Cogeneration gaining in popularity for CHP and CCHP

Caleb Finch, communications manager at Capstone Turbine Technology, considers the advantages of modern microturbine technology in CHP and CCHP installations, explaining that microturbine CHP is 'especially suitable for healthcare facilities that are looking to increase their energy efficiency, lower their greenhouse emissions, and save money at the meter'.

In the face of climate change and rising energy costs, 'small-cap' industrial organisations are identifying with the need to implement sustainable energy solutions. The push to improve energy efficiency is growing on a global scale, as these organisations seek out ways to reduce their operating costs and minimise greenhouse emissions. This trend is being further driven by stringent environmental regulations, with government and private entities increasingly developing clean energy programmes for their industrial facilities. More clean energy programmes are being enacted on a global scale than ever before – an example being the Energy Efficiency Accelerator Platform launched at the 2014 United Nations Climate Summit – and others are still under development, creating platforms for making energy infrastructure improvements that are good for both business and the environment.

Rise of cogeneration

For small-cap industrial organisations like hospitals and medical centres, one such improvement is on-site cogeneration. Thousands of cogeneration and trigeneration systems, also known as combined heat and power (CHP) or combined cooling, heat and power (CCHP) systems respectively, are being installed around the world, and in several different application environments. Investing in CHP allows these organisations to operate independently of the local electricity utility, and increase energy efficiency through the use of clean-burning, low emission power generation technologies.

Unfortunately for the utility companies, their distribution grids can only sell electrical power, not thermal power. Unless the utility can deliver exhaust heat to a local municipality for underground distribution to the site, the distributed waste heat cannot be utilised as an asset. With that said, the utility company will typically dump this waste heat, which is just as valuable as its electrical output, through cooling towers, or pipe in water from a nearby source. Utility generating plants are constructed alongside water sources precisely for this heat-dissipating advantage.

What is a microturbine?

Microturbines are derived from turbocharger technologies such as those found in jet aircraft. Ranging in size from 30 kilowatts (kW) to 10 megawatts (MW), they run at high speeds, allowing for high power output with minimal noise and vibration. By definition, microturbines are small combustion turbine engines that turn gaseous and liquid fuels into usable electricity. With only one moving part – the rotor – they serve as a low-maintenance technology intended to run for long intervals and without the need for exhaust after-treatment. In addition to electrical generation, microturbines continuously produce clean exhaust heat, which can then be recovered via a heat exchanger and fed either to a thermal energy storage tank or an on-site distribution system. This thermal energy can be used in a variety of ways, including for the production of hot water, for space heating, and for cooling via a chiller, as well as to fuel industrial equipment.

Microturbine power plants are able to run '24/7', and among their additional benefits to end-users are improved environmental performance and reduced congestion on the electric grid. Moreover, centralised electricity generation, paired with separate on-site heat generation, has a combined efficiency of about 45 per cent, whereas microturbine energy systems can achieve efficiency levels of up to 80 per cent with CHP, and up to 90 per cent with CCHP, or higher in some cases.

A Capstone C65 microturbine rotor – the only moving part in the entire system.

Microturbine CHP

Microturbine CHP is especially suitable for healthcare facilities that are looking to increase their energy efficiency, lower their greenhouse emissions, and save money at the meter. Hospitals, in particular, are ideal applications for CHP systems, because they require heat and electricity on a continuous basis. Cogeneration plant sizes range in scale according to the type of building they are used for and the energy load required. Virtually any commercial or industrial application that requires heat, cold air, or hot and cold water production, is a candidate for microturbine CHP systems, which can generate at least 10 to 20 per cent in energy savings for most applications.

Another benefit of microturbine CHP is that the amount of heat loss associated with on-site distributed generation is much lower. Microturbine generators are located

precisely where the CHP output has an immediate application – about 80 per cent of the value of the fuel. While traditional diesel engines require users to check oil and coolant every week, microturbines only require the air filter to be replaced annually, with a standard engine overhaul about five years after commissioning.

There are multiple factors when it comes to determining whether a microturbine CHP plant is worth the investment, and, with them, some misconceptions. Many prospective customers are not familiar with microturbine technologies, and so they assume that they are a complicated solution to implement or maintain. To remedy this, manufacturers offer training courses to educate these customers, while others offer aftermarket service and protection plans so that the customer does not need to know how to service the equipment. That said, it remains important for healthcare organisations to understand their electrical and thermal loads, and any seasonal effects on those loads. Correctly sizing microturbine equipment based on the load is imperative, as oversizing can lead to a longer payback period. Fortunately, microturbines are scalable, allowing for accurate sizing, as well as the ability to add additional microturbines as the need arises. Furthermore, microturbines come as a complete system and conform to grid interconnect standards, reducing ancillary equipment costs and simplifying permitting.

Since its initial development in the 1990s, and spurred on by increasing energy prices and air quality concerns, the market for CHP has grown tremendously. As governments move to increase energy efficiency programmes and encourage distributed generation, private entities look to reduce their operating costs and carbon footprint. Microturbine CHP continues to help organisations meet their energy efficiency goals by providing them with a clean, efficient, energy system.

In the field

Microturbines have been helping healthcare organisations to achieve their sustainability goals for years; let us look at a few examples of microturbine CHP installations currently in the field.

In 2006, five 60 kW Capstone microturbines were commissioned at a university medical facility in Portland, Oregon. The microturbine CHP plant has since made the Oregon Health & Science University facility 49 per cent more energy-efficient than the state code requires, and reduced annual carbon emissions by 630 tons. The microturbines help the facility to eliminate nearly two-thirds of the power loss incurred when transporting electricity from a distant utility power plant.

In 2015, meanwhile, eight 65 kW Capstone microturbines were installed at a medical centre serving US veterans in Syracuse, New York. The microturbine CHP plant at the site reduces energy consumption and improves overall efficiency and reliability for the Veterans' Administration Medical Center. The microturbines operate in parallel with the grid, and produce a portion of the centre's electricity, as well as hot water. The plant provides the customer with a solid economic return, while reducing the facility's impact on the environment.

Eastern European installations

In 2016, three 65 kW Capstone microturbines were commissioned at a cardiac center in Minsk, Belarus. The CHP plant supplies electricity, space heating, and hot water for the Ministry of Health's Scientific and Practical Center for Cardiology. The microturbines operate in parallel with the grid, and cover 60 per cent of the centre's power demand, including its intensive care and surgical units. In instances of utility power loss, the microturbines switch on automatically, and run continuously during electrical outages.

At another medical facility in Eastern Europe, two Capstone C200 microturbine power generating systems were installed at the Novo mesto General Hospital, a regional hospital in Slovenia that provides a range of inpatient and outpatient services to around 132,000 inhabitants of Novo Mesto, Črnomelj, Metlika, Komunala, and part of the Krk municipality, as well as providing services to part of the Brežice and Sevnica municipality.

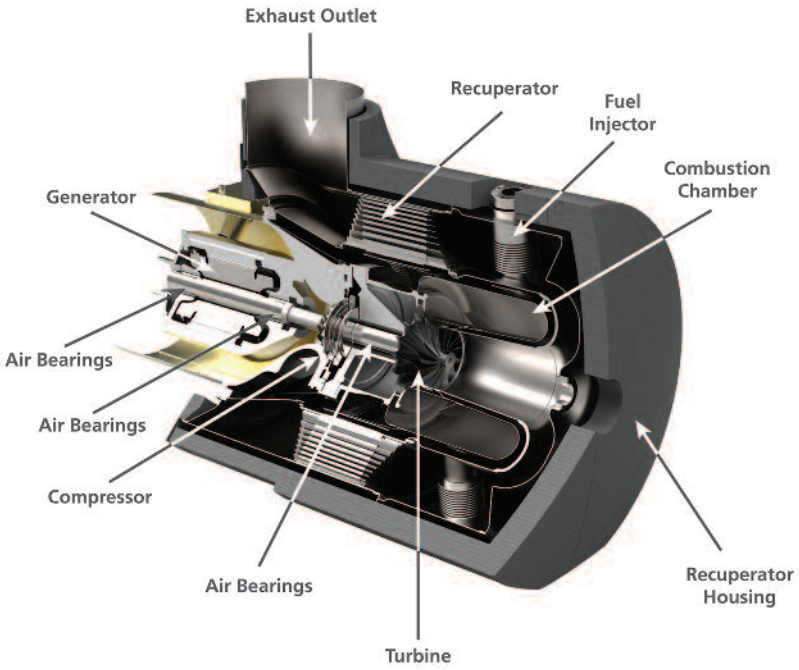
Installed in 2014, the two C200 microturbiunes are located on the hospital's rooftop, and operate in a combined cooling, heating, and power (CCHP) mode to lower emissions, increase energy efficiency, and ensure reliable power generation for the 377-bedded regional hospital.

The natural gas-fuelled microturbines are grid-connected, and provide electricity, heating, and domestic hot water for the facility. The project was funded in part by the Council of the European Union to help the hospital meet international efficiency standards. The EU is aiming for a 20% cut in Europe's annual primary energy consumption by 2020. Following installation of the C200s, staff at the hospital report an increase in natural gas efficiencies from 34% to 73%.

'Ultra-low' greenhouse gas emissions

"The microturbines' ultra-low greenhouse gas and noise emissions, low vibration, and low maintenance costs, paired with their ability to withstand Slovenia's harsh climate, make them the best technology for the hospital," explains Jim Crouse, Capstone's executive vice-president of Sales and Marketing. The C200 features Capstone's patented oil-free air bearing technology, remote monitoring and diagnostic capabilities, and integrated utility synchronisation and protection. The small, modular systems allow for easy and low-cost installation.

These examples clearly show how microturbine technology can provide a proven, cost-effective, and efficient solution to hospitals and other healthcare facilities under increasing pressure to cut carbon emissions and reduce energy bills while simultaneously reducing their reliance on the grid. hej



A 'cutaway' image of a Capstone C65 microturbine.

Capstone microturbine CHP plant at Oregon Health & Science University.

About Capstone and the author

Caleb Finch is the communications manager at Capstone Turbine Corp. In 2014, after spending time on Oracle's corporate communications team, he joined Capstone's marketing team to advance the visibility and goals of the company. He manages key message development and marketing logistics, including written editorials and 'all things traditional and social media'. One of his main objectives is to maximise awareness around clean energy technologies, and to one day become a thought leader in the space. He holds a Bachelor of Arts degree in communication from the University of Arizona.

Capstone Turbine Corporation is a producer and developer of low emission microturbine energy systems, and claims to have been the first to market commercially viable microturbine energy products. The company said: "Capstone has shipped thousands of microturbines to customers worldwide. These innovative and award-winning systems have logged millions of documented runtime operating hours, and are compliant with current and future emissions regulations."

With over 86 distributors worldwide, Capstone offers a comprehensive product line-up, providing scalable solutions from 30 kW to 30 MW. Capstone microturbines can also operate on a variety of gaseous or liquid fuels and, the company maintains, 'are the ideal solution for today's distributed generation needs'. Turner EPS is the official UK distributor for Capstone Turbine Corporation.