Block CHP plants with diesel and gas engines

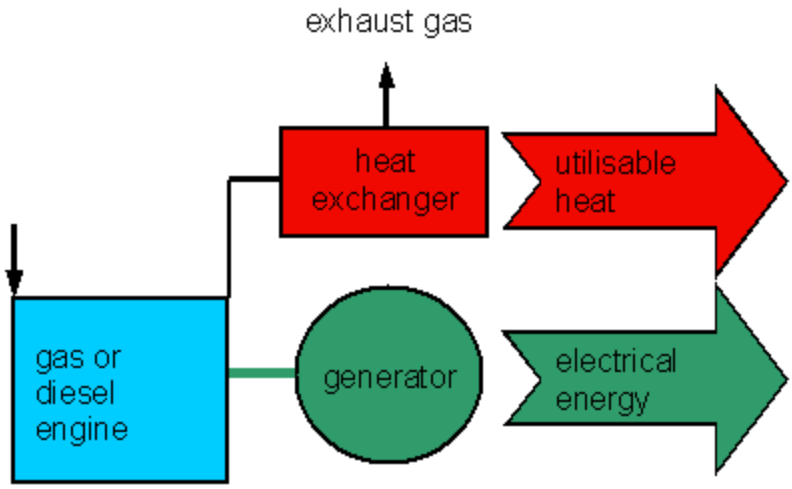
Diesel and gas engines are often used as block heat and power plants (also see CHP concepts).

Definition of a block heat and power plant: A block heat and power plant is a CHP plant which is completely installed, delivered and run as a "block".

>> Basic principle

- Mechanical energy (gas and diesel engine) is converted into electrical energy with the help of a generator.
- Hot exhaust gases are used for providing heat.

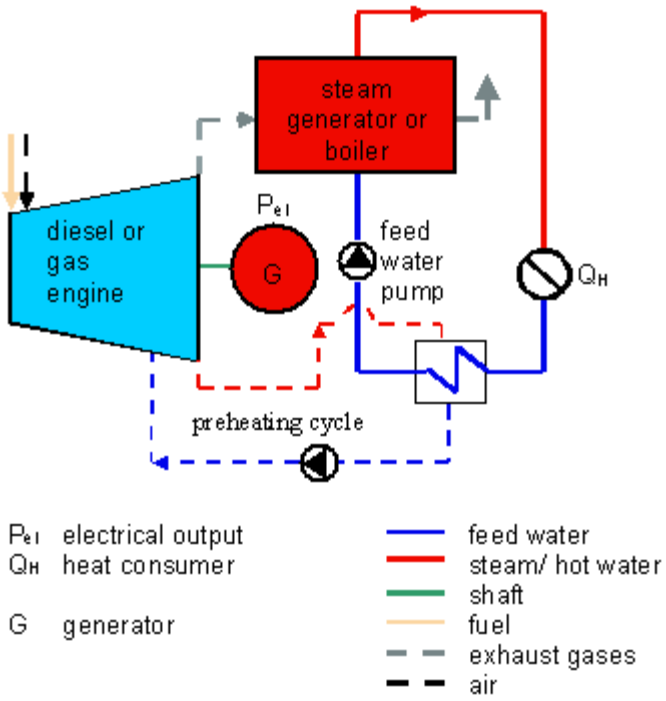
Figure 20: Basic principle of a block heat and power plant



Functionality

The generator is converting mechanical work produced at the engine shaft into electrical energy. The heat resulting from combustion during power generation is used for process heat supply or heating purposes. Exhaust gases and engine cooling water function as heat sources.

Figure 21: Diesel and gas engine block CHP plants



>> General information on block CHP plants with diesel and gas engines

Application

- For decentralized power and heat supply of lower to medium output (from ~15 kWel upwards)
- Examples: housing estates, industry (drying processes), hospitals, sewage plants (utilization of sewage gas)

Possible fuels

- gas
- biogas (sewage gas, landfill gas)
- diesel
- gas from biomass gasification, methanol, rape oil
- gasification products

Advantages

- Power and heat are generated right at the spot where they are needed and thus big transmission losses like they occur in district heating networks can be prevented.
- Overall efficiency of such block heat and power plants amounts to 85% and more referring to the end user. Thus its efficiency is up to 10% higher than in conventional district heating plants.
- Reduction of primary energy consumption with the help of high efficiency Ø t
  - through waste heat utilization of exhaust gases
  - though waste heat utilization of engine cooling
  and therefore
- Reduction of environmental pollution through waste heat and harmful substances.
- Modular design is possible Ø
  - Adjustment to variable power requirements is possibleØ
  - Maintenance work on one of the modules is possible while the other modules are at work.
- Low maintenance expenditure
- Many providers available

Disadvantages

- High temperature heat supply is not possible (temperature level of waste heat is too low)

In table 13 some data from a plant within a certain range of performance is outlined.

Table 13: Data of a block heat and power plant

Plant size ~30-75 MWel	Unit	Value
Specific investment costs	[EUR/kWel]	1.250 - 1.800
Specific maintenance costs	[EUR/kWhel]	~ 0,2 - 0,3
Electrical efficiency [etha]el	[%]	28 - 31
Thermal efficiency [etha]el	[%]	52 - 57
Overall efficiency	[%]	80 - 88
Emissions (NOx) 1)	[mg/Nm³]	100 - 250
1) based on 5% O_2 in exhaust gas		

High efficiency is reached at normal flow temperatures of up to about 90°C. In the water flow temperatures of about 120°C can be reached by using hot-cooled engines.

Best operational mode

Power or heat operated

Design

Usually various modules, each consisting of a gas or diesel engine, a generator and a heat exchanger, are connected in parallel. According to the requirements one or more modules can be operated so that the individual units can be run near full load in a favorable efficiency range. Another advantage is that maintenance work and repairs at multi-module plants can be carried out easier.

Figure 22 shows an example of modular concept.

Figure 22: Block CHP plant with modular construction (Source Jenbacher)

Another extension possibility for a block heat and power plant is to use a combination with an absorption refrigerating machine which uses waste heat of the exhaust gas for generating cold. This combination is particularly favourable if besides heat there is also cold required, e.g. for air conditioning.

Control

Control can be achieved through the fuel supply.

Maintenance

Maintenance intervals amount to 2000 hours.

Ecological aspects

The exhaust gas resulting from combustion is cleaned in a catalyst. Exhaust gas emissions are usually below the permitted. Incidental amounts of waste oil have to be disposed of separately.

Stage of development

Block heat and power plants with gas and diesel engines are very well-established and therefore used in big quantities all over the world.

In the future, operator convenience of the plants is to be increased so that an automatic control of plant conditions is transmitted to plant administrators via internet. This allows them to react quicker to possible malfunctions.

Some important parameters regarding stage of development and outlook are summed up in the following table.

Table 14: Stage of development / outlook

Stage of development / outlook	status
Present stage of development	ready for the market 1)
Short term cost reduction potential	medium 2)
Short term development potential	medium 2)
1) Stages of development: concept stage, laboratory stage, pilot stage, demonstration stage, market maturity 2) 1 year...high, 2 years...medium, 3 years...low	