POWERING THE FUTURE

Learning Lab®

Teacher Information

Learning Lab: Powering the Future is supported by OPITO, a global not-for-profit skills body for the energy industry. They offer services and products to meet international skills needs, and support workforce development.

Energy and Climate Change

Current goals for limiting climate change aim to keep average warming under 1.5°C above **pre-industrial levels**. If climate change continues at its current rate, it's predicted that this limit could be reached as early as 2030. At this level of warming, the worst effects of climate change will be seen, such as extreme temperatures, extreme rainfall, forest fires, drought, rising sea levels and loss of entire species. While Earth's climate does change naturally, human actions are speeding up this change. One of the biggest drivers of climate change is the burning of fossil fuels to meet energy demand. This energy is used for electricity, heating, and transport.

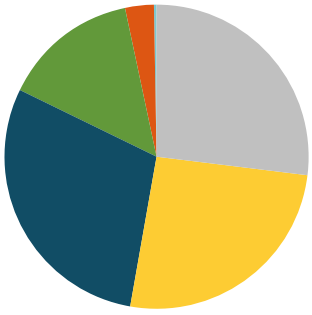
On a local scale, the UK is aiming to achieve **net zero** carbon emissions by 2050. A major part of this is an **energy transition**: from a society that relies on fossil fuels to one that uses renewable energy.

Electricity

As of 2024, around half of the electricity generated in the UK came from renewables. There are plans to continue building renewables to meet increasing electricity demand.

2024 Renewables Capacity in the UK (MW)

- Onshore wind - 15,613
- Offshore wind - 14,800
- Solar photovoltaics - 16,943
- Bioenergy and waste - 8,272
- Hydro - 1,890
- Wave/Tidal - 10



Onshore and offshore wind: The UK's capacity to generate renewable electricity remains dominated by wind turbines as of 2025.

Building turbines offshore is desirable because there are stronger and more consistent winds out at sea. The further out from shore, the windier it can be. One innovation that will allow us to take advantage of these strong winds is floating wind turbines, as opposed to those built on fixed structures. This allows us to place turbines further out at sea than would otherwise be possible.

Solar photovoltaics: While solar panels do work well in sunny weather, it's not necessary to have strong sunshine and they can work on cloudy days. There is support for solar panels to be implemented on a more local scale.

Bioenergy and waste: Different kinds of biomass or waste are burned in a furnace to generate steam. This steam expands and builds up pressure to turn turbines that generate electricity.

Hydro: There are ambitions to increase the UK's hydroelectric capacity with the Coire Glas project between Fort William and Inverness in Scotland. If it goes ahead, the project will be able to power 3 million homes for up to a full day.

Wave/Tidal: While its contribution to overall electricity generation is comparatively small, the UK is a world-leader in development of these technologies, with the world's most powerful tidal turbine on Orkney.

Electrification

The UK's renewable electricity generation capacity must be increased because electricity is crucial in the move towards reducing emissions from both transport and heat. This transition away from using fossil fuels as an energy source and towards electricity is called **electrification**.

Transport

The UK is making a move towards ultra-low emission vehicles, with a ban on new petrol and diesel cars and vans set for 2035.

These ultra-low emission vehicles will typically include electric cars and hydrogen-powered vehicles.

Electric vehicles: While there are over 70,000 public charging points operating across the UK, there are plans to continue installing charging points and improving reliability of access.

Hydrogen vehicles: Compared with electric vehicles, hydrogen vehicles generally have greater range and faster fuelling times, but are more complex, more expensive, and we lack fueling infrastructure in the UK. They are currently being developed for heavy duty applications like buses, HGVs, and trains.

There are various hydrogen fuel cell projects across the country, such as the Tees Valley hydrogen transport hub.

Hydrogen fuel: The hydrogen that is needed to fuel hydrogen vehicles can be generated in a few different ways. The most sustainable method of hydrogen production uses electricity in a process called **electrolysis**, where electricity is used to split water into hydrogen and oxygen.

The hydrogen is collected and used in a fuel cell, where it combines with oxygen to generate electricity.

Heat

Heating homes results in 17% of the UK's greenhouse gas emissions. There are plans for low-carbon heating systems to be installed across UK homes.

Biomass boilers: The majority of this heat comes from biomass burned in boilers. The biomass used is normally wood in the form of pellets, chips or logs. The heat generated is used to warm buildings in a similar way to gas central heating systems, warming water for radiators and taps.

Heat pumps: There has been a steady growth in heat produced by heat pumps, with over 250,000 installed across the UK.

Heat pumps use electricity to capture heat from outside and move it into a building. The quantity of heat delivered into your home is much greater, in terms of energy, than the quantity of electricity used to power the system.

Because heat pumps capture heat that is already present in the environment, the system itself does not burn any fuel and therefore emits no **carbon dioxide**.

Heat networks: Sometimes called district heating, this network of pipes moves heat from a central source to other buildings in the surrounding area. The heat could be generated using something like a central biomass boiler, or it could be waste heat from somewhere like a power station or factory.

Carbon Capture

The Intergovernmental Panel on Climate Change highlighted that if we are to limit future temperature increases to 1.5 degrees, we must do more than just increase efforts to reduce emissions. We also need to use technologies to remove carbon from the atmosphere, especially considering that we know fossil fuels will still be in use for some time.

Carbon capture technologies can be used alongside processes which release **carbon dioxide** into the atmosphere, such as burning fossil fuels. The **carbon dioxide** is separated from other gases produced before being compressed and transported to a safe site for storage. Finally, the **carbon dioxide** is injected underground for permanent storage. Alternatively, the **carbon dioxide** could be re-used in industrial processes, such as those which make plastics or cement.

Natural carbon capture: The UK is full of natural resources that also take in and store **carbon dioxide**, such as trees, salt marshes, sea grasses, and peatlands. Peatlands are the largest store of carbon in the UK and are effective because the waterlogged peat soil prevents dead plant life from fully decomposing and releasing stored **carbon dioxide** back into the atmosphere. Peatlands can be damaged by human activities, such as farming and construction, which can release massive amounts of **carbon dioxide**. This is why work is being done to restore damaged peatlands across the country.

Glossary

Pre-industrial temperatures - Average global temperatures recorded between 1850 and 1900, before massive fossil fuel use began.

Carbon dioxide - An invisible gas that is classed as a greenhouse gas because it traps heat and contributes to climate change. One of the major processes releasing it into the atmosphere is the burning of fossil fuels.

Energy mix - The mix of energy sources that are used to meet energy demand. The energy mix could be made up of fossil fuels, nuclear energy, and solar energy, for example.

Energy transition - The process of moving our energy production away from fossil fuels and towards renewable technologies.

Net zero - Achieving net zero means that the greenhouse gases that are released into the atmosphere are no more than those removed from the atmosphere.

Electrification - The process of replacing technologies that use fossil fuels, with those that use electricity as a source of energy.

kWh - A kilowatt hour is a measure of energy an appliance uses.

Electrolysis – When electricity is used to break chemical compounds down into simpler substances. For example, electrolysis can be used to split water into hydrogen and oxygen.

Fuel cell – A device that generates electricity as long as it is supplied with the appropriate fuel, such as hydrogen. Hydrogen fuel cells combine hydrogen with oxygen to generate electricity, water and heat.

Generator – A device that converts movement energy into electrical energy, or electricity, using magnets and copper wire.

Our Future Energy

Our Future Energy is a Glasgow Science Centre site which is funded and supported by OPITO. This site is recommended as a resource for teachers and pupils who wish to explore topics covered throughout the Learning Lab in more detail. Links to related activities are given below.

Electricity

Lesson 1 | The Project Manager

In this 'day in the life', pupils can find out about one of the roles needed to build a wind farm. https://ourfuture.energy/day-in-the-life/the-project-manager/

Lesson 2 | The Senior Project Technical Analyst

In this 'day in the life', pupils can find out about the variety of tasks that need to be completed in the renewables industry, focusing on wind energy. https://ourfuture.energy/day-in-the-life/the-senior-project-technical-analyst/

Lesson 2 | Demanding Electricity

This article outlines the purpose of the national grid, and details some of the considerations that are made when managing it across the country. https://ourfuture.energy/in-focus/demanding-electricity/

Lesson 2 | Living Off Grid

This article explores how communities in rural areas which are not connected to the UK's energy network access electricity and gas. https://ourfuture.energy/in-focus/living-off-grid/

Transport

Lesson 1 | Internal Combustion Engine

Pupils can watch a video which looks at how diesel and petrol are used in traditional cars, within an internal combustion engine. https://ourfuture.energy/in-focus/internal-combustion-engine/

Lesson 1 | Alternative Fuels

In the second video in our Future Fuels series, pupils find out how biogas (specifically methane) can be used as an alternative to fossil fuels in transport. https://ourfuture.energy/in-focus/alternative-fuels/

Lesson 2 | Energy Storage

In this article, pupils can learn how hydrogen can be used to store excess energy from the grid. Other methods of storing energy are also explored. https://ourfuture.energy/how-it-works/energy-storage/

Heat

Lesson 2 | Heat From Waste

This article explores an alternative source of heat energy – sewage. The heat that is typically lost to the environment can be harnessed to heat buildings using heat pumps. https://ourfuture.energy/bright-idea/heat-from-waste/

Carbon Capture

Lesson 2 | Carbon Capture

Pupils can find out about the potential uses of captured carbon dioxide in products. https://ourfuture.energy/bright-idea/carbon-capture/