WHAT IS COMBINED HEAT AND POWER?

by

William Delmar, P.E.

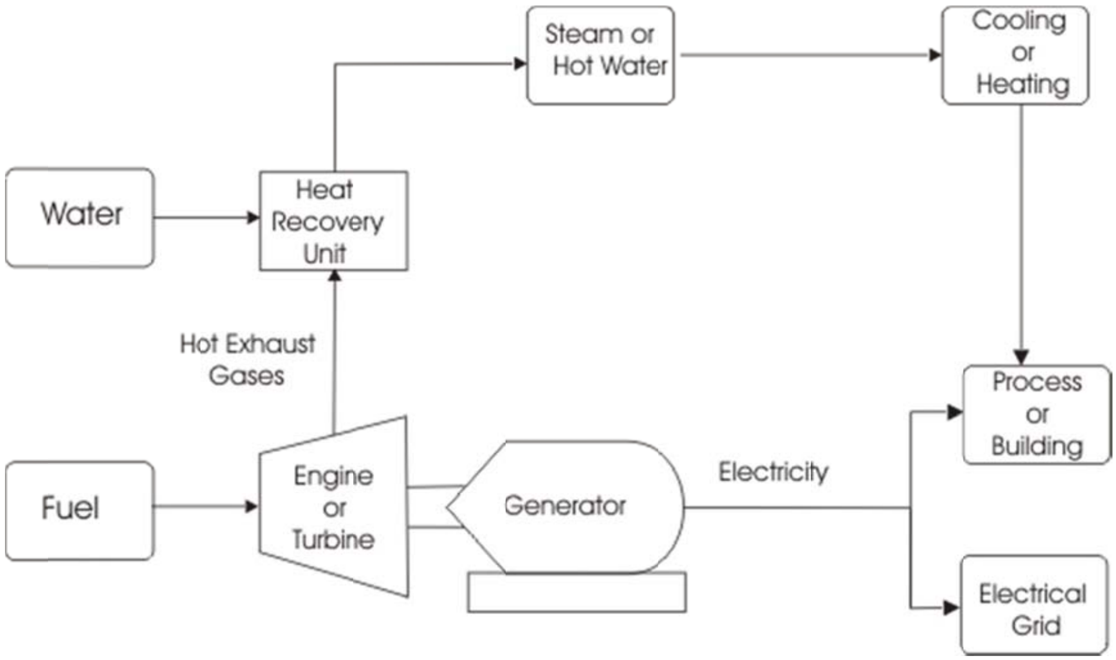

Figure 1. Combined Heat and Power Example System

Combined Heat and Power (CHP) is an attempt to make the most efficient use of any fuel source by using it several different ways. Thermodynamics tells us that energy is neither created nor destroyed, but the quality of energy degrades with each use, until its present usefulness is negligible and the energy, as heat, is discharged into the surroundings.

Since the beginning of commercial electricity production, there has been some degree of combined heat and power being produced and used. The first modern use of energy recycling was done by Thomas Edison. His 1882 Pearl Street Station, the world's first commercial power plant, was a combined heat and power plant, producing both electricity and thermal energy while using waste heat to warm neighboring buildings. Recycling allowed Edison's plant to achieve approximately 50 percent efficiency.

CHP (cogeneration) uses a heat engine or a power station to simultaneously generate both electricity and useful heat. When the main use of the energy is strictly to produce electricity, it is often called cogeneration, the concurrent production of electricity and steam. When it is less clear how the heat is used, such as building heating, it is now more often called combined heat and power.

All thermal power plants emit a certain amount of heat during electricity generation. This can be released into the natural environment through cooling towers, flue gas, or by other means. By contrast, CHP captures some or all of the by-product heat for heating purposes. In Scandinavia and Eastern Europe there is district heating that uses hot water with temperatures ranging from approximately 80 to 130 °C. This is also called Combined Heat and Power District Heating or CHPDH.

Small CHP plants are an example of decentralized energy. Industrial facilities such as refineries, chemical plants, or paper mills can use much higher quality steam products. They may use a natural gas-fueled turbine to generate electricity and then discharge very high temperature exhaust gases, which, in turn, heats water in boiler tubes to generate 600 psig or higher pressure steam. This high-pressure steam can be used to drive compressors and pumps within the facility, and the lower pressure steam discharged from these devices, 250 psig or 40 psig, can be used as heat in the processes within the plants. These can run equipment such as evaporators, product driers, or distillation columns, or even run various devices that produce cooling, such as chilled water.

While the simple explanation of the process described is a large industrial process, it is not always the case. There are now numerous smaller scale operations, often within a building complex or even a very large building, where fuel is used to generate some, or all, of the building's electrical load, and the resultant "waste heat" is used in a heating or cooling plant to deal with other building utilities.

Cogeneration has been used for many years in commercial buildings for large-scale applications such as generating energy for college campuses, hospitals, and commercial buildings in campus-like settings where there is considerable power and thermal demand. Currently, reciprocating engines are the most common and most efficient prime movers (engines) used in commercial cogeneration systems because of their cost, reliability, and availability. However, micro-turbines, fuel cells, and Stirling engines may be economically viable for cogeneration in the next few years as technology advances.

A new report, *Combined Heat and Power: A Clean Energy Solution*, provides a foundation for national discussions on effective ways to achieve 40 GW of new, cost-effective CHP by 2020 and includes an overview of the key issues currently impacting CHP deployment and the factors that need to be considered by stakeholders involved in the dialogue.