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Hot Water Design Guide

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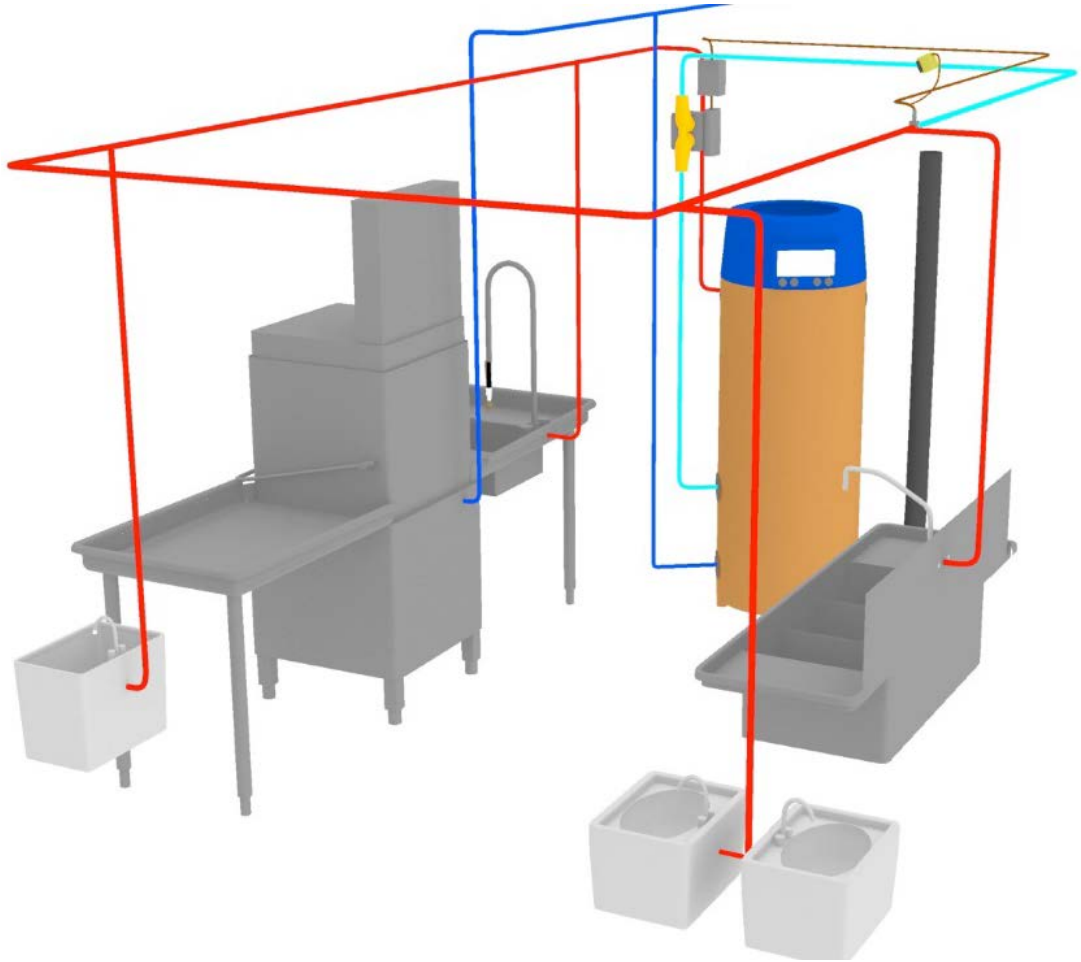
Special Thanks

Sponsoring Utilities

Learning Objectives

- CEC HW Project summary
- What are some common issues with current design practices?
- What are some technologies that can help?
- How can we achieve savings by design?
  - Business as usual design example
  - Optimized design example
- Cost comparison and incremental ROI

Hot Water System Demonstration Project



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March 22, 2018

by: **Don Fisher**

Fisher Consultants

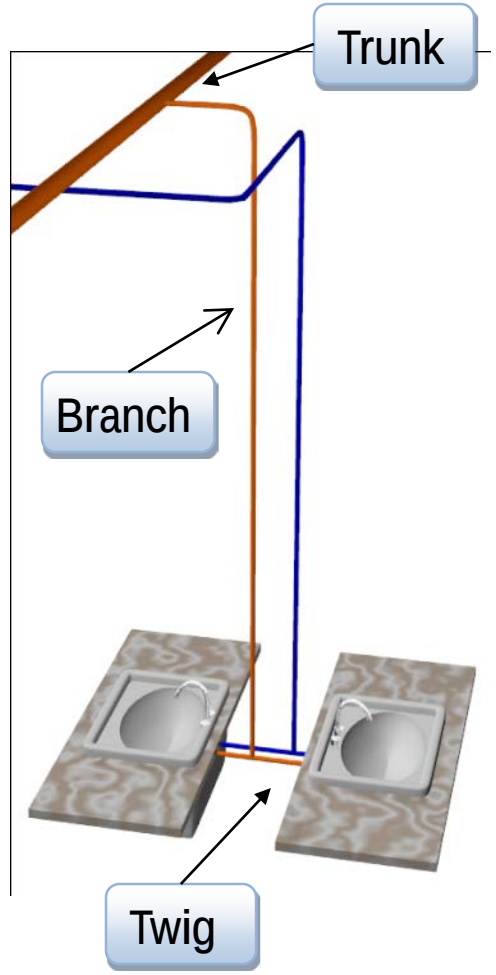
Project Summary

- 2 Field Sites
  - The Counter, San Mateo, CA
  - Franklin Elementary, Santa Barbara, CA
- In-Depth Lab Study
- Interactive Design Tool
- Design Guide 21st Century Update
- Design Examples

Conventional distribution systems

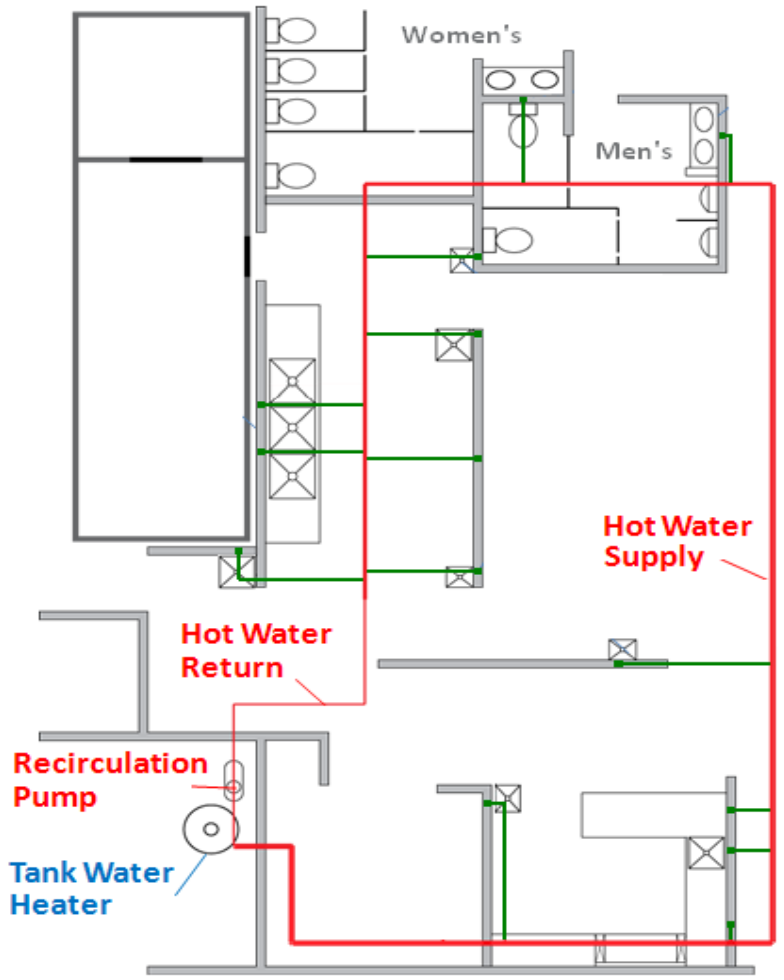
Simple Distribution

- Uses a trunk, branch and twig configuration to deliver water from the heater to the point of use
- Benefit: compatible with all heater types
- Drawbacks: long wait times at hand sinks
- Typically designed for QSR where each line is kept to 60 feet or less
- Two common systems: single line and two-line distribution providing 140°F water to sanitary equipment and 100°F-120°F to hand sinks

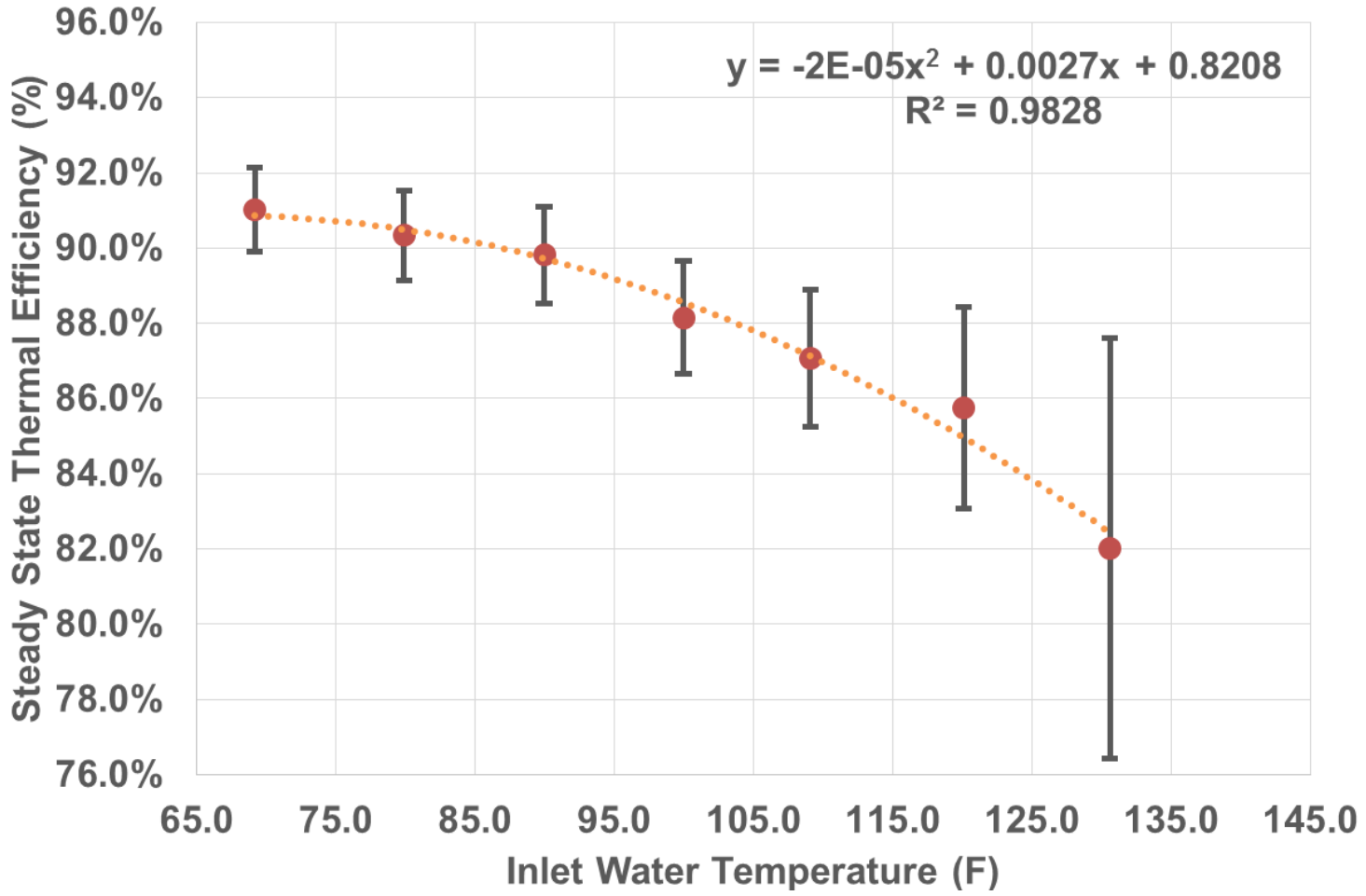


Continuous Recirculation

- Task is to keep the distribution line hot at all times – like moving the heater much closer to the points of use
- Drawbacks: this method does not always ensure that hot water makes it to the faucet
- High operating costs are incurred in a typical FSR as 140°F water circulates all the time constantly loosing heat to the surroundings



Effect of Inlet Water Temperature on Thermal Efficiency of Condensing Tankless



Hot Water Delivery Performance

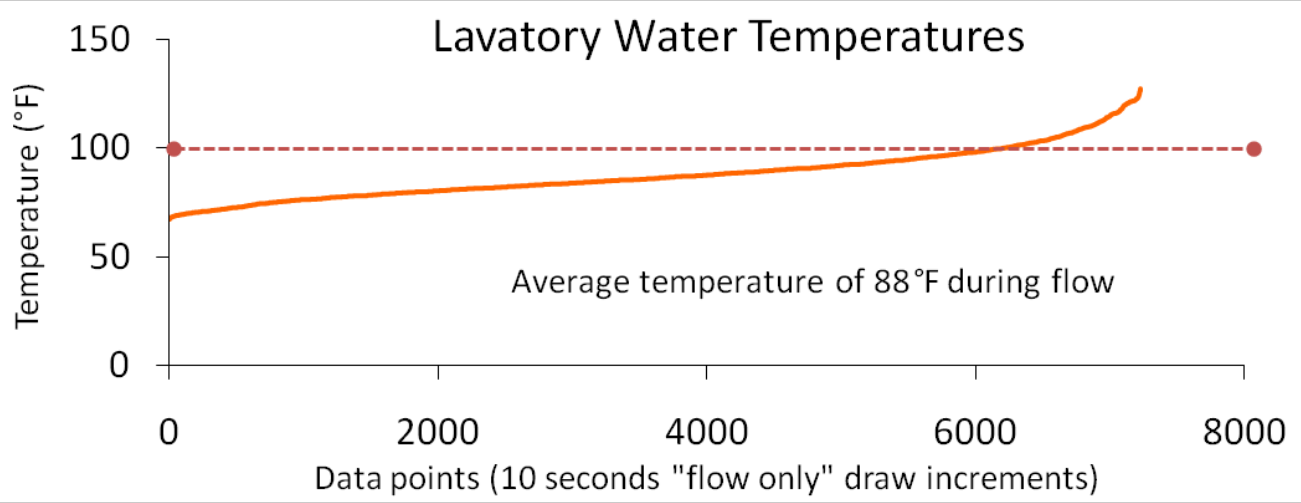
Hot Water Delivery Problems

Dishwashers and hand sinks are two areas where getting hot water to the point of use is critical

- For good dish cleaning and sanitation inlet water at 140°F is typically required to feed low-temp dishwashers or booster heaters for a high-temp machine
- Hand washing targets 100°F to 108°F hot water in a timely manner for good hand sanitation

Hand Sink Delivery Problems from a High-Foot-Traffic Facility with no Recirculation

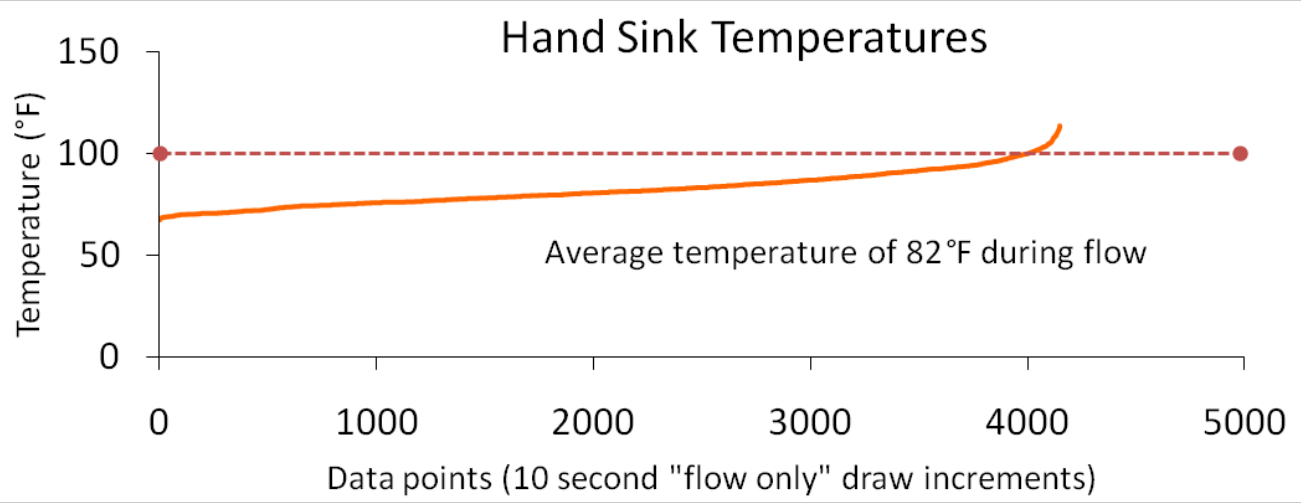
- 1-month data set
- Recorded 10-sec data intervals
- Filtered only for flow periods
- Sorted by temperature
- Temp. deemed satisfactory for hand washing if >100°F



<u>Results of testing</u>

100°F water reached the **lavatory 14% of the total draw time**

At the staff **hand sink only 3% of the total draw time**

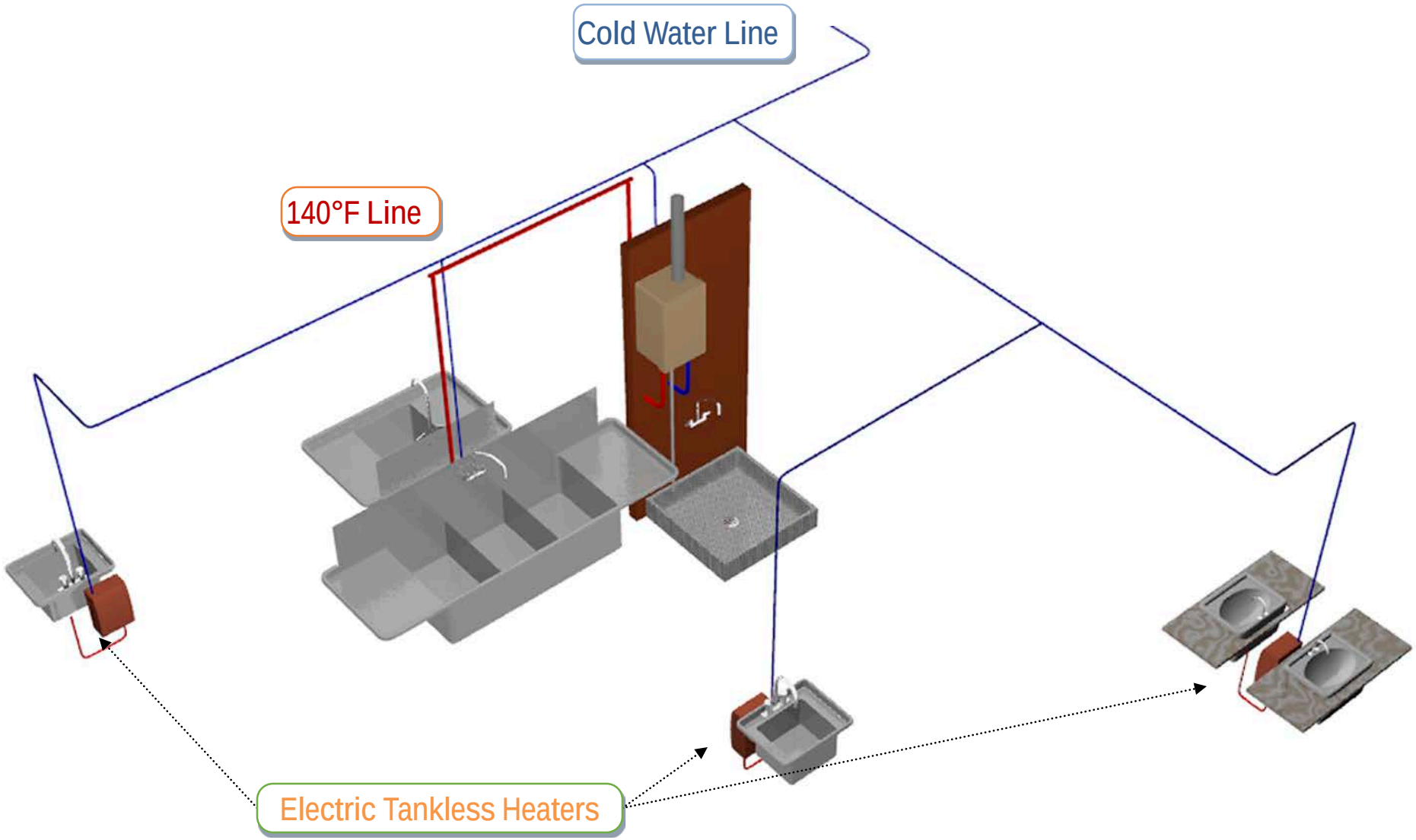


Another Solution: Distributed Generation

- A hybrid system that is a combination of *electric tankless heaters* at remote hand sinks and a *simple distribution system in the kitchen fed by a water heater placed centrally*

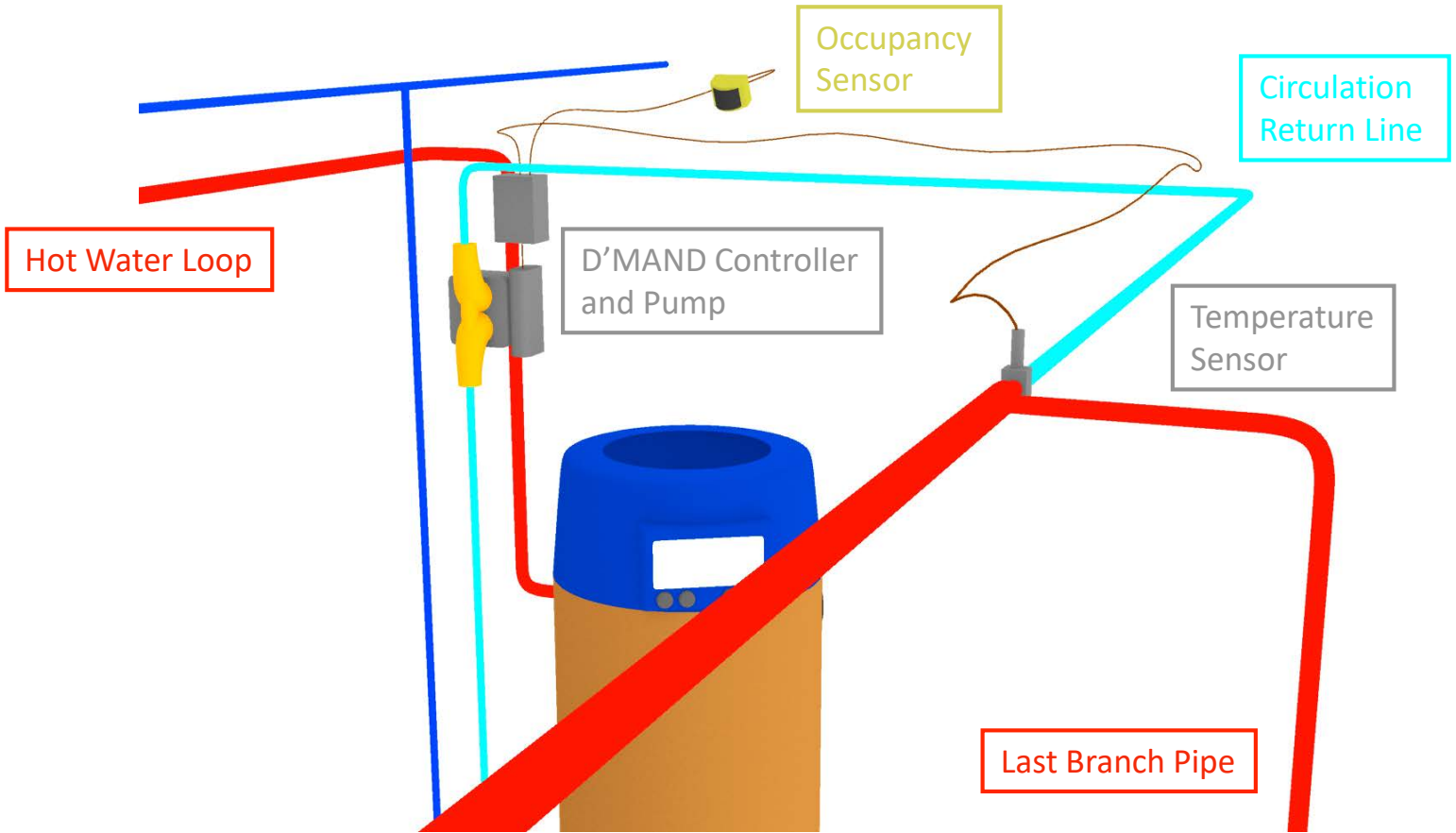
- Benefits: works well with low flow aerators, saves energy and increases hot water delivery performance

Hybrid System w/ Electric Tankless



Demand Circulation

- Demand circulation circulates cooled off hot water in the supply line and back to the heater ON DEMAND and de-activates automatically when hot water has reached its target
- D'MAND circulation saves pump energy, improves water heater operating efficiency and reduces hot water recirculation system pipe heat losses



Dishwashers with Heat Recovery

- Exhaust-air heat recovery (EAHR) preheats incoming cold water saving energy at the water heater.
- Cold water passes through copper pipes while a fan extracts steam and forces it through thin aluminum plates. The steam condenses on the cold fins and the latent heat is transferred to the cold incoming water.
- The cold supply water at a minimum of 50°F can be preheated to 110-130°F before reaching the booster.

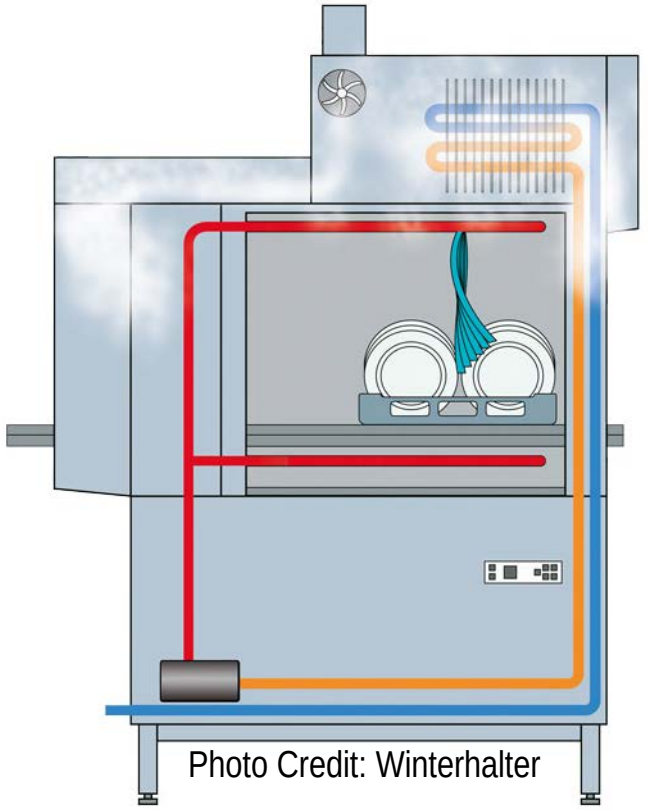
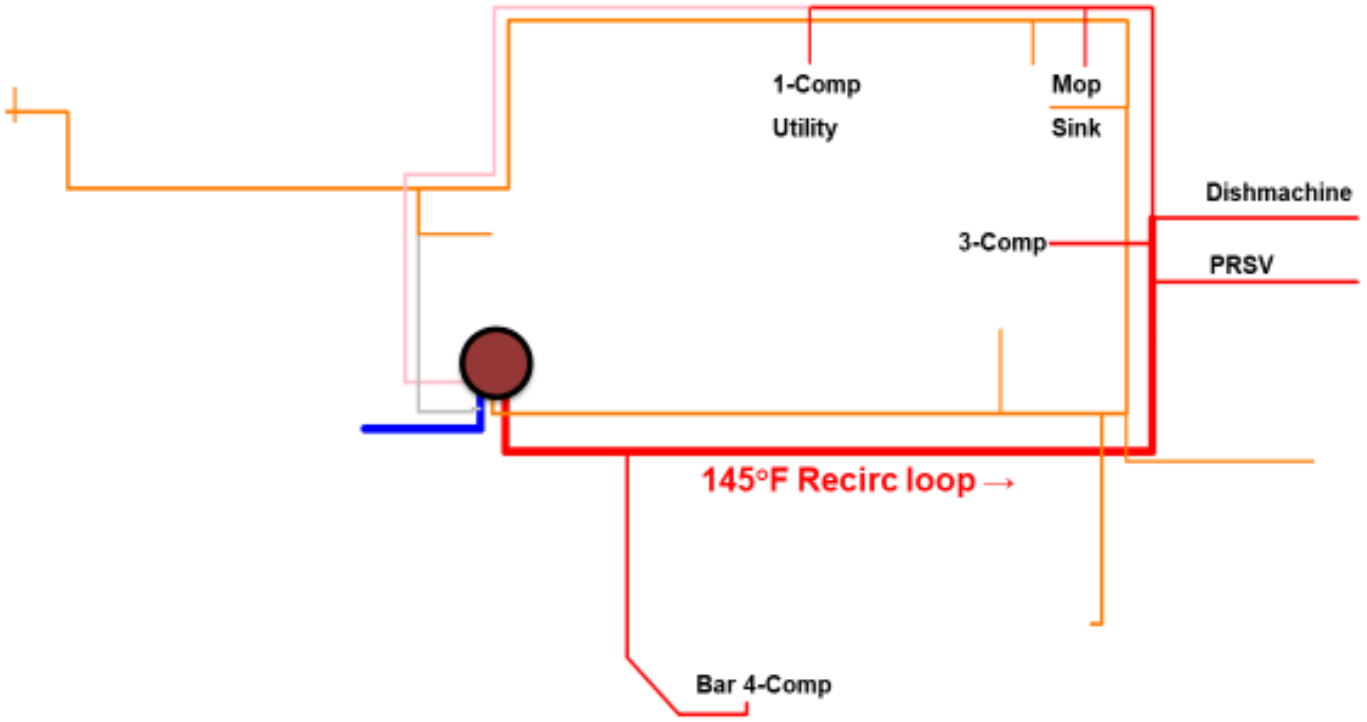


Photo Credit: Winterhalter

Business As Usual Specifications

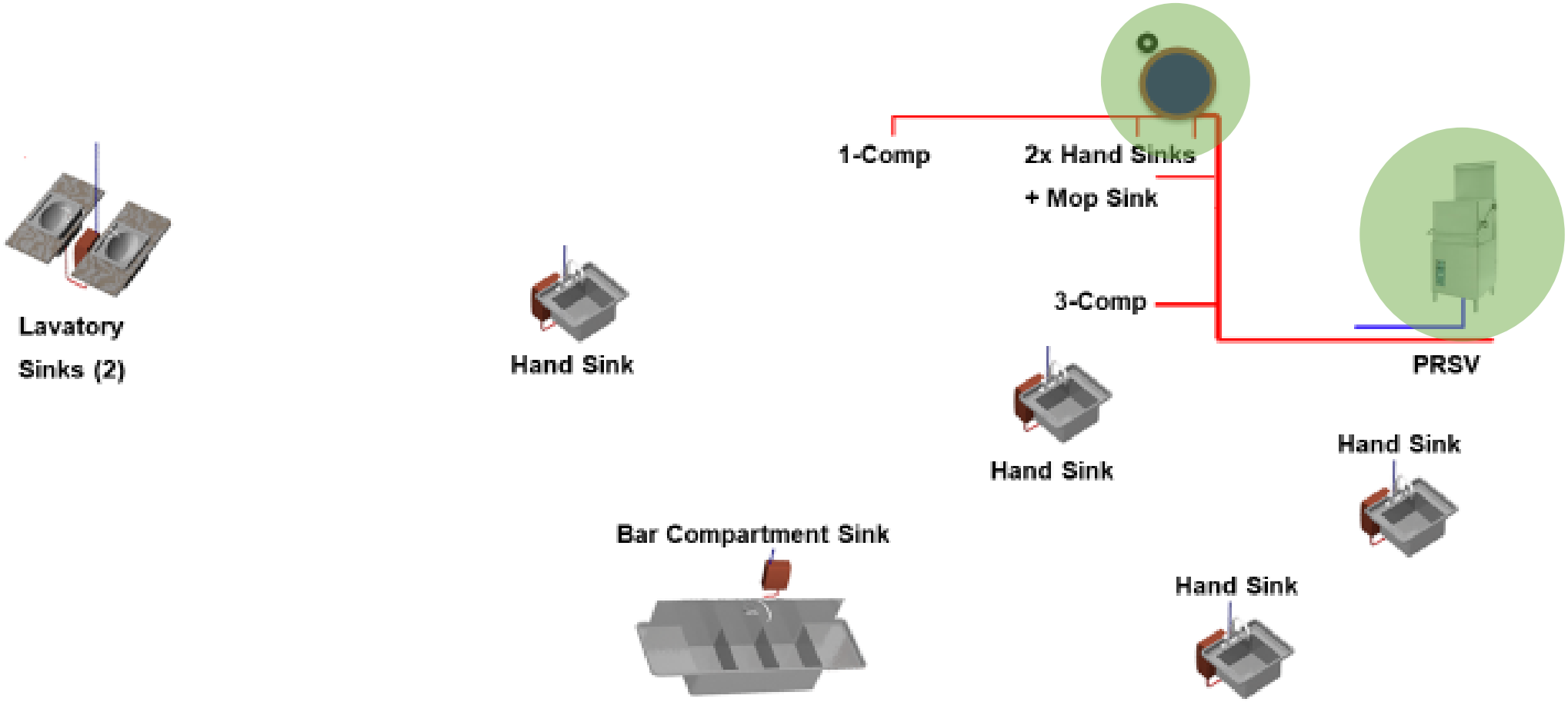
Fixture	Count	Tank Flow Rate (gph)
Restroom Sinks	2	5
Hand Sinks	5	5
3-Comp Sinks	1	42
Bar 4-Comp Sink	1	18
1-Comp Utility Sinks	1	5
Conventional Dishmachine	1	58
Pre-Rinse Spray Valve	1	45
Mop Sink	1	5



BAU Cost

System Components	Water Use (gal/d)	Energy Use at Water Heater (therm/d)	Electricity Use (kWh/d)	Utility Cost ($/y)
0.96 gpr Dishmachine building pressure rinse	480	5.3	80	9,500
1.6 gpm PRSV	83	0.9		800
Mop Sink	77	0.9		700
Compartment Sinks + Bar	120	1.3		1,100
Hand Sinks	45	0.5		400
Totals	805	8.9	80	$12,600

Distributed System Specifications and Cost



Cost Comparison

	Conventional System	Distributed Generation with NG Heater	Distributed Generation with HPWH
Install Cost	$29,780	$25,300	$27,800
Water Use (gal/y)	294,000	199,000	199,000
Gas Use (therm/y)	3,257	453	0
Electricity Use (kWh/y)	29,200	44,052	48,936
Annual Operating Cost	$12,600	$10,700	$11,000
First Year Cost	$42,400	$36,000	$38,800
10 Year Cost	$155,800	$132,300	$137,800

Initial costs of more efficient systems turn out to be lower due to easier installation

Energy Costs based on CA averages

Conclusions

- We have quite a ways to go with hot water in CFS
- Turns out efficient technologies are cheap and effective
- Uncontrolled big recirculating systems are inherently inefficient

- In other aspects of this project, these technologies were implemented in the field to realize savings!

Questions?

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