Overcoming Key Barriers to Electrification of Full-Service Restaurant Hot Water

CalNEXT Project Team: 2050 Partners, TRC Companies, Frontier Energy

2050 PARTNERS
DECARBONIZATION EXPERTS

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Project Overview

- Goals:
  - Support foodservice hot water system decarbonization
  - Overcome key barriers: HPWH sizing for full-service restaurants
- Research Objectives:
  - Characterize hot water demand and equipment consumption through field data collection
  - Engage with key stakeholders
  - **Present field data and alternative water heater sizing approaches to key stakeholders**

Image Source: ECO_2 Systems LLC

Key Stakeholders & Collaborators

- Air Districts: CARB, South Coast AQMD, Bay Area AQMD
- Health and Safety Department Directors, Plan Checkers, and Reviewers
- California Conference of Directors of Environmental Health (CCDEH)
- Researchers: Code Readiness & CalNEXT

Barriers to HPWH Technology in the Full-Service Foodservice Sector

Market Barriers

High first cost

Lack of familiarity with the technology

Technical Barriers:

Added complexity

Space and ventilation constraints

Limited electrical infrastructure

Noise

Installation challenges: not a one for one replacement

Operating cost

Regulatory Barriers:

Meeting California Retail Food Code sizing requirements: CCDEH Guidelines for Sizing Water Heaters

Barriers to HPWH Technology in the Full-Service Foodservice Sector

A holistically sized HPWH system can address many market and technical barriers:

- **Optimize storage tanks and minimize recirculation loads to decrease the number of heat pumps:**
  - Lowers first cost
  - Reduces electrical needs
  - Reduces noise
  - Lowers operating cost

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Meeting California Retail Food Code sizing requirements: CCDEH Guidelines for Sizing Water Heaters

California Retail Food Code & CCDEH

- The California Retail Food Code states: “Hot water generation and distribution systems shall be sufficient to meet the peak hot water demands throughout the food facility.”
  - **Assigns primary enforcement responsibility to the local enforcement agency**.
  - Nearly all California county enforcement agencies point to the **CCDEH Guidelines for Sizing Water Heaters.**

- California Conference of Directors of Environmental Health, CCDEH
  - A non-profit organization whose membership is comprised of Environmental Health Directors from 62 jurisdictions, including all 58 California counties and 4 California cities
  - **Food Policy Committee developed guidelines to support jurisdiction review of water heater sizing.**

California Retail Food Code: Chapter 7, Article 1, Section 114194 (b)
https://www.ccdeh.com/

CCDEH Guidelines for Sizing Water Heaters

Objective: ensure **the water heater recovery rate meets the peak one-hour hot water demand (GPH).**

Sizing Requirements for Storage Water Heaters:

1. Identify facility peak demand:
   - **Identify all hot water end uses** and **calculate peak demand (GPH)** using reference tables or equipment specs.

Food facility that utilizes multiservice eating and drinking utensils:
Assume:

Number	Type	Demand
1	Three compartment sink (18”x18”)	42 GPH
1	Automatic dish machine	80 GPH
1	Hand spray	45 GPH
1	Food prep sink	5 GPH
2	Hand lavatories	10 GPH (5 GPH each)
1	Janitorial sink	15 GPH
	Total	**197**

https://www.ccdeh.com/

CCDEH Guidelines for Sizing Water Heaters

Sizing Requirements for Storage Water Heaters:

2. With the GPH in hand, you then **determine the input rate of the water heater.**

kW Input Calculation for Electric Storage Water Heater

$$kW\ Input = \frac{Heat\ Recovery\ Rate\ (GPH) \times T_{Rise\ required}(°F) \times \frac{8.33lb}{gal.}\left(\frac{Density}{of\ water}\right)}{Thermal\ Efficiency \times 3{,}412\left(\frac{BTU}{kW}\right)}$$

3. Designers must then submit a water heater with equal or higher input rate (kW for electric).

For the electric thermal efficiency, the default is **98%.**

https://www.ccdeh.com/

CCDEH Guidelines for Sizing Water Heaters

- Simplified calculation that works for gas and electric resistance systems
- Gaps Include:

Doesn't account for higher HPWH COP

Doesn't factor in elements that impact COP including recirculation

Doesn't account for storage tank capacity

Doesn't offer a path for hybrid or dual-fuel systems

CCDEH Guidelines for Sizing Water Heaters

- We recommend the Sizing Guidelines be updated to support HPWH technology:

A. Update the existing guideline calculations and framework

B. Engineered approach, or a comprehensive sizing tool

- **Challenge:**
  - It's a big leap to go from the simplistic equation to a complex engineered approach.
  - **In the short term, we expect** CCDEH and Health Departments to only be comfortable with **revisions to the existing framework**.

What's Next?

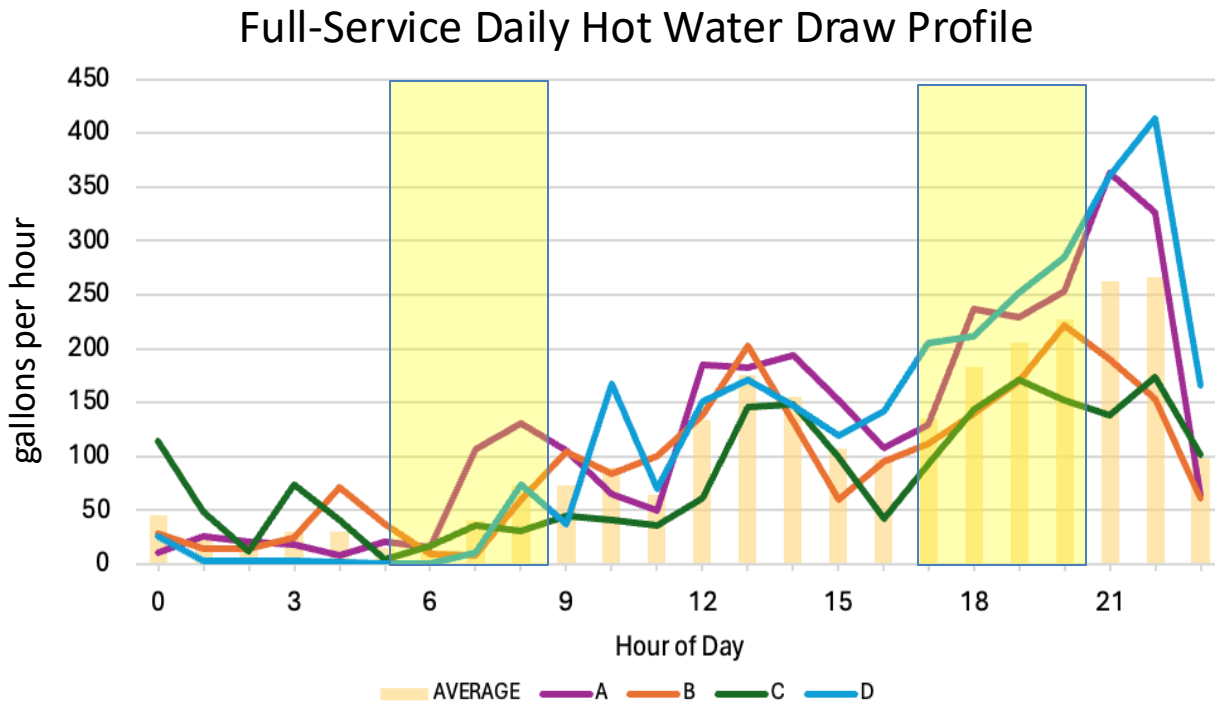
- **Support the short-term solution:**
  - **Document sizing updates** and **workshop** them with Health Department Directors and CCDEH Technical Advisory Committee.
  - Support education to plan checkers and installers

- **Support the long-term solution:**
  - Holistic sizing tool that considers:
    - **Load shifting** – to minimize peak electric demand impact
    - Heat pump **location, climate zone, and setpoints**
    - **Recirculation** and controls
    - Supplemental heat sources
  - Gather **present-day hot water draw profiles** to support sizing recommendations

Field Data Collection

- We aim to get present-day draw profiles to add to the existing data sets:
  - 3 full-service restaurants
  - 6-9 months starting October 2024
  - Collecting **hot, cold**, and **recirculation** flow data (gpm) and temperature
  - **Equipment hot water draws**

- **Collaboration:**
  - Share data to support lab testing and modeling tools



Key Takeaways

- Foodservice water heating system decarbonization requires a multi-prong approach:
  - **Update sizing guidelines** to support high-efficient technology
  - Holistic HPWH **sizing tools**
  - **Education** & Support: Designers, Installers, Owners, and Operators
  - Research of present-day **hot water profiles**
  - **Lab testing**
  - **HPWH field demonstrations**

This project is funded by CalNEXT. CalNEXT is a statewide initiative to identify, test, and grow electric technologies and delivery methods to support California's decarbonized future. Find more information here.

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