

Energy Resources

There are lots of energy resources available on Earth. They are either renewable or non-renewable resources.

Non-Renewable Energy Resources Will Run Out One Day

Non-renewable energy resources are fossil fuels and nuclear fuel (uranium and plutonium). They currently provide most of the world's energy. Fossil fuels are natural resources that form underground over millions of years that are typically burnt to provide energy. The three main fossil fuels are coal, oil and (natural) gas.

- 1) Fossil fuels and nuclear energy are RELIABLE. There's still plenty of fuel around to meet current demand, and power plants always have fuel in stock. This means they can respond quickly to changes in energy demand — they use more fuel to release more energy.
- 2) The cost to extract fossil fuels is low and fossil fuel power plants are relatively cheap to build and run.
- 3) Nuclear power plants are pretty costly to build, and to safely decommission.
- 4) Fossil fuels are slowly running out.
- 5) They create ENVIRONMENTAL PROBLEMS. Fossil fuels release carbon dioxide (CO₂) into the atmosphere when they're burned, which adds to the greenhouse effect, and contributes to global warming.
- 6) Burning coal and oil can also release sulfur dioxide, which causes acid rain. Acid rain can be reduced by taking the sulfur out before the fuel is burned, or cleaning up the emissions.
- 7) Oil spillages cause serious environmental problems, affecting mammals and birds that live in and around the sea. We try to avoid them, but they'll always happen.
- 8) Nuclear power is clean but the nuclear waste is very dangerous and difficult to dispose of. And there's always the risk of a major catastrophe like the Fukushima disaster in Japan.

Renewable Energy Resources Will Never Run Out

Renewable energy resources include:

- 1) Bio-fuels
- 2) Wind
- 3) The Sun (solar)
- 4) Hydro-electricity
- 5) Tides

- These will never run out — the energy can be 'renewed' as it is used.
- Most of them do damage the environment, but in less nasty ways than non-renewables.
- The trouble is they don't provide much energy and some of them are unreliable because they depend on the weather.

Bio-fuels are Made from Plants and Waste

- 1) Bio-fuels are renewable energy resources created from either plant products or animal dung. They can be solid, liquid or gas and can be burnt to produce electricity or run cars in the same way as fossil fuels.
- 2) They are supposedly carbon neutral, although there is some debate about this as it's only really true if you keep growing plants (or raising animals) at the rate that you're burning things.
- 3) Bio-fuels are fairly reliable, as crops take a relatively short time to grow and different crops can be grown all year round. However, they cannot respond to immediate energy demands. To combat this, bio-fuels are continuously produced and stored for when they are needed.
- 4) The cost to refine bio-fuels is very high and some worry that growing crops specifically for bio-fuels will mean there isn't enough space or water to meet the demands for crops that are grown for food.
- 5) In some regions, large areas of forest have been cleared to make room to grow bio-fuels, resulting in lots of species losing their natural habitats. The decay or burning of this cleared vegetation also increases methane and CO₂ emissions.



Burning poo... lovely...

Given our electricity-guzzling ways, it's pretty important we find ways to generate electricity without destroying the planet. Burning cow pats may not be the ultimate fix, but it's a start. See the next page for more ways.

Q1 State two renewable energy sources.

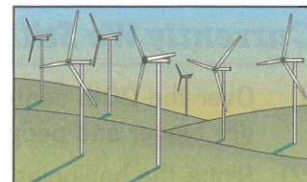
[2 marks]

More Energy Resources

Renewable energy resources, like **wind**, **solar**, **hydro-electricity** and **tides**, won't run out. They don't generate as much **electricity** as non-renewables though — if they did we'd all be using solar-powered toasters by now.

Wind Power — Lots of Little Wind Turbines

- 1) Each wind turbine has a **generator** inside it — wind rotates the **blades**, which turn the generator and produce **electricity**. So there's **no pollution**.
- 2) **Initial costs** are quite **high**, but **running costs** are **minimal**.
- 3) But **lots** of them are needed to produce as much **power** as, for example, a **coal** power plant. This means they can **spoil the view**. They can also be **noisy**, which can be annoying for people living nearby.
- 4) They **only** work when it's **windy**, so you can't always **supply** electricity, or respond to **high demand**.



Solar Cells — Expensive but No Environmental Damage

- 1) Solar cells are made from **materials** that use energy **transferred** by **light** to create an **electric current**.
- 2) Solar power is often used in **remote places** where there's not much choice (e.g. the Australian outback) and to power electric **road signs** and **satellites**.
- 3) There's **no pollution**. (Although they do use quite a lot of energy to make.)
- 4) **Initial costs** are **high**, but there are basically **no running costs**.
- 5) They're mainly used to generate electricity on a relatively **small scale**, e.g. in **homes**.
- 6) Solar power is most suitable for **sunny countries**, but it can be used in **cloudy countries** like Britain.
- 7) And of course, you **can't** make solar power at **night** or **increase production** when there's extra demand.

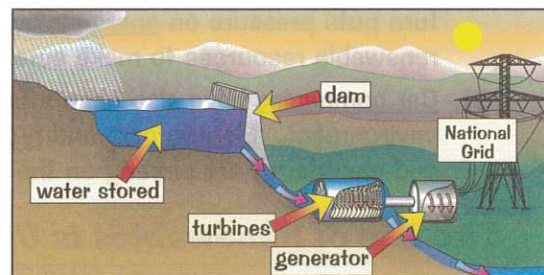
There's some pollution when the energy resources on this page are made, but not when they're in use.



Time to recharge.

Hydro-electricity — Building Dams and Flooding Valleys

- 1) **Producing hydro-electricity** usually involves **flooding** a **valley** by building a **big dam**. **Rainwater** is caught and allowed out **through turbines**. There is **no pollution** (as such).
- 2) There is a **big impact** on the **environment** due to the flooding of the valley and possible **loss of habitat** for some species.
- 3) A **big advantage** is it can **immediately respond** to increased electricity demand — **more** water can be let out through the turbines to generate more electricity.
- 4) **Initial costs** are often **high** but there are **minimal running costs** and it's generally a **reliable** energy source.



Tidal Barrages — Using the Sun and Moon's Gravity

- 1) **Tidal barrages** are **big dams** built across **river estuaries** with **turbines** in them.
- 2) As the **tide comes in** it fills up the estuary. The water is then let out **through turbines** at a controlled speed to generate electricity.
- 3) There is **no pollution** but they **affect boat access**, can **spoil the view** and they **alter the habitat** for wildlife, e.g. wading birds.
- 4) Tides are pretty **reliable** (they always happen twice a day). But the **height** of the tides is **variable** and barrages don't work when the water **level** is the **same either side**.
- 5) **Initial costs** are **moderately high**, but there are **no fuel costs** and **minimal running costs**.



The hydro-electric power you're supplying — it's electrifying...

There are pros and cons to all energy resources. Make sure you know them for solar, wind and water.

- Q1 The government is considering closing down a traditional coal-fired power station. Explain the benefits and disadvantages of replacing the power station with a wind farm.

[4 marks]

Trends in Energy Resource Use

Over time, the types of energy resources we use change. There are lots of reasons for this — breakthroughs in technology, understanding more about how they affect the environment or changes in cost are just a few.

Currently We Still Depend on Fossil Fuels

- 1) Over the 20th century, the electricity use of the UK hugely increased as the population got bigger and people began to use electricity for more and more things.
- 2) Since the beginning of the 21st century, electricity use in the UK has been decreasing (slowly), as we get better at making appliances more efficient (p.158) and try to be more careful with energy use in our homes.
- 3) Most of our electricity is produced using fossil fuels (mostly coal and gas) and from nuclear power. But we do use renewable energy resources like wind power to generate some of our electricity.
- 4) Generating electricity isn't the only reason we burn fossil fuels — oil (diesel and petrol) is used to fuel cars, and gas is used to heat homes and cook food.
- 5) However, renewable energy resources can be used for these purposes as well. Bio-fuels can be used to exclusively power vehicles, and solar water heaters can be used to heat buildings.
- 6) We are trying to increase our use of renewable energy resources (the UK aims to use renewable resources to provide 15% of its total yearly energy by 2020). This move towards renewable energy resources has been triggered by many things...



Energy Resources are Chosen for their Effect on the Environment

- 1) We now know that burning fossil fuels has a lot of negative effects on the environment (p.160). This has led to many people wanting to use more renewable energy resources that have less of an effect on the environment.
- 2) Pressure from other countries and the public has meant that governments have begun to introduce targets for using renewable resources. This in turn puts pressure on energy providers to build new power plants that use renewable resources to make sure they do not lose business and money.
- 3) Car companies have also been affected by this change in attitude towards the environment. Electric cars and hybrids (cars powered by two fuels, e.g. petrol and electricity) are already on the market and their popularity is increasing.



The Use of Renewables is Usually Limited by Reliability and Money

- 1) Building new renewable power plants costs money, so some smaller energy providers are reluctant to do this — especially when fossil fuels are such a cost effective way of meeting demand.
- 2) Even if new power plants are built, there are a lot of arguments over where they should be. E.g. many people don't want to live next to a wind farm, which can lead to protests.
- 3) Some energy resources like wind power are not as reliable as traditional fossil fuels, whilst others cannot increase their power output on demand. This would mean either having to use a combination of different power plants (which would be expensive) or researching ways to improve reliability.
- 4) Research into improving the reliability and cost of renewable resources takes time and money. This means that, even with funding, it might be years before improvements are made. In the meantime, dependable, non-renewable power stations have to be used.
- 5) Making personal changes can also be quite expensive. Hybrid cars are generally more expensive than equivalent petrol cars and things like solar panels for your home are still quite pricey. The cost of these things is slowly going down, but they are still not an option for many people.

Going green is on-trend this season...

So with more people wanting to help the environment, others not wanting to be inconvenienced and greener alternatives being expensive to set up, the energy resources we use are changing. Just not particularly quickly.

Q1 Give two reasons we currently do not use more renewable energy resources in the UK. [2 marks]



3 A university is considering ways to reduce their energy bills. They are considering building either a single wind turbine nearby, or installing solar panels on top of their buildings.

a) Suggest **two** reasons why students living near the turbine may prefer the use of solar power.

1.

2.

[2]

b) Suggest **one** reason why the university may choose a wind turbine over solar panels.

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[1]

[Total 3 marks]

4 An energy provider is looking to replace their old fossil fuel power plant. They are eligible for a government grant, so the initial building costs are negligible.



a) The energy provider is interested in building a power plant that uses renewable energy resources. They have narrowed their choice to either a hydro-electric power plant or a tidal barrage. Compare generating electricity using these two energy resources, commenting on their reliability and their impact on the environment.

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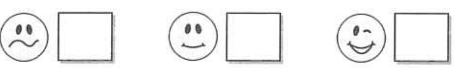
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b)* An alternative is replacing the old power plant with a new power plant that is run on fossil fuels. Discuss the advantages and disadvantages of using fossil fuels to generate electricity.

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[6]

[Total 11 marks]

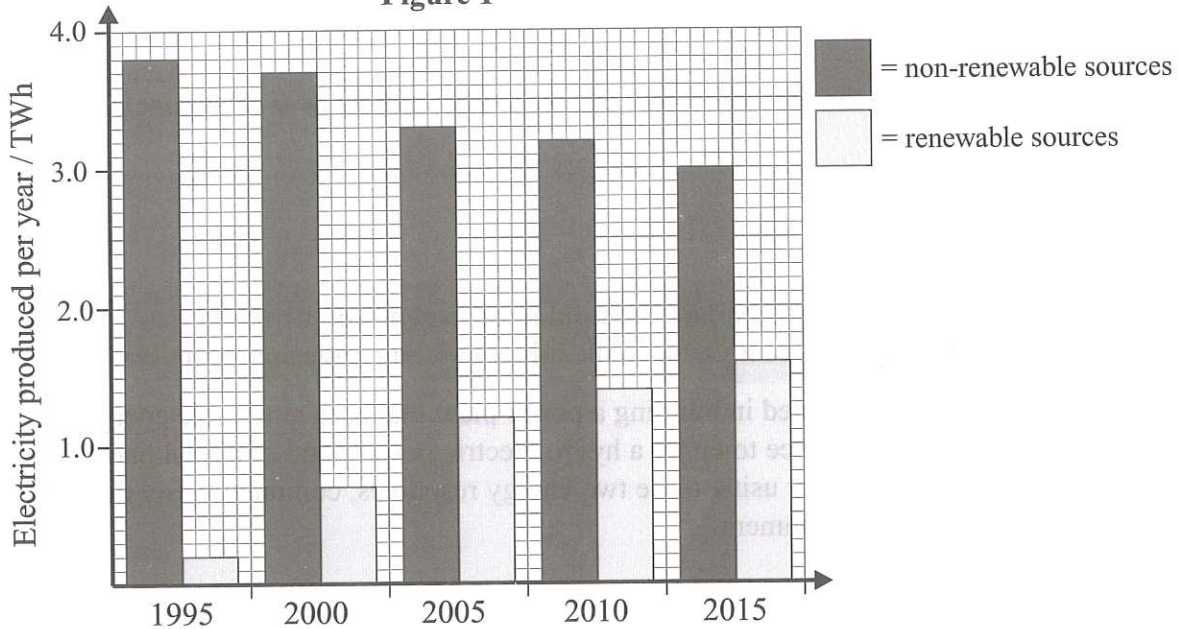


Trends in Energy Resource Use

1 The bar chart in **Figure 1** below shows the electricity generated from renewable and non-renewable energy sources in a small country over 20 years.



Figure 1



a) Determine how much electricity the country produced from renewable sources in 2005.

..... TWh
[1]

b) i) Calculate how much **more** electricity the country produced per year in 2015 than in 1995.

..... TWh
[2]

ii) Suggest **one** reason why the country needed to produce more electricity.

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[1]

c) Describe the trends in use of energy resources shown by the graph. Suggest reasons for these trends. You should refer to information from **Figure 1** in your answer.

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[4]

[Total 8 marks]

