



A Collection of Primary Tools



Tool GI 2 - Energy efficiency and cogeneration

What this tool does:

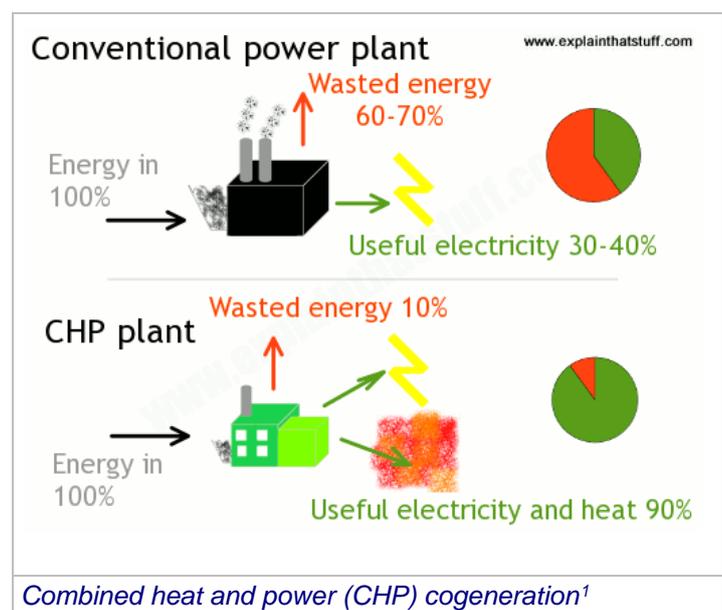
This tool helps industry and city CEOs to decide about the use of cogeneration new (or existing) energy choices for new industries being developed in their city.

How does it work?

Infrastructure needs to be developed which shares energy production and distribution adapted to industrial on-site demand, and off-site city demand: shared production and production of heat and steam for industrial processes (e.g. through efficient cogeneration plants fuelled by waste and biomass) and shared infrastructures for electricity production is using renewable energies. Developing shared infrastructures for wastewater collection and (pre-)treatment to mutualize water management is an additional feature of the design of cogeneration infrastructure. CHP is most efficient when heat can be used on-site or very close to it. Overall efficiency is reduced when the heat must be transported over longer distances. This requires heavily insulated pipes, which are expensive and inefficient; whereas electricity can be transmitted along a comparatively simple wire, and over much longer distances for the same energy loss.

According to the IEA 2008 modeling of cogeneration expansion for the G8 countries, the expansion of cogeneration in France, Germany, Italy and the UK alone would effectively double the existing primary fuel savings by 2030. This would increase Europe's savings from today's 155.69 Twh to 465 Twh in 2030. It would also result in a 16% to 29% increase in each country's total cogenerated electricity by 2030.

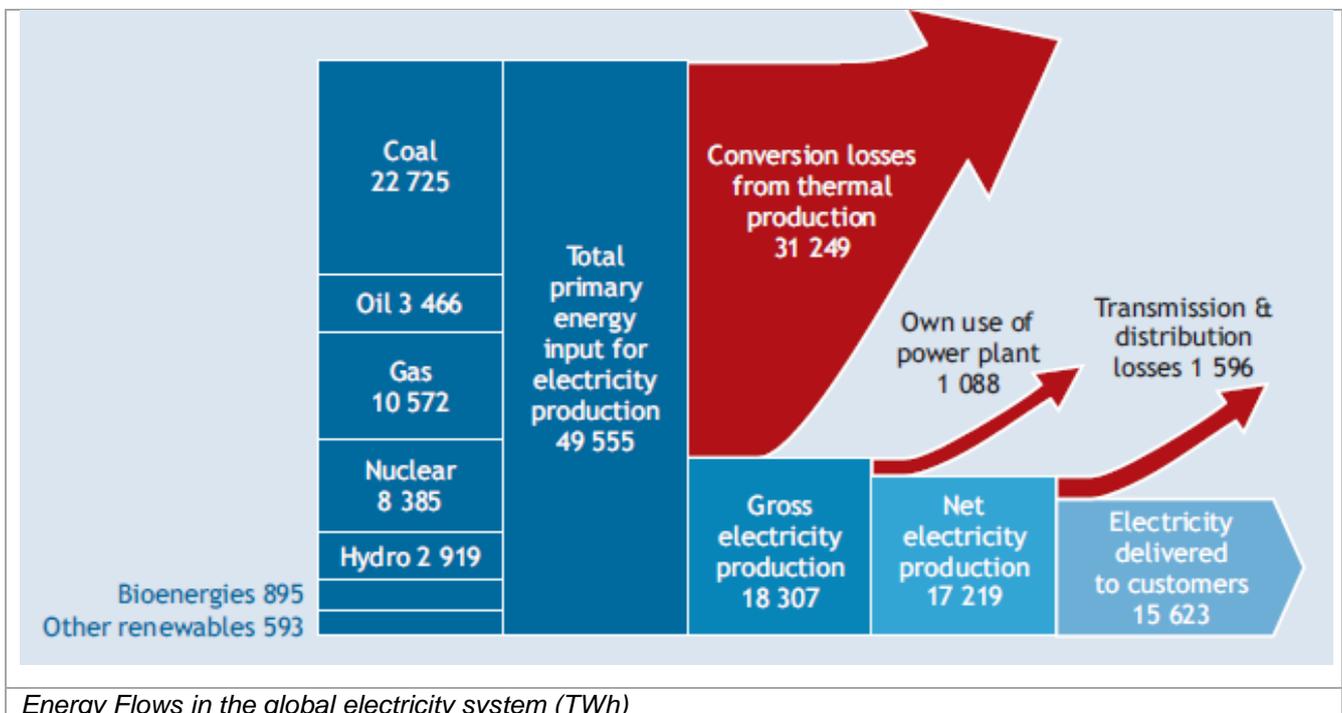
Cogeneration or **combined heat and power (CHP)** is the use of a heat engine or power station to generate electricity and useful heat at the same time. **Trigeneration** or **combined cooling, heat and power**

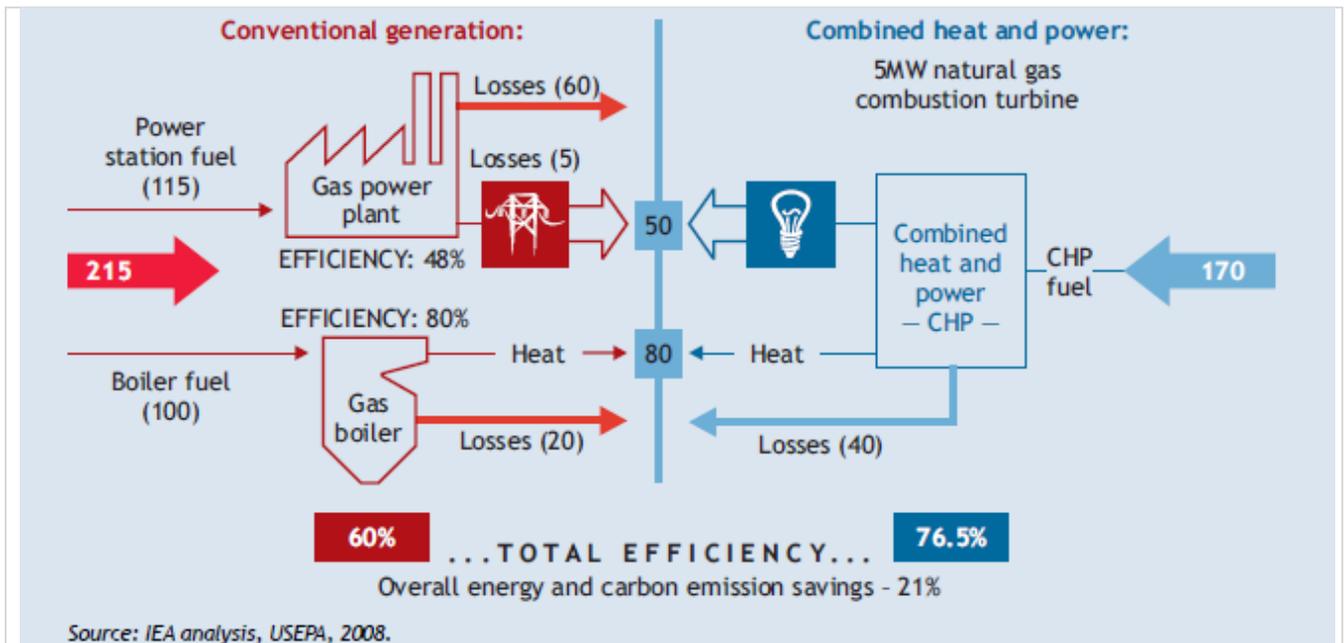


(CCHP) refers to the simultaneous generation of electricity and useful heating and cooling from the combustion of a fuel or a solar heat collector. Cogeneration is a thermodynamically efficient use of fuel. In separate production of electricity, some energy must be discarded as waste heat, but in co-generation some of this thermal energy is put to use. All thermal power plants emit heat during electricity generation, which can be released into the natural environment through cooling towers, flue gas, or by other means. In contrast, CHP captures some or all of the by-product for heating, either very close to the plant, or—especially in Scandinavia and Eastern Europe—as hot water for district heating with temperatures ranging from approximately 80 to 130 °C. This is also called **combined heat and power district heating (CHPDH)**. Small CHP plants are an example of decentralized energy. By-product heat at moderate temperatures (100–180 °C, 212–356 °F) can also be used in absorption refrigerators for cooling.

The supply of high-temperature heat first drives a gas or steam turbine-powered generator and the resulting low-temperature waste heat is then used for water or space heating as described in cogeneration. At smaller scales (typically below 1 MW) a gas engine or diesel pump engine may be used. Trigeneration differs from cogeneration in that the waste heat is used for both heating and cooling, typically in an absorption refrigerator. CCHP systems can attain higher overall efficiencies than cogeneration or traditional power plants. In the United States, the application of trigeneration in buildings is called **building cooling, heating and power (BCHP)**. Heating and cooling output may operate concurrently or alternately depending on need and system construction.

Cogeneration was practiced in some of the earliest installations of electrical generation. Before central stations distributed power, industries generating their own power used exhaust steam for process heating. Large office and apartment buildings, hotels and stores commonly generated their own power and used waste steam for building heat. Due to the high cost of early purchased power, these CHP operations continued for many years after utility electricity became available.²





Efficiency Gains of CHP – one example (all values HHV)³

Authors:

Christine Rud Wennerberg, SWECO
 With Florian Steinberg, EC-Link

Editor: Kosta Math y

References

- ¹ <https://cdn4.explainthatstuff.com/combined-heat-power-plant-efficiency.png>
- ² <https://en.wikipedia.org/wiki/Cogeneration>
- ³ Source: International Energy Agency. 2008. Combined Heat and Power. Evaluating the benefits of greater global investment. p.10. https://www.iea.org/publications/freepublications/publication/chp_report.pdf