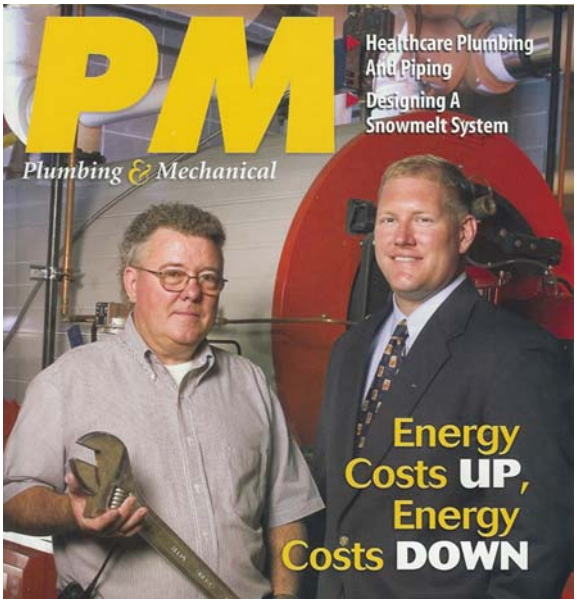

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Energy Costs Up
Energy Costs Down

By Steve Smith

Modern hydronics offers customers relief from high heating costs.
We don't need to tell you that a tank of gas costs more than it did in the not too distant past. But what about filling up a "tank" of heating oil or natural gas to power hydronic equipment?

The price of crude oil hovers in the high-$40 range as we write this in late July, about a quarter higher than the price a year ago. Economists worry that refiners may focus on producing higher-priced gas and diesel, putting a crimp in the supply of heating oil.

Meanwhile, the energy industry isn't producing enough natural gas, more a homegrown source of fuel than oil, due to industry consolidation that has slowed exploration and drilling operations. The number of rigs drilling for natural gas, for example, is about a third less than what it was at the start of the new century.

Combine cold weather with tight fuel supplies and experts promise little prospect for relief soon. Or is there? A look at a couple recent installations shows modern hydronic equipment and heating strategies can offer relief in the form of double-digit energy cost-savings.

School District of Portage, Ind.

We first met manufacturers' rep Henry Nichols about four years ago when Viessmann Mfg. Co. held an open house at its new Canadian operations.

We kept in touch since Nichols also filled us in on the type of jobs in which the rep also went the extra mile for the contractor. While PM always highlights installations, Nichols was the type of pro who showed us how much other work often precedes the hard work of the actual installation.

We traveled to Portage, Ind., to take a first-hand look at a retrofit for 12 facilities that make up the area's school district and ultimately represented the largest order in North America for Vertomat condensing boilers for Viessmann.

"School districts are searching for creative ways to stretch their budgets to cover increasing expenses for school and student development," Nichols says, who after 10 years as a manufacturers rep was about to join Viessmann as its regional manager for the Midwest. "By substantially reducing energy use, the Portage schools are finding that money typically used for fuel and capital expenditure can be redirected into other areas of the curriculum for greater student development."

Antiquated: The adjectives "old" and "antiquated" don't quite do the school district's boilers justice. In some cases the boilers - larger water tube models - were almost 50 years old, the original heating equipment installed when the building was first constructed. In most cases, the boilers that were originally coal-fired, were later converted to oil-fired, and finally converted to natural gas. Basically, the boilers were running at a collective efficiency rate of 40 percent to 45 percent.

Nursing the aging equipment along was testament to the work directed by Don Dean, the district's director of facilities.

"A few years ago we knew we needed to update our equipment throughout the district," Dean says. "We certainly needed to do a lot of homework since the entire work would represent a large expenditure. With this kind of a large project, particularly when it will be for a public school district, often it's very easy to go with lower-priced equipment without necessarily considering the real value of long-term savings associated with energy and maintenance."

To get a better feel for the Viessmann equipment, Dean spent the day in Chicago with Nichols touring a couple of recent projects. And while energy and maintenance were chief concerns regarding any decision, another concern easily could have been missed without the Chicago field trip.

"Sure we wanted to save money on heating the buildings," Dean adds, "but noise was a big factor for us. Many of our buildings are in neighborhoods and we wanted to make sure the boilers we went with were quiet."

Quiet, it turns out, inside and out. "When we walk into our boiler room we literally have to scream at each other to hear over the noise. It was very apparent when I toured the Chicago installations that that would not be the case with the Viessmann equipment."

Although Dean looked at a couple of other manufacturers, the school district's board of directors approved the higher price of the Viessmann decision. Given the scope of the job, the retrofits were broken down into three phases: Phase I, with five buildings, was completed in 2002; Phase II, with another five buildings, was done in 2003; and Phase III, with the final two buildings, was being wrapped up this summer.

Phases I and II showed energy savings after the new boilers were powered up to face their first heating seasons. Take the Portage East High School. One of the keys to the savings is the use of condensing boilers. Four Viessmann Vertomat condensing boilers equipped with Dekamatik digital indoor/outdoor system controls were installed in the high school. By collapsing the flue gas temperate into the condensing range, the boilers extract the additional, latent heat contained in the flue gases - heat lost with conventional, noncondensing boilers - and are able to reach a combustion efficiency of more than 98 percent.

Portage Energy Savings
Average energy reduction per school compared with old system.

Phase I

Crissman	22%
East	19%
Kyle	52%
Saylor	48%
South	25%

Phase II

Aylesworth	33%
Jones	32%
Central	10%
Myers	46%
Adult Ed.	N/A

Average savings 32%

The boiler supply temperature is modulated according to the outdoor weather conditions with the Dekamatik control logic. Long burner cycles and lead-lag communications between the individual boiler controls provide efficient and accurate operation.

Nichols kept track of the cost savings for each facility. The high school was part of Phase I so over the last couple of heating seasons, Nichols' figures show an energy savings of 19 percent compared to the old boilers. Given the individual numbers for Phase I and Phase II, that turns out to be quite modest. (For a breakdown of the individual savings for each the 10 buildings in Phases I and II, see above "Portage Energy Savings.")

While Nichols verified the savings on energy costs, Dean also could tell the retrofit would mean savings on maintenance costs, too.

"Unlike energy savings, which are straight-forward dollars and cents figures, maintenance is a harder amount to quantify," Dean explains. "Still, we had zero problems during our first year, and usually you do expect to have some problems in understanding brand-new equipment and operations."

After two years, Dean says routine maintenance is a snap with the new boilers. "Just opening up the old boiler could take a long time," he says. "Now it's literally a couple of screws to remove."

Equipment Used
Portage used 28 Viessmann Vertomat boilers, ranging in ouput from 2.5 million Btus to 12.5 million Btus.

Shoreline Community College, Seattle, Wash.

A multisite project at Shoreline Community College near Seattle quickly won accolades from school administrators, bean counters and maintenance staff alike.

Working with engineers from the headquarters office of McKinstry Co. (ranked No. 58 in PM's 2004 Pipe Trades Giants list), the school obtained a new system that improves boiler operating efficiency alone by more than 20 percent.

Overall energy improvements are guaranteed to provide more than $80,000 in annual utility savings and qualify the school for gas and electric utility rebates of nearly $90,000. In addition, the guaranteed annual utility savings will cover the principal and interest on a 10-year low-interest loan from the State of Washington treasurer's office. When everything is said and done, only 35 percent of the project's $1.2 million cost will be funded from the college's capital budget.

"Normally boilers don't pay for themselves quite so rapidly because the equipment is expensive," says King Tang, P.E., senior program manager with McKinstry. "But by combining the savings from the utility rebates for boiler upgrades, heating controls and lighting, along with the state's low-interest energy financing program, Shoreline gets the benefit of many financial advantages."

According to Tang, Shoreline had been using 40 percent to 45 percent more energy than the benchmark for colleges in the region. That was the call to action.

"And we're now just beginning to make a real impact in the school's energy consumption by replacing some of the many inefficient and malfunctioning mechanical systems," Tang adds.

Two Problems: Before the retrofit, Shoreline was plagued by two key problems: poor system design and a maintenance regimen that became more difficult each year. Shoreline's original systems layout called for 22 boilers to be installed in 13 separate boiler rooms. Add to that an additional 50 HVAC units and Shoreline's modest maintenance staff was clearly overwhelmed. Boilers were operated with very low return-water temperatures; this caused acidic condensation and the premature corrosion of many boiler components and flue pipes.

The boilers also were plagued by combustion air problems. Many were housed in rooms too small to adequately access or install air louvers for ventilation - a major code deficiency. In many cases, a build-up of leaves and debris in the air intake louvers contributed to an overall problem with incomplete combustion, as well as flame roll outs, flame impingement conditions and overheating of the rooms.

After a complete testing it was clear that more than 40 percent of the boilers had completely failed or burned out. And in cases where the boilers still functioned, carbon monoxide levels in some of the boiler rooms were deemed "very unsafe" which, according to Tang, "is an efficiency issue and, of course, a cause of health and safety concern."

The problems facing Shoreline were not an overnight occurrence - the hydronic systems' gradual decline continued to worsen during a period of several years.

Fast Track: But the need for an overhaul was recognized by several new administrators, including a new vice president, Beverly Jo Brandt, hired from another community college. Among the changes made by Brandt was the hiring of a new facilities director. Brandt also had worked successfully with McKinstry in a former college post and was familiar with the state treasurer's loan program. A retrofit quickly became a priority for her at Shoreline.

Getting the job done quickly also became a priority for McKinstry, manufacturers rep firm Columbia Hydronics, and boiler manufacturer Laars Heating Systems due to a tight budget and a compressed time schedule. Final approval of the project was not received until late June, and the new system was required to be operational by the beginning of the new school year - a "window" of only 10 weeks time.

One of the primary challenges for the project was getting the key players to agree on the choice of boilers.

The McKinstry team - after conducting a full analysis of compatible boiler types and suppliers - recommended the use of a new generation of copper-fin boilers from Laars. Based on McKinstry's findings, the copper-fin boilers would provide the lowest lifecycle cost, while significantly boosting operating efficiency, increasing system capacity, and reducing equipment footprint.

Meanwhile, Greg Angus, Shoreline's maintenance supervisor, needed to be sold on the ease of maintenance regarding this type of boiler.

So Columbia Hydronics sales engineer Mike Petterson arranged to take Angus on a factory tour of the Laars facility in Moorpark, Calif., to review the equipment and put his fears to rest.

"That trip really did the trick," Petterson says. "Greg was able to see firsthand how the heat exchanger is easy to get to. The panel pops off so you can easily access the igniter."

In the end, Shoreline agreed to install 12 Laars copper-fin boilers. Because of the fan-assisted, sealed-combustion design of 10 of the boilers, system efficiency was increased to 85 percent, and more than 87 percent with the other two boilers - substantially better than the 50 percent to 60 percent operating range of the remaining functioning boilers.

Modulation: The ability to stage or modulate individual boilers enables the system to efficiently meet varying heating system loads. And, now, each boiler room is equipped with a dedicated boiler system controller to maintain minimum boiler temperatures, reset temperatures, and to fire only the required number of stages, or boilers, to meet the demand.

"Using these low-mass boilers in a primary-secondary system approach is an ideal solution for energy retrofits," says Dave Lockhart, sales manager, Columbia Hydronics. "Rather than maintaining high-mass, standby energy at considerable cost, these systems quickly inject incremental energy into system loops on demand."

Because of the staged boiler arrangements at Shoreline, the school benefits from several of the most efficient boilers on the market: the off boiler. Yet the standby boiler is fully available and exercised as the alternate lead boiler every 24 hours. For most of the season, system demand is met with just one boiler, frequently with partial gas input. No standby losses, and no wasted energy.

In addition to the new boilers, the school's hydronic systems also were upgraded to primary/secondary loop configurations (from earlier single loops), and each boiler now has its own dedicated pump to maintain constant water flow and consistent temperature, factors that help to extend boiler life expectancy.

The design team also worked closely with local code officials, providing fire dampers, smoke dampers for better fire rating, as well as increasing combustion air inlets where necessary to bring the boiler rooms up to code compliance.

In addition to boiler upgrades, outdated pneumatic HVAC controls were replaced with new direct digital controls for more precise system control and temperature accuracy. The boiler controls also are factory-equipped with alternate start/stop and a setback capability to provide additional energy savings.

Improved maintenance will be a major factor in keeping the new systems operating at their best. Columbia Hydronics led Shoreline's mechanical staff through several sessions that focused on boiler and boiler control operation and maintenance.

In turning over the systems, just prior to initial commissioning earlier this year, McKinstry provided a CD with all the mechanical plans and control documents. The McKinstry team also will provide seasonal commissioning and maintenance schedules.

Equipment Used

The Shoreline project used 12 Laars copper-fin, low-Nox boilers, including 10 stage-fired boilers (two 1,000 MBH, four 750 MBH, and four 500 MBH systems) and two 1,200 MBH fully-modulating Rheos boilers - reducing the former boiler count by nearly half.

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