Long-Term Load Forecast

Apr 28th, 2026

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Agenda

1. Forecasting Methodology Overview
2. Baseline Forecast Inputs
3. Electric Vehicles, Heat pumps, and Solar Assumptions
4. Forecast Results

Forecasting Framework

1. Reconstitute historical VELCO system and zonal load data for solar generation, managed EV charging, and flexible load management.

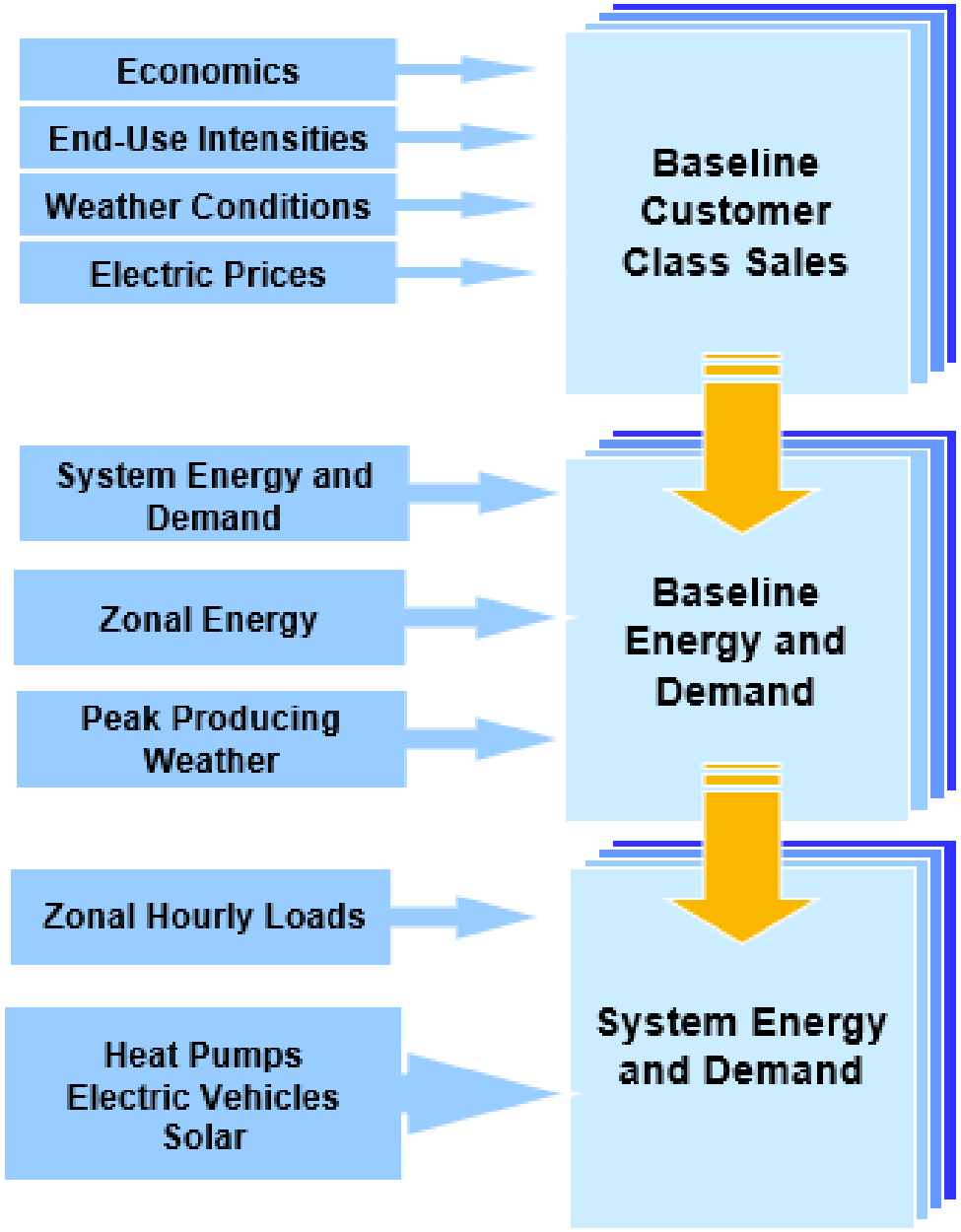
2. Develop customer class sales and energy requirements.

3. Estimate baseline system and zonal energy and demand models.

4. Develop baseline hourly system and zonal forecasts.

5. Develop technology forecasts; electric vehicles, heat pumps, and solar. Hourly technology profiles.

6. Apply technology forecasts to baseline hourly system and zonal forecast to generate final adjusted forecast.

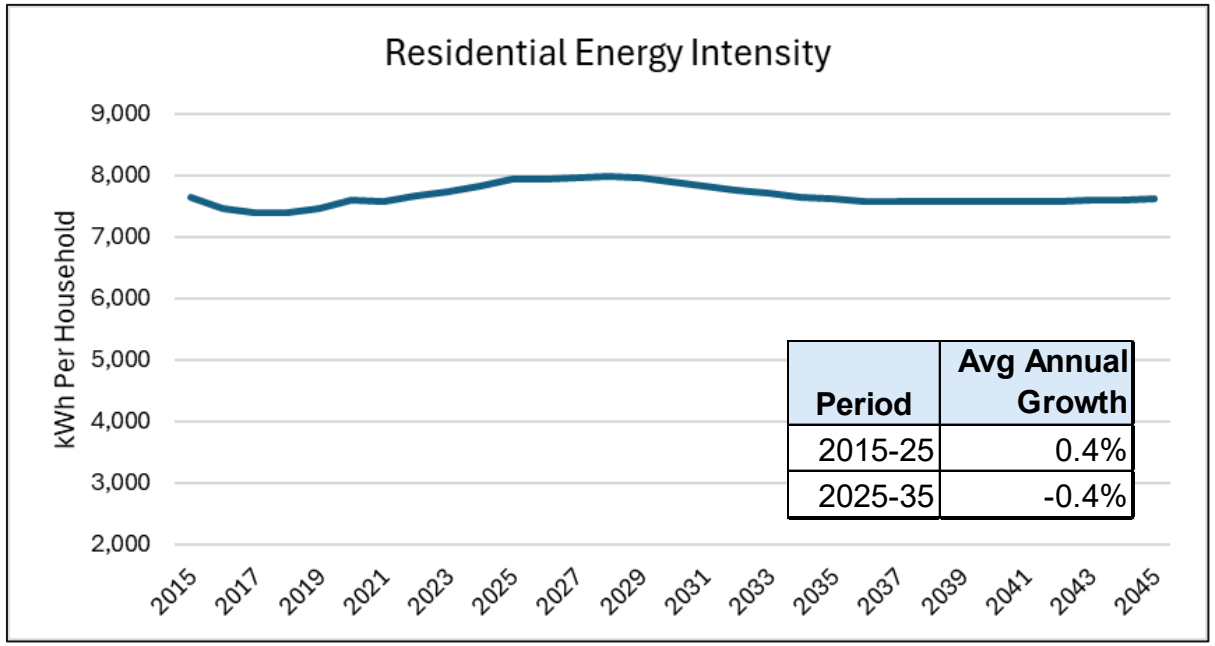


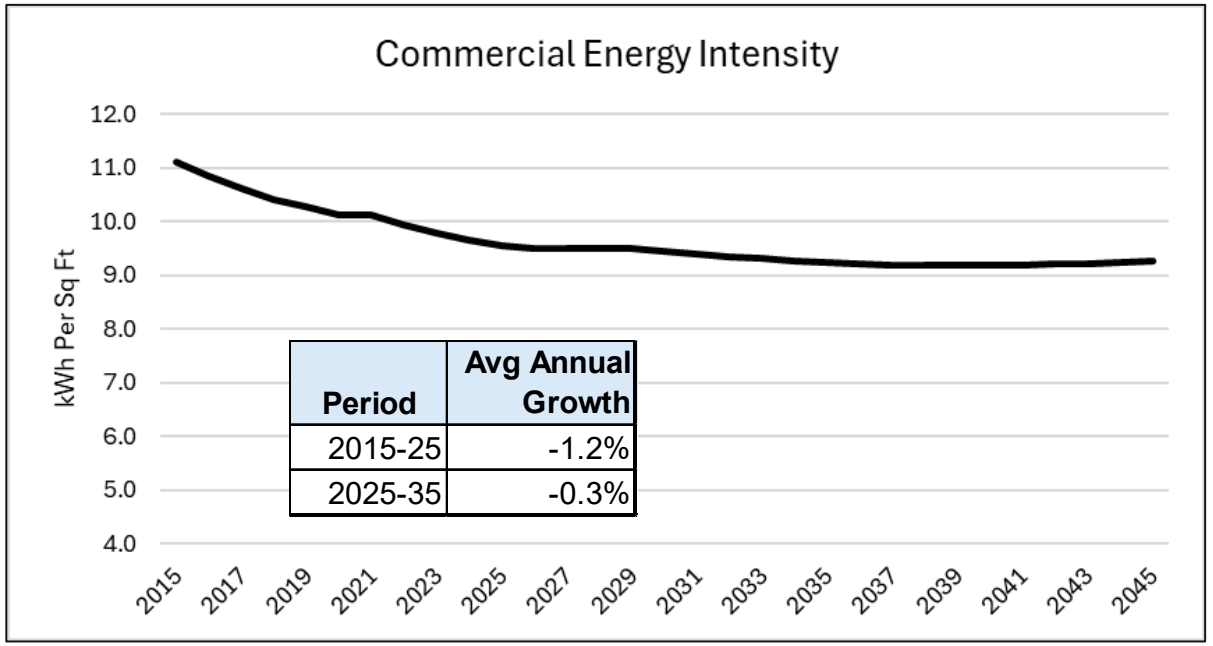
State Economic Outlook

- Forecast based on Wood & Poole state economic outlook
  - County-level forecast for zones
- Slow and steady population and economic growth
  - 1.4% long-term gross state product growth
  - In comparison, U.S. GDP growth over the next five years is1.8% to 2.2%

Year	Households (thou)	GDP ($ thou. Real)	Employment (thou)	Population (thou)
2020	277,549	32,673,205	427,056	653.08153
2025	289,327	36,156,454	451,838	660.73499
2030	296,280	38,798,233	468,423	668.14649
2035	299,411	41,633,791	484,854	674.50285
2040	300,707	44,674,017	501,474	679.60401
2045	301,730	47,937,198	518,431	684.0517
2020-25	0.83%	2.05%	1.13%	0.23%
2025-30	0.48%	1.42%	0.72%	0.22%
2030-45	0.12%	1.42%	0.68%	0.16%

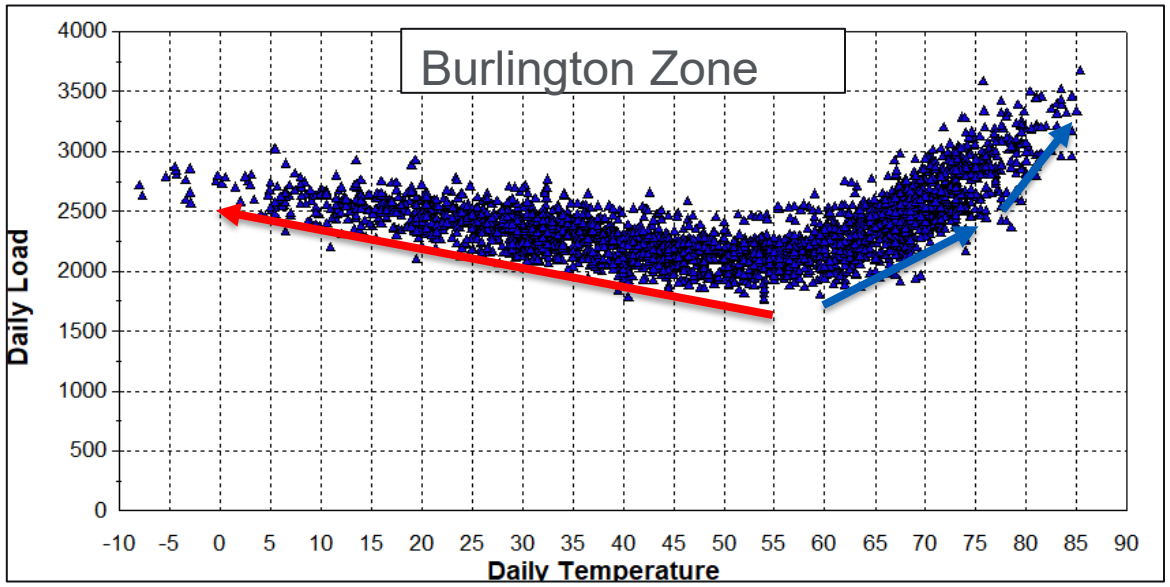
Sector Energy Intensity Trends

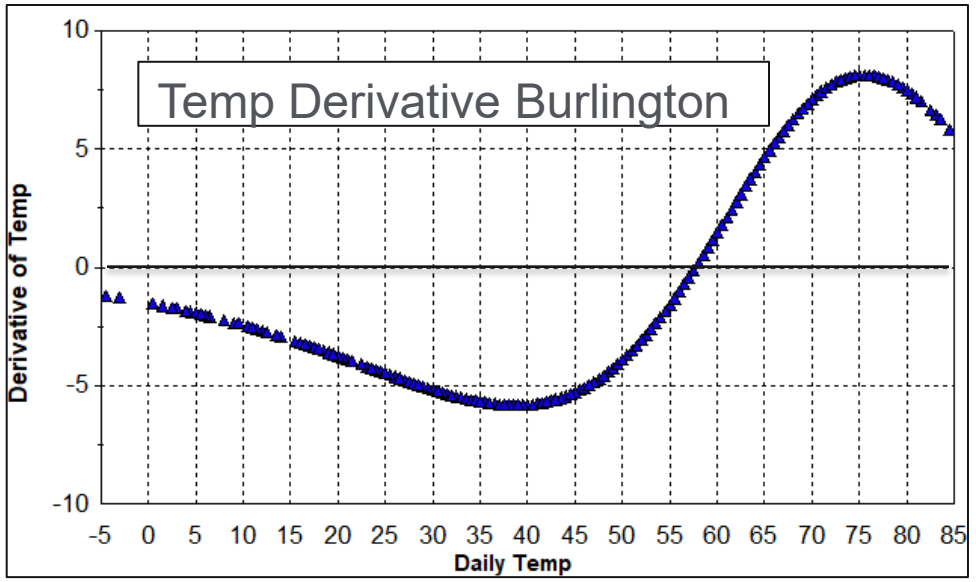


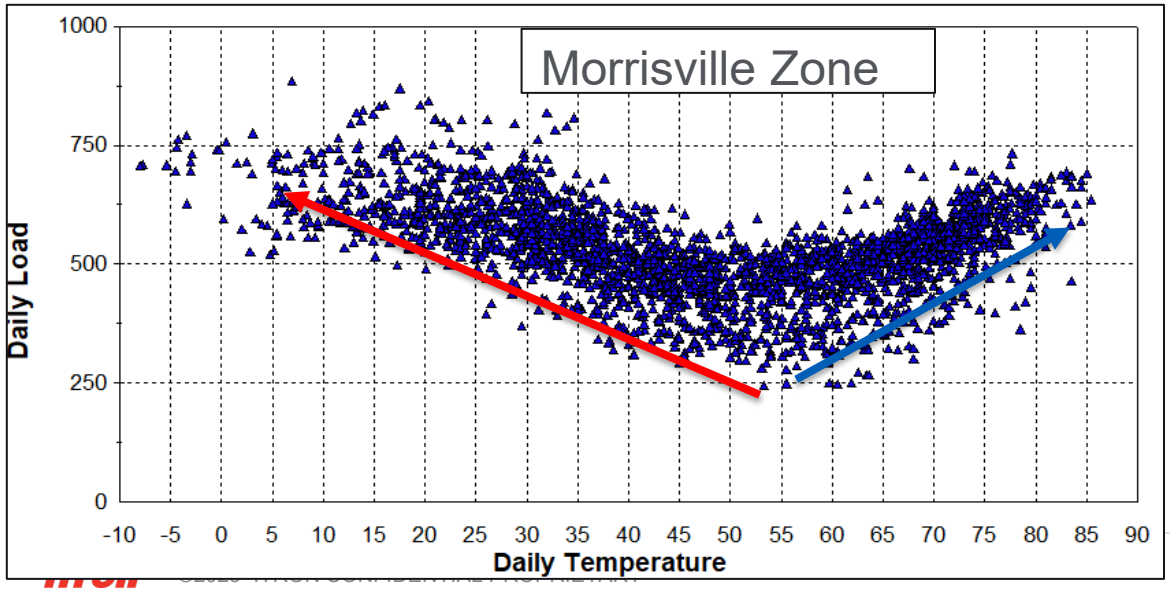


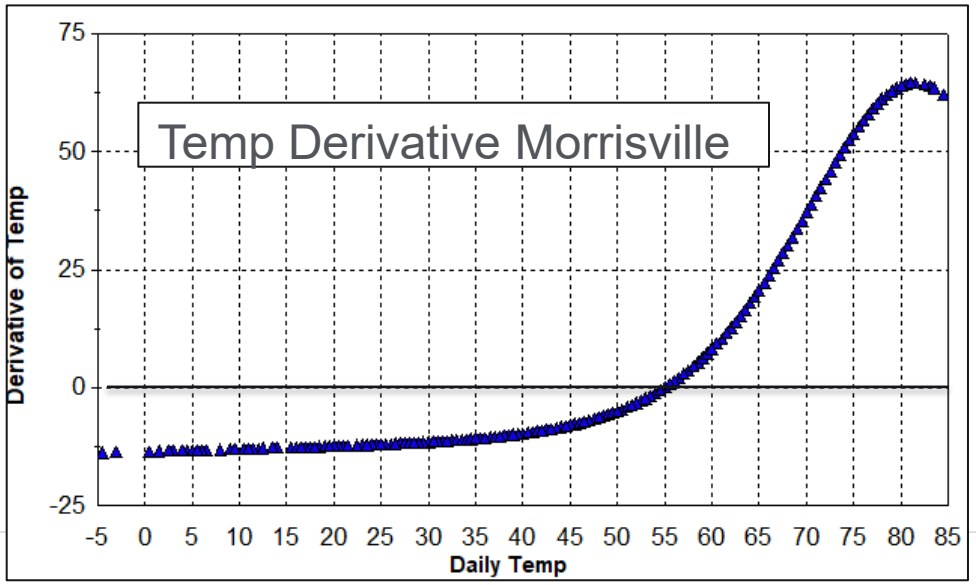
- Intensities incorporate end-use saturations and average stock efficiencies for residential and commercial customers.
- Based on the 2025 Annual Energy Outlook forecast from the Energy Information Administration, New England census region.
- Calibrated to Vermont to reflect Vermont end-use saturations

Unique Weather Response by Zone







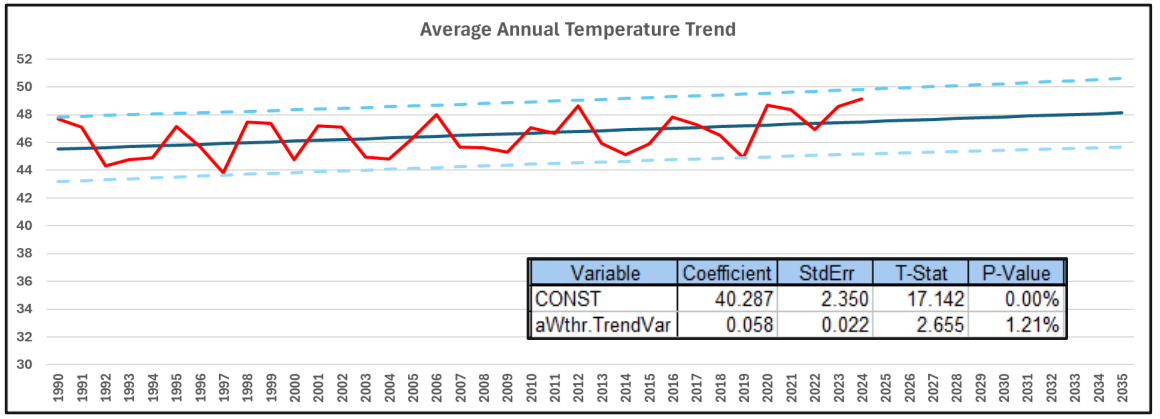


Temperature Trends – 1990 to 2024

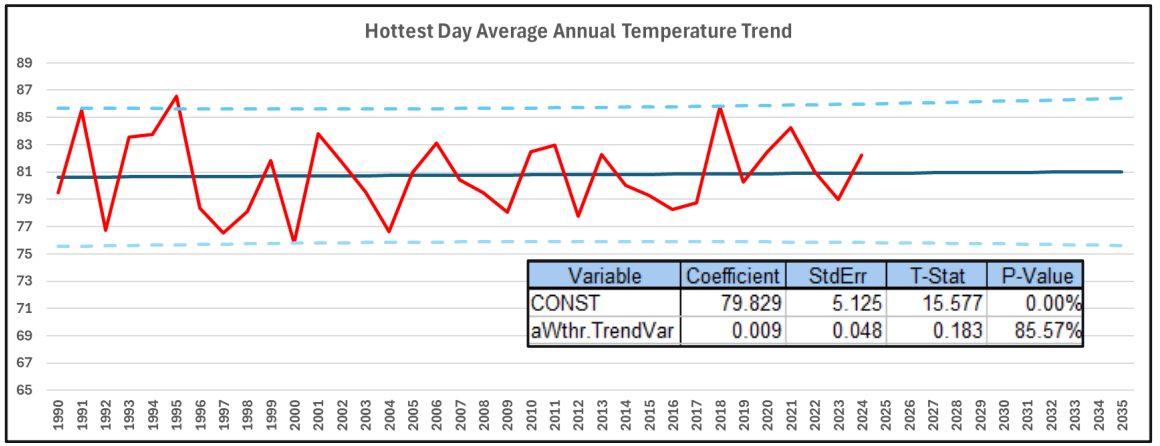
» Average Annual Temperature
- Increasing .058 degrees per year (0.58 degrees per decade)

» Hottest Day Average Annual Temperature
- Statistically insignificant trend – the warmest days are not getting hotter
- But there are more of them

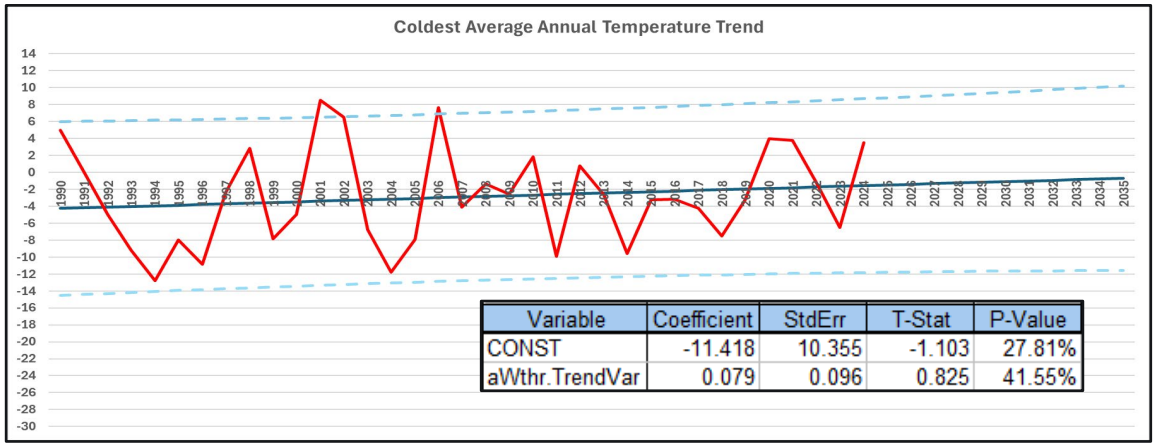
» Coldest Day Average Annual Temperature
- Increasing 0.079 degrees per year (0.79 degrees per decade)



Variable	Coefficient	StdErr	T-Stat	P-Value
CONST	40.287	2.350	17.142	0.00%
aWthr.TrendVar	0.058	0.022	2.655	1.21%

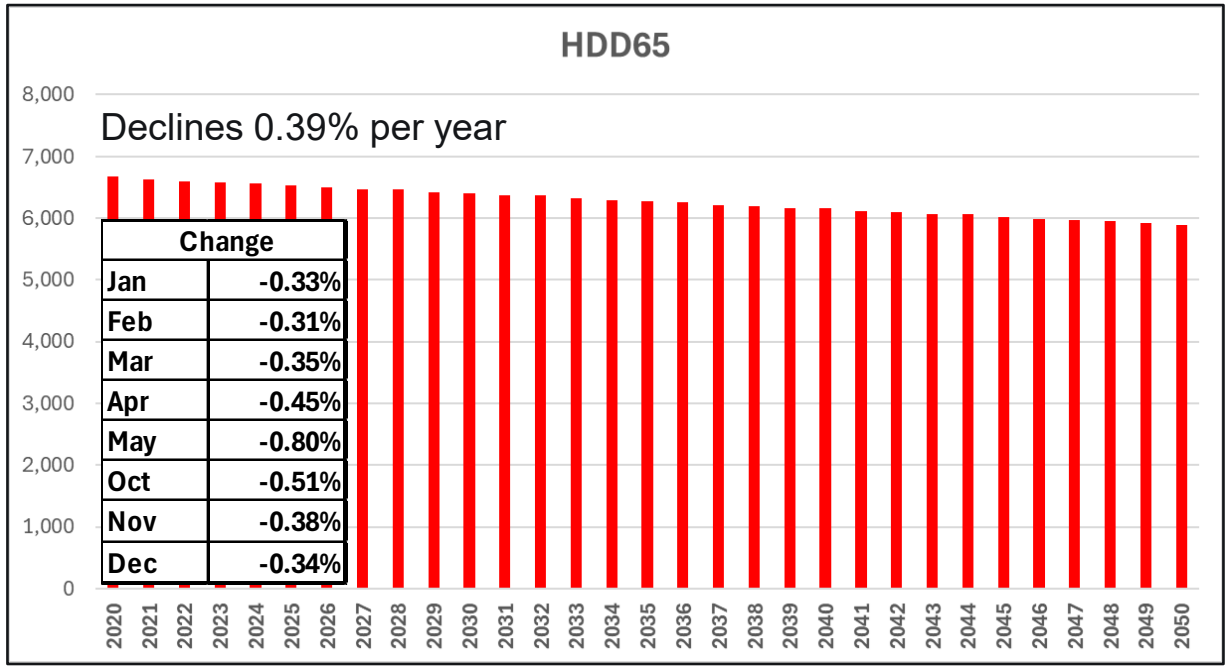


Variable	Coefficient	StdErr	T-Stat	P-Value
CONST	79.829	5.125	15.577	0.00%
aWthr.TrendVar	0.009	0.048	0.183	85.57%

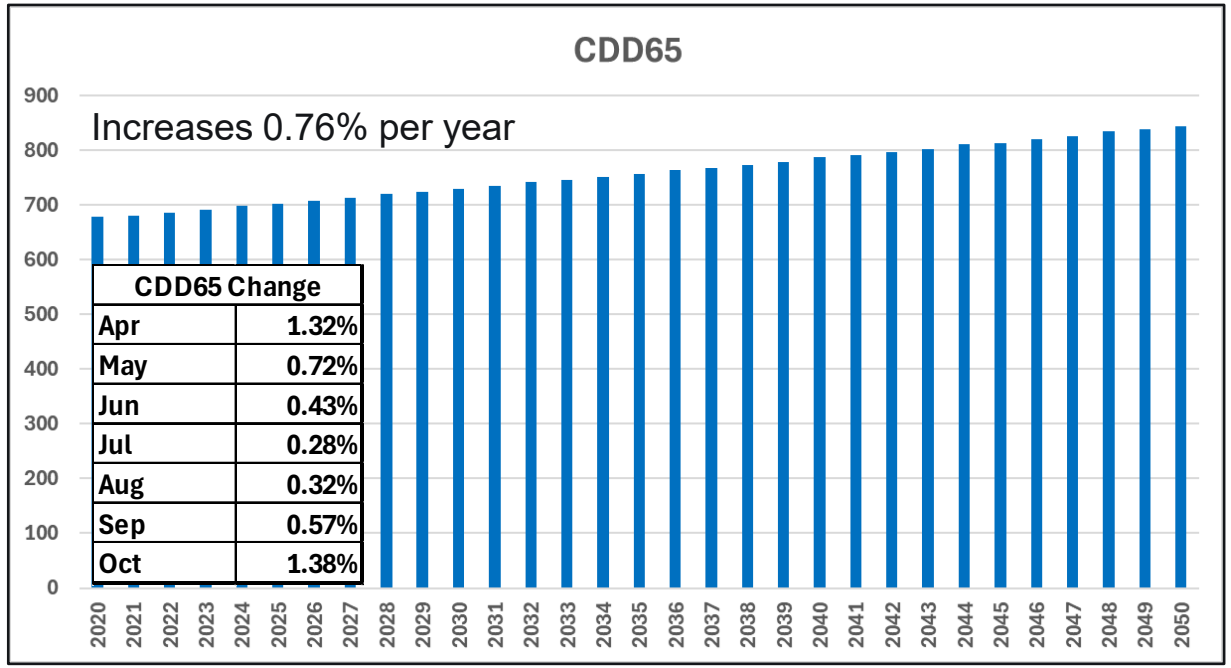


Variable	Coefficient	StdErr	T-Stat	P-Value
CONST	-11.418	10.355	-1.103	27.81%
aWthr.TrendVar	0.079	0.096	0.825	41.55%

Trended Degree Days



Change	
Jan	-0.33%
Feb	-0.31%
Mar	-0.35%
Apr	-0.45%
May	-0.80%
Oct	-0.51%
Nov	-0.38%
Dec	-0.34%



CDD65 Change	
Apr	1.32%
May	0.72%
Jun	0.43%
Jul	0.28%
Aug	0.32%
Sep	0.57%
Oct	1.38%

» Fastest decline in HDD and increase in CDD are in the shoulder months.

Electric Vehicle Forecast

- Two EV forecast are produced, a medium forecast based on the EIA's forecast for New England, and a policy forecast based on EV sales targets where 100% of new vehicle sales are electric by 2035.
  - The medium EV forecast will be used in the medium load forecast
  - The policy EV forecast will be used in the high/policy load forecast

- Both EV forecasts use the same assumptions regarding EV hourly charging, miles driven, kWh per mile, and life cycle of vehicles.

- The medium forecast results in 197,578 registered EV in Vermont by 2035

- The policy forecast results in 266,514 registered EV in Vermont by 2035

Electric Vehicle Forecasting Methodology

1. Develop a state-level EV forecast using the EIA (Energy Information Administration) or policy target EV sales targets.
   I. Starting with the most recent EV sales and EV registrations
   II. EV sales targets based on state mandates or EIA forecast
   III. Assumptions regarding BEV/PHEV splits, annual miles, kWh per mile, average vehicle life

2. Forecast county EV registrations as a function of county household income.
   i. Calibrate county EV forecast to state EV forecast
   ii. Validate reasonableness of county allocation

3. Combine EV MWh forecast with hourly charging profiles
   i. Home charging versus public charging
   ii. Uncontrolled home charging versus controlled or time-of-use rates

Hourly EV Charging Assumption

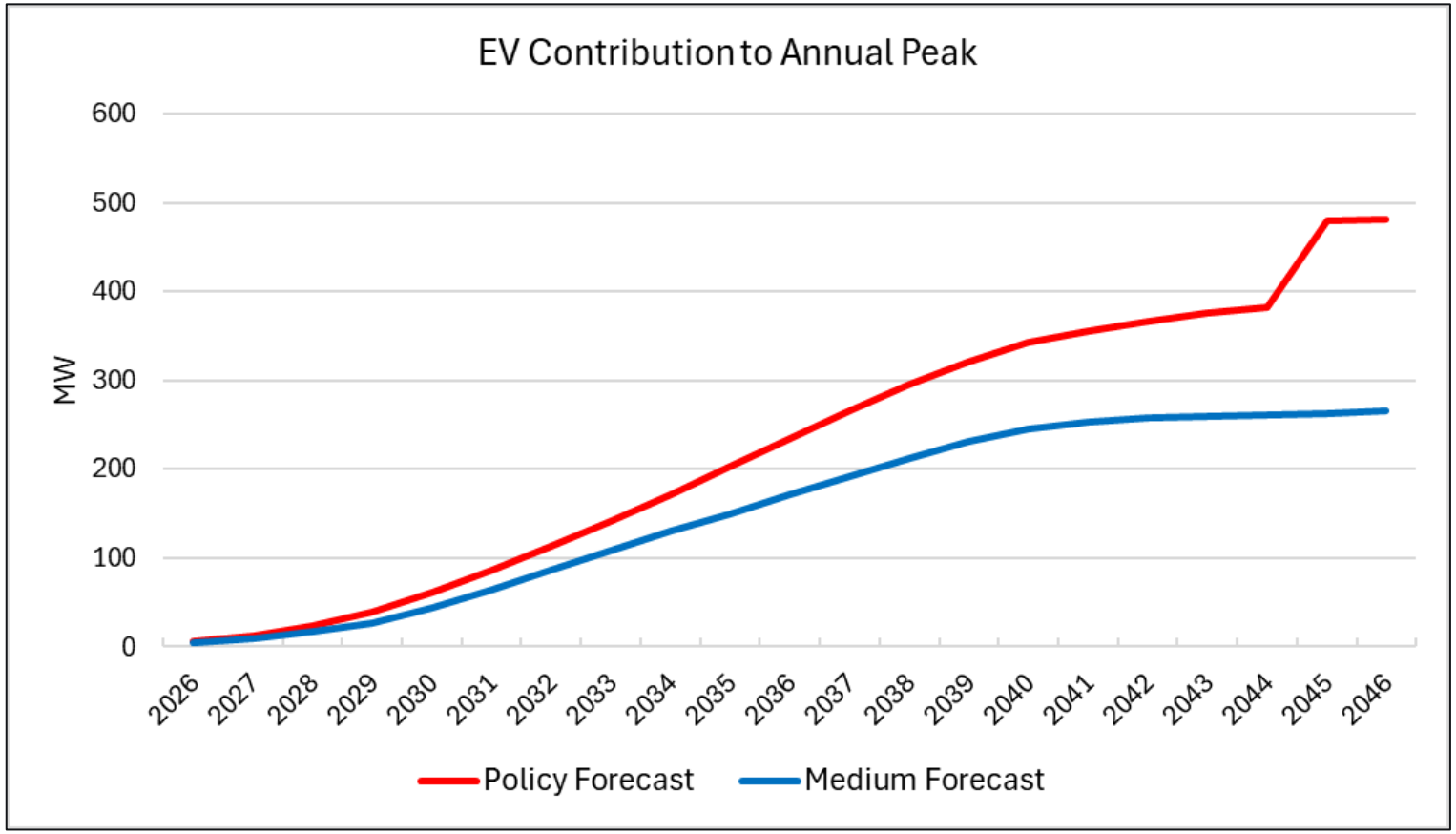
- Forecast assumes that 80% of charging occurs at home and 20% away from home at public or workplace chargers. Home charging is allocated to one of three charging strategies.

- **Non-incentivized rate**: We assume 25% of BEV owners are not signed up for any rate, this increases to 35% by 2046. The hourly charging pattern is based on publicly available EV charging patterns from the Dept. of Energy's EVI-Pro Lite online tool.
  - We assume all PHEV charging will be on a non-incentivized rate.

- **Incentivized Time-of-Use Rate**: 2/3 of customers on an incentivized rate are on the TOU rate. All BEVs on this rate begin charging at the same time, there is no staggered start. The hourly charging pattern is based on GMP rate 74 hourly charging data.

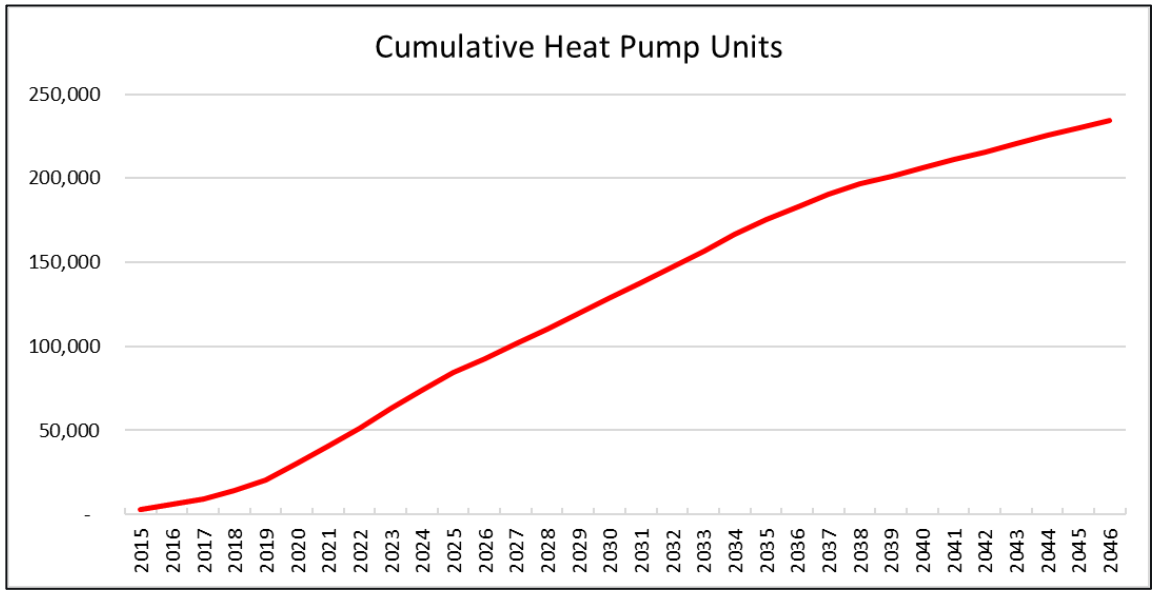
- **Incentivized Managed/Controllable Rate**: 1/3 customers on an incentivized rate are on managed/control rate. The hourly charging pattern is based on GMP rate 72, non-event days, hourly charging data.
  - The impact of controlled charging is not included in the Itron load forecast.

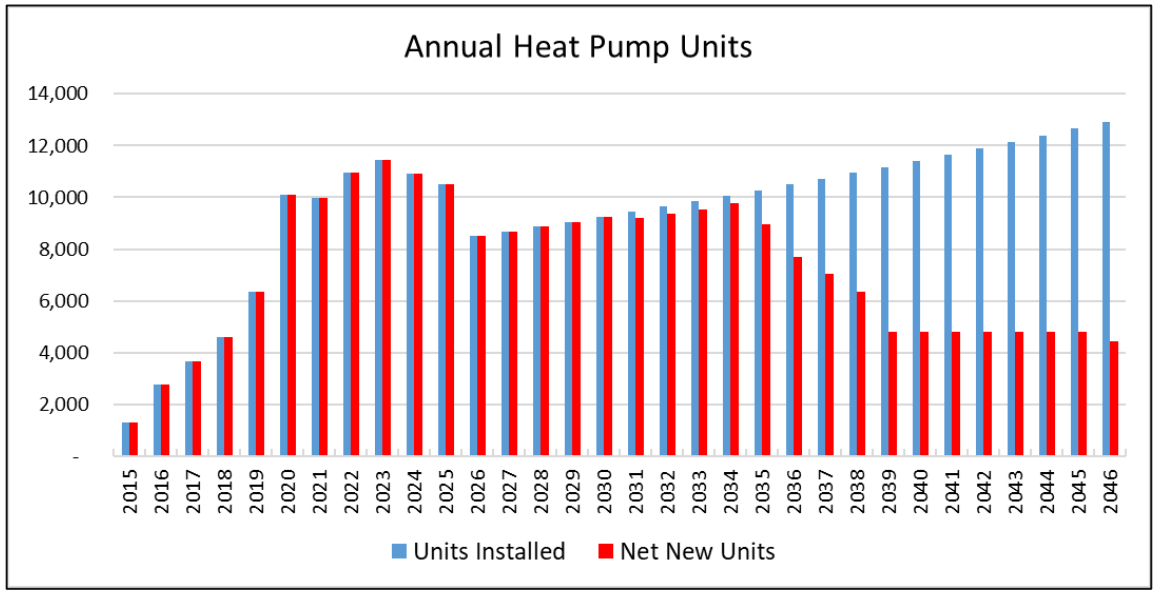
EV Coincident Demand Impact



- The EV demand impact jumps up in 2045 due to the timing of the system peak, which shifts from 18:00 to 21:00.
- The demand impact in the medium forecast is 17 MW lower in 2030 and 53 MW lower in 2035

Heat Pump Forecast: Units and Saturations



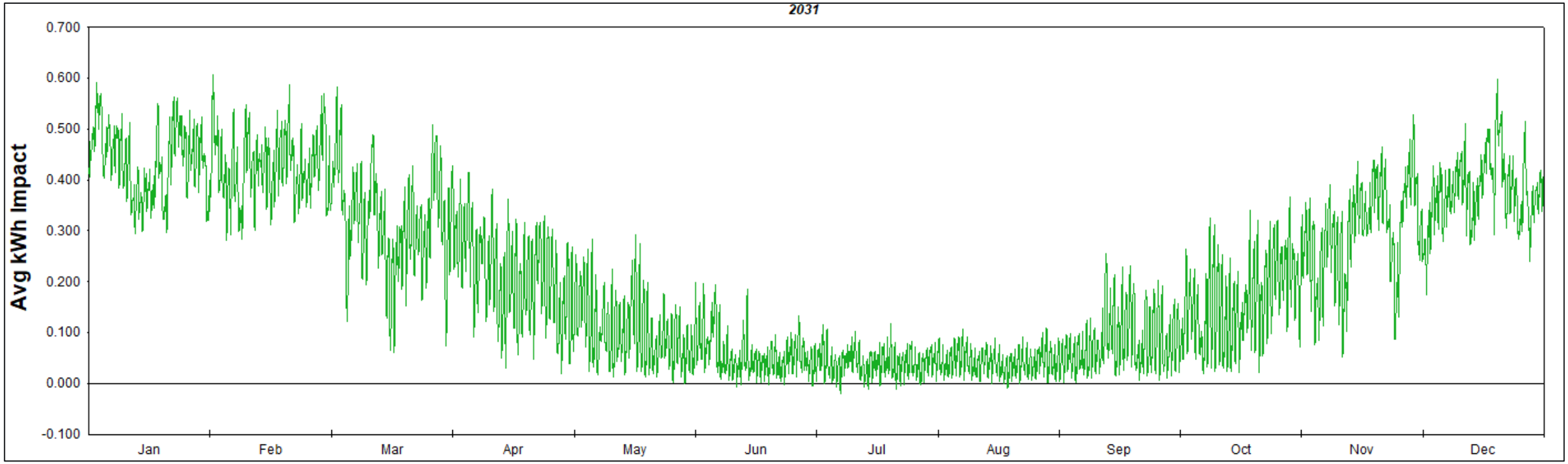


» Assume 8,500 units per year starting in 2026, growing at the same rate as residential customers

» Assumes a 15-year life cycle, in the outer years most units are replacing existing units and not adding to net new heat pumps.

» By 2046 50% of Vermont residential customers have a heat pump

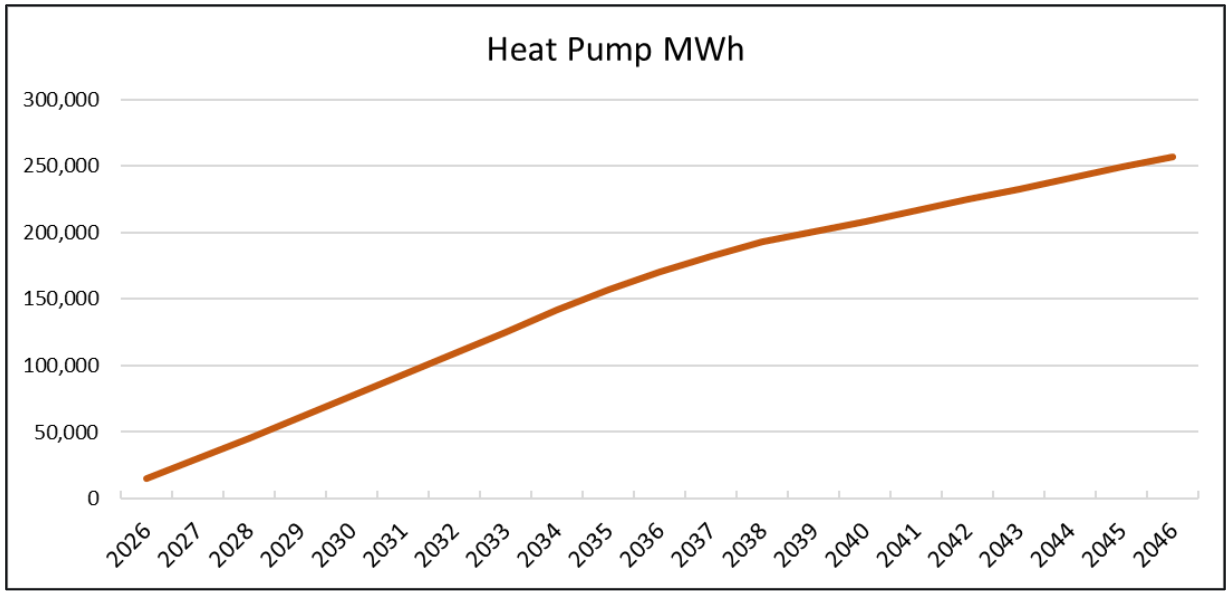
Heat Pump Profile Hourly Profile

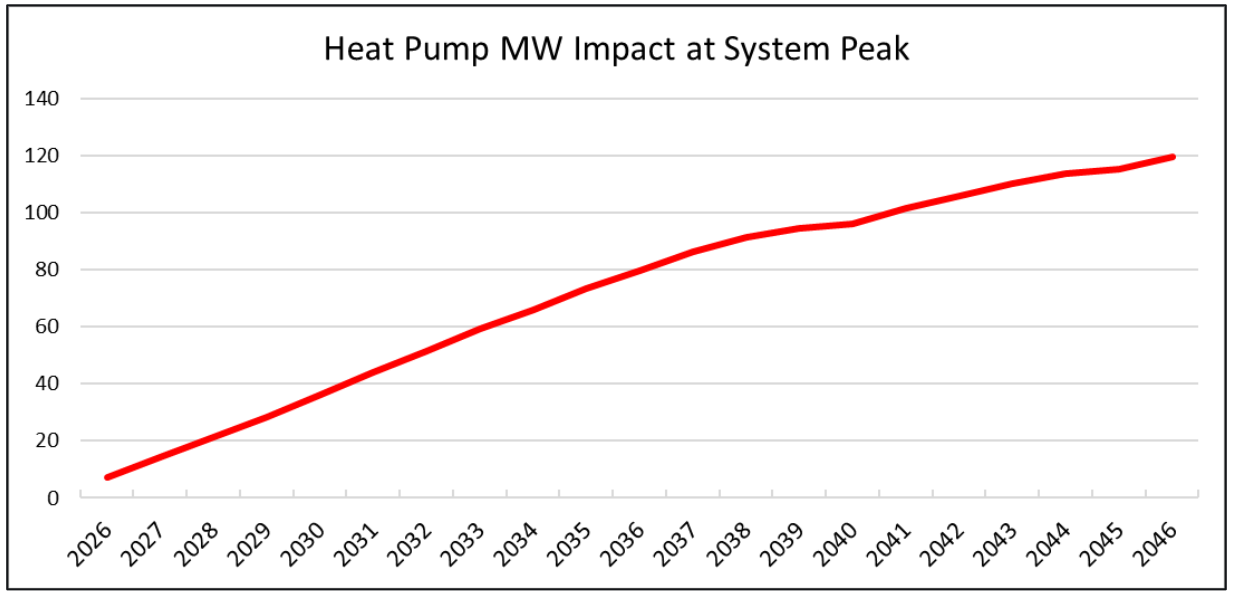


» Hourly heat pump based recent state level heat pump study

» Hourly data shows the average impact of installing a heat pump. Positive values imply the heat pump added load; negative values imply the heat pump reduced load.

Current Heat Pump Forecast: MWh and Impact on Demand



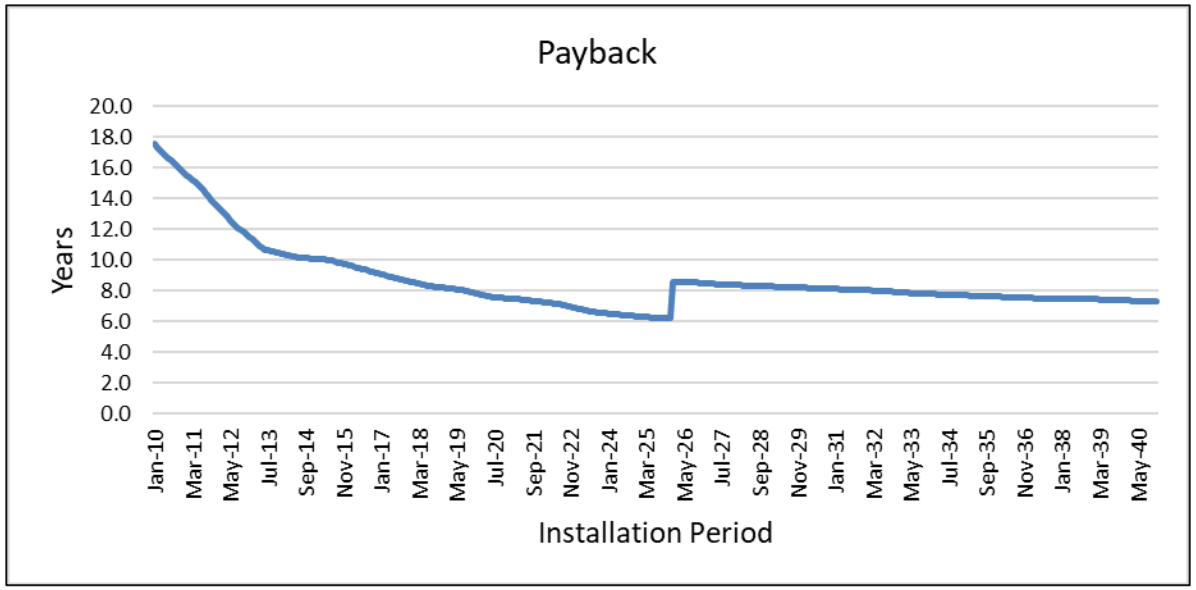


- The forecast is adjusted for cumulative incremental new heat pumps, the impact of existing heat pump is embedded in the historical load data
- We assume 2,087 kWh per heat pump for all zones except Addison, Chittenden, and Frankline.
  - Based on the 2024 Vermont heat pump study the average UEC for customers in areas with access to natural gas is 989 kWh. For these zones we use a weighted average ranging from 1,353 kWh to 1,981 kWh.
- Demand impact is based on hourly heating profile and coincident with system and zonal peaks.

Solar Capacity Forecasting Approach

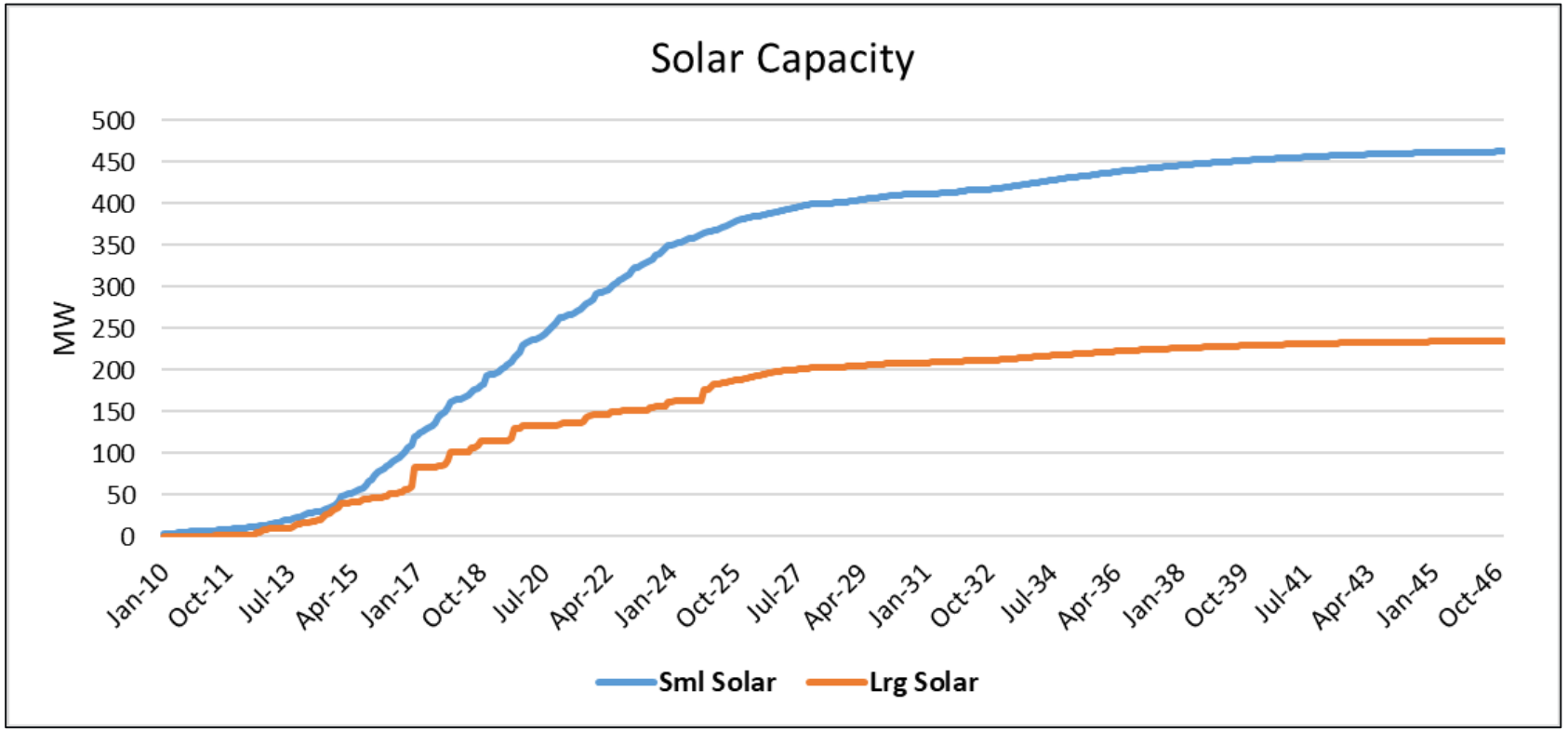
» Capacity is modeled as a function of simple payback.

- Payback incorporates:
  - system costs, incentives (expiring tax credits), electric rates, and payments for excess generation.
- Cubic model specification used to impose S-shaped adoption curve.



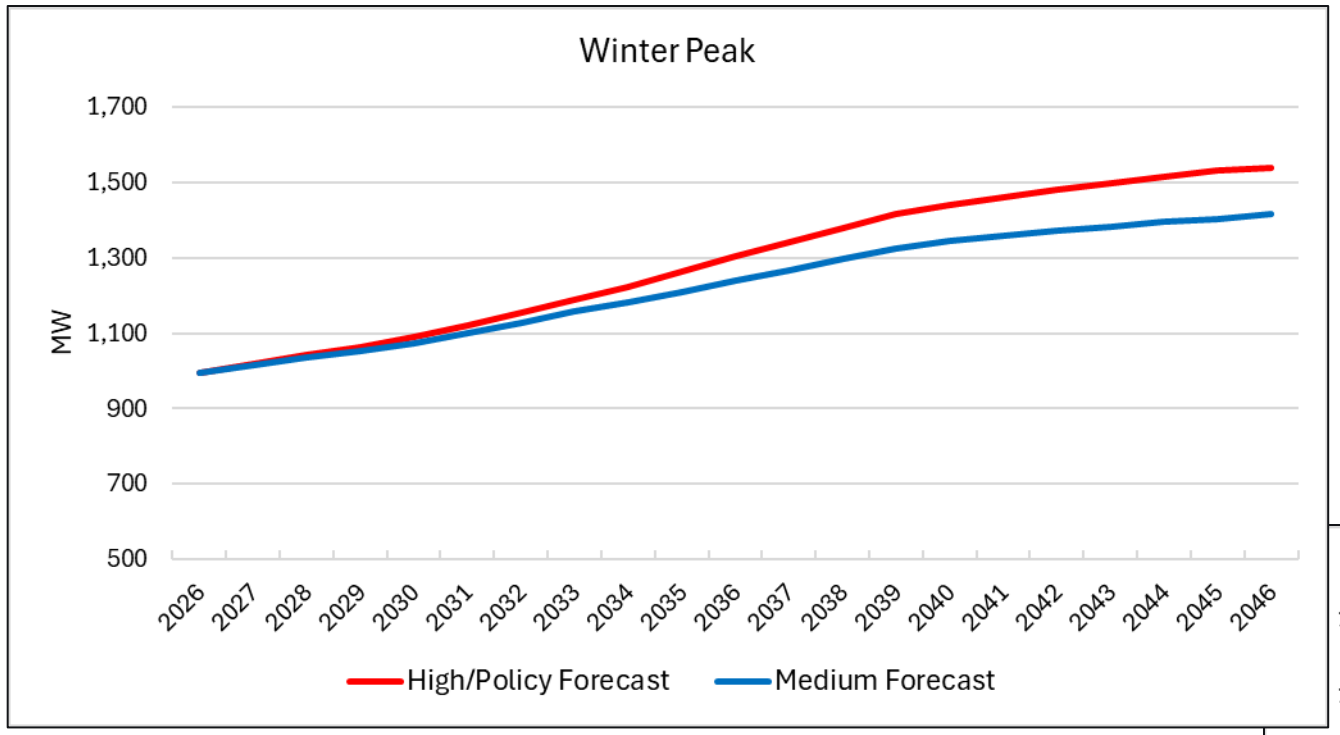
» Expiration of federal tax credits increases the payback from 6 to 8 years. Adoption in 2026 and 2027 is assumed to be 50% lower. Beginning in 2028, adopting begins to increase.

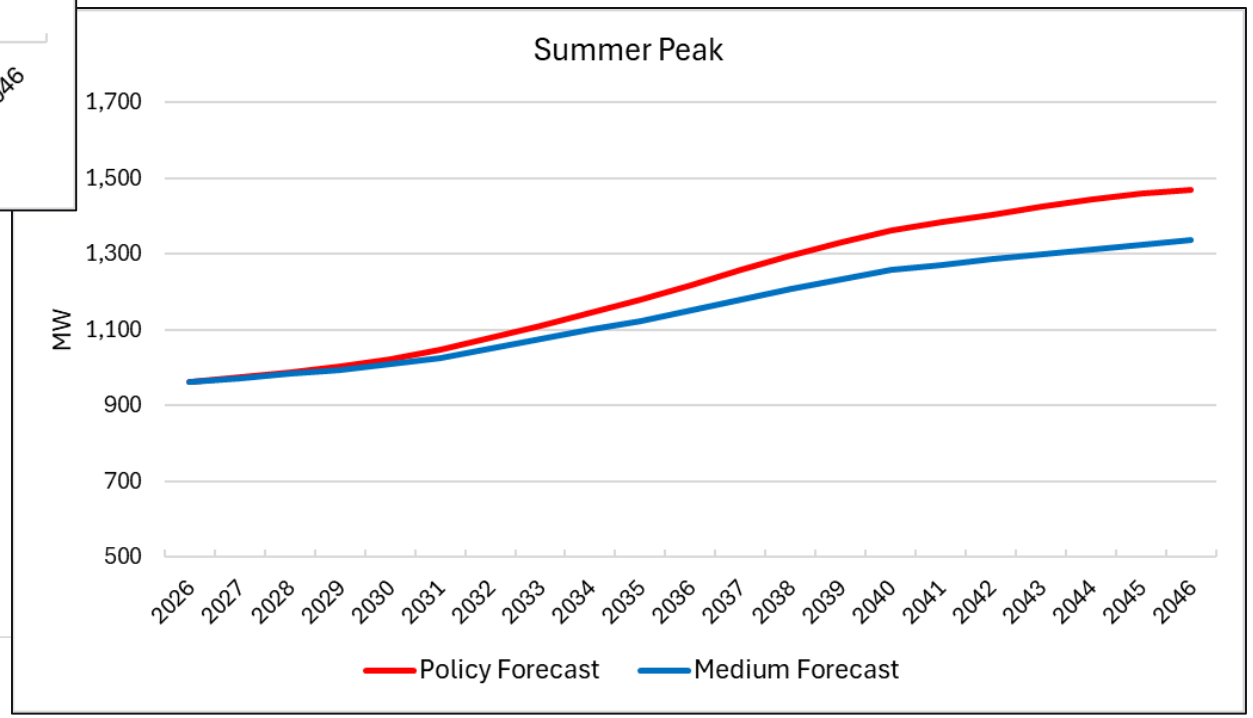
Solar Capacity Forecast



- A unique small and large solar capacity forecast is generated. Specific load factors and shape are used to determine solar generation and hourly impacts.
- Small systems are defined as systems less than 1000 kW.
- Solar has no impact on winter peaks and minimal impact on summer peaks to the timing of summer peaks

Medium vs. Policy Forecast





» The medium winter peak forecast is 17 MW lower in 2030, 53 MW lower in 2035, and 96 MW lower in 2040.

» Summer peak differences are similar.

Medium vs. Policy Forecast

Year	Winter Peak (MW)		Summer Peak (MW)	
	High/Policy	Medium	High/Policy	Medium
2026	996	995	961	960
2027	1,018	1,014	974	971
2028	1,042	1,035	988	983
2029	1,064	1,052	1,004	994
2030	1,091	1,074	1,021	1,008
2031	1,121	1,099	1,046	1,024
2032	1,155	1,128	1,079	1,051
2033	1,190	1,157	1,110	1,074
2034	1,224	1,182	1,144	1,100
2035	1,262	1,210	1,179	1,123
2036	1,303	1,239	1,218	1,149
2037	1,341	1,267	1,258	1,179
2038	1,380	1,297	1,297	1,208
2039	1,415	1,324	1,331	1,234
2040	1,440	1,344	1,360	1,257
2041	1,461	1,358	1,382	1,272
2042	1,481	1,372	1,403	1,285
2043	1,500	1,383	1,424	1,299
2044	1,517	1,396	1,443	1,313
2045	1,532	1,404	1,459	1,325
2046	1,540	1,416	1,470	1,336