

A whole school approach

Involving the school community
in reducing its carbon footprint



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Reducing energy use has many advantages for schools – it saves money, reduces carbon emissions (helping to combat climate change), improves the learning environment and can enhance a school's reputation.

To be really effective, the whole school must be involved in energy saving. This guide outlines an approach to energy management which involves pupils, teachers and other staff. By motivating staff and pupils through lessons, as well as providing practical advice on how to go about saving energy, a whole school approach to energy management can reduce the school's carbon footprint and provide long-term benefits for the school, its people and the environment.



Introduction

Managing and reducing energy use can have significant benefits for a school and everyone in the school community can contribute to making savings. From pupils, teachers, governors, caretakers and administrative staff to cleaners, catering staff, parents and even those hiring the premises, all have an impact on energy use and should therefore be encouraged to play their part.



Cost savings from reducing energy use can be reinvested in other aspects of the school (or further energy saving projects); however, they are not the only benefit to saving energy. Energy saving reduces carbon emissions which helps combat climate change. The whole school approach recognises that schools are uniquely placed to take advantage of the strong links between staff, pupils, parents and the wider community. Engaging pupils in saving energy at school is an excellent opportunity to translate global concerns into local action. It helps educate children about climate change, its causes (including carbon emissions) and how to tackle it; it raises awareness of the stewardship of finite resources which can be taken home and on into future workplaces.

By following the straightforward approach in this guide, your school could save money and energy whilst reducing environmental impact. Annually, it should be possible for UK schools to cut costs by around £20 million and reduce 300,000 tonnes of CO₂¹ emissions through improved energy management.

This publication focuses on low-cost measures, motivating people to change and to become more energy efficient and is the companion guide to the Carbon Trust's Schools sector overview (CTV019) which outlines the key carbon saving opportunities to be found in the majority of schools. Coupled with a robust energy management plan, it is possible for every school to save energy and reduce its carbon footprint.

For the whole school approach to be successful it must:

- Recognise that everyone has a valuable contribution to make
- Encourage the school community to work together to achieve maximum results
- Empower pupils to be proactive in promoting the wise use of energy — not just under teachers' instruction
- Enthuse parents, pupils, the board of governors and senior staff by providing roles and activities applicable to them.

¹ www.dfes.gov.uk/valueformoney/docs/VFM_Document_84.pdf

The benefits of energy management

Saving money

Energy is not a fixed overhead – it can be managed and costs can be reduced. By saving energy, more funds can become available for other school resources and facilities.

Improvement of environmental performance

Carbon dioxide (CO₂) is emitted to the atmosphere whenever heat and electricity are used. Saving energy decreases these emissions, helping to minimise climate change.

Improvement of comfort conditions

Reducing carbon emissions through improving energy efficiency can enhance working conditions and comfort levels for staff and pupils, for example, by the elimination of draughts or overheating. This, in turn, can increase morale and pupils' productivity.

Reduction of other costs

Saving energy often reduces maintenance costs. Equipment lasts longer if it is operated efficiently, allowing capital replacement costs to be deferred.

Education opportunities

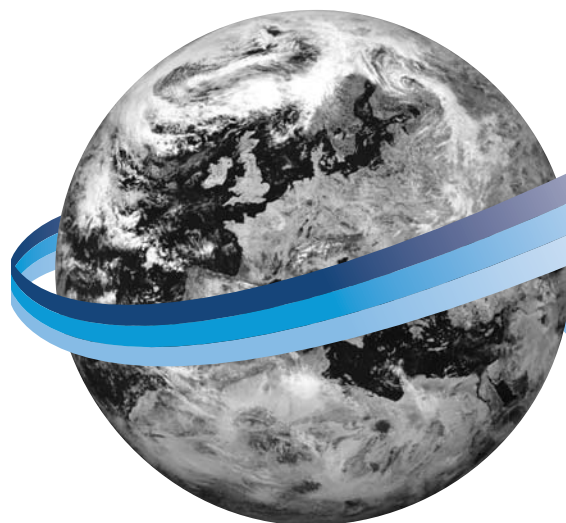
School provides an excellent opportunity for pupils to be involved in responsible use of energy and water, helping them to understand how everyday actions impact on the environment. It provides practical, hands-on experience and gives an insight into the goals of sustainable development.

Did you know?

UK schools release up to four million tonnes of CO₂ a year, at least 300,000 tonnes of which could be saved through effective energy management. Just one tonne of CO₂ would fill six double-decker buses.

Calculate your school's carbon footprint

Use the calculator tool at www.carbontrust.co.uk/footprintcalculator



Appoint an energy team

Appointing an energy team will make it easier to identify problems and encourage a sense of ownership for the solutions, which should improve the potential for savings.

Why have an energy team?

It is unlikely that your school will have a single individual with all the necessary time and skills to effectively manage energy use. It is therefore a good idea to appoint a team of people with some understanding of the school's energy services/heating system to share responsibility. Team members should be assigned duties that complement their skills and experience and take a leading role in designing and implementing a carbon saving programme.

Who should be on the team?

In primary schools, a small team could comprise the headteacher, caretaker and bursar/administrator.

Secondary schools might have a larger team involving the headteacher or deputy, caretaker, bursar/administrator, teaching staff, school governor and a representative pupil.

It is important to get a team with a mix of skills and responsibilities. The table opposite gives some ideas about how to assign roles in the energy team. In areas where there is insufficient expertise within the school, your local authority's Energy Manager should be able to advise.

Invite input from the whole school

Involving the school community in addition to those in the energy team will help to get everyone on-board with energy saving. This will particularly give people the opportunity to:

- Report problems and suggest how energy might be used more effectively
- Find out what actions are being considered or have already been carried out
- Discuss what actions can and cannot be undertaken
- Contribute to the formulation of the policy
- Participate in devising and implementing the action plan
- Take part in the periodic review of progress.



KILOWATTHOURS

Table 1 Roles and responsibilities

Who can do what?	Headteacher/ Deputy	Teacher	Governor	LA Energy Manager	Pupil	Bursar Administrator	Caretaker Site Manager	Energy Coordinator
Actions								
Essential								
Policy and planning	✓✓	✓	✓			✓		✓
Identify responsibilities/energy team	✓✓							
Leading role in whole school approach	✓	✓✓						
Identify curriculum opportunities		✓✓						✓
Raise awareness of staff and pupils	✓	✓			✓	✓	✓	✓✓
Active participation in no-cost measures		✓			✓✓	✓	✓	✓
Read meters regularly							✓✓	✓
Record/analyse/monitor energy consumption					✓	✓		✓✓
Identify areas of avoidable waste		✓		✓	✓	✓	✓✓	✓
Review progress towards targets and benchmarks	✓		✓			✓	✓	✓✓
Desirable								
Conduct energy walk rounds	✓	✓		✓	✓	✓	✓	✓✓
Advise on technical measures				✓✓			✓	✓
Advise on energy purchasing				✓✓				
Identify all energy-using systems/equipment					✓		✓✓	✓
Identify controls, timers, set points							✓✓	✓✓
Maintain energy-using equipment							✓✓	
Sanction appropriate investment	✓✓		✓			✓		
Apply for relevant grants	✓					✓		✓✓
Provide regular progress reports						✓		✓✓

✓ Could do the task ✓✓ Best suited for the task

Actions are divided into 'essential' and 'desirable'. A single tick means the person in a particular job function is likely to be well suited to the task. For some tasks, a number of different people could be involved, for example, conducting energy walk rounds.

Other tasks are of a more specialist nature (such as energy purchasing). A double tick indicates the person who is likely to be the best choice for the task.

Understanding current performance

The energy team's first job is to understand and assess how the school is performing at the moment. This can be done using the energy management matrix.

Energy management matrix

This tool can help schools assess their strengths and weaknesses across the six main areas of energy management:

- Policy – what commitments has the school made?
- Organisation – whose job is it to manage energy at the school?
- Training – are staff aware of the issues and their role in tackling them?
- Performance measurement – what systems are in place to give you the data needed?
- Communicating – are staff, pupils, parents and the board interested in reducing the school's carbon footprint? Do they know what to do and what has been achieved?
- Investment – spending money on energy saving programmes and equipment can pay back. Does the school make the most of investments?

How to use the matrix

Select the field from each column that corresponds with the school's current performance. Highlight this either by ticking the box or circling it. Then join the fields to create a graph which will highlight current strengths and weaknesses and show what needs to be addressed.

The best way to use this approach is to focus on the weak areas identified. Once the matrix is more balanced (producing a straight line), a school should work to improve all areas together and simply 'raise the bar'.

Not everyone has the same opinion!

By asking different users of the school to carry out this assessment it is possible to determine how others believe the school is performing. This can then be used to inform a school awareness campaign and action plan. Remember to include pupils' opinions as well as those of the staff.

Below is an example of a completed version, and a photocopyable version is available as an insert in the back of this publication.

Energy management matrix						
	Policy	Organising	Training	Performance measurement	Communicating	Investment
4	Energy policy action plan and regular review have active commitment of top management <input type="checkbox"/>	Fully integrated into management structure with clear accountability for energy consumption <input type="checkbox"/>	Appropriate and comprehensive staff training tailored to identified needs, with evaluation <input type="checkbox"/>	Comprehensive performance measurement against targets with effective management reporting <input type="checkbox"/>	Extensive communication of energy issues within and outside the school <input type="checkbox"/>	Resources routinely committed to energy efficiency <input type="checkbox"/>
3	Formal policy but no active commitment from top <input type="checkbox"/>	Clear line management accountability for consumption and responsibility for improvement <input type="checkbox"/>	Energy training targeted at major users following training needs analysis <input type="checkbox"/>	Weekly performance measurement for each building or site <input type="checkbox"/>	Regular staff briefings, performance reporting and energy promotion <input type="checkbox"/>	Same appraisal criteria used as for other cost reduction projects <input type="checkbox"/>
2	Unadopted policy <input type="checkbox"/>	Some delegation of responsibility but line management and authority unclear <input type="checkbox"/>	Ad hoc internal training for selected people as required <input type="checkbox"/>	Monthly monitoring by fuel type <input type="checkbox"/>	Some use of school communication mechanisms to promote energy efficiency <input type="checkbox"/>	Low or medium-cost measures considered if short payback period <input type="checkbox"/>
1	Unwritten set of guidelines <input type="checkbox"/>	Informal, mainly focused on energy supply <input type="checkbox"/>	Technical staff occasionally attend specialist courses <input type="checkbox"/>	Invoice checking only <input type="checkbox"/>	Ad hoc informal contacts used to promote energy efficiency <input type="checkbox"/>	Only low or no-cost measures taken <input type="checkbox"/>
0	No explicit energy policy <input type="checkbox"/>	No delegation of responsibility for managing energy <input type="checkbox"/>	No energy-related staff training provided <input type="checkbox"/>	No measurement of energy costs or consumption <input type="checkbox"/>	No communication or promotion of energy issues <input type="checkbox"/>	No investment in improving energy efficiency <input type="checkbox"/>

Create an energy policy and plan for change

An energy policy forms an essential part of raising the profile of carbon emissions within a school and serves as a benchmark against which, achievements can be celebrated.

Developing a policy

A good first step is to analyse any existing energy policy and if there isn't one, to create one straight away.

An energy policy is a written document stating the way the school will use energy and what targets it hopes to achieve. It should show how it intends to go about meeting such targets, state how it will involve pupils, what it expects of teaching and support staff and plan for how it will continue improving energy efficiency and reducing carbon emissions in the future. By calculating the school's carbon footprint at the beginning of the campaign, you can measure the real impact the school's energy use has on the environment. Then by publicising the reduction in carbon emissions year on year, you can demonstrate the positive effect of your campaign. Go to www.carbontrust.co.uk/footprintcalculator

A good energy policy:

- Makes a statement of commitment
- Specifies clear and achievable objectives and targets for energy consumption
- Identifies responsibilities and resources
- Provides an action plan
- States the mechanisms to implement the action plan
- Commits to a review process.

The policy should be developed by the energy team in consultation with other teaching and support staff and pupils. Although members of the energy team should take the lead on developing the policy, consultation with other pupils and staff can be the first step in securing commitment from the whole school community.

Note

An example of an energy policy can be found at the back of this publication.

Produce an action plan

Once objectives and targets have been agreed, an action plan should be drawn up to define what has to be done.

The results of the energy matrix exercise may suggest actions that can be taken:

- Immediately
- In the next few months
- Over the next year.

It is important to choose tasks which are appropriate and match resources available in the school, as setting unrealistic plans could undermine the school's progress.

To be effective, the action plan should:

- Be agreed and approved by the appropriate level of management. It should involve the senior teacher who is ultimately accountable for energy management performance.
- Relate actions to individual objectives and targets, which should come in turn from specific policy commitments. There should be short, medium and long-term actions with clearly identified resource requirements.
- Assign actions to individuals with clear deadlines for reporting progress and completing tasks. Individuals should be given the time and budget to realistically achieve targets.
- Clearly indicate who has authority, that is, who is responsible for approval or signing off the action when it has been completed.
- Outline the resources that are available.
- Provide a clear priority of actions, and in what order they will be taken; for example, consider project cost (if any), possible savings, ease of taking action and available resource.

Further information

Further help in identifying energy saving opportunities can be found in the Carbon Trust's *Schools* sector overview (CTV019) and *Assessing the energy use in your building* fact sheet (CTL003).

Case study: Woodheys Primary School

Internationally recognised for its environmental activities and involved in WWF and Global Sustainable Cities projects, the school has installed solar photovoltaic panels which, as well as saving energy, act as a visible statement of its commitment to sustainable operation.

There is an enthusiastic Energy Team comprising five Year 6 pupils and led by an Environmental Projects Coordinator. The team was established following an initial school energy and water audit. The results of this audit prompted changes to monitoring systems and the development of an action plan, setting out clear ongoing targets.

An energy notice board is regularly updated and newsletters are sent home to parents, communicating energy-related issues to the wider community and raising awareness.

“We all approach each task with the words of our school motto in mind, *‘Together Everyone Achieves More’*,” says Headteacher, Laura Daniels. “The long term dedication of staff, governors and pupils involved in the energy teams helps make these improvements possible.”



The Team read gas and electricity meters on a weekly basis so that consumption patterns can be clearly identified. This information is recorded and then forwarded to the local authority’s Building Services Manager who helps the team produce graphs and other curriculum resources to demonstrate progress and help tackle any problem areas early on. The Eco-School Council and Premises Committee circulates the data, ensuring all school users are kept informed and involved in generating new ideas and energy saving activities.



Get meter data

In order to manage energy in a school it is vital to have the correct energy data. Without it, it is very hard to measure the success of the campaign.

Meters

Some schools read their own meters and check them against their invoices. This is a commonly used method for looking at gas consumption. However, it may be better to take readings more regularly; for schools with monthly bills, a weekly meter read may be beneficial. For schools with quarterly bills, a monthly meter read may be more appropriate.

For electricity, a better way to understand energy use is to analyse data taken at half-hourly intervals. Larger schools (with a peak consumption of over 100kW) should automatically have the provision to get half-hourly meter readings from their supplier. Schools below this threshold may also benefit from having a meter installed to give them this information.

Collecting accurate data can mean:

- Obtaining reliable information for regular monitoring
- Detecting waste quickly and taking preventive action
- Comparing consumption against benchmarks to determine the potential savings
- Identifying and rectifying invoicing errors quickly
- Providing feedback to end-users on savings achieved
- Using readings for teaching purposes.

Reading meters for energy management

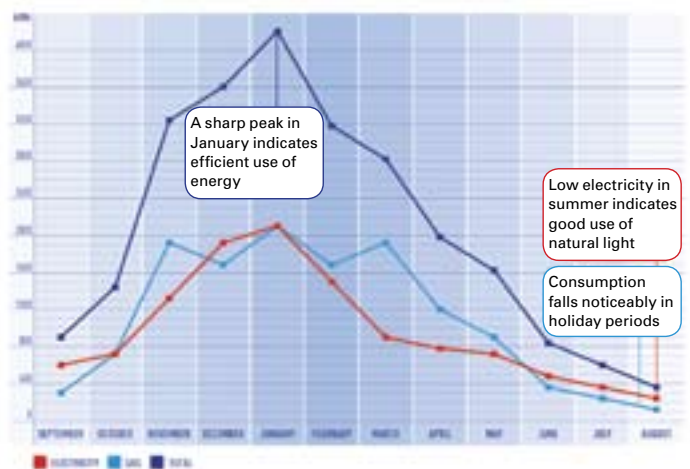


Having collected the data, it is important to record and analyse any trends. If targets have been set, it is useful to compare consumption against these and plot progress. If there is a change in consumption which cannot be easily explained, then corrective action is required.

Plotting monthly energy consumption on a graph for 12 months can be useful, as the analysis below shows.

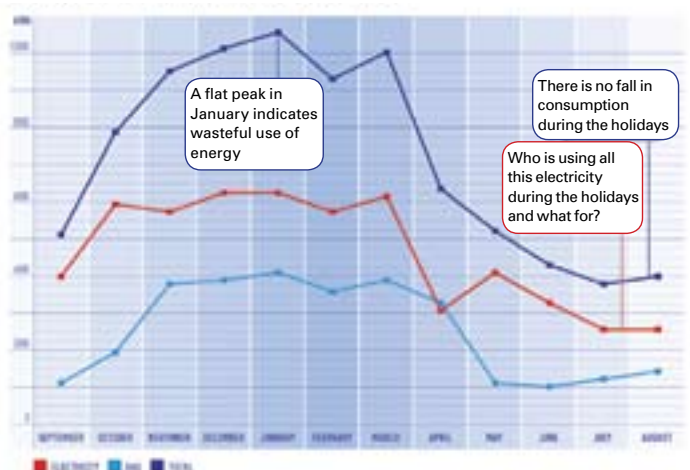
Does your graph look like this?

A school with lower than average energy use



Or like this?

A school with higher than average energy use



Involving pupils

Reading meters and recording and analysing data provides an ideal opportunity for pupils to get involved in understanding energy use and data handling. If meters are inaccessible, ask the caretaker to provide meter readings for the class to use. Pupils can use spreadsheets, produce graphs and conduct analysis of results. These graphs can then be displayed on notice boards to raise awareness across the school.

Benchmarking your energy use

Benchmarking is a useful exercise to:

- Understand energy use and spend so it can be compared to use after the school has made changes to its management and operations
- Compare performance with other schools.

Use the data collected, to calculate annual consumption in kWh for each fuel (gas, oil and electricity) separately.

Convert where necessary into kWh (conversion calculations can be found at www.carbontrust.co.uk/conversionfactors).

Divide each number by the floor area to get energy consumption in kWh/m² for each fuel.

Comparing this:

- Year on year can help measure the effects of efficiency campaigns
- To national benchmarks (found on your DEC – see Did You Know? box, right) allows you to see how you are doing against others schools.

If your school compares badly, this is evidence of a strong potential for savings and it would be worth focusing on this initially. If it compares well, this is reassuring; however, there may still be opportunities for improvement. Continue to take meter readings on a regular basis as this will allow monitoring of energy use and demonstrate any successes the energy team may have. It also quickly flags up any problems.

Did you know?

A new EU Directive (Energy Performance of Buildings) will require many schools to publicly display their energy performance (in kWh/m²). From October 2008 all publicly funded buildings over 1000m² will have to put up a Display Energy Certificate (DEC) in a public place, showing their energy use on an A-G scale similar to domestic white goods. This is covered in more detail on page 18.

Further information can be found at www.sustainablelearning.info

Case study: Hazel Grove High School

At this school in Stockport, the classrooms are used for a range of evening classes as well as being in use during school hours, and its recreation centre is used by the local community during evenings and weekends.

The school was incurring annual energy bills of more than £64,000 and contacted the Carbon Trust for some expert advice. They subsequently received an energy survey which identified a number of low-cost energy saving recommendations.

If all of the suggested measures are implemented, the school expects to reduce its energy expenditure by almost 25 per cent, significantly reducing its carbon emissions.

In order to make further savings, however, the school is also considering decentralising hot water services in its east building and installing meters to ensure correct recharging of electricity use in its recreation centre.

Take a walk round

Energy walk rounds are a quick and simple method for identifying how a school can save money and reduce carbon emissions by reducing its energy consumption.

What is an energy walk round?

Energy walk rounds involve making a visual inspection of each room and:

- Establishing where energy is being used
- Identifying wasteful practices and opportunities for savings
- Isolating where maintenance work or repairs are needed (to reduce energy costs)
- Indicating a need for capital investment to improve energy efficiency.

Walk rounds can be used on their own to identify energy saving opportunities or can be incorporated into a school's overall energy management plan. Either way, the simple checks and easy-to-follow format at the back of this guide allow real progress in reducing both energy consumption and carbon emissions.

Who should be involved?

Although responsibility for walk rounds should remain with the energy manager or a dedicated staff member from the energy team, they can also provide a great opportunity for pupils to get involved.

Preparing for a walk round

Calculate the power and energy rating for the equipment in the school.

Each piece of equipment in the school has a power rating measured in Watts (W), for example, a 100W light bulb consumes a hundred Watts of power per hour.

The energy consumed will depend on how long the piece of equipment is used. For example a 100W light bulb used for 10 hours will use 1kWh of energy ($100\text{W} \times 10\text{hours} = 1,000\text{Wh}$ or 1kWh). Use this method to calculate how much energy each piece of equipment uses.

Other power-using equipment to consider includes computers and monitors, photocopiers and vending machines.

Assemble the paperwork

Prepare checklists for all the areas in the walk round. Inserts four to seven in the back of this publication can be copied or adapted to suit a particular school. They include checklists for:

- Calculating out-of-hours demand
- Energy consumption before, during and after school hours
- Inspecting specialist areas
- Checking repairs and maintenance.

Prepare the kit

Some things you may need to have with you when conducting a walk round include: tags (such as post-it notes) to mark faults, torch, safety equipment, thermometer, camera, stopwatch, tape measure and ladder.

Plan when to go

Conduct walk rounds at designated times – before school starts, during normal hours and after school. Why not read the meters during a walk round? This will allow you to gain solid details of demand at different times of the day.

When walking round the school, pay attention to typical areas of waste – heating and hot water, lighting, computer equipment, ventilation and building fabric. The checklists suggest the key areas to watch for. Also refer to the Carbon Trust's *Schools* sector overview (CTV019) for more ideas.

Out-of-hours consumption

When checking the out-of-hours consumption, calculate the overnight electricity by simply adding together the power ratings of all equipment that must operate overnight (security lighting, alarm systems, computer networks, fax machines, refrigerators and so forth). Multiply this figure by the number of overnight hours to establish consumption for that period in kilowatt-hours (kWh).

This estimate of electricity consumption can be compared with actual electricity use. A meter reading taken at the end of the school day and a second reading taken early the following morning will tell you how much electricity has been used overnight. If the expected overnight energy consumption is significantly lower than the recorded consumption from the meter, other equipment is being left on. This is likely to be computers, general lighting, or equipment such as kilns.

A further check can be made by comparing the ratio between day and night consumption. Energy consumption overnight should account for less than 10% in an efficiently run school. **Insert four can help you record the data.**

10 minute demand test

Read the electricity meter twice, 10 minutes apart, take the difference between the two and multiply by 6. Because the meter is reading consumption in kWh, multiplying by 6 allows you to determine the kW demand on-site at that particular time of day. Add up all the power ratings of equipment that need to be on at that time to find out what to expect. The difference between the expected and the actual is caused by unnecessary equipment being left on, which is costing money. Find out what is left on and make sure it gets switched off.

This test should be carried out in the morning before staff and pupils arrive, during the working day and after normal school hours (taking after-school clubs and activities into account).

Writing your own action plan?

Visit the Carbon Trust website and try out the Action Plan Tool: www.carbontrust.co.uk/apt

The tool provides a list of prioritised actions according to sector and size of organisation. It's a great way to get started.

Holiday shutdown

A significant amount of energy can be wasted during the school holidays (and over weekends and bank holidays) because equipment is not switched off. Make sure to schedule a walk round on the last day before long weekends and breaks when staff and pupils have left the building. A tour of all areas should be made, noting (and turning off) all non-essential equipment. The worst culprits are normally:

- Computer base stations left running
- Computer screens left running or in screen-saver/sleep mode
- Photocopiers in sleep mode
- Point-of-use electric water heaters left running
- Extractor fans left running
- Lighting left on.

To make it easier for the next holiday, essential equipment that cannot be turned off should be labelled and a list drawn up and handed out to staff.

Involving pupils

- Appoint energy monitors each term to switch off lights/equipment and close windows at home time. This is a useful housekeeping activity as well as an excellent way of conducting a mini walk round several times a day.
- Enlist the class to identify the draughtiest door in the school. Have the class submit a report of their investigations, and then check the difference once it's fixed.

Did you know?

The unit for power rating is the kilowatt (kW). It is sometimes given in Watts, which must be divided by 1,000 to convert to kW.



Case study: Tetsworth School

Tetsworth is a small school made up of around 40 pupils split into three classes. The Energy Team was initially set up by the School Council but is now the remit of class 3. This typically involves 12 children spanning Years 4 to 6, a teacher and the school secretary who are the driving force of energy management initiatives. The Energy Team meets regularly and conducts energy walk rounds to establish where energy is being used and how savings can be made. There are Energy Monitors in each of the other two classes who check that all electrical equipment and lights are only switched on when needed and that windows and doors are kept closed in cold weather.

As the school is a listed Victorian building, some energy efficient measures such as lowering ceilings or installing double glazing are either too expensive or do not comply with regulations. However, the school has achieved an 11% reduction in electricity use by changing all lighting in the school to low energy or slim fluorescent tubes and carrying out the ongoing actions outlined below:

- Regular Energy Team meetings
- Continued energy monitoring by pupils and staff
- Weekly meter readings
- Progress reports to governors via KS2 teacher
- Keeping pupils staff and visitors informed via assemblies and an energy notice board
- Keeping parents informed via a newsletter
- Publicising the project to encourage energy saving in the wider community.



Meter readings are carried out on a weekly basis by the oldest pupil on the Energy Team (Year 6) during term time, and by a teacher during the holidays. The data are then entered on a spreadsheet by pupils and the resulting graphs help to explain the usage pattern to the rest of the school.



Think curriculum

Energy education is already embedded in the curriculum and curricular guidelines for all ages. Sometimes it is explicit (such as keeping warm and energy resources), while other times it is not so obvious (such as sustainable development and transport). Energy education is an entitlement for all pupils, not an optional extra to be included if there is time.

Teachers already include energy and carbon emissions in their normal schemes of work as energy concepts underpin many of the topics in Science and Geography that pupils will study, even at primary level. In addition, energy impacts on aspects of History and Technology as well as providing a context and/or inspiration for work in other subjects such as English, Mathematics, Information Technology and the Arts.

Learning is enhanced if pupils can apply their knowledge by seeing practical applications of classroom theory in familiar real-world situations. The school and its energy systems provide many good examples of energy concepts that affect their comfort and facilities.

During activities involving energy and carbon issues, pupils will often ask questions about the way the school uses energy and suggest possible improvements. The whole school approach capitalises on this by encouraging pupils to contribute to the responsible use of energy within their school and including them as partners in the process of school energy management.

Education for sustainable development

Education for sustainable development is a requirement of all areas of the curriculum. It should be incorporated into all subjects and works well as a cross-curricular theme. Energy management is a good introduction to Education for sustainable development because:

- It allows pupils to translate general concerns about the environment into practical action within their schools and homes which can be started at any time of the year.
- Energy consumption can be quantified so improvements can be identified quickly and then celebrated by the pupils involved.
- Wiser use of energy can lead to improved comfort levels together with financial savings, which can be put to educational uses.
- Research has shown that where pupils are empowered to take action on energy, their attitude to other environmental issues becomes more positive.

Case study: Woodhouse College

Based around an 18th Century manor house in Finchley, North London, this sixth-form college has around 80 staff and 1,000 pupils. The original building was extended in the 1920s and 30s, with further areas added in 1997 and 2000.

Woodhouse College's annual energy bill is around £50,000, making it one of the largest expenses after staff salaries. The Carbon Trust carried out a free detailed energy survey to see what could be achieved based on low-cost solutions.

The resulting survey produced a range of recommendations for how the college could reduce energy consumption by almost 17 per cent, saving 134 tonnes of carbon dioxide per year. The advice ranged from installing more energy efficient light bulbs, to developing an energy efficiency awareness campaign for staff and students.

Eighteen months on and many of the recommendations have been implemented. Pipes and valves have been insulated, light bulbs are being replaced with energy efficient types and computers turn off automatically. The college has even installed more light circuits, giving greater control over the lighting of different areas, so that better use can be made of natural light. An ongoing energy efficiency awareness programme has also been successfully implemented, which has led to direct change in the way students and staff use energy.

The college's energy consumption is falling month by month, with a six per cent reduction over a year, saving 48 tonnes of CO₂. This has been achieved despite an increase in student numbers, which means the college's classrooms are being used for longer.

Table 2 Ideas for including energy within the curriculum

Level	Idea
LP	Categorising rooms as 'hot', 'cold' or 'comfortable' and relating these sensations to numerical values on a thermometer.
LP	Identifying, classifying and counting the number of appliances that use energy in a school.
LP-UP	Devising a play or pageant for a special assembly or for a performance to parents.
UP-LS	Using a lighting survey as the basis for work in Mathematics, e.g. how much energy is used when all the lights are on.
UP-LS	Challenging pupils to design energy awareness posters and 'Save it' stickers; carrying out experiments to determine how frequently they should be changed to maintain their impact.
UP-LS	Weekly reading and recording of electricity and gas meters; calculating consumption for each meter and for the whole school. Comparing total consumption with previous week/month and the same period in earlier years.
US-SF	Comparing consumption with weather severity, school benchmarks, local authority and national data.
LS-SF	Investigating the sensors and controls used to regulate heating and lighting systems, and constructing simple working models to test understanding.
UP-SF	Using data-loggers to record the temperature of a room over a period; e.g. Thursday to Tuesday, to see if it reaches target temperature only at appropriate times.
UP-SF	Writing articles for local newspapers and radio on how the school is working to use energy more wisely.
All	Inviting a professional theatre company to present a play on energy issues.
All	Devising events for families and other members of the community where pupils present information and advice on energy efficiency in school (and at home). This can involve quizzes, games, comedies, dance, mime, music, song and art.

Key: (LP) Lower primary (UP) Upper primary (LS) Lower secondary (US) Upper secondary (SF) Sixth-form

Table 3 Ideas for short projects

Theme	Idea
Stick-'em-up day	Pupils (and adults) put up descriptive post-it notes wherever they see energy being wasted.
Low energy day	Just how little energy can the school use and still operate successfully?
Energy challenge	A reward if the school reduces its consumption by an agreed amount.
Pay your way day	Each pupil is issued with energy tokens. They have to 'buy' energy whenever they need it by handing in tokens.
Visit	An energy expert leads an activity, perhaps involving adults as well as pupils.
Energy detectives	Pupils seek out places where energy is being wasted.
Energy survey	Pupils collect and evaluate evidence to support or refute statements about the effectiveness of different aspects of energy management.

Run an awareness campaign

Awareness campaigns can help kick start an energy saving programme and get everyone interested and motivated to save energy.

A successful campaign will be designed around the school's circumstances – bearing in mind the ages of the pupils, the staff's level of energy experience and the time and resource available.

Great energy campaigns make staff, pupils and the school community more aware of:

- The energy they are using – and what it is costing in both environmental and monetary terms
- How their habits have an impact on energy use and how changing them has a positive effect on carbon emissions
- Specific actions they could and should be taking
- What larger actions the school is taking, such as fixing draughts or installing new lights
- The savings their efforts have made, to encourage them to keep on trying.

Designing the campaign

Although a spectacular launch is a great way to get people interested, remember that a drip feed strategy is better than a big bang. To keep energy in the minds of the school community and to keep people contributing to the savings, campaigns should be designed to be ongoing, monitored and refreshed periodically. Maintain momentum through a two or three-year rolling programme of themes, such as:

- Doors and draughts in autumn
- Heating in winter
- Sensors and controls in spring
- Windows and lighting in summer
- Electrical appliances and hot water in any season.

Themes can be linked to curriculum projects with a definite end-point and the contribution of all participants should be recognised and rewarded in appropriate ways. Ideas for short projects have been included in the Think curriculum section on page 15.

Case study

A class devised a TV news bulletin devoted to energy issues, including location reports from correspondents around the world. This was performed at a special assembly to launch their school's Energy Team.

Communicating

Schools have a variety of mechanisms to tell staff and pupils about their energy saving plans and achievements. The possibilities are probably endless – but here are some good ideas to start with:

- Have a poster competition to target bad habits that increase the carbon footprint, such as opening the windows when the heating is on, or leaving the lights on when no one is there. The best posters could be professionally reproduced and put up around the school.
- Dedicate a central 'energy notice board', and fill it with
 - Posters (either from the Carbon Trust or designed by the pupils)
 - Energy consumption charts, highlighting savings
 - The best projects to come out of the classes studying the issues
 - A copy of the energy policy, perhaps simplified for younger pupils
 - A suggestion box for feedback.
- Have a special assembly or series of assemblies on energy. Classes could perform material based on their course work and awards could be presented. Invite parents to spread the message. This could introduce an annual carbon saving week which enthuses and informs the school community in different ways.
- Add basic energy saving tips and hints to the school newsletter. This can highlight the excellent work the school is doing and also spread the message to the home.
- Invite experts from environmental groups to talk about the issues, or local businesses to present on what they have done to save energy in their organisations.

Maintaining awareness

Revisit the campaign frequently. Refresh the messages so pupils and staff stay interested and get feedback about what is not working so well. Change the campaign to target areas which need improvement, and reward individuals and classes which make outstanding efforts. The Carbon Trust's *Creating an awareness campaign* management guide (CTG001) has lots more ideas.

Useful resources

There are many free publications, websites and other resources available to help schools improve their energy efficiency and reduce their carbon emissions.

Department for Children, Schools and Families (DCSF)

The DCSF has a Sustainable Schools framework which supports schools wishing to become more sustainable. The framework is broken into eight doorways, and provides information and resources to help make improvements either in one of these doorways or across a number or all of them. The doorways are:

- Food and drink
- Energy and water
- Travel and traffic
- Purchasing and waste
- Buildings and grounds
- Inclusion and participation
- Local well-being
- Global dimension.

By focusing on energy use and, in particular the whole school approach, a school can also cover some of the elements from all the doorways. Examples include:

- Producing a purchasing policy that requires running costs to be considered when purchasing new equipment:
Purchasing and waste
- Checking and replacing damaged windows and doors, fitting automatic door closers to external doors and looking at the lighting and heating systems installed:
Buildings and grounds
- Getting everyone involved: Inclusion and participation
- Completing a travel plan looking at energy use from different travel options: Travel and traffic
- Class projects to look at energy use in the home and compare to other young people around the world, or looking at where our energy comes from:
Global dimension
- Consider energy use and the conditions this leads to in buildings such as levels of lighting and heating: Local well-being
- Study energy use and the safe storage of food through chilling, cooking and keeping warm: Food and drink and local well-being.

s3

There is a self assessment tool called s3 available to help schools assess their current sustainability. It covers general management and operational issues in school and looks specifically at the eight doorways. This assessment can be used as part of a school's Ofsted inspection. Inspectors can already ask to see a sustainability plan for the school and this is likely to become part of the compulsory assessment process over time. A copy of s3 can be found in the tools section of the Sustainable Schools website at www.teachernet.gov.uk/sustainableschools

Bursar's Guide to sustainable school operation

A free guide for bursars on operating a sustainable school can be found on the Sustainable Schools website by searching for 'bursars'. The publication looks at energy, water, waste and purchasing as well as ranking simple actions for cost and ease of implementation.



Sustainable Learning

An energy and water management programme for schools is supported by the DCSF and allows a school to manage its energy and water consumption using a whole school approach. The programme breaks management down into a number of smaller tasks using the same structure and requirements as the s3 energy and water doorway; so taking part will help a school assess itself under s3.

The programme also offers A-G style certificates to allow schools to get an initial idea of their likely DEC rating when it becomes compulsory in April 2008. The rating given is on a school site basis and will not as yet meet the EU Directive requirements. It does, however, allow smaller schools who may not be affected by the initial legislation to get an idea of how their school is performing as a whole and is expected to be useful to any school wishing to manage its energy use as it allows a year-on-year assessment.

The programme also offers services to help schools progress including benchmarking and monitoring tools, posters and stickers, a progress booklet, discussion forums with others participating in the programme, case studies and links to other useful organisations and sites.

Progress within the programme allows schools to download colourful certificates which can be displayed on notice boards and perhaps alongside the A-G certificate to show the commitment the school is making to improvements. Any school can take part and actual financial investment is not required to succeed. Many schools, however, do go on to invest in improvements as a result of their activity on the programme. To find out more and to register visit: www.sustainablelearning.info

Curriculum support

The Centre for Research, Education and Training in Energy (CREATE) motivates and educates people in businesses, communities and schools to achieve more sustainable uses of energy and reduce carbon emissions. Visit www.create.org.uk

Groundwork provides regeneration and educational programmes and can offer support to primary schools on energy awareness and energy management. Visit www.groundwork.org.uk

Many of the utility companies provide dedicated curricular resources for schools. Further details can be found on their websites.

Other useful websites

Eco-Schools is a European initiative to help schools become environmentally friendly in both the curriculum and the management of the school. The prestigious Eco-Schools flag is awarded to schools which meet the criteria.

Visit www.eco-schools.org.uk

Related publications from the Carbon Trust

Fact sheets

Energy management (GIL136)

How to monitor your energy use (GIL157)

Assessing the energy use in your building (CTL003)

Overviews

Schools (CTV019)

Creating an awareness campaign (CTG001)

In-depth guides

Swimming pools (CTG009)

Next steps

Take a methodical approach to energy efficiency to give the project its best chance of success.

Step 1. Appoint an Energy Manager

Appoint a team to the role of putting energy on the map in your school.

Step 2. Understand current performance and identify opportunities

Compile an energy checklist. Walk round the school and complete the checklist at different times of day (including after hours) to identify where energy savings can be made. An example checklist can be found at the back of this publication. Take meter readings so that you can measure future savings against current performance.

Step 3. Prioritise your actions

Fill in an energy management matrix (at the back of this publication) and draw up an action plan detailing a schedule of improvements that need to be made and when, along with who will be responsible for them. Where funding is limited, focus on energy intensive areas or those that are performing badly first.

Step 5. Make the changes and measure the savings

Implement your energy saving actions and measure against original consumption figures. This will assist future Board of Governors' decisions regarding your energy priorities. Some actions may require specialist assistance. Discuss the more complex or expensive options with a qualified technician or the Local Authority property department.

Step 6. Communicate

Hold an assembly, put up posters and stickers or run competitions to generate awareness and motivate staff and pupils; publicise successes using notice boards and other media and think of other ways to get the message across – celebrating wins and keeping up the momentum. Enforce energy policies, systems and procedures to ensure that the school continues to operate efficiently and that savings are maintained in the future.



Go online to get more

The Carbon Trust provides a range of tools, services and information to help you implement energy and carbon saving measures, no matter what your level of experience.

Carbon Footprint Calculator – Our online calculator will help you calculate your organisation's carbon emissions.

→ www.carbontrust.co.uk/carboncalculator

Interest Free Loans – Energy Efficiency Loans from the Carbon Trust are a cost effective way to replace or upgrade your existing equipment with a more energy efficient version. See if you qualify.

→ www.carbontrust.co.uk/loans

Carbon Surveys – We provide surveys to organisations with annual energy bills of more than £50,000*. Our carbon experts will visit your premises to identify energy saving opportunities and offer practical advice on how to achieve them.

→ www.carbontrust.co.uk/surveys

Action Plans – Create action plans to implement carbon and energy saving measures.

→ www.carbontrust.co.uk/apt

Case Studies – Our case studies show that it's often easier and less expensive than you might think to bring about real change.

→ www.carbontrust.co.uk/casestudies

Events and Workshops – The Carbon Trust offers a variety of events and workshops ranging from introductions to our services, to technical energy efficiency training, most of which are free.

→ www.carbontrust.co.uk/events

Publications – We have a library of free publications detailing energy saving techniques for a range of sectors and technologies.

→ www.carbontrust.co.uk/publications

Need further help?



Call our Customer Centre on 0800 085 2005

Our Customer Centre provides free advice on what your organisation can do to save energy and save money. Our team handles questions ranging from straightforward requests for information, to in-depth technical queries about particular technologies.

The Carbon Trust was set up by Government in 2001 as an independent company.

Our mission is to accelerate the move to a low carbon economy by working with organisations to reduce carbon emissions and develop commercial low carbon technologies.

We do this through five complementary business areas:

Insights – explains the opportunities surrounding climate change

Solutions – delivers carbon reduction solutions

Innovations – develops low carbon technologies

Enterprises – creates low carbon businesses

Investments – finances clean energy businesses.

www.carbontrust.co.uk

0800 085 2005



The Carbon Trust supports ACT ON CO₂, the Government's initiative to help individuals understand and reduce their carbon footprint. To calculate your personal carbon footprint, visit <http://actonco2.direct.gov.uk>

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CTV037



Energy management matrix

Energy management matrix						
	Policy	Organising	Training	Performance measurement	Communicating	Investment
4	Energy policy action plan and regular review have active commitment of top management <input type="checkbox"/>	Fully integrated into management structure with clear accountability for energy consumption <input type="checkbox"/>	Appropriate and comprehensive staff training tailored to identified needs, with evaluation <input type="checkbox"/>	Comprehensive performance measurement against targets with effective management reporting <input type="checkbox"/>	Extensive communication of energy issues within and outside the school <input type="checkbox"/>	Resources routinely committed to energy efficiency <input type="checkbox"/>
3	Formal policy but no active commitment from top <input type="checkbox"/>	Clear line management accountability for consumption and responsibility for improvement <input type="checkbox"/>	Energy training targeted at major users following training needs analysis <input type="checkbox"/>	Weekly performance measurement for each building or site <input type="checkbox"/>	Regular staff briefings, performance reporting and energy promotion <input type="checkbox"/>	Same appraisal criteria used as for other cost reduction projects <input type="checkbox"/>
2	Unadopted policy <input type="checkbox"/>	Some delegation of responsibility but line management and authority unclear <input type="checkbox"/>	Ad hoc internal training for selected people as required <input type="checkbox"/>	Monthly monitoring by fuel type <input type="checkbox"/>	Some use of school communication mechanisms to promote energy efficiency <input type="checkbox"/>	Low or medium-cost measures considered if short payback period <input type="checkbox"/>
1	Unwritten set of guidelines <input type="checkbox"/>	Informal, mainly focused on energy supply <input type="checkbox"/>	Technical staff occasionally attend specialist courses <input type="checkbox"/>	Invoice checking only <input type="checkbox"/>	Ad hoc informal contacts used to promote energy efficiency <input type="checkbox"/>	Only low or no-cost measures taken <input type="checkbox"/>
0	No explicit energy policy <input type="checkbox"/>	No delegation of responsibility for managing energy <input type="checkbox"/>	No energy-related staff training provided <input type="checkbox"/>	No measurement of energy costs or consumption <input type="checkbox"/>	No communication or promotion of energy issues <input type="checkbox"/>	No investment in improving energy efficiency <input type="checkbox"/>

Sample school energy policy

Sample energy management policy (draft)

Policy statement

e.g. School is committed to the responsible management of energy and water.

By efficient management of these resources, the school aims to:

- Minimise expenditure and environmental impact
- Maintain health and safety standards
- Maintain an acceptable comfort level for staff, pupils and other building users.

Targets

Target energy/water performance is as follows:

	Current yearly performance	Target yearly performance	% target reduction
Electricity kWh/m ² /annum			
Gas kWh/m ² /annum			
Water m ³ /pupil/annum			

Strategy

This policy statement will be implemented through a 10-point plan:

1. Responsibility

The overall responsibility lies with the Headteacher,

Day-to-day energy management responsibilities lie with

working in conjunction with the policy and direction set by the Energy Team.

Policy, strategy and targets for energy management will be the responsibility of the Energy Team which currently consists of:

Headteacher/Deputy _____

Caretaker/Site Manager _____

Bursar/Administrator _____

Teacher _____

Pupil _____

The Energy Team will meet quarterly to review progress, plan initiatives and prepare an annual energy report for submission to the Board of Governors. Teachers will have a responsibility to set a good example to pupils who can also make a significant contribution to end-use energy efficiency.

2. Energy selection and purchase

Energy purchase is currently undertaken by _____ Local Authority who negotiates with utility providers.

_____ will check invoices monthly against meter readings for gas, oil, electricity and water.

3. Energy information

Electricity, gas and water meters will be read weekly and closely monitored against expected usage. Abnormal consumption will be investigated and corrective action taken. Each year, realistic energy reduction targets will be set and monitored regularly. Targets will be set relative to national published benchmarks.

4. Maintenance

Energy conversion plant, distribution systems and energy using equipment will be correctly maintained to avoid energy and water wastage.

5. Awareness

The school will adopt a whole school approach involving everyone associated with the school.

Regular awareness initiatives for staff and pupils will emphasise the cost and environmental benefits of saving energy and water and how to avoid waste. Energy saving information will be provided to catering and cleaning staff. Staff and pupils will also be provided with information on how to save energy at home.

Energy coordinators will be appointed with checklists for good housekeeping initiatives.

6. Curriculum

The curriculum will be reviewed annually, to ensure that energy issues are built into each subject area at appropriate levels.

7. Investment in energy efficiency

The school aims to invest in energy saving schemes of less than £1,000 with paybacks of less than three years.

Savings achieved by good housekeeping measures will be reinvested in energy efficiency projects.

Where available, grants will be sought to improve energy efficiency. An energy survey of the school will be updated annually with costed proposals.

The school will make use of any grant schemes available to improve its overall energy efficiency.

8. Design

Energy efficiency will be taken into account in the design of new building projects and during any refurbishment.

Energy efficiency will be considered in the purchase of all new equipment, for example computers and catering appliances.

9. Reporting

An annual energy performance report will be prepared by the Energy Team. This will be submitted to the Board of Governors and a summary will be incorporated into the school annual report and school development plan.

10. Policy review mechanism

This policy will be reviewed and updated annually by the Energy Team and included in the annual report. The review will include an evaluation progress against the energy management matrix.

Out-of-hours checklist

Complete the following checklist to determine how much unnecessary out-of-hours electricity use could be costing.

Out-of-hours checklist			
Meter:	Date of reading:	Carried out by:	
Overnight consumption			
Electricity meter reading (PM)	a	<input type="text"/>	kWh
Electricity meter reading (AM)	b	<input type="text"/>	kWh
Hours between meter readings	c	<input type="text"/>	Hours
Overnight consumption	d	<input type="text" value="b-a"/>	kWh
Expected overnight consumption			
Necessary equipment left on overnight:		Power rating in watts	
e.g.	<input type="text" value="Intruder alarm"/>	<input type="text"/>	
1	<input type="text"/>	1	W
2	<input type="text"/>	2	W
3	<input type="text"/>	3	W
4	<input type="text"/>	4	W
5	<input type="text"/>	5	W
6	<input type="text"/>	6	W
7	<input type="text"/>	7	W
8	<input type="text"/>	8	W
9	<input type="text"/>	9	W
10	<input type="text"/>	10	W
Total power of necessary equipment	e	<input type="text"/>	Sum 1 to 10 above W
Necessary overnight consumption	f	<input type="text"/>	$(e/100) \times c$ kWh
Cost of unnecessary overnight consumption			
Unnecessary equipment being left on	g	<input type="text" value="d-f"/>	kWh
Electricity price per kWh – from bill	h	<input type="text"/>	p
Cost of unnecessary overnight electrical use	j	<input type="text" value="g \times h"/>	
Predicted annual energy cost of unnecessary out-of-hours energy use*	k	<input type="text" value="j \times 7200"/>	

*Note 7,200 hours derived from total number of hours a year (24x365) of 8,760, minus a 39-week school year with 8 hours a day, 5 days a week occupation (39x8x5) - 1,560 hours. Assumes equipment is left on during weekends and holiday periods as well as overnight.

Walk round checklist

This checklist should be photocopied for each area of the school and can be used to collect information for each room at four separate times.

Walk round checklist				
Area:	Date of inspection:	Inspected by:		
Time of Inspection:				
Pre-occupancy				
Has lighting been left on unnecessarily?				
Have PCs/screens been running overnight?				
Is any electrical equipment running unnecessarily?				
What is the room temperature? <i>Is this excessive?</i>				
Does the room have a thermostat? <i>Is it set correctly/does it work?</i>				
Is any portable electric heating running? <i>Should it be switched off?</i>				
Are radiators/heaters free from obstructions?				
Have doors/windows/other areas been left open?				
Are there any other problems?				
Occupancy				
Has lighting been left on in unoccupied areas?				
Could daylight be used more effectively?				
Have unoccupied PCs/screens been left running?				
Is any electrical equipment running unnecessarily?				
What is the room temperature? <i>Is this suitable?</i>				
Does the room have a thermostat? <i>Has it been tampered with?</i>				
Is any portable electric heating running? <i>Could it be switched off?</i>				
Are radiators/heaters free from obstructions?				
Have doors/windows/other areas been left open?				
Are there any other problems?				
Post-occupancy				
Has lighting been left on in unoccupied areas?				
Have all PCs/screens been turned off?				
Is any electrical equipment running unnecessarily?				
What is the room temperature? <i>Is this suitable?</i>				
Does the room have a thermostat? <i>Has it been tampered with?</i>				
Is any portable electric heating running? <i>Should it be switched off?</i>				
Are radiators/heaters free from obstructions?				
Have doors/windows/other areas been left open?				
Are there any other problems?				

Specialist area checklist

This checklist should be photocopied and can be used to collect information at four separate times.

Specialist area checklist				
Building:	Date of checks:	Checked by:		
Time of Inspection:				
Pre-occupancy				
Are there any leaks/drips? <i>Look at taps and showers</i>				
Are there any controls on the extractor fans? <i>Are they working?</i>				
Are there any urinal water controls? <i>Are they working?</i>				
If the water is electrically heated, are there any time controls? <i>Are they working/set up correctly?</i>				
Kitchens				
Are the extractor fans fitted with controls? <i>Are they working/set up correctly?</i>				
Does the hot water production have time control? <i>It may come from the main plant room or be separate</i>				
Is any equipment running unnecessarily? Check: Plate warmers Ovens Hobs Lights				
Swimming pool				
What temperature is the pool water?				
What is the air temperature in the pool hall?				
Does the swimming pool have a cover? <i>Is it in good condition?</i> <i>When is it being used?</i>				
Are the extractor fans controlled to just avoid condensation, or do they run continuously? <i>Are there any time/humidity controls? What are they set to?</i>				
Any other issues				
Are there any other problems?				

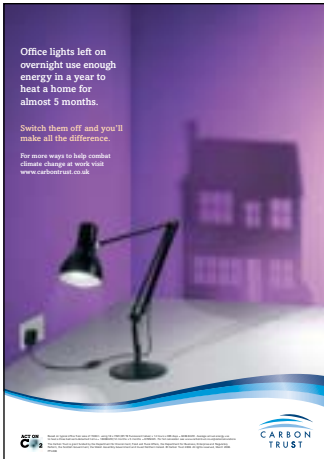
Maintenance checklist

This checklist should be photocopied and can be used to collect information at four separate times.

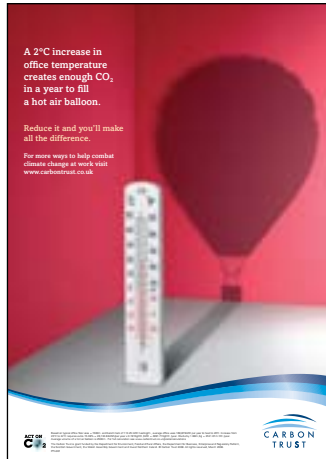
Repairs and maintenance checklist				
Building:	Date of checks:	Checked by:		
Time of Inspection:				
Heating and hot water				
Arrange for boiler to be serviced and ensure engineer checks: <i>Combustion efficiency</i> <i>Flue gas temperatures</i>				
Install/repair/replace controls/thermostat <i>Check controls are set correctly</i>				
Ensure boilers are sequencing correctly				
Install/repair/replace thermostatic radiator valves (TRVs) <i>Check TRVs are set correctly, i.e. not max or min</i>				
Clean air filters in fan convector heaters				
Improve draught seals <i>On doors, windows and any other areas where warm air is escaping from the building</i>				
Lighting				
Clean lamps and light fittings				
Clean windows and roof lights				
Replace flickering fluorescent tubes <i>Where possible, replace 38mm tubes with 26mm tubes</i>				
Replace tungsten bulbs with energy saving bulbs				
Clearly label all light switches and try to change the labels regularly to encourage people to notice them				
Water				
Repair leaking/dripping taps				
Repair leaking/dripping showers				
Install/repair/test urinal water controls				
Check overflows in toilets/storage cisterns				
Air extraction				
Install/repair/test kitchen extractor fan controls				
Install/repair/test toilet extractor fan controls				
Install/repair/test swimming pool hall extractor fan controls				
Swimming pools				
Repair/replace damaged swimming pool covers				
Any other issues				
Are there any other problems?				

Posters

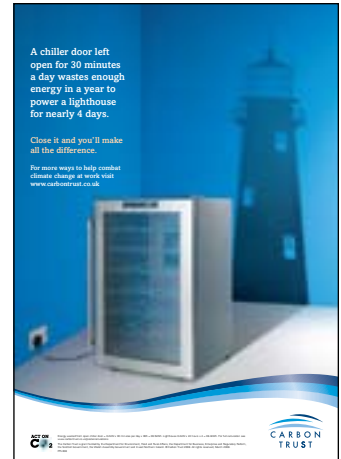
The following posters are available free from the Carbon Trust website www.carbontrust.co.uk/energy



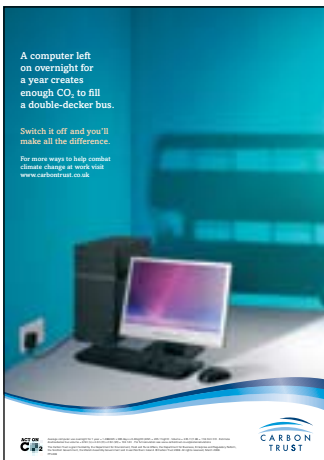
PFL306



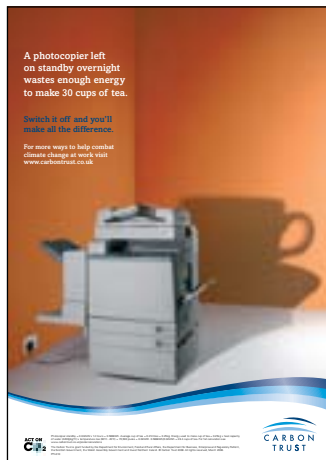
PFL307



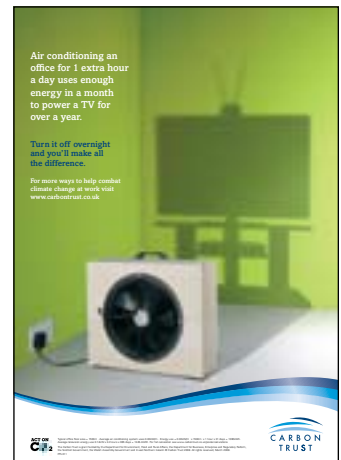
PFL308



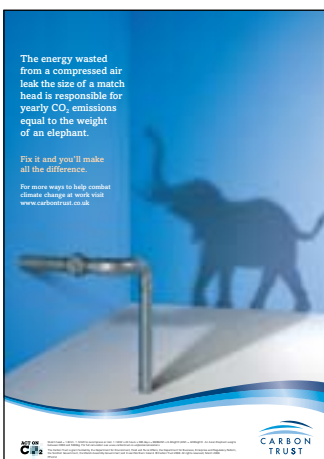
PFL309



PFL310



PFL311



PFL312