

# Energy from fossil fuels

For most of human history, people relied on the power of their own muscles, animals, wind, and water to get things done. But about 300 years ago, everything began to change when we discovered that burning certain black rocks and liquids from deep underground could release huge amounts of energy. These fossil fuels were formed millions of years ago from the remains of ancient plants and animals buried beneath the Earth's surface.

The use of fossil fuels sparked the Industrial Revolution, a period when machines began to replace hand tools, and factories, trains, and steamships transformed the world. Energy from coal powered engines and lit cities; oil and gas later fuelled cars, planes, and electricity for homes.

Fossil fuels made modern life possible, providing energy for transport, industry, and communication. But, burning them also releases carbon dioxide and other gases that trap heat in our atmosphere, leading to climate change. Today, humanity faces a major challenge: how to keep the benefits of energy while protecting the planet by developing cleaner technologies.

## Using fossil fuels

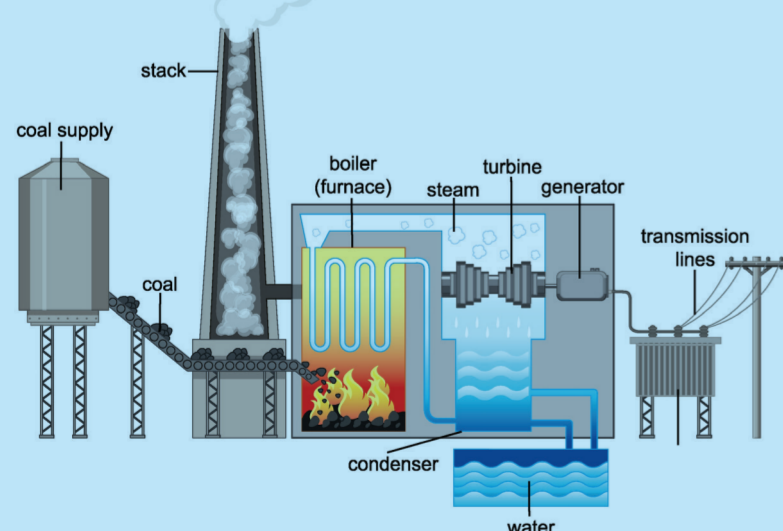


Before we can use them to generate energy, coal, oil, and natural gas have to be extracted from deep underground.

Coal is usually found in solid layers called seams and is mined using deep tunnels or open-pit mines. Oil and natural gas are trapped in rocks beneath the Earth's surface. To reach them, workers drill wells deep into the ground or the seabed. The oil is pumped to the surface, and the gas is brought up through pipes. Oil and gas are then transported to refineries where they are cleaned and processed in to forms that can be used for energy generation.



Coal, oil and gas can all be used to fuel traditional steam turbine power stations. The fuel is burnt in a furnace which has pipes running through it containing water. The water evaporated into superheated steam which is directed through a turbine. The turbine is connected to a generator which produces electricity to power the grid. As the water cools, it condenses and can be recirculated through the system. The heat produced can also be used by local heating networks.



## Material challenges



The pipes used to extract oil and gas from the ground have to be able work in an aggressive chemical environment and corrosion is a major issue.

Corrosion is the gradual damage or wearing away of metals when they react with substances in their environment, like water, air, or chemicals. A common example is rust, which forms when iron reacts with oxygen and moisture. Corrosion weakens materials and can cause structures to break or fail over time.



Oil and gas often contain hydrogen sulphide which can lead to a special type of corrosion called stress corrosion cracking. Free hydrogen can also cause the materials it comes in to contact with to become brittle. These can cause the properties of oil and gas pipelines to degrade over time, and they must be carefully monitored.

Sometimes the pipelines run for hundreds of miles overground where they may encounter all sorts of hazards from vehicles accidentally crashing into them, to erosion and corrosion caused by the weather, to earthquakes.

Where platforms and wells are located in the sea, the materials have to withstand long-term exposure to salty sea water and repeated impact from waves.

These conditions mean that special materials need to be used. These materials are **strong** and **tough**, able to withstand operating at **low temperatures**, and **resistant to corrosion**.

## Material protection



There are three main methods for protecting steel from corrosion:

- 1. Painting** – Painting is a common and relatively cheap way of protecting steel. The paint provides a barrier so that the oxygen and moisture in the air cannot reach the surface of the steel to cause the iron to oxidise and go rusty. If the paint is damaged it will expose the steel underneath so regular inspection and repainting is needed
- 2. Galvanising** – This involves coating the steel in a thin layer of zinc which provides protection in two ways. Firstly, like paint, it provides a physical barrier. But, secondly, it provides sacrificial protection. This means that if the surface is scratched, the zinc reacts instead of the steel.
- 3. Alloying** – Steel is an alloy of iron and carbon, but by adding other elements the properties of the steel can be carefully controlled. Adding chromium and nickel produces stainless steel. Chromium forms a very thin but very stable oxide layer on the surface of the steel that forms a barrier to oxygen and moisture. Stainless steels are more corrosion resistant in most circumstances, but they are expensive.

## Future role

For over a century the UK was powered by coal-fuelled power stations. The last one was switched off for good in September 2024.

There are still around 50 gas-fired power stations in the UK with a combined generating capacity of around 35GW<sup>1</sup> The main purpose of these is to provide backup power to support energy generated from renewable sources. In 2024 electricity generated from gas accounted for ~30% of that produced<sup>2</sup>. More gas-fired plants are being planned and these are being designed to be ready to link to carbon capture and storage facilities so that the carbon dioxide produced is not released to the atmosphere.

## REFERENCES

- <sup>1</sup> [wattdirection.substack.com/p/uk-gas-power-stations-capital-costs](https://wattdirection.substack.com/p/uk-gas-power-stations-capital-costs)
- <sup>2</sup> [assets.publishing.service.gov.uk/media/68dbe477ef1c2f72bc1e4c4d/DUKES\\_2025\\_Chapters\\_1-7.pdf](https://assets.publishing.service.gov.uk/media/68dbe477ef1c2f72bc1e4c4d/DUKES_2025_Chapters_1-7.pdf)

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