Vermont Long-Term Forecast Update And Challenges
April 12, 2023

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Agenda

1. System Load Review – Solar and Heat Pump Impacts

2. Modeling Overview and Baseline Assumptions
   - Economics
   - End-Use Intensity Calibration
   - Efficiency
   - Weather

3. The Forecast Drivers
   - Solar
   - Heat Pumps
   - Electric Vehicles

4. Modeling Challenges and Questions

System Load Review
Solar and Heat Pump Impacts

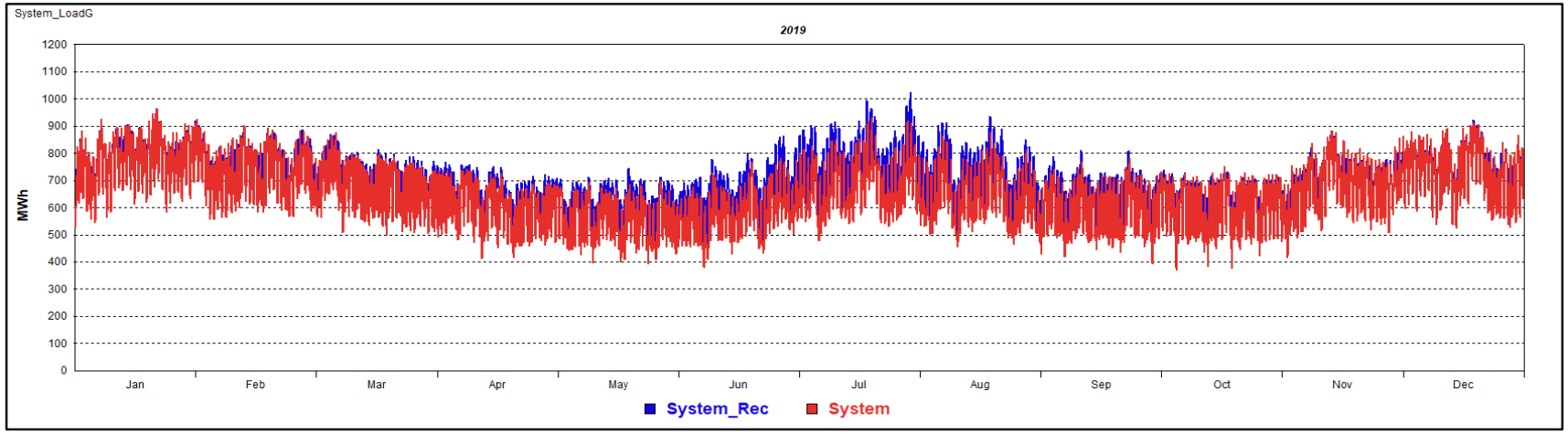
How Load has Changed

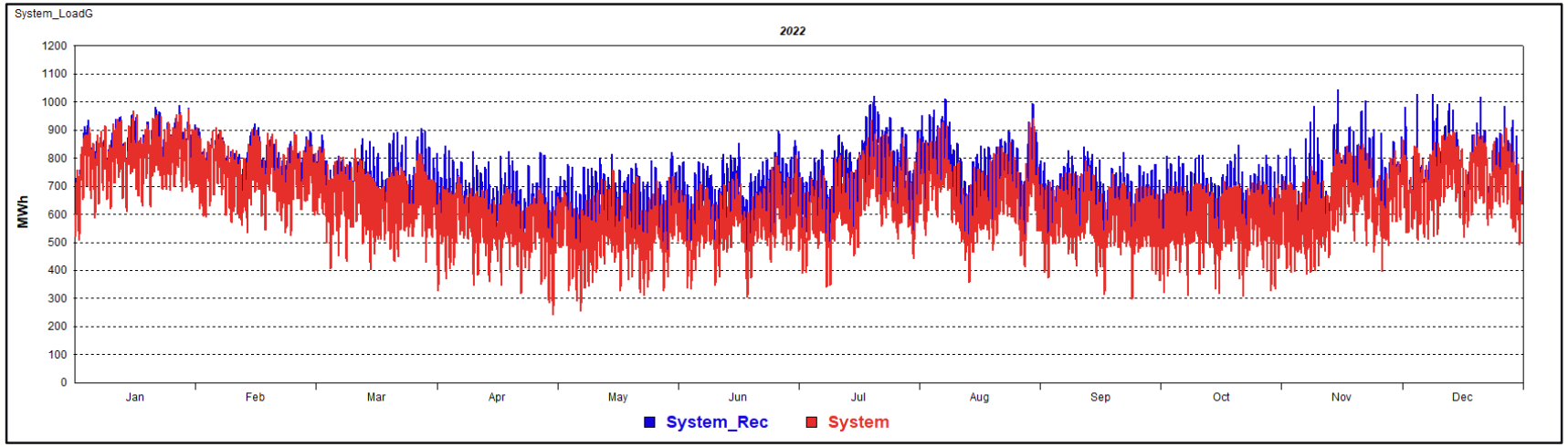
» In three years, a lot has changed
- Red is what we see and measure
- Blue is what we think is used

- COVID has changed how and where we work

- Significantly more behind the meter solar
  - The load we can’t see

- Adoption of heat pumps that’s reshaping loads
  - Can't see this either



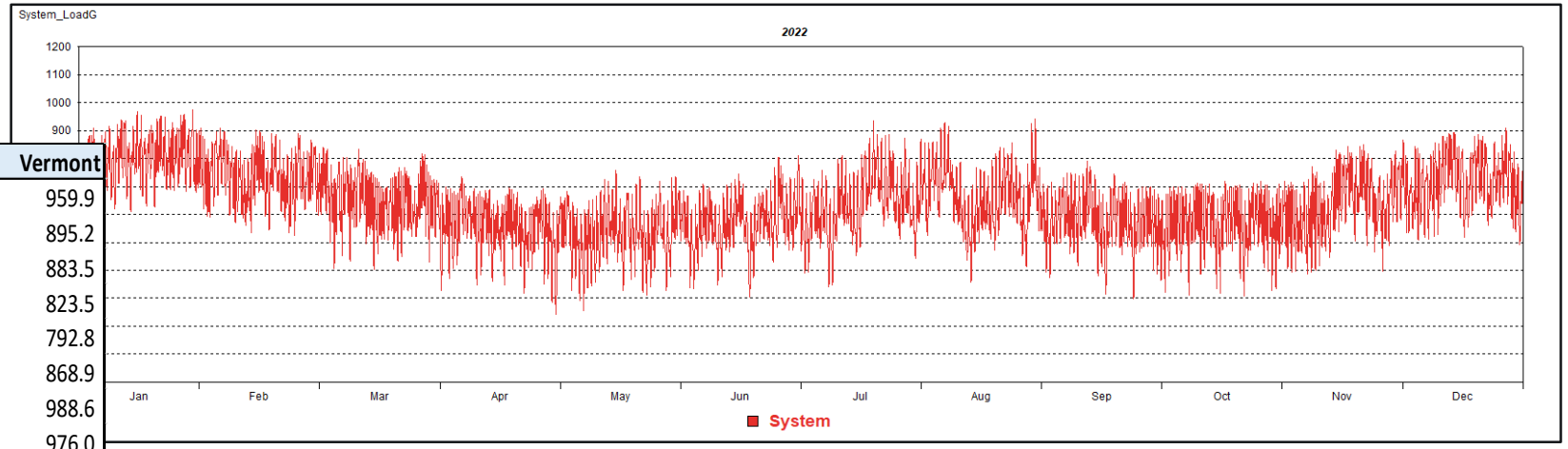


Comparison with Reconstituted Loads - 2022

Month	PeakTime	Measured	PeakTimeRec	Reconstituted	Vermont
Jan	1/29/2022 17:00	976.0	1/27/2022 10:00	989.0	959.9
Feb	2/5/2022 18:00	908.7	2/15/2022 9:00	920.6	895.2
Mar	3/1/2022 18:00	842.3	3/29/2022 10:00	905.4	883.5
Apr	4/7/2022 19:00	733.9	4/4/2022 9:00	844.1	823.5
May	5/16/2022 18:00	756.5	5/31/2022 12:00	819.4	792.8
Jun	6/26/2022 21:00	804.5	6/27/2022 10:00	894.6	868.9
Jul	7/20/2022 21:00	933.7	7/21/2022 14:00	1,020.4	988.6
Aug	8/30/2022 18:00	942.6	8/8/2022 11:00	1,009.2	976.0
Sep	9/12/2022 20:00	789.2	9/12/2022 10:00	841.4	817.9
Oct	10/26/2022 19:00	717.4	10/21/2022 9:00	845.9	823.9
Nov	11/21/2022 19:00	848.6	11/15/2022 9:00	1,042.9	1,020.5
Dec	12/27/2022 19:00	908.4	12/5/2022 9:00	1,028.6	1,006.3

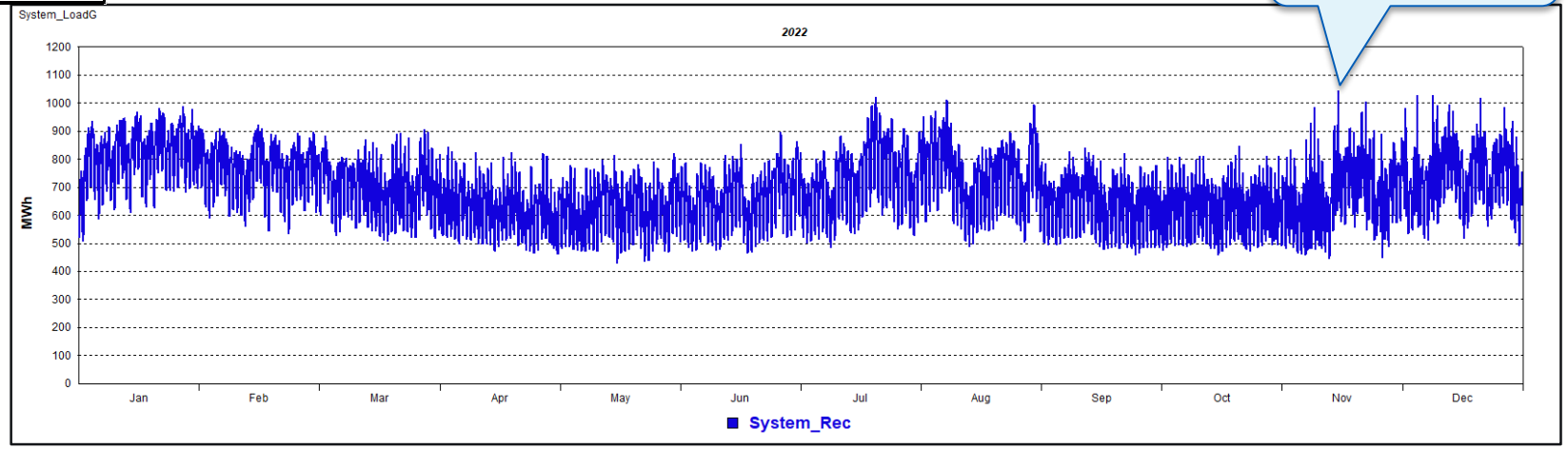
Peaks shift from evening to morning

What's Measured



When Reconstituted for Solar

Peaks in November



Peak Time Shifted Too

- 2019
  - Measured peak between 6:00 PM and 8:00 PM
  - Reconstituted peak between 1:00 PM and 3:00 PM

  - 2022
  - Measured peak between 6:00 PM and 9:00 PM
  - Reconstituted peak 10:00 AM to 12:00 PM

  - Fall and Spring Reconstituted Peaks
    - 2019: between 5:00 PM and 6:00 PM
    - 2022: between 9:00 AM and 10:00 AM

Hour Beginning

2019

Date	PeakTime	Measured	PeakTimeRec	Reconstituted	VT_RecPk
Jan-19	1/21/2019 17:00	966.2	1/21/2019 17:00	966.2	934.5
Feb-19	2/12/2019 17:00	901.3	2/12/2019 17:00	901.3	874.5
Mar-19	3/7/2019 18:00	875.2	3/7/2019 18:00	875.2	846.7
Apr-19	4/9/2019 18:00	742.2	4/1/2019 11:00	771.8	750.2
May-19	5/28/2019 18:00	697.6	5/20/2019 14:00	743.8	723.6
Jun-19	6/27/2019 19:00	781.4	6/28/2019 15:00	863.8	838.1
Jul-19	7/20/2019 20:00	928.8	7/30/2019 13:00	1,024.5	993.9
Aug-19	8/19/2019 18:00	877.7	8/19/2019 14:00	936.3	903.7
Sep-19	9/23/2019 18:00	780.9	9/11/2019 13:00	811.1	786.1
Oct-19	10/17/2019 18:00	752.8	10/17/2019 18:00	752.8	728.9
Nov-19	11/13/2019 17:00	881.3	11/13/2019 17:00	881.3	853.8
Dec-19	12/19/2019 7:00	912.8	12/19/2019 9:00	923.7	896.1

2022

Date	PeakTime	Measured	PeakTimeRec	Reconstituted	Vermont
Jan-22	1/29/2022 17:00	976.0	1/27/2022 10:00	989.0	959.9
Feb-22	2/5/2022 18:00	908.7	2/15/2022 9:00	920.6	895.2
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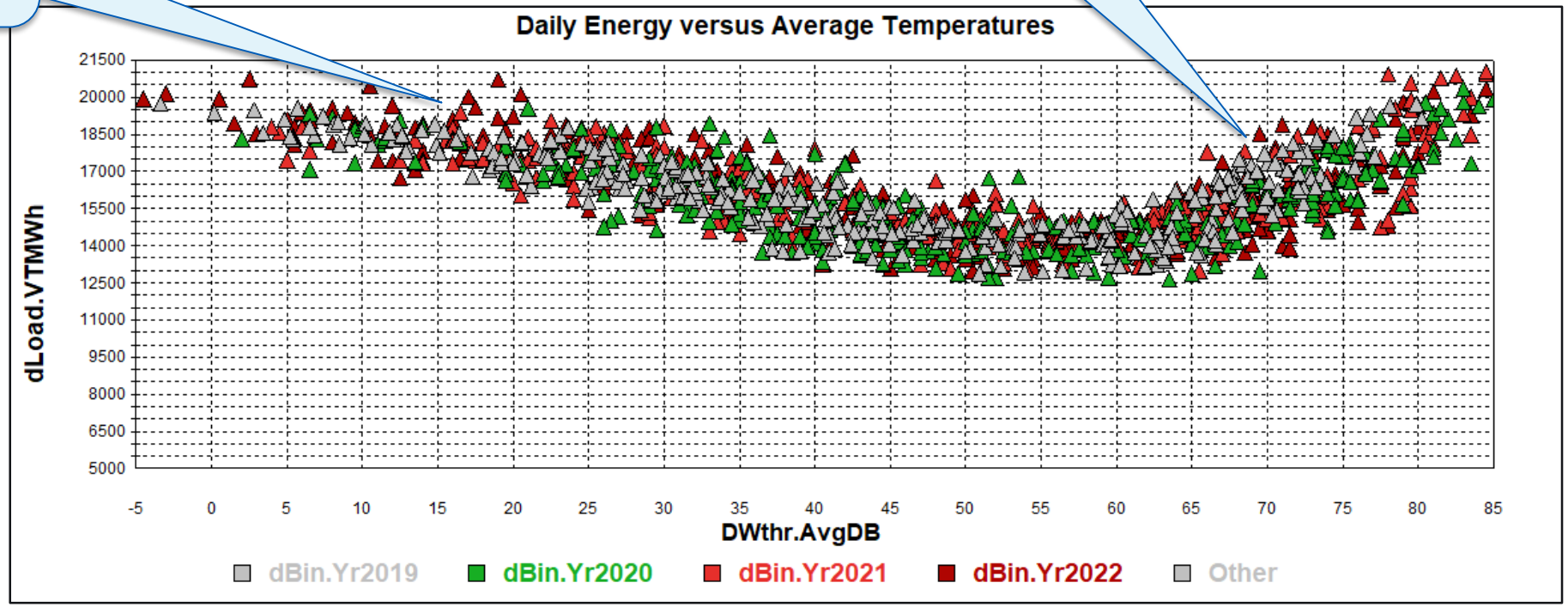
Not only is solar shifting loads, but so are heat pumps

Another way to look at loads

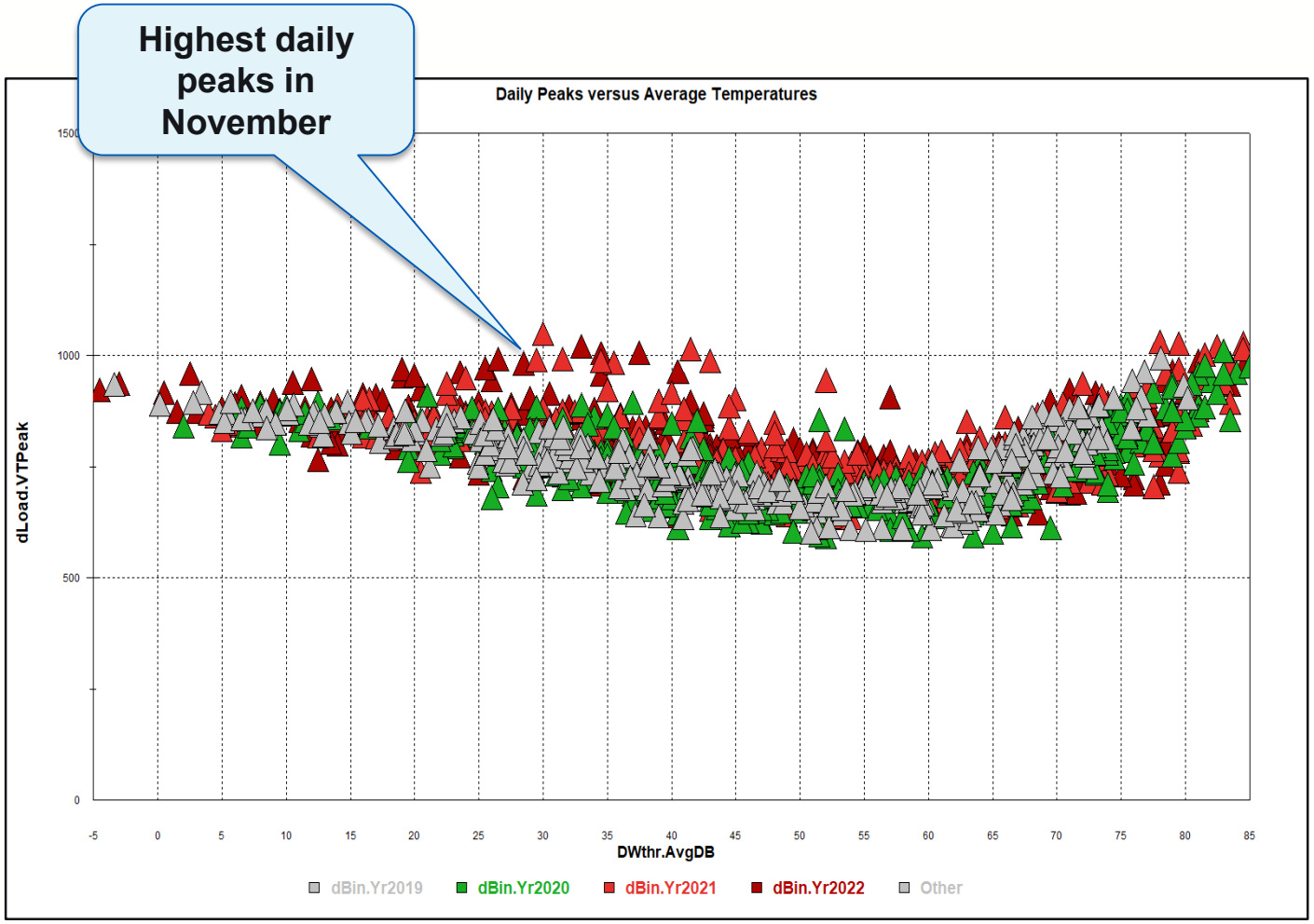
Higher average winter loads for same temperature

Higher average summer loads for same temperature



Daily Peaks vs. Temperature

- In 2021 and 2022, highest daily peaks in occur in November
  - Daily peaks are consistently higher between 60 degrees and 25 degrees
- The 2021 and 2022 coldest temperature peaks are no higher than prior years
- Potentially indicates how supplemental heat pumps are being used
  - Running through the fall with maximum output
  - Running at a lower rate or not at all on the coldest days
    - The primary heating system is heating the space
- Does November become the new peak month ?



Baseline Forecast

The Baseline Forecast

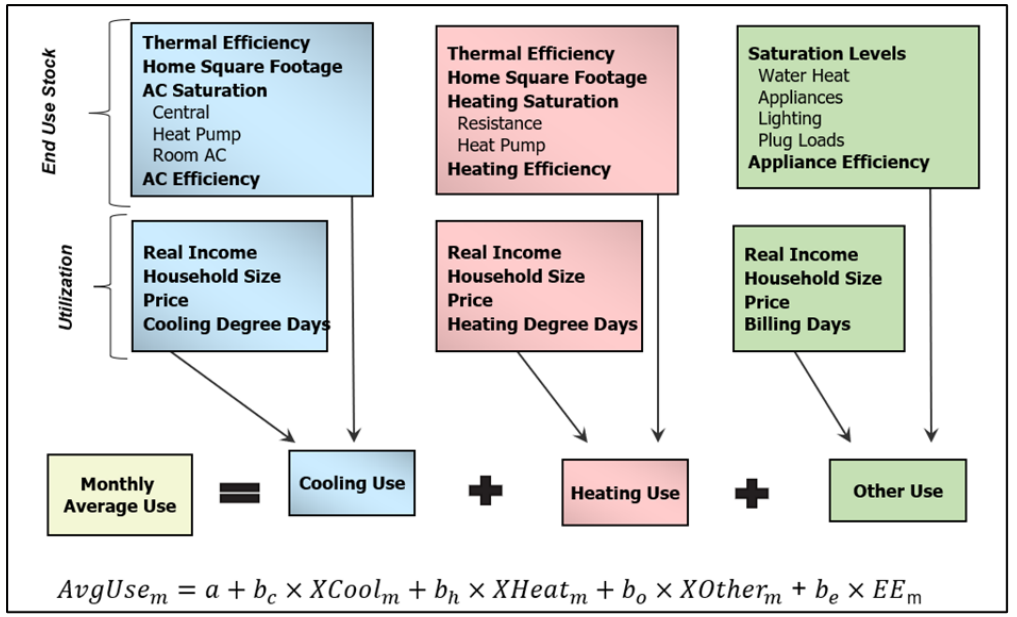
» Residential
- End-use intensity trends
  - Saturation (ownership)
  - Efficiency (both standards and EE programs)
- Square Footage
- Thermal shell efficiency
- Household size and income
- Weather (HDD and CDD)

» Commercial
- End-use intensities trends
  - Efficiency (both standards and EE programs)
- GDP and Employment
- Weather

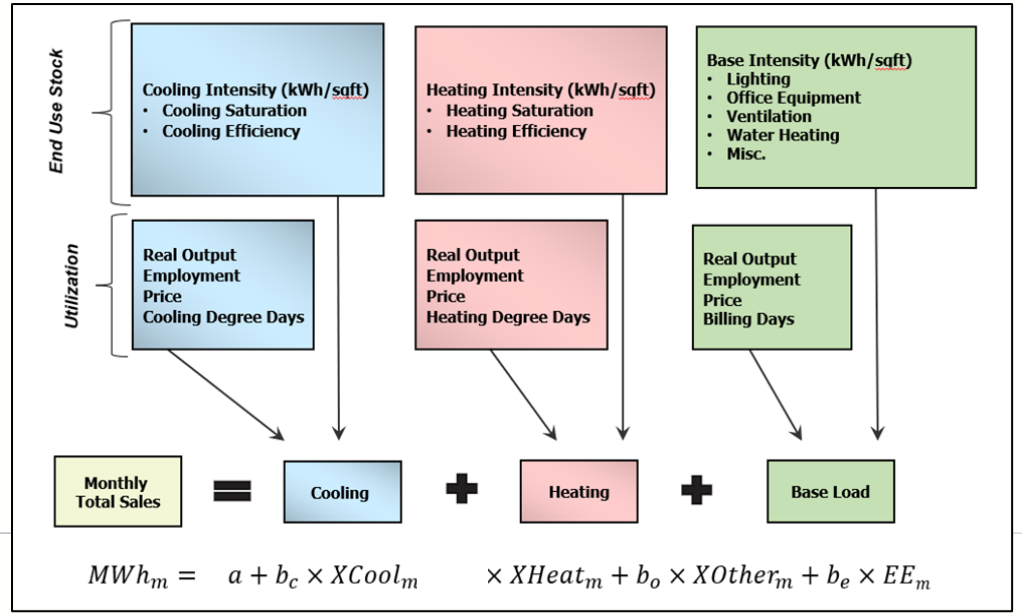
» Construct estimates of monthly heating (XHeat), cooling (XCool), and non-weather sensitive (XOther) energy requirements

» Regression models used to estimate models
- Models estimated with billed sales data
  - January 2011 - December 2022

Residential Model



Commercial Model

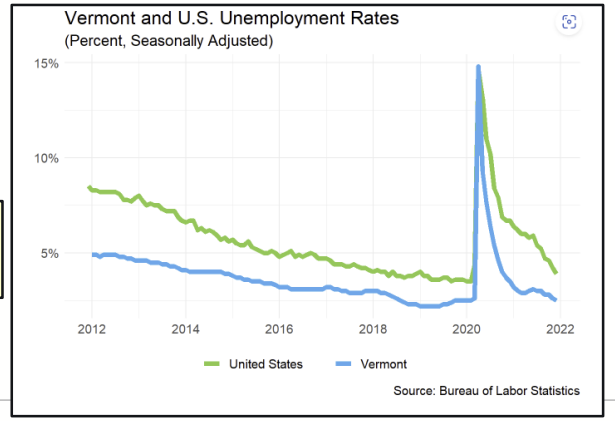


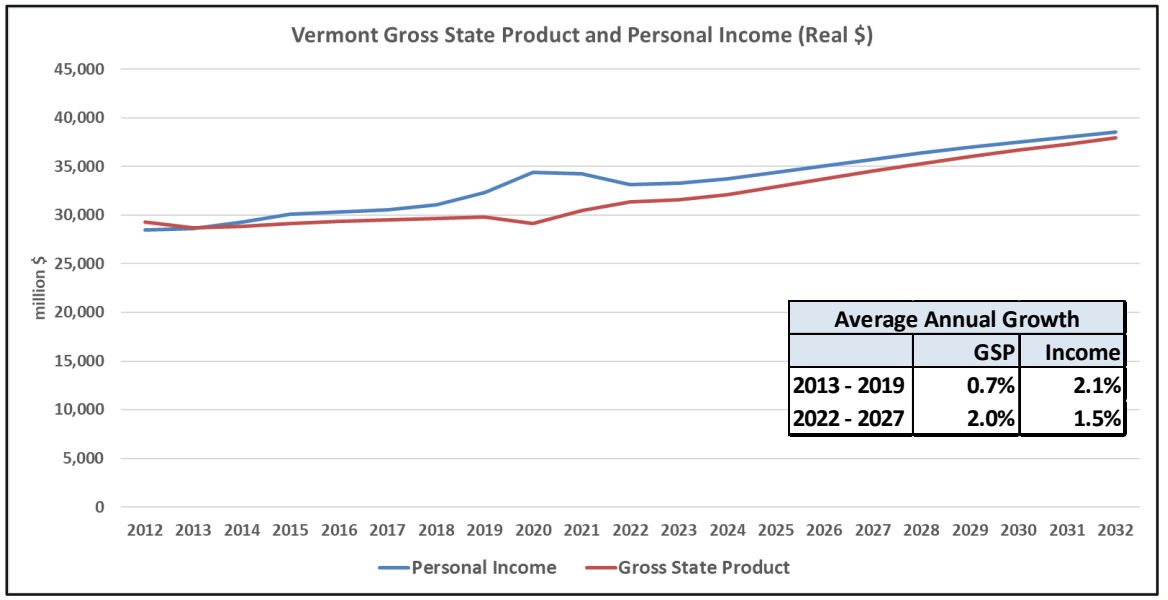
The Economy

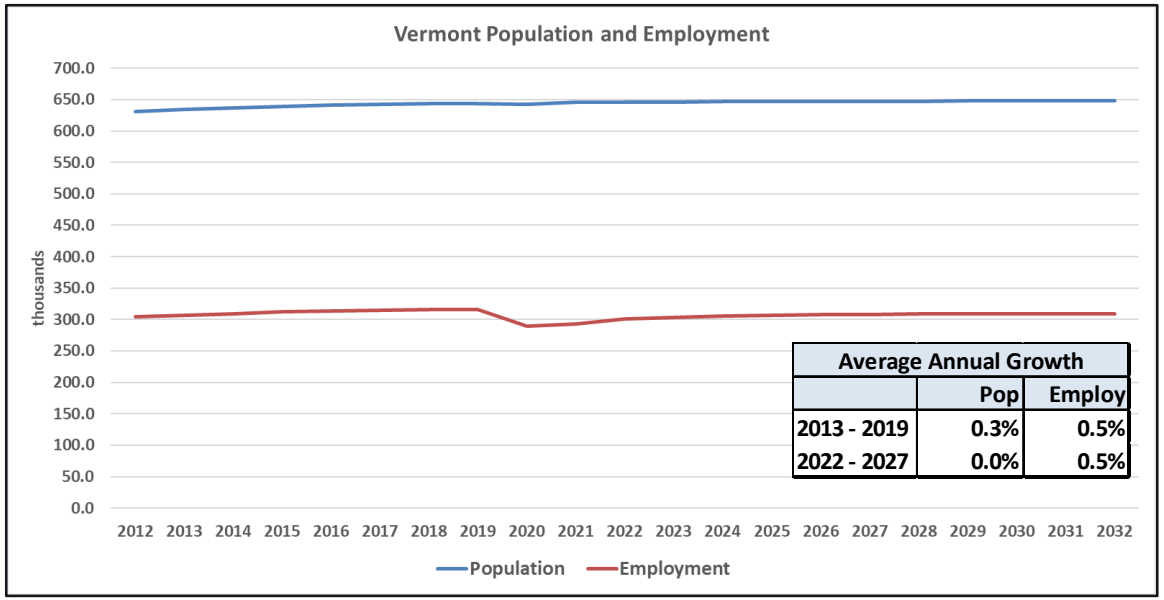
» Economy constrained by population growth
- 0.3% annual population growth pre-COVID
- No population growth through 2027
- Shrinking labor force. Percent of population over 65 increased from 10.5% to 16.4% over the last ten years

» But the economy continues to grow at a moderate rate
- Real income growth 1.5% per year
- State output 2.0%
  - Largely driven by increase in productivity
  - Transition to higher value-added businesses
    - tech and biotech
  - Strong tourism and second home market
  - 13 million visitors a year

Unemployment rate: 2.8%
U.S.: 3.6%

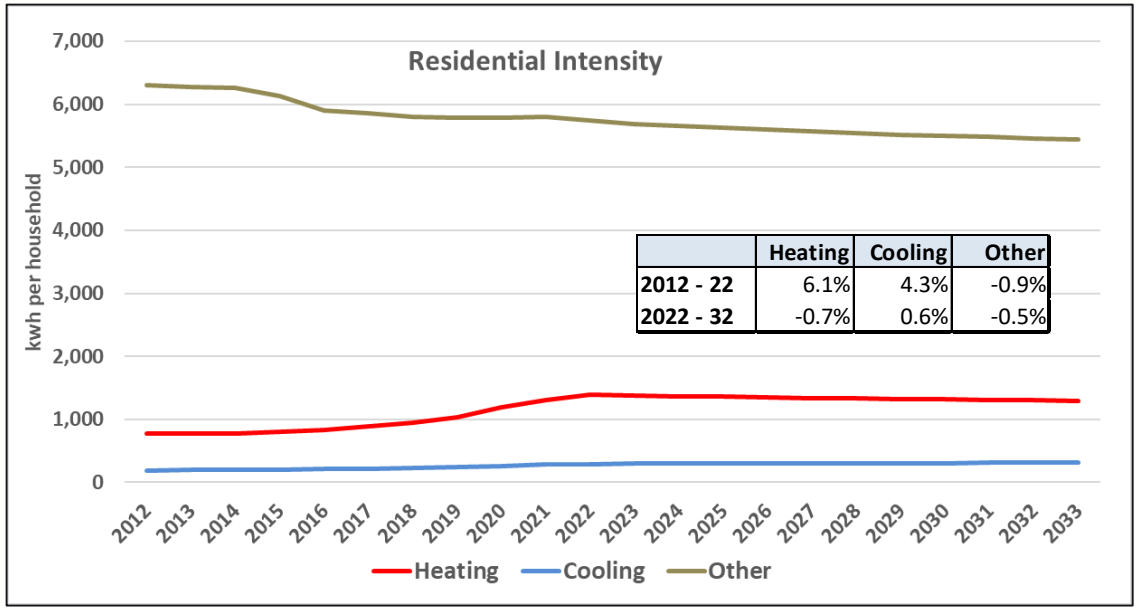




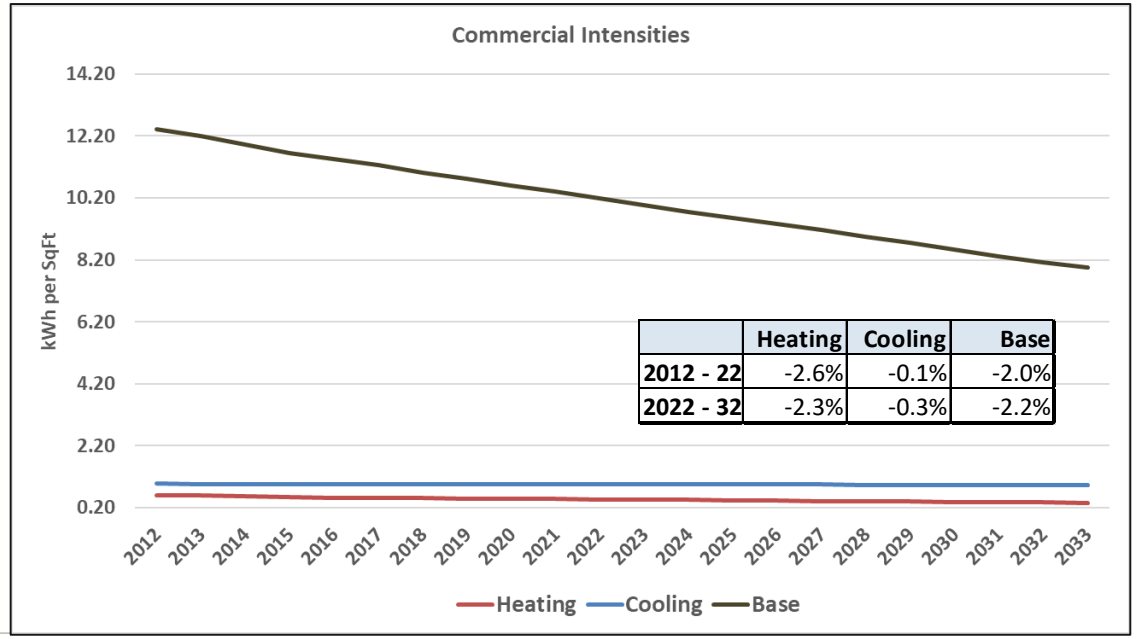


End-Use Intensities

- End-use intensities based on EIA saturation and efficiency 2022 projections for New England.
  - Residential: 20 end-uses (including miscellaneous)
  - Commercial 10 building types and 10 end-uses
- Calibrated to recent state residential survey, and NREL residential and commercial building simulation results for 2018
- Residential heating adjusted for the recent increase in heat pumps
  - Over 30,000 added across the state
- Heat pump intensity is held constant. Additional heat pump sales added to the forecast.
  - Assumes anyone purchasing a heat pump will take advantage of state rebates.
- 2023 AEO has just been released includes some of the expected impact of IRA
  - Includes tax credits, doesn't include rebates that will be distributed by the state



	Heating	Cooling	Other
2012 - 22	6.1%	4.3%	-0.9%
2022 - 32	-0.7%	0.6%	-0.5%

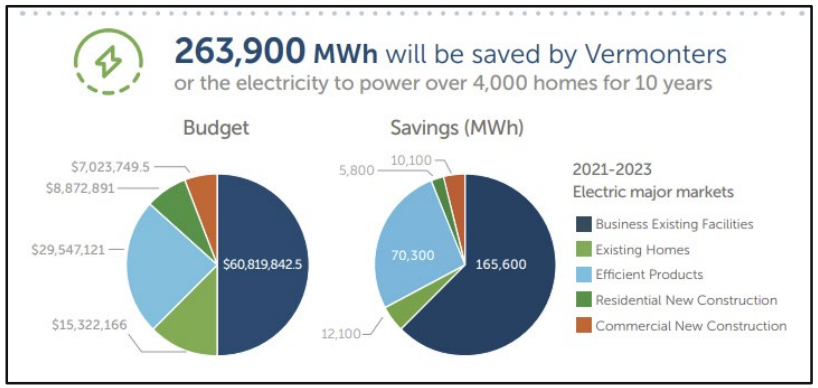


	Heating	Cooling	Base
2012 - 22	-2.6%	-0.1%	-2.0%
2022 - 32	-2.3%	-0.3%	-2.2%

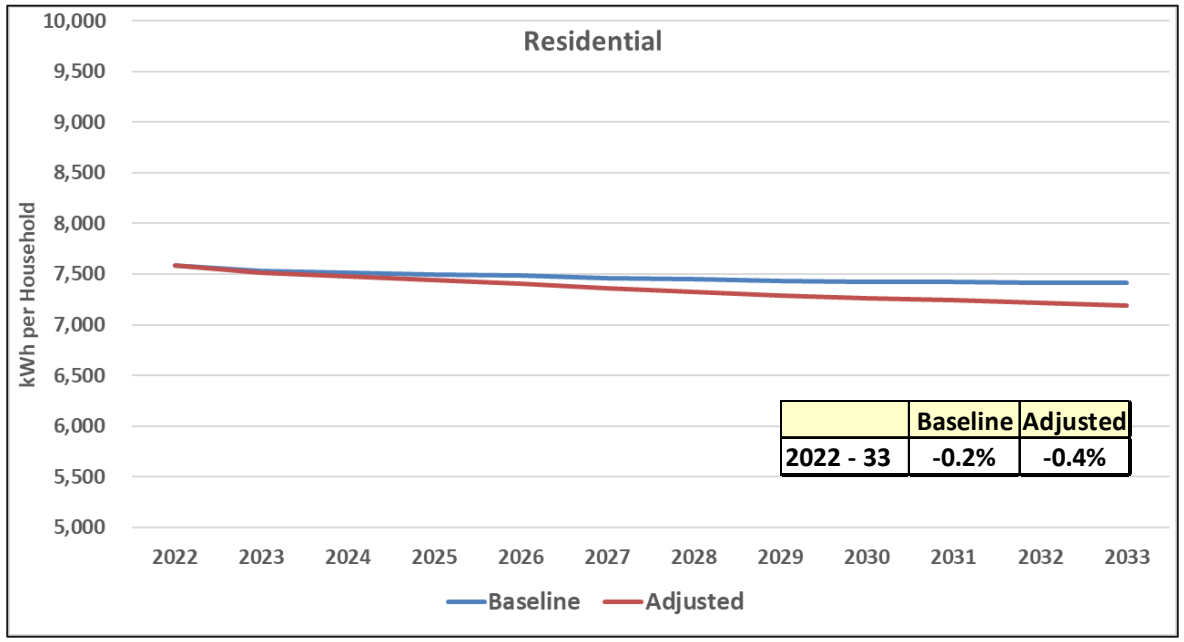
Energy Efficiency

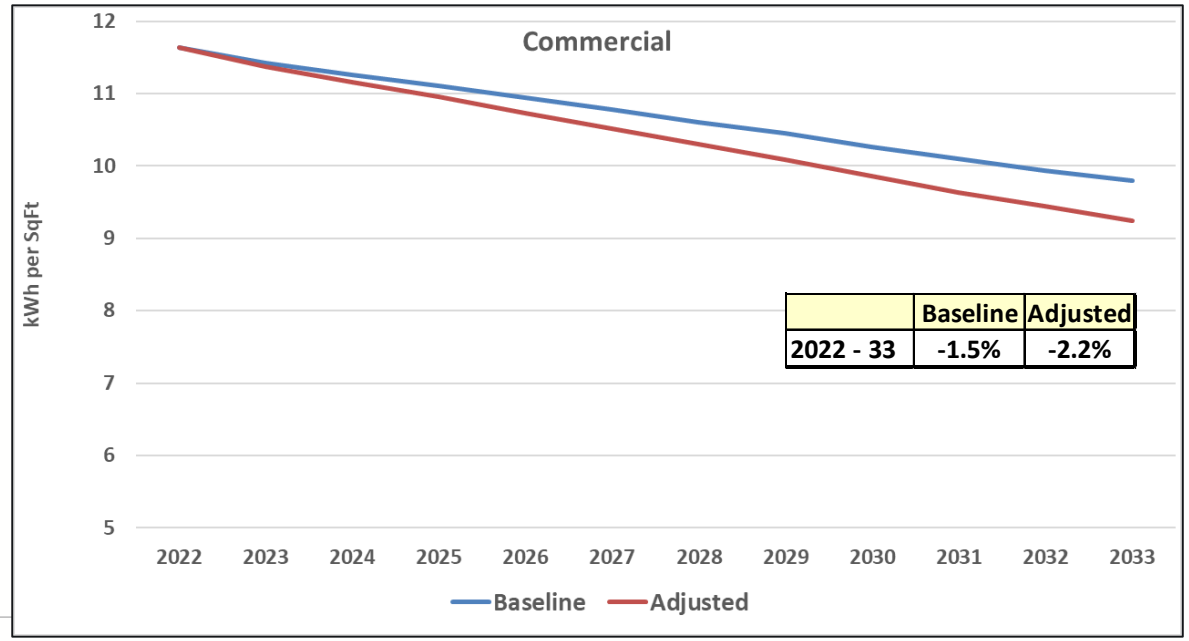
» End-use intensities adjusted to account for EE program savings
- EIA projections reflect regional EE program activity
- Model indicates that Vermont is doing roughly 30% more

» EE savings forecast based on the current Demand Resource Plan
- Current proceedings for the 2024 – 2026 planning period
- Assume the state continues to spend $30 million per year through the forecast period



» Strongest gains expected in the commercial sector
- Largely lighting and ventilation

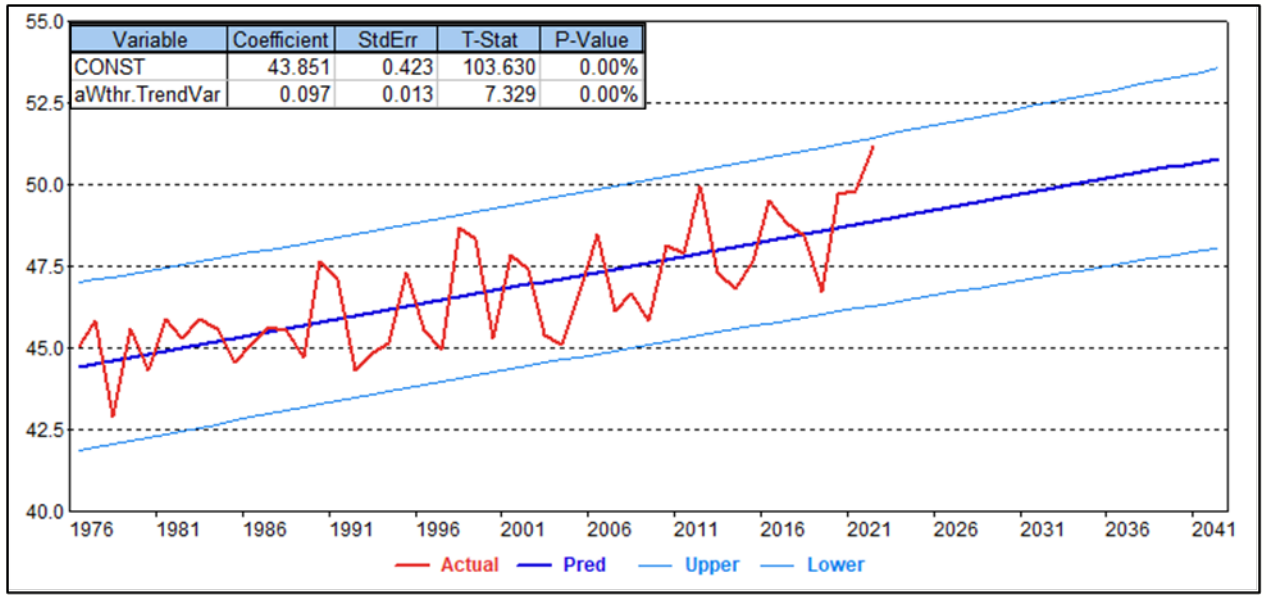


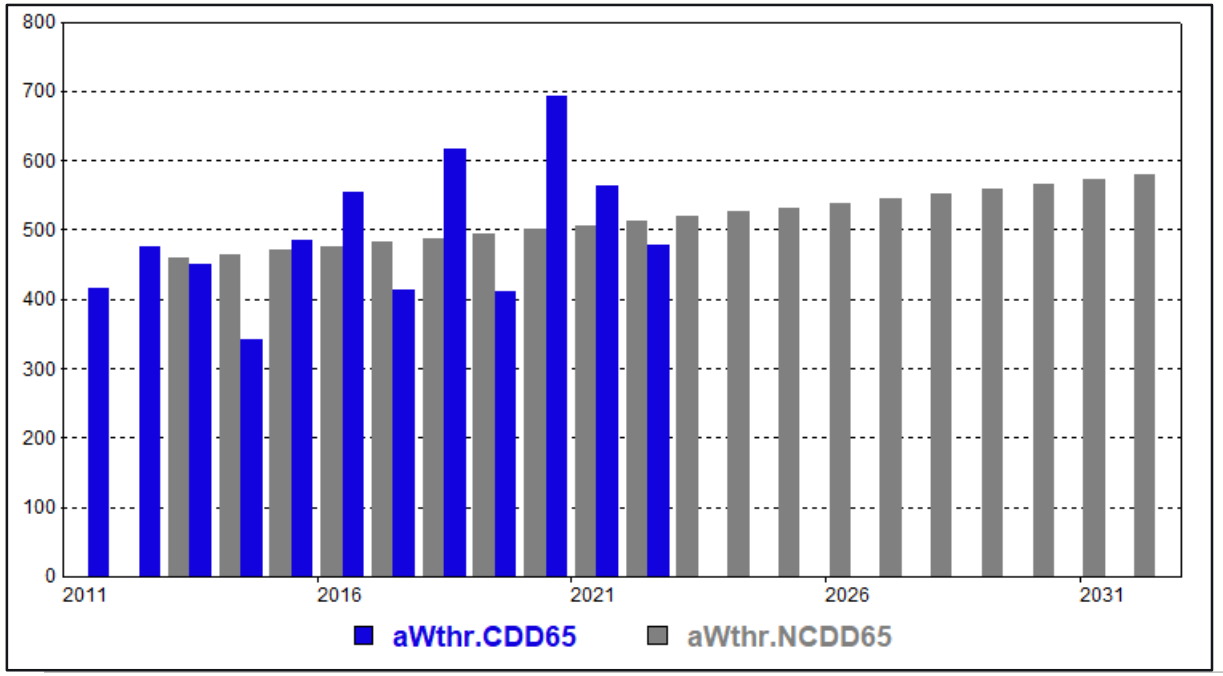


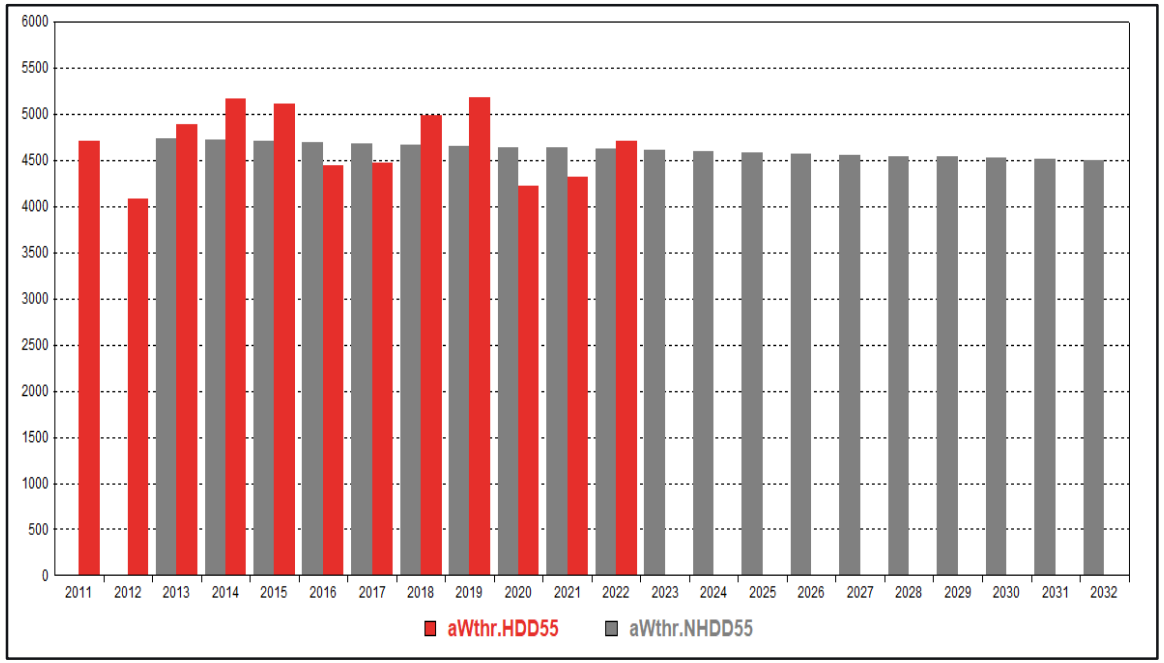
Weather

» Clear evidence of increasing temperatures (BTV)
  • Average temperature increasing 1.0 degrees per decade
    - Expected average temperature in 1976: 44.4 degrees
    - Expected average temperature in 2022: 48.9 degrees

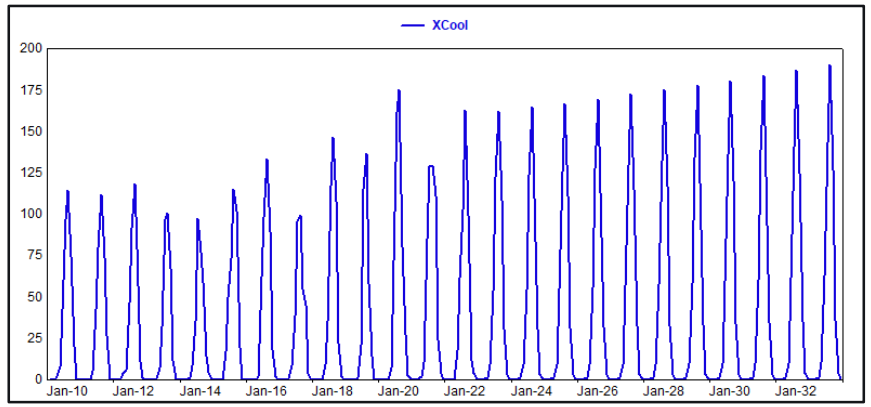
» Trend consistent with climate models
» Translates into more CDD and fewer HDD

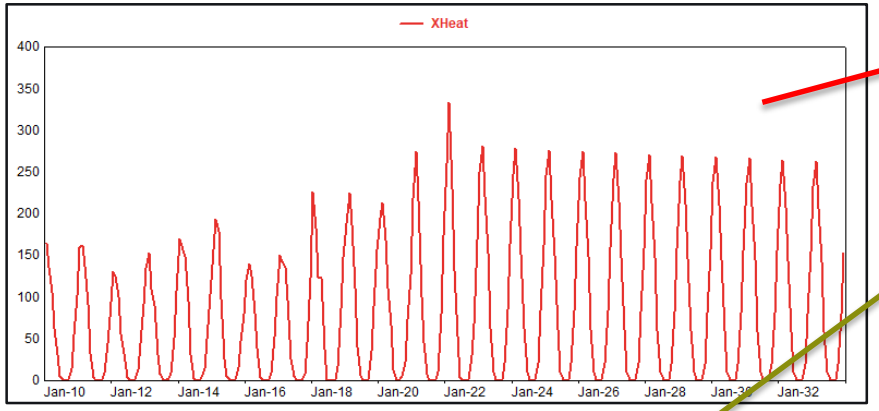


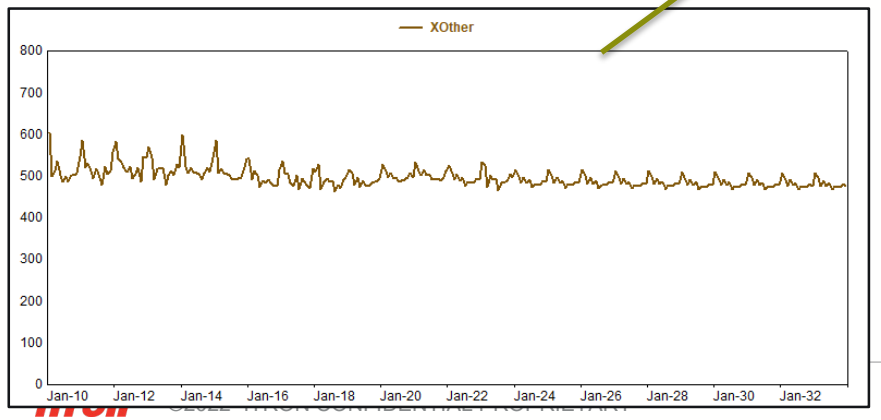




When You Put Them All Together

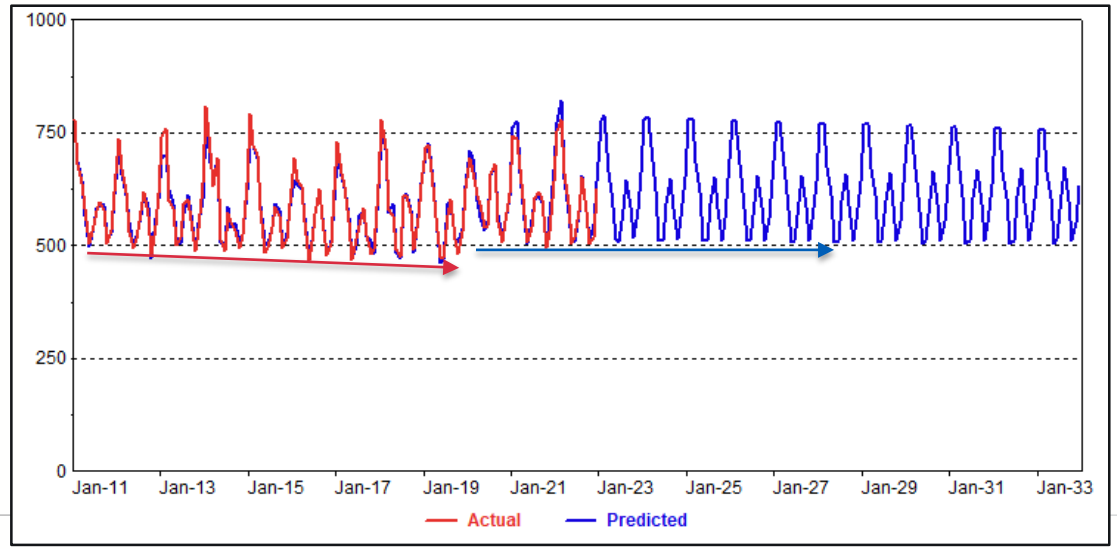






Variable	Coefficient	StdErr	T-Stat
mStructRevRes.XHeat	1.211	0.045	26.662
mStructRevRes.XCool	1.212	0.057	21.237
mStructRevRes.XOther	0.938	0.014	66.714
mBin.Feb	-23.300	5.860	-3.976
mBin.Mar	-32.482	6.958	-4.668
mBin.Apr	-27.866	7.370	-3.781
mBin.May	-26.080	7.293	-3.576
mBin.Jun	-26.553	5.830	-4.555
mBin.Apr14	105.127	14.847	7.081
AR(1)	0.700	0.067	10.388

Model Statistics	
Iterations	9
Adjusted Observations	143
Deg. of Freedom for Error	133
R-Squared	0.957
Adjusted R-Squared	0.954
AIC	5.782
BIC	5.990
F-Statistic	#NA
Prob (F-Statistic)	#NA
Log-Likelihood	-606.35
Model Sum of Squares	895,510.10
Sum of Squared Errors	40,350.53
Mean Squared Error	303.39
Std. Error of Regression	17.42
Mean Abs. Dev. (MAD)	12.45
Mean Abs. % Err. (MAPE)	2.06%
Durbin-Watson Statistic	1.563

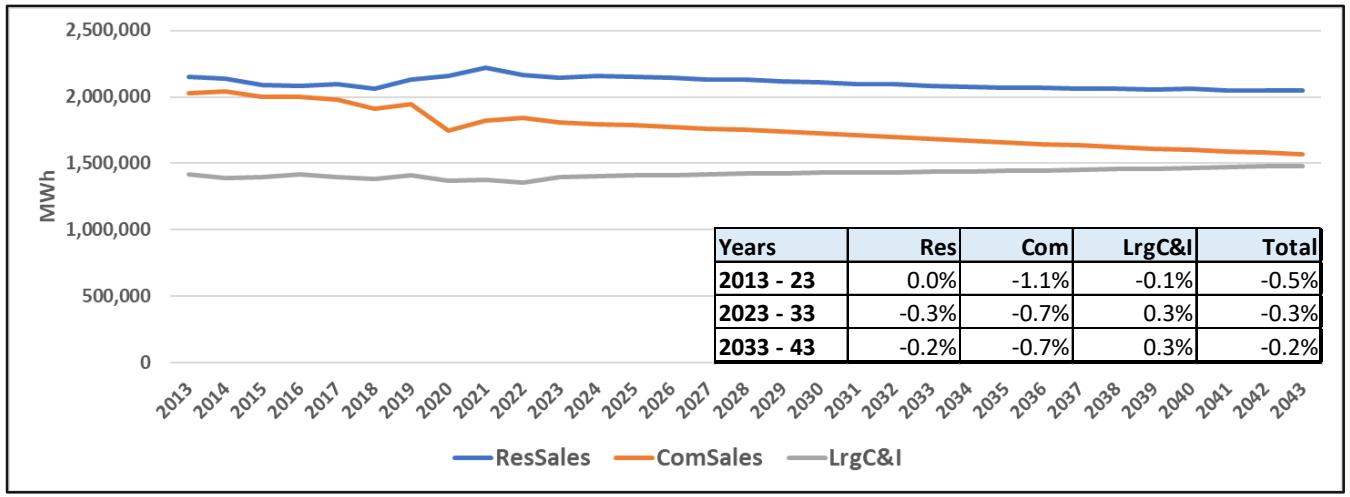


Preliminary Baseline Sales Projection

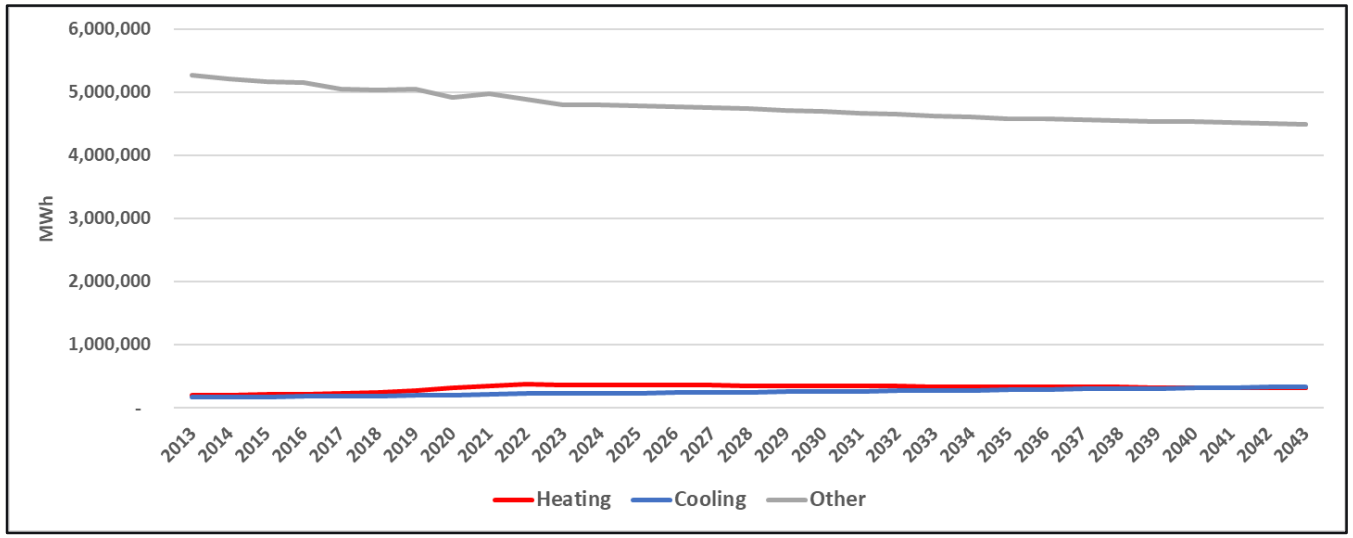
» Estimated from state reported sales and customer data through December 2022

» Forecast based on:
- Moody Analytics January 2022 state economic projections
- EIA 2022 Annual Energy Outlook
  - Calibrated to state survey and NREL ResStock data
- Current DRP energy efficiency savings projections
- Trended HDD and CDD with data through 2022

» Nothing has really changed
- Projected efficiency gains outweigh customer and economic growth.
  - Slightly positive when adjusted for customer own-use generation

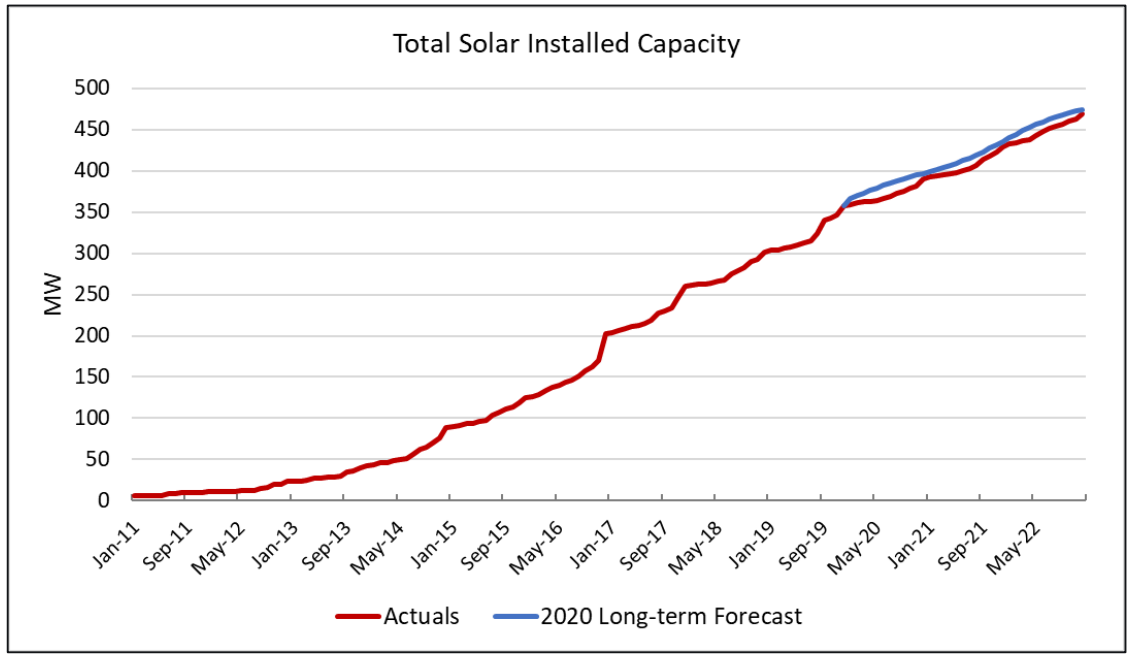


Years	Res	Com	LrgC&I	Total
2013 - 23	0.0%	-1.1%	-0.1%	-0.5%
2023 - 33	-0.3%	-0.7%	0.3%	-0.3%
2033 - 43	-0.2%	-0.7%	0.3%	-0.2%



Solar

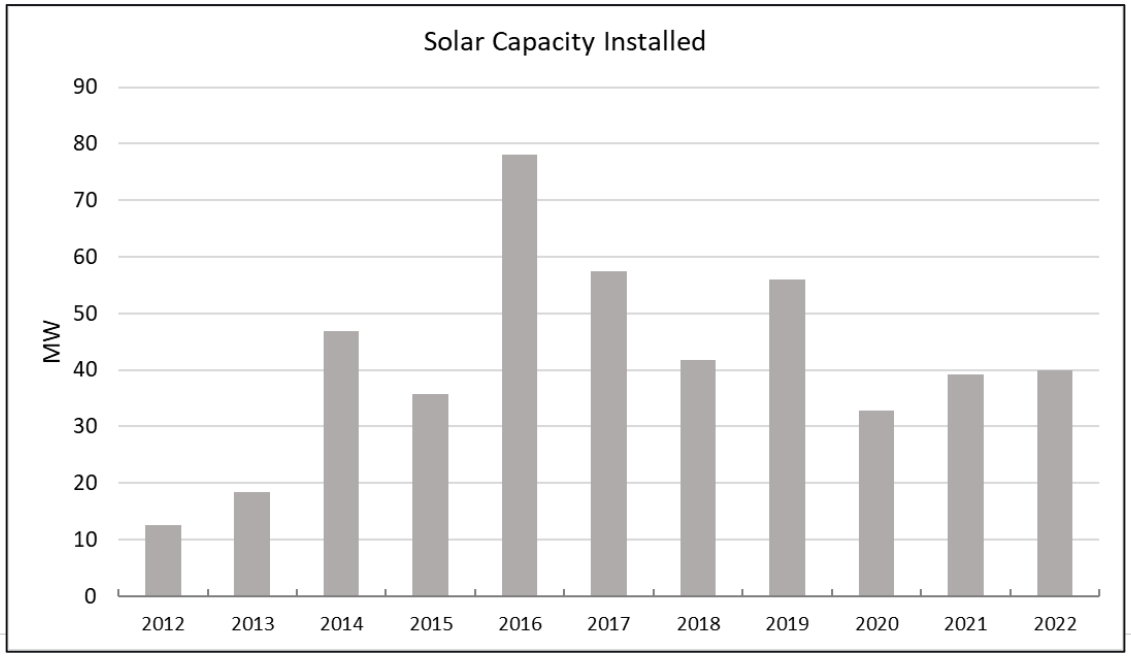
Historical Solar Capacity



» Total capacity includes approximately 70 MW of standard offer solar

» Solar capacity has steadily increased, averaging 40 MW of additional capacity per year

» Prior solar capacity forecast, estimated in Sept 2019, forecasted 475 MW of installed capacity by Dec 2022, actual Dec 2022 capacity of 469 MW.



Breakdown of Installed Capacity

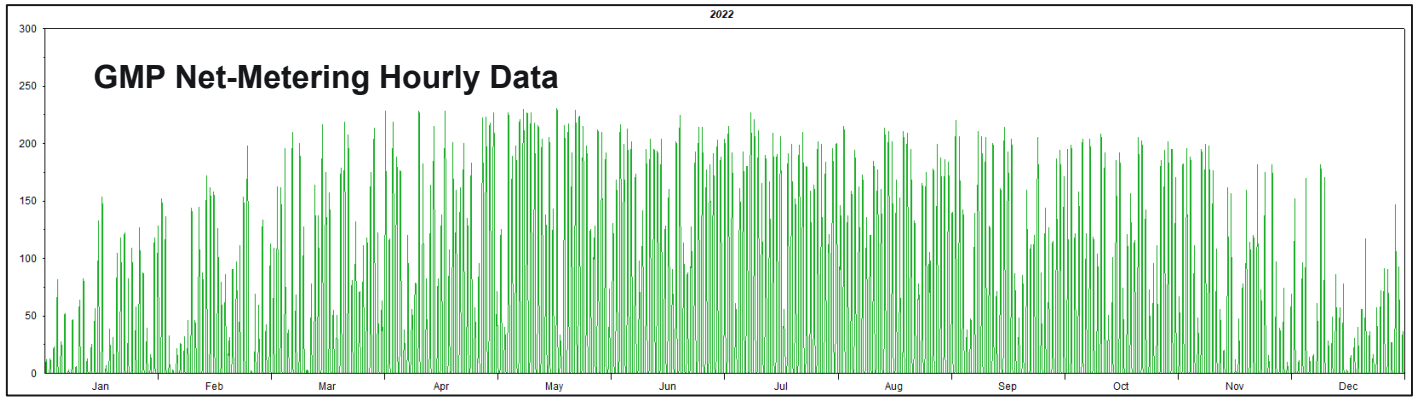
» Most capacity falls under Vermont's net-metering program

Dec 2022 Capacity		
Program	**MW**	
Net-Metering	322.6	69%
PPA	74.8	16%
Standard Offer	66.9	14%
Utility	4.9	1%
Other	0.1	0%
Total	469.4	

» Only 1% of systems installed in 2022 were larger than 200 MW, but they comprised 41% of the capacity added

Total Installations					2022 Installations				
System Size	**Count**		**Capacity MW**		**System Size**	**Count**		**Capacity MW**	
<=10 kW	15,446	80%	92.7	20%	<=10 kW	1,825	76%	11.8	30%
>10 <=20 kW	2,783	14%	36.8	8%	>10 <=20 kW	448	19%	5.9	15%
>20 <=200 kW	861	4%	67.6	14%	>20 <=200 kW	100	4%	5.9	15%
>200 kW	314	2%	272.4	58%	>200 kW	23	1%	16.3	41%
Total	19,404		469.4		Total	2,396		39.8	

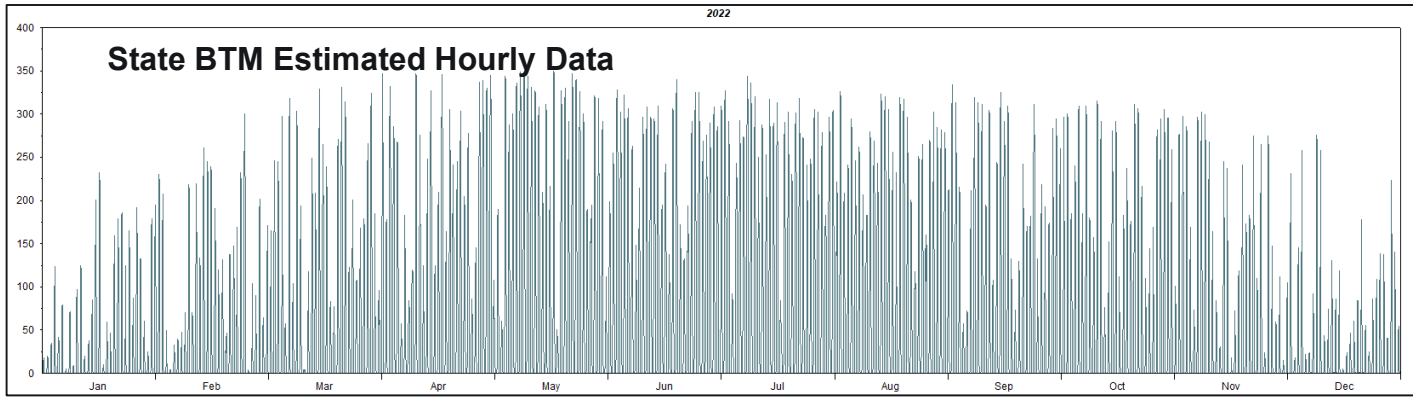
System and Customer Class Reconstitution



» Non standard offer hourly solar generation is estimated based on monthly capacity and GMP hourly solar data

- This estimated BTM hourly solar, and hourly standard offer, is added to system load to arrive at reconstituted system load

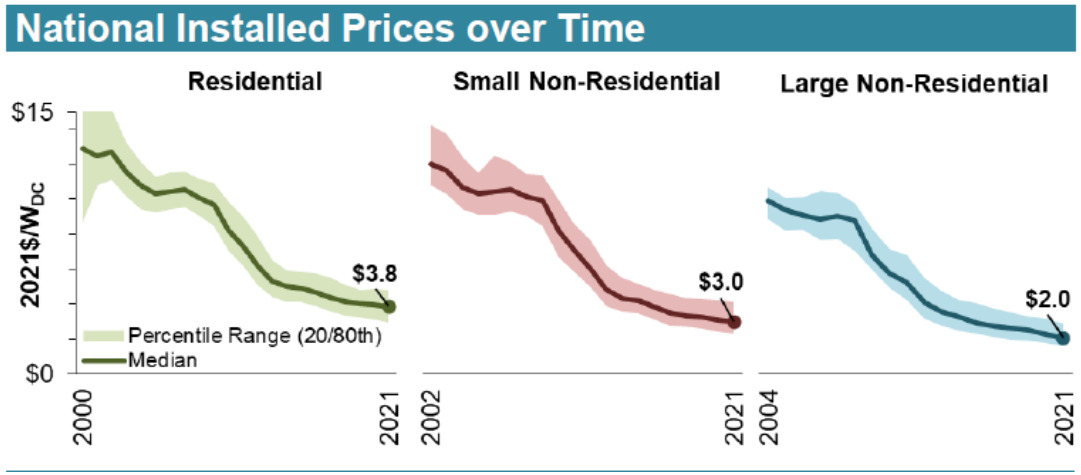
» Monthly residential and commercial sales are reconstituted for solar own-use



Solar Costs

» Costs have continued to decline

» The Office of Energy Efficiency and Renewable Energy (EERE) projects costs continue to decline



Residential System Targets

Parameter	2020 Benchmark	2030 Low Cost	2030 High Performance
Module efficiency	19.5%	20%	30%
Number of modules	22 (7 kW_{dc})	36 (12 kW_{dc})	36 (18 kW_{dc})
Module cost	$0.41/W	$0.17/W[10]	$0.30/W
Balance-of-system cost[30]	$1.68/$W_{dc}$	$0.92/$W_{dc}$[13]	$0.80/$W_{dc}$[31]
Project overhead[32]	$0.62/$W_{dc}$	$0.32/$W_{dc}$	$0.33/$W_{dc}$
Initial operating cost[16]	$14.4/$kW_{dc}$-yr	$8.7/$kW_{dc}$-yr	$10.7/$kW_{dc}$-yr
O&M cost escalation[17]	5.4%	3.0%	1.0%
Initial annual energy yield	1542 kWh/kW_{dc}	1593 kWh/kW_{dc}[33]	1593 kWh/kW_{dc}
Performance degradation[26]	0.7%/yr (30 yr)	0.5%/yr (30 yr)	0.4%/yr (30 yr)
Loan interest and duration	5%/yr for 18 yr	4%/yr for 30 yr	4%/yr for 30 yr
LCOE (2019 US$)[34]	**12.8¢/kWh**	**5.0¢/kWh**	**5.0¢/kWh**

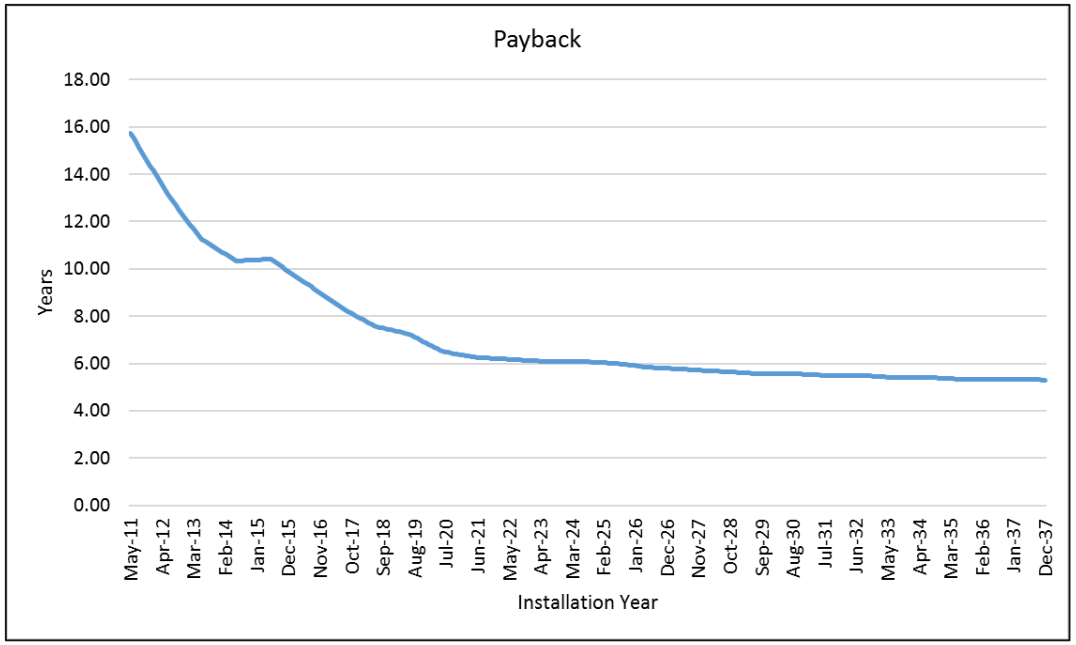
Commercial System Targets

Parameter	2020 Rooftop[8]	2020 Ground[8]	2030 Rooftop	2030 Ground
System size	200 kW_{dc}	500 kW_{dc}	200 kW_{dc}	500 kW_{dc}
Module efficiency	19.5%	19.5%	20%	20%
Module cost	$0.41/W	$0.41/W	$0.17/W	$0.17/W
Balance-of-system cost	$0.78/$W_{dc}$	$0.72/$W_{dc}$	$0.43/$W_{dc}$[23]	$0.54/$W_{dc}$[24]
Project overhead[25]	$0.63/$W_{dc}$	$0.68/$W_{dc}$	$0.32/$W_{dc}$	$0.42/$W_{dc}$
Initial O&M cost[18]	$9.3/$kW_{dc}$-yr	$9.4/$kW_{dc}$-yr	$4.6/$kW_{dc}$-yr	$5.8/$kW_{dc}$-yr
O&M annual escalation[19]	5.6%/yr	5.6%/yr	3%/yr	3%/yr
Initial energy yield	1454 kWh/kW_{dc}	1559 kWh/kW_{dc}	1502 kWh/kW_{dc}[26]	1740 kWh/kW_{dc}[27]
Degradation rate[28]	0.7%/yr (30 yr)	0.7%/yr (30 yr)	0.5%/yr (30 yr)	0.5%/yr (40 yr)
LCOE (2019 US$)	**8.7¢/kWh**	**8.1¢/kWh**	**4.0¢/kWh**	**4.0¢/kWh**

Forecasting Solar Capacity

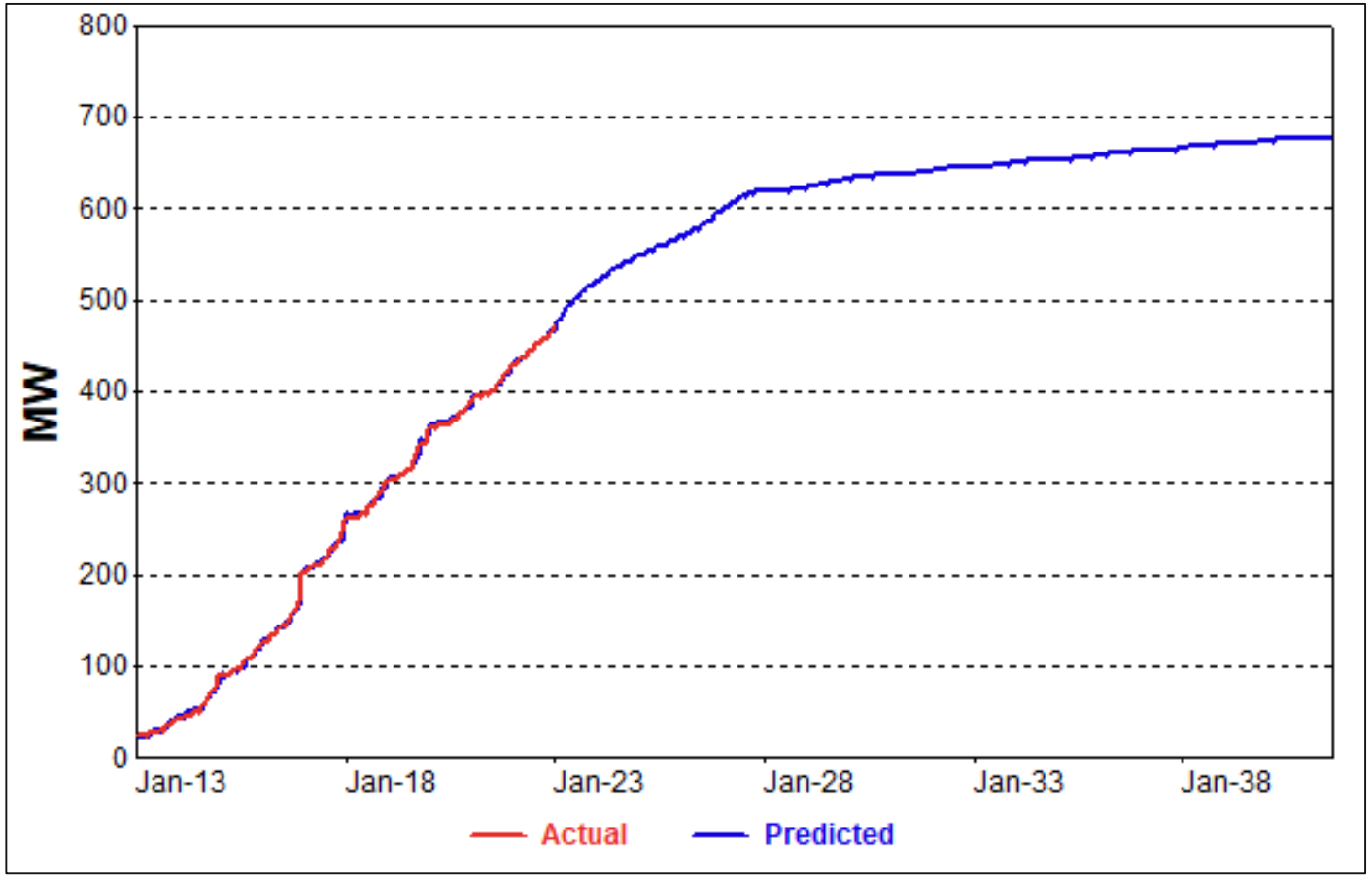
» Capacity (excluding utility scale and standard offer) modeled as a function of simple payback.

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



Prelim Solar Capacity Forecast

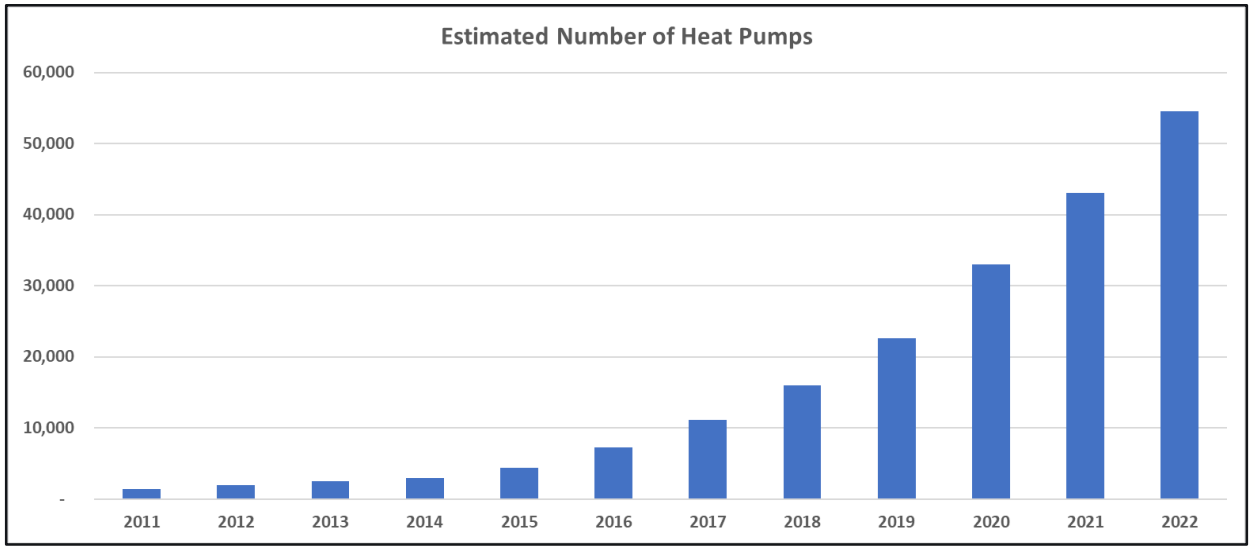
» Capacity forecast is higher than the prior long-term forecast
  - Inflation Reduction Act extended and increased the federal tax credit from 26% to 30%

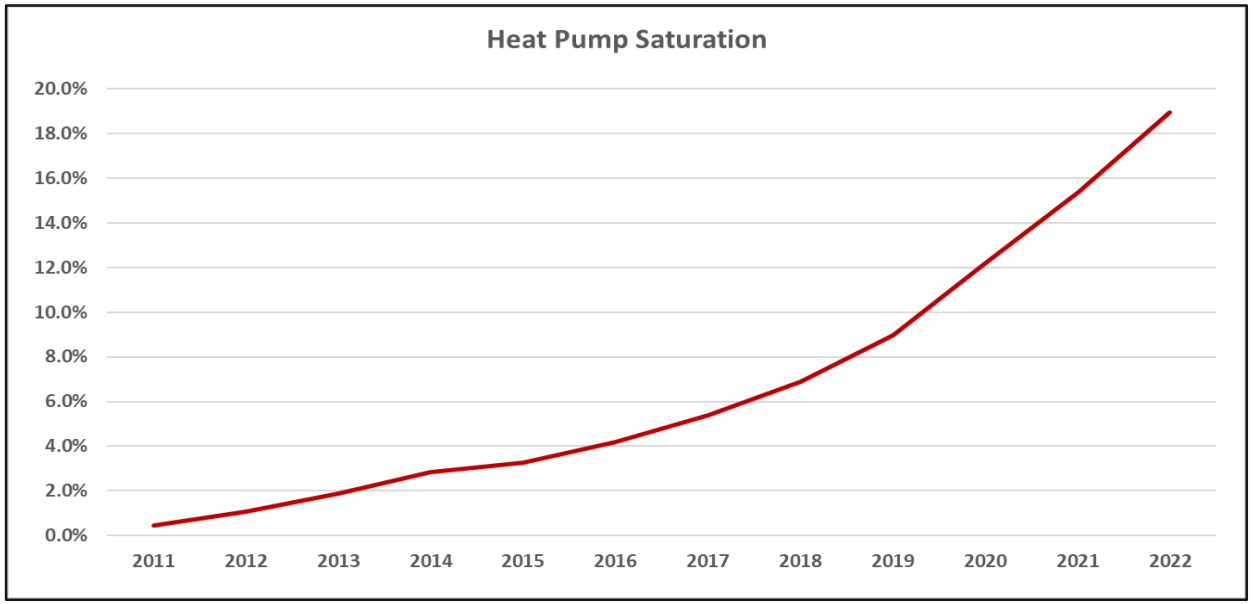


Heat Pumps

Heat Pump Market

- Approximately 55,000 installed heat pumps
  - Based on EIA (early years) and VEIC data
- 17% saturation in 2022 (Total heat pumps divided by residential electric customers)
- Actual saturation depends on definition. If you account for homes that have multiple units, then the saturation is lower (and starting UEC (kWh use per household) is higher)
- Saturation increased from 5% to 17% in four years
  - Incentives clearly move the market
  - Program has been a huge success – doubled number of heat pumps than initially projected





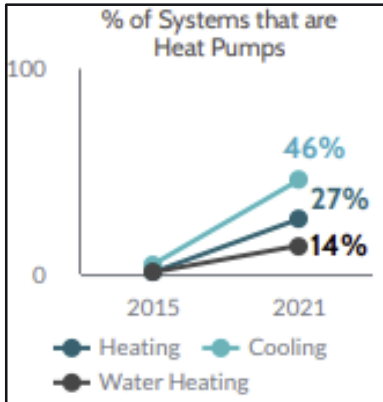
2020 Vermont Single-Family Existing Homes Baseline Study

Final

January 24, 2023

SUBMITTED TO:
Vermont Department of Public Service

SUBMITTED BY:
NMR Group, Inc.
50 Howard St, Somerville, MA, 02144



The use of heat pumps technologies has increased for heating, cooling, and water heating leading to improved energy efficiency for residents.

The percent of heating systems that are heat pumps increased from 1% in 2015 to 27% in 2021. For cooling, the increase was from 5% to 46% and for water heating the increase was from 1% to 14%. The greatest growth occurred with ductless mini-splits which were present in 4% of homes in 2015 and 37% of homes in 2021. This could be indicative of additional permanent heating and cooling capacity being installed as homeowners added space conditioning to rooms that previously had no distribution system or only relied on room air-conditioners. Indeed, the vast majority of ductless mini-split systems are used only for secondary heating or cooling and the share of homes with some type of permanently installed cooling has increased by 47% since 2015.

2021

- Heat pump heating saturation 1% in 2015 to 27% in 2021
- Heat pump cooling saturation 5% to 46% (implies 19% use heat pumps only for cooling)
- Mini-splits: 4% to 37% of homes (implies a large percent of mini-splits are cooling only)

Number of Electric Customers	317,644		2021
Number of SF Customers	219,174	69%	2020
Pct with Heat Pump Heating	27%		
Number of Heat Pumps	59,177		2021

Based on our compiled data 43,000 in 2021 and 54,600 in 2022
20% saturation and 25% saturation if all heat pumps installed in SF houses

- The higher the current saturation, the more difficult it becomes to penetrate the market.
  - Physical constraints, income constraints, ownership constraints, and just don't like them

What do heat pumps cost?

» Large range depending on size, efficiency, and number of zones

- Unit size: 24,000 BTU (2 ton) will heat/cool roughly 1,000 sqft
  - High-efficient heat pumps (2 tons) – $3,000 to $5,000 (HSPF above 10)
  - Installation costs $2,000 – $8,000
  - All in $5,000 to $13,000

> Customers who are low or moderate income can save more! Apply online or download the form and qualifying customers will get GMP's low or moderate income rebate combined with Efficiency Vermont's rebate in one simple step. Up to $800 more in savings!

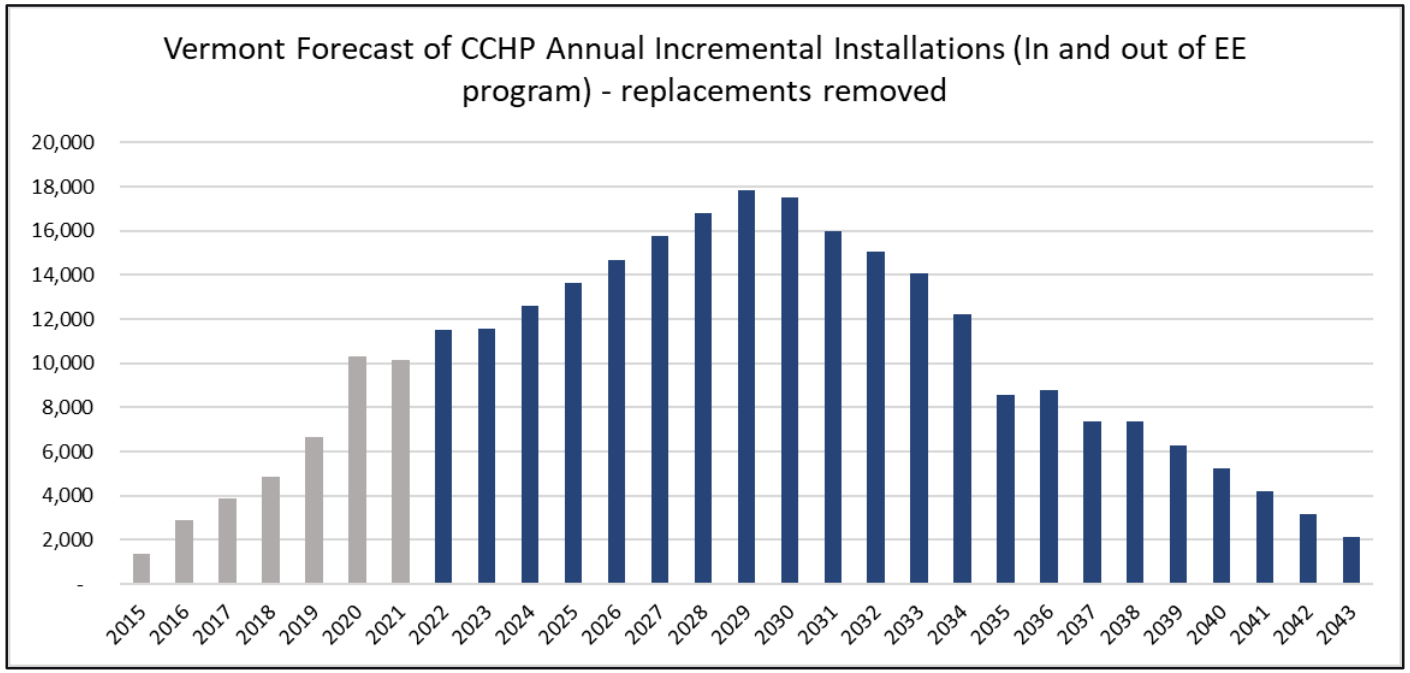
- Current incentives
  - VEIC shows
  - $350 rebate for 2 Tons or less
  - $450 rebate for greater than 2 Tons
  - Additional rebates based on income, location, and number of people living in the house

  - GMP incentives
  - $400 per condenser plus income-related rebates
  - Up to $800 more in savings - $1,200 based on income?
  - No information on what you can save until you select a contractor on Vermont Efficiency website

- Best estimate: Rebates cover 15% of system costs
  - $800 would cover 15% to 25% of unit cost – likely encourages purchases of smaller units.

Heat Pump Forecast

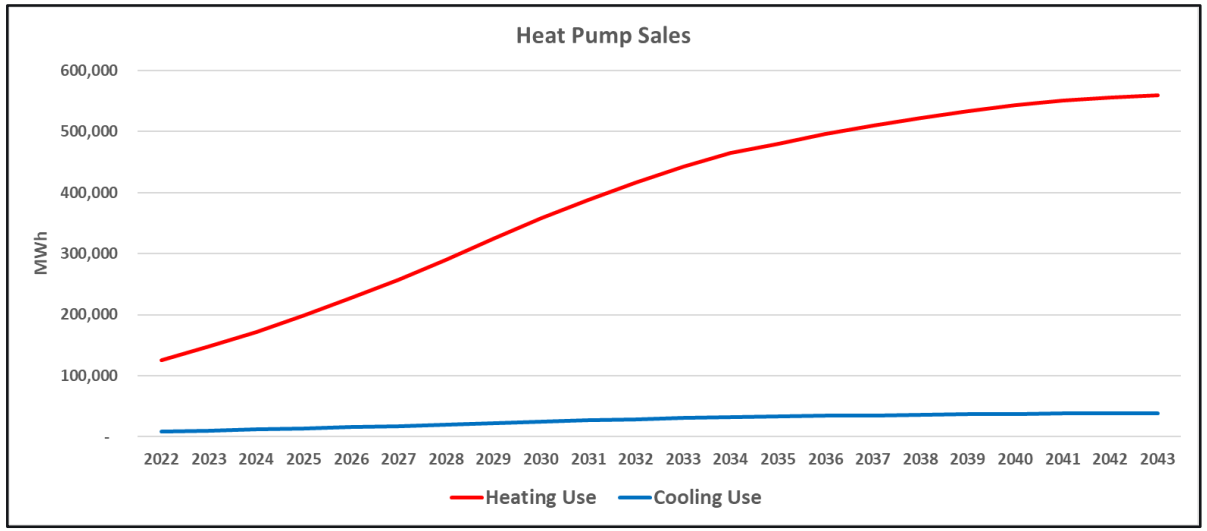
» VEIC's 2023 heat pump forecast (included as part of the current DRP filing)



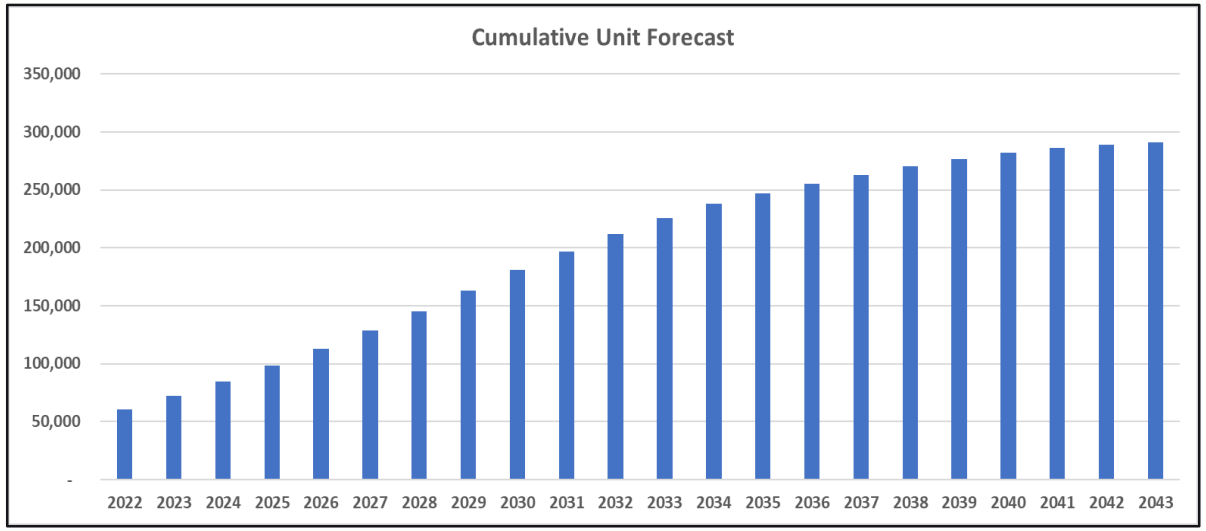
» Currently adding approximately 10,000 units per year – projected to increase to nearly 18,000 per year by 2030.

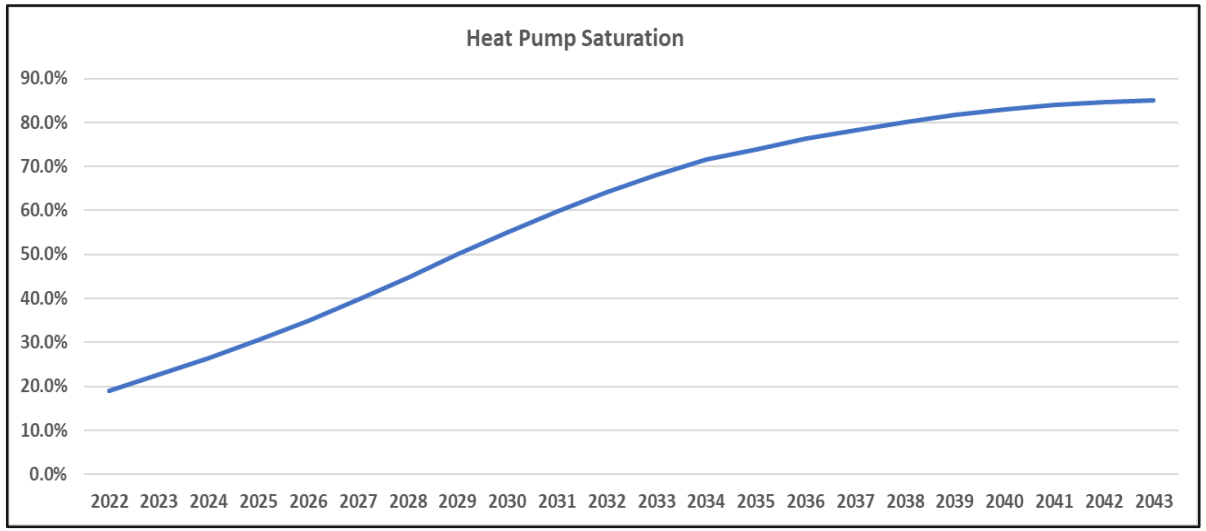
Heat Pump Forecast

» Heat pump use based on Cadmus Study (2017)
- Starting with 2,085 kWh heating and 146 kWh cooling (declines with system efficiency improvement)
- 461,000 MWh in 10 years, 67% saturation, 85% saturation in 20 years



- NSP heat pump study (mostly mini splits) – the average heat pump used 2,000 kWh in just January (and its not as cold)
- Simulating with NSP profile and Vermont weather – 4,461 kWh heating, and 484 kWh cooling
- GMP IRP, 2,905 kWh heating, 482 kWh cooling





High level of uncertainty

» Market Potential

- Saturation trend not likely to be linear
  - At some point it gets harder to increase market saturation
  - Cost barriers, structural barriers, market resistance

» What is driving sizing decisions ?

- cooling or reducing heating costs ?

» Heat pump kWh use

- Currently usage levels reflect relatively small capacity units (2,085 kWh)
- New construction and ducted central heat pump systems will use significantly more electricity – all electric homes use between 12,000 and 18,000 kWh per year in cold climates
- Average heat pump in NSP study used 3,000 kWh, 4,000 kWh when simulating with colder Vermont weather

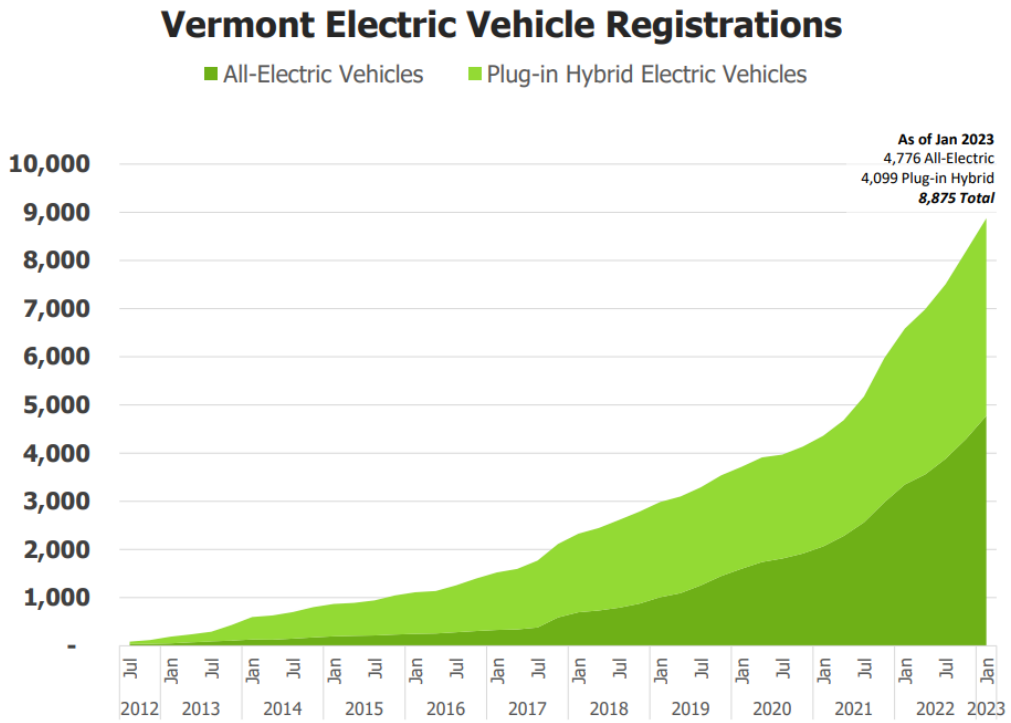
» Heat pump load impact

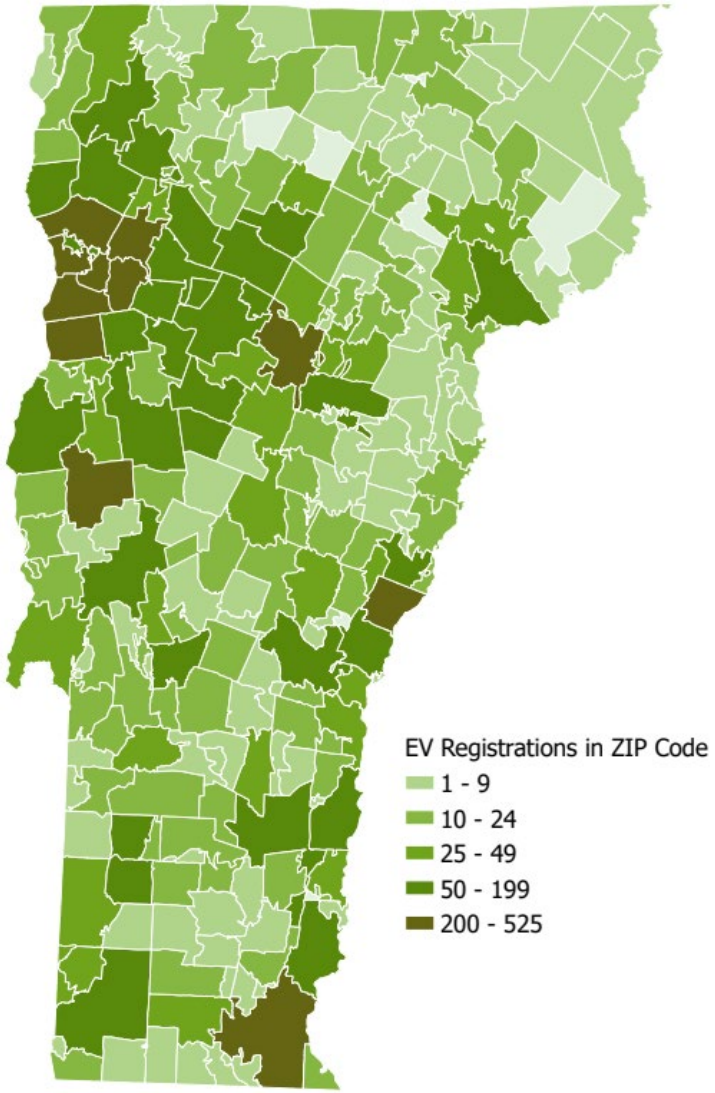
- Data indicates heat pump loads may be peaking in November (but just one year of data)
- NSP heat pump loads peaked in the morning on the coldest winter days

Electric Vehicles

Current EV Market: Vermont

- 8,875 registered EV in the state
  - 35% growth over the past year
- Electric vehicles constituted 6.9% of all new light duty vehicle sales in 2022
  - Higher than the U.S. average of 5.8%





Source: Drive Electric Vermont, January 2023 EV Registration Updates

Current Electric Vehicle Market Information: U.S.

» Electric vehicle sales increased by 65% in 2022, while total vehicles sales decreased by 8%

» Over 800,000 electric vehicles were sold in 2022, accounting for 5.8% of all vehicle sales, up from 3.2% in 2021
  - Electric vehicles accounted for 7.8% of sales in January 2023

» Over 225,000 EVs sold in the 4th quarter, highest quarter sales to date

» Tesla accounted for 58% of sales in 4th quarter, down from 74% in 1st quarter

» Average sales price of an EV was $61,000, compared to $49,000 for internal combustion engine vehicles
  - Average EV sales price fell 5.5% in 2022

Sources: Cox Automotive Group, Inside EVs, Kelly Blue

Federal Incentives

» IRA (Inflation Reduction Act)

New Vehicles

- Removes the 200,000 per manufacturer unit cap
- $7,500 tax credit
- Maximum vehicle cost of $55k for cars and $80k for SUV/trucks
- Maximum income of $150k for single filers and $300k joint filers
- Final assembly must take place in North America
- Battery and critical component requirements

Used Vehicles

- $4,000 or 30% tax credit
- Maximum vehicle cost of $25k
- Maximum income of $75k for single filers and $150k joint filers

State/Utility Incentives

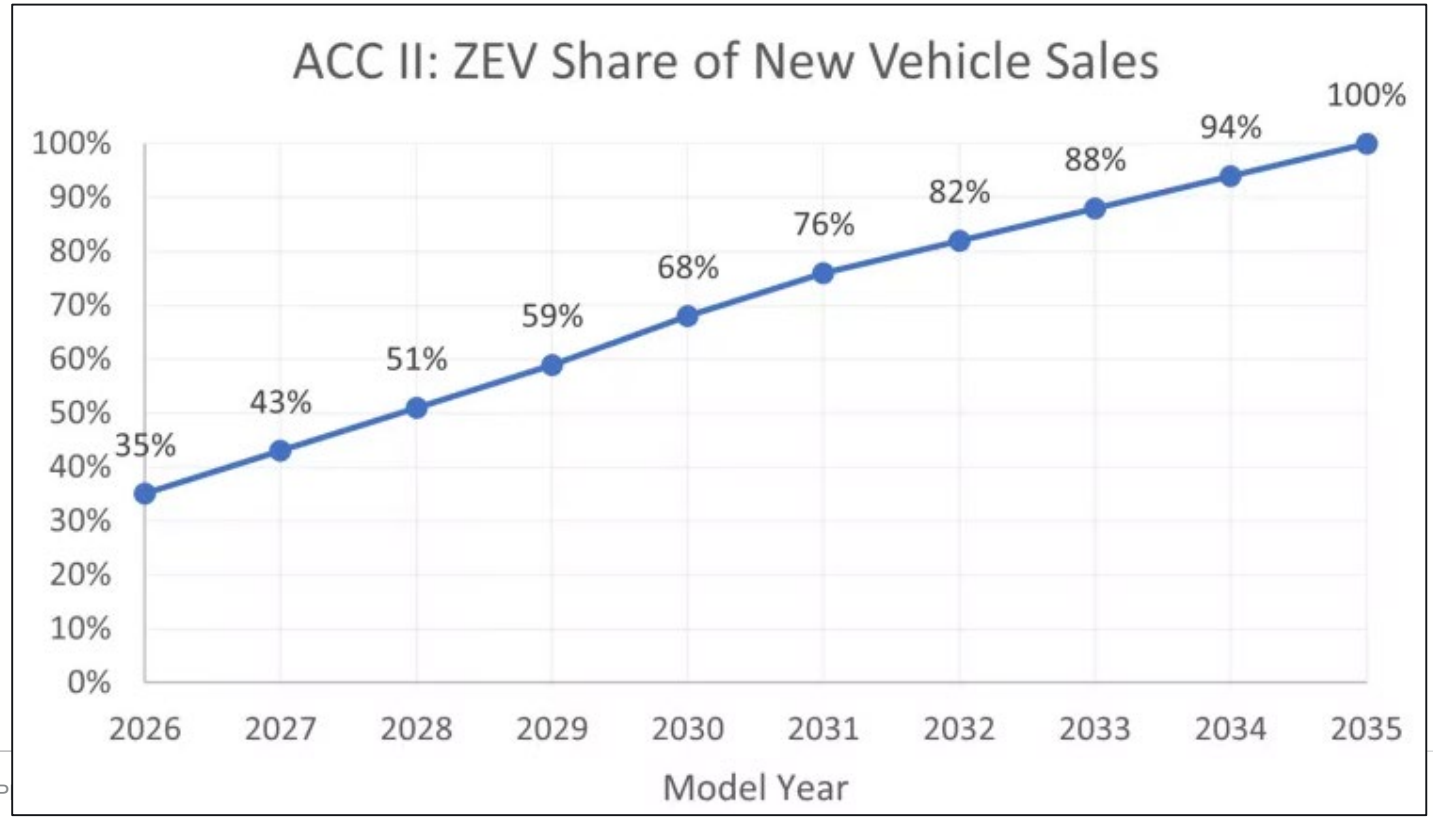
» State incentive of up to $8,000 for the purchase of electric vehicles
- Maximum vehicle cost of $40k/$45k for PHEV and BEV
- Maximum amount applicable for adjusted gross income of less than $50k, no incentives for income greater than $125k

» Utility incentives of $750-$3,200 for the purchase of electric vehicles
- Free or discounted level 2 chargers
- Incentivized charging rates

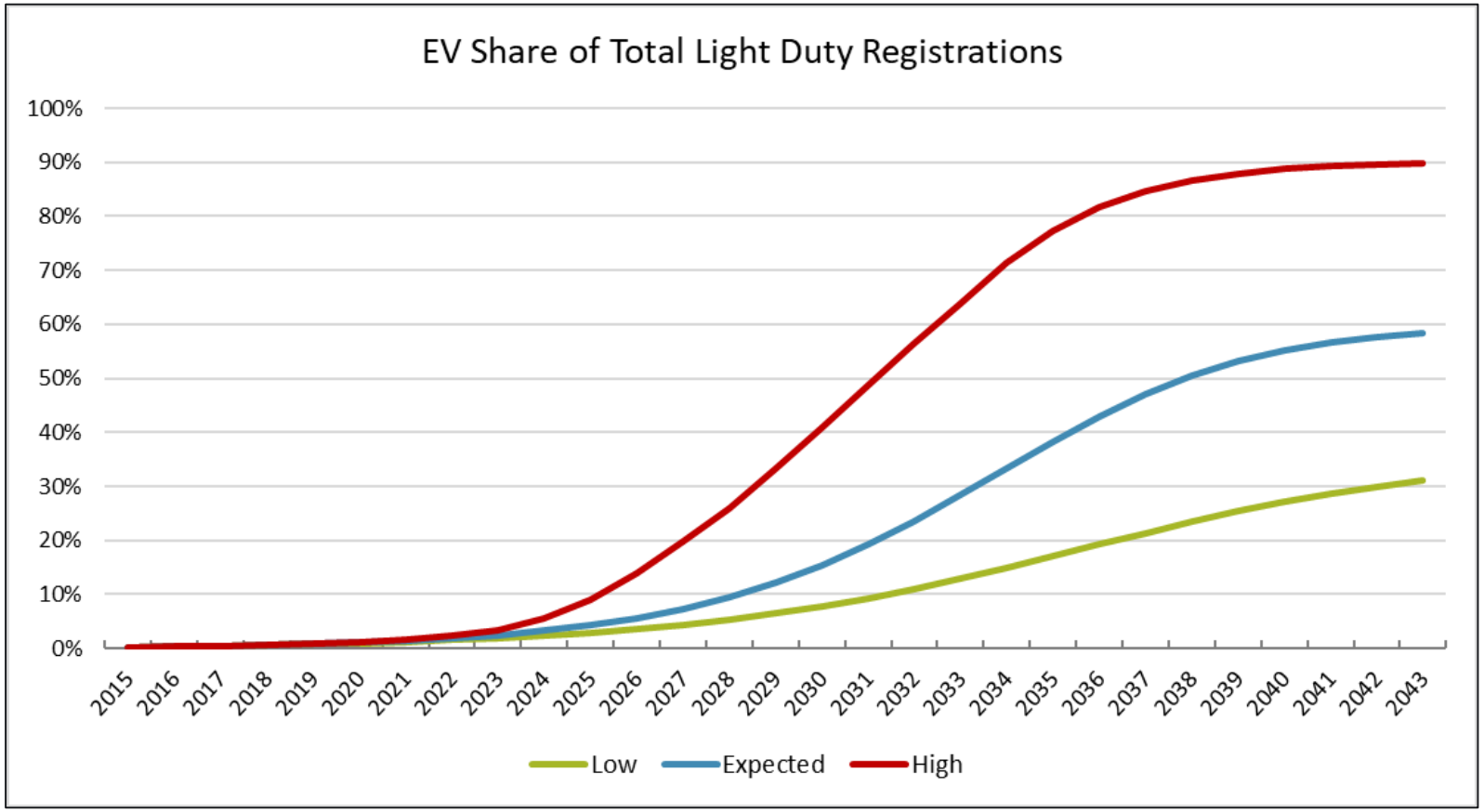
State Vehicle Targets

» Vermont have adopted California's Advanced Clean Car II standard (ACC II) as of Nov 2022

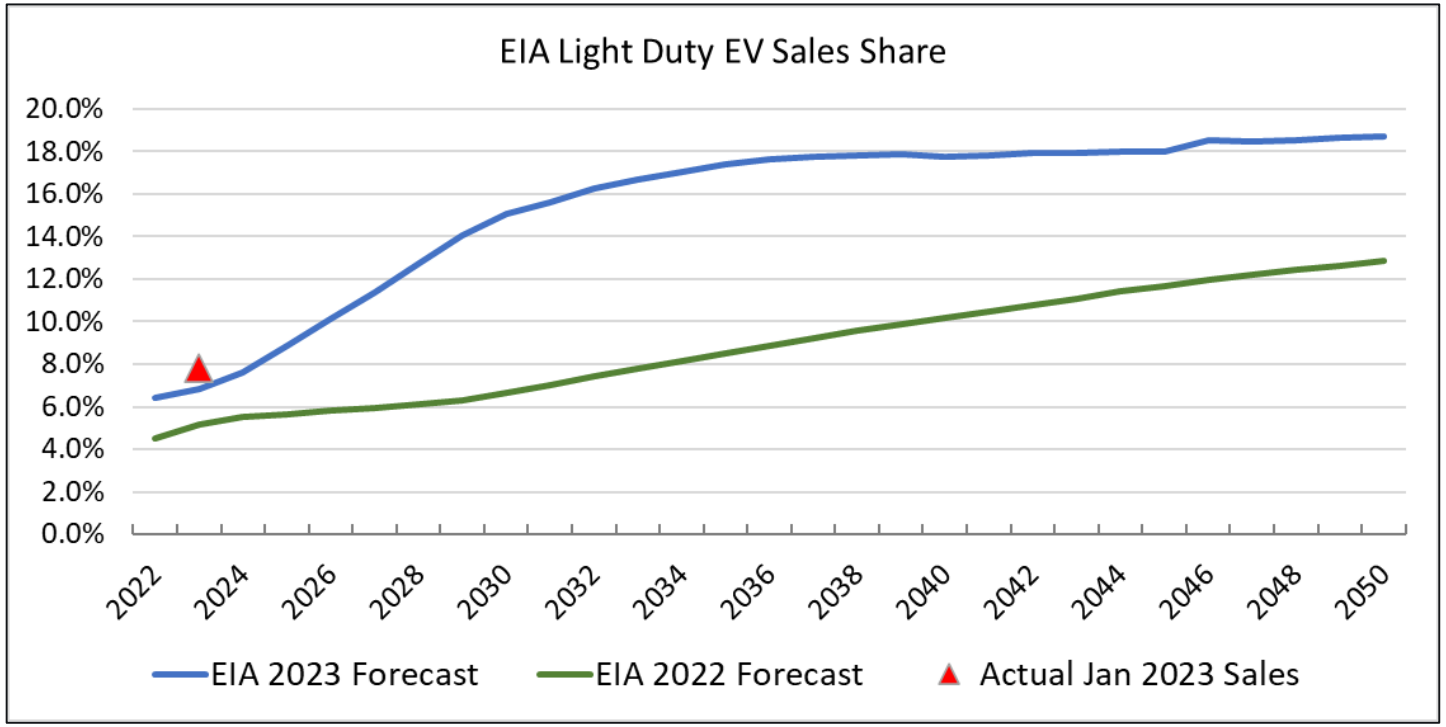
- Requires automakers to produce for sale in states an increasing number of new zero emission vehicles (ZEV) each year
- Eligible ZEVs include battery electric vehicles (BEVs), plug-in hybrid vehicles (PHEVs), and fuel cell electric vehicles (FCEVs)

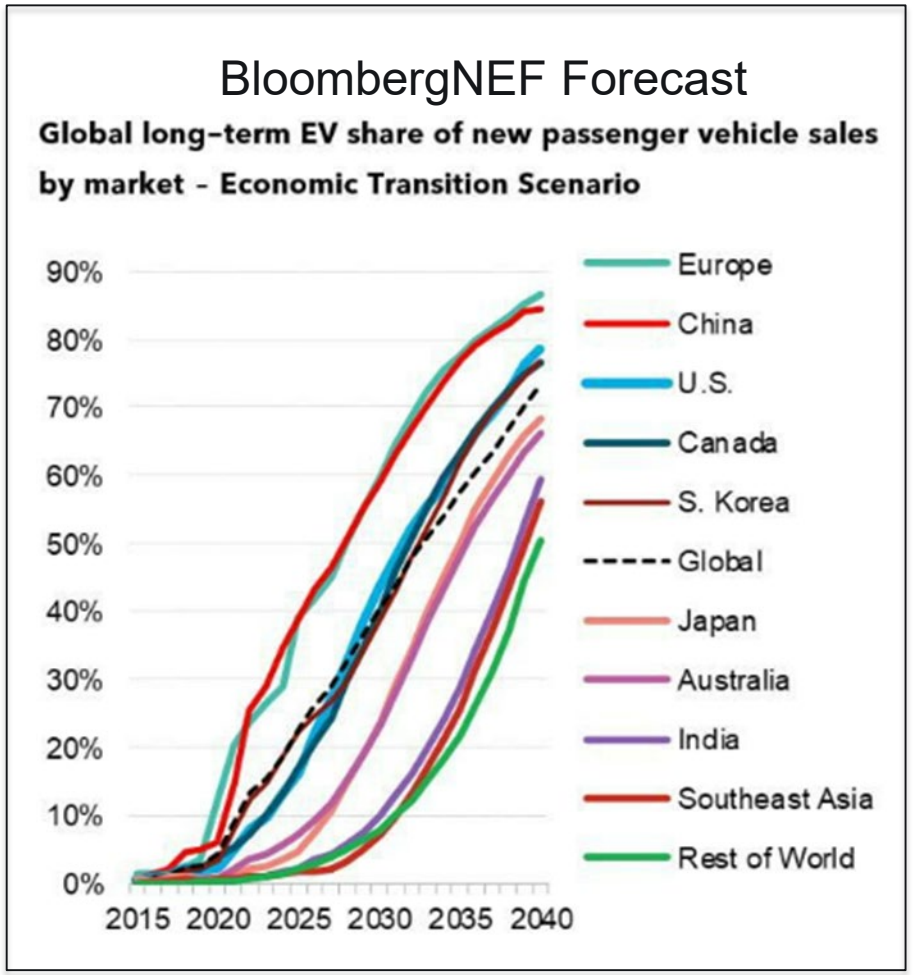


Prior Electric Vehicle Forecasts



National Vehicle Forecasts

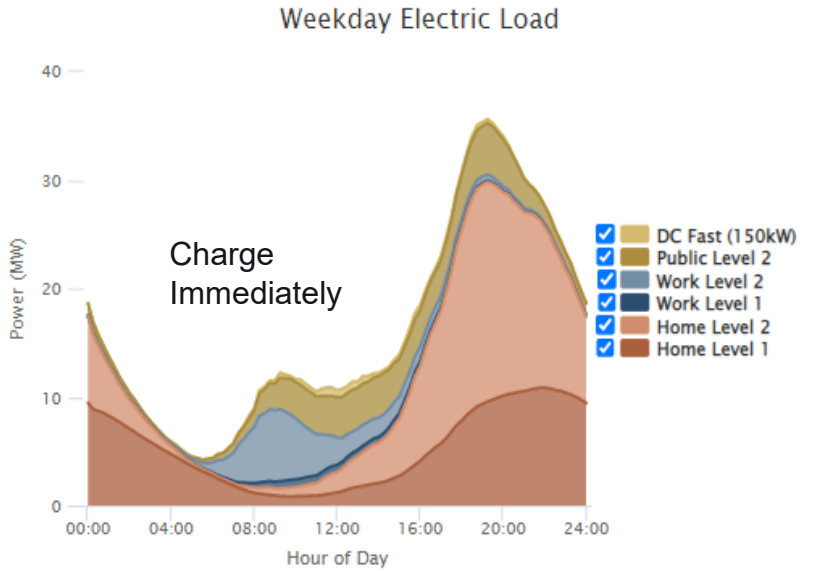


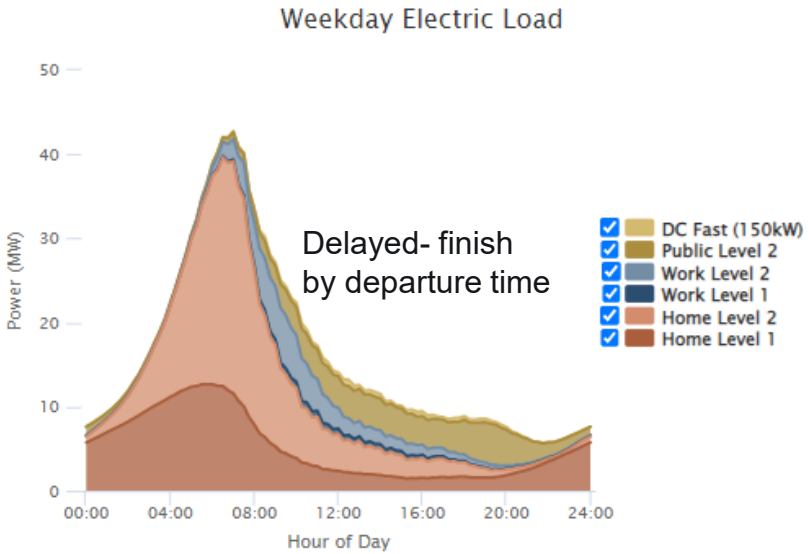


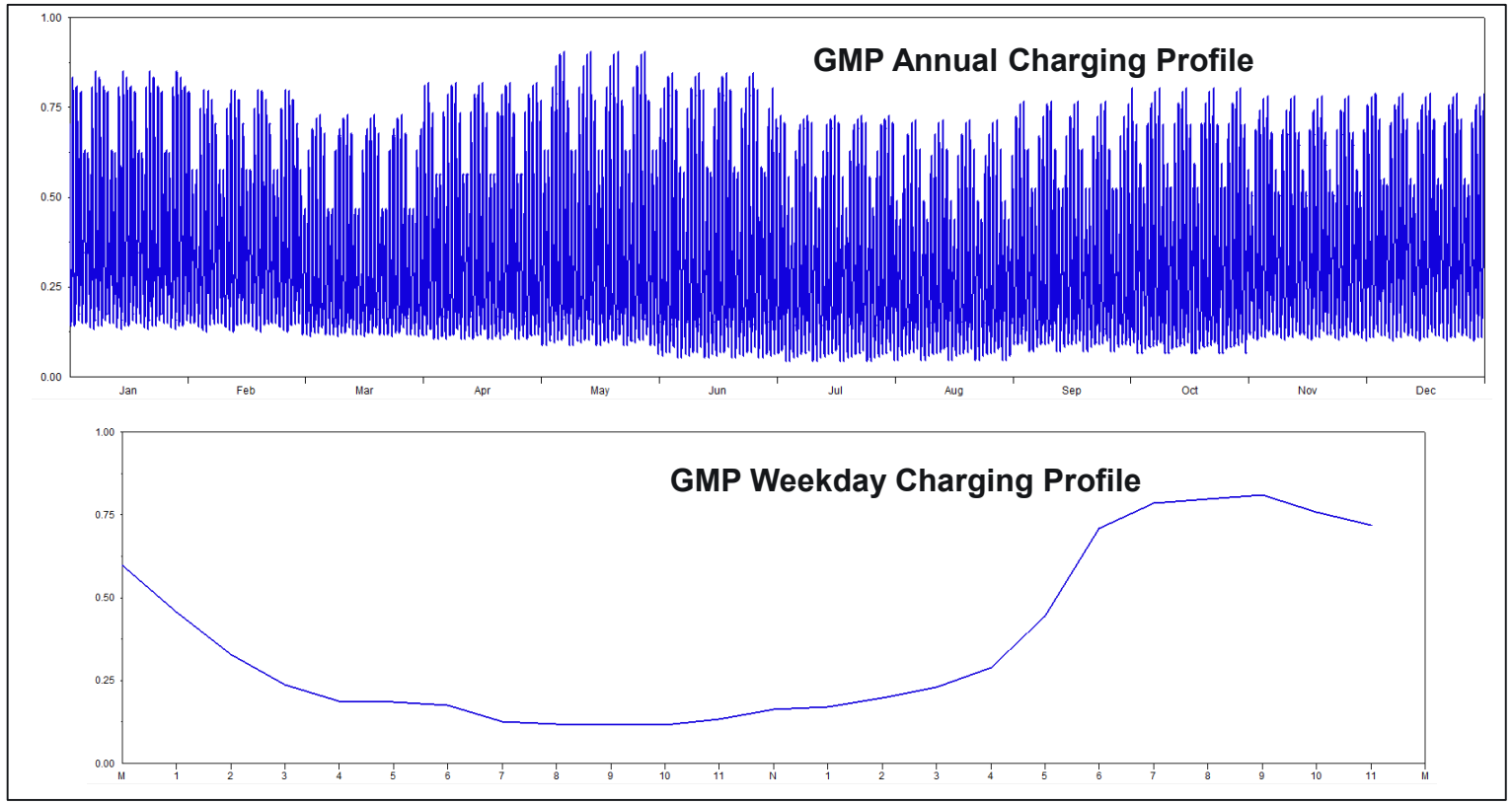
- The Energy Information Administration (EIA) continues to forecast low EV adoption compared to all other industry experts
- Bloomberg forecasting 80% of new cars sales will be electric by 2040, compared to 18% forecasted by EIA

Available Vehicle Charging Profiles

Electric Vehicle Infrastructure Projection Tool (EVI-Pro) Lite



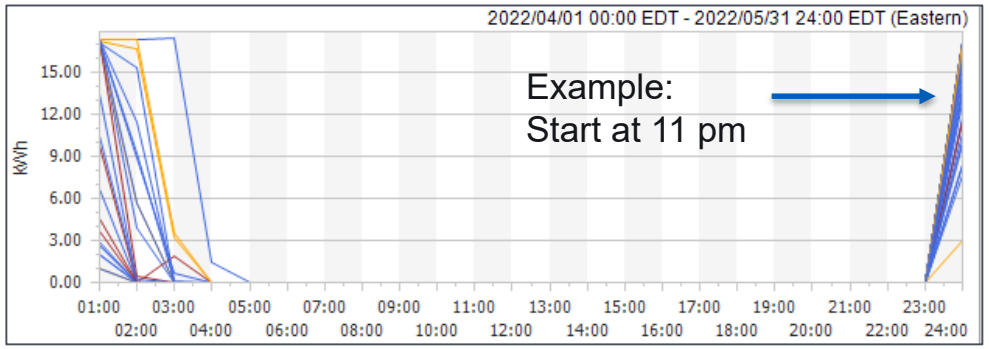


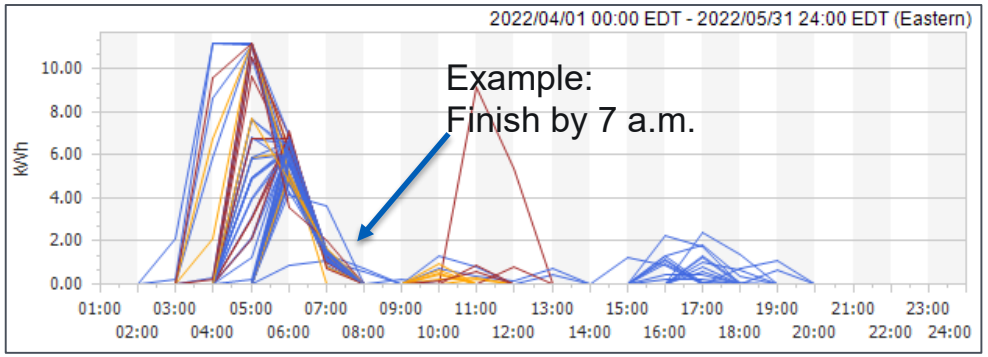


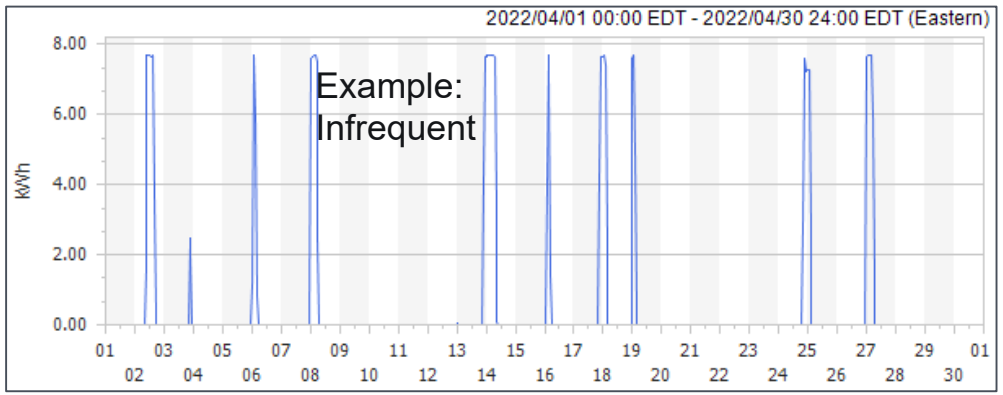
- Up to 20% of vehicle charging occurs away from the home
- With high levels of EV adoption utilities are likely to implement TOU or incentive rates
- GMP data provides a valuable seasonal pattern

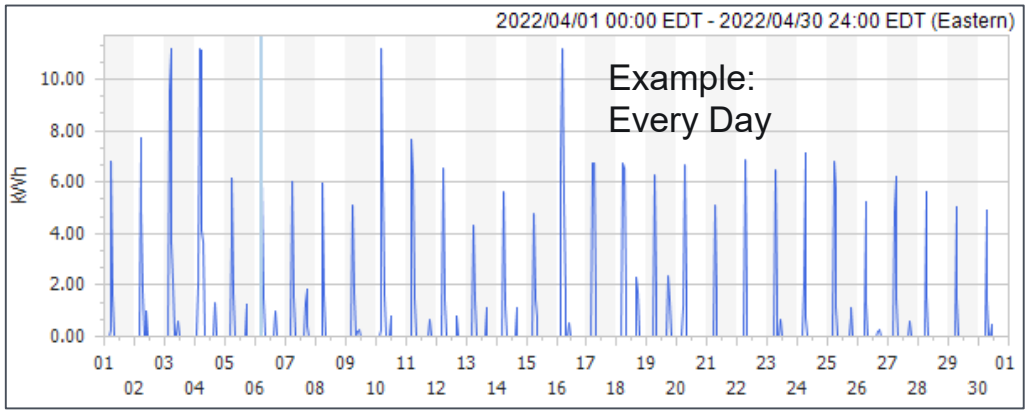
Res Level 2 Charging – Midwest Utility

- Utility has ~1,200 customers on their EV Rate
  - Dedicated meter for EV charging
  - 11 pm - 9 am is off peak
  - Off/On price ratio: ~1/2
  - Data analyzed for ~10 weeks
- Customers have 2 main charging strategies
  - Start at (example, start charging at 11 pm or later)
  - Finish by (example, 80% charged by 7 am)
- Most customers do not charge every day

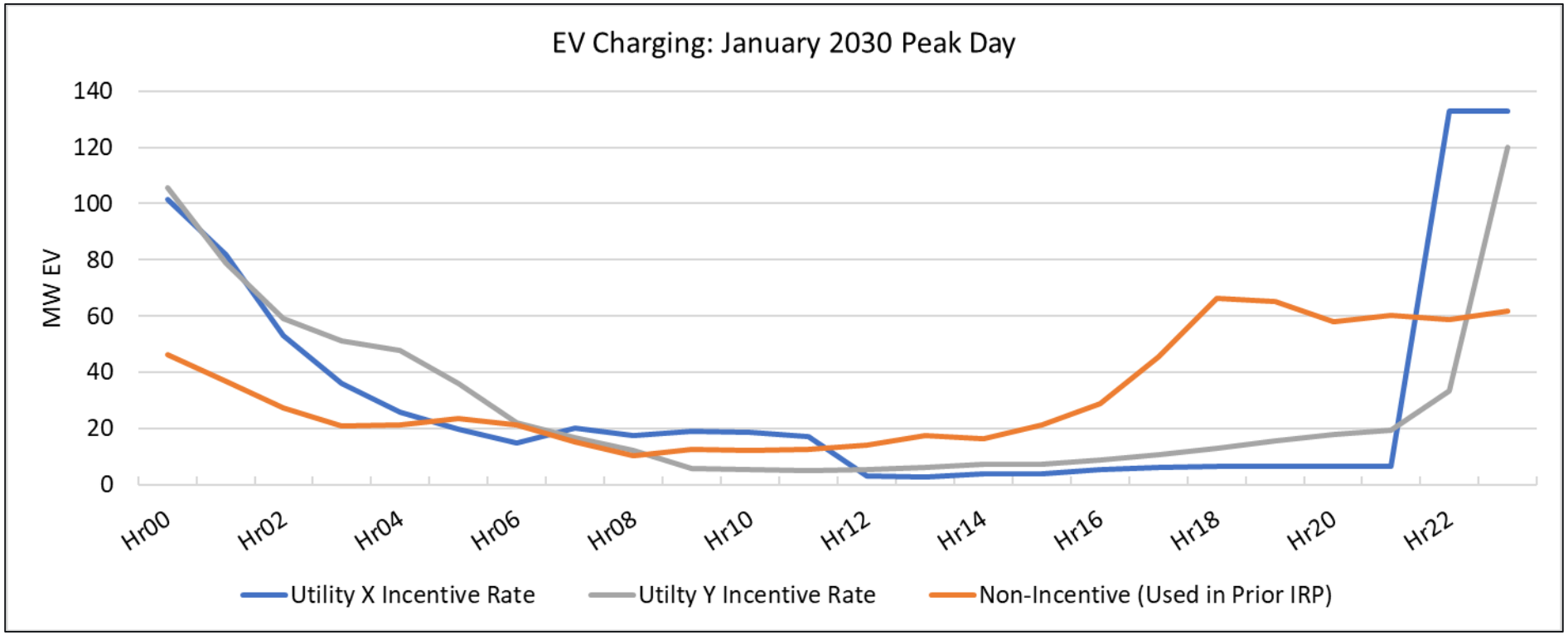






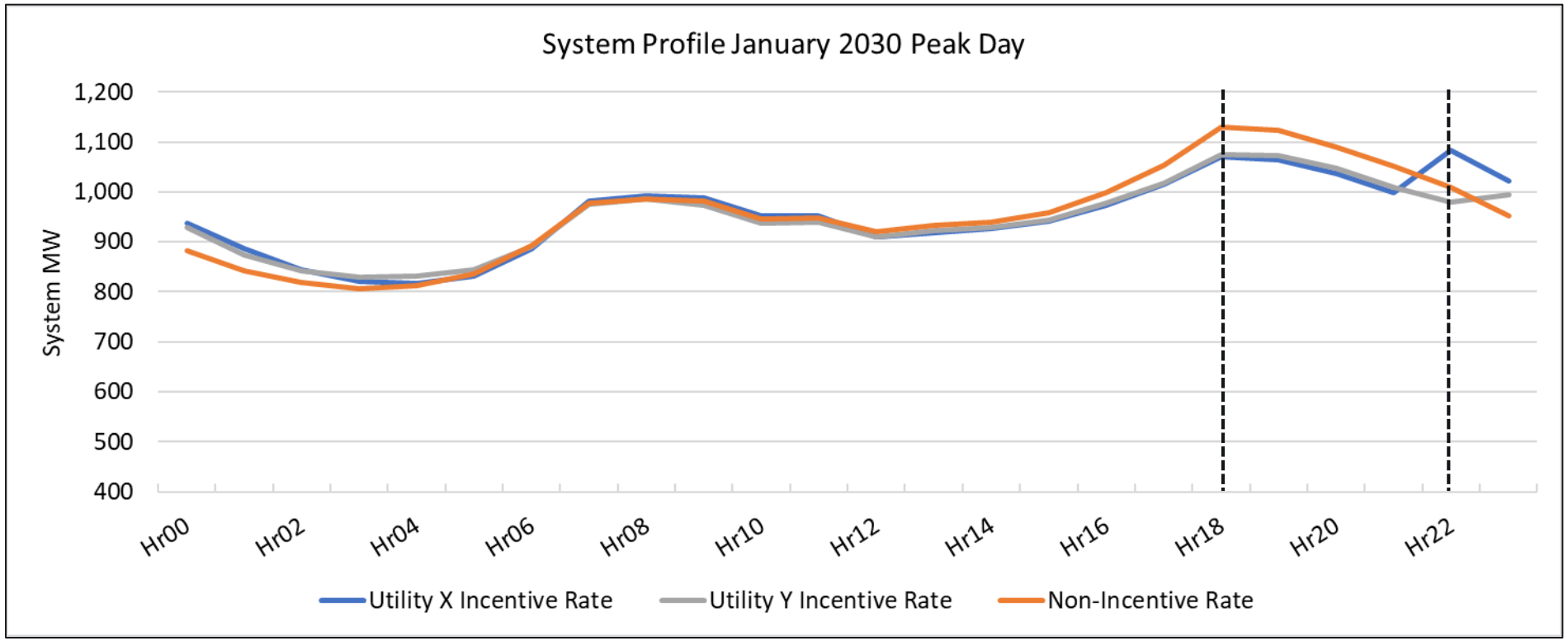


Charging Profiles Matter: Residential Charging



- Approximately 72,000 EVs by 2030
- With incentivized rates total EV demand could be twice as large but maximum demand would occur 4-5 hours later in the evening

Charging Profiles Matter: Impact on System Demand



» Coincident demand impact is still lower with incentivized rates, timing of system peak may change

Challenges

Challenges

» Big difference between what we measure and what customer use.
  • Not only is the X variable an estimate, but so is the Y variable

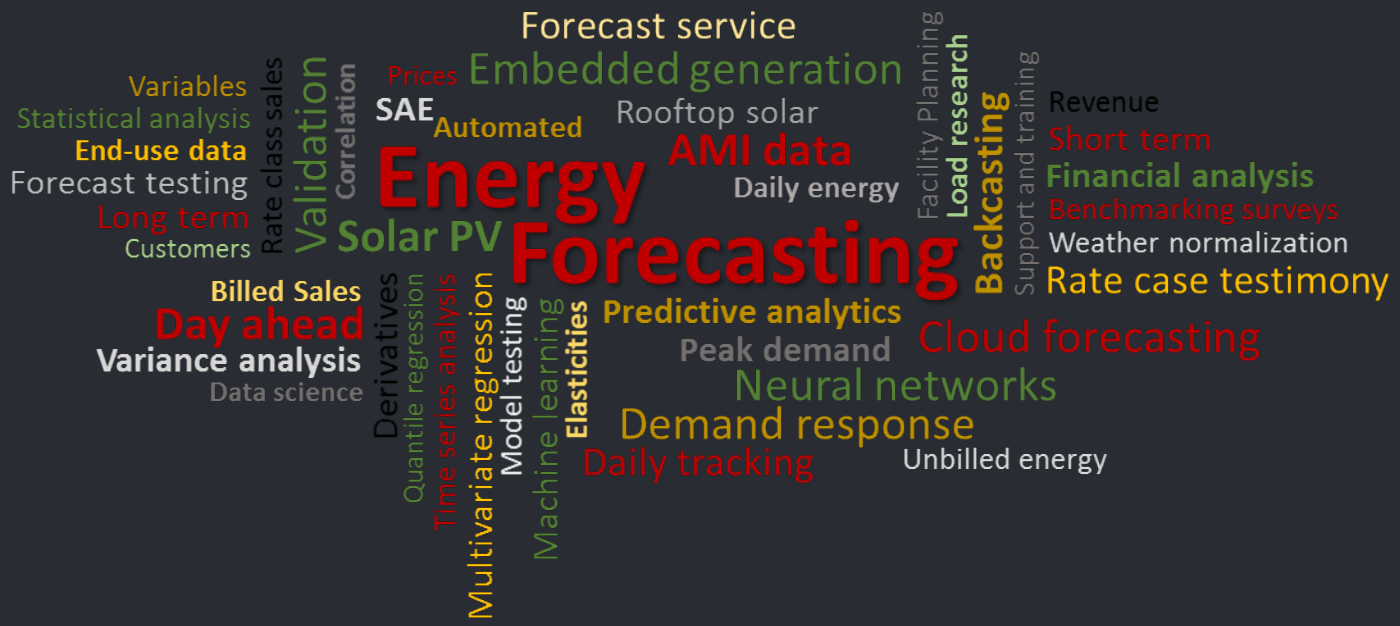
» New technologies with relatively high levels of uncertainty drive the forecast
  • Limited information behind EV and Heat Pump projections
    - EV charging profile assumptions will significantly impact demand

» Prior method of forecasting peak demand with econometric models may no longer work
  • Loads today don't look like loads in the past
    - Change in customer load mix as a result of COVID
    - Solar and heat pump adoption have significantly altered when peaks occur
      ○ Peak shifting from summer to shoulder/winter and from afternoon and evening to mornings.

» Alternative approach – system hourly build-up from customer class and end-use loads
  • Goes back to old days - HELM

» Need to figure out the best approach to address zonal level load forecasts

Questions ?



Thank You

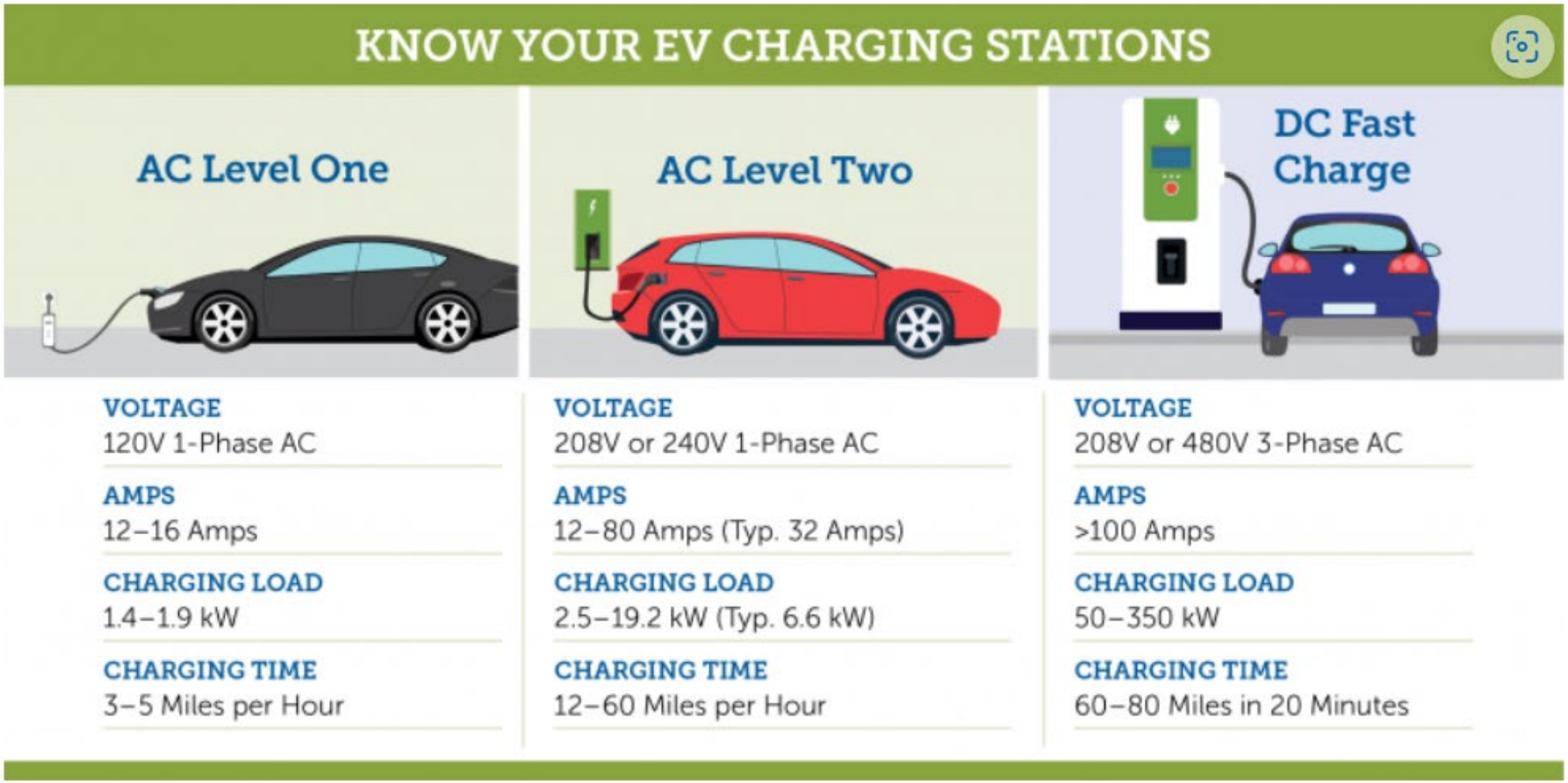
Itron

http://www.itron.com/forecasting

www.itron.com

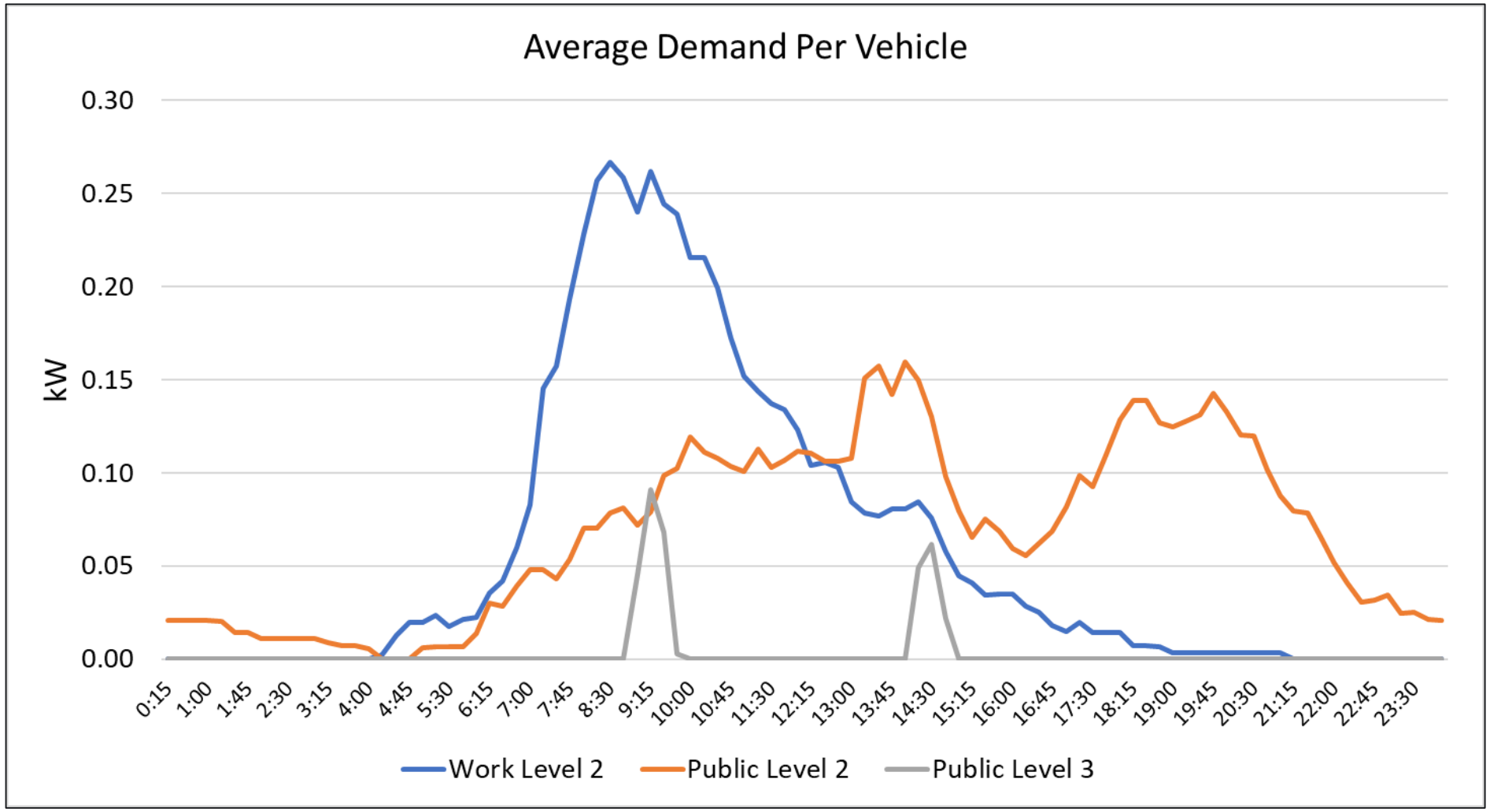
EXTRA MAY NOT USE

EV Charging Supply Equipment



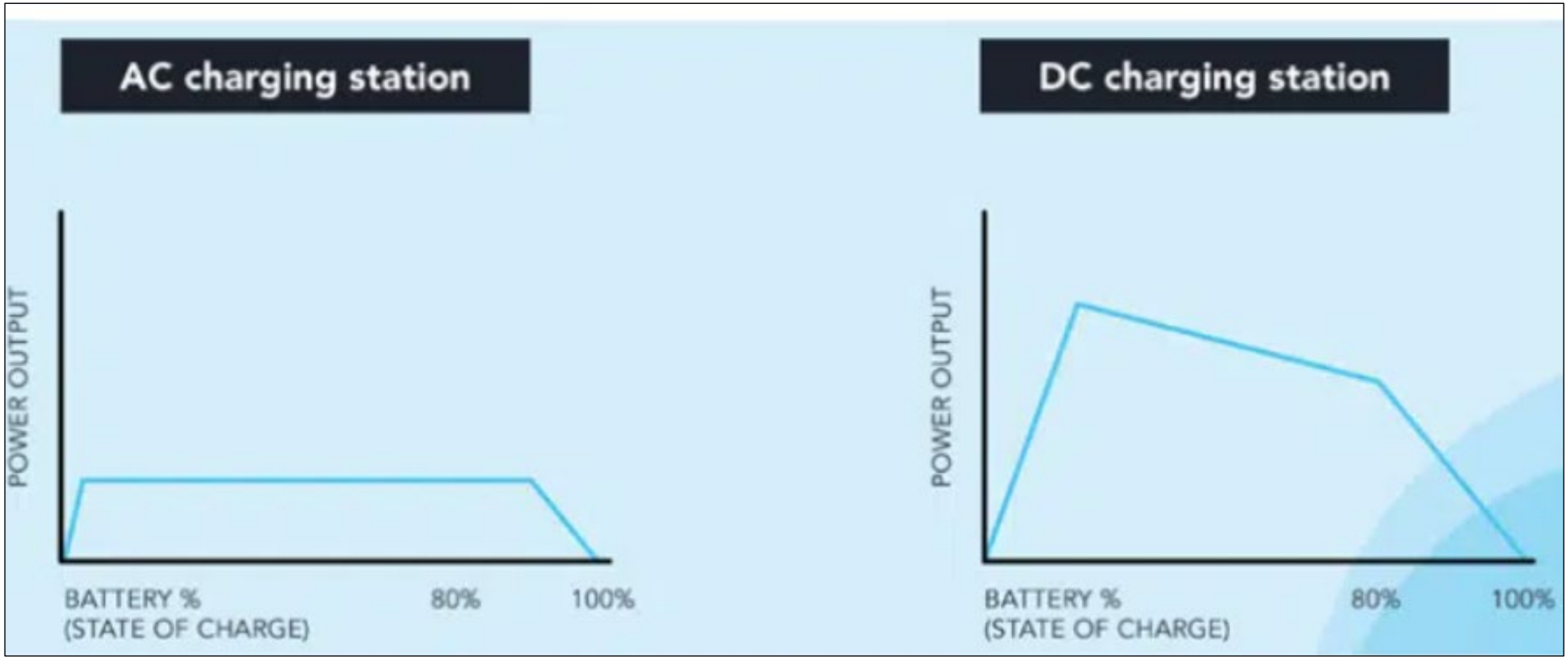
Source: https://www.carolinacountry.com/your-energy/energytech

Work and Public Charging: 1,000 Vehicle Market



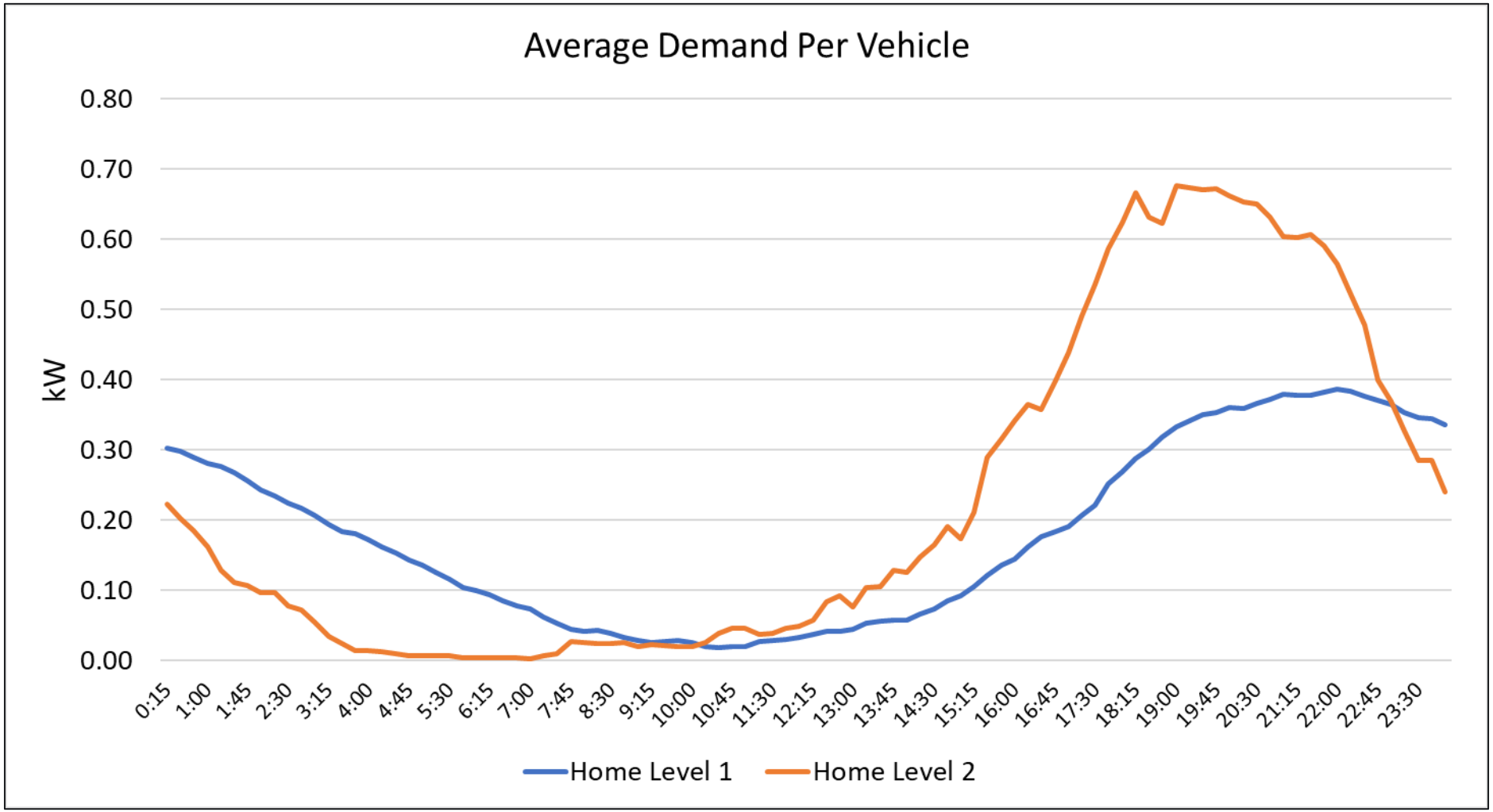
» Approximately 10%-20% of charging occurs away from home

AC vs. DC EV Charging Curve

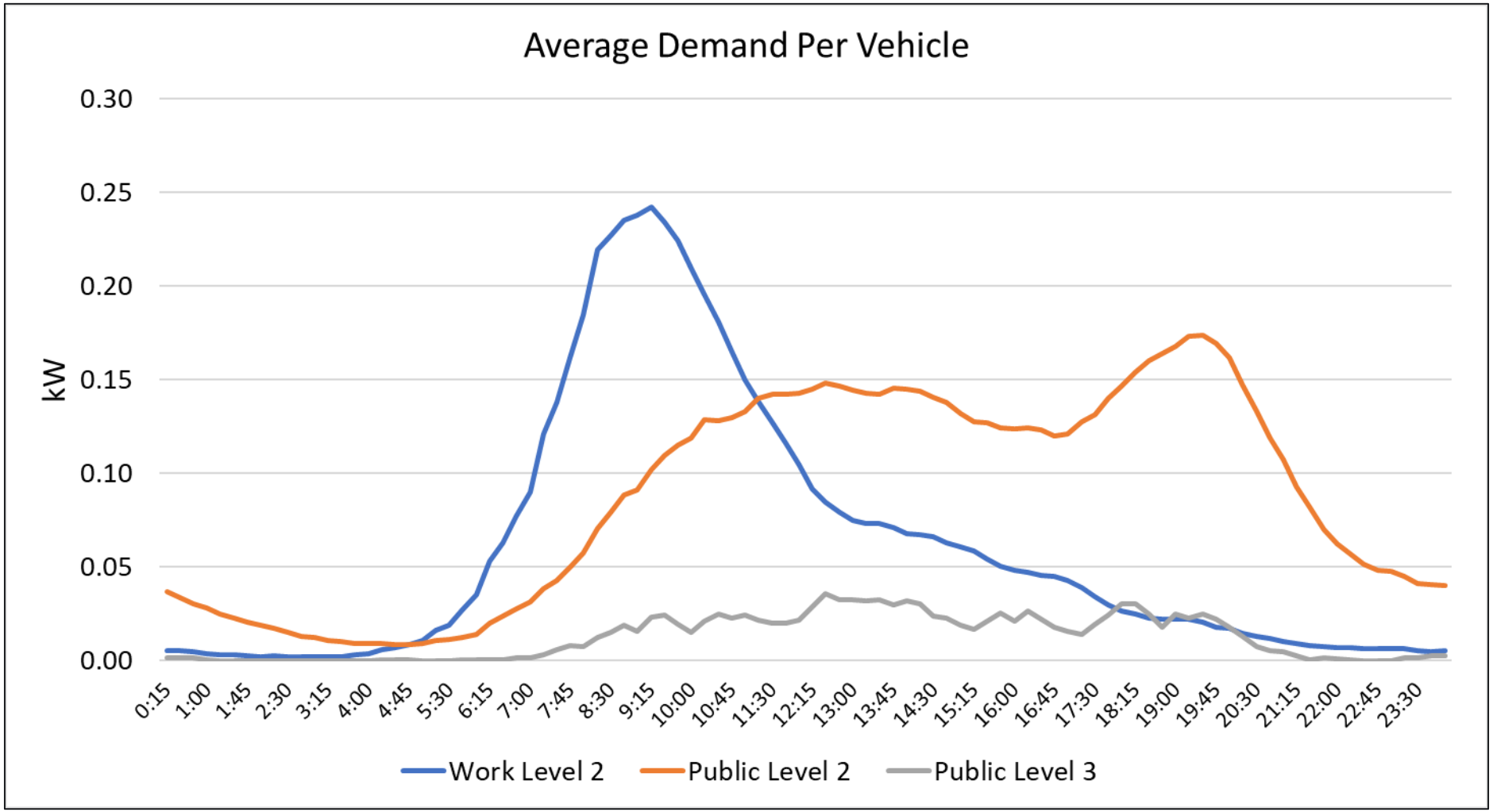


Source: https://cyberswitching.com/electric-car-charger-guide/

Home Charging: 1,000 Vehicle Market

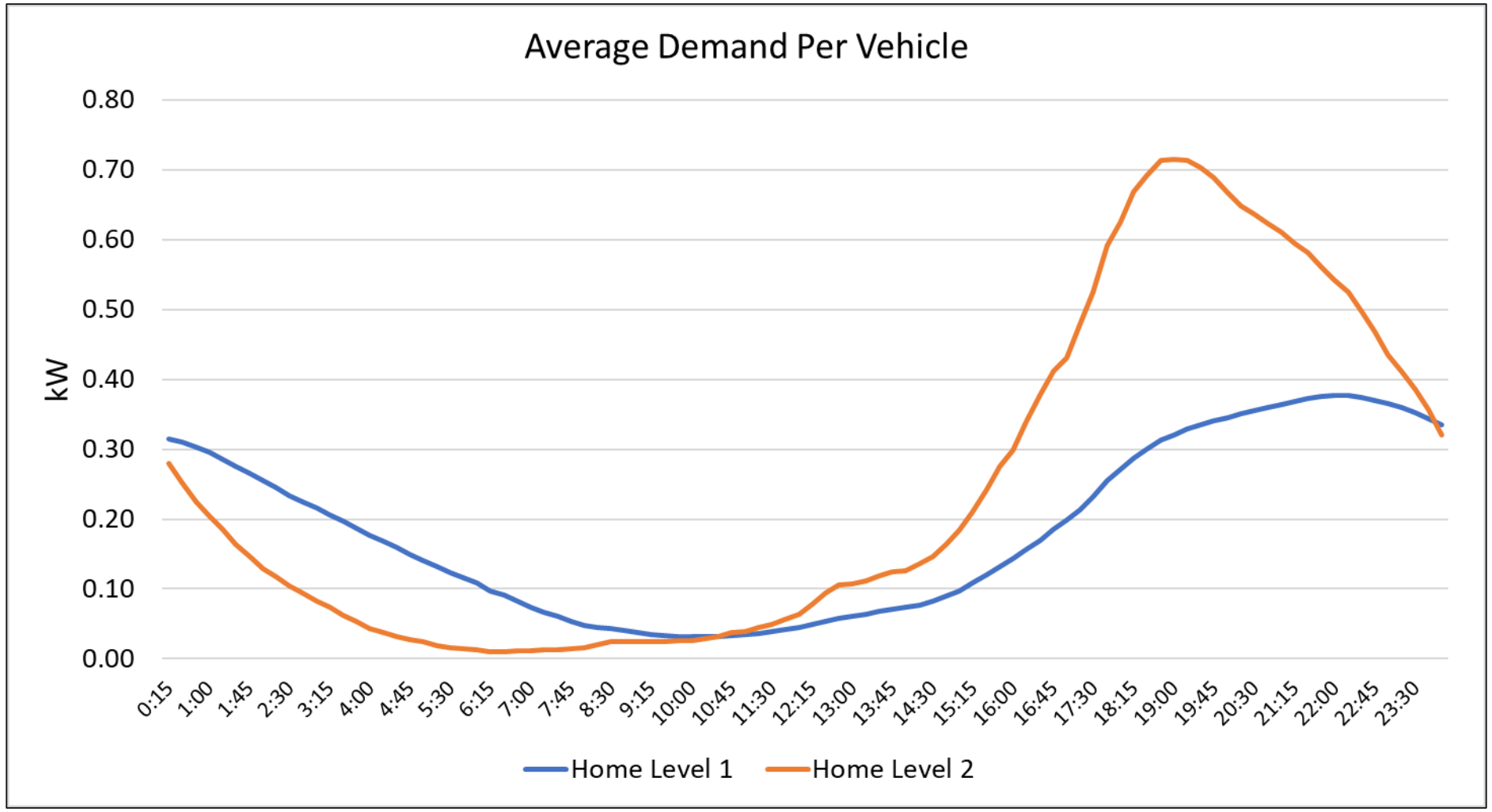


Work and Public Charging: 70,000 Vehicle Market



» Lower impact per vehicle with larger EV market, more diversified charging

Home Charging: 70,000 Vehicle Market



» Charge curve smooths out as more vehicles are added