

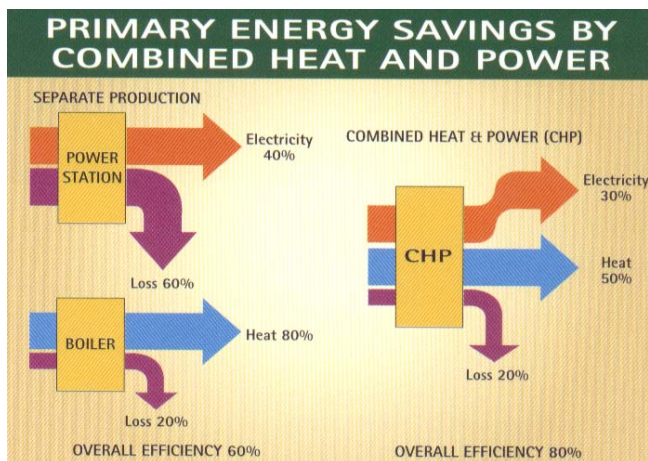
# Combined Heat and Power



## What is CHP?

Combined Heat and Power, or CHP as it is more commonly referred to, is the simultaneous generation of electricity and heat in a single process.

Applications that are generally suitable for co-generation include hotels, hospitals, industrial processes and commercial buildings, where a continuous demand for heat and power exists for a minimum of 5 000 hours per annum.



## What are the advantages of CHP?

CHP or cogeneration provides a potentially cost effective way of servicing the simultaneous heating and electrical demands of commercial and industrial processes.

The main advantages of CHP are:

- reduced energy costs,
- reduced CO<sub>2</sub> emissions, making a valuable contribution to the environment,
- enhanced security of energy supply
- conservation of valuable resources.

## How does it work?

CHP applications can be divided into two broad categories based on design output: small scale (typically less than 1 MW) and large scale (greater than 1 MW).

Small scale CHP is particularly suitable for applications such as hotels, hospitals and leisure centres, where there is a steady demand for heat and power throughout the year.

The CHP unit consists of a reciprocating engine, which is mounted on an acoustic enclosure. Heat exchangers recover heat from the engine exhaust gases and cooling system to produce hot water, which can be integrated into the site services. The unit is normally designed to meet the site's base heat and electrical power requirements. Peak heating demand can be supplied using high efficiency modular gas boilers to provide additional hot water, with additional electricity being imported from the national grid. A control system will allow the automatic operation of the unit to meet the heat and power demands of the site.

## Which technologies exist?

The most important and distinctive part of a co-generation system is the engine.

Cogeneration cycles can be classified into four basic types according to the engines used:

- cycle with steam turbines
- cycle with gas turbines
- cycle with endothermic engine
- combined cycle

### Steam turbines

The steam turbines are the most widely used type in municipal cogeneration systems. However, this technology is also applied for industrial uses when high temperature heat is needed. Steam

turbines are used in many industrial sectors, such as agro food, textile, iron and steel, etc.

### Gas turbines

Compared with the other types of engine, the gas turbine is relatively young, having developed greatly in the last 40 years. Gas turbines are widely used both in industry and in the non-residential building sector, when high temperature thermal energy is needed for continuous use during the day and throughout the year (as in hospitals).

The electric power range supplied by these turbines is quite wide: 250-500 kW for small turbines up to 50-200 MW for big units.

### Endothermic engines

Endothermic engines are the most flexible machines and are particularly suited to low temperature use. It is possible to exploit both heat coming from the exhaust gases, at 400-600 °C, and the heat recovered from other sources at lower temperature, such as cooling water, lubricating oil, supercharging air and heat radiating from the engine or from the generator.

Endothermic engines are widely used in small plants because they allow compact and effective modular systems, where several small power units are assembled in one system.

There are two main types of endothermic engines: diesel engines and Otto engines.

### Combined cycle plants

Some combined heat and power plants can combine two thermodynamic cycles: gas turbines and steam turbines connected in series. They are mainly used in industry or when there is a high power demand.

### Which parameters to consider?

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The parameters to be considered when selecting the most suitable engine are:

- electrical and thermal power required
- temperature of thermal energy required by the user
- load diagrams from which the ratio between the electrical energy and thermal energy required by the user and the number of hours at full load can be deduced
- availability and cost of fuel
- distance of heat users from the generating unit
- laws and regulations and options for connection to the national electricity grid
- plant reliability and its organization and management

### What are the costs?

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Determination of the cost of equipment presupposes a knowledge of the various parameters that influence it. The price of the engine depends on the number of cylinders, speed of rotation and the presence or absence of turbo charging.

Variable costs include fuel, maintenance, control and supervision, of which the fuel cost is the most important. The following factors determine variable costs:

- the cost of fuel itself
- the intrinsic characteristics of the engine
- required energy output
- utilisation of the plant

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