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Energy Solutions
for Commercial Buildings

Mission critical:

CHP provides reliability and energy savings for health care facilities

Plus

Natural gas offers attractive multifamily solutions

Cleaner power grid: Is beneficial electrification the answer?

ESC Energy Solutions Center

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People's choice

Natural gas offers attractive multifamily solutions.

By Drew Robb

As the economy recovers, the demand for rental properties has risen rapidly and, developers are rushing to fulfill the need by building multifamily projects throughout the nation. And more and more developers and owners are looking to natural gas to add value to their properties while keeping costs down.

Meadville Housing Corp. in Northwest Pennsylvania, for example, is involved with National Fuel Gas Distribution Corp. of Williamsville, New York, in a multifamily conversion project: taking buildings that were previously all-electric and converting their heating systems to forced-air natural gas.

One of the sites managed by Meadville Housing is a 32-townhouse complex spread across six adjacent buildings. High tenant electric bills, however, were a major factor in a vacancy rate of 25 percent. That added up to nearly $5,500 a month in lost income.

National Fuel assisted Meadville Housing in equipment evaluation of available heating options to replace inefficient electric strip board heating and wall-mounted individual air conditioning units.

"Tenants previously struggled with electric bills as high as $400 to $500 per month during winter months," said Bob Muth, executive director, Meadville Housing. "Since the conversion, total energy bills during the heating season ranged between $140 and $220. That alone makes these units far more rentable."

Meadville Housing also added a gas stub option in each unit. This allows tenants to opt for a natural gas clothes dryer if desired. The project's success has made it a showcase for developers.

Meadville Housing worked with National Fuel to convert previously all-electric heating systems (like below) to forced-air natural gas. A small utility closetcontains the bulk of the natural gas equipment.

PHOTO COURTESY OF MEADVILLE HOUSING CORP.

"This has grown into a demonstration project to show similarly situated multifamily facilities the benefits of natural gas," said Marti Sawyer, energy consultant, National Fuel. "Meadville Housing now serves as a model of the retrofit conversion process."

Going tankless

New-build developers, too, are showing a preference for gas. Florida Public Utilities (FPU) has been working with Tampa, Florida-based Spanos Corp. on a 250-unit multifamily complex. The multifamily housing project in Sanford, Florida, is spread across five buildings with 50 apartments in each. A bank of five Noritz condensing tankless water heaters are installed in a mechanical room at one end of each building. Water is heated by these units and re-circulated at 140° Fahrenheit to offset temperature drop. A one-inch water supply pipe transports the hot water. There is no need for holding tanks since the one-inch pipe acts as a holding tank in itself.

PHOTO COURTESY OF FLORIDA PUBLIC UTILITIES

A bank of five Noritz condensing tankless water heaters are installed in a mechanical room at one end of each of the five buildings making up the 250-unit multifamily Spanos Corp. complex in Sanford, Florida. The design saves $800 per unit, or $200,000 in upfront costs.

This innovative design eliminated the need for individual water heaters and meters for each apartment. This saved $800 per unit, or $200,000 in upfront construction costs, according to Jim Hayhurst, commercial/industrial account manager, Florida Public Utilities.

"Residents don't need water heaters in their units," he said. "This design reduces the cost of heating water by 50 percent to 60 percent per unit while opening up more space."

Hayhurst added that the amperage of the electrical master panel is considerably reduced since a significant percentage of amp draw is for heating water.

PHOTO COURTESY OF REAL ESTATE EQUITIES DEVELOPMENT LLC

The Village Cooperative in Kansas City, Missouri, (seen here under construction) is another multifamily project preferring natural gas to electricity for heating. Each unit at the Village Cooperative has a natural gas Magic-Pak by Lennox for space heating.

Magic for seniors

Another multifamily project preferring natural gas to electricity for heating is the Village Cooperative in Kansas City, Missouri. A 52-individually-metered apartment complex is under construction for senior living by Real Estate Equities Development LLC (REED) of Eagan, Minnesota. REED performed cost comparisons on natural gas versus electric. Natural gas came out easily on top. Each unit has a natural gas Magic-Pak by Lennox for space heating. In addition, natural gas powers the central water system for all units as well as furnaces for common area fireplaces.

"The all-in-one design of the natural gas heating unit fits in a compact space and eliminates the need for 50 or more condensing units around the building," said Andrew Schaefer, vice president, development, developer REED.

Magic-Paks are available in sizes from 1 ton to 3 tons. They come pre-charged and pre-wired for easy installation. As a result, engineers no longer need to specify many of the components that accompany traditional split-system heating and cooling solutions: No chaseways, basepads, external utility connections, disconnects or refrigerant lines. Estimated savings per unit: $480.

The small footprint of these natural gas heaters makes them attractive for new build as well as retrofit projects. Further, the absence of multiple condensing units conserves open space on the grounds.

Beverly Passantino, senior business development representative, Spire Missouri West, worked closely on the project with REED.

"Even though natural gas proved to be cheaper and more energy efficient, those were not the most important or deciding factors," Passantino said.

The ultimate reason natural gas appliances are used in these projects, she said, is customer preference.

"After countless requests for natural gas from our customers, we now spec all of our multifamily projects with natural gas appliances," Schaefer said. "Natural gas is a warmer, more comfortable heat, and tankless units never run out of hot water."

FOR MORE INFORMATION

Nortiz: *www.noritz.com*
Lennox's Magic-Pak: *www.magic-pak.com*

Just chilling

Natural gas chillers have become the preferred choice of many commercial customers.

By Drew Robb

Natural gas appliances and furnaces have earned a reputation as a more reliable, lower cost and more environmentally-friendly alternative to electrical equipment. However, how natural gas can be used to bring these same benefits to cooling is not that well understood.

Natural gas absorption chillers have been available for many years. Recently, they have become the preferred option for many commercial, governmental and industrial customers.

Take the case of Rock Church of San Bernardino, California. The Rock Church and World Outreach Center campus consists of dozens of buildings. This includes administrative units, schools, nurseries, religious sanctuaries, cafes, bookstores and more. Its Southern California desert location made reliable, low-cost cooling an essential element.

"Due to the expense of electricity from the grid, Rock Church elected to use gas-fired absorption chillers, which run directly on natural gas to save on total utility costs," said Andrew Ho, sales engineer, Broad USA Inc.

The direct-fired absorption chiller from Broad USA burns natural gas and converts that to chilled water for air conditioning. Ho said the energy savings provide a payback period of 2.5 to 3.5 years.

Rock Church officials had decided to use natural gas chilling some time ago; it wasn't a matter of if, but when. Recently, however, church expansion and tighter emissions standards in the Golden State led Rock Church to add a new, high-efficiency chiller. The Southern California Air Quality Management Department mandated an emissions requirement of less than 20 parts per million (ppm). The new unit came with a Power Flame low NOx burner which provides cooling at only 9 ppm.

"The new unit from Broad is so efficient that we rarely even need to run the old chiller," said Walter Navarro, maintenance supervisor, Rock Church. "Our old chiller is mainly used for backup and during extremely hot days to add a little extra cooling."

He recommends natural gas-based cooling to other building maintenance professionals for many reasons: The equipment is easy to manage. And on rare occasions when service is needed, Broad is on-site within a few hours.

"We especially like the economics of natural gas," Navarro said. "As a domestic source of energy, it is far cheaper than electric cooling."

PHOTO COURTESY OF BROAD USA INC.

The Rock Church campus boiler room was fitted with direct-fired absorption chiller from Broad USA Inc. to burn natural gas and convert it to chilled water for air conditioning.

HVAC for historical landmark

Pike Road Schools in Alabama is another example of affordable natural gas-based cooling. This is achieved via a gas heat pump, which provides both heating and cooling, using Yanmar's Variable Refrigerant Flow (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 which distribute hot or cold air. A prime advantage of VRF is that each zone can have its own thermostat control. This enables different rooms to have varying temperatures or even operate heating and cooling simultaneously.

The school site consists of two 10-ton, three 12-ton and two 14-ton VRF units. They use a fuel-efficient, natural gas-powered engine to drive dual com-

Pike Road Middle School in Alabama opted for affordable natural-gas based cooling.

PHOTO COURTESY OF YANMAR USA

pressors. The engine's operating speed is varied according to the cooling or heating demands of the building, and the system. It can also maintain powerful heating performance, even with low outdoor temperatures, by capturing heat from the engine to increase efficiency.

This 100-year-old Pike Road School building never had HVAC equipment. Due to its significance to the community in Montgomery Country, Alabama, however, the local historical society saved it from being torn down and sold it back to the local school board for renovation.

"The school system needed an HVAC solution that would not change or alter its original design as the building is a registered historical landmark," said Chris Dockery, regional sales and service manager, energy systems division, Yanmar USA.

As the VRF system only heats and cools spaces as required, it rarely runs at full capacity and needs minimal power to operate. Other technologies, such has electrical VRF and traditional HVAC systems, typically run at 100 percent capacity all the time. This leads to overcooling or overheating in different areas. Through the utilization of a natural gas-powered variable speed engine and dual scroll compressors, the Yanmar VRF system can reduce electricity usage by up to 90 percent compared to traditional air conditioning systems, Dockery said.

Further, operating and infrastructure costs are lower. When combined with greater efficiency, the result is substantially reduced system lifecycle costs compared to electric systems. In fact, the infrastructure costs to upgrade the facility to run any type of electric HVAC equipment would have been cost prohibitive. By working with the local natural gas utility, Spire Energy Inc., lifecycle costs made the project attractive to the school.

"By lowering the school's overall peak power demand and power consumption, the natural gas heat pumps help Pike Road Middle School reduce the cost of the electric bill on an annual basis," said Joshua Vick, commercial business development representative, Spire Energy. "Combined with the stable, low cost of natural gas, the school experiences an overall reduction in energy cost while reducing its dependency on the power grid."

PHOTO COURTESY OF YANMAR USA

Yanmar's Variable Refrigerant Flow (VRF) technology 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 which distribute hot or cold air.

FOR MORE INFORMATION

Broad U.S.A. Inc.: *www.broadusa.net*
Yanmar USA: *www.yanmar-es.com*

Banking on blankets

Keeping the heat in saves university $1 million.

By Drew Robb

Studies indicate that commercial buildings can experience energy losses as high as 33 percent. As a result, conduction losses can be as great as 10.8°Farenheit (6°Celsius), according to the Lawrence Berkeley National Laboratory. While natural gas systems typically are cheaper and more energy efficient than their electrical equivalents, the fact remains that attention must be paid to correct system design and finding ways to minimize heat loss.

In particular, the heating, ventilation and air conditioning (HVAC) system is usually one of the biggest energy consumers within any facility. Heat loss from the HVAC system in winter can lead to unnecessarily high utility bills. What isn't realized, however, is that this can also cause excessive wear on equipment. As the HVAC system has to work harder to keep up with losses, parts wear out faster and more frequent maintenance is required.

Considerable savings, therefore, can be achieved via proven remedies such as insulation. George Mason University, for example, saved more than $1 million by applying thermal insultation to its heating and cooling system. The university's energy manager Patrick Buchanan calculated this number based on estimated annual energy savings from keeping the heat in versus letting it dissipate into the environment due to lack of insulation.

During the last few years, George Mason facilities have grown to 145 buildings. That has expanded its footprint from 3.5 million square feet to 9 million square feet today. Yet, over that same period, energy costs have risen by only 20 percent.

Reusable blankets

How was this achieved? Its campus in Fairfax, Virginia, installed more than 725 reusable blankets designed to retain heat. These were added to various equipment in the facility's central heating and cooling plant as well as in its boilers, hot water systems, tunnel vaults and mechanical rooms. All of its boilers, valves, fittings, pumps, expansion joints, piping and ducts were covered with custom-engineered thermal blankets supplied by Shannon Enterprises of Western New York Inc.

Johnson Center and Center for the Arts, George Mason University, Fairfax, Virgina, campus

"Reusable blankets were definitely part of keeping energy costs low during this period," Buchanan said. "With the blankets installed, we can safely work alongside the valves and fittings, and the ambient temperature has dropped from extreme to comfortable."

The Shannon reusable insulation system consists of blankets tailored to the shape of the equipment. A detailed survey is done to isolate areas of radiant heat loss to determine where to place blankets of what type and how they should be sized. Computer-aided design (CAD) software and drawings are used to carefully engineer the spaces and equipment with insulation to minimize heat losses.

"By reducing heat loss and energy, we got a payback in under 15 months with our reusable blankets," Buchanan said.

He received additional support for the insulation project via a demand response program. This ended up funding the bulk of the thermal blankets as well as their installation.

"This program compensated us for reducing electric load when asked by our utility," he said.

FOR MORE INFORMATION

Shannon Enterprises of Western New York Inc.: *www.blanket-insulation.com*

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Mission critical

CHP provides power, reliability and energy savings for health care facilities.

By Tonya McMurray

On a stormy spring night, there was a brief flickering of the electricity coming into the 289-bed Peninsula Regional Medical Center (PRMC) in Salisbury, Maryland. But for the staff and patients, it was business as usual — thanks to the facility's combined heat and power (CHP) system.

"Nobody even knew anything happened," said Tom Anderson, facilities director, PRMC. "We knew in the power plant because we track and monitor it. There have been a number of times when we've lost normal power, but nobody [else] has known anything happened because the CHP has continued to operate correctly."

In many businesses, a power loss is an inconvenience, but in health care facilities, it can literally be a matter of life and death.

Because medical facilities need reliable power generation with redundancies to ensure stable power even if the electricity goes out, they are an ideal candidate for CHP systems, which use natural gas to generate power on-site while capturing excess heat for use in other applications.

"CHP is ideal for medical facilities because it provides steady electric and thermal loads," said Jack Sins, Unison Energy LLC, which designed PRMC's CHP system. Hospitals use large amounts of hot water and need reliable heat, ideal uses for the heat recovered during CHP operation.

With CHP systems, the cost used to generate a kilowatt-hour on-site is much cheaper than the cost of energy delivered from the grid, said Kieran McGovern, major accounts executive, Philadelphia Gas Works, which helped install a CHP system for the Philadelphia location of Cancer Treatment Centers of America (CTCA Philadelphia).

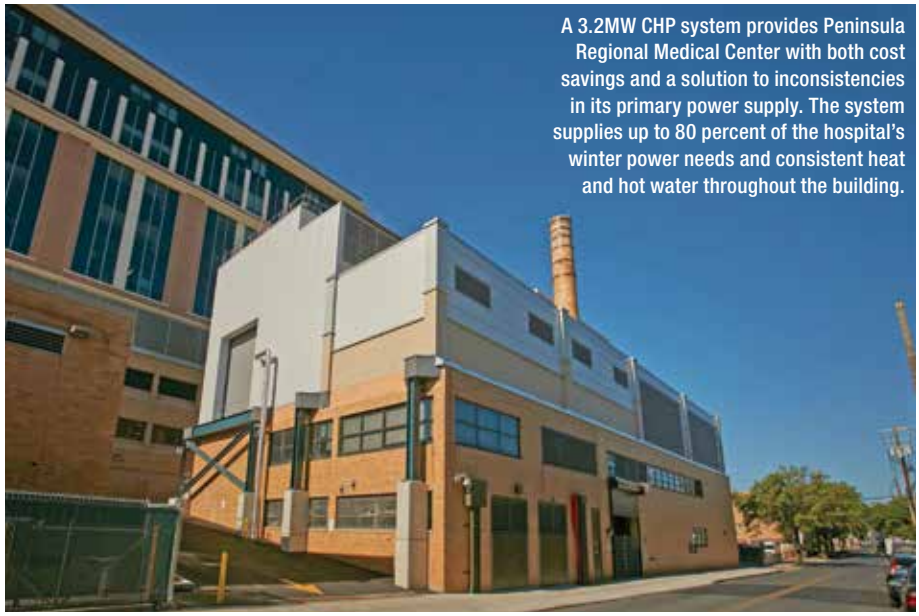


PHOTO COURTESY OF PENINSULA REGIONAL MEDICAL CENTER

A 3.2MW CHP system provides Peninsula Regional Medical Center with both cost savings and a solution to inconsistencies in its primary power supply. The system supplies up to 80 percent of the hospital's winter power needs and consistent heat and hot water throughout the building.

Perfect timing

Pennsylvania's Lancaster General Hospital (LGH) first began looking at CHP 10 years ago. With reductions in the cost of natural gas and a stable natural gas supply, hospital executives decided that a planned facility expansion was the perfect opportunity to add a CHP system

A 3.5 MW solar turbine installed in early 2017 generates up to 85 percent of the electricity used by the hospital, said John Hartman, senior director, facilities and construction management, LGH. The heat from the turbine is captured in a heat recovery steam boiler that supplies the facility's hot water needs and provides steam for cooking, humidification, food prep, HVAC, sterilization and laundry. A 1,000-ton chiller provides consistent 42-degree chilled water for cooling.

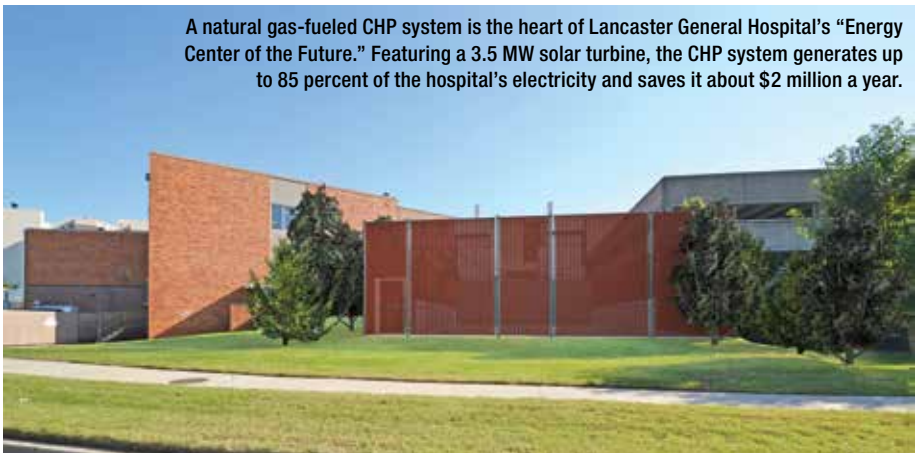
The CHP project saves LGH about $2 million a year while producing only about half of the greenhouse gas emissions. Plus, the system can power the hospital even in the event of a power outage so critical systems are always online, Hartman said.

Most effective solution

Like LGH, CTCA Philadelphia was looking to control energy costs while providing redundancy for its power supply. In 2016, CTCA Philadelphia installed a 1.1 MW Cummins natural gas-fired reciprocating system at its northeastern Philadelphia facility, one of five hospitals in the CTCA network of cancer treatment facilities throughout the United States.

The system provides about 75 per-

PHOTO COURTESY OF ROBERT J. POLETT



A natural gas-fueled CHP system is the heart of Lancaster General Hospital's "Energy Center of the Future." Featuring a 3.5 MW solar turbine, the CHP system generates up to 85 percent of the hospital's electricity and saves it about $2 million a year.

cent of the hospital's daily electricity and 80 percent to 90 percent of the building's heating needs, said Jeff Ryan, chief operating officer and senior vice president of finance, CTCA Philadelphia. While the system is not part of the hospital's emergency power plan, it can be used to take the load off the facility's diesel backup generators if needed.

"CHP was the most effective action that the hospital could take to control energy costs while improving resiliency," Ryan said.

CTCA expected to save about $500,000 a year, but the CHP system saved more than $800,000 in its first year of operation, McGovern said. The project has also significantly reduced energy and emissions.

Consistent power supply

For PRMC, CHP offered both cost savings and a solution to an increasing number of inconsistencies with its primary power supply. Delmarva Power and Light Co., the electricity supplier for PRMC, had difficulty regulating the alternating current that comes into the hospital in a three-phase system, resulting in instances where one of the three phases of electricity would have a decrease in voltage, producing small blips in the hospital's power supply, Anderson said.

"When equipment with electronic controls de-energizes and then starts back, it takes a while to get up and running," he said. "We do have an uninterrupted power supply that provides power to critical areas, but for other equipment, it can be disruptive to operations. And, it can cause motors to burn out."

With the installation of a 3.2MW CHP system in the summer of 2017, PRMC was able to address the phasing problem while also implementing a more cost-effective way of providing for the hospital's electrical load and thermal needs.

PRMC's existing natural gas provider, Chesapeake Utilities, worked with the hospital to help it prepare for the new CHP system and secure favorable gas rates.

"We assisted with a new service line and reinforcement of nearby infrastructure to support the incremental gas load," said Dave Detrick, commercial and industrial account manager, Chesapeake Utilities. "We also negotiated a reduced delivery rate within tariff guidelines to ensure the economics of the project were positive."

The system supplements and replaces 60 percent of the hospital's primary power in the summer and 80 percent of it in the winter, Anderson said. The heat created from the operation of the generator heats water to about 190 degrees for use throughout the facility for even more savings.

"The 'blips' no longer affect the hospital thanks to the CHP, and the hospital is saving a large amount of money," Sins said. "The wear and tear on the boilers is greatly reduced, as they are not working as hard due to the CHP providing much of the thermal load. And, the hospital has reduced its carbon footprint."

FOR MORE INFORMATION

Cummins Inc.: *www.cummins.com*
Solar Turbines Inc.: *www.solarturbines.com*

PHOTO COURTESY OF CANCER TREATMENT CENTERS OF AMERICA

A 1.1MW Cummins natural gas-fired reciprocating CHP system provides about 75 percent of the daily energy needs for Eastern Regional Medical Center, one of five hospitals in the Cancer Treatment Centers of America network. The CHP system also provides up to 90 percent of the center's heating needs.

Staying warm

Natural gas delivers reliable, comfortable and cost-effective heating solutions.

By Tonya McMurray

Giant Tiger Stores Ltd., a discount retail chain serving Canadians for more than 50 years, promises its customers "giant value and giant savings." To fulfill that promise, it must carefully manage operating expenses. And the retailer turns to natural gas heating options as one solution for lowering expenses, with about 80 percent of the chain's 220 stores using natural gas.

Targeting heating costs to operating expenses is generally a good strategy for commercial buildings. Heating costs are typically one of the biggest energy expenses for businesses, according to the U.S. Energy Information Administration. Natural gas heating options offer solutions that reduce both energy consumption and overall costs.

"Natural gas is the most affordable energy solution for space and water heating, and it costs significantly less than heating with electricity, oil or propane," said Octavian Ghiricociu, senior advisor national accounts, Ontario, Canada-based Union Gas Ltd. "And with massive supplies right here in North America, the price of natural gas will remain low for years to come. This will help businesses be more competitive as well as attract new businesses, creating and supporting direct and indirect local jobs."

With a background in energy consulting, Mark Pasini, Giant Tiger's senior manager, energy and facilities, knew that using natural gas for heating whenever possible could save the retailer money.

Enhancing efficiency

Since 2012, all new stores have installed natural gas-fueled package rooftop systems to provide both heating and cooling. The units include demand-control ventilation units, which bring in only enough fresh air to maintain proper indoor air quality. Because the units operate only when needed, instead of running around-the-clock, the system uses less energy while still monitoring and maintaining air quality.

PHOTO COURTESY OF GIANT TIGER STORES LTD.

Giant Tiger Stores Ltd., a Canadian discount retail chain, relies on natural gas heating solutions to deliver better indoor air quality and significant savings for most of its 220 stores located throughout Canada.

"Just visually looking at the units and the dampers, I can see the amount of fresh air we bring in is quite a bit less because of the demand-control ventilation," Pasini said. "So, I know it is saving us energy."

New buildings also use air curtains to prevent outside air from coming into doorways, reducing the demand on heating and air conditioning equipment and lowering energy costs even more.

"Our new stores, in general, use quite a bit less energy than our older stores," Pasini said. While there may be several factors contributing to that, he believes the technologies that help save natural gas heating are a significant factor.

Giant Tiger has also renovated the heating systems in some of its existing stores, including its Belleville, Ontario, location. The building's previous rooftop ventilation units ran 24/7, including throughout the night when no one was in the building. Replacing that system with one that included demand-control ventilation reduced natural gas use by about 30 percent, saving the company about $1,500 a year.

In addition to the savings from reduced energy use, Giant Tiger receives incentives for most projects, making the business case for the natural gas units even stronger, Pasini he said.

"The energy savings are the main benefit for us," Pasini said. "There are also some comfort improvements as well, especially in winter if you're not bringing in as much cold air."

Increasing comfort

Comfort was a key factor for Cap Sante Court, a 41-unit independent living facility in Anacortes, Washington, when the property's new management team decided to upgrade its heating and hot-water equipment to new, high-efficiency natural gas appliances.

After purchasing the property from a previous owner, the new team found that the 1980s boiler required significant maintenance and was neither energy efficient nor reliable. Even worse, the heating system produced significant variability in room temperature throughout the facility, which impacted the comfort of residents.

"Everything was working, but it was very dated," said Bradey Day, program manager at Lockheed Martin Co., which worked on the Cap Sante project on behalf of Cascade Natural Gas Corp. "They were trying to upgrade and get more efficient, but there was also a comfort concern for their residents. They wanted more consistent heating and a more comfortable feeling for residents."

Cap Sante Court updated the property with two energy-efficient 399,000 British thermal unit IBC boilers and three 199,000 Btu Navien tankless water heaters. A $4,272 cash incentive from Cascade Natural Gas increased Cap Sante Court's cost savings and reduced the payback time for the system, Day said.

With completion of the project in late 2017, Cap Sante Court estimates the boilers and water heaters will save 1830 therms of energy per year. Cap Sante Court has already seen a 19 percent reduction in quarterly costs, Day said. The equipment requires minimal maintenance and, residents can rely on consistent heat and hot water in every room of the facility.

PHOTO COURTESY OF LOCKHEED MARTIN/CASCADE NATURAL GAS CORP.

Cap Sante replaced its aging boiler and water heaters with new, energy-efficient natural gas appliances to help create a more comfortable atmosphere for its residents while also saving money and reducing energy use.

"The upgrade improved their bottom line with a more reliable system," Day said. "They have seen a decrease on their gas bills, and they've been happy with more consistent and more comfortable temperatures for their residents."

It is that combination of energy and cost savings, combined with better comfort, that makes natural gas heating a winning solution for a variety of businesses.

"Natural gas is the most affordable energy solution for space and water heating, and it costs significantly less than heating with electricity, oil or propane. And with massive supplies right here in North America, the price of natural gas will remain low for years to come. This will help businesses be more competitive as well as attract new businesses, creating and supporting direct and indirect local jobs."
— **Octavian Ghiricociu,** senior advisor national accounts, Ontario-Canada-based Union Gas Ltd.

FOR MORE INFORMATION

Navien Inc.: *www.navieninc.com*
IBC Technologies: *www.ibcboiler.com*

Cleaner power grid

Is policy-driven beneficial electrification the answer?

By Tonya McMurray

The goal of a greener energy supply unites environmentalists, policy makers and energy providers. But the path to that goal can be a challenging one.

One idea promoted by some environmental groups, state regulators and other energy stakeholders goes by many names: beneficial electrification, environmentally beneficial electrification, efficient electrification or deep decarbonization. But whatever the name, the concept is the same: Dramatically reduce energy consumption, eliminate fossil fuel from the power grid by using only renewable energy sources to generate electricity and then convert all energy applications to electricity.

That idea is ambitious and potentially quite costly, said Rick Murphy, the American Gas Association's (AGA) managing director for sustainable growth. The plans also ignore more cost-effective ways of achieving significant emission reductions.

The AGA conducted a study that examines the cost implications of policy-driven residential electrification. The study concludes that electrification of residential space and water heating would require a dramatic increase in electric grid capacity and be burdensome to customers.

Meeting demand

To estimate the electricity required to heat homes and businesses, utilities must plan for those times when energy needs are greatest.

"There are significant fluctuations on a daily basis as to the amount of energy required to heat a home," Murphy said. "You have to be able to deliver the energy

that's required on the coldest day even though you have all the other days where you don't have that same demand."

If government policy forced the electrification of the residential market, it could require the size of the entire U.S power generation sector to more than double, Murphy said. Consumers would likely end up bearing the cost of expanding the electric infrastructure to serve the incremental demand from electrification policies as well as significant cost to convert all energy appliances to electricity while losing choice in the marketplace.

"There is an inherent desire and preference for natural gas, and that gets taken away from consumers if they're mandated to switch to electric appliances," said Eric Burgis, director of commercial and residential markets, Energy Solutions Center.

And the cost would not necessarily mean a better energy system because renewable energy sources are not flexible enough to be able to respond to fluctuating power needs.

"If it gets hot and a lot of cooling is needed, the fossil plants respond, and when we don't need power at 2 a.m., the fossil plants shut down," Burgis said. "Wind power works only when the wind is blowing, and solar power works only when the sun is shining. So, there is a question of how the electric producers plan to meet the marginal mix on a daily basis."

He said the drawbacks to an all renewable approach are highlighted by California's current energy mix.

"California has so much solar power that they export electricity every day, and then their peak demand hits at 9 p.m. when there is no more solar power," Burgis said. "They struggle with meeting electric power demand every night as a result. So too much of a good thing is actually not that good when it comes to power production and supply."

Cleaner electricity

The electric grid is already becoming less carbon intensive. The U.S. Energy Information Administration reports that 17 percent of 2017 electricity generation came from renewable resources, and projects that share will grow to 27 percent by 2035. In addition, natural gas has become a bigger source for electricity generation.

"The shift from coal power to gas and renewables is already occurring," Burgis said. "Coal is very dirty and only around 32 percent efficient when generating power. New natural gas combined cycle plants can exceed 50 percent efficiency."

Gary Heikkinen, a professional engineer with NW Natural, said there are many ways to achieve significant emission reductions with a mix of renewables and more environmentally friendly fossil fuels such as natural gas.

"The biggest misconception of those promoting beneficial electrification is that it is the only path to reach deep decarbonization goals," he said.

The natural gas industry has historically looked to increase energy efficiency. Murphy said natural gas utility companies invest nearly $2 billion a year in energy efficiency programs. The success of such programs has resulted in stable residential demand for natural gas over the last 50 years while the number of customers has grown more than 70 percent.

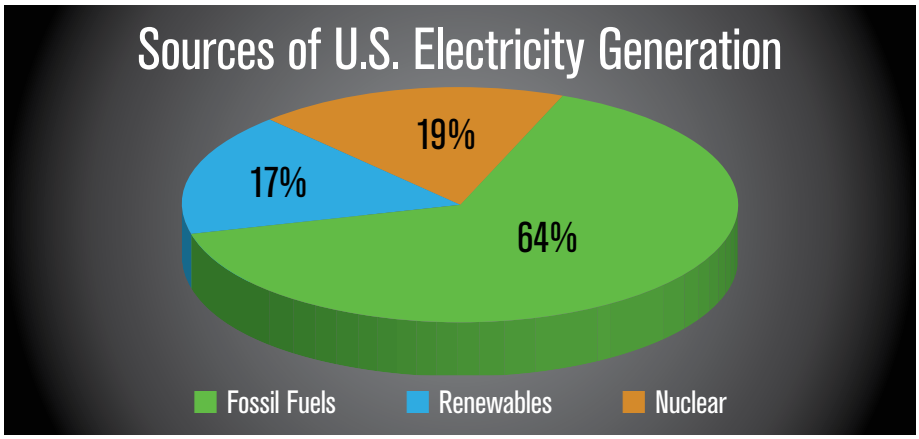
Making natural gas more efficient

Heikkinen notes that the natural gas industry has many initiatives aimed at further reducing emissions, including new production technologies and more efficient appliances.

"Renewable natural gas captured from waste water treatment plants and dairy farms, for example, has the potential for significant reductions in emissions," he said. "Power to gas technologies can use excess renewable energy to create hydrogen, which can then be injected into the natural gas pipeline for further reductions. Carbon capture technologies are being developed that will actually remove CO_2 from the air and store or sequester it permanently, or use it to make synthetic fuels."

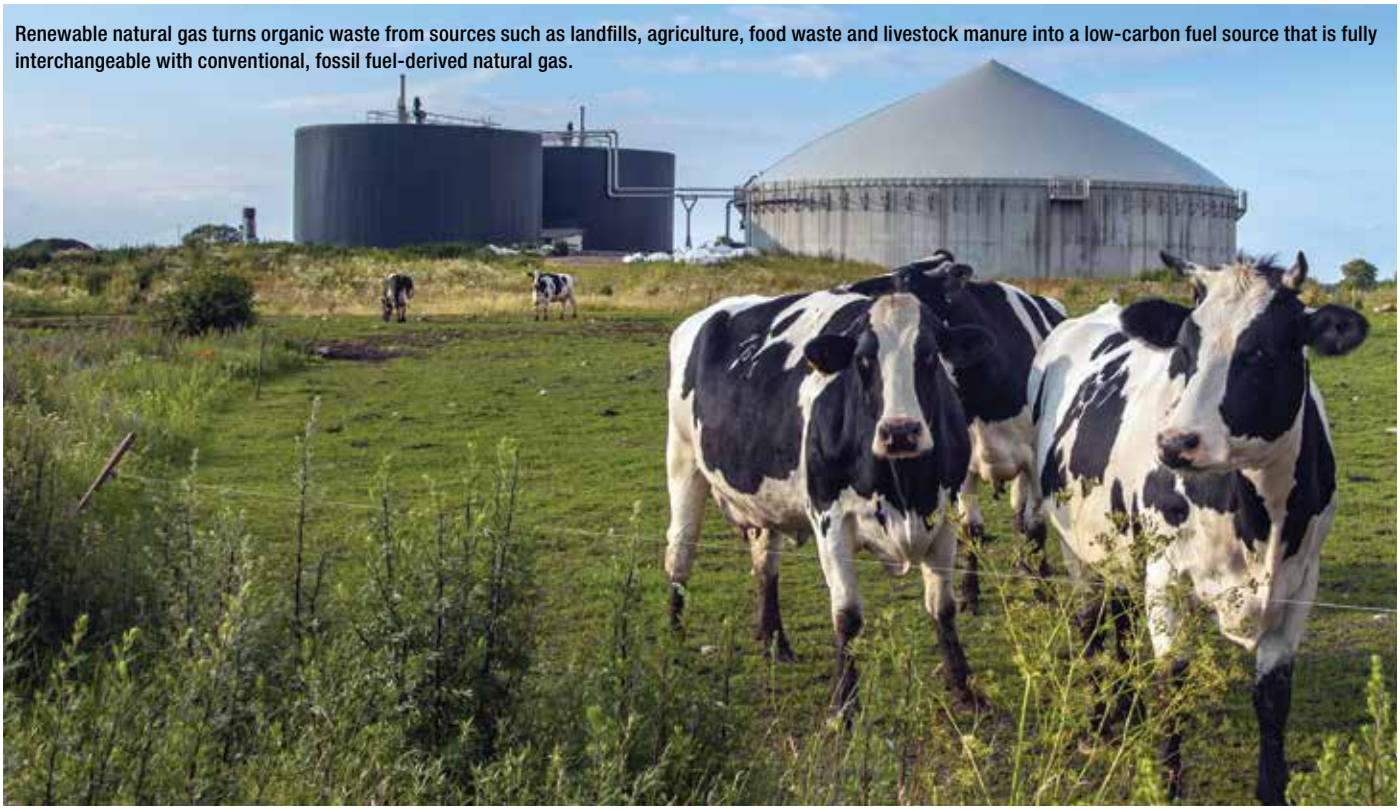
In addition, several residential space and water heating systems being developed would dramatically increase end-use efficiency. For example, emerging natural gas heat pump technology has the potential to achieve energy efficiency ratings of close to 140 percent, about a 40 percent improvement over the most efficient gas-heating system on the market today, Murphy said.

"A more integrated and comprehensive solution using some of these technologies and strategies will have a much better chance of success in comparison to a single strategy of beneficial electrification," Heikkinen said.



SOURCE: EMISSIONS & GENERATION RESOURCES INTEGRATED DATABASE (EGRID)

Caption: Because most of the electric grid still relies on fossil fuels (including more environmentally friendly fossil fuels such as natural gas), a move toward an electric grid generated solely by renewable sources would require significant infrastructure costs, which would likely be passed along to consumers and businesses purchasing electricity.


Renewable natural gas turns organic waste from sources such as landfills, agriculture, food waste and livestock manure into a low-carbon fuel source that is fully interchangeable with conventional, fossil fuel-derived natural gas.

Green energy

New technologies make natural gas a renewable resource.

By Tonya McMurray

Most people associate renewable energy with wind and solar power, but advances in technology are making renewable natural gas an alternative.

"We understand and appreciate the need for reducing greenhouse gas emissions and mitigating the impacts of climate change," said Rick Murphy, managing director, sustainable growth, American Gas Association (AGA). "Natural gas can play a key role in emissions reduction by complementing the existing supply of natural gas with renewable natural gas from several sources."

Renewable natural gas

Renewable natural gas (RNG) turns organic waste from sources such as landfills, agriculture, food waste and livestock manure projects into a low-carbon fuel source that is fully interchangeable with conventional, fossil fuel-derived natural gas.

The United States produces more than 70 million tons of organic waste each year, according to the Environmental and Energy Study Institute, an independent bipartisan organization for the promotion of environmentally sustainable societies.

When that organic wastes break down, it produces a mixture of carbon dioxide, methane and other trace elements, all of which can contribute to greenhouse gas emissions and contaminate surface and ground water.

But new technology allows the gases produced from the breakdown of organic waste to be captured and processed into renewable natural gas, essentially pure methane that is interchangeable with conventional fossil-fuel derived natural gas. RNG is recognized as a low-carbon fuel under the federal Renewable Fuel Standard.

At landfills and wastewater treatment plants, raw methane is collected

and purified. Other types of waste (such as food, yard, construction, agricultural and forest waste) are broken down by bacteria in an oxygen-free environment, a process called anaerobic digestion. Once processed, the RNG can be injected into natural gas pipelines, used for transportation fuel, or delivered to businesses and consumers.

The National Association of Clean Water Agencies estimates that energy generated at wastewater treatment plants alone has the potential to meet 12 percent of the nation's power demand.

Power-to-Gas

Another new technology uses excess electric power to generate natural gas. Power-to-Gas (P2G) technologies convert electricity generated during periods of low demand into hydrogen and oxygen gases from water.

The oxygen can be released into the atmosphere or sold for industrial use while the hydrogen can be stored. The stored hydrogen can be blended with natural gas or combined with carbon dioxide to create synthetic methane, which can be used as a replacement for fossil-fuel generated natural gas.

The U.S. Energy Information Administration reports P2G technology is still in its infancy with great interest throughout Europe. In the U.S., P2G technology is being evaluated for commercial application by Southern California Gas Co. in partnership with the U.S. Department of Energy's National Renewable Energy Laboratory and the National Fuel Cell Research Center at the University of California, Irvine.

Source	Amount Available
Food Waste	66.5 Million Tons/Year
Waste Water	17,000 Facilities
Agricultural Waste	8,000 Large Farms and Dairies
Landfill Gas	1,750 Landfills

Many sources currently exist to produce renewable natural gas, which can be injected into the pipeline, used for transportation fuel, or delivered to businesses and consumers.

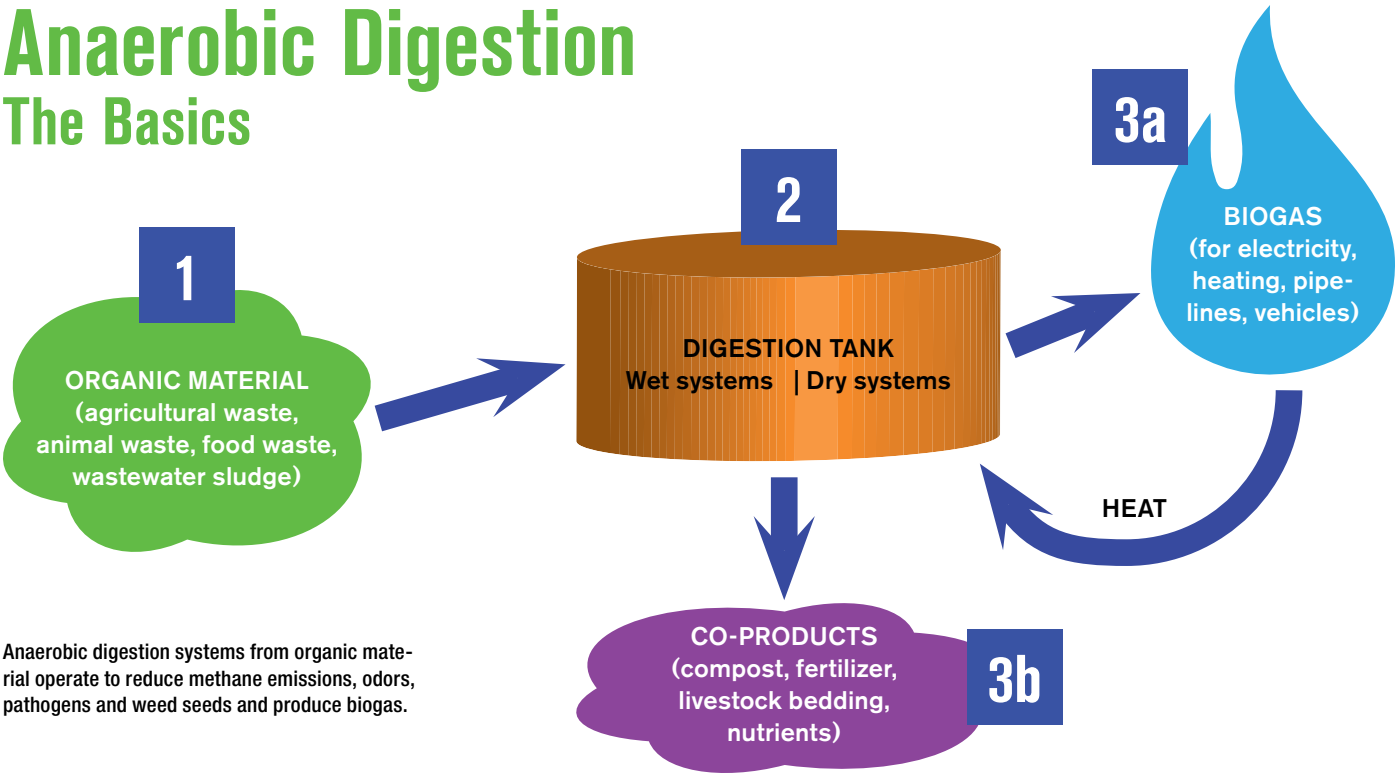
SOURCE: RENEWABLE NATURAL GAS COALITION

Carbon Capture and Storage

A third technology, Carbon Capture and Storage (CCS) can catch up to 90 percent of the carbon dioxide created by using fossil fuels in electricity generation and industrial processes. Once captured, the carbon is stored deep underground in depleted oil and gas fields or saline aquifer formations.

CCS allows for the continued use of fossil fuels such as natural gas in the generation of electricity while still substantially reducing greenhouse gas emissions, according to the Carbon Capture and Storage Association.

Anaerobic Digestion
The Basics



Anaerobic digestion systems from organic material operate to reduce methane emissions, odors, pathogens and weed seeds and produce biogas.

SOURCE: AMERICAN BIOGAS COUNCIL

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☐ *Condensate Neutralizer (Accessory)*	☐ *Automatic Shut-Off Valve*
☐ *Remote Diagnostic Alerts*	☐ *Built-In Smart Monitoring Technology*
☐ *BMS Connectivity (Accessory)*	☐ *ASME-Grade Steel Heat Exchanger*
	☐ *Integrated BMS Connectivity/ BACnet MS/TP*
	☐ *Built-In Condensate Neutralizer*
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