

1. Sustainable Energy?

Look at these images and then discuss as a group the ones which you think are sustainable and which are not, giving reasons for your decisions and using evidence from your research for your decisions.

1



2



3



4



5



6



7



8



Using the examples which you have decided to be unsustainable, can you offer alternatives and give your reasons why?

The Scottish Macaulay Land Use Research Institute has developed a film resource centred around the challenge of Climate Change but specifically addressing the idea that we have choices in the ways that we individually and collectively respond to this challenge.

Their key message is that these choices will result in very different outcomes. Watch the "video diaries" of members of a farming family in the future Scotland of 2050. The diaries are collectively entitled: "Choosing our Tomorrows".

<http://www.macaulay.ac.uk/videos/cc/>

*DSRL and the Nuclear Decommissioning Authority

2. Your Image of Renewable Scotland

1



DLR

2



HIE

3



HIE

4



5



Gretar Ivarsson

6



Aquamarine Power

Look at these images and decide which category each image belongs to:

- A **Definitely in Scotland**
- B **Unlikely to be in Scotland**
- C **Probably in Scotland**
- D **Definitely not in Scotland**

Share your thoughts with the rest of your group and discuss your reasons for your answer. Your teacher will give you the key to show where the images are, once you have this you should be prepared to discuss together how the Scottish images impact on your impression of Scotland.

In your group, list all the ways in which you use energy (such as electricity, gas, petrol etc) in your daily life. Decide how you will organise your work as a team – will you all list everything in your lives, or will individuals look at different times of the day or different activities?

Now imagine that you didn't have these sources of energy – discuss how your daily life would be different?

Use the resources available to you such as the information sheets in the pack and the internet to learn more about how the energy for the daily activities you have identified is generated. Discuss in your group:

- **What are fossil fuels?**
- **Give examples of fossil fuels?**
- **Which of your activities involve fossil fuels?**
- **Do fossil fuels create pollution?**
- **Give some examples of renewable energy and how these might be used in your daily energy needs**
- **Do renewable energy sources create pollution?**
- **What will happen if we keep using non-renewable energy?**

Your teacher will be able to give your group an energy saving monitor, courtesy of the Energy Saving Scotland advice centre Highlands and Islands.

Use the information you gather from the energy use monitor to present to the class on your energy usage. You can use bar graphs or power point presentations to illustrate your findings. Which energy usage were you most surprised by and will your findings change your behaviour when it comes to energy usage?

Some of these websites might be useful for you:

<http://www.hi-energy.org.uk/Why/hi-energy---how-can-we-save-energy.html>

<http://wallaceandgromit.npower.com/>

<http://www.energysavingtrust.org.uk>

http://www.direct.gov.uk/en/Environmentandgreenerliving/Energyandwatersaving/DG_064371

People view the development of wind turbines and wind farms in many different ways and they can be a source of heated local debate across the UK.

Use the wind power fact sheet in the pack and other resources to find out more about wind turbines and to develop an informed view about the pros and cons of wind farms. Organise yourself as a team so that you cover as many resources as you can including the internet and local and national newspapers. Use your judgement to establish which sources provide a balanced, convincing viewpoint rather than extreme views. Make notes as your research progresses and be prepared to feedback to your colleagues on your findings.

As well as learning more about the technology behind wind farms, you could consider:

- **Aesthetic qualities of the turbines**
- **Positive/negative effects on tourism**
- **Effect on local jobs**
- **Effects on wildlife**
- **Possible sound pollution**
- **Economic benefits for the local community**
- **Cheaper, cleaner power for all**
- **Effect on house prices**

As a team, draw a spider diagram which shows who/what might benefit from a new wind farm and who/what might suffer. Work as a group using all your research to add as many connections in your diagram as you can.

Once you have completed this, colour those who would be directly affected by the development in yellow and those who would be indirectly affected blue.

Break into two teams with one team picking a yellow group and the other team a blue and discuss the main issues which your individual or organisation faces with the wind farm.

5. The Ultimate Design?

This is the design of wind turbine which we are most familiar with:



Most wind turbines have a horizontal axis carrying a two or three bladed rotor.

In the case of this design, the wind turbine must be constructed to face the prevailing wind direction. If the wind direction changes considerably, the turbine becomes inefficient or stops working.

Engineers have found that this is perhaps not the most efficient design to harness the power of the wind. Turbines which swivel as the wind increases may be more efficient.

As a group, research wind turbine design and find at least three other wind turbine designs which are either currently in use or are planned for use in future. Find an image or make a sketch of each turbine type you find.

Be ready to discuss with your group why the design you find may – or may not – be more efficient than the one above

You may also be able to demonstrate this by cutting out cardboard rotors to illustrate this.



6. Solar Power for the Whole family

Solar power is not all about solar panels on your roof producing hot water or photovoltaic (PV) cells producing electricity. A revolution in solar energy is taking place as a new generation of solar cells comes into use. These can be thin, coloured, translucent and flexible.

Imagine how these new solar cells could be of benefit to these people now or in the future.

- **A teenager who loves their iPod and mobile phone**
- **A travelling businessperson who needs their laptop to keep in touch with the office as they travel internationally**
- **Doctors trying to prevent the spread of disease in a natural disaster who need to keep inoculations cold**
- **The keen gardener who likes to keep their garden looking good**
- **Elderly people who are afraid to go out in the evening because their street lighting is poor**
- **An Ethiopian family living without electricity or gas**
- **A toddler who doesn't like to go to sleep in the dark**
- **An injured hillwalker lost on the hills of the Highlands at night**

<http://www.hi-energy.org.uk/Downloads/Micro-generation-Small-scale-energy-Factsheets/Solar%20Water%20B2.pdf>

<http://www.practicalaction.org.uk/education/renewable-energy-resources#posters>

<http://science.howstuffworks.com/environmental/energy/solar-cell.htm>

Wave power refers to the capture of ocean wave energy to generate electricity. The waves that lap around the rugged shoreline of the Highlands and Islands are therefore a natural store of 'free' energy.

Thanks to our location in the North Atlantic at the periphery of Europe we have an abundance of wave energy waiting to be unlocked. Recognising the potential associated with exploiting wave energy, there are a number of companies actively involved in the development of wave energy devices.

Among the best known of these renewable wave energy pioneers is Inverness-based Voith Hydro Wavegen Limited. They are world leaders in wave energy and wave power, having built the first ever grid-connected commercial-scale wave energy device. Using globally-patented technology, Voith Hydro Wavegen Limited have succeeded in supplying the national grid with electricity from The Limpet, a 500kW wave turbine device, in Islay.

Another example of a leading-edge technology developer is Pelamis Wave Power (PWP), an Edinburgh-based company. Their new P2 device is about to undergo testing at the European Marine Energy Centre in Orkney, and is also lined up to be used in projects under the world's first commercial scale leasing round in the Pentland Firth and Orkney Waters.

In your group:

- **Research how wave power works and the advantages and disadvantages of wave power.**
- **Make a list of the pros and cons of wave power for Scotland.**
- **Research Highlands and Island companies which are involved in the production or testing of wave and tidal devices. Consider the implications on their local economy if these companies did not exist.**

These links may also be useful:

Voith Hydro Wavegen Limited - www.wavegen.com

Pelamis Wave Power - www.pelamiswave.com

Scottish Government – Forum for Renewable Energy – Marine Energy Group Route Map - <http://www.scotland.gov.uk/Publications/2009/08/14094700/12>

European Marine Energy Centre (EMEC) - www.emec.org.uk

RenewableUK - www.bwea.com/marine

Greenpeace - <http://www.greenpeace.org.uk/climate/islay-energy-vision-the-mission>

Famous French author Victor Hugo wrote in his book 'Ninety Three',

"Think about the movement of the waves, the ebb and flow, the to-and-fro motion of the tides, the ocean is a vast amount of lost power."

The region's geographical location and long coastline puts it among the best in the world for its tidal resources, notching up six of the top ten of the UK's tidal stream sites, 25% of Europe's resource and leading some of the world's most cutting-edge research and development. Foremost on the tidal energy map are the waters around the northern and western coasts of the Highlands and Islands, mainly the Pentland Firth and the powerful tides around Orkney, Shetland and the West Coast.

Suggested questions:

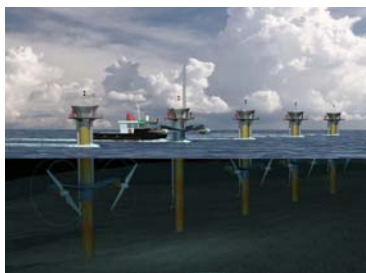
- How fast does the tide have to flow in order to make a tidal turbine work effectively?
- Why is the Pentland Firth one of the most energetic tidal streams in the world?
- Why is that attractive to tidal energy project developers?
- How many different types of tidal turbine design can you find?
- Can you come up with other ways to generate power out of tides?

There are potential advantages and disadvantages for tidal power stations. List these, using researched examples. You could include the environmental impact; jobs for the local economy; tourism; energy for rural communities; shipping; leisure activities on the water; birds; road traffic etc.



HIE

The Open Hydro tidal current turbine which is being tested at the moment at the European Marine Energy Centre, Island of Eday, Orkney.



Courtesy of Marine Current Turbines Ltd.

The SeaGen tidal current turbines at Anglesey.



EMEC

Atlantis Resources AK1000 being trialled at the European Marine Energy Centre test site off Eday in Orkney.



9. Bananas Growing in Scotland

Geothermal energy is heat from within the Earth. This heat is recovered as steam or hot water and can be used to heat buildings or generate electricity. The word geothermal comes from the Greek words *geo* (earth) and *therme* (heat). Geothermal energy is a renewable energy source because the heat is continuously produced inside the Earth.

Geothermal energy is an important resource in volcanically active places such as Iceland and New Zealand. One of Iceland's most visited attractions is The Blue Lagoon, which is fed by the water output of the nearby geothermal power plant Svartsengi.

Surprisingly, Iceland has become a producer of bananas which are grown in greenhouses which are heated by geothermal energy.

Is it possible – theoretically – that Scotland could grow such exotic fruits as bananas in our climate using geothermal energy?

These websites might help you to decide. Research this and present your conclusions.

<http://www.hi-energy.org.uk/Sectors/geothermalenergy.html>

http://www.bbc.co.uk/climate/adaptation/geothermail_energy.shtml

<http://news.bbc.co.uk/1/hi/scotland/3116564.stm>

http://www.st-andrews.ac.uk/~wes/research/Geothermal_overview.html

<http://www.scottish.parliament.uk/business/research/briefings-06/SB06-54.pdf>

Look at this image of a busy city centre at night time:



In your group research, discuss and present your ideas on how, in the future, more of the energy being used can be derived from renewable sources.

You might want to examine to use of bioethanol fuels.

How many different – and unusual - ways of powering cars in the future can your group find?

You will find some of these websites useful:

<http://www.hi-energy.org.uk/Sectors/biomassenergy.html>

<http://news.bbc.co.uk/1/hi/sci/tech/6294133.stm>

<http://biofuel.org.uk/>

<http://www.whatgreencar.com/bioethanol.php>