Electric Self-Generation

May Be for You — Combined Heat and Power (CHP) Growing in Popularity

AT A GLANCE

- CHP now more attractive for smaller systems
- Many system configurations possible
- Key to success is using combustion heat
- Advantage to both recip engines and turbines
- Absorption cooling an exciting cooling opportunity

Energy costs are on everyone's minds. We are currently seeing the highest level of interest since the U.S. Public Utility Regulatory Policy Act (PURPA) was passed in 1978, to promote alternative energy sources and energy efficiency, and to diversify the electric power industry. One of the instruments of change that was promoted was cogeneration — the system of supplying one's own electric power and at the same time taking advantage of the waste heat from electric generation. That was the first many of us heard of cogeneration, today more widely called combined heat and power (CHP).

Originally Seen Mostly Suitable for Industry

Also for many of us, it was quickly concluded that CHP mostly made sense for large industrial energy users. Indeed the most successful early adopters of CHP were these users. Perhaps you haven't noticed that that's no longer the case. Increasing numbers of commercial and institutional energy users have discovered the value of the CHP concept. These users include schools, healthcare, lodging, office buildings, retail facilities, and food service. It may be worth your while to give CHP a second look.

If you are concerned about rising electric utility rates, and if you have a practical use for a quantity of hot water or steam for heating, for domestic hot water, or even to feed an absorption chiller, this may be an idea worth pursuing.

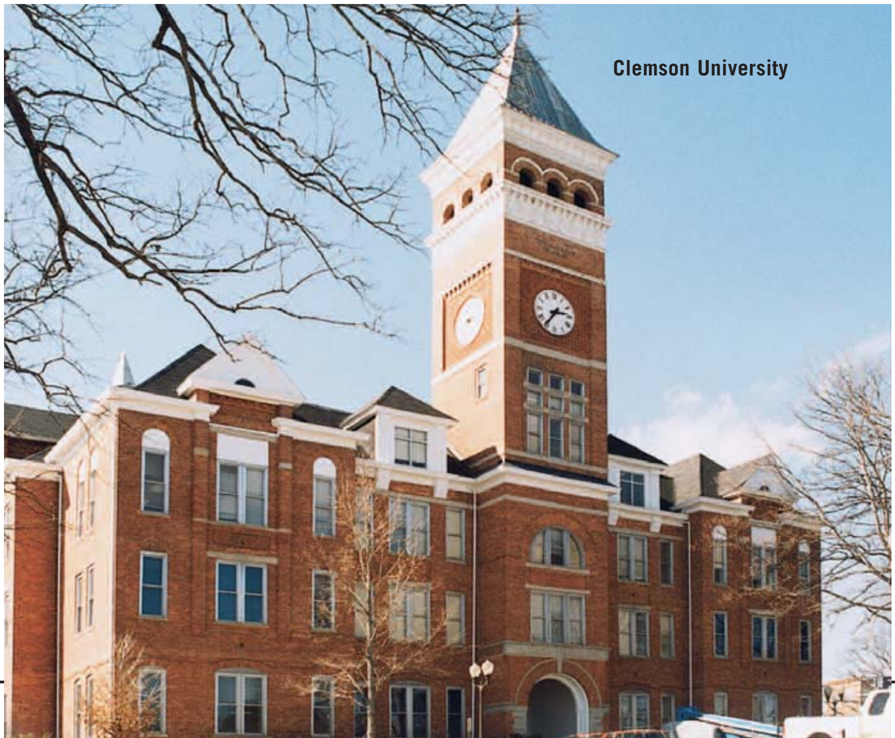
The attraction of CHP is that it allows owners to take advantage of the thermal output as well, allowing total energy utilization in the range of 70% to 80%. Let's take a look at CHP and consider where it may make sense for owners of commercial and institutional buildings.

Many Configuration Options

CHP is not necessarily an "all-or-nothing" proposition. You might choose to use this technology to meet a *portion* of your electrical or heating needs. Some campuses and other institutions have taken this "partial CHP" approach very successfully. Units installed to run parallel with central station supplies are designed to synchronize with grid power. Under some circumstances, it is practical to sell surplus electric energy back to the electric utility.

Even if you remain interconnected with the utility, it may be valuable to choose a system design that offers "black start" capability, allowing you to start up the unit or keep it in service during utility blackout conditions. Alternatively, it is entirely possible for modern gas-fired electric generation equipment to reliably meet all of your needs, allowing you to disconnect entirely from the central-station source.

The equipment used for natural-gas supplied CHP usually consists of either a reciprocating engine or a gas turbine, an electric generator, a heat recovery system, and system controls. Other alternatives



Clemson University

In a stand-alone application, Waukesha engines provide all of the electric energy plus hot water for a nursing home in New York.

such as fuel cells and Stirling engines are still developing as well.

Choosing Recip Engines vs. Microturbines

Generally speaking, reciprocating engine systems are more efficient on the electric generation side, but produce a lower grade of byproduct heat, typically in the form of hot water ranging from 220°F to 250°F. Microturbines, and their larger cousins industrial turbines, have somewhat lower electric generation efficiency, but provide more and a higher grade of turbine exhaust heat, suitable for larger volumes of higher-temperature water. Larger industrial turbines alternatively can generate steam in a waste heat boiler.

Manufacturers of CHP systems have made great strides in unit efficiency, and today the units are nearly as efficient as utility generation. When one takes into account the electric utility losses in transformers, transmission lines and power distribution, and the fact that the owner has the full benefit of the byproduct heat, CHP generation is far more energy-efficient.

PARTIAL LIST OF SYSTEM MANUFACTURERS

NATURAL GAS ENGINE GENSETS
- CATERPILLAR
- COAST INTELLIGEN
- CUMMINS
- DEUTZ ENERGY
- FAIRBANKS MORSE ENGINES
- GE/JENBACHER
- TECOGEN
- WARTSILA
- WAUKESHA

MICRO-TURBINE GENSETS
- BOWMAN POWER
- CAPSTONE
- ELLIOTT / EBARA
- INGERSOLL-RAND POWERWORKS
- MARIAH ENERGY

GAS TURBINE GENSETS
- FAIRBANKS MORSE
- GE
- ROLLS-ROYCE
- SOLAR
- KAWASAKI
- VERICOR

ABSORPTION CHILLERS
- BROAD USA
- ENERGY CONCEPTS
- THERMAX-USA
- TRANE
- YAZAKI ENERGY
- YORK INTERNATIONAL

FOR MORE INFORMATION SEE WWW.POWERONSITE.ORG AND WWW.GASAIRCONDITIONING.ORG.

System Isolation Necessary

In the past, electric utilities often discouraged on-site generation because of well-founded concerns about interconnection safety. Today, transfer switches and system isolation gear, properly installed, have largely eliminated this concern. Nonetheless, owners contemplating an on-site generation project need to scrupulously follow local electrical codes and utility rules.

In locations where there is a need for cooling, a great opportunity is to use the generation byproduct heat to supply absorption chillers. Single-effect absorption chillers can operate using hot water in the 200°F to 250°F range, typical for the engine cooling water from a recip engine generation system. Special models are available that can use water temperatures as low as 158°F.

Additionally, there are absorption chillers available that can receive the exhaust gas from a combustion turbine and use it directly to generate chilled water.

Turbines Feed Double-Effect Absorption

Larger systems using industrial gas turbines can feed more efficient double-effect absorption units. An example of such an installation is at Clemson University in South Carolina.

According to Jeff Hinson of the University staff, "We were looking for new approaches in the energy market and were ready to consider a lot of new ideas." In 2000 the University installed two natural gas-fired combustion turbines, rated at 4.2 and 4.8 megawatts (MW) respectively. This reduced their peak electric demand by 40%. By use of a heat-recovery boiler that utilizes turbine exhaust, they generate steam for campus use. During the cooling months they use the steam to serve a Trane Horizon™ double-effect absorption chiller rated at 1,000 tons. As often happens, their peak months for cooling coincide with the times of greatest steam availability.

Getting Started in Evaluating Feasibility

A good first step in evaluating your suitability for CHP is to take a look at the CHP evaluation tool at www.poweronsite.org. There are many things to consider when you do an evaluation. You will need to consider electric demand charges as well as the electric usage charges, and in addition look to see if you have any winter demand penalties that might be reduced or disappear as a result of your potential project.

Unit Sized 1 kW and Up

Currently, self-contained microturbine generation units are available in sizes from 30 to 250 kW. Larger gas turbine units are of course also available in sizes up to several megawatts (MW). Similarly, reciprocating engine gensets rated for continuous duty are available in sizes from 1 kW to several MW.

In each case, you want to evaluate the experience of the manufacturer and should ask for examples of other customers who have units in service. Look for detailed information not only on the electric generation capability, but the thermal output of the units. This includes electric transfer switches, heat recovery equipment, and unit controls.

If the energy balance and the operating savings are right, it may be that CHP could open up new doorways to operating efficiency for your commercial building. Certainly it's worth considering.