

Energy Solutions

for Commercial Buildings

Multifamily design innovation

brings natural gas
to high-rise apartments

Plus

A new technology with
a twist = a heat pump
that makes hot water

Utilities help federal
agencies implement
energy-saving solutions



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Driving sustainability

Natural gas vehicles offer cleaner and cheaper alternative for small fleets.

By **Tonya McMurray**

For Cumberland County Improvement Authority (CCIA), natural gas vehicles (NGVs) and the cleaner,

more efficient compressed natural gas (CNG) that fuels them are a perfect fit for the organization's mission to support environmental sustainability initiatives.

CCIA's new CNG fueling station, scheduled for completion by year's end, will serve its growing NGV fleet as well as offer fuel for about 200 trash trucks coming to the facility daily.

"Trash trucks are converting at a fast pace, so this a perfect location for CNG," said Gerard Velazquez III,

CCIA executive director. "We can get past the issue of where to fuel up, which lets us have a serious conversation about the benefits of CNG."

Natural Gas Vehicles for America estimates there are about 165,000 NGVs on American roads with about 87,000 of those being vehicles used by small fleets and consumers. Navigant Research proj-

CNG fueling stations are not as commonplace as traditional gas stations, the number continues to grow with more and more stations being built every year.

— Peter Morano, manager of natural gas vehicle business development, South Jersey Gas



Cumberland County Improvement Authority is converting its fleet to NGVs and installing a CNG fuel station for trash trucks coming into its landfill to help further the county's sustainability initiatives.

PHOTO COURTESY OF CUMBERLAND COUNTY IMPROVEMENT AUTHORITY

The Lancaster County Solid Waste Management Authority's fast-fill station provides CNG for customers, approved trash haulers and municipal vehicles. The availability of public stations is critical for continued adoption of NGVs.



PHOTO COURTESY OF LANCASTER COUNTY SOLID WASTE MANAGEMENT AUTHORITY

ects annual North American fleet sales will reach about 30,000.

“Ford, GM and FCA all offer CNG options for full-size pickups, and Ford also offers it as an option for vans,” said Sam Abuelsamid, senior analyst, Navigant Research. “However, those are pretty much only purchased by fleet and commercial customers.”

Filling up

The continued expansion of NGVs requires a robust refueling infrastructure. Abuelsamid said there are currently about 960 publicly accessible CNG fueling stations across the country.

Shaun Hart, manager of major accounts for UGI Utilities Inc. said more public fueling stations are critical for continued adoption of NGVs. Over the last five years, UGI has completed 16 CNG stations and is actively working on several more.

Peter Morano, manager of natural gas vehicle business development for South Jersey Gas, said the CNG fueling network continues to expand, especially in the mid-Atlantic region. Currently, there are eight operational stations and plans to construct four more in South Jersey Gas territory.

“While CNG fueling stations are not as commonplace as traditional gas stations, the number continues to grow with more and more stations being built every year,” he said.

Small fleets, big savings

Morano notes there are three factors that make a fleet well-suited for NGVs: low fuel economy, high mileage, and nightly returns to a base location for convenient fueling.

Velazquez said CCIA expects to save

between 50 and 60 cents a gallon with its switch to CNG. “That may not sound like a lot, but when you buy 200,000 gallons a year, it adds up,” he said.

The Lancaster County Solid Waste Management Authority (LCSWMA) was also focused on cost savings when it replaced its aging waste transfer fleet in May 2014. LCSWMA converted 14 waste transfer trucks and two ash dump trucks to NGVs and added a dedicated, time-fill CNG fueling facility, as well as a fast-fill CNG station for customers and other select fleets.

LCSWMA Deputy Chief of Community Relations Kathryn Sandoe said the conversion resulted in significant monthly savings. Last year, LCSWMA averaged monthly fuel savings of \$7,100, and in the first half of 2017 has averaged savings of just over \$10,000 a month. The total project yields an annual reduction of about 10 million pounds of air pollutants.

LCSWMA's cost savings are not unique, Hart said. “Businesses have experienced about 60 percent cost savings from converting vehicles to natural gas,” he said. “This price advantage is expected to remain stable for the foreseeable future due to the abundance of domestic natural gas supply.”

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— Shaun Hart, UGI Utilities Inc.

Economic case for CHP

CHP provides reliable backup power and saves money.

By Drew Robb

Combined heat and power (CHP) is a great way to save money and provide reliable backup power for

any commercial or industrial facility. Research shows that electricity costs more than three times the price of natural gas. As the price gap is estimated to only widen, this trend makes CHP even more competitive.

“U.S. homeowners and businesses can expect to pay 3.6 to 3.9 times more for electricity in 2018,” said Eric Burgis, director, commercial and residential markets at the Energy Solutions Center (ESC). “Keep this price difference in

mind when the time comes to replace an appliance, water heater or HVAC equipment that run off natural gas as opposed to electricity.”

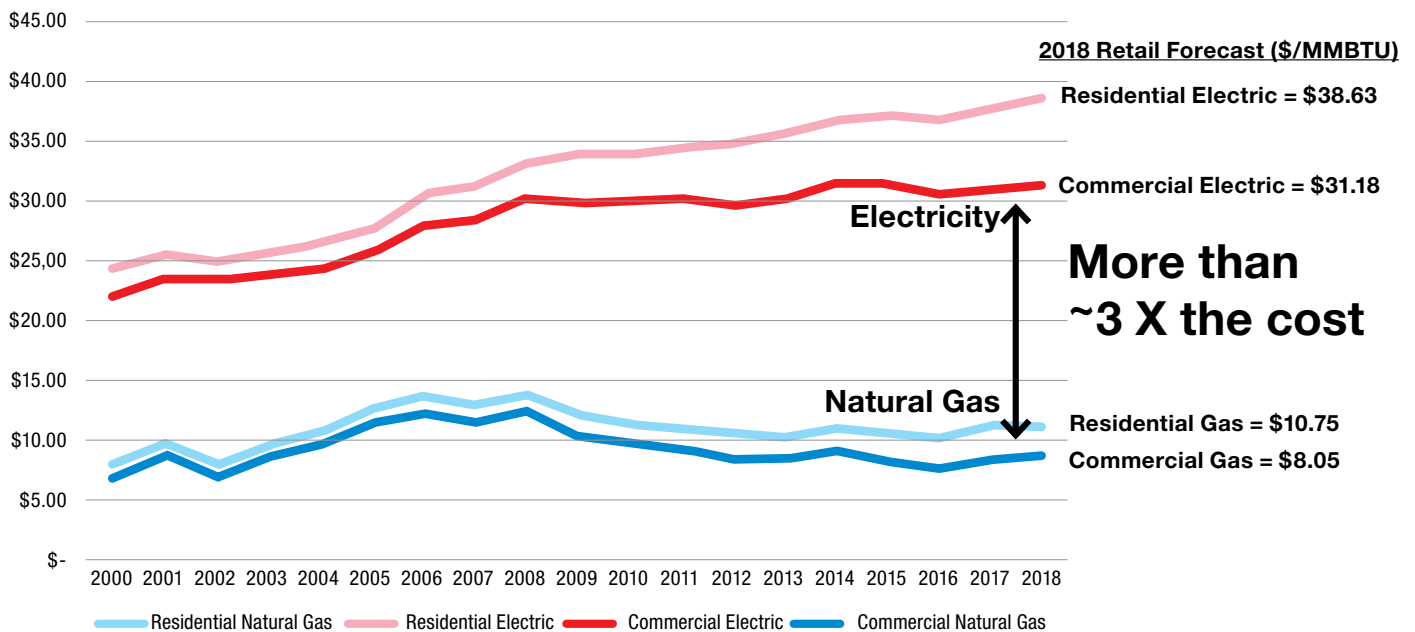
Economic case for CHP

CHP is the sequential or simultaneous production of two different forms of energy from a single input energy. By far the most common fuel used is natural gas. It is harnessed to provide usable heat as well as power. There are already more than 82.7 GW of CHP installed at over 4,400 industrial and commercial facilities in the United States. This amounts to 12 percent of the nation’s annual generation.

More than three quarters of commercial CHP plants utilize natural gas, with coal next at 17 percent. Natural gas-based CHP is environmentally friendly, highly efficient and uses relatively less fuel. But just as importantly, sound economics are spurring more facilities to turn to natural gas.

Take Oak Point Recreation Center in Plano, Texas. The building includes an indoor and outdoor pool, a gymnastics center, basketball courts, racquetball courts, a climbing wall, a walking track and a weight room. Waste heat is used to heat the pool and maintain a constant temperature.

Average Retail U.S. Residential and Commercial Energy Prices including Short Term EIA Outlook (\$/MMBTU)



*EIA data. Uses 1032 BTU/CF Natural Gas and 3412 BTU/KWH Electric. (2017 & 2018 are from EIA STEO)



PHOTO COURTESY OF MD ENGINEERING LLP

The economic case for CHP at the Oak Point Recreation Center in Plano, Texas, included substantial energy savings and the ability to lower dependency on an over-taxed grid.

The economic case for CHP began with a comparison of prices, said Michael Smith, P.E. LEED AP, president of MD Engineering LLP, who designed the CHP unit at Oak Point. The price of electricity in Texas was 3.34 times more than natural gas. As well as substantial energy savings, the argument in favor of CHP included the ability to lower dependency on an overtaxed grid.

“Since the indoor pool is heated year-round, we could take advantage of the waste heat to heat the pool through a shell and tube heat exchanger,” Smith said.

The small electrical load required by the facility turned out to be ideal for the deployment of natural gas reciprocating engine-based CHP. From a maintenance standpoint, too, the City of Plano has existing contracts with recip engine service companies. The

project also helped the facility comply with American Society of Heating, Refrigeration and Air Conditioning Engineers standards for air change rate per hour for indoor pools. This upgrade kept the air fresh without the need to replace any existing ductwork.

Smith’s advice to other engineers considering CHP is to coordinate efforts beginning with the local gas company, beginning early in the planning phase.

He worked closely with local gas utility Atmos Energy Corp. to ensure the project was well-designed and maximized the economic benefits.

“Cost of operation is one of the reasons that natural gas is so popular,” Smith said. “The CHP system has reduced the cost of natural gas consumption at the Oak Point Recreation Center, which uses about 12,000 Mcf per year, *(continued on page 6)*”

“U.S. homeowners and businesses can expect to pay 3.6 to 3.9 times more for electricity in 2018. Keep this price difference in mind when the time comes to replace an appliance, water heater or HVAC equipment that run off natural gas as opposed to electricity.”

— Eric Burgis, Energy Solutions Center

(continued from page 5)

as well as providing heat to maintain a consistent 84-degree water temperature in the center's swimming pool."

This isn't the first time the city has included natural gas during building renovation and upgrades. It has utilized natural gas absorption chillers and natural gas heat pumps in other facilities.

"We have always encouraged the City of Plano to try different natural gas technologies to save energy," said Greg Anderson, Atmos Energy commercial marketing manager.

Spark spread

How can project managers and building engineers know when CHP will be profitable in their area? Burgis of ESC explained that the economic picture varies from state to state and city to city. Yet

natural gas prices are so low that there is a high likelihood of being able to work out a cost-effective solution just about anywhere in North America.

He laid out five factors that exert the greatest impact on the location of CHP plants:

- Local grid interconnection policies;
- Availability of net metering;
- State or local incentives;
- Tariff rates; and
- Spark spread

Spark spread is the relative difference between the price of fuel and the price of electricity, Burgis explained. The magic number is three, meaning that electricity is three times more expensive than natural gas in that area.

"Spark spread is the largest motivator for people considering CHP as it has the greatest economic impact,"

Burgis said. "Only a handful of states have spark spreads between 2.5 and 3, whereas all other states and provinces in North America have spark spreads between 3 and 5."

Some other areas of the power industry may be struggling, but the CHP market is expanding. According to Navigant Research, the commercial CHP market is expected to be worth more than \$14 billion annually by 2024.

"The CHP market as a whole is experiencing steady growth," said Brett Feldman, senior research analyst, Navigant Research. "In light of concerns about grid reliability, demand for electricity and greenhouse gas emissions, policymakers, utilities and building owners in a growing number of countries are becoming more interested in commercial CHP systems."



Greg Anderson (left), commercial marketing manager, Atmos Energy Inc., and MD Engineering President Michael Smith inspect the combined heat and power (CHP) system at the Oak Point Recreation Center in Plano, Texas. Smith designed the unit, which provides power for operating the facility's constant electric load as well as heat for maintaining consistent 84-degree water temperature in the center's large swimming pool.



PHOTO COURTESY OF MD ENGINEERING LLP

The CHP system has more than doubled the natural gas consumption at the Oak Point Recreation Center, which uses about 12,000 Mcf per year.

Reducing grid dependency

Smith noted grid dependency as another factor that drove the City of Plano's decision to adopt CHP.

"Power outages are far more frequent than gas outages," he said. "Additionally, the electrical demand at the community center reduced by adding CHP; plus, the city can now keep the pool heated and the water recirculating during times when the power may be out."

CHP, then, offers a safeguard against grid outages. It offers some facilities the ability to drop from the grid and island themselves when necessary, as well as providing ancillary services such as black-start capability.

One facility that has implemented a CHP-based microgrid is the Open Access Technology International (OATI) data center in Minneapolis. It is powered

by a combination of the local grid, solar panels, wind turbines, a Capstone C600 microturbine for CHP, lithium ion batteries and a diesel generator.

"CHP is being diverted into multiple areas of our five-story, 100,000-square-foot tower," said Terry Mohn, microgrid executive consultant, OATI. "Waste heat is used for chillers to keep the data center cool."

In emergency mode, the building is capable of self-generation using natural gas power from its microturbine as

well as battery backup power. Similarly, if electricity becomes too expensive, it can go into island mode and operate as a microgrid.

Such an arrangement could well become the way of the future as stable, low natural gas prices encourage more and more facilities to make the switch.

"Today's grid is antiquated and could benefit from CHP's sustainability and reliability characteristics," said Anthony Cirillo, senior project director for power at engineering firm AECOM. ▀

"Cost of operation is one of the reasons that natural gas is so popular. The CHP system has more than doubled the natural gas consumption at the Oak Point Recreation Center."

— Michael Smith, MD Engineering LLP



Tenants' choice

Multifamily design innovation brings natural gas to high-rise apartments.

By Drew Robb

There is an acute need for rental properties and new-build residencies throughout North America. But for

developers to have the confidence to invest in a large multifamily property, they have to find a way to balance cost with the features that families want. And, at the top of the list is natural gas for heating hot water and to fuel appliances. A recent study by Market Strategies International, for example, found an 80 percent preference for natural gas among residential tenants.

To satisfy this demand, developers and manufacturers are finding ways to affordably add natural gas to multi-unit properties. They are using design innovation and system design to bring natural gas to a wider residential audience operating at a lower cost and far more efficiently.

Savings at The Slate

Natural gas is always the popular choice for family dwellings. But when developers want to add natural gas systems and appliances to multifamily projects, their options are sometimes limited. If developers wish to install meters in each unit, strict venting and installation regulations can add significantly to the materials budget. Additionally, such requirements could impose limits on space availability. In many cases, these restrictions can make projects cost-prohibitive, and they require some help and creative thinking from one's local utility. That's why so many multifamily developments lack the natural gas amenities their tenants desire.

This was the challenge facing a project known as The Slate. Situated in Portland, Oregon, it is a 10-story building that

includes office and retail space on the lower levels as well as 75 studios, one-bedroom and two-bedroom apartments. These units offer dramatic skyline views, easy access to downtown, and a modern look and feel that is attractive to young families and professionals.

Looking for a way to incorporate natural gas into the project, The Slate's developers called in the help of system designers at NW Natural, the largest gas utility in the Pacific Northwest.

"In this competitive market, developers and renters seek out those amenities that set a project apart," said Mark Vuong, The Slate's project manager. "NW Natural's engineering team came up with creative design solutions that let us upgrade our units to natural gas cooktops while still meeting our price points."

As well as the precision and reliability of natural gas cooktops in every unit, the design included common-area heat, a gas-fired central boiler for domestic hot water, and gas heating for commercial and retail spaces. NW Natural engineers devised an innovative approach that cut the developers' costs by \$30,000, tracks usage by unit, and improves system safety and control.

A single regulator positioned outside the building eliminated the venting required when regulators are used indoors. Lower pressure extended service lines run from the regulator to meter closets on each level which contain all meters for the floor. This arrangement greatly reduced the amount of piping needed, as well as adding to the space availability of each unit.

When scheduled or unscheduled maintenance is called for, gas can be shut off to a single apartment or floor, rather than

The Slate residential, office and retail complex includes natural gas cooktops in every apartment unit, common-area heat, a gas-fired central boiler for domestic hot water, and gas heating for commercial and retail spaces.



having to shut down the entire building. Further, technicians can service equipment without disrupting tenants.

Thomas Jefferson Tower rejuvenated

The Thomas Jefferson Tower (previously Hotel Thomas Jefferson, then Cabana Hotel) is a 19-story building, formerly a 350-room hotel, completed in 1929 on the western side of downtown Birmingham, Alabama. Listed in the National Registry of Historic Places, it had sat empty for decades.

Developer and building owner Reed Realty Group faced many challenges in bringing this iconic structure back to life. In exchange for preserving the historic features of the building, the company received tax credits. However, this imposed many design and engineering limitations. So Reed Realty turned to Spire Inc., a natural gas utility serving customers across Missouri, Mississippi and Alabama.

"The switch to gas from electric would not have been possible without the support and expertise of our local gas utility," said Alex Dzyuba, principal and director of construction, Reed Realty. "Spire's creative approach enabled us to save money on the front end and helped us to reduce the electrical infrastructure throughout the building."

Spire devised an aesthetic and economical system for the 96-unit Thomas Jefferson Tower. Placing three natural gas tankless hot water heaters in the me-

Thanks to the installation of the Rinnai Tankless Rack System at the 94-apartment Thomas Jefferson Tower in Birmingham, Alabama, each of the units feature a gas stove.



PHOTO COURTESY OF REED REALTY GROUP

chanical room on each floor, serving six residential units and installing gas stoves in each apartment. This reduced electrical system needs by over 5,000 amps. The selection of three tankless Rinnai Corp. water heating units per floor served by a centralized hot water system further enhanced project objectives.

"The Rinnai Tankless Rack System drastically reduces your cost, space and maintenance requirements, yet it has redundancy built into the system," said Rachel Young, commercial business representative, Spire.

The State Historic Preservation Office allowed the water heaters to be vented with a single-point exhaust at each level of the tower. This enabled a building configuration whereby it required only one fuel line to run vertically through the mechanical rooms of each floor. These simple but effective design adjustments meant there was no need to

run gas lines to each unit, only water lines.

"The design enabled the developer to not have to run individual fuel lines and 200-volt electric lines to all 96 units, and eliminated two 220-volt lines per unit," Young said. "It also saved the developer \$225,000 due to the reduction in electrical cost and gas piping requirements."

Young's advice for developers is to expand mechanical rooms slightly on floors as this saves far more space in each unit via a centralized water heating system design. She also recommends that owners and developers seek advice from their local utilities before submitting floor plans.

In short, natural gas is an environmentally friendly, energy-efficient fuel that allows users to do things faster and for less money, giving them more time to spend and save cash for other activities. And with new products by top manufacturers designed with multifamily in mind, there has never been a better time to add natural gas service.

"Our tenants love the fact that they have instant and endless hot water and the availability of gas stoves," Dzyuba said. ▀

PHOTO COURTESY OF REED REALTY GROUP



The Rinnai Tankless Rack System, featuring three natural gas tankless water heaters, was installed in the 16-story Thomas Jefferson Tower. The installation drastically reduced electrical system needs by 5,000 amps as well as decreased cost, space and maintenance requirements in the historic building.



In hot water

A new technology with a twist = a heat pump that makes hot water.

By *Tonya McMurray*

When Miami Beach's Harbour House needed to cut the high operating costs of traditional

boilers in its 16-story, 457-unit condominium complex, it turned to a new technology that puts a different twist on a traditional heat pump and hot water system.

The Harbour House condo board chose the Tecogen Inc. Ilios heat pump water heater. Fueled by low-cost, abundant natural gas and harnessing heat from the surrounding air, the Ilios heat pump provides an economic solution for delivering hot water throughout the complex and heating the condo's pool and spa.

With the Ilios heat pump water heater, Harbour House is on track to save more than \$25,000 annually while reducing its use of natural gas by 50 percent.

"We selected the Ilios water heater not only for the monetary savings the system generates but also because it's an environmentally friendly choice," said Allen Scherl, vice president of Harbour House's condominium association. "It's important that we provide our community with sustainable solutions. With this system, we can cut our carbon footprint and our energy consumption for heating in half."

"We selected the Ilios water heater not only for the monetary savings the system generates but also because it's an environmentally friendly choice. It's important that we provide our community with sustainable solutions. With this system, we can cut our carbon footprint and our energy consumption for heating in half."

— Allen Scherl, Harbour House condominium association.

Tecogen's high-efficiency Ilios heat pump water heater uses a combination of two proven technologies: the heat pump cycle and a natural gas-powered internal combustion engine.

The heat pump extracts heat from the surrounding environment. This renewable energy includes the surrounding air heated by the sun or geothermal energy from the earth. Energy existing at the site of the building can also come from the recovery of waste energy such as a low-grade waste heat stream or energy that would typically be rejected in a chilled water system.

The free, low-temperature energy recovered on-site is then raised to a higher, more useful temperature via the vapor compression refrigeration cycle. The higher temperature heat is then transferred to the water via a heat exchanger.

New way to heat water

The key to the super high efficiency of this system is its ability to combine the energy moved from the outside air to the indoors and boost that heating with the waste heat off the engine that drives the compressor. The end result is 'a' natural gas-fired heat pump water heater that is around 200 percent efficient. Compare

this to a standard residential tank water heater that is around 62 percent efficient or a standard boiler that is 82 percent efficient. Even the highest efficiency residential and commercial water heaters can't exceed 100 percent efficiency.

The Ilios is a system that uses a natural gas engine rather than an electric motor to power the compressor while recovering waste heat from the engine, said Stephen Lafaille, product manager, Tecogen. The engine's waste heat is recovered and used in combination with the heat extracted in the refrigeration cycle, increasing system efficiency by up to three times that of a conventional boiler and up to 50 percent more than an electric heat pump when compared on a source efficiency basis.

The system emissions have near zero criteria pollutants and exceed current emissions standards. Tecogen estimates that an average installation saves more than 120 tons of carbon a year, the equivalent of taking 22 cars off the road.

"A lot of people are confused by heat pumps because they think you are creating energy, which is impossible," Lafaille said. "You are simply moving the heat or energy from where it is in the surrounding air to the buildings' hot water loop where you want it. It takes a lot less energy to harness and move that heat than it does to heat water by burning a fuel in a boiler."

The Ilios high-efficiency hot water heater leverages mechanical energy to take advantage of the heat pump cycle. Systems, such as Tecogen's Ilios water heater and its TecoChill chillers, reduce operating costs, improve source efficiency and reduce carbon emissions at a lower cost than traditional systems.



PHOTO COURTESY OF TECOGEN INC.

The Ilios system uses a natural gas engine rather than an electric motor to power the compressor while recovering waste heat from the engine. The engine's waste heat is recovered and used in combination with the heat extracted in the refrigeration cycle, increasing system efficiency by up to three times that of a conventional boiler and up to 50 percent more than an electric heat pump when compared on a source efficiency basis.

"It's a simpler way, and it's more efficient," Lafaille said. "You get the same technology for a tenth of the cost."

"The Ilios product is merely a high efficiency water heater, so it's easy to justify the cost," Lafaille continued. "You begin seeing results almost immediately. The more the energy costs, the more you save. At the end of the day, you use less fuel on-site as well, so that makes the product very strong."

The Ilios water heater produces between 300,000 and 600,000 BTUs an hour of hot water at up to 165 degrees Fahrenheit and requires minimal power, about as much as a countertop appliance. The system is well-suited for hotels, hospitals, schools, industrial facilities, laboratories and multifamily residential sites that need a steady supply of hot and/or cold water.

Special natural gas rates and incentives

The savings alone make economics

very favorable for any commercial business with large hot water needs. But if that is not enough to peak your interest, the federal government defines cogeneration as: The generation of electricity or shaft power by an energy conversion system and the concurrent use of rejected thermal energy from the conversion system as an auxiliary energy source. This means that the Ilios product falls under the federal terminology for cogeneration and, as such, it may qualify you for special natural gas rates for cogeneration and/or any sort of rebates or incentives offered for the installation of cogeneration.

A study in efficiency

The gas heat pump water heater solution offered by Tecogen was important to Scripps Research Institute, which put the technology to work in its world-renowned research facility in Jupiter, Florida. The 350,000-square-foot campus houses

more than 600 full-time faculty, scientific, technical and administrative staff members.

At the Institute, the heating and cooling systems work overtime to help maintain strict climatic conditions, and it was looking for a way to improve efficiency. The Institute replaced steam boilers with steam generators to meet lab sterilization needs. Its hot water generation plant combined seven Ilios HEWH-500-WS water heaters as the base load, backed up for full redundancy by a hydronic boiler system.

The Ilios installation saves more than 2 million gallons of water each year and more than 2,000 tons of carbon dioxide annually, while implementing a dedicated heat recovery chiller that simultaneously heats and cools the facility, Lafaille said. Overall, the project provides more than 30 percent savings in natural gas consumption, while free cooling offsets electricity and demand charges for the central chilling plant. ▶

Staying warm

Infrared heaters extend outdoor patio season.

By Tonya McMurray

Outdoor patios are popular features for restaurants, hotels and bars. But chilly nights — especially

in early spring and late fall — can dampen patrons' enjoyment of outside seating.

To help extend the outdoor seating season, many restaurants and hotels are turning to natural gas infrared heaters to create safe, energy-efficient warmth.

"Our patrons enjoy being outdoors," said Liz Wonder, sustainability coordinator, Founders Brewing Co. "When the fall rolls around and the days are warm but the nights are really chilly, infrared heaters help us create a cozy outside atmosphere that folks can enjoy until the real cold of winter sets in."

Founders, a Grand Rapids, Michigan, brewery and taproom, has 26 infrared natural gas heaters spread over two covered porches and a patio. The heaters — a combination of tube-style radiant heaters and mounted and free-standing umbrella style heaters — cover about 2,000 square feet.

Bringing the heat

Wonder said the heaters allow Found-

ers to keep its patio and beer garden comfortable for several additional months in the spring and fall.

Infrared heaters deliver heat by radiation, acting a bit like the sun. Typical heating systems blow hot air into a room. The hot air rises while the cooler air stays at the lower eye level. Only the air is heated (not objects in the room).

Unlike other heating systems, infrared heaters heat the objects in the room. Floor-level surfaces absorb the heat first and then re-radiate it back to the surrounding air. For restaurants and bars, that means seating areas are among the first to be heated, and they stay warm longer.

Objects warmed by radiant infrared heat will maintain warmth even with a burst of cold air from doors opening and closing, making them ideal for restaurants and other businesses with a lot of customers coming in and out.

Radiant infrared heat provides better comfort at lower temperatures, much the same way that standing in the sun on a cool day provides more warmth than a shady spot even though there is little or no difference in temperature.

Infrared heaters come in two versions: low-intensity tube heaters and high-intensity heaters.



Founders Brewing Co., a Grand Rapids, Michigan, brewery and taproom, has 26 infrared natural gas heaters spread over two covered porches and a patio. The heaters — a combination of tube-style radiant heaters and mounted and free-standing umbrella style heaters — cover about 2,000 square feet.

PHOTO COURTESY OF FOUNDERS BREWING CO.

In tube heaters, a mixture of gas and air is ignited and the resulting flame heats the tube and emits infrared radiant heat. High intensity heaters have a mixing chamber, ceramic tiles and a reflector around the burner. An air-gas mixture is burned at the surface of the ceramic tile, heating the tiles which then emit infrared radiant heat.

Founders opted for the infrared heaters based on the combination of safety and sustainability concerns, Wonder said.

"We have hundreds of patrons coming and going on busy nights, and open flames are a major safety concern, given that we serve alcohol," she said. "For us, it is safer to have a heating option that does not lend itself to easy injury. The infrared heaters are also more efficient than other types of heating to keep our patrons comfortable."

With infrared heaters fueled by natural gas, restaurants, hotels and bars have a safe, energy-efficient way to expand the season for outdoor patio seating so valued by patrons. ▀



Infrared natural gas heaters help Founders extend the outdoor patio season from early spring through late fall with a safe and efficient heat source.

PHOTO COURTESY OF FOUNDERS BREWING CO.

Government partnerships

Utilities help federal agencies implement energy-saving solutions.

By Tonya McMurray

The United States Army National Guard's Camp Swift Training Center in Bastrop, Texas, faces a problem

common to federal departments and agencies: It is tasked to meet federally-mandated energy reduction goals but historically has lacked the funding necessary to achieve those goals.

Since 1992, various legislative and executive orders have required the federal government to reduce energy usage. A 2007 presidential mandate required the government to reduce energy consumption annually.

Federal energy managers are charged with identifying the most cost-effective measures for implementing capital improvements with a 2011 presidential mandate requiring governmental agencies to enter into a minimum of \$2 billion in performance-based contracts. In 2014, the government committed an additional \$2 billion for energy efficiency contracts.

Utility Partnerships Program

The U.S. Department of Energy's Federal Energy Management Program's Utility Partnerships Program facilitates utility partnerships, allowing government agencies to connect with utilities through a General Services Agreement (GSA) to meet reduction demands while addressing the funding problems that challenge Camp Swift and countless other government entities.

"Under the GSA, the government and utility provider can identify energy measures that reduce energy demand, conserve water, replace inefficient equipment and add energy-saving devices," said T.J. Noland, sales manager, CenterPoint Energy Inc.

The work to be performed is typically outlined in a Utility Energy Services Contract (UESC), an agreement between the local utility provider and the governmental agency that allows the utility to assist the agency in identifying energy conservation measures and bundling them into an energy performance contract.

A UESC allows the federal agency and utility to work together to assess a project's potential and to design solutions to meet the agency's energy-saving goals. Utilities have the option of partnering with an Energy Service Company (ESCO) to identify conservation measures, obtain project financing, quantify project goals and measurements, and provide government documentation. ESCOs develop, design, build and fund energy-saving initiatives, serving as the project developer for a range of energy conservation measures and assuming the technical and performance risks for the project.

Finding the money

Many projects that meet the government mandates to save energy require significant upfront equipment and installation costs, which can be a burden on agencies. A UESC allows the utility to obtain financing to fund the initial project costs. The government has the option of paying the contract back with the savings



The United States Army National Guard's Camp Swift Training Center partnered with Energy Systems Group and CenterPoint Energy Inc. to implement energy conservation measures that are estimated to save \$125,000 annually.

obtained from implementing cleaner and more efficient technologies and systems.

"Participation in performance contracts, such as Utility Energy Services Contracts, allows the military to leverage utility budgets to implement energy, water and renewable measures that are essential to meeting federal mandates, facility goals, and operations and maintenance objectives," said Brian P. Stevens, director, energy programs and sustainability branch chief, construction and facilities management office, Texas Military Department.

From the utility's perspective, a UESC allows utility providers to enhance relationships with government partners while creating new product offerings for government customers that might later expand to other customer segments, Ross said.

According to the Department of Energy's Federal Energy Management Program, nearly 1,700 UESC projects have been awarded since 1994, saving more than 14 trillion BTUs while allowing federal agencies to invest about \$2.3 billion in its facilities.

An example of the many types of
(continued on page 15)

PHOTO COURTESY OF THE UNITED STATES ARMY NATIONAL GUARD



Harnessing VRF technology

Gas heat pumps outperform electric VRF systems.

By Drew Robb

Gas heat pumps (GHP) using Variable Refrigerant Flow (VRF) technology are relatively new

to the U.S. market, but they have a long track record of success around the globe. There are more than 600,000 GHP systems in operation worldwide, but only 300 operating in the United States, according to John Cole, CEO of IntelliChoice Energy (ICE). Yet that number is growing rapidly as American building owners become familiar with the technology.

A big reason for the rise in popularity is that GHPs compare very well against older technology such as electric VRF heat pumps, said Cole, whose company offers several GHP models.

Gas for city hall

Adairsville City Hall in Georgia, for example, switched from an electric model to a VRF system after the building was damaged by a tornado. Its Yanmar heat recovery VRF system fueled by natural gas provides simultaneous heating and cooling in different zones of the building.

"We are proud to be the first government building in the United States operating with a Yanmar VRF heat pump system," said Pam Madison, city manager, Adairsville City Hall.

The city reports that in the first year of operation, the 16-ton VRF unit provided operating cost savings of \$1,432, or 80 percent, per month. It can run 100 percent of its heating and cooling needs, can be controlled remotely, and used to turn off heating and cooling in unoccupied areas. This will reduce its carbon footprint by 30 percent, and slash electrical consumption for cooling by 90 per-



PHOTO COURTESY OF YANMAR AMERICA CORP.

A Yanmar VRF heat pump, like above, produced cost savings of \$1,432 a month for Adairsville City Hall in Georgia.

cent due to the switch to natural gas.

"By utilizing a highly efficient natural gas-powered variable speed engine to drive compressors, a VRF system can reduce electricity usage by up to 90 percent compared to traditional air conditioning systems," said Mike Mehrvarz, senior engineer, Yanmar America Corp. "Natural gas provides cost savings over the life of the system. And a VRF system brings down overall running costs by 30-70 percent, depending on local utility costs."

Harnessing VRF technology

VRF is an HVAC technology that uses refrigerant as the cooling and heating medium. The refrigerant is conditioned by an outdoor condensing unit and circulated within the building to multiple indoor fan coil units where heat or cool air is distributed. Unlike electric-driven HVAC, natural gas VRF systems can be configured in ducted or non-ducted applications, so indoor fan coil units may be installed in any space.

Another VRF advantage is the ability for each zone to be controlled by its own thermostat. This enables different rooms to have varying temperatures at the same time, and for heating and cooling to occur in different zones simultaneously. These units use a natural gas-powered engine to drive dual compressors, and can maintain powerful heating performance, even with low outdoor temperatures, by capturing heat off the unit's engine to increase efficiency.

As the GHP pump proves itself, more and more customers are moving to this technology. Fire Station 106 in Las Vegas, Nevada, for example, changed from electricity to GHP and realized immediate savings.

"We are not only saving \$1,200-plus a month in energy use, but the lower electrical load keeps us out of the peak demand charge rates," said Samuel Tolman, architectural project manager, City of Las Vegas.

Going green

Military bases, too, are beginning to harness natural gas-based VRF units. Sam Montanez, energy engineer at the U.S. Army's Fort Huachuca in Arizona, said the majority of the posts in the nation are moving steadily toward becoming green energy buildings. Army posts have a mandate to meet a water and energy usage reduction of 30 percent by 2020. And natural gas VRF units are playing their part in the achievement of this target.

So far, Montanez says Fort Huachuca has achieved energy savings of 35 to 45 percent from the GHP retrofit installation. Total projected savings over the 20-year equipment life include: 93 percent reduction in peak electric demand (181 kW), 97 percent decrease in water use, 69 percent reduction in carbon (26,770,340 lbs.) and 68 percent savings in primary energy (147,060 MMBtu).

GHPs offer "trouble-free duty for years with a payback of less than five years," Montanez said. Another facility using gas heat pumps to reduce energy consumption is the 63,000-square-foot GreenCap Advisors development in Houston, Texas. The building uses 24 PowerAire systems by M-TriGen Inc., which provide 144 kW of electricity, 600 kW of cooling/heat and 15 kWh of battery storage. The system produces heat, electricity and cooling simultaneously. GreenCap is realizing energy savings as high as 70 percent compared to an electric system, and it provides automatic backup in the event of an outage.

"Gas heat pumps add great efficiency since they use zero to 10 percent of the electricity of comparable electric heat pumps," said M-TriGen founder and CEO Donald Williams. "This enables our customers to save significantly on their electric bills and to reduce peak-load power requirements." ▶

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projects completed under UESCs is the construction of a U.S. Food and Drug Administration (FDA) campus in White Oak, Maryland, where the government is building a combined heat and power (CHP) plant in coordination with a multi-year campus development.

With natural gas combustion turbines powering chillers and hot water boilers, the CHP system will result in significant cost and energy savings, according to the U.S. Department of Energy. Combined with integrated plant controls, building automation systems and solar arrays, the CHP will contribute to an estimated \$5.8 million in annual energy savings costs and \$6.5 million in reduced operating and maintenance costs.

A UESC can include a broad range of energy conservation measures (ECM), including system upgrades and recommissioning, deep retrofit projects, renewable energy, cogeneration plants and microgrids.

Identifying the savings

CenterPoint Energy entered into its

first UESC last year with Camp Swift, where military personnel go for major training exercises and pre-deployment training. Together, CenterPoint Energy, Energy Solutions Group (an ESCO) and Camp Swift personnel worked to identify several energy-saving measures. Ross said the project is unique because the federal government is funding the project upfront rather than waiting on energy savings to pay back the advanced financing.

Stevens said potential energy-conservation measures for Camp Swift were identified during an Investment Grade Energy Audit conducted between 2014 and 2015. The Army National Guard contracted with Energy Systems Group and CenterPoint Energy in October 2016 and began work on five conservation measures:

- Replacing toilets and urinals with more efficient and lower flow versions and adding aerators to faucets for an expected 50 percent reduction in water use.
- Upgrading systems to provide better control and scheduling of the HVAC systems at Camp Swift, integrating the system into the Global Utility Monitoring and Control

System to allow for ongoing monitoring and control for increased efficiency.

- Adding window shading film to many of the camp's windows to reduce the thermal load on buildings.
- Restoring the HVAC system in one of the camp's largest buildings to ensure increased comfort in a more efficient and cost-effective manner.
- Converting fuel use for heating units in one of Camp Swift's larger buildings from propane to natural gas to take advantage of fuel cost savings.

Stevens said the project, scheduled for completion in late August 2017, is expected to reduce Camp Swift's energy use so it can meet reduction goals through 2025. He estimates the project will result in cost savings of \$125,000 annually.

"Conservation and efficiency are critical components in our efforts to ensure energy and water security and sustainability in the future," he said. "Camp Swift is one of our most heavily utilized training centers, and these ECMs will definitely help us to optimize use of our resources while enhancing our mission readiness." ▶



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