Find out about biomass energy

Aim

To discover one way that biomass gives off energy

Introduction

Biomass is plant or animal material that can be used as fuel, to provide heat or electricity. Grass cuttings are a type of biomass that can be used to give off heat in a process called decomposition.

What to do

1. Collect enough freshly cut grass cuttings to fill a bin liner half or two-thirds full.

2. As soon as the grass cuttings are in the bag, measure their temperature with a thermometer. Record this figure below.

Temperature of grass cuttings at start of test: _____ ˚C

3. Close the bag tightly to keep air out, and seal it with tape. Put the bag into the box and leave it for 24 hours.

4. After 24 hours, open the bag and take the temperature of the grass in the middle of the bag. Record the temperature below.

Temperature of grass cuttings at end of test: _____ ˚C

5. Feel the grass in the bag. (Wash your hands afterwards.) What does it feel like?

_____

6. Can you explain what has happened?

_____

7. Smell the grass cuttings: what is being given off?

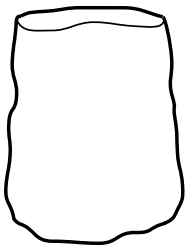
_____

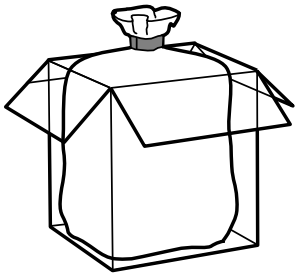
Conclusion

Bacteria in the grass are breaking it down. This is called decomposition. The grass gives off biomass energy in the form of heat and gas. This is why compost heaps are usually warm.

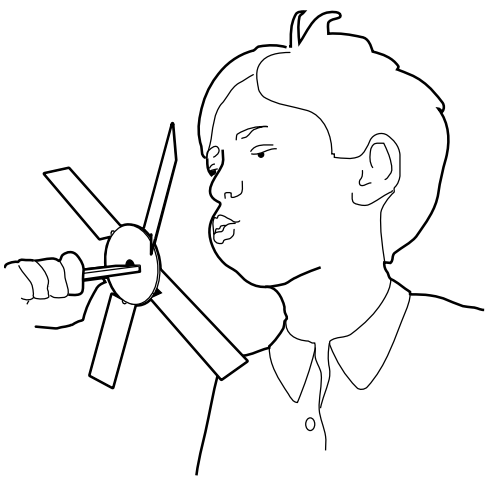
You will need

- Lots of grass cuttings
- Garden rakes (not essential)
- A black bin liner
- A thermometer
- A large cardboard box





Make a wind turbine



Aim

To find out which materials make the best rotor blades

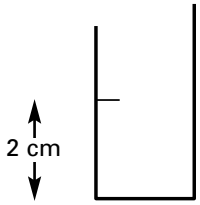
You will need

Your teacher will give you a list.

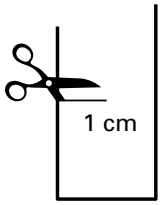
What to do

1. Cut out four 8cm x 2cm rectangles from each sheet of material you want to test. Each will be a rotor blade.

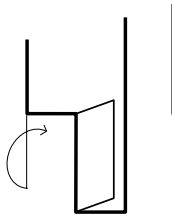
2. For each rotor blade, follow the instructions below.



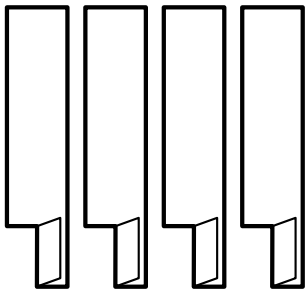
a) Make a mark 2cm from one end of the blade.



b) Cut a slit half-way across the rectangle.



c) Fold over the flap.



d) Your finished rotor blades should look like this.

3. Choose one type of **material** to test, e.g. thin card. Attach the four rotor blades made of thin card to a card wheel as shown. The blades must be angled as shown in the picture at the top of this page.

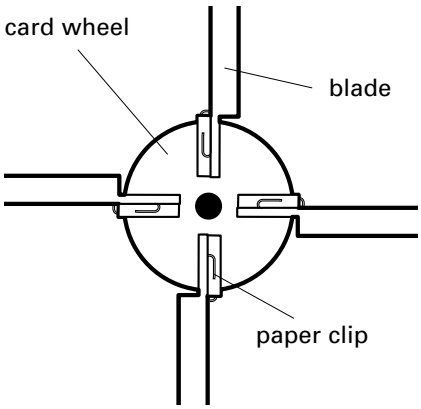
4. Take a second card wheel and push the paper fastener through both wheels as shown. Tape the fastener to the end of a ruler so that the rotor is free to spin. You may need a friend to help you hold it.

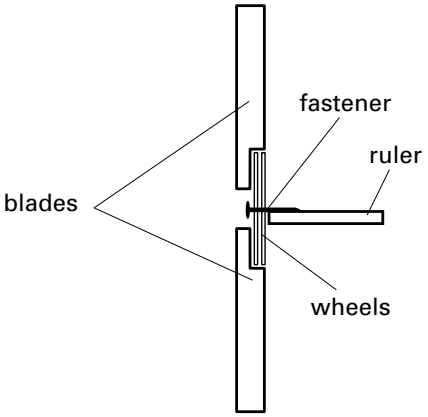
5. Blow on your rotor to test it. You need to ask permission before you go outside to test it in the wind. Predict which materials will work best. Outside, point the rotor into the wind and look carefully at how the rotor spins. How will you keep your test fair?

6. Now test another material. Simply unclip the blades and fit new ones to the wheel using paperclips. You could also test different rotor blade **shapes**.

7. Write down what happened.

- How did each type of rotor spin?
- Which materials worked best? Why?





Use solar energy to make electricity and heat water

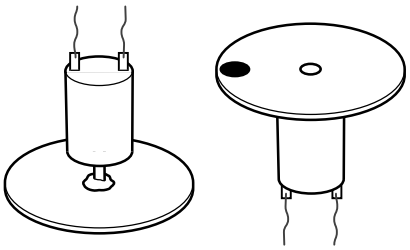
Experiment 1: PV cells

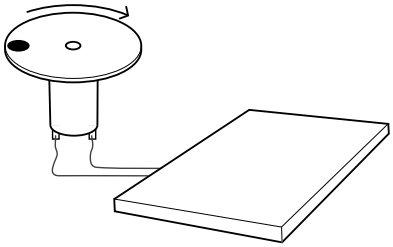
Aim

To find out how different conditions affect the energy produced by PV cells ('photovoltaic' cells)

You will need

- A solar energy kit with PV cells, and a small motor. If you do not have a solar motor kit, you can do similar tests with a solar calculator





What to do

PV cells make electricity from light. You can use the electricity to work a small motor.

1. Attach a cardboard wheel to the motor with Blu-tack.

2. Draw a large dot on the edge of the wheel.

3. Count the number of turns in 10 seconds, using a stopwatch.

4. Test the solar motor in different places, and record the results:

a) indoors under a table, **b)** indoors by a window, **c)** outside in shade, **d)** outside in full sun.
How will you keep your test fair?

5. What do the results of these tests tell us about PV cells?

Experiment 2: Make a solar collector

Aim

To measure the effect of the sun on water in a solar collector

What to do

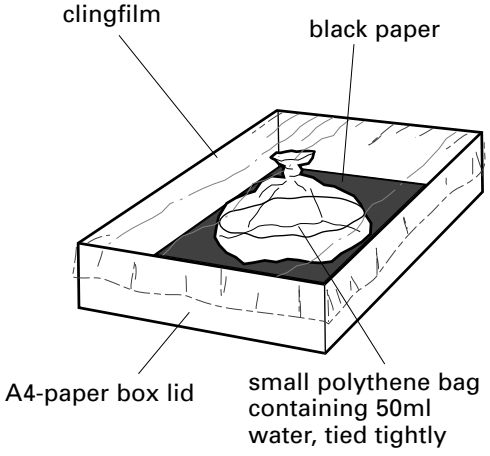
1. Your teacher will help you set up a solar collector. Record the temperature of the water before the test.

2. Make sure the box lid is well covered with clingfilm (no gaps).

3. Leave the box outside in a sunny place for 1 or 2 hours.

4. Measure the temperature of the water.

5. Write down what happened and explain why.



Make a water turbine

'Hydro' means water. Hydroelectric power is a form of renewable energy that uses fast-moving water to turn a turbine, which turns a generator to produce electricity. A turbine is a wheel with blades, which spins round.

Aim

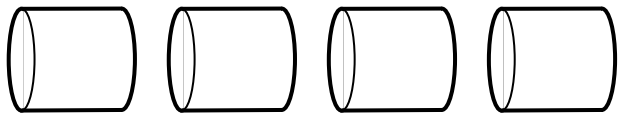
To make your own very simple water turbine.

You will need

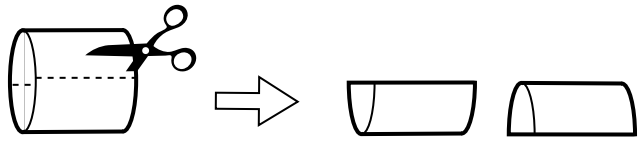
- A strong cardboard tube
- A long rod
- Scissors and a stapler

What to do

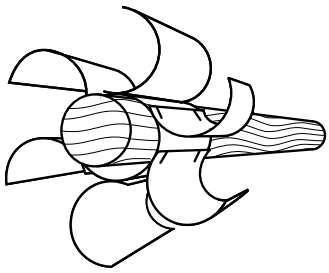
1. Cut the tube into four equal lengths.



2. Cut three of the pieces in half as shown.

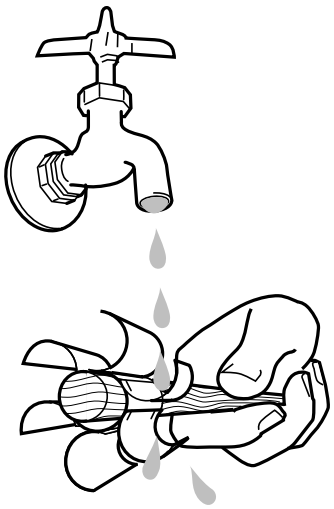


3. Staple the half-pieces to the last full piece of the tube as shown.



4. Put the rod through the tube and check that the turbine spins. Test in a large sink with a high tap, as shown. Make sure that there is only a gentle stream of water!

5. Cardboard soon goes soggy! Suggest three improvements to make this turbine work better. Ask your teacher if you can make the improvements.



A tidal energy test

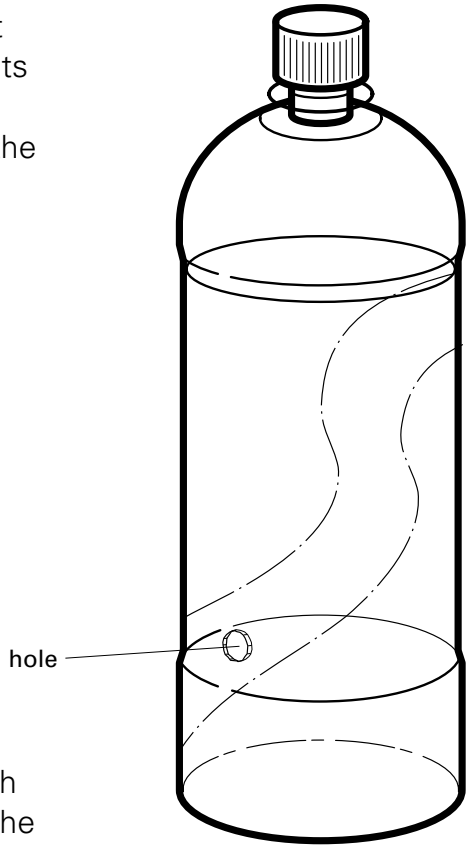
Tidal energy works by using the movement of the sea as the tide moves in and out twice a day. A tidal barrage is a giant wall (dam) that traps an area of sea at high tide and then lets the water pour through gates so that it turns turbines to make electricity. Water needs to be higher on one side of the barrage than the other side for the turbines to work.

Aim

To show how a higher level of water produces more pressure.

You will need

- Two 2-litre plastic drinks bottles
- A sharp pointed tool such as a bradawl or a pair of compasses
- Strong cloth tape (e.g. duct tape)



What to do

1. Ask your teacher to make a small hole in the side of each bottle, about 5cm from the bottom. The holes must be the same size.

2. Cover each hole with a piece of cloth tape, pressing it down firmly.

3. Fill one bottle with water, to the top, and half fill the other.

4. Place the bottles next to a sink, with the holes facing the sink.

5. Predict what will happen when the tape is removed from each bottle.

_____

_____

6. Remove the tape from each bottle at the same time and watch what happens.

7. Explain the results. Why did it happen like this?

_____

_____

_____

Find out about wave energy

Aim

One of the most exciting new renewable energy technologies is the Pelamis wave machine. The machine uses the movement of waves at sea to generate electricity. But how does it work? This model will help you find out.

You will need

- 3 pieces of thick wooden dowelling or 3 plastic tubes (e.g. from old pens)
- A piece of plastic film, e.g. OHT acetate
- Elastic bands
- Plasticine and scissors

What to do

1. If you are using hollow tubes, seal the ends with plasticine.

2. Cut two narrow strips of acetate, 1cm wide and about 8cm long.

3. Assemble the model Pelamis as shown in the diagram below.

4. Check that the joints of the Pelamis can move freely.

5. Check that the Pelamis floats, using a large sink, a basin half-full of water, or a water tray.

6. Using your hand or a plastic ruler, make gentle movements in the water to create small waves. Can you get the waves to move the sections of the Pelamis at different times? Write down what happened in your tests.

_____

7. Can you improve your model Pelamis? How?

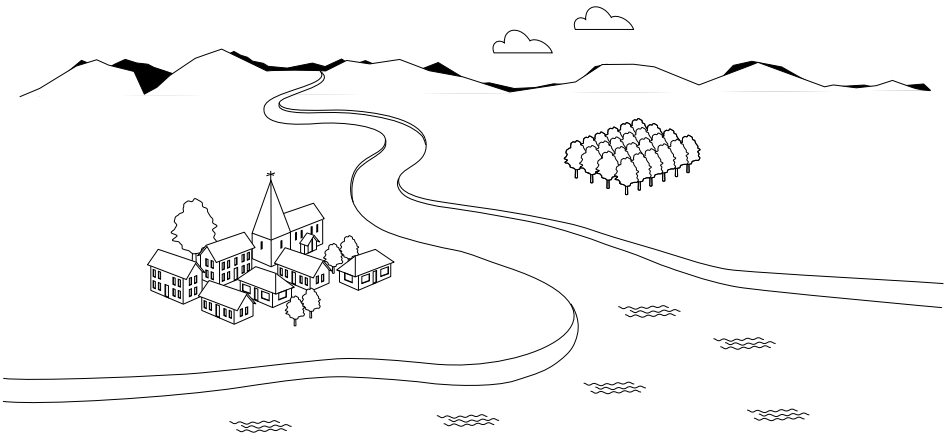
_____

8. Research how the up and down movements of the real Pelamis wave machine make electricity.

Choose sites for renewable energy projects

Aim

To choose the best sites for six renewable energy projects



What to do

You are in charge of building the six new **renewable energy projects** listed in the table below.

Where is the best place to locate each one? Mark a **number** on the picture for each project and write down the **reason** why you chose this place.

Number on picture	Renewable energy project	Why you chose this location (try to give two reasons for each)
1	A wind farm	
2	A wave machine	
3	A biomass wood-burning project	
4	A tidal barrage	
5	5000 solar PV panels	
6	A hydroelectric dam	

Energy sources: what do you think?

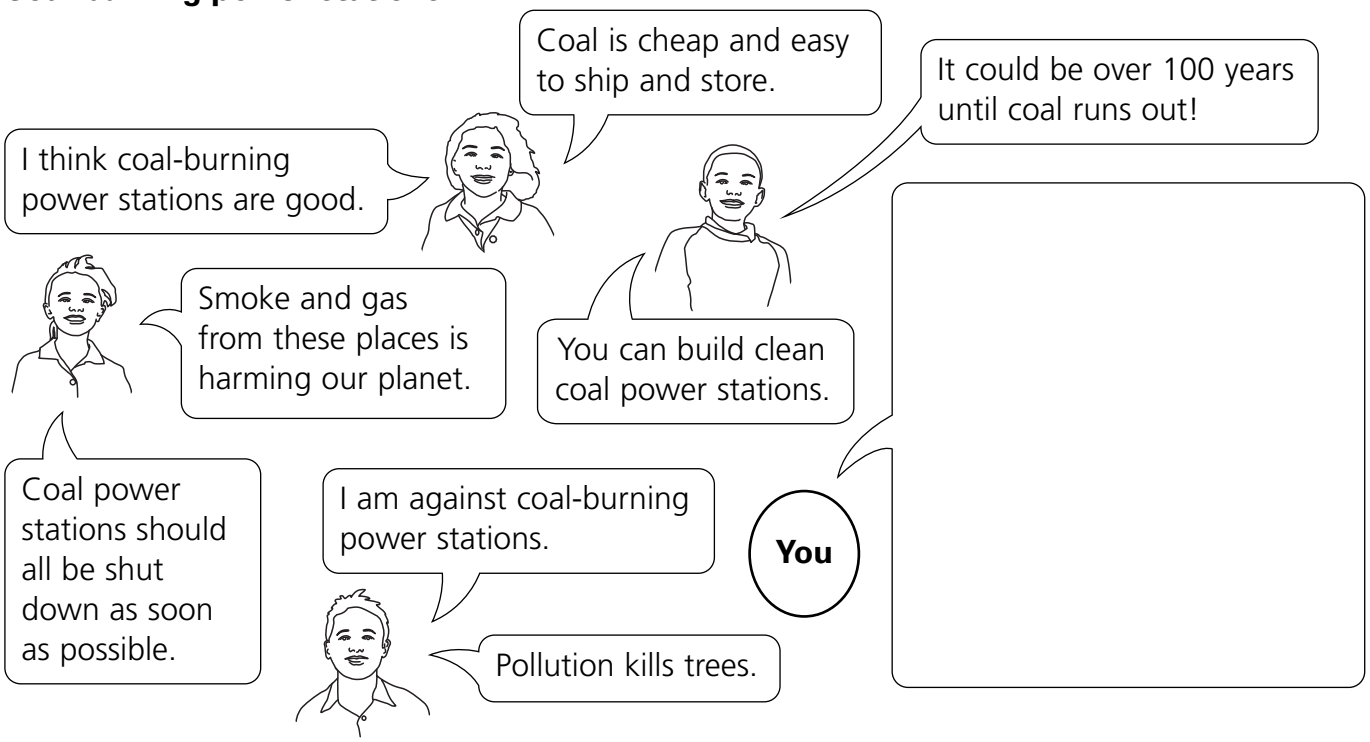
Aim

To discuss your views on the use of coal and wind as energy sources

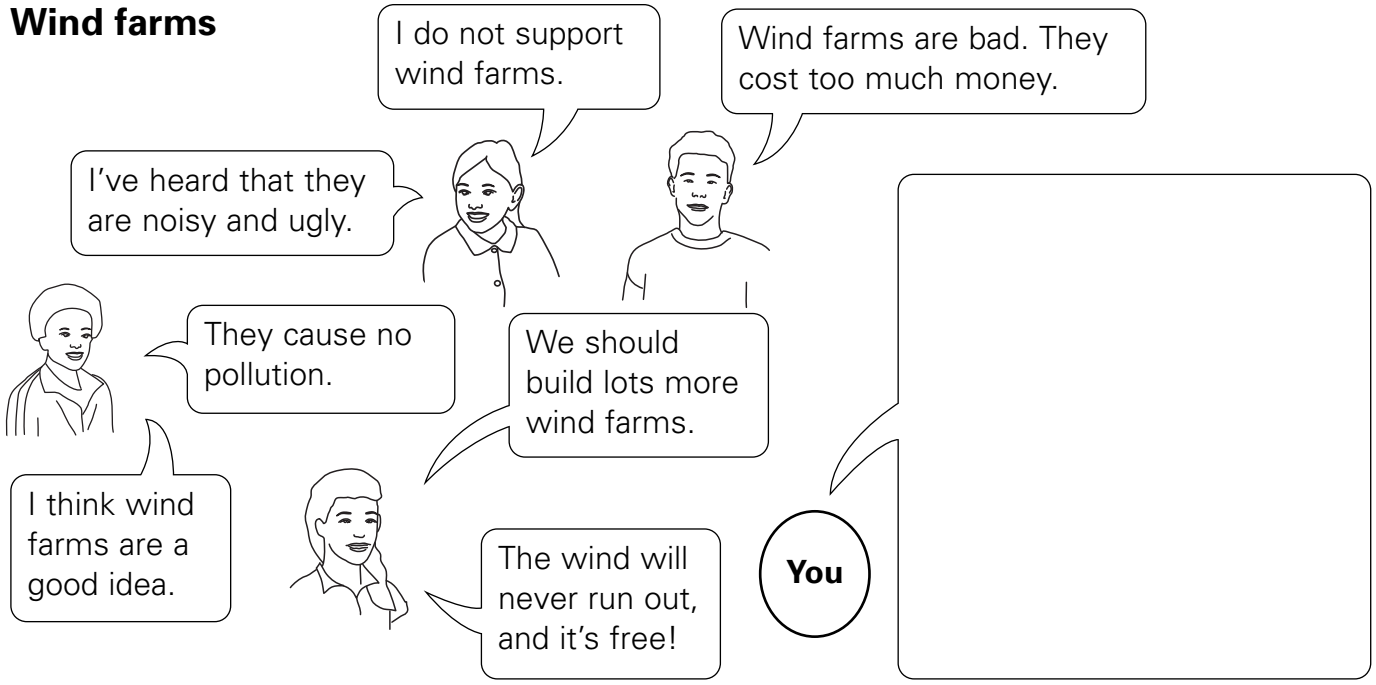
Coal or wind?

The people below are discussing coal-burning power stations and wind farms. Which one is best for generating electricity? Read these people's views, then write what you think in the empty speech bubble.

Coal-burning power stations



Wind farms



Where does the UK's electricity come from?

Aim

To learn about renewable and non-renewable sources of electricity in the UK

Information

Today only about 3% of the UK's electricity is supplied by renewable energy such as wind power, biomass and solar energy.

The government wants to increase this to 10% by the year 2010. This will cut down pollution and save fossil fuels such as oil and gas.

How is the UK's electricity generated?

Type of fuel or energy	% of UK's electricity supplied
Coal	30
Gas	29
Nuclear	15
Oil or mixed fuel	13
Other (e.g. waste)	10
Renewable energy	3

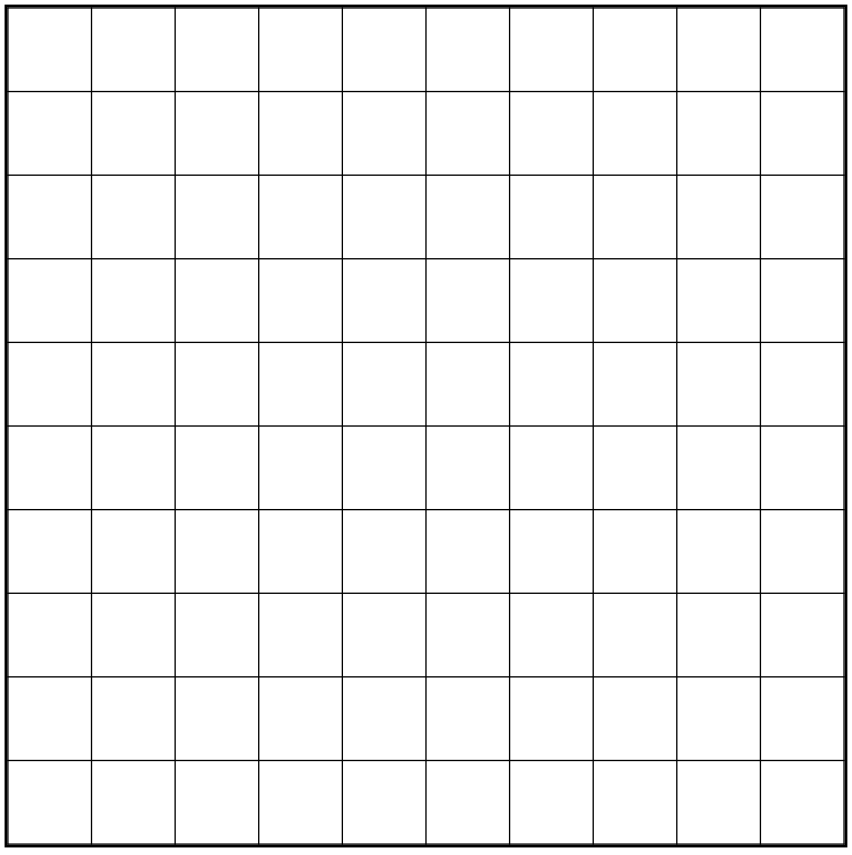
What to do

1. Show the above percentages on a **graph** using the grid below. The graph will need:

- A title
- Numbers on one axis
- A label for each axis
- Bars (shaded or coloured)

2. List eight types of renewable energy.

3. Which type of renewable energy supplies the most electricity at present in the UK?



Non-renewable energy

Fossil fuels
Fossil fuels are oil, coal and natural gas.

They are the remains of ancient plants and animals, found underground.

These fuels are limited – one day they will run out.

Today, most of the UK's electricity comes from power stations that burn fossil fuels.

Burning fossil fuels creates 'greenhouse gases', such as carbon dioxide (CO_2), which are thought to damage the Earth's atmosphere.

Other types of pollution, such as acid rain, are also caused by these power stations.

Nuclear energy
Nuclear power generates electricity using dangerous substances as fuel.

The radioactive metal uranium gives off heat, which can be used to make steam to drive generators.

Nuclear power stations do not produce much pollution, but the waste they make can be dangerous to living organisms.

Research

1. What is climate change?

_____

2. What has it got to do with supplying energy?

_____

3. What is acid rain?

_____

4. Why are fossil fuels not renewable?

_____

5. Write down two disadvantages of coal as a fuel.

_____

6. In addition to burning it to make electricity, what else is oil used for?

_____

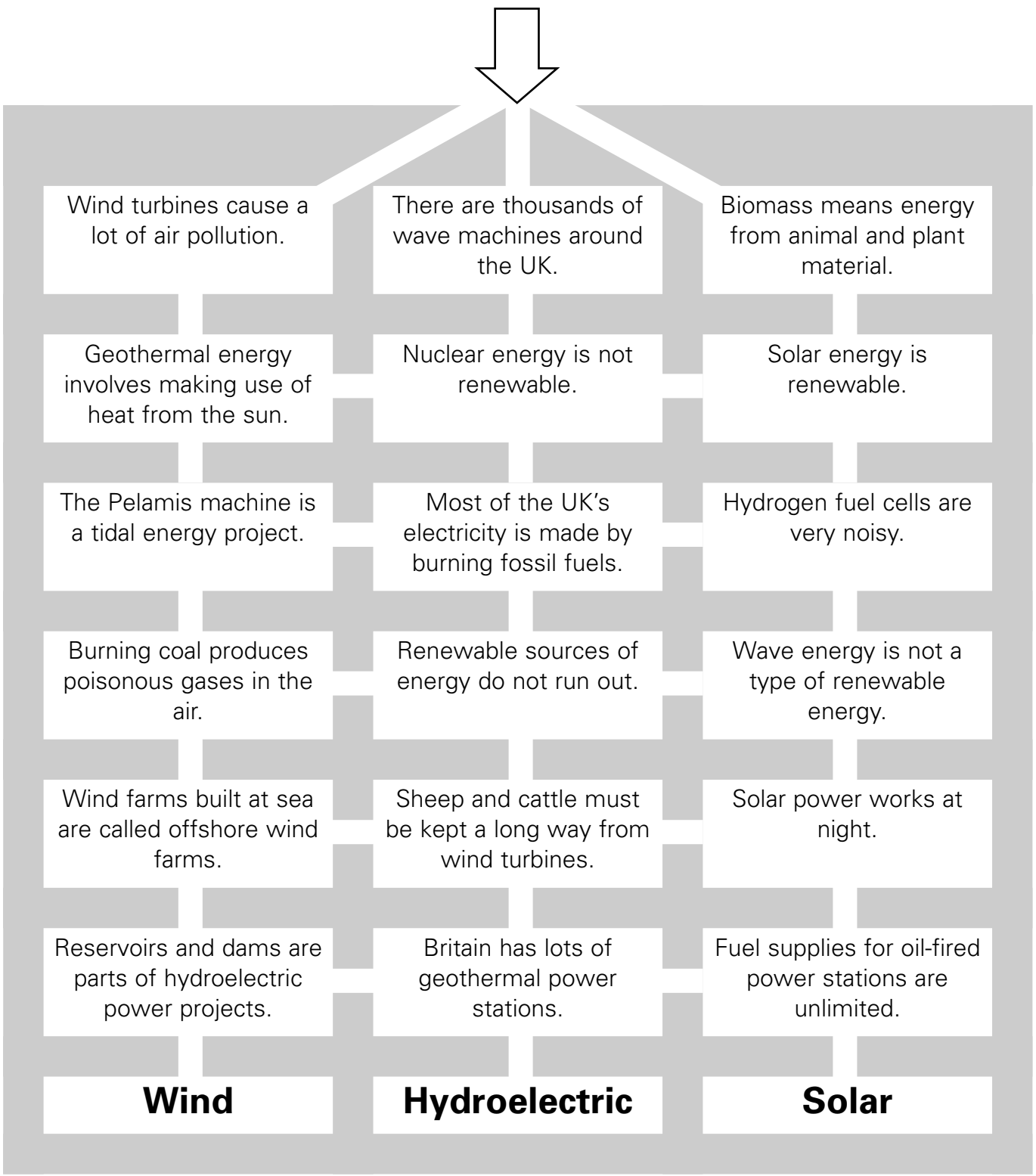
7. Why are the UK's nuclear power stations all by the sea?

_____

The renewable energy maze

There is only one correct way through this maze – it follows all the **true statements**. Colour your way through the maze. Which type of renewable energy do you reach?

START HERE



Compare types of renewable energy

Here are the eight types of renewable energy.

Wind Waves Solar Biomass Tidal
Hydroelectric Geothermal Hydrogen fuel cells

1. Which renewables depend heavily on the weather?

_____

_____

2. Which renewables can work on a small scale (e.g. to provide energy for just one building)?

_____

_____

3. Which renewables have the smallest effect on the environment?

_____

_____

4. Which renewable projects are very expensive to build?

_____

_____

5. Which renewables are the most suitable for the UK?

_____

_____

6. Identify the renewable (circle the answer).

a) It uses PV cells.	Hydroelectric	Solar	Biomass
b) It needs a supply of gas.	Fuel cells	Geothermal	Wave
c) It produces gas from rubbish.	Biomass	Wind	Hydroelectric
d) It uses heat from the Earth.	Fuel cells	Biomass	Geothermal

A mock public inquiry

When a large renewable energy project such as a new wind farm is planned for a particular place, there is always a chance for people to say what they think about the idea before it goes ahead.

Some people might agree with it being built there, and some people might object to it. If there is a lot of disagreement, there may need to be a **public planning inquiry** to decide whether to build it or not.

What to do

1. Read the box about public planning inquiries. Your class is going to hold a mock (pretend) public inquiry to decide if a new wind farm should be built on hills close to a village in the countryside.
2. Your teacher will tell you which side you are on: for or against.

   I am _____ the new wind farm.
3. You must work as a team to convince the commissioner (your teacher) that you are right.
4. You need to write a short written statement (50 words) to sum up your three main arguments. Also think of what you will say to support your arguments.
5. You can also collect pictures, facts or other information to help you convince the commissioner.

Public planning inquiry

- It is a meeting to decide if a project or building should be built in a particular place. It is like a court in some ways.
- There is one person in charge – the **commissioner**.
- Each side (the people for and against the plans) reads out a **written statement** explaining their views.
- Anybody else at the meeting can also speak to give their **opinions.**
- The two sides can call **witnesses**, e.g. experts who can say whether the chosen site is the best place for the planned project. These people can be questioned.
- **Documents**, containing **evidence**, can be given to the commissioner by each side.
- The commissioner reads out a summary of evidence then **decides** whether the plans should go ahead or not.

Our three main arguments

1.

_____

2.

_____

3.

_____

Renewables and the environment

1. Draw lines to match each type of renewable energy on the left with the boxes that show how the environment is affected. You may match each renewable with more than one box.

Wind energy

Wave energy

Solar energy

Hydroelectric energy

Biomass energy

It is very visible, even from a distance. It could spoil the landscape for some people.

It does not have a bad effect on wildlife.

It blends in well with surroundings and does not spoil views.

There is some air pollution.

It is a very clean source of power. It causes almost no pollution.

Building the project could have a big effect on animal and plant habitats.

It is a very quiet technology.

It uses up a lot of land.

2. Write down which renewable you think is best for the environment. Explain why.

_____

_____

_____