CHP Does It All

Large Packaged Units More Attractive Than Ever

IT'S NOT ENTIRELY A NEW IDEA. We started talking seriously about cogeneration back in the 1970s. The idea was to find a use for waste heat from the engines or turbines used for on-site electric generation. This concept has found many adopters, and today is getting a serious foothold in the industrial energy market. Today, we're more likely to call it by the more descriptive name of "combined heat and power" (CHP). Refinements on the idea, and its range of applications in industry, have also expanded.

Better Than Ever

Industrial energy users often choose natural gas-powered engine units 1 MW or larger. Numerous manufacturers offer CHP equipment packages in this category, in a wide range of sizes and configurations. Today's engines are far more efficient than those when the cogeneration idea was first discussed.

Because of precise digital controls and overall improvements in engine design, the balance between electric production and heat output is more balanced than in the past. Where in the 1970s, efficiencies of natural gas-fired engines ranged from 28% to 33%, today a 2MW Caterpillar engine-generator set offers efficiency of 42.2%, and in a combined heat and power application, an overall thermal efficiency of 85% or higher. Packaged large gensets from GE Energy and others offer similar performance.

Capturing the Heat

Caterpillar is one of the major suppliers of both engines and packaged engine-generator sets. Brian Snyder from Caterpillar was a presenter at the Midwest Cogeneration Association conference in October, 2011. He explained that with a modern CHP arrangement, 42% of the fuel energy is converted to electric power. Approximately 3% is lost as radiated engine heat. The remainder, 55% of the heat energy, is with the exhaust gases, the engine jacket cooling water, the engine aftercooler and the oil cooler.

Typically 80% or more of this waste heat can be captured and used for plant process purposes, for building heating, or to supply energy for absorption cooling. Thus the unit thermal utilization efficiency goes from 42% to 86%. To accomplish this, the CHP packaged unit is equipped with the appropriate heat recovery devices. This includes coolant liquid-to-water plate heat exchangers and exhaust gas-to-water/steam heat exchangers.

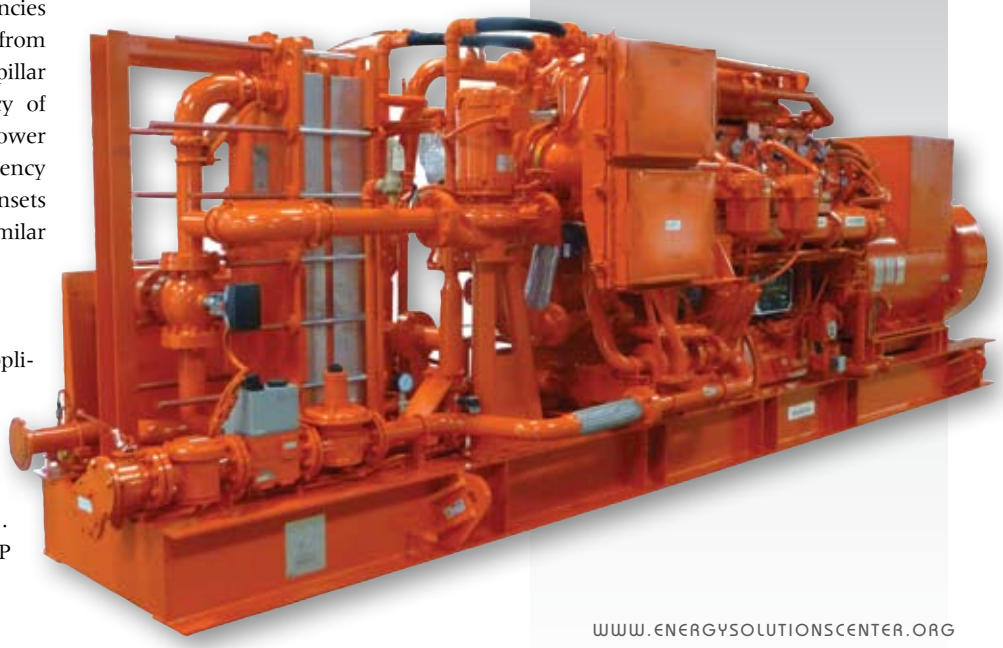
Wide Variety of Applications

Snyder stressed the wide range of industrial applications for engine byproduct heat. He noted that one of the most basic applications was heating water with energy recovered from the engine exhaust to a temperature of up to 99°C. Such a hot water stream, as an example, supplies a water-to-air heat exchanger with 35° C air preheat for a drying tunnel in brick manufacturing.

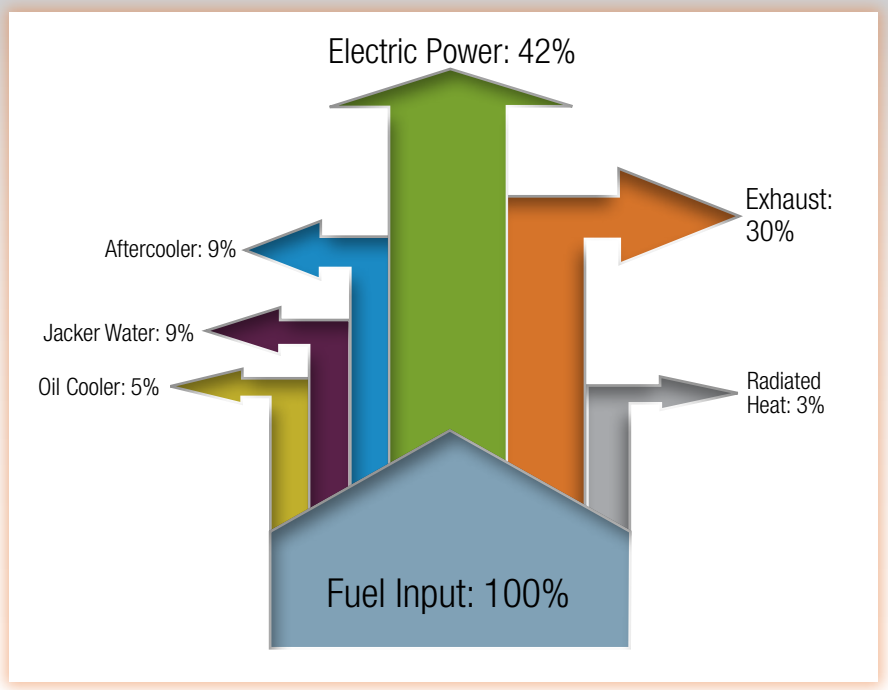
Other applications he described included systems that provide both saturated steam from the engine exhaust and 90° C hot water from the other engine heat sources. The steam and hot water can either be used for process purposes, or can supply an absorption chiller for building cooling or process chilled water.

Large Engines for Large Applications

GE Energy offers two lines of large engine-generator sets suitable for CHP applications. The company's Jenbacher engines are man-



GE Energy's Waukesha APG1000 Enginator® with CHP package, complete with plate and frame heat exchanger, control panel, gas train with design for easy customer connections. This unit is rated at 1,100 kWe, 1,260 kWth @ 60 Hz for 89.4% total efficiency. Photo courtesy GE Energy.



This illustration shows a typical distribution of the energy from a modern engine CHP installation. Illustration courtesy Caterpillar.

ufactured in Austria and sold worldwide for a wide range of applications. They are available in sizes ranging from 500 kW to 9.5 MW. According to Kerstin Lienbacher from GE, these engines are used both with natural gas, and with a wide range of other fuel gases, including landfill gases. These other gases can be used alone or in combination with natural gas.

Lienbacher gives an intriguing example of a sophisticated Canadian installation where not only the electric energy and the byproduct heat, but also the exhaust CO_2 are all used. This is at Great Northern Hydroponics, a division of Detroit-based Soave Enterprises, at a sprawling 55-acre tomato greenhouse complex in Kingsville, Ontario, near the north shore of Lake Erie.

Using All the Outputs

The site has a high-efficiency power plant powered by four 3.0 MW GE Jenbacher cogeneration modules. The electric energy from the plant is used on the site, and the surplus is sold to the Ontario Power Authority under a 20-year contract. According to the Power Authority, the plant will supply enough electricity to power 12,000 to 15,000 homes annually.

The engine heat will warm the greenhouses, eliminating the need for other supplemental heating equipment. In addition to generating power and heat to support greenhouse operations, the power plant also treats the exhaust stream from the gas engines, enabling CO_2 from the exhaust to be recycled and applied as a nutrient for greenhouse crop production.

According to Roger George, general manager for GE's Jenbacher gas engine business in North America, "Facilitating additional cogeneration projects in the greenhouse industry will support new sustainable energy, environmental and employment opportunities throughout this multi-billion dollar industry."

Interest on the Upswing

Interest in industrial application of CHP with large engines is definitely increasing. According Aaron Trexler, Power Generation Product Line Manager with GE Energy's Waukesha unit, this application has long been recognized in Europe. "We are starting to see more of this in the U.S. due to lower natural gas prices, which can help reduce the customer's overall cost of electricity while helping relieve grid congestion, increase energy security, and eliminate losses that normally occur in the transmission and distribution of electricity from a power plant to the user."

Trexler also points out that using engine CHP to supply steam or hot water can also eliminate or reduce the use of boilers, thus increasing overall system efficiency. "You are not wasting the heat provided by a reciprocating engine driving a generator. These cost saving provide additional competitiveness for industrial and commercial users, while also offering affordable heat and cooling."

Trexler points out that the growing desirability of CHP is not only a function of its increasing efficiency and low fuel costs, but also improved emission controls. "Advanced control technologies help minimize emissions to levels which are much lower than what were seen in the past decade."

Case-by-Case Evaluation

He stresses that customers need to evaluate project feasibility on a case-by-case basis. "In the case of natural gas-fueled CHP, which is the industry norm, users trade the capital costs of equipment and increased fuel costs for lower electricity costs. Electricity savings must exceed the increased natural gas, capital and operating costs to realize project profitability."

Many large industrial energy users are good candidates for natural gas-fired engine CHP. If your installation uses large blocks of electric power, and at the same time needs hot water or steam for process or comfort applications, now might be the time to have a qualified engineer do a study of this option. And if it has been some years since you have done such a study, it might be time to take another look. **GT**

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