Working together to improve utility forecasting processes

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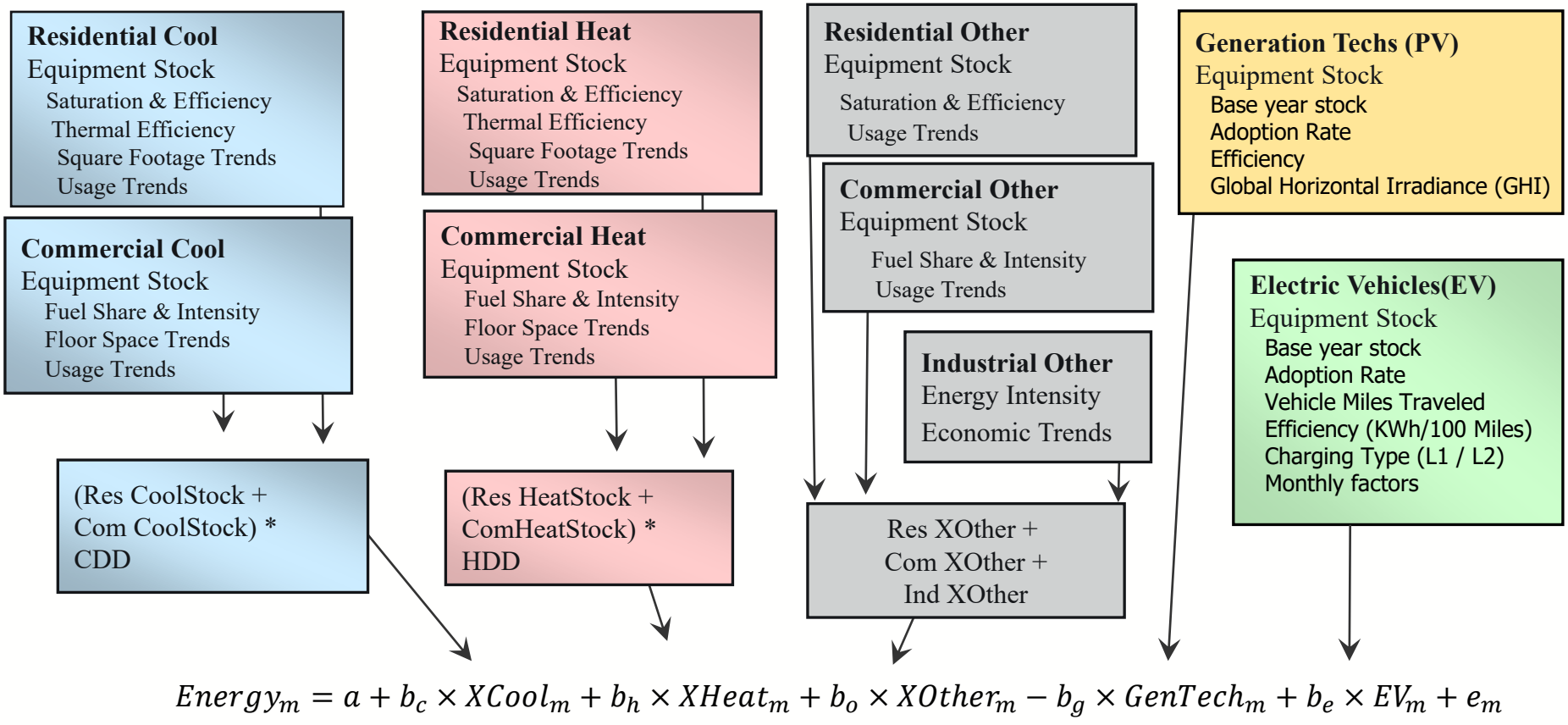
ESIG Load Forecasting Conference

June 15, 2023

SAE Modeling Framework

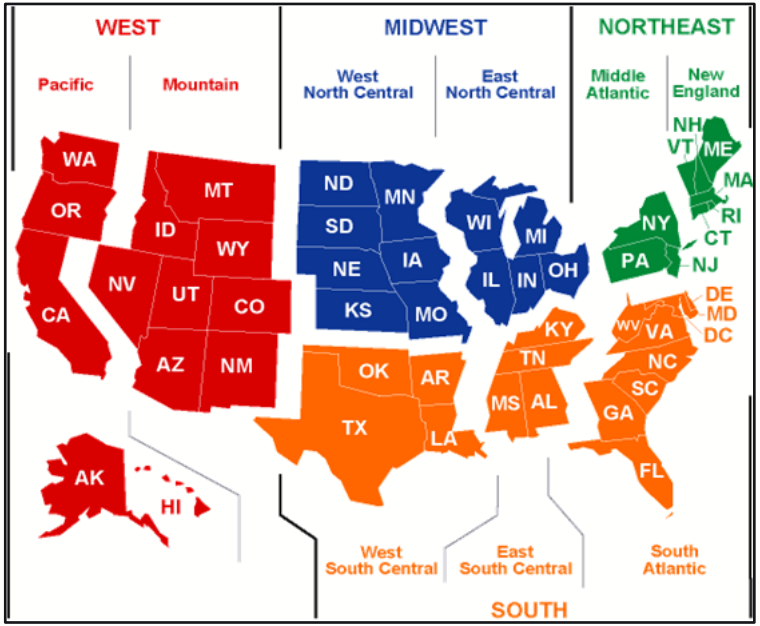


$$Energy_m = a + b_c \times XCool_m + b_h \times XHeat_m + b_o \times XOther_m - b_g \times GenTech_m + b_e \times EV_m + e_m$$

EIA Regional End Use Forecasts

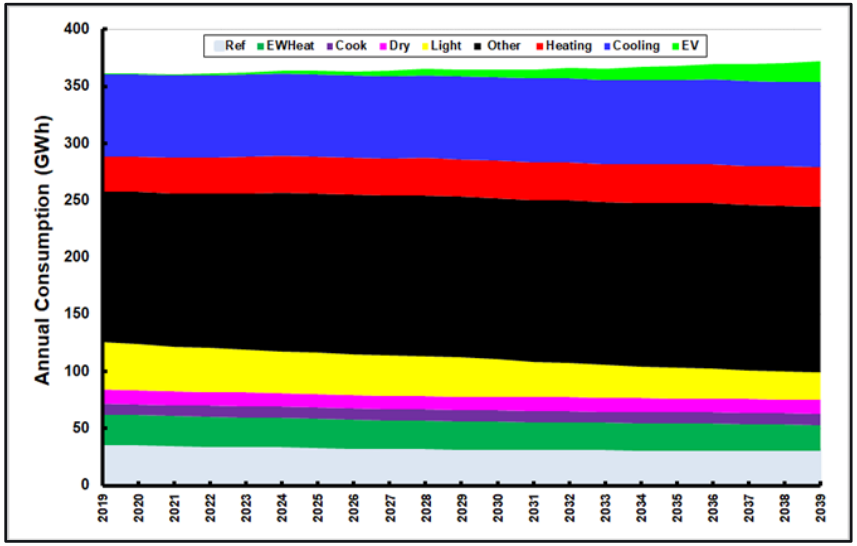
- The U.S. Energy Information Administration develops a detailed end-use forecast for nine U.S. census divisions every year.
- Each year, Itron mines the forecast database for:
  - Number of households
  - Number of appliances
  - End-use consumption
  - End-use saturations
  - End-use average stock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

US Census Divisions



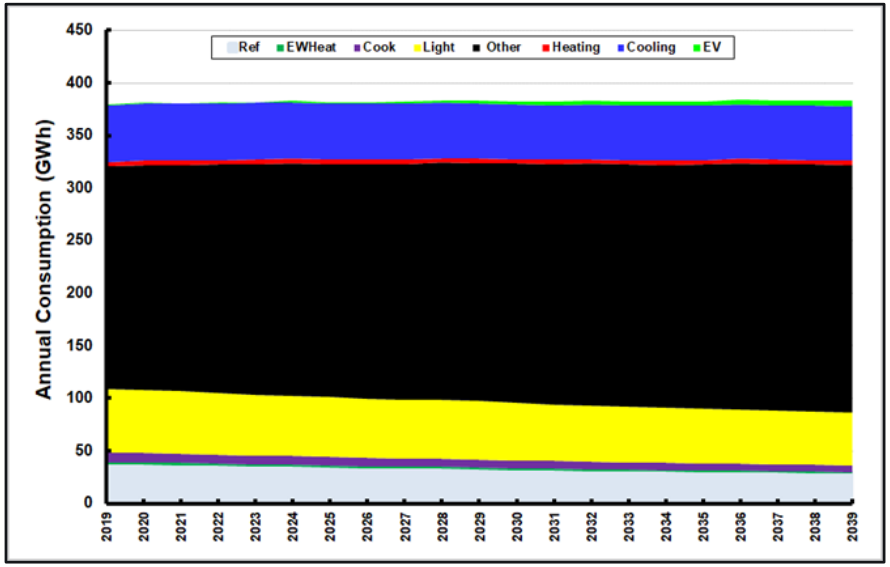
Annual End Use Forecasts

Residential



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

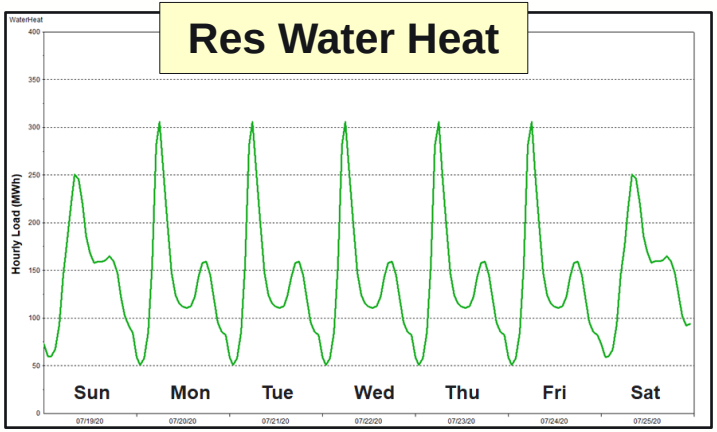
Commercial



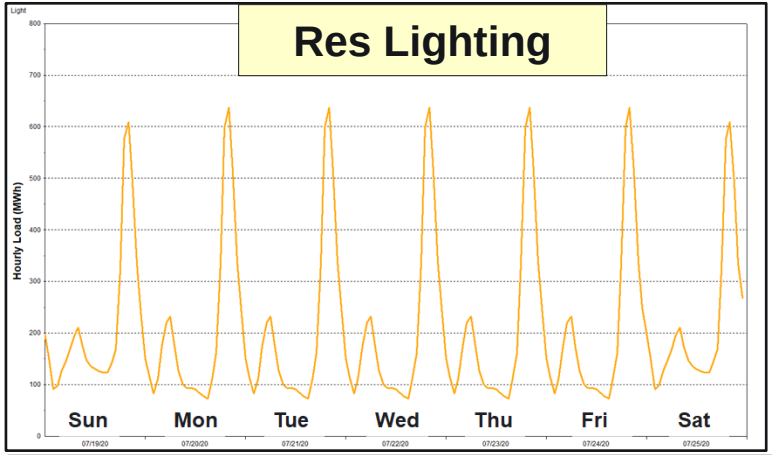
Commercial End Use forecasts are applied their corresponding hourly profiles and scaled.

Residential End Use Shape examples

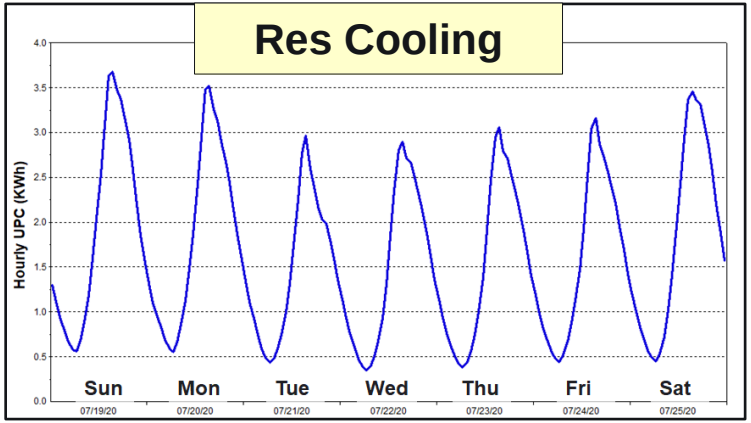
Res Water Heat



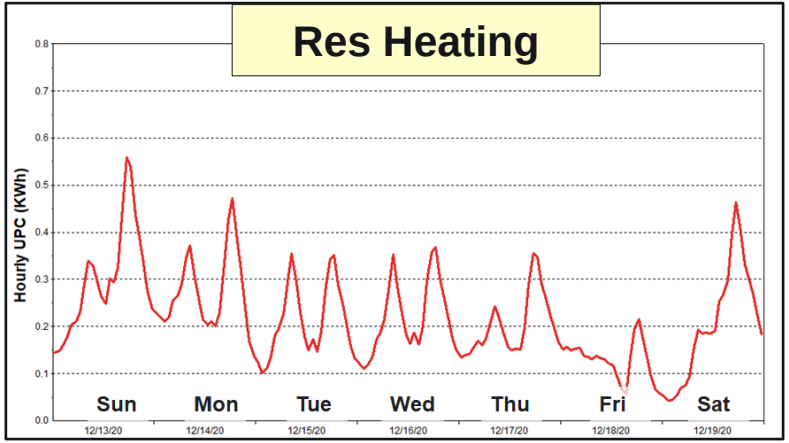
Res Lighting



Res Cooling



Res Heating



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.

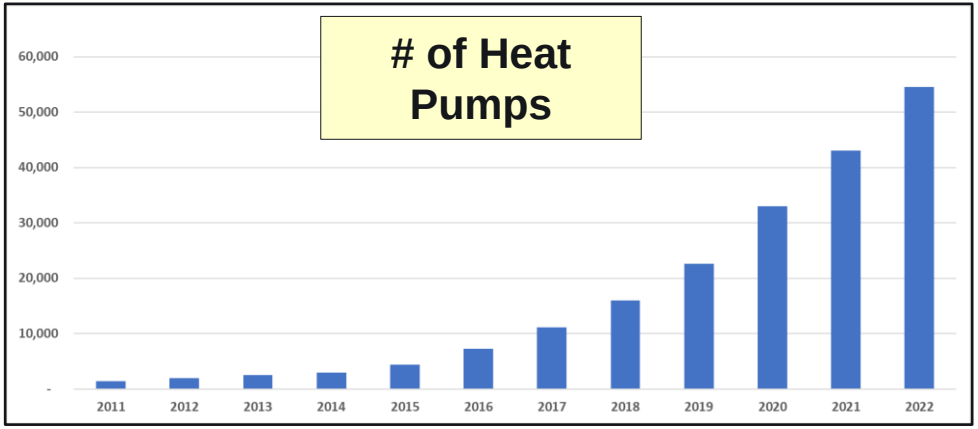
- Building Electrification requires deeper end use segmentation into technologies and measures.

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

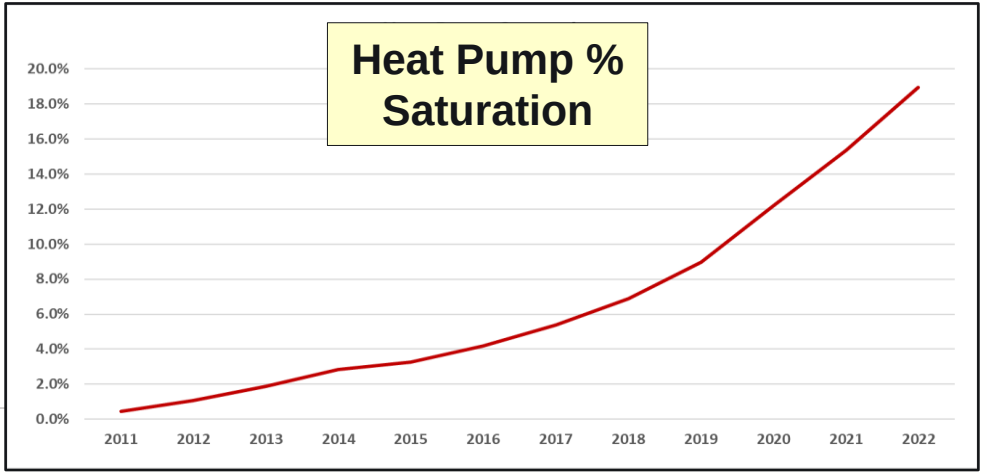
Building Electrification

Heat Pump Market (Vermont Example)

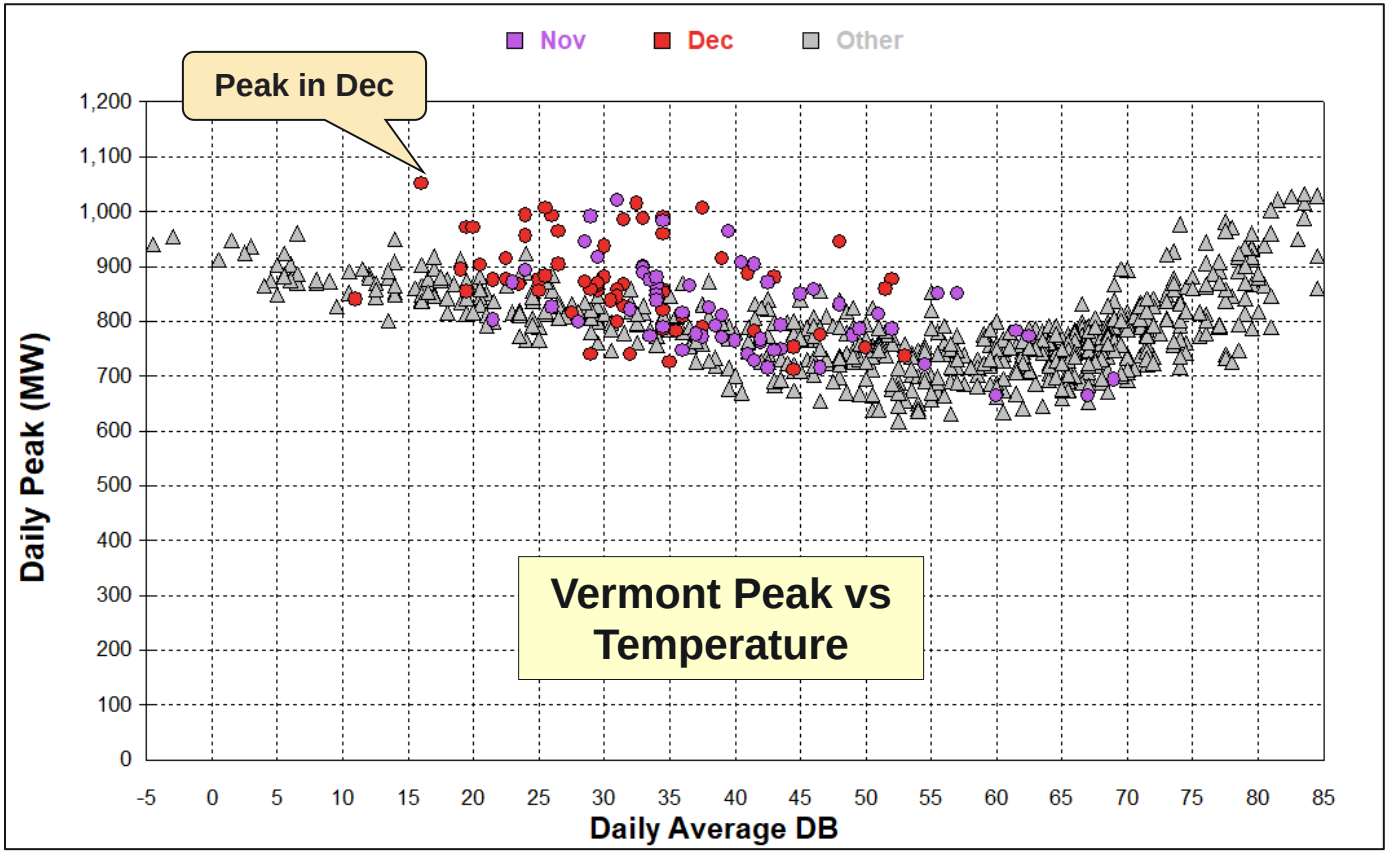
- Approximately 55,000 installed heat pumps, equating to 17% saturation in 2022.



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

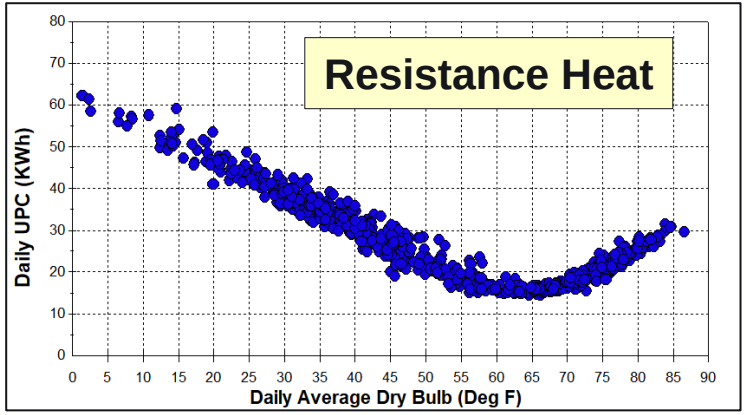


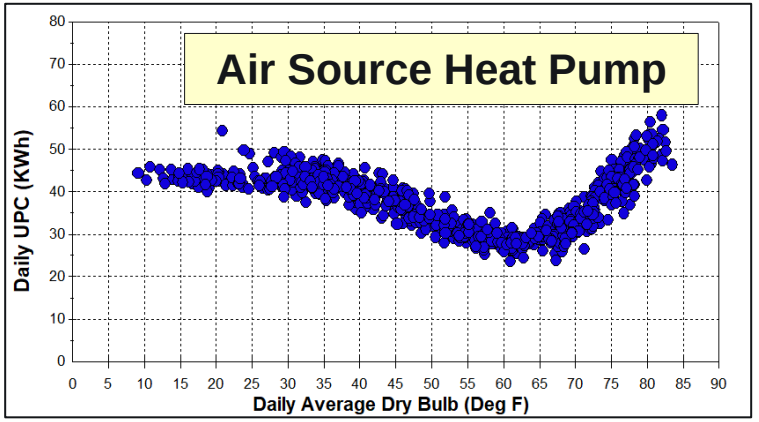
Building Electrification (Heat Pump Impacts)

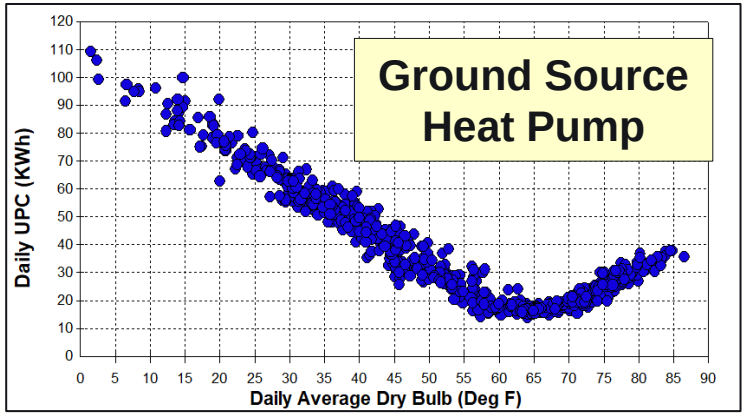


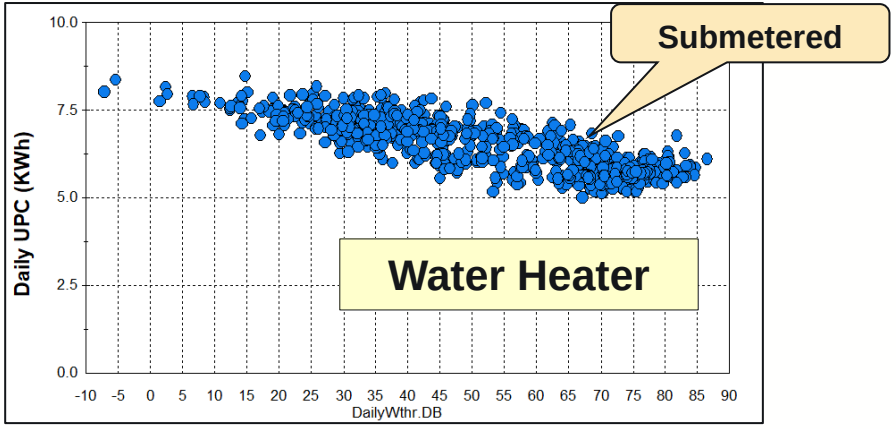
Residential Heating Equipment Impacts

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







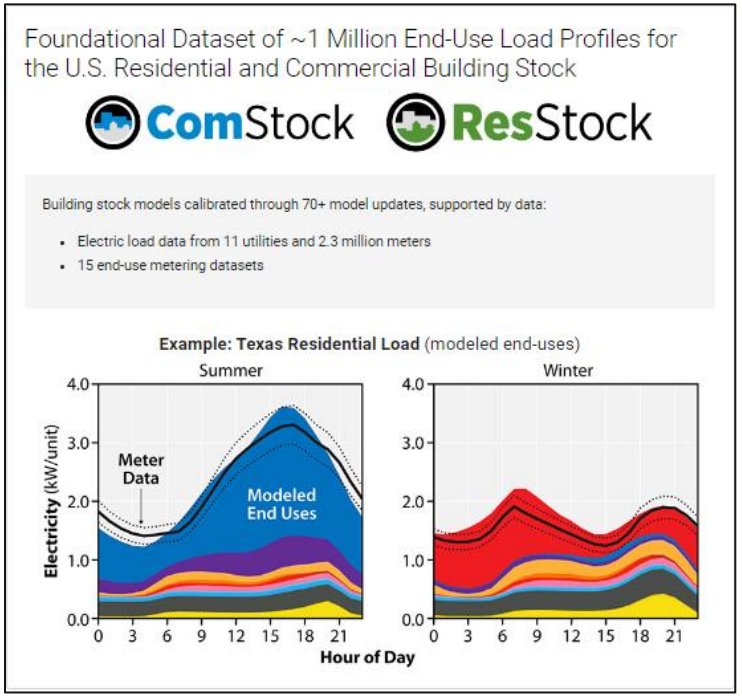


NREL ResStock & ComStock

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



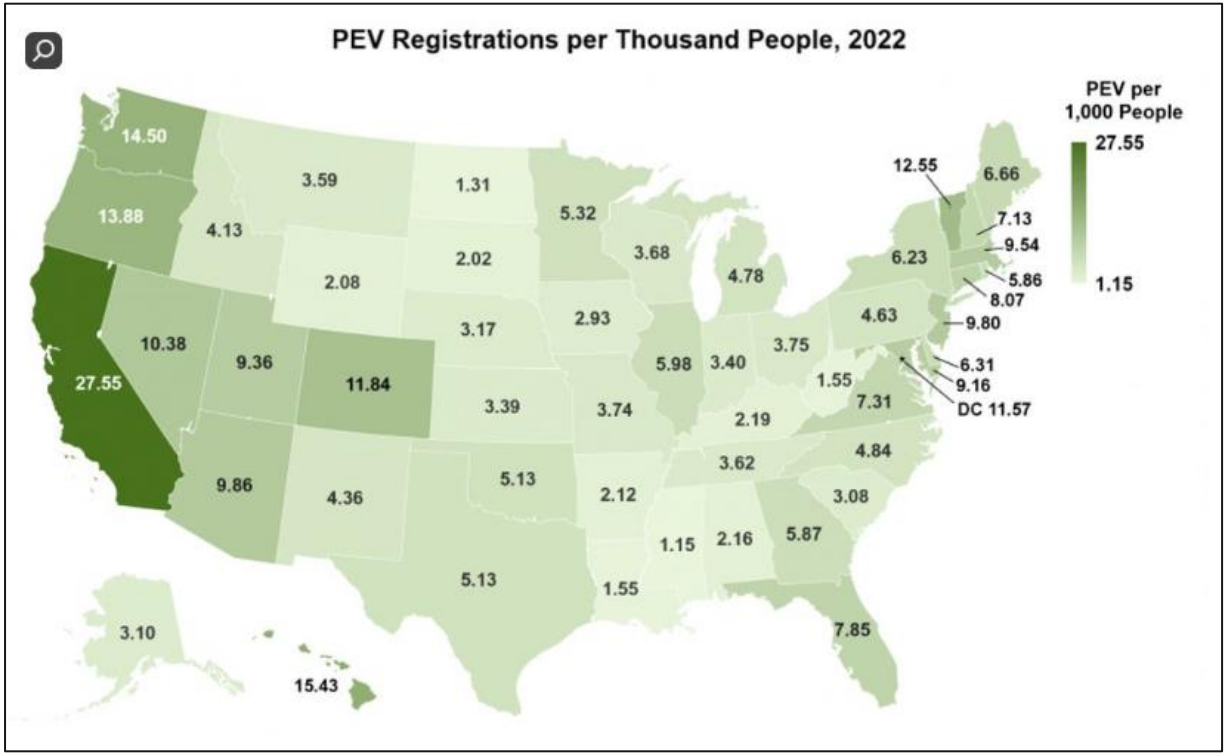
Res Stock: End Use Saving Shapes (EUSS)

- 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

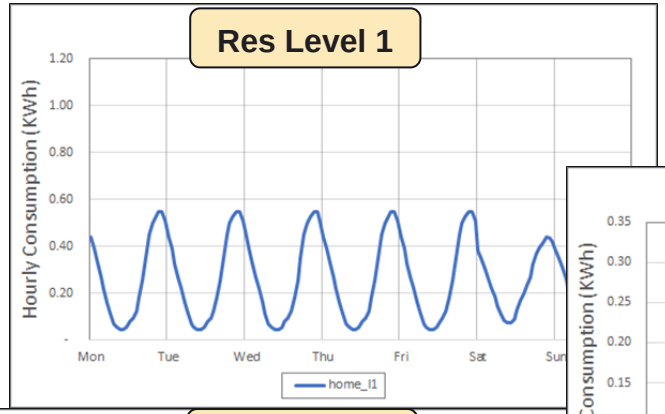
Electric Vehicles: Passenger Vehicles

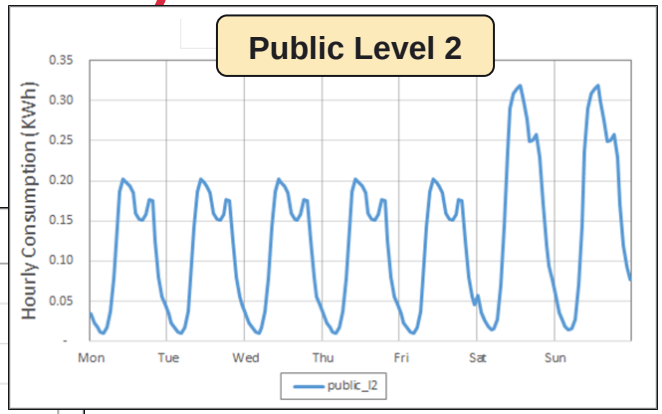
EV Adoption rates vary across the country

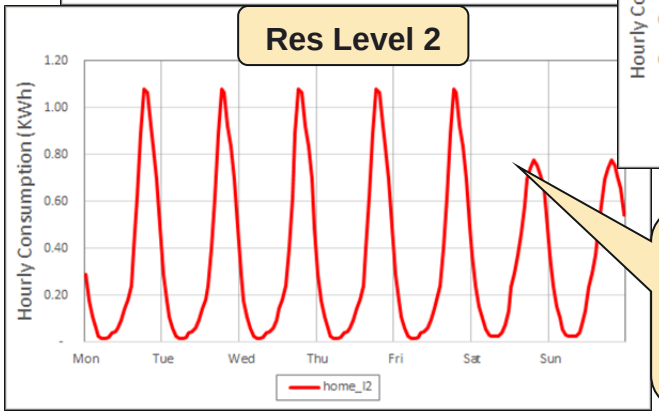


Sources: Experian Automotive, Argonne National Laboratory, US Census Bureau

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

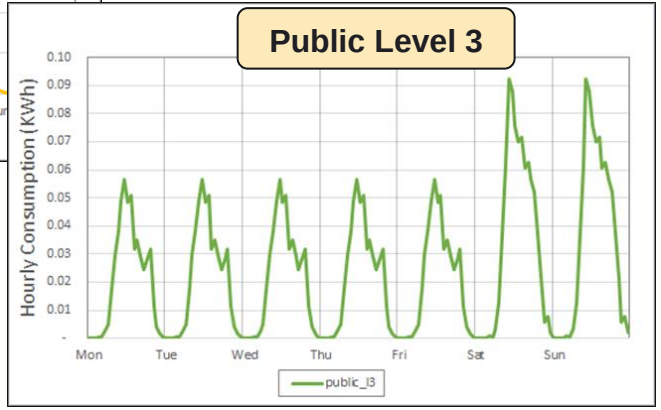






Charging Strategies

1. Immediate
2. Delay
3. Slow



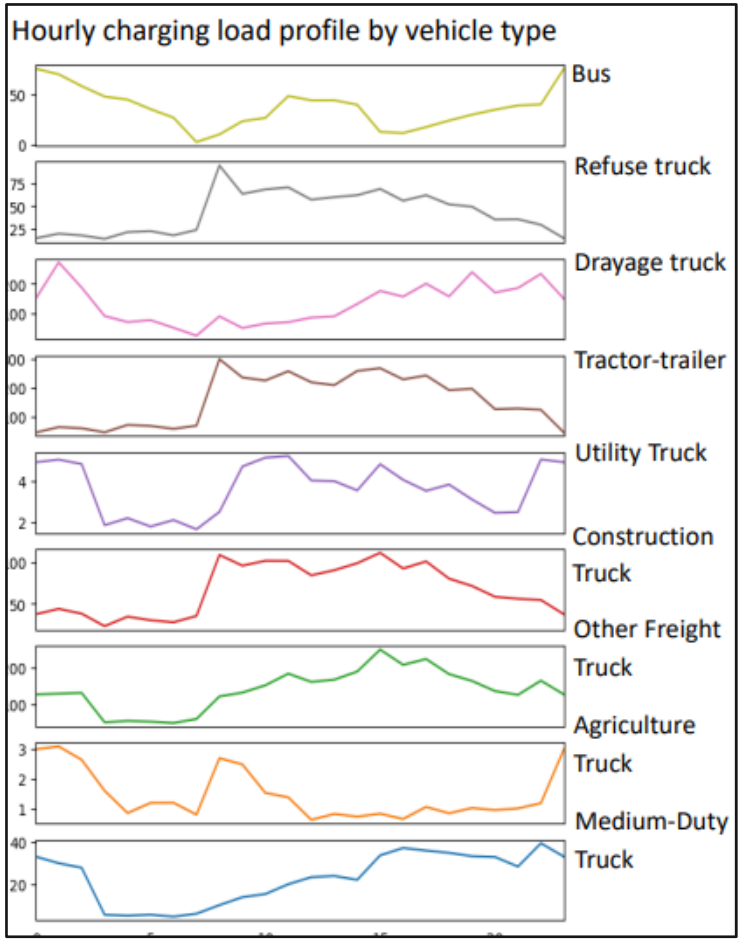
Electric Vehicles: Fleet Vehicles

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)]

CONTACT US

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