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Hotel, hospital, residential markets — and even greenhouses — reaping CHP benefits

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Making it work

CHP meets power needs of manufacturers such as 3M.

BY TONYA MCMURRAY

Manufacturing processes require significant electricity and heat, making them ideal for combined heat and power (CHP) installations. In fact, the Environmental Protection Agency Agency (EPA) reports that 88 percent of existing CHP installations power a variety of industrial and manufacturing applications.

CHP provides on-site electricity generation that captures the heat that would otherwise be wasted to provide useful thermal energy that can be used for space heating, cooling, hot water and industrial processes.

"Many manufacturing plants have a high demand for both heat and power, so installing a CHP system that produces both efficiently from a single source can result in significant savings for production and facility costs," said Paul Glenister, president and CEO of 2G Energy Inc. "Another key benefit is system security. The need for uninterrupted power is a key factor to many critical manufacturing operations as CHP makes it possible to operate when the grid is down, allowing operations of key business processes to continue."

PHOTO COURTESY OF 2G ENERGY INC.

Manufacturer 3M has seen significant benefits since installing a CHP system in its Brockville, Ontario, plant last year.

For manufacturers, CHP offers lower overall utility costs while also reducing greenhouse gases and carbon dioxide emissions, said John Reid, 3M Co. engineering specialist.

'GOOD GREEN INITIATIVE'

3M, best known to consumers as the manufacturer of products such as Post-it® notes, Scotch® tape, Nexcare™ bandages, and Scotch-Brite® kitchen products, produces nearly 50,000 products including abrasives, adhesives, coatings and sealers, plastic films, roofing granules, traffic control products, computer-related office products, medical and dental products, electrical connectors and commercial chemicals.

In early 2016, 3M implemented CHP in two of its Ontario, Canada, facilities: a 2-megawatt system at its Brockville, Ontario, site, which makes masking tape, and a 1.2 MW unit in its Scotch-Brite plant in Perth, Ontario. The systems provide the necessary power and heat for the manufacturing processes while the waste heat is used for space heating throughout the plants, Reid said.

In addition to the projected cost savings from the system itself, 3M was able to take advantage of a rebate to offset a portion of the initial capital costs of the CHP systems.

"With the help of rebates, and considering current and projected future utility prices, CHP was both a valid economic investment and a good green initiative," Reid said.

3M partnered with consultants from CEM Engineering, based in St. Catharines, Ontario, to help with the design specifics and program execution. The company evaluated different CHP and heat recovery options, eventually settling on a reciprocating engine system from 2G Energy.

Reciprocating internal combustion engines are a mature technology well-suited for CHP systems, according to the U.S. Office of Energy Efficiency and Renewable Energy. Reciprocating engine CHP systems burn fuel to turn generators to produce electricity. Heat recovery devices capture the heat that is produced from the engine and exhaust and turn it into useable thermal energy, usually in the form of steam or hot water.

The EPA notes that current generation natural gas engines offer low initial costs, fast startup, proven reliability and significant heat recovery potential. 3M has seen those results in only a short time.

"The program is on track with overall gas use efficiencies of 60 to 65 percent," Reid said. "Our projected net annual cost savings are in the range of $600,000 to $900,000 for each CHP system." **CHP**

For more information about combined heat and power (CHP), go to:

Combined heat and power (CHP):
www.understandingchp.com

2G Energy Inc.:
www.2g-energy.com

A new twist

Innovative CHP applications go beyond heat and hot water.

BY TONYA MCMURRAY

In the late 1980s, Edgar D. Prince proposed a new idea for keeping his hometown's streets and sidewalks clear during snowy Michigan winters: a downtown snow removal system using underground tubes to pipe hot water through the downtown area. He had seen such a system in Europe and returned to Holland, Michigan, hoping to convince town officials of its benefits.

PHOTO COURTESY OF SIEMENS

The 114 MW Siemens CHP system powers the City of Holland's snow melt system, which keeps downtown sidewalks and streets snow-free during snowy Michigan winters.

At the time, the City of Holland was already using boilers for smaller snowmelt systems for building entrances, but officials were so intrigued that in 1988 the city began implementing Prince's idea, drawing water from nearby Lake Macatawa and heating it with standard boilers.

In 2016, a state-of-the-art combined cycle natural gas power plant designed to increase the efficiency and cost-effectiveness of the snowmelt system went online. Using a 114-megawatt Siemens combined heat and power (CHP) turbine unit, the new technique allows the city to circulate potable water through the snow melt system, reducing sediment and excess wear on valves that was created by the lake water.

"We have not seen many applications of CHP for snow melt systems here in the U.S.," said Dalia El Tawy, director of thermal power solutions, Siemens USA. "However, it has been done in other countries, particularly in Europe. Prime movers used for power generation, particularly gas turbines, generate a lot of heat as part of the process. That heat is ideal for a snow melt system."

CLEARING THE SIDEWALKS

With the CHP system, the Holland Energy Park plant heats downtown sidewalks and streets by circulating warm water through 190 miles of plastic tubing underneath city streets, walkways and parking lots, said Amy Sasamoto, interim Downtown Development Authority coordinator for the City of Holland. The system pumps more than 4,700 gallons of water per minute at 95 degrees Fahrenheit, melting snow at a rate of 1 inch per hour in temperatures of 20 degrees Fahrenheit with up to 10 mile-per-hour winds.

Sasamoto said there are several benefits to the CHP snow melting system. The city doesn't have to invest in or maintain snow removal equipment. The system eliminates the need for salt, sand and deicer, which extends pavement and brick paver life and results in less wear inside retail stores. There are no snow banks and there is a reduced risk of slips and falls on icy streets or sidewalks.

CREATIVE APPROACHES

"Customers are looking for many ways to utilize the waste heat derived from power generation," said Todd

PHOTO COURTESY OF SIEMENS

The Holland Energy Park circulates warm water through 190 miles of plastic tubing underneath city streets, walkways and parking lots.

Marentette, manager of commercial and industrial sales, Union Gas Ltd., which worked with Green Metals Canada Inc. on a CHP system that began operation two years ago.

"The challenge can be for customers, engineers and utilities alike to look for innovative ways to use the recovered heat — such as de-icing applications, snow melt or hot water for washing, cleaning or heating," he said.

Green Metals Canada, a scrap metal and plastic recycling company, found an innovative way to use the system's excess heat to keep the company's truck scale functional throughout the winter.

"The scale often freezes up on extremely cold weather days," said Tim Cornell, general manager, Green Metals Canada. "We used to call in an outside company to power wash away the ice buildup with hot water at considerable cost. Now, we are able to utilize hot water generated from the CHP unit and de-ice our scale at zero costs whenever we need to. This has saved us significant costs and time."

The company chose a CHP system for many of its traditional benefits — reducing its carbon footprint and operating costs by switching from the electric power grid to natural gas as an electricity source.

Green Metals Canada partnered with its sister company, Toyota Tsusho Canada Inc., to install a 35-kilowatt Yanmar CHP unit with an internal combustion engine to provide the base electrical load for its facility, heat for office space, and hot water for the facility and the truck scale.

Using a CHP system for de-icing has significant benefits, Marentette said. Not only does de-icing and snow melt applications often improve productivity by making streets, walkways and other surfaces more usable, but they also increase safety by reducing the risk of slips and falls. And CHP provides those benefits in a more cost-effective way.

"If a customer previously utilized a hot water boiler to produce heat for de-icing, there is a significant reduction in the input energy cost required to make the hot water," Marentette said. "The net cost savings comes from both the production of electricity at three to five times less than it can be purchased and the incremental natural gas the engine requires to produce the electricity."

(continued on page 13)

PHOTO COURTESY OF TOYOTA TSUSHO CANADA INC.

Green Metals Canada Inc.'s CHP system provides hot water necessary to keep its outside truck scale free of ice and in usable condition throughout the winter.

Checking in

CHP gaining popularity in hotels as benefits present sound economic case.

BY DREW ROBB

The use of combined heat and power (CHP) is growing steadily throughout North America. In fact, an eighth of the annual power generation in the United States comes from CHP. Its benefits include independence from the grid and resilience from it during disturbances, lower utility bills, and a means of lowering harmful emissions.

Those are just a few of the reasons why many hotels are eager to deploy the technology. The Westin Hotel in Jersey City, New Jersey, and the Lotte New York Palace Hotel in New York City are recent examples.

WESTIN JERSEY CITY

The Westin Hotel is situated in Jersey City's waterfront financial district. This highly rated hotel is just 200 steps and one subway stop away from New York City. Featuring spacious guest rooms and inspiring views of Manhattan, a major renovation project has recently transformed the Westin's 429 rooms. A key aspect of the upgrade was the addition of a brand-new power, heating and cooling infrastructure via CHP.

Bruce Kortvely, director of engineering, Westin, said rising utility prices prompted a change of approach. Electricity was costing the facility $625,000 per year. Its net operating costs were rising steadily at the same time natural gas prices were dramatically falling. As a result, the hotel chain saw natural gas as a way to slash utility costs and greatly improve the level of comfort to its guests.

Engineering staff reviewed various options and chose a reciprocating natural gas engine as the most viable power source. The team opted for three Tecogen InVerde-100 units, totaling 300 kilowatts. In addition, the Westin added two 50-ton Yazaki chillers. All of this equipment was placed on the roof.

From design to final commissioning, installation took 15 months. Yet, it was done without interruption of guest services. Once completed, the project reduced operating expenses by more than $150,000 per year.

"These savings come from greatly reduced energy costs as well as transforming waste heat into hot water," said Jeffrey Glick, vice president of sales, Tecogen Inc. "With an efficiency level of close to 90 percent, the system can even harness waste heat in summer when heating is not required. In that case, CHP helps power the chillers, which enables the facility to reduce its hefty air conditioning bill."

Glick noted further benefits such as resiliency and environmental stewardship. On the resilience side, the presence of the rooftop CHP system means the hotel has a backup strategy during any interruption in utility power. In the event of a power outage, 300 kW of backup power is immediately available. While this isn't enough for all hotel systems, it is sufficient to power selected loads to ensure guest comfort and continuing hotel operations.

"In the event of an outage, the Tecogen CHP systems provide emergency power for key building systems such as the boilers, AC, hot water, lighting and one elevator," Glick said.

Environmentally, Glick said greenhouse gases (GHGs) have been reduced by 32 percent and carbon emissions by about 50 percent by switching to CHP. This is in keeping with the Westin chain's goal of reducing overall energy consumption and GHGs by 30 percent. This is the equivalent of removing 343 cars from the road or planting 42,000 trees.

(continued on page 15)

PHOTO COURTESY OF WESTIN HOTEL

The Westin Hotel in Jersey City's waterfront financial district opted for three Tecogen InVerde-100 units, totaling 300 kilowatts. The CHP system helps power new chillers, which enable the facility to reduce its hefty air conditioning bill.

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Welcome home

Micro CHP becomes a reality for residential and multifamily properties.

BY DREW ROBB

Just about everything is getting smaller these days. Supercomputers that used to fill entire rooms can now fit inside a briefcase. A multitude of gadgets ranging from cameras to cell phones, calculators to flashlights and alarm clocks to satellite navigation systems can now be found inside one tiny iPhone. And now a natural gas-driven unit about the size of a small refrigerator can provide the electricity to power an entire home or multifamily residence.

Known as a micro CHP (mCHP), it comes from industrial technology known as combined heat and power (CHP). The basic concept is to have an engine or generator produce power and capture the heat from its exhaust as a second form of energy from a single input energy. This novel approach greatly increases efficiency, slashes fuel consumption and lowers greenhouse gas emissions (GHG).

In years past, the technology was only available to relatively large industrial complexes, commercial properties and institutional campuses. But innovation has made it possible to scale CHP down so that it's available to single family homes and multifamily projects. Not only does natural gas supply heating, cooling, cooking and drying, it can also provide the electric power for the home.

"mCHP is an economically viable, energy-efficient solution used in Europe and Japan that is starting to be available to residential properties in North America," said Greg Caldwell, senior manager, research and innovation, ATCO Gas of Edmonton, Canada. "mCHP is ready to play a significant role in the reduction of GHG emissions."

PHOTO COURTESY OF ATCO GAS

This house in Edmonton, Canada, twinned solar photo-voltaic roof panels with microCHP (combined heat and power) to increase efficiency, slash fuel consumption and lower greenhouse gas emissions by 55 percent.

SOLAR AND MCHP COMBO

mCHP systems convert natural gas into heat and electricity. They use natural gas engines to produce power in tandem with an engine heat recovery system for functions ranging from space heating, water heating, dehumidification, snow melting, pool heating and cooling. The technology is even being twinned with solar photo-voltaic (PV) roof panels to provide comprehensive systems with top notch environmental credentials.

"In Alberta, Canada, a retrofit of mCHP into a residential house can reduce emissions by 35 percent, and integration with solar can boost that as high as 55 percent," Caldwell said. "Even when our local grid becomes cleaner due to the phase out of coal-based generation, mCHP will still reduce home-based emissions by up to 20 percent, versus purchasing power from the grid."

Caldwell knows a thing or two about the one-two punch of solar and mCHP. He volunteered to make his own home a showcase for this approach. Solar provides power during sunny days. Natural gas is used to make electricity when the

PHOTO COURTESY OF ATCO GAS

The home in Edmonton, Canada, is powered by an Aisin 1.5 kilowatt natural gas engine. The waste heat is used to heat water as well as for space heating.

> ***"With mCHP technology, electricity gets produced at the point of consumption and waste heat is captured and utilized to heat the home or hot water supply."***
>
> ***— Greg Caldwell***

sun isn't shining. To slash the carbon footprint of his home, he recently replaced his electric range with a natural gas unit. The next stage was for ATCO to install an mCHP unit.

"With mCHP technology, electricity gets produced at the point of consumption and waste heat is captured and utilized to heat the home or hot water supply," Caldwell said. "With the addition of mCHP in my house, I achieved GHG reductions upward of 55 percent within the first three months."

He added that this mainly came from the home's electricity generation, which is now primarily produced by the mCHP unit and not from the electric grid. Further, mCHP can also create redundancy for a home's hot water system.

Caldwell's home is powered by an Aisin 1.5 kilowatt natural gas engine. The waste heat is used to heat water as well as for space heating. This is achieved by tying the unit to an additional hot water tank connected to the existing tank. It supplies hot water for the entire home. When room temperatures drop, a coil installed in the furnace makes it possible to heat up the return air and provide an abundance of space heating.

A 1.5 kW solar PV array installed on the roof is the source of most of the home's electricity in the summertime. During warmer months, the run time requirements of the mCHP unit are far less due to a lower demand for heat.

"The mCHP system allows for savings on the utility bills, particularly electricity," said Imad Khaled, senior engineer, research and innovation, ATCO. "For environmentally conscious homeowners, the addition of the mCHP unit means that the property needs a much smaller solar array size. This makes a big difference in terms of capital investment for solar power."

Yoshi Sekihisa, life and energy department manager, Aisin World Corp. of America, advises homeowners to conduct an economic study to see how either mCHP or an mCHP/solar combo will work out financially. By reviewing the upfront costs, lifetime costs, savings on electricity, and any incentives for emissions reduction, it is possible to determine the return on investment for such a project. In many cases, the payback period is rapid.

"If someone is planning to build all-electric homes with a solar PV system, solar PV plus mCHP will prove to be less expensive in most cases," Sekihisa said. "At the same time, PV and mCHP offer a great deal more flexibility in the design process."

MICHIGAN MCHP HOME

mCHP is also gaining traction in the United States. A home in Traverse City, Northern Michigan, has installed an M-TriGen PowerAire unit for power, heat and cooling. DTE Energy Co. fitted the 3,500-square-foot home with mCHP earlier this year. It successfully coped with freezing conditions to keep the home warm without the need for a backup furnace. And when the summer highs hit, the home stayed cool.

"Although micro CHP involves higher upfront costs, it works out cheaper compared to purchasing a home generator, an air conditioner unit and a high efficiency furnace," said Geri Nelson, residential natural gas account manager, DTE Energy. "By using natural gas, it takes advantage of one of the safest, cleanest, reliable and most affordable energy sources." **CHP**

For more information about combined heat and power (CHP), go to:

Combined heat and power (CHP): *www.understandingchp.com*

Aisin World Corp of America: *www.aisinworld.com*

M-Trigen Inc.: *www.mtrigen.com*

Face-lift

Eastern Michigan University turns to CHP savings for a third time.

BY DREW ROBB

A good index of technology viability is returning customers. That is very much the case with many combined heat and power (CHP) clients that were early pioneers of CHP and are keen to come back for more.

Take the case of Eastern Michigan University (EMU). Its campus in Ypsilanti, Michigan, serves more than 20,000 students. Heating needs for the campus are met by a central boiler house to supply steam. Absorption chillers are used for summer air conditioning to balance summer and winter steam loads.

In the early 1990s, the university supplemented this with a natural gas-fired CHP system based on a 3.5 megawatt gas turbine from Solar Turbines Inc. Exhaust heat from the gas turbine was directed to a supplementary-fired waste heat recovery boiler, operating in parallel with several existing fired boiler units. In 1998, this turbine was replaced by a larger Solar Taurus 60 model that increased production to about 4.5 MW.

With nearly 20 years of operating experience under its belt, the results have been impressive. According to energy management engineering firm Cogen Designs Inc., the availability of EMU's CHP system averaged well in excess of 98 percent across a seven-year period.

THIRD TIME'S A CHARM

Now, EMU is in the process of replacing its existing turbine with a larger 8 MW model from Solar Turbines.

"The benefits of this CHP upgrade will include greater power reliability, sustainability, the fulfillment of the university's environmental goals, and considerable life cycle savings," said Eric Bruski, principal account manager for gas major accounts, DTE Energy Inc. "The new system, which will be up and running by early 2018, will provide electricity as well as district steam production for space heating, water heating and cooling."

CHP ECONOMICS

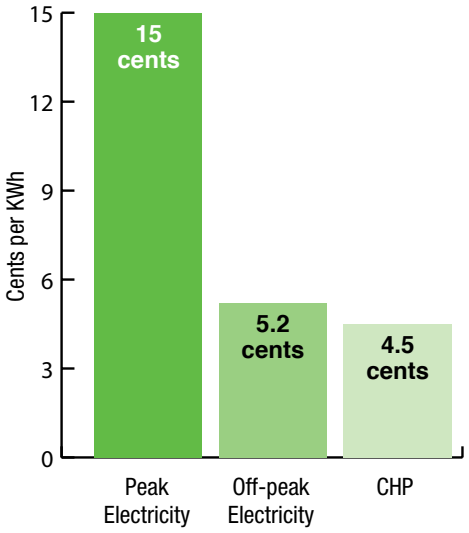
Economically, the costs of running and maintaining CHP compare favorably with local electricity rates. A study by Cogen Designs converted all costs to a cents per kilowatt-hour (kWh) (See figure.) On-peak power from the utility worked out at 15 cents/kWh, while off-peak came in at 5.2 cents/kWh. The total cost of providing both power and steam via CHP totals about 11cents/kWh.

However, the engineering consulting firm noted the value of campus steam production from the turbine's waste heat to be nearly 7 cents/kWh. The result: The net cost for CHP is 4.5cents/kWh. This is more than three times less than peak utility power and more than 10 percent below the off-peak costs.

The study noted, though that the existing gas turbine at EMU placed limitations on power output and availability. It recommended an upgrade to a larger model as well as the addition of a new generator. By doing so, the university could boost annual operating savings from an already impressive $804,092 to $1,011,666. That represents a jump in annual savings from 12.3 percent of overall cost to 15.6 percent. In terms of return on investment, the study said a CHP upgrade would have a payback period of 7.6 years.

"The economic case for CHP has been proven time and time again," said Eric Burgis, director, commercial and residential markets, Energy Solutions Center. "And in states where electrical rates are high or local incentives are readily available, the payback period can be very short." **CHP**

CHP versus Grid Electricity



SOURCE: COGEN DESIGNS INC.

For more information about combined heat and power (CHP), go to:

Combined heat and power (CHP): *www.understandingchp.com*

Solar Turbines Inc.: *mysolar.cat.com*

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Growing power

CHP system fuels high-tech greenhouse.

BY TONYA MCMURRAY

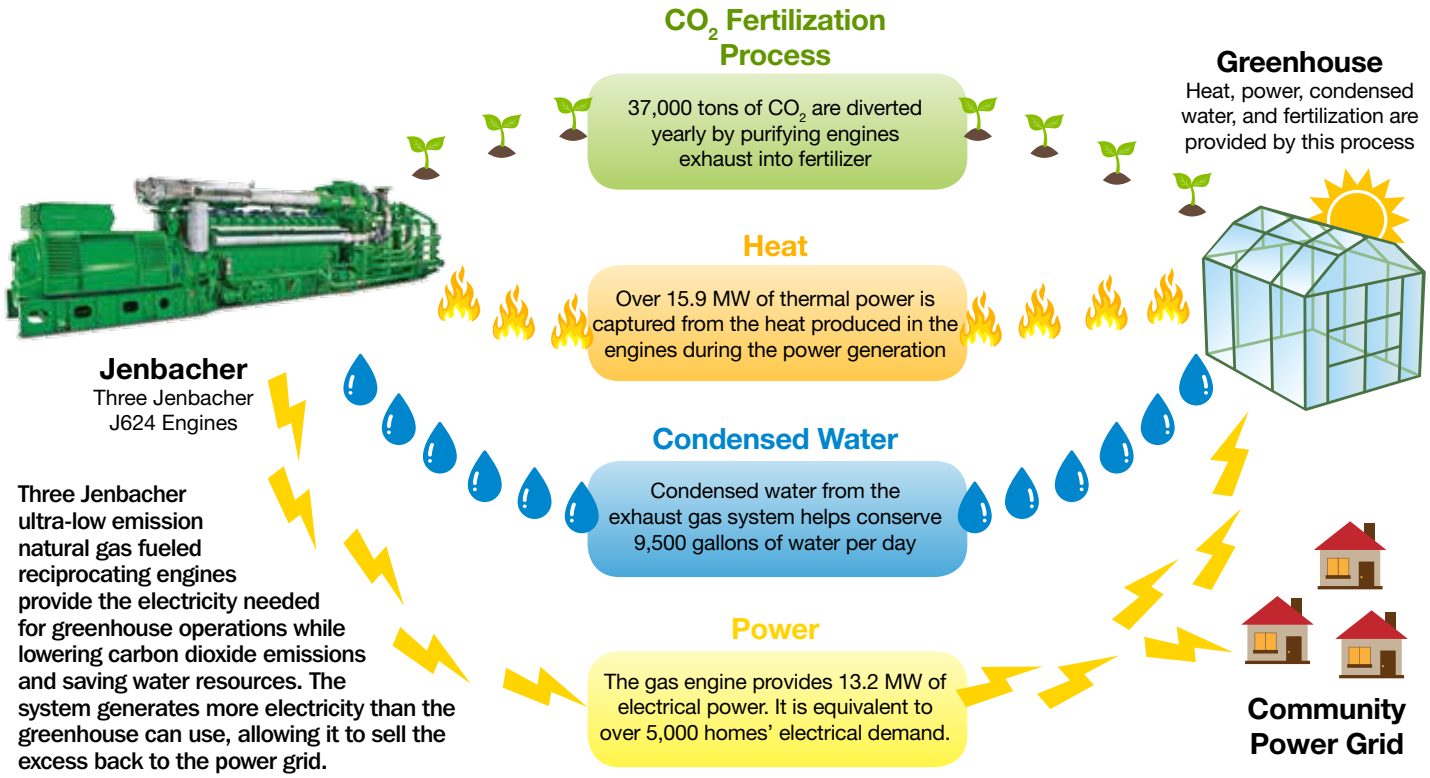
It might be hard to think of a greenhouse as a high-tech operation, but Houweling's Tomatoes prides itself on its use of technology to save on both operating costs and energy. The greenhouse holds several patents and was a 2011 recipient of the California Governor's Environmental and Economic Leadership Award in recognition of its innovations and investments in green business practices.

Family-owned and operated with facilities in California, Utah and British Columbia, the greenhouse produces more than 80 million pounds of tomatoes and cucumbers each year, providing jobs for more than 500 employees.

Houweling's most recent technology innovation was a three-year project to design and install a 13.2-megawatt combined heat and power (CHP) system with maximum heat recovery and low heat loss thermal storage with the ultimate goal of reducing greenhouse gas emissions while saving energy costs and increasing crop production.

"The greenhouse could continue as it had been, using boilers, liquid carbon dioxide, be connected to the existing power grid, or invest in cogeneration technology," said Casey Houweling, founder and proprietor of the greenhouse. "The cogeneration option was the best, as it made the most sense from a cost perspective, and we could use the waste heat and CO2 on-site."

Houweling partnered with Southern California Gas Co. and the California Energy Commission to design the CHP (also known as cogeneration) system. The approach was the first in the United States to capture traditionally wasted heat, water and carbon dioxide for use within the



Three Jenbacher ultra-low emission natural gas fueled reciprocating engines provide the electricity needed for greenhouse operations while lowering carbon dioxide emissions and saving water resources. The system generates more electricity than the greenhouse can use, allowing it to sell the excess back to the power grid.

COURTESY OF SOUTHERN CALIFORNIA GAS

PHOTO COURTESY OF HOUWELING'S TOMATOES

Casey Houweling has a long history of using technology to save energy and operational costs at his greenhouse. The implementation of a CHP system helped reduce carbon dioxide emissions while saving money and increasing crop production.

greenhouse, Houweling said. The technology produces more electricity than the greenhouse uses, allowing Houweling to sell the excess electricity back to the power grid.

In 2014, Houweling's Tomatoes installed three GE Jenbacher J624 ultra-low emission natural gas-fueled reciprocating engines to produce heat and electricity for grow lights for its tomatoes and cucumbers at its California facility. More than 15.9 MW of waste heat from the engine jacket and exhaust stack is captured and stored in multiple thermal storage tanks, allowing for hydronic heating of the facility's six greenhouses, said Cherif Youssef, technology development manager at Southern California Gas.

The exhaust is cooled to ambient temperatures and fed back into the greenhouses to supplement the use of liquid carbon dioxide used from on-site storage tanks, producing a carbon dioxide concentration ideal for crop production.

In addition, the exhaust is purified to obtain fertilizer for the greenhouses. By recapturing and using the carbon dioxide, the greenhouse saves 37,000 tons of carbon dioxide yearly, Youssef said. The system also saves 14,300 gallons of water each day by condensing water out of the exhaust gas system.

"As a result, the facility is able to reduce its energy costs while increasing productivity within the greenhouse," Youssef said.

The waste heat is captured and used for hot water storage to regulate nighttime greenhouse temperatures through a hydronic heating system.

When compared to conventional open-air tomato farming, Houweling's Tomatoes uses 25 times less land and 90 percent less water, said Jim Kerrigan, project manager research and development at Southern California Gas.

"The heat from the CHP system also allows for year-round vegetable production," Kerrigan said. "Even in sunny southern California, outdoor tomato plants do not produce in winter months."

Since implementation, the system has increased crop production while reducing criteria pollutants and greenhouse gas emissions with overall efficiencies of 85 percent, Youssef said. Because of the results at the California facility, Houweling's Tomatoes has now implemented the system in its Canadian facility.

"Cogeneration should be a no-brainer for applications similar to ours," Houweling said. "It's the right thing to do." **CHP**

For more information about combined heat and power (CHP), go to:

Combined heat and power (CHP): *www.understandingchp.com*

Houweling's Tomatoes: *www.houwelings.com*

General Electric Co.: *gepower.com*

(continued from page 5)

Green Metals Canada's CHP system operates during production times at the plant — about 21 days a month, producing about 15,000 kW hours of electricity each month, Cornell said. The system saves about $2,700 CAD (Canadian dollars) in electricity costs. When the cost of the natural gas is factored in, the company sees a net savings between $1,500 CAD and $1,800 CAD each month.

Kazuko Newton, senior sales engineer, Toyota Tsusho Canada, said applications such as de-icing and snow melt are still unusual for North American CHP installations.

"Most locations use the heat for water heating or space heating," he said.

But CHP manufactures are hoping that will change as municipalities and companies see examples such as those at Green Metals Canada and the City of Holland.

"There is a lot of interest in the City of Holland project because it's an opportunity to use it as a benchmark," El Tawy said. "We're collaborating with the City of Holland to spread the word and use it as an example so we can replicate it for other areas with heavy snow here in the U.S." **CHP**

For more information about combined heat and power (CHP), go to:

Combined heat and power (CHP): *www.understandingchp.com*

Siemens USA: *www.Siemens.com*

Yanmar USA: *www.yanmar.com/us*

Mission critical

CHP provides reliability medical facilities require.

BY TONYA MCMURRAY

For hospitals, power is literally a life and death matter. No hospital can afford a power outage that puts patient care at risk.

"Health care facilities are critical operations and have legally required standby power systems to serve essential loads," said Rick Hart, energy manager, Veterans Affairs North Texas Health Care System. "These loads represent about 40 percent of the total electrical demand."

The fact that hospitals need reliable power generation with redundancies to ensure a stable power supply even if the electricity goes out makes health care facilities an ideal candidate for combined heat and power (CHP) systems, which generate power onsite while recapturing excess heat for use in other applications.

"Health care facilities can be terrific applications for CHP as they have significant 24/7 heat requirements, which CHP can help provide while reducing the electric grid dependence of the campus," said Greg Anderson with Atmos Energy Corp., which partnered with the VA North Texas Health Care System on a CHP installation at its Dallas Veteran's Affairs Medical Center (DVAMC).

RELIABLE POWER

Hart said CHP gives DVAMC the ability to provide 50 percent of its electric power demand to augment its standby power generation.

"With emergency conservation efforts, the facility can function at full potential in an emergency," he said.

Anderson said the use of natural gas in CHP systems increases its reliability.

"Because natural gas is the primary fuel for most CHP installations and interruptions in gas supply are extremely rare, the electricity produced by these systems remains exceptionally reliable, even when grid power constraints or outages are present," he said.

CHP systems also offer reduced operating costs, said Sherif Youssef, director of sales and marketing, Philadelphia Gas Works, which collaborated with the Cancer Treatment Centers of America® (CTCA) on a CHP installation at its Eastern Regional Medical Center in Philadelphia, Pennsylvania.

"A CHP system provides the hospital with their needs of redundancy and resiliency while reducing the cost of electricity and heat," Youssef said. "In addition, a CHP system reduces the hospital's carbon footprint."

In addition, Youssef said, hospitals often have the staffing and infrastructure needed to support a CHP installation without some of the upfront and ongoing maintenance costs other organizations might incur.

"Hospitals tend to have their own maintenance crews, which helps reduce the cost of operation and maintenance of the equipment," he said. "Hospitals also tend to have their own mechanical room, so adding a piece of equipment is more of an incremental cost."

SUSTAINABLE ENERGY

Located on 86 acres in South Dallas, DVAMC consists of several buildings totaling 1.96 million square feet of facility space. The hospital provides full inpatient and outpatient care with 10,000 clinical visits a week and 450 beds for long-term care.

PHOTO COURTESY OF PHILADELPHIA GAS WORKS

(From left) Sherif Youssef, director of sales and marketing, Philadelphia Gas Works; Michael Franz, director of plant operations, Cancer Treatment Centers of America® (CTCA); Nancy Hesse, president and CEO, CTCA; and Jeff Ryan, senior vice president of operations and business development celebrate the launch of the hospital's CHP system.

In July 2017, the facility finished final testing on a 4.5-megawatt natural gas-fired Solar Turbine Mercury 50 to generate electricity and a Rentech Heat Recover Steam Generator (HRSG) able to burn either natural gas or biodiesel to capture and reuse the heat created during the energy generation. A steam turbine then powers two 1,000-ton steam turbine chillers.

"This was an energy conservation and sustainability project," Hart said. "A natural gas turbine is the most efficient method of electric generation. The CHP advances our sustainability health care commitment of keeping the doors open in an emergency situation."

Getting the system fully functional required a lengthy testing process, he said.

"Testing the components of CHP is very tricky in an operating health care setting," Hart said. "A component within a system can perform adequately by itself but when other systems are added and react, issues are exposed. The power side CHP relay functions is very complex and can only be tested against the actual dynamic loads of the individual circumstances of a particular facility."

One key requirement for the DVAMC was to ensure it could use all of the excess heat created from the turbine generator.

"DVAMC has a year-round heat load with the steam chiller," Hart said. "This is Texas, so cooling is very important. We installed two steam turbine centrifugal chillers to base load our cooling for the facility. We now use the natural gas that once went into conventional boilers to make steam to generate electricity, and the exhaust now used to make steam."

'PERFECT FIT'

Like DVAMC, Cancer Treatment Centers of America's (CTCA) Eastern Regional Medical Center was looking for reliable and cost-effective energy production with its recent CHP installation. One of five hospitals in the CTCA network of cancer treatment facilities throughout the United States, the 74-bed Eastern Regional Medical Center provides both outpatient care and short-term acute care to cancer patients.

Philadelphia Gas Works partnered with Eastern Regional Medical Center to install a 1.1 MW Cummins CHP system in May 2016. The unit uses natural gas to fuel an engine-driven system, which produces electricity to power the facility while the recaptured waste heat is used for heat and hot water throughout the facility.

The system provides an average of 75 percent of the hospital's daily electricity and 80 percent to 90 percent of its heating needs, said Jeff Ryan, senior vice president finance and business development, Cancer Treatment Centers of America. 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 the hospital could take to control energy costs while improving resiliency," he said.

The CHP system has resulted in about $500,000 in annual net operational savings. The project has reduced energy and emissions by about 12.7 million pounds of carbon dioxide, 16,475 pounds of sulfur oxides and 10,539 pounds of nitrogen oxides per year. In addition, the system has resulted in a reduction of 2.9 million gallons of water.

Youssef said those results are significant for the facility's bottom line as well as its energy footprint.

"The constant need for electricity, heat and domestic hot water makes health care facilities a perfect fit for CHP," he said. **CHP**

For more information about combined heat and power (CHP), go to:

Combined heat and power (CHP): *www.understandingchp.com*

Solar Turbines Inc.: *mysolar.cat.com*

Rentech Inc.: *www.rentechboilers.com*

Cummins Inc.: *www.cummins.com*

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He advises other hotels and commercial properties to look into CHP. In particular, hotels with a consistent summer and winter hot water load, he said, are likely to see a rapid return on investment from CHP. "CHP is typically an excellent investment over the long term," Glick said.

LOTTE NEW YORK PALACE

Management at the Lotte New York Palace agrees that CHP is a good investment. Located in midtown Manhattan, the hotel installed CHP to combat the high cost of city steam. The Lotte New York Palace consists of 813 rooms, 86 suites, a 22,000-square-foot meeting and event space, a spa and a fitness center. But with city steam being the most expensive fuel source in the city, it was time for change. Hotel management worked with RSP Systems, a Capstone Turbine Corp. distributor, to run sufficient gas volume and pressure to the site to greatly reduce its electrical and fuel costs.

Like the Westin, the Lotte New York Palace instituted CHP to provide cooling, heating and power. Its system consists of 12 Capstone C65 microturbines, a 200-ton chiller and hot water heat exchangers. The 65 kW turbines provide up to 780 Kw of electrical capacity via integrated heat exchanger modules. In summer, the hot water is used for chilling. Over the cold winter months, the microturbines displace city steam, greatly saving the hotel significantly in operating costs.

"The CHP plant is the largest of its kind in a New York City hotel," said Cory Glick, president of RSP Solutions. "It was designed to save the hotel 30 percent to 40 percent of its annual electric and thermal energy expenses by providing cooling in the summer and heating in the winter."

He said the greatest benefit is felt in the winter months with moderate saving across the summer. He added that the hotel's carbon footprint has dropped by 481 tons per year due to the recapture of thermal energy from the Capstone turbines. In addition to a dramatic reduction in operating expenses, CHP has lowered the Lotte New York Palace Hotel's reliance on the local grid.

"By capturing the thermal energy produced from the microturbine's clean exhaust, businesses can save exponentially on their energy costs with efficiency levels of 80 percent or higher," said Jim Crouse, Capstone's executive vice president, sales and marketing. "Businesses that invest in on-site power production often see a very short return on investment." **CHP**

For more information about combined heat and power (CHP), go to:

Combined heat and power (CHP): *www.understandingchp.com*

Tecogen Inc.: *www.tecogen.com*

Capstone Turbine Corp.: *www.capstoneturbine.com*

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