

The background of the slide is an aerial photograph of a large solar farm. The solar panels are arranged in neat, parallel rows on a grassy field. The surrounding landscape is lush and green, with rolling hills, dense forests, and a few scattered buildings in the distance. The sky is bright with some light clouds.

Vermont Long-Term Forecast Overview and Inputs

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Agenda

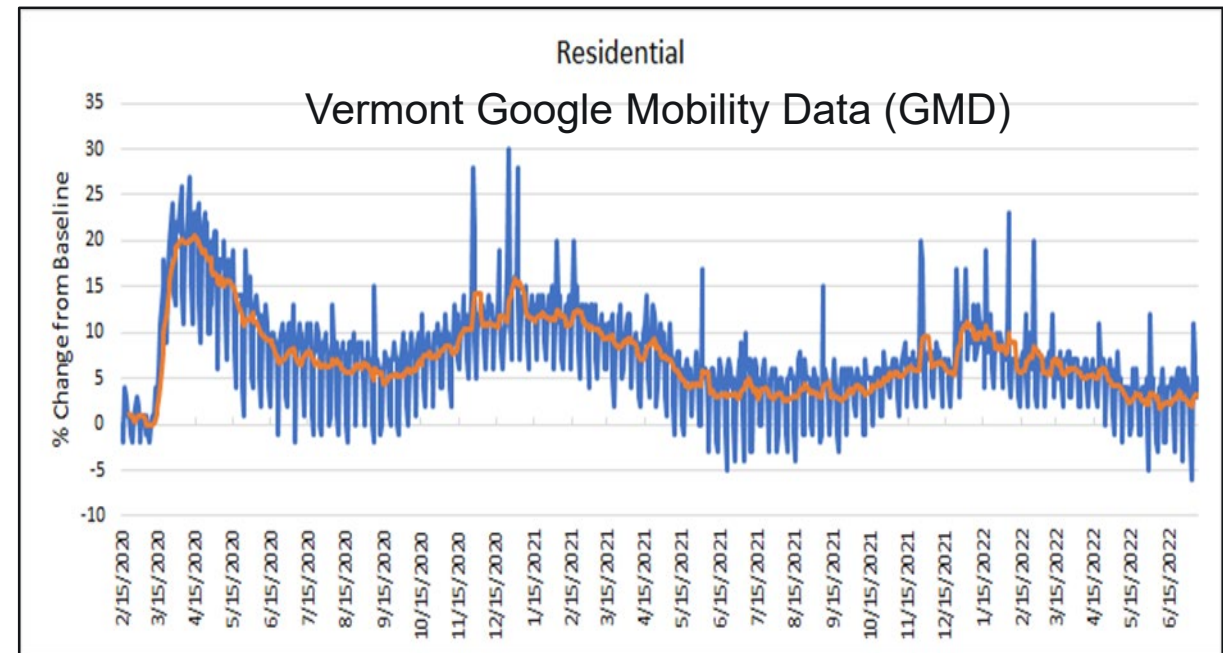
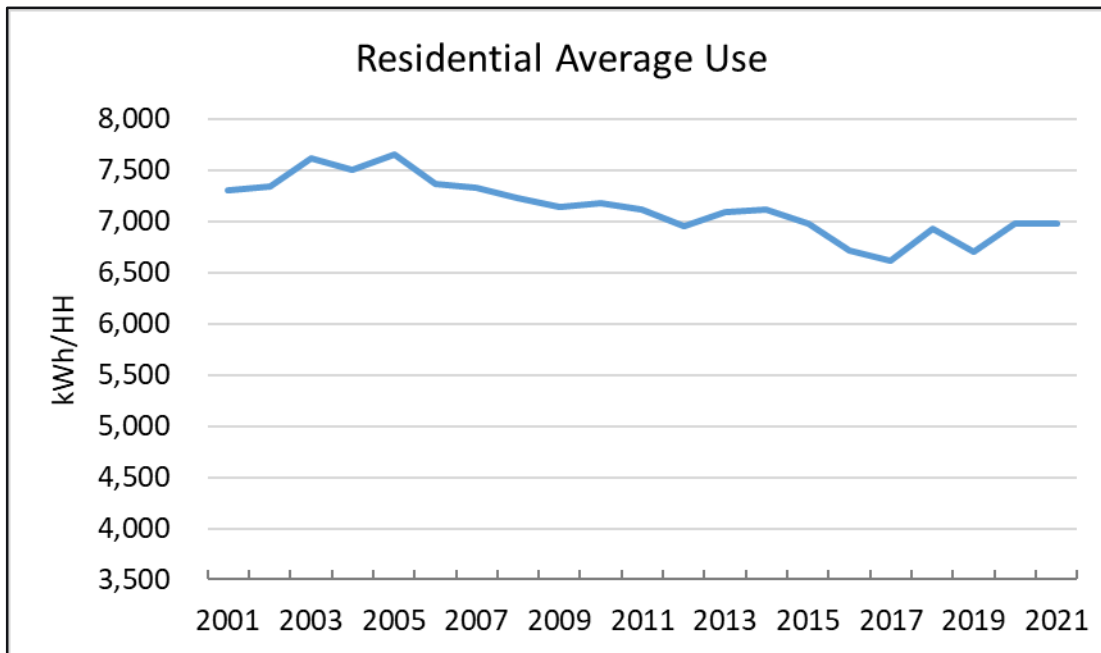
- » Sales Trends
- » Model Overview
- » Data Requirements and Sources
 - Identifying the experts
- » Climate Action Plan
 - Electrification technology focus
- » Effort Focus for 2022



Sales and Economic Trends

Residential Use

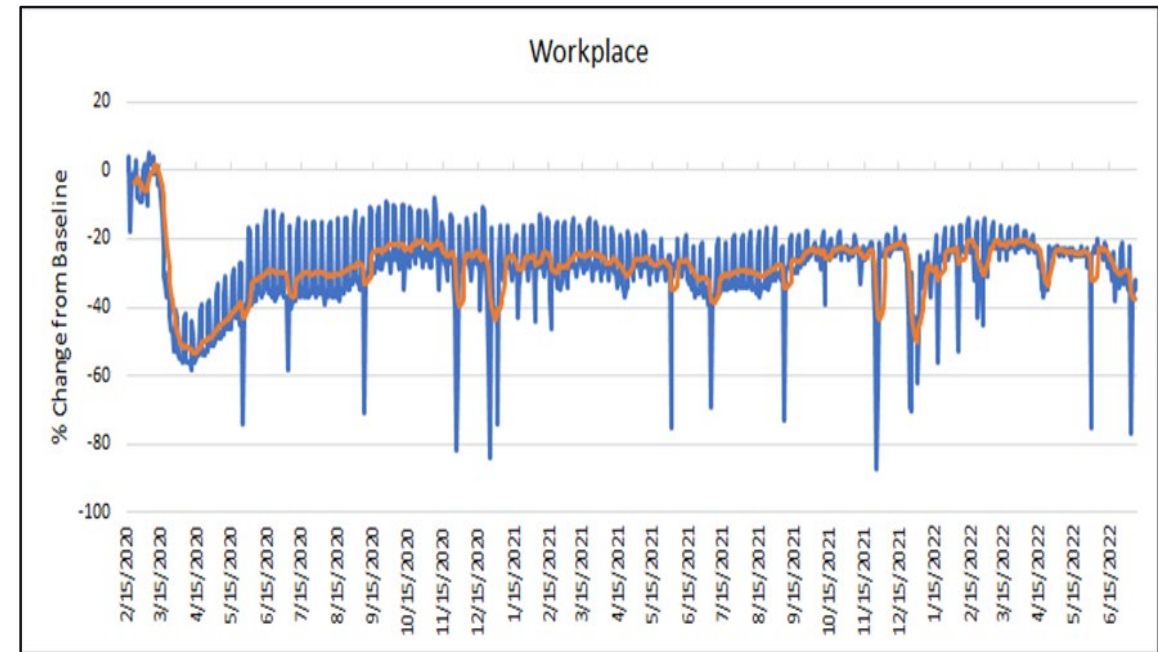
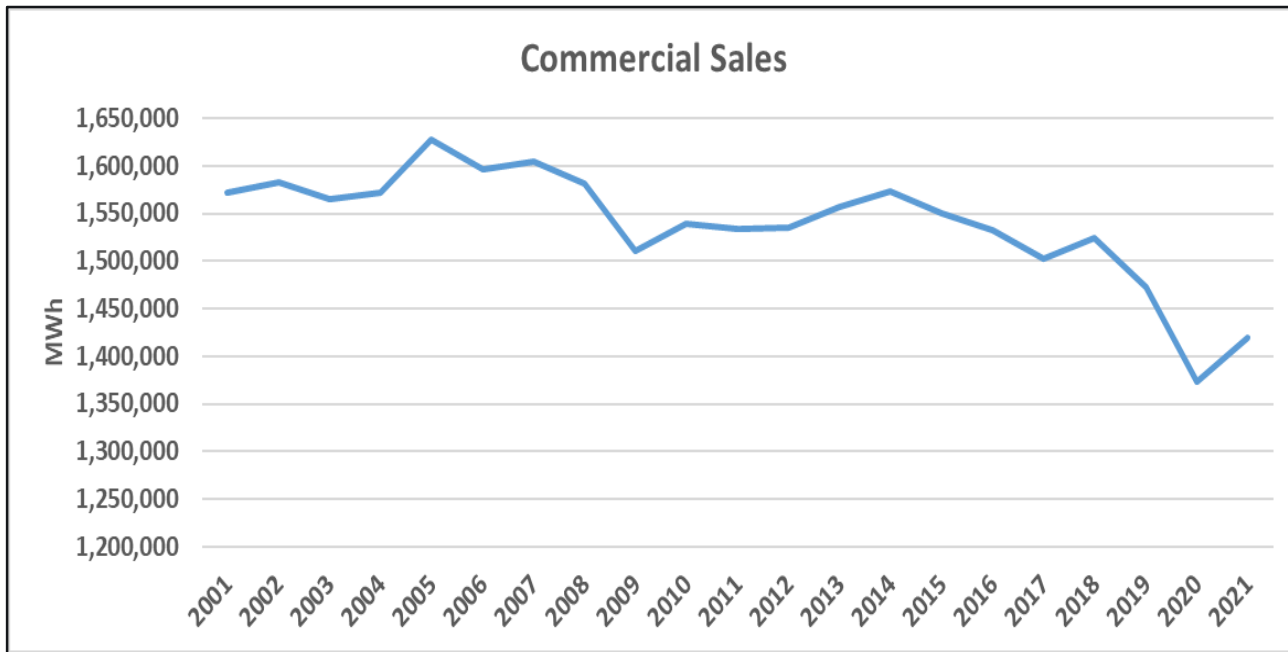
- » Since 2001, average use has been declining 0.2% per year, but appears to have leveled out at round 7,000 kWh. Between 2016 and 2019, average use declined 1.0% per year.
- Continued work at home, likely holding usage up. GMD still above Feb 2020 level.



Tracks cell phone activity, Feb 2020 is the reference point

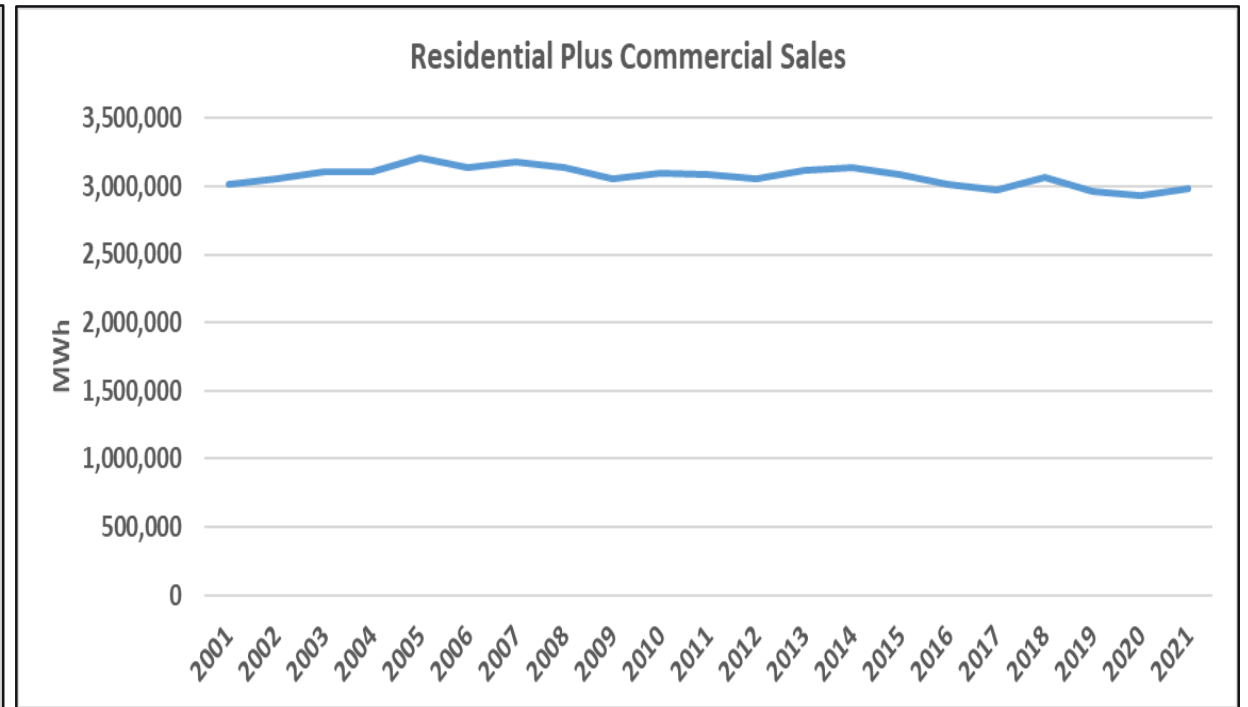
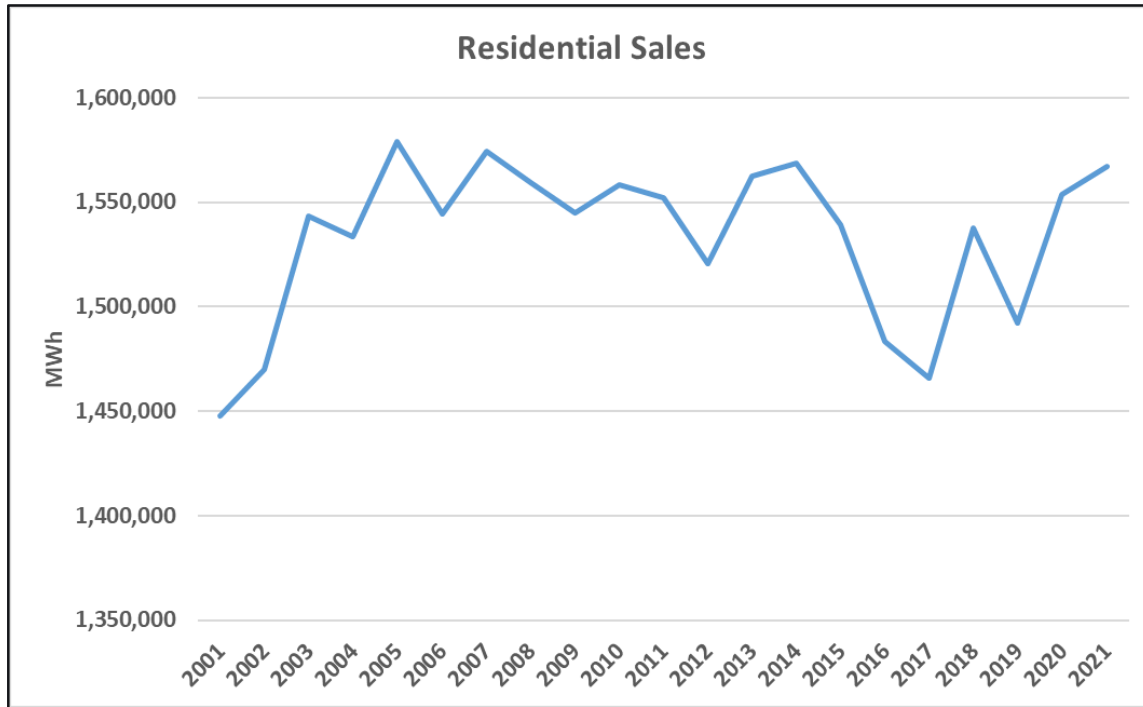
Commercial Sales

- » Large decline in sales starting in 2019. Commercial sales declining 0.4% per year Pre-Covid19. Opposite of residential, Workplace GMD still below 0.



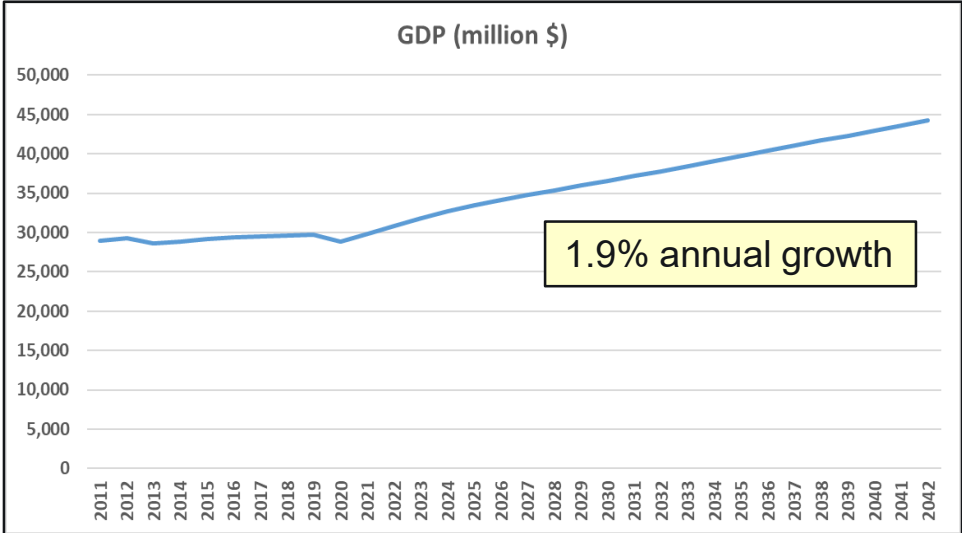
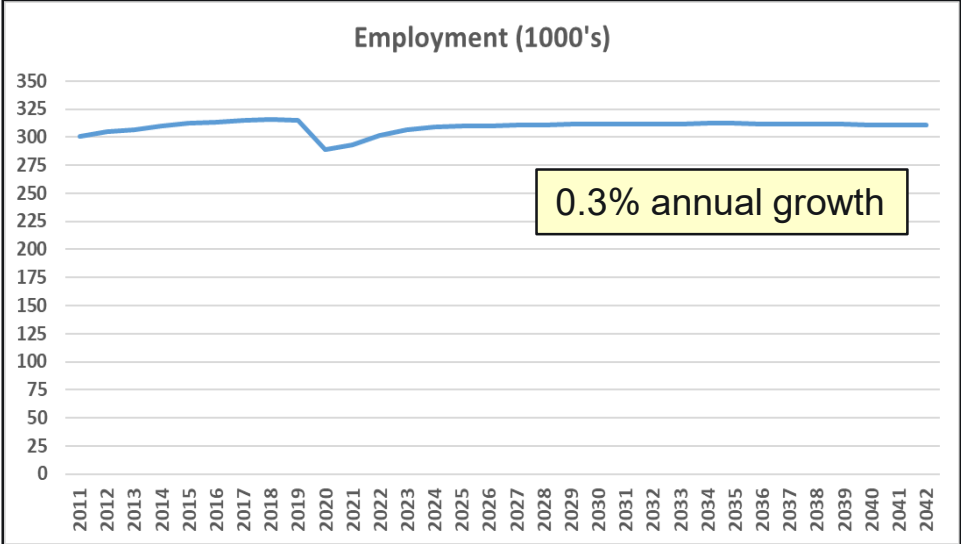
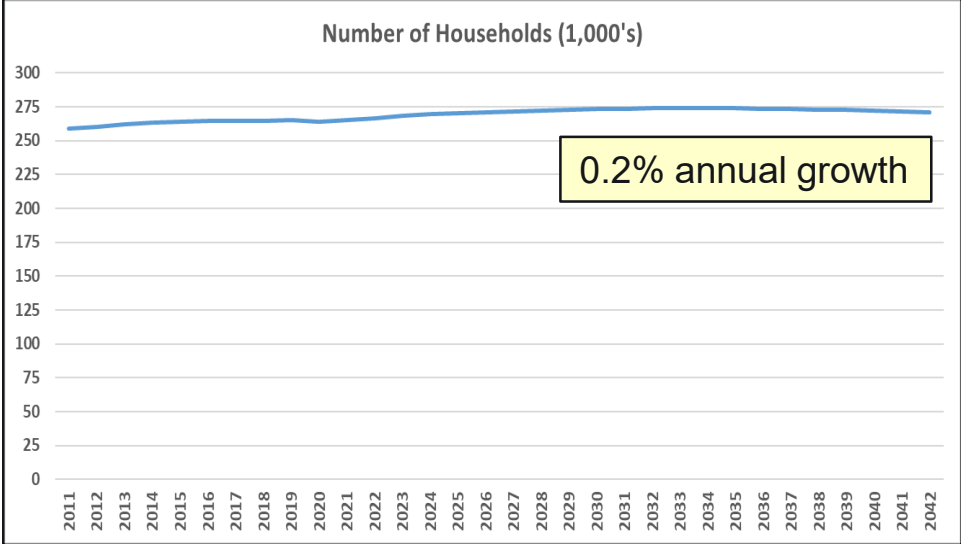
Residential and Total Sales

- » Decline in commercial sales matched by increase in residential sales
- » Net impact of COVID19 is neutral



Expected Long-Term Economic Growth

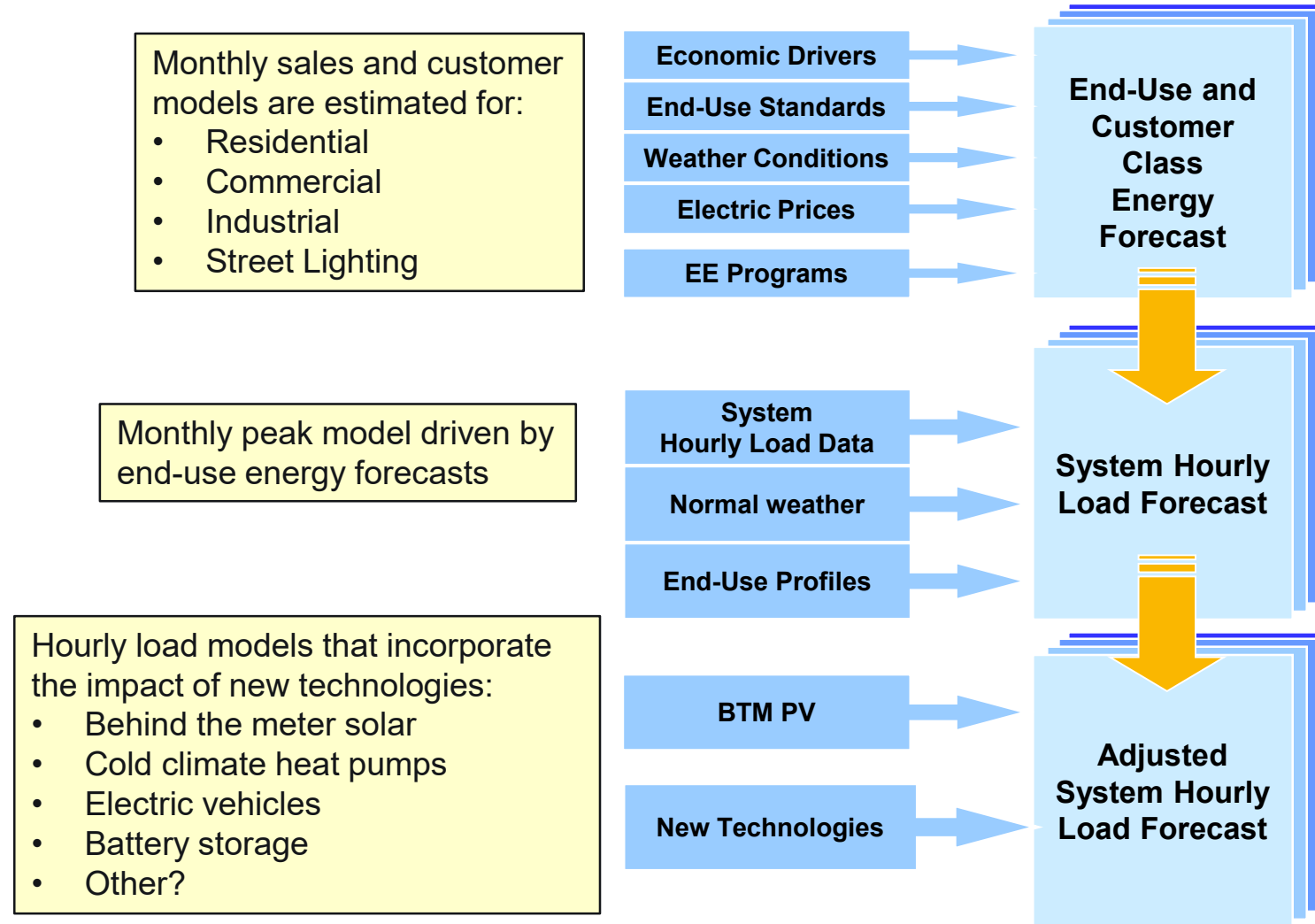
Moody Analytics January 2022 Forecast



Relatively slow population and economic growth

Model Overview

SYSTEM FORECASTING MODEL BOTTOM-UP APPROACH

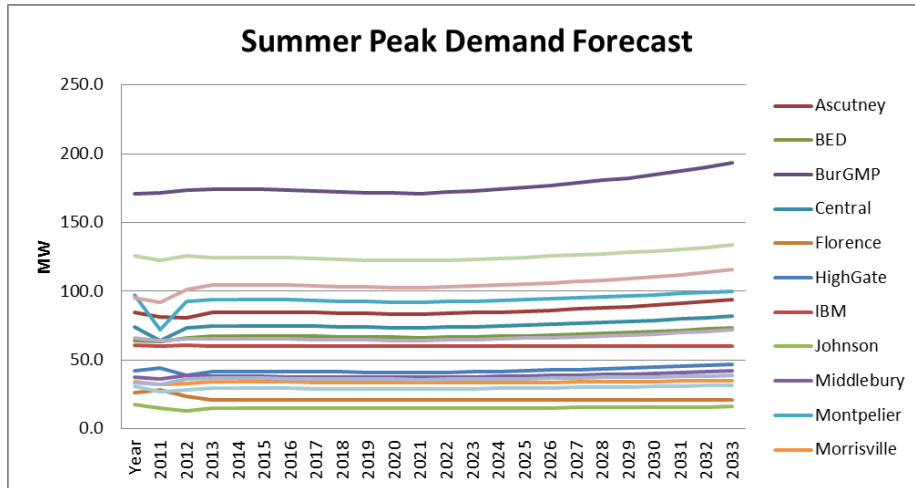
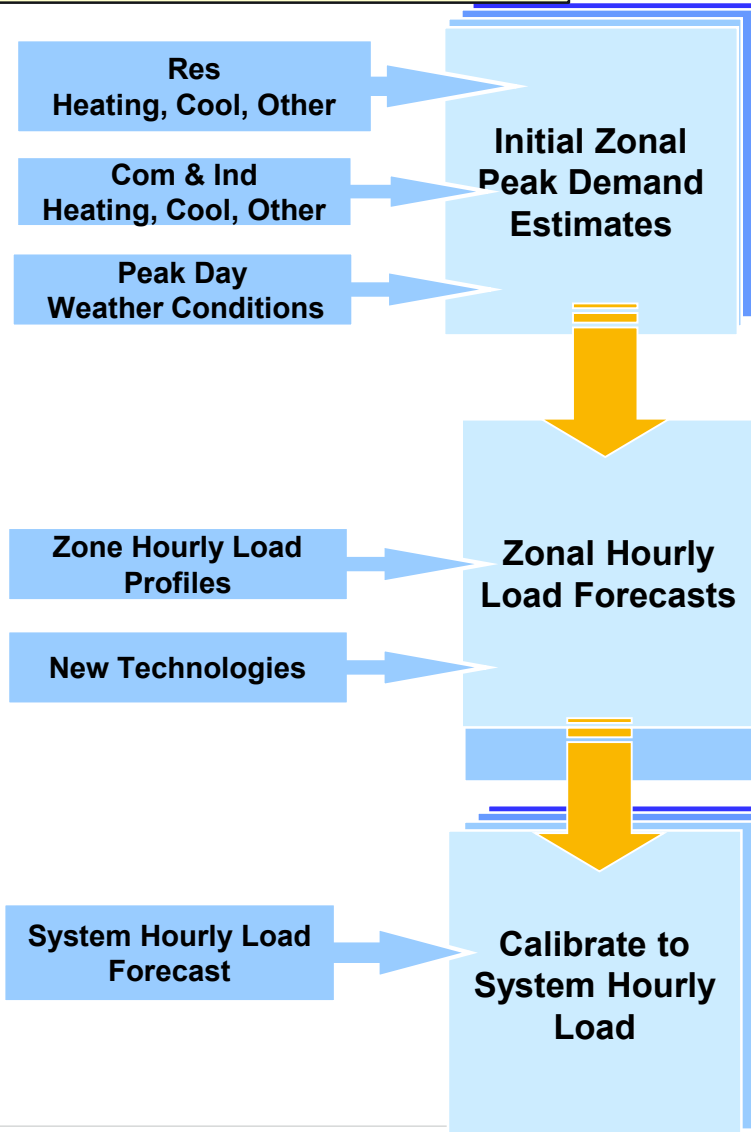


TOP-LEVEL ZONAL LOAD FORECAST

Demand forecasts developed for 16 planning areas

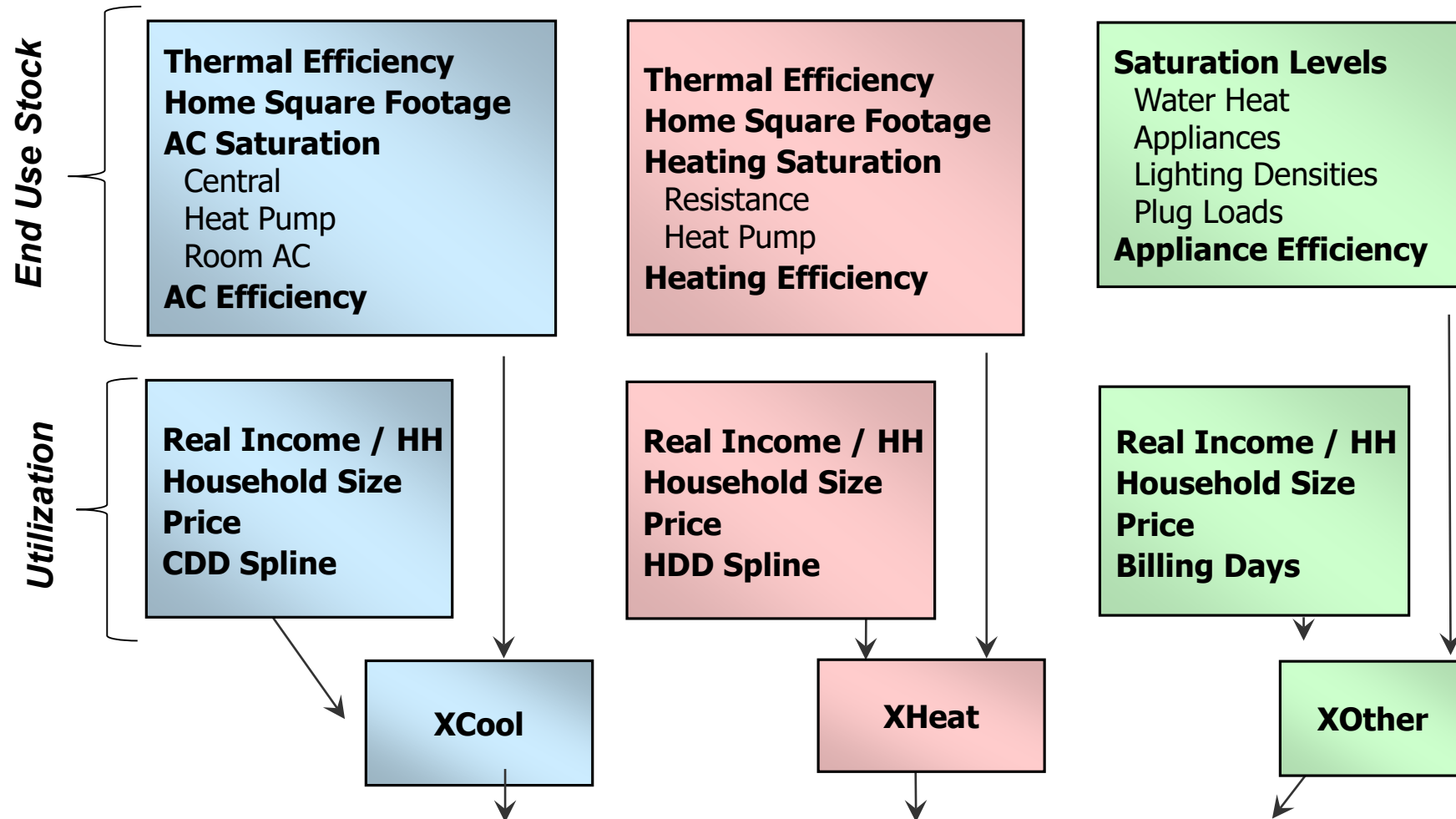
Based on zone-level economic data series

Sectors weights based on estimated customer mix (i.e., res, com, industrial)



8,760 hourly load forecast for each zone

Start at the Rate Class Level of Detail (Residential Model)



$$AvgUse_m = a + b_c \times XCool_m + b_h \times XHeat_m + b_o \times XOther_m + e_m$$

Estimate monthly model with historical Use / Customer data

End-Use Variable – Cooling

$$XCool_{y,m} = CoolEqpy \times CoolUse_{y,m}$$

End-Use
Stock

$$CoolEqpy = Structural Index_y \times \sum_{Type} EI_{2015}^{Type} \times \frac{\left(\frac{Sat_y^{Type}}{Eff_y^{Type}} \right)}{\left(\frac{Sat_{2015}^{Type}}{Eff_{2015}^{Type}} \right)}$$

kWh per
household

Utilization

$$CoolUse_{y,m} = \left(\frac{HHSize_{y,m}}{HHSize_{2015}} \right)^a \times \left(\frac{HHIncome_{y,m}}{HHIncome_{2015}} \right)^b \times \left(\frac{RPrice_{y,m}}{RPrice_{2015}} \right)^c \times CDD_{y,m}$$

The Ingredients

Data Input for the Baseline Load Forecast

1. System hourly load (reconstituted for solar generation and interruptible loads), Source: VELCO
2. Monthly customer and sales data, Source: EIA/state utilities
 - Residential, commercial, industrial, street lighting
3. Economic and demographic drivers, Source: Moody Analytics and Woods & Poole
 - Variables: population, number of households, state and regional output, employment
4. Residential and commercial end-use intensities. Source: EIA: New England Census Forecast
 - State Sources: Vermont RASS, State DSM Potential Study, NREL – ResStock, ComStock
 - o Residential: number of households, end-use units, stock efficiency, end-use consumption
 - o Commercial: square footage by building type, end-use consumption by building type
5. Energy efficiency (EE) program savings
 - Source: VEIC
6. Weather Data: Historical hourly temperature data – Burlington and Rutland

Data Input for the Adjusted Load Forecast

1. Behind the Meter Solar (BTM), Source: PSD
 - Residential and Commercial Capacity, Generation Profile
2. Electric Vehicles, Source: Drive Electric Vermont, PSD/VEIC projections (CAP Pathways), EIA, GMP
 - Number of vehicles (light duty and fleet), vehicle characteristics (miles per kWh, miles driven), charging profile
3. Electrification Program, Source: DPS/VEIC projections (CAP Pathways), EIA
 - Focused technologies: cold-climate heat pumps, heat-pump water heaters, other ?
 - o Number of units
 - o Size (kW)
 - o Operating load profiles
 - Large new building or electrification projects
4. Battery Storage and Load Control, Source: ?
 - Capacity, Operation: Charging and discharging hours

Climate Action Plan (CAP)

Climate Action Plan (CAP) Emission Targets

- » Vermont's green house gas (GHG) emissions reduction requirements tied to three time periods: 2025, 2030, and 2050.
 - 2025: No less than 26% below 2005 levels
 - 2030: No less than 40% below 1990 levels
 - 2050: No less than 80% below 1990 levels

- » Targeted sectors that impact electric demand
 - Transportation: 39.7% of total emissions (3.43 MMTCO₂e)
 - Buildings, including residential and commercial fuel use, and emissions from natural gas distribution,
 - 33.9% of total emissions (2.93 MMTCO₂e)

- » Targeted technologies to achieve GHG emission reduction levels
 - Electric Vehicles
 - Heating technologies – CCHP
 - Energy efficiency
 - Water heating – Heat-pump water heaters
 - Other gas end-uses, cooking, drying, ?

This Year's Focus – On the Ingredients

» Baseline Forecast Inputs

- End-Use Intensity Development (appliance Saturation and stock efficiency estimates)
- Integration of Vermont-specific information with EIA projections

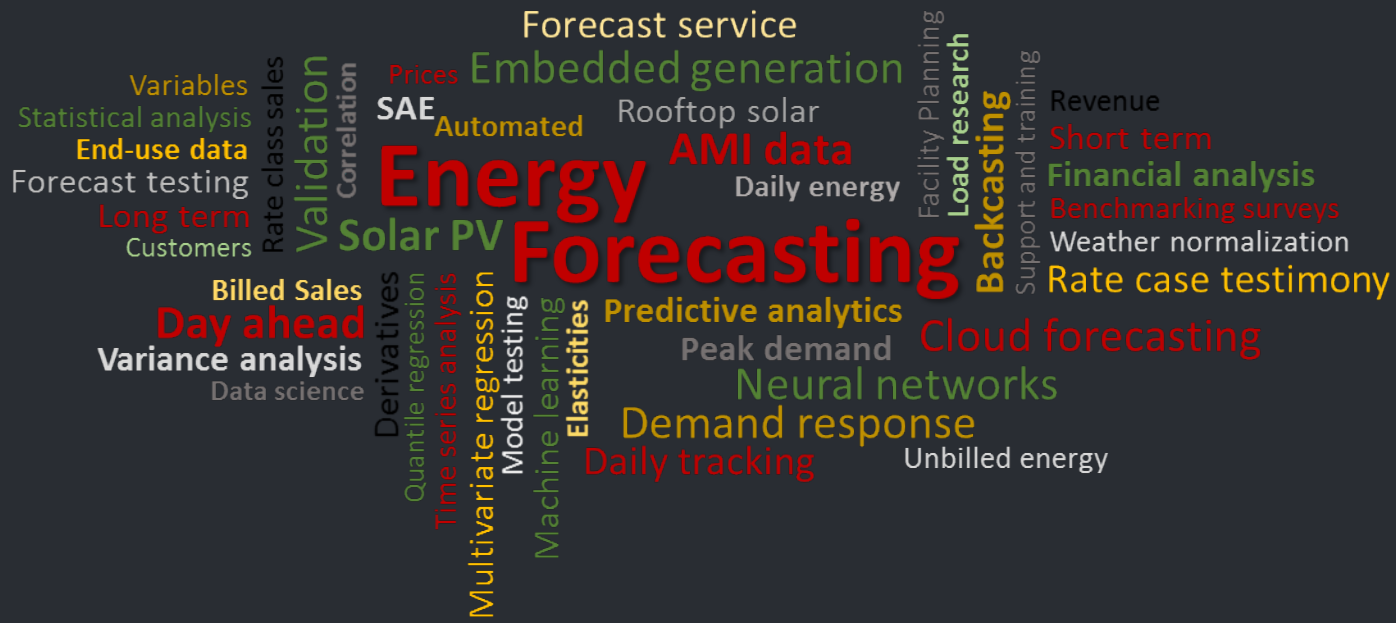
» CAP impacts – understanding how CAPS impact electric vehicles (fleet vehicles) and CCHP data and projections

» Technology hourly load profiles

- Solar
- CCHP
- Electric Vehicle Charging – Incentivized, Non-incentivized

» Technology discussions – CCHP, solar, battery storage (GMP Tesla Wall Pilot), and load control

» Other ?



Thank You



<http://www.itron.com/forecasting>
www.itron.com