**Combined heat and power**

Consider a conventional (ie coal or gas-fired or nuclear) power station that uses a heat engine,

usually a steam or gas turbine, to drive an alternator to generate electricity. The engine will

obey the laws of thermodynamics, and if it operated between say upper (source) and lower

(sink) temperatures of 500 C (773 K) and 25 C (298 K) its maximum theoretical efficiency will be

61%. In practice the power station is unlikely to be more than about 35%

efficient. This means that it is nearly twice as good at sending heat into the surroundings (via

cooling towers and the local river or sea) than it is at generating electricity. In fact power

stations could be thought of as massive heaters with electricity generation as a by-product. In

CHP plants, instead of this thermal energy going to waste, it is harnessed for other purposes,

usually space heating for houses, factories, business units or horticulture, eg for heating

greenhouses. Because many large power stations and nearly all nuclear power stations are

sited away from centres of population, large scale CHP has not enjoyed much popularity in

Britain. If smaller electrical generation schemes using heat engines (steam, gas turbine or

diesel) were set up near where people live and work, and the energy rejected from the engine

were used for local heating, the useful energy per kg of fuel burned would be increased

enormously. CHP schemes are most likely to be of benefit to enterprises that use plenty of

thermal energy, for example hospitals, schools, and chemical, brewing and paper industries.

In some of these the CHP generating plant may need to be screened for noise.

A car internal combustion engine is typically 35% efficient. It, too, is in effect a heater. A large

car pulling up a hill at maximum power will be sending thermal energy to its surroundings via the

exhaust and radiator at a rate equal to the heating needs of a small junior school. The move

toward regenerative braking and hybrid power units goes some way to improve fuel consumption

and reduce CO2 emissions, but the basic drawback of low efficiency will not be overcome. Electric powered vehicles using electricity generated in CHP plants will, of course, not produce as much .waste heat overall.

1. Show that the maximum efficiency is 61%
2. Explain in detail why large scale CHP has not taken off in the UK
3. Give three ways of making this method of saving energy more usable in the UK
4. Explain how using CHP benefits the environment