

**Boilers can make facilities more efficient: with fuel prices going through the roof, more building owners are looking for opportunities to reduce costs that go through the boiler. See how one apartment complex lowered expenses by lowering return temperature, then check out a list of adjustments big and small that could pay off for existing systems**

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Fuel prices keep rising, and with them, consumer interest in how to save energy. Building owners, in particular, are looking for ways of making their facilities more efficient. Because space heating is the largest end use of fuel in commercial buildings, an obvious place to look for savings is at the boiler plant.

Depending on the geographic area, space heating energy costs in a typical commercial building can account for between 25% and 30% of the total energy costs. This percentage is obviously much smaller in warmer climates, where large commercial buildings require little space heating. It is estimated that half of all space heating systems use natural gas, with a typical efficiency of around 70%, although many newer commercial boilers now have efficiencies greater than 90%.  
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Given the combination of high fuel prices and the availability of more efficient boilers, many building owners are becoming more willing to pay a little more upfront for energy-saving boilers, both in new construction and retrofit applications, in order to realize long-term fuel savings.

## **ENERGY SAVING APARTMENTS**

There are advantages to constructing a new multifamily building as there are many inherent opportunities to save energy. Because the units share structural and mechanical systems and due to the fact that less of the building envelope is exposed, heating and cooling an apartment building usually requires less energy when compared to a single-family home.

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Bristol-Pacific Homes of Fall River, MA, is aware of these potential energy savings and thus routinely constructs energy-efficient buildings. The developer has been building homes to "Energy Star" standards since 2002. Indeed, the company won the Massachusetts Energy Star Homes Builder Achievement Award in 2004 due to their incorporation of energy-efficient upgrades into each home they build. These upgrades include cellulose insulation, high-efficiency heating equipment, and extensive air sealing.

When Bristol-Pacific Homes started construction on two new apartment buildings on Sandy Road in Westport, MA, the company was also interested in providing an energy-efficient design for the space heating and hot water needs of all 50 apartments. They looked to Buderus, Londonderry, NH, for ways to make this happen.

"The owner was looking for high-efficiency equipment to be able to provide both heating and hot water at the lowest operating cost," noted Lou Vorsteveld, president of Buderus. "They wanted to minimize the lifetime operating cost, not necessarily the initial cost. They also wanted system simplification, redundancy, and some back-up."

Two boilers were selected to meet these objectives. The heat load in the buildings came to around 1 MBtu, and the domestic hot water load was about 400,000 Btu. The equipment chosen included a Buderus 800,000 Btu "SB" high-efficiency, stainless steel, gas-fired condensing boiler and a second 400,000 Btu mid-efficiency "G334X" atmospheric gas boiler for back-up and summertime domestic hot water heating.

The apartment building's boiler design calls for both boilers to provide heating as well as domestic hot water heating. The SB boiler is used as the main source for heating, and the cast iron boiler is used as a secondary boiler during high-demand season. The boilers were configured to achieve the highest possible efficiency and maximum runtime of the SB boiler, as well as improve the efficiency of producing domestic hot water.

"Because boiler efficiency is primarily a function of the return water temperature, we wanted to lower this temperature as much as possible by bringing some of that return water down to an even lower temperature. To do that, we pulled the return water off and sent it through a DHW preheat tank, which is really a reverse indirect-fired hot water tank," stated Vorsteveld.

This 80-gal preheat tank has multiple copper coils through which 40[degrees] to 60[degrees]F incoming domestic water flows. The heating system return water temperature ranges between 120[degrees] and 140[degrees] and flows around these tube bundles, preheating the incoming cold water and cooling the return water. This configuration makes it possible to preheat the incoming domestic water temperature up to 80[degrees] to 100[degrees], while lowering the return water temperature to around 90[degrees] to 110[degrees].

The SB boiler has two return connections. The lower connection is used to accept the reduced boiler temperature water from the DHW preheater. This supercooled return water dramatically enhances the efficiency of the condensing boiler for both space heating and DHW efficiency, both of which result in reduced gas consumption. High-temperature system return water is piped into the second, or upper, return connection.

This configuration also saved the owners some initial capital costs, because the original plan called for three 80-gal tanks to produce DHW. "We saved them one indirect-fired hot water heater and replaced it with the preheating tank. Basically they're preheating the domestic hot water for free and at the same time, dramatically enhancing the boiler efficiency for space heating. It's a win-win all around," stated Vorsteveld.

The lower dual return connection requires only 20% of the total flow in order to achieve optimum efficiency. Vorsteveld explained that in this application, space heating is required most of the heating season, while the preheating of DHW is done for free. "So if the main flow is 50 gpm, only 10 gpm is needed to circulate for the domestic hot water preheat to lower that temperature going into the bottom connection to achieve the higher efficiency."

Each apartment has its own temperature control, and both boilers are operating on outdoor reset. This is a standard efficiency feature in a multifamily building, as the property owner controls the water temperature to the building and also, to some extent, the overall heating bill. Everyone has ample heat but if, for example, a tenant wants to open up all the windows and turn up the thermostat, the water temperature is controlled based on outside temperature conditions, so the amount of waste incurred will be minimal.

As another energy-saving feature, the main boiler is equipped with a modulating burner, so in the spring and fall when less heat is required, it operates at 30% to 40% of the maximum rated input. The system achieves near constant burner operation throughout the heating system, as the burner simply modulates up and down as needed.

The first apartment building came online in October 2003, while the second building became operational in August 2004. And just how much money has been saved by utilizing the energy-efficient boilers? In January 2005, the average cost for heat and domestic hot water was \$30.00 per apartment.