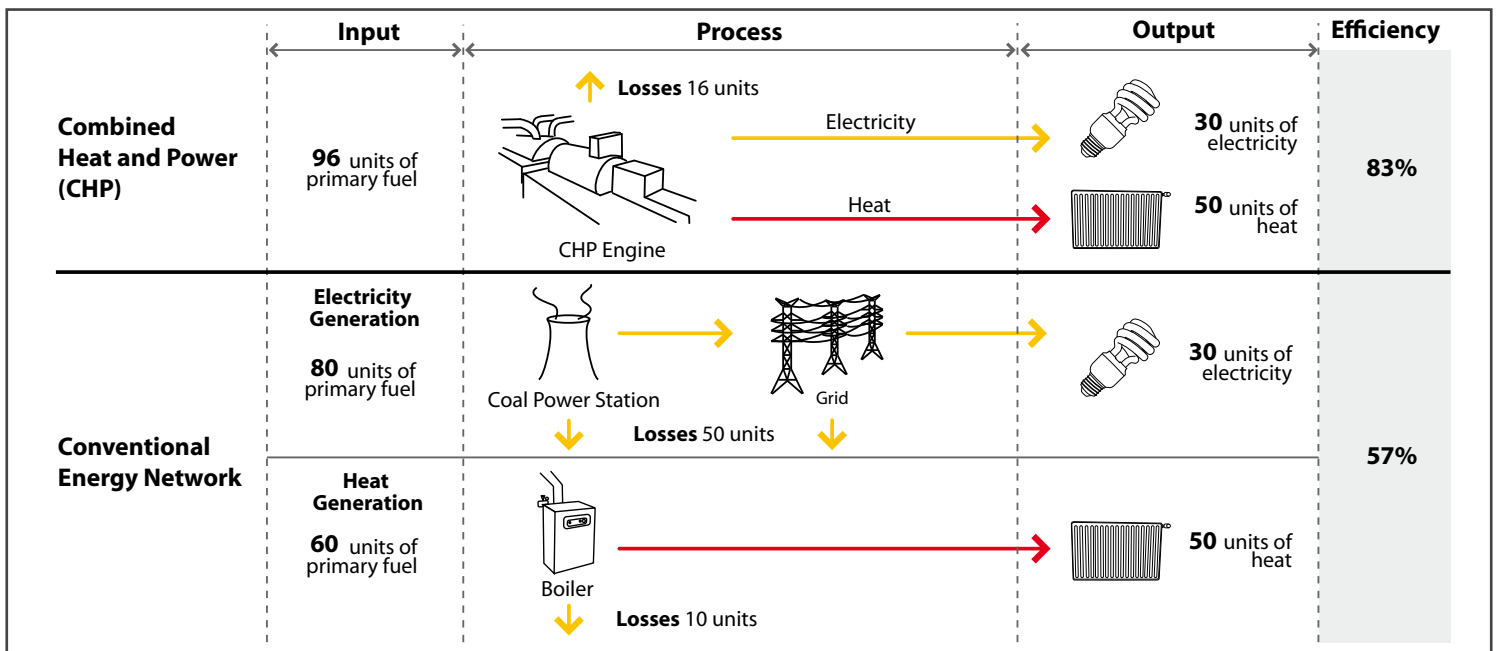




02: Combined Heat and Power/Trigeneration

Combined heat and power (CHP) is a system where heat, which is usually lost during the electricity generation process, is recovered and used. This results in much greater overall efficiencies than grid-supplied electricity and, therefore, carbon emissions are usually reduced. In addition, a trigeneration system can convert the waste heat into chilled water for cooling uses with the inclusion of an absorption chiller.



Building Scale CHP

- CHP is generally suitable for the following types of building due to their high constant heat demand:
 - Hotels
 - Hospitals
 - Leisure Centres (especially with swimming pools)
 - Universities
- In addition to these building types, any mixed use development, such as offices and retail, may also be feasible as, together, they provide a constant heating demand.
- The feasibility of CHP for any building relies on many factors (see Building Evaluation); however, a good heat baseload is usually essential.



Micro CHP

- Micro CHP is a relatively new technology that attempts to service buildings with low heating loads (<50kW).
- Systems between 10kW - 50kW aim to serve small complexes, such as nursing homes or small housing estates.
- Even smaller units (<10kW) which are designed to replace individual boilers in dwellings are rare although several new units are expected to be released in the near future.
- Questions over the viability of these sub-10kW CHP engines remain due to the inconsistent heat demands of individual dwellings.



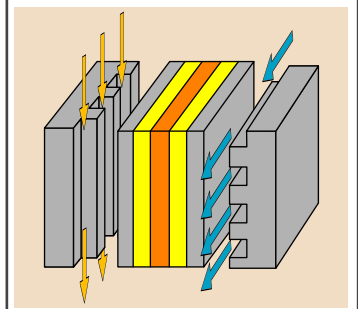
Biomass CHP

- Biomass fuel can be any form of fuel that is derived from recently dead biological matter.
- The most common forms of biomass are:
 - wood chip/pellet
 - biodiesel/bioethanol/biogas
- Wood based biomass CHP is only typically suitable for large scale power production in biomass power stations.
- Smaller units, in the region of 100kW are becoming available but are not yet widespread.
- Biodiesel, bioethanol and biogas can usually be used in standard CHP engines with little modification.



Fuel Cell CHP

- Fuel cells are electrochemical devices that convert fuel, for example hydrogen or natural gas, directly into electricity.
- The main advantages of fuel cell CHP over traditional mechanical CHP is the greater degree of modulation and the heat-to-power ratio is typically much lower (see glossary).
- Fuel cell CHP is potentially more viable for domestic markets as the power generated per unit of heat is greater than non-fuel cell CHP.
- Currently, there are very few small-scale fuel cell CHP engines available; however, the technology is developing quickly and costs are falling rapidly.



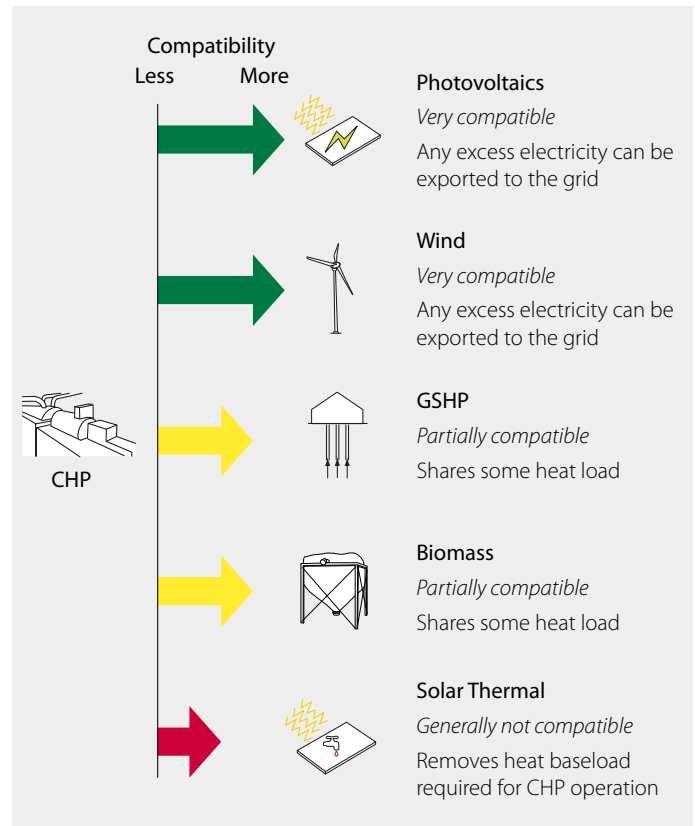
Trigeneration

- Trigeneration makes use of the waste heat for cooling purposes.
- An absorption chiller converts the heat from the CHP engine into chilled water.
- Heat can be used for heating purposes during the winter and, with the application of the chiller, can provide cooling during the summer.
- Because of this, Trigeneration can result in much larger installations than CHP providing much greater environmental and financial benefits.
- Single, double and triple-stage absorption chillers require different temperatures to operate.
- Most building-size applications will use single-stage absorption chillers which typically have a coefficient of performance (COP) of 0.6 - 0.7.
- Absorption chillers can require significant heat rejection infrastructure and is likely to be expensive.

Building Evaluation

- Heat and electricity demand - Ideally the hourly heat and electricity demand of the development is required. However, in the case of new developments, assumptions have to be made as to the likely energy consumption patterns throughout the year.
- Space implications - CHP plant is larger than typical boilers and will require more plant space.
- Fuel type - Certain gas pressures are required and oil/biomass CHP will require large storage space.
- Noise implications - noise attenuation may be needed and noise levels in adjacent areas, air inlets, exhaust outlets and nearby buildings should be considered.
- Vibration - anti-vibration mounting of engine and pipework may be required.
- Stack height - special consideration must be taken when specifying exhaust gases and flue heights.
- Location - CHP engines can be situated in plant rooms, on roofs and externally in weather-proof enclosures.

Integration with Renewable Technology



London Plan

- The London Plan provides an approach for reducing the operational carbon emissions of new developments.
- This is commonly known under the mantra "Lean, Clean, Green", which denotes the order of improvements to be made.
- Lean - passive design energy efficiency measures
- Clean - CHP, Trigeneration and/or district heating networks
- Green - Renewable energy technologies (biomass, wind, solar thermal, etc.)
- Incorporating CHP or Trigeneration into a new development reduces the quantity of renewable technology needed to meet the 20% target.
- Depending on the type of development, the post-efficiency CO₂ emissions can be reduced by 5 - 15%.

XCO2 Energy Services

When specified correctly, CHP can produce good carbon savings and provide short payback periods of only five to ten years.

Our services include:

- **CHP Sizing** - Feasibility study for installing CHP in either new developments or retro-fitting into existing buildings.
- **Site-wide Energy Strategies** - CHP integration into large-scale developments, energy networks and district heating.
- **Multi-Utility Service Company (MUSCo) Feasibility Studies** - Investigation into economic viability in terms of return on capital investment for site-wide services strategies.
- **Energy Statements** - Local Authority planning application reports considering energy efficiency, clean technologies and renewable technology feasibility.

Glossary

- **Cogeneration** - CHP is sometimes referred to as cogeneration.
- **Coefficient of Performance (COP)** - A ratio of the heat energy extracted for each unit of heat energy inputted. e.g. a COP of 0.6 means that for every unit of heat supplied, 0.6 units of cooling is provided.
- **Heat-to-power ratio** - The ratio of heat output to power output. e.g. an engine that produces 100kW of heat and 50kW of power would have a ratio of 2:1 (100/50). Micro CHP engines (domestic) typically have ratios of 3:1 - 15:1, small-scale systems (large buildings) have ratios of 2:1 and large systems (district energy power stations) have ratios of 1:1.
- **Baseload** - The minimum amount of heat or power required for a CHP engine to be feasible.
- **Modulation** - The ability of an engine to work below full capacity. Most CHP engines can only modulate to approximately 75% of full power before shutting down.
- **Load Profile** - a graph showing a particular building load (e.g. heat) throughout the year enabling a visual representation of the CHP operation. This is usually an hourly profile.
- **CHCP/CCHP** - Trigeneration is sometimes referred to as either "Combined Heat, Cooling and Power" or "Combined Cooling, Heat and Power".
- **Spark Gap** - The difference in price between a kWh of electricity and gas. The "wider" the gap, the greater are the economic benefits that can be obtained from CHP.
- **Climate Change Levy (CCL)** - A levy imposed on electricity (0.456p/kWh) and gas (0.159p/kWh). Certain CHP installations can be exempt from this levy (see Good Quality CHP) providing an additional economic incentive.
- **Good Quality CHP** - Through a process known as CHP Quality Assurance, a CHP engine can be certified as "Good Quality". Any CHP installation that meets these requirements is exempt from paying the CCL.