WINTER/12

VOLUME 25 / ISSUE 3

gastechnology

THE SOURCE FOR ENERGY SOLUTIONS WWW.ENERGYSOLUTIONSCENTER.ORG

SUPPLEMENTAL HEAT

for Comfort and Efficiency

UNIT HEATERS

MAKEUP AIR HEATERS

AIR TURNOVER SYSTEMS

ESC
Energy Solutions Center

on the cover

Most large industrial buildings benefit from supplemental heating units fueled with clean, efficient and affordable natural gas.
Photos courtesy
Modine Manufacturing and
Johnson Air Rotation.

ESC Energy Solutions Center

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:
Energy Solutions Center Inc.
400 N. Capitol St., N.W.
Washington, DC 20001
(202) 824-7150
www.energysolutionscenter.org

David Weiss, Executive Director
Jake Delwiche
Contributing Editor
Comments may be directed to:
Gas Technology Editor
Plant Engineering Magazine
1111 W. 22nd Street, Ste. 250
Oak Brook, IL 60523
(630) 571-4070
Printed in the USA

energy solutions center websites

www.aircompressor.org
www.cleanboiler.org
www.energysolutionscenter.org
www.naturalgasefficiency.org
www.gasairconditioning.org
www.poweronsite.org

inside

Supplementary Heat for Industrial Spaces

Systems Improve Efficiency, Add Comfort

TODAY'S INDUSTRIAL OR WAREHOUSE SPACES are different from other comfort conditioning applications. These buildings typically have high ceilings and may have large ventilation requirements. Depending on the geographic location and the processes within the building, the building heat requirement may be large or modest, but industrial buildings in all but the warmest climates require some heat for at least part of the year. The building primary heating system could be furnaces, air heaters, radiant floors, a steam hydronic system, or even byproduct hydronic heat from process hot water.

Keeping It Positive

Most industrial buildings can benefit from supplementary heating and airflow equipment. An issue for many facilities is maintaining correct building pressurization. Today's stringent industrial ventilation requirements can result in a partial vacuum in the building. If there are open-flame processes in the building such as welding, brazing, ovens, boilers or heat-treating equipment, then negative building pressures can create problems.

A partial vacuum could affect flame stability and the ability to maintain exhaust flows. Another issue with negative pressure is that building doors become difficult to open or control, and this may be a safety hazard. Further, negative pressures will draw unfiltered outdoor air into the building that may contaminate manufacturing or food processes and may also be detrimental to employee health. A challenge in maintaining correct pressurization is that building pressure levels can change rapidly with ventilation units being cycled, or large doors being opened.

Makeup Air Heating Needed

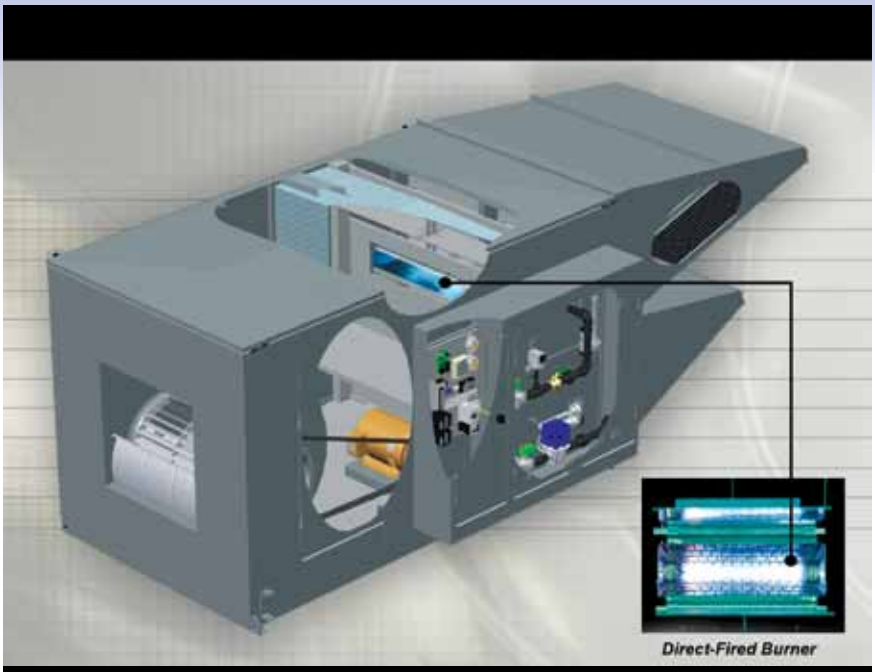
When neither heating or cooling are required, problems with negative building pressures may be relieved simply by leaving open large doors, or by continuous operation of propeller fans to supply makeup outdoor air. During the heating season, these solutions won't work, at least if building comfort and efficiency are issues. The best solution is often the use of air handlers with natural gas-fired heating to supply filtered building makeup air.

Makeup air handlers commonly have heaters that are either direct-fired or indirect-fired. Direct-fired units are more common. These are usually installed on a rooftop, but can be free-standing next to the building on a pad or elevated platform. Vertical makeup units are sometimes mounted on an exterior wall. Makeup air handlers are designed to provide variable volumes of pre-heated filtered outdoor air to the building to offset ventilation losses and building leakage.

Match Flows to Demand

Usually makeup air heating units are a "draw-thru" design, that is, the blower is downstream from the heating section. Some units use a variable-frequency drive (VFD) on the blower to allow the unit to modulate airflow to match building ventilation rates, or match a set building air pressure.

Rooftop makeup air handlers with direct firing are available in a wide range of sizes and can be matched to the makeup air requirements of most industrial buildings. Photo courtesy Cambridge Engineering



Cutaway view of the heating function in a direct-fired rooftop makeup air handler.
Illustration courtesy Four Seasons Controlled Climates Ltd.

For units that will operate year-round, packages are also available with cooling/dehumidification coils as well as heating sections. This type unit is widely used with facilities such as food processing, wastewater treatment and other industries where it is important to maintain building pressures and control the indoor environment at all times.

Douglas Kosar is an engineer with the Gas Technology Institute, specializing in building energy efficiency. He indicates that for industrial spaces, makeup air handlers are especially important. "They reduce infiltration of cold outdoor air and drafts through open doors, i.e., if negative building pressure and resulting infiltration is allowed it can defeat proper operation of air curtains at large shipping/receiving doors. Further, they can promote proper operation of exhaust systems."

Warehouses are Different

Kosar points out that warehouse spaces generally have much lower required exhaust flows. "But bonded warehouses may be required to maintain specific temperature and humidity ranges and should employ controlled tempered introduction of any needed makeup/ventilation air. This can be a requirement as well in industrial facilities that must maintain specific temperature and humidity ranges for manufacturing processes such as food and beverage, or pharmaceuticals."

To install the correct size makeup air system, Kosar says, it is necessary to add up all the exhaust equipment to determine the makeup air requirement, plus ventilation air for workers, and a little extra for some positive pressurization. "That airflow combined with the needed temperature rise from winter design air temperature will determine the heating capacity."

Focus on Specific Need

Kosar points out that in designing new facilities or retrofitting existing facilities, owners should consider isolating outdoor air treatment to a limited number of specialized, dedicated outdoor air systems. "This approach allows energy efficiency technologies to be more cost effectively applied while delivering improved facility operations."

Units can be controlled on both a temperature and a building pressure basis to assure maximum comfort and efficiency. The heaters can either be non-ducted or ducted. Ducted air handler outlets are sometimes used to deliver heated air to lower levels or to more distant parts of the building that need extra heat.

Generally the direct-fired heaters are available in the larger capacities – up to 100,000 cfm and sometimes more. Commonly the design temperature rise is approximately 60° to 75° F. Because of the greater weight of indirect-fired units, you may need to install special structural supports for such units in rooftop installations.

Advantages to Direct-Fired

According to John Szymanski from Trane, a supplier of such equipment, the direct-

Most air turnover units are available with plenum extensions to reach to the ceilings of industrial buildings.
Photo courtesy Johnson Air Rotation.

MORE info

CAMBRIDGE ENGINEERING
www.cambridge-eng.com

GAS TECHNOLOGY INSTITUTE
www.gastechnology.org

GREENHECK
www.greenheck.com

JOHNSON AIR ROTATION
johnsonairrotation.com

MODINE MANUFACTURING COMPANY
www.modinehvac.com

REZNOR
www.rezspec.com

TRANE
www.trane.com

fired models provide lower first cost and a smaller footprint. He adds, "Because they also have a lower internal static pressure, a smaller blower is required." According to Szymanski, the direct-fired units can also be ordered in a vertical arrangement. "This can assist in air turnover for structures with large floor to ceiling height like warehouses and heavy manufacturing."

For spaces where outdoor air makeup is not a primary requirement, another solution to improve building comfort is dedicated air turnover units, sometimes called air rotation units. These floor-mounted indoor or outdoor units are designed to overcome inefficiencies caused by air stratification in high-ceiling spaces. They add to building comfort by adding primary or supplementary heating and cooling. In a high industrial or warehouse space without air rotation, ceiling level air temperatures can be as much as 25 degrees higher than at the floor level.

Mixing is the Key

In heating mode, these units draw in air near the floor level and pass it over heating sections as needed and direct it upward in the tall plenum, which can be extended as needed to reach even very high ceilings. Warmed low-velocity conditioned air exits at ceiling level and spreads across the ceiling level, slowly tumbling down the sidewalls. This causes room air to mix and floor level temperatures become much closer to those at the ceiling. In this way, thermostat levels can be set much lower to achieve the same level of comfort, and significant energy is conserved.

A third approach that is widely used in spot industrial applications is unit heaters. These are compact high output units using gas heating with high-velocity air distribution by either propeller or centrifugal fans. Unit heaters are a common solution near high heat-loss areas such as loading docks or openings to unheated warehouse space.

Unit Heaters for Spot Comfort

Unit heaters are available in either direct-fired or indirect-fired styles. For maximum operating efficiency with indirect firing, Modine Manufacturing offers its Effinity[93] Model PTC which features a four-pass heat exchanger. The final pass is a condensing coil to extract the maximum heat from the combustion gases. Units are available in sizes from 55,000 to 310,000 BTU/hr — all operating at 93% efficiency. Because it is a condensing unit, it is necessary to pipe condensate to a plant drain.

In addition to these three approaches — makeup air heaters, air turnover units and unit heaters — there are specialty gas-fired heating products such as gas infrared heaters and gas-fired heated air knives for installation at large open doorways. In all cases, owners enjoy the benefits of gas space heating at fuel costs that are highly attractive compared to the other alternatives – oil, propane or resistance electric heat.

Natural Gas a Natural Choice

To achieve a comfortable and efficient industrial environment, it is usually necessary to offset exhaust air flows with makeup air handlers. Air turnover devices assure more even distribution of heat in high-ceiling spaces, and improve overall heating efficiency. Specialty devices such as unit heaters, heated air knives, and gas infrared heaters improve comfort levels in high heat loss areas.

For all of these applications, natural gas is the preferred energy source because it is clean, safe, efficient and affordable. Your engineer can help you improve building comfort and actually reduce heating expense by installing the right kind of supplementary heating equipment. **GT**

Unit heaters are available in a wide range of sizes and can be either directly or indirectly fired. Photo courtesy Modine Manufacturing.

Natural Gas Vehicles on the Rise

Infrastructure Developing to Meet Demand

A DYNAMIC CHANGE in vehicle fuels in North America is happening right now — the wide-spread adoption of natural gas as a vehicle fuel. We've long understood its potential. Now the change is underway. Dissatisfaction with high gasoline and diesel fuel costs abound.

Problems with Petroleum

Today about 50% of U.S. crude oil comes from sources outside of the U.S. or Canada. This compares with U.S. natural gas supplies, 98% of which are currently from the U.S. or Canada. Further, gasoline and diesel have emission problems with NO_x, particulates and VOCs. Diesel engines in particular are often noisy. These fuels are expensive and promise to remain so into the indefinite future.

With burgeoning production of natural gas using new drilling technologies, the price of compressed natural gas (CNG) on a gallon-of-gasoline-equivalent (GGE) basis is increasingly attractive. Industrial and commercial operators of road vehicles with significant daily mileage requirements have discovered CNG and in some cases liquid natural gas (LNG) as the fuel of choice for now and for the future. Retailers are typically selling CNG at a price well below $2 per GGE.

Infrastructure Under Construction

The infrastructure for refueling is developing. Take the example of a retailer that is enthusiastic about the future of natural gas as a motor fuel — Kwik Trip Inc., a privately-held firm headquartered in La Crosse, Wisconsin with over 400 convenience stores and travel centers in Wisconsin, Minnesota and Iowa.

Kwik Trip representative Chad Hollett was recently a presenter at a Technology & Market Assessment Forum sponsored by the Energy Solutions Center. Kwik Trip operates the first "alternative fuels fueling station" in the U.S., offering access to propane, biodiesel, E-85, electric vehicle charging, LNG and CNG.

Full Range of Fuel Options

Hollett indicated, "Kwik Trip is committed to developing a functional natural gas infrastructure in Wisconsin, Minnesota and Iowa." He notes that the company has already developed two natural gas fueling sites in La Crosse, Wisconsin and one each in Sturdevant, Wisconsin (near Milwaukee) and in Rochester, Minnesota. As many as a dozen more sites, mostly along Interstate Highway routes, are currently under study for CNG fueling development.

Kwik Trip's Alternative Fuels Superintendent Joel Hirschboeck emphasizes the company's focus on development of a functional infrastructure. "We see great potential for this as a motor fuel. As we qualify locations for CNG fueling, we evaluate local energy users who might convert to CNG usage." He feels that key users might be refuse haulers, ready-mix concrete firms or regional haulers.

Certain Users Obvious Winners

"Typically these are operators of low-mpg vehicles that put on considerable annual mileage and return to a home station at night." If they are relatively small operations, or if they are just getting into CNG, they may not want the immediate expense or uncertainty of a dedicated fueling operation. "That's where we come in. We will offer a fast-fill capability in a convenient location and we can get them started on CNG."

Hirschboeck notes that Kwik Trip itself operates a fleet of 150 heavy-duty road trucks and an additional 100 light-duty trucks and cars. Currently the company is operating 24 vehicles on CNG, with 14 more on order and an additional 11 vehicles planned for spring delivery. He explains that the acceptance of the CNG ve-

Vehicles such as this City of Milwaukee refuse truck that have high annual mileage and low mpg are ideal candidates for time-fill fueling with CNG.

hicles by drivers has been excellent. "The 8.9 CNG liter truck engine we use is relatively small and it pulls loads of 65,000 lbs and more. But the drivers have adjusted to CNG and like it. They notice that that it is significantly quieter and it doesn't leave an oily diesel smell on their clothes. And they like the idea of using a domestic fuel resource. They feel good about that."

Questar Fueling has worked with the State of Utah and other private developers in building fueling infrastructure along the I-15 corridor in Utah. Photo courtesy Questar Fueling.

From the company's perspective, the biggest attraction is significantly lower fuel cost per ton-mile. Hirschboeck adds that because there are fewer residual combustion byproducts, engines stay cleaner and lubricating oils last longer. Further, with future diesel engines, more expensive fuel treatment and emission controls will be required.

Short Payback

Similarly, with light duty vehicles, for Kwik Trip the first attraction is also lower fuel cost. Hirschboeck says, "If you are operating a light-duty vehicle 25,000 to 30,000 miles per year the payback is very short — less than two years."

According to Natural Gas Vehicles for America (NGVA), there are more than 120,000 natural gas vehicles operating in the U.S. today, and more than 15.2 million worldwide. This includes more than 11,000 transit buses, 4,000 refuse trucks, 3,000 school buses, about 17,000 medium duty vehicles such as airport shuttles, and more than 30,000 light duty vehicles. There is also a growing use of natural gas fueling for heavy-duty over-the-road trucks.

Roles for Both Public and Private Sites

For some fleet operators the best fueling option may be an in-house time-fill refueling station. For operators that have less predictable fueling needs, the best solution may be an on-site fast fill facility, or using a public facility. Currently there are approximately 525 public CNG fast-fill facilities in the U.S., with many more planned or under study. Public facilities are particularly abundant in California, Oklahoma, and Utah.

Susan Davis from Questar Corporation was a recent presenter at a Technology & Market Assessment Forum. Questar in Utah is one of the national utility leaders in encouraging and sponsoring the development of natural gas vehicles. Davis explained that the company feels infrastructure development is one of the keys to a successful national adoption of natural gas vehicle use.

I-15 Corridor in Utah

In Utah, there are 72 natural fueling stations, including 27 operated by Questar and available for public use. Others are operated by the State of Utah, and by other private owners. The I-15 corridor from north to south through Utah is dotted with many fueling stations, making inter-city transportation by natural gas vehicles possible.

Davis indicated that Questar Corporation recently created a non-regulated subsidiary called Questar Fueling with a mission of developing natural gas fueling with a national scope. The firm offers consultation, design, installation and leasing for natural gas fueling stations, both public and private.

Judd Cook is Director, Business Development for Questar Fueling. He says that the I-15 corridor experience shows the growth potential of natural gas for transportation. Cook says, "We have seen just under a 20% increase in sales volumes this year over the same period last year." Vehicle operators have begun to understand the potential.

Short Paybacks Encourage Transitions

Cook credits the obvious savings in fuel costs for fleet operators for the growing interest in natural gas fuels. "Many of the customers we are working with in the heavy duty market are currently seeing paybacks between 14 and 18 months." He believes paybacks of two to three years or less will incent users to convert or purchase new vehicles.

Interest in CNG fueling is growing. Cook says, "We are currently working with several of the nation's largest trucking companies who are testing natural gas vehicles."

Consider the Natural Gas Option

Whether your business is inter-city trucking or local delivery, refuse pickup or ready mix delivery, school busing or parts expediting, there's a good chance that natural gas should be in your vehicle planning cycle. There are many organizations that can help you do the evaluation. But before you commit to buying your next diesel or gasoline vehicle, consider the third choice — natural gas. **GT**

MORE info

DOE ALTERNATE FUELS DATA CENTER
www.afdc.energy.gov/locator/stations

KWIK TRIP
www.kwiktrip.com

NATURAL GAS VEHICLES FOR AMERICA
www.ngvc.org

QUESTAR FUELING
www.questarfueling.com

Kwik Trip has committed to natural gas fueling for additions to its fleet of trucks and light-duty vehicles. The company is also developing a network of alternate fueling stations in Wisconsin, Minnesota and Iowa.

Use Infrared Imaging

With Training, You Can Do It Yourself

WITH INFRARED CAMERA prices dropping and their capabilities increasing, many large energy users are considering doing their own infrared energy analysis rather than hiring specialists. This may be a good idea, but using a camera and accurately interpreting results are two different things. You probably can do it, but your users will need some training, or the exercise may be a complete waste.

Regular Audits Becoming the Norm

Increasingly, facility owners recognize that energy auditing is not a one-time procedure. It needs to be a continuing routine to assure that manufacturing processes and buildings are operating at optimum efficiency. Processes change, equipment ages, and buildings are modified and can also change in their efficiency through time.

For this reason, organizations today frequently organize internal energy audit teams. For these auditors, digital infrared imaging has become an important tool. Until quite recently, infrared imaging was seen as an activity best out-sourced. For complex projects, or for companies that do not have staff and training, that is still often the case. But an increasing number of companies are taking advantage of lower equipment prices and improved infrared imaging capabilities to buy their own equipment and use their own staff.

Infrared imaging can be performed by a trained in-house audit team to identify areas of heat loss, failing equipment and steam leaks in an industrial plant. Photo courtesy Fluke.

Companies Offer Range of Imaging Equipment

Brad Risser from FLIR was a recent presenter at a Technology & Market Assessment Forum sponsored by the Energy Solutions Center. FLIR is one of the global leaders in the manufacture of digital infrared imaging, and offers units ranging from quite basic "point-and-shoot" models to sophisticated professional units. Risser noted that the interest in digital infrared is increasing because it allows users to identify heat gradients and spot thermal anomalies. He notes, "This technology allows us to 'see' heat."

Can Quickly Spot Problems

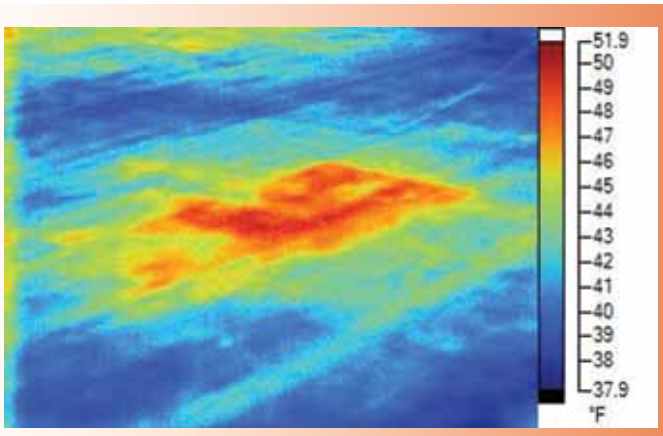
The most basic use of a digital infrared camera with an on-board screen is to allow the user to spot anomalies in a manufacturing or mechanical room such as overheated bearings, belt rubs, failing pipe or fitting insulation, hot electrical connections, bad switches, overheated motors, or steam and condensate leaks. The point-and-shoot camera is ideal for these applications.

In addition to process applications, the camera can be used to evaluate building energy concerns by identifying uninsulated areas, leaky windows and doors, water damaged areas and other anomalies. A section of exterior wall without adequate insulation will not be detectable by visible light, but this area will show up clearly on the imaging tool as a hot spot. Thus the infrared camera is a useful supplement to other building energy audit resources.

Camera and Training Vary with Purpose

Gary Orlove is an application engineer with FLIR and is curriculum manager for FLIR's infrared camera training activities. He says that the choice of cameras and the amount of training varies with the in-

For Energy Auditing



Building efficiency can be checked. This infrared image shows an area of moisture penetration in roof insulation. Photo courtesy Drysdale & Associates.

tended application. "It depends on several factors: How much is the auditor's time worth? What type of equipment is being evaluated, what resolution is needed on the equipment surface, and what temperature range is needed?" He points out that a foundry would be a very different infrared environment from a meat packing plant.

He adds, "A qualified auditor can make use of any of the cameras, just like a photographer can use an inexpensive camera, but the results would be better with a better camera." He explains that the same camera equipment can be used for energy auditing on the building and on process equipment. "Prices start just below $2,000 and go up."

In-Depth Training for Detailed Analysis

Orlove feels that the needed amount of training depends on the depth of analysis the auditor is going to do. "Is the auditor just looking for insulation problems, or is it necessary to measure R values and calculate energy losses and savings? For the latter, a minimum of 32 hours of classroom and a couple of weeks of hands-on experience are needed."

He points out that FLIR offers these types of training sessions. "We do it at our campus, at regional courses we set up, and at customer sites. We offer all three. Beyond the basics on using the camera, the courses include interpretation of the image and procedures for correct temperature measurement." While some energy calculations are taught at the infrared class, the majority of that training is usually included in the auditor's general energy auditing learning program.

Images Can Be Stored, Transferred

Orlove points out that all of the cameras have the capability to store the images as desired. "The images are initially stored on memory cards in the camera, and then transferred to a PC for archival and report generating purposes." Because the images are in standard file formats, they can be transferred to other sites for analysis or for training purposes.

Fluke Offers Combination Imaging

Fluke is a broad spectrum manufacturer of electronic test tools and also offers a line of digital thermal imaging cameras. An interesting feature available on some of the imaging systems is what is called IR-Fusion™ technology. This capability allows the user to merge visible light images with infrared images, thereby speeding identification of specific problem areas and simplifying reports on audit results.

In addition to general purpose infrared imagers, Fluke offers point-and-shoot imagers designed for process applications as well as units designed specifically for building efficiency analysis. Fluke also emphasizes the importance of training for users of infrared imagers, and offers online basic and in-depth training courses and webinars, as well as training classes conducted by Fluke's training partner, The Snell Group. Classes are set for multiple training levels.

Include Training in Your Plans

A wide range of thermal imaging products are now available from multiple manufacturers. Whether your interest is doing occasional trouble-shooting or incorporating the imaging equipment into an ongoing audit process, there is equipment made for your needs. Remember the importance of your staff getting startup and continuing training in the use of the equipment. Done the right way, infrared imaging can pay for itself in a very short time. **GT**

MORE **info**

FLIR
www.flir.com/US

Fluke
www.fluke.com/fluke/usen/products/categoryti.htm

MICROTURBINES

Power Plus Heat with Reliability, Efficiency

IN THE NEWS

IT'S A GREAT IDEA: Generate your own electric power for use in your plant or on your campus, and use byproduct heat for space heat, water heating, process heat, absorption cooling — almost any thermal application. If you have surplus electric capacity, it can be sold back to your utility. That's the promise with combined heat and power (CHP) installations, and one attractive option is microturbines. These are sometimes called "aeroderivative" turbines, reflecting their design ancestry as auxiliary power generators for aircraft. But in recent years they have carved out their own improved designs and flexible roles.

Growing in Size and Flexibility

Today's North American commercial microturbine products were initially introduced in the 30 kilowatt (kW) size class. They have since been supersized to 60, and today 200 or 250 kW scale. One U.S. manufacturer also offer multiple turbine packages with coordinated controls and enclosures so they operate as a unit rated at up to 1,000 kW (1 MW). Beyond this, multiple packages can be combined for total capacities of 5 MW and more.

Byproduct heat is extracted from the turbine exhaust at temperatures of 600° F or higher. Because all of the waste heat is present in the exhaust gas stream, it is relatively simple to direct this waste heat through a steam generator to make steam to support or supplement various comfort and process applications. A microturbine can provide hot air, steam, or hot water for various industrial applications, or can also supply thermal energy to absorption chillers for building or process cooling.

Cutaway view of microturbine sections.
Illustration courtesy FlexEnergy.

A leader in the U.S. microturbine industry is Capstone Turbine Corporation, headquartered in Chatsworth. California. Capstone sells microturbine units in the 30, 65 and 200 kW class worldwide, as well as multiple turbine assemblies with capacities in multiples of megawatts. Aaron Tasin from Capstone was recently a presenter at a Technology & Market Assessment Forum sponsored by the Energy Solutions Center.

Green Energy Solution

In his presentation, he emphasized that microturbines are a green energy solution for several reasons. First, they typically burn either natural gas or a waste byproduct gas from a digester, solid waste site or from a petroleum production site. Any of these fuels have smaller carbon footprints than most utility electric generation sources. Secondly, because the microturbine produces both electric power and hot water or steam, it more fully utilizes the fuel energy used.

He reminded conference attendees that in large part, because of development of vast reserves of natural gas in shale formations, the U.S. now has a 100+ year supply of natural gas in the ground, plus a large potential for methane production from reclaimed landfill gas, and from agricultural and municipal wastewater digesters. He indicated that world reserves of natural gas are three times those of petroleum.

Efficiency To 85%

Tasin suggested that a microturbine installation that fully uses the thermal byproduct has a total efficiency of 85% compared to 58% or less for systems that use utility electric power plus an on-site boiler. Further, he emphasized that natural gas as a fuel has much lower emissions than the typical utility mix of coal, oil and some nuclear generation. Combine the lower initial emissions with the lower total energy input, and there can be no argument that this is truly a green solution.

Tasin noted that with thousands of turbines installed in locations around the world serving many types of heat and electric loads, microturbine technology is in the mainstream and an attractive solution for many types of users. He indicated that typically owners size their installation to meet their thermal requirement, and use all or as much of the electric output as possible and if there is a surplus, sell it to their interconnected central-station electric utility. "In this way, they get the full benefit of both the thermal and electric output."

Three 250 kW gas turbines provide both electric power and water heating at the John Muir Medical Center in Walnut Grove, California. Photo courtesy FlexEnergy.

Serving Critical Winery Load

An example of an industrial load served with Capstone microturbines is Vineyard 29 in the Napa Valley of California. Here two 60 kW machines provide power to the plant for daily operations, plus heat for building heating in the colder months and to supply an absorption chiller for cooling in the hot months. The units run parallel with utility electric service, but can pick up load in the event of an outage during the critical grape harvesting period.

FlexEnergy manufactures microturbines for use in industrial, institutional and commercial settings. This company acquired Ingersoll Rand Energy Systems in 2010 and is headquartered in Irvine, California, with a worldwide spare parts depot at that location. Gas turbine production and assembly is done at its plant in Portsmouth, New Hampshire.

Wide Range of Applications

According to company spokesperson Su Anne Huang, the current product is the Flex Turbine™ MT250, a 250 kW-rated unit with broad applications for industrial and institutional users. Huang notes, "In most of the installations we've done, owners want to take full advantage of the thermal output of the machine. Generally we recommend that the unit be sized for the expected thermal load."

She points out that FlexEnergy turbines meets all current and upcoming emission standards, and the Flex Turbine MT250 was the first combustion technology ever to meet the California Air Resource Board (CARB) 2007 emission standards. No exhaust catalyst treatment is required, and the NO_x output is less than 5 ppm. The product has integral heat recovery and can be used for a wide variety of industrial applications that require hot air, hot water, steam or chilled water.

Medical Center Reduces Demand Charges

An example of an institutional user of microturbines is a recent addition to the John Muir Medical Center in Walnut Grove, California. This 324-bed acute care facility chose three Flex Turbine MT250 units, for an installed capacity of 750 kW. The goal of the project was to reduce utility electric demand charges, increase power supply reliability, and provide an economical source of domestic hot water for facility demands. The 2011 installation generates 3.3 million Btu per hour of thermal energy for water heating and meets rigorous CARB emission requirements. The medical center's goal was a system with high reliability and minimal maintenance.

Is it Right for You?

Is there a gas turbine in your future? If you have natural gas service and a need for both electric power and thermal energy, it might well be the best solution. Your engineer should be able to help you calculate the potential costs and savings. Small gas turbines are in the mainstream, and can be a great solution for reducing costs and using fuel resources more efficiently, while reducing emissions and lowering your contribution to greenhouse gases. Give it some thought. **GT**

MORE info

CAPSTONE TURBINE CORPORATION
www.capstoneturbine.com

DOE INFORMATION ON MICROTURBINES
www1.eere.energy.gov/manufacturing/distributedenergy/microturbines.html

ENERGY SOLUTIONS CENTER INFORMATION ON MICROTURBINES
www.energysolutionscenter.org/gas_solutions/microturbines.aspx

FLEXENERGY
www.flexenergy.com

Run Your Boiler at Its Best

Maintaining Efficiency Is a Continuing Goal

MORE info

CLEAVER-BROOKS
www.cleaver-brooks.com

DOE ON BOILER EFFICIENCY
www1.eere.energy.gov/manufacturing/tech

HURST BOILER & WELDING CO.
www.hurstboiler.com

MIURA BOILER
www.miuraboiler.com

TOO OFTEN A HIGH-EFFICIENCY package boiler is purchased at a premium price and then allowed to decline in performance from lack of proper maintenance or from incorrect operation. Today's boilers are rugged and finely-tuned machines. Digital burner controls and on-board flue gas analysis make the job easier, but it's as important as ever to keep an eye on the goal of optimum efficiency.

Feedwater is Critical

Perhaps the single most important item to watch is feedwater quality. Good feedwater is critical for the life and efficient operation of a boiler. Rakesh Zala, Director of Product Engineering for Cleaver-Brooks Packaged Boiler Systems, points out that poor feedwater quality can lead to premature boiler failure. "It can also lead to fouling and scale buildup on heat transfer surfaces, raising stack temperature and reducing efficiency."

It is important to follow manufacturers' recommendations for feedwater pH and to use the recommended anti-scaling treatments. A modest investment in feedwater treatment chemicals and periodic tube cleaning can pay large rewards in boiler integrity and efficiency. Follow the recommended blowdown frequency, and inspect the boiler interior regularly for signs of erosion or scaling.

Keep Controls in Calibration

Zala also points out that newer boiler controls often use an O2 sensor to optimize combustion. This means many fewer adjustments of draft and fuel linkages are needed than with older mechanical controls. However, he says, "Typically the sensor requires periodic calibration. Some control systems are designed to perform automatic calibration." Check with the control system provider to confirm the status of your system.

Chad Fletcher from Hurst Boiler emphasizes the importance of regular maintenance and echoes comments of others on the importance of maintaining feedwater quality. He points out, "The newer technology digital controls do offer easier maintenance and offer easier setup and dealing with problems." He notes that much of this maintenance work can be done during the bi-annual boiler inspection.

Flue gas analysis will give information on boiler efficiency. Typically you want excess air less than 15% and no measurable carbon monoxide (CO). This will indicate clean combustion. Higher excess air or the presence of CO indicates adjustments are needed. If your boiler offers on-board flue gas analysis, then be sure to take advantage of this very useful tool.

In many industrial plants, the boiler system is the single largest energy user. It makes sense to regularly check its operating efficiency, and run boilers near their most efficient points. Photo courtesy Cleaver-Brooks.

Find the Sweet Spot and Stay There

Most steam boilers have efficiency "sweet spots" when firing somewhere between 60% and 80% of maximum capacity. Condensing hot water boilers are most efficient at rates somewhat below this. If you have a single boiler, you may not have a choice of the firing rate, but if you have multiple boilers, you should be trying to operate as many as possible at or near the sweet spot. Ask your system designer or the boiler manufacturer for information on what firing rates offer the highest efficiency.

Related to the discussion of sweet spots is the reality that for many industrial and institutional systems, there is a year-round need for steam. Yet summer steam requirements are much less, so a boiler has to operate far from its optimum rate, or cycle an unacceptable number of times a day. This hurts year-round efficiency.

A Place for Ponies

The solution may be a small "pony" boiler for off-season minimum loads. Small horizontal or vertical tube or tubeless boilers are available to match up with your off-peak pressure and volume requirements. Adding a pony boiler can make your entire plant more efficient year-round.

According to the DOE, boilers are commonly the single largest energy using device in many plants and institutions. Doesn't it make sense to closely watch the efficiency of this system and try for the best? **GT**