

FIELD EVALUATION OF ADVANCED WATER HEATERS

2015 ACEEE Hot Water Forum

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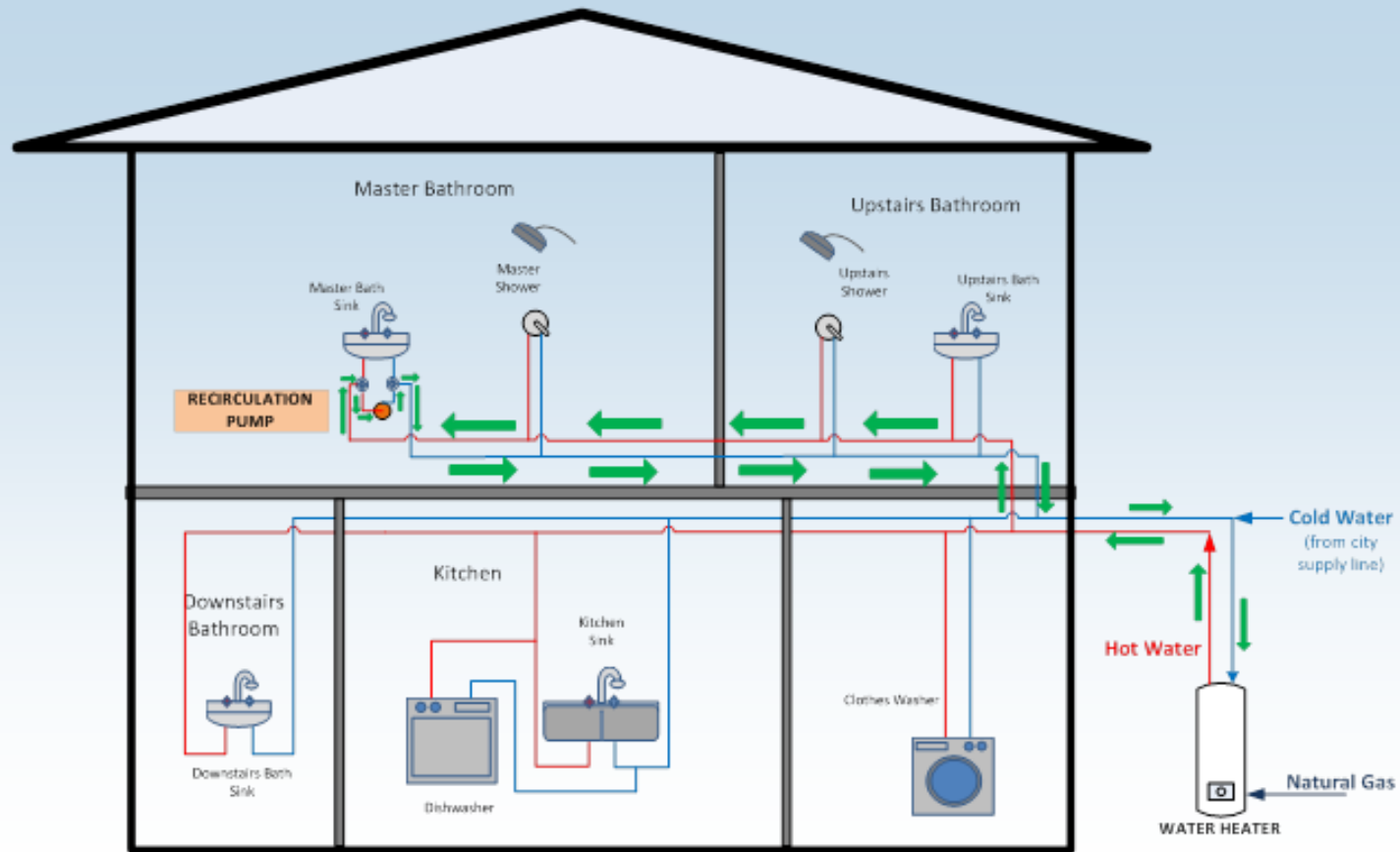
Presentation Overview

- » Objective
- » Scope Study & Results
 - Hybrid Water Heater 1.1
 - Hot Water Delivery Optimization Study
 - Hybrid Water Heater 1.2
 - Instant hot water mode (auto-learn)
 - Condensing Tank Water Heater
 - Hybrid Water Heater 2
 - Improvement after cross-flow valves fix
- » Neutralizer Requirement
- » Conclusions

Objective

- » To evaluate the potential for water and gas savings with the use of advanced hybrid water heaters and condensing tank water heater
 - Part of residential recirculation pump study
 - Test along with a customer-selected recirculation pump was also conducted

Sample Set-Up

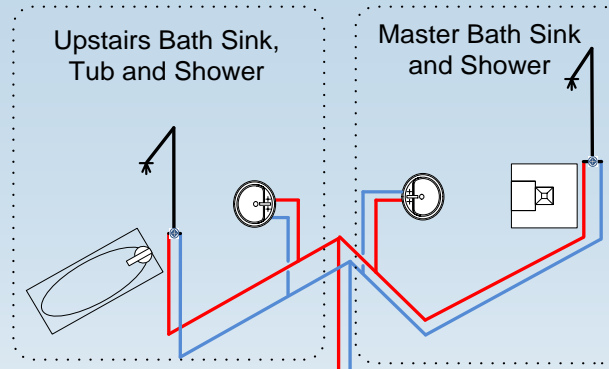


“Cold Water Sandwich”

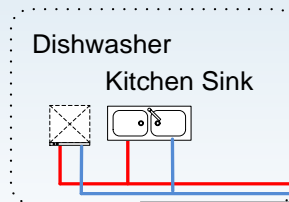
- » Westminster test site had two sources
 - Water heater operation (tankless)
 - Piping lay-out

Westminster Site Piping Layout

Site Number	2
Location	Westminster, CA
Living Area, (ft ²)	2,100
No. of level(s)	Two-story
Number of Occupants	3 – 4 (adults)
Water Heater Location	Water heater closet
Home Year Built	1964



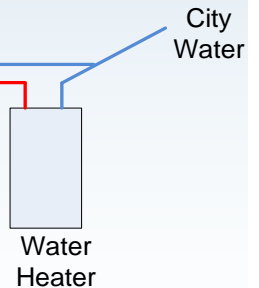
Downstairs Bathroom Sink



Living Room



Garage – Concrete Slab



Hybrid Water Heater 1.1: Hot Water Delivery Optimization Study

- » Objective: To optimize hot water delivery system by utilizing the advanced water heater's internal pump in addition to the first recirculation pump already installed
 - Use thermal bypass valve under kitchen sink and another pump upstairs
 - Both upper and lower hot water branches have hot water recirculation

Hybrid Water Heater 1.1: Hot Water Delivery Optimization Study

- » Water heater set on fast start mode
 - Designed to maintain hot water in the buffer tank for the next five minutes after initiated by a small hot water flow
- » Lower level
 - Use of thermal bypass valve under kitchen sink
- » Upper level
 - Initial plan: install user-activated pump (Pump B)

Hybrid Water Heater 1.1: Hot Water Optimization Study

- » Challenge:
 - Water heater feature: built-in pump runs for internal circulation to equalize temperature across water heater
 - Pump B check valve has low cracking pressure → unnecessary heating of water
- » Pump B is not compatible with the use of water heater with internal pump
- » Solution: Use another pump (Pump E – timer-operated)
 - Check valve responsive to pump-generated pressure
 - Operated on manual on/off mode

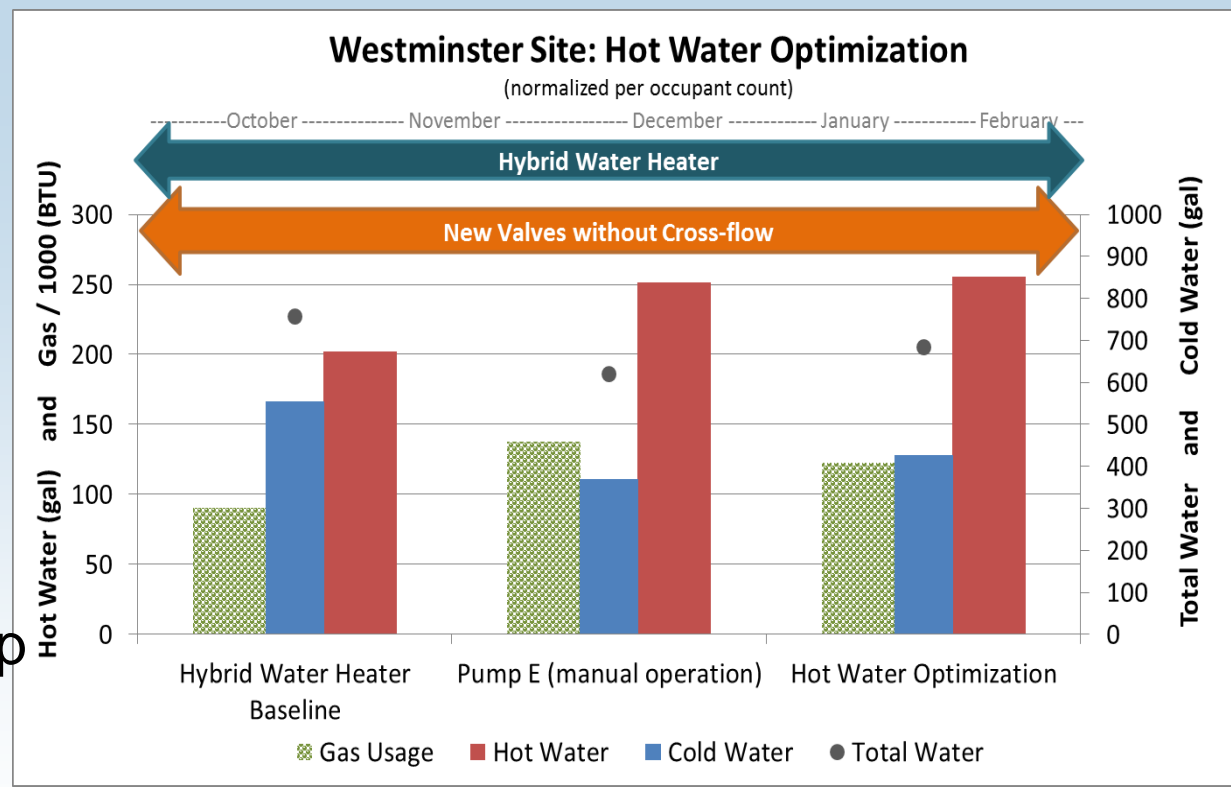
Hot Water Delivery Optimization Study Results

» Savings compared against hybrid water heater baseline:

- Gas: **-35%**
- Hot Water: **27%**

» Savings compared against selected pump on manual mode

- Gas: **11%**
- Hot Water savings: **-2%**



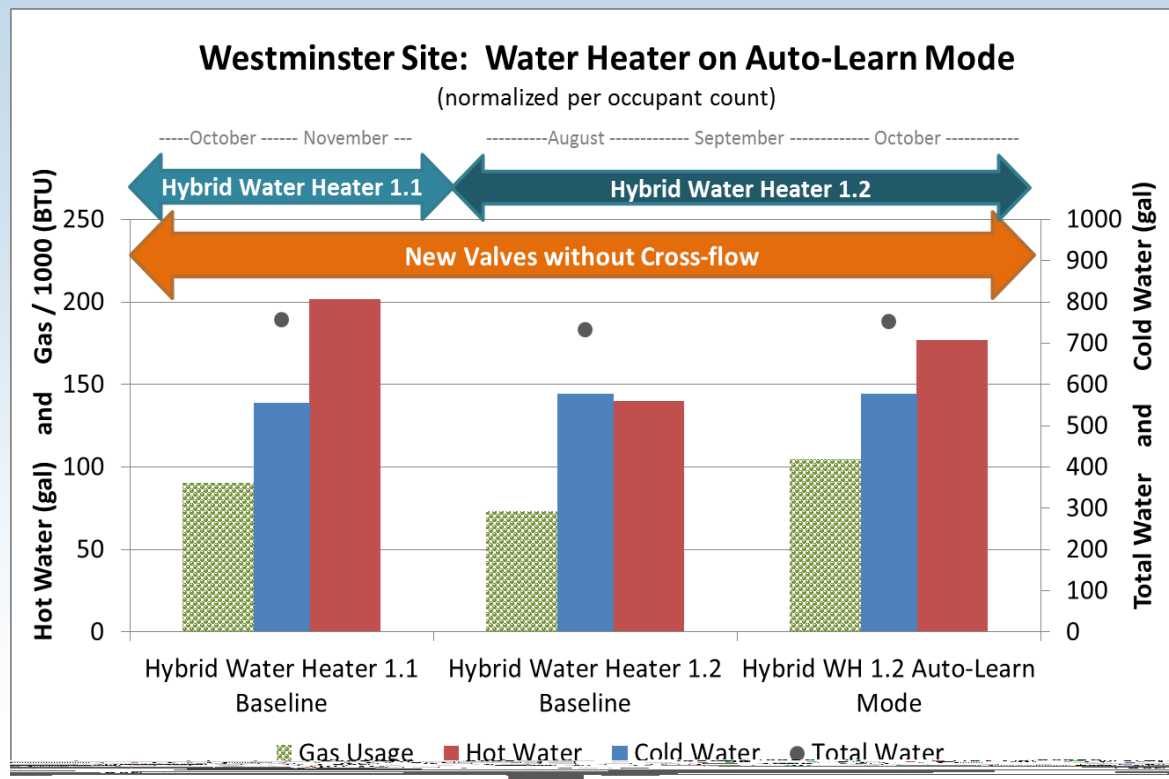
Note: Positive percentage values indicate savings while negative values indicate increase in consumption.

Hybrid Water Heater 1.2: Auto-Learn Mode

- » Auto-learn mode: daily hot water usage anticipated for the rest of the week
 - Measures and logs hot water use → self-program
 - Internal pump runs a few minutes before “learned” times
 - Thermal bypass valve installed under kitchen sink (lower level) and master bath sink (upper level) to serve hot water branches
 - Advantage: takes into consideration difference in weekday and weekend hot water usage

Hybrid Water Heater 1.2: Auto-Learn Mode

- » Baseline for two hybrid water heaters shown for comparison
- » Savings compared against hybrid WH1.2
 - Gas: **-43%**
 - Hot Water: **-26%**
- » Savings compared against hybrid WH1.1
 - Gas: **-16%**
 - Hot Water: **12%**



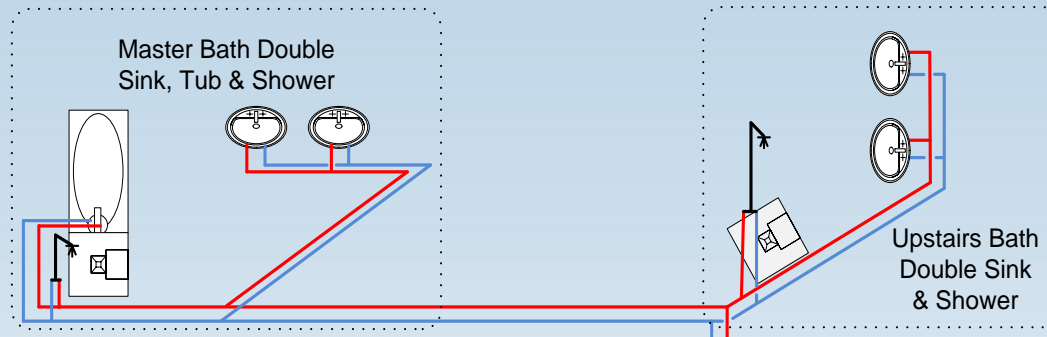
Note: **Positive percentage values** indicate savings while **negative values** indicate increase in consumption.

Condensing Tank Water Heater

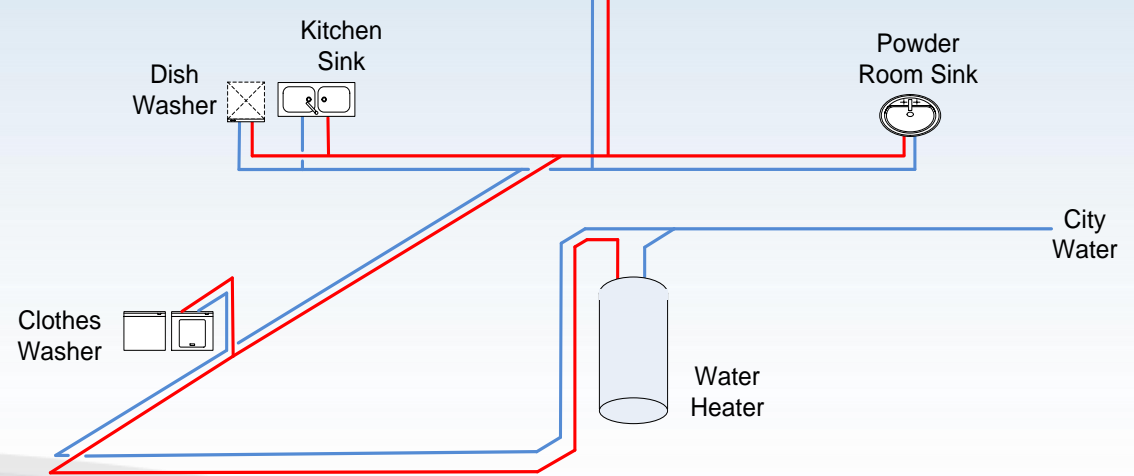
- » Site with 8 occupants
- » Replaced with larger capacity gas meter



Chino Site Piping Layout



Site Number	3
Location	Chino, CA
Living Area, (ft²)	2,300
No. of level(s)	Two-story
Number of Occupants	8 (2 adults, 6 children – ages 4 to 17)
Water Heater Location	Water heater closet
Home Year Built	1991



Condensing Tank Water Heater

» Baseline for tank water heater collected during summer and winter shown for comparison

» Savings compared against summer baseline

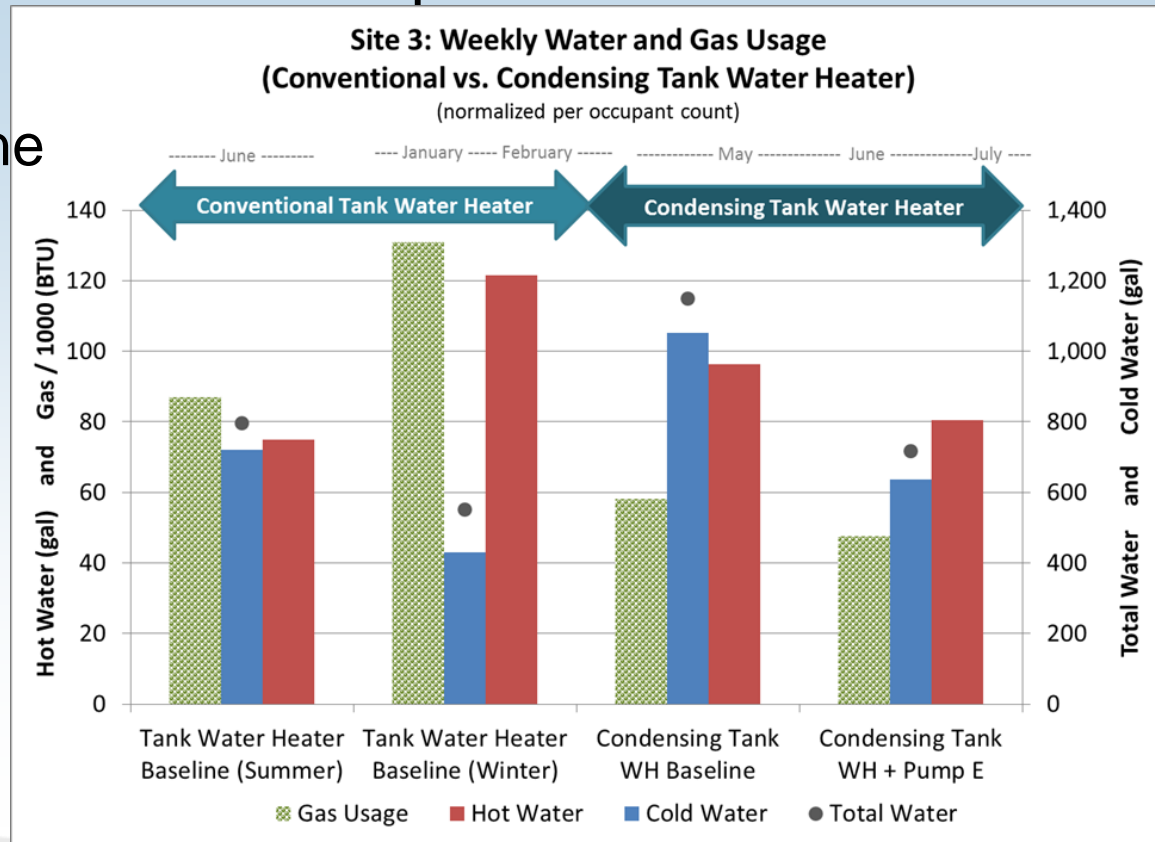
- Gas: 33%
- Hot Water: -29%

» Savings compared against winter baseline

- Gas: 56%
- Hot Water: 21%

» Savings with pump

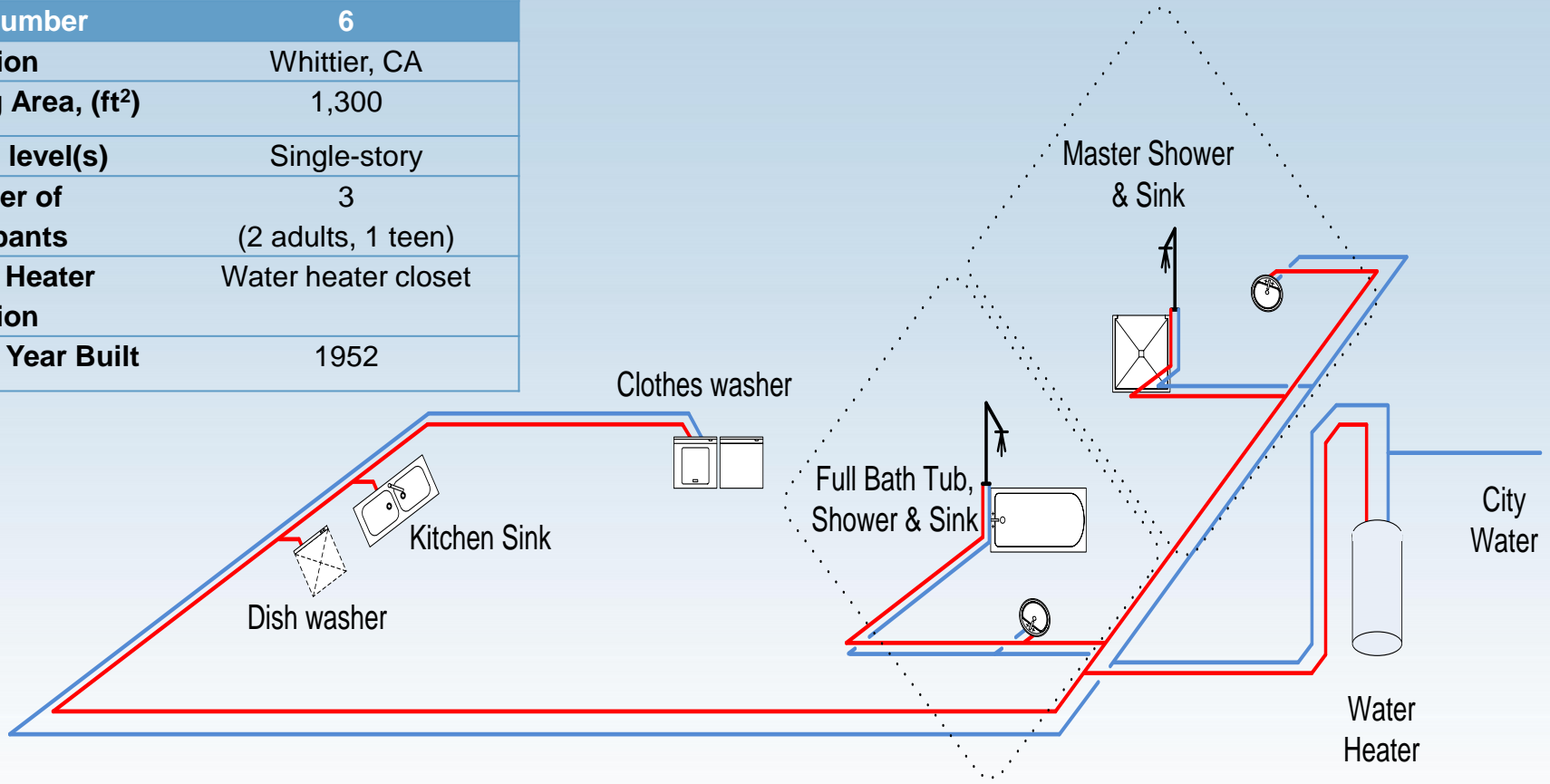
- Gas: 18%
- Hot Water savings: 16%



Note: Positive percentage values indicate savings while negative values indicate increase in consumption.

Whittier Site Piping Layout

Site Number	6
Location	Whittier, CA
Living Area, (ft²)	1,300
No. of level(s)	Single-story
Number of Occupants	3 (2 adults, 1 teen)
Water Heater Location	Water heater closet
Home Year Built	1952



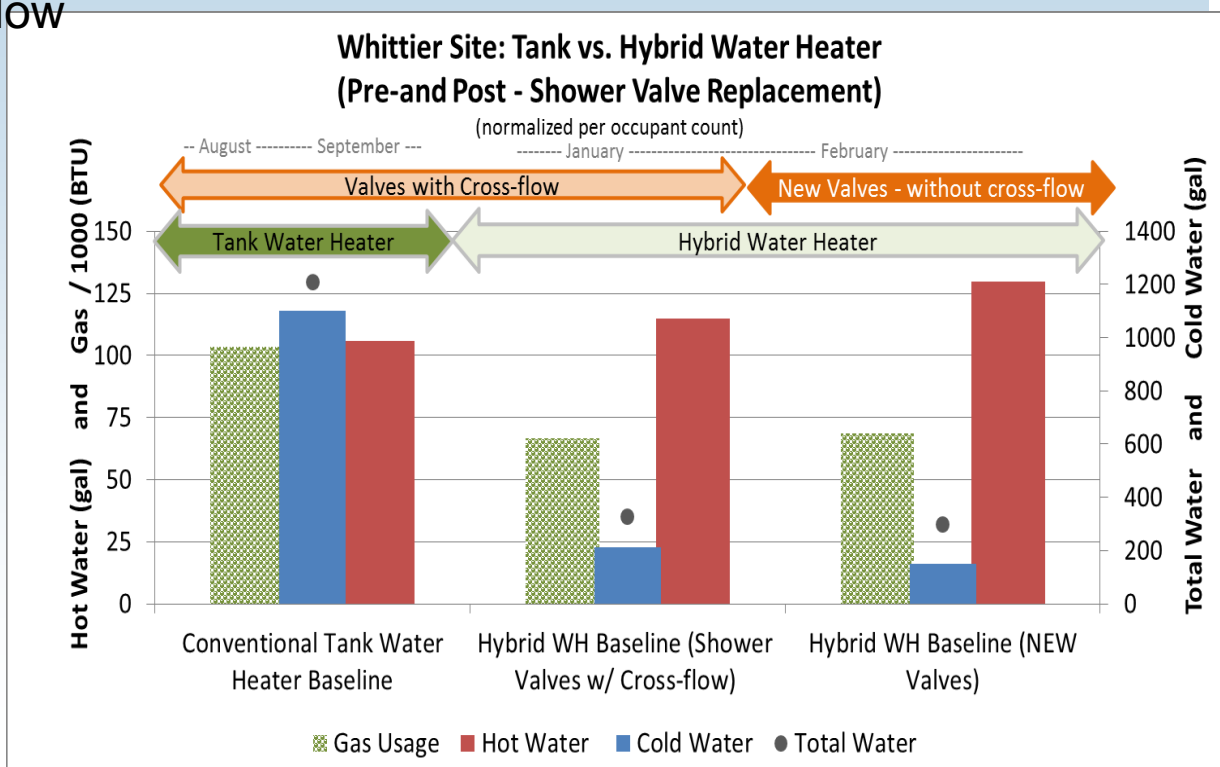
Hybrid Water Heater 2

» Two baseline data collected for new hybrid water heater:

- Valves with Cross-flow
- Valves without cross-flow

» Savings compared against tank water heater

- Gas: 34% to 36%
- Hot Water: -9 to -23%



Note: Positive percentage values indicate savings while negative values indicate increase in consumption.

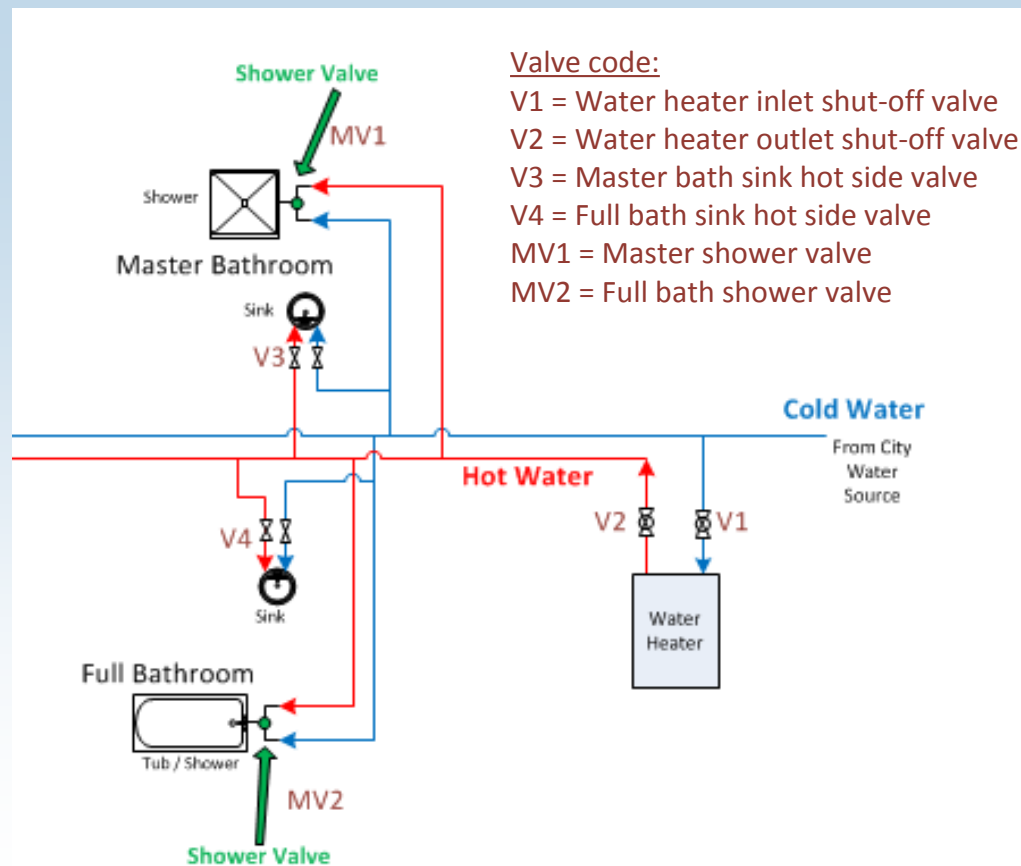
Valves with Cross-flow Problems

- » Usual source: old faulty or non-pressure balanced shower valves
- » More easily noticed for homes with hybrid advanced water heaters



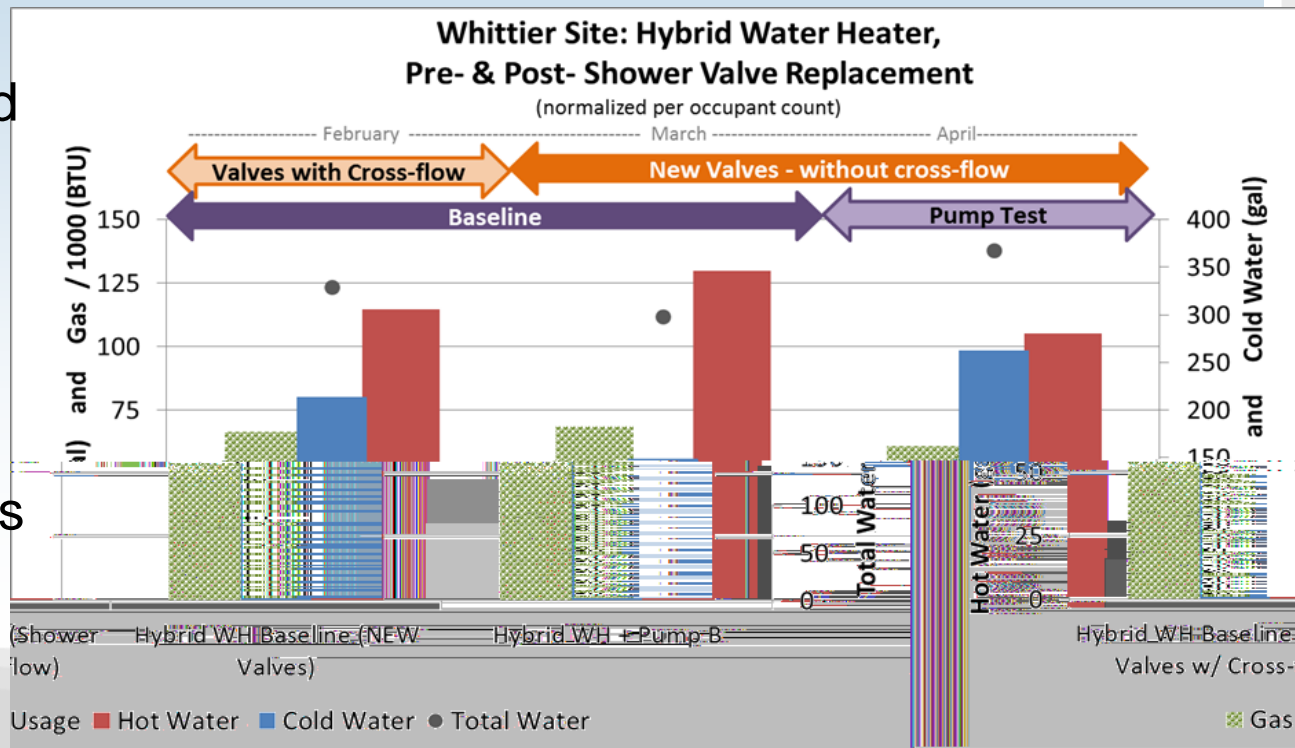
Checking for Cross-flow

- (1) Shut off inlet water valve to water heater
- (2) Open hot water faucets one at a time
 - Flow should gradually decrease and stop
 - If flow continues, there is a source of cross-flow



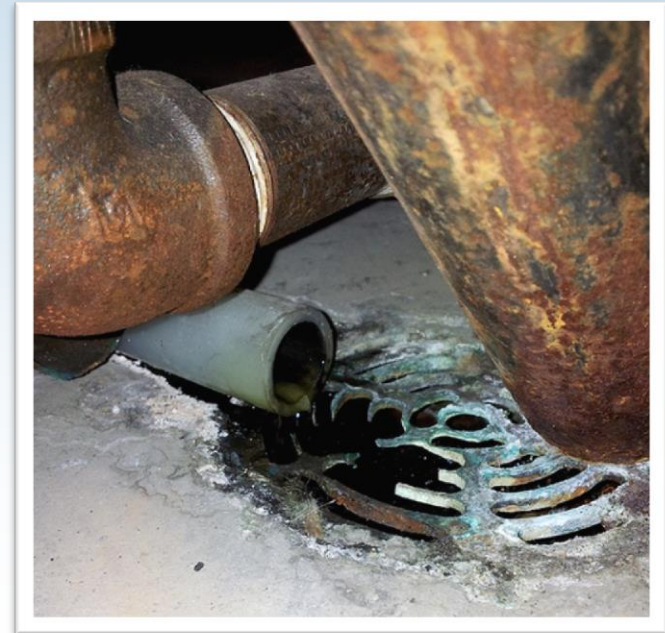
Hybrid Water Heater 2: Before and After Cross-flow Valve Fix

- » Baseline (for valves with cross-flow) not realistic presentation of hot water use
 - Customers experienced running out of hot water during shower
 - Change in shower method
- » Savings compared against baseline + old valves
 - Gas: **-3%**
 - Hot Water: **-13%**
- » Savings with pump compared against baseline + new valves
 - Gas: **11%**
 - Hot Water: **19%**



Treating Condensate from Condensing Water Heater

- » Acidic condensate requires treatment to avoid damage to piping systems, sewer and other items it may come in contact with



Pictures Source: <http://axiomind.sasktelwebhosting.com/CondensateNeutralizers.php>

Neutralizing Kit

- » Designed to raise the pH level of the condensate discharged by high-efficiency boilers and water heaters
- » Orientation: outlet should be at a higher elevation than the inlet
 - Higher contact surface area
- » Challenge: water heater not working properly as condensate would not properly drain
 - Condensate hose loop requirement
 - Neutralizer in vertical position



Neutralizing Kit

» Solution:

- Change to horizontal position
- Lessen by one loop (as long as neutralizer is always water-filled)



Savings from switching to an advanced water heater

	Original Water Heater Type	New Water Heater Type	Savings	
			Gas	Hot Water
Site 2	Tankless	Higher Efficiency Water Heater - Hybrid	25%	39%
Site 3	Conventional Tank Type	Higher Efficiency Water Heater – Condensing Tank (50 gal)	44%	-4%
Site 6	Conventional Tank Type	Higher Efficiency Water Heater - Hybrid	-15%	-16%

Note: **Positive percentage values** indicate savings while **negative values** indicate increase in consumption.

Savings with New Water Heater & Selected Recirculation Pump

	Site 2	Site 3	Site 6
Pump Selected	Pump E	Pump D	Pump B
Mode of Operation	On-demand (customized)	On-demand (customized)	On-demand
Gas Usage by Water Heater	-19%	18%	11%
Hot Water Consumption	-18%	16%	19%

Note: **Positive percentage values** indicate savings while **negative values** indicate increase in consumption.

Conclusions

- » Customer satisfied with “endless” hot water availability for hybrid tankless water heater
- » Cross-flow issues were noticeable with hybrid water heater
- » Customer with condensing tank type water heater satisfied with added capacity of hot water
- » Gas and hot water savings were observed in some, but not all locations
 - Dependent on user behavior

Thank you!

Questions?

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