ET Summit 2024

Presented by

ETCC
ENERGY TRANSITION
COORDINATING COUNCIL

GAHP Sizing

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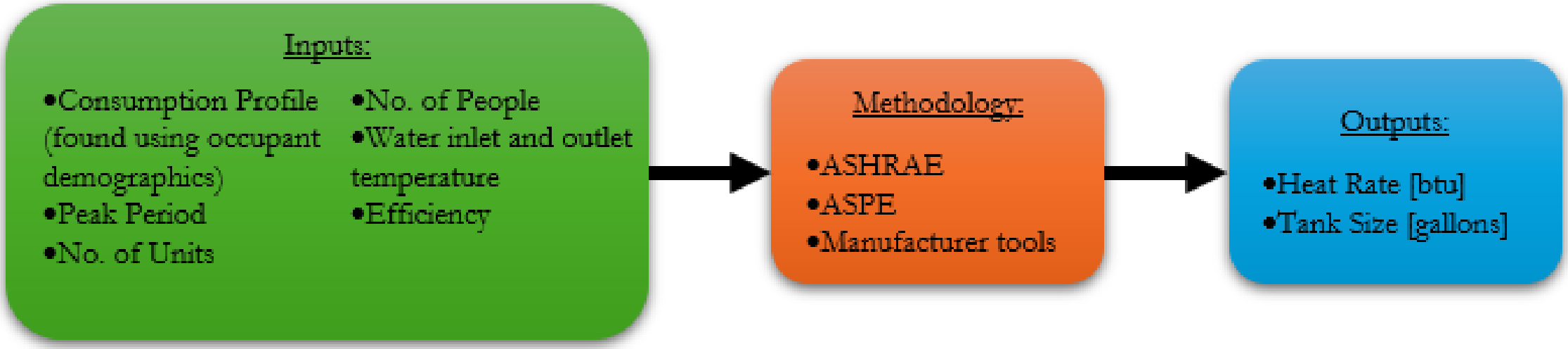
Agenda

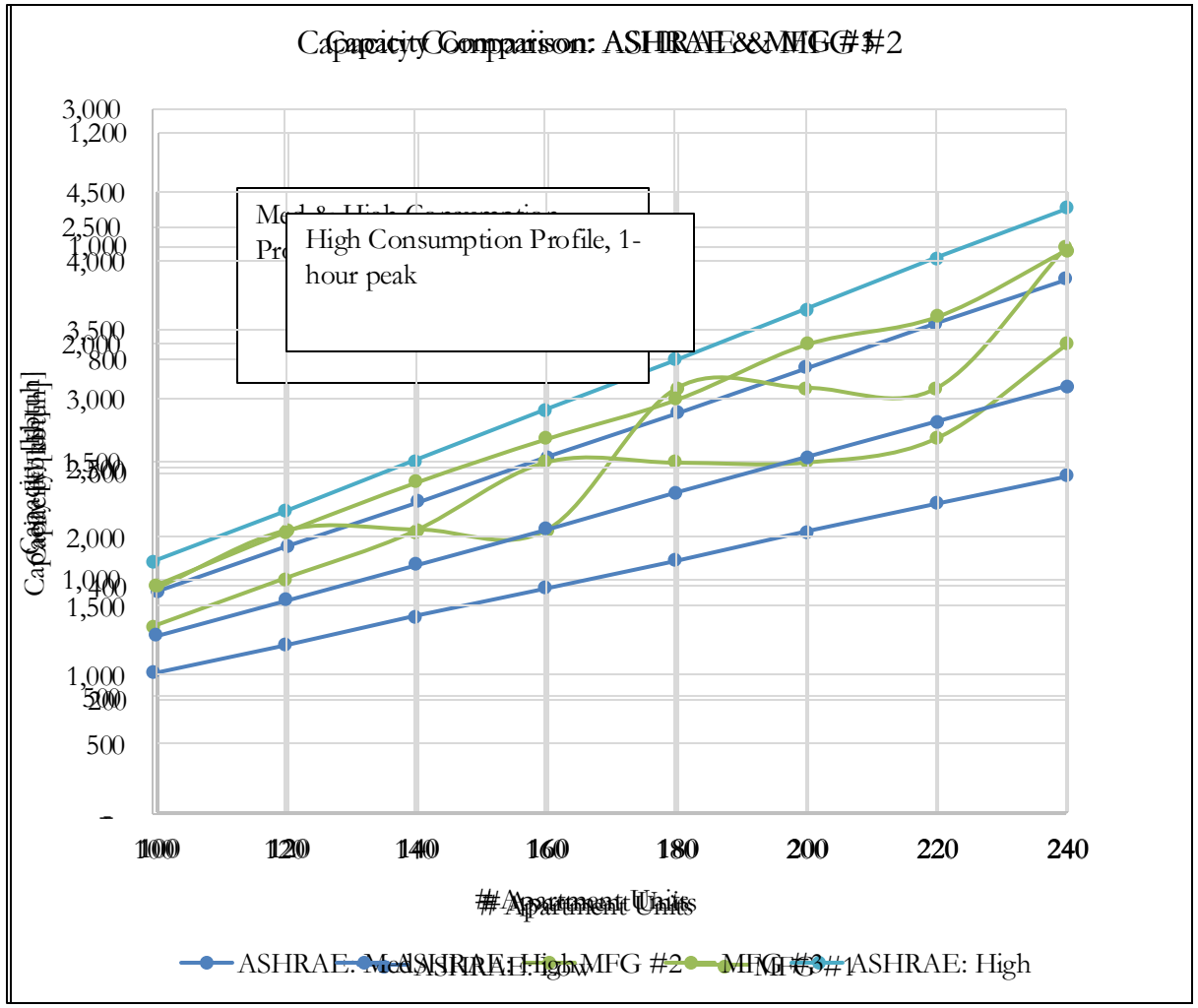
- DHW Sizing Tools
- Comparing DHW Loads to DHW Sizing Tools
- Site Screening Recommendations
- Conclusion

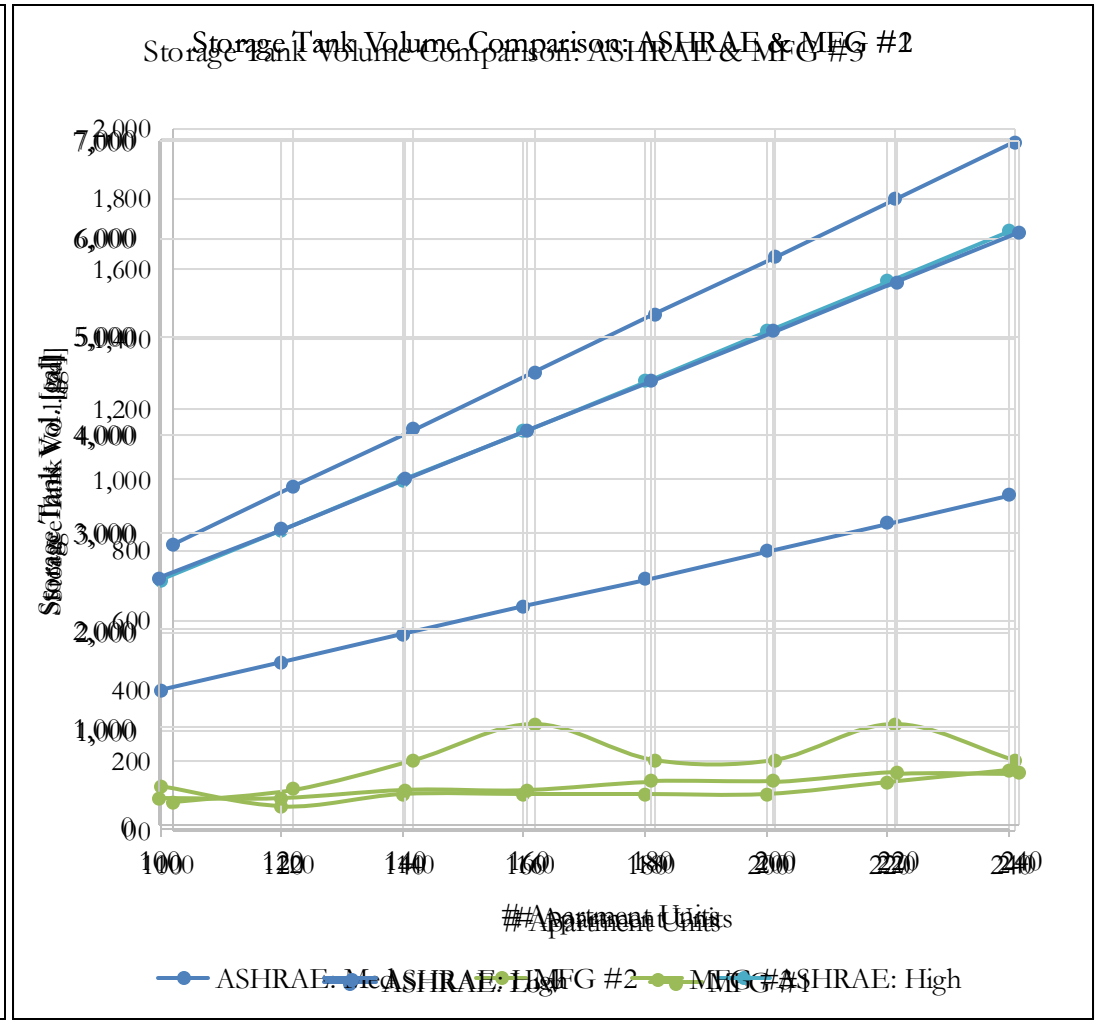
Comparing Water Heater Sizing Methods

- Literature review of DHW Sizing methods
- ASHRAE and ASPE are considered the same
- 3 manufacturer tools were considered, each with different load profiles



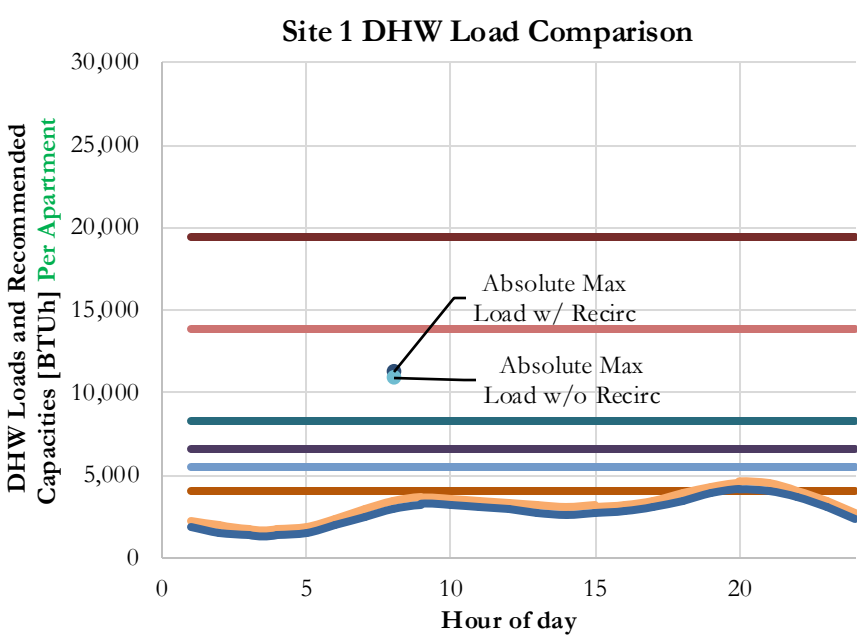
Comparison: ASHRAE v. Manufacturer Tools

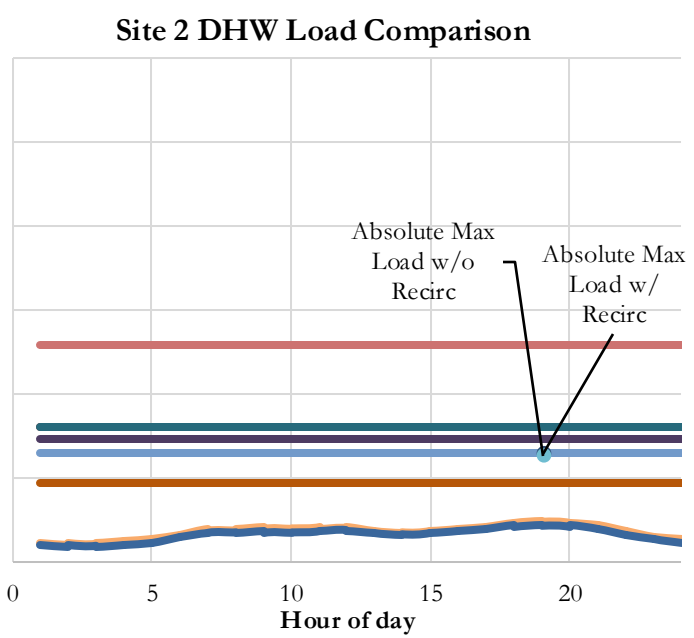


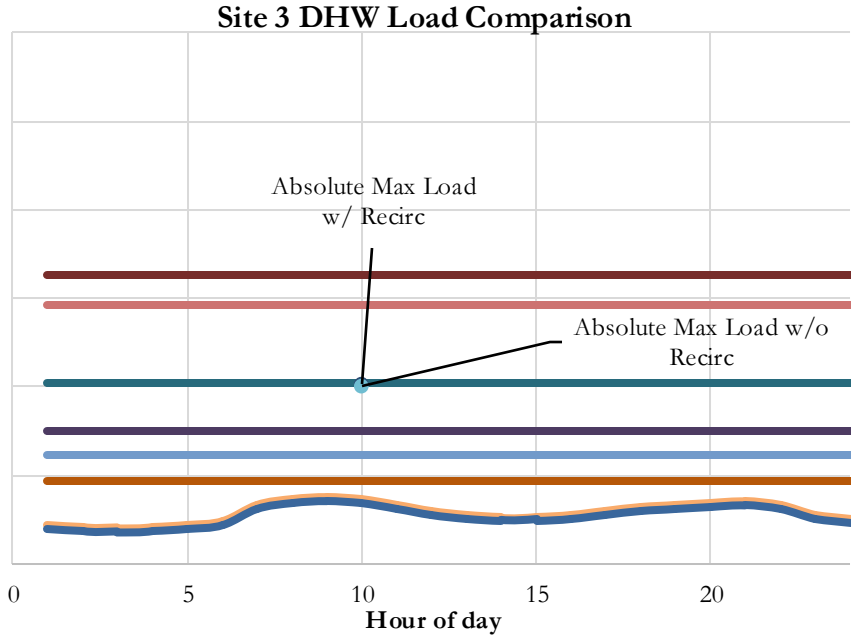


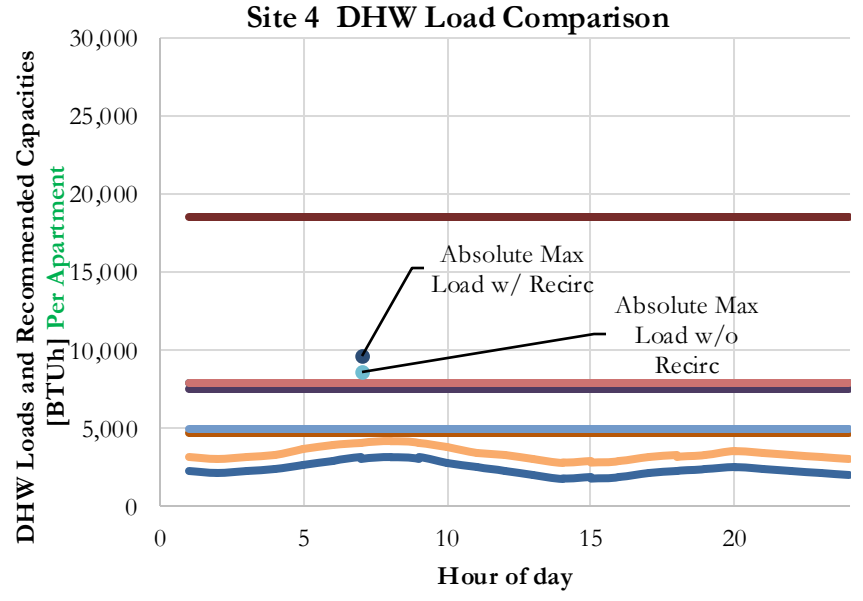
Comparing Actual DHW Loads to DHW Sizing Tools

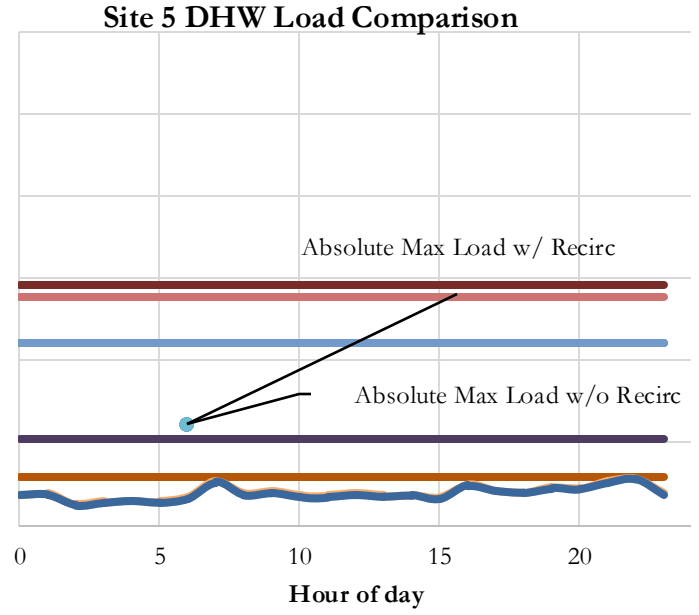
- **Data Sources**
  - **Hourly gas billing data** for multifamily properties in California
  - Compared to **ASHRAE**, **Manufacturer tools**, and **EHPWH sizing tool**
- **Purpose**:
  - Compare **max DHW loads** to sizing tool recommendations.
  - Highlight significant **oversizing** by DHW tools.

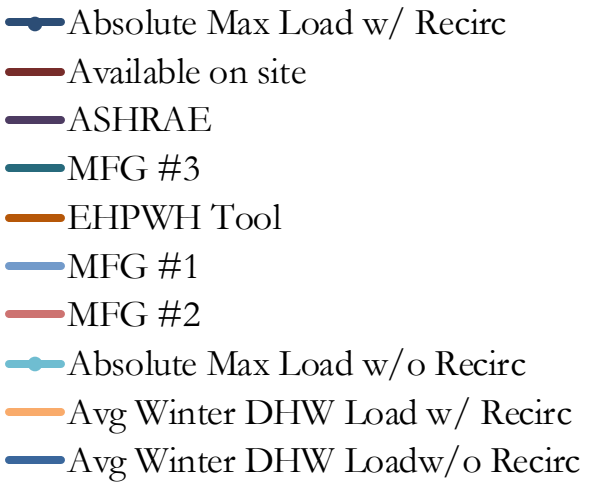

Site 1 DHW Load Comparison
DHW Loads and Recommended Capacities [BTUh] Per Apartment
30,000
25,000
20,000
15,000
10,000
5,000
0
0
5
10
15
20
Hour of day
Absolute Max Load w/ Recirc
Absolute Max Load w/o Recirc


Site 2 DHW Load Comparison
0
5
10
15
20
Hour of day
Absolute Max Load w/o Recirc
Absolute Max Load w/ Recirc


Site 3 DHW Load Comparison
0
5
10
15
20
Hour of day
Absolute Max Load w/ Recirc
Absolute Max Load w/o Recirc


Site 4 DHW Load Comparison
DHW Loads and Recommended Capacities [BTUh] Per Apartment
30,000
25,000
20,000
15,000
10,000
5,000
0
0
5
10
15
20
Hour of day
Absolute Max Load w/ Recirc
Absolute Max Load w/o Recirc

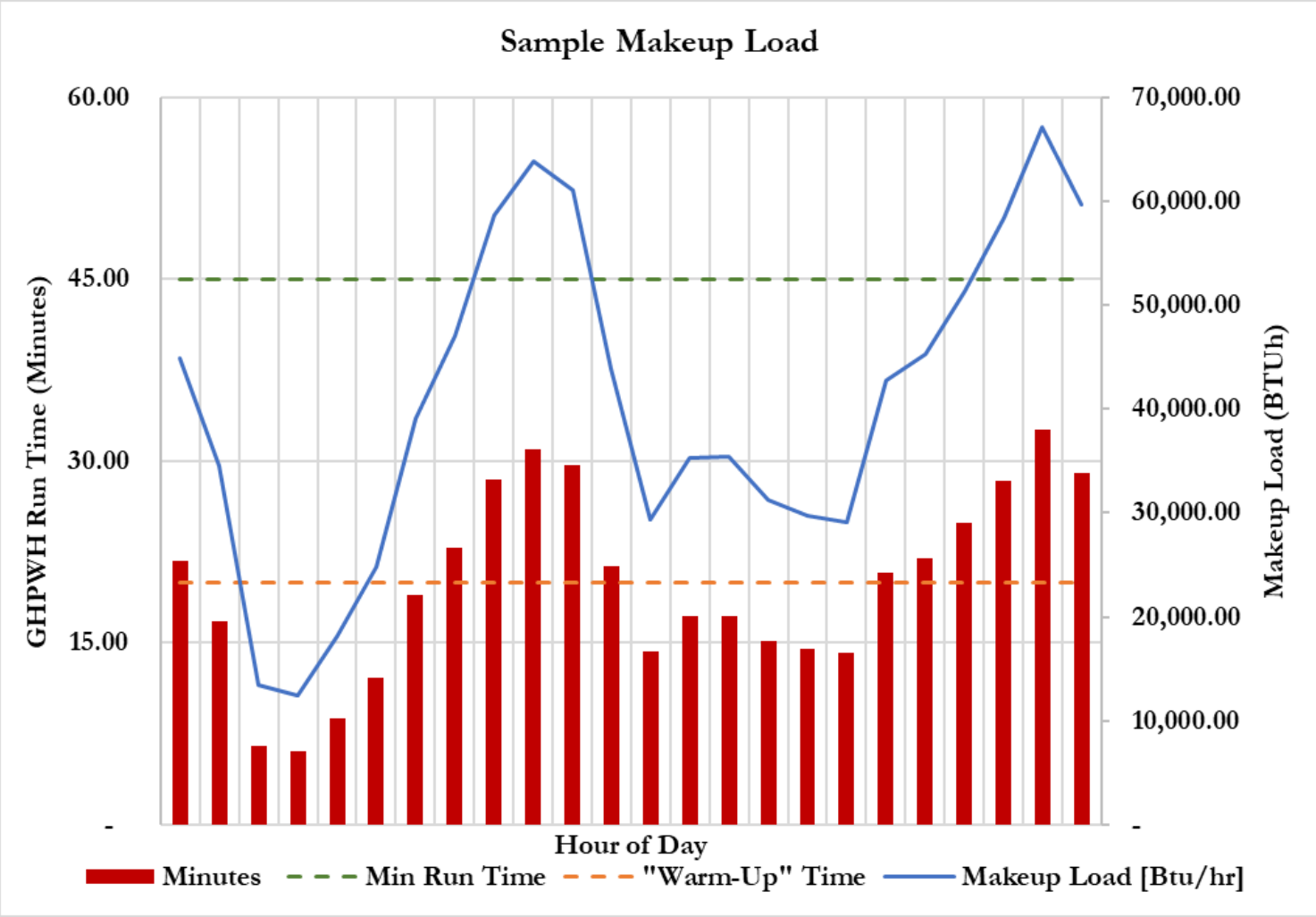

Site 5 DHW Load Comparison
0
5
10
15
20
Hour of day
Absolute Max Load w/ Recirc
Absolute Max Load w/o Recirc


Absolute Max Load w/ Recirc
Available on site
ASHRAE
MFG #3
EHPWH Tool
MFG #1
MFG #2
Absolute Max Load w/o Recirc
Avg Winter DHW Load w/ Recirc
Avg Winter DHW Loadw/o Recirc

Comparing Actual Water Heating Loads to Manufacturer Recommendations

- Key insights
  - **Absolute Max DHW Loads** at all sites exceed **average winter DHW loads**
    - **DHW Sizing Tools** commonly oversize systems to handle worst-case scenarios
  - Traditional Boilers cycle more when oversized - not perceived as an issue
  - **Oversizing HPWHs** leads to **inefficiency**
  - **HPWHs** size based on **average DHW loads**, conventional boilers used **absolute max**

Gas Absorption Heat Pump (GAHP) Water Heater Example



Site Screening Recommendations

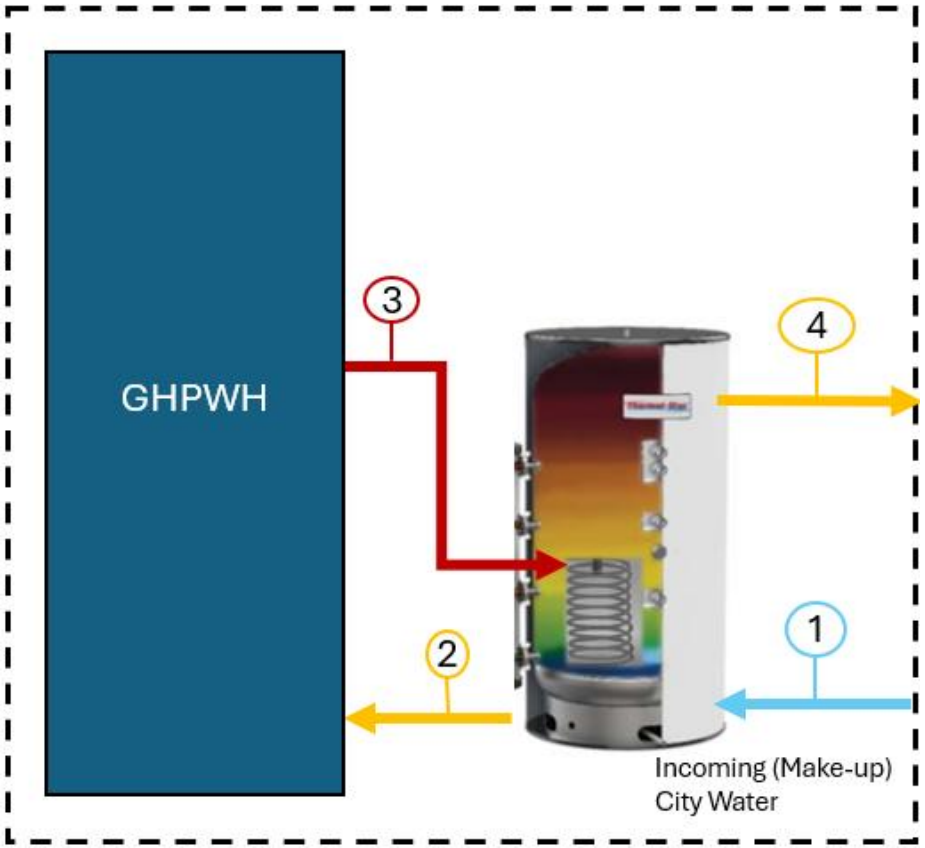
- **Pre-Heat Configuration**:
  - GAHP handles **average load**, gas boiler supports **peak demand**.
- **Hot Water Demand**:
  - Minimum **flowrate** required, based on GAHP capacity and temperature difference.
- **Operational Efficiency**:
  - **Continuous heating loads** preferred; avoid short cycling with minimum flow rates.
  - GAHP performance varies by **run time** and cycle time.
- **Temperature Limitations**
- **Storage Tank Needs**:
  - **Indirect storage tank** for GAHP + boiler system.
  - **Buffer tank** with certain MFG

Minimum Flowrate &Indirect Storage Tank Volume

- Minimum Flowrate
  - $$Min\ Flow\ Rate\ \left[\frac{Gal}{hr}\right] = \frac{GAHP\ Capacity\ \left[\frac{btu}{hr}\right]}{\rho\left[\frac{lbm}{gal}\right] c_p \left[\frac{btu}{lbm - °F}\right] \Delta T\ [°F]}$$

- Indirect Storage Tank Vol

$$Indirect\ Storage\ Tank\ Vol\ [Gal] = \frac{GAHP\ Capacity\ [BTUh] * GAHP\ run\ time\ [hr]}{\rho\left[\frac{lbm}{gal}\right] c_p \left[\frac{btu}{°F - lbm}\right] \Delta T\ [°F]}$$



Conclusion

- **ASHRAE and manufacturer** tools oversize water heaters at 5 sites compared to average loads.
- Oversizing is problematic for **HPWHs and especially for GAHPs**
  - **EHPWH tool** is most accurate
- **GHPWHs** lack a tool to calculate **base load**
  - Potential solution: Adapt **EHPWH tool** or gather DHW data.

This project was conducted through the ICF implemented, SoCalGas administered California Statewide Gas Emerging Technologies Program.

The project report can be found on cagastech.com

For more information, contact get@caenergyprograms.com

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Thank you

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