



TEACHER NOTES



# ENERGY PICK 'N' MIX ACTIVITY

KS3



SAVE INK - don't print this first page!



## Lesson overview

In this activity, students learn about the energy mix; the sources that we use in the UK to generate electricity – and the pros/cons of these – and the factors that have influenced the UK's energy mix over time.

## Learning objectives

- ▶ Understand the important role electricity plays in our lives – and what we can do to reduce our use of energy
- ▶ Explore how electricity is generated in a power station
- ▶ Learn about the advantages/disadvantages of different renewable and non-renewable energy sources
- ▶ Appreciate the impact that human activity has on the planet through pollution and climate change
- ▶ Consider the UK's mix of energy sources over time
- ▶ Learn about the variety of jobs in the energy industry

## Subjects

Science (Chemistry / Physics)  
 Geography  
 PSHE

## WARM-UP (10 mins)

### Part 1: It's electric!



### Do you know what electricity is?

**Omit this section if a recap of the basics isn't needed.** Electricity is created when tiny invisible things called electrons move. This flow is called an electric current.

### HPC Inspire

We're Hinkley Point C's Education Programme in Somerset and the wider South West region. And we're here to help young people take advantage of the huge opportunities that the construction and

operation of HPC has to offer. We do this through a range of fun and innovative activities: including hands-on STEM workshops, careers assemblies and online learning resources.

### Can you see electricity? Or hear it?



Can you remember what these structures are called? They're **pylons** and they carry electricity above ground from where it's generated to businesses and homes. Electricity can also be carried underground through pipes.

### Do you use electricity at home?

*Ask students: How do you know it's in your home, if you can't see it?*



Electricity comes into our homes through power cables. We can't see it. But we are able to use it by plugging in things like our PlayStations, TVs and kettles to power sockets in the walls. Electricity also powers our lights.

Some people use electricity to heat their home and charge their car too.



**Did you know?**

From 2035, you won't be able to buy a petrol, diesel or hybrid car. Instead we'll be driving electric or some other type of powered car. Imagine being able to recharge your car at home, in a car park or even on the street.

**Part 2: 1-minute challenge!**



**Ask students to write down in their Worksheet as many things they can think of in the home that need electricity to operate. It might be something they use (e.g. a games console or phone charger). Or it could be something other people in their family use (e.g. oven, heater etc).**

Have a brief discussion about what they've included on their list – did everything they include use electricity? Are there any unusual things they've included? Make clear the distinction between battery-operated or gas-powered devices, and those that use electricity.

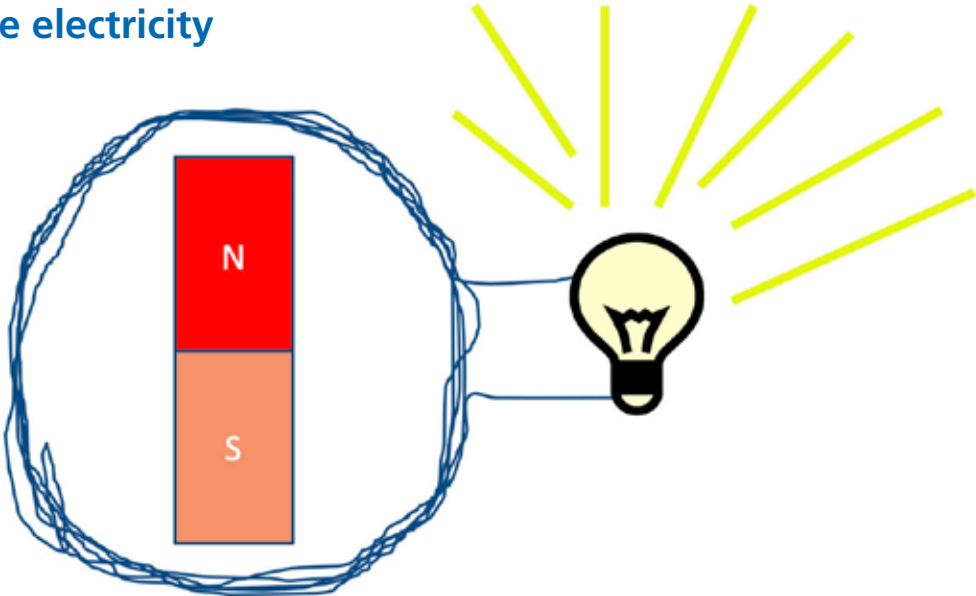
**Part 2: How we generate electricity**

**Most of our electricity is supplied by generators in power stations.**

Does anybody know how this works?  
*Invite students to answer.*

Electricity is created by spinning a magnet inside a coil of copper wire. We call this a **generator**. The magnet moves the tiny electrons and that makes an electrical current.

The magnets need to move really fast to generate electricity. How do you think this is done?



The generator is connected to **turbines, which make it spin**. This picture shows the turbines inside a nuclear power station (*point to the circular discs*). They are made up of lots of blades and they spin 3,000 times a minute!

**Ask everyone to click their fingers.**

**Did you know...** In the time it's taken you to click your fingers, they will have spun 50 times!

## THE MAIN ACTIVITY

(40-60 mins)

### Part 1: Where do we get our power from?



**All generators need an energy source to create electricity.**

**Ask students: Can you name the energy sources in your Worksheet?**

From (top, left-right): solar, wind, hydro (water), nuclear, wave, biofuel, coal, gas, geothermal, tidal and oil.

There are lots of differences between these energy resources. One of the main differences is that some are **renewable**. And some are **non-renewable**.

**Renewable energy resources** will never run out. They can be replaced and are a natural source of energy.

**Non-renewable energy resources** won't last forever, as they're based on materials we get from the Earth. So they will run out at some point and cannot be replaced when they're all used up.

*Ask students to fill in the table on their Worksheet based on whether they think the energy resources on the previous page are renewable or non-renewable.*

<b>RENEWABLE ENERGY RESOURCE</b>	<b>NON-RENEWABLE ENERGY RESOURCE</b>
Solar	Coal
Wind	Oil
Wave	Gas
Hydro	Nuclear
Biofuel	
Geothermal	
Tidal	



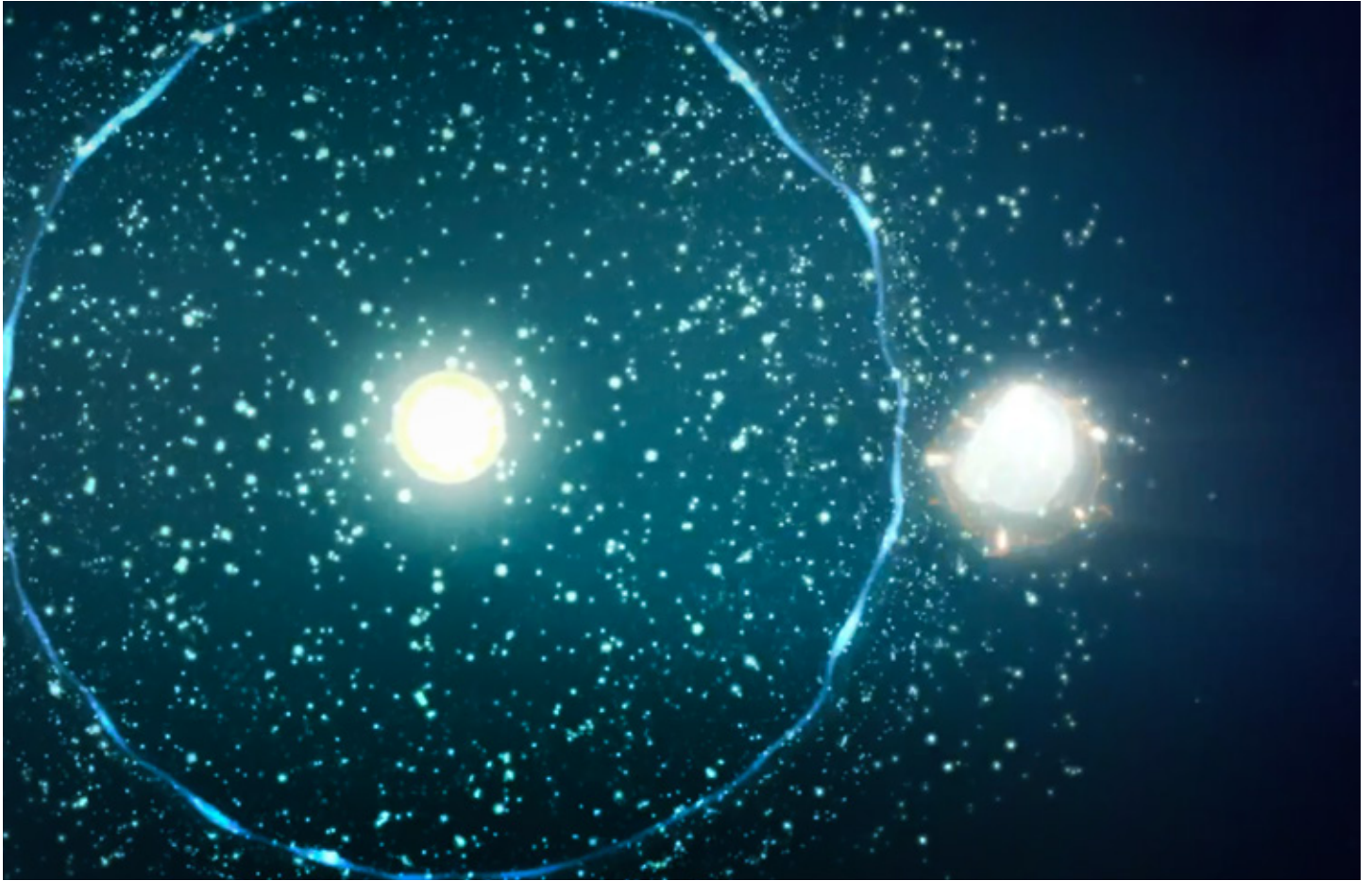
**What are non-renewable energy resources?**

Although there are fewer of them, most of the electricity we get in the world comes from **non-renewable resources**. And has done for many, many years.

Coal, oil and gas are non-renewable energy sources, and they're collectively known as **fossil fuels**. They're formed from the remains of plants and animals: coal was formed from dead trees and plants; while oil and gas were formed from the remains of marine life that died millions of years ago. When fossil fuels are used up, they've gone forever. Although they could be replenished, it would take much too long.

Burning fossil fuels produces pollution – because it releases gases like carbon dioxide and sulfur dioxide. This increases the **greenhouse effect** and is making the Earth warmer (**global warming**). This is having an impact on our climate (**climate change**). Examples of climate change include:

- ▶ Warmer temperatures and more rain in wetter places
- ▶ A rise in sea levels
- ▶ Melting glaciers around the world, and ice in the Arctic and Antarctic
- ▶ Changes in the behaviour of wildlife.



### Nuclear is a different type of non-renewable energy resource.

**Nuclear** is also a non-renewable energy resource. This is because it uses a metal mined from the ground called uranium. But it's different to fossil fuels because it doesn't release any carbon dioxide to generate electricity.

The big difference is that in a nuclear power station, heat is produced to spin the turbines using a **nuclear reaction** (see the image above) rather than burning any fuel. So it's known as a **low-carbon energy source**. Show [this film](#) exploring how nuclear power is generated if you want to explore this topic in more detail.



### Renewable energy resources don't cause pollution.

Unlike fossil fuels, **renewable energy resources** don't create carbon dioxide emissions or pollution to generate electricity. So they don't contribute to climate change.



They're also important because they won't run out (like fossil fuels). So as our demand for electricity increases – as more of us start driving electric cars and heating our homes this way – we'll need to rely more on other energy sources to meet demand. These are some of the reasons why many countries – like the UK – are switching to generate more electricity from renewable energy sources.

Non-renewable energy sources (except nuclear) generate electricity by burning fossil fuels to create heat. What's interesting about renewable energy sources, however, is that **they create electricity in different ways**:



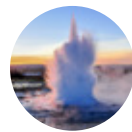
▶ **Wind power** converts the energy from the **movement of the wind** to turn a turbine and generate electricity.



▶ **Hydro power** converts the energy from **moving water** to turn a turbine and generate electricity.



▶ **Wave power** converts the energy from the **movement of waves** to turn a turbine and generate electricity.



▶ **Geothermal power** converts the thermal energy from **hot water and steam underground** to turn a turbine and generate electricity.



▶ **Tidal power** converts the energy from the **pull of the tides** to turn a turbine and generate electricity.



▶ **Solar power** converts **the Sun's energy** directly into electricity.

*Ask students to complete the 'What happens next?' challenge in their Worksheet.*

## Part 2: Quiz time!

*Test how much students remember about renewable and non-renewable energy resources with the quiz in their Worksheet.*

**1. Q. What material is a source of nuclear power?**

**A.** Uranium. This is a very special metal as it contains lots of unstable atoms (it's a radioactive material). We need this to create a nuclear reaction and produce heat.

**2. Q. What type of energy generation relies on the movement of water?**

**A.** Hydro power – also known as hydroelectric power – uses energy created from falling water. This runs through turbines, connected to a generator, and produces electricity. It's a renewable form of energy, as water won't run out. But we're limited geographically by how many hydro power plants we can have in the UK.

**3. Q. What are coal, oil and gas collectively known as?**

**A.** Fossil fuels because they're formed from the remains of plants and animals from millions of years ago.

**4. Q. Burning coal, oil and gas releases what?**

**A.** Carbon dioxide. It also releases other gases, like sulfur dioxide. These gases produce pollution and are contributing to climate change.

**5. Q. How does wind power work?**

**A.** Wind turbines use the wind to turn their blades. This turns a central shaft that drives a generator to produce electricity.

**6. Q. In a nuclear power station, how is heat generated?**

**A.** Through a nuclear reaction. This releases a tremendous amount of heat, which turns water into steam and drives the turbines to create electricity.

**7. Q. Give one reason why we need to generate more electricity from renewable energy resources.**

**A.** Renewable power resources don't produce pollution. So they don't contribute to climate change. Fossil fuels are also running out. So we need to find alternative ways of generating electricity to meet demand from homes and businesses.

**Part 3: Pick 'n' mix**



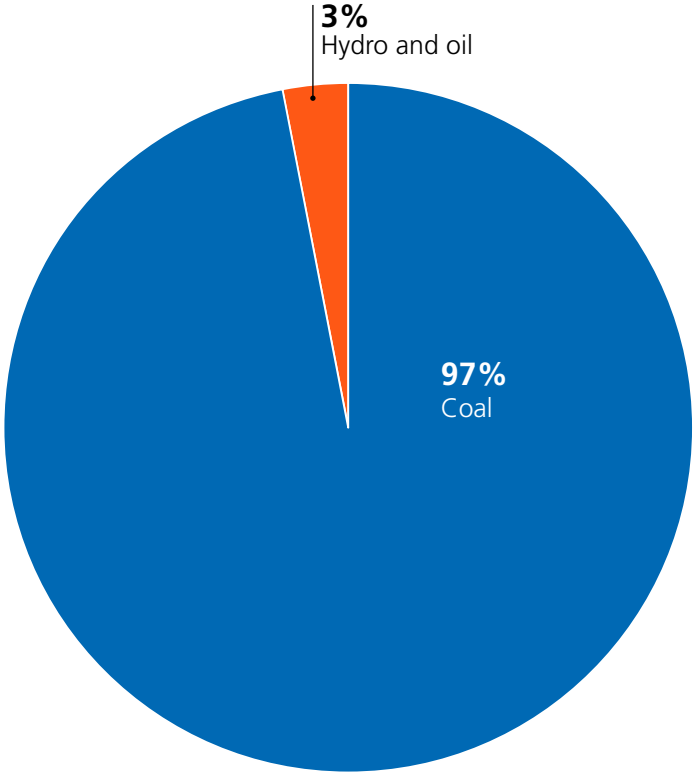
We don't rely on just one power source for electricity. Since we began using electricity more than a hundred years ago, we've used a combination of different energy resources in the UK. We call this combination the **energy mix**.

**We need a 'mix' because:**

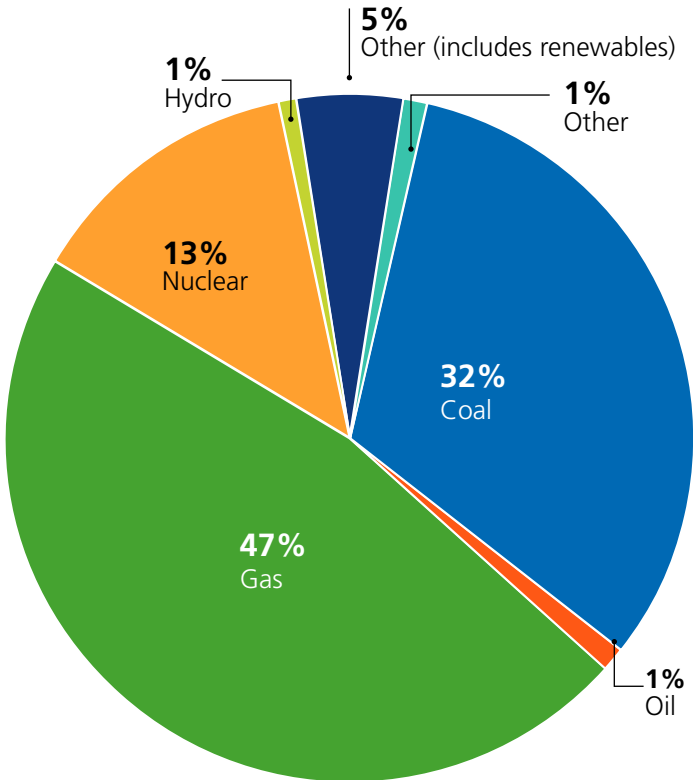
- ▶ No single energy source will power all our lights (or gadgets)
- ▶ They all have strengths and weaknesses.

The two pie charts opposite show how much the UK's energy mix has changed over the decades. For instance, we're no longer reliant on mainly one fuel (coal) – as we were in the 1950s – to produce electricity. There are also a lot more energy resources in the mix since 2000. And you can also see the share of electricity generated from low-carbon energy resources – such as renewables and nuclear – has increased in recent decades.

**The UK's energy mix in 1950**



**The UK's energy mix in 2008**



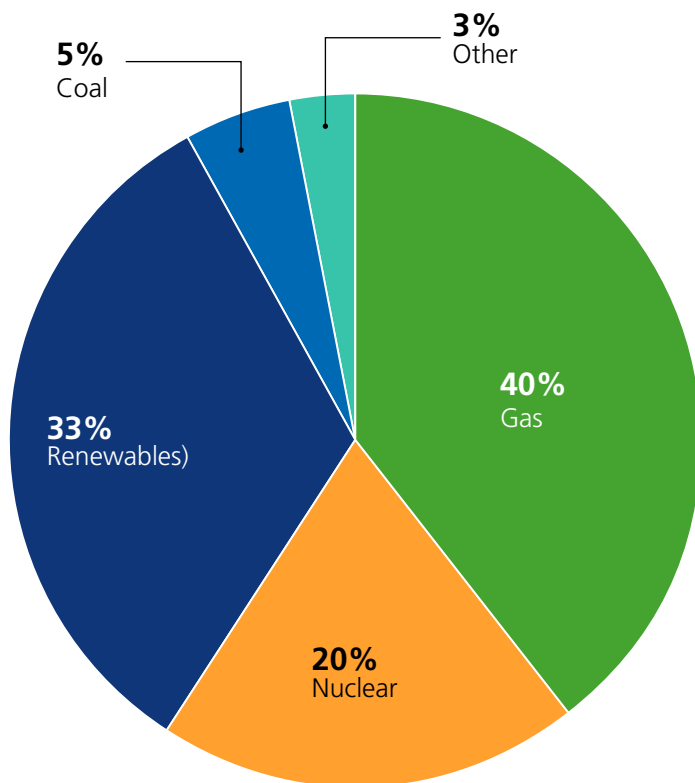
**Our energy mix has changed over the years for a number of reasons:**

- ▶ **Government rules:** In recent decades, the Government has said it wants to use more renewable energy resources to meet its climate change targets.
- ▶ **Price:** The price of fossil fuels has gone up and down over time. For example, in the early 1970s, oil became really cheap so the UK switched to using more oil at the start of that decade.
- ▶ **New technologies:** The UK started to use more nuclear from the 1960s onwards; while in the 1990s, gas became a significant source as the first gas-fired generation plant was built at the start of the decade.
- ▶ **Geography and climate:** You need hills and windy areas for wind power to work, for instance. And sunny weather for solar!

**Now it's your turn... Look at each of the pie charts in your Worksheet. These represent the energy mix in different years. Using the clues and what you've just learnt about the factors that have affected the UK's energy mix over time, can you label each of them with the correct energy resources?**

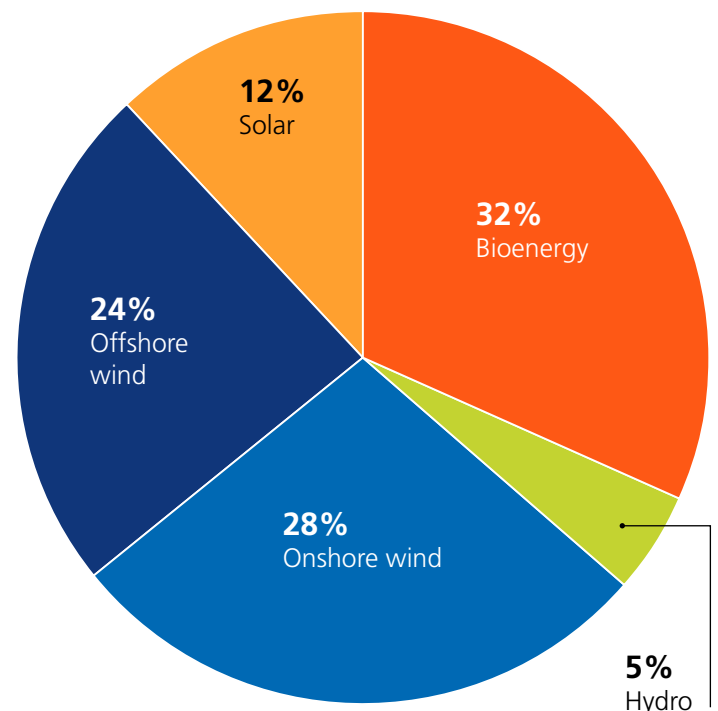
Note: The Government's statistics group 'renewables' together as one energy source. So flag this up with students for pie chart 3 onwards (i.e. they don't need to break each renewable technology out separately on their pie charts).

### 1. The UK's energy mix in 2018



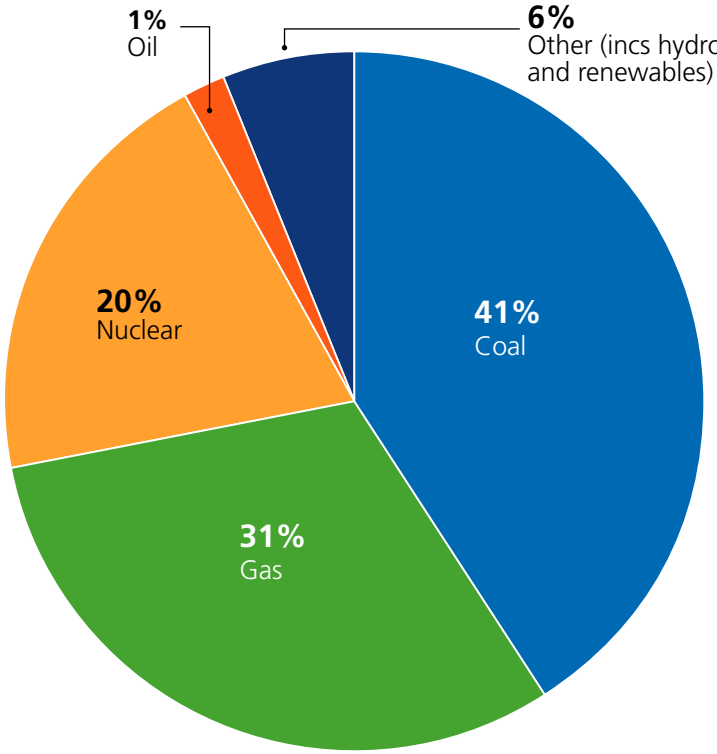
*NB: We have rounded up the stats, so it doesn't quite represent 100%. The Government stats for the UK's energy mix are released every July. If you want to update the pie chart, you can find the most recent [here](#). Click into each year you want to review, and then scroll down to the report labelled 'Digest of UK Energy Statistics (DUKES): Electricity'.*

### 2. How did renewables contribute to the UK's energy mix in 2018?



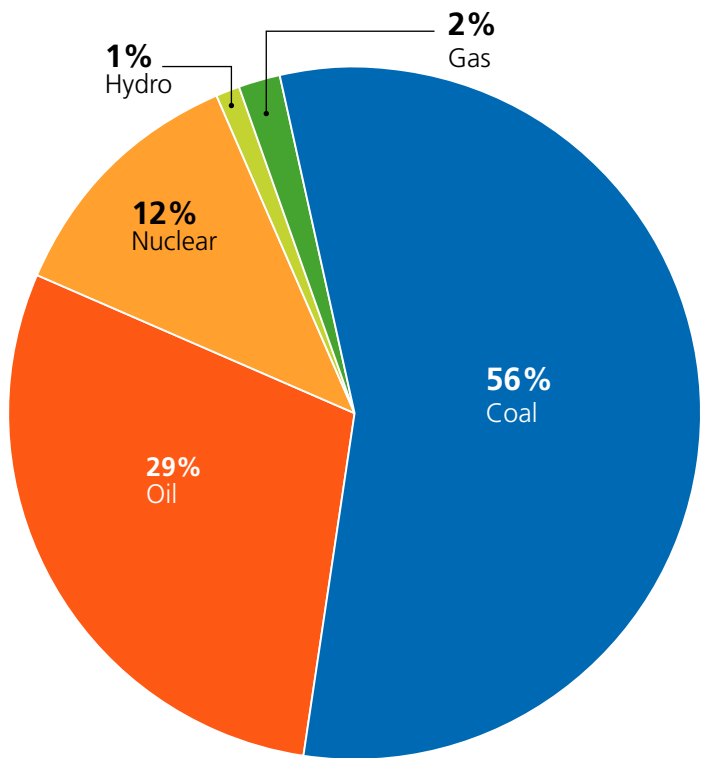
**Did you know...** Renewables generated a record share of electricity generation in 2018 – up 4% from the previous year. Ask students if they were aware that wind was the biggest provider of renewable electricity? Have they seen any wind turbines? What about solar farms?

**3. The UK's energy mix in 2006**



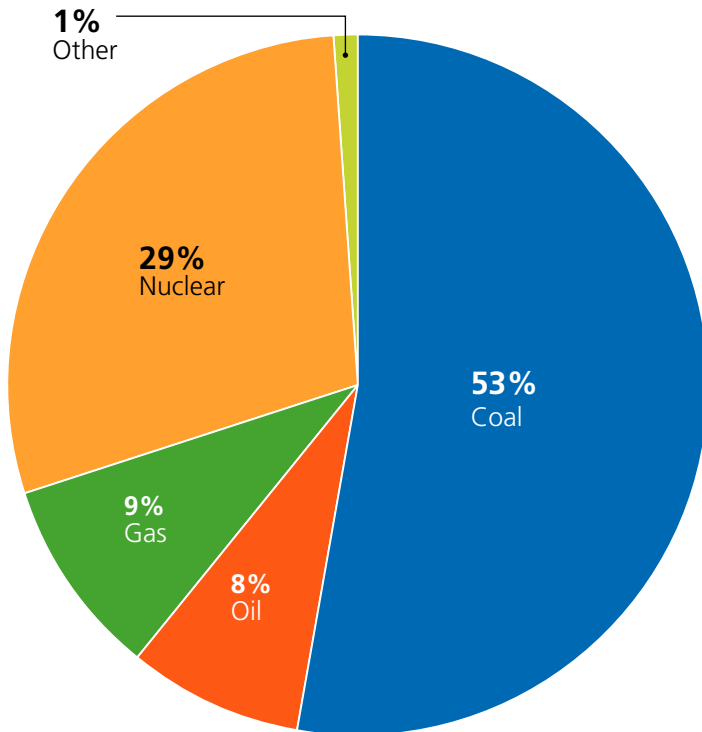
- ▶ In the early 2000s, we were still heavily reliant on fossil fuels. Although the role of oil had declined in recent decades.
- ▶ Nuclear power generated a fifth of our electricity.

**4. The UK's energy mix in 1972**



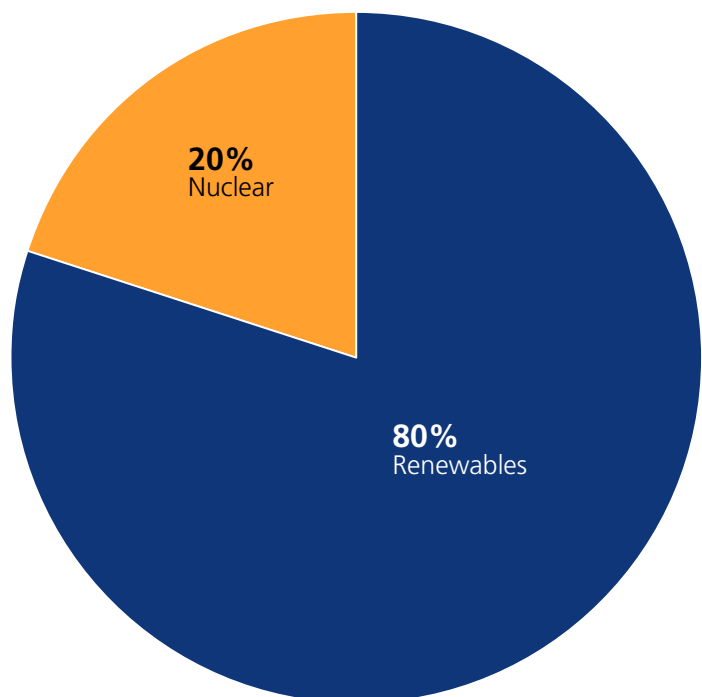
- ▶ Until the 1970s, the UK had been reliant on coal – so this was still an important part of the energy mix at the start of the 1970s.
- ▶ Oil became a major source of electricity generation in the early part of the 1970s. But it became less dominant towards the end of the decade as oil became very expensive (following the 1973 oil crisis – you could explain what this was, if time).
- ▶ Gas wasn't a big contributor to our energy mix in the 1970s.
- ▶ Nuclear also started to contribute more to our energy mix from the 1960s onwards.

### 5. The UK's energy mix in 1993



- ▶ We were still reliant on coal in the 1990s as a major fuel source.
- ▶ But for the first time, oil had been overtaken by another fossil fuel (gas). Gas became a significant energy source for electricity after the first gas-fired generation plant was built at the start of the 1990s. This was called the 'dash for gas' as more electricity companies turned to this fuel source for generating electricity.
- ▶ Oil, on the other hand, saw its role in the UK's energy mix dwindle progressively after this, year on year.

### 6. The UK's energy mix in 2050



This is a trick question, as we're asking you to estimate what our energy mix might be in the future! 2050 is an important date though, as it's the date by which the Government has committed to achieving 'net-zero' carbon emissions. This means our energy mix needs to be entirely reliant on low-carbon energy sources, like renewables and nuclear, by this date.

- ▶ **What do you think the phrase 'net-zero' means?** It means that the amount of carbon dioxide emissions released in the UK – from activities like generating electricity, transport and heating – is balanced by how much carbon we can 'remove', using all sorts of new technologies.
- ▶ **What's so important about the year 2050?** The net-zero target for 2050 was recommended by the Committee on Climate Change, an organisation that advises the Government. They believe that it could help prevent the world from warming up by more than 1.5°C – as long as other countries also reduce their own carbon emissions. Although 1.5°C doesn't sound like much of a temperature increase, it's widely acknowledged by scientists that global warming any higher than this could be catastrophic.

## CAREERS IN ENERGY

10 mins

### Part 1: What jobs are involved in building a new power station?



**“This project provides you with a unique opportunity to learn new skills and establish a foundation for your personal career.”**

Rob Jordan, Site Construction Director for Hinkley Point C

Hinkley Point C (HPC) is the first new nuclear power station to be built in 25 years. And it's really important because it will help the UK generate more power from low-carbon energy resources in the future.

HPC is also providing lots of new jobs. It's a massive infrastructure project, which is creating about 25,000 job opportunities in total. HPC will still be in the construction phase by the time you leave school – so you could be one of the people that helps to build the new power station!



**“** HPC has given me loads of opportunities to learn a trade and get paid. It's suited to me as while I love learning, I love actually doing something as well. **”**

**Sam, Civil Engineer Apprentice**

There are so many job opportunities involved in building a new nuclear power station:



**Spotlight on careers in construction**



Gemma is a Geotechnical SME (Subject Matter Expert), and has been working at HPC during its construction:

“ You’d be very surprised where you can be employed as a Geologist! I have worked in residential, rail, highways and energy so far. I like the mix of challenging my brain with technical queries and interpretative reporting, as well as field work and site supervision. ”

**Read the rest of the article**

**Part 2: Jobs in the low-carbon energy sector**

**There will be all sorts of future careers in the energy sector.** When HPC starts to generate electricity, for instance, there will be jobs for about 900 people to keep the power station running. And because we need more low-carbon sources in our future energy mix, it's a growing and exciting area to work in that could give you a skillset for life and take you all over the world!



Planning the development of new wind farms



Helping to ensure the safe generation of nuclear power



Looking after wind or solar sites



Working with new technologies and devices



Using virtual reality technology as part of your everyday job



Building robotic tools to repair or maintain equipment



## Homework activities

Choose from one of the following:

1. Research the UK's energy mix for electricity and produce pie charts to illustrate the mix in 1970, 1995 and 2015 (Share **this dataset** with students)
2. Research the pros and cons of the following energy resources: nuclear, gas, wind and solar. (Students could use the **Pod's Power the UK** game and/or **BBC Bitesize for Science** and **Geography** if they need further guidance.)

Ask students to complete the table in their Worksheet listing the pros and cons of different energy resources:

ENERGY RESOURCE	PROS	CONS
<b>Nuclear</b>	<ul style="list-style-type: none"> <li>▶ Low carbon</li> <li>▶ Not likely to run out any time soon</li> <li>▶ Reliable: provides baseload electricity</li> <li>▶ Higher output and less land space required than for renewables</li> </ul>	<ul style="list-style-type: none"> <li>▶ Uses a non-renewable fuel (uranium)</li> <li>▶ Building a nuclear power station is a big investment project, involving government and other organisations</li> <li>▶ Nuclear waste remains radioactive, so the waste products require long-term management in special facilities</li> </ul>
<b>Gas</b>	<ul style="list-style-type: none"> <li>▶ Reliable</li> <li>▶ Flexible</li> <li>▶ Fairly low-cost way to generate power</li> </ul>	<ul style="list-style-type: none"> <li>▶ Gas is a non-renewable resource, so it will run out</li> <li>▶ Not low carbon</li> <li>▶ It produces pollution and contributes to climate change</li> </ul>
<b>Wind</b>	<ul style="list-style-type: none"> <li>▶ Low carbon; no pollution. The UK is also the windiest country in Europe</li> <li>▶ Offshore wind turbines can generate more electricity than onshore wind</li> <li>▶ Relatively low cost to run and no fuel costs</li> </ul>	<ul style="list-style-type: none"> <li>▶ Variable power source (no wind = no electricity)</li> <li>▶ Limited development onshore due to available land space</li> <li>▶ Offshore wind farms are trickier and more expensive to build</li> </ul>
<b>Solar</b>	<ul style="list-style-type: none"> <li>▶ Low carbon; no pollution</li> <li>▶ We get enough sunlight in the UK to make it a viable energy source</li> <li>▶ No fuel costs</li> </ul>	<ul style="list-style-type: none"> <li>▶ Variable (it doesn't work well in cloud or at all at night)</li> <li>▶ Restricted by the amount of land space required</li> <li>▶ Solar power can't be stored very easily or cheaply over a long period</li> </ul>

## Curriculum links

**Science:** Electricity

**Geography:** Human and physical geography – describe and understand key aspects of: human geography, including types of settlement and land use, economic activity including trade links, and the distribution of natural resources including energy, food, minerals and water.

**PSHE:** Living in the wider world: L5. ways of carrying out shared responsibilities for protecting the environment in school and at home; how everyday choices can affect the environment (e.g. reducing, reusing, recycling; food choices).

Find out more about **Hinkley Point C** and **careers in the nuclear industry**

## WARM-UP

### 1-minute challenge!

Write down in one minute as many things as you can think of in your home that need electricity to operate.

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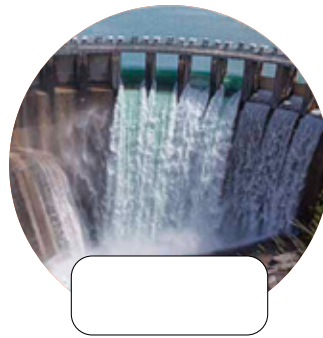
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## THE MAIN ACTIVITY

### Part 1: Where do we get our power from?

Can you name the energy sources in these pictures?



## Which of the energy resources on the previous page are renewable or non-renewable?

Fill in the table below with your answers.

<b>RENEWABLE ENERGY RESOURCES:</b>	<b>NON-RENEWABLE ENERGY RESOURCES:</b>

## What happens next?

Fill in the blanks to explain how electricity is generated from each energy resource.



1. **Wind power** converts the energy from \_\_\_\_\_  
to turn a turbine and generate electricity.



2. **Wave power** converts the energy from \_\_\_\_\_  
to turn a turbine and generate electricity.



3. **Tidal power** converts the energy from \_\_\_\_\_  
to turn a turbine and generate electricity.



4. **Hydro power** converts the energy from \_\_\_\_\_  
to turn a turbine and generate electricity.



5. **Geothermal power** converts the thermal energy from \_\_\_\_\_  
to turn a turbine and generate electricity.



6. **Solar power** converts \_\_\_\_\_  
directly into electricity.

## Part 2: Quiz time!

Test how much you know about renewable and non-renewable energy resources in this quick quiz.

**1. Q. What material is a source of nuclear power?**

A. \_\_\_\_\_  
\_\_\_\_\_  
\_\_\_\_\_

**2. Q. What type of energy generation relies on the movement of water?**

A. \_\_\_\_\_  
\_\_\_\_\_  
\_\_\_\_\_

**3. What are coal, oil and gas collectively known as?**

A. \_\_\_\_\_  
\_\_\_\_\_  
\_\_\_\_\_

**4. Q. Burning coal, oil and gas releases what?**

A. \_\_\_\_\_  
\_\_\_\_\_  
\_\_\_\_\_

**5. Q. How does wind power work?**

A. \_\_\_\_\_  
\_\_\_\_\_  
\_\_\_\_\_

**6. Q. In a nuclear power station, how is heat generated?**

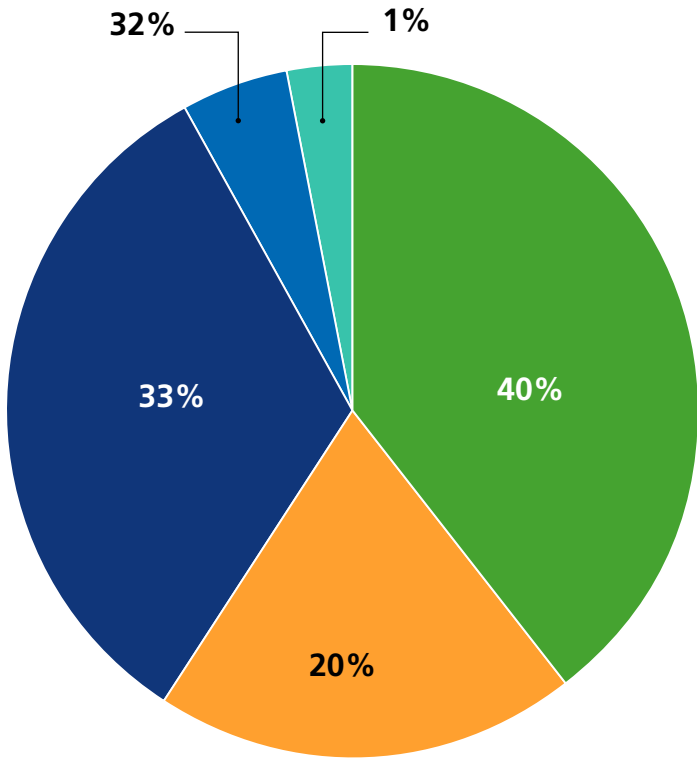
A. \_\_\_\_\_  
\_\_\_\_\_  
\_\_\_\_\_

**7. Q. Give one reason why we need to generate more electricity from renewable energy resources.**

A. \_\_\_\_\_  
\_\_\_\_\_  
\_\_\_\_\_

### Part 3: Pick 'n' mix

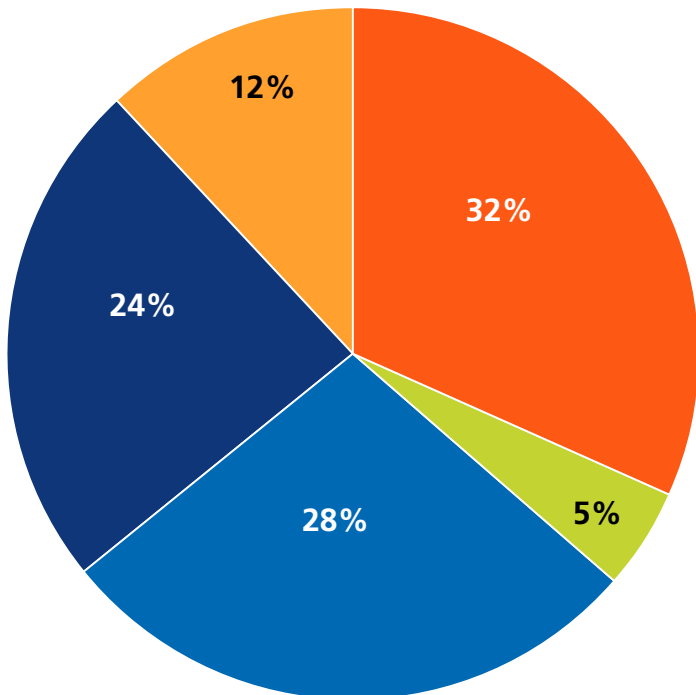
Look at the pie charts below for the UK's energy mix. Using the clues and what you've just learnt, can you work out which percentage matches each energy source?



#### 1. The UK's energy mix in 2018

- Gas: \_\_\_\_\_
- Coal: \_\_\_\_\_
- Renewables: \_\_\_\_\_
- Nuclear: \_\_\_\_\_
- Other fuels: \_\_\_\_\_

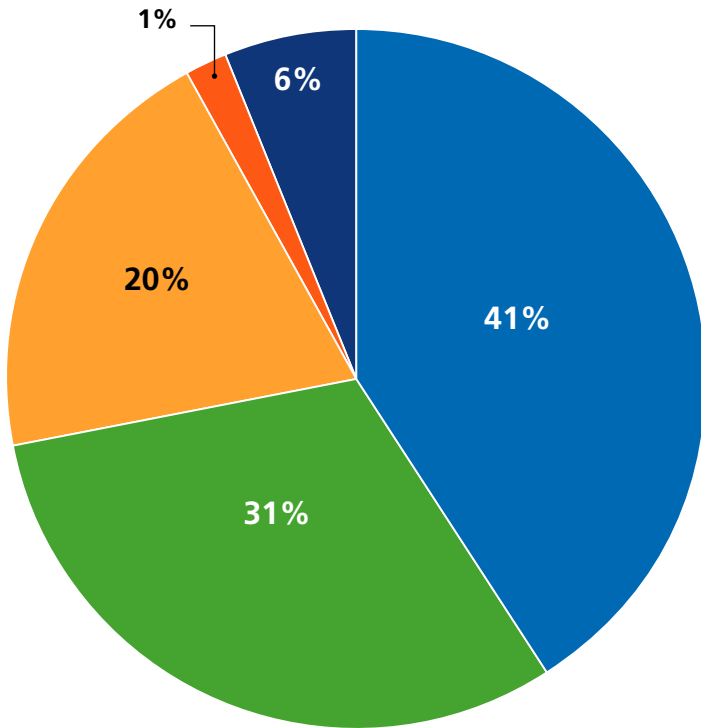
**Clue:** The UK's main energy source is still a fossil fuel.  
**Clue:** Renewables contributed a record amount to electricity generation in 2018.



#### 2. What was our renewables energy mix in 2018?

- Onshore wind: \_\_\_\_\_
- Offshore wind: \_\_\_\_\_
- Hydro: \_\_\_\_\_
- Solar: \_\_\_\_\_
- Bioenergy: \_\_\_\_\_

**Clue:** We have more onshore than offshore wind farms  
**Clue:** Bioenergy has replaced coal in some old power stations (and there were a lot of old coal power stations!)



### 3. The UK's energy mix in 2006

Nuclear: \_\_\_\_\_

Oil: \_\_\_\_\_

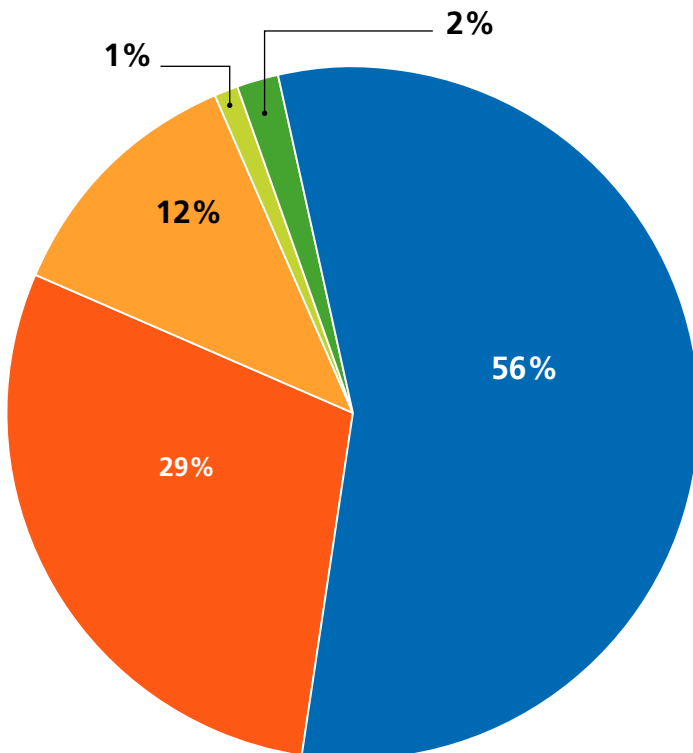
Gas: \_\_\_\_\_

Coal: \_\_\_\_\_

Other:  
(includes hydro and renewables) \_\_\_\_\_

**Clue:** In the early 2000s, we were still heavily reliant on fossil fuels.

**Clue:** Nuclear power generated a fifth of electricity in this year.



### 4. The UK's energy mix in 1972

Hydro: \_\_\_\_\_

Gas: \_\_\_\_\_

Oil: \_\_\_\_\_

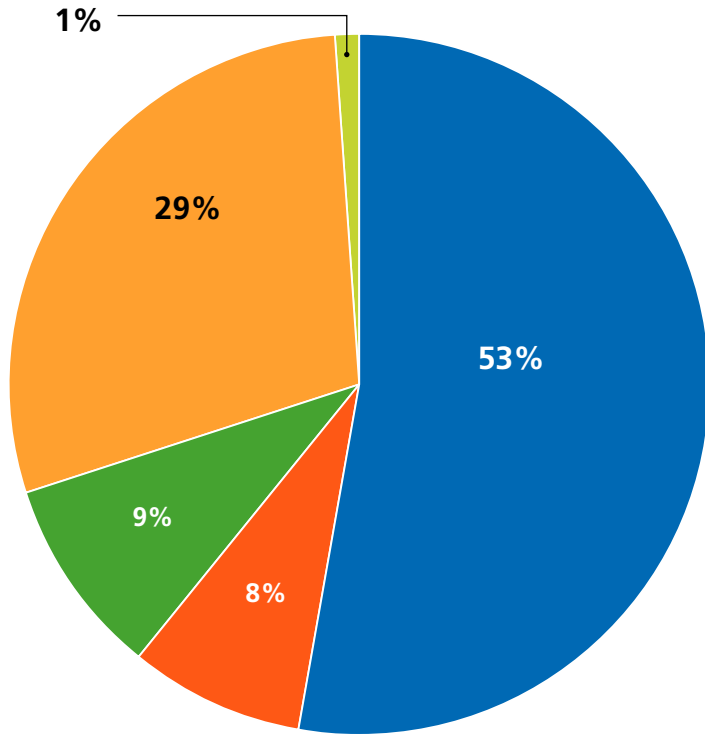
Nuclear: \_\_\_\_\_

Coal: \_\_\_\_\_

**Clue:** Until the 1970s, the UK had been reliant on coal, so this was still an important part of the energy mix at the start of the 1970s.

**Clue:** Another fossil fuel became a major source of electricity generation in the early part of the 1970s... Can you name it?

**Clue:** Gas wasn't a big contributor to our energy mix in the 1970s.



### 5. The UK's energy mix in 1993

Oil: \_\_\_\_\_

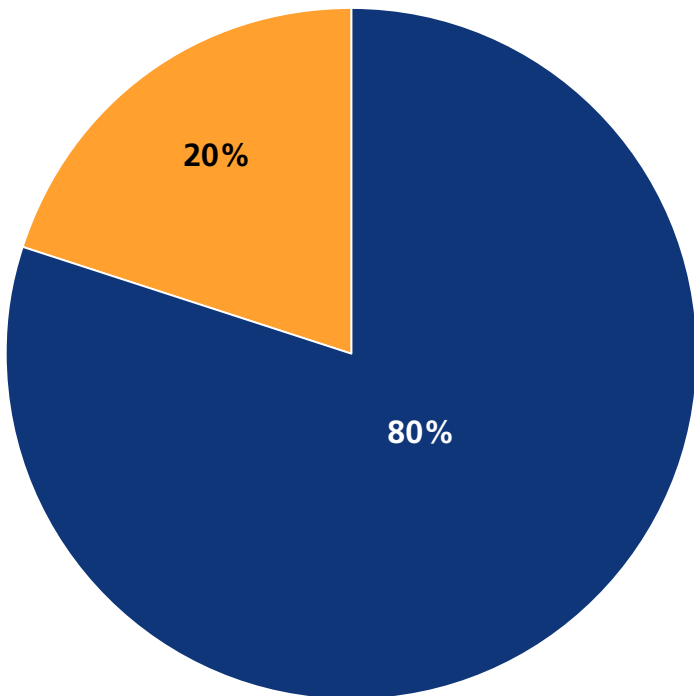
Gas: \_\_\_\_\_

Other: \_\_\_\_\_

Nuclear: \_\_\_\_\_

Coal: \_\_\_\_\_

**Clue:** The main energy source was also popular in the 1950s  
**Clue:** For the first time, oil was overtaken by another fossil fuel. Can you guess which one?



### 6. The UK's energy mix in 2050

Nuclear: \_\_\_\_\_

Renewables: \_\_\_\_\_

**Clue:** The UK wants to achieve 'net-zero' emissions by 2050. This means we need to be 100% reliant on low-carbon energy sources by this date... How much do you think each low-carbon energy source will contribute to the energy mix?

## HOMEWORK ACTIVITIES

Choose from one of the following:

- 1. Research the UK's energy mix for electricity and produce pie charts to illustrate the mix in 1970, 1995 and 2015** (this [dataset](#) will help).
- 2. Research the pros and cons of the following energy resources: nuclear, gas, wind and solar** (Try *the Pod's Power the UK game* and *BBC Bitesize for Science* and *Geography* if you're stuck.)

ENERGY RESOURCE	PROS	CONS
Nuclear		
Gas		
Wind		
Solar		

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