

# Closing the CHP Loop

Cooling Makes a Good Idea Even Better



The Ronald Reagan Library Project was an ideal application for Integrated CHP because of its suitability for absorption cooling, using microturbine waste heat as a thermal source.



**On the cover:** Flexible underfloor heating systems using PEX tubing are also being used for snow-melting, turf warming, and space cooling applications.

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## AT A GLANCE

- ▶ Adding cooling to benefits of CHP
- ▶ Absorption cooling uses byproduct heat from electric generation
- ▶ Packaged systems simplify design, installation
- ▶ Controls integrate with building automation

## BUILDING COOLING A NEW OPTION

Recently, the concept has become more important for commercial and institutional buildings. Owners know that building cooling is a major energy use, and CHP can also support this need. Various terms have been created for this newer concept, including Integrated Cooling, Heating and Power (ICHHP) and Building Cooling, Heating and Power (BCHHP). Regardless of what you call it, the key to this additional feature is to use of some of the heat energy released by electric generation to operate a cooling system — typically an absorption chiller.

This idea makes special sense in the commercial sector because many buildings do not have a sufficiently high demand for steam or hot water to use all of the thermal energy from electric generation directly as heat. But by using thermally driven cooling equipment, the size of the electric generator can actually be reduced and the utilization of the thermal product is better.

## GROWING INTEREST IN ICHHP

According to Gearoid Foley, President of Integrated CHP Systems Corp., there has been a definite trend toward including cooling in CHP. His firm specializes in the design and development of prepackaged thermally activated technologies for integration with a variety of on-site electric generating technologies.

Foley notes, “The two basic reasons for the growing interest in ICHHP are rising energy costs,

**T**he Ronald Reagan Presidential Library and Museum posed a comfort system challenge. It not only included 95,000 square feet of space, but also a climate control requirement that was demanding. The facility’s Simi Valley, California, location has an extremely hot climate. The solution chosen was an integrated building cooling, heating and power system. This project is typical of the giant steps being taken today to include building cooling along with heating and electric supply.

## USING ON-SITE GENERATION

It’s not a new idea. The concept of CHP — *Combined Heat and Power* — has been around for a long time. In fact, Thomas Edison’s first central station electric generation plant in Manhattan also featured sales of system steam to nearby commercial and industrial customers. The concept is also called cogeneration and features the use of on-site electric generation as well as the use of the byproduct heat created by thermal generators — recip engines and steam or gas turbines.

which have increased the value of all forms of thermal output including cooling, and the fact that many state grants for CHP projects are conditional on meeting PURPA-type efficiency requirements which mean having a high load factor 12 months of the year.”

### ABSORPTION COOLING A KEY TECHNOLOGY

According to Foley, a wide range of thermal electric generation types can be used for integrated CHP applications. For chilled water production, Foley notes, “Single-stage absorbers are particularly well suited to use with recip engine-based systems.” He adds, “For larger systems where facility staffs are more experienced and the byproduct heat is at a higher temperature, two-stage absorbers and steam turbine chillers offer higher output and efficiency.”

Foley stresses the importance of sizing the system correctly, so that the cooling plant has adequate thermal energy to operate for the maximum number of hours annually. He notes, “We do try to make people understand that the efficiency of a chiller is of little concern if it isn’t running.”

### PAYBACKS LESS THAN FIVE YEARS

He feels that in North America, commercial building operators are only starting to explore the potential of CHP. “Even at projected commercial “burner tip” gas rates of \$9 per million Btu, most CHP configurations provide a payback in less than five years against commercial electric rates over 10¢ per kWh,” he said. Many regions of the country are already well above this level and we expect the trend to expand into other utility regions.”

Capstone Turbine Corporation manufactures and markets microturbines in the 30-65 kW range and also sees great potential for CHP systems including cooling for the commercial and institutional market sector. According to Capstone spokesman Steve Gillette, the high temperature exhaust gas of microturbines can generate steam or hot water, and can readily be adapted to supply either single-stage or two-stage absorption chillers.

### MICROTURBINES GENERATE HIGH TEMPERATURE EXHAUST

Gillette says Capstone is seeing growing interest in including cooling in the CHP mix, especially for commercial and institutional buildings. “Often these types of facilities do not have a high enough demand for steam or hot water to justify CHP, but when you add in cooling, it really makes sense.”

Like Foley, Gillette stresses the importance of sizing the electric generation system to the thermal load requirement. “This is the way to take advantage of the real economies of CHP. And by adding cooling to the mix, you smooth out the thermal load curve on an annual basis.”

### REAGAN LIBRARY USES PACKAGED MICROTURBINES AND ABSORPTION

This was the approach taken at the Ronald Reagan Presidential Library. The installed system consists of three PureComfort™ packages, each with four 60 kW Capstone microturbines and one 129-ton Carrier absorption chiller, plus four additional 60 kW microturbines. The direct exhaust-fired absorption chillers capture thermal energy from the microturbines and create 387 tons of refrigeration for cooling both the library and the pavilion.

Sixteen 60 kW microturbines produce 960 kW of total generating capability. Exhaust from these turbines raises the temperature of water to heat the pavilion during cooler periods. Because the cooling and power requirements of the complex vary greatly during the day, the use of the sixteen smaller microturbine units allows for ramping up and down as needed.

### ADVANCED CONTROLS INTEGRATE WITH BUILDING SYSTEM

Supervisory control provided by UTC Power allows the system to load follow in an efficient manner and also integrates with the building management system to provide the required cooling or heating. “We can give



**The equipment yard at the Ronald Reagan Library encompasses 16 Capstone microturbine units. Waste heat from 12 of the units supplies a Carrier absorption chiller. The other four supply building hot water.**

them heat when it’s cool and chilling when it’s warm,” says John Fox, Product Manager for PureComfort Systems at UTC Power. “For hot water, they run the exhaust from the microturbines through a heat exchanger.” A supplemental boiler produces additional hot water as required, he adds.

Rick Lyons, P.E., is Vice President of the Syska-Hennessey Group’s Energy Services Division of San Diego, the designer of the cogeneration system. He says his firm estimated this package will save roughly \$300,000 in annual operating costs, compared to using utility power.

### GAS UTILITY PROVIDES INCENTIVE

The system also qualified for a rebate through California’s Self-Generation Incentive Program, which is administered by the Southern California Gas Company for this location. This reduced the installation cost by about 30%. This program provides qualifying businesses with incentives of up to 50% of the costs of buying and installing combined heat and power systems.

For this installation, and for thousands of other commercial and institutional buildings around the country, an integrated CHP system could meet some or all of the buildings’ energy requirements. If you haven’t yet considered integrated CHP, your gas utility can work with you and your engineer to consider the possibilities.

## MORE INFORMATION

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