Guidance

Organisation & Management

School Business Managers
Bursars, Headteachers
Science Teachers
& Caretakers

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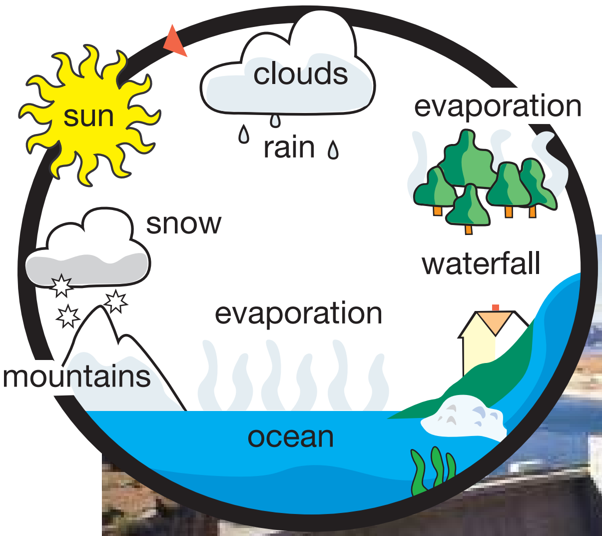
Energy and Water Management

A Guide for Schools



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Contents

Introduction

Welcome to the Energy and Water Management Guide. This guide will help you save energy and water in your school. It contains practical suggestions and simple ideas that you can easily implement in your school. Major savings can be achieved, for example, through an education programme raising awareness about the importance of conserving water supplies and reducing waste.

SAVING ENERGY

The total annual energy consumption of the UK schools sector is 11,378 million kWh of energy or 25 per cent of the total public sector energy costs. The total potential for cost savings for schools is estimated to be 20 per cent, equivalent to £80 million per year.

Figures from the Audit Commission suggest that energy saving measures can cut fuel bills by 10 per cent. A well thought out action plan can double this figure. These are not one-off savings – the reduced energy consumption can be maintained year after year.

SAVING WATER

Schools in England spend approximately £61 million a year on water. The average annual water bill for a primary school with 250 pupils in England is £1,630. A secondary school with four times as many pupils and more water-using facilities spends between £3,200 and £8,600.

Reducing the amount of water your school uses can result in real savings. A carefully managed school may consume only half the amount of water a poorly managed school consumes.

But saving water is not just about saving money. Water is an important, natural resource vital for human, animal and plant life. A sufficient supply of clean water is essential for public health. The raw material may appear to be plentiful but water shortages do occur in the UK. Involvement of staff and pupils in saving water can help raise their awareness of environmental issues.

About this guide

This guide is divided into two parts:

Part 1: Saving energy

Part 2: Saving water.

There are three main sections in each part:

- strategic overview – ideas for developing a comprehensive energy or water saving strategy
- operational issues – some of the operational issues involved in introducing an energy or water saving strategy
- curriculum opportunities – some of the many ways in which you can incorporate energy or water saving activities into the curriculum.

Part 1 also has a final section on purchasing energy – different sources of energy and energy suppliers, what they offer, and how you can make the best buys for your school.

PART 1

Saving Energy

1. Strategic overview

This section provides a strategic overview to energy saving. Even if you cannot implement some of the energy saving ideas in this section at the moment because of current budget restraints, it is still worth developing a comprehensive energy management strategy. You will then be in a strong position to respond quickly when you can afford to adopt cost effective energy saving measures.

Note: Before you commit any resources to a long-term project or signing a contract, always seek independent, professional advice from a reputable consultant or your local authority energy management unit.

1.1 WHY SAVE ENERGY?

The average annual energy cost per pupil in all English schools is £44. Even when the type of fuel, floor area, numbers on roll, hours of use, and age and condition of the buildings are taken into account, annual energy costs at similar schools can vary widely. The difference is the price paid for poor energy management.

Some schools will have more scope for savings than others, but there is always room for improvement. Even new schools with the very latest energy management systems will incur avoidable expenditure if they do not manage their energy use wisely.

Energy conservation in schools can also help provide a greener world and contribute to the UK's Sustainable Development Strategy. This strategy includes the environmental action plan for the next twenty years that was established as a result of the Rio Earth Summit. By using less energy schools will help to:

- reduce demand on the world's finite energy sources
- cut pollution – every year the energy used to heat and light each classroom produces four tonnes of carbon dioxide
- create a healthier working environment.

The need to save energy is even greater now that the Climate Change Levy adds additional costs to the energy bill.

1.1.1 Climate Change Levy

The Climate Change Levy (CCL) was introduced on 1 April 2001. It adds a premium to the unit cost (kWh) of energy, increasing the cost of energy used by about 10 per cent. All UK businesses and public sector organisations pay the levy. The cost depends on the type of fuel bought.

- The premium for electricity is **0.43** pence per kWh.
- The premium for gas, coal, lignite, and coke is **0.15** pence per kWh.

Residential buildings not used for business purposes, and schools that are eligible for charitable status, are exempt. These include foundation schools, city technology colleges, voluntary controlled and voluntary aided schools. Natural Gas in Northern Ireland is exempt for five years.

There are more details about the CCL on the Customs and Excise Department website at **http://www.hmce.gov.uk**.

1.1.2 Green electricity

Some utility companies are now offering 'Green electricity' – electricity that is produced from environmentally benign sources such as wind turbines. This is often exempt from the CCL, which offsets its normally higher price.

Details of utility companies supplying Green electricity can be found at **http://www.greenprices.co.uk**.

An accreditation system called Future Energy gives details of all electricity that is exempt from the CCL. More details can be found at **http://www.est.co.uk**.

Combined heat and power plants

Many local authorities and large establishments now have combined heat and power (CHP) schemes, in which a fuel such as gas or coal, fuels an engine which drives a generator to produce electricity. The cooling water from the engine is used in heating and hot water systems just like water circulated from a boiler. These plants are extremely efficient if there is a constant load for electricity and heat such as that required for a swimming pool. Some very large CHP schemes have district heating in which hot water or steam from the CHP unit is pumped around the streets in a network of pipes. These may become more common and city centre schools and colleges might be asked if they want to take advantage of this option for their heat and/or electricity. This would most likely be as a customer to take the heat and power, rather than as a supplier.

Supplies of energy from 'good quality' combined heat and power (CHP) plants that are registered on the Government's CHP Quality Assurance scheme are eligible for CCL exemption and may be eligible for Enhanced Capital Allowance.

If you are considering this, make sure you get advice from an independent source such as the local authority or the Combined Heat and Power Association (CHPA) to ensure that any proposed option is in the best interests of your school. This particularly applies to the metering of the hot water that will be purchased. Visit the CHPA website at **http://www.chpa.co.uk** for more information.

1.2 MANAGING ENERGY EFFECTIVELY

To manage your school's energy use effectively, you need a carefully thought out, balanced **action plan** that brings together the widest range of measures.

A senior member of staff should be appointed as the **site energy manager**, responsible for day to day energy management. In smaller schools this job may be done by the head teacher or deputy head. Specialist knowledge of energy management is not needed; commitment is more important than technical expertise. The site energy manager's first task is to produce the action plan.

The action plan must be supported by sensible energy saving targets (based on benchmarking and comparison with other similar schools) and a regular review and monitoring programme to make sure targets are attained. In many schools 15-20 per cent of the annual energy bill is a reasonable and attainable target.

In the best schemes, staff, pupils and governing bodies accept a personal responsibility to co-operate with each other to save energy. It is a team effort but there must be positive leadership. If senior management are not enthusiastic or prepared to take the first steps, other staff are less likely to play their part. Staff and pupils must know what they are trying to achieve and be given real, tangible credit for their efforts.

Steps to an energy management action plan

You can use these steps as the basis of your own energy management action plan.

- *Identify* the current status of energy management within your school. There is a copy of an energy management matrix chart in Appendix A. Draw a line connecting the boxes to indicate the current position of the school. This will help you see at a glance how far your school has progressed in its energy strategy and what still needs to be achieved.
- *Monitor* to show the current pattern and costs of energy use.
- *Evaluate* areas of possible savings and decide how they can best be introduced.
- *Benchmark* energy use for comparison with other buildings. Further details of benchmarking can be found in Appendix A3.
- *Agree* a realistic target for savings in your school.

- *Implement* no-cost and low cost energy saving measures. Examples can be found in Appendix A4.
- *Rationalise* your use of school accommodation to make sure you are using it most effectively in terms of energy consumption and cost.
- *Maintain* your school's energy systems and related building elements.

Identify the most suitable long-term measures for inclusion in your building development plan taking the future environmental costs into account.

- *Calculate* the economic energy costs of lettings and the shared or joint use of your premises.
- *Educate* and train staff and pupils in energy management and conservation. Pupils can undertake many of these tasks as part of curriculum activities (see Section 3).

1.3 REVIEWING ENERGY SAVING OPPORTUNITIES

We have listed below some of the key areas in which you can save energy. You might want to consider these when you are drawing up your action plan.

1.3.1 Reviewing your heating

Heating and hot water make up 60 per cent of a school's energy budget. The School Premises Regulations require a minimum temperature of:

- 18°C for parts of the school where there is a normal level of activity
- 21°C for areas where the occupants are inactive or sick
- 15°C for other teaching accommodation, washrooms, sleeping accommodation and circulation areas.

The temperature of hot water in hand basins should be 43oC or lower in primary and nursery school hand basins and at this temperature for all baths and showers in all schools including secondary schools. This is to prevent scalding.

However, small economies can bring big savings. For example, raising room temperatures by one degree increases fuel bills by at least 5 per cent and sometimes by as much as 10 per cent.

You can look at the efficiency with which your school uses fuel heating by applying a degree day analysis. You can find a clear description of degree day analysis at **http://www.energy-efficiency.gov.uk** and a downloadable spreadsheet for performing degree day analysis at **http://www.vesma.com/index.htm**.

1.3.2 Costing lettings and shared use

Hiring school facilities to outside organisations is only a source of income if the full cost of providing the facility is recovered. Heating and lighting costs are often underestimated. Providing hot water in a secondary school costs around £2.50 an hour.

When you are calculating your letting charges you should always include a standard hourly rate for heating and lighting. Calculate charges to hirers sharing the premises, including outside contractors, on a full cost recovery basis.

If hirers using the school consume a lot of energy it might be worth installing meters so that they can be billed for what they use. If you want to provide discounted rates to some organisations that need financial support, you can recover more of the costs on some lettings than on others.

Try encouraging as many hirers as possible to use the same one or two nights a week. This keeps the costs of heating and lighting shared areas like toilets and corridors to a minimum and allows the zoning of the heating system to be used efficiently.

Tell hirers about the school's energy conservation policy and give them guidance on how they can reduce costs. Identifying energy charges separately and passing on some or all of the savings they make might help to highlight the benefits of energy conservation.

1.3.3 Reviewing surplus accommodation

If your school has unoccupied areas you are paying more per pupil for your energy than you need to. If you have accommodation that is underused or no longer required you can think about ways of either recouping or avoiding its energy costs. As a priority any hut or other temporary accommodation which is surplus to requirements should be removed. Other options include:

- letting the underused space at an economic rent
- mothballing (although this can be difficult and can bring unexpected costs as background heating and lighting will still be needed).

1.4 CALCULATING PAYBACK

Many people think it is too expensive to introduce energy saving measures. But it's important to calculate the **payback** (when something pays for itself) before you make a decision. It may be that you can save more money than you spend.

This can be done by using either a simple payback method of calculation or a discounted cash flow (DCF) analysis. The simple payback method of calculation can be best explained as the cost of implementing the project divided by the projected annual savings. This gives a payback in years. An example of a payback calculation can be found in Appendix C1.

Life cycle costing can also be used to calculate the costs associated with a project over its lifetime. This is then compared with the costs associated with the present approach. An example of this type of calculation can be found in Appendix C2.

Projects with payback periods of between two and five years

Projects that typically pay for themselves within two to five years are listed below.

- Installing a heat pump to a swimming pool.
- Fitting a swimming pool cover.
- Installing push button spray taps and showers. These automatically switch off after a pre-set period. Individual showers are better than the run through type where all the heads are on regardless of the number of pupils using the showers
- Altering wiring systems to allow for banked lighting in classrooms.
- Providing boilers with new burners.

Examples and case studies can be found in Appendix D.

Projects with payback periods of more than five years

Projects that usually have **payback periods** of more than five years are listed below. However, if they are carried out as part of another project some or all of their cost can often be absorbed and the payback period correspondingly reduced.

- Installing draught lobbies.
- Replacing some windows with insulated panels.
- Insulating the roof.
- Insulating walls.
- Replacing boilers.
- Fitting suspended ceilings in rooms with high ceilings (but remember this may also mean modifying the light fittings).
- Building covered walkways between blocks and round courtyards used for circulation.

Examples of potential projects and case studies can be found in Appendix E.

Implementing some long-term measures might depend on other projects even though the payback calculation shows that they will result in a cost saving. For example, around 22 per cent of the heat losses from a 1960s system built school are through the roof but insulating a flat roof can only be carried out when the school is being re-roofed.

If a project has a projected payback period of more than five years you may need to calculate in any interest you might have to pay.

1.5 MAKING THE MOST OF FINANCIAL INCENTIVES

The **Enhanced Capital Allowance (ECA)** scheme allows buyers and suppliers of equipment and plant meeting energy efficiency criteria to claim the full amount of capital allowance in the first year rather than over a period of three years.

The scheme covers eight categories:

- boilers
- pipe insulation
- motors
- variable speed drives
- lighting
- refrigeration
- thermal screens
- combined heat and power (CHP) systems.

Schools are not able to benefit directly from the ECA scheme unless they run a business or are supplied by an energy services company that will pass on the savings to the school.

The **School Energy programme** run by the Energy Saving Trust provides rebates for energy efficiency measures in schools. More details of School Energy can be found at **http://www.schoolenergy.org.uk**.

2. Operational issues

This section looks at some of the operational issues involved in implementing an energy conservation and management strategy. To save money you will need to set up and keep in place a maintenance schedule for heating and lighting.

2.1 MAINTENANCE

The most energy efficient buildings are those that are wind- and watertight with their heating, hot water and electrical systems in good condition. This can be achieved through **regular maintenance** and the **prompt repair of defects**.

2.1.1 Setting up a maintenance schedule

Maintenance should be carried out under the following schedule:

- before each heating season
- during each heating season
- once a term
- as necessary.

Routine tasks are described below. You might need the help of a heating engineer or your local authority energy management unit for some of the work.

Before each heating season

1 Service the heating system

Check that it is working efficiently and confirm that the fuel/air mixture in the boiler is within the manufacturer's recommended levels.

2 Check that the froststat is correctly set

In cold weather a special thermostat called a **froststat** prevents the heating system freezing. It should be set at:

- 2°C if it is installed outside
- 5°C if it is installed inside the building.

If it is set too high the boilers will come on too soon and overheat an empty school.

3 Bleed the radiators

During the heating season

1 Check the heating system is balanced

An unbalanced system means that some areas are overheated and others are too cold.

2 Visually check the insulation on pipe work

3 Check draught proofing to external doors and windows

Depending on the time of year the gap between a door, or window, and its frame can vary by 3mm. On a standard door this is a hole equivalent to a house-brick. Draught stripping solves this problem.

4 Check the heating system for leaks

5 Check the cold and hot water systems, including taps, for leaks

Once a term

1 Clean the filters in fan assisted heaters

Except in the smallest schools it will not be possible to clean all the filters during school holidays. Set up a rolling programme cleaning so many filters a week.

As necessary

1 When the clocks change and after every power failure

Reset all time clocks.

2 Repair broken windows promptly

A broken window is an open window. Until a broken window can be repaired, use a purpose designed, proprietary self-adhesive polythene film. This holds the broken glass in place, and prevents heat loss until a permanent repair can be carried out.

2.2 RUNNING THE HEATING SYSTEM EFFICIENTLY

Running the heating system efficiently is essential if you are to make the most of your energy consumption. Here are some ideas.

2.2.1 Heating the school

- Do not overheat the school. If rooms are too hot then switch the heaters off. Try to observe a 1 September to 30 April heating season.
- Set thermostats to the desired room temperature and check their settings regularly. Turning up the thermostat does not heat a room more quickly. It just runs the heating longer and costs more.
- Turn off water heaters, extract fans and similar equipment at night, weekends and holidays.
- Never place furniture in front of heaters unless the heaters are designed to allow this.
- Have the school cleaned during the pre-heat and residual heat periods.
- Do not leave windows open out of hours. They may need to be open at other times to ensure adequate fresh air provision.
- If electrical equipment, including computers, is not being used and continuous operation is not essential, switch it off.
- Monitor **maximum demand**. Do not run heavy load items like kilns or stage lighting simultaneously especially during winter months. The greater your maximum demand the higher the charge per unit of electricity for every unit used.
- Investigate areas that are always too warm.
- In zoned heating systems where one thermostat controls entire blocks or floors, solar gain can confuse the system. Some rooms become too warm, others remain cold. This is particularly noticeable in buildings with north-south aspects. One solution is to fit the heaters in each room with their own thermostats and control valves. An alternative is to fit separate thermostats and control valves on north and south facing zones.
- Make sure that at the end of each day all heaters are switched on, the time clocks and controls correctly set and the heating system is ready to start heating the building the next day.
- Keep pre-heat time to a minimum. For a 9.00am start a three-hour pre-heat period means the heating system must begin work by 6.00am. If working temperatures are consistently reached before 9.00am you can cut the pre-heat time. A reduction of 15 minutes can save 2-5 per cent on your heating bill. If your heating system does this automatically, monitor it to make sure it is doing it most efficiently.
- Switch off the heating as early as possible at the end of the school day.
- Only use approved portable electric and gas heaters:
  - as a last resort for supplementary heating
  - for emergency heating
  - to provide local heat during holidays when only parts of the school are in use.
- Avoid overheating storerooms and other areas that are normally unoccupied.
- Fit reflective foil behind radiators.

- Fit time and temperature control units to temporary classrooms.
- Install point of use hot water heaters in staff rooms and similar areas.
- Do not heat the entire hot water system during the school holidays.
- Consider using appropriate cold water detergents rather than hot water for cleaning the school.

2.2.2 Heating during holidays

There are usually six weeks of holidays during the heating season (1 September to 30 April), representing 17 per cent of the overall heating season. This means that introducing controls to automatically turn off heating during the holiday periods can save you 17 per cent of your overall heating fuel costs. If you do not have these controls, it will be important for the caretaker to be diligent about turning off the heating during these periods.

2.2.3 Heating a swimming pool

Swimming pools can be expensive to run so you need a strict energy management regime.

Heat the water to a maximum of 28°C with the surrounding air temperature 1°C higher. This keeps the relative humidity to around the ideal of about 65 per cent. In these conditions ventilation is at a minimum and heat losses at their lowest.

If the relative air temperature is more than 2°C above the pool temperature evaporation levels rise, ventilation losses increase and more heat is needed to maintain pool and air temperatures.

If the relative air temperature is below the pool temperature the pool acts like a huge radiator with correspondingly high heat losses.

Using a pool cover when the pool is not in use can save up to 30 per cent of pool related energy costs by cutting:

- evaporation losses
- heat losses
- the energy needed to bring the pool back to working temperature
- the amount of water to make up for that lost by evaporation
- ventilation requirements.

2.2.4 Using ventilation efficiently

For your school's energy use to be efficient, you need controllable ventilation to avoid excessive heat losses and draughts. Uncontrolled ventilation can mean heat losses of up to 60 per cent. For example, if a room is allowed to cool it will take around half an hour to return to working temperature. To stop this happening:

- Keep the draught lobbies at entrances to buildings in good repair and make sure they are used properly.
- Fit door closers to external doors and keep them in good repair.
- Fit draught strips to external doors and windows.
- Open windows and ventilators as required.

2.3 LIGHTING THE SCHOOL EFFICIENTLY

There are two main ways in which you can make more efficient use of lighting:

- using lighting control
- using fluorescent lighting and other energy efficient lights.

2.3.1 Using lighting control

A large fraction of the energy used in lighting comes from using lights unnecessarily, for example, for lighting areas that are unoccupied, or where daylight levels are adequate. A common problem is that lights are switched on first thing in the morning when daylight is inadequate and are then left on all day even though there is enough daylight.

Most schools have manually controlled lighting throughout. Although this is appropriate for most installations and rooms, there are some areas in the school where automatic lighting controls can be beneficial. These include:

- toilets – occupancy sensor
- changing rooms – occupancy sensor
- sports halls – occupancy sensor
- assembly halls – occupancy sensor
- corridors – daylight sensor, occupancy sensor
- external/security lights – occupancy sensor, daylight sensor, and timeswitch.

Here are more details about the different kinds of lighting controls.

- **Occupancy sensors**: These switch lights on when they detect occupancy within a room or area. Lights then remain on for a pre-determined time after which the lights are switched off unless occupancy is still detected.

  The time for which the lights remain on after detecting occupancy varies depending upon the area under control. In areas such as storerooms or stairways, lights should not go off while the area is still occupied but with the occupant in an 'undetectable' area, as this could be dangerous.

- **Daylight sensors**: These use a photosensitive cell to switch lights on in response to falling daylight levels. Within a school, these will be most appropriate for external lighting. They are sometimes used in well daylit classrooms to control the lights in rows parallel to the windows.
- **Timeswitches**: Timeswitches switch lights on and off at pre-determined times. Within schools timeswitches are most commonly found controlling security lights and external lights.
- **Combinations**: For external lights, a common approach is to use a combination of daylight sensor and timeswitch. The daylight sensor turns lights on when it becomes dark, therefore turning lights on earlier as the year moves into winter. The timeswitch is used to turn the lights off at a predetermined time, for example, midnight, after which external lighting may not be considered beneficial.

2.3.2 Using fluorescent lighting

Fluorescent lighting offers energy savings because most of the energy consumed is used to provide light and not heat. Tungsten lamps convert about 5 per cent of their energy into light compared to around 20 per cent for fluorescent tubes. On average, compact fluorescent lamps use 40-70 per cent less electricity than tungsten bulbs with equivalent light output. Using compact fluorescent and other energy efficient lamps can cut costs by 60-70 per cent.

A compact fluorescent lamp has a life of about 10,000 hours, compared with 1,000 hours for a standard tungsten bulb. This means that fluorescent lights that are on for an average of six hours a day need replacing only about once every five years instead of every eight months or so, saving maintenance time as well as replacement cost.

It is therefore worth introducing a rolling programme of replacing tungsten bulbs with their low energy equivalents.

A template for calculating the savings by replacing tungsten lamps with compact florescent lamps can be found in Appendix H.

If you are replacing tungsten bulbs with fluorescent lighting, please note the following.

- A blackened end on a fluorescent tube is a sign that it is reaching the end of its useful life. Make sure you inspect fluorescent tubes regularly and replace them if you see this sign.
- In many cases the old style 38mm (T12) diameter fluorescent tubes can be replaced on a one for one basis by modern 26mm (T8) fluorescent tubes. This can be done as part of the replacement programme and will save 8-10 per cent on running costs.
- Switch off fluorescent lights when they are not needed. It is widely and wrongly believed that it is cheaper to leave fluorescent lights on all day than to switch them off when they are not needed. Frequent switching did shorten the life of old style fluorescent tubes but this is no longer true (see below).

- Whenever possible use fluorescent tubes rather than compact fluorescent lamps, as they are more energy efficient.

When not to replace tungsten bulbs

- Most compact fluorescent lamps cannot be used with dimmers and are not suitable for emergency light fittings.
- Some fluorescent lamps are longer than tungsten bulbs and quite heavy, so they are not suitable for all light fittings.
- Theft of the relatively expensive fluorescent lamps can be a problem in some schools, especially if the light fittings are not enclosed and are therefore easy to steal.

Using high frequency ballast and control gear

The parts of the fluorescent lamp that control the light output are called the **ballast and control gear**. A fluorescent lamp works by discharging light many times a second. In the past the ballast and control gear featured a wire wound choke and required a warm up time. This resulted in a time lag between light switching and light being produced. It also resulted in flicker and meant that the life of the tube was reduced with frequent switching on and off.

Nowadays, the high frequency ballast and control gear in fluorescent lighting is constructed from solid state electronics. They operate at speeds of around 30 thousand cycles per second (30kHz), and reduce losses by more than 50 per cent. Given that the efficacy of a fluorescent tube increases at high frequency, additional savings are also made.

It is therefore recommended that new installations of fluorescent lighting feature high frequency ballast and control gear. Existing fluorescent light fittings can also be retrofitted with high frequency ballast and control gear.

3. Curriculum opportunities

This section looks at some of the many ways in which you can incorporate energy saving activities into the curriculum. By building on children's enthusiasm for green issues you can encourage an informed awareness of energy conservation. By involving pupils directly you can use the school as a living laboratory and bring energy issues to life.

Energy issues can be taught through a range of National Curriculum subjects including:

- science
- technology
- mathematics
- history
- geography
- citizenship
- English.

You can also cover energy issues in non-statutory studies such as economic and industrial understanding, and health education.

If you introduce an energy-saving project, pupils must see be able to see the practical benefit from their contribution. For example, you could appoint pupils as energy monitors to switch off unnecessary lights and close doors and windows. If this saves money you can tell them how much and how the cash is being spent. A little money spent on projects chosen by the pupils will encourage them to get involved in energy saving.

Putting energy conservation on the agenda of staff meetings keeps staff informed and provides a forum for views and ideas. All staff should attend an introductory course on energy conservation and be given support and encouragement. Others may need more detailed training.

There are more details on curriculum opportunities in 'Energy Zone' on the SchoolEnergy website at **http://www.schoolenergy.org.uk**.

Here are some other ideas.

3.1 CARRYING OUT AN ENERGY AUDIT

One class or group of pupils could survey one of the areas listed below and another group could survey a different area. Alternatively, one could do the survey and another could input the data into a spreadsheet. There is more on carrying out an energy audit later in this section and in Appendix G.

Hot water

- Record water temperature.
- Record volume of tepid water drawn from taps before water reaches required temperature – this is wasted energy and water.
- Record the number and location of dripping hot taps.
- Suggest ways of using hot water more efficiently.

Insulation

- Record window type e.g. single/double/triple-glazed, and what the frames are made of.
- Record the type and condition of insulation on the hot water tanks and pipes. (Insulation in walls, floors and ceilings is more difficult to investigate and might be beyond the ability of younger pupils.)

Lighting

- Record the number and identify the type of lights in each classroom.
- Record the classrooms where lights are left on when the room is unoccupied e.g. breaks and lunchtimes.
- Record the classrooms where lights are left on when there is sufficient daylight.
- Record the classrooms where lights near the window cannot be switched off separately.

Appliances

- Record the time that equipment is left on standby.
- Calculate electricity used while equipment is on standby.
- Calculate the savings in cost and CO_2 emissions if the equipment is switched off.
- Calculate the cost of running an appliance for a week.

Heating

- Measure air temperature in different parts of the school. Recommended temperatures are a minimum of:
  - 180°C for normal activity
  - 210°C where occupants are inactive or sick
  - 150°C for other teaching accommodation, washrooms, circulation areas and sleeping accommodation.
- Discuss comfort temperatures.
- Measure air temperature in different parts of a room. Try near the floor or ceiling, near the door or window. Plot the temperature on a room plan. Does the temperature vary much? Why? Use knowledge of convection currents to suggest how to reposition furniture.
- Identify supplementary heating and when it is used. Is it necessary?
- Identify and record the temperature controls in the school, e.g. room thermostats, thermostatic radiator values. What are these typically set to? How are these adjusted and by whom? Are they tamper-proof?
- Identify whether the sensors and/or room thermostats are located in appropriate positions. Will they truly represent the room temperature? If they are located above heat sources or in direct sunlight they will result in underheating; if they are located in draughts they will result in overheating.
- Identify obstructions in different rooms. For example, how many radiators/emitters are under windows? Are there protruding window sills above them? Is there reflective foil behind them? What type are the windows? Do they act as a cold radiator?
- Produce an action plan to remove obstructions, e.g. removing obstructions from heaters to ensure free flow of air and heat, educating staff to improve room layout to avoid blocking heaters.
- Record weather data – an increase in consumption may be due to a spell of colder weather rather than energy wasting.
- Record room temperatures in problem areas over a 24 hour period using a data logger. Draw a graph of the results and explain any anomalies.

Draughts and ventilation

- Record which doors/windows are left open regularly.
- Design a simple questionnaire to investigate why people don't shut doors/windows.
- Discuss need for fresh air and what makes good indoor air quality. Measure and compare carbon dioxIde concentrations of air in various rooms.
- Input data into spreadsheets and produce charts to display on the energy noticeboard.

3.2 DESIGNING EXPERIMENTS

- Design experiments to investigate the insulating effect of double-glazing.
- Design simple experiments to investigate draughts around windows and doors. Consider air flow in more detail e.g. use fume cupboards as an air flow problem.

3.3 RECORDING ENERGY USE

Pupils can act as energy monitors, taking meter readings. Real time meter readings can provide a range of curriculum opportunities but make sure that meters are read correctly.

It is best if pupils can take readings themselves but be aware of health and safety issues if the meters are located in inaccessible or dangerous locations.

Each meter, including water meters, should be read at the same time each day or each week. On Fridays at the end of school activities is a good time. A second check first thing on Monday morning gives weekend consumption.

There is more on using data from meter readings in Section 4.

3.4 ANALYSING ENERGY USE

Monitoring patterns of consumption is a simple way of introducing the use of graphs into the curriculum. Real time meter readings (see 3.3) are an excellent source of data for analysis.

If you don't have meter readings, you might be able to obtain half-hourly consumption data from your energy supplier. This will be in Comma Separated Variables (CSV) format which can be downloaded into a spreadsheet and used to produce graphs for analysis.

Pupils can:

- Compare patterns of use. Today's pattern of energy use should be very similar to the same time last year and not that different from yesterday. You can also look at data for the school week, the weekend, the month, term or school year Differences, more or less, can be investigated.
- Determine the general trend in energy consumption – this term/year – up or down?
- Try to relate changes in energy use to changes in weather, occupancy, community use or other factors.
- Benchmark consumption by working out the floor area of the school or the total number of people on the site.
- Estimate progress towards your energy saving objectives.

A simple software package called Eco Warrior can help with analysis. This interfaces with real time meter or half-hour readings. Further details can be found at **http://www.sotaew.co.uk**.

Another simple free software package for analysis of meter readings is KULU at **http://www.vt.fi/kulu**.

A website that illustrates the volume associated with carbon dioxide can be found at **http://www.defra.gov.uk/environment/climatechange/schools/index.htm**.

You can use this spreadsheet for calculating carbon dioxide:

Fuel type	**Quantity** (kWh)	**CO_2 factor**	**Total CO_2** (kg)
Electricity	A	0.43	A * 0.43
Gas	B	0.19	B * 0.19
Oil	C	0.25	C * 0.25
Coal	D	0.34	D * 0.34

Figures are from latest government reports of October 2001.

3.5 CALCULATING PAYBACK

Many simple energy saving measures are cash-free. Any measure which has a payback period of two years or less is a low cost measure. There is more on calculating payback in Section 2.

Typical payback periods (years) for improving roof insulation

Added Thickness	**Cost of Extra Insulation £/m²**	**Original Thickness**		
		0 mm	50 mm	100 mm
50 mm	1.50	4 – 5 yrs	5 – 6 yrs	6 – 7 yrs
100 mm	2.00	3 – 4 yrs	4 – 5 yrs	5 – 6 yrs
150 mm	2.50	2 – 3 yrs	3 – 4 yrs	4 – 5 yrs

Ask the caretaker or school representative what level of roof insulation your school has, and if possible confirm this through a visual inspection.

Use the information above to calculate the payback period for your school for improving roof insulation.

3.6 CALCULATING HEAT LOSS

In many school buildings, two thirds of the heat input into the school is lost through the building fabric – walls, windows, roof and floors. The remaining third is lost through **infiltration** and **ventilation**.

Infiltration is the uncontrolled leakage of air through small gaps and cracks in the building fabric, such as around window and door openings, around skirting boards and at wall/ceiling junctions. In existing buildings infiltration can be reduced by draught stripping. This will improve comfort by reducing draughts as well as reduce the level of noise and dirt coming into the school.

Ventilation is the intentional replacement of stale internal air with fresh outside air. Some level of ventilation is required for comfort and to maintain the integrity of the building fabric. It is provided by:

- natural ventilation – windows that can be opened, ventilators and grilles
- mechanical ventilation – fans.

In modern highly insulated buildings built to the current Building Regulations, the amount of heat lost through infiltration and ventilation can be reduced.

The rate at which heat is lost depends upon:

- The temperature difference between inside and outside.
- The thermal transmittance of the fabric, which is dictated by the composition of the structure.
- The volumetric air change rate, dictated by how well doors and windows fit.

The equation for ventilation (infiltration) heat loss is: $0.33\ n\ V\ T_{diff}$

where:	n	=	number of air changes per hour (air change rate)
	V	=	heated volume of building (m^3)
	T_{diff}	=	$T_{inside} - T_{outside}$

3.7 STARTING AN ENERGY NOTICE BOARD

Pupils might be able to start an energy notice board for the whole school. This can be used to:

- Report on problems and progress.
- Produce a large-scale plan of the school and use it to record results of surveys, for example, hot and cold spots.
- Display weekly energy consumption figures. Raw figures need interpretation for different audiences, so graphical representation is important.
- Equate costs with common items of food. For younger pupils kWh can be referred to as units.
- Highlight the steps taken to conserve energy.
- Highlight trends in consumption whether caused by changes in season, school activities, holidays or pupil and staff action.
- Praise classes that remember to turn off lights and appliances and shut doors and windows.

- 'Name and shame' classes that persistently leave lights and appliances on and doors and windows open, if this seems appropriate.

3.8 INTRODUCING LITERACY ACTIVITIES

There are a number of literacy activities that can be linked to energy management and conservation activities. Here are some ideas.

- Keep an energy dictionary.
- Role-play an energy adviser.
- Write labels about energy saving and put them next to appliances and light switches. Older children could give running costs and CO_2 emissions.
- Organise energy saving awareness events such as a 'Save it' campaign involving families, friends and neighbours of the school.
- Compile an 'Energy Trail' around the school and neighbourhood, showing how the different forms of energy are provided and controlled.
- Organise drama, music, assemblies, discussions and art productions with the theme of energy conservation.
- Write articles for the school newsletter and local newspaper.
- Make presentations about energy management progress involving the different groups within the school e.g. report to Governor meetings, PTA.
- Link up with a European school – you can get more details from the European Eco-Schools programme at **http://www.feee.org/eco-schools**.

3.9 MONITORING AND EVALUATION

Pupils could be responsible for monitoring and evaluating energy-saving activities in the school, answering questions like these.

- Are doors and windows still open?
- Are lights still left on?
- Is supplementary heating still used?
- Are room temperatures correct?
- Is the temperature of the water at the hand basins correct?
- Has the amount of tepid water drawn off been reduced?
- Have any dripping taps been mended?
- Has any single glazing been replaced?
- Have any draughts been reduced?
- Has any obstructing furniture been moved away from the radiators?

- Are thermostats correctly set?
- Are the heating times appropriate?
- Are there shelves above and foil behind radiators on external walls and under windows?

3.10 FITTING RENEWABLE ENERGY SYSTEMS

Several schools have fitted renewable energy systems that provide some generation capacity as well as a valuable learning resource.

Case studies of schools with renewable energy systems and grants available to install systems can be found at **http://www.natenergy.org.uk**.

Further renewable energy teaching resources within schools can be found by visiting **http://www.atschool.eduweb.co.uk**.

4. Purchasing energy

In the early 1990s the electricity and gas industries were privatised, giving consumers choice about where they purchase their energy. Some electricity companies now offer gas, and vice versa, as they progress to becoming complete utility suppliers. In this section we look at the different suppliers, what they offer, and how you can make the best buys for your school. Further information about UK energy suppliers can be found at http://www.services-24.com/Shops/energy_electricity.htm.

Note: Once you have chosen a supplier, check your contract carefully before you sign it. On the agreed date of changeover of supplier make sure that you take a reading of the meter/s so that you can check the last reading of the original supplier and the first reading of the new supplier. Contact your new supplier to confirm that they have taken over your site(s).

About OFGEM

The gas and electricity markets are regulated by OFGEM (Office of Gas and Electricity Markets) with a remit to oversee both the gas and electricity markets. OFGEM's role is to:

- ensure a safe supply to meet all reasonable demand
- promote competition in generation and supply
- protect customers' interests
- promote energy efficiency
- ensure financial viability of parties licensed to generate, transmit, distribute and supply electricity.

For more information visit OFGEM's website at **http://www.open.gov.uk/offer/offer.htm**.

4.1 MEASURING CONSUMPTION

Energy and utilities are probably the only areas of expense in the education annual budget for which the actual costs are not known until the bills arrive. Even then a bill could be an estimate so you may have to wait a year for an accurate bill. If you do not know how much energy is being used you can't know whether you have spent your budget allocation or not.

Perhaps more importantly, wiithout a good idea of how much energy your school consumes you can't take advantage of the best energy prices on offer.

To get the data you need, keep a record of annual energy consumption figures and, with electricity, the entire tariff details. The more accurate this information the better – ideally aim to keep monthly records for electricity. We recommend the following method.

Kitchen equipment

- Kitchen equipment can be estimated consumption rate and the time used.

Hot water domestic

- A plot of energy consumption against services derived from a degree day data will give the non-degree day central boiler plant element.

Electricity day/night split

- Read electricity meters in the morning on arrival and again at night when the school is closed.

It is worth recording this information on a computer spreadsheet. The spreadsheet could also form the basis of a monitoring system for your energy consumption.

4.1.1 Checking your bills

Electricity and gas bills can also carry a significant amount of information to help you make your energy savings.

When you receive a bill check it to make sure the cost relates to the consumption and that it is correctly related to the tariff. Check consumption to see if it seems reasonable for the time of year, the severity of the weather or the consumption of water related to the number of people. This can be done using degree-day analysis and performance indicators (See Section 1).

If you are missing any bills you may need to work out the energy consumption for certain months yourself. Make sure your calculations are reasonable compared with bills for similar months.

4.2 BUYING ENERGY

Once you have collected your data on your costs and consumption for each energy account, convert the energy to a common unit, ideally the kWh. A kilowatt-hour (kWh) is 1000 watts in use for one hour. It is very easy to grasp if you consider that a one bar electric fire switched on for one hour uses one kWh. Record the M number for the gas account and the supply number for the electricity account, together with the reference number on the meter (or meters).

You can then get quotes from different energy suppliers. Send each supplier the same information and stipulate the date by which you want to receive their quotation, allowing them a reasonable time.

Here are some points you might want to clarify with suppliers when you ask them for quotes.

Prices

Ask suppliers about their pricing structures. Suppliers usually quote different prices for different payment options e.g, standard payment, direct debit, monthly or quarterly. Tiered arrangements are based on the principle that the more you use, the lower the price. Aim for a minimum of three prices from each supplier.

VAT

Check whether the price per unit includes VAT.

Notice of change of supplier

Check how much notice you have to give if you change to another supplier and whether there are any penalties for doing this. In the domestic market a supplier has to allow a customer to change to another supplier with 28 days notice, but there may be some penalties for changing after only a short time. Commercial contracts are usually for a minimum period of one year.

Penalty charges for late payment

Check whether suppliers charge for late payment of the account. A punitive charge could wipe out any expected savings.

Fixing of the contract price

Find out whether the contract price is fixed for a certain time period or if it can vary. This is similar to mortgage offers e.g. a fixed price for a period of time which is initially slightly higher may be a better deal than a short term very low price which is much higher in the longer term.

4.2.1 Purchasing groups

To help you get the best supplier at the best price, you can contact – or even set up – a purchasing group. Different kinds of purchasing groups are described below.

Local authority energy management units

Where they still exist, local authority energy management units have a wealth of knowledge and experience and usually provide a high-quality service. Because of the introduction of compulsory competitive tendering these units may now be part of a building practice or a client department. A charge is made for their services but this may be covered by a rebate from the energy supplier.

Buying consortia

Buying consortia help reduce the costs faced by each school by taking advantage of the economies of scale. They may be formed by a group of schools, or they may be operated regionally by local authorities.

Costs for operating a consortium can be recovered in many ways.

- In the public sector, local authorities may pay the salaries and operating costs and therefore the cost of the service is essentially free to those using it.
- Consortia operating as a business or in a cost reflective environment in local government have to make a charge for their services. This is normally done via a rebate paid to the consortium by the successful tenderer. This rebate is recovered by a fractional cost added to the energy price to cover overheads etc.
- A specific charge may be made – either a fixed fee or an amount based on a percentage of the savings. Many tariff consultants in the business sector charge 50 per cent of the saving achieved from the original price.

Consultancy and contract energy management

Many consultancies operate specialist energy units which may be able to provide an individual service to your school or college but this could be an expensive option.

You may have received letters from companies suggesting that they can check the price that you are paying and arrange a cheaper package at no extra cost. They will probably be receiving a rebate from a supplier so you may not be getting a true indication of all available prices. It is quite normal for these companies to claim up to 50 per cent of the saving for three to five years, so watch the small print.

It is also possible to obtain your energy supply through a process known as contract energy management or through an energy services company. Further information on these options can be found in Appendix B.

4.2.2 Establishing your position within the market

From your annual total consumption figures you can establish the markets that you will be buying in. This will affect the lowest price that will be achievable.

For **gas** this is based on the annual total consumption:

> **Gas under 73,167 kWh** (2,500 therms)
> **Gas 73,267 to 732,677 kWh** (2,500 to 25,000 therms)
> **Gas Over 732,677 kWh** (25,000 therms)

For **electricity** this is based on the average of the highest three maximum demands in a year:

> **Electricity under 100 kW**
> **Electricity over 100 kW but under 1MW**
> **Electricity over 1MW**

Gas supply

Gas supply involves gas producers, gas shippers and gas suppliers.

- *Gas producers* carry out the business of exploration, drilling and transporting gas to the mainland. The gas is put into the distribution system at a number of input terminals.
- *Gas shippers* trade in transporting gas, buying input gas and selling it at the output point. They have their main dealings with British Gas Transco (Transco; see below).
- *Gas suppliers* are the interface through which gas is sold to businesses, schools, colleges etc. A supplier may also be a shipper or have a contractual arrangement or affiliation with a shipper.

Transco and the independent gas shippers have agreed a network code. One of the requirements of this code is that all users of the pipeline system must each day balance the gas their customers take out against what they add in to the system.

This daily balancing has meant that to avoid the shippers having a shortfall and paying penalty charges to Transco to make up the difference a mechanism has been devised that allows shippers to buy the gas from whoever has it for sale. This has created a daily gas price market similar to that existing for oil.

British Gas Transco

Transco operates the pipeline and meter system for the country. The Transco network has millions of outlet points but only a few inlets from three sources:

- off-shore gas.
- on-shore gas.
- gas that has been stored.

Imagine a gigantic balloon with many outlets and a few inlets. If gas is taken out more quickly than it is put in, the pressure in the balloon will drop. Conversely if the inlets keep supplying gas and it is not flowing from the outlets the pressure will rise and it could explode. To maintain the gas pressure at a constant level gas can be put into or taken out of storage. This facility is used to even out the daily and seasonal variation of requirements.

The largest colleges (more than 2500 students) with annual consumption over 5,861,420 kWh (200,000 therms) can get a price reduction if they elect to be on an interruptible contract. To have this option they must have an alternative fuel system that they can switch to at short notice, involving work and therefore costs for technical staff. The interruptions give Transco and the shipper the option of cutting off the supply at times of very high system demand, such as on peak winter days, in order to balance supply and demand and maintain the pressure at other sites.

Transportation charges

The costs associated with moving gas from inlet to outlet, balancing and metering are known as the transportation charges. The transportation charges can account for 23-40 per cent of the total cost of the gas supplied to your school. The transportation charges are made up of the following:

- National and local capacity charges (based on peak day consumption) and how this varies over the year, the input terminal and which of the 33 exit zones in the country it is used in.
- A national commodity charge and local commodity charges relative to the peak day consumption.
- Customer charges eg type of metering.

The transportation charges can be calculated for each supply point in the country once the above information is obtained from Transco.

Load factor

Unlike a process using gas to make a product which consistently consumes the same amount of gas each day, a gas boiler in a school burns different amounts of gas during the day depending on how much heating and hot water is needed. The load factor is a measure of the consistency of a load.

You can get a lower price for your gas supply if you can achieve a more consistent load during the year. This isn't easy in a school with a normal consumption pattern of heating in winter and hot water service during the year. However, fabric insulation can reduce the heating demand and if gas use is maximised with cooking and hot water use the load factor will rise. The long summer holiday also affects the load factor by reducing the annual consumption.

Electricity supplies

Electricity accounts for less than 15 per cent of all energy consumed but more than 40 per cent of the energy bill. On a unit for unit comparison it offers the greatest savings.

Schools with metering over 100 kW supply

Most secondary schools and colleges spending about £12,000 a year on electricity are already on a contract for their electricity. Since October 1997 it has been a requirement that all supplies over 100kW must have half-hourly metering. These meters are known as Code of Practice 5 (COP5) meters and have built in modems. The special meter can be rented or purchased.

The half-hour consumption data of your school is sent to the Data Collector every night. The information is used by your supplier to provide billing information. As we have seen, this information is very useful when you are reviewing energy use, with a view to saving energy and therefore money. Some suppliers provide the information to be downloaded over the internet and with the right connections it is also possible to dial them up directly. Some suppliers provide a free service to allow customers to do this.

Schools with metering under 100 kW supply

Under 100kW sites that do not have COP5 metering are assigned one of eight standard consumption profiles by the electricity pool in conjunction with suppliers.

The profiles are the mechanism by which the suppliers account for the energy they use. The customer would not normally know of their existence and will still continue to pay on a tariff or contract price. However if the profiles are known, the customer can notify the supplier when consumption moves into a different standard profile.

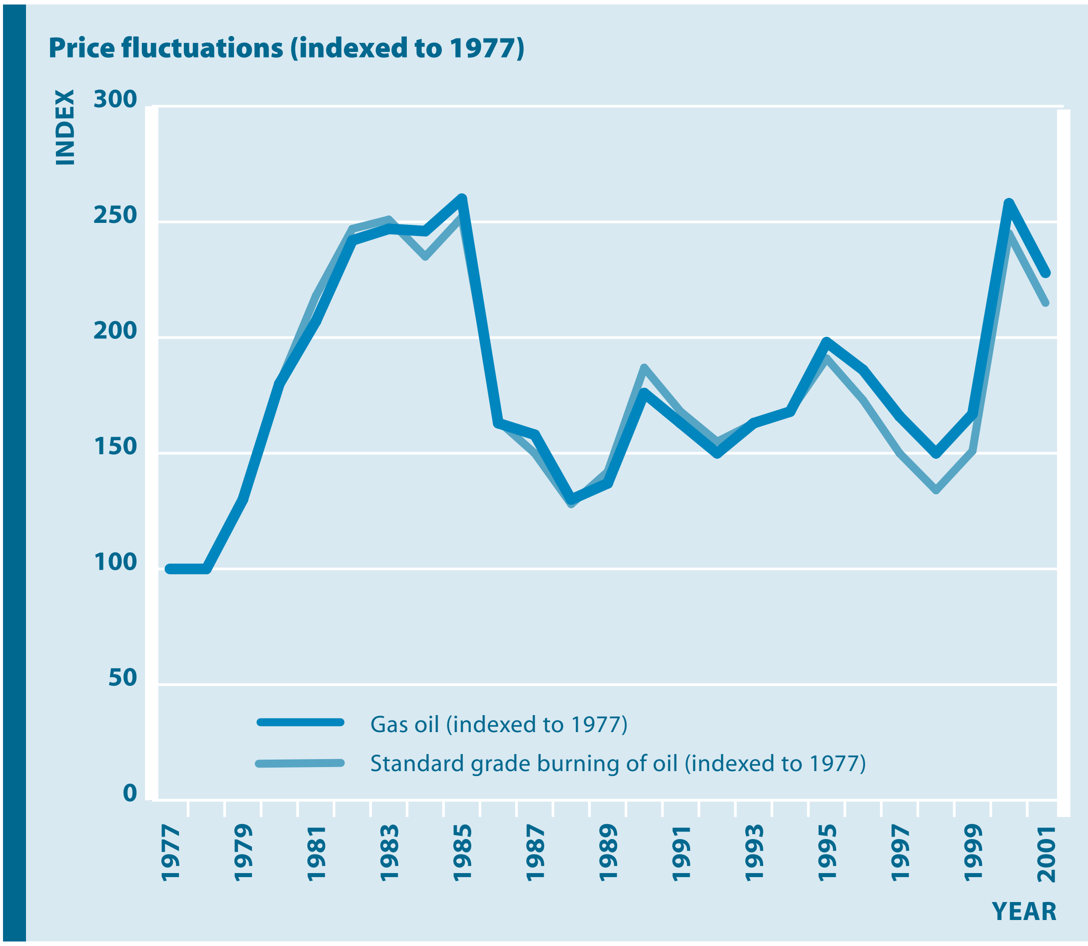
Oil supplies

The price of oil depends on rates set in the global market and can be subject to sudden change. During the Gulf oil crisis prices almost doubled to 20 pence a litre. The graph below shows how the price of oil has varied over the last 30 years.

Contract types

Purchasing oil through a consortium will, over time, probably give the lowest costs. There are a number of ways in which oil can be purchased by a consortium to maximise the group purchasing power.

- Rotterdam related contracts take the daily price for a particular oil stock averaged over a number of weeks as a base. Oil duty and a delivery margin including profit are added giving a final cost per litre.
- Inland Schedule Price (ISP) contracts generally give a low price at the start of the contract for a fixed period. The price rises during the length of the contract period. The contract administrator carries out continual negotiation to try and limit the schedule price rises and maximise schedule price falls caused by world events.
- Fixed price contracts are another alternative, giving a price that is negotiated for a fixed period of time such as one year. Although this offers protection from large prices increases it may also rule out benefits from a fall in price.



Oil surcharge costs

If a full tanker load of 22,000 litres cannot be delivered at a site a surcharge is added to the cost of a part load. To reduce costs, establish the surcharge rates of your supplier so that the quantity you order falls in the cheapest price band. However, if you are soon to start an ISP contract, with a low start price, a small quantity would be a better option.

Solid fuel supplies

Until the early 1990s most coal was mined and sold by British Coal. In 1995 all coal production moved to private ownership. There are also wholesalers and traders who source fuel from other countries.

Coal is a natural and variable source of energy and its inherent properties differ from colliery to colliery. There are two types of coal, bituminous and anthracite, and various grades within the two types. When purchasing solid fuel you need to know the grade, type and inherent qualities such as calorific value, ash content and free burning characteristics you require. Your local authority, plant manufacturer or fuel supplier can advise you. Some typical grades are washed singles, washed doubles, cobbles, and washed smalls and pearls.

Pricing

Solid fuel is sold in tonnes (1,000kg) in varying quantities depending on storage, size of delivery vehicles, and bulk discounts.

Coal can be purchased from a producer or a local supplier but if your local authority has tendered a bulk purchase arrangement you should take advantage of this.

The cost of coal may be affected:

- total bulk purchase contract
- annual requirement for your property
- size of individual load – larger loads attract possible discounts
- geographical location and costs of transporting the coal to you
- prevailing market pressure
- availability of seasonal discounts.

Delivery

Coal can normally be delivered within two to three days of ordering, but delivery times may be longer during the winter holiday period. Bulk delivery is normally by a heavy goods vehicle with a pneumatic system that can blow coal into the bunker. Smaller deliveries may be bagged or loose tipped fuels.

Bottled gas supplies

Bottled gas may have been installed in your school as a temporary solution, for example, in extra classrooms when mains gas was not available. Short term heating installations like these can be the most costly so it is worth reviewing them. Do this by:

- calculating the total cost and consumption of gas bought in a year
- comparing this price with prices from different suppliers
- comparing this price with the cost of obtaining the energy from a different source, such as mains gas.

If it's cheaper to use mains gas, you then need to assess whether the difference in cost will finance the installation of a mains gas supply.

Becoming a generator

Your school could also become a generator of energy itself or use renewable energy. Some schools have already done this and case studies and further information about funding for this can be found at **http://www.schoolenergy.org.uk/se_england.asp**.

PART 2

Saving Water

5. Strategic overview

This section provides a strategic overview to saving water. Even if you cannot implement some of the water-saving ideas in this guide at the moment because of current budget restraints, it is still worth developing a comprehensive water management strategy. You will then be in a strong position to respond quickly when you can afford to adopt cost effective water-saving measures.

5.1 REVIEWING WATER CHARGES

It is important to know how much you are paying for water so that you can keep within your budget allocation and plan your spending. You can also use your current costs as your starting point for monitoring any water-saving activities you decide to undertake.

Water charges in schools are broken down into several elements. In all but the smallest schools the cost contains a unit rate per cubic metre used and a standing charge. There are separate charges for water supply and sewerage services.

Metered water charges and rate for water and sewerage may vary. Within a water company area the rate will be the same for all schools but it may be different for other users.

Standing charges depend on the size of the meter. Meter size in a school depends on the anticipated water consumption when the school was designed. Some schools have an oversized meter because it was once used to supply more than one school or community building on the same site. Smaller meters can be fitted to reduce the standing charge. The fire fighting supply mains should bypass the meter as water for fire fighting is exempt from charges. If the fire main passes through the meter, the meter will be much larger than necessary. This occurs in some old schools and an easy cost saving can be made here.

The way in which water charges are structured is different for **metered** and **unmetered** services. This is explained below.

Metered services

If your school has a water meter, charges for water may be composed of several elements. For a normal metered supply you will be charged:

- A standing charge for water supply depending on the size of your meter.
- A standing charge for waste water also depending on the size of your meter.
- An amount for water, based on metered consumption multiplied by a unit cost.
- An amount for waste water (sewage), usually calculated as a percentage of the water consumption, known as the Return to Sewer (RTS) percentage. The default RTS% varies between water companies. The unit cost for waste water is usually greater than the unit cost for water. Discounts can sometimes be claimed on waste water that is not returned to the sewer.

Unmetered services

If your school doesn't have a water meter, charges are calculated on a rated basis. You will be charged:

- Standing charges for water supply and waste water sewerage.
- A charge based on the rateable value of the property multiplied by a rate per pound of rateable value. This may be subject to a minimum charge.
- For premises without a rateable value (i.e. built after 1990) there is a fixed licence charge.

If one company supplies your water and another one deals with waste water, you will receive two bills each showing standing and usage/rated charges. For metered supplies, the water consumption should be notified to the waste water company by the water supply company.

Other charges

There may also be additional or alternative charges as listed below.

- An abstraction licence charge for taking water direct from watercourses or wells. The Environment Agency raises this.
- Standing charges for swimming pools.
- Standing charges for garages.
- Surface water charges for rain water that drains to main sewers (e.g. car parks).
- A cesspit emptying charge.

More details and links to water companies can be found at ***htttp://www.ofwat.gov.uk/coadd.htm***.

5.1.1 Benchmarking water use

Benchmarking is a useful way of finding out how much water you are using or saving compared with other similar schools. To do this you will need an annual figure for consumption based on a unit such as floor area or number of pupils. This results in an output such as litres per square metre per year or litres per person per year. You can then compare this with consumption in other similar schools. For schools annual water consumption in m^3/pupil and annual cost/pupil are the most widely used benchmarks. A template for benchmarking can be found in Appendix A2.

The Government has recently launched a national programme of water use benchmarking within the public sector. Further details are available at **http://www.watermark.gov.uk**.

Office of Water Services (OFWAT)

The supply of water and waste water in England and Wales was privatised in 1989. Ten companies now supply both water and waste water and 18 companies supply only water. The water and waste water companies are responsible for the abstraction, treatment and supply of water and the collection, treatment and return of the waste water to the aquatic environment.

The industry is highly regulated. The economic regulator is OFWAT (Office of Water Services). OFWAT is responsible for making sure that the water industry in England and Wales provides customers with a good quality and efficient service at a fair price. Its primary duty – laid down in the Water Industry Act 1991 – is to ensure that the water companies can adequately finance their functions. In other words the Director General of OFWAT controls the prices which the water companies can charge to finance their operation and investment programmes.

Further information about OFWAT can be found at http://www.ofwat.gov.uk.

5.2 COMPLYING WITH THE WATER REGULATIONS

On 1 July 1999 the Water Byelaws in the UK were replaced by new regulations – The Water Supply (Water Fittings) Regulations 1999 – and the Water Regulations Advisory Scheme (WRAS) became responsible for assessing the suitability of materials for use with drinking water. Details of the Water Regulations can be found on the HMSO website at **http://www.hmso.gov.uk/stat.htm**. You can find out more about WRAS at **http://www.wras.co.uk**.

The Water Regulations are aimed at preventing undue consumption, waste, misuse or contamination and erroneous measurement of water supplied by a water provider.

Schools, like any other building, have to comply with the Water Regulations. You need to be aware of the following in order to be make sure you are complying.

- *Urinal flush controls* – ensure that urinal cisterns flush at the minimum frequency required and consider installing control devices.

- *Risk of back-siphonage* – this can happen when drinking water supplies are contaminated because water is flowing in the 'wrong' direction. Equipment such as potato peelers in kitchens must be fitted with suitable air gaps or back flow prevention devices.
- *Cisterns used to store water for cooking etc* – these must be in good condition with tight fitting lids, protected against contamination by insects, vermin and dust and also effectively insulated.
- *Overflows, or warning pipes as they are now called, including those fitted to water cisterns* – these should be visible at the point of discharge as they signal problems to be tackled.
- *New toilets* – these should be six litres per flush or less. Dual flush toilets are allowed. The short flush should be no more than 2/3 of the full flush.

If possible, supplies for drinking or cooking should come directly off the water main. If this isn't possible, supplies can be taken from a portable water tank. This must, however, be correctly designed and maintained.

Tanked supplies should be provided to toilets. Storage for three hours is sufficient for all supplies to toilet areas. If the main water supply fails and the toilets have no storage, children must be sent home.

The Water Regulations are not generally retrospective and fittings installed before July 1999 should continue to meet the byelaws then in force. In most cases it is not necessary to modify fittings or systems installed before 1999 but if part of a plumbing system is extensively repaired or renewed the new part of the installation should meet the Water Regulations.

5.3 CALCULATING PAYBACK PERIODS

Many people think it is too expensive to introduce water-saving measures. But it's important to calculate the **payback** (when something pays for itself) before you make a decision. It may be that you can save more money than you spend.

This can be done by using either a simple **payback method** of calculation or a **discounted cash flow (DCF) analysis**. The simple payback method of calculation can be best explained as the cost of implementing the project divided by the projected annual savings. This gives a payback in years.

Life cycle costing can also be used to calculate the costs associated with a project over its lifetime. This is then compared with the costs associated with the present approach.
An example of this type of calculation can be found in Appendix C.

6. Operational issues

This section looks at some of the operational issues involved in implementing a water-saving strategy. Many of the ideas in this section are simple and low cost but very effective.

6.1 USING A WATER MANAGEMENT CHECKLIST

You can use this water management checklist as the basis of your own water management action plan.

Water management checklist

- Map out the school water system checking for leaks, long pipe runs and un-lagged pipes. Arrange any modifications or maintenance needed.
- Check your water meter size to make sure it is not bigger than you need for your water usage.
- Monitor water consumption by reading the meter regularly. Act quickly if there is any increase, or if the meter stops working.
- Check for leaks by checking the water meter when water is not being used eg at night or at weekends. Consider installing one or more meters to identify consumption in certain areas, such as kitchens or swimming pools.
- Ensure that urinal cisterns flush at the minimum frequency required and consider installing control devices.
- Make regular checks of taps and repair any leaks. Consider fitting self-closing taps or spray heads.
- Encourage pupils to save water by using plugs in basins and turning off taps properly.
- Ensure that caretakers and at least one other member of staff, know how and where to shut off the water supply to different buildings or areas. It is important that they are instructed **never** to turn off supplies to fire mains.

We will look at some of these ideas in more detail next.

6.2 IDEAS FOR CONSERVING WATER

The next few pages list some of the many ways in which you can make sure your school is using water carefully and efficiently.

6.2.1 Taps

Leaking taps

Leaking taps can be repaired simply be replacing worn washers.

Self-closing taps

Taps left running can waste enormous amounts of water. Consider replacing conventional screw taps with percussion taps that close automatically after a preset period of between 1 and 30 seconds, virtually eliminating the possibility of taps leaking or being left running. Some models also have an adjustable flow rate restrictor which can be set to deliver a lower flow rate than conventional taps. Self-closing taps need to be inspected and maintained regularly.

Spray taps

Spray taps can save up to 50 per cent in water consumption although the slow rate of flow on hot water taps can mean a long wait for warm water resulting in minimal savings. Spray taps need to be inspected and maintained regularly to make sure there is no soap, grease or limescale blocking the spray head.

6.2.2 Toilets

Installing water dams and displacement devices in WCs

Installing water dams and displacement devices in WCs acts as a water displacement device and reduces the water consumption required for flushing. It is, however, important to ensure that there is sufficient water to remove all soils.

Installing reduced flush toilets

Replacing a nine-litre flush toilet with a dual flush toilet with three- and six-litre flushes can save up to half the water used for WC flushing. From 1 January 2001 a maximum flush volume of 6 litres came into force and non-syphonic systems are allowed.

Installing waterless and vacuum toilets

Waterless (composting) toilets compost the waste into a form that can safely be used as fertiliser. They range in size from a large box that fits in a bathroom to larger vaults installed in a basement.

Vacuum toilets are not currently cost effective or practical, although they can be economic for larger projects, where conventional gravity would be problematic.

Installing automatic flushing systems

Older schools that do not have any control devices on their urinal tanks could benefit considerably by installing cistern flush controllers. The Water Regulations include various conditions that you must comply with if you are installing automatic flushing systems.

Ball valves and overflows

Ball valves and overflows on WC cisterns should be checked regularly. You can install devices to reduce WC cistern volume but any reductions in volume depend on the WC pan design and should not be carried out at the expense of effective flushing.

6.2.3 Hot water supplies

Hot water taps and showers in schools can be a major source of wasted water particularly if pipes are too long and not lagged properly. A great deal of tepid water may be lost before the hot water comes through.

Where poorly lagged hot water pipes run close to drinking water taps the cold water will warm up and the user will waste water trying to get a cool drink. It is, therefore, important to keep runs of pipework short and to lag pipes properly.

It is worth considering installing small point-of-use water heaters, separate from the central hot water supply, at points which would otherwise require very long pipe runs. If you are installing this kind of water heater please note that you do not need to set the water temperature above 55°C in order to avoid Legionella risk – this is only applicable to stored water. If the water temperature is set high you should install a mixing valve to reduce the temperature to below 43°C.

6.2.4 Frost prevention

Adequate frost protection is vital to prevent burst pipes and leaks. Caretaking staff should always visit the school when frost is expected, especially during weekends and holidays.

Be especially careful to protect incoming cold water mains from frost. Cold water tanks should be insulated, pipework lagged and clustered together to reduce the risk of freezing. An outside thermostat set at 2°C should be used to start all heating and hot water pumps. An internal thermostat in a normally heated room should turn on the boilers and heating when the internal temperature falls below 5°C.

6.2.5 Swimming pools and playing fields

Swimming pools should not be drained and refilled more than necessary, although sufficient filter backwashing and dilution must be carried out for hygiene purposes. Discharges of swimming pool *water should qualify for a discount against normal effluent charges. You might also get a reduction in sewerage charges for water loss through pool evaporation.*

If you use a significant amount of water for watering playing fields you should arrange for the supply of this water to come from a separate meter so that you do not have to pay the normal sewerage charges.

Your water company will give you advice on using water for swimming pools and playing fields.

6.2.6 Water butts

Water butts collect rainwater from downpipes such as building guttering. It is worth considering installing water butts. In any one year, 3,600,000 litres of rain falls on to a typical primary school roof (4000 square metres)- enough to fill almost 19,000 water butts! Water butts usually cost around £25 to £35 each, but most water companies offer subsidised butts for sale.

You can capture rainfall all year round by placing a water butt by sheds, greenhouses and conservatories. Rainwater is better for your plants.

6.2.7 Mulch

If you apply organic mulch around plants and on borders you can conserve water by reducing surface evaporation and keeping down competition from weeds and other plants. Used tea leaves or tea bags make good mulch – roses in particular like cold tea.

On free draining soils mix in organic matter to improve water retention. On heavy soils, incorporate a mixture of organic matter and sharp sand or grit. This will open up the structure, improve water retention, and reduce the chances of clay soils cracking during a dry summer.

6.2.8 Lawns

Don't overwater lawns – it encourages surface rooting and susceptibility to drought damage. A good soaking once a week is better than daily light sprinkling; the latter will not penetrate the roots and will encourage fine roots to grow near the surface where they will perish as soon as the lawn dries out. Watering is best carried out first thing in the morning or in the cool of the evening.

The most efficient way to protect a lawn in dry periods is to adjust the height of the mower blades to 4cm to encourage dense growth that allows the morning dew to be trapped. Cut your lawn less frequently during dry weather and leave the cuttings on the lawn – it will return moisture and nutrients to the soil.

Lawns may turn brown during the summer but they will 'green' up over the wetter autumn or winter months.

6.2.9 Greywater and rainwater

One method of reducing the amount of mains water consumed is to use greywater or rainwater for certain applications.

Greywater is usually defined as all waste water from domestic (non-process) appliances and fittings except waste water from WCs and bidets. It includes the discharges of waste water from kitchen sinks, washroom basins, baths, showers, washing machines and dishwashers. Occasionally greywater is defined as not including wastewater from sources such as kitchen sinks.

Using greywater or rainwater represents a considerable water-saving opportunity. For example, if you could collect enough greywater or rainwater you could supply the total demand for toilet flushing at your school, reducing mains water consumption by up to 35 per cent. However, in a school very little greywater is produced in comparison to the demand for toilet flushing so it will be important to carry out an audit of the amount of greywater produced before you make any decisions.

Potential problems

The main concern people have when considering using greywater and rainwater is the potential risk to human health because of the possible presence of pathogenic microorganisms. There is generally a lower risk of this when rainwater rather than greywater is used. This is because rainwater does not generally come into contact with humans before it is used and so there is less chance that it will contain human pathogens, but some degree of contamination can still occur. To overcome this problem treatment before use may be necessary and many greywater systems incorporate a water treatment process.

The actual epidemiological risk to health posed by the use of greywater and rainwater depends on the degree to which the water is contaminated, and the degree of human exposure to the water. Where there is little or no human contact with the water, it may be safe to omit treatment.

Another possible problem is the impact on plumbing systems and associated equipment, and on the external environment as a whole. There are four areas of concern for plumbing systems:

- the possibility of increased growth of microorganisms (closely linked to health and hygiene concerns)
- corrosion of metals
- scaling
- fouling or sedimentation.

The potential for damage to the environment or to plumbing systems depends on a wide range of factors and there may even be a range of beneficial effects. For example, rainwater may produce fewer problems in plumbing systems in hard water areas than the public supply, as it contains a lower concentration of scale-forming minerals. Greywater may be beneficial for certain types of plants as some of the constituents, such as phosphates, act as fertilisers.

Further information about using greywater and rainwater can be found at **http://www.fwr.org/waterq/dwi0779.htm** and on the Research Database on Water Conservation at **http://www.databases.dtlr.gov.uk/water/index.asp**.

6.2.10 WATER PIPES

It is important to know who is responsible for the water pipes servicing your school. The part of the service pipe from the water main to the boundary of the school is called the communication pipe and it belongs to the water company. The part from the boundary into the school is called the supply pipe and it belongs to the school.

There is normally a stop tap at the boundary between the water company part of the service pipe and the school. This is located in a small chamber with a lid at surface level. If you have an external water meter it will be located in this chamber.

It is your responsibility to detect leaks in any pipes although any overpayments made to the water company as a consequence of leaks in the supply pipe can sometimes be reclaimed. There have been some very large repayments where leaks have gone undetected for months or even years.

The Environment Agency (EA)

The Environment Agency (EA) is the leading public agency for protecting and enhancing the environment for England and Wales. This includes a duty to secure the proper use of water resources. For further information on water efficiency, visit **http://www.environment-agency.gov.uk**.

7. Curriculum opportunities

This section looks at some of the many ways in which you can incorporate water-saving activities into the curriculum. By building on children's enthusiasm for green issues you can encourage an informed awareness of water conservation. By involving pupils directly you can use the school as a living laboratory and bring water conservation issues to life.

Water conservation issues can be taught through a range of National Curriculum subjects including:

- science
- technology
- mathematics
- history
- geography
- citizenship
- English.

You can also cover water conservation issues in non-statutory studies such as economic and industrial understanding, and health education.

Putting water conservation on the agenda of staff meetings keeps staff informed and provides a forum for views and ideas. All staff should attend an introductory course on water conservation and be given support and encouragement. Others may need more detailed training.

A good web site for pupils is **http://www.dcs.ac.uk/water/contents.htm**. You can also find curriculum materials on a website produced by the water industry at **http://www.waterintheschool.org.uk**.

Here are some ideas for activities in school on the theme of water conservation.

7.1 KEY STAGE 1 ACTIVITIES

- Count how many taps there are around the school. Where does the water go from the sink? Find the drains. How many are there?
- Investigate plant growth with and without water.
- Observe and describe water and ice. Look at steam from warm water.
- Investigate things that float and things that sink. Can you make a sinker into a floater?
- What do we use water for? What do you think it was like before we had taps and toilets in our homes?
- Discuss the importance of water for washing and cleaning teeth.
- Visit a local stream, river, pond, lake, reservoir, or beach if possible.
- Listen to recordings of different water sounds eg rain falling, splashing in puddles, running water from a tap, water boiling, the sea, and underwater sounds.

7.2 KEY STAGE 2 ACTIVITIES

- Estimate the amount of water used in school. Take meter readings to compare the estimate with actual usage.
- Estimate, then measure and calculate the amount of water produced from a dripping tap. Do this for one hour, one day, one week or one year.
- Estimate and measure the length of pipe lagging needed to insulate the hot water pipes.
- Measure and record at intervals the temperature of water from a hot water tap. Do you get the same results from all hot water taps?
- Plot a graph of weekly water consumption readings – explain any sudden increases or decreases.
- Compare water use in your school with national benchmarks. Further details can be found at **http://www.watermark.gov.uk**.
- Measure and record root growth of a plant. Observe and compare the root systems of different plants.
- Design an investigation to find out if plants produce water.
- Research how plants and animals have adapted to survive in extreme wet or dry climates.
- Design and produce a picture book telling the story of a water droplet, to illustrate the water cycle for younger children.
- Observe, measure and record changes in water as it is heated.
- Compare different samples of water e.g. coloured water and water with floating debris, soil or sand.
- Write a profile of an engineer or scientist who has contributed to the advancement of water use or availability.

- Write a letter to the local newspaper about the condition of a local river or beach (if polluted or at risk).
- Contact a local conservation group to find out about their work to improve a wetlands, river or lake.
- Compare how different artists have represented images of water.
- Listen and respond to music that represents water.
- Compose and perform a group piece of music to represent before, during and after a storm.
- Design and make a leaflet or poster informing others of the health benefits of drinking plenty of water.

7.3 LITERACY ACTIVITIES

Writing styles

Persuasive argument

Write an argument for introducing water-saving devices and behaviour to save money and/or to protect the environment.

Procedural

Explain to an audience the process water goes through before reaching the school/our homes.

Discussion

Discuss the arguments for and against using greywater or rainwater in school.

Report

Write a report on the findings of a school water survey and any subsequent action taken.

Comparative reports

Write a report outlining water consumption before and after an awareness raising campaign.

Explanation

Write an explanation of the water cycle.

Recount

Recount a visit to an eco home or water treatment plant.

WaterLiterate

WaterLiterate is produced by Wateraid as a resource for Key Stage 2, particularly Years 4 or 5 Term 3 pupils. It is designed to raise issues and introduce the use of persuasive language through reading and writing. WaterLiterate provides a topical and international perspective, its source material is recent, and it deals with the kind of real issues facing millions in the world. For more details go to **http://www.wateraid.org.uk/education/index.html.**

7.4 NUMERACY ACTIVITIES

Recording water use

Pupils can act as energy monitors, taking meter readings. Meter readings can provide a range of curriculum opportunities but make sure that meters are read correctly.

It is best if pupils can take readings themselves but be aware of health and safety issues if the meters are located in inaccessible or dangerous locations. If they are, caretaking staff may need to take the meter readings or at least ensure safe access to the meter enclosure.

Water meters should be read at the same time each day or each week. On Fridays at the end of school activities is a good time. A second check first thing on Monday morning gives weekend consumption.

Analysing water use

Monitoring patterns of consumption is a simple way of introducing the use of graphs into the curriculum. Pupils can collect their own meter readings (see above) and create their own spreadsheets.

Pupils can:

- Compare patterns of use. Today's pattern of energy use should be very similar to the same time last year and not that different from yesterday. You can also look at data for the school week, the weekend, the month, term or school year Differences, more or less, can be investigated.
- Determine the general trend in water consumption – this term/year – up or down?
- Try to relate changes in water use to changes in weather, occupancy, community use or other factors.
- Benchmark consumption by working out the floor area of the school or the total number of people on the site.
- Estimate progress towards your water-saving objectives.

Collecting rainwater

Pupils can work out how much rainwater can be collected from your school roof by calculating the area of the roof in metres and multiplying this by the annual rainfall in millimetres for your area. This will give them the total volume of water in litres per year. They then need to deduct 30 per cent from this figure to allow for evaporation to give them the final figure.

Pupils can also calculate the potential rainfall collection from collectors of different sizes. The annual rainfall in your area can be found at **http://www.weather.co.uk**.

WaterNumerate

WaterNumerate is produced by Wateraid as a resource for Years 6 or 7 to support the teaching of numeracy. It provides three weeks of planned lessons on data handling and percentages for the post-SATs summer term. The teacher's booklet and three large colour posters offer the opportunity to analyse the positive impacts of a well scheme on a Nepalese hill village and on the life of one 13 year-old girl in particular. Other activities explore the global dimension of resource access and consumption. For more details go to **http://www.wateraid.org.uk/education/index.html**.

7.5 THE ECO-SCHOOLS SCHEME

This scheme can offer schools:

- an opportunity to make environmental issues from the curriculum influence the life of the school and its impact on the environment
- an opportunity to help develop children's decision making skills
- curriculum materials and ideas for projects and events
- access to a network of support agencies.
- links with other schools in the UK and Europe
- a prestigious award
- opportunities for local and national publicity
- potential for financial savings.

To be successful the programme requires:

- the support of the headteacher and governors
- a willingness to involve children in decision making and action at every stage
- active involvement of staff
- a willingness to take action to investigate long-term change.

There are four stages in the scheme:

Stage 1: registration

Stage 2: implementing the Eco Schools programme

Stage 3: applying for an award

Stage 4: award renewal.

You might also like to look at these websites for other ideas:

http://www.tidybritain.org.uk

http://www.encams.org/pages/water/water_pub.as

	Energy policy	Organising for energy efficiency	Education	Information and collection	Communication	Investing in energy efficiency
4	Senior management are committed to energy policy and action plan with regular review as part of environmental strategy.	Energy management fully integrated into management structure. Clear delegation of responsibility for energy consumption.	Full involvement of students in the management of energy in the school to a level appropriate to their age.	Comprehensive system setting targets, monitoring consumption, identifying faults, quantifying savings and providing budget tracking.	Formal and informal channels of communication regularly exploited by energy co-ordinator, students and school management team.	Positive discrimination in favor of green schemes with investment appraisal of all new build and refurbishment opportunities.
3	Formal energy policy but only low level commitment from senior management.	Energy co-ordinator accountable to senior management and governors.	Co-ordinated approach to energy efficiency education linked to the school energy policy.	Monitoring and tracking reports for premises and major users where possible. Savings not reported effectively to users.	Programme of energy awareness, including regular publicity campaigns aimed at all users of the building.	Same payback criteria employed as for all other investments.
2	Unadopted energy policy set by senior management.	Energy co-ordinator in post but line management and authority are unclear.	Some identification of opportunities for using the school to teach about energy efficiency.	Monitoring and targeting reports based on actual meter readings. Analysis of trends and input into budget setting.	Some ad hoc awareness training for all users of the building.	Investments using short term payback criteria only.
1	An unwritten set of guidelines.	Energy management responsibilities have been identified but are not co-ordinated.	Unco-ordinated delivery of energy efficiency education in the school.	Annual cost reporting based on fuel bill data with some analysis of yearly trends.	Informal contacts used to communicate school energy performance and plans for improvement.	Only low cost measures taken.
0	No explicit policy.	No energy management or formal delegation of responsibility for energy consumption.	No known teaching of energy efficiency.	Meter readings not recorded and bills not analysed.	No communication of school energy performance.	No investment in increasing energy efficiency of the premises.

Appendix A1 – Benchmarking

Benchmarking is a way of comparing a school's consumption with established indicators for the type of building. These performance indicators (PI) are expressed in terms of annual consumption divided by the floor area or the number of pupils – for example, kWh/m^2 per year for energy and m3/pupil for water usage.

Energy consumption benchmarking

Electricity consumption should be kept separate from fossil fuel consumption because of its different cost and environmental impact.

Electricity PI

£/m^2 – cost (monthly for trend analysis or annual) divided by floor area of school

kWh/m^2 – consumption of electricity divided by floor area of school

Gas PI

£/m^2 – cost (monthly for trend analysis or annual) divided by floor area of school

kWh/m^2 – consumption of gas divided by floor area of school

Carbon PI

KgC/m^2 – production of carbon dioxide associated with energy consumption divided by floor area of school

The following benchmarks have been calculated by BRECSU from the energy records of over 2,000 schools across the UK.

	£/Pupil (Regional Ave.)		kWh/ Pupil		kgC/ Pupil		£/m²		kWh/m²		kgC/m²	
	L-M	M-H	L-M	M-H	L-M	M-H	L-M	M-H	L-M	M-H	L-M	M-H
Primary Schools												
Fossil Fuel	13	42	808	1631	44	90	1.3	2.2	129	227	7	12
Electricity			136	247	19	35	1.7	3	21	41	3	6
Secondary Schools												
Fossil Fuel	21	51	1177	2187	65	119	1.3	1.8	135	222	7	12
Electricity			223	348	32	49	1.7	2.5	24	37	3	5
Key	L-M	Low to Medium										
	M-H	Medium to High										

If consumption is very different from the average performance indicator there may be exceptional reasons to do with either the building or with the weather conditions. For example, it may have been an exceptionally cold winter (increasing consumption) or the school building may have been unoccupied (reducing consumption). It is best to treat the results as a broad indication of performance rather than an absolute assessment.

Water consumption benchmarking

For water consumption benchmarking you will need the following information:

- floor area of school
- number of pupils at school
- standing charges for electricity/gas/water
- monthly consumption/charge for electricity/gas/water.

Calculate the performance indicators as follows.

- £/pupil – cost (monthly for trend analysis or annual) divided by number of pupils at school
- m^3/pupil – water consumption divided by number of pupils at school.

It is often useful to plot performance indicators on bar graphs or box and whisker plots, especially where determining potential trends.

	Poor performance	Median	Good performance
Primary schools			
Consumption/pupil (m^3/pupil)	4.73	3.99	2.86
Consumption/unit floor area (m^3/m^2)	0.77	0.68	0.52
Secondary schools			
Consumption/pupil (m^3/pupil)	5.44	4.6	3.65
Consumption/unit floor area (m^3/m^2)	0.53	0.53	0.35

Appendix A2 – No and low cost measures

Lighting

- Switch off lights if daylight is sufficient.
- Switch on lights needed only for tasks in hand.
- Make sure blinds and furniture do not prevent maximum use of daylight.
- Use only local task lighting if possible.
- Switch off lights when leaving room for more than ten minutes and at the end of the day.
- Use reduced lighting levels for cleaning, night-time and security staff.
- Switch off exterior security lighting during daylight hours.

Hot water

- Turn off taps.
- Check for and report leaking or dripping taps.
- Report if water temperature in taps is excessive.
- Turn off electric water heaters when they are not required.

Cold water

- Turn off taps.
- Check for and report leaking or dripping taps.
- Check frequency of urinal flushing.
- Check for leaks by checking the water meter when water is not being used (eg weekends).

Office equipment

- Switch off electrical appliances, including computers, printers and photocopiers, when not in use.
- Do not use high energy consuming equipment during daily maximum demand period for electricity, unless it is essential to meet operational needs (check tariff arrangements).

Space heating

- Check that room thermostats are set to temperatures consistent with comfort.
- Check heating controls (eg thermostatic radiator valves) are at the correct setting.
- Do not use portable electric heaters (except as a last resort).
- Do not place obstructions in front of radiators or heaters.
- Switch off non-automatic extract fans when the room is unoccupied.
- Close blinds or curtains at the end of daylight.
- Turn off non-automatic heating when the room is unoccupied.
- Report faulty door closers and window catches and draughtstripping.
- Report if the room suffers from under- or over-heating.

Boiler room plant

- Check that controls are labelled to indicate function, and are set correctly.
- Check that optimum start/stop controls and weather compensation controls are set and work correctly.
- Check that boiler sequencing controls are set correctly.
- Ensure timer switches are set to minimum periods consistent with requirements.
- Make sure fans and pumps run only when required.

Swimming pools

- Cover swimming pool when pool is not in use – eg lunch times, and after hours – to save both water and energy (pool covers on external pools can save 80% of energy costs).
- Check the water temperature is correct (not above 27°C).

Temporary classrooms

- Temporary classrooms can often be high users of energy due to their poor insulation, large areas of glazing and use of electric heating. Has the use of temporary classrooms been minimised where possible and proper replacements planned?
- Has heating been switched off when not in use?
- Investigate the cost of installing occupancy sensors to the electric heaters, with night setback temperatures.

Other

- Recommission optimiser and heating controls.
- Check that boiler air/fuel ratio is correct (as part of regular maintenance).
- Fit boiler sequence controls.
- Repair leaks on distribution mains.
- Reduce use of supplementary electric heaters.
- Install, repair or replace thermostats.
- Insulate domestic hot water cylinders.
- Provide additional heating controls for individual heaters.
- Reset domestic hot water thermostats and time switches and make them tamperproof.
- Fit reflective foil behind radiators.
- Replace tungsten lighting with compact fluorescent lamps.

Appendix B – Energy costs

Electricity

Larger commercial premises (over 100kW) are usually offered individual contract terms through the utility companies and as a consequence the price of electricity will vary between individual premises.

Small and medium sized businesses (included within will be a substantial number of schools) are usually able to secure one of the following three tariff types:

- Single rate tariff.
- Economy 7 tariff.
- Weekend tariff.

Tariff rates vary according to location and electricity supplier. They are currently about 6p/kWh for the single rate tariff and £40 per annum for the standing charge.

Gas

Larger commercial premises (over 2500 therms) are usually offered individual contract terms through the utility companies and as a consequence the price of gas will vary between individual premises.

Similarly as for electricity various suppliers offer gas and the price varies according to the specific site and supplier.

Appendix C – Simple payback calculation example

Project	Cost (£)	Savings (£/year)	Payback Period (years)
PROJECT 1	100	20	= 100/20 = 5
PROJECT 2	1000	100	= 1000/100 = 10

DCF calculations are usually done to compare project options over the life cycle of the asset which can be 60 years in the case of a building. The project with the highest net present value is the one which is the best value for money.

LIFE CYCLE COSTING

Life cycle costing involves discounted cash flow analysis. The net present value of recurrent costs such as energy costs and maintenance costs over the lifetime of the equipment are added to the initial capital costs and any discounted future capital costs or receipts.

For example,

Capital cost equipment A =	£100,000
Discounted Energy costs over equipment A lifetime =	£100,000
Total costs over lifetime =	**£200,000**

Capital cost equipment B =	£75,000
Discounted Energy costs over equipment B lifetime =	£150,000
Total costs over lifetime =	**£225,000**

Consequently, Equipment A is £25,000 cheaper over its lifetime to buy and operate, despite its higher capital costs, than equipment B.

Appendix D – Case studies

Pellet fired heating

Introduction:

A heating company has installed a 150kW heating system at a school in Staffordshire, fuelled by wood pellets. The system produces hot water to heat the school's dormitories and schoolhouse.

Key Success Points:

A novel form of renewable fuel successfully harnessed. A public facility takes up 'green' energy.

Detail:

The pellets provided are deposited in a bunker storage system. The hydraulic lid on top of the container allows the loading of the pellets into the bunker. The fuel is then fed into the combustion zone, on demand, through sensitive temperature controllers and the boiler is heated to provide 120°C medium-pressure hot water. As the pellets have free-flowing properties feeding is carried out using a simple screw auger, with an air-locked rotary valve for safety. The system is connected into the school's existing pipework system, heating radiators and providing domestic hot water. Being containerised, no mechanical components are exposed, ensuring the safety of the school children, and that the equipment is protected from the elements. The conversion to pellet-firing was supported by the DTI New and Renewable Energy Programme.

Wood fuel heating

Introduction:

A school in Herefordshire is helping to raise the profile and promote the credibility of wood as a fuel with its 350kW wood-fired boiler demonstration project. With the twin objectives of assisting sustainable development and stimulating rural employment, and working with the Rural Development Commission (RDC) and the Department of Environment, Food and Rural Affairs (DEFRA), the then Hereford and Worcester County Council established the new primary school as a demonstration scheme incorporating a heating system fuelled by locally grown wood, high standards of energy efficiency and local building materials, wherever feasible. The heat produced by the boiler is also used by the adjoining secondary school.

Details:

The wood fuel system was installed in the winter of 1997. A 350kW wood-fired boiler meets the primary school's baseload heating needs, as well as those of the secondary school on the adjoining site. An oil-fired system sited in the secondary school provides back up, eg when the wood-fired system is undergoing maintenance. As well as meeting the need for heat, the system will play an important educational role in terms of helping the children to understand energy issues. The school is supplied with 150-300 tonnes of locally-grown dry wood chips a year. These chips are derived from woodland thinnings and from willow and poplar short rotation forestry crops. On arrival at the school, the chips are stored in a concrete silo built to receive the twice-weekly deliveries. Pushrods in the silo move the chips to the screws, which take them up to the stoker, which in turn moves them to the burner head for combustion. The gases produced pass through the hot water boiler, and pumps move the heated water from the boiler to the school's underfloor heating system. Exhaust gases are cleaned prior to emission into the atmosphere via a low-level chimney. The small amount of ash produced by combustion and by the exhaust gas cleaning process is collected in an ash bin prior to use as fertiliser on the school garden. During the first year of operation it is estimated that heat from wood burning saved 78.5 tonnes of CO_2 emissions to the atmosphere. The boiler produces no smoke and the exhaust is totally clear. It is considered that the wood supply process has generated the equivalent of one full-time job. The benefits of promoting a trend towards wood fuel in the education sector would be environmental (wood is a carbon-neutral fuel) as well as economic (utilising a locally produced resource helps stimulate local jobs etc). The cost of fossil fuels is expected to rise, whilst wood fuel is likely to fall, resulting in future energy cost savings.

Key Success Point:

Due to the environmentally responsible design, there is a substantial reduction in CO_2 emissions to the atmosphere. This is also a demonstration project with potential for replication.

First wind turbine installation at a primary school.

Introduction:

The first wind turbine to be installed at a school site in mainland Britain has been established at in County Durham

Details:

An Atlantic Orient Corporation 15/50-type wind turbine produces an average of 270kWh/day, which is approximately twice the school's electricity requirement. The surplus energy is exported to the Grid via an import/export meter. A County Council and an Electric plc jointly funded the project. The children at the school have designed an interactive display panel with information from the turbine. The school now plans to develop an environmental centre within its grounds – it has already won the Tetra Pak Award for Environmental Work.

Key Success Point:

An on-site wind turbine is meeting a school's electricity needs.

District Council: "A Green Authority"

Introduction:

This district council is a market town of 20,000 inhabitants based in a valley within the Cotswolds Hills. The local authority has a low total electricity demand of 3,638,692 kWh per annum of which 554,513 kWh is used by civic offices.

Project Profile:

The District Council published an environmental strategy in 1995, which outlined the desirability of using renewable energy sources. This document led the regional electricity company to offer the council green electricity supplied at a slight premium for its main council offices. The following year, with the opening of the market to 100kW sites, the council put out a call for tender for the councils offices, which they stated would give priority to electricity from renewable energy sources.

Approach & Outcomes:

The cheapest response to the tender from all sources came from the Renewable Energy Company, a locally based electricity trading company. The Renewable Energy Company (RECo) offers a product called "Ecotricity", which is derived from sources that are less polluting and more sustainable than those used to generate conventional 'brown' electricity.

The technologies supported by The RECo include wind power, hydro power, solar power, landfill gas and sewage gas. They generally only offer electricity that is fed into the local distribution network, avoiding the cost of long distance transport in the high tension grid. They proposed that the council use electricity generated by local renewable sources. A major part of the electricity purchased comes from a wind turbine situated at Nympsfield, only 15 km from the council offices and the rest comes from a landfill gas site in the neighbourhood.

Lessons Learnt:

The existence of an environmental strategy referring to the desirability of renewable energy facilitated both the council's acceptance of green electricity at a premium, and the initial proposal of supply from the electricity supplier.

The internal and external support generated by the supply of green electricity to the offices has developed a considerable interest in renewable energy. This support can then be used to encourage the development of local renewable energy schemes such as; the production of hydro-electricity from the old water. Furthermore, a proposal has also been made for a renewable energy park in the town, which would be supported in principle by a small grant from the council.

Appendix G – Case studies

A County Council: Green Energy for the Shire Hall Complex

Introduction:

This County Council has a commitment to environment sustainability. This commitment is supported by the "Environmental Protection and the Conservation of Energy and Water in Council Premises Policy" passed by the Property Committee in May 1999. To achieve this policy the council has pledged to contribute to a 30% reduction in CO_2 emissions caused by council activities by 2005, to monitor and appraise the market for fuel so as to obtain the best competitive prices, and to purchase energy from renewable sources so far as practical and economically acceptable.

Project Profile:

In order to meet the councils commitment to purchasing energy from renewable resources and reducing CO_2 by 30% by 2005, the council planned to purchase enough "green electricity" for its main offices at the Shire Hall Complex. The Shire Hall's electricity demand is approximately 2,900,000 kWh, which represents 10% of the councils total electricity consumption.

Approach & Outcomes:

The tender for supply was advertised in OJ and also sent to all UK licensed second tier electricity suppliers on the list supplied by OFGEM. The technical information for the tender was collated from three meters installed at the site, which covered the main offices, crown courts and the Quayside House and Quayprint Buildings.

The tender advised bidders that their bids would be evaluated on cost, quality and the levels of CO_2 emissions associated with their supply of electricity.

The successful tender was the lowest in cost and contained an offer of 100% renewable generation for the entire Shire Hall site, which was generated by two major landfill sites.

Lessons Learnt:

The pledge to reduce CO_2 emissions and purchase renewable energy included a commitment to pay a small premium for green energy, which proved invaluable when purchasing power at a premium.

The contractor was able to identify and monitor its sources of renewable energy, where as some suppliers noted that they had no way of identifying the source of green power since it was purchased via the electricity pool. Furthermore, the contractor offered the council a local source of power with the benefits of local employment and favourable local publicity.

The procurement of "green electricity" has generated a large amount of interest in the tendering process used by the council, from other organisations.

Appendix H – Replacing tungsten lamps

Assuming that the lights are on for 6 hours per day for 200 days a year that means each lamp is on for 1,200 hours a year. If each lamp is rated at 75 Watts, this results in an annual electricity consumption of 90 kWh per lamp. This is an annual electricity consumption of 9,000 kWh for all 100 lamps. In the 8 year period this makes a total consumption of 72,000 kWh.

Using compact fluorescent lamps, which may last for 8 years, with a rating of 25 Watts the electricity consumption associated with each lamp is 30 kWh. This is an annual electricity consumption of 3,000 kWh for all 100 lamps. In the 8-year period this makes a total consumption of 24,000 kWh.

If you buy 100 tungsten filament lamps at 50 pence each this would cost £50. If you replace them every year this would cost £400 over 8 years. The cost of 100 compact fluorescent lamps is approximately £600.

The total running costs, therefore, of the tungsten filament lamps is:
£400 + (£0.07 *72000) = £5,440.

The total running costs of the compact fluorescent lamps is:
£600 + (£0.07*24000) = £2,280
(Assuming electricity costs are 7 pence per unit)

The cost savings over 8 years are:
£5,440 – £2,280 = £3,160

This an annual saving of (£3,160 divided by 8 years) £395.

Appendix J – Energy audit walk-round

The aim of the walk-round is to provide a systematic visual inspection of each room and circulation area. You can do most or all of the walk-round yourselves although you may wish to use a specialist consultant or local education authority advisor for the Plant Room.

- Are lamps, light fittings and reflectors clean so as to maximise light output?
- Are light-coloured walls and ceilings cleaned regularly to maximise reflected light?
- Have 38mm fluorescent tubes been replaced with higher efficiency 26mm tubes, where possible? Have starters been replaced?
- Have tungsten bulbs been replaced with more efficient compact fluorescent lamps?
- Have both sides of windows and roof lights been cleaned to maximise available daylight?
- Are there are enough switches to avoid lighting up large areas when only small areas are in use?
- Has task lighting been introduced where required? (Task lighting is, for example, the use of one energy efficient desk lamp instead of turning on all the lights in a room.)
- Have overall lighting levels been reduced where required? eg avoiding excessive lighting in circulation areas.
- Are automatic controls such as timers and daylight sensors working correctly?
- Are occupancy sensors installed in areas of intermittent use?
- Does external lighting use high-efficiency sources?
- Have all light fittings been fitted with reminder switch off stickers?
- Are all computers, photocopiers, and other standby machines switched off at source after normal working hours?
- Have signs been installed in the computer room to remind users to turn off machines that are not in use?

- What is the hot tap water temperature? Is it excessively high for health and safety purposes, producing a scalding hazard and wasting energy?
- Are localised hot water generators installed, to avoid long pipe runs?
- What temperature are the room thermostats set at? They can be reduced to 19°C for classrooms and offices and 15°C for the gymnasium?
- Have thermostats had a six-monthly calibration check to ensure that the thermostats are working correctly?
- Is the heating sensor operating correctly and located in an area that is free from draughts?
- Are thermostatic radiator valves set at the correct level and operating correctly?
- Are all air filters in fan convector heaters clean? Are the fans operating correctly?
- Are time and temperature settings of electric panel and storage heaters correct?
- Is airflow unobstructed from radiator surfaces, grilles and vents?
- Are all motorised valves and dampers open and closing without sticking?
- When were heating controls last calibrated?
- Has the pipework been lagged?
- Are boilers sequenced? (Or do they all run all the time?)
- Are valves lagged or fitted with insulated jackets?
- Is there an outside temperature sensor and is it connected to the heating control system?
- Are pumps running freely? (Are there any deposits around the glands?)
- Are hot water storage tanks fully insulated?
- Is water storage temperature correct?
- Is the timer set correctly for the time of year (and for the correct number of days)?
- Can the heating be zoned?
- Are plant controls delivering heating only where and when required?
- Are boiler combustion efficiency and flue gas temperatures checked at six-monthly intervals as part of a maintenance programme?
- Is there smoke coming out of the flue of the oil fired burner? (If yes, the fuel efficiency needs to be checked.)
- Have ceilings been insulated to best practice standards to minimise heat loss?
- Is the draughtstripping around doors and windows in a satisfactory condition?
- Have self-closers been fitted to external doors? Do they function properly?
- On 1960s style buildings where glazing panels run from the ceiling to the floor have the lower portions had insulated panels installed to reduce heat loss?

In situations where catering services are contracted out, the catering areas should be on separate water and energy meters where possible. This will ensure that the catering division adheres to the school's energy and water management policy. Regular maintenance is a prerequisite to controlling energy costs. This can be achieved by confirming the following:

- Have you replaced filters for equipment and air conditioning units at the manufacturer's recommended intervals to ensure unobstructed airflow?
- Have you ensured regular cleaning of extract duct grease filters?
- Do you check plant operation and controls regularly?
- Have you checked refrigeration temperature levels?
- Do you clean and straighten cooling evaporator and condenser fins?
- Have you checked the condition of the fridge freezer seals?
- Are the fridges and freezers properly defrosted?
- Is food served as soon as it is cooked to minimise the energy required to keep food hot?
- Have you considered point-of-use for the hot water supply if the kitchen is a long distance from the hot water source?
- Do you use low-energy fridges and freezers?
- Do the steamers and fryers have good temperature controls with a high degree of insulation?
- Are the ovens and dishwashers well insulated?
- Are the dishwashers low water use?

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