COMBINED Heat and Power

An Emerging Technology

More than 200 hospitals and healthcare facilities nationwide are using combined heat and power (CHP) as part of their comprehensive energy management programs to reduce energy costs by up to 50% and decrease power outages and interruptions by up to 95%, according to the Midwest CHP Application Center.

Fueled by electric industry deregulation, environmental concerns, unease over energy security, and a host of other factors, interest in CHP technologies has been growing among energy customers, regulators, legislators, and developers. CHP is a specific form of distributed generation, which refers to the placement of electric power generating units near facilities to supply on-site energy needs. Typically, CHP systems recover waste heat to generate hot water or steam and use it for process heating, but it can also be directed to an absorption chiller to provide process or space cooling. These applications are also known as cooling, heating, and power.

Hospitals represent one of the largest potential markets (7 GigaWatts) for commercial CHP applications. That's because many characteristics of hospital operations fit well with the technology. With 24/7 operations, hospitals have constant thermal and electrical load requirements. High occupancy levels create high load factors that help amortize the investment in CHP systems. Ownership of multiple buildings is another advantage, allowing electricity, heating, and cooling loads to be aggregated and served by a large central system that is more cost-effective than several smaller ones. In addition, the close proximity of campus buildings reduces the cost of connecting them to the hot water/steam/chilled water distribution pipes.

CHP Applications

CHP systems can be driven by reciprocating engines, combustion or gas turbines, steam turbines, microturbines, and fuel cells. These so-called prime movers are capable of burning a variety of fuels, including natural gas, coal, oil, and alternative fuels to produce shaft power or mechanical energy.

CHP may be used in a variety of healthcare applications, ranging from less than 100 kW to 5,000 kW systems. The first step in choosing the right CHP application for a particular facility is to identify whether there is coincident demand of electrical and thermal energy at the host site. The CHP project will be most economically viable when the system provides the maximum amount of energy that can be used. Therefore, CHP project development begins with an analysis of site electrical and thermal load profiles. These profiles determine the type of CHP technology which most closely matches the facility's power and demand.

Cost-effectiveness will improve when the purchase of a CHP system is timed to coincide with a major overhaul or replacement of the chiller or boiler. Additional factors influencing CHP project economics and design include the need for reliable backup power, the cost of electricity, the availability and cost of fuel, the system operating hours, and the impact of favorable or unfavorable policies and incentives in the region where the project is being considered.

Lower Energy Costs

Compared to conventional stand-alone equipment, CHP systems can save money through increased energy efficiency. CHP has the potential of converting 80 percent or more of the fuel into useable energy. These higher efficiencies enable CHP systems to consume nearly

40% less fuel than conventional systems while providing the same level of power reliability, cooling, heating, and indoor air quality. Energy savings of this magnitude also significantly reduce monthly power demand charges ($/kW) as well as peak electric energy costs.

Improved Power Quality

During peak days throughout the summer and winter, grid supplied hospitals are often plagued with voltage sags that cause fluctuations in frequencies which often wreak havoc on medical equipment. Some hospitals report as many as 70 disruptions of power a year, causing downtime of laboratory equipment, costly delays, and medical practice disruptions. CHP can help hospitals avoid these interruptions by providing continuous operation of clinical devices.

Increased Reliability

Safeguarding power sources is becoming a top priority for many hospitals. Whether it is from natural disasters, such as the hurricanes that devastated the Gulf coast in August or Florida last year, or accidents such as the one that plunged 50 million people into darkness across the Northeast and Midwest in 2003, emergency incidents can throw hospitals into crisis operations. Since CHP systems generate power on-site, many hospitals that utilize them are able to maintain power and provide medical services to the extent of their on-site generation capacity. CHP can also help reduce congestion on the electric grid by removing or reducing load in areas of high demand.

Lower Emissions

The U.S. Environmental Protection Agency supports combined heat and power because there are significant cost-effective emissions reductions that can be achieved by increasing efficient energy supply. The average efficiency of fossil-fueled power plants in the U.S. is 33% and has remained virtually unchanged for 40 years. This means that two-thirds of the energy in the fuel is lost–vented as heat–at most power plants in the United States. CHP systems achieve effective electric efficiencies of 50% to 70%. This improvement in efficiency is an excellent pollution prevention strategy that reduces emissions of air pollutants and carbon dioxide, the leading greenhouse gas associated with climate change. Furthermore, CHP may reduce electric transmission and distribution losses resulting in further efficiency gains.

Franciscan Sisters of Perpetual Adoration (La Crosse, WI)

The Franciscan Sisters of Perpetual Adoration (FSPA), a partner in EPA's CHP Partnership, manages a CHP system that powers a 1.3 million square foot campus

Is My Facility a Good Candidate for CHP?

If you answer "yes" to 3 or more of these of these questions, your facility may be good candidate for CHP.

Yes	No	
☐	☐	Do you pay more than $.06/ kWh on average for electricity (including generation, transmission and distribution)?
☐	☐	Are you concerned about the impact of current or future energy costs on your business?
☐	☐	Is your facility located in a deregulated electricity market?
☐	☐	Are you concerned about power reliability? Is there a substantial financial impact to your business if the power goes out for 1 hour? For 5 minutes?
☐	☐	Does your facility operate for more than 5000 hours/ year?
☐	☐	Do you have thermal loads throughout the year (incl. steam, hot water, chilled water, process heat, etc.)?
☐	☐	Does your facility have an existing central plant?
☐	☐	Do you expect to replace, upgrade or retrofit central plant equipment within the next 3-5 years?
☐	☐	Do you anticipate a facility expansion or new construction project within the next 3-5 years?
☐	☐	Have you already implemented energy efficiency measures and still have high energy costs?
☐	☐	Are you interested in reducing your facility's impact on the environment?

The next step in assessing the potential of an investment in CHP is to have a Level 1 Feasibility Analysis performed to estimate the preliminary return on investment. The EPA CHP Partnership offers a comprehensive Level 1 analysis services for qualifying projects and can provide contact information to others who perform these types of analyses. For more information, visit www.epa.gov/chp consisting of a hospital, university, and convent. Even though the scale of this CHP project is considered small by industry standards, cogeneration supplies up to 40 percent of the electricity used at the convent and is the primary heat source for the most of campus buildings.

Moving to CHP took several years and required collaboration between the three Franciscan institutions. After deciding to generate electricity from the steam that was being produced in the central heating plant, FSPA installed two steam turbine generators to create the electricity. As the campus expands, they have plans to connect steam pipes to new buildings. However, regulations limit the scale of electricity distribution; only FSPA buildings can receive energy from the FSPA district plant.

By producing a portion of their electricity, the FSPA reports that it saves $55,000 annually in utility costs. These savings will pay back the $440,000 cost of the generators in eight years. Kevin O'Neil, director of FSPA facilities services notes, "This system is a win for the FSPA and a win for the ecosystem. It saves on the utility bills and gives FSPA back-up protection during area power outages as well as reducing fuel consumption and harmful air emissions." ASHE

Clark Reed is the National Healthcare Manager for ENERGY STAR at the U.S. EPA. Last year, ENERGY STAR helped Americans save enough energy to power 24 million homes, reducing greenhouse gas emissions equivalent to that of 20 million cars—all while saving consumers $10 billion. To join, visit ENERGY STAR's website or contact the author at the U.S. Environmental Protection Agency - MC 6202J, 1200 Pennsylvania Ave NW, Washington, D.C. 20460. Email: reed.clark@epa.gov Phone: 202-343-9146