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Advancing Clean Energy for a Sustainable Economy

Clean Power & Industrial Efficiency | www.nccleantech.ncsu.edu

Combined Heat & Power

About CHP

Combined Heat and Power (CHP), also known as cogeneration, is the concurrent production of electricity or mechanical power and useful thermal energy (heating and/or cooling) from a single source of energy.

CHP is a type of distributed generation, which, unlike central station generation, is located at or near the point of consumption. Instead of purchasing electricity from a local utility and then burning fuel in a furnace or boiler to produce thermal energy, consumers use CHP to provide these energy services in one energy-efficient step. As a result, CHP improves efficiency and reduces greenhouse gas (GHG) emissions. For optimal efficiency, CHP systems typically are designed and sized to meet the users' thermal baseload demand.

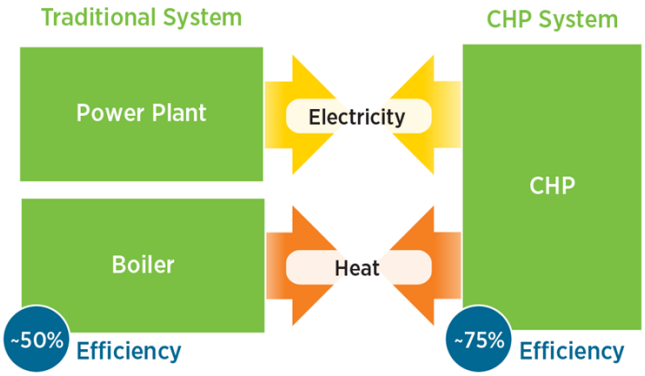
CHP has been employed for years, mainly in large commercial, industrial, and institutional applications. The U.S. Department of Energy reports 82 gigawatts (GW) of existing CHP capacity in the United States with technical potential for twice as much to meet existing energy demands[1]. An Executive Order issued in August 2012 calls for an additional 40 gigawatts of CHP to be developed by the year 2020 to realize the energy and economic benefits of this resource.

What a CHP System Produces

CHP is unique among electricity-producing technologies and methods because it generates more than one output. For most industrial applications, the thermal energy produced by the systems is the most valued output; clean electricity is an ancillary benefit that helps to control energy costs and reduce grid power demand.

CHP systems can provide the following useful outputs:

Electricity	Direct mechanical drive
Steam or hot water	Process heating
Cooling	Dehumidification



Efficiency Benefits of CHP

CHP Technologies

CHP systems are complex, integrated systems that consist of various components ranging from prime mover (heat engine), generator, and heat recovery, to electrical interconnection.

CHP systems typically are identified by their prime movers or technology types, which include:

Reciprocating Engines	Steam Turbines
Gas Combustion Turbines	Micro-turbines

Each of these CHP prime mover technologies produce excess heat that is recovered for another thermal energy need, such as space heating, domestic hot water, air conditioning, humidity control, process steam for industrial steam loads, product frying, greenhouses, or nearly any other thermal energy need. The end result is significantly more efficient than generating power, heating, and cooling separately. Some of the technologies that run on the recovered thermal energy are:

Absorption Chillers
Adsorption Chillers
Desiccant Dehumidifiers
Heat Recovery Steam Generators

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Fuels for CHP

CHP is not a fuel-specific technology. Even with price volatility in natural gas markets in recent years, natural gas is still the predominant fuel for CHP systems. While fossil fuels such as coal and oil will continue to be utilized, the ability of CHP systems to operate on cleaner fuels - including biomass, wood, and opportunity fuels such as landfill and digester gas—makes them key to developing a balanced and sustainable energy portfolio.

CHP Emissions

CHP and other forms of waste heat energy recovery typically reduce total air emissions by half compared to grid-supplied power and separate onsite thermal systems. However, CHP systems are still required to meet environmental permitting requirements that regulate the emission of pollutants into the air.

History of CHP

Decentralized CHP systems located at industrial sites and urban centers were the foundation of the early electric power industry in the United States. In fact, the nation's first commercial power plant, Thomas Edison's Pearl Street Station, which began operations in New York City in 1882, served lower Manhattan with both electricity for lighting and steam for local manufacturing. However, as power generation technologies advanced, the power industry began to build larger central station facilities to take advantage of increasing economies of scale.

Partly in response to the oil crisis of the early 1970s, Congress in 1978 passed the Public Utilities Regulatory Policies Act (PURPA) to promote energy efficiency. PURPA encouraged energy-efficient CHP and power production from renewables by requiring electric utilities to interconnect with "qualified facilities" and to purchase excess electricity from them at the utilities' avoided costs.

Today, CHP is being encouraged through tax credits, renewable and energy efficiency portfolio standards, and loan programs across the country.

U.S. DOE Southeast CHP Technical Assistance Partnership

The U.S. DOE CHP Technical Assistance Partnerships (CHP TAPs) promote and assist in transforming the market for combined heat and power, including waste heat to power and district energy, throughout the U.S. The Southeast CHP TAP works in ten states: Alabama, Arkansas, Florida, Georgia, Kentucky, Louisiana, Mississippi, North Carolina, South Carolina and Tennessee.

The CHP TAP assists prospective adopters of clean energy, fosters clean energy technologies as viable technical and economic options in the region, coordinates networks of stakeholders, and supports energy policy makers.

For more information visit http://www.southeastchptap.org/
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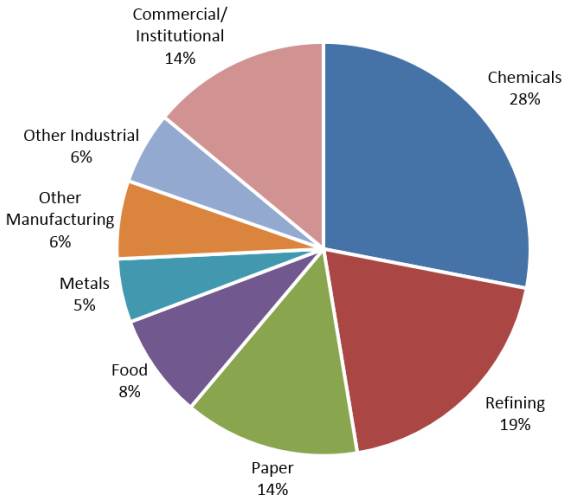

Existing CHP Capacity by Industry

Source: US DOE 2015