

RENEWABLE ENERGY RESOURCES

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Natural resources are any kind of natural substance required or desired by humans. Natural resources used to generate heat and/or electricity are known as **energy resources**.

RENEWABLE ENERGY RESOURCES

Sunlight, wind, waves, running water and heat from the Earth are all types of **renewable energy resources**. They are naturally replenished within human timescales so can be used again and again without running out. Renewable energy resources are an alternative to **non-renewable** energy resources such as coal, gas, oil and nuclear power. As global population continues to increase we will need to utilise renewable energy resources to meet our future energy needs and to help mitigate (reduce the effects of) climate change.

UK ENERGY MIX

Figure 1 shows that the use of renewable energy resources has increased over the last decade. In 2017 the UK produced 29% of its electricity from renewables compared with 4% in 2006. Renewable energy resources made up 11% of total UK primary energy consumption in 2017 compared with 2% in 2006 and just 0.2% in 1990. Fossil fuels share of primary energy consumption has dropped from 91% in 1990 to 80% 2017.

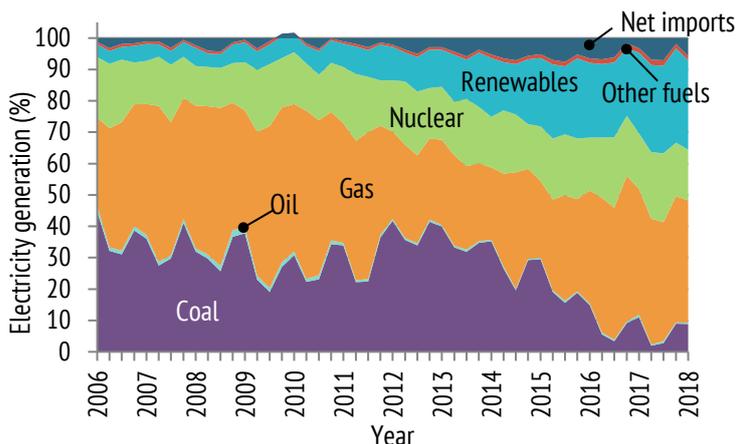


Figure 1: UK electricity generation by fuel type 2006-2018.
Data from Department of Business, Energy and Industrial Strategy.

WHY DO WE NEED RENEWABLES?

Burning fossil fuels releases **carbon dioxide (CO₂)** and other **greenhouse gases** into the atmosphere. Over the past 250 years, increasing amounts of CO₂ have caused the Earth's atmosphere and

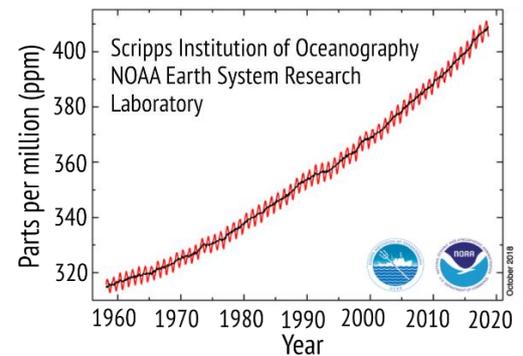


Figure 2: Atmospheric CO₂ at Mauna Loa Observatory

oceans to heat up, in a process known as **global warming**. As Figure 2 shows, these levels have increased rapidly in recent decades, from below 320ppm in 1960 up to 407ppm in Oct 2018. This warming is causing sea levels to rise, ice sheets to recede, seasons to intensify, habitats to change and oceans to become more acidic. Developing and using renewable energy resources will play a crucial part in reducing global CO₂ emissions and mitigating the impacts of global warming.

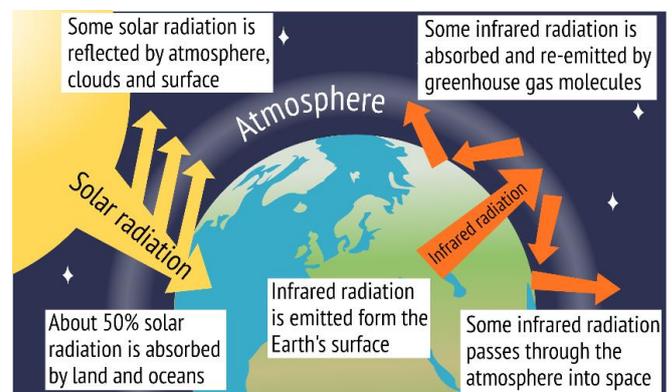
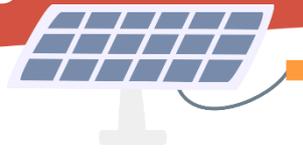


Figure 3: The Greenhouse Effect

Greenhouse gases in the Earth's atmosphere warm the planet by trapping **infrared radiation**. Without the greenhouse, illustrated in Figure 3, the Earth would be about -18°C. However, increasing CO₂ levels in the atmosphere are strengthening the greenhouse effect causing the atmosphere to heat up. Average global temperature has increased by 0.7-0.9°C since 1906.

RENEWABLE ENERGY RESOURCES

SOLAR POWER



Solar power uses energy from sunlight (photons) and converts this into electrical energy. Solar panels called photovoltaic cells (PV cells) are made from two layers of silicon crystal. When photons hit the top layer of silicon they 'excite' electrons in the silicon atoms giving them enough energy to move. They move in the direction of the bottom layer of silicon (this has a more positive charge) and induce an electrical current.

Solar power has no fuel costs, does not produce greenhouse gases and can provide electricity to remote areas. However, because PV cells require rare metals like cadmium and indium, they are very expensive. The average house in the UK uses around 3kW of energy each year – you would need between 12-15 PV cells to generate this much power. Additionally, PV cells can only process 15-25% of the sun's energy into electricity so they are inefficient, making electricity generated from solar power expensive.

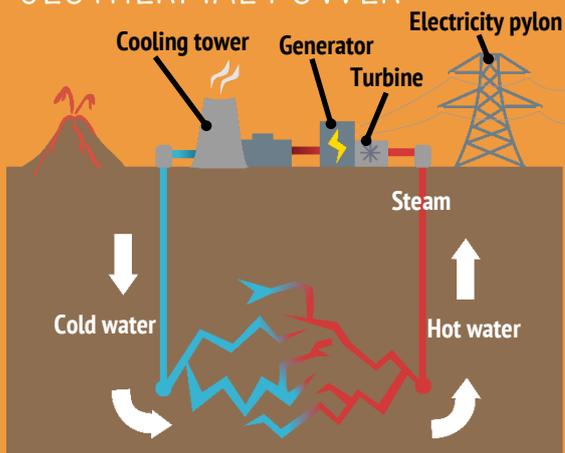
BIOFUELS



Biofuels are fuels produced from biomass either directly from plants or indirectly from agricultural, commercial, domestic and/or industrial waste. Biofuels absorb as much carbon dioxide from the atmosphere whilst they are growing as they give off when they are burnt. However, because fossil fuels are used in the production of biofuels (fertilizers, fueling farm equipment) they are not currently carbon neutral, although they do release less CO₂ than burning fossil fuels directly.

There are ethical issues surrounding the use of biofuels. The crops being used to provide the raw materials for biofuels could be used to feed people, plus the change in land-use to grow biofuel crops reduces plant biodiversity leading to an increase in pests.

GEOTHERMAL POWER



Geothermal energy is heat energy from the Earth generated by the decay of radioactive elements and the residual heat from the Earth's formation 4.5 billion years ago. To use geothermal energy water is pumped down into hot rocks through pipes where it is heated. When this water and steam comes back up to the surface it can be used directly to heat buildings or the steam's kinetic energy can be used to generate electricity through spinning turbine connected to a generator.

Geothermal energy can only be harnessed where the rocks are hot enough. This initially was only at plate boundaries as hot rocks tend to be much closer to the surface in these situations e.g. in Iceland, New Zealand and Italy. However, technology improvements in the last 20 years have increased the geographical range of geothermal power. Granite beneath Cornwall has been targeted as a potential source for UK geothermal power.

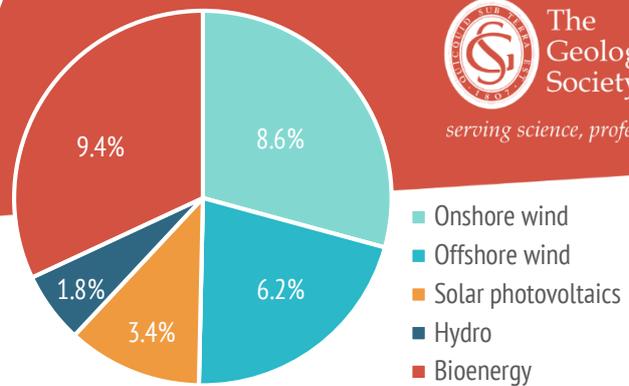


Figure 3: Percentage of electricity generated by renewables in 2017.
Total energy generated by renewables was 29.3% or 99,300 Gwh

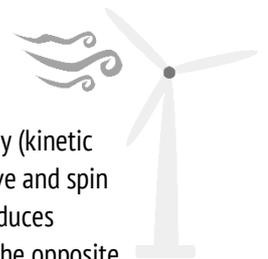
HYDROELECTRIC POWER



Hydroelectric power harnesses kinetic energy from running water. Hydroelectric dams are built to store large amounts of water in reservoirs made from flooding river valleys. When electricity is needed, water is let out through pipes in the dam. The water flows downwards under the influence of gravity and turns turbines linked to generators, generating electricity.

Hydroelectric power is more reliable than wind and solar power, although it does depend on enough rain. Hydroelectric dams are very expensive to build. When a dam is built, a huge area is flooded to make a lake which effects the people and animals living there, it can also badly affect fish migration patterns. It can be difficult to find suitable sites to build reservoirs.

WIND POWER



Wind turbines are built to harness wind energy (kinetic energy). When the wind blows the blades move and spin a turbine connected to a generator which produces electricity. Wind turbines essentially work in the opposite way to a fan, instead of using electricity to make wind, they use wind to make electricity.

To create enough energy capable of powering thousands of homes, energy companies build large wind farms with lots of wind turbines. The UK currently has 8,680 wind turbines (2018) with a capacity for 18.4 Gw of power making it the 6th largest producer of wind power in the world.