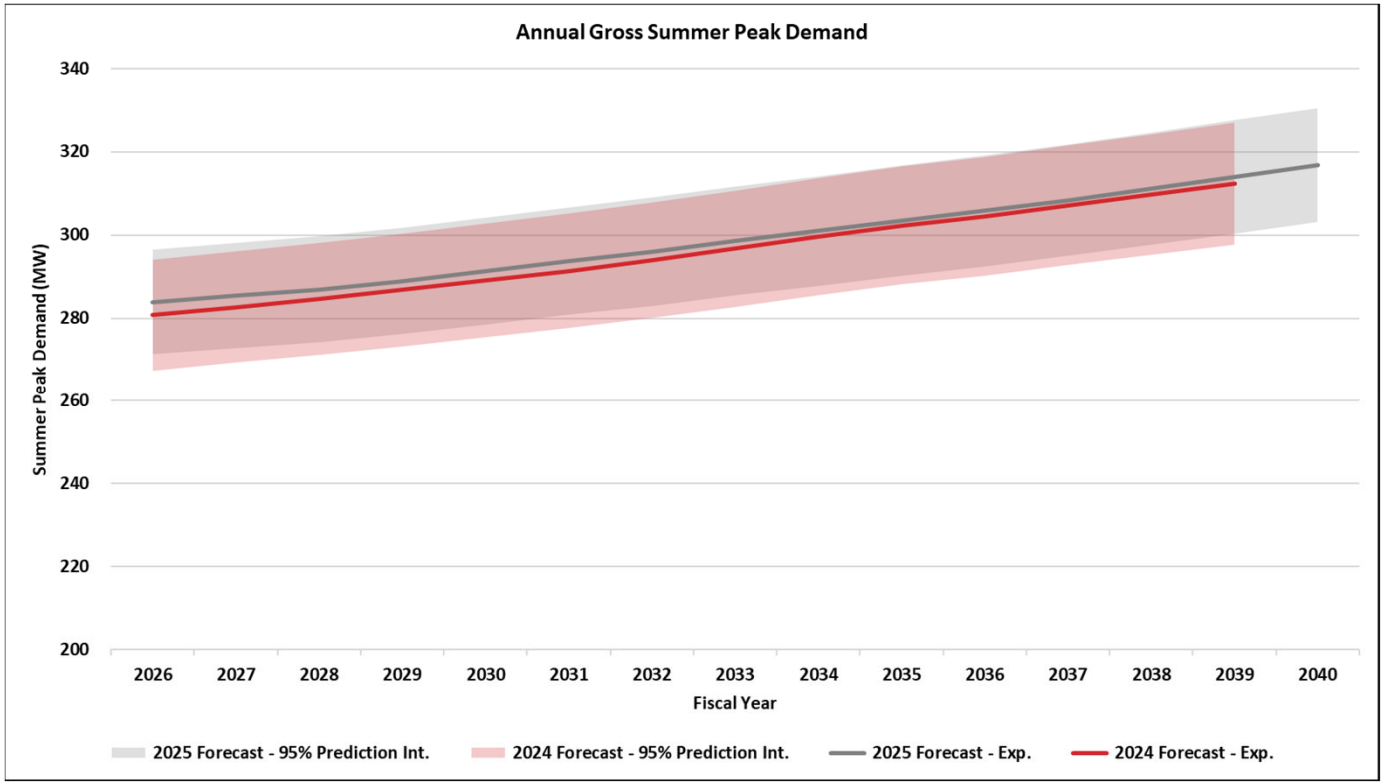
PRIOR YEAR COMPARISON – TOTAL ENERGY



Fiscal Year	Gross Total Energy (GWh)		
	2024 Forecast	2025 Forecast	Difference
2026	1,244	1,265	20
2027	1,251	1,270	19
2028	1,261	1,278	17
2029	1,267	1,285	17
2030	1,276	1,295	19
2031	1,286	1,306	21
2032	1,298	1,319	20
2033	1,308	1,328	20
2034	1,321	1,339	18
2035	1,332	1,350	18
2036	1,343	1,363	20
2037	1,352	1,373	21
2038	1,363	1,385	22
2039	1,375	1,398	23
2040		1,413	

- Increased total energy in 2025 forecast due to:
  - Differences in economic growth projections & EV charging growth.

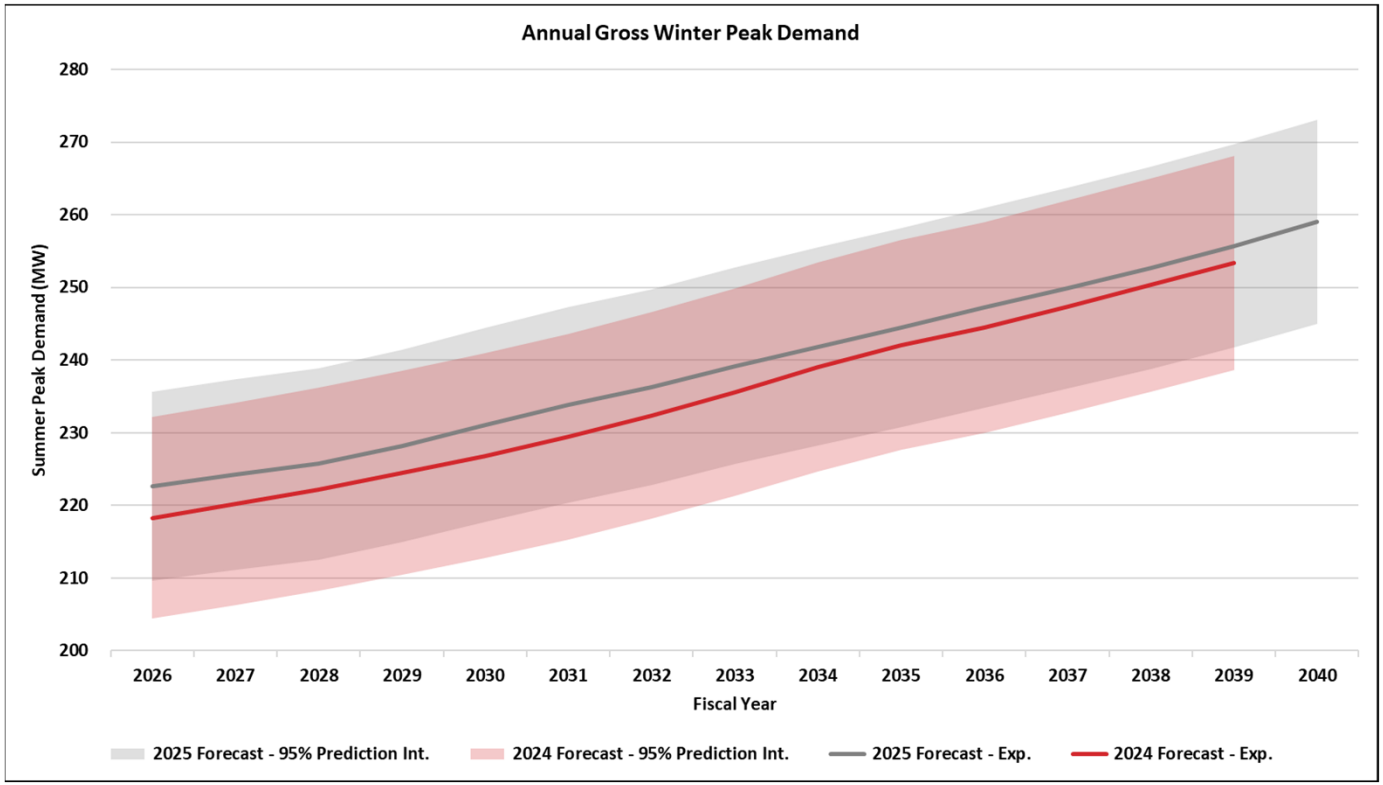
PRIOR YEAR COMPARISON – SUMMER PEAK DEMAND



Fiscal Year	Gross Summer Peak Demand (MW)		
	2024 Forecast	2025 Forecast	Difference
2026	281	284	3
2027	283	285	3
2028	285	287	2
2029	287	289	2
2030	289	291	2
2031	291	294	2
2032	294	296	2
2033	297	299	2
2034	300	301	1
2035	302	303	1
2036	305	306	1
2037	307	308	1
2038	310	311	1
2039	312	314	2
2040		317	

- Increased peak demand in 2025 forecast due to:
  - Differences in economic growth projections & EV charging growth.

PRIOR YEAR COMPARISON – WINTER PEAK DEMAND



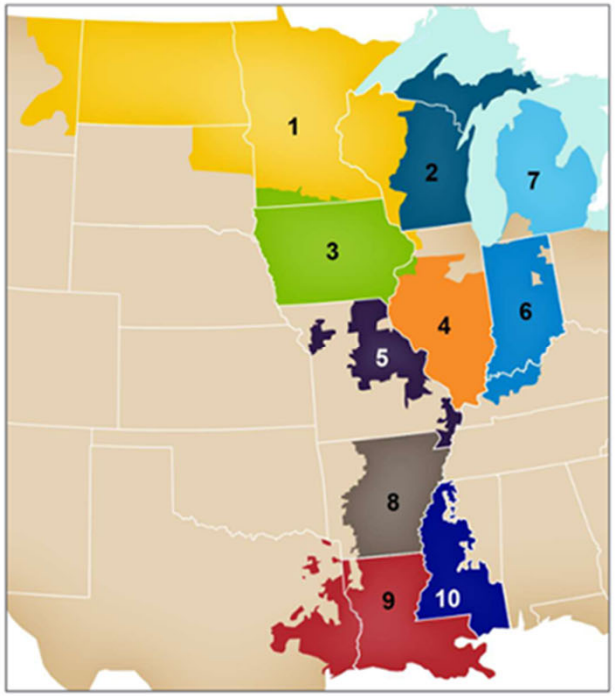
Fiscal Year	Gross Winter Peak Demand (MW)		
	2024 Forecast	2025 Forecast	Difference
2026	218	223	4
2027	220	224	4
2028	222	226	4
2029	224	228	4
2030	227	231	4
2031	229	234	4
2032	232	236	4
2033	236	239	4
2034	239	242	3
2035	242	245	2
2036	244	247	3
2037	247	250	3
2038	250	253	2
2039	253	256	2
2040		259	

- Increased peak demand in 2025 forecast due to:
  - Differences in economic growth projections & EV charging growth.

COINCIDENT PEAK DEMAND FORECAST

COINCIDENT PEAK DEMAND

Zone	Local Balancing Authorities
1	DPC, GRE, MDU, MP, NSP, OTP, SMP
2	ALTE, MGE, UPPC, WEC, WPS, MIUP
3	ALTW, MEC, MPW
4	AMIL, CWLP, SIPC, GLH
5	AMMO, CWLD
6	BREC, CIN, HE, IPL, NIPS, SIGE
7	CONS, DECO
8	EAI
9	CLEC, EES, LAFA, LAGN, LEPA
10	EMBA, SME
ERZ	KCPL, OPPD, WAUE (SPP), PJM, OVEC, LGEE, AECI, SPA, TVA

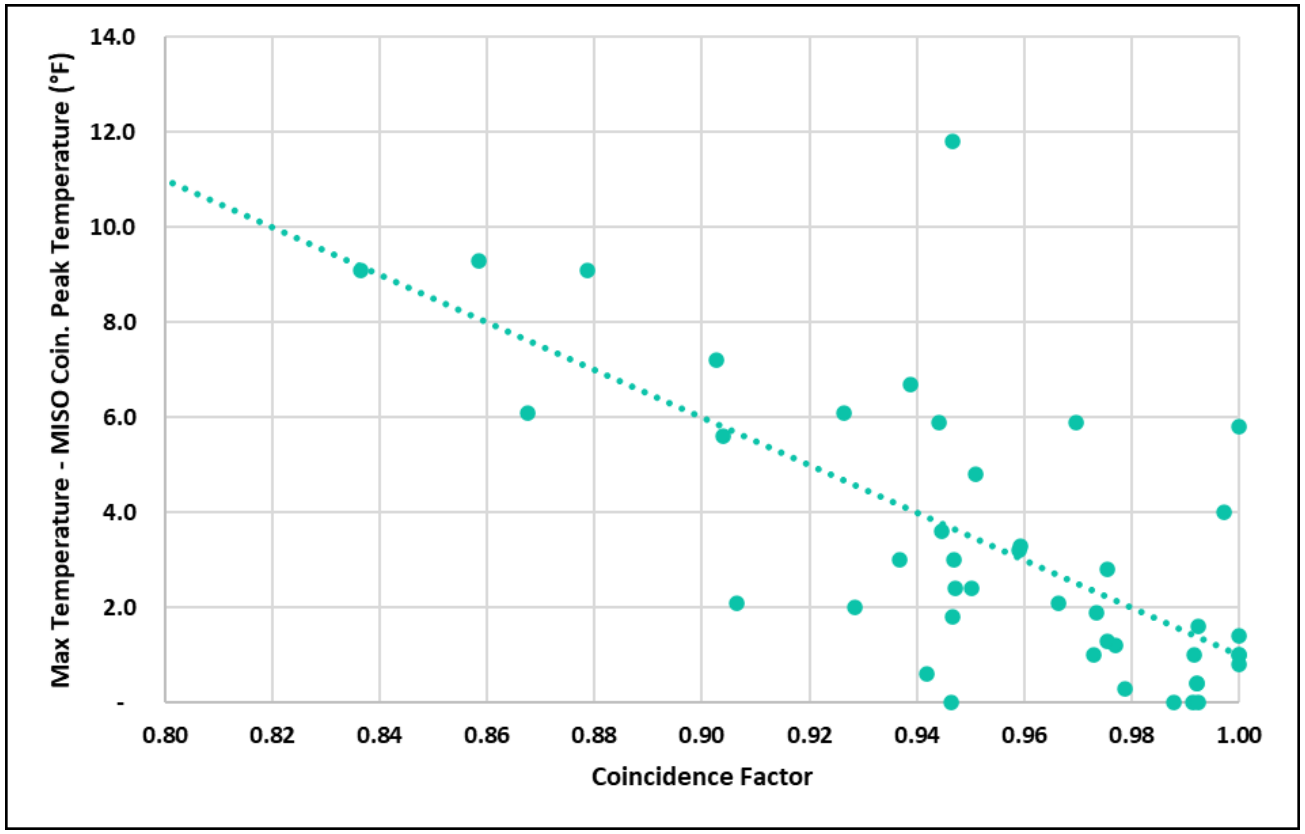


Source: https://help.misoenergy.org/knowledgebase/article/KA-01127/en-us

$$Coincident\ Peak = Non - Coincident\ Peak * Coincidence\ Factor$$

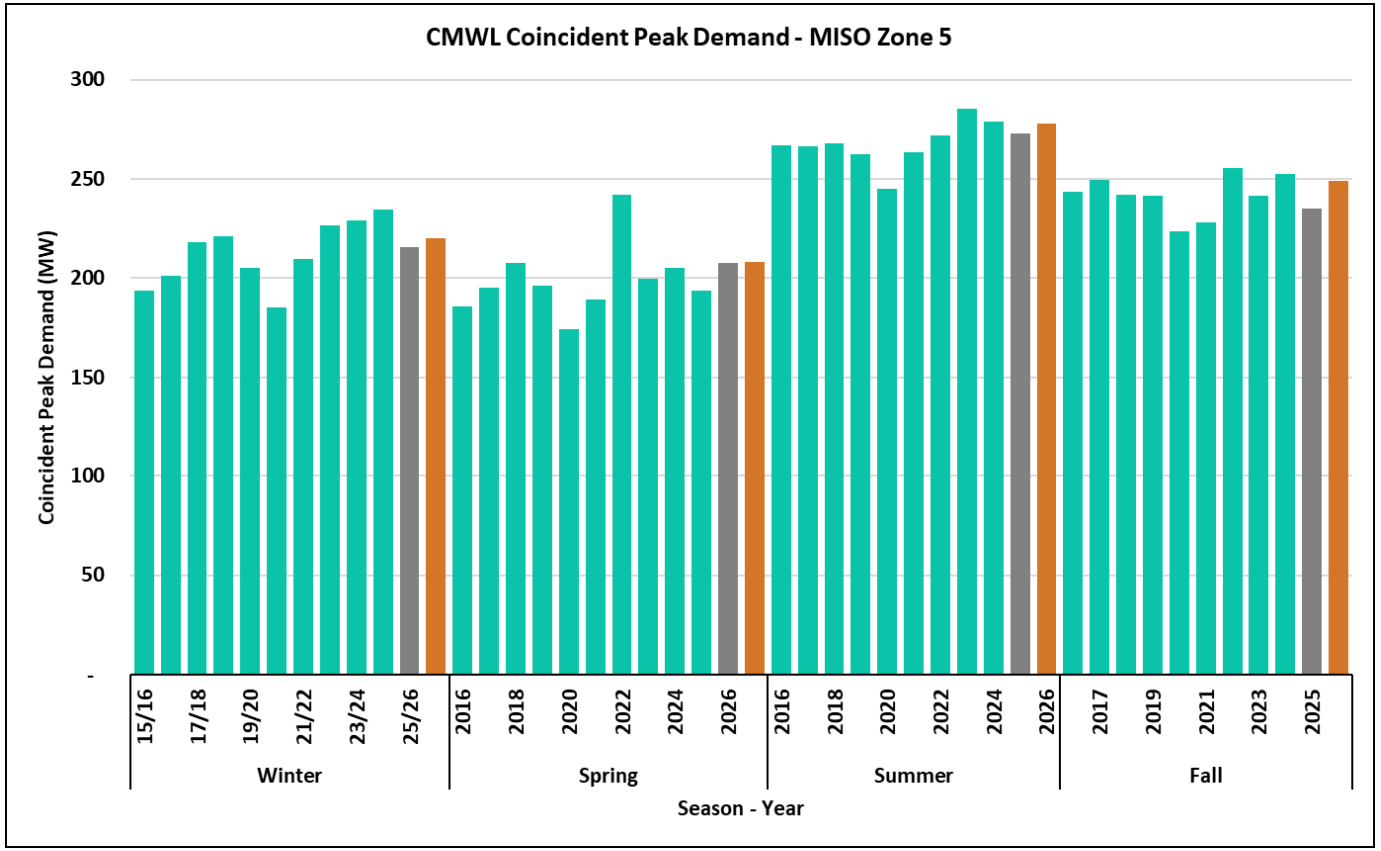
- As part of MISO's resource adequacy process, CMWL is required to forecast seasonal peak demand coincident with:
  - MISO zone 5
  - MISO system
- To derive coincident peak, non-coincident peak is multiplied by a coincidence factor.
  - Coincidence factor is the ratio of coincident peak to non-coincident peak.
  - Unique coincidence factor for MISO's system and MISO zone 5.

MISO COINCIDENCE FACTOR – COOLING MONTHS



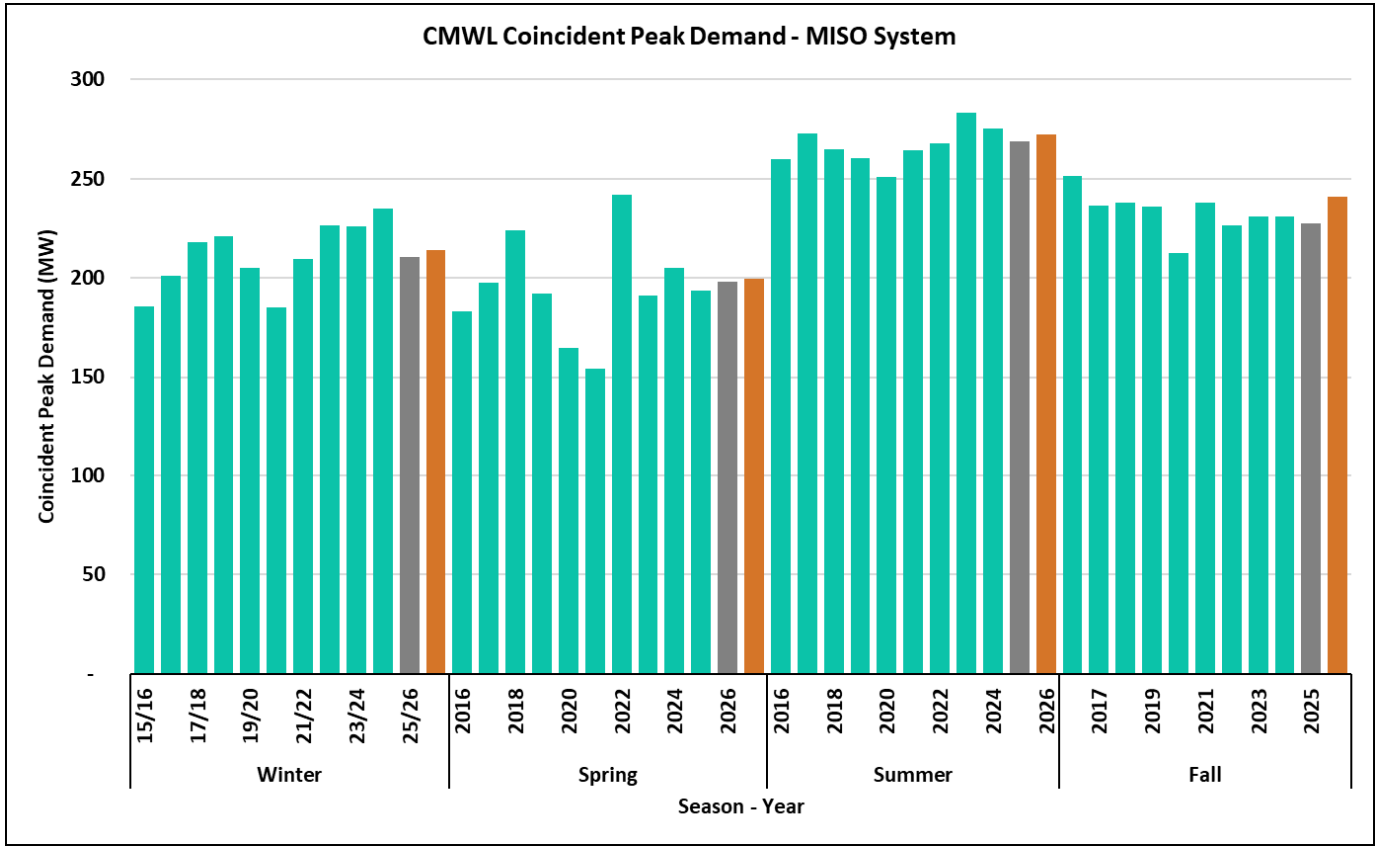
- As maximum temperature deviates from MISO system peak-producing temperatures, CMWL's coincidence factor declines.

COINCIDENT PEAK – MISO ZONE 5



- Grey columns reflect prior year's submittal data to MISO.
  - Orange columns reflect updated forecast projections.
- Increase in Fall coincident peak demand, with similar coincident peak in all other seasons.

COINCIDENT PEAK – MISO SYSTEM



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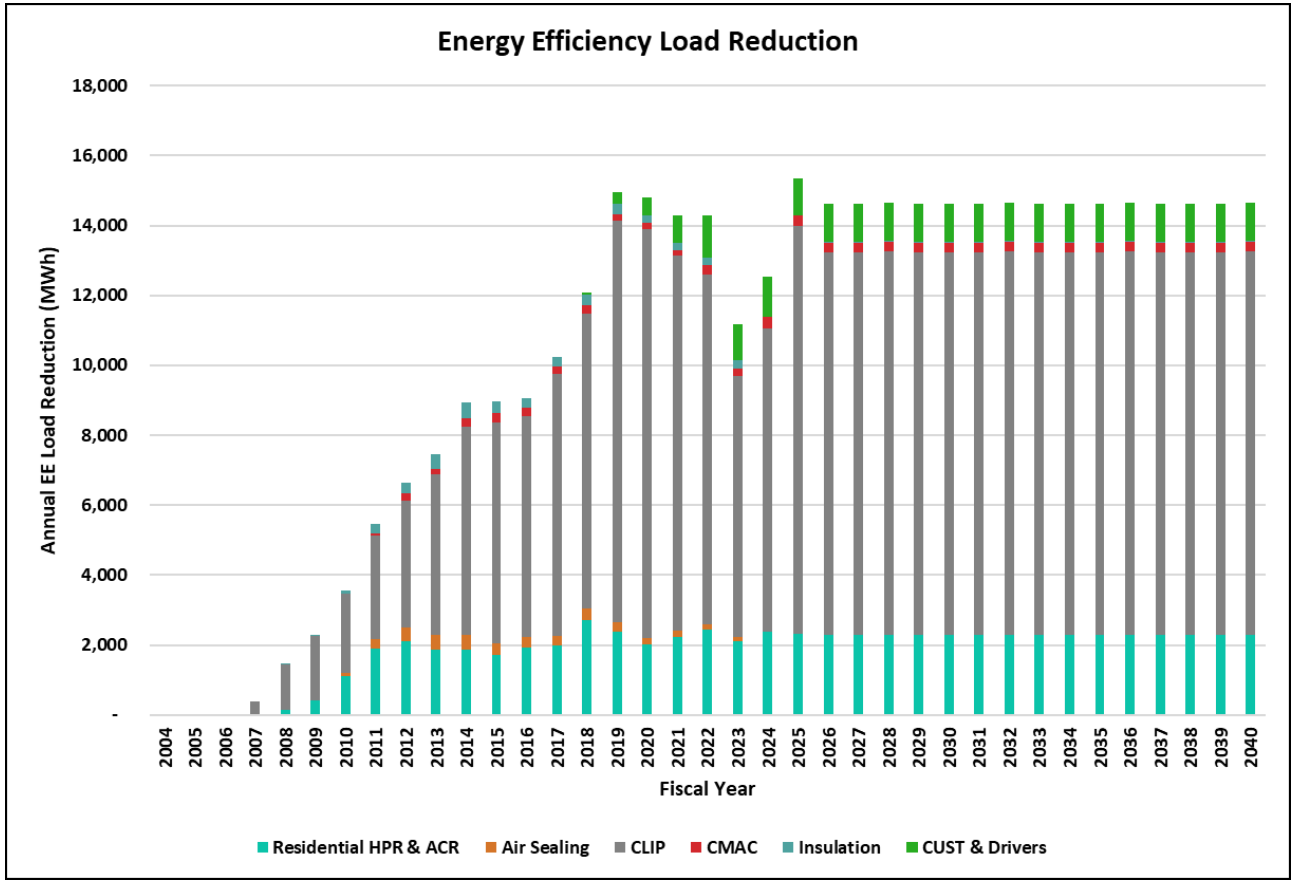
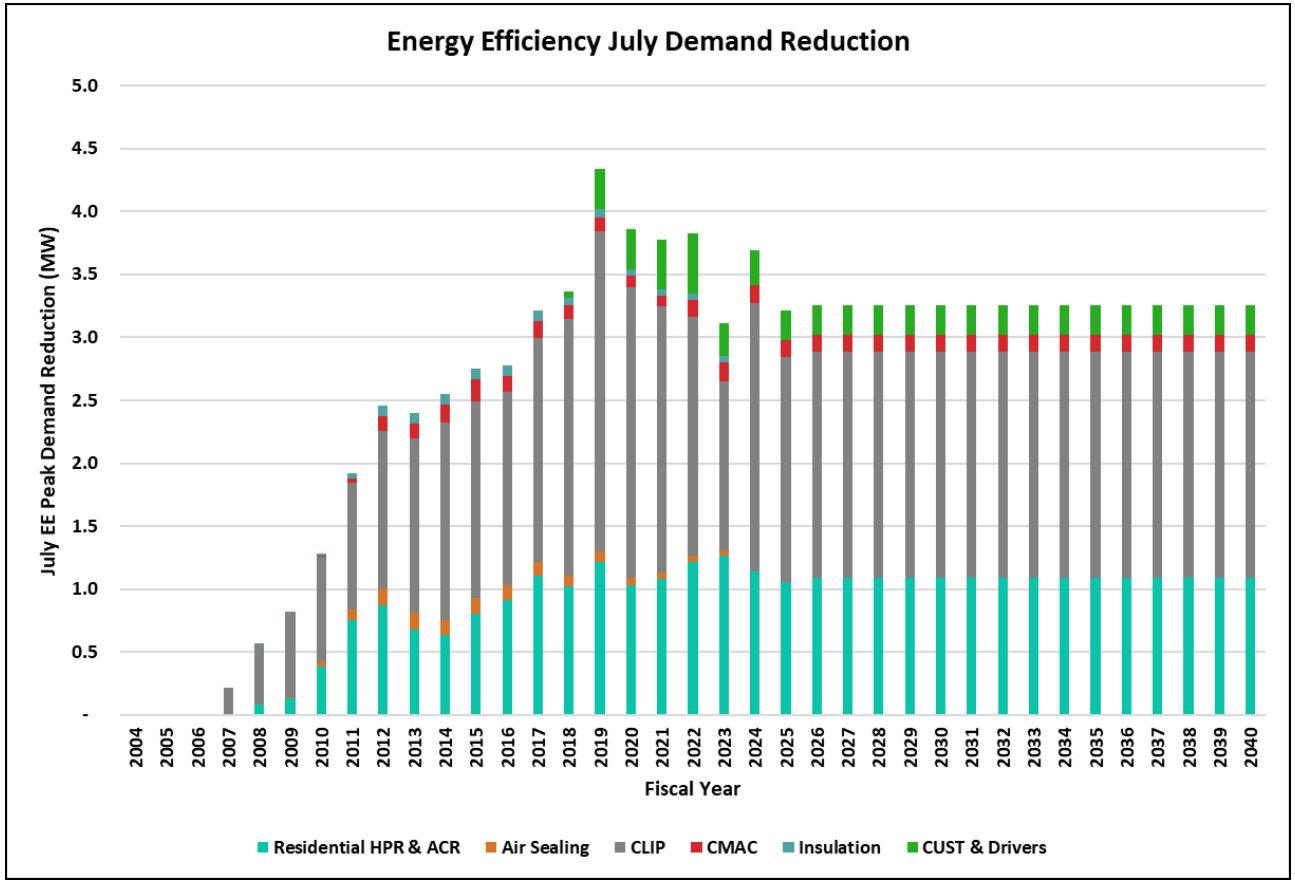
APPENDIX

ENERGY EFFICIENCY – TOTAL LOAD REDUCTION



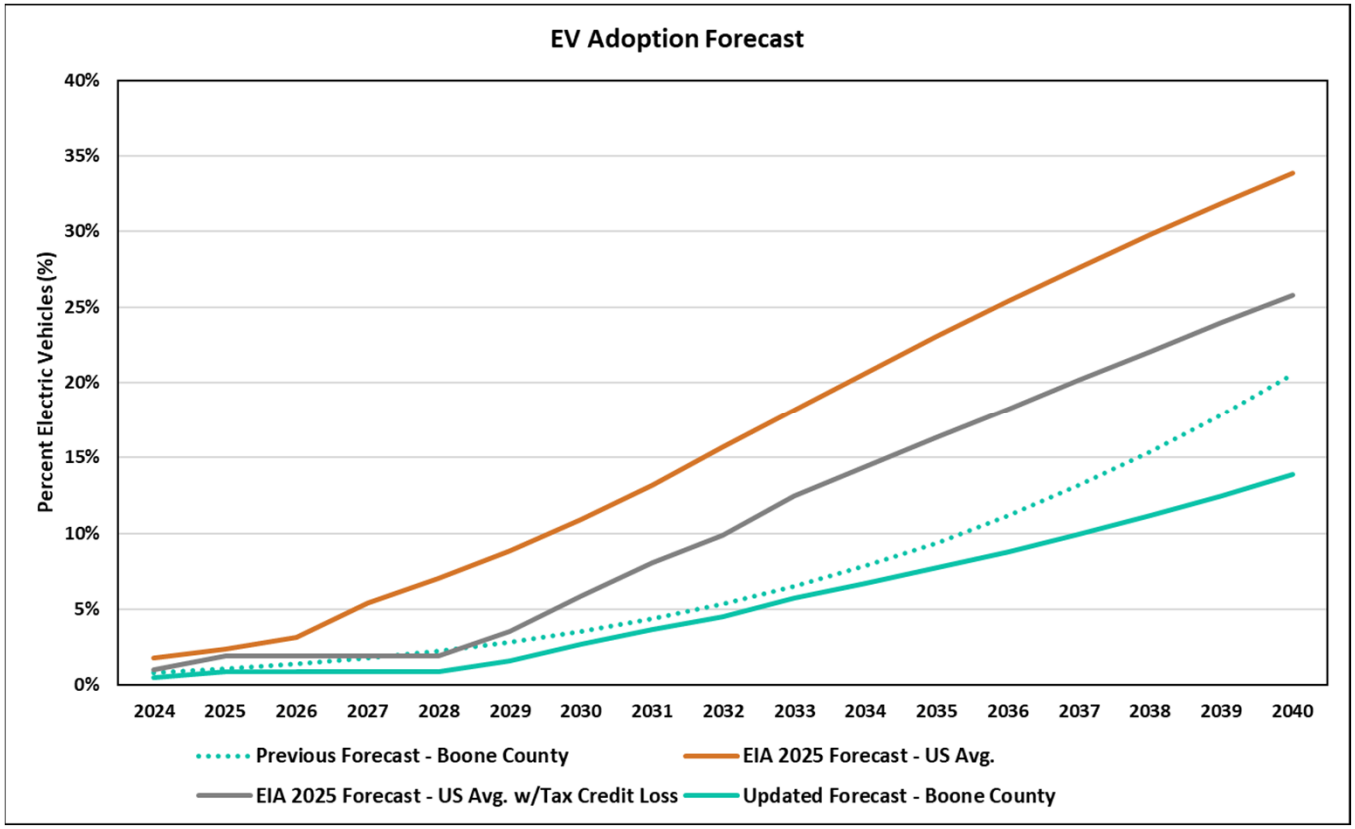
- Historical data from January 2007 – July 2025.
- Both historical and projections are cumulative EE savings observed over the prior 4 years.
  - Past 4 years, prior EE installations are assumed to be baked into load.
- Large jump in 2025 commercial lighting incentive program (CLIP) savings, due to large addition in June 2024.
  - ~6.6 GWh annual energy reduction.

ENERGY EFFICIENCY – PEAK DEMAND REDUCTION



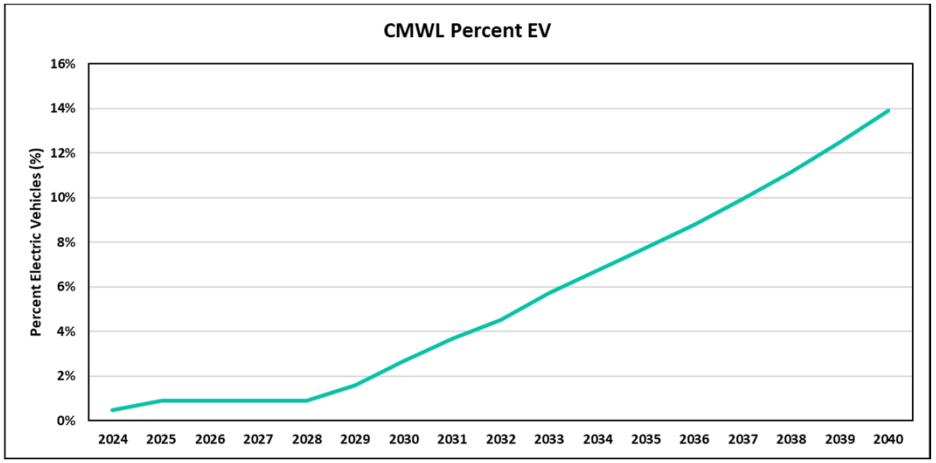
- Historical data from January 2007 – July 2025.
- Both historical and projections are cumulative EE savings observed over the prior 4 years.
  - Past 4 years, prior EE installations are assumed to be baked into load.
- Large jump in 2025 commercial lighting incentive program (CLIP) savings, due to large addition in June 2024.
  - ~0.9 MW peak demand reduction.

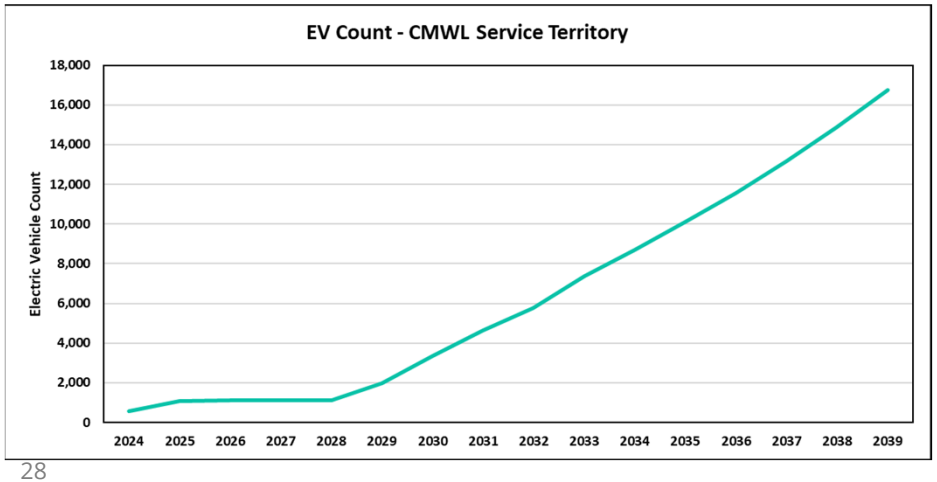
ELECTRIC VEHICLES – VEHICLE COUNT



- Annual US EV growth obtained from EIA's 2025 Annual Energy Outlook.
  - Adjusted to include expiration of EV tax credits in September 2025, using EIA vehicle price forecast for electric and combustion engine vehicles.
- US EV forecast regressed to the county level using S&P's state EV percentage data and Woods & Poole income per capita data.

ELECTRIC VEHICLES – VEHICLE COUNT





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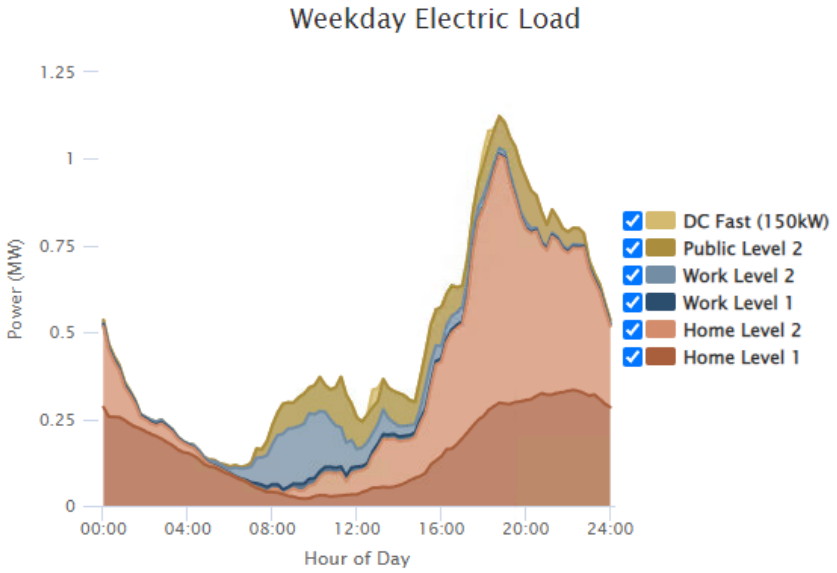
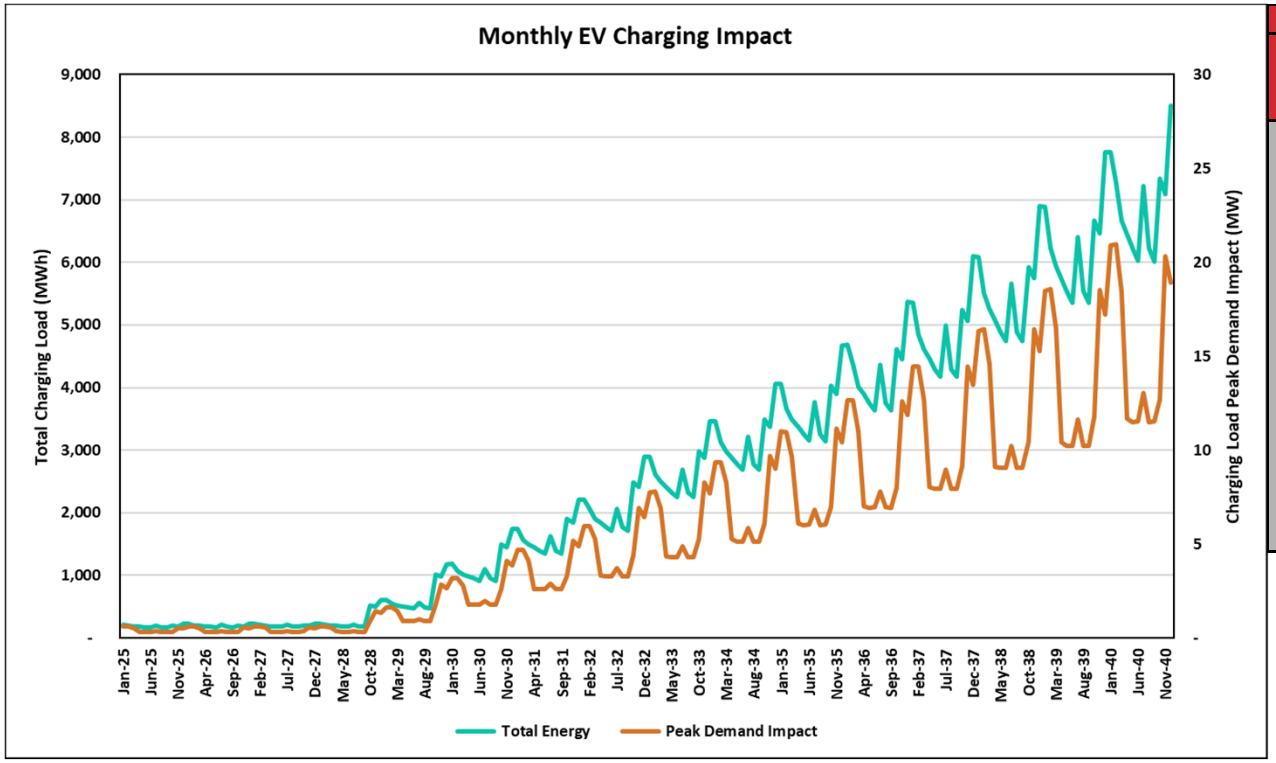
- US EV forecast regressed to the county level using S&P's state EV percentage data and Woods & Poole income per capita data.

ELECTRIC VEHICLES – HOURLY CHARGING SHAPE

- Electric Vehicle Infrastructure Projection Tool
  - Developed by the National Renewable Energy Laboratory (NREL).
- Provides hourly charging load shape for weekdays and weekend days.
- Several of these inputs can be adjusted to determine impacts on charging load.
  - Vehicle type (sedans vs SUVs, fully electric vs plug-in hybrid)
  - Vehicle chargers (level 1 vs level 2)
  - Daily distance traveled
  - **Temperature**
    - Used 10-year historical average for each month
  - **Charging behavior**
    - Assumed unmanaged charging shape
      - Peaking in early evening hours



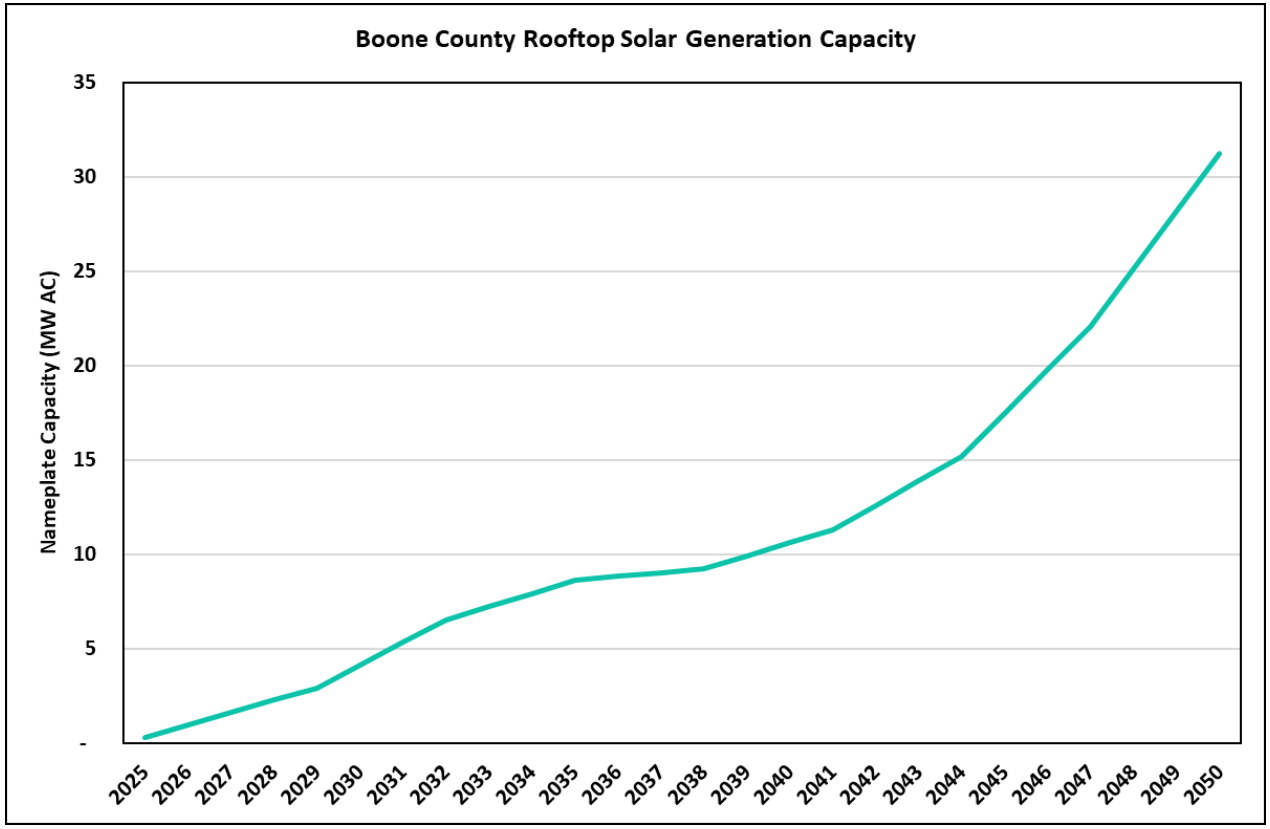
ELECTRIC VEHICLES – CHARGING IMPACT



EV Charging Impact			
Fiscal Year	Total Energy (MWh)	July Peak Demand Impact (MW)	January Peak Demand Impact (MW)
2025	1,686	0.4	0.6
2026	2,321	0.4	0.6
2027	2,365	0.4	0.6
2028	2,416	0.4	0.6
2029	6,263	1.0	1.6
2030	12,280	2.0	3.2
2031	18,066	2.9	4.7
2032	23,037	3.7	6.0
2033	30,059	4.9	7.8
2034	35,939	5.8	9.3
2035	42,120	6.8	11.0
2036	48,732	7.8	12.7
2037	55,656	9.0	14.4
2038	63,273	10.2	16.3
2039	71,558	11.6	18.5
2040	80,769	13.0	20.9

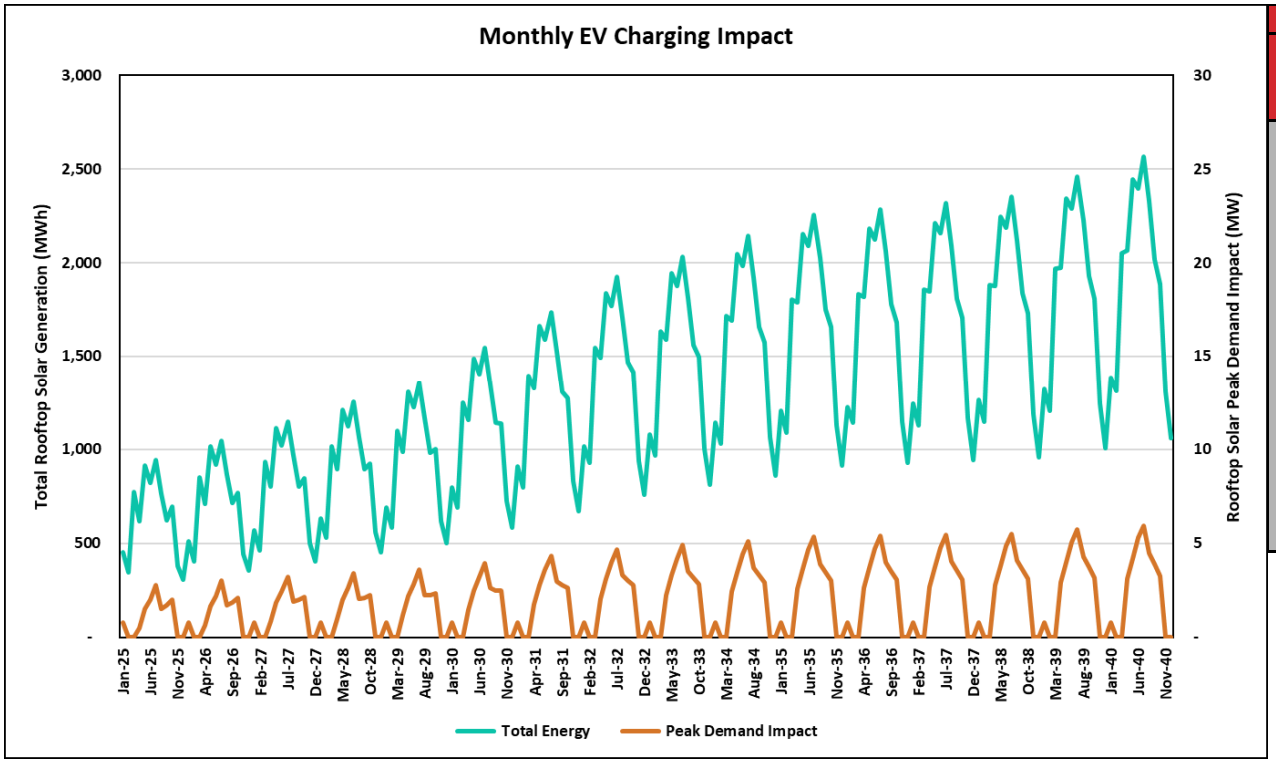
- Difference in summer/winter peak demand impact driven by the time of the day that peak demand occurs most often.
  - ~5 PM during summer months.
  - ~7 PM during winter months.

ROOFTOP SOLAR ADOPTION



- Sourced projections from the National Renewable Energy Laboratory's ReEDS model.
  - 2024 standard scenarios: No IRA scenario.
- Provides forecasts for rooftop solar adoption broken out into six regions in Missouri.
  - Pulled results for the appropriate state and scaled down the rooftop solar adoption forecast based on regional total number of households to Boone County number of households.
- Fixed axis solar generation profile used.
  - ~17% capacity factor.

ROOFTOP SOLAR IMPACTS - GENERATION



Rooftop Solar Generation			
Fiscal Year	Total Energy (MWh)	July Peak Demand Impact (MW)	January Peak Demand Impact (MW)
2025	6,256	2.8	0.8
2026	8,425	3.0	0.8
2027	9,395	3.2	0.8
2028	10,373	3.4	0.8
2029	11,335	3.6	0.8
2030	12,940	4.0	0.8
2031	14,693	4.3	0.8
2032	16,471	4.7	0.8
2033	17,612	4.9	0.8
2034	18,641	5.1	0.8
2035	19,670	5.3	0.8
2036	20,147	5.4	0.8
2037	20,417	5.5	0.8
2038	20,722	5.5	0.8
2039	21,587	5.7	0.8
2040	22,625	5.9	0.8

- Difference in summer/winter peak demand impact driven by the time of the day that peak demand occurs most often.
  - ~5 PM during summer months.
  - ~7 PM during winter months.