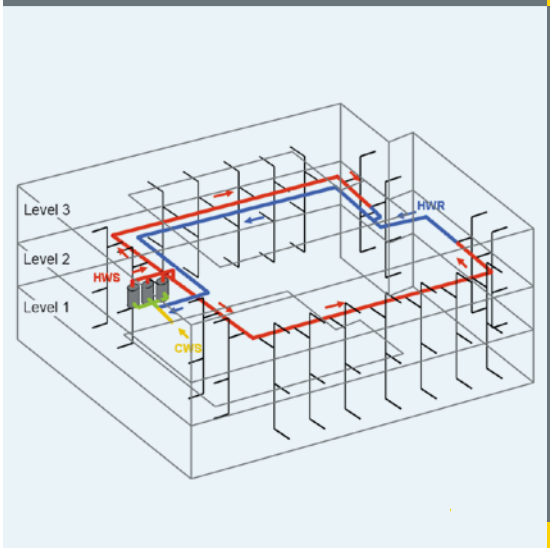
U.S. DEPARTMENT OF ENERGY | Energy Efficiency & Renewable Energy



Building America Case Study
Technology Solutions for New and Exisiting Homes

Control Retrofits for Multifamily Domestic Hot Water Recirculation Systems

Brooklyn, New York

PROJECT INFORMATION

Project Name: Control Retrofits for Multifamily Domestic Hot Water Recirculation Systems

Location: Brooklyn, NY

Partners:

Enovative Systems, *enovativegroup.com*

Advanced Residential Integrated Energy Systems (ARIES Collaborative)

Building Component: DHW recirculation system

Application: Multifamily retrofit

Year Tested: 2014

Applicable Climate Zones: All

PERFORMANCE DATA

Cost of energy-efficiency measure (including labor): $2,500 for demand control; $2,000 for temperature modulation control

Projected energy cost savings: $1,250/year after including interactive effects on space conditioning (will scale with building size and vary by climate and fuel type).

Domestic hot water (DHW) is the second-largest energy end use in U.S. buildings, exceeded only by space conditioning. Recirculation systems that consist of a pump and a piping loop are commonly used in multifamily buildings to reduce wait time for hot water at faucets; however, constant pumping exposes supply and return line piping to continuous heat loss, even during periods when there is no demand for hot water.

In this study, the U.S. Department of Energy's Building America research team Advanced Residential Integrated Energy Solutions (ARIES Collaborative) installed and tested two types of controls in a pair of buildings to evaluate their energy-saving potential. Each building included approximately 50 apartments and was three stories tall. The control types were:

- Demand recirculation controls sense both hot water demand and the temperature of the recirculation loop and run the pump when there is demand and the pipe has cooled below 100°F. This reduces energy use from the electric pump and hot water fuel consumption.
- Temperature modulation controls reduce the DHW supply temperature set point during periods of low or no demand, which typically occur during the middle of the day and overnight. The pump still runs continuously in this case, but hot water fuel use is reduced because the cooler DHW piping radiates less heat.

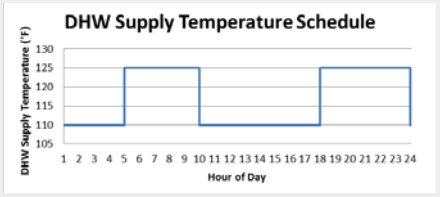
These control strategies were combined at one of the buildings for a measured DHW fuel reduction of 15% and an average pump runtime of only 14 minutes per day, without sacrificing resident comfort. Additional benefits include longer pump lifetime and less wear and tear on pipes.

Building America® U.S. Department of Energy

DESCRIPTION

A demand control panel and recirculation pump are shown in the photo above. The control can accept either hard-wired pump connections or removable three-prong plugs. This flexibility simplifies the retrofit process.

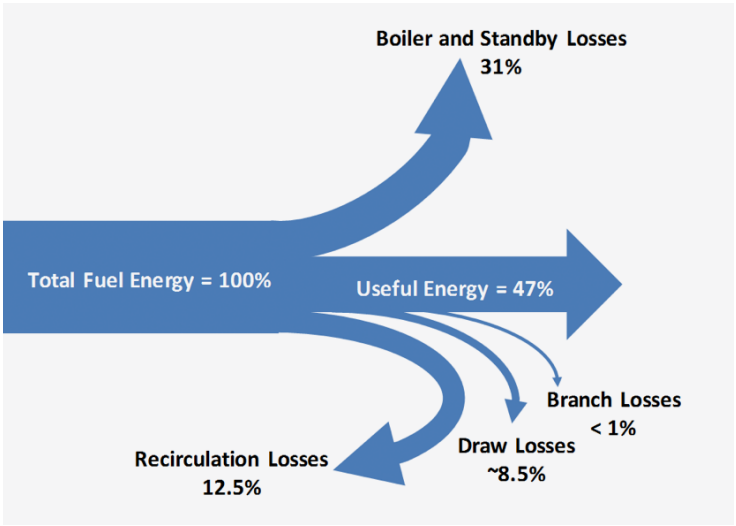
Supply temperature can be modulated with an aftermarket programmable control that is wired to the boiler and a temperature sensor mounted in a well in the DHW storage tank:



The temperature modulation schedule should be configured to approximate typical peak and off-peak use at the site.

For more information see the Building America report *Control Strategies to Reduce Energy Consumption of Central Domestic Hot Water Systems* at *buildingamerica.gov*.

Image credit: All images were created by ARIES and HMG, Inc.



Left, the energy budget for one of the pilot sites highlights the low system efficiency levels that are typical of multi-family DHW systems and underscores the need for energy-efficient DHW controls.

Lessons Learned

- Commissioning is critical. At a minimum, log supply and return temperatures with a data logger for a few days after the controls are installed to ensure they are operating as expected.
- Even though hourly hot water demand was highly variable, occupant comfort was not affected by the lower off-peak supply temperatures. An optimal strategy may be to supply constant lower-temperature water in conjunction with demand control. This would also minimize initial costs by avoiding the cost of installing temperature modulation control.
- Some multifamily DHW systems use mixing valves. When installing demand controls, ensure the existing valve is rated for noncontinuous flow or replace it with a valve that is.
- If isolation valves are not present or are not working properly, install or replace them during the flow switch installation to simplify future service.
- The intended reduction in pipe heat dissipation may impact space conditioning, which would increase the winter heating load and reduce the summer cooling load. For the New York climate, this reduced the overall annual cost savings by about 25%.
- The installation costs incurred in this pilot study were substantially higher than installation costs in regions with greater market familiarity.

Looking Ahead

DHW recirculation demand controls are now a code requirement for commercial new construction in California and supported by a utility program in parts of New England. The ARIES team is currently conducting an expanded research effort with demand controls in the New York area.

DOE/GO-102016-4704 • December 2016