



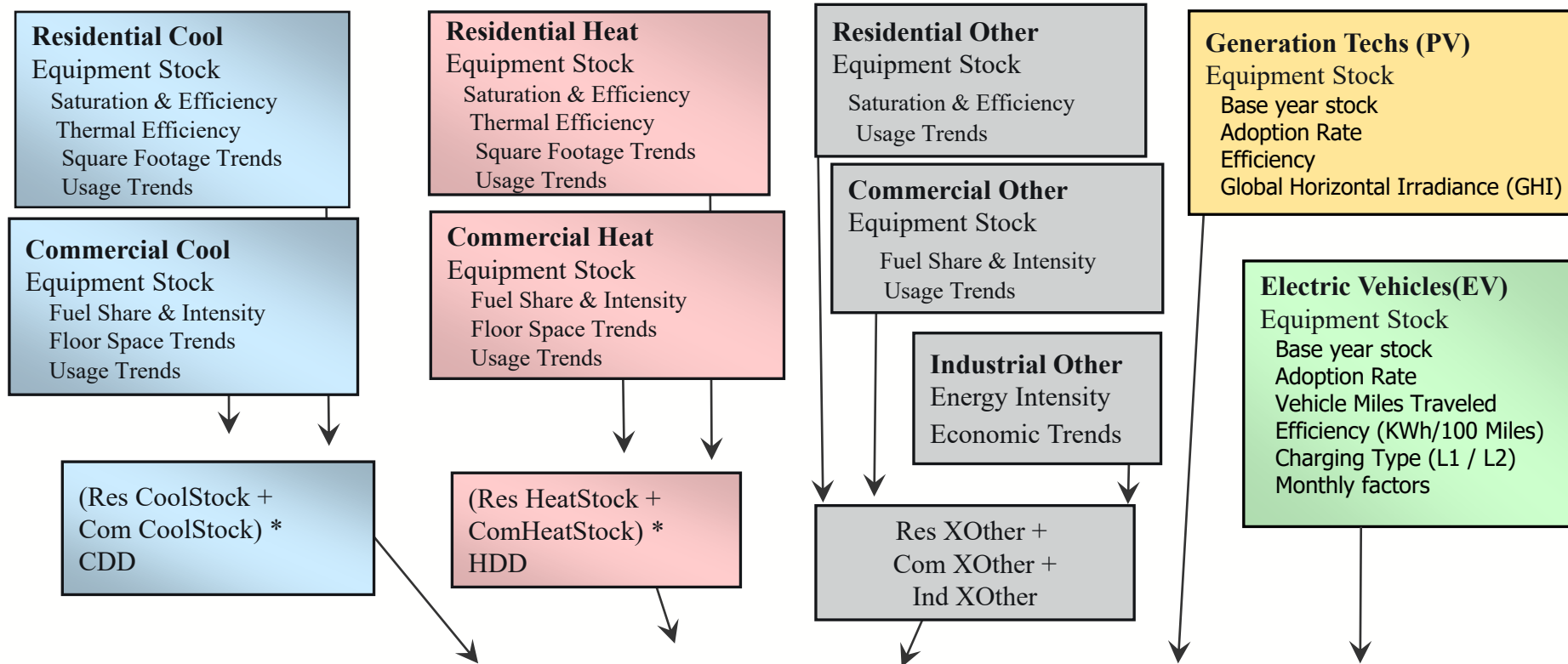
Working together to improve utility forecasting processes

Andy Sukenik, Itron
ESIG Load Forecasting Conference

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June 15, 2023

SAE Modeling Framework

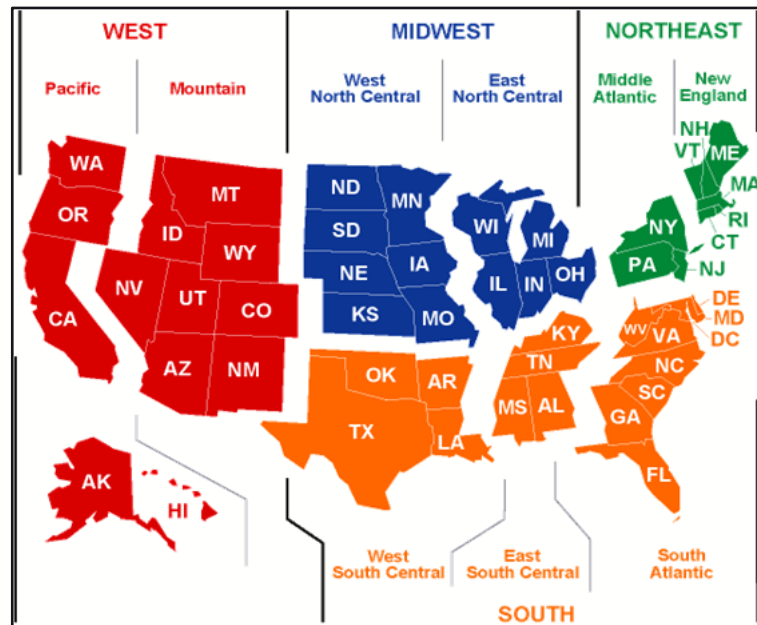


$$Energy_m = a + b_c \times XCool_m + b_h \times XHeat_m + b_o \times XOther_m - b_g \times GenTech_m + b_e \times EV_m + e_m$$

EIA Regional End Use Forecasts

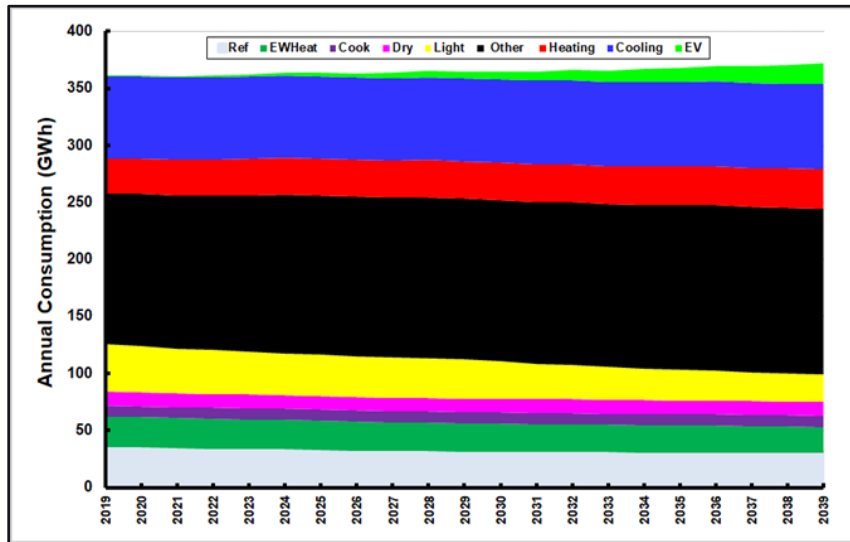
- » The U.S. Energy Information Administration develops a detailed end-use forecast for nine U.S. census divisions every year.
- » Each year, Itron mines the forecast database for:
 - Number of households
 - Number of appliances
 - End-use consumption
 - End-use saturations
 - End-use average stock efficiency
- » Residential
 - 3 housing types
 - 11 end-uses
- » Commercial
 - 11 building types
 - 10 end-uses

US Census Divisions



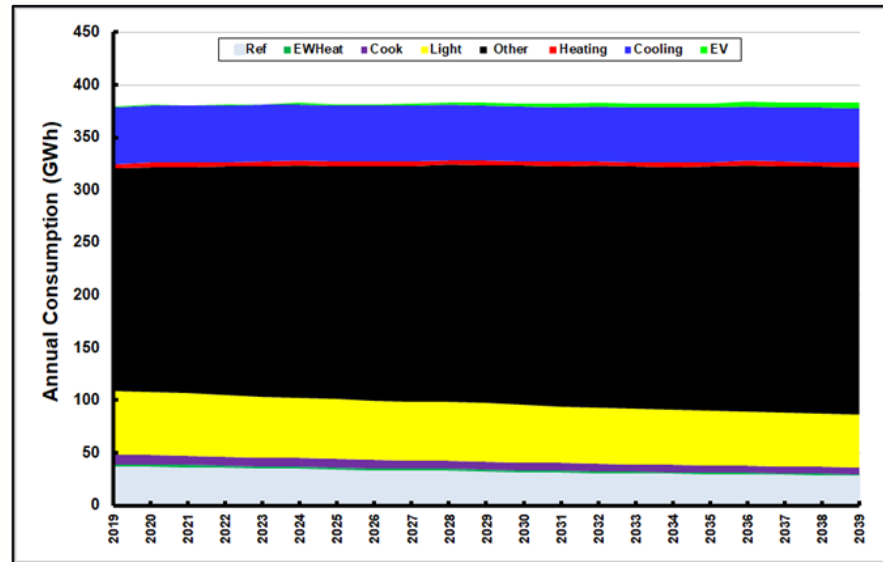
Annual End Use Forecasts

Residential



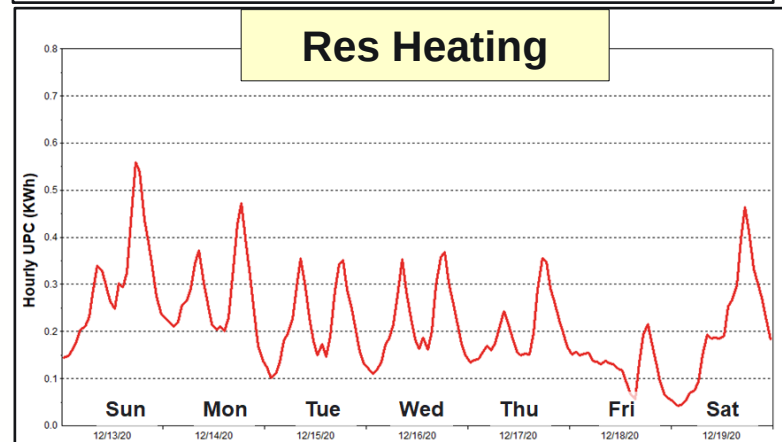
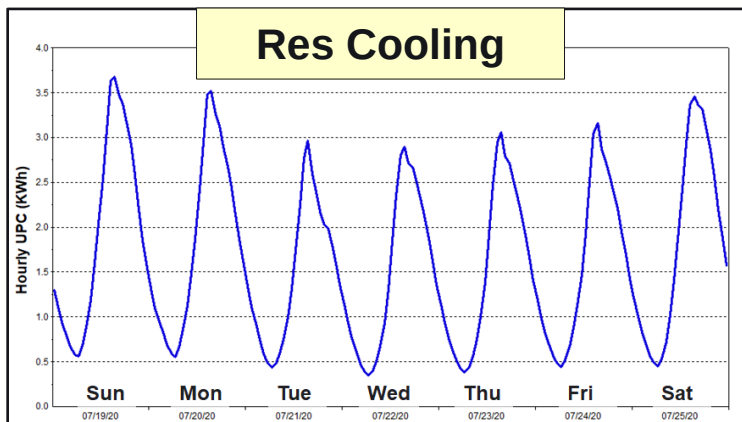
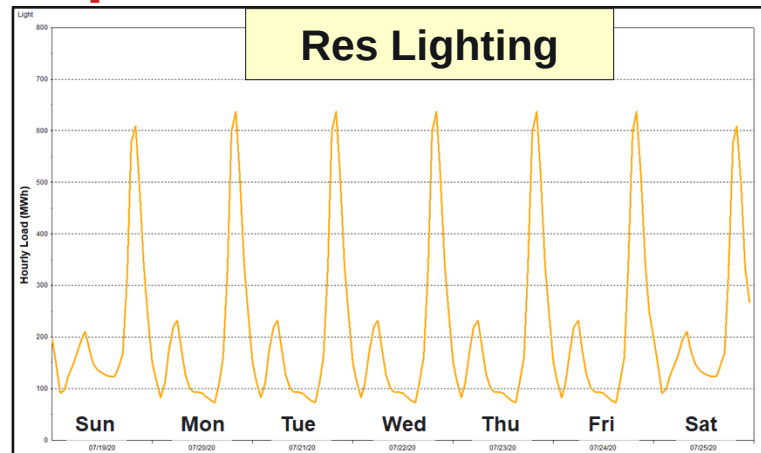
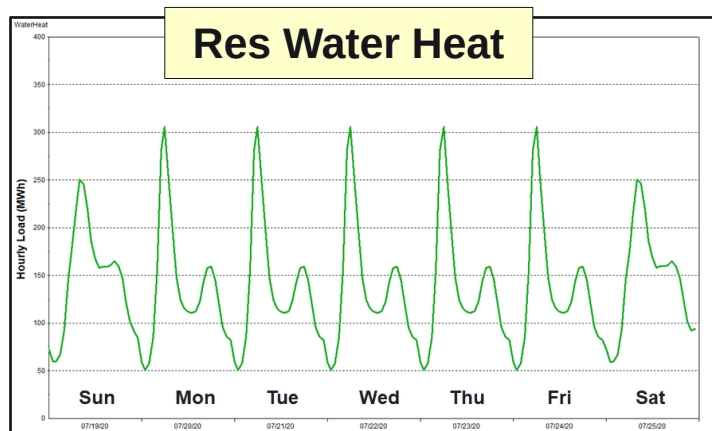
Residential End Use forecasts are applied their corresponding hourly profiles and scaled.

Commercial



Commercial End Use forecasts are applied their corresponding hourly profiles and scaled.

Residential End Use Shape examples



Areas for Improvement

- » Utilities must continue to maintain their models with localized data:
 - End Use Saturation, Efficiency, Unit Electric Consumption (UEC)
 - Integrate behavioral impacts driven by economics, price, and locational data to transition into the “new normal”.
 - Integrate New Technologies (Solar PV, Battery Storage, EVs)
 - Track Sector-level (Res, Com, Ind, Ag, etc.) forecasts daily using AMI data.

- » Building Electrification requires deeper end use segmentation into technologies and measures.

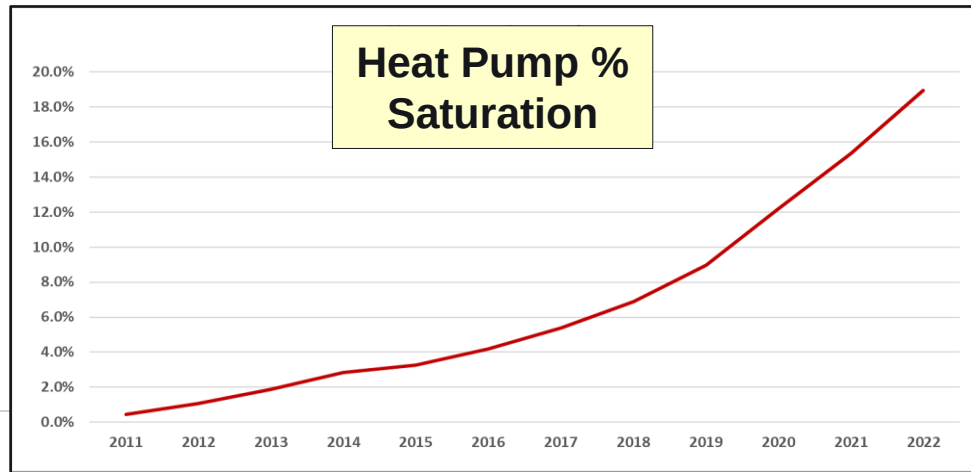
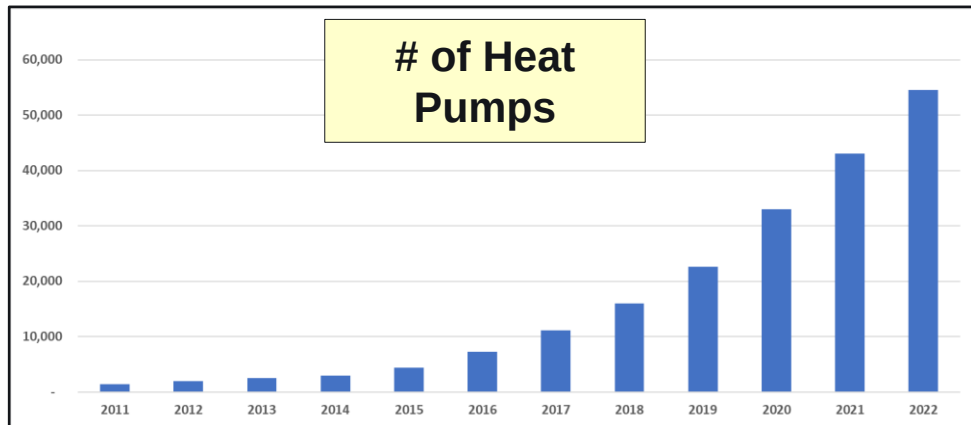
- » Transportation Electrification requires further segmentation.
 - Passenger Vehicles
 - Fleet Vehicles
 - Public Charging infrastructure

Building Electrification

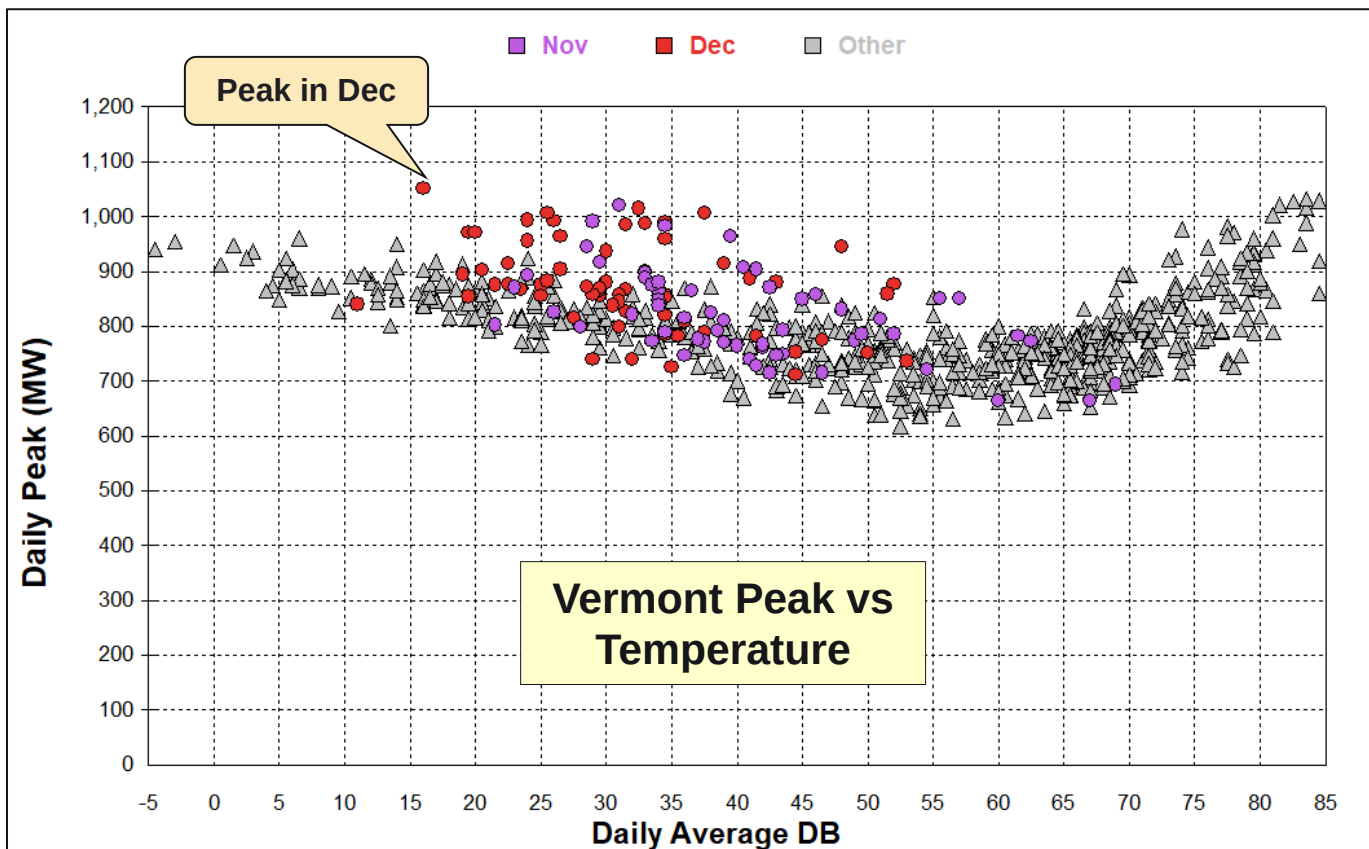
Heat Pump Market (Vermont Example)

» Approximately 55,000 installed heat pumps, equating to 17% saturation in 2022.

» Saturation increased from 5% to 17% in four years

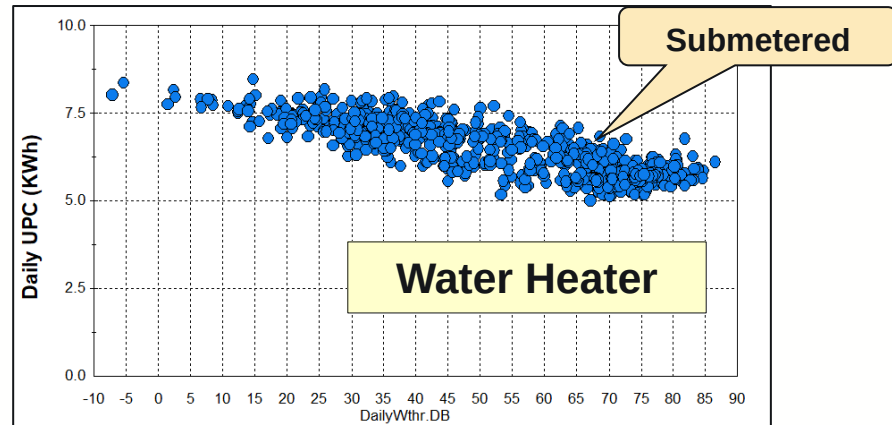
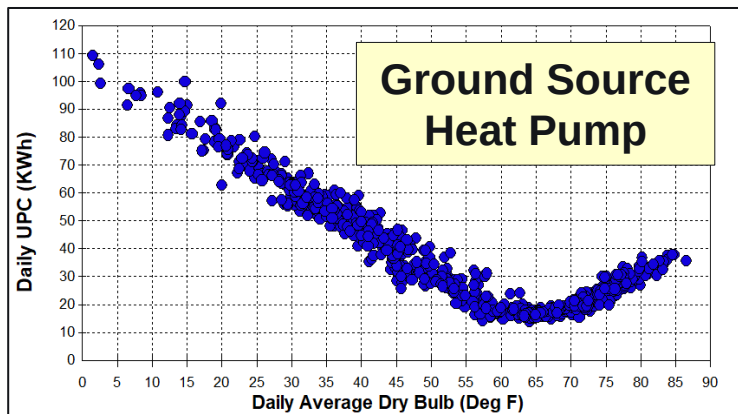
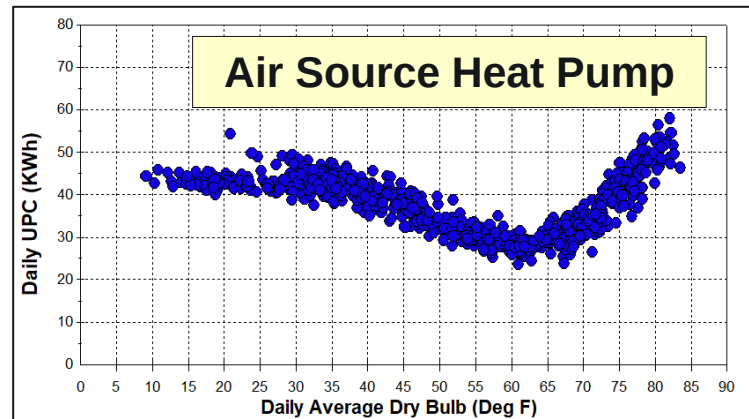
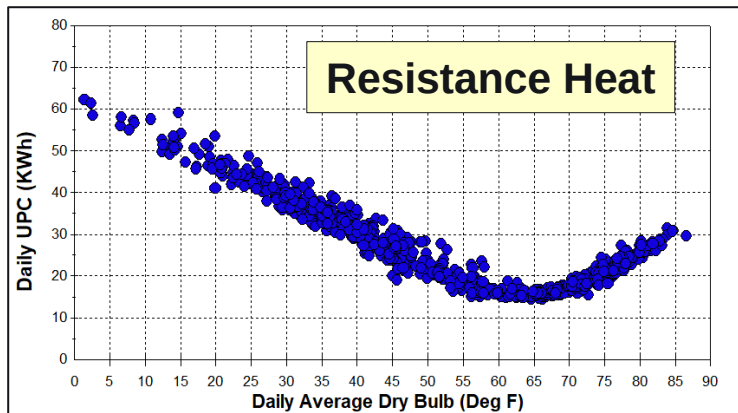


Building Electrification (Heat Pump Impacts)



Residential Heating Equipment Impacts

Use / Customer (KWh) vs Daily Average Dry Bulb Temperature (Deg F)



NREL ResStock & ComStock

End-Use Load Profiles for the U.S. Building Stock

- » End Use Load Profiles for the US Building Stock.
- » 1,000s–100,000s of statistically representative physics-based building energy models
- » DOE-funded, NREL-developed models of the U.S. building stock

	Commercial	Residential
Models Run (per weather year)	350,000 buildings	550,000 dwelling units
Representing	64% of U.S. commercial building stock per CBECS	137 million U.S. homes Excludes AK, HI, PR
Building Types	14	5
End Uses	19	49

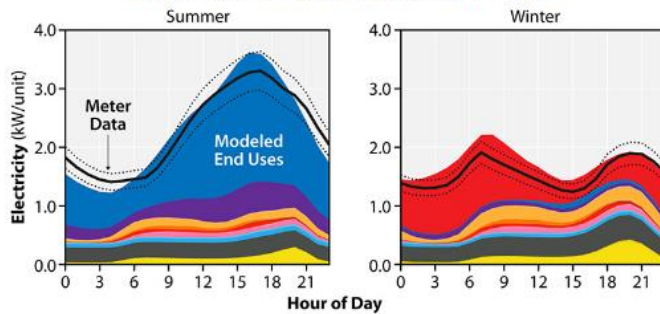
Foundational Dataset of ~1 Million End-Use Load Profiles for the U.S. Residential and Commercial Building Stock



Building stock models calibrated through 70+ model updates, supported by data:

- Electric load data from 11 utilities and 2.3 million meters
- 15 end-use metering datasets

Example: Texas Residential Load (modeled end-uses)



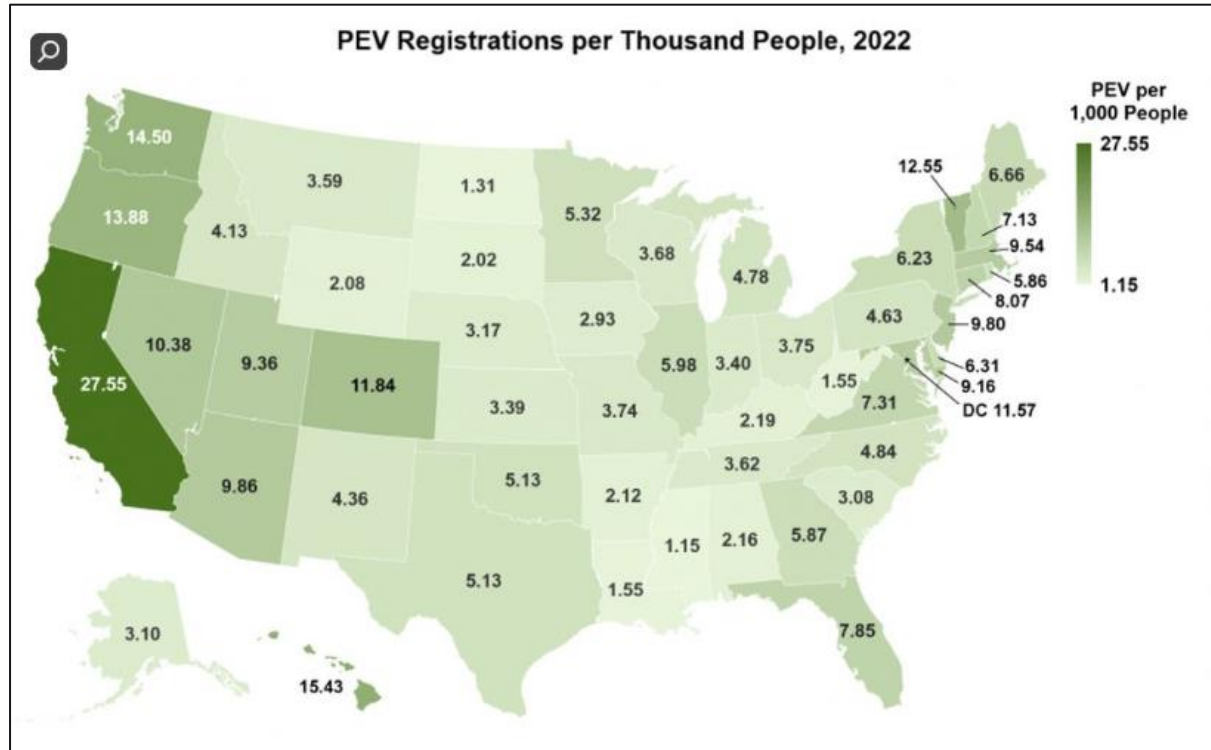
Res Stock: End Use Saving Shapes (EUSS)

- » Basic enclosure
- » Enhanced enclosure
- » Heat pumps, min-efficiency, electric backup
- » Heat pumps, high-efficiency, electric backup
- » Heat pumps, min-efficiency, existing heating as backup
- » Heat pump water heaters
- » Whole-home electrification, min-efficiency
- » Whole-home electrification, high efficiency
- » Whole-home electrification, high efficiency + basic enclosure package
- » Whole-home electrification, high efficiency + enhanced enclosure package

**Unique Shapes by
Building Electrification
measure**

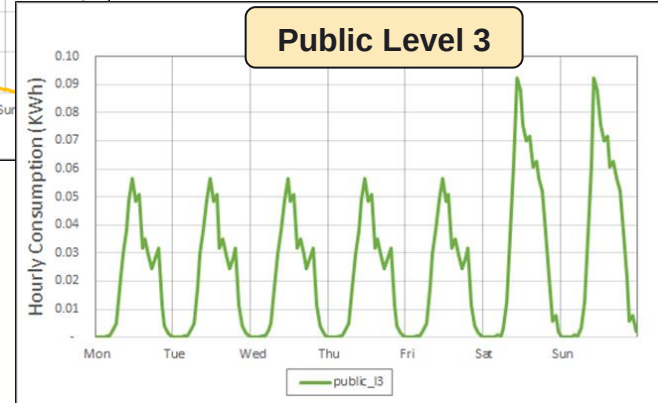
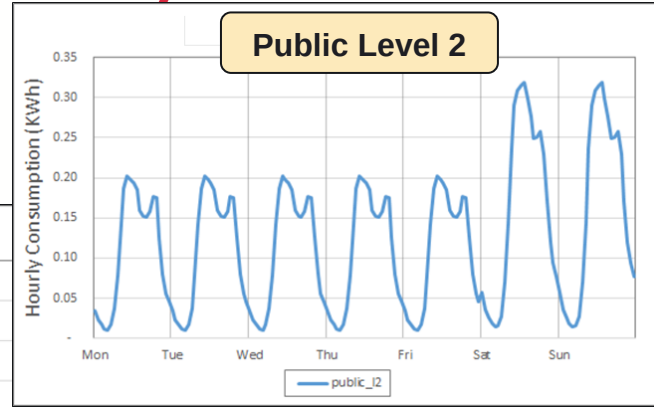
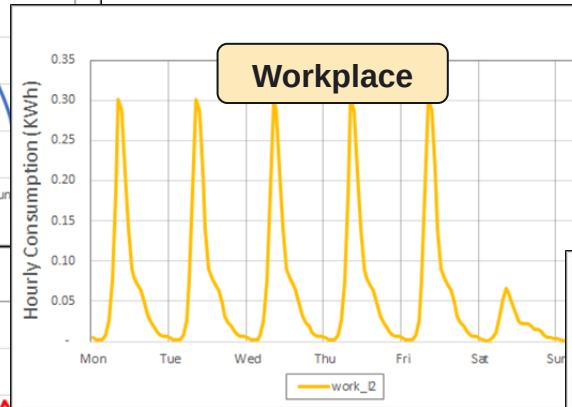
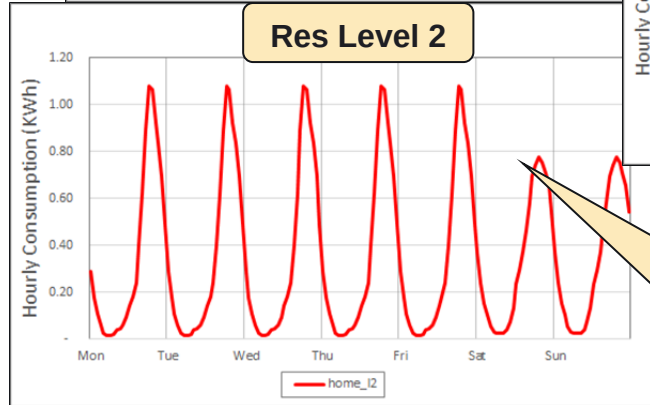
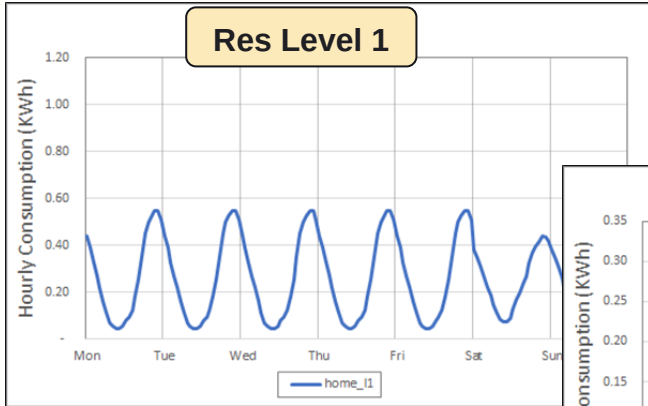
Electric Vehicles: Passenger Vehicles

EV Adoption rates vary across the country



Sources: Experian Automotive, Argonne National Laboratory, US Census Bureau

NREL / DOE EV Load Shapes (EVI-Pro Lite)



Charging Strategies

1. Immediate
2. Delay
3. Slow

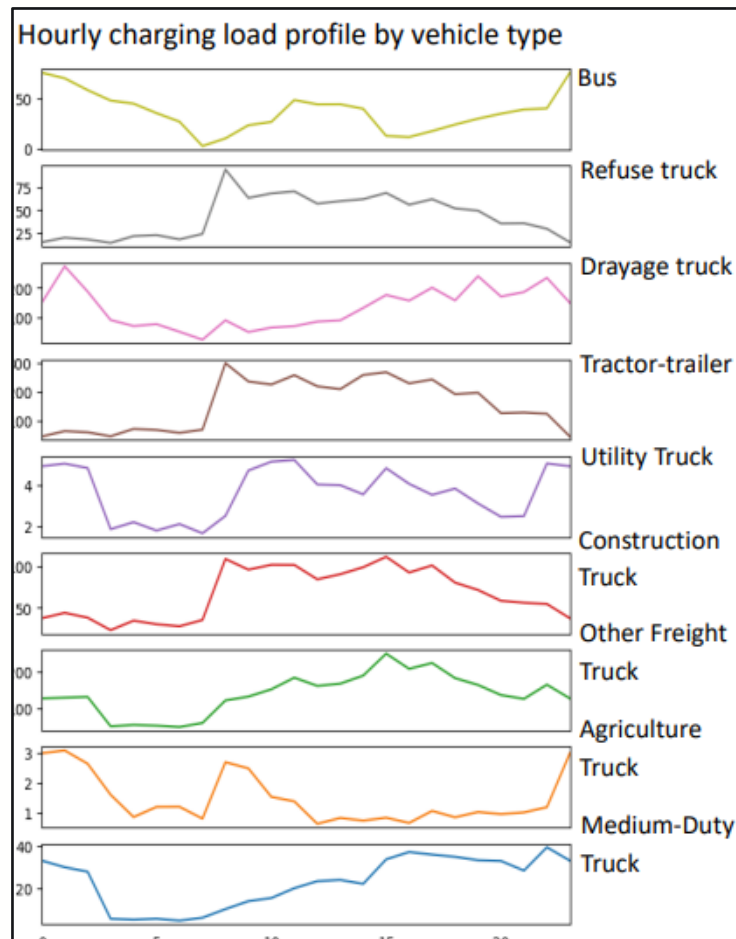
Electric Vehicles: Fleet Vehicles

Fleet Vehicle Electrification

- » Fleet data are available in California, but not in other parts of the country.
- » Utilities must identify where the current fleets exist (ICE, Diesel, Electric)
 - » Top 50 customers are well monitored.
 - » Medium – Large Customer fleets must be identified and mapped to the distribution network.
- » Identify the type of fleet and their electrification plans with the goal of approximating Vehicle Miles Traveled (VMT)
 - » Light-Duty Sedan
 - » Medium-Duty Truck
 - » Agriculture Truck
 - » Construction Truck
 - » Utility Truck
 - » Tractor-Trailer
 - » Drayage Truck
 - » Bus

EV Fleet Shapes

- » EV Fleet Shape data are limited.
- » Lawrence Berkeley National Labs (LBNL) HEAVY-LOAD application produces shapes.
- » There are shapes available by Fleet segment on the California Energy Commission website.



Source: CEC [Medium and Heavy-Duty Vehicle Load Shapes \(ca.gov\)](https://www.energy.ca.gov/vehiclesandmodes/medium-and-heavy-duty-vehicle-load-shapes)



CONTACT US

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