

# Monitoring of HPWH for Multifamily Applications

Building America Technical Update  
Meeting

April 30<sup>th</sup> 2013



# Context

- Heat Pump Water Heaters have the potential for 50+% energy savings over conventional electric storage heaters
- Gaps
  - Little data available on Multi-Family applications of HPWH
  - Field testing of single-family HPWHs have shown lower than rated performance due to a range of factors
- Target Questions
  - How does the unit compare with manufacturers claim?
  - How well does the unit meet the loads?
  - How viable are HPWH's to other conventional options?

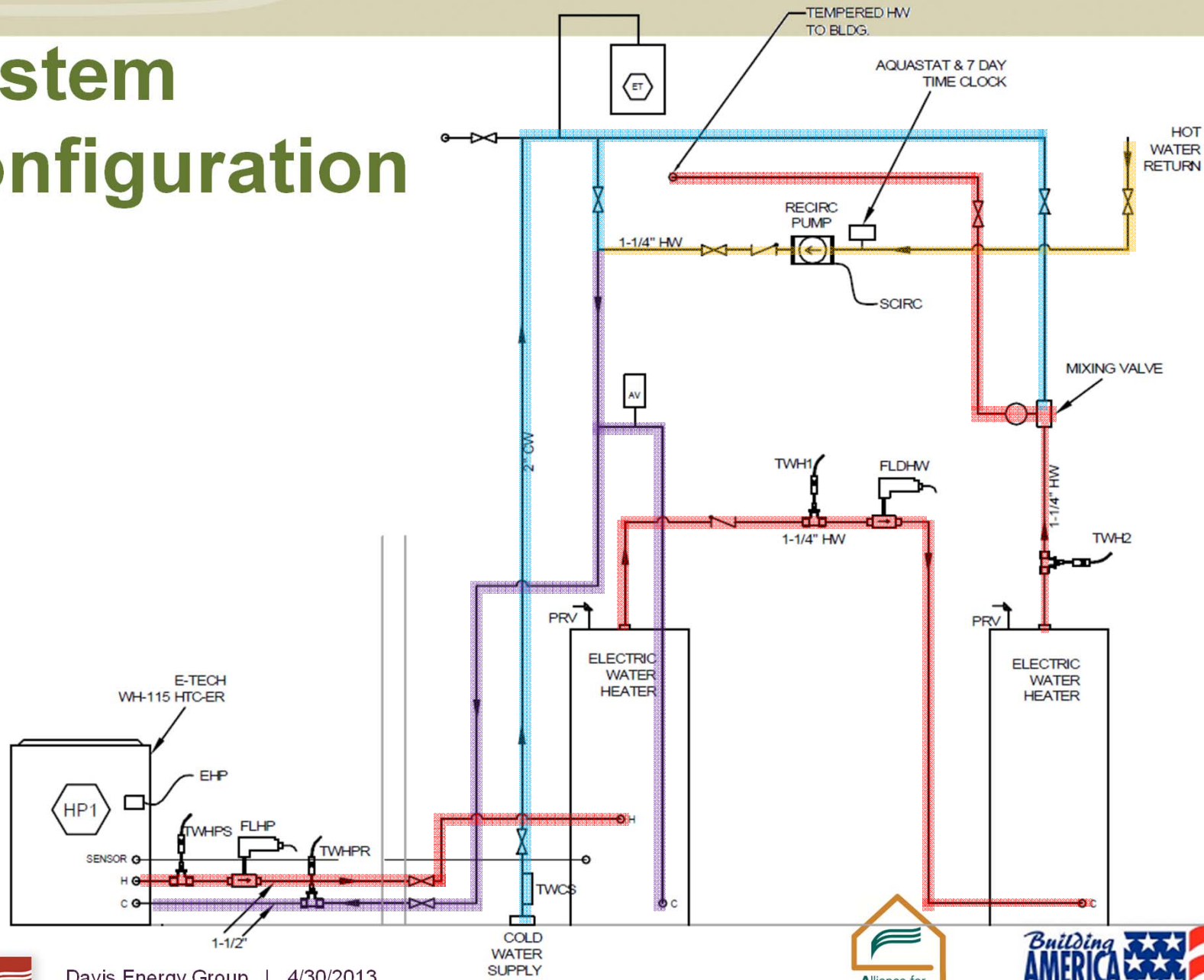


# Technical Approach

- Monitoring
  - Installed at UC Davis West Village ZNE Community as part of all-electric efficiency package Nominal 10.5 ton AO Smith HPWH with two 120 gallon electric storage WH's serving 32-42 occupants/building
  - Monitored September 2011- February 2013
- Commissioning Support
  - Monitoring immediately identified system operating problems present upon installation (plumber unfamiliar with HPWHs, inadequate system commissioning)
- Modeling
  - Developed TRNSYS Model; validated with monitoring data
  - Evaluate vs. alternative WHs in various climates



# System Configuration



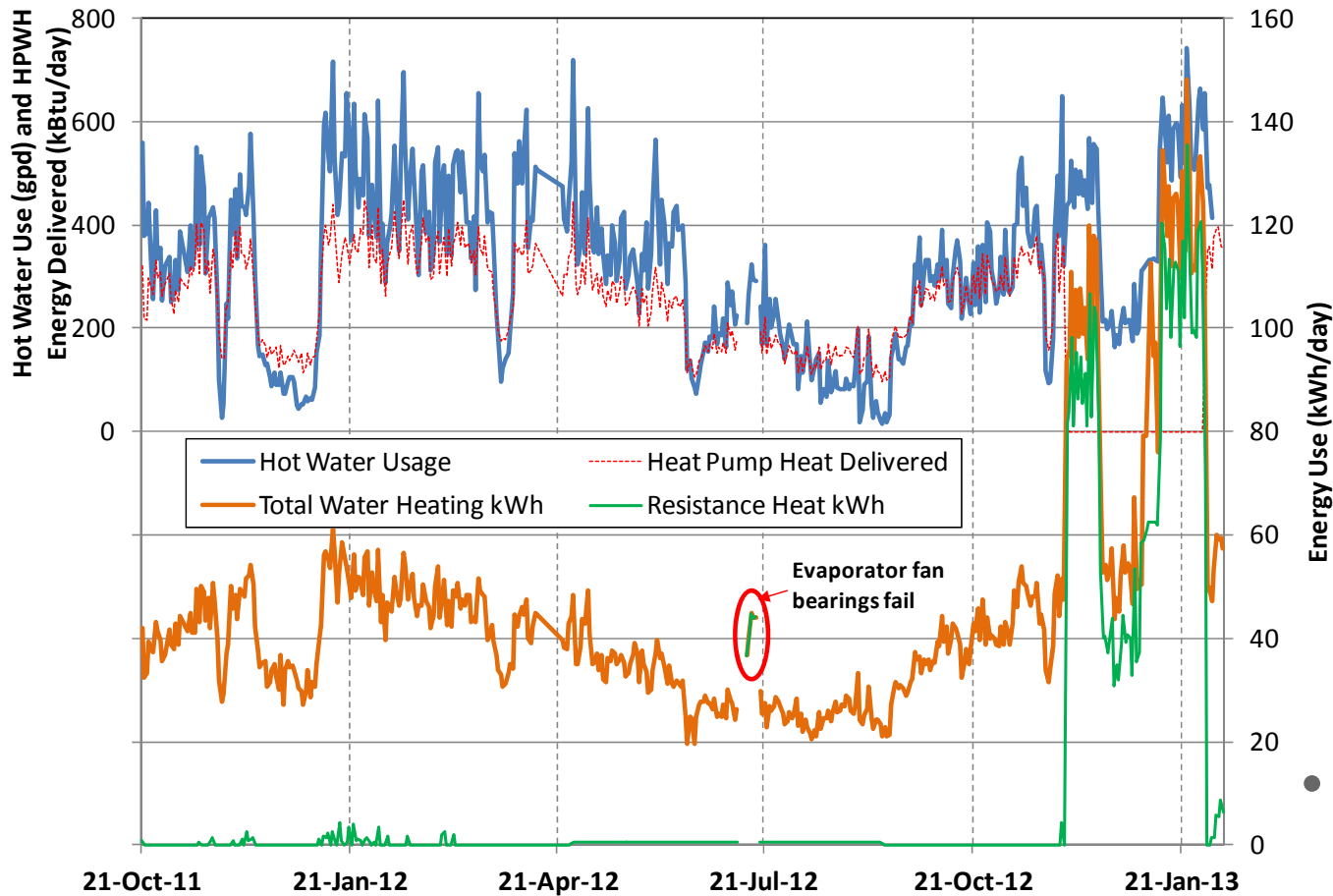
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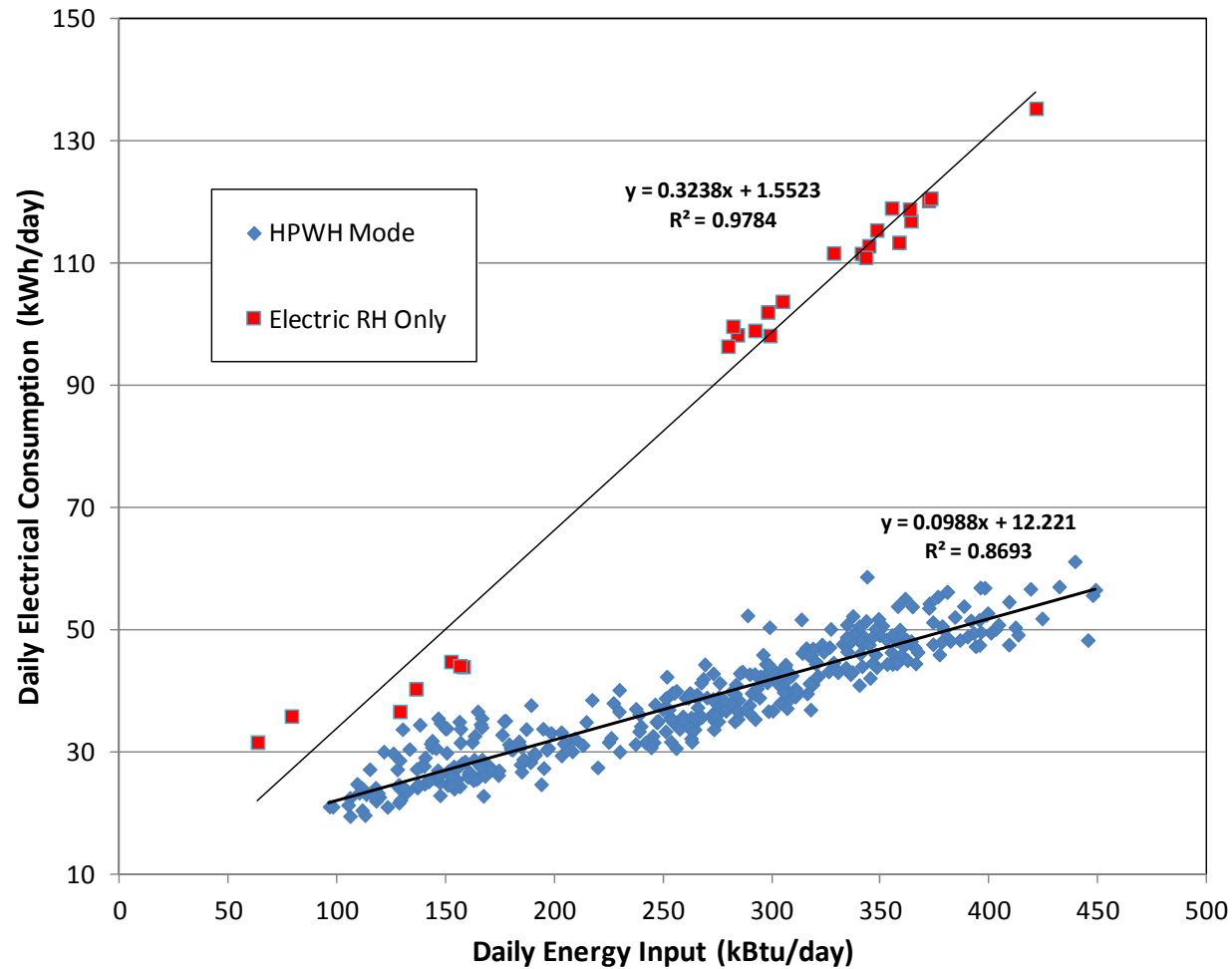
# Monitoring and Commissioning



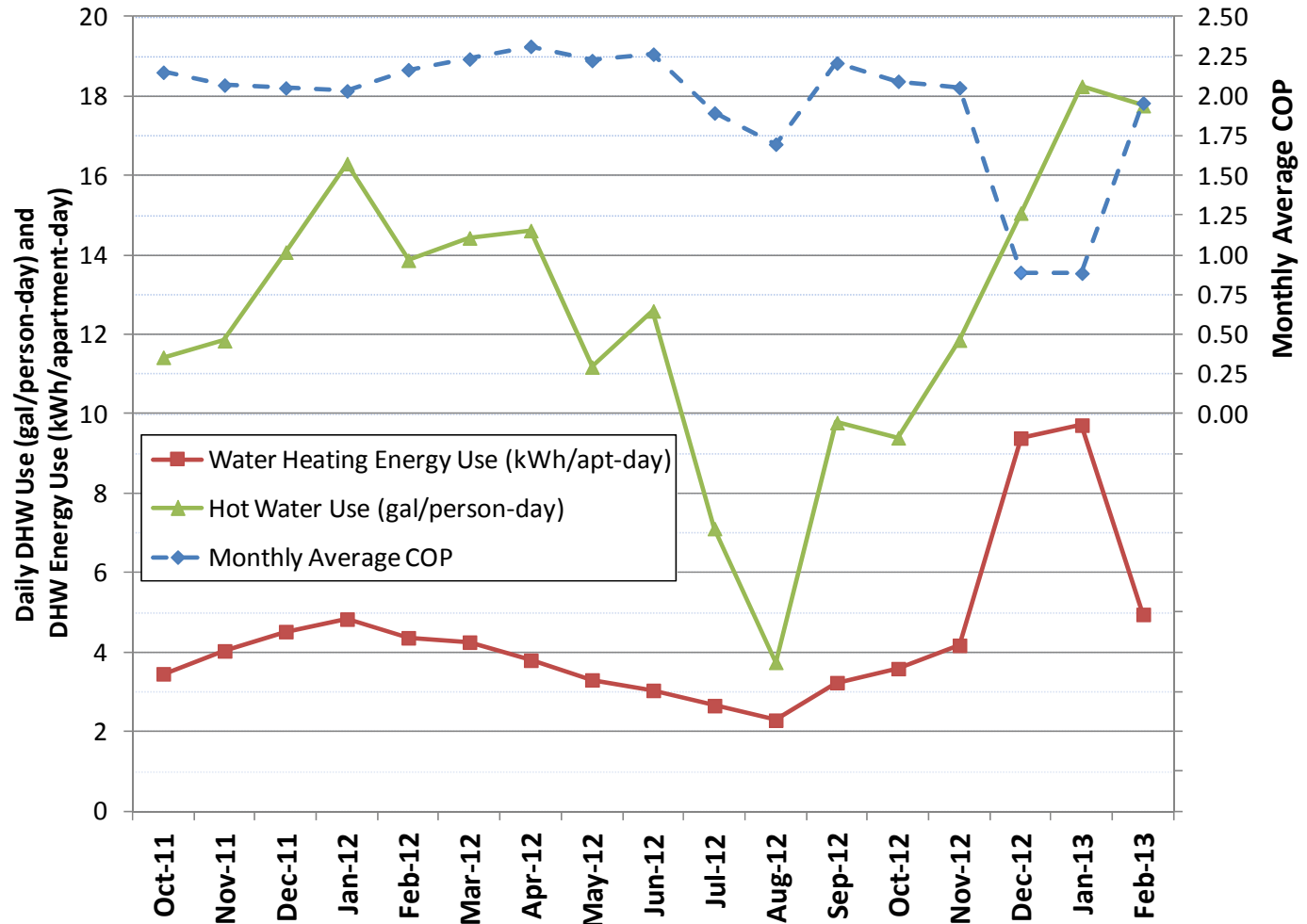
- Data revealed issues with contractor commissioning
  - Improper setpoints
  - Tank probe failure
  - Bearing failure, high temperature cutoff
- Utility bill analysis revealed more problems with other of the 16 systems



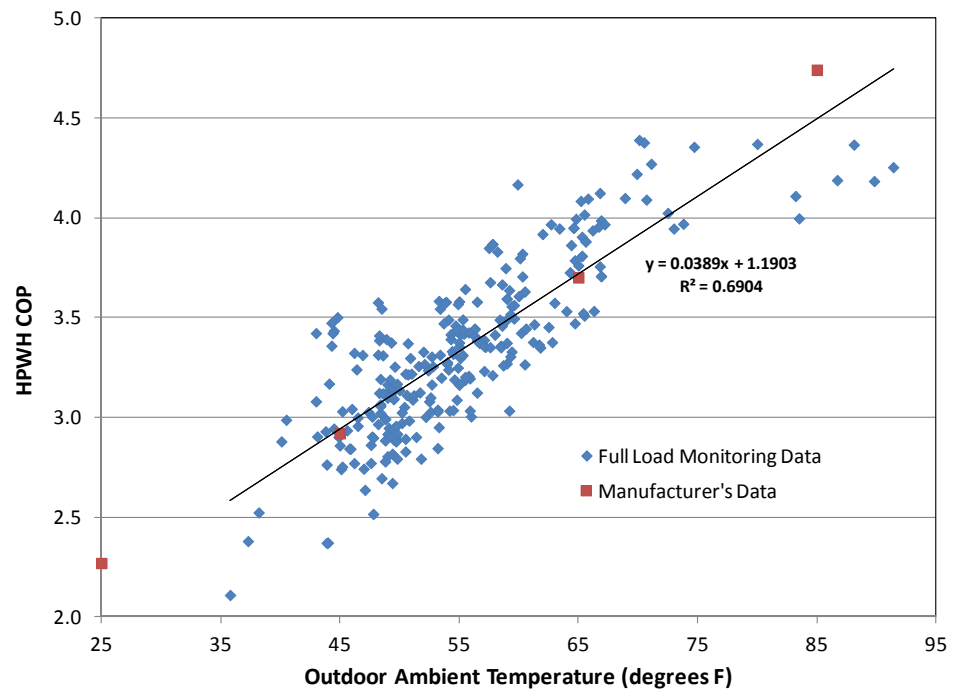
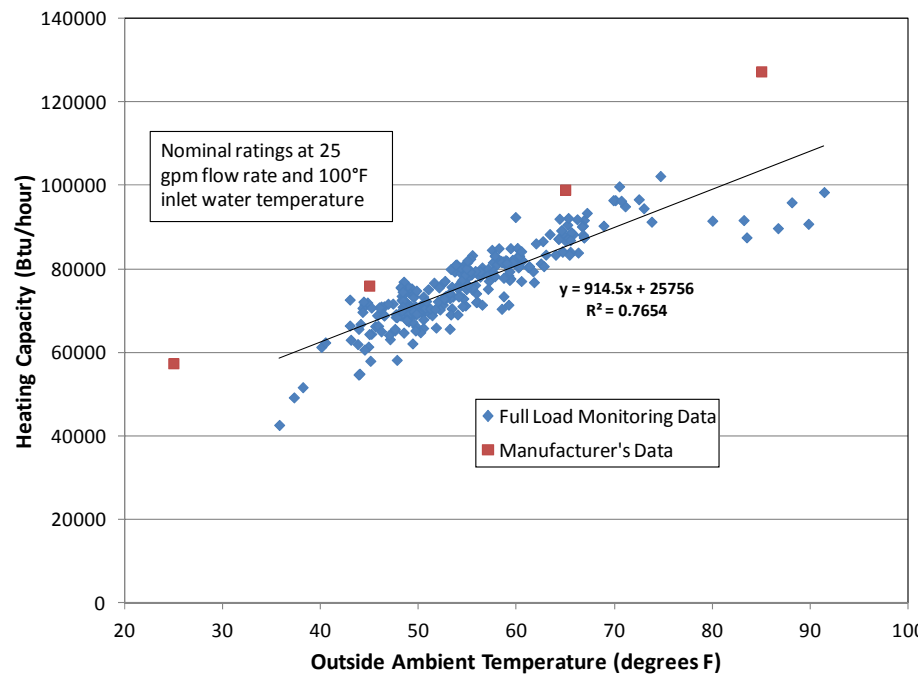
# Monitored Performance



# Monitored Performance



# Performance vs. Manufacturer's Rating





# Modeling

- BEopt is unable to accurately simulate central HPWHs
- Developed TRNSYS Model based on installed configuration
- Validated with monitoring data
- Compared performance in varied climates using representative draw schedule

	Phoenix	Houston	Sacramento	Seattle	Denver	Chicago
Heat Pump Energy Input (kWh/yr)	14,692	16,385	17,850	18,838	15,628	15,185
Electric Resistance Energy Use (kWh/yr)	-	-	275	1,150	8,161	10,562
Heat Pump Energy Delivered (kBtu/yr)	114,284	127,612	139,782	154,558	128,231	122,771
Hot Water Use (gallons/day)	587	609	609	647	647	649
Annual COP	2.28	2.28	2.26	2.27	1.58	1.40

- Evaluating cost performance tradeoffs with standard natural gas and electric resistance storage units



# References

- Dakin, B.; Backman, C.; Hoeschele, M., German, A. 2011. *West Village Community: Quality Management Processes and Preliminary Heat Pump Water Heater Performance*. Alliance for Residential Building Innovation.
- Pacific Gas and Electric Company, 2010. *Laboratory Evaluation and Field Testing of Residential Heat Pump Water Heaters*. PG&E Applied Technology Services Test Report #:491-10.04.
- Shapiro, C., S. Puttagunta, and D. Owens. 2012. “Measure Guideline: Heat Pump Water Heaters in New and Existing Homes”. Building America report completed by CARB.

Coming soon...

- Hoeschele, M. and E. Weitzel. 2013. *Multi-Family Heat Pump Water Heater Evaluation*. Alliance for Residential Building Innovation.



**Thank you!**  
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