Resource Efficiency Guide for Schools

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1 Introduction

The primary purpose of this Guide is to provide Building Managers, Facilities Managers and Caretakers with guidance and reference information that can be used to help improve resource efficiency in schools.

1.1 Background to Resource Efficiency

As resources become increasingly scarce and energy prices continue to rise resource efficiency is increasingly recognised as a valuable method of reducing running costs and other overheads, which could release funds for curricular activities and facility improvements.

In addition to the financial benefits, there are environmental and social benefits to be gained by becoming more resource efficient, such as reducing your school's Greenhouse Gas (GHG) emissions and meeting regional and national targets, raising awareness of these issues amongst pupils and staff, and providing pupils with an excellent opportunity for real-life learning.

This Guide aims to highlight some opportunities available to schools and provide guidance to allow you to help your school to reduce its energy, waste and water consumption.

1.2 Identifying Key Stakeholders within the School

The first step for schools working towards improved resource efficiency is to identify key stakeholders and gain their support in implementing initiatives to reduce resource consumption. The diagram to the right shows possible stakeholders and an outline of their potential roles. As Building Managers, Facilities Managers and Caretakers you are in a unique position to play a key role in bringing together and organising stakeholders and delivering resource efficiency projects.

Note: this diagram is a generic outline of stakeholders and is likely to be different from school to school, stakeholder mapping may need to be conducted by each school to ensure relevant personnel are engaged and involved in this process.

1.3 Collating and Analysing Data

Once you have identified the key stakeholders, the next step is to ensure that the school is collating and considering relevant data for the following components:

1. Electricity consumption;
2. Natural gas consumption;
3. Other on-site fuel consumption;
4. Waste production and its management;
5. Water consumption; and,
6. Wastewater production.

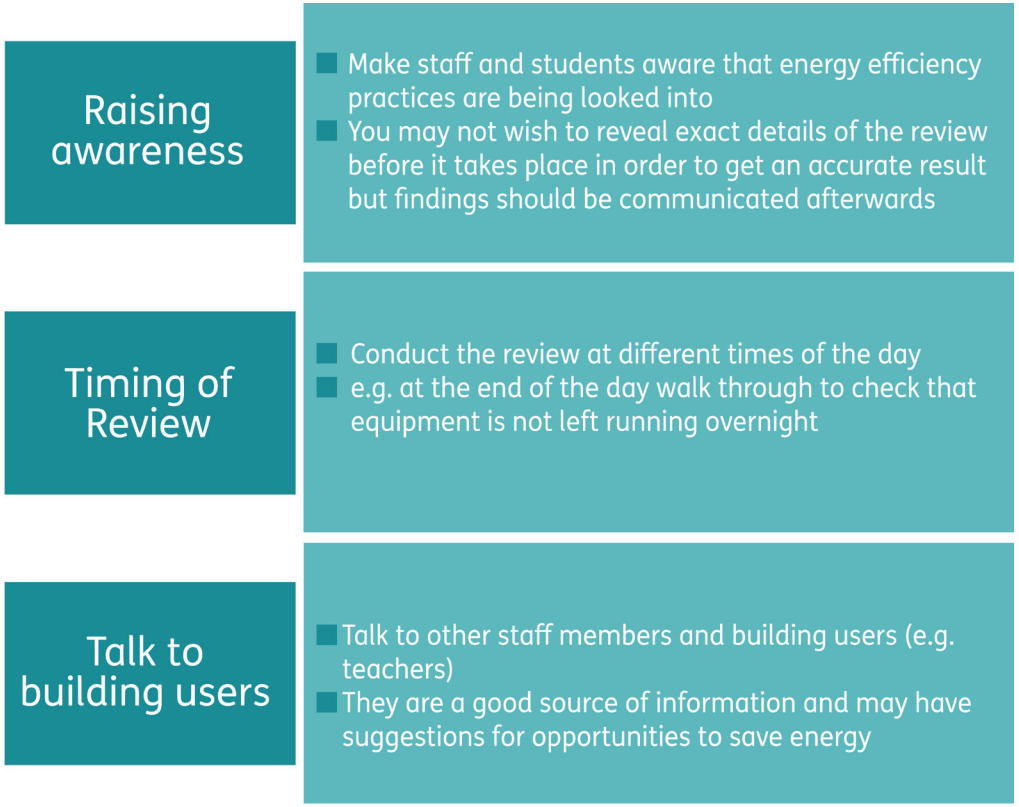
This initial data gathering exercise is fundamental, as the school will not be able to manage these aspects effectively without gaining an initial understanding of the current on-site consumption and waste production. Specific guidance on which data to record and how to record it can be found in the **Energy**, **Waste** and **Water** sections of this Guide. To help you with this a resource efficiency data management tracker has been provided with this Guide.

1.4 Conducting a review of resource efficiency practice

Once the initial review of key data is complete the next step (note that often these steps can be undertaken in parallel with each other) is to review the energy, waste and water management practices in the school.

It is suggested that all stakeholders within the school are made aware of the review and are encouraged to assist where possible. To gain a picture of the school's resource efficiency practice, a review in the form of a walk around the school should be conducted at different times on different schools days (particularly important when reviewing energy and water management practices).

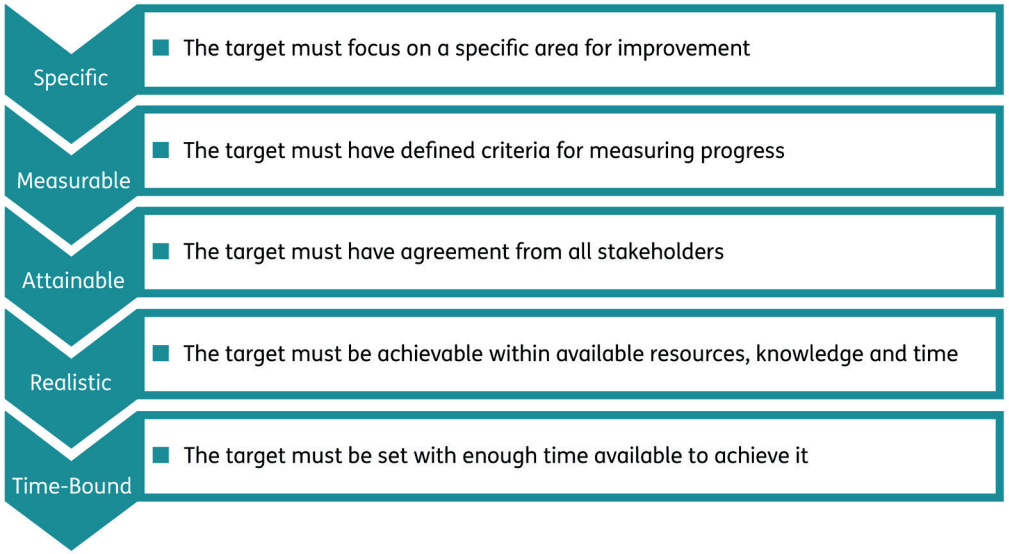
A suggested template for the review is provided in Appendix A. The template recommends noting the details of the review itself (e.g., who conducted the review, and when was it undertaken); the remainder is primarily a checklist to work through with space to note down observations. See the graphic below which summarises key actions when undertaking a review.



1.5 Setting Targets

It is recommended that a committee is formed from the relevant stakeholders highlighted in the stakeholder diagram in Section 1.2. If the school has an eco-committee or a green team you may wish to include resource efficiency of the estate within its remit. This committee should work together in collaboration to agree and approve collective resource efficiency targets.

When setting targets the school should consider, for example, other targets set by the Eco School Programme and their respective Local Authority. Targets should be designed to be SMART as described in the figure below:

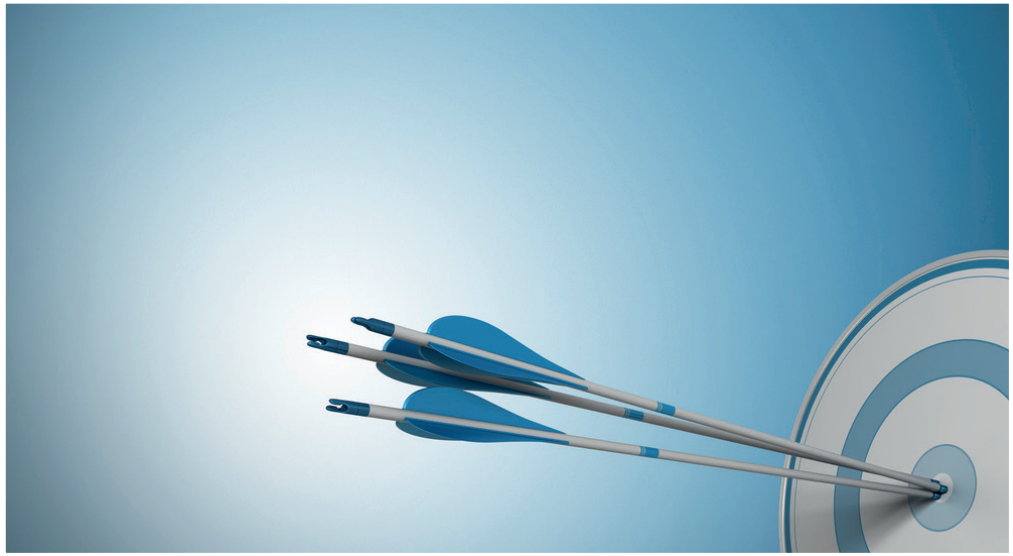


1.6 Developing an action plan

When the necessary data has been collected, a review of resource management practices has been conducted, and resource efficiency targets have been set, the next step is to develop an action plan. This should be a collaborative exercise and the committee may wish to lead the development and implementation of the action plan. The committee should agree to an action plan, based on all the information collated, which will enable the school to meet its targets and improve overall resource efficiency.

The action plan should include:

- A list of projects to be implemented, including the following information:
  - anticipated capital costs, likely payback periods and benefits;
  - probable timescales;
  - details of who is responsible for overseeing the implementation and monitoring of the project effectiveness;
- A range of low cost initiatives which will help to raise the profile of resource efficiency, change staff and student behaviour, and provide 'quick wins'; and,
- Larger or longer term projects that improve the school's infrastructure and as a result improve performance and reduce overheads.



1.7 Ongoing communications

Once the action plan has been agreed and projects are being undertaken it is important to communicate progress against the initial action plan and the targets to the school community and external stakeholders.

Monitoring of energy, waste and water data should be undertaken regularly to allow analysis of the impact that different projects are having, identify payback and to monitor progress against the targets. This information should be communicated to key stakeholders within the school and relevant external stakeholders. This will allow informed interventions to take place if a project is not performing as well as predicted and can ensure that resources (including staff time and financial) are not wasted on projects that are unsuccessful. If projects are not working, consider why this may be the case, perhaps the project was too ambitious, or there was not appropriate buy-in from stakeholders.

Successes can be celebrated by recognising the key individuals and teams involved and the activities could be integrated into the life of the school to enhance the awareness amongst pupils. This is important to ensure the momentum around resource efficiency is maintained, which is key to implementing successful resource efficiency programme.

The following sections provide a more detailed guidance on energy, waste and water management. Each section is structured as follows:

- Introduction;
- Data;
- Possible initiatives; and,
- Summary.

At the end of the guide there is a summary of all aspects of the guide. There is also a list of further sources of resource efficiency information and help.

2 Energy Management

2.1 Introduction

The school estate in Scotland is responsible for at least 15% of Public Sector greenhouse gas emissions and 50% of local authority emissions. There are significant opportunities to improve performance, save money, avoid adverse environmental impact and provide learning opportunities.

You can make a difference in your day-to-day activities. Particularly in older schools there are great opportunities to make savings in energy use. This acts not only to protect the environment and reduce emissions, but also to save money and enhance the school environment for all. Cost saving through energy management can be significant, freeing up funds for use elsewhere. It is estimated that schools could save 20% on their energy bills through a combination of behavioural change and improved energy management.

This section of the guide will help you to understand and reduce the energy use in your school. This section covers:

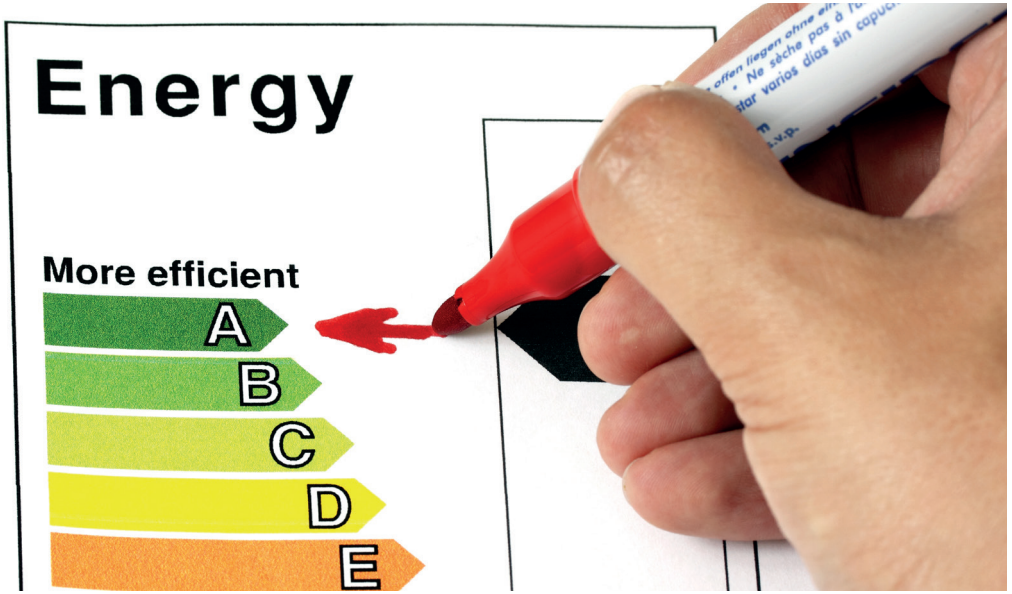
- Energy data
  - Understanding the amount of energy used at the moment, and tracking any improvements you make
- Initiatives which can make improvements
  - This includes ideas for optimising your Building Management System (BMS), using lighting, heating and hot water controls, and installing renewable energy technology

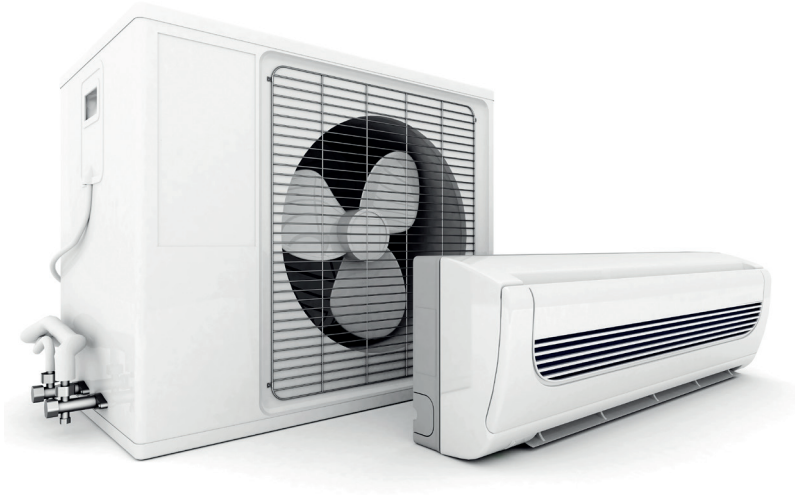
2.2 Energy Data

Essential to the process of energy management is an understanding of the school's energy consumption. Without an understanding of the amount of energy used on your site it is difficult to develop a targeted reduction plan and then track the impact of energy saving measures once they are implemented.

Some tips for collecting energy data:

- Record your meter readings and compare your readings with your bills
  - This will not save you any energy by itself, but it will help you pick up problems with meters or your billing. Getting these resolved quickly can help reduce incorrect billing and any associated issues;
- Record your energy consumption to show your energy use profile over time, detailing days of the week and months of the year where energy use is highest;
- Take meter readings last thing at night and first thing in the morning;
  - This lets you see how much energy is used when the school is closed at night and over the weekend. You can then consider whether out of hours energy use is higher than it should be. Excessive out of hours use can be a good area to focus on finding energy savings;





- Know what meters you have and what they cover, this can be used to target equipment or activity that contributes most to your energy consumption;
  - If you have a half hourly meter (HHM) (if you are unsure you can check with your supplier) it is usually possible to request the HHM data. Some suppliers will even provide this data in a pre-analysed form providing daily profiles for electricity (and occasionally gas) consumption and often providing details of days with the highest consumption;
  - Sub-metering (measuring energy use on multiple meters across different buildings or departments) provides a breakdown of the energy use on a site. It can help to highlight and monitor energy intensive areas such as boilers, catering facilities and swimming pools. This can also be particularly useful if services are provided by a third party such as catering (who may pay for the energy and water use associated with their activities); and,
  - If sub-metering is possible sub contractors, such as catering staff, could be given more responsibility in reducing their energy use because it can be monitored separately.

Energy benchmarks can be a good way to monitor your school's performance by comparing one year against another. There are a number of ways to develop a benchmark for your school:

- Floor area basis
  - Divide your total annual energy use (in kWh) by the gross floor area of the school (in m^2) to get a benchmark figure (kWh/m^2)
- Student number basis
  - Divide your total annual energy use (in kWh) by the total number of students in the school to get a benchmark figure

Benchmarks can be used to measure performance against other schools through published benchmarks such as those in the Chartered Institute of Building Services Engineers (CIBSE) Guides[1]. However, care needs to be taken when making comparisons, as newer buildings may be inherently more efficient than older buildings, and your performance may be biased by factors such as swimming pools, on-site catering and intensive use of the buildings during holidays.

2.3 Potential initiatives to reduce energy consumption

2.3.1 Optimising your Building Management System (BMS)

Heating and ventilation (and cooling if present) may be controlled via a Building Management System (BMS).

Using the BMS

If a BMS is present a control panel or dedicated BMS computer should exist on your premises (known as a BMS interface)

It is important that you have an individual who is confident in using your BMS interface and has had the appropriate training from your BMS provider. Many BMS providers will provide the relevant training free of charge, or for a very small cost.

[1] These guides can be purchased from the Chartered Institute of Building Services Engineers' website or are free to CIBSE members

Making changes to the BMS to alter the way that the building temperature and ventilation is controlled can have a large beneficial impact upon energy consumption, with even simple, low-cost measures making a difference.

Often timings and the usage of areas change as the needs of the site change. For these reasons BMS optimisation should be a priority for your energy management programme and as a minimum should consider the following measures. Note that it is important that feedback is sought from staff and students on a regular basis to check that comfort levels are being maintained and that any problems are highlighted and dealt with quickly. This will help to reduce tampering with controls, use of secondary heating/cooling and the opening windows in mechanically ventilated spaces.

Temperature set-points

Guidelines from the Department for Education and Skills (DfES) recommend the temperatures shown below:

Temperature	Available Spaces
☐ 18°C	Normal teaching spaces (classrooms, etc.)
☐ 15°C	Circulation Spaces (e.g., corridors) and areas of high activity such as sports halls
☐ 21°C	Special needs schools, low activity areas or areas with very young children

- Maintain optimum temperatures for staff and students. This improves comfort conditions and can help boost attentiveness. Comfortable students can be easier to communicate with and contribute to a more productive learning environment;
- Unless temperatures are grossly inappropriate, adjustments to set points should be made gradually to find desired temperature that is suitable for a particular area. Gradual changes to temperatures can also avoid complaints or conflicts with staff and students which often go un-noticed; and,
- It is important to ensure BMS sensors are not influenced by draughts, sunlight or internal heat sources. Ensure that where possible radiators and vents are not obstructed by equipment or furniture and that filters are kept clean and free of dust.

Plant timings

- Heating and ventilation needs will vary throughout the day and week, so it is important to check that the system operating hours match the times when building services are required;
- Ensure that heating and ventilation are not operational out of hours except where they are required for specific purposes (e.g., swimming pools);
- Time settings should be adjusted so that the building reaches optimum temperature just as building users arrive at the start of the day; and,
- Time settings should be adjusted gradually, always checking the response of the building and the occupants, consideration should be made to the fact that different timings will be appropriate on different days and at different times of the year. Time settings should be checked at regular intervals (at least monthly) to ensure that they are appropriate.

Other systems

The BMS may also control systems other than heating ventilation and cooling (HVAC) for example lighting and hot water;

- Timings and set points must be appropriate for building use;
- Systems should be switched off when not required (bear in mind the requirements for legionella, etc.); and,
- It is important that feedback is sought from staff and students on a regular basis to check that comfort levels are being maintained and that any problems are highlighted and dealt with quickly.

2.3.2 Lighting, Heating and Hot Water Controls

Where systems are not controlled by a central BMS it is essential that local controls are optimised to make sure that lighting and heating are appropriate for the area in question.

Lighting Controls

Adequate lighting is essential for an effective learning environment; lighting accounts for approximately 10% of the total energy used in an average school. There are frequently opportunities for energy savings through simple housekeeping measures;

- Raising awareness with staff and students of the benefits to both the school (reduced costs) and the wider environment (less greenhouse gas emissions) can help to encourage more efficient behaviour. Raising awareness can be facilitated through posters or sticker prompts and also through assemblies and other existing meetings;
- Where glare from the sun is an issue, blinds should be orientated to direct sunlight towards the ceiling of the room, reducing glare and the need for the use of artificial light. If possible blinds which reduce glare but allow light to filter into the room should be installed;
- Where areas are occupied and/or daylight controls are present, ensure that timers and Digital Addressable Lighting Interface (DALi) settings are optimised; and,
- Where only on/off switches are present consider fitting enhanced lighting control such as:
  - time switches with a manual override for teaching areas
  - occupancy sensors in intermittently occupied spaces
  - daylight control for areas with good daylighting (adjacent to windows or in atria)

Heating Controls

Where a BMS is not present, assess the level of control that is currently available and how easily it can be improved;

- Temperature set points and timing controls are important; this can be more difficult to achieve when a BMS is not present as a number of different systems may need to be optimised (for example boiler time clocks, thermostats, and radiator valves etc.) and therefore any adjustments should be gradual over time to fully assess what the effect is; and,
- Timers should have the capability to be set across a period of seven days to account for different usage and occupancy patterns throughout the week.

A limited upgrade to controls may provide significant benefits in terms of energy saving:

- External temperature compensation control will modulate the internal temperature of the building and switch the heating system off completely once a particular external temperature is reached;
- Various types of controller are available that 'learn' how the building warms up depending on time of year and building occupation to determine the optimum time to begin heating the building;

- Fitting tamper-proof thermostatic radiator valves can prevent temperatures being adjusted in areas where radiators are present. Where thermostats are present staff should be discouraged from using them as on/off switches and if possible tamper-proof covers should be used. If some temperature control is required then investigate whether a limited range thermostat (+/- 3°C) can be installed. Thermostats should be located out of the way of draughts, sunlight or internal heat sources. Ensure that where possible radiators and vents are not obstructed by equipment or furniture and that filters are kept clean and free of dust; and,
- Where comfort cooling is installed interlocks should be fitted which do not allow cooling to be activated unless the outside air temperature is above a certain point. This prevents cooling being used when the ambient temperature is low and therefore cooling could be achieved by opening windows (provided natural ventilation is present).

Hot Water Controls

Excess use of hot water is a waste of energy and water. Energy costs relating to hot water can be reduced without compromising safety or hygiene through careful consideration of your existing infrastructure and rigorous and pro-active maintenance;

- Fit sensor-activated taps in toilets and changing rooms;
- Ensure that pipe and tank insulation is adequate and well maintained (also applies to wet heating systems); and,
- Rationalise the system where possible – it may be more appropriate to have point-of-use water heaters in some areas.

When tackling energy use with regards to hot water care must be taken to ensure that health and safety and other requirements, such as those pertaining to Legionella control are strictly adhered to.

2.3.3 School Shutdown

Good practice concerning lighting and heating shutdown at the end of the day is dealt with in the earlier sections of this chapter. This section covers specialist learning equipment which can be highly energy intensive;

- Consider energy efficiency when procuring new ICT equipment;
- Effective communication with ICT technicians should be undertaken to establish the most efficient guidelines for staff and pupils, some of the following energy saving techniques could be established but implementation will depend heavily upon your school's system:
  - Where ICT is networked it is possible to remotely switch on computers (wake-on-LAN) using software that may already be built in to your operating system, otherwise proprietary software can be purchased;
  - Ideally all equipment should be switched off when not in use, however as a back-stop all equipment could be set to power down automatically at the end of the day (with the exception of specific systems where required); and,
  - ICT should be set up to 'hibernate' or 'sleep' if left idle for a pre-set time period, for example 10 minutes.

Also important is other small power and specialist equipment, particularly in art, science and technology departments:

- Conduct an inventory of equipment to identify an individual responsible for the maintenance and safe and efficient operation of that equipment;
- It is important that staff and students are aware of the energy consumption of equipment and that it is switched off after use where appropriate. It may be appropriate in areas where curriculum based equipment is used to assign responsibility to individuals to check that equipment is switched off at the end of the day;
- Unless immediately obvious, equipment should always be supplied with simple to use instructions that detail the most efficient means to operate the equipment; and,
- Equipment such as glass drying cabinets and fume cupboards are large consumers of energy and should be switched off when not in use. Where fume cupboards cannot be switched off users should ensure that the sash is positioned as low as possible to reduce the volume of air that must be drawn through the cupboard. A simple sticker that alerts the user to the energy cost of leaving the sash open can prompt good user behaviour.

Swimming pools are likely to be major users of energy

A pool cover allows heating ventilation and cooling to be reduced when the pool area is unoccupied. The pool cover should only be removed when the pool is in use. If the pool is used by the community out of hours make sure that an individual has designated responsibility for covering the pool at closing time.

Where possible heat recovery should be used to recover heat from the ventilation exhaust and used to pre-heat the ventilation inlet. For other aspects of pool maintenance, such as backwashing, manufacturer's instructions should be followed.

An investigation into alternative backwashing regimes could be undertaken into how to save energy, however any switch in regime should not be carried out without prior consultation with the manufacturer or pool installation specialist.

2.4 Summary

This section has covered energy management opportunities, ranging from no cost, through to low cost and high capital cost.

The first stage to implementing any of the initiatives suggested in this guide is to understand the amount of energy used at the moment. This will help identify areas where you can make the most difference. Management of your energy data will also enable you to track the impact of any improvements made in future.

The opportunities identified save money through the improvement of energy efficiency and reduction of electricity, gas and hot water use. It is important to identify which opportunities can be used in your school to make a difference in your day-to-day activities. The opportunities covered in this guide include ideas for optimising your Building Management System (BMS), using lighting, heating and hot water controls, and installing renewable energy technology.

CASE STUDY Notre Dame Primary school: Installation of Combined Heat & Power and Ground Source Heat Pumps and Behavioural Change

The refurbishment of a local landmark dating back to 1894 was conducted, bringing together several low carbon technologies to achieve annual savings of up to 125 tonnes CO_2 and £48,000.

The build and refurbishment project funded by Glasgow City Council cost £12.3 million and took place over a three year period, allowing the amalgamation of two primary schools and the integration of a nursery school into the site.

CASE STUDY Speyside High School: Installation of biomass Boilers

In 2008 the process began for the installation of a biomass boiler in Speyside High School, Aberlour. Undertaken by Moray Council, the project cost £350,000 and led to annual savings of £55,000 on the fuel alone, with a further £50,000 of forecast annual savings through the Renewable Heat Incentive (RHI) payments. A reduction in carbon dioxide emissions of 96% has been achieved through the substitution of biomass for oil.

3 Waste Management

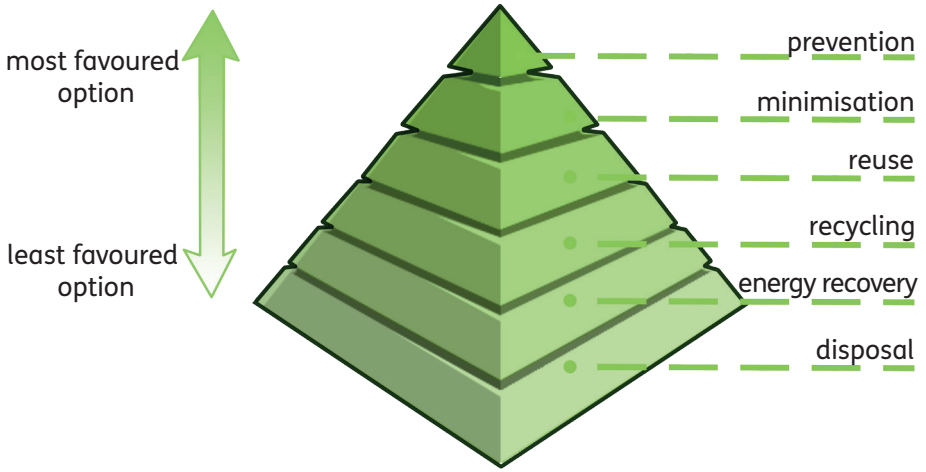
3.1 Introduction

Scotland produces about 20 million tonnes of waste a year and the average primary school produces 45 kg of waste per pupil per year; secondary schools produce less, at an average of 22 kg of waste per pupil per year. In schools the majority of waste is made up of food, paper and packaging, as well as glass, plastic, and metal.

Landfill capacity is due to run out by 2018 and if current rates of disposal continue there are concerns about the health impacts of this disposal technique. Recycling and other more sustainable waste management techniques are helping to reduce waste to landfill but much can still be done. The waste hierarchy shows the most and least sustainable methods of waste disposal.

This section will cover how to collect and estimate your waste data and suggested initiatives to reduce waste.

The Waste Hierarchy



The Waste (Scotland) Regulations now require all schools in Scotland to take all practicable steps to recycle as much of its waste as possible. If your school produces over 50kg of food waste per week, you must present it for segregated collection.

Other requirements of this new regulation include:

- All businesses and organisations to present key recyclable material for collection from 1 January 2014;
- Food waste businesses producing over 5kg of food waste per week to present it for separate collection from 1 January 2016;
- A ban on the use of macerators to discharge food waste into the public sewer from 1 January 2016;
- Local authorities to provide a basic recycling service to all households by 1 January 2014;
- Local Authorities to offer a food waste recycling service in non-rural areas from 1 January 2016;
- A ban on material collected for recycling going to landfill or incineration; and,
- A ban on municipal biodegradable waste going to landfill by 1 January 2021.

3.2 Waste review and data

The first step in reducing waste and improving recycling within your school will be to find out what is currently thrown away by the school and undertake a review of waste management practices.

A waste review can:

- Establish the main waste streams generated by the school and how they are currently managed;
- Provide information on which activities produce the most waste; and,
- Help identify and prioritise opportunities to improve waste reduction and management, including optimising container size and collection frequency.

The waste review should be repeated at set intervals on the same waste bins to assess the impacts of improvements implemented. Improvements can be publicised on school notice boards to promote the ongoing success of a waste reduction schemes and promote more participation. The resource efficiency checklist in Appendix A provides information on how to undertake a waste review.

Your waste management contractor or Local Authority's Environmental Services Team may be able to help quantify the amount of waste your school produces and provide data. If the data is available then it is recommended that you record it in the Resource Efficiency Data Management Tracker provided with this Guide and then set up a system for ensuring the data is provided on an ongoing basis. If they are unable to provide data the internal waste review will provide relevant information and volumes.

Introducing a Waste Minimisation Programme

Once the waste review is complete and the results analysed the next step is to develop a waste minimisation programme. There are many benefits of introducing a programme such as reducing costs and minimising environmental impacts, in fact Scotland spends over £100 million throwing away recyclable materials. There are also educational benefits for pupils and teachers, and the school can

experience financial savings, by evaluating the school's waste according to the general rules of 'the four Rs':

- Can we **remove** (eliminate) it? If not,
- Can we **reduce?** If not,
- Can we **reuse?** If not,
- Can we **recycle?**

The Eco-Schools Programme in Scotland has resources to support waste minimisation http://www.keepscotlandbeautiful.org/sustainable-development-education/eco-schools/ten-topics/waste-minimisation

3.3 Potential initiatives to reduce waste and improve recycling

Possible initiatives which could be introduced within the school to reduce waste and improve recycling can be divided into those that apply to the school as a whole and those that apply to specific areas of the school (e.g., school office, catering facilities, offices and office equipment/classrooms). Many of the initiatives are straightforward and simple to implement, and they should be implemented gradually to avoid any significant change.

3.3.1 The School as a whole

- Repair broken items where it is safe to do so and where possible or engage with online services within the local area between schools, nurseries, playgroups, community centres and other similar organisations to share unwanted items;
- Donate unwanted school equipment to charities and non-for-profit organisations which can find reuse opportunities in developing countries;
- Send old and broken IT equipment to organisations which can refurbish for reuse;
- Find the local "re-use network" which could have links to others who could reuse equipment;
- For wooden furniture there may be a local Wood Recycling Project http://www.communitywoodrecycling.org.uk/ refurbishes unwanted furniture for reuse and resale;
- Avoid the use of disposable items such as paper or plastic cups and paper towels; and,
- Provide water fountains and promote the use of reusable drinking bottles.

3.3.2 School Office

- Set all printers to double sided printing;
- Ensure paper purchased for the school have a high recycled content (e.g., paper which is FSC certified);
- Encourage electronic communication where practical to reduce paper use;
- Participate in mobile phone, printer cartridge and battery recycling schemes;
- Participate in reuse schemes for scrap paper and craft materials like Scrap Store UK https://www.scrapstoresuk.org/ ; and,
- Liaise with the Governors and Parent Teacher Organisation for reuse opportunities for unwanted uniforms.

3.3.3 Catering facilities/kitchen areas

- With the catering manager review all sources of food waste, any over ordering, stock rotation, kitchen wastes and portion sizes - in Scotland, we throw away 566,000 tonnes of food every year, much if which could have been eaten. This good food and drink costs us around £1 billion a year;

- Introduce a school meal selection system to reduce over production;
- Encourage pupils with packed lunches to take waste and uneaten food home (parents can also see what has not been eaten);
- The Love Food Hate Waste Campaign website contains practical hints, tips and recipe ideas for reducing food waste (www.lovefoodhatewaste.com);
- Provide food waste caddies along with an education programme to inform what wastes are acceptable, such as teabags, coffee grounds, fruit peelings and cores; and,
- It may be possible to compost some food waste for use on the school grounds.

When considering actions to take regarding waste, especially with respect to composting, it is important that they do not conflict with the waste regulations, such as food waste collections, mentioned in section 3.1. It is also important to consider the space and security requirements.

3.4 Summary

There are many benefits for the school in introducing a program to minimise the volume of waste generated and improve recycling; these could be to reduce overheads and costs (not just in the disposal of waste but through spending money on things which are not needed and thrown away, e.g., producing too many school meals and over purchasing), meet legislative requirements and wider national and regional resource efficiency targets. There are also numerous environmental benefits associated with reducing waste this could include any of the following:

- Reduction in pollution resulting from in correct waste disposal;
- Reduction in production of greenhouse gases from waste treatment and transportation; and,
- Reduction in raw material use and the associated adverse environmental impacts

There are also educational benefits for pupils and teachers who can experience real personal rewards, the school environment can be improved and it can receive recognition, funding and reward for its efforts in resource efficiency.

CASE STUDY North Ayrshire Council: Bringing schools together to tackle food waste

North Ayrshire Council selected four local schools to take part in a project to set a food waste baseline. Bins and provision for waste separation were strategically placed throughout the schools to promote waste minimisation.

The project lead to the realisation that catering staff had control over waste generation and the success and learnings of the project informed the planning process for food waste collection on a wider scale by the Council.

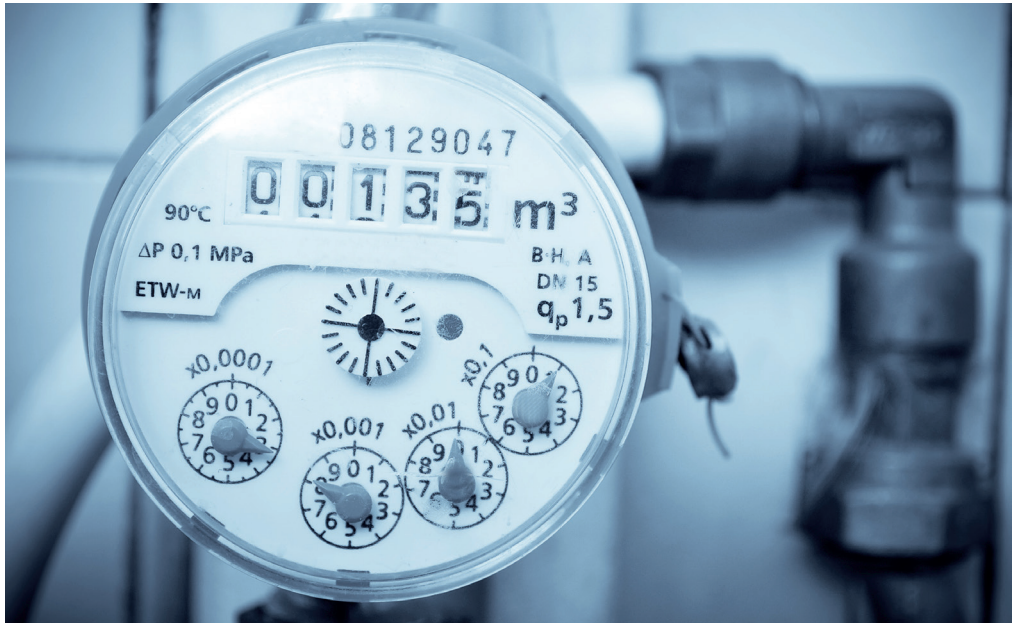
4 Water Management

4.1 Introduction

Water is a resource that we share with the environment. It is essential to the health and wellbeing of people through direct uses like drinking and washing through to enjoying the water in the environment.

Treating water for our use has an environmental, energy and economic cost associated with it. By being water efficient, it is possible to safeguard supplies for the future; save money, energy and reduce greenhouse gas emissions.

This section on water provides an overview on collecting water data and how to begin to monitor water use for your school. This Guide also provides suggested opportunities for reducing water consumption.



4.2 Water Data

Understanding the amount of water consumed in your school is essential. Without accurate data for the estates' water consumption and waste water (sewage) production, a targeted reduction plan cannot be made without the data. This information is also crucial to track the progress of the action plan and the impact of water saving measures implemented.

Collating and analysing data

It is recommended that water readings are taken from the main water meter onsite and from sub-meters where these are in place. Water consumption per building can then be recorded in the Schools' Resource Efficiency Data Management Tracker which accompanies this Guide and compared against your utility bills. Doing this can also highlight discrepancies in billing, which can help to ensure invoices are accurate in the future.

Analysing water consumption data will highlight particular times when water consumption is higher than usual. Where schools have half hourly water meters in place a daily profile can be reviewed to highlight peak points in a day and thereby help to identify the equipment or activities that are using the most water.

Overnight and weekend water usage

Good practice exercises that all schools should undertake regarding their water consumption data include:

- Take a meter reading at night and then in the morning before staff and pupils come in; and,
- Conducting a meter reading on Friday after hours and Monday before staff and students enter the premises.

Both of these exercises will provide greater insight into how much water is used overnight and over the weekend and can often highlight water leaks and other areas of unnecessary water consumption.

Approximately 95% of water entering a school goes down the drain, so taking extra effort to reduce this figure can achieve cost savings as well as environmental benefits. Remember when measuring this that some losses may come from evaporative losses during cooling, this figure can be factored into your water bill.

Sub-metering

Schools can also consider the viability of sub-meters particularly for water intensive areas such as catering facilities and swimming pools. Sub-metering will give a more detailed breakdown of water consumption and allow better targeting of water saving measures and enable more effective monitoring of their impacts.

Sub-metering of third party areas such as catering facilities could be incorporated into the contract renewal process. Having the data will help to involve catering contractors in the Schools Resource efficiency programme.

Benchmarking

Benchmarking is a useful way of finding out how much water is being used compared to other similar schools and is an important tool for monitoring performance and progress. Benchmarking water consumption in a school is typically against the gross floor area or the number of students present at the school. To create a benchmark an annual figure for water consumption (measured in litres) is divided by either:

1. The total gross floor area of the school (metre squared, m^2) to give a benchmark figure in litres per metre squared per year (l/m^2/year) or,

2. The number of students in the school to give an alternative benchmark figure of litres per pupil per year (l/pupil/year).

4.3 Identifying main uses of water within the school

Once water consumption and data has been collated and analysed, and a baseline for annual consumption has been calculated, the next step is for the school to conduct a review of current water management practices. This can be done using the resource efficiency checklist given in the appendices, to identify the main uses of water on the school estate.

The review should be conducted by several different stakeholders from the school community working together in order to keep the momentum around resource efficiency going and also to gain local knowledge on different aspects of the school estate. When conducting the review, the water management checklist should be utilised to improve the review findings. Contractors such as kitchen staff could be given more responsibility to reduce their water use if sub-metering is available.

4.4 Potential initiatives to reduce water consumption

This section gives a range of potential opportunities to reduce water consumption in your school.

4.4.1 Taps

- Leaking taps can be repaired simply by replacing worn washers;
- Taps left running can waste enormous amounts of water. Consider replacing conventional screw taps with percussion taps that close automatically after a pre-set 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;
- If self-closing taps are not an option, sensors can be installed to turn off the taps when the basin is too full; and,
- Spray taps can save up to 50% 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.

4.4.2 Toilets

- Installing water dams and displacement devices in toilet cisterns reduces the water consumption required for flushing. It is, however, important to ensure that there is sufficient water to remove all soils;
- 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 alternative toilets could be considered for new built toilet facilities;
- 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; and,

- Older schools that do not have any control devices on their urinal tanks could benefit by installing automatic cistern flush controllers. When installing automatic flushing systems, ensure they can be turned off out of hours. The Water Regulations include various conditions that you must comply with if you are installing automatic flushing systems.

4.4.3 Hot water supplies

- Hot water taps and showers in schools can be a major source of wasted water particularly if pipes are long and not lagged properly. A great deal of tepid water may be wasted 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; and,
- 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.

4.4.4 Swimming pools and playing fields

- Swimming pools should not be drained and refilled more frequently 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; and,
- Your water company will give you advice on using water for swimming pools and playing fields.

4.4.5 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; and,
- 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.

4.4.6 Lawns and playing fields

- Do not 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; and,
- 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.

4.4.7 Greywater and rainwater

- One method of reducing the amount of mains water consumed is to use greywater or rainwater for certain applications;
- 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; and,
- 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 a full review of the amount of greywater produced before you make any decisions.

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

Greywater

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.

4.4.9 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; and,
- An internal thermostat in a normally heated room should turn on the boilers and heating when the internal temperature falls below 5°C.

4.5 Summary

There are many benefits to the school associated with saving water not just through the direct cost of water and sewerage but through a reduction in energy used to heat the water within the school. Additionally, the environmental benefits include:

- Less water requires treatment and the associated environmental impact is reduced; and,
- Flood risk can be reduced downstream during periods of intense rainfall by collecting water falling on the school site.

Additionally, there are great learning opportunities for students to monitor water use at different times of the day, to understand how water is used within the school, how water is treated before and after we use it. Additionally, they can calculate the cost benefit of saving water and how that can improve their school community.

CASE STUDY St Andrews High School: Water Efficiency Audit and Improvement Action Plan

A site-wide water efficiency audit was conducted in December 2013 at St Andrews High School (owned and operated by North Lanarkshire Council) by Resource Efficient Scotland's Water Efficiency Audit Team.

A bespoke water efficiency action plan was created outlining several areas where water efficiency could be improved in the school grounds.

By late January 2014 the water efficiency action plan had been implemented in full and led to an estimated 64% reduction in projected annual water consumption, saving £32,021 per annum.

5 Summary

This Guide is intended to provide Building Managers, Facilities Managers and Caretakers with guidance and reference information that can be used to help improve resource efficiency in schools.

Resource efficiency is an important consideration as resources become increasingly scarce and energy prices continue to rise. This Guide has shown how resource efficiency can be used to reduce running energy and water use, and water and waste disposal costs; potentially releasing funds for curricular activities and improving facilities.

In addition to the financial benefits, there are environmental and social improvements gained by becoming more resource efficient, such as reducing your school's greenhouse gas emissions and meeting regional and national targets, raising awareness of these issues amongst pupils and staff, and providing pupils with an excellent opportunity for real-life learning.

This Guide has given consideration to the key steps that need to be taken to assess the current baseline of the school, and to develop an action plan to improve resource efficiency:

- Stakeholders: identify key stakeholders and to gain their support in implementing initiatives;
- Data: ensure that the school is collating and considering relevant data;
- Resource efficiency review: review the energy, waste and water management practices in the school, do a walk-through review and speak to building users;
- Targets: form a committee of interested stakeholders to agree and approve collective resource efficiency targets; and,
- Action plan: include a list of projects to be implemented and the staff responsible for these.

A key principle for energy, waste and water management is the importance of data. Understanding energy and water consumption and waste production is essential to manage and improve resource efficiency. Without an understanding of the amount of energy, waste or water used on your site, it is difficult to develop a targeted reduction plan and then track the impact of resource efficiency measures once they are implemented. Specific information on what and how to record data is provided in the Energy, Waste and Water sections of this Guide. To help you with this a resource efficiency data management tracker has been provided with this Guide.

This Guide has covered many potential opportunities to reduce resource consumption for energy, waste and water. Further sources of information are provided in section 6.

Remember to keep tracking progress against the targets set. Continually review how initiatives are progressing, how your data is looking, and where further savings can be made. It's important to communicate progress against the action plan and the targets to the school community and external stakeholders. This could be via the school newsletter, on poster boards or during assemblies. Let the staff and pupils know what initiatives are in place and what savings have been made so far. Successes can be celebrated by recognising the key individuals and teams involved. This will encourage people to help out and do their bit to contribute to meeting the targets set.

6 Further Sources of Information

The following further sources of information may also help with improving resource efficiency in your school.

6.1 Energy

Resource Efficient Scotland

http://www.resourceefficientscotland.com/resource/resource-efficient-scotland-schools-pack-how-save-energy-your-school - Downloadable schools pack providing information on how to save encourage school children to save energy in their school.

Resource Efficient Scotland

http://www.resourceefficientscotland.com/resource/resource-efficient-scotland-renewable-energy-presentation - Downloadable presentation with information on different renewable technologies that may be appropriate for schools.

Energy Saving Trust

http://www.energysavingtrust.org.uk/scotland/Publications2/Local-delivery/Strategy-development/Guide-to-NI186-Schools - Downloadable guide with information on how local Councils can help schools reduce their energy consumption and carbon dioxide emissions.

Eco-Schools

http://www.keepscotlandbeautiful.org/sustainable-development-education/eco-schools/ten-topics/energy/ - The Eco-Schools Programme in Scotland has resources to support energy reduction.

Carbon Trust

http://www.carbontrust.com/resources/guides/sector-based-advice/schools - The carbon trust has several sources of information on energy reduction in schools and including a guide which has specific information on renewable energy.

Benchmarks

Chartered Institute of Building Services Engineers (CIBSE). 2008. CIBSE TM46 Benchmarks. Available at: http://www.cibse.org/Knowledge/CIBSE-TM-(1)/TM46-Energy-Benchmarks

Chartered Institute of Building Services Engineers (CIBSE)., 2012. CIBSE Guide F: Energy Efficiency in Buildings NEW 2012. Available at: http://www.cibse.org/Knowledge/CIBSE-Guide/CIBSE-Guide-F-Energy-Efficiency-in-Buildings

6.2 Water

Resource Efficient Scotland

http://www.resourceefficientscotland.com/resource/resource-efficient-scotland-how-save-water-your-school - Downloadable schools pack providing information on how to save encourage school children to save water in their school.

Eco-Schools

http://www.keepscotlandbeautiful.org/sustainable-development-education/eco-schools/ten-topics/water/ - The Eco-Schools Programme in Scotland has resources to support water reduction.

Zero Waste Scotland

"Implementing a Water Minimisation Programme: A complete guide for organisations in Scotland" takes organisations through a step-by-step programme of improvement. It looks at assessing the baseline through data collection exercises, provides technological solutions to common water issues, presents information on how to collate data and describes how to implement a successful water minimisation action plan and programme. http://www.zerowastescotland.org.uk/sites/files/zws/ZWS_Implementing_a_water_minimisation_programme_a%20_complete_guide_for_organisations_in_Scotland.pdf

WaterWise

The "Save Water at Schools" provides tips for saving water in schools. http://www.waterwise.org.uk/pages/schools.html

6.3 Waste

Confederation of Paper Industries

http://www.paper.org.uk/information/pages/school_resources.html - Downloadable teachers' information packs about recycling paper for Primary and Secondary schools.

The Recycling Guide

http://www.recycling-guide.org.uk - Fun website which shows step by step guides to what happens in the recycling processes for different materials such as, paper, cans and glass.

recycle-more.co.uk

http://www.recycle-more.co.uk/schools/homepage.aspx - Help and advice on all aspects of recycling at school, including teaching resources divided into age groups with activities. The 'downloads section also includes information on packaging labels and recycling.

Recycle Now Partners – Education and Schools

Recycle for Scotland. http://www.recycleforscotland.com/ - Advice, facts and figures on the topic of Reduce, Reuse and Recycle in Scotland.

Eco-Schools

http://www.keepscotlandbeautiful.org/sustainable-development-education/eco-schools/ten-topics/waste-minimisation The Eco-Schools Programme in Scotland has resources to support waste minimisation.

7.1 Resource efficiency review template

Please complete details about your school's resource use in the following tables. Where boxes are shaded, an answer is not required. By using the comments box frequently, you can keep track of your thought process as you carry out the review.

School Name	
Date	
Name of person carrying out the check	

1. ENERGY	Yes	No	Quantity and units (if applicable)	Comment
Are energy invoices available for electricity?				
- How much electricity has your school used in the last 12 months?				
- How much electricity has your school used in the previous 12 months?				
Are energy invoices available for gas?				
- How much gas has your school used in the last 12 months?				
- How much gas has your school used in the previous 12 months?				
Does your school use any other types of energy, if so, how much?				
- Oil				
- Solar				
- Wind				
- Other, please specify in the comments box				
Does your school have any sub-meters?				
- If yes, please specify which areas these cover in the comments box				
Are you able to allocate your energy consumption against any specific activities (e.g. gas used for boilers, electricity used for lighting). If so, please detail this in the comments box.				

1.1 ENERGY METERING	Yes	No	Comment
Where is your electricity meter located?			
Where is your gas meter located?			
Do you have smart meters?			
- If so, can half hourly readings be provided by the energy company?			
- Is live energy usage displayed in the school?			
Is energy usage measured during unoccupied hours?			

1.2 LIGHTING	Yes	No	Comments
Are you lights controlled by an on/off switch?			
Are you lights controlled by a dimmer switch?			
Are occupancy sensors installed? If only in specific areas, please detail in the comments box			
Are day light sensors or timers installed? If only in specific areas, please detail in the comments box			
- If timers are installed are they working correctly?			
Who is responsible for switching off lights that are not needed?			
Can lights be switched off individually in unused areas of zones?			
Can use of natural lighting be increased through opening blinds?			

1.2.1 TYPE OF LIGHTING FITTED IN THE SCHOOL	Number fitted	Which areas of the school are these used in?	Comments
Incandescent *(standard filament type bulb)*			
Fluorescent tubes *(standard tube lamp)*			
Energy saving bulbs			
LED Lighting			
Halogen down lights			
Other *(please provide details)*			

1.3 HOT WATER	Yes	No	Comment
Is your water heated by:			
- Electricity			
- Gas			
- Wood			
- Solar			
- Other			
Check the temperature settings; is the hot water too hot?			
Is water heated when it is not required?			
Is hot water stored in a central hot water tank?			
- Is the hot water tank insulated?			
Is the water heated only when it is needed?			
- If so, is it heated at point of use?			
Are hot water pipes insulated?			

1.4 HEATING	Natural Gas	Oil	Gas stored on site	Other (please specify)
How is the school heated? *(Please tick)*				

1.4.1 HEATING	Yes	No	Comments
Does the school have any radiators circulating hot water?			
- Please state which areas have these radiators in the comments box			
- Are the radiators the same temperature at the top and the bottom?			If no, they may need bleeding to remove any trapped air
Does the school have any warm air blowers?			
- Please state which areas have these blowers in the comments box			
- Are the vents free of dust?			If no, they may need cleaning to increase air flow
Does the school have air conditioning?			
- Please state which areas have air conditioning in the comments box			
Does the school have double glazing?			
- If some areas of the school are not double glazed, are there any areas where it could be installed?			
Do any areas of the school suffer from external drafts? *(please specify which areas in the comments box)*			
- Can seals be improved to prevent existing drafts?			
Are building occupants at a comfortable temperature?			
How is temperature controlled? Please specify in comments box			
Can temperature be adjusted by individuals other than building management staff?			
- If temperature can be adjusted by other individuals, by what means can they be changed (e.g., radiator valves, thermostats)			
Is the central heating controlled on a timer?			
- If so, is the timer synchronised with school opening and closing times?			
Is the heating system regularly maintained and serviced? *Please state the frequency of service checks in the comments box.*			

2. SOLID WASTE	Yes	No	Comment
Are recyclable materials segregated prior to collection?			
Is food waste collected separately?			
Has your waste management contract been reviewed in the last 12 months?			
Is there scope to increase the amount of materials recycled? Please state cost implications of this.			
Has a waste review taken place to establish which items end in in the bin?			
Can any of your unused or unwanted equipment be given to a local charity instead of being thrown away?			
Can old IT equipment be acquired for reuse once properly cleared of old data?			
Do consumable items contribute to the waste volume, i.e. are paper cups or towels used?			
Could green waste from school gardens or play areas be composted on site?			

3. WATER USAGE	Yes	No	Comment
Where is your water meter located?			
Are separate meters fitted for your major use areas (e.g., kitchens, swimming pools)			
Can readings be taken easily?			
- If so, can you take readings each day and plot water usage?			
- If so, can you take readings at end of day and again before school restarts?			

3.1 WATER WASTAGE	Yes	No	Comment
Are there any dripping taps? If yes, please specify their location in the comments box.			
Are low volume flush cisterns fitted in all of the school toilets *(i.e. 6 litres or less)*			
Are overflows on cisterns and water tanks flowing? *(If so, this could indicate faulty ball valves)*			
Do taps automatically switch off after use?			
Are spray heads of aerators fitted to the taps?			

7.2 Resource efficiency action plan template

The resource efficiency action plan should define specific targets, actions, responsibilities and deadlines for reducing impacts and achieving the desired improvements. The action plan should be quite detailed and cover specific actions. Objectives should be smart, supported by clear deadlines, well defined actions, and the team knowing and understanding their responsibilities.

	Focus Area	Project	Person Responsible	Capital Cost (£)	Savings (£)	Likely payback period (years)	Specific Actions	Completion Date	Complete (Y/N)
E.g.	*Energy*	*Reduce energy use by 2% by 2015*	*John Smith*	*£0*	*£250 per year*	*0 years*	*Poster and awareness campaign to promote light and computer switch-off*	*31/12/2014*	*N*
	Energy								
E.g.	*Water*	*Install water butts to capture rainwater for watering the vegetable patch*	*Ellen Cooper*	*£100*	*£25 per year*	*1 year*	*Buy 4 water butts and place around the school, introduce the idea of watering plants from the butts to the gardening club*	*30/06/2014*	*Y*
	Water								
E.g.	*Waste*	*Reduce food waste by 10% by 2018*	*Joe Hall*	*£40*	*£300*	*3 years*	*Survey food waste and identify which foods are not being eaten. Adjust cooking habits to minimise waste.*	*31/12/2018*	*N*
	Waste								

Resource efficiency action plan maintenance

- Targets and actions should comply with the SMART target principles in section 1.5 of the guide; making tracking progress easier
- It is important to review this plan frequently; it is recommended that a progress review takes place at least every 6 months
- The sheet should be refreshed annually to remove completed projects

Case study

Growth that doesn't cost the earth

Installation of Combined Heat & Power and Ground Source Heat Pumps

By combining several low carbon technologies in an historic building, Glasgow City Council has achieved carbon and cost savings and preserved a local landmark.

Key facts

- A build and refurbishment project funded by Glasgow City Council was conducted over a three year period from design to operation
- An existing building, which was already a local landmark, was used to amalgamate two primary schools and a nursery
- Savings of up to 125 tonnes CO_2 and £48,200 per year

Background

The original Victorian red sandstone building was built in 1894, is 'C' listed and a landmark in the local area. The decision was taken by Glasgow City Council to refurbish this building rather than build new or look for an alternative site. This refurbishment allowed the amalgamation of St Peter's and Notre Dame Primary schools and to house Elie Street Nursery (formerly Anderson Street Nursery) via a complete refurbishment of the existing building (formerly Dowanhill Primary School) together with a five-storey extension sympathetic to the original red sandstone elevations.

The school has been operational for over a year and accommodates 434 pupils and 60 nursery children, with 15 classrooms, an assembly and dining hall, a games hall, a library, and a state of the art information and communication technology library.

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The process/methodology

The design process began in 2010 when energy costs were a key consideration, and the construction phase began in January 2012. The school became operational a year and a half later in August 2013. Whilst the main driver behind the use of renewable and low carbon technologies was to reduce running costs, the sustainability of the project, including carbon footprint reduction and sustainable energy production was considered right from the earliest stage of the project. Development and Regeneration Services within Glasgow City Council saw this project as an opportunity to demonstrate sustainability best practice. To this end they have endeavoured to keep both the best architectural features of the original building as well as enhance the surrounding neighbourhood and incorporate modern sustainable technologies. The new-build/refurbishment remains a landmark in the local area.

> "This project demonstrates the advantage of up-front investment when refurbishing or building from new. The benefits will be felt well beyond the payback period." **Andrew Mouat, Principal Officer Carbon Management, Glasgow City Council**

Key Technologies

1. Gas-fired CHP plant: this is used to deliver both heat and electricity to the school. The use of natural gas represents a carbon saving compared to the oil-fired boilers that previously heated the school.
2. Ground Source Heat Pumps: the pumps are driven by electricity generated by the CHP plant and deliver renewable heat to the school. The CHP plant need not run at the same time as the ground source heat plant.
3. Thermal efficiency of the building: through super-insulation, including the original red sandstone structure and underfloor heating, the school is very energy efficient, to the extent that heat from the ground source heat pumps can be delivered at a lower temperature (45°C) compared to traditional heating systems. The motto 'insulate tight, ventilate right' was used to achieve this.
4. Heat recovery: heat is recovered from the ventilation plant, providing an end of pipe solution which pre-heats the water going into the heating system so less energy is required from the CHP/ground source heat pump.
5. Comfort Cooling: This is achieved for the following areas of the school without the use of refrigeration:
   - All classrooms
   - Assembly and Dining Hall
   - Games Changing Rooms
   - Kitchen
6. Cooling is carried out via the ground source heat borehole pumps that normally have a 12°C flow temperature.

> This project "demonstrates the shift in how we view building stock from a design perspective, we now consider the whole life cycle more than we perhaps previously did". **Andrew Mouat Carbon Management, Principal Officer, Glasgow City Council**

Stakeholders

The main refurbishment and construction contractor for the works was proactive regarding sustainability, with achievements culminating in the award of the Queens Award for Enterprise: Sustainable Development. They have an ISO 14001 certified Environmental Management System and have a team of certified renewable energy technology installers. The contractors were able to take lessons from other projects and apply them accordingly at Notre Dame.

Engagement with the pupils and staff of the two schools was conducted, with joint sports days and other activities taking place to facilitate an effective amalgamation process. Further efforts to integrate the two school communities have

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Resource Efficient Scotland, Ground Floor, Moray House, Forthside Way, Stirling, FK8 1QZ.

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resulted in the incorporation of the keys of St Peter into the new school crest.

Key Outcomes

The Benefits

Through the use of low carbon technologies, the project has led to both greenhouse gas emission savings and cost savings in the long-term. The table below summarises these savings, demonstrating that the project will save up to 125 tonnes CO_2 per year as compared to an average of schools of a similar size in the local area. Additionally, with Renewable Heat Incentive (RHI) payments savings of up to £48,200 could be achieved per annum.

School	CO_2 Emissions (tCO_2/yr)	Utility Costs* (£/yr)
Averages from 12 local GCC Primary Schools	259	£59,000
Notre Dame (boilers in use)	153	£33,800
Low Carbon Trust Exemplar School	145	£31,000
Notre Dame (CHP & GSHPs in use)	134	£11,800 (incl. RHI payments)

*Utility costs were assessed at 2.5p/kWhr for gas, 13.5p/kWhr for electricity, 8.4p/kWhr with RHI.

The use of CHP and ground source heat pumps on such a constrained site has proved an example of best practice and has led to widespread benefits. For example, it has allowed the contractor to upscale work on other projects as a result of learning experiences here. It has also resulted in the incorporation of heat pumps as the standard specification for refurbishments managed by Glasgow City Council and led to further examples of this technology being used throughout Glasgow City Council's new schools.

The school has had visits from delegations from outside of Scotland and from all over Europe seeking to replicate the project and its successes. It has been awarded two awards from the Civic Trust Awards Scheme, an award which is only one of six in Scotland, as well as the Special Award for Scotland. Set up in 1959, the awards are given to projects that demonstrate high quality architecture or design, have demonstrated sustainability, are accessible to all users and have made a positive cultural, social or economic contribution to the local community. The project has also received two awards from Glasgow Institute Architects (GIA) Design Awards 2013 for Conservation and for Education Design and has been nominated for a number of other awards including an internal Glasgow City Council 'Flourish' Award. It has been featured in the Architects Journal, and featured in the 2014 Glasgow Doors Open Day. This is Glasgow's free built heritage festival which celebrates the buildings, streets, parks, architecture, history and people of Glasgow. The project will be featured in the journal Architecture + Design Scotland, due for publication before Christmas.

The CHP arrangement and the design of the M&E have been put forward to the Combined Heat and Power Association (CHPA) and the Chartered Institute of Building Services Engineers (CIBSE) for this year's award. These nominations came about via observations made by one of the plant manufacturers after reviewing results and data retrieved from their own BMS and data provided by the energy supplier.

The Challenges

The nature and size of the site presented many challenges. The listed status of the building required additional planning conditions to be met, such as replacing the original sash windows with a like-for-like substitute but with high quality double glazing. The site itself is located in a residential area with traditional tenement housing so access for vehicles was restricted. From an early assessment Biomass was not an option due to Air

Quality Management policy, site logistics and safety as well as Scottish Natural Heritage (SNH) conditions. Noise associated with the project; in particular the drilling of 30-40 boreholes was a major concern. These issues were largely addressed through community engagement led by the Education Department and elected members for the area. The attitude of local residents was largely positive due to the preservation and upgrade of a local landmark. Generally speaking these days every encouragement is given to the use of natural ventilation in school classrooms. However, it was not possible to introduce natural ventilation principally due to SNH concerns. At Notre Dame a successful ventilation strategy was achieved via mechanical ventilation with heat recovery. The system deployed recovers 65% of the heat gains and boosts the heat output of the refurbished cast iron radiators. In addition, the system provides the building with tempered fresh air.

One of the greatest concerns was the complexity of the system, which involves a backup boiler, storage tanks which act as a thermal store, the CHP plant, and ground source heat pumps. The requirement for a backup boiler is standard Glasgow City Council policy.

Due to its complexity the system has remained within the control of Glasgow City Council with input from school staff. This is particularly important whilst the operation of the system is monitored to establish the correct settings for optimising the efficiency of the equipment. This management approach is quite different to previous models, and has required a lot of trust between the caretakers and facility management staff at the school and the Council staff dealing with the system.

Top tips

- To improve sustainability, use refurbished/cleaned materials rather than buying new, e.g. Notre Dame reused its existing pre-1933 cast iron "Princess" radiators. A sample was sent to the Building Services Research and Information Service (BSIRA) for testing in the early stages of the design process for evaluation. All the radiators were then completely refurbished and pressure tested to 6 bar.
- Make use of what you have got, e.g., as any ground source system is best operated at 45°C, in the classrooms at Notre Dame tempered air is blown through the cast iron columns to boost the radiator's performance.
- Even if it's not required now, include the flexibility to export electricity from renewables at a later date.
- Old buildings, especially pre-World War One structures are easier to convert to low carbon buildings than many post World War two buildings. Many preconceptions about old buildings are unfounded. For example: It was easy to convert the internal walls in to a lightweight building and asbestos was not found anywhere onsite.
- A well-insulated and appropriately ventilated building reduces the heat load. Make good use of the high ceilings of old Victorian school classrooms as they assist in the ventilation process.
- Don't be afraid of using a combination of low carbon technologies – for this project it means the electricity required to run the GSHPs is produced by the CHP at gas prices (currently around a quarter of electricity prices).
- Allow time for monitoring and adjustment via the buildings BMS as this is important to ensure the maximum efficiencies are achieved. This process is currently ongoing.

Bob McNair, Mechanical Engineer, Glasgow City Council

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Case study

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Installation of Biomass Boilers

A switch from oil-fired to biomass-fuelled boilers at Speyside High School has led to large carbon and financial savings, with a 3 year payback period.

Key facts

- Installation of a biomass boiler costing £350,000 was undertaken by Moray Council at Speyside High School, Aberlour
- Annual savings of £55,000 were made on the fuel alone, with a further forecast £50,000 per year to be made through Renewable Heat Incentive (RHI) payments
- Carbon dioxide emissions have been reduced by 96% through the substitution of oil with biomass
- A payback period of 3 years when Renewable Heat Incentive (RHI) payments are included (6.5 years excluding RHI payments)

Background

Speyside High School in Aberlour comprises 479 pupils with facilities including a swimming pool. Previously heated by oil-fired boilers, Moray Council's Property Management Team made the decision to install biomass-fired boilers as a more cost effective and sustainable alternative. A feasibility study was undertaken in 2008 and the project became operational during the summer of 2013.

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The process/methodology

Key Steps

The project had a relatively simple timeline and can be split into four main steps:

1. Feasibility Study: undertaken in 2008 by consultants, which included consideration of the fuel options available, proposed delivery and storage arrangements and the storage capacity required on-site, as well as the forecast capital costs and revenue savings. It was also agreed that the oil boilers should be retained and maintained for top-up and back-up purposes.
2. Council Decisions: the Property Management Team at Moray Council gave the go-ahead to progress with the project.
3. Construction phase- once the Council had made a decision, construction began
4. Operation and Maintenance: a biomass heat specialist currently holds the maintenance contract, coordinated and paid for by the Property Management Team at the Council, which is the contract administrator.

The Renewable Heat Initiative (RHI)

Launched in November 2011, the RHI is the world's first long-term financial support programme for renewable heat. The scheme provides subsidies (payable for up to 20 years) for eligible, non-domestic renewable heat generators and producers of bio-methane in Great Britain and aims to bridge the gap between the cost of fossil fuel heat installations and renewable heat alternatives through financial support for owners.

Roll-out

Although there was a long period between the feasibility study being produced and the implementation of the project (due in part to this being the first installation of its kind proposed by the Council), a kick-off event was organised with the key stakeholders, such as caretakers at the school, to provide information and to talk through what the installation would mean for individuals as well as the school overall. A biomass heat specialist involved in the project, ran a roadshow for the school, known as the 'Biomass Heat Trailer', which provided information for pupils and teachers about the new boilers and included a guided tour of the boiler room.

Key Outcomes

The Benefits

The financial and carbon benefits are summarised in the table below. Taking just the financial savings from switching to biomass from oil as a fuel, the payback period would be 6.5 years. However, once you include the forecast RHI payment, the payback period is just 3 years.

"The sustainability and financial benefits of the project cannot be argued with".
Lindsey Jackson, Energy Technician, Moray Council

The carbon savings achieved by the school will help Moray Council to reduce carbon emissions in accordance with its position as a signatory to the Scottish Climate Change Declaration. The Council's targets in accordance with the Declaration also include an overall reduction in energy of 2% year on year.

Saving	Amount
Annual financial saving	£55,000
Annual income through the RHI	£50,000
Reduction in carbon dioxide emissions	96%
	435 tCO_2/year

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Case study – Installation of Biomass Boilers 3

The success and savings achieved by this scheme have strengthened the case for biomass boilers in schools in the region. The Council has plans to roll out similar schemes to primary schools within the region, including the primary school located in Aberlour. This would have the potential for synergies between schools, which could be coordinated given the schools' proximity to each other.

The Challenges

One challenge was the need to ensure the wood fuel supplier is within a reasonable distance of Aberlour. The Council did not want to leave the school in the position that a delivery could not be made due to poor weather conditions. This has so far been achieved but is largely dependent on the supply in the area.

Whilst the project was undertaken in association with various external consultants, all with experience in the field, the project still provided learning experiences for all involved. One such experience was the issue encountered as a result of the moisture content of the wood chips. At one stage, the water content was too high, which resulted in a temporary breakdown of the biomass burner. In preparation for an event such as this, the old oil-fired boilers have been left intact, which means that the School always has an emergency back-up energy supply to enable it to keep running as normal. The moisture content of the fuel is being monitored to prevent another breakdown.

Whilst the majority of challenges were associated with the hardware and fuel, there was a small amount of uncertainty about such a significant change to the system. Stakeholder engagement was significant to the success of the project. As a result of communication with the school from an early stage, everybody quickly came round to the idea and involved parties were kept up to date throughout the project.

Top tips

- Take advice from reputable and well experienced firms regarding technology installation.
- If the project qualifies for the RHI, get assistance in completing the necessary paperwork, which can be complicated; this will save much time and effort.

Lindsey Jackson – Energy Technician, Moray Council

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Case study

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Bringing Schools Together to Tackle Food Waste

Through working with four primary schools, North Ayrshire Council has set a baseline for food waste and set the foundations needed to reduce emissions from food waste.

Key facts

- North Ayrshire Council selected four local schools to take part in a project to set a food waste baseline
- Timed to coincide with the European Week for Waste Reduction in 2012
- Bins and provision for waste separation were strategically placed to promote waste minimisation
- The success and learnings of the project informed the planning process for food waste collection on a wider scale by the Council

Background

The project, devised by North Ayrshire Council, targeted four schools: Winton Primary in Ardrossen; Hayocks Primary in Stevenson and Mayfield Primary and St Anthony's Primary in Saltcoats. The schools were selected through collaboration with the East Council management section who manages with the catering at the schools.

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The process/methodology

Key Steps

The project can be split into several steps, the chronology of which were the key to success:

1. Seminar with catering staff: this involved a presentation about the project and its background from North Ayrshire Council. The aim was to explain the reasons behind the project and to provide an opportunity for on-site staff to contribute suggestions.
2. Meetings with head teachers and catering managers: these meetings were on a school-by-school basis. As education and catering come under different sections within the Council the meetings were organised in an effort to get buy-in from both departments.
3. Floor plans: every school had a different layout concerning: bin locations; where children entered the dining area; where trays are left; and, whether trays are collected from tables. A floor plan, which included the kitchen, dining area and staff room, was drawn up for each school.
4. Identification and implementation of layout improvements: once the floor plans had been produced, improvements to the location of bins and provision of separate bins for food waste and packaging (including a caddy in the kitchen) were made.
5. Monitoring food waste generation: involved collection of the food waste disposed of in the specified bins and transportation to a location where the waste was analysed and weighed. This had to take place during a 'typical' week, i.e., when there were no events or special menus to distort the results.

Drivers

One of the main drivers behind the project was recently enacted national legislation with forthcoming requirements, as well as initiatives organised at the European level. The Waste (Scotland) Regulations 2012 came into force in May 2012, and make several provisions in relation to food waste. The project was organised to coincide with the 2012 European Week for Waste Reduction, co-ordinated by Zero Waste Scotland and held between 17th and 25th November. During this week, the implementation of awareness-raising actions regarding sustainable resource and waste management was promoted, and a wide range of audiences were encouraged to participate.

The Waste (Scotland) Regulations 2012
Requirements relevant to this case study include:

- Food businesses producing over 50 kg of food waste per week to present that waste for separate collection from 1st January 2014;
- A ban imposed on the use of macerators to discharge food waste into the public sewer from 1st January 2016;
- Local authorities to offer a food waste recycling service in non-rural areas from 1st January 2016.

Communication

Communication was key to the success and smooth running of this project. The first step of the project was to hold a seminar with catering staff and further meetings followed throughout the project. This kept the communication channels open and allowed further learnings to take place.

The project was explained to the pupils of the schools initially through assemblies, involving an animated interactive presentation about waste. Competitions between school classes were devised to develop posters for the school's 'eco-boards' in the halls which was used as a tool to engage the children, this was particularly important as four schools were competing. The existing Eco-Committees were involved and managed the delegation of bin monitoring during lunchtimes.

Initially a staff member from the Council was on hand to answer any questions and to show the pupils what should be disposed of in which bins etc. The Eco-Committees were key in providing clear signage for their fellow pupils directing waste

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Case study – Bringing Schools Together to Tackle Food Waste 3

to the correct bins and providing 'green footprints' to help pupils find the appropriate bins.

Key Outcomes

The Benefits

One of the benefits of the project was the effect of continued communication with the catering staff, particularly with regard to the waste analysis. This sparked a realisation that staff had the ability to control how waste could be minimised and prompted an investigation from a procurement perspective, in particular as to why certain food required packaging. Controlling the amount of waste generated once the food is beyond the kitchen door in the dining area is to a large extent down to the pupils. However, following communication of the waste analysis conducted on the food waste collected, revision of menus took place across the schools to tailor it to the preferences of the pupils, whilst maintaining a healthy menu with a choice of dishes. This led to a three tier menu being introduced with smaller portions for the younger pupils to avoid unnecessary waste generation.

This project was effectively a trial and was conducted on a very low budget. The only costs were the time of the staff involved, with sample bins provided by various waste companies and collection of the waste conducted in-house by the Council. The project findings and successes informed the planning process for food waste collection on a wider scale by the Council.

The Challenges

One of the barriers the Council encountered was the disjointed nature of the management of the schools between the school teaching staff and catering staff. Despite both elements belonging to the Council, education and catering fall within different budgets and under different management. As a result the head teacher does not have the authority to implement changes to the catering staff's operations and procedures. The barrier between staff within each school had to be overcome before the Council could begin to implement changes around the systems in place for the pupils. Speaking with hindsight, Evonne Kent, a representative from North Ayrshire Council during the project, would have incorporated a member of the Education Department to help overcome this issue. As they hold the budget for both education and catering in schools, they would be able to identify with both sides and provide more authority regarding budgets.

Another challenge was the individual nature of the schools. Each had a different kitchen and dining layout and approach to school meals, such as how meals were served (whether children entered the dining hall in a staggered approach or all at once), whether disposable cutlery was used, and whether children with packed lunches were separated from those receiving hot school meals. This meant a 'one size fits all' approach wasn't appropriate. This was where involvement from staff at each school aided the process, with suggestions specific to the school and from people who knew the system used to identify a solution.

The provision of improved bin layouts and food waste bins, particularly in the kitchen area, proved a challenge due to health and safety and the associated legal issues. These issues were addressed through a consultation meeting with health, safety and cleaning coordinators to ensure compliance with relevant legislation such as the use of peddle bins to remove direct contact with food waste, and to enable the kitchen staff to continue to efficiently carry out their day-to-day tasks.

Top tip

Collaboration and communication are key to making sure you have the right people on board and have buy-in. People can operate in different ways, so you might need to tailor plans to get the results you are looking for.
Evonne Kent, former Waste Awareness Officer at North Ayrshire Council

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Case study

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Water Efficiency Audit & Improvement Action Plan

Through a comprehensive site-wide water efficiency audit at St Andrews High School, North Lanarkshire, a bespoke water efficiency action plan was created and implemented leading to water, carbon and financial savings.

Key facts

- A site-wide water efficiency audit was conducted in December 2013 at St Andrews High School, owned and operated by North Lanarkshire Council, by Resource Efficient Scotland's water efficiency audit team.
- A bespoke water efficiency action plan was created which identified several areas of improvement for water efficiency on the school grounds.
- By late January 2014 the water efficiency action plan had been implemented in full.
- The action plan led to an estimated 64% reduction in projected annual water consumption, saving 13,841 m^3 per annum and £32,021 per annum.
- Further savings of £3,192 per annum may be achieved via a reduction in water meter size.

A programme from

Background

St Andrews High School, which is located in Coatbridge, North Lanarkshire was relocated to its new site in 2006. Over the 3 years from 2011 to 2014 water consumption had continually increased. In the space of just two years, there was an increase in water consumption of almost 60%. This increase highlighted the need for the project and suggested that water use efficiency had the potential to be improved, and that investment in water saving technology warranted further investigation as a priority activity for the school.

The process/methodology

Key Steps

The following key steps or stages within the project can be identified as:

1. A site-wide water efficiency audit, undertaken in December 2013
2. The generation of an inventory of the items in the school that consumed water
3. Research into appropriate water saving technologies
4. Formation of the bespoke Water Efficiency Action Plan based upon the findings in the above steps
5. Implementation in full of the Water Efficiency Action Plan.

Drivers

The principal driver for this project arose after St Andrews High School's water consumption had increased in volume by almost 60% over a two year period, which had led to increased associated costs.

At this time Resource Efficient Scotland was working in partnership with the Scottish public sector to push the implementation of water efficiency measures across a range of organisations and building types, including schools. As such a comprehensive site-wide water efficiency audit was completed by Resource Efficient Scotland to identify specific opportunities to reduce water consumption and to highlight the water consumption reductions that St. Andrew's High School could make via implementation of the action plan.

Key Outcomes

The Benefits

Data on water consumption had been well recorded for the previous 4 years. This ensured predicted savings, from implementing the water efficency action plan in full, will lead to high confidence in the resulting carbon, water and financial savings.

The implementation of all recommendations should mean a reduction in water consumption from 21,668 m^3 per annum to 7,827 m^3.

Based on the conservative assumption that 5% of this water is hot, it is expected that this will translate to an implemented cost saving of ~ £32,021 per year.

Saving	Amount
Annual financial saving (£)	32,021
Water Saving (m^3/year)	13,841
Reduction in annual carbon dioxide emissions (tonnes CO_2e/year)	14.5

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Case study – Water Efficiency Audit & Improvement Action Plan 3

The Challenges

One of the fundamental reasons for the success of the project was the access to accurate data on annual water consumption including data for the previous four years and the 5 hourly data available from the site's Automatic Meter Read (AMR) data. Without this data the business case to conduct the audit and the associated water efficiency action plan would have been more difficult. Furthermore, recording the water, carbon and financial savings would also have been harder to determine.

Going forward with the project, additional cost savings expected through a reduction in water meter size may be more challenging. Based on a projected annual consumption of 7,827 m^3, it is tentatively suggested that there may be potential for the site to achieve a cost saving by downsizing to a 40 mm meter from its current 50 mm meter.

Scottish Water meter sizing guidance indicates that a 40 mm meter is appropriate for facilities with an annual consumption between approximately 6,200 – 10,500 m^3. Therefore if St. Andrews High School is able to achieve the predicted annual water consumption of 7,827m^3 then this could be a viable option in the future. This would ultimately save the school £3,192 per annum reducing annual water meter fees from £5,476 a year to £2,284 per year.

In order to be able to make this change further investigation will be need as meter size selection is based not only on annual volume consumed, but also peak flow rate and on-site water storage availability. Therefore, these details should ideally first be established to further confirm the validity of this opportunity.

Top tips

- Having access to reliable data is important to accurately quantify potential savings from water saving imitative and technologies.
- An inventory of all water consuming appliances allows greater understanding of peak water usage and can allow informed decisions on new technologies be made.
- Communicating the action plan will allow for staff buy-in which will enable the actions to be implemented more effectively.

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8 Glossary

Baseline - the point of reference from which future measurements are compared.

Benchmarking - the process by which comparisons are made against similar organisations to measure performance against industry best practice.

Biomass - constitutes plant material that has been processed for easy combustion in an appropriate boiler, for example wood waste in compressed pellet or chipped form.

Building Management System (BMS) - installed in buildings, this computer-based control system allows the building's mechanical and electrical equipment (such as ventilation, lighting, power systems) to be controlled and monitored.

Combined Heat and Power (CHP) - the use of a heat engine or power station to simultaneously generate electricity and useful heat.

Digital Addressable Lighting Interface (DALi) - developed jointly by several manufacturers of lighting equipment, it allows equipment from different manufacturers to be connected together and controlled from one place.

Greenhouse gases (GHG) - gases present in the atmosphere that lead to the greenhouse effect through absorbing and emitting radiation within the thermal infrared range. These include carbon dioxide, methane and nitrous oxide.

Greywater - 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.

Ground source heat pumps - a central heating and/or cooling system which transfers heat to or from the ground.

Interlocks - a device fitted to comfort cooling equipment to restrict cooling to be activated only when the outside air temperature is above a certain point.

LAN (Local Area Network) - a computer network that interconnects computers within a limited area such as a home, school, computer laboratory, or office building, using network media.

Low or zero carbon energy source technologies - relates to energy source technologies that generate fewer greenhouse gases during power conversion.

Payback period - the period of time it takes to recuperate the costs of the initial investment.

Photovoltaic panel - a panel used to generate electrical power by converting sunlight into direct current electricity using semiconducting materials.

Potable water - water safe enough to be consumed by humans or used with low risk of immediate or long term harm.

Renewables - a source of energy from natural or recurring sources such as the sun, wind or from plants (biomass) to generate energy.

Sub-metering - the measuring of energy or water use on multiple meters across different buildings, departments, areas etc.

Thermostatic radiator valves - a self-regulating valve fitted to hot water heating system radiator, to control the temperature of a room by changing the flow of hot water to the radiator.


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