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Clean coal technology: How it works

When burned, coal is the dirtiest of all fossil fuels but a range of technologies are being used and developed to reduce the environmental impact of coal-fired power stations.

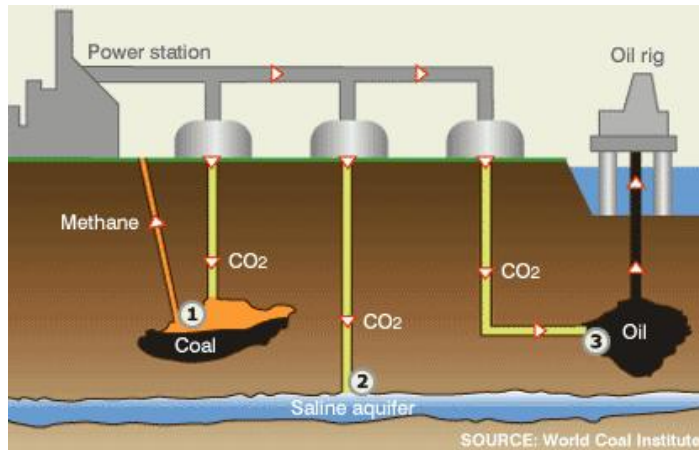
Collectively, they are known as clean coal technology (CCT).

CARBON CAPTURE AND STORAGE

Despite the improving efficiency of coal-fired power stations, CO2 emissions remain a problem.

Carbon capture and storage (CCS) involves capturing the carbon dioxide, preventing the greenhouse gas entering the atmosphere, and storing it deep underground.

OPTIONS FOR CARBON CAPTURE AND STORAGE



1. CO2 pumped into disused coal fields displaces methane which can be used as fuel
2. CO2 can be pumped into and stored safely in saline aquifers
3. CO2 pumped into oil fields helps maintain pressure, making extraction easier

A range of approaches of CCS have been developed and have proved to be technically feasible. They have yet to be made available on a large-scale commercial basis because of the costs involved.

COAL PREPARATION

Coal arriving at a power plant contains mineral content that needs to be removed before it is burnt. A number of processes are available to remove unwanted matter and make the coal burn more efficiently.

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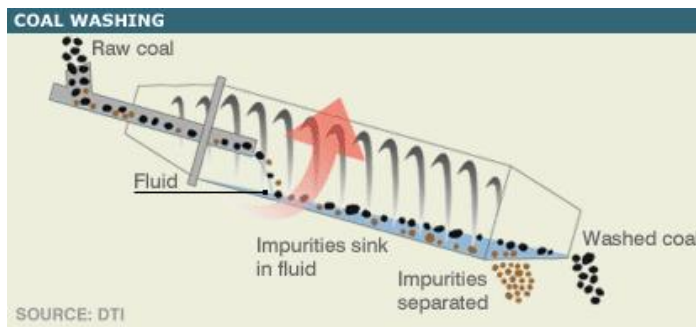
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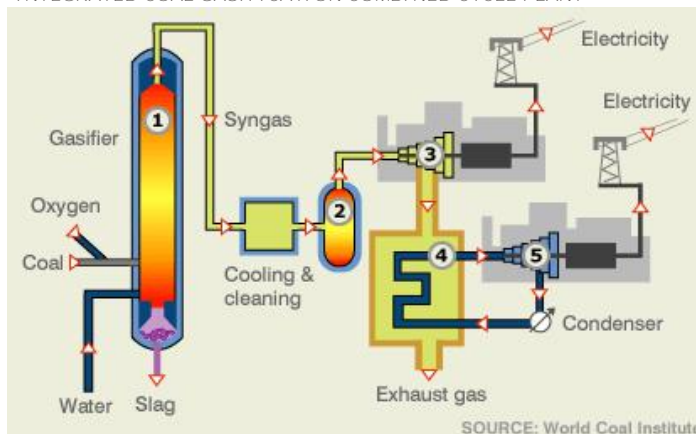
Coal washing involves grinding the coal into smaller pieces and passing it through a process called gravity separation.

One technique involves feeding the coal into barrels containing a fluid that has a density which causes the coal to float, while unwanted material sinks and is removed from the fuel mix. The coal is then pulverised and prepared for burning.

GASIFICATION

Coal gasification plants are favoured by some because they are flexible and have high levels of efficiency. The gas can be used to power electricity generators, or it can be used elsewhere, i.e. in transportation or the chemical industry.

INTEGRATED COAL GASIFICATION COMBINED CYCLE PLANT



1. Coal burnt to produce syngas
2. Syngas burnt in combustor
3. Hot gas drives gas turbines
4. Cooling gas heats water
5. Steam drives steam turbines

In Integrated Gasification Combined Cycle (IGCC) systems, coal is not combusted directly but reacts with oxygen and steam to form a "syngas" (primarily hydrogen). After being cleaned, it is burned in a gas turbine to generate electricity and to produce steam to power a steam turbine.

Coal gasification plants are seen as a primary component of a zero-emissions system. However, the technology remains unproven on a widespread commercial scale.

REMOVING POLLUTANTS

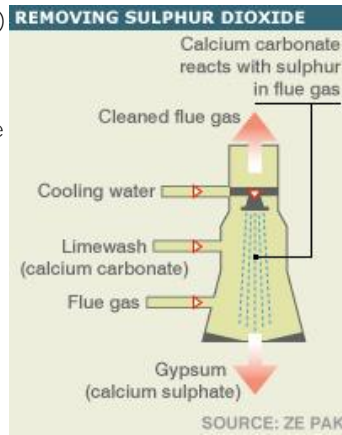
Burning coal produces a range of pollutants that harm the environment: Sulphur dioxide (acid rain); nitrogen oxides (ground-level ozone) and particulates (affects people's respiratory systems).

There are a number of options to reduce these emissions:

Sulphur dioxide (SO₂)

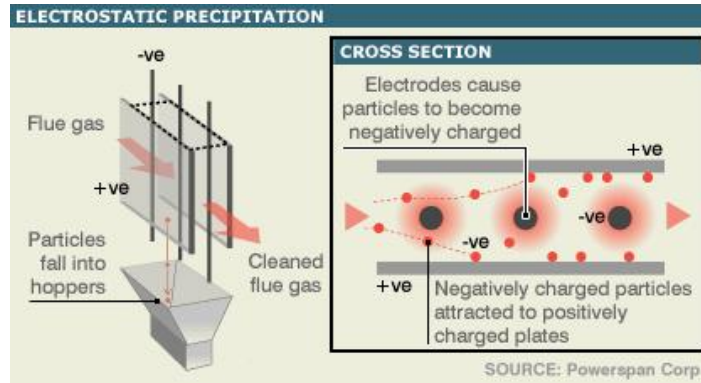
Flue gas desulphurisation (FGD) systems are used to remove sulphur dioxide. "Wet scrubbers" are the most widespread method and can be up to 99% effective.

A mixture of limestone and water is sprayed over the flue gas and this mixture reacts with the SO₂ to form gypsum (a calcium sulphate), which is removed and used in the construction industry.



Nitrogen oxides (NO_x) NO_x reduction methods include the use of "low NO_x burners". These specially designed burners restrict the amount of oxygen available in the hottest part of the combustion chamber where the coal is burned. This minimises the formation of the gas and requires less post-combustion treatment.

Particulates emissions



Electrostatic precipitators can remove more than 99% of particulates from the flue gas. The system works by creating an electrical field to create a charge on particles which are then attracted by collection plates. Other removal methods include fabric filters and wet particulate scrubbers.

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