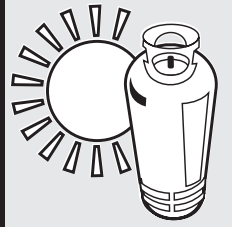
Activity card **1**



Energy World

Renewable and non-renewable energy sources: Scotland and Italy

As part of the Kyoto agreement, many countries are trying to reduce their carbon dioxide emissions and investing in renewable energy sources.

Your task

The west coast of Scotland and southern Italy want to use renewable energy sources. Using all available information, decide which sources will be best for them. You can choose more than one resource for each area.

You should consider:

- the resources available
- the needs of the population
- the geography of the region
- where people live

West coast of Scotland

Physical:
- Consistent, temperate climate
- Cool and wet
- Fjord-type landscape with deep inlets
- Mountains and offshore islands
- High annual rainfall with many fast flowing rivers
- Occasional very strong westerly winds

Human:
- Population: 208,690
- Population density: 8 people/km^2
- Largely dependent on subsistence farming and tourism
- Other industries include fish farming and whisky distilling

Current non-renewable energy sources:
- Limited oil and gas reserves

Southern Italy

Physical:
- Mediterranean climate
- Hot and dry in summer
- Coastal strip with hills inland
- Semi-desert in places
- Low annual rainfall
- Occasional strong onshore winds

Human:
- Population: 21 million
- Population density: 170 people/km^2
- Population mainly live on the coastal strip
- Almost entirely dependent on agriculture and tourism

Current non-renewable energy sources:
- Limited reserves of coal, oil and gas

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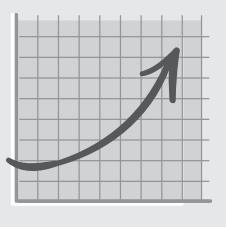
Activity card **2**



Energy World

Local to global: Your usage

Did you know an average UK household uses **86kWh** or **units** of electricity per week? That is equivalent to making toast all day and night for just over three and a half days! The amount of carbon dioxide (CO_2) produced depends on the generation method, but for each unit of electricity generated, an average of **454g** of CO_2 is released into the atmosphere. This is almost the same weight as a pound of strawberry jam, but because CO_2 is a gas, it has more volume.

Our energy demand has increased over the years, and it will continue to rise unless we all make changes to our lifestyles.

Not only is demand rising, but a number of UK power stations will be closed by 2015.

What about the rest of the world's needs?

Your tasks

1. How much electricity do you use a week?

You need an electricity bill to work this out. The bill will cover either one month, a quarter (three months) or a year. The bill will refer to **units**. Remember, **one unit** is equal to **one kilowatt** hour (kWh).

To work out your weekly usage, divide the total number of units on the bill by the time in weeks. Write your answer in the box below.

If you cannot see a bill, use the average figure above.

A month = 4 weeks
A quarter = 12 weeks
A year = 52 weeks

Our weekly usage of electricity is ☐ **units.**

2. How much CO_2 is released when generating that electricity?

To work this out, take your answer from question one and multiply it by **0.454**. This will give you an answer in kilograms (kg).

Each week, our electricity releases ☐ **kilograms of CO_2 into the atmosphere.**

3. What if the rest of the world used the same amount of energy?

To work out this out, take your answer from questions one and two and multiply each answer by 1.625 billion, or 1,625,000,000. This number is based on a population of 6.5 billion, divided by the average number of people in a 'household' (four).

If everyone in the world used the same amount of energy, the world's weekly usage would be

☐ **units and** ☐ **kilograms of CO_2 would be released into the atmosphere.**

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Energy Experience

Activity card **3**

Energy World

Climate change: Advantages and disadvantages

Climate change is affecting all countries, but in different ways. Do you think it could ever be a positive change?

Your task

Look at the evidence for the UK and Argentina. Can you find some advantages and disadvantages for climate change in these countries?

UK

Wildlife

Toads, frogs and newts are spawning early. Spawning has occurred nine to 10 days earlier over a 17-year period.

Birds are shifting northward. Over a 20-year period, many birds have extended the northern margins of their ranges by about 12 miles (19km).

Flowers

The average first flowering date of 385 British plant species has advanced by four-and-a-half days in the past decade. In the 1990s, 16% of species flowered earlier than ever before, with an average advance of 15 days.

Temperature in England

Wednesday 19th July 2006 was England's hottest July day ever. A temperature of 36.5°C was recorded in Wisley, Surrey.

In 2001, central England had the warmest October in the 343 years of weather records. Four of the five warmest years on record occurred in the last decade.

Cold days have been in decline, while hot days have been on the increase since 1772. 1995 brought 26 days above 20°C versus an average of four days per year since 1772.

Argentina

Rainfall

Buenos Aires had its heaviest rain in 100 years in May 2000. 13.5 inches (34.2cm) of rain fell in five days. This was more than four times the average monthly rainfall.

Nearly eight million acres (3.2 million hectares) of land in the Pampas region was flooded in 2001 after three months of high rainfall. Average annual precipitation in the humid Pampas region increased by 35% in the last half of the 20th century.

Flowers

The populations of two native Antarctic flowering plants increased rapidly between 1964 and 1990. The Antarctic pearlwort population increased five-fold while the Antarctic hairgrass increased 25-fold.

The increases are attributed to warmer summer temperatures and/or a longer growing season.

Temperature in Argentina

3.7 million acres of forest (1.5 million hectares) burned in the La Pampa province, due to fires caused by record high temperatures and persistent drought. The annual average temperature in Argentina has increased by nearly 1°C over the last century.

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Activity card **4**

Energy World

Using energy: Think safe!

It is easy to take electricity for granted and forget that it can be dangerous if it is not handled correctly.

Look at the electrical rules on Information card 18 Safety first! Are these good rules? Can you think of any others?

Your task

Imagine that you have 20 minutes to teach a group of primary school children about using electricity safely. You are going to write a short lesson plan to show how you would do it. Use the lesson planner template to help you.

Start the lesson by telling the children what they are going to do and finish it by summarising what they have achieved. The lesson needs to be interesting and fun, but you must make sure your pupils have learnt what you wanted to teach them. Include some short activities so the lesson is not just you talking and them writing!

Lesson planner template	**Time for lesson: 20 minutes**

Title of lesson:

Lesson objectives:

(What I want them to learn)

-
-
-
-
-

Materials and apparatus I will need:

The lesson:

(You should write a detailed, step-by-step account of what you are going to do. This should include the main points of what you are going to say and descriptions of any demonstrations or activities.)

Finding out what they have learnt:

(Describe how you are going to check your pupils have achieved your objectives.)

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Activity card **5**

Energy World

Using energy: The energy efficient kettle

If you used the kettle this morning, you have contributed to the greenhouse effect and climate change!

We all know we need to save energy. Wasting it means we are burning more fossil fuels than necessary and increasing the amount of carbon dioxide in the atmosphere. This is amplifying the greenhouse effect and causing climate change.

It takes around 100,000 Joules of energy to boil a cup of cold water. However, most of us boil more. The water left in the kettle cools down and the energy radiates away and is wasted. On average, people making their morning brew use up to double the amount of energy they need to!

So why do people overfill their kettles? Here are some reasons. Do they sound like you?

> “The amount of energy we’re talking about is tiny! How can I, boiling a little bit of extra water, make any difference to a global problem?”

> “I put extra water in the kettle so all the flakes of scale at the bottom don’t get in my tea.”

> “It’s really hard to judge the right amount. I’d rather boil too much than not enough.”

Your task

You are going to form a design team to produce a kettle that makes sure users only boil what they need. It must have a standard plug that connects to the mains, but otherwise the design is up to you.

Be innovative. Look at the reasons above to see why some people boil too much water, or do some of your own market research to find other reasons. Consider these reasons when you start designing.

The kettle has to be commercial – this means it needs to be **practical**, **affordable** and **desirable**. People must want to buy it.

Once you have finished your design you need to:

- Name it
- Produce some marketing materials (an advert or press release)
- Produce a presentation to encourage a major supermarket chain to sell your kettle

Check out the energy saving kettle at **www.ecokettle.com** for inspiration but remember to use your own ideas. Be original!

e·on Energy Experience

Activity card **6**

A nuclear future? The class debate

Nuclear energy is currently being considered as a possible solution to the energy shortage the world may face in the future.

Your task

You are going to prepare a debate on the advantages and disadvantages of using nuclear power.

Choose whether you are for or against the following motion:

> "Our class believes that nuclear power is the right choice to meet the UK's energy needs in the 21st century."

Use all information available to you to help you structure your argument.

Structuring a debate

A debate always involves discussion of the advantages and disadvantages of a subject.
A successful debater uses argument and persuasion to convince others that he or she is right.

A good debater will:

- research the subject thoroughly, so they know what they are talking about
- think critically about the information they see
- form a logical argument
- use facts and figures to support their argument
- think of some of the counter-arguments to help them work out their case in advance
- be enthusiastic and confident
- keep to the point
- be consistent on their point of view, and never contradict themselves
- try to answer questions, even if they are difficult

Activity card **7**

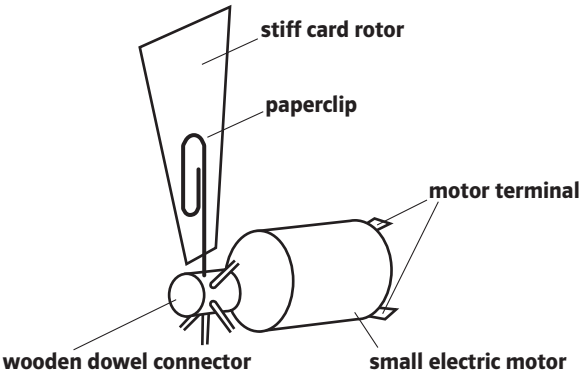
Energy World

Energy transformations: Build a wind turbine

Wind can be wonderful! The energy we get from it is completely renewable and emits no carbon dioxide. Wind turbines transform the kinetic energy of the wind into useful, electrical energy we can use at home.

Your task

You are going to build your own turbine using an electric motor. An electric motor usually needs electricity to spin, but we can use it as a generator, by spinning it, to produce electrical energy.



You need:

- six paperclips
- stiff card
- glue or sticky tape
- a thick wooden dowel (with seven pre-drilled holes – six to connect the blades, one to connect the dowel to the motor)
- motor
- retort stand
- desk fan

Instructions

The blades

1. Unbend one end of each of the six paperclips
2. Cut out six blade shapes from stiff card
3. Glue or tape them to the folded ends of the paperclips

The rotor

4. When the glue is dry, push the straight end of your paperclips into the holes in the wooden connector dowel
5. Arrange the blades so they are all at the same angle, or 'pitch'
6. Push the rotor onto the motor shaft

The motor

7. Connect the terminals of the motor to a voltmeter and clamp it to a retort stand

Test it!

8. Use a desk fan to simulate different wind speeds, and record the different voltages it produces

Try it!

- Change the pitch of the rotor blades and try the same wind speeds. What difference does that make?
- Invent new innovative blade designs. How does this affect the voltage?
- Try fewer blades. Will this generate more or less electricity?

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Activity card **8**

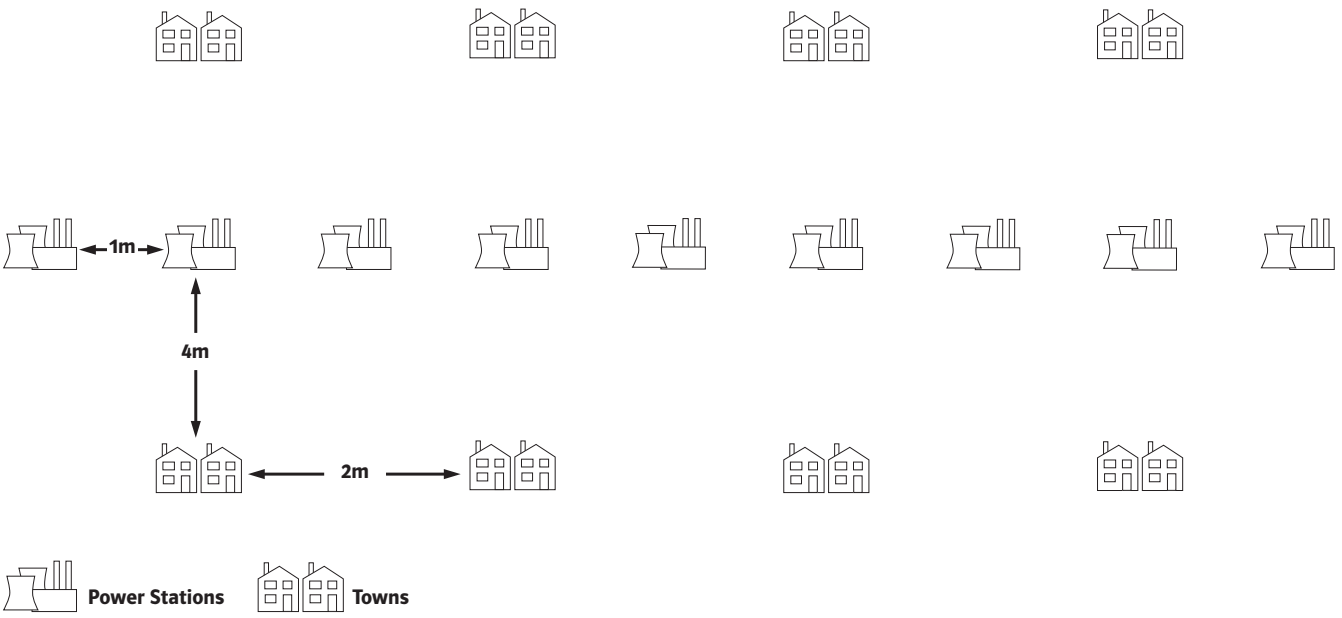
Energy World

Distributing energy: Distributing electricity

Your task

You and your team have just opened a highly efficient combined cycle gas turbine power station, producing 100 megawatts of electricity. It is your job to connect to as many towns as possible.

The towns and power stations are laid out like this:



Your power station generates electricity at 22,000 volts. To transmit your electricity, you need to use a **transmission line** to connect your power station to a **step-up transformer**. This increases the voltage to 400,000 volts and decreases the current. This reduces the energy lost due to the heating of the transmission wires. Once your electricity reaches a town, you need to reduce the voltage to 33,000 volts with a **step-down transformer**. You need to purchase your equipment from the grid shop.

Grid shop	
• Step-up transformer	**£50 each**
• Step-down transformer	**£50 each**
• 11,000–33,000 volt transmission line	**£10 for 50cm**
• Low-voltage pylon	**£5 each**
• 400,000 volt transmission line	**£50/metre**
• High-voltage pylon	**£15 each**
• Branch connector	**£25 each**

e·on Energy Experience

Activity card **8**

The rules

1. Any interference with another team's transmission lines will result in a £100 fine or confiscation of assets to that value.
2. You will get a £500 connection bonus if you are the first team to connect to a town. The second team receives £350, the third team £150.
3. No more than three teams can connect to any one town.
4. The transmission line has to be set up correctly for you to qualify for the connection bonus.
5. When using a transmission line for 11,000–33,000 volts, a pylon must be used every 25cm.
6. A transmission line for 11,000–33,000 volts can be used in maximum lengths of 50cm otherwise energy losses become too great.
7. When using a transmission line for 400,000 volts, a pylon must be used every 50cm.
8. A transmission line for 400,000 volts can be used in any length.
9. You are allowed to take a maximum of two branches off a main power line. A main power line is one that is connected directly to the power station.
10. You may take a maximum of one sub-branch off a branch line.
11. Sub-branch lines cannot be split further.
12. All branches must be made with a proper branch connector.
13. A maximum of two outgoing lines can be connected to a step-up transformer.

The winner

At the end of the game each team will receive '£200' for every completed connection to a town. The team with the largest sum of money will be judged the winner.

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