

ET Summit 2024

Presented by



Comprehensive Laboratory Evaluation of Heat Pump Water Heaters for Commercial Food Service Applications

Assessment of heat pump water heaters under strictly controlled lab environment is crucial for accurate understanding of the performance of these devices in commercial food service environments. This presentation will touch on past projects performed at PG&E's Applied Technology Services, as well as current work being done to identify best practices and optimizations that can lead to significant energy savings and operational efficiency in commercial food service applications.



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Agenda

- Past Projects Overview
- Lab Virtual Tour
- System Under Test
- Findings Highlights and Project Goals
- Questions

Project Goals

1. Supports the development of HP water heater sizing guidelines for commercial kitchens that may be used by health departments in California
2. Supports T24 CASE proposals for the 2028 rule-making cycle
3. Develop installation criteria for CK HPWH systems
4. Conduct performance testing of CK HPWH components
5. Enhance the CBECC-Res CK simulation model to enable commercial HPWH compliance

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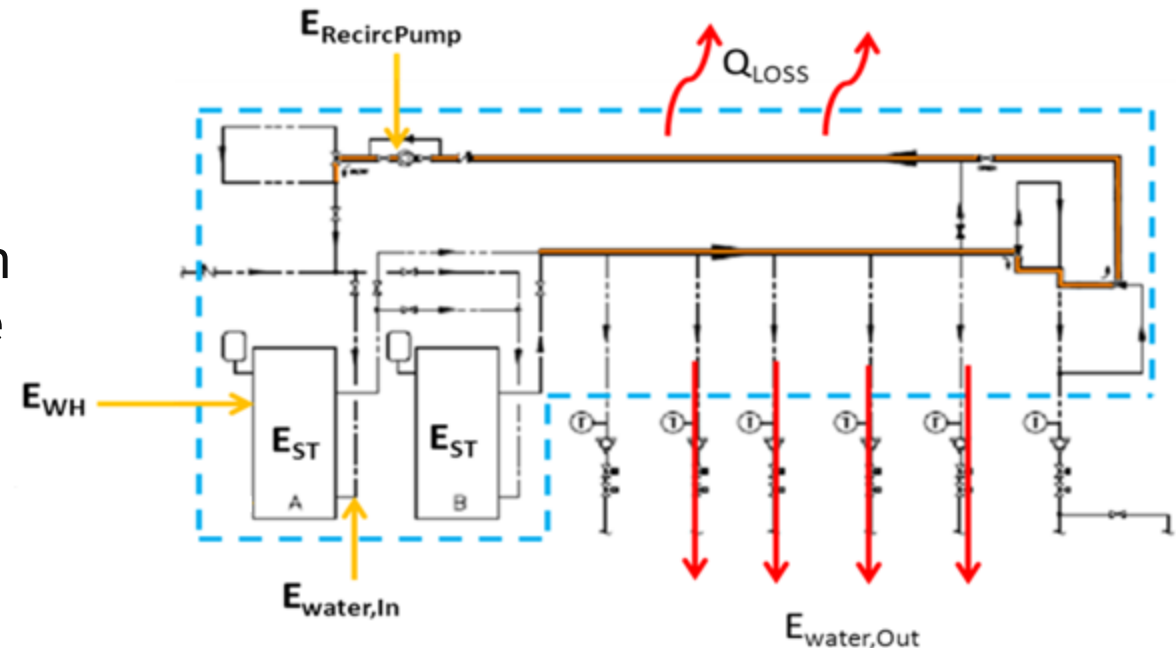
Why Lab Testing

Ability to vary distribution system

- No recirculation
- With recirc loop heat loss rate controlled to mimic distribution system sizes ranging from cafes to full-service restaurants

Ability to vary setups

- Series and parallel storage tanks
- Unitary and split HP test configuration with single pass or multi-pass heating
- Single or multiple units
- With temperature maintenance tank or return to primary configurations



Example Schematic: Simplified hot service water system for commercial kitchen application

Applied Technology Services – PG&E

Past Projects

- Comprehensive water heater testing began at PG&E at the ATS Water Heater Laboratory in 2007.
- In 2010, the laboratory expanded from a residential water heater focus to a commercial hot water system testing facility.
- In 2018, a real-life scale hot water generation and distribution system built to mimic commercial space heating and service hot water application



Commercial water heater system testing setup 2010



Commercial hot water system testing setup 2018

Image source: <https://www.energy.ca.gov/publications/2021/commercial-hot-water-systems-field-retrofit-characterization-study-lab-testing>

Applied Technology Services – PG&E

Advanced Technology Performance Lab (ATPL)

Hosts seven (7) independent, climate-controlled test chambers and a flow loop facility for calibrating flow meters

- Four (4) chambers currently dedicated to testing residential and commercial HVAC systems up to 15 tons
- Three (3) chambers currently dedicated to testing commercial & residential water heaters and hot-water distribution systems



Heat Pump Water Heater System Testing



Hot Water Distribution System Testing

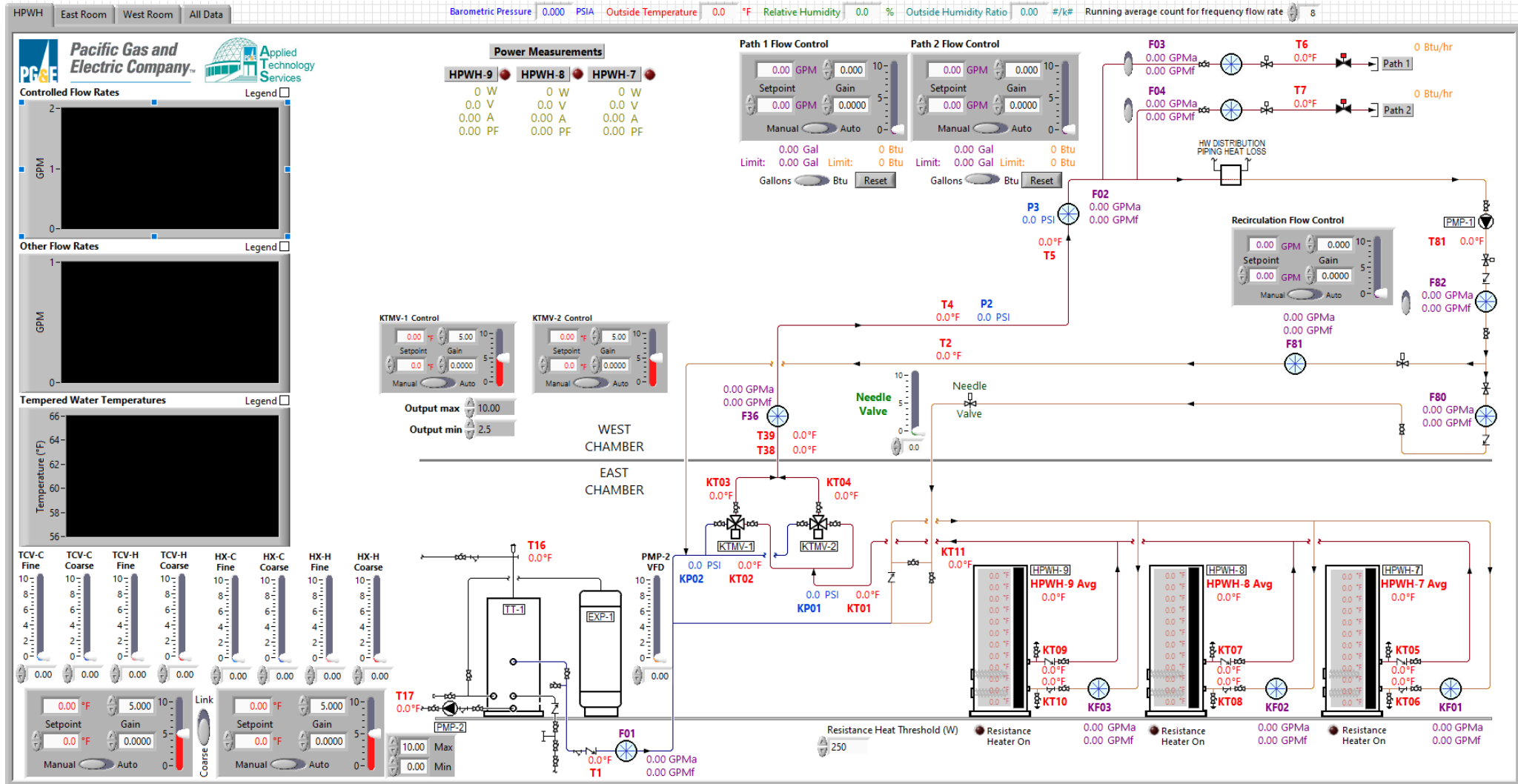
Lab Setup

HPWH test chambers were constructed with dimensions of 14.5' in length 12' in width and 12' in height. The chambers sizes and placement of equipment were chosen to adequately accommodate a range of various HPWH sizes.



Placement of equipment in test chambers

Lab Setup



Lab Setup

To switch between the plumbing configurations, the lab set up a digital and mechanical mixing valves were installed to be switched seamlessly during tests.



Mechanical and digital mixing valves

Lab Setup

To simulate a building recirculation loop heat losses water is piped through a water-to-water heat exchanger which can be set to the varying heat loss rates needed in testing



Simulated circulation loop

Lab Setup

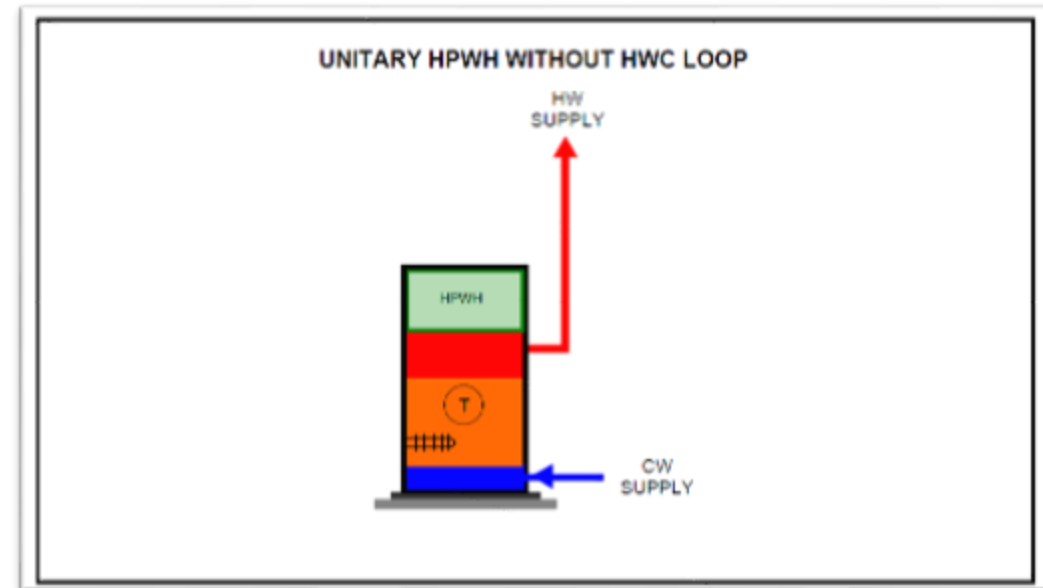
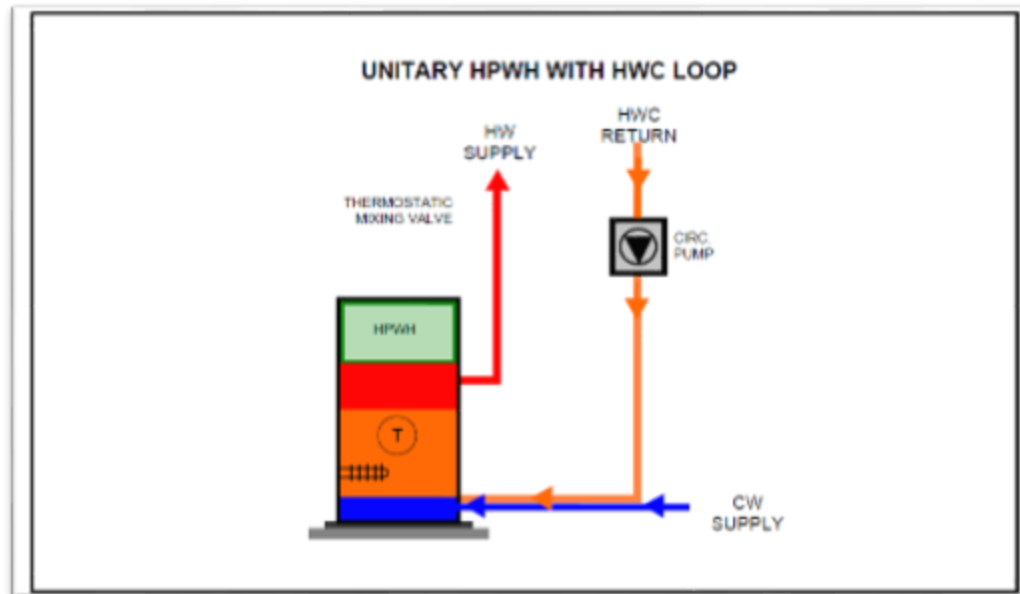
Three unitary HPWHs are installed to be able to operate one by one or combined. The plumbing designed to bring HPWHs in and out of the loop with ease.



Primary heaters setup

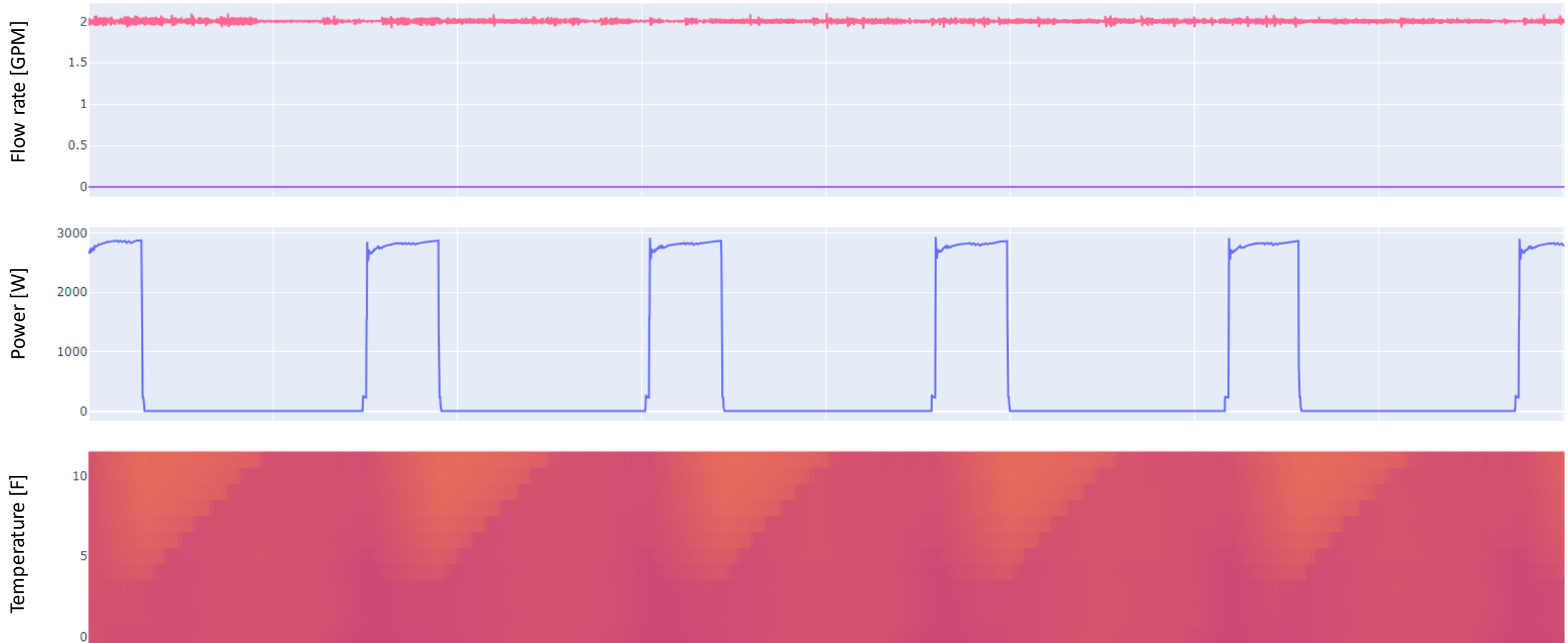
Application Tests

24-h application tests will be conducted to measure the performance of various design configurations under similar operation conditions.



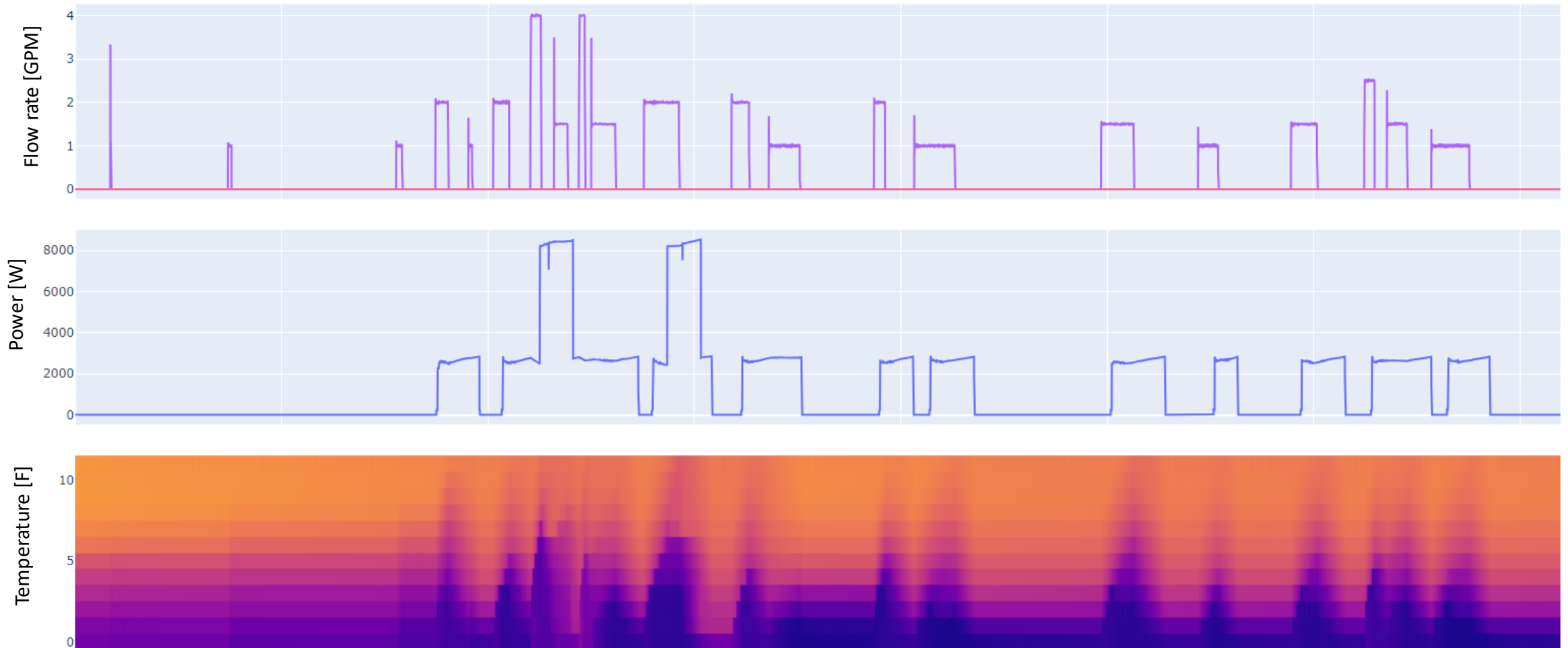
Application Tests

Only Recirculation – No draws



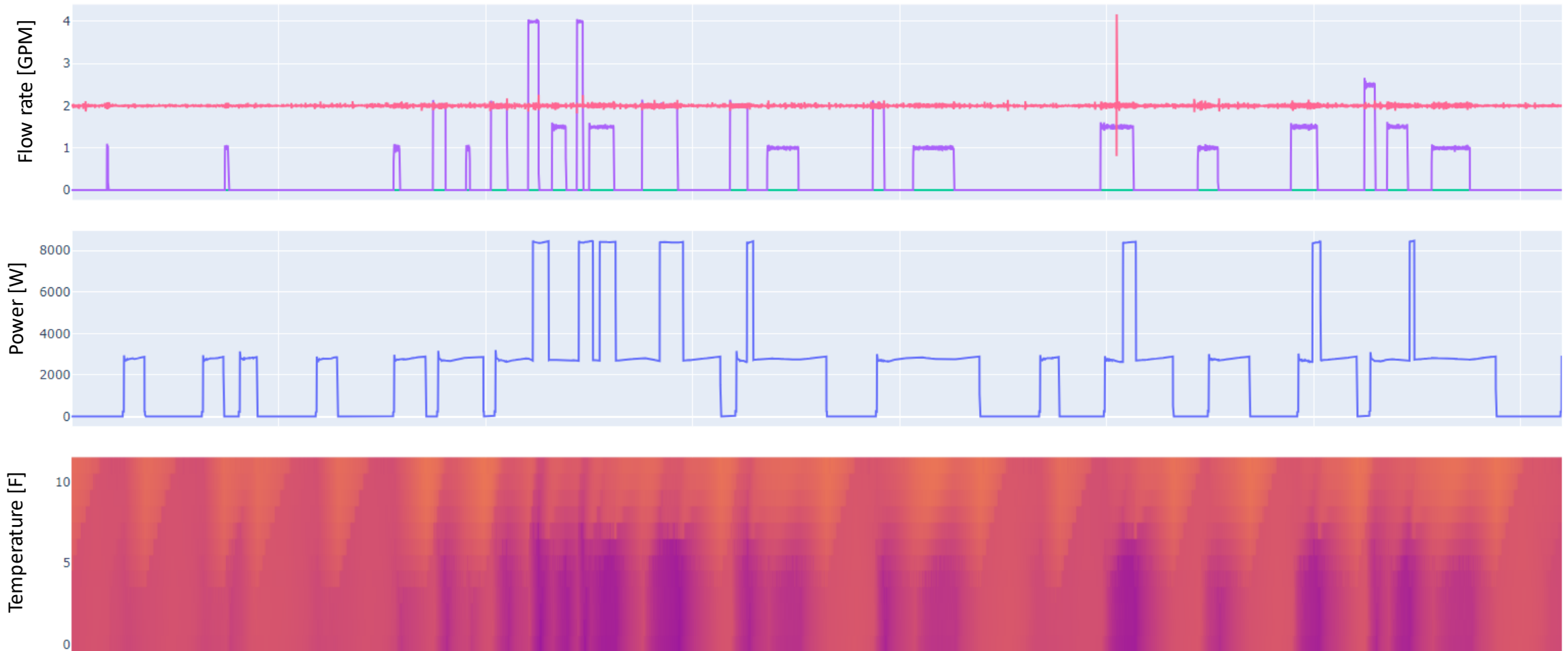
Application Tests

No Recirculation – Only draws

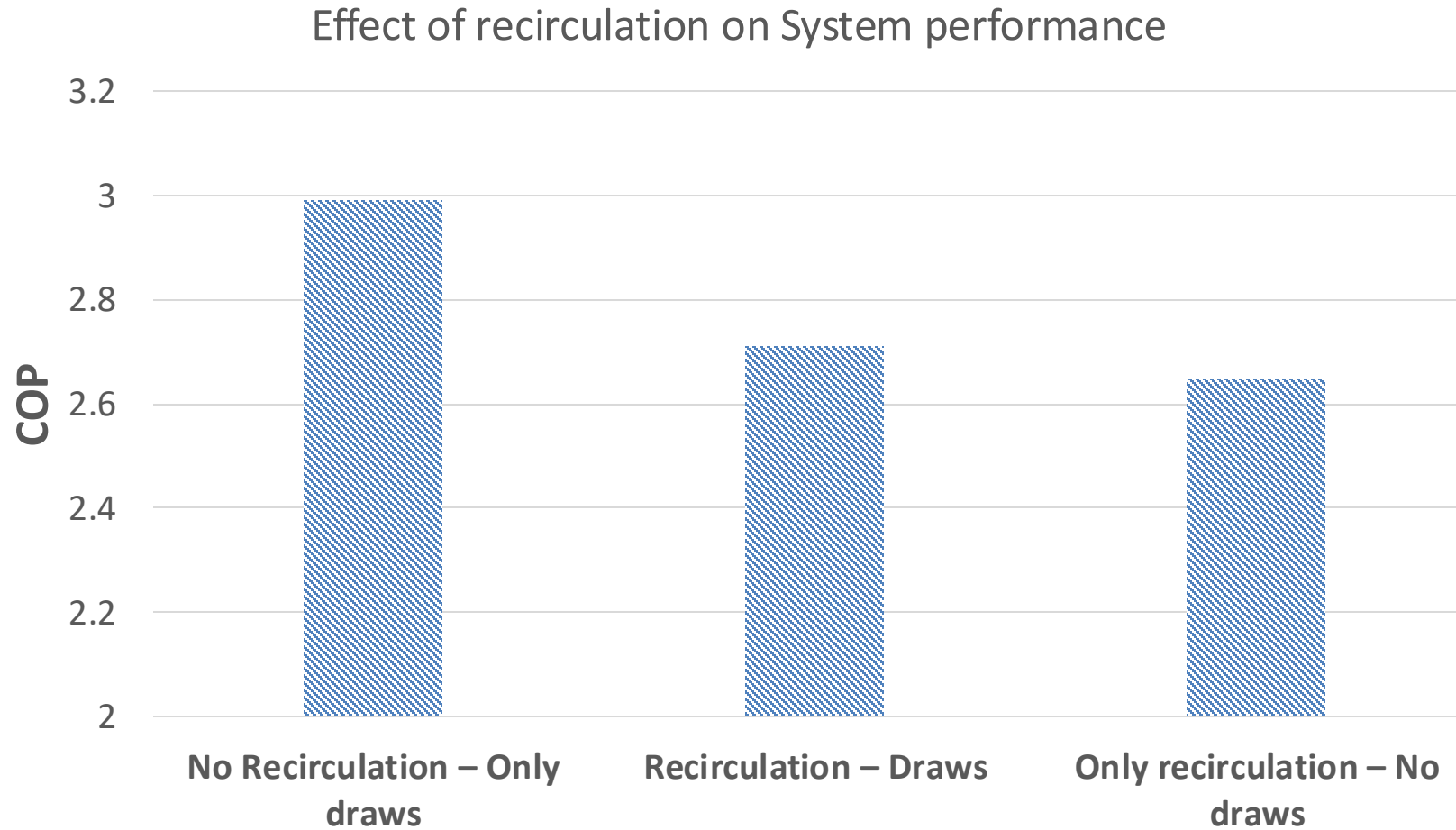


Application Tests

Recirculation – Draws



Application Tests



Project Goals

- Develop, evaluate, and validate viable HPWH DHW system configurations
- Conduct simulated 24-h application testing
- Results may lead to CBECC modelling updates
- Lead to future C&S CASE T24 work
- Publish findings to support design community and broad range of stakeholders
- Assist health departments to develop sizing guidelines for HPWHs:
 - Design for winter air/water design conditions
 - Use output capacity instead of input capacity for sizing
 - Factor in impact of recirculation systems
 - Size heaters using stored hot water capacity
 - Revisit hot water device usage values

Acknowledgement:

This project is supported by PG&E's Codes and Standards program, with the intention of providing data for the development of Statewide Building Codes Advocacy and codes and standards enhancement (CASE) proposals for consideration by the California Energy Commission to advance the California Energy Code (Title 24, Part 6).

Questions?

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