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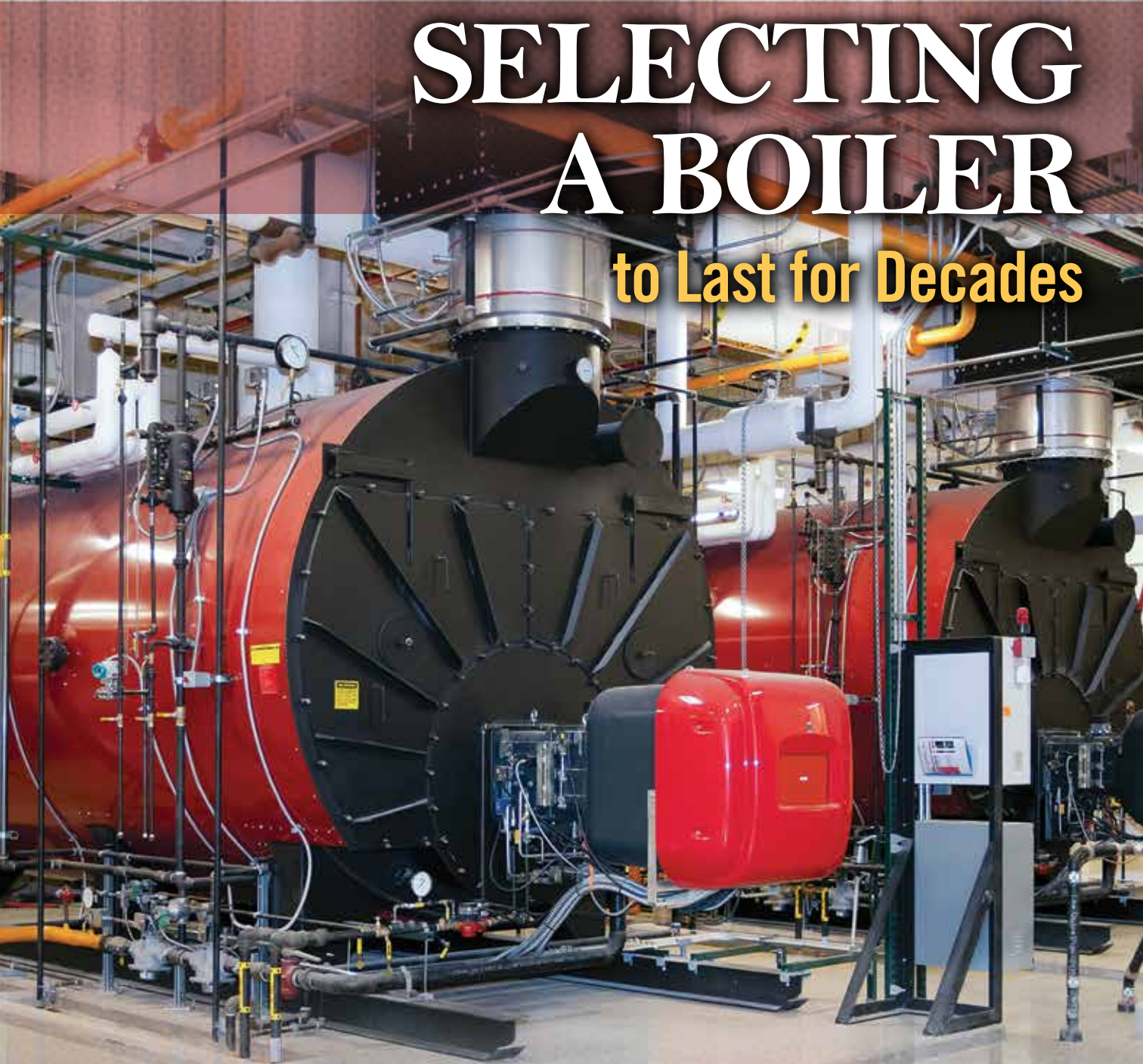
VOLUME 26 / ISSUE 3

gastechology

THE SOURCE FOR ENERGY SOLUTIONS

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SELECTING A BOILER to Last for Decades





inside



on the cover

Selection of a new boiler requires consideration for today's needs and those for decades to come. Efficiency, emissions, and reliability are all considerations. Photo courtesy Hurst Boiler.



Gas Technology is a trademark of Energy Solutions Center Inc. and is published in cooperation with CFE Media, LLC.

Gas Technology is an educational supplement from:

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Washington, DC 20001
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Oak Brook, IL 60523
(630) 571-4070
Printed in the USA

energy solutions center websites

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Boilers are available in a wide range of sizes, with varying steam characteristics. Because this is a long-term decision, it is well to give serious consideration to getting the right boiler in the right size.

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Since 2008, reserves and production of natural gas in the U.S. and Canada have spurred industrial development here at home, and even repatriation of industries from previous overseas locations. An NAM executive shares the excitement of this opportunity.

SELECTING THE RIGHT BOILER

Make the Best Long-Term Decision

FEW PURCHASING DECISIONS for your facility have larger and longer-term energy consequences than purchasing a new or replacement boiler. Yet this purchase is often undertaken without complete consideration of all the options and possibilities. A typical industrial boiler, if properly maintained, has an operating life measured in decades. Thus, operating efficiency and suitability for the intended application are usually more significant considerations than just the first cost of the unit.

Emissions Rules Change the Game

Increasingly, air quality regulations are causing operators of coal- or oil-fired boilers in industrial and institutional applications to switch to natural gas-fired replacement boilers. In the U.S. in 2012, the EPA promulgated the final rulemaking titled National Emission Standards for Hazardous Pollutants for Major Sources: Industrial, Commercial and Institutional Boilers and Process Heaters, commonly known as "ICI Boiler MACT."

This rulemaking has made natural gas the fuel of choice (and often the only option) for these boilers. Fortunately, it comes at a time when natural gas is being produced in increasing abundance, at prices that are attractive. Further, many existing natural gas-fired boilers must be brought up to more rigorous emission standards. Thus many owners are studying the options in natural gas-fired equipment.



Modern package boilers have high efficiency and factory assembly of the entire unit simplifies installation and startup, as in this microbrewery application. Photo courtesy Hurst Boiler.

Look at Lifetime Costs

In a recent presentation at a Technology & Marketing Assessment Forum (TMAF) sponsored by the Energy Solutions Center, Ron Polidori from Clayton Industries stressed the importance of selecting the right boiler from the very beginning. He indicated, "30 years is a reasonable life expectancy. Many boilers will last much longer if they are well maintained, however, they will not last long at all if they are not properly maintained."

He noted that in examining the total cost of typical natural gas-fired boiler systems over ten years, fuel cost typically represents 94% of the total expense, while the initial cost of the boiler represents only 4%, and upkeep and maintenance of the system is only 2%. It is important to select a high-efficiency boiler that is well-suited to the application, and to maintain it to operate at its peak efficiency with compliant emissions.

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www.claytonindustries.com

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DOE BOILER MACT ASSISTANCE
www1.eere.energy.gov/manufacturing/distrib-
edenergy/pdfs/boilermact_tech_asst_factsheet.pdf

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www.cleanboiler.org

HURST BOILER
www.hurstboiler.com

MIURA BOILER
www.miuraboiler.com

VISSMAN MANUFACTURING CONDENSING BOILERS
www.viessmann.com

Detailed Evaluation Needed

Polidori emphasizes the benefit of doing a complete analysis of your steam or hot water needs before committing to a new or replacement boiler. This means an evaluation of your steam pressure and volume needs, the daily, weekly and annual cycle of boiler loads, and having a full understanding of special steam quality characteristics.

of these elements.” This is costly not only because of the direct expense, but also the loss of boiler use while this maintenance is being done.

Requirements May Have Changed

Industrial and institutional steam usage patterns often change over time. It may be today that your existing boiler is too

rest of the year for water heating or other minimal demand applications. Often the large boiler cycles off and on during these low-load periods, further reducing its efficiency. For these situations, it is often beneficial to install a single, small “pony” boiler, allowing the large main boiler to be shut down seasonally.

In many parts of the country, particularly in the Northeast, in California, and in parts of Texas, air quality regulations require the use of ultra-low NO_x burners as well as more rigorous exhaust gas monitoring. It is anticipated that some other areas will have these requirements in the future. Ask your engineer to include these considerations in your boiler installation or replacement plans.

Condensing Boiler an Option

For some applications, particularly comfort heating and low-temperature process applications, condensing boilers have become an important option. A condensing boiler offers very high efficiency by recovering the latent heat of vaporization from the boiler exhaust.

In natural gas-fired boilers this is accomplished with a feedwater return at temperatures below 135° F. If your feedwater return is usually above this temperature, there is no efficiency benefit with the condensing design, and in fact there can be a cost penalty because condensing boilers necessarily use more expensive stainless heat exchangers for the wet condensing portion.

Economizers Often Make Sense

Even if you do not have an application suitable for a condensing boiler, there are often major efficiency improvements possible with the use of a boiler economizer to extract more heat from the boiler exhaust. Economizers are available in both condensing types and non-condensing designs, and in some cases are offered by boiler manufacturers as integral elements of the boiler.

The economizer is most frequently used to preheat feedwater, but can also be used for potable hot water, process

water, or to heat makeup water for applications where there is significant utilization of live steam in a process. Ask your engineer and boiler manufacturer for the information on the appropriate size and type of economizer. Paybacks on a boiler economizer can be as short as six months in many cases.

Combine Conventional and Condensing Systems

Chad Fletcher from Hurst Boiler was recently a presenter at an Energy Solutions Center TMAF. In his presentation, he discussed the merits of both conventional (non-condensing) and condensing economizers. He pointed out that conventional economizers have lower investment cost, easy installation and very low maintenance. Condensing units have the potential for a higher level of energy recovery, but can be more costly to purchase and install.

He offered the possibility of a hybrid economizer solution, with a conventional economizer collecting most of the sensible heat from the exhaust stream, then a smaller condensing unit for the final stage of heat recovery. Fletcher indicated that economizers make the most sense in boilers sized larger than 50 hp.

Burner Choices

Fletcher also discussed the need to select the right burner to match with the new boiler, especially in areas requiring ultra-low NO_x compliance. Hurst offers boilers equipped with burners that provide fuel and air premixed at optimum levels and combustion on the surface of the burner for optimum radiant energy with very low NO_x creation. These burners typically are available with turndown ratios as low as 4:1. The boiler burner can be purchased as part of the boiler package, or can be sourced separately. Especially in smaller vertical, horizontal and

tubeless package boilers, it is important to match the burner to the geometry of the heat exchange surface. Often these boilers are equipped with high-efficiency factory-specified burners.

Get Help with the Decision

Obviously the process of selecting the right boiler is complex, and very dependent on the application. Tools for scoping and modeling boilers for your specific plant configuration are available from DOE’s Division of Energy Efficiency and Renewable Energy (EERE). Look also for help from energy consultants, especially if you are in an ultra-low NO_x area.

Boiler manufacturing companies also offer valuable help in sizing and finding a boiler with the ideal steam characteristics. If your boiler is due for replacement, and particularly if you are changing from another fuel to natural gas, it is important to begin with choosing the right boiler. It’s a decision you’ll live with for decades. **GT**



Installation of multiple boilers adds system reliability and allows units to be staged to keep the system operating at high efficiency through the daily and seasonal cycles. Photo courtesy Clayton Industries.

Polidori says, “Steam quality is important, as it describes the amount of water droplets that are present in the steam. Dry, saturated steam should contain no droplets, and 99% saturated steam would contain 1% water droplets. Steam with a high amount of droplets will have substantially lower heat content, and reduced heat transfer capability and therefore, results in lower efficiencies.” If the boiler is only producing 95% steam quality, the boiler will need to make 104-105 lbs. of steam rather than the 100 lbs. with a boiler at 99% steam quality.

Polidori adds, “Wet steam can also have detrimental effects on the steam distribution system - valves, controls, etc. If the droplets of water are not removed, you can experience premature replacement

large, too small or operates at the wrong temperature or pressure for current heating or process requirements. Modern package boilers are available in a wide range of sizes, and offer very good efficiencies even in the smaller sizes. It frequently is valuable to specify multiple boilers rather than a single larger unit to allow unit redundancy for greater plant reliability. This approach also allows owners to operate boilers in a modular fashion to stay near the peak boiler efficiency with varying loads.

Strategies for Seasonal Loads

Certain applications have a large steam or hot water requirement for only part of the year, but keep a large boiler operating at low load (and low efficiency) the



The service life of a well-maintained boiler is measured in decades, so it's important to size it correctly and to accurately specify the desired steam conditions for each site. Photo courtesy Hurst Boiler.

Infrared Heat Increases Comfort, Lowers Energy Costs

Put the Heat Where It's Needed

FOR MANY INDUSTRIAL and institutional facilities, space heating during the cold months is a major expense. Yet many portions of these buildings do not require continuous comfort-level heating. Examples are warehouses and high overhead spaces in manufacturing areas. Other facilities need heating only during certain times of the day, or during certain operations. Yet convection heating necessarily heats the entire space, and often has to continue to operate even when the space is unoccupied. An energy-saving solution is natural gas-fired infrared heat.

Heating People, Not Air

Modern gas infrared heating units take several forms, including radiant tubes, ceramic panels, and various types of radiant reflector units. A large portion of the heat they produce does not heat the room air, but rather heats solid objects in its path – tables, work surfaces, floors, and most importantly . . . people. Thus infrared is inherently more energy efficient, and because it begins heating immediately, need only operate when the area is occupied.

Infrared is the portion of the light spectrum with a wavelength longer than visible light. Much of the heat we get from the sun is in the infrared wavelength. Think of the heat one feels from the sun outdoors on a bright February day, when air temperatures may still be quite low. That's infrared.

Suitable for Many Environments

Jim McLellan from Schwank Group was recently a presenter at a Technology & Marketing Assessment Forum (TMAF) sponsored by the Energy Solutions Center. Schwank is one of the major suppliers of infrared heating products for industrial,

institutional and commercial buildings. McLellan points out that gas-fired infrared heating units can be used in a wide range of environments. He notes, "Infrared heaters provide comfort based on the principle that comfort temperature is equal to the average of ambient air temperature and mean radiant temperature in the space. So by increasing the radiant temperature in a space, the ambient temperature can be reduced, yet comfort of personnel remains the same."

McLellan adds that warm-air systems result in hot air near the ceiling that is called the 'chimney effect.' "The greater the temperature differential from outside, the greater the rate at which the hot air

will escape from the building, and draw in cold air at lower building levels to replace it." Because infrared systems do not heat air, temperature stratification is greatly reduced, thus dramatically reducing heat loss. He emphasizes, "Reduced heat losses equal reduced fuel consumption compared to systems that only provide comfort with warmed air."

Improved Infrared Output

According to McLellan, the proportion of heat emitted by infrared heaters as actual infrared has significantly increased over the years. The ANSI/CSA Standards by which IR heaters are approved require a minimum of 35% radiant output to qual-



Industrial areas with high ceilings can use radiant infrared units to provide floor-level comfort without excessive heating of overhead areas. Photo courtesy SchwankUSA.



Shipping and receiving areas with doors frequently open are ideal locations for overhead infrared heating. Photo courtesy SchwankUSA.

ify as an "infrared radiant" heater. Early technology achieved levels of 45% to 50% radiant output. McLellan notes that Schwank has invested in R&D that has allowed certain infrared appliances to reach outputs of up to 81% infrared efficiency. Tube heater technology has improved from 45% to the 60-65% range. As IR efficiency goes up, heat losses go down.

One of the principal advantages to infrared comfort heating is its adaptability to zoned heating. McLellan indicates, "Not only is zoning practical, it is the standard procedure. Storage and warehouse areas can be maintained at lower temperatures than personnel production areas to provide further reductions in operating costs . . . try that with warm air systems!" In many production facilities, certain areas are only used part of the day, or during certain times of the year. Infrared units can be switched on or output levels increased only during those occupied hours.

Radiant Tubes

A widely used type of infrared heating system is indirectly-fired radiant tubes. In this system, a burner directs a long flame into the end of a specially-designed coated metal tube. The tube is surrounded by a polished metal reflector, which directs the energy down and outward, to warm people, machinery, products and the floor below. These systems can be used for wide areas, even entire buildings.

According to Bob Alcott from Schwank,

in industrial facilities the best applications are buildings with ceiling heights of 14 feet or greater. It is generally recommended that the heating units be placed in greater density in areas with the greatest heat loss, such as overhead doors and perimeter walls. Because part of the heat output of an infrared is convective heating of the surrounding air, the use of these units will contribute to higher room air temperatures as well.

Range of Climate Applications

Industrial and institutional infrared space heating is an attractive primary or supplementary resource in cold climates such as the northern tier of the U.S. or Canada, but it is also very suitable for climates further south, that have a shorter heating season. Owners of facilities in these areas may not wish to invest in a forced air or hot water heating system for the entire facility, but need spot heat during the coolest months of the year. Gas-fired infrared is affordable and valuable facility floor space need not be tied up with heating equipment that is used only a few months of the year. Overhead infrared units are ideal.

According to John Vancak, President of Calcana Industries Ltd., the flexibility of infrared is one of its greatest features. Calcana offers its SR-Series of radiant tube heater for industrial, commercial and agricultural applications. This product is available with an input rating of 40,000 to 200,000 Btu/hr in lengths from 10 to 80 feet. For ease of in-

stallation, the first ten feet is pre-assembled, and can be configured for L-shaped and U-shaped installations.

Significant Savings Possible

Vancak says, "By using infrared tube heaters, one can realize significant savings over conventional boilers and forced air units in the 40% range. This is supported by ASHRAE studies." He adds, "Infrared heaters not only offer significant fuel savings, but they offer the ability to zone and spot heat an area, thereby giving comfort to a specific spot without heating the entire space. Also, there is very little noise with our units, and the draft-free heat combined with warm, dry floors gives workers an outstanding work environment."

Manufacturers of infrared equipment such as Calcana and Schwank indicate that industrial or institutional owners can contact them directly for guidance on sizing and placement of infrared heating equipment for optimum efficiency and comfort. If your industrial or warehouse building heat plan needs an update, be sure to include the infrared option as a consideration.

GT

MORE info

CALCANA INDUSTRIES
www.calcana.com

DETROIT RADIANT PRODUCTS COMPANY
www.reverberray.com

ENERGY SOLUTIONS CENTER INFORMATION ON INFRARED HEATING
www.energysolutionscenter.org/gas_solutions/infrared_heating_standard_and_tube.aspx

LINK TO ASHRAE AND OTHER STUDIES ON ENERGY SAVINGS
www.reverberray.com/about-infrared/benefits-of-infrared/independent-studies

SCHWANK
www.schwankusa.com

SUPERIOR RADIANT PRODUCTS LTD.
www.superiorradiant.com

CCI THERMAL TECHNOLOGIES, INC.
www.ccithermal.com/cata-dyne/cata-dyne-product-line.php

Burner Replacement on Existing Boilers

Dramatic Efficiency
Gains Possible

YOU KNOW THAT YOUR BOILER is a major energy user, and you may have concerns about its efficiency. But if boilers are the right size and type for their operations, some owners are reluctant to replace them. The efficiency problem may not be the boiler itself, but the burner. Owners are discovering that they can make major improvements in operating efficiency by installing a replacement burner, with improved turndown, higher combustion efficiency, lower emissions, and precise control capability.

Role of the Burner

A report from the DOE's Energy Efficiency and Renewable Energy Division (EERE) indicates, "The purpose of the burner is to mix molecules of fuel with molecules of air. A boiler will run only as well as the burner performs. A poorly designed boiler with an efficient burner may perform better than a well-designed boiler with a poor burner. Burners are designed to maximize combustion efficiency while minimizing the release of emissions."

The report goes on to point out the importance of minimizing excess air in the combustion process, and the value of high turndown ratios in minimizing startup-shutdown energy losses. It also advises that in many cases, burners that were designed for oil-burning and were converted to natural gas are quite inefficient and are likely candidates for replacement.

Newer Technologies to Upgrade Existing Boiler

In a recent presentation at a Technology & Marketing Assessment Forum (TMAF) sponsored by the Energy Solutions Center, Hikmet Demiryol from Weishaupt Corpora-

tion discussed potential benefits of replacing older burners on boilers, taking advantage of advanced technologies. Weishaupt is a global provider of boiler burners, both as original equipment and for retrofit installations. Demiryol pointed out that the thermodynamic properties of many older boilers are still very acceptable.

He noted that a well-maintained boiler has a long life – as long as 40 years. He stated that there have not been major changes in the design of the heat exchanger in the boiler in 60 years. However, replacing the original burner with a high-efficiency modern system can result in fuel savings ranging from 5% to 40%. Demiryol said that current Weishaupt burners significantly reduce excess air at all firing rates. Lower excess air means higher combustion efficiency.

Burner Cost Low Compared to Savings

Demiryol advised that the vast majority of older boilers can be retrofitted with new burners, but a comprehensive feasibility study should be done in all cases. He emphasized that the cost of the burner, plus the cost of burner maintenance, during the lifetime of the burner represented only about 2% of the cost of the fuel that would be fired through it. Therefore, installing the most efficient replacement burner makes the most sense. Manufacturers such as Weishaupt offer burners in a wide range of sizes for many of the commonest brands of boilers.

Demiryol also stressed that today's boiler burners do have improved turndown ratios. This is important because often the boiler is at low load during certain times of day, or during certain seasons of

the year. If the boiler's original burner does not have adequate turndown capability, the boiler will cycle, with consequent significant losses in boiler efficiency. Burners are available with turndown capabilities as low as 10% load, minimizing boiler cycling and improving system efficiency.



Older serviceable boilers can be equipped with advanced burners to improve boiler turndown, reduce excess air and reduce emissions. Often efficiency gains of 5% to 30% are achievable. Photo courtesy Riello Burners.

Excess Air Control Critical

A key to burner efficiency is strict regulation of the amount of excess air for combustion at all operating levels. Today's burners – both gas-only and gas/oil – are designed to minimize energy-wasting excess air. By holding excess air levels to 4% or less, boiler efficiency is significantly improved. Many modern gas burners can hold these levels through the full turndown range. The key to excess air control is a precise damper mechanism for combustion air that maintains accurate and low excess air levels through the entire range.

Another important provider of replacement burners is Riello Burners, a global firm headquartered in Italy, with a broad international presence. According to Riello's Jack McDonald, the company offers replacement burners for a wide range of commercial and industrial boilers. McDonald points out that the potential savings from a burner replacement can vary widely. "An average of between 5% and 15% would be expected, though I have seen as high as 30% savings."

Oxygen Trim for Varying Conditions

McDonald indicates that an option that is frequently being chosen is an oxygen trim control that senses O₂ levels in the exhaust gas and adjusts combustion air accordingly. "We use O₂ trim on units above 200 hp, as this is the area where the added expense will show benefits in terms of payback." He notes, "O₂ trim is really only useful if there are large swings in the combustion air conditions in the boiler room, variations in the fuel Btu ratings, and/or the boiler breeching has uncontrolled swings in draft."

In any case, McDonald says, Riello burners are capable of running between 3.5% and 4.5% excess air. "This is because the mechanical cam versions of our standard burners are precisely machined and have turnbuckle-type connections so there is very little or no free play in the linkages."



Facilities with multiple boilers especially benefit from burner replacement where they can be linked to central plant control to allow boiler optimization for varying plant loads. Photo courtesy Riello Burners.

Precision Mechanical Controls

He indicates the Riello mechanical cam burners have a high repeatability, such that an initial setting will maintain that correct level for years, provided there are not changes in the combustion air temperature, fuel supply, or fouling of the burner fuel and air passages. "They should be checked at minimum yearly, though, since components can wear for a variety of reasons, causing changes in combustion."

McDonald suggests that owners evaluate their boilers for a possible efficiency upgrade with a new burner and controls. "There are many good mechanical contractors who can provide those services. They should supply owners with a detailed overview of their systems, including boiler and system efficiencies as well as potential savings both in equipment efficiencies and reductions in maintenance and downtime."

Wide Range of Boiler Burners

Another Energy Solutions Center TMAF presenter was Pawel Mosiewicz from In-

dustrial Combustion, a Cleaver-Brooks company. He described how his company's line of natural and dual fuel burners cover the full range of commercial and industrial boiler markets and conserve energy through precise parallel-positioning fuel and air controls, high turndown ratios, and O₂ trim to match varying fuel, air and environmental conditions. Mosiewicz also explained how modern burners can also conserve electric energy through the use of high-efficiency motors and variable frequency drives. These results are achieved while achieving NO_x compliance.

Opportunities for Savings

Is it time to replace your boiler burner? At a minimum, if your burner is more than ten years old or doesn't have the high-efficiency features of newer designs, it is appropriate to do an evaluation. Ask a qualified boiler engineer or energy efficiency expert for help in this stage. It could be that a comparatively small investment in a new burner could pay for itself in a few months. After that, it would begin paying you. **GT**

MORE info

DOE - EERE REPORT ON BOILER BURNER REPLACEMENT
www1.eere.energy.gov/manufacturing/tech_assistance/pdfs/steam24_burners.pdf

ENERGY SOLUTIONS CENTER BOILER BURNER CONSORTIUM
www.cleanboiler.org

INDUSTRIAL COMBUSTION, A CLEAVER-BROOKS COMPANY
www.ind-comb.com

RIELLO BURNERS
www.riello.com

WEISHAUP T BURNERS
www.weishaupt-america.com

CNG REFUELING NETWORKS ARE EXPANDING

An Increasingly Important Option

“SOME PEOPLE SAY natural gas fueling is an important option for the future. They are wrong. It is here now.” This statement by Joe Rende of Trillium CNG™ reflects the rapid development of CNG as a transportation fuel in North America. As an example, Rende notes that in 2012, 50% of the new transit buses ordered in the U.S. were CNG-powered as well as 25% of the refuse collection trucks. Many operators of industrial and commercial vehicles have become aware of the CNG option, and it is increasingly being selected.

Growing Production, Attractive Pricing

Rende points out that since 2007, the price of natural gas has become decoupled from gasoline and diesel fuel prices due to its growing resource base and increasing domestic production volume. Ten years ago, the few public purchase points for CNG were mostly in California, and at scattered locations around the country, mostly at gas utility vehicle yards. Today, a network of public CNG refueling stations at convenient high traffic volume locations is springing up. These facilities are equipped for quick-fill fueling



Intercity truckers take advantage of the growing development of public fueling points along the Interstate Highway system. Photo courtesy Questar Gas.

of vehicles in a time frame comparable with that of gasoline or diesel fueling.

Certain companies have taken leadership positions in public CNG fueling. One is Kwik Trip, a privately-held chain of 430 fuel and convenience stores in Wisconsin, Minnesota and Iowa. Since 2010, the company has opened public CNG fueling points at 17 of its convenience stores. According to Joel Hirschboeck, the company's Superintendent of Alternative Fuels and Commercial Accounts, there are an additional nine locations scheduled for opening by the end of the first quarter, 2014, and an additional ten sites planned for the balance of 2014.

Role of Public CNG Fueling Sites

The company uses the public fueling sites for refueling its own vehicles as well as for outside sales. Kwik Trip currently operates over 40 CNG vehicles, including both light duty trucks and tractor-trailer rigs for product and fuel delivery, with more planned as vehicles are replaced. Kwik Trip is specifically interested in CNG fuel sales to commercial and industrial fleets in addition to private passenger vehicles.

Hirschboeck indicates fleet sales include customers as diverse as general contractors, electricians, landscaping firms, airport shuttles, parts and service vans, delivery vans, mail haulers, regional freight haulers, waste disposal contractors, bulk liquid haulers and livestock haulers.

Fueling Sites Springing Up

Another leader in the CNG transportation field is Trillium CNG™, mentioned above. Trillium provides CNG fueling services as well as serving as a single-source provider of CNG fueling facility design, construction, operation and maintenance. According to Joe Rende from Trillium, the company is currently operating 80 fueling points, with another 20 in the building stage, and another 20 in the development stage. Further, they are providing development and operation services for many other public and private fueling sites.

Rende indicates that the company locates its public facilities at high traffic volume locations that are logical fueling points. Often they develop agreements with “anchor volume customers” at locations that have potential for significant volumes of fleet sales of CNG. The stations are also open to smaller users, including passenger motor vehicles. Volume users might include transit bus lines, refuse haulers, ready-mix concrete companies, delivery companies or other fleets.

Ideal for High-Mileage Vehicles

Rende indicates that the economics of switching to CNG are compelling, especially for high-mileage users such as freight lines or



Development of CNG refueling networks simplifies arrangements for smaller fleets that require frequent refueling on varying schedules. Photo courtesy Questar Gas.

transit bus companies. Commercial CNG vehicles include both diesel conversion engines, which are only partially fueled with natural gas, and design-CNG engines such as the Cummins Westport 8.9- and 11.9-liter engines that are designed for dedicated CNG use.

Major truck manufacturers including Kenworth, Peterbilt and Freightliner offer factory-built CNG-powered trucks for a wide range of markets. According to Rende, the cost premium for a heavy truck equipped with a dedicated CNG engine may range from \$30,000 to \$60,000, depending on the engine type and the on-board CNG storage requirement.

“But,” he says, “If you look at the operating cost benefit for a vehicle that’s logging 100,000 miles per year and using 5 mpg of fuel, the payback can be short, in some cases one to two years.” Prices for CNG are variable, but are currently around \$2 or less per gasoline gallon equivalent (GGE). Most industry experts expect prices to stay in this area for an extended time.

Vehicle Cost Premium May Decline

Rende also believes that the added cost for a CNG vehicle may decline in the future as production volumes go up. “We see that happening with transit buses already. As CNG takes an increasing proportion of the market, the price differential is getting much closer.”

At Kwik Trip, company usage of CNG in its own fleet is resulting in growing confidence in the technology, and interest in helping other commercial customers

get involved. Joel Hirschboeck notes that the company has been logging and tracking maintenance data on its CNG vehicles along with its standard fleet. “So far we are seeing our maintenance costs remain neutral. However, there is reason to believe that as our vehicles reach 250,000 miles, the cost to maintain the diesels will increase due to necessary work on the emissions controls. As diesel costs rise, we anticipate natural gas vehicle maintenance costs to remain steady, putting them at a maintenance cost advantage.”

Drivers Largely Supportive of CNG

Hirschboeck indicates that Kwik Trip has conducted extensive training that provides an explanation for drivers of CNG vehicles, helping them understand why they are good for the company, the environment and the economy. He says, “The vast majority [of drivers] stand by CNG because it’s good for the company, but also because it is a domestic fuel. A ‘Made in the U.S.A.’ fuel product has definitely made a hit with our workforce.”

Utility Involved

Natural gas utilities have also been active in building the public and private infrastructure to support advancement in the use of CNG as a motor fuel for all types of users. Questar Gas serves customers in Utah and southwestern Wyoming and has taken a leadership position in this region. The company presently operates 30 CNG stations within its regulated service area, and also operates a non-regulated busi-

MORE info

CUMMINS WESTPORT ENGINES
www.cumminswestport.com

DOE CNG FUELING INFORMATION
www.afdc.energy.gov/fuels/natural_gas.html

KWIK TRIP CNG REFUELING
www.kwiktrip.com/Fuel/Alternative-Fuels/Natural-Gas

QUESTAR FUELING
www.questarfueling.com

TRILLIUM CNG
www.trilliumcng.com



In the U.S. and Canada, refuse trucks are early adopters of the benefits of CNG fueling. Photo courtesy Questar Gas.

ness, Questar Fueling, which is currently building stations for Swift Transportation, Central Freight Lines and Frito Lay.

Questar Gas Executive Vice President and Chief Operating Officer Craig Wagstaff notes, “Fleet operators are primarily motivated by economics. So when they see that America has abundant supplies of natural gas costing between 20% and 60% less than gasoline and diesel, they pay attention. The existence of a nearby public CNG fueling station makes the decision even more economical.”

Do Your Own Evaluation

Potential commercial and industrial energy users can get guidance on the feasibility and economics of converting (fleets) to CNG from the U.S. DOE site <http://www/afdc.energy.gov/tools>. On this website pay special attention to the “Vehicle Cost Calculator” and the “GREEN Fleet Footprint Calculator.” Today, CNG represents a unique opportunity to use an economical fuel that also reduces emissions and uses largely domestic energy sourcing. GT

New Natural Gas Resources Spark Domestic Industry

Industry Expert Describes Developments

INCREASINGLY, WE SEE EVIDENCE that recent expansion of natural gas resources and stable prices are encouraging industrial development in the U.S. and Canada. In some cases, industries with significant energy requirements are returning to North America from overseas locations. Ross Eisenberg is Vice President, Energy & Resources Policy for the National Association of Manufacturers, and he shares with us his thoughts on the influence of the recent natural gas expansion.

Already Underway

Asked if he felt the increased resource base and moderate pricing of natural gas has the potential to increase the U.S. manufacturing base, he is emphatic. "Not only do we believe this will happen, we are already seeing it." As examples, he cites a \$750 million iron facility in Louisiana being developed by Nucor, and its \$3 billion joint venture with Canadian oil and gas producer Encana for 20 years of access to its natural gas wells.

Other examples cited included a \$2.1 billion expansion of fertilizer facilities by CF Industries, and another \$1.4 billion nitrogen fertilizer facility being built by Orascom Construction Industries in Wever, Iowa. Eisenberg indicates there are many other examples of industrial startups or expansions that are directly tied to natural gas supply expansion.

Expanding Energy While Reducing Emissions

He notes, "At NAM we believe in an "all-of-the-above" energy resource policy, and natural gas is a major part of it." Regarding greenhouse gas emissions, he says, "Through greater efficiency and fuel diversity, we've been able to make major reductions in our greenhouse gas emissions. We believe we should be focusing on developing the technologies necessary to continue to make these reductions rather than simply phasing out particular fuels."

Chemical Industries First Winners

Asked which industries could be most positively influenced by growing natural gas resources and their moderate cost, Eisenberg gives several examples. "To date, chemical manufacturers have been the largest beneficiaries, owing to less expensive ethane, a natural gas liquid derived from shale gas. Other energy intensive industries like fertilizer, iron & steel, aluminum, and plastics have begun to

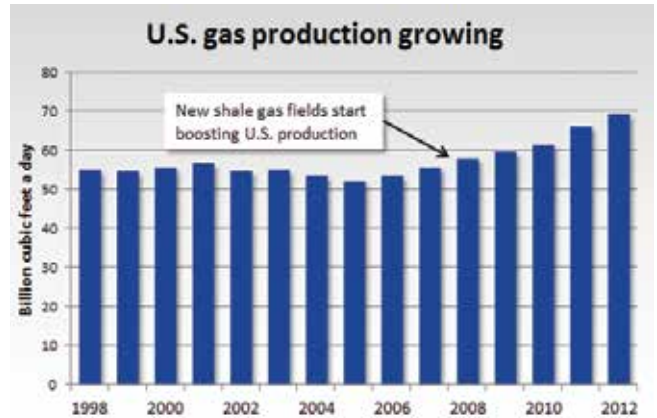


Illustration: US Natural Gas Resource Growing

take advantage in recent years. We believe the next big step is going to be from the products that use natural gas-derived chemicals as building blocks." As examples, he cites chlor-alkali used to make diverse products such as siding, pipe, flooring, coating and adhesives, toothpaste and cosmetics. Other chemicals such as ethylene and propylene are used for many plastic products.

Correct Policies Needed for Future

Eisenberg points out, "Thanks to newfound supply and price stability, manufacturers in the United States enjoy natural gas prices considerably lower than in China, India, Brazil, Japan and the United Kingdom." Eisenberg explains that this is very important, because due to domestic tax, tort, and regulatory policies, it is now 20 percent more expensive to manufacture in the U.S. than any of its nine largest trading partners. He feels that the U.S. has a slight advantage with energy costs, and with the right policies, this advantage can grow.

He cautions, "As bright as the future looks for energy in the U.S., we remain concerned that the wrong government policies can threaten manufacturers' competitive advantage. So as bright as the future seems for energy, the right policies still matter."

Improving our Economic Health

Finally, Eisenberg notes that global research firm IHS released a study finding that unconventional oil and gas activity already supports more than 2.1 million total jobs and has increased disposable income by \$1,200 per U.S. household and added \$284 billion to the U.S. gross domestic product in 2012. **GT**

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"NATURAL GAS IN A SMART ENERGY FUTURE"
www.energysolutionscenter.org/assets/1/AssetManager/Natural_Gas_in_a_Smart_Energy_Future_01-26-2011.pdf

MARCELLUS SHALE COALITION, REPORTS ON SHALE GAS DEVELOPMENT AND ISSUES
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