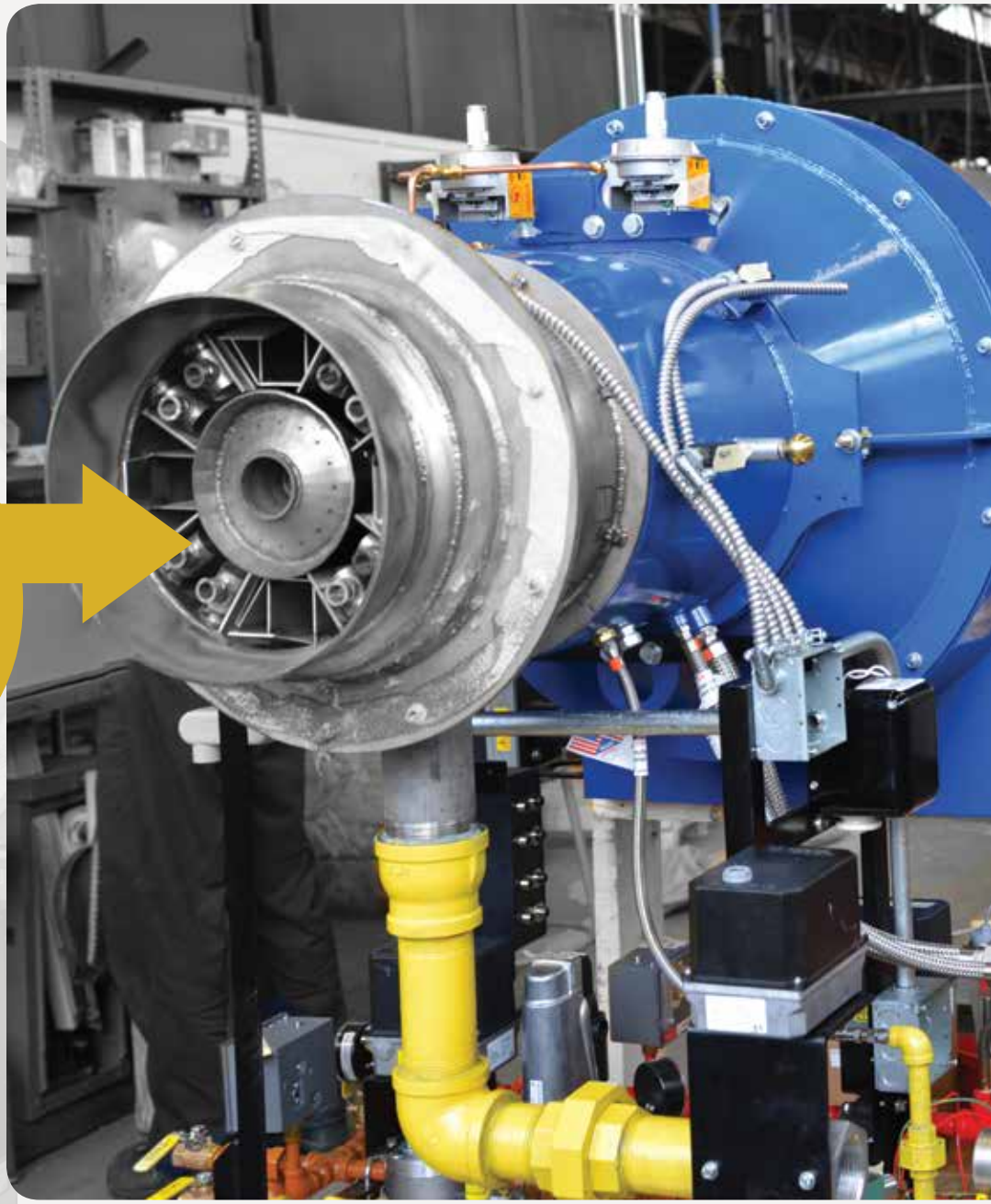
INCREASING ENERGY EFFICIENCY USING

New Technolo



Two low NOx burners in production.

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By David Bohn

Any facilities manager will tell you that no matter how dedicated their organization is to improving the efficiency of their heating equipment, it can be difficult to justify spending millions of dollars on new boiler equipment. Boiler equipment technology is generally sturdy and expensive, so boilers are seldom replaced. As a result, even large, well-respected facilities often have antiquated and inefficient boilers.

Since boilers remain reliable over the course of their decades-long lifespans, it is often cost prohibitive to consider upgrading any parts of the system (pumps, burners, control systems) until the boiler itself requires replacement. However, with recent advances in technology, there are now many ways to improve the performance of boilers without replacing the entire system.

INNOVATIONS IN BIOFUELS

In 2007, colleges and universities began signing the American College & University Presidents' Climate Commitment (now administered as the Climate Leadership Network by Second Nature) and committed to becoming carbon neutral by 2020. As the deadline approaches, many of them are now wondering if there's any way to increase energy efficiency and decrease emissions of the boiler without a complete overhaul. Facilities from all sectors with a sustainability goal to reach are in the same boat.

Traditional biofuels such as wood chips or pellets require a major overhaul. "Liquid wood" or "bio-oil" is a lesser-known biofuel that is quite difficult to burn properly. Thanks to recent innovations, that has now changed. Boilers can now be modified to be compatible with liquid wood for about a tenth of the cost of replacing the system.

Left: Boiler side view with burner that can switch between "liquid wood" and natural gas. Above: All-stainless-steel boiler can process and burn "liquid wood."

Liquid wood is created via a thermochemical process called pyrolysis by which wood is burned in excess of 500° Celsius (932° F), in the absence of oxygen, and is transformed into a combustible liquid. Because there is no oxygen, the wood does not combust: it first becomes charcoal, and then further decomposes into gas and liquid. It behaves similarly to natural gas or crude oil except that it has much lower carbon emissions. The raw wood is harvested from tree farms and more trees can continuously be planted to replace those used for fuel oil, so liquid wood is renewable and has the added benefit of being far less cumbersome to store than traditional biofuels.

Bates College in Maine recently implemented liquid wood as their primary heating source and saw its carbon footprint reduced by an astounding 83 percent. Bates weighed the idea of converting to wood chips, but storing the wood on campus and building a wood chip plant would have cost $10 million upfront compared to the $1 million cost to convert the entire campus to liquid wood.

RETROFITTING COMPONENTS OF EXISTING BOILER SYSTEMS

Like many types of facilities with a long lifespan, the majority of large multi-family housing facilities have older boilers that are reliable but operate quite inefficiently. These boilers typically use a technology called *jackshaft linkages* and are perfectly suited for having specific boiler components retrofitted. The purpose of the jackshaft linkage is to send specific proportions of air and fuel to the burners.

The analog nature of jackshaft linkages presents complications in configuration and maintenance. Even though the service manual may list specs for some common output parameters, making adjustments to the settings requires a highly skilled operator, and because this fine-tuning can affect the entire system, it is an error prone and time intensive process. This all means that the norm is merely to set these systems for one scenario and then not update them—even when it's obvious that under current conditions, a different configuration would be more efficient.

Additionally, because the components are made of metal and connected by bolts, the system slips from the desired configuration over time and introduces serious inefficiencies. The incorrect ratios of air and fuel being dispensed to the combustion system have an outsized effect on the efficiency of the boiler, which is called hysteresis. These systems are using considerably more fuel or electricity—and producing more emissions—than the burner necessitates for the given firing rate.

With both electrical and fuel prices on the rise, replacing jackshaft linkages with a *parallel positioning system* may be the ideal compromise. Parallel positioning systems digitally adjust the ratios of air and fuel delivered for optimum combustion. The ratios can be adjusted via computer to ensure that prime efficiency becomes nearly automatic. Parallel positioning system installation costs start as low as $5,000 and pay for themselves quickly by reducing electrical usage by as much as 75 percent.

STRIKING THE BALANCE BETWEEN ELECTRICAL USE AND NOX EMISSIONS

Although greenhouse gases are the chief focus of most sustainability goals, they are not the only emissions to consider. Industrial boilers also emit nitrogen oxide (NOx), which is a significant air pollutant and the key component in harmful "smog."

These emissions are regulated by the EPA and state agencies, with standards becoming steadily tighter since the 1990s.

Unfortunately, decreasing NOx emissions means upping electrical usage—the lower the NOx, the more electricity required. This can be a source of concern for those looking at low-NOx burners: they seem to face the tough choice of getting a system with the lowest possible emissions while sacrificing significant electrical efficiency, or else a somewhat higher emissions system that might become obsolete in a few years if regulations continue to get stricter. This rock-and-hard-place situation is even tighter in states with high electrical costs such as Connecticut and Hawaii.

The solution lies in the flexibility afforded by a new generation of low-NOx burners with configurable emissions. These systems can be configured to meet current regulations or targets, while operating at the highest electrical efficiency possible. Should regulations ever change, the burner can easily be updated for the new target NOx levels.

REMOTE MONITORING: BOILER CONTROLS AND DATA IN YOUR POCKET

As "the Internet of Things" becomes the norm, remote monitoring of heating equipment is growing increasingly common. Who wouldn't want to access a complete backlog of data and to get instant notifications of issues on a smartphone rather than manually keeping records and physically accessing a boiler to check its status?

Naturally, remotely monitored boiler systems have an edge in emergency situations because they send alerts in real time. For mission-critical facilities such as data centers and hospitals, round-the-clock maintenance staff for facilities containing heating and cooling units is a major expense. Remote monitoring makes on-call staff just as effective. Additionally, remote monitoring frees up staff members to attend to other tasks while remaining readily available to respond to malfunctions or failures of any boiler system.

Real-time alerts provide a head start allows most issues to be solved before they have a noticeable effect on the temperature of the building. This is critical on hot or cold days when the temperature inside can change quickly. In some cases, the problem can actually be fixed remotely as well using a reset button or other troubleshooting measures. For residential and office facilities, issues can arise and be dealt with without tenants noticing—a sharp contrast to the typical situa-

Remote monitoring system can be customized to full or more compact SCADA system (supervisory control and data acquisition).

tion of learning of issues on the phone with upset tenants.

Remote monitoring tools also don't take holidays. A staff member on call is likely to be unbothered as they enjoy Thanksgiving or Memorial Day, but in the event of an emergency, there will be enough time to prevent an untimely disaster. Plus, most remote monitoring systems provide a great level of detail on an issue. If a notification comes in on New Year's Day, the staff member receiving it will likely have sufficient information to determine if immediate action is necessary or if the issue can wait until the next day.

KNOW YOUR SYSTEM AS NEVER BEFORE

In addition to shortening reaction times, remote monitoring can enable the collection of a great deal of useful data. The determining factor here is the age of the controller and how much data is able to report. Older controllers may be able to tell only when a boiler is running properly and when one shuts down unintentionally. On the other hand, newer controllers likely will communicate why a boiler shut down, how much fuel it was using, what the heating demand is for the building each day, how efficiently the boilers were running, whether they were firing natural gas or backup oil, and more. This information can be used to diagnose potential problems and inefficiencies.

Plus, this information adds up over time so trends can be observed. Facilities managers no longer have to log issues by hand or rely on memory to tell them when the last time a similar issue occurred. By effortlessly providing detailed tracking, informed decision making becomes easier.

Boiler systems that can communicate higher order technical information not only help facilities managers stay ahead of problems, but also empower them to analyze fuel usage trends and heating efficiency. The best remote monitoring tools can be set to optimize the facility's carbon footprint and reduce operating expenses by cutting fuel and electricity usage.

Comparing the operating characteristics of a boiler over time, facilities managers can sometimes predict when the boiler needs to be tuned or foresee that components are going to fail and replace them before this happens. The ability to preempt problems helps regulate costs by reducing overtime for what would have been time time-consuming fix if left unchecked.

IF IT AIN'T BROKE, IT MAY STILL BE TIME FOR AN UPGRADE

It is easy to fall into a pattern of replacing what breaks, but something as reliable as boilers, it's important for facilities managers to ask themselves what an upgrade could allow for. Would it help reach a climate commitment or dramatically reduce emissions? Would it improve workflow and tenant experience? Would it cut costs in the long term?

The last few years have seen major innovations in boiler technology. If they're not paying close attention to the industry, it would be easy for facilities managers to miss opportunities to contribute to strategic climate initiatives, help balance the budget, and deliver greater reliability.

Replacing a boiler is, of course, massively expensive. However, from liquid wood to remote monitoring, there are drastic improvements that can be made affordably. Doing so not only reduces costs and increases efficiency, it helps the facilities manager's role tie in to the overall mission of the facility.

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