Environmental Studies
FACT SHEET
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Coal-Fired Power Stations

Coal mining in the UK remains in decline. However, we still managed to extract 29 million tonnes in 2002/3 – 17 million tonnes from deep mines and 12 million tonnes form open-cast sites. Over the same period we imported another 29 million tonnes, mainly from Australia, Poland, Columbia, South Africa and the USA. Most of this coal is used for generating electricity (Table 1).

Table 1. Source of electricity in UK

Source of UK electricity	Percentage contribution
Gas	38
Coal	32
Nuclear	23
Renewables	7

Fig 1. Main features of a coal-fired power station

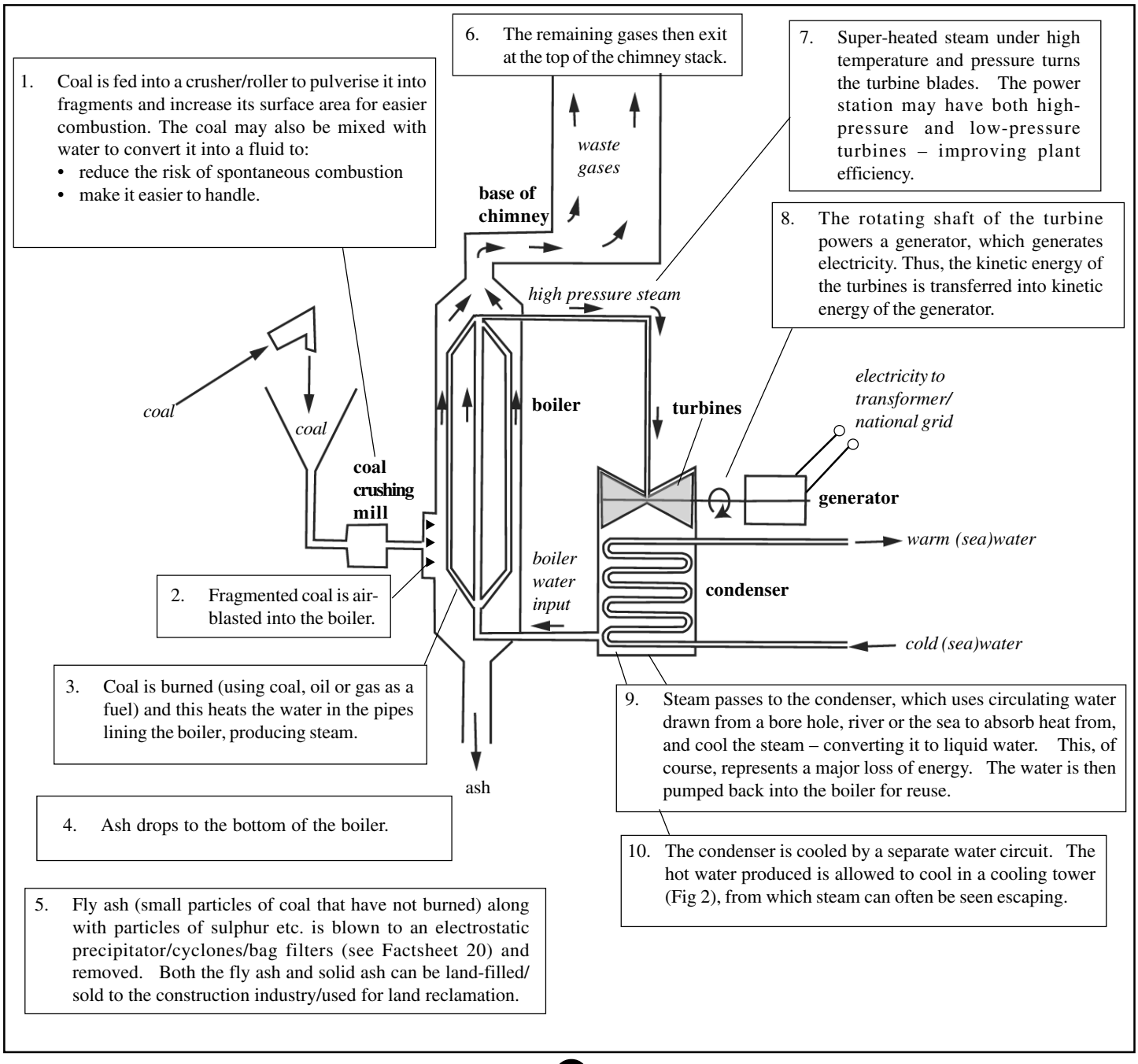
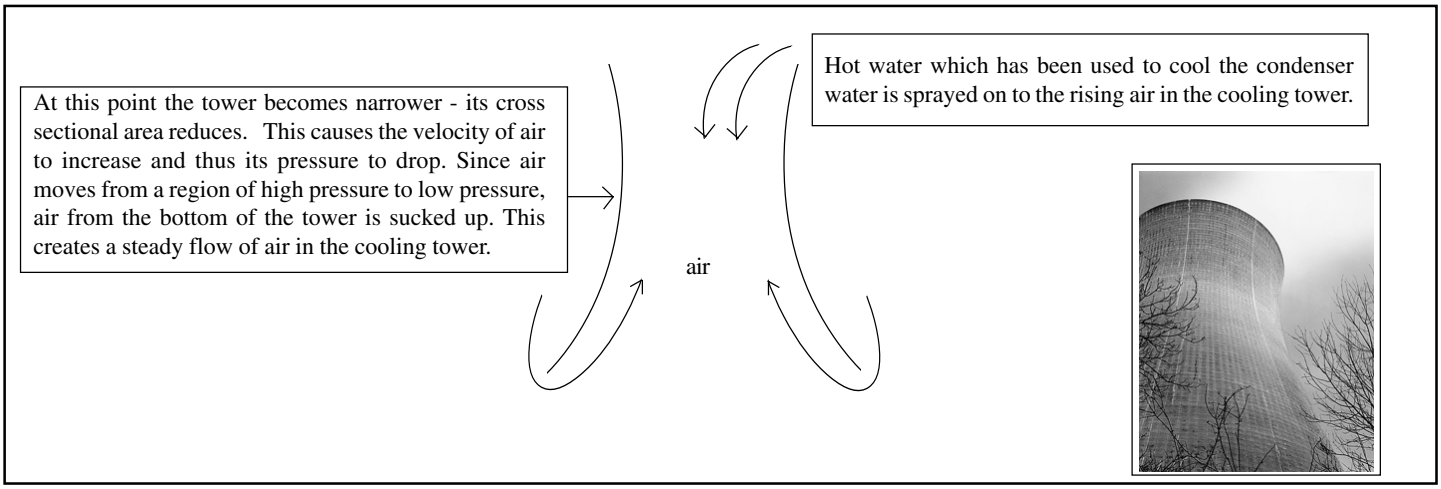


Fig 2. What happens in a cooling tower?



Environmental Impacts

1. Coal-burning power stations burn coal to generate electricity. All fossil fuels, including coal, contain carbon, so burning them releases carbon dioxide – a greenhouse gas. The coal is burned using energy from coal, oil or gas, again, all fossil fuels.
   Many types of coal contain N, S and Cl as impurities; hence NO_X, SO_2 and HCl may be released to form acid rain.
2. Despite the increased use of electrostatic precipitator, some particles escape, causing smog.
3. Abstraction of cooling water from the river or sea may harm wildlife as may release of warm water, because the oxygen concentration in the water is inversely proportional to its temperature.

Global climate change is the major environmental concern; carbon dioxide is the most significant greenhouse gas and its major source is the burning of fossil fuels like coal (UK coal-fired power stations release 5-10 million tonnes of CO_2 every year). Thus, the government is spending huge amounts of money trying to develop methods to reduce emissions of carbon dioxide.

Unfortunately, the developed world seems locked into dependence on fossil fuels – many people simply cannot imagine how we would run our daily lives without the continued combustion of coal, oil and gas. But this is exactly what we are going to have to do! Fossil fuels are finite; they will become scarcer and more expensive as time goes on. The government is committed to reducing carbon dioxide emissions by 60% by 2050. One of the way in which it hopes to do this is by capturing and storing the carbon dioxide. This is known as **sequestration**.

Two technologies are being developed to reduce carbon dioxide emissions rom power stations:

1. Scrubbing the flue gases with a solvent which reacts with the CO_2. The solvent is then heated to release high-purity CO_2 which is then compressed and stored.
2. Removing the carbon dioxide from the fuel before it is burned – again the end product is highly-pure CO_2 which can be compressed and stored.

In both cases the CO_2 is in gaseous form and it is cheapest to transport the CO_2 in this form too –almost certainly in a pipeline.

What to do with it next?

There are three possible approaches:

1. Pump it into near-depleted oil wells (in the US 22 million tonnes of CO_2 are piped annually down oil wells to push out more of the oil (enhanced recovery or tertiary oil extraction – see Factsheet 13) . If the wells are then sealed there is a good chance the CO_2 will not be able to escape. Gas fields could also be used.
2. Pump it into saline aquifers – where the water is too salty to be of use. Statoil has been pumping 1MteCO_2/yr – a waste product from gas extraction in the North Sea -into an aquifer 800m beneath the seabed since 1996. Such aquifers represent the biggest potential carbon dioxide store (Table 2).

Table 2. Estimated storage capacity of CO_2 in the North Sea ($GtCO_2$)

	Depleted oil fields	Depleted gas fields	Deep saline aquifers
Denmark	0.1	0.4	0
Netherlands	0	0.8	0
Norway	3.1	7.2	486.8
UK	2.6	4.9	248.6
Total	5.8	13.3	735.4

3. Pump it into unusable coal seams. The coal adsorbs CO_2 in preference to methane which would then be released and could be captured as a useful product.

Typical Exam Question

The table shows the result of a cost-benefit analysis which was used to try to determine the most economically –sensible way of reducing carbon dioxide emissions.

Technique	**Cost (£/teCO_2)**
Improving domestic energy efficiency	-30
Onshore wind	-10
Offshore wind	45
Energy crops	40
Nuclear	30
Wave	30
Tidal	70
Photovoltaics	600
Sequestration from coal	50

1. (a) Identify the least economically sensible way of trying to reduce carbon dioxide emissions. (1)
   (b) Suggest an explanation for the poor viability of this technique. (2)
2. Explain the significance of the figure for **Improving domestic energy efficiency** (2)

Answers

1. (a) Photovoltaics;
   (b) Low efficiency of conversion of sunlight into electricity;
   Semiconductors may be expensive;
   Would require huge areas of solar cells;
2. this technique would actually save money;
   because energy currently lost has to be paid for;
   cheaper to conserve energy than generate more;

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