Energy

Eco Schools objectives

The Eco Schools objectives in this area are:

- to raise awareness of the importance of monitoring energy consumption by regularly tracking the school's use of gas, electricity or oil
- to make pupils aware of the link between energy supply, use and the potential for environmental damage
- to make pupils aware of the link between energy use and financial cost
- to establish partnerships with energy providers, helping to put into place effective energy-saving measures
- to show that simple low- or no-cost measures to conserve energy can be effective and bring about significant savings
- to consider using alternative sources of energy.

Learning outcomes

Through work on energy, pupils should be enabled to:

- discuss the importance of renewable and non-renewable resources
- understand the processes of energy transfer and conservation
- carry out an audit of energy use in the school
- suggest ways to make the school more energy efficient
- collect, interpret and present data in different forms, using ICT, where appropriate
- make presentations on reducing energy consumption to different audiences, such as other pupils, parents and the local community
- work cooperatively with others.

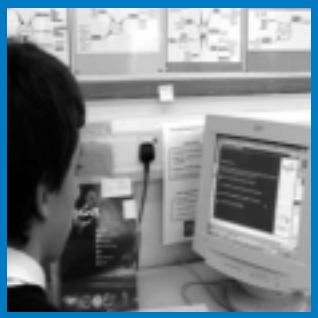
1 2 3 4
5 6 7 8
9 10 11 12
13 14 15 16

Energy pictures

1. Electricity from the wind
2. Monitoring energy use
3. Electricity pylons
4. Clean beaches
5. Renewable energy from the waves
6. Posters promoting renewable energy
7. Discussion time
8. Electricity conservation
9. Solar panels at Portobello High School
10. Energy from the wind
11. Experiment and learn
12. Lunnasting Primary School's wind turbine
13. Switch off when not in use

14/15. A close up of the turbines at Lunnasting Primary School

16. One of the causes of global warming

The big picture

The amount of energy the world uses every day has trebled over the last century. To keep up with growing demand for energy to heat and light our homes and power our industries, power stations are burning more and more fossil fuels. As well as using up limited natural resources, this process is releasing increasing volumes of carbon dioxide (CO_2) into the atmosphere – the greenhouse gas emission most responsible for global climate change.

Global warming

The extra CO_2 released into the atmosphere over the last half century has been linked to a rise in the average global temperature of half a degree Celsius. This may not seem much, but the global average temperature was only 2.5ºC warmer 120,000 years ago, when hippos and crocodiles swam in the river Thames in the south of England.

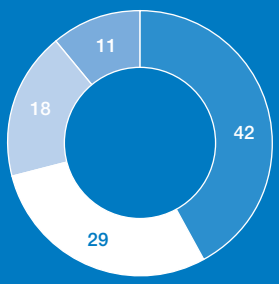
The exact nature of the effects of global warming, including rising sea levels (caused by melting ice caps) and climate change, are unclear. However, they are likely to vary from place to place. Parts of southern Europe may become so warm that their tourist industry suffers. In Britain, it is thought that global warming will result in extreme weather patterns and severe flooding (particularly in the south of England and East Anglia).

Unequal fuel distribution

Energy use is distributed unequally worldwide: the 20% of the global population living in the richest countries in the world consume 17 times as much energy as the remaining 80%, who live in the poorest countries. Whereas people in developed countries generally use far more fossil fuel than they need, developing countries urgently need access to more fossil fuels in order to reduce poverty and improve their economies.

To address this imbalance, the UK Royal Commission on Environmental Pollution's 2000 report says that Britain should be aiming at a 60% reduction in our greenhouse gas emissions, not the 20% reduction that has just been achieved.

See the website for more facts and figures about energy use and climate change, alternative sources of energy, and information about how the government is responding to the problem.



42% Nuclear
11% Renewables & other sources
18% Gas
29% Coal

These figures include electricity generated for export[8]

↑ SOURCES OF ELECTRICITY GENERATION IN SCOTLAND, 1997[8]

Energy source	Generation cost (p/kWh)
Wind	1.8–3
Hydro	<3.8
Biomass	4.79, 6.88
Photovoltaics	10
Coal	4.0
Gas	2.5
Nuclear (lifetime generation costs)	3.5–5.75

p/kWh = pence per kilowatt hour

↑ THE COST OF GENERATING ELECTRICITY[8]

Energy sources in Scotland[8]

Scotland currently has a capacity to generate more electricity than that required to meet the peak demand in Scotland. Surplus electricity is exported to England and Wales and there are plans to supply Northern Ireland. However, a recent analysis suggests that Scotland faces an energy shortfall after the closure, over the next two decades, of one of its two remaining nuclear power stations and two of its three major coal-fired stations. Together, these account for about half of the current 12,000 megawatt production nationally. The energy industry in Scotland is mainly based on natural raw materials: gas, oil, coal and uranium. These are non-renewable resources, as their reserves are finite and their continued exploitation is not sustainable indefinitely. Scotland has large underground reserves of the fossil fuels offshore and inland, and is a net exporter of all of them. Uranium ore for nuclear power is imported from Australia and Namibia into the UK, where it is processed for use in Scotland.

The Scottish Executive has proposed a target of generating 40% of Scotland's energy from renewable resources by 2020. This figure includes the 10-11% currently produced from large scale hydroelectric schemes.

Costs of energy sources in Scotland[8]

Although Scotland has one of the best potentials for renewable energy in Europe, only a tiny proportion of Scotland's energy needs is met by renewable sources (i.e. sources that can be replaced or replenished). Energy from renewable sources was often considered more expensive than that produced by other sources, but wind and hydro (including small-scale hydro) are now both economic ways of generating electricity (see table above).

Energy generation from renewable resources

As noted above, the Scottish Executive has proposed a target of generating 40% of Scotland's energy from renewable resources by 2020.

The UK Climate Change Programme plans that, by 2010, greenhouse gas emissions will be 20% below 1990 levels. Investment in research into and building capacity of renewable energy resources may provide an answer. Scotland could have an overall capacity of in the region of 60 gigawatts (GW) from renewables. This amounts to around three quarters of the installed electricity generating capacity across the entire UK and would be enough to meet Scotland's current peak winter demand 10 times over. The greatest potential resource by far is wind.

Technology	Capacity (GW)	Energy (GWh)
Onshore wind	11.50	45,000
Offshore wind	25.00	82,000
Wave	14.00	45,700
Small hydro	0.30	1,000
Tidal stream	7.5	33,500
Landfill gas	0.07	555
Forestry residues	0.09	700
Energy crops	0.14	1,100
Agricultural wastes	0.40	3,500
Municipal solid waste	0.10	900
TOTAL	**59.10**	**213,955**

Source: Garrad Hassan (2001) *Scotland's renewable resource 2001* Scottish Executive

62% of respondents said the world's climate is definitely changing and a further 26% believed it probably is.

Over three-quarters of respondents agreed that 'most people in Scotland today need to change their way of life so that future generations can continue to enjoy a good quality of life and environment'. Just under half believed they personally needed to change their way of life for these reasons.

Public opinion in Scotland[6]

While 10% of Scotland's electricity is currently generated from renewable sources (such as hydro, wave and solar power), public preferences would be for half of Scotland's electricity to be produced in this way.

What it means for schools

The energy required for heating, lighting, and powering equipment in an ordinary school classroom releases about 4,000 kg of CO_2 every year – enough to fill four hot-air balloons 10 metres in diameter. UK schools spend about £450m on energy each year; three times as much as they do on books, and about 3.5% of their budgets. Some schools will spend four times more per pupil than similar schools in the same region. The difference is often to do with how effectively schools manage their energy use within the limits of building materials and design.

Energy use	% of total energy
Heating	40
Hot water	11
Cooking	12
Lighting	23
Other appliances (computers, videos, etc)	14

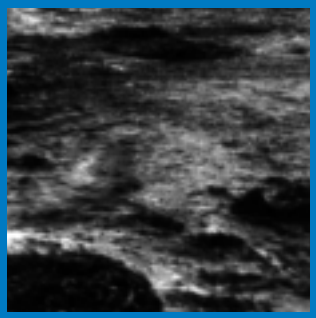
Surveys show that, through simple low-cost and no-cost measures, schools can reduce their fuel bills by up to 10% while also reducing their CO_2 emissions. Some of these measures are outlined on the following pages.

Where is energy used in a typical school?

The table to the left shows how energy use is divided up in an average school. The percentages shown here will vary according to the types of appliance used in the school and any energy-saving measures already underway.

Heat losses

All schools lose heat through the walls and roof. If a building is well insulated and draught proofed, the rate of heat loss will be lower and so less heat energy will be required to keep the internal environment at a comfortable temperature.





What schools can do

The most important first step schools can take is to conduct an energy audit, setting targets for reducing unnecessary energy use and regularly monitoring consumption.

The outcomes of the audit might include switching off lights and devices more often, and buying energy saving light bulbs. Compact fluorescent lamps and tubes produce up to five times as much light per watt than traditional tungsten lamps. The most modern fluorescent fittings (high frequency ballast) can be six or seven times more efficient.

The activity outlined on the following pages suggests ways your school could work together to conduct an energy audit and improve energy efficiency.

Advice and support

A successful, comprehensive energy review will require teamwork and cooperation. You will need the help and support of pupils, other teachers, non-teaching staff and organisations within the local community.

The caretaker or janitor will have an important role to play in a school energy audit. He or she will have most information about the school's heating and lighting systems. The local authority may hold some additional information about the building that you may find helpful. Advice from your local Energy Advice Centre is also available. A contact address can be found in the useful organisations section on page 136, which also provides more information about how to get in touch with other organisations and energy providers that may be able to help.

Curriculum links

The energy audit is clearly related to environmental studies, science, design and technology and geography. The audit encourages pupils to use their skills in maths – for example, when collecting data and calculating energy costs. Pupils could also make presentations, both to the class and to school staff, about improving energy management procedures – an activity that relates closely to elements of the English programme of study. Using computer software and other tools to develop and present their findings will help to develop ICT skills.

Activity: the energy audit

One of the best ways for pupils to find out about the cost of energy consumption and how to cut down on energy use is to learn in a familiar context. This activity gives pupils a chance to conduct an energy audit of the school, identifying problem areas and drawing up an action plan to conserve energy more efficiently and raise awareness of the issue.

1. Why conserve energy?

To realise why it's important for the school to conserve energy, pupils first need to understand the big picture: what energy is, how it is generated, and the global consequences of overuse. Introduce the class to the topic, drawing on the information in the previous pages and from the website. Can pupils think of ways the school might be able to help?

2. Measuring the cost of energy

Get pupils thinking about what energy use costs the school. Ask them to look at last year's energy bills and calculate the amount of energy used each quarter. They can then compare the figures with the benchmark table (see over) to get an estimate of how efficiently their school manages energy. While they do this, encourage pupils to think about the factors that might affect the figures – for example, the size of the school, the location of the school, and the weather in different seasons. Can they explain why more energy is used in some quarters compared with others?

NOTE
Younger pupils could draw pictures of potential 'hot spots' on a big diagram of the school. Older pupils could use mapping software to record potential impacts.

3. Identifying hot spots

Now pupils have an idea of the cost of energy and how well their school manages it they can start thinking of ways to make their school more efficient. Start by asking the class to identify every possible impact on energy use in the school. The sorts of things the class would discuss include:

- heating (including hot water)
- insulation, drafts and ventilation
- lighting
- appliances (such as computers and TVs).

4. Investigating

Pupils are now ready to investigate problem areas to find out whether they could be made more efficient. This is a big job, so several groups of pupils could be assigned one specific area to investigate. Encourage pupils to consider each area carefully. Are lights left on unnecessarily? Are doors and windows sealed properly or are they draughty? Are computers, monitors and TVs switched off when not in use – not just switched to 'standby'? (Standby mode can still use as much as 40% of the normal power of an appliance). What about hot water – is tap water comfortably hot or scalding? (Apart from in kitchens and cleaners' rooms, water should be no hotter than 43ºC.) Pupils could use the energy section of the environmental review checklist on pages 129 and 130, adapting it if necessary.

5. Presenting findings

When each group has finished their investigation, ask them to make a short presentation to the class, explaining any relevant problems or issues they have discovered. Get pupils to write down all the findings and compile them, perhaps on the school diagram.

6. Bright ideas

Time to think of solutions. Get the class to look at all the problem areas and discuss ways to tackle them. Problems will usually fall into different types: those that cost money (such as fitting better insulation and thermostats) and those that just require procedures or for people to be better informed (such as closing doors and switching off lights).

7. The action plan

NOTE
The action plan could link with the SchoolEnergy Programme, a grant-giving scheme run by the Energy Saving Trust (EST – see www.est.org.uk). The programme provides grants towards the costs of installing energy saving measures and advice, together with information about your local Energy Efficiency Advice Centre. For more information about the SchoolEnergy Programme, phone the helpline on 0870 7000 457 or visit the website at www.schoolenergy.org.uk

Pupils now develop an energy action plan and set clear targets to be achieved. Special 'energy squads' could be set up to raise awareness by making posters, stickers and leaflets, creating procedures and giving presentations in assemblies. For solutions that cost money, older pupils could draw up cost benefit analysis charts (for example, comparing the cost of installing thermostats in every classroom with the money saved over the years) and make presentations to the headteacher.

8. Monitoring progress

Monitoring is a crucial part of any energy audit. Get pupils to take meter readings every week, record them and compare them with figures from weeks in previous years. (A chart pinned up in a conspicuous location within the school could show results.) Pupils should also create a system to make sure that the improvements they have put forward are continually being put into place, and maintain the momentum of the action plan.

	Fossil fuels (kW/m²)		Electricity (kW/m²)	
	Benchmark	Average	Benchmark	Average
Primary school	126	173	20	28
Secondary school	136	174	24	30

The table above provides some benchmark data for the average energy performance of primary and secondary schools. You can get an idea of the efficiency of your school's energy management by estimating your own average values and comparing them with the figures here.

Additional activities

The website contains a number of additional energy activities that could be used to reinforce the knowledge pupils gain while carrying out the energy audit, or as stand-alone exercises as part of science, design and technology or geography lessons.

1. **Boiling the kettle**
   In this experiment pupils can find out how much energy is needed to make a mug of tea, then calculate the long-term cost of over-filling kettles.

2. **Invisible savings**
   An experiment that demonstrates how trapped air can work as an insulator.

3. **Windows**
   Pupils taking part in this activity investigate the impact of windows on the temperature in a house.

4. **The world's energy consumption**
   Pupils explore the differences in energy use around the world, investigating the interrelationships between places and exploring the differences in fossil fuel consumption of developed and developing countries.

Energy: case studies

The balance of power in the UK is changing, literally. Scotland has been a net exporter of energy to England and Wales, but the scheduled closure of one of our two remaining nuclear power stations and two of our three coal-fired stations means we face an energy shortfall. Will the last one out please turn out the light!

> A solar powered fountain adds a bit of a splash and interest to the school pond in one of the school's quadrangles … inspiring pupils engaged in art and design.
>
> Currie Community High School, Edinburgh

> we really enjoy trying to save energy at our school … we make sure when we leave at night, to switch off all the lights.
>
> Dunino Primary School, Fife




Sun power

Currie Community High School, Edinburgh

At Currie Community High School a solar powered fountain adds a bit of a splash and interest to the school pond in one of the school's quadrangles. This area is used extensively in teaching right across the curriculum, from inspiring pupils engaged in art and design, to providing a biodiversity interest for those studying biology.

Cutting costs

Keir Hardie Memorial Primary School, Newarthill, North Lanarkshire

Targets at Keir Hardie School include studying energy consumption and trying to devise ways of reducing use. The amount of electricity and gas being used has been monitored to understand seasonal differences. Using the data gathered, the school has turned its attention to ways of raising awareness of the importance of energy saving through good management. Part of the campaign includes continuing meter readings on a weekly basis. The school aims to become an energy saving school and ensures thermostats are checked, doors and windows are kept shut to avoid drafts, and lights are switched off when classrooms are empty.

Save it – at school and at home

Dunino Primary School, Fife

In their Eco Schools action plan, Dunino School looked at energy use at school and home. The pupils were keen to ensure that they raised awareness at home by devising an energy checklist asking questions such as: do you use low energy light bulbs? Do you keep your freezer at least three-quarters full? Is your central heating set too high? The school gave one of their action days an energy focus. This included holding an assembly, where visitors were told about different sources of energy and how they could save energy. During that day they decided to use less electricity in school by turning off as many lights as possible and also switching on their water heaters later than usual. The number of units of electricity used during the day was 18 instead of the average 30.