Data-Driven Boiler System Design and Installation

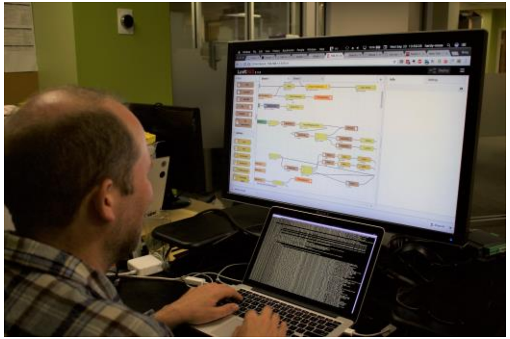
NEW ECOLOGY
Community-Based Sustainable Development

New Ecology works nationally to bring the benefits of sustainable development to the community level, with a concerted emphasis on underserved populations.

A mission-driven non profit, we seek to make the built environment more efficient, healthy, durable, and resilient.

THIS IS MANIFESTED IN OUR CORE WORK TO:

- Research, test and implement new approaches to sustainability, resiliency, healthy environments and energy efficiency;
- Monitor, test, diagnose and solve operational and building performance issues on existing buildings;
- Help design, build, certify and operate new high performance buildings;
- Share our learnings with building professionals, contractors, government, financiers, owners and managers through education and training.



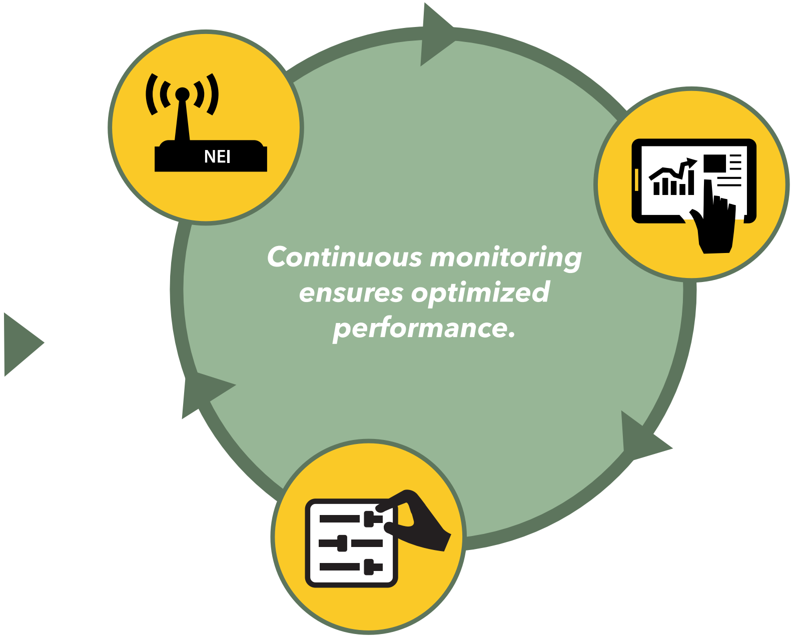
Background

Buildings are Under-Performing

1. INSTALL
We custom build, test and install monitoring equipment in your building.

2. MONITOR
We pull your data into our platform for analysis by our engineers.

3. OPTIMIZE
We customize solutions based on the analysis.



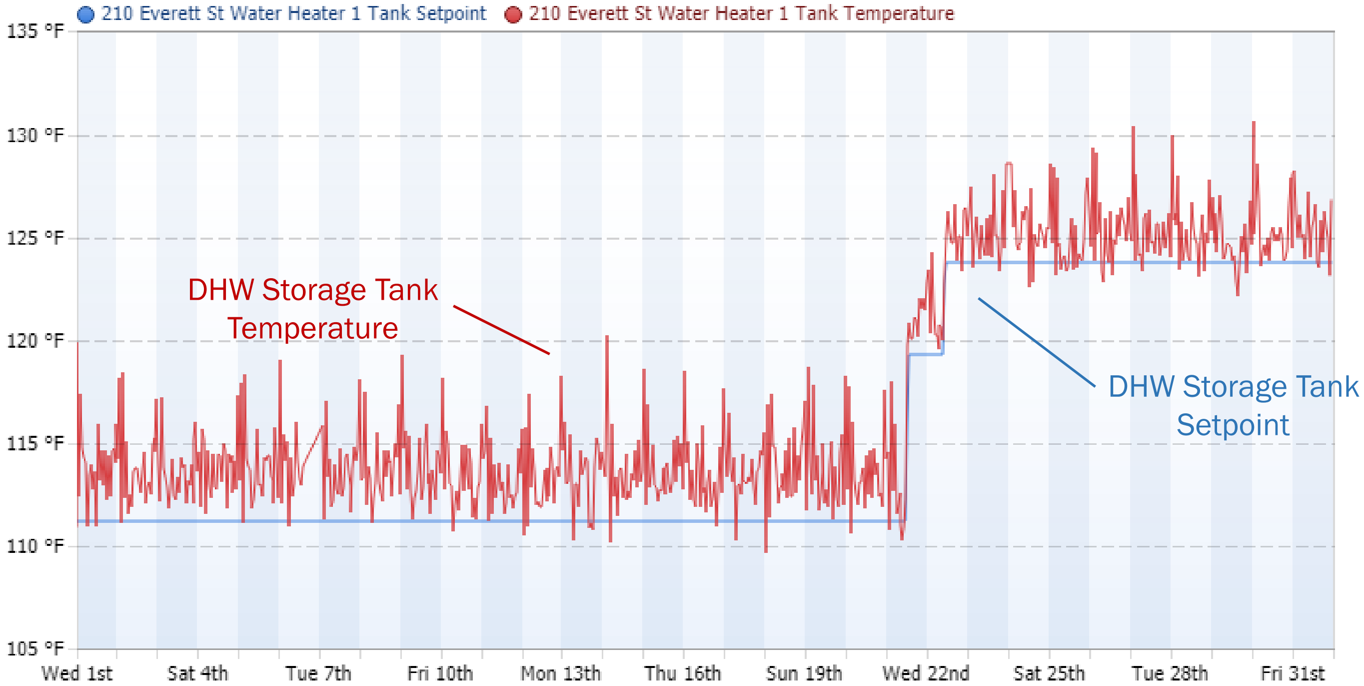
Background

Hydronic System Monitoring Pilot Project

- Assessed **123** buildings in **5** months
- Installed Remote Monitoring systems in **103** buildings
- Installed **>1000** temp sensors
- Built Database w/average of **62** data points/building
- Monitoring **312** boilers and water heaters
- Monitoring **184** Modbus boilers

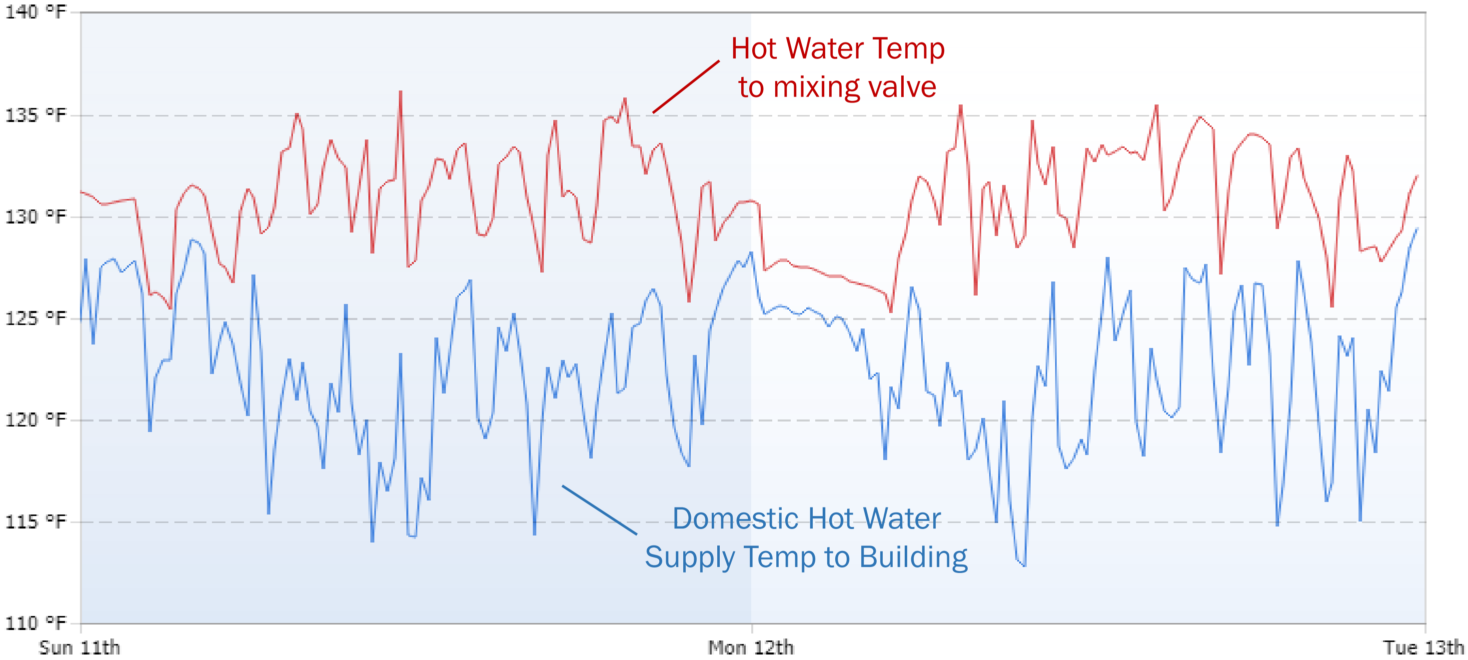
Background

Common Solution: Reactive Maintenance



What we found

Mixing Valve: Typical Operation



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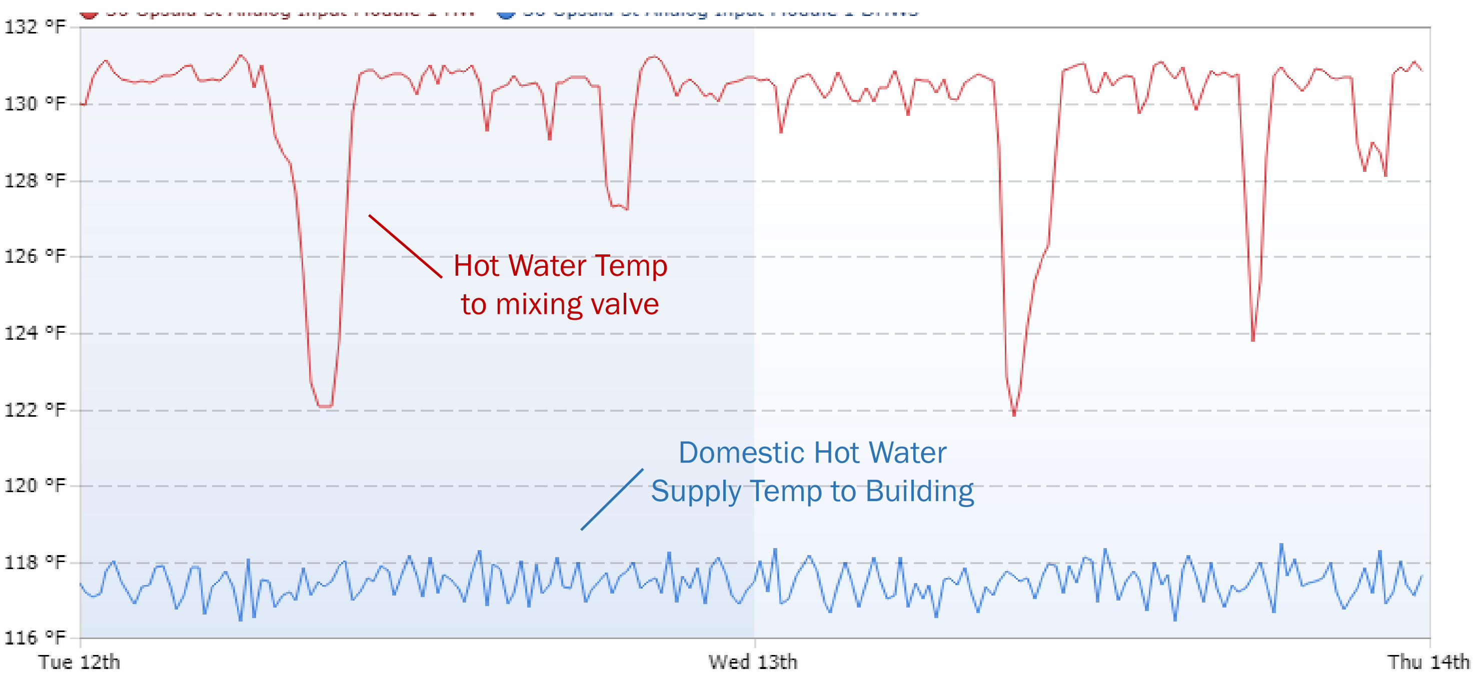
What we found

Mixing Valve: Ideal Operation



What we found

80% had temperature settings that needed to be lowered

58% had outdoor air sensors in the wrong location

19% had inappropriate controls configurations

54% of buildings with combined systems are mixing water

30% of boilers are excessively cycling

39% were delivering unsafe potable water temperatures to tenants

60% of hot water heaters show excessive cycling

31% need DHW tank temperatures lowered

54% of buildings with combined systems are mixing water

39% had mixing valves needing service, repair or changes

Results

Hydronic System Monitoring Pilot Project

- **94%** = buildings that achieved some savings
- **65,753** = therms saved so far
- **12.6%** = gas savings in average building
- **1,000s** = reduction in number of boiler cycles

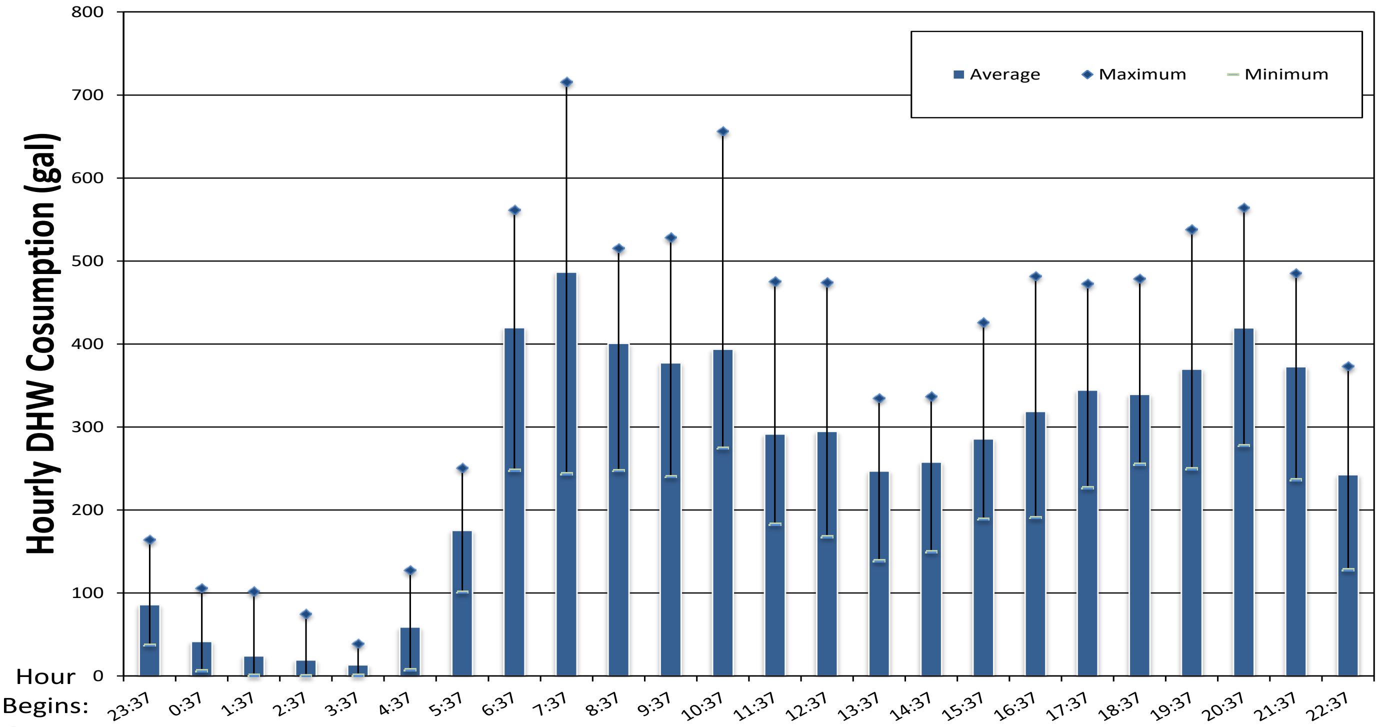
Strategies

Design

- Early owner and team buy-in
- Start design with low water temperatures as the goal
- Standardizing communications protocols
- Decouple domestic hot water and heating
- Size equipment based on real data
- Specify system setpoints

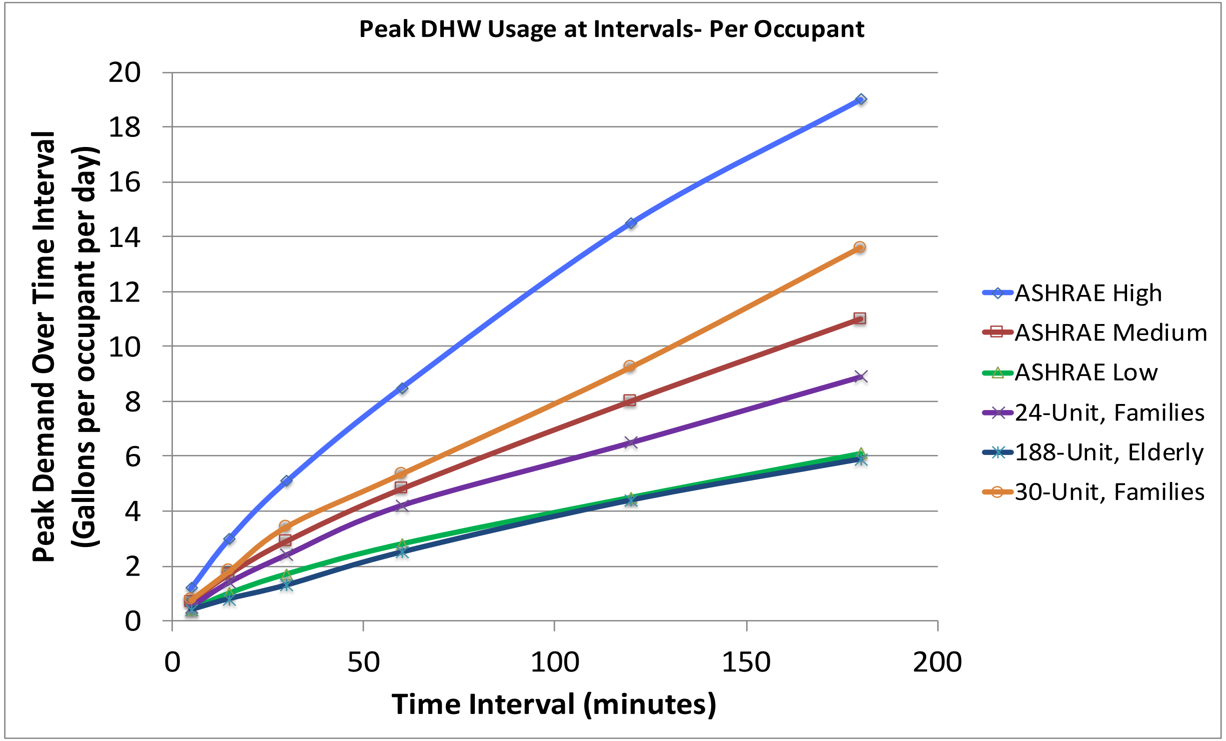
Strategies

Design: Size Equipment Based on Real Data



Strategies

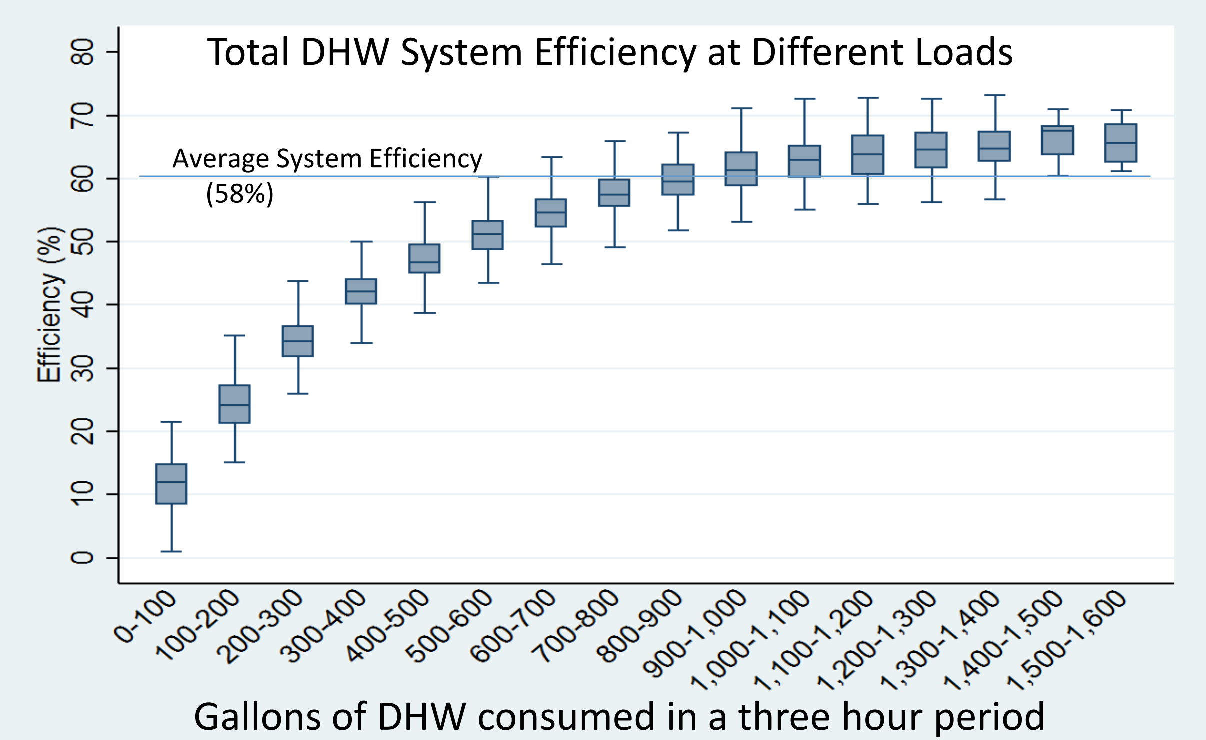
Design: Size Equipment Based on Real Data



Strategies

Design: Size Equipment Based on Real Data

Building Characteristics	
Number of units	188
Number of bedrooms	201
Population	Elderly
Water heater capacity	2x 500,000 Btu/h
Storage volume	4x 120 gallon



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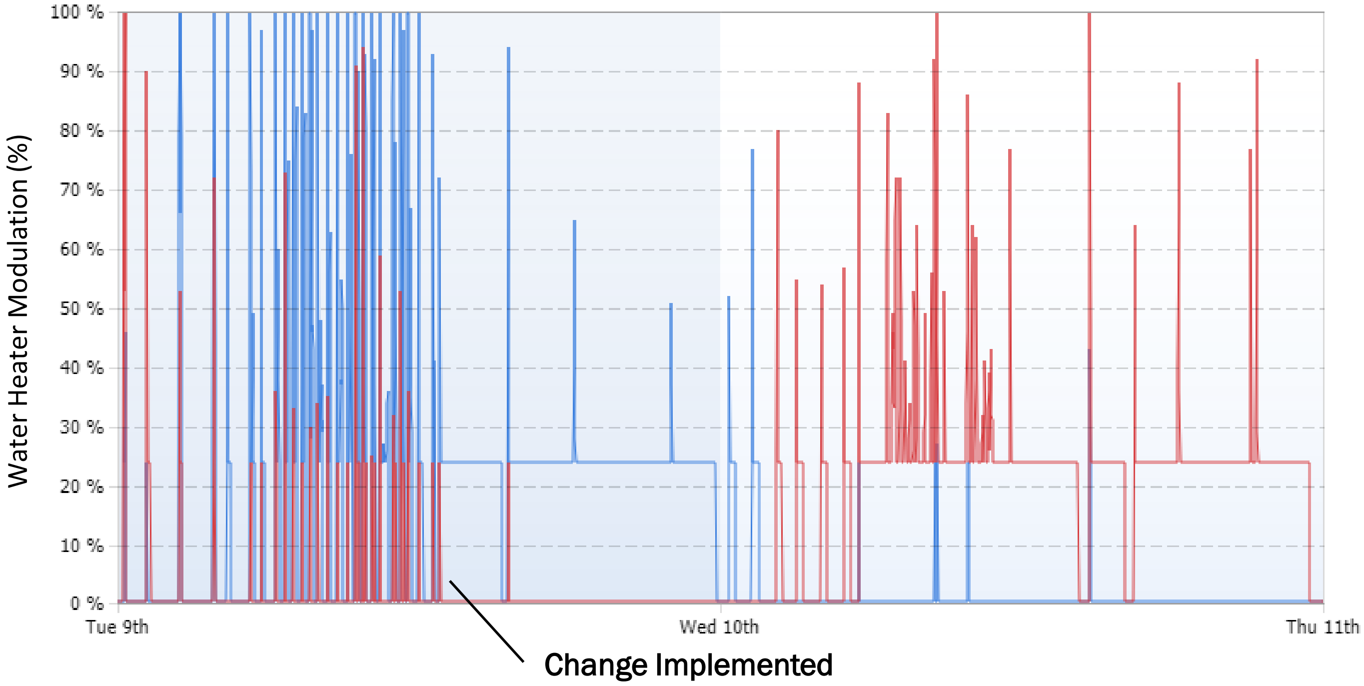
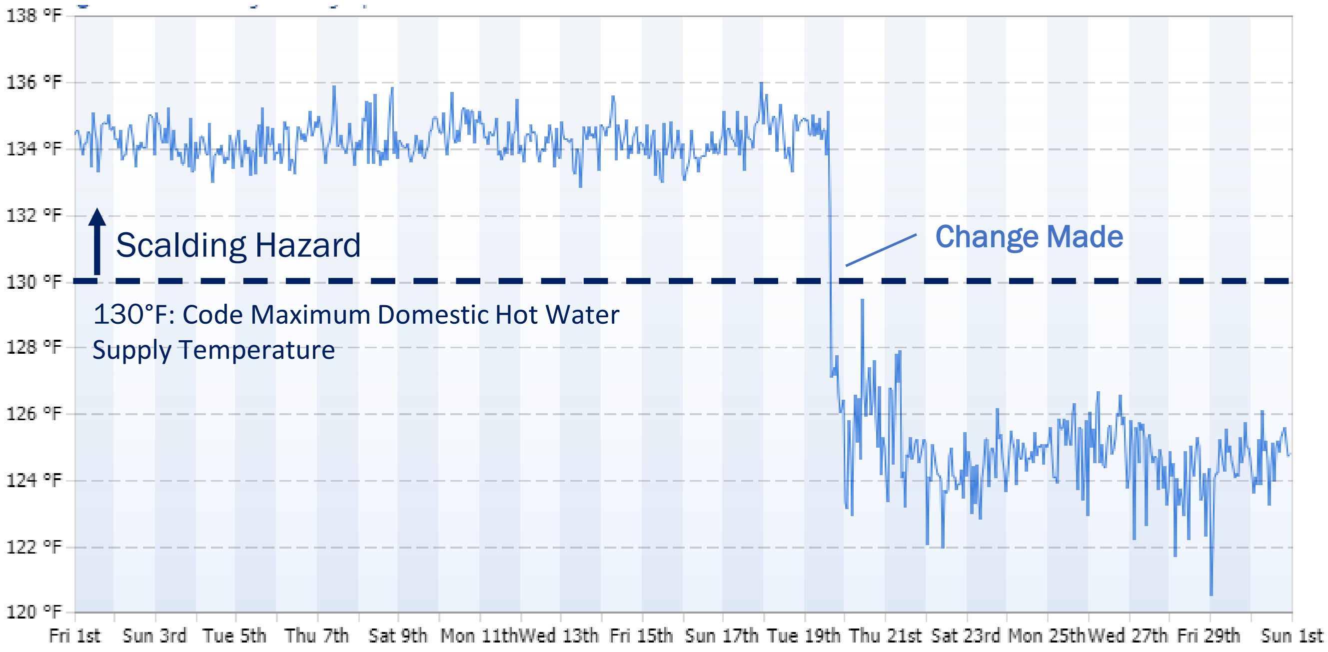
Strategies

Operation: Reduce Equipment Cycling



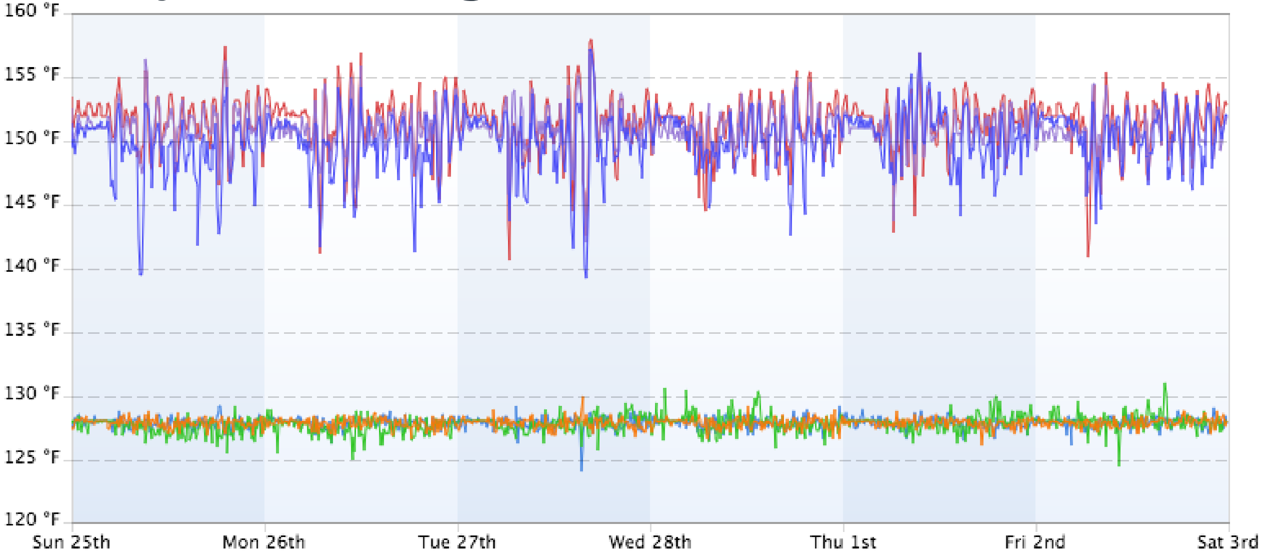
Strategies

Operation: Lower Domestic Hot Water Temperatures



System Design

Key Elements- Potable Side



- DHW Submeters with data output
- Pressure regulating valve per zone
- Electronic Mixing Valves with data output
- Variable speed recirculation pumps with temperature setpoint control

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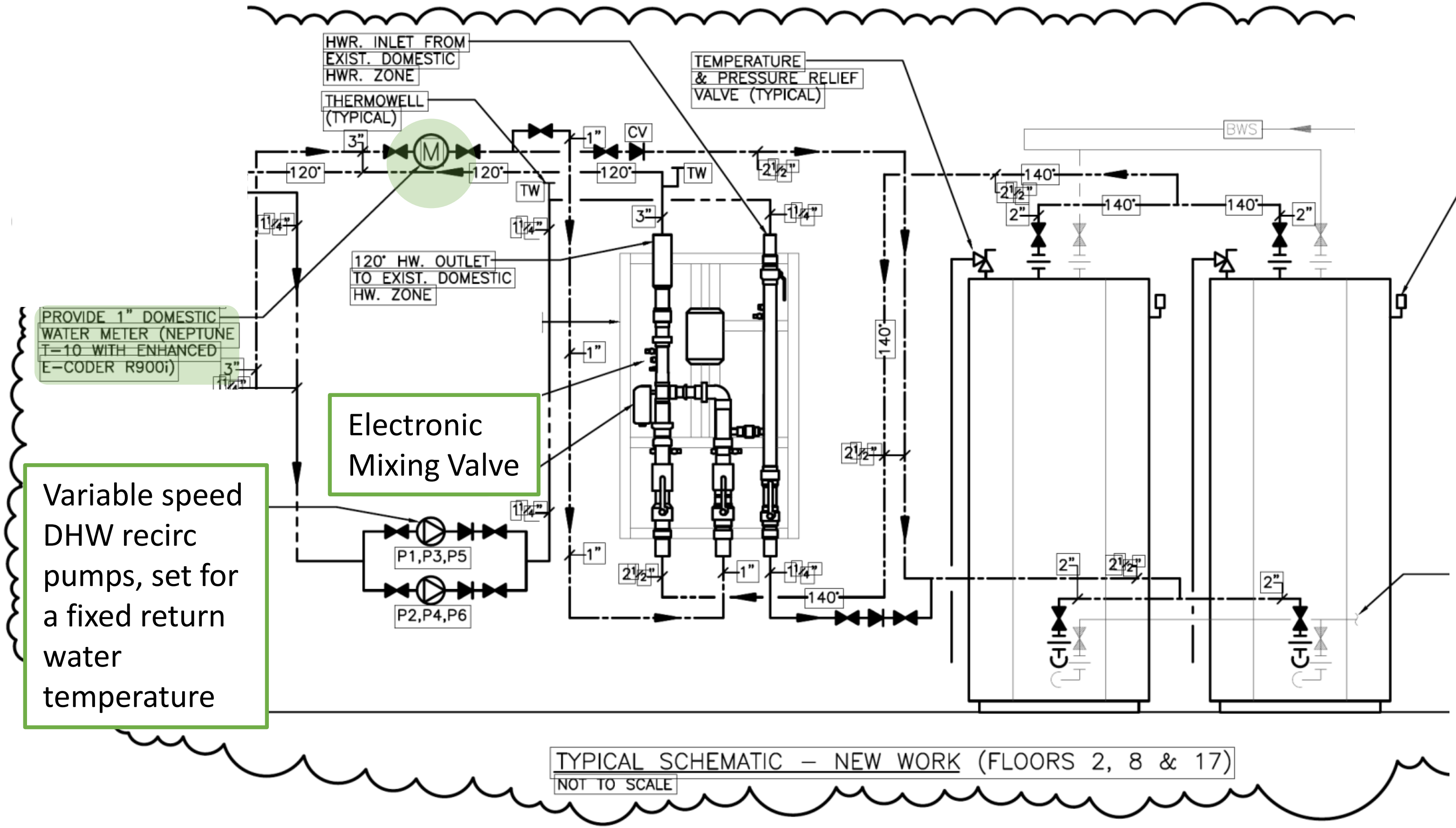

Variable speed DHW recirc pumps, set for a fixed return water temperature

Electronic Mixing Valve

Boiler water tank sensor used to control flow of boiler water through tanks

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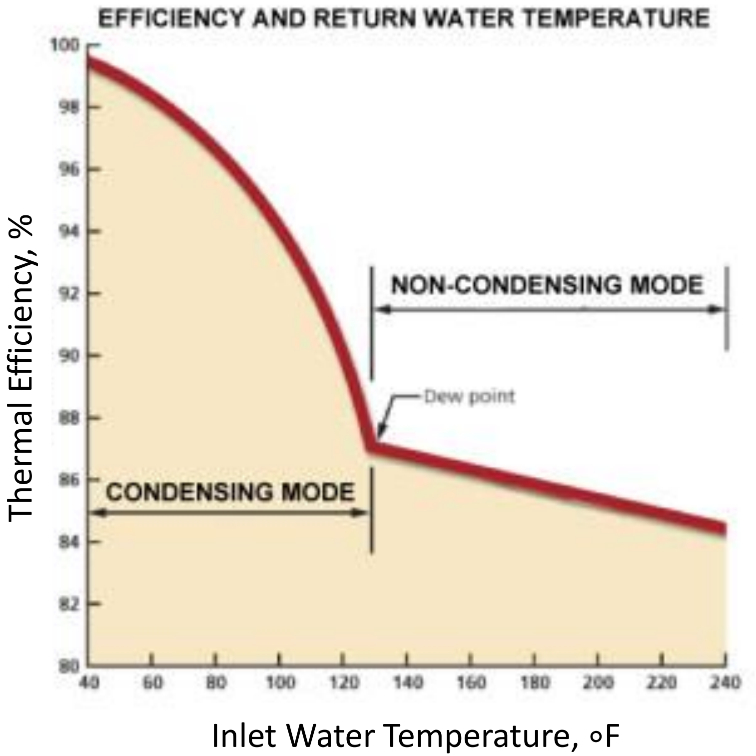
Background

Common Problem: Condensing Boilers not reaching Condensing Mode



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System Design

Key Elements- Boiler Side

Valve Size	Model Number	GPM at 5 psi differential		C_V		
		Open	Closed*	Open	Closed*	Design[4]
½″	CS-1/2-XXX	2.9	0.2	1.3	0.1	0.6
¾″	CS-3/4-XXX	4.0	0.2	1.8	0.1	0.85
1″	CS-1-XXX	7.4	0.2	3.3	0.1	1.57
1¼″	CS-1-1/4-XXX	11.4	0.3	5.1	0.15	2.48
1½″	CS-1-1/2-XXX	17.0	0.3	7.6	0.15	3.72
2″	CS-2-XXX	31.8	0.3	14.2	0.15	7.02

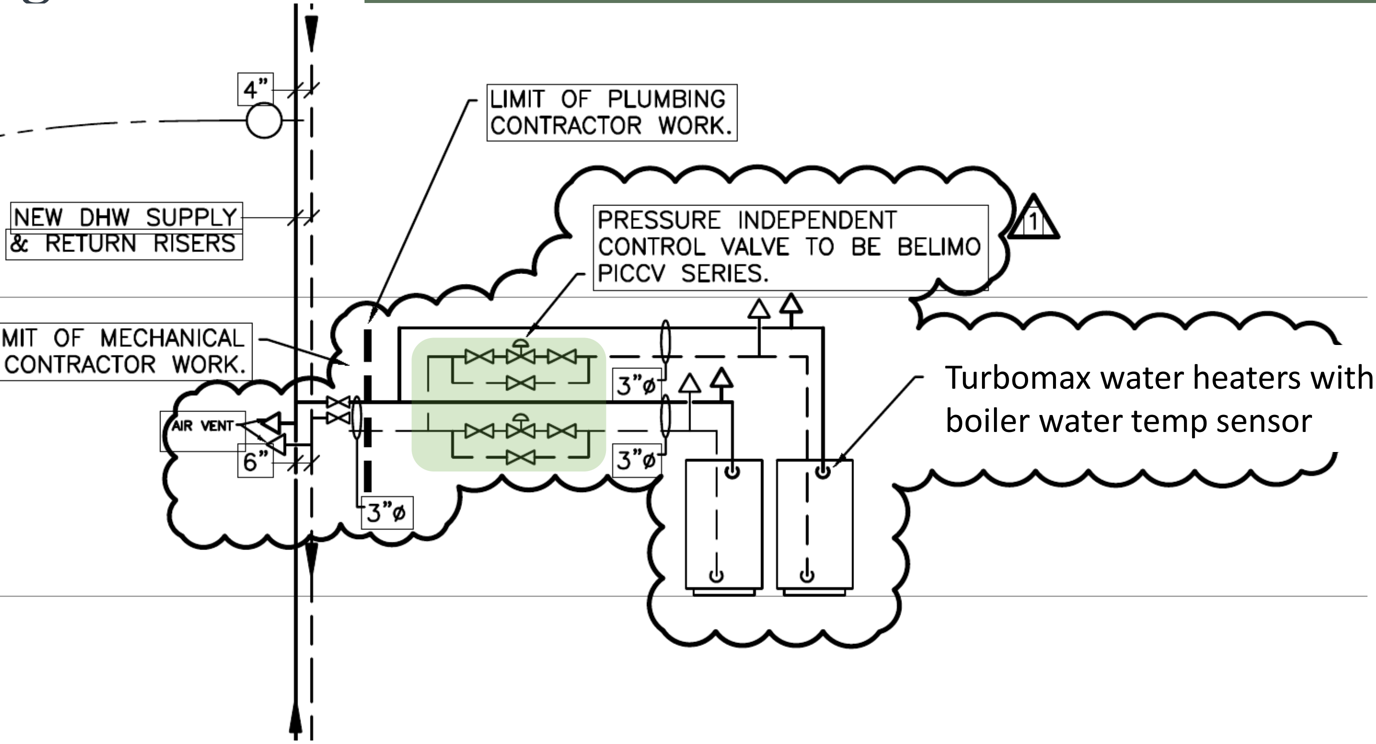
1. XXX = Desired close temperature
2. Open temperature = XXX-10°F
3. Valve position is linear with temperature. Example: For a 110°F desired return temperature, CircuitSolver® is approximately 60% open at a water temperature of 104°F
4. Use the Design Cv to calculate pressure loss across the CircuitSolver®. (Refer to the CircuitSolver® design guide.)

- Cold Water Reset
  - city water gets colder, boiler water gets hotter
- Variable speed boiler pumps
  - modulation controlled
- 10:1 boiler modulation
- VSD pumps for boiler water circulation
  - pressure controlled
- Temperature controlled HWR
  - 2x CircuitSolver thermostatic restrictor (130F)
  - Pressure independent control valve

Strategies

Typical DHW Mechanical room- Boiler Water Side

Pressure sensor back to VFD



Turbomax water heaters with boiler water temp sensor

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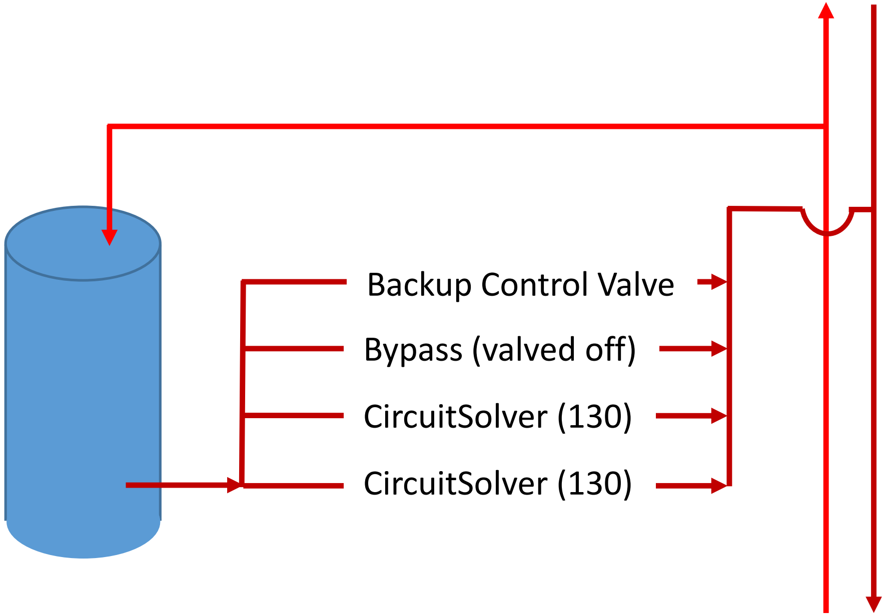
Typical DHW Mechanical room- Boiler Water Side



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