Building America Case Study

Boiler Control Replacement for Hydronically Heated Multifamily Buildings

Cambridge, Massachusetts

PROJECT INFORMATION

Project Name: Cambridge Alliance for Spanish Tenants Apartments

Location: Cambridge, MA

Partners:

Homeowners Rehab, Inc., *homeownersrehab.org*

Advanced Residential Integrated Solutions Collaborative, *levypartnership.com*

Building Component: HVAC

Application: Retrofit, multifamily

Year Tested: 2010–2013

Applicable Climate Zone(s): Mixed-Humid and Cold

PERFORMANCE DATA

Cost of energy efficiency measure (including labor): $21,575

Projected energy savings: 19% heating savings

Projected energy cost savings: $6,100 per year with internal rate of return of 23%

Homeowners' Rehab Inc. (HRI) is a nonprofit affordable housing owner in Cambridge, Massachusetts. Its Cambridge Alliance for Spanish Tenants housing development is a 42-unit complex of three, three-story masonry buildings. Gas is used for space heating, water heating, cooking, and laundry, and accounts for about 80% of the annual property energy expenditures. The utility meters each apartment for electricity directly. HRI recognized that heating fuel use in this development was excessive compared to its other similar properties. Although a poorly insulated thermal envelope contributed to high energy bills, adding wall insulation was not deemed practical given the building's historic exterior and likely tenant disruption. A more readily available option was improving heating system efficiency. Efficient operation of the heating system faced several obstacles, including inflexible boiler controls and failed thermostatic radiator valves.

The U.S. Department of Energy's Building America research team, Advanced Residential Integrated Solutions Collaborative (ARIES), worked with HRI on this project in 2011 to replace the boiler controllers in all three buildings. During the first heating season (2011–2012), the team altered various control settings and system configurations and adjusted the systems to maximize comfort and energy savings. During the second and third seasons, control settings were adjusted on schedules intended to provide data to compare various techniques, including indoor temperature controls and nighttime setback.

In one building, the new controller included a feature to reduce heat when included apartment temperatures exceeded a set point. This Web-enabled system allows remote operation and modification of the control parameters and provides real-time access to apartment temperature data so that building operators can ensure the legally required minimum heating temperature without an excessive safety factor. After implementing the new controls, weather-adjusted space heating gas consumption declined by an average of about 20% and comfort was maintained. The simple average payback is projected to be less than 3 years for the three buildings together.

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Description

A state-of-the-art boiler control system includes a controller that allows for remote tracking and control of all parameters, as well as setbacks. It also incorporates wireless temperature sensors in all apartments that provide input into the control algorithm. The central controller communicates with an offsite server that stores logged temperature and boiler operation data and makes these available on a website. The Web-based system allows remote operation and modification of the control parameters and provides real-time access to apartment temperature data.

For more Information, see the Building America report, *Hydronic Heating Retrofits for Low-Rise Multifamily Buildings Boiler Control Replacement and Monitoring Study,* at: *buildingamerica.gov*

Image credit: All images were created by the ARIES team.

In the three buildings, new boiler control systems were installed and achieved 10%–34% energy savings.

Jane Carbone, HRI's senior project manager, remarked, "Our partnership with the ARIES Collaborative enabled us to take a fresh approach to reducing energy use in our older building stock and to try out and evaluate energy saving technologies that have provided an excellent return on our investment."

Lessons Learned

- Boiler control improvements in hydronically heated multifamily buildings can be a cost-effective and nonintrusive strategy with large potential energy savings and enhanced comfort. It can effectively maintain satisfactory indoor air temperatures.
- An indoor temperature cutoff control feature based on average apartment temperatures can provide significant energy savings (28% in the building studied). However, outdoor reset control alone may achieve similar results if properly tuned to the building and climate.
- The data showed negligible effect of a 5°F nighttime supply water temperature setback.
- One risk of indoor temperature control is that tenants may use supplemental heating or cooling that can affect temperature sensor readings. However, the averaging of all apartment temperatures minimizes the impact any one apartment can have on the system.

Looking Ahead

Similar case studies of the effectiveness of these control features in steam-heated buildings would be valuable.

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Energy Efficiency & Renewable Energy

For more information, visit:
buildingamerica.gov

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