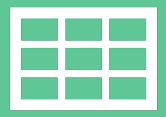
Track 1 – Load Modeling

Revolutionizing Power Demand Forecasting: Cadmus Leads with Innovative Load Modeling

Data Models - Insights on Load Estimates



Cadmus combines multiple data models to process input and provide insights on load estimates.

Factors considered: weather, building type, and time of year.

Model creation: Utilized 3 years of data, 25,000 buildings, and millions of data points with 85% accuracy.

Electrification Factor - Predicting Substation Load

THE MODEL INCORPORATES THE PERCENTAGE OF HOMES WITH ELECTRIFICATION TO PREDICT AND EXPLAIN SUBSTATION LOAD.

USER APPLICATION: INTERACTIVE MODELING, ALLOWING NEW DATA INPUT AND MANUAL FIXED-LEVEL ADDITIONS TO CLIMATE-RELATED EFFECTS.

Energy Demand Insights - Informed Decisions

The user-friendly model provides clear insights into how climate effects and building features impact energy demand.

Optimization: Cadmus enhances the open-source model to help utilities anticipate energy consumption variations based on weather patterns, reducing costs.

Targeted Energy-Saving Initiatives - Grid Stability

- The interpretable model identifies key building features affecting energy consumption, enabling targeted energy-saving initiatives.
- Transparency: The approach fosters trust among stakeholders and aligns with sustainable practices.
- Load Forecasting: The model aids in load forecasting, enhancing grid stability, and preventing blackouts or overproduction of energy.

Trico Electric Cooperative

Trico Today

- 47,000 Members (over 51,000 services)
- Majority Residential (95%)
- Energy Sold 819,719 MWh
- 253 MW Peak Summer Demand (less than 100 MW Winter)
- 2,500 square mile service territory
- 4,037 miles of distribution line

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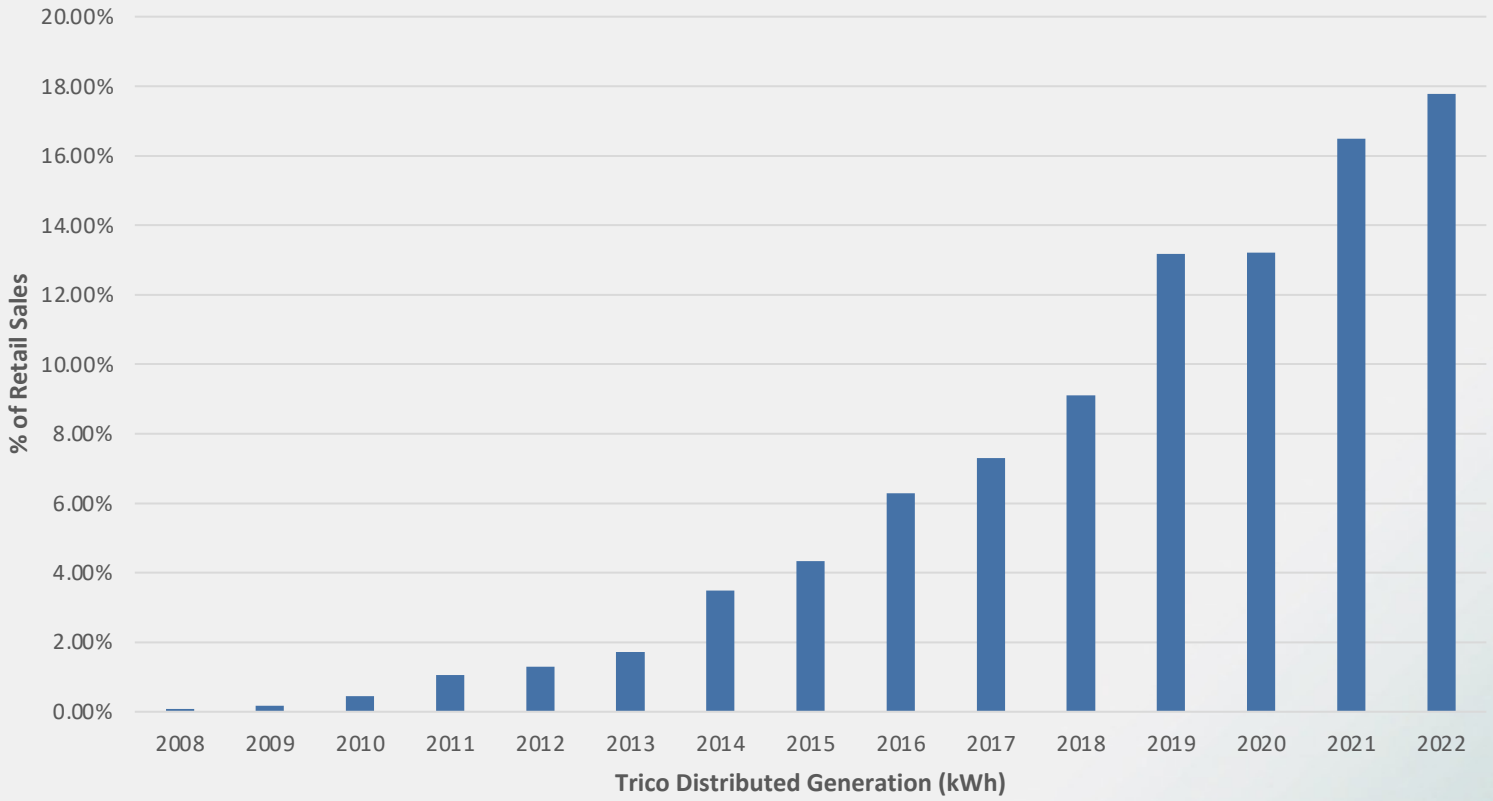
Distributed Generation



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Trico's Renewable Portfolio

- Approximately 33% of retail sales are from renewable sources
  - 50 MW of Distributed Generation
    - 5,000 installations
  - 25 MW of utility scale solar
    - Avion Solar, Chirreon Solar, Apache Solar
    - Additional 5MW by EOY 2023
- Goal is to invest in renewables and batteries in a cost-effective and sustainable way

Target:
Reduce emissions by 50% by 2032

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The Industry is Changing

Three Overarching Trends

• DECARBONIZATION •DECENTRALIZATION •DIGITIZATION

1. **Decarbonization of power supply**
   - Moving away from fossil fuels to generate
   - Moving away from fossil fuels at the end use
2. **Decentralization**
   - Investing in local generation - solar and batteries
3. **Digitization**
   - Grid intelligence in the form of sensors and automation
   - Replacing electromechanical devices

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A Fourth Trend

The industry is changing.
Generate → Transmit → Deliver

- Decarbonization of power supply
- Decentralization
- Digitization
- **Members are changing**
  - More diverse
  - Tech is easy to integrate in our homes
  - Concerns about the environment

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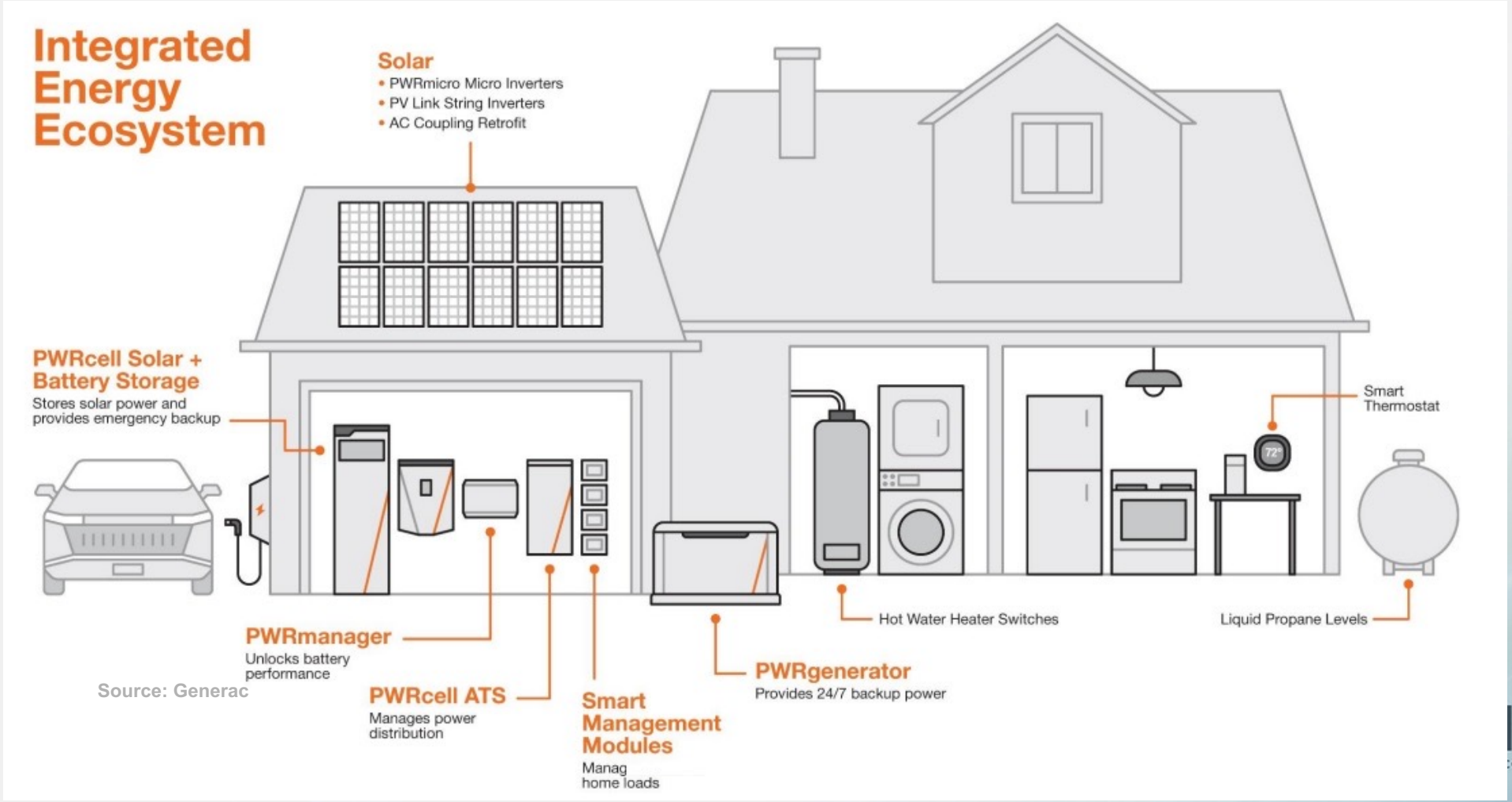
Member Adaptation — ‘Bring Your Own Device’ Era Expands



Trico's Future

2030 Vision

"To be our member's energy provider and partner of choice."

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Advanced Grid

Strategic Initiative:

Pursue advanced grid technology in order to increase reliability and to meet member's needs

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Grid Modernization

Distributed Generation Assets

AMI Meters

Sensors

Voltage regulators/ Capacitors

Intelligent relays

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DERMS

Implementation of load control measures can offer targeted reduction of system loading to reduce demand during critical periods.

Goals

- Peak shaving
- Demand Reduction
- Energy Conservation
- Market Transactions

Programs

- Smart Thermostats
- Water Heaters
- Battery Storage
- Heat Pumps
- Electric Vehicles

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Thank you!

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Hot Showers & (no) Cold Calls

Wesley Whited
Principal Consultant – IoT Technology

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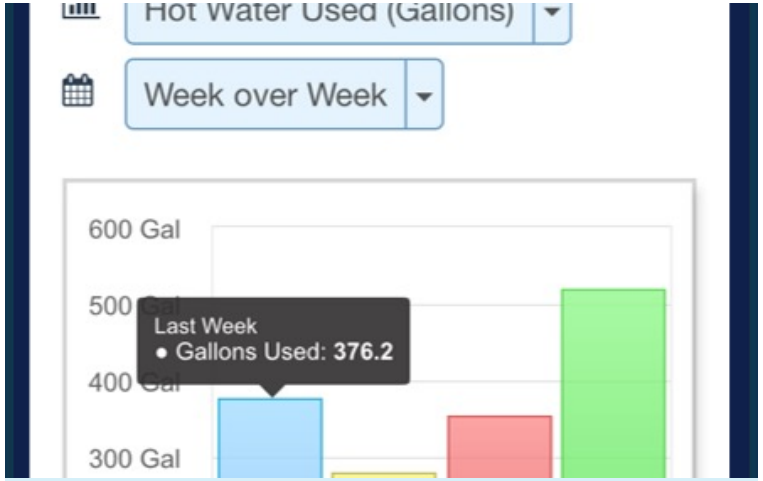
DNV

Why build a distributed, thermal battery?

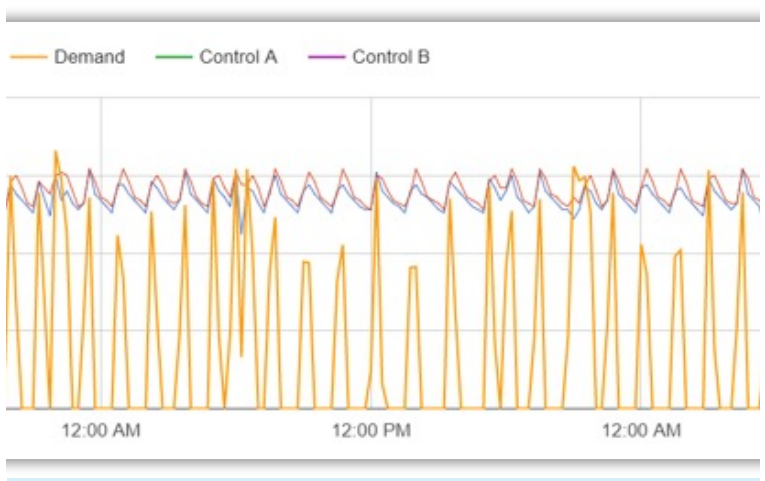
Grid Flexibility

- Solar PV to be 46% of installed capacity by 2050
- Demand for electricity will double



Economic Value

- Customers spend $35B /year to heat water
- Utilities can stack multiple value streams



Non-Energy Benefits

- App based controls for customers & utilities
- Predictive maintenance & proactive replacement

Domestic hot water: an uncharged battery

118M+ Residential WH Installed Base

- Natural Gas: 48%
- Electric: 46%
- Other Fuel: 6%

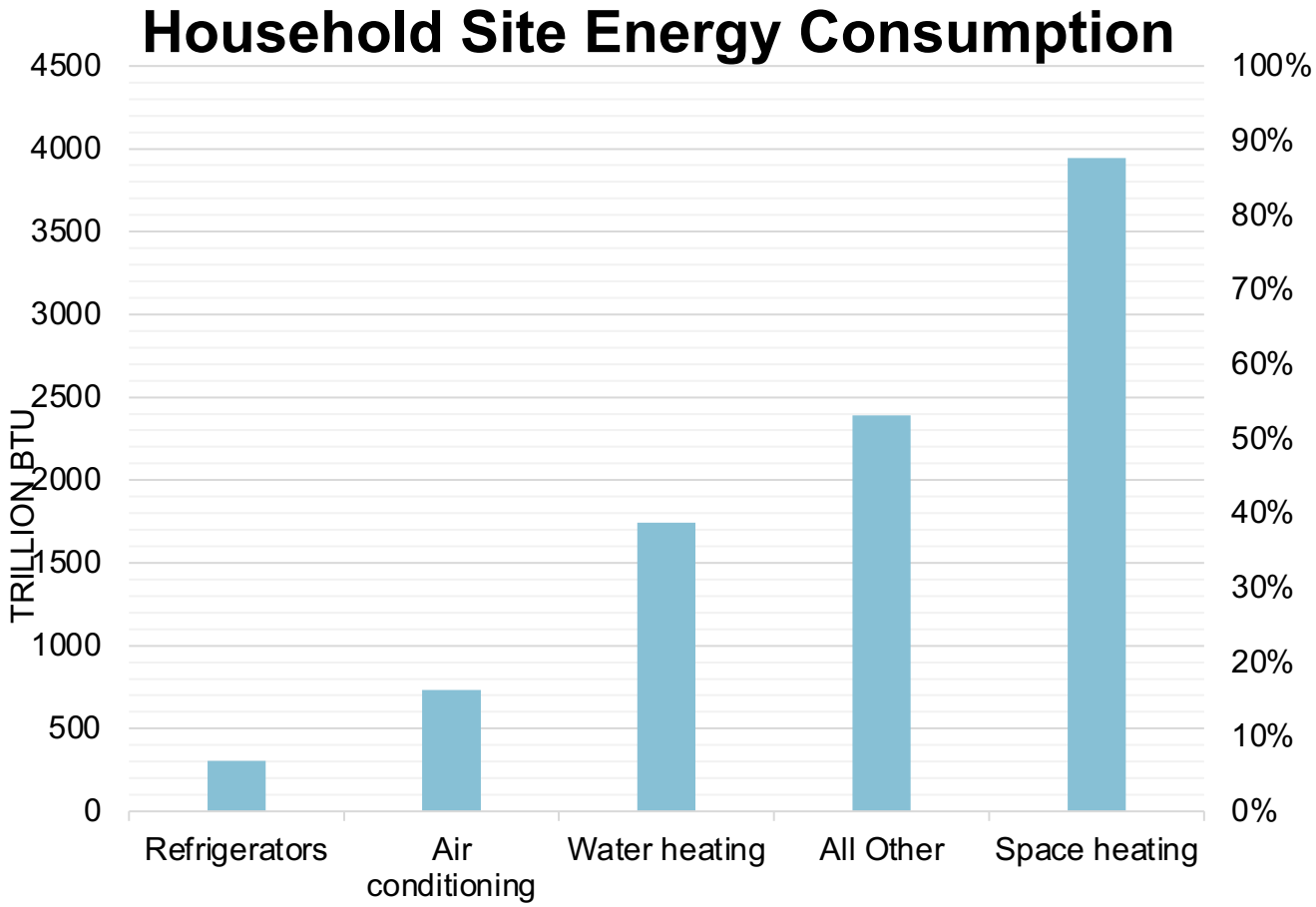
19% of average household energy use

- 1,750 Trillion Btu
- 150mm metric tons CO2

Nominal Storage Size

- <30G: 13%
- 31-49G: 44%
- 50G+: 27%
- Tankless: 3%
- Central WH: 14%

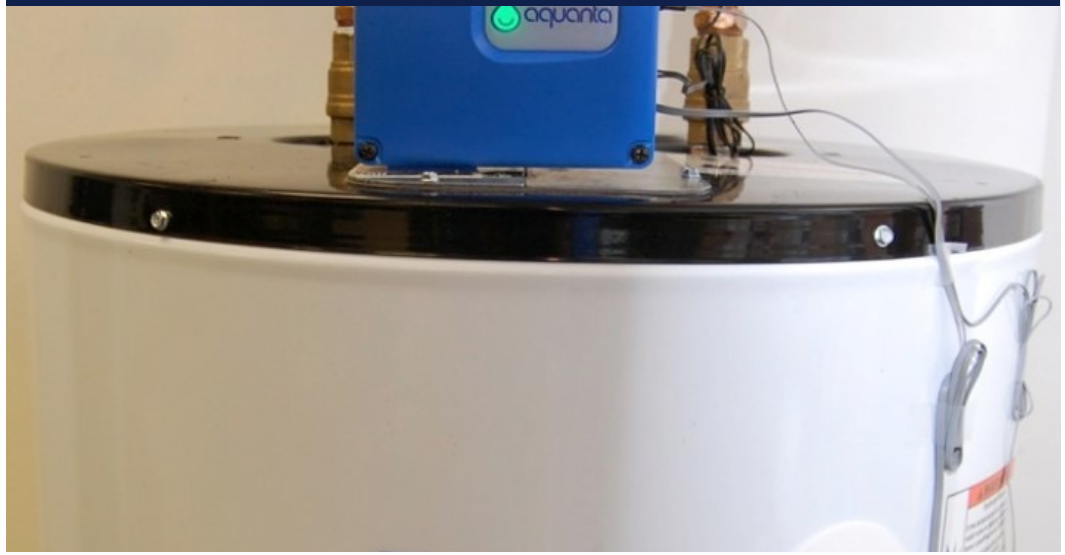
2/3rds of units <10 years old



Types of water heater controllers

Retrofit controller for ERWH

- Unlocks multiple value streams
- Installation does not alter tank
- Optional sensors



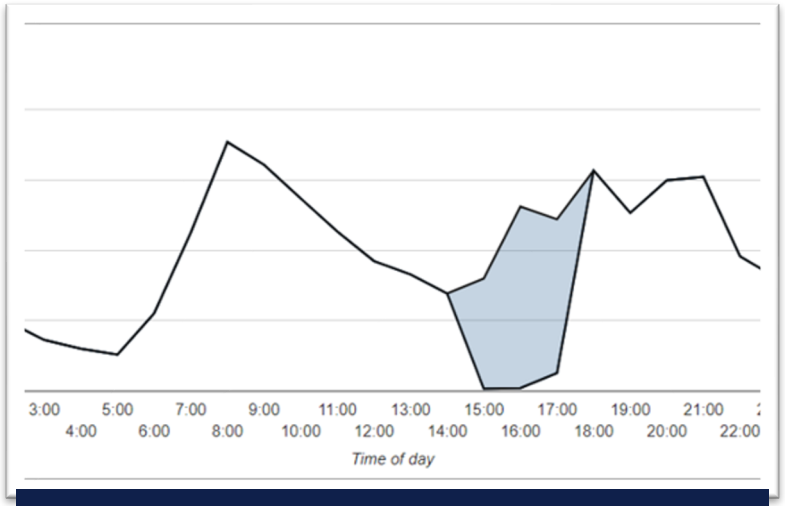
CTA-2045 device for HPWH

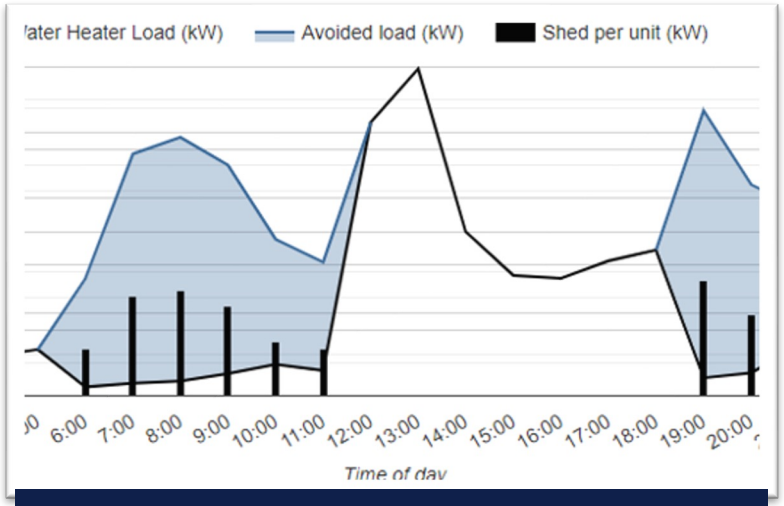
- Plug-n-Play connectivity
- Same value stacking options
- Pair w/HPWH at time of sale

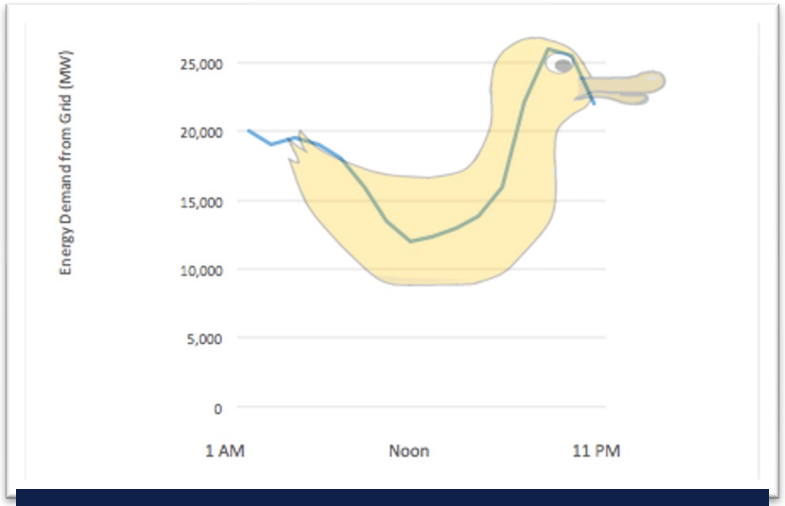
Utility Use Cases

The top 3 utility use cases

104 Units Peak Shaving @ 4:00 PM







Prices to devices

- Automated load shed based on a customer defined price trigger
- Device is registered and assigned a resource ID by an aggregator
- Device & Aggregator communicate over the life of an event

TOU rate integration

- Time sensitive rates loaded into the devices firmware
- Learning Algorithm baselines a user's consumption pattern
- Load is scheduled out of high price periods; rebound occurs during low price periods

Solar sponging

- Optimize recharge cycle to soak up excess solar capacity
- Solar sponging pairs well with normal customer demand for DHW
- Estimated 30% reduction in water heating CO_2

Energy equity

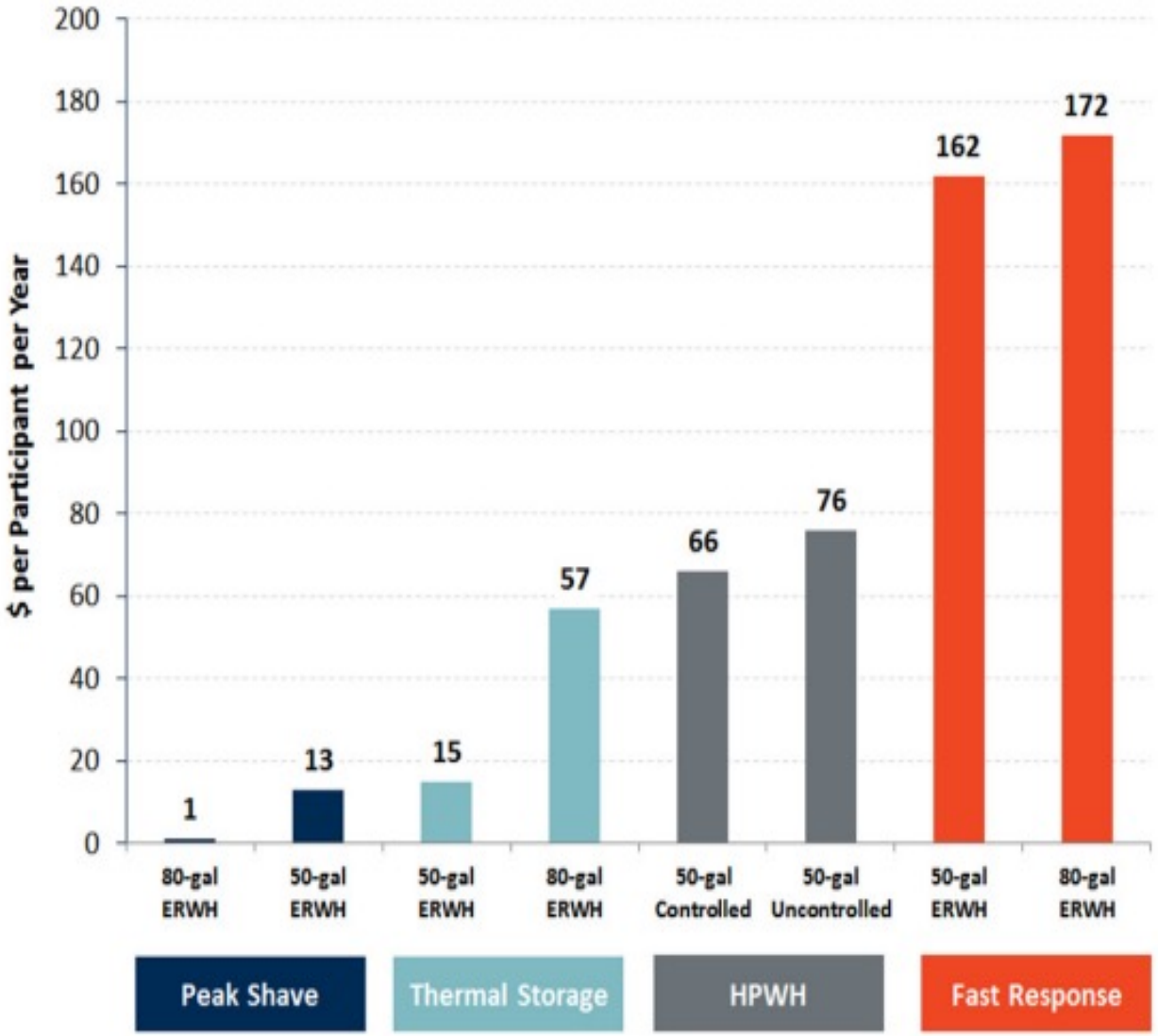
HIGHEST CONCENTRATION OF EXISTING ELECTRIC WH ARE IN THE SOUTH & SOUTHWEST

MOBILE HOMES HAVE THE HIGHEST LIKELIHOOD OF USING AN ERWH

CONTROLLERS CUT ENERGY CONSUMPTION BY 2-10% BY REDUCING STAND-BY LOSSES

PEAK SHAVING & THERMAL STORAGE SHIFT LOAD INTO MORE AFFORDABLE TIMES

FREQUENCY REGULATION & DR OFFER PASSIVE INCOME STREAM OPPORTUNITIES



Source: Brattle Group

Let’s connect!

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