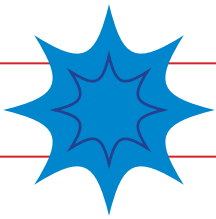


C O M B I N E D
HEAT AND POWER



**CHP's Spark Spread
Over Competition =
Economic No-Brainer**





Fire Up the Turbines

Microturbines generate a stable power source.

BY TONYA MCMURRAY

More than 3,600 combined heat and power (CHP) systems are installed across North America, saving money, improving energy efficiency and reducing greenhouse gas emissions. And, many of those

systems are run with small, compact, lightweight and low-emission microturbines.

Widely used, microturbines represent an energy management solution that uses natural gas to produce electricity and, with a heat exchanger, captures the heat generated so that it may be used for

thermal needs. Ranging in size from 30 kW to 400 kW, microturbines run at high speeds, allowing for high efficiency with minimal noise and vibration. Multiple microturbine units can be connected together to meet larger electric demands.

These small turbine engines are de-

rived from turbocharger technologies, such as those found in large trucks and the turbines found in jet aircraft. While the most commonly used fuel is natural gas, microturbines can also run on a variety of gaseous elements.

Heated air and fuel are combined in the microturbine's combustor, igniting the mixture and feeding it to the turbine. This ignited air-fuel mixture spins the turbine to operate the generator, producing electricity for use onsite.

Captured thermal energy can be used for the production of hot water for local use, space heating, absorption cooling, desiccant dehumidification, and to supply other thermal needs.

COMPACT POWER

Microturbines were put into commercial use beginning in 2000. In the 15 years since, they have proven to be powerful drivers for CHP systems, especially in large installations with significant heat needs. Customers can expect to see up to 80 percent combined heat and power efficiency with a CHP application and up to 90 percent efficiency when an absorption chiller is added to the system to provide space cooling using the heat recaptured from the microturbine. With those efficiencies, Capstone microturbines typically pay for themselves within three to five years, said Jim Crouse, executive vice president of sales and marketing with Capstone Turbine Corp.

According to the U.S. Energy Information Administration (EIA), natural gas-powered CHP equipment offers the lowest carbon emissions.

The systems' electrical efficiencies increase as the size of the microturbine increases. Multiple units can be connected



Capstone Turbine Corp. manufactures microturbines that typically pay for themselves within three to five years, according to Jim Crouse, executive vice president of sales and marketing.

PHOTO COURTESY OF CAPSTONE TURBINE CORP.



able to install the system directly over guest rooms because there is no sound or vibration to disturb hotel guests.

CAPPING THE RITZ

The Ritz-Carlton San Francisco was the first in the world to install the Capstone microturbine-based UTC Power Company's PureComfort combined cooling, heating and power (CCHP) system to conserve energy and protect the environment. The system's quiet, low-vibration microturbines were ideal for the hotel, which wanted to ensure the unit didn't interfere with its relaxing ambiance.

During the 10 years the system has been in operation, the Ritz-Carlton has reduced its energy consumption by 20 percent, saving an estimated \$120,000 in energy costs each year. With incentives from California's Self Generation Incentive Program and the U.S. Department of Energy, the hotel saw a payback on its investment within four years.

Besides hotels, microturbines can be found in educational institutions, medical facilities, data centers, landfills, and a variety of commercial operations. Microturbines are ideally suited for industrial or commercial CHP applications requiring large amounts of both electricity and heat.

Facilities that are able to use the cap-

tured heat on an ongoing basis are the best candidates for microturbine technology, Zuk said.

"Everyone can use electricity," he said. "The question is, can you use the waste heat 24/7 for cooling or heating? Hotels, for example, can use the waste heat for hot water, for guest room heating, for the kitchen and laundry, and, sometimes, even for pools and hot tubs. Some customers use the waste heat for heating during the winter and for cooling during the summer, so they're using it 365 days a year. That's when the application makes sense. Otherwise, you go from system efficiencies of 80 percent down to 30 percent when you're not using the heat."

HEATING UP

"Microturbines produce more heat and steam than other technologies," said Bob Fegan, principal technical consultant for DTE Energy. "For any application that needs steam or any application that needs a large volume of very hot air, such as kilns and drying operations, microturbines have the advantage."

Fegan worked with the VA Medical Center in Ann Arbor, Michigan, on one of the first installations of the Capstone C1000 microturbine with a steam heat

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The Ritz-Carlton San Francisco has reduced its energy consumption by 20 percent, saving an estimated \$120,000 in energy costs in each of the first 10 years since installing a microturbine-based combined cooling, heating and power system.

together to handle larger loads and increase reliability. Because the units are small and lightweight, they can be installed in almost any facility. The turbines can often be lifted in freight elevators to the top floors of multi-story buildings.

The compact, modular design of microturbines makes them flexible and adaptable, said John Zuk, vice president of marketing and sales for Philadelphia Gas Works.

"Sometimes a customer will put in one or two units, and then will realize the benefits and want to expand, so they'll add a couple of more units," he said. "Because they're modular, you can expand the system simply and easily."

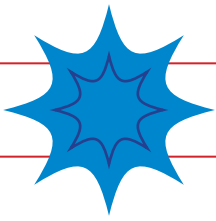
The systems are also quiet with minimal vibration, Zuk said. He added that some hotels have rooftop installations and are



PHOTO COURTESY OF CAPSTONE TURBINE CORP.

The Ritz-Carlton San Francisco was the first in the world to install the Capstone microturbine-based UTC Power Company's PureComfort combined cooling, heating and power system to conserve energy and protect the environment.





COMBINED HEAT AND POWER

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recovery system. The Capstone micro-turbine boasts 33 percent electrical efficiency and an overall CHP efficiency of up to 90 percent. Total CHP efficiency is the sum of the net electricity generated plus hot water or steam produced for building thermal needs divided by the total fuel input to the system.

“The system is installed in the boiler house next to conventional boilers and is used just like a standard boiler, producing steam that goes directly into the facility’s steam header,” Fegan said. “Electricity produced from the turbine is fed into the main distribution system and used just like electricity from the grid.”

Other facilities use the excess heat generated by the microturbine for both heat and cooling throughout their buildings. In 2013, the Pennsylvania State Employees Credit Union (PSECU) decided to invest in a natural gas CCHP system to reduce overall operational costs and become more environmentally friendly.

PSECU needed power generation as well as space heating and cooling for its 239,000-square-foot LEED Gold-certified facility and data center. The CCHP system relies on a Capstone C800 Power Package, four 1,000,000 BTU heat exchangers

and a 250 ton, flue gas-fired absorption chiller. The system is able to work independently from the local utility grid to maximize efficiency. The system produces 800 kW of electricity as well as hot and chilled water for the facility.

Since the system was completed in October 2013, it has reduced carbon emissions by 1,468 tons per year, the equivalent of removing 243 cars from the road.

A GOOD INVESTMENT

Microturbines produce stable and reliable power. Capstone microturbines have only one moving part, which allows for longer service intervals, minimal vibrations and lower operating costs. Maintenance for microturbines is pretty straightforward with no oils that need replacing. Zuk noted that many manufacturers offer maintenance contracts to ease ongoing maintenance needs even further.

The reliability, combined with low maintenance cost, makes microturbines a good investment, Fegan said. Like all CHP and CCHP systems, microturbines reduce the risk of electric grid disruptions and enhance energy reliability by allowing for continued operation during electrical power outages.

Microturbines typically have extremely

low emissions. In fact, most microturbines are able to meet even the most stringent emission requirements with built-in technology so that the system won’t require post combustion emission control techniques.

When correctly engineered, the small microturbine helps facilities achieve optimal performance in the production of electricity and thermal loads.

“Microturbines are best utilized by customers looking to break free from the burden of high utility bills,” Crouse said. “By running 24/7, almost any commercial or industrial business can fully utilize the electrical and thermal outputs, maximizing the economic benefit. The low life-cycle cost of the microturbines, paired with the ease of achieving high overall efficiency and reliability, makes for a smart investment in clean energy production.” **CHP**



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

CHP Consortium:
www.understandingchp.com

Energy Information Administration:
www.eia.gov

Capstone Turbine Corp.:
www.capstoneturbine.com

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WASTE HEAT FOR CHILLING

Baltimore Gas and Electric (BGE), Maryland’s largest natural gas and electric utility and part of Exelon Corp., is the utility provider for the UCMC project. Jim Libertini, product manager for the BGE Smart Energy Savers Program, said the UCMC CHP unit is designed to run 24/7 and operates in conjunction with BGE’s electric grid.

The waste heat from the gas engine, he explained, supports a 350 ton absorption chiller purchased as part of the project. This unit takes steam or very hot water and uses it to generate chilled water through a chemical action process.

“The waste heat generated from operating the CHP unit is collected and delivered to the chiller,” Libertini said.

“Utilizing this waste heat vastly increases the efficiency of generating electricity.”

For Libertini, the overall benefits of CHP are:

- Resiliency and ability to control one’s own destiny in the event of a catastrophic emergency;
- Ability to use the waste heat to offset thermal or heating needs, making the system highly efficient;
- Ability to use a potential backup generator full time, allowing beneficial use out of the investment as opposed to a part-time diesel generator;
- Ability to better control energy costs;
- If using natural gas to power the unit, no onsite fuel storage concerns; and
- Reduces carbon footprint.

Libertini advises those considering CHP not to be tempted to oversize the

unit. The best approach, he said, is to understand your thermal needs and size the unit to closely match those specific thermal requirements. This will take input from engineers and contractors who have plenty of experience with this technology. But once in place, CHP provides peace of mind that hospital facilities will have the wherewithal to keep running in the face of a disaster or power outage.

“The new CHP unit enables UCMC to expand that umbrella of protection to operate additional heating and cooling systems as well as other necessary equipment in order to keep their facility up and running during an emergency,” said Libertini. “In addition, UCMC has also been able to significantly reduce their energy costs.” **CHP**