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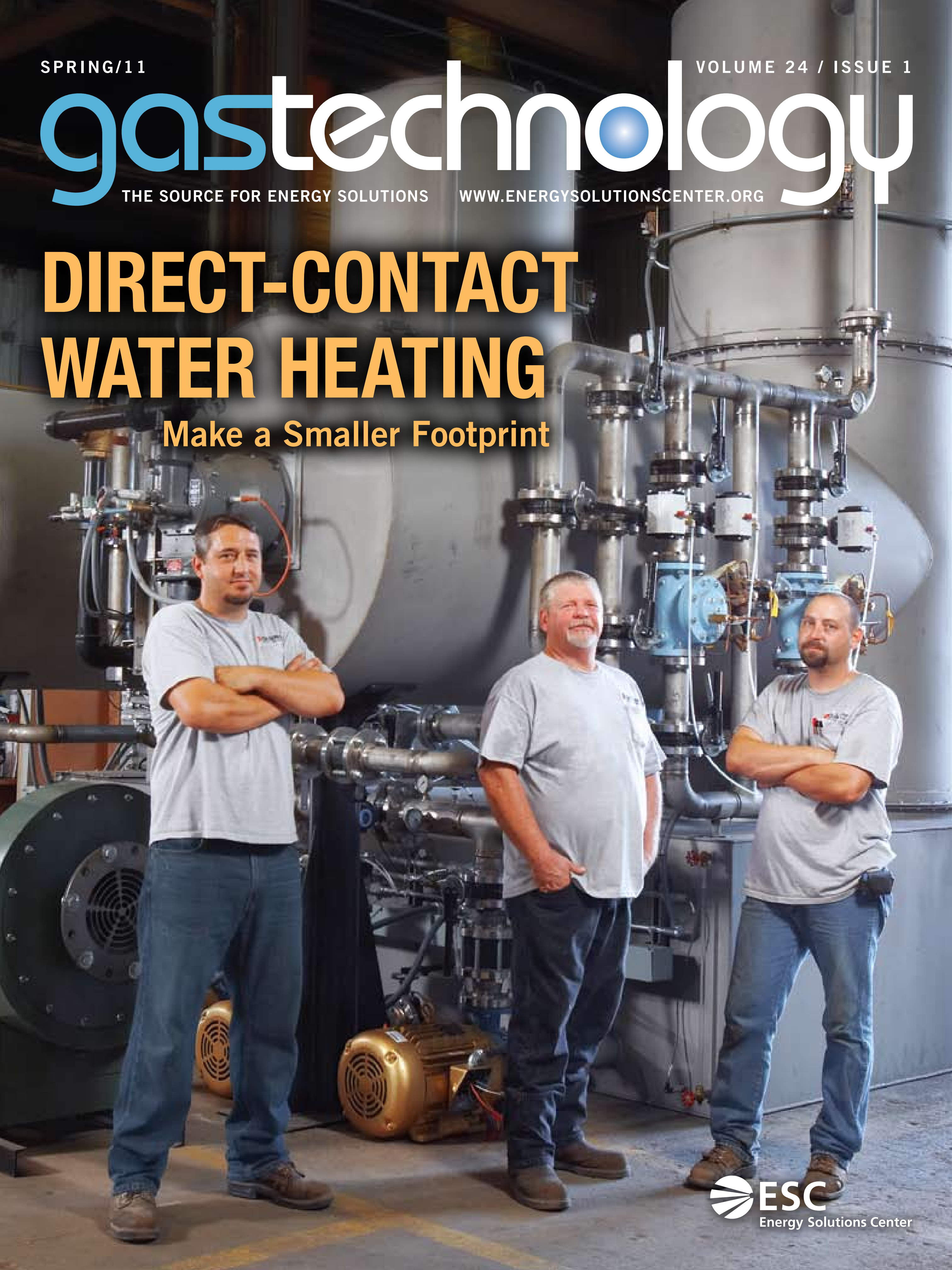
DIRECT-CONTACT WATER HEATING

Make a Smaller Footprint



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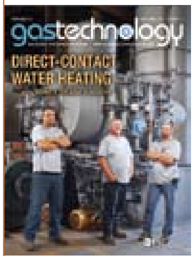

on the cover

Direct-contact water heating, as shown in this installation of a QuikWater unit, offers significant improvements in efficiency for industrial and large commercial users. It's a good step toward reducing your carbon footprint.

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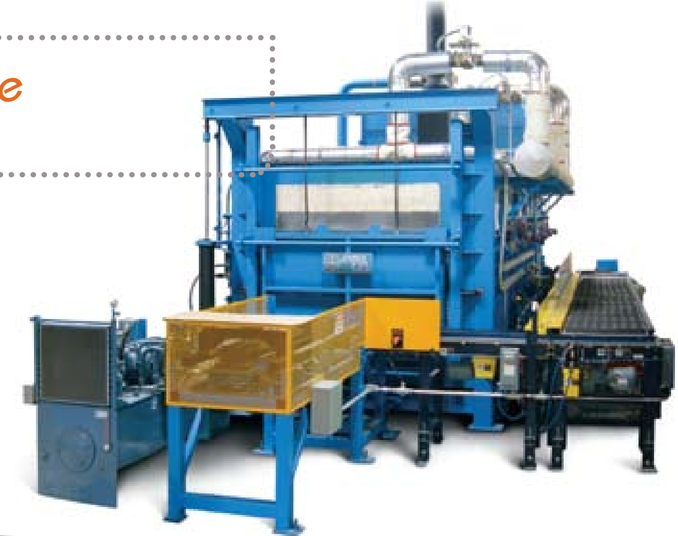
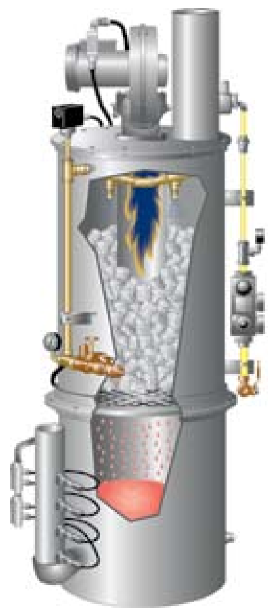
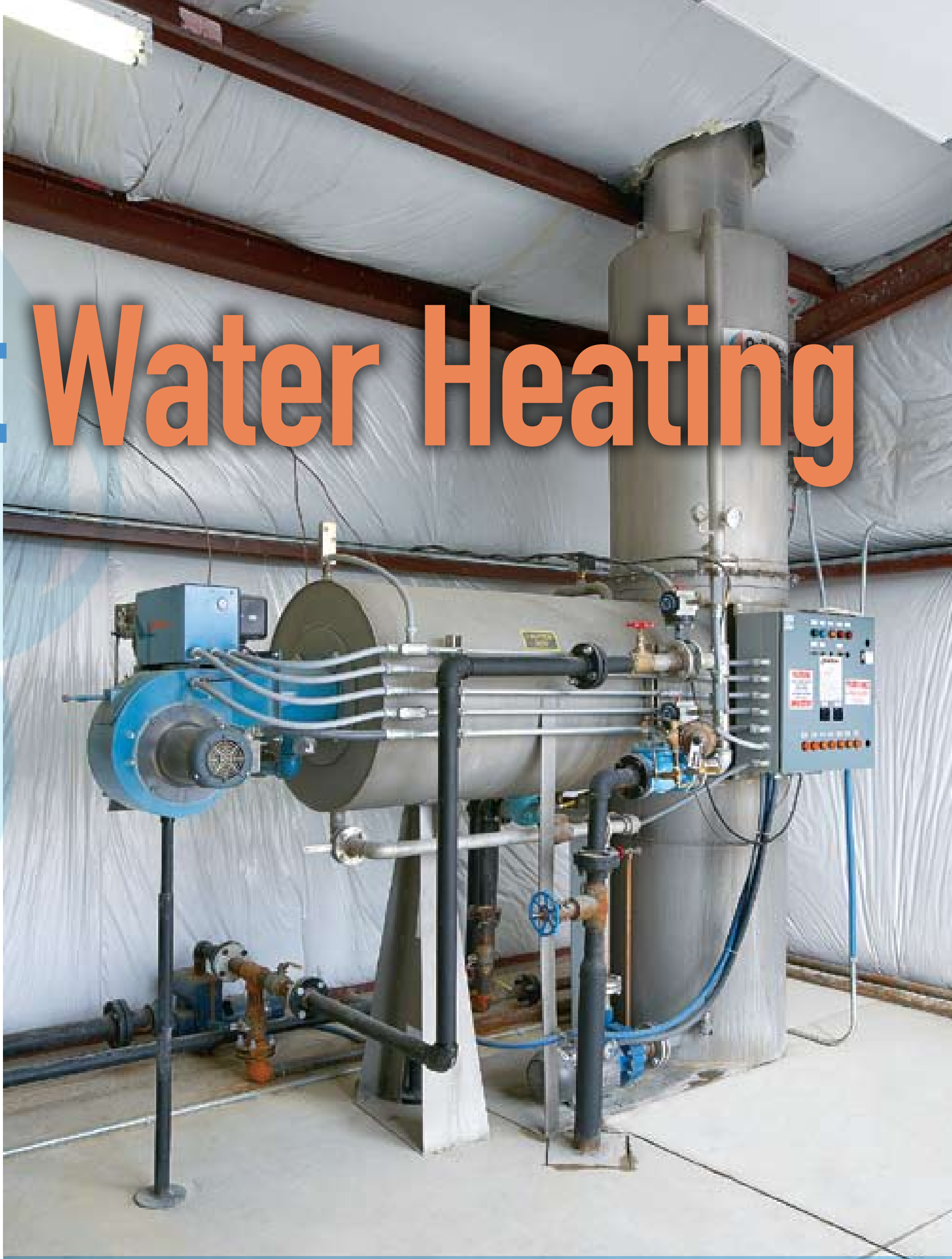




Direct-Contact Water Heating

Saving Energy and Reducing Your Footprint



A QuikWater heater in an industrial installation. Part of the attraction of this unit is its ability to supply large volumes of hot water from a small floor footprint.

WHEN YOU NEED HOT WATER, you need it now, and you want it delivered with efficiency. A great way to achieve this is with direct-contact water heating, fueled with clean natural gas. Every year, more owners are discovering the benefits of this system for water heating that can be nearly 100% efficient. Further, it offers an immediate response to need without the energy or floor space wasted in large-volume hot water storage.

Smaller Carbon Footprint

Individuals and businesses are being asked to reduce their impact on atmospheric carbon. Thus, they have made commitments to reduce carbon emissions. Natural gas is a preferred fuel in itself because of its advantageous composition, its high combustion efficiency, and thus its inherent lower emissions of carbon oxides. For companies already using natural gas for water heating that are striving to make further reductions in their carbon footprint, direct-contact water heating offers additional gains in energy efficiency. Changing to this system can pay for itself in reduced energy costs.

Industries that frequently benefit from direct-contact systems include laundries, dairy operations, food processing plants, concrete plants, greenhouses and many other medium- to large-volume users of hot water. Potential large commercial and institutional operations include health care centers, hotels, universities, prisons, and large food-service facilities. Direct-contact units can also be used to supply hydronic heating systems and to preheat boiler-makeup water.

These systems utilize a burner that directly heats a spray or cascade of cold water. Heat and combustion products move upward as the water descends, resulting in a nearly complete utilization of the heat. Units can response very quickly to changes in the demand for hot water.

Pressure Vessel Not Required

Because they operate at atmospheric pressure, the need for a pressure vessel is eliminated, thus reducing code compliance requirements and other complica-

The Armstrong International Flo-Direct unit is popular for use in the food and beverage industry and features efficiencies as high as 97.3%. Photo courtesy Armstrong Industries

Cutaway view of the Armstrong International Flo-Direct water heater. The key to its efficiency is nearly complete utilization of combustion heat energy.

tions. Manufacturers offer direct-contact units in sizes ranging from 10 to 12,000 gpm. Additional capacity is available with multiple units. One industry expert notes that today's direct-contact units are up to 99% energy efficient and can provide water heating saving of up to 40% percent.

The indirect water heating method using a steam boiler is typically less than 80% efficient, and in some cases much less. In some situations this approach allows an owner to shut down a boiler which otherwise was being fired for water heating duty only.

Most units can be modulated to adjust to varying hot water demands. This maximizes unit efficiency.

Units More Attractive Than Ever

According to John Rivers from Armstrong International's Hot Water Group, owners are seeing savings of as much as 50% when they replace inefficient steam boilers. "However, typical savings are 30% to 40%. And from an environmental standpoint, Armstrong Flo-Direct Complete Thermal Exchange (CTE) water heaters provide a significant reduction in CO_2 emissions."

Asked about typical paybacks, Rivers says, "It all depends on how much hot water you are using and how you are heating it. For customers that are using steam as a heating medium, Armstrong has documented paybacks in as little as a few months. Other customers might expect paybacks of no more than three years." He indicates that any industry that requires hot water generation of at least 20,000 gallons per day is a good candidate for Armstrong's CTE technology. "More specifically, Armstrong has gained favorable acceptance within the food and beverage industries for applications such as bottle warming, patch production, wash-down and other applications."

Rivers adds, "As businesses become increasingly concerned with driving corporate sustainability initiatives, technologies that require less fuel and leave a smaller carbon footprint naturally become more popular. To that end, Armstrong International's CTE water heater has drawn considerable interest, in large part because of its 99.7% efficiency.

Flame Doesn't Impinge

According to Tammy Collins from QuikWater, another major manufacturer of direct-contact water heaters, this technology is gaining converts. "This is being driven by the high efficiency and the environmentally friendly carbon-footprint." She feels energy efficiency may be the biggest driver, but there are others. "In the food industry, unit reliability and potability of the hot water supply is also a factor."

Collins indicates that some specific features of the QuikWater system make it unique. "We have a 'dry fire' design. This means that we do not allow the water stream to impinge the flame. This allows us to obtain complete combustion, giving us the lowest emissions possible and near 100% efficiency." She indicates the QuikWater units are recognized for their reliability and durability.

Collins adds that there are some hot water situations where direct-contact heat is not appropriate. "One example is applications where you are heating or re-heating water that is already over 120° F. Water hotter than about 120° F will drop the efficiency."

Fully Modulating Burner

Another example of the direct-contact concept is the Percomax™ unit manufactured by Sofame Technologies, Inc. of Montreal. In this unit, combustion occurs in a fully modulating, integrated gas burner. Cold water entering the unit at the top is uniformly distributed over the upper surface of a packing of stainless steel nodules which serve as the heat transfer medium.

The water percolates down where it comes in contact with the rising, hot products of combustion from a fully-modulating burner. Both the sensible and latent heat contained in the gas is transferred to the water. The Percomax unit is designed to heat water to temperatures as high as 185° F.

Stainless Steel Construction

The heated water collecting at the bottom of the unit is then pumped directly to the process, or across a plate and frame heat exchanger to transfer its energy to a building heating loop or process fluid. All wetted components and materials, including the unit's shell and the packing, are entirely fabricated of stainless steel, and are covered by a 5 year guarantee. The Percomax is available in capacities varying from 1 million to 50 million Btu/hr (300 to 15,000 kW).

As another product, Sofame also offers the Percotherm™ condensing stack economizer, which captures the heat from a boiler exhaust or other industrial heat source and uses a direct-contact method for water heating. The heated water can be used as preheated feedwater or in any other hot water application.

Scale Growth is Minimal

Because direct-contact water heaters maintain a continuous flow of water across the heat exchange surfaces, the growth of hard-water scale is minimal or non-existent. The hardness (or softness) of the water remains unchanged through the heating process. In most direct-contact applications, the rate of water heating can keep up with plant demand. In rare instances, owners may choose to use a storage tank for hot water to meet demand surges. In situations such as food industry applications, direct-contact water heaters are available with all-stainless steel construction.

With all of the direct-contact water heating units, efficiency of the units is so high that exhaust temperatures from the units are low and can be managed without an expensive chimney. An example of the benefits of direct-contact water heating is a case study done for an installation at a facility of Cargill Foods in Toronto. Cargill uses 28,000 gallons of hot water a day at 153° F for plant wash-down, laundry, domestic hot water and other needs. Previously, these needs were being met by a 4.5 MBtu water tube boiler fed with water preheated by reclaimed heat from compressor cooling water. The boiler was in need of repair or replacement and the thermal efficiencies were in the order of 40-50%, providing a significant opportunity for energy savings. The options included a new steam boiler or a direct-contact water heater.

After reviewing the options, it was determined that a direct-contact water heater was the best choice. Cargill chose a QuikWater 2500 (2.5 MBtu unit) to meet their hot water needs. Obviously, the combustion emissions and related carbon discharge impact were reduced proportionately.

Making the Change

If you've been contemplating making the change to direct-contact water heating, it will be useful to know peak hot water flow demand, and typical daily volume requirements. Make sure your engineering staff or consulting engineer is familiar with the products available for water heating, and ask them to size the installation for possible future changes in water demand.

The major direct-contact water heater manufacturers can help with design and sizing issues, and can coordinate delivery for an optimum installation time for your operation. With growing emphasis on optimizing energy efficiency and reducing corporate carbon footprints, now may be the ideal time to take this step forward in water heating. GT

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Natural Gas-Powered Fuel Cells Make

Solutions for a Greener Environment

WE ARE A LONG WAY from the era when fuel cells were used only to power spacecraft. Today many types of fuel cells are commercially available and increasingly affordable for a myriad of uses. These have accumulated thousands of hours of operation. Additional concepts, such as the solid oxide fuel cell, are now in field demonstration stages.

Installation of a ClearEdge 5 kW unit serves an office complex in Florida, and also generates 700-800 gallons of hot water per day.

Natural Gas as Hydrogen Source

Fuel cells convert energy from a fuel directly into electrical energy without a mechanical conversion stage. Electricity is generated by the reaction between the fuel and an oxidizing agent. Fuel and oxygen flow into the cell and reaction products flow out, while the electrolyte remains. Fuel cells use hydrogen as fuel and oxygen (usually from air) as oxidant. One challenge has been that the generation of pure hydrogen is itself often an energy-intensive process. As a potential source for hydrogen, natural gas is widely used as an economically viable fuel. The conversion process (reforming) can be realized with very low emissions and the widespread availability of natural gas makes this the preferred fuel for today's fuel cells.

In most fuel cell designs, individual cells produce relatively low voltages and amperages of energy. By both stacking cells and operating parallel stacks, voltage and amperage are multiplied, resulting in unit packages rated at multiple, sometimes hundreds, and even thousands, of kilowatts. The DC voltage output is usually converted to AC power for ready application in our power circuits.

Heat a Valuable Byproduct

With natural gas fuel cell systems, process byproducts are water and heat from the fuel cell and a relatively clean stream of hot flue gases from the combustion of natural gas in the reformer that converts natural gas to hydrogen for the fuel cell.

Heat is a major byproduct of all fuel cells, and this plays into their potential use in residential, commercial and industrial distributed energy systems. By making maximum use of byproduct heat, the effective efficiency of a fuel cell plant can approach 90%. Therefore, fuel cells running on natural gas are an efficient and environmentally attractive solution for electric generation.

"Black Start" Capability

Fuel cells are completely enclosed units with few or no moving parts. They are today capable of operating for thousands of hours without interruption. Another attractive feature in urban locations is their quiet operation and minimal emissions. Most units are capable of operating in "black start" situations, making them an attractive asset for data centers or other facilities that cannot tolerate an extended power outage. Redundant units assure the high reliability required for these applications.

An example of the commercial fuel cell products available today is the proton exchange membrane (PEM) fuel cell manufactured by ClearEdge Power. ClearEdge was a presenter at a recent Technology and Market Assessment Forum sponsored by the Energy Solutions Center. According to Nicole Elovitz from ClearEdge, fuel cells offer a "more energy for less" advantage over power drawn from the grid.

She notes, "With central station power, right from the start there is waste as the burning of fuel occurs to convert feedstock to electricity. Transmission losses add to the issue and in the end we are suffering from potentially as much as 65% of the energy being wasted before it reaches the user."

Hot Water Has Variety of Uses

In the case of the ClearEdge product, the 5 kW units generate 700-800 gallons of hot water daily at 150° F. This can be used for

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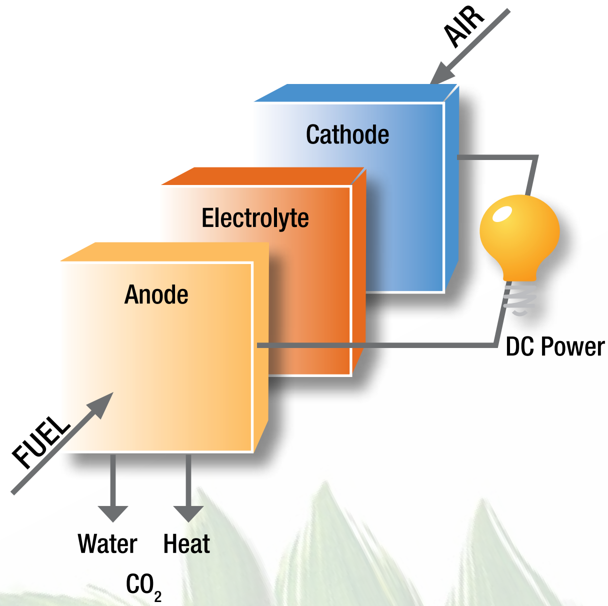

Simplified drawing of the fuel cell cycle. Natural gas-fired fuel cells use a reformer to generate hydrogen for fuel.

potable hot water, processing, pre-heating boiler water or for radiant floor heat. According to Elovitz, the ClearEdge 5 kW product is meeting a market demand by providing smaller entities with scalable, flexible fuel cells that are "right-sized" for their use. Elovitz says, "We have a number of customers who have multiple units installed, dictated by their energy needs. Also, we can design a solution for a customer that provides redundant architecture for critical loads."

Another fuel cell technology that was also featured at the Technology and Market Assessment Forum was the DFC© Stationary Fuel Cell produced by FuelCell Energy, Inc. This product uses the molten carbonate (MC) fuel cell technology. Here the cell electrolyte is a molten carbonate mixture suspended in a ceramic substrate. According to Andrew Skok, Executive Director, Strategic Marketing for FuelCell Energy, this technology has certain advantages.

High Availability is Now a Key Asset

Skok points out that these fuel cells now offer availability of up to 95%. This is comparable to the best conventional electric generation technology and of the "green" technologies, is far better than solar at 15% to 25% or wind at 20% to 35%. The electrical generation efficiency of FuelCell Energy's DFC units ranges from 45% to 70%, depending on the specific application.

Skok adds that an important aspect of the DFC technology is its adaptability to a wide range of fuel sources, including biogas, methanol, ethanol, coal gas and process methane as well as natural gas. This fuel flexibility makes possible installations such as at the paint shop at the Ford Motor Oakville, Ontario auto plant. Here a 300 kW FuelCell DFC package can use paint shop fumes as fuel, augmented by natural gas. In this way, a potential problem emission is converted into a valuable fuel resource.

Larger Sizes to Meet Industrial Load Demands

FuelCell Energy offers packages in sizes of 300 kW, 1.4 MW and 2.8 MW. Larger capacities are available in multiple unit packages, with capabilities of 5MW to 50MW. Skok points out that units can also be combined with other electric generation technologies including solar photovoltaic, combustion turbines and heat recovery steam turbines to provide hybrid solutions with enhanced efficiency and availability.

UTC Power, a division of United Technologies Company, is another leader in developing fuel cells for transportation and stationary applications. Examples of this technology in everyday use are cited on the UTC Power website. One example is a 200 kW PureCell® unit installed and operating at a Whole Foods Market in Glastonbury, Connecticut.

This customer fully utilizes both the electrical output and the hot water generated by the unit, and it provides an important standby source of power. In the event of a grid power outage the fuel cell package will ensure a reliable food supply for customers and protect against costly food spoilage.

UTC Power has research and development experience with all five major types of fuel cells. Its PureCell® Model 200 and Model 400 units have an output of 200 kW and 400 kW respectively and utilize natural gas for its phosphoric acid fuel cells. The company has more than 270 fuel cell systems deployed in 19 countries and with over 9 million operating hours of experience.

Is a fuel cell appropriate for your operation? It is certainly worth considering if your needs are for an environmentally 'green' primary and/or backup power supply, and you can use the heated water byproduct in your manufacturing operation or for building heat or domestic hot water. Fuel cells are constantly improving, and for many applications, they can be the right choice. **GT**

Condensing Hydronic Boilers

GETTING THE MOST FOR YOUR ENERGY DOLLAR

An example of the efficiency benefit from modern condensing boilers is at a southern university that replaced three early 1900s steam boilers that served the heating demands of 36 main campus buildings. These were replaced with 14 Fulton 3 MMBtu/hr boilers which are controlled by a Fulton ModSync sequencing program. As a result of this upgrade, the university boiler plant has reduced gas consumption by more than 60%.

IT'S A CLEVER IDEA. Condensing hydronic boilers can operate at efficiencies in the mid-90s and above. The key to these fantastic efficiencies is to have incoming feedwater at temperatures below 140° F, and to be able to either modulate the boiler or have sufficient redundancy that operating units can be held near their efficiency "sweet spot."

Extract More Heat from Combustion Exhaust

Hydronic boilers can be used for either building heat or for process hot water applications. The condensing boiler extracts latent heat, in addition to sensible heat, from combustion exhaust. For new natural gas-fired units, the efficiency difference is typically about 10% higher. This presumes that the return water is low enough in temperature to permit a high level of condensation from the combustion exhaust.

Efficiencies as High as 97%

Cleaver-Brooks is one of the leaders in the manufacture of condensing hydronic boilers. Duane Rolkosky, Regional Vice President of the firm was a recent presenter at a Technology and Market Assessment Forum sponsored by the Energy Solutions Center. In his presentation he demonstrated that with a 130° F single return water flow, the boiler could achieve efficiencies as high as 90%. By using a dual return with 90% of the return flow at 150° F and 10% at 80° F, efficiencies as high as 97% were achievable. The 80° F portion of the flow helped achieve the nearly-complete condensation of water in the combustion exhaust.

Another Cleaver-Brooks spokesperson, Alan Wedal, Product Manager – Packaged Boilers, indicates there is growing acceptance of the condensing hydronic boiler in the marketplace. "The order entry level for our condensing units has remained strong and continued to increase significantly over the last three years. Certain areas of the country have adopted this technology more strongly than others." He feels that the influences on growing adoption of the technology are incentives and rebates, design engineer experience, and owner knowledge.

Alufer® Tube for Better Heat Exchange

A relatively recent introduction by Cleaver-Brooks is their ClearFire Condensing unit. Wedal notes that the patented Alufer tube in this unit greatly increases the heat transfer surface area and also allows a higher heat transfer coefficient through the use of aluminum alloy fins, and a design to keep the flue gas flow turbulent through the entire length of the tube.

Wedal notes that many owners are experiencing a 20% to 30% reduction in fuel consumption by replacing older boilers with newer units. He points out, "This is happening in some cases even without the use of condensing boilers, due to more efficient unit designs, and to firing modulation becoming standard on many units." He emphasizes that with the use of condensing boilers, the reduction can be even more dramatic. "We have seen up to a 50% reduction in energy use in systems that make proper use of outdoor reset schedules, aggressive night/weekend setback schemes and larger system temperature differentials."

Combine Condensing with Non-Condensing

Wedal discusses the paybacks available with boiler replacement. "This will depend on the quantity and type of boilers replaced. We have seen typical payback times to be around five years." However, he explains that with the design of hybrid boiler plants – condensing and modern non-condensing boilers together – payback times sometimes drop to as low as two years. "The smaller initial investment can still return near the same energy reduction, so the payback is shorter and the ROI is higher."

Wedal cautions that not all applications are suitable for a condensing hydronic boiler. "While a condensing boiler can be used to replace almost any boiler or be used in new applications, there is a cost premium to manufacture a boiler that can withstand the effects of the acid condensate formed during the condensing action. If an application will never see return water temperatures low enough to cause condensing in the boiler, a better choice would be to use a near-condensing boiler. At return water temperatures at or above 140° F, the condensing boiler and the near-condensing boiler will have approximately the same efficiency but the latter will have a lower initial cost."

Reduce Overall Energy Use

According to Erin Sperry, Commercial Heating Product Manager from Fulton Boilers, their product is also growing in popularity and this is influenced by commercial and industrial applications with budget constraints in a competitive economy. "Using condensing boilers provides opportunities not only to increase thermal efficiencies of the boiler plant, but to decrease overall energy use."

Sperry notes that the Fulton Pulse boilers were the first commercially sized condensing boiler available in North America. "The Fulton Pulse and Vantage boilers are designed to be rugged, robust and reliable. Pressure vessel designs feature high product mass and higher water volume." This is a benefit because high volume pressure vessels experience less cycling and have greater tolerance of varying flow and/or no-flow conditions.

Take Advantage of Condensing Feature

Sperry points out that most condensing boilers have a high temperature limit around 210° F. For this reason, she says, higher temperature applications are not appropriate. "Further, systems should be designed to take advantage of the high efficiencies at which condensing boilers are capable of operating."

Multiple Units with Modulation

Sperry points out, "It is very common to use multiple boilers in condensing applications. Multiple boilers with modulation (turndown) capabilities facilitate better overall system load matching." As mentioned earlier, condensing boilers have high thermal efficiencies even at lower firing rates. Sperry continues, "Thus it is important to have a sophisticated boiler sequencing system that keeps multiple boilers on at their lowest proper firing rates."

The Laughlin Memorial Hospital in Greeneville, Tennessee replaced their existing steam boilers with four Fulton Vantage 4.0 MM Btu/hr boilers and a custom ModSync controller. Photo courtesy Fulton Boiler Works.

MORE info

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Old Boiler Replacement Saves 60%

Greg Hughes from Thermal Solutions, another prominent condensing boiler manufacturer, echoes the multiple unit advantage. "By installing smaller and multiple condensing boilers, owners are able to stage the boilers depending on the heating load, which will help in fuel savings compared to one larger boiler." He adds, "Another benefit of multiple units is in housing complexes or military bases that have eliminated a central boiler plant. They are now installing multiple boilers to better control heat where it is needed and to save on fuel and electricity."

The Thermal Solutions condensing boiler product features a ceramic radiant burner design along with their TSBC advanced control system. Hughes says, "This gives our EVCA condensing boiler the ability to achieve and sustain the higher efficiencies our customers are looking for in a condensing boiler."

Worth Investigating

Not all boiler replacement projects will result in high levels of savings, but for the right application, a condensing boiler system can yield significant energy savings, reduced plant emissions, and rapid response to changing heating load conditions. If your hydronic operation fits the temperature regimes for condensing boilers, it is certainly worth making that investigation. **GT**

Better Process Furnaces

Furnace Energy Improvements For the Metal Casting and Heat Treating Industries

MANY INDUSTRIAL PROCESSES rely on process furnaces and ovens. Distinctions between industrial furnaces and ovens can be somewhat variable between industries and manufacturers. All are heated enclosures that perform a process function. Typically, ovens operate at temperatures below 800° to 1000°F and furnaces operate above this level. Functions of furnaces include metallurgical heat treatment, mold-making, surface coat treatment, as a heat source for petrochemical processes, and many others.

Conveyor Furnaces Have Savings Potential

Of particular interest today are conveyor-type natural gas-fired furnaces in the metallurgical and castings industries. These typically use an insulated enclosure with doors and a mechanical system for moving work through the heated area. The enclosure is insulated with a cast or brick refractory, or with a ceramic fiber material. Often the insulation is a combination of these materials, with ceramic fiber normally used on the walls and roof.

Furnaces typically have multiple burners, which can either heat the furnace atmosphere directly or through a network of radiant tubes. Increasingly, furnaces have sophisticated digital controls for temperature management, process control, and for assurance of safety through flame detection and stabilization.

Various Methods for Moving Work

Pusher furnaces for casting processes or heat treatment slide work through the treatment area on racks or in baskets. Other conveyor furnaces use rollers or rotary beds to achieve the same purpose. Various steps can be taken to improve or replace older furnaces to improve energy efficiency as well as increase process speed.

Armil C.F.S. has designed manufactured, installed and repaired ovens, kilns and furnaces for over 40 years. Their products include investment casting pusher furnaces, roller hearth furnaces, box ovens and many other furnace and oven designs. The company was a recent presenter at a Technology and Market Assessment Forum sponsored by the Energy Solutions Center. According to spokesman Tom Krowl, the company emphasizes its custom design capabilities and uses its wide experience to maximize operating efficiency.

Furnace Heat Recuperation for Significant Energy Reduction

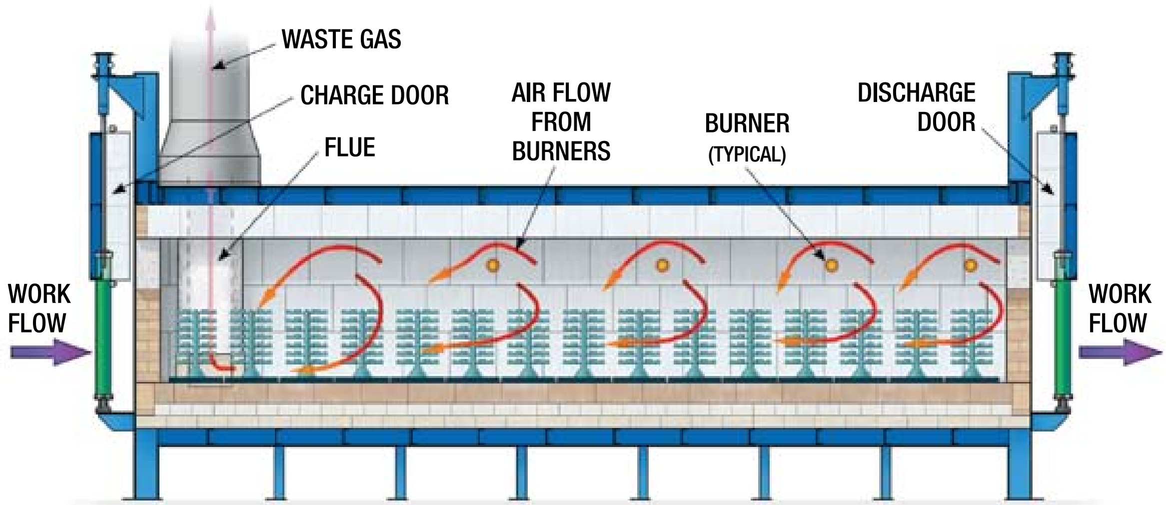
Krowl indicates that owners achieve major energy savings through the use of recuperation in furnace designs. For example, in a pusher furnace this involves extracting much of the heat from furnace burner exhaust and from cooling products to preheat incoming products or combustion air. In the investment casting mold-making process, molds undergo a wax burnout step in the pusher furnace and the lost wax provides some or all of the furnace fuel. He notes, "Recuperation can provide energy cost reductions of up to 40% for a furnace operating at 2000°F with 6% oxygen. This also results in lower furnace emissions since you are using less fuel."

Krowl points out that many of the newer furnace designs include recuperation. In addition, Krowl says, "Most all furnaces can have recuperation added, as long as there is space in the manufacturing area. A cross-flow recuperator is normally only 2' X 2' X 4' in size. However, hot combustion air piping must be routed from each burner."

Increasing Throughput for Lower Unit Energy Costs

Beyond pusher furnaces that benefit from recuperation, a selection of other furnace types can be beneficial because they provide increased production volume. Krowl notes that roller hearth or rotary hearth furnaces, which are widely used in the metallurgical industries, are not necessarily more fuel-efficient than multiple batch furnaces. However, he points out, "These types of continuous furnaces have an ad-

Front end of a pusher furnace. Notice the overhead ducting to transfer burner exhaust forward to preheat incoming product load.
Photo courtesy Armil C.F.S.



The cross-section of a pusher furnace illustrates how burner exhaust is directed back into the furnace front end, preheating the incoming product load. Illustration courtesy Armil C.F.S.

vantage in reduced material handling and labor requirements." Thus they can handle more product in a given time period, and are more energy-efficient on a product throughput basis.

Russ Chapman from Firebridge Inc., a furnace design and engineering firm, agrees on the potential savings from the use of recuperation on certain process furnaces. He notes, "Recuperators are generally restricted to about 1800° F flue gas temperatures, though our company is working on a 2200° F design." Chapman points out that potential savings depend on the operating temperature of the furnace. "In general the recuperator efficiency is around 50%, which means that about half of the exhaust heat is being recovered." This would be a 20% efficiency gain in a 1200° furnace and almost 40% in a furnace operating at 1800° F.

Higher Temperatures Have Most Potential

Chapman adds, "Obviously if you are using less fuel, you're emitting less CO_2 , but for every two degrees of preheat on the combustion air, you get a one degree increase in flame temperature and hotter flames produce more NOx. Fortunately, since the overall quantity of emissions is reduced, the amount of NOx has an overall reduction, so the short answer is that all emissions go down."

Chapman feels that the idea of adding recuperation to existing furnaces is pretty well accepted, but it does come at a cost. "Burner ratio controls have to be upgraded to compensate for the variation in oxygen content in the air. Also, ductwork has to be insulated. Often the configurations and the size of the burners and exhausts from the furnace make it too expensive. That being said, if the unit is large enough and hot enough, it is a very good alternative." He adds "If a recuperation conversion is practical, the payback might be 18 to 36 months, or possibly somewhat longer with the unusually low price of natural gas today."

Insulation to Reduce Energy Losses

In addition to recuperation, Chapman indicates that today's new furnaces can be improved in efficiency through better insulation and refractory materials. "Today we have fiber-type insulation products that have less than 1% shrinkage at 2500° F. They last much longer and insulate better [than older products]." In addition, he points out that there are hard refractories that provide extended life and better insulating value per inch of insulation."

He also explains that there are regenerative burner options that have a place at the higher temperatures in improving furnace efficiency. "Often big gains are made by looking at the whole process and integrating heat sources with heat sinks elsewhere in the process or plant." Further, large batch heat-treat furnaces are being designed that have improved (shorter) cycle times, better temperature uniformity and about 30+% energy savings at homogenizing temperatures and 40%+ at hardening temperatures.

Furnace temperature management is more important than ever. In some industrial applications, it may not be necessary to maintain high temperatures throughout the entire cycle. Temperatures can sometimes be reduced without a penalty in process time or handling. Today's sophisticated burner control and temperature sensors make it possible to optimize furnace temperature throughout the process.

Take Initiative in Finding Savings

Additional information on improving furnace process efficiency is available on the DOE website, and from the various furnace manufacturers. Many furnaces in industrial use today that have not been recently upgraded are operating at less than optimum efficiency, and would benefit from a professional review, with a view to upgrading or replacement. GT

MORE info

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Renewable Natural Gas

A Green Solution Adds to Fuel Resources

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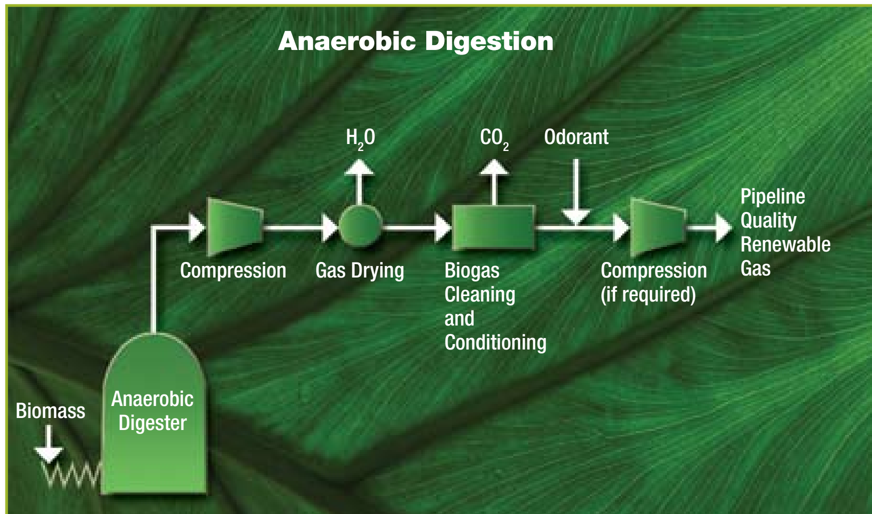
www1.eere.energy.gov/cleancities/pdfs/ngv_wkshp_smith.pdf

GENERAL INFORMATION ON RENEWABLE NATURAL GAS
www.renewablenaturalgas.com

NATIONAL GRID WHITE PAPER ON RENEWABLE GAS
www.nationalgridus.com/non_html/NG_renewable_WP.pdf

WE TEND NOT TO THINK of the origins of our natural gas resource. We instead consider issues of price, availability, and its usefulness in commerce, industry and in our homes. Today's conventional natural gas originated with organic materials — mostly plants — that were buried in deep geological strata and were subjected to biological and thermal decomposition. This so-called "fossil fuel" is a cornerstone of our energy supply.



Looking at Renewable Sources

In recent years, we are seeing the potential for supplementing fossil fuel natural gas with gas produced in digesters by anaerobic decomposition of organic wastes, and by thermal processing of other organic material. These fuels not only have the potential to replace some fossil natural gas, but also help solve waste disposal issues and reduce total emissions of greenhouse gases.

At a recent Technology and Market Assessment Forum, this was the topic of a presentation by Donald Chahbazpour, Director of the Sustainable Gas Group of the northeastern utility National Grid. This corporation has instituted a major effort to identify and encourage development of renewable gas sources. Chahbazpour identified renewable gas as "Pipeline quality gas derived from biomass resources that is injected into the natural gas distribution network for direct use in existing natural gas equipment." He explained that this fuel could originate from either anaerobic digestion or thermal gasification of biomass.

Variety of Sources

Sources of biomass include waste water treatment plants, landfills, wood waste, livestock manure, municipal solid waste, agricultural residues and energy crops. Regardless of the source of the gas, it needs to be treated to remove water vapor, carbon dioxide, sulfur oxides or other contaminants. After treatment, the renewable gas is essentially interchangeable and compatible with pipeline natural gas.

Chahbazpour indicated that in the four states served by National Grid, New York, Massachusetts, Hew Hampshire and Rhode Island, there is technical potential to produce 268 billion cubic feet of renewable gas. This represents 16% of the overall demand, and 25% of the demand without power generation. This is not a minor contribution.

Reducing Greenhouse Gas Emissions

A main driver for adoption of processes for recovering and using renewable gas is that it lowers greenhouse gas emissions. Because it is beneficially consuming methane that might otherwise have been emitted to the atmosphere, the impact of replacing fossil natural gas with renewable gas is a positive contribution. According to Chahbazpour, another benefit is diversity of fuel supply by using local renewable gas sources.

He adds that renewable gas stimulates the local economy, creates jobs, and reduces waste disposal impacts. An alternative use for biogas is to burn it directly — untreated — in engines or turbines for electric generation. However Chahbazpour feels that upgrading it to natural gas standards is a more efficient use of the resource.

Gas Must Meet Utility Standards

A wide range of systems are available for renewable gas collection and treatment. In all cases, the utilities accepting the renewable gas for injection in pipelines require it be treated and tested for complete compatibility with utility and downstream customer equipment. Suppliers of renewable gas can contract for deliveries to users using existing natural gas pipelines.

Renewable gas is an additional benefit to the already environmentally attractive features of natural gas as a fuel for the future. Suppliers of renewable gas continue to put facilities on the line, and the trend is for a major increase in the use of this valuable energy resource. **GT**