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FIELD EVALUATION OF RESIDENTIAL RECIRCULATION PUMPS

2015 ACEEE Hot Water Forum

February 24, 2015

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Presentation Overview

- Project Objectives
- Tested Pumps
- Test Sites
- Test Methodology
- Results (Hot Water and Gas Savings)
- Customer Feedback
- Recommendations
- Conclusion

Objectives

» To evaluate the performance and potential water and gas savings from the use of recirculation pumps
  - Baseline: data collected with existing plumbing set-up
  - Retrofit: data collected with recirculating pumps in use at five homes

» To evaluate potential savings after putting in new water heater
  - Baseline: data collected with existing plumbing set-up
  - Retrofit: data collected with customer-selected pump in use

Recirculation Pumps Tested

Residential Recirculation Pump	Pump A	Pump B	Pump C	Pump D / Pump E (for tank-type / tankless water heater use) *(by same manufacturer)*
Pump Location	Pump at water heater outlet; thermal bypass valve installed under the sink	Under the sink	Under the sink	Under the sink
Activation System	Built-in 24-hour timer in 15-minute increments	On-demand by wireless or wired push-button	On-demand by wireless or wired push-button	Built-in 24-hour timer in 30-minute increments
Pump Operation	- Continuously runs on "ON" mode and during pre-set times. - bypass valve prevents flow at set temperature	-Starts at a push of a button - Shuts off after internal thermistor detects a set temperature rise	-Starts at a push of a button - Shuts off when circuitry detects a set temperature rise	- Starts on "ON" mode and during pre-set times. -Stops when set high temperature is met -Runs again when temperature cools down to low set temperature

Site Selection Process

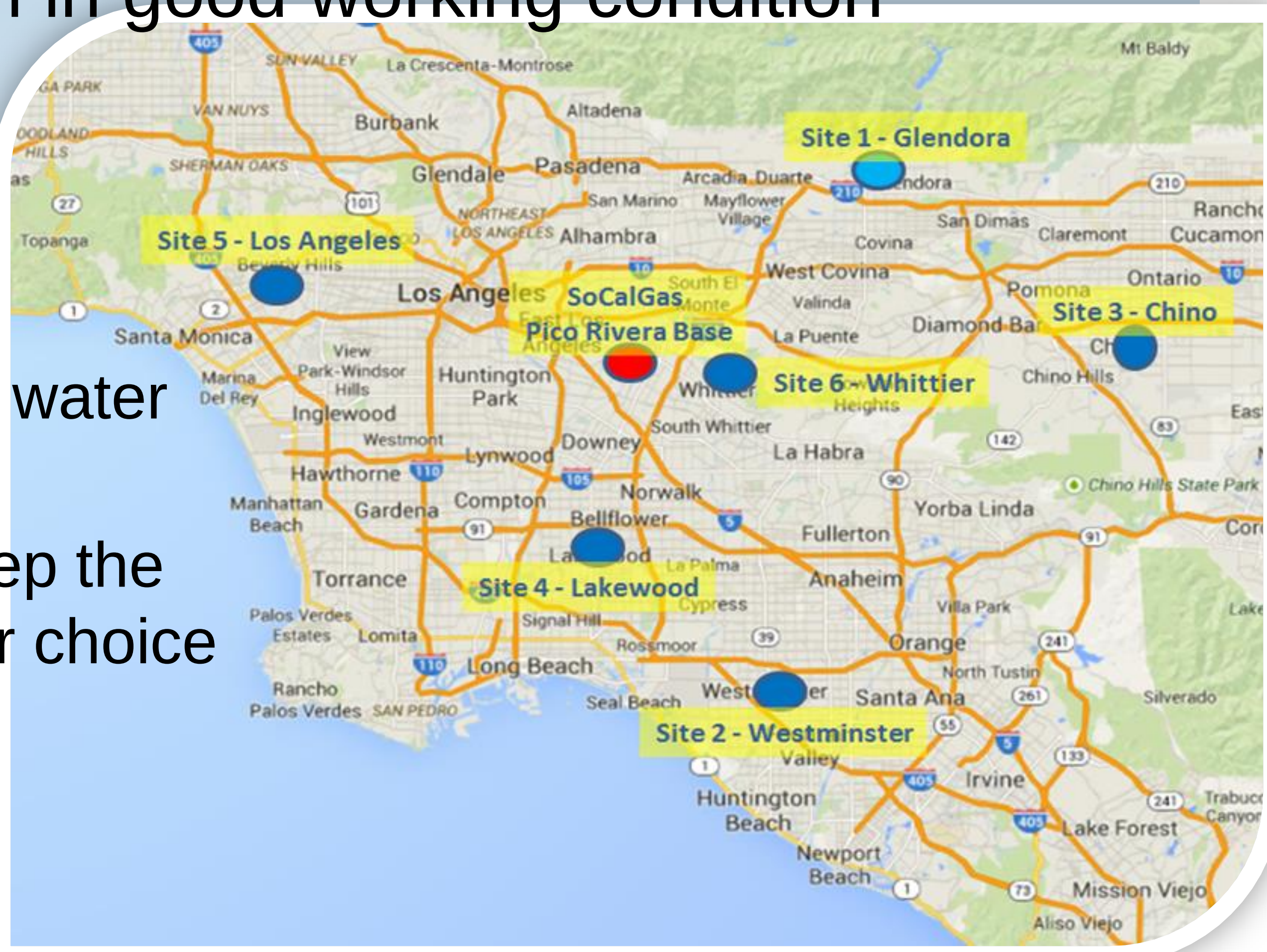
» Located within SoCalGas territory

» Piping system in good working condition

» Customer availability

» Incentive:

- Provide new water heater
- Option to keep the pump of their choice



Test Matrix

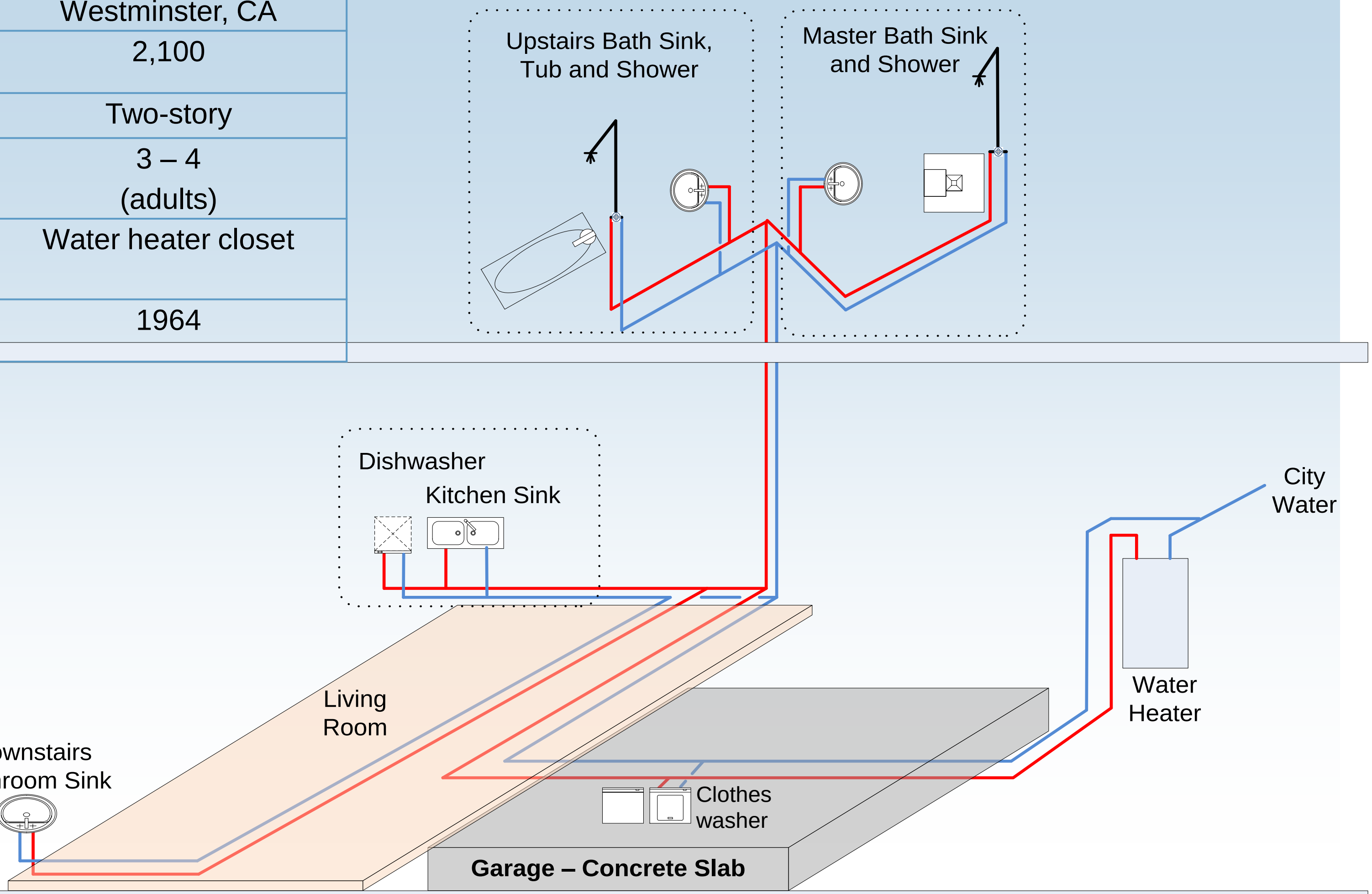
	Old Water Heater					New Water Heater	
	Baseline	Pump A	Pump B	Pump C	Pump D/E	Baseline	Selected Pump
Site 2 – Westminster							
Site 3 – Chino							
Site 4 – Lakewood							
Site 5 – Los Angeles							
Site 6 – Whittier							

Legend:

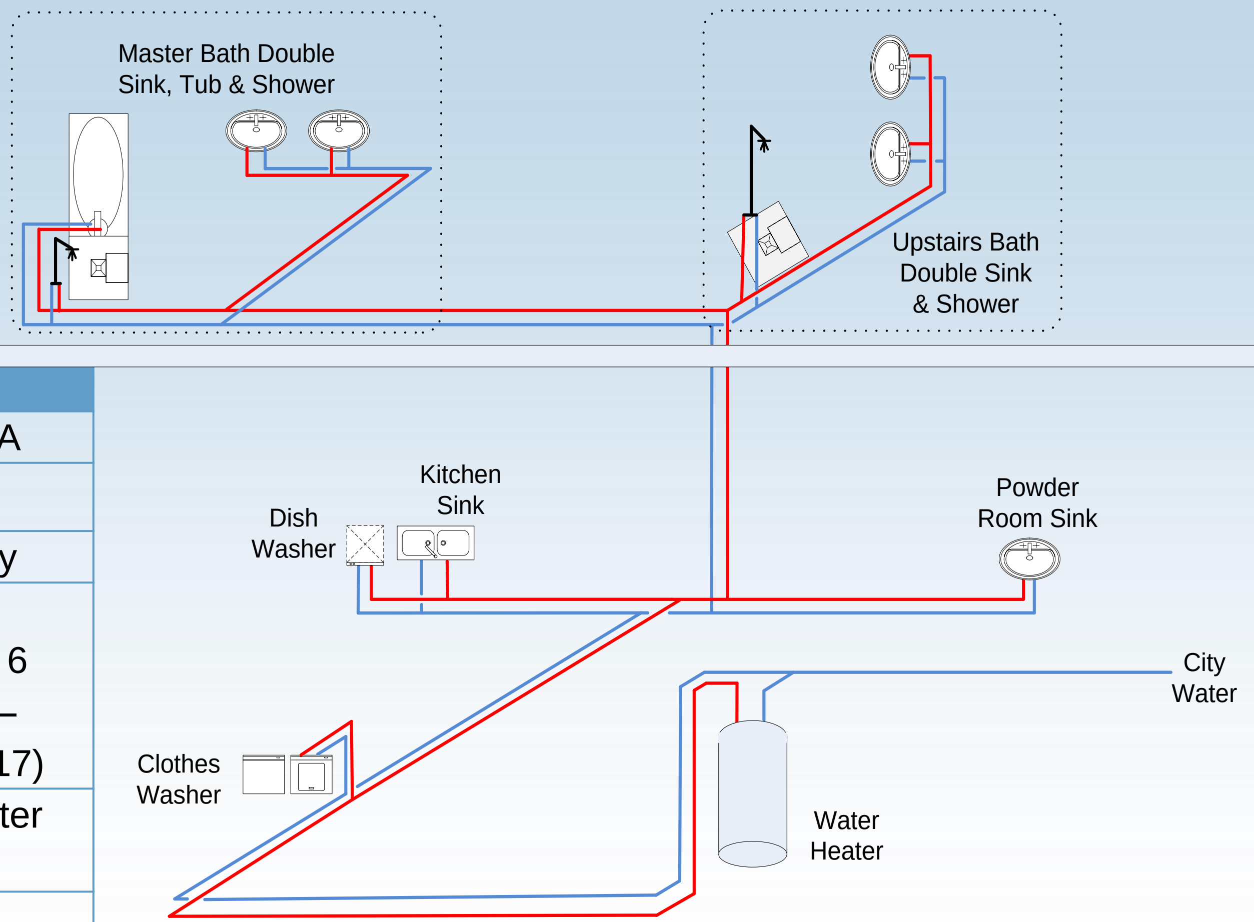
- Recirculation pump
- Fall baseline
- Summer baseline
- Winter baseline
- Lower WH Set point
- Higher WH Set point
- Pump on timer
- Pump manual on/off
- Hot Water Optimization Study
- Instant Hot Water / Auto-Learn Mode
- New Shower Valves (no cross-flow)
- Old Shower Valves (w/ cross-flow)

Westminster Site Piping Layout

Site Number	2
Location	Westminster, CA
Living Area, (ft²)	2,100
No. of level(s)	Two-story
Number of Occupants	3 – 4 (adults)
Water Heater Location	Water heater closet
Home Year Built	1964



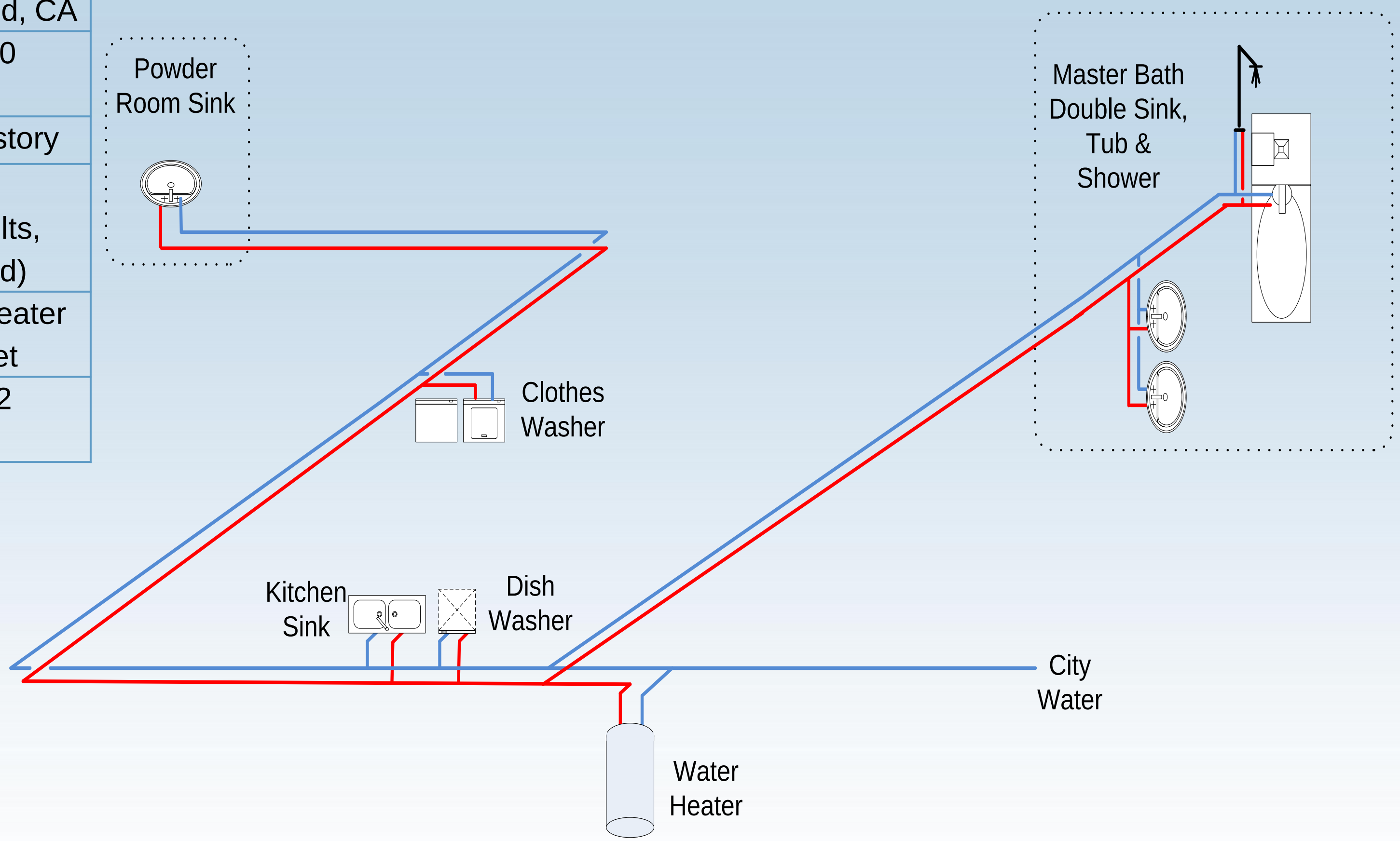
Chino Site Piping Layout



Site Number	3
Location	Chino, CA
Living Area, (ft^2)	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

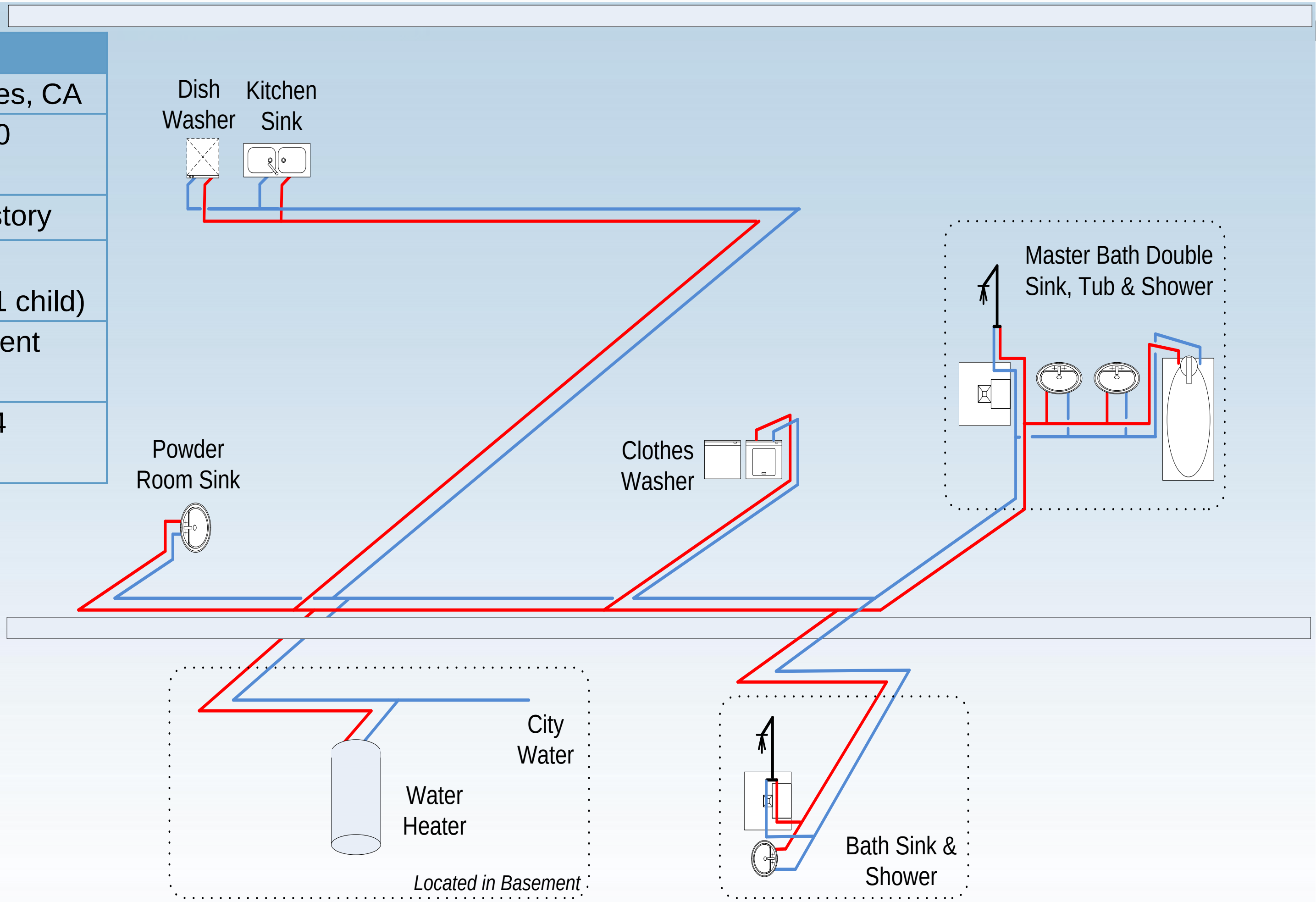
Lakewood Site Piping Layout

Site Number	4
Location	Lakewood, CA
Living Area, (ft^2)	1,800
No. of level(s)	Single-story
Number of Occupants	3 (2 adults, 1 child)
Water Heater Location	Water heater closet
Home Year Built	1942



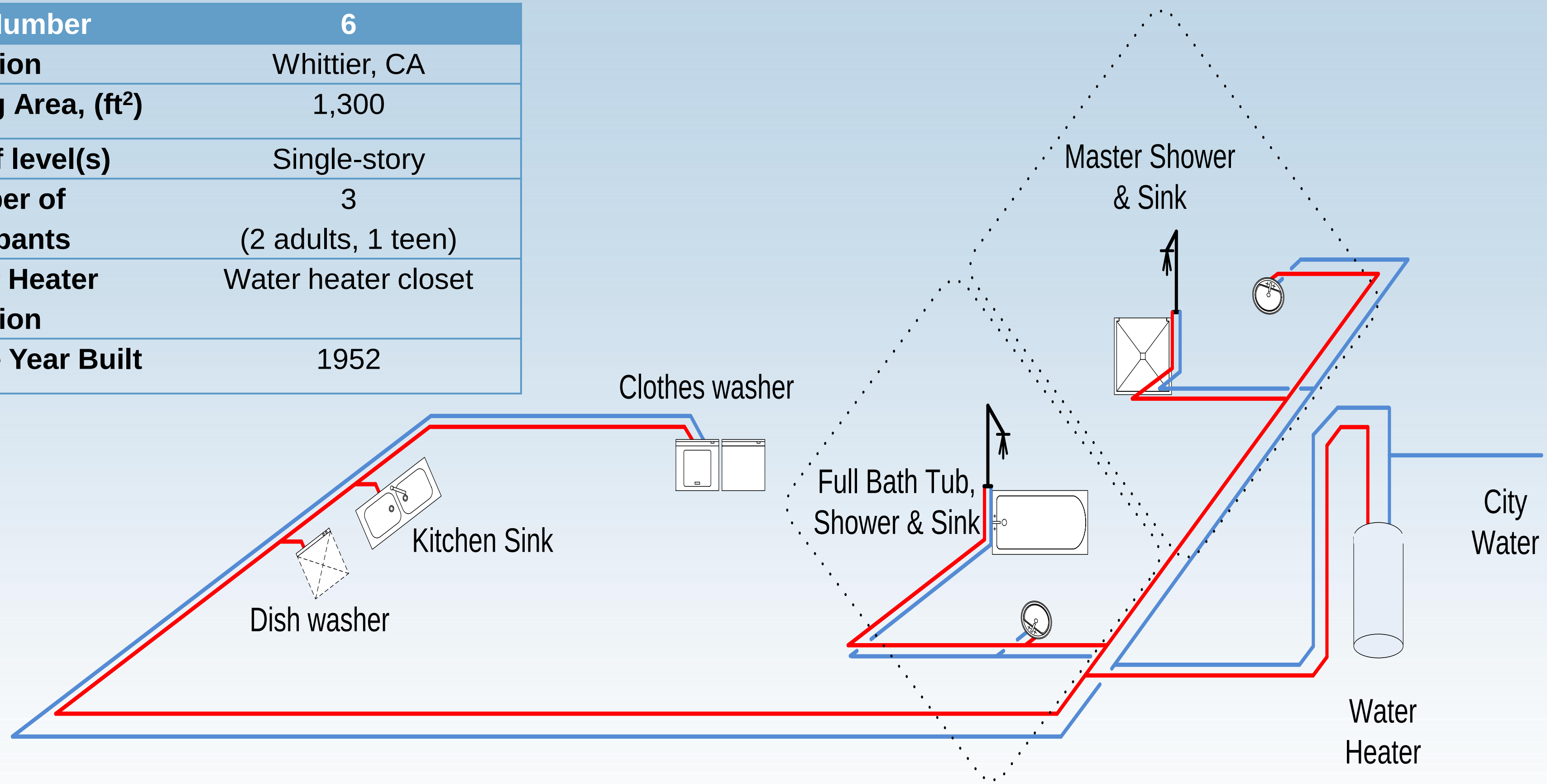
Los Angeles Site Piping Layout

Site Number	5
Location	Los Angeles, CA
Living Area, (ft^2)	1,750
No. of level(s)	Single-story
Number of Occupants	3 (2 adults, 1 child)
Water Heater Location	Basement
Home Year Built	1924



Whittier Site Piping Layout

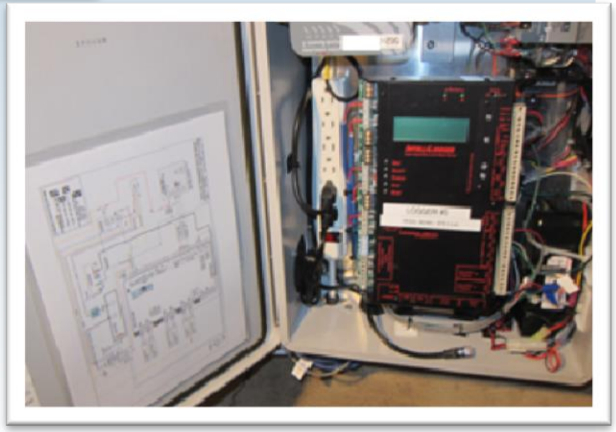
Site Number	6
Location	Whittier, CA
Living Area, (ft^2)	1,300
No. of level(s)	Single-story
Number of Occupants	3 (2 adults, 1 teen)
Water Heater Location	Water heater closet
Home Year Built	1952



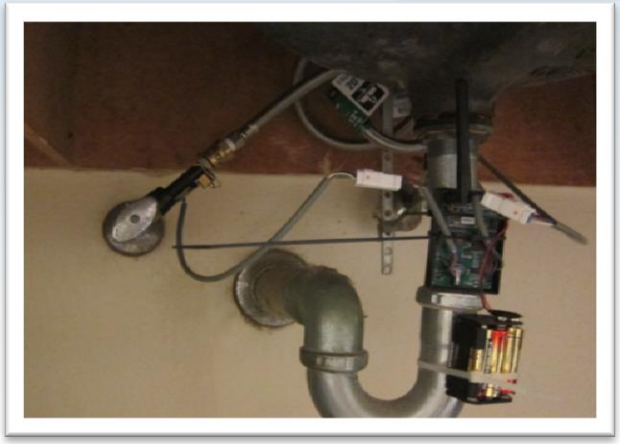
Measured Parameters

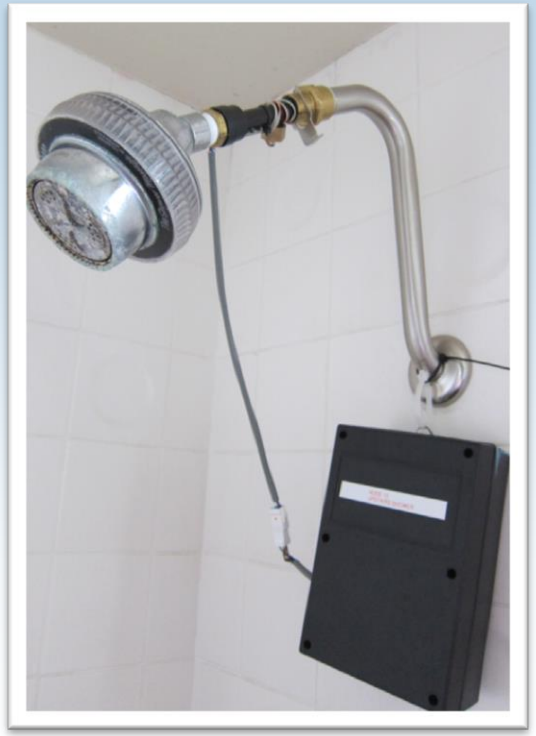
Description	**Tag**
Temperature Data Points (^{o}F)	
Ambient Temperature (probe)	T1
Water Inlet Temperature (surface)	T2
Water Heater Outlet Temperature (surface)	T3
Exhaust Temperature (probe)	T4
Gas Temperature (probe)	T5
Flow Data Points	
Water Meter Flow – water heater (gpm)	F1
Gas Meter Flow (CFH)	F2
Curb Water Meter ×Vü"ÊQB6P4r)¾rÞQy@cÀwuiÀQëiQ	

Instrumentations



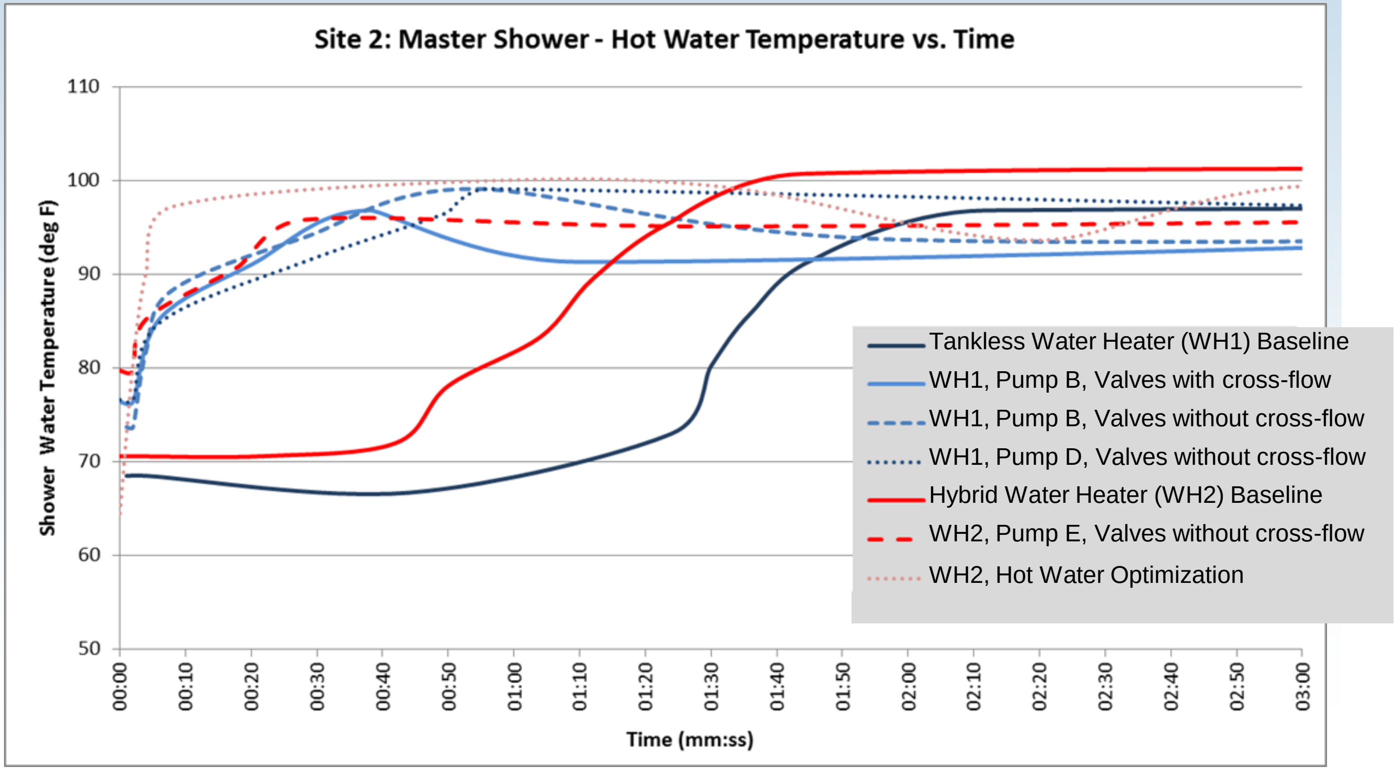
Instrumentations:
Water Fixture Sensors





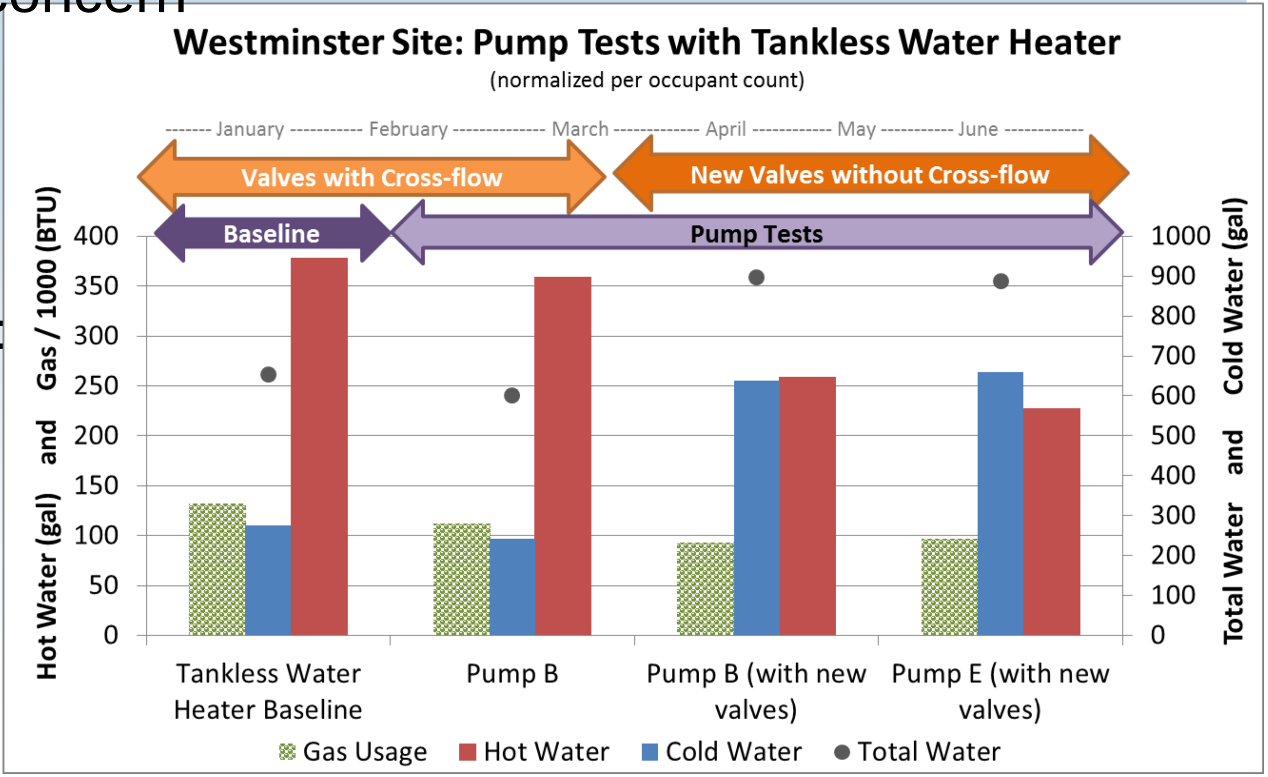
Faster Hot Water Delivery with Recirculation Pump

- Without pump: >1 minute wait time
- With pump: <10 seconds
  - Time saved: 30 seconds to 3 minutes
  - Water saved: 3 to 8 gallons per shower



Westminster Site Results

- Four pumps tested but data collected for only two pumps
  - Pump A - not compatible with tankless water heater
  - Pump C - noise concern
- Findings:
  - Gas savings:
    15% to 30%
  - Hot Water savings:
    5% to 40%
  - New valves (no cross-flow) increased gas & hot water savings



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

Chino Site Results

» Less gas & hot water usage in the summer vs. winter

» Compared to summer baseline
- Gas savings:
  -10% to -51%
- Hot water savings:
  -2% to -43%

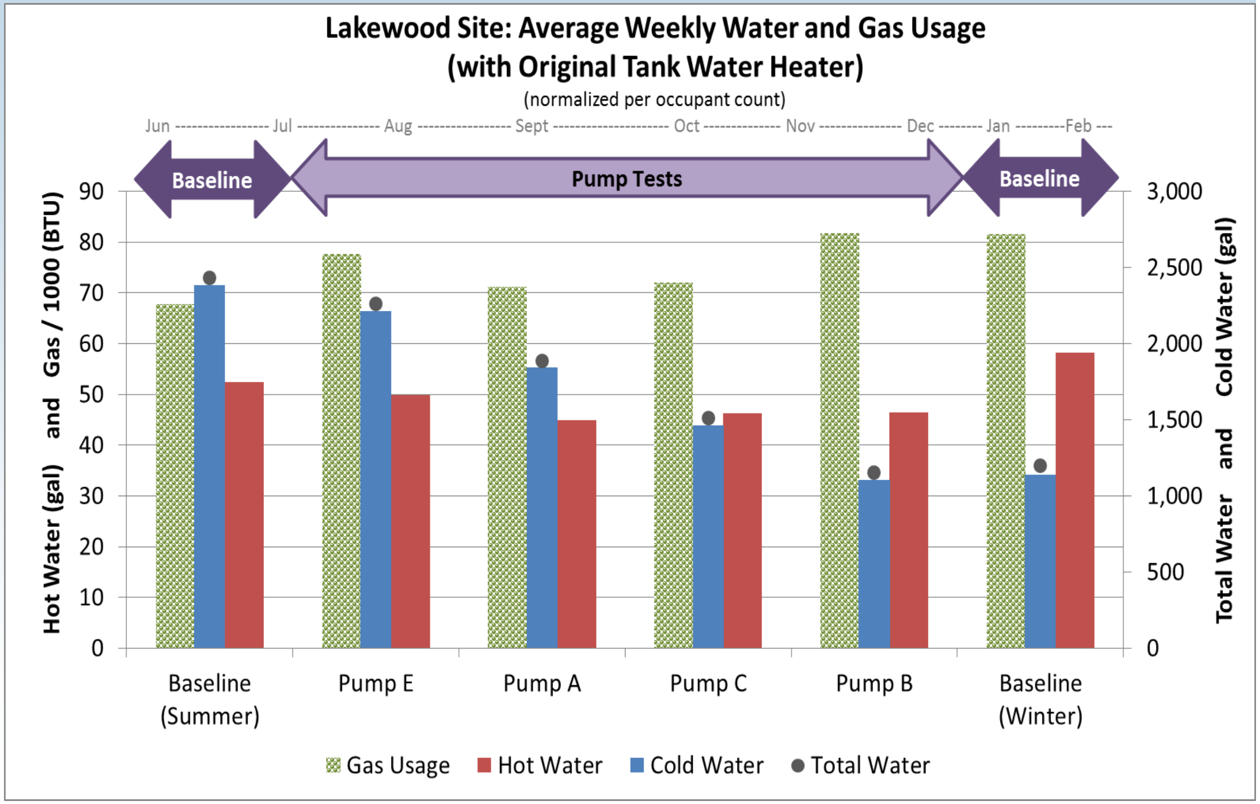
» Compared to winter baseline
- Gas savings:
  19% to 27%
- Hot water savings:
  12% to 30%

» Selected pump varying mode of activation
- Timer vs. on-demand

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

Lakewood Site Results: Original Tank Water Heater

- » Less gas and hot water usage in the summer vs. winter
- » Compared to summer baseline
  - Gas savings: -5% to -21%
  - Hot water savings: 5% to 14%
- » Compared to winter baseline
  - Gas savings: 5% to 13%
  - Hot water savings: 15% to 23%



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

Lakewood Site Results: New Tank Water Heater

» Lower water heater temperature setting = decreased gas usage

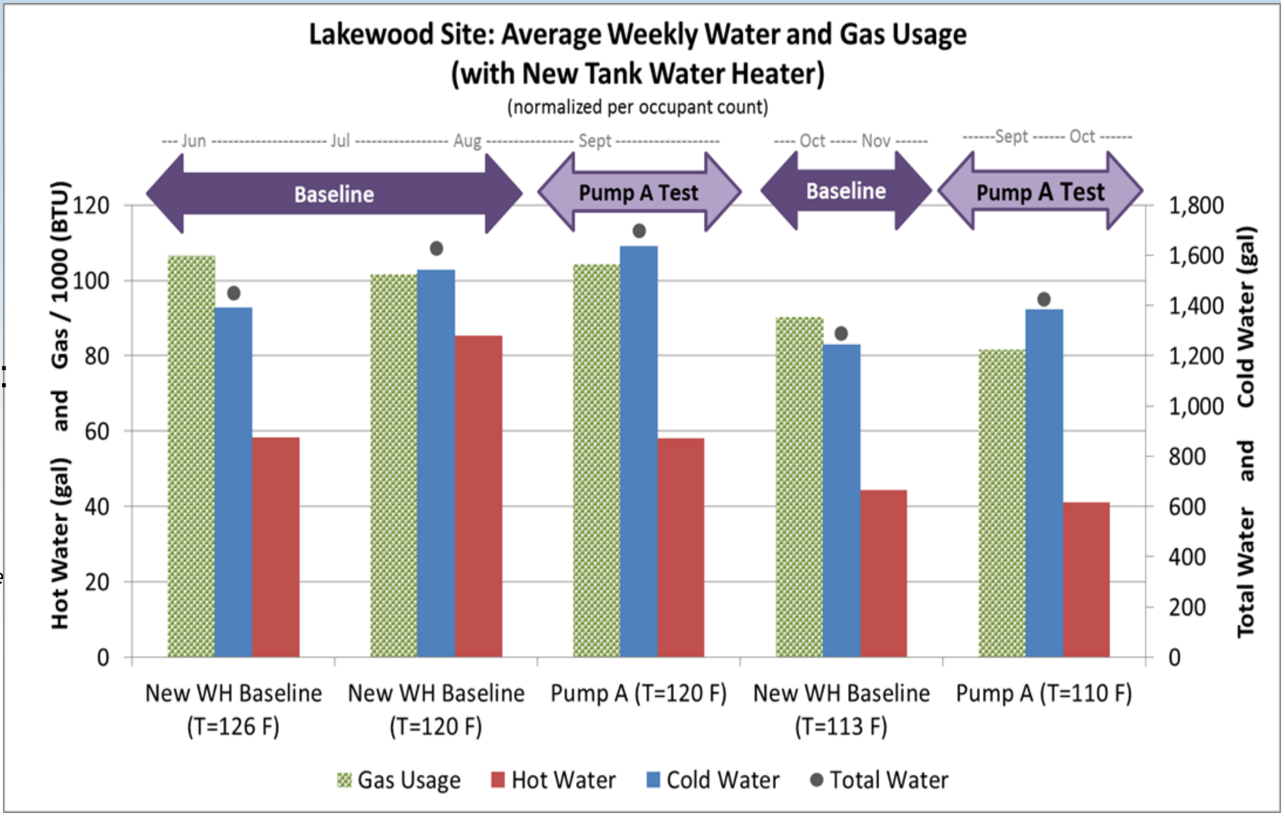
» Savings compared against baseline @ T_{set} = 126ºF:

	@120 ºF	@113 ºF
Gas	5%	15%
Hot Water	-46%	24%

» Savings with selected pump:

	@120 ºF	@113 ºF
Gas	-3%	10%
Hot Water	32%	7%

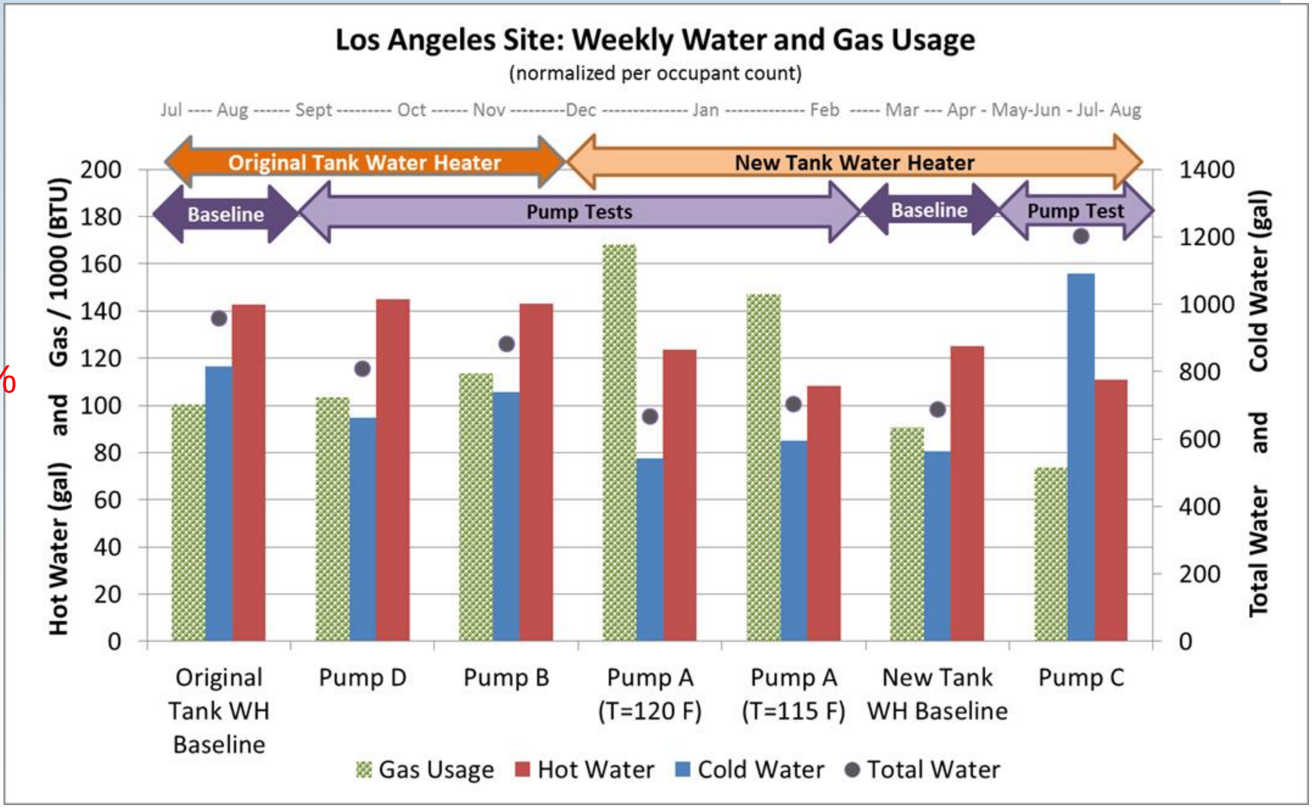
**compared against baseline close to its running temperature*



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

Los Angeles Site Results

- » Tank water heater failed mid-test; replaced with a new conventional tank type water heater
- » Compared to original water heater baseline
  - Gas savings: -3% to -13%
  - Hot water savings: 0% to -2%
- » Compared to new water heater baseline
  - Gas savings:
    Pump A: -63% to -86%
    Pump C: 19%
  - Hot water savings:
    Pump A: 1 to 14%
    Pump C: 11%



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

Whittier Site Results

» No gas savings for any of the pumps

» Only one pump showed hot water savings

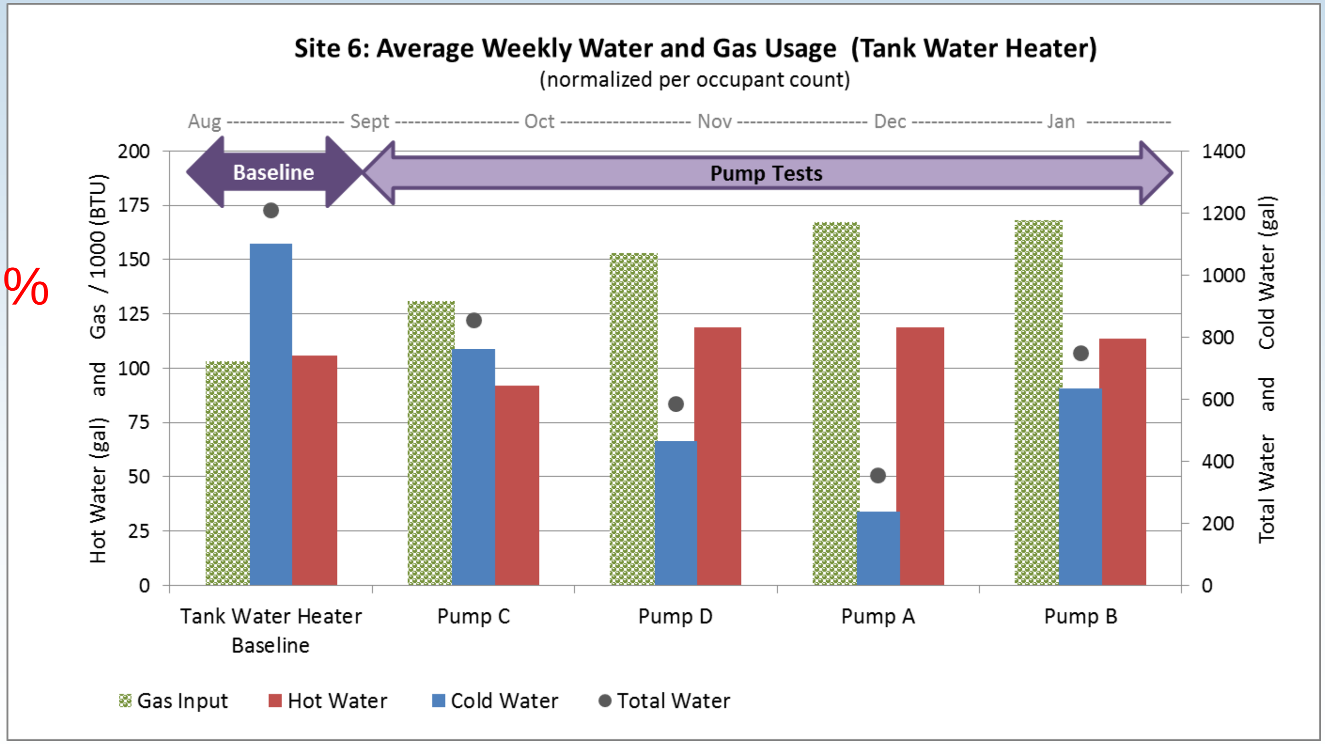
- Gas savings:

  -27% to -63%

- Hot Water Savings:

  Pump C: 13%

  Others: -8% to -13%



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

Hot Water and Gas Savings

» All pumps showed hot water savings
» Only one pump showed minimal gas savings

Average Savings in:	Pump A	Pump B	Pump C	Pump D/E
Hot Water Consumption	7%	5%	15%	9%
Gas Usage by Water Heater	-30%	-17%	1%	-7%

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

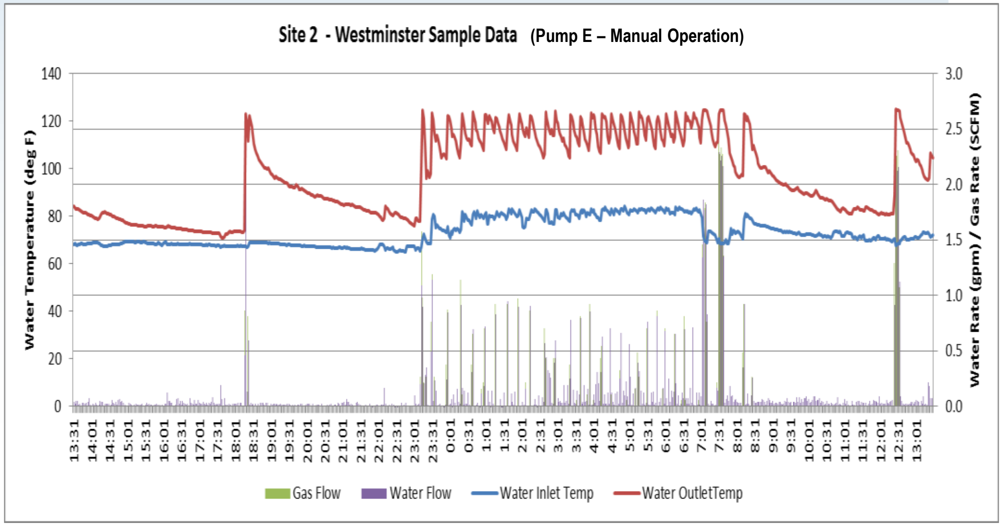
Customer feedback

- Presence of hot water in the cold water line
- Adjustment period to learn to push the button first prior to hot water use
- Main factors for pump choice:
  - Size
  - Quietness
  - Ease of operation

Recommendations

» Pump activation

- hybrid between timer and on-demand



Sample of pump left on internally circulating overnight

Conclusions

- » Low cost retrofit without installing a dedicated recirculation line
- » Savings (water and gas) are highly dependent on how the pump is used by the customer
  - Amount of savings varies depending on hot water habits of the users
  - Hot water usage vary even on a day to day basis
- » User activation was preferred by the majority of the customers
- » Customer education is a must!

Thank you!

Questions?

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