The Geological Society
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Key Stage 2 Energy presentation – Teachers Notes

Learning objectives

- To understand and that energy resources are a type of natural resource
- To understand the difference between non-renewable and renewable energy resources
- To be able to describe examples of non-renewable and renewable resources and discuss some of the positives and negatives
- To understand the basics of how energy sources are used to produce heat and electricity
- To understand that appliances in the home use energy
- To understand that recycling products is a way of saving energy

Presenter notes

Some suggested notes for each slide and information for the presenter. Questions the presenter could ask students are highlighted in bold. The Geological Society gives permission for presentations and notes to be adapted to suit the presenter's needs.

Energy resources overview

Natural resources are any kind of natural substance which is required (or desired) by humans. Different natural resources occur in different countries and regions and are not are spread equally. As a result, nations trade their natural resources to meet their needs. Energy resources such as oil, gas, coal, wood, wind, sunlight and geothermal energy are all natural resources that can be used to produce heat and electricity.

Energy sources can be either renewable or non-renewable. Non-renewable energy sources are things like oil, natural gas and coal. They cannot be easily replaced, because they have taken millions of years to form. As a planet we are using them up faster than they are being made – so they are finite resources. Renewable energy resources like wind power, wave power, solar power, geothermal power and biofuel will not run out (on human timescales) or can be easily replaced.

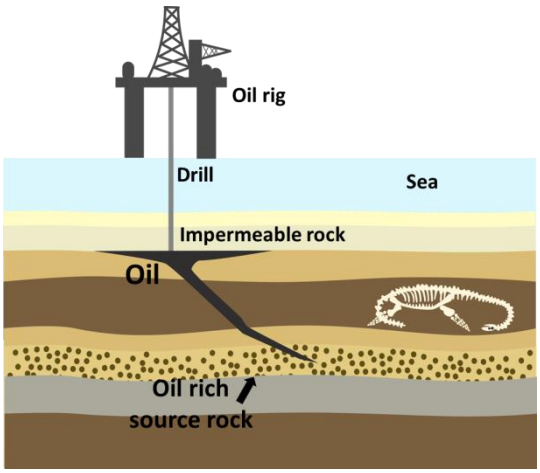
Non-renewable energy resources

Coal, gas, oil and nuclear power, often called fossil fuels, are the most common non-renewable energy resources. About three-quarters of the electricity generated in the UK comes from power stations fueled by fossil fuels.

Positives	**Negatives**
Efficient - burning a small amount of oil, gas or coal, or reacting a small amount of uranium releases a lot of energy.	Release large amounts of carbon dioxide and other gases into the atmosphere. Carbon dioxide is a greenhouse gas and is contributing to dangerous levels of global warming and climate change.
Convenient - can be used whenever (they don't rely on certain environmental conditions e.g. lots of wind) they can be transported easily	Release pollutants such as sulfur dioxide and nitrogen dioxide which cause acid rain. Acid rain harms sensitive ecosystems such as lakes and forests.
Well established – humans have been using fossil fuels for the past 200 years so our towns and cities are built to make transporting and using fossil fuels easy	Methods used to access fossil fuels such as mining and drilling for oil can harm the environment e.g. oil spills can devastate marine wildlife.
Relatively cheap to generate electricity	Harmful radioactive waste from nuclear power

Oil and natural gas

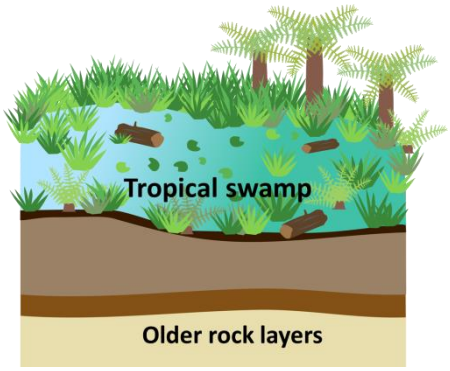
All of Earth's crude oil and natural gas is formed from microscopic marine plankton that died millions of years ago. When they died the microorganisms sank to the bottom of the ocean and were gradually covered in layers of sediment. As the organic rich sediments were buried, the heat and pressure acting on them increased, turning the organic matter into oil and gas. Oil and natural gas has formed are less dense than the surrounding rock so move upwards through tiny pores and fractures. Some oil and natural gas manages to get all way to the surface and escapes through vents into the atmosphere. Other oil and natural gas deposits get trapped under impermeable layers of rock or clay. These trapped deposits are where we find oil and natural gas today.

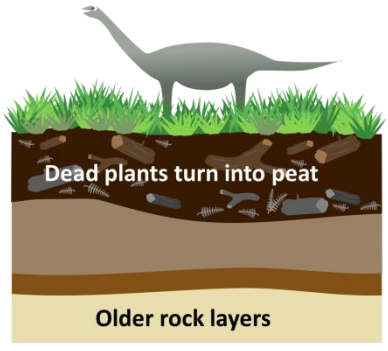


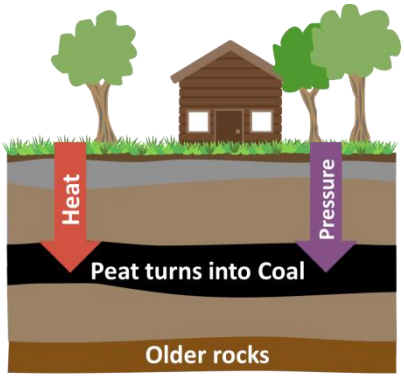
To generate electricity, oil and gas are burnt in power plants to heat water and produce steam. This steam (which has kinetic energy) then propels the blades of a turbine (mechanical energy). The turbine is attached to a generator and when it spins it produces electricity (electrical energy). Oil can also be used directly as fuel in cars, planes, buses and trains (chemical energy). Before it can be put into cars at the petrol station, crude oil has to be refined in an oil refinery to turn it into different fuels like petrol, diesel and jet engine fuel.

Coal

Most of the coal we have on Earth today was formed during the Carboniferous period 360 – 299 million years ago (before the dinosaurs!) when much of the Earth including the UK was covered in tropical swamps. As the plants died their remains sank to the bottom of the swampy areas, making layers and layers of squashed plant material. This eventually turned into a brown spongey material called peat. Over millions of years and with changing environments layers rock began to build up and the peat became buried. As the peat was buried further and further heat and pressure acting upon it turned it into coal. The hotter the temperature, the deeper the coal is buried and the longer the amount of time the coal is buried, the more efficient coal you get – anthracite is the name of the most efficient coal.







Coal can be burned for heating or for electricity in the same way as oil and gas. Coal is cheap and fuelled our industrial revolution but when coal is burnt it releases more carbon dioxide than oil and gas so it is the one of the worst contributors to global warming.

Nuclear power

The main nuclear fuels are the radioactive elements uranium and plutonium. Nuclear fuels are not burnt to release energy; they are involved in nuclear reactions where atoms are split to release large amounts of energy as heat. The rest of the process of generating electricity is then the same as in coal oil and gas, the heat energy is used to boil water which generates steam. This steam then spins turbines, which drives generators to produce electricity.

Nuclear fuels do not release harmful greenhouse gases. They are very efficient; a tiny amount of nuclear fuel produces a lot of energy. However nuclear power produces harmful radioactive waste which must be removed and disposed of from power plants it has to be sealed in containers and buried for thousands of years until it is no longer radioactive. Nuclear power is reliable but a lot of money has to be spent on safety so it is expensive.

Renewable Energy

Once renewable energy resources are established (i.e. once wind turbines, solar panels etc. have been constructed) they do not release harmful greenhouse gases into the atmosphere so they can be used to mitigate climate change.Generating electricity from renewable sources is more complicated than from fossil fuels so it requires lots of new technology which can be expensive to develop.

Wind

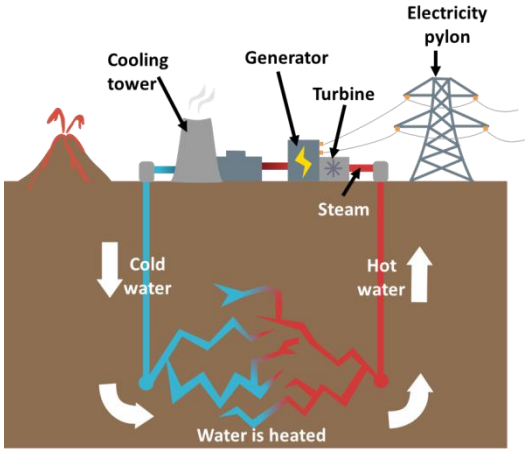
Wind turbines essentially work in the opposite way to a fan, instead of using electricity to make wind they use wind to make electricity. In order to generate enough energy capable of powering thousands of homes, energy companies build large wind farms either onshore or offshore. One major issue that people have with wind turbines is that they can ruin the look of the landscape; they can also be harmful to birds that might fly into them.

Solar

The primary source of all energy on planet Earth is from the sun - plants get energy from the sun for photosynthesis and heat from the sun drives atmospheric circulation, controling the wind, tides and waves. Solar thermal panels are filled with water which heats up in the sunlight. The heated water is then pumped through a tank heating the water that is connected to the taps in the house. Solar photovoltaic cells are used to turn sunlight directly into electricity. Photovoltaic cells are made from silicon which when exposed to lots of sunlight generates an electrical charge. Solar cells can be placed on the roof of a building or home, not taking up any extra space. Individual photovoltaic cells are expensive and they don't generate a lot of electricity so you need thousands of them in order to generate enough electricity to power a town.

Geothermal

Geothermal energy is heat energy from the Earth. It is high in volcanic areas like Iceland and New Zealand. To use geothermal energy to generate electricity or heat, water is pumped into hot rocks through pipes. When this water comes back up to the surface it can be used directly to heat people's homes, or the steam can be used to generate electricity using a turbine and a generator. In Iceland water naturally filtering down into hot volcanic rocks can come up to the surface in volcanic springs like the Blue Lagoon or explode upwards as geysers. 85% of Iceland heating and 25% of its electricity comes from geothermal energy.



Hydroelectric

Hydroelectric power harnesses electricity from running water. Hydroelectric dams are built to store large amounts of water in reservoirs. When electricity is needed, water is allowed to escape through pipes in the dam. The water flows downwards under the influence of gravity and turns turbines linked to generators. 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 displaces the people and animals living there, it can also badly affect fish migration patterns. The UK currently generates about 1.5% of its electricity from hydroelectric schemes - most of which are in the Scottish Highlands.

Biofuels

Biofuels such as biodiesel and bioethanol are fuels produced from crops like rapeseed and sugar cane. Ideally biofuels should be carbon neutral i.e. absorb as much carbon dioxide from the atmosphere as they give off when they are burnt. However at present because fossil fuels are used in the production of biofuels, for example in making fertilizers and in fueling farm equipment they are not currently carbon neutral, although they do still release less CO_2 than burning fossil fuels directly. There are ethical issues surrounding the use of biofuels. For example, crops that could be used to feed people are being used to provide the raw materials for biofuels instead.

Energy use and recycling

Appliances in the home have a power rating which tells you how much energy is used by the device every second: power (watts) = energy (joules) / time (seconds). The more powerful the appliance, the more energy it needs every second. Power is measured in watts which is equal to joules per second e.g. a 50 watt lightbulb uses 50 joules of energy every second. Sometimes power is shown in kilowatts rather than watts 1 Kw = 1000 w.

The products we use every day take a lot of energy to produce. Smartphones for example need electrical energy to charge up, but they also need a huge amount of energy in the first place to find and mine the metals and other minerals they are made from such as silicon, tin, gold, aluminium, cobalt and many more. Recycling is crucial for reducing our global energy use and CO_2 emissions - products being recycled usually require much less processing to turn them into usable materials.

Two recycling examples:
Aluminum is produced from aluminum ore which needs to be processed to isolate the aluminum metal. This processing requires a huge amount of heat and electricity. None of this processing is required for recycled aluminum metal (e.g., in the form of cans), which can be simply cleaned and re-melted. This saves 94% of the energy that would be required to produce the aluminum from the ore.

Glass is made by melting sand and other minerals at very high temperatures. The molten mixture is then cooled to form glass. The heat necessary to melt the mineral mixture is the most energy intensive part of the process. Because recycled glass still needs to be re-melted to make new glass products, the energy savings from recycling glass are less than aluminum at roughly 10-15%.

Useful links

KS2 energy activity https://www.geolsoc.org.uk/Education-and-Careers/Resources/Activity-Sheets-And-Presentations