SCoRE

Taking Control of Your Heating

Introduction

Sound energy management is good for your school's finances and good for the environment. Approximately 50% of the money that schools spend on energy is used for heating and, although we need to keep warm and comfortable, savings of 15-25% can often be achieved simply by ensuring that heating systems are being controlled effectively.

This document provides school managers with a process for establishing effective control of their heating system.

The process involves five basic steps:

Step 1: **Make someone responsible for managing the control of your heating system**

Step 2: **Understand the basic configuration of your heating system and its controls**

Step 3: **Ensure that heating times match your requirements**

Step 4: **Ensure that room temperatures match your requirements**

Step 5: **Monitor on-going performance in order to maintain savings**

The following sections discuss each of these steps in turn.

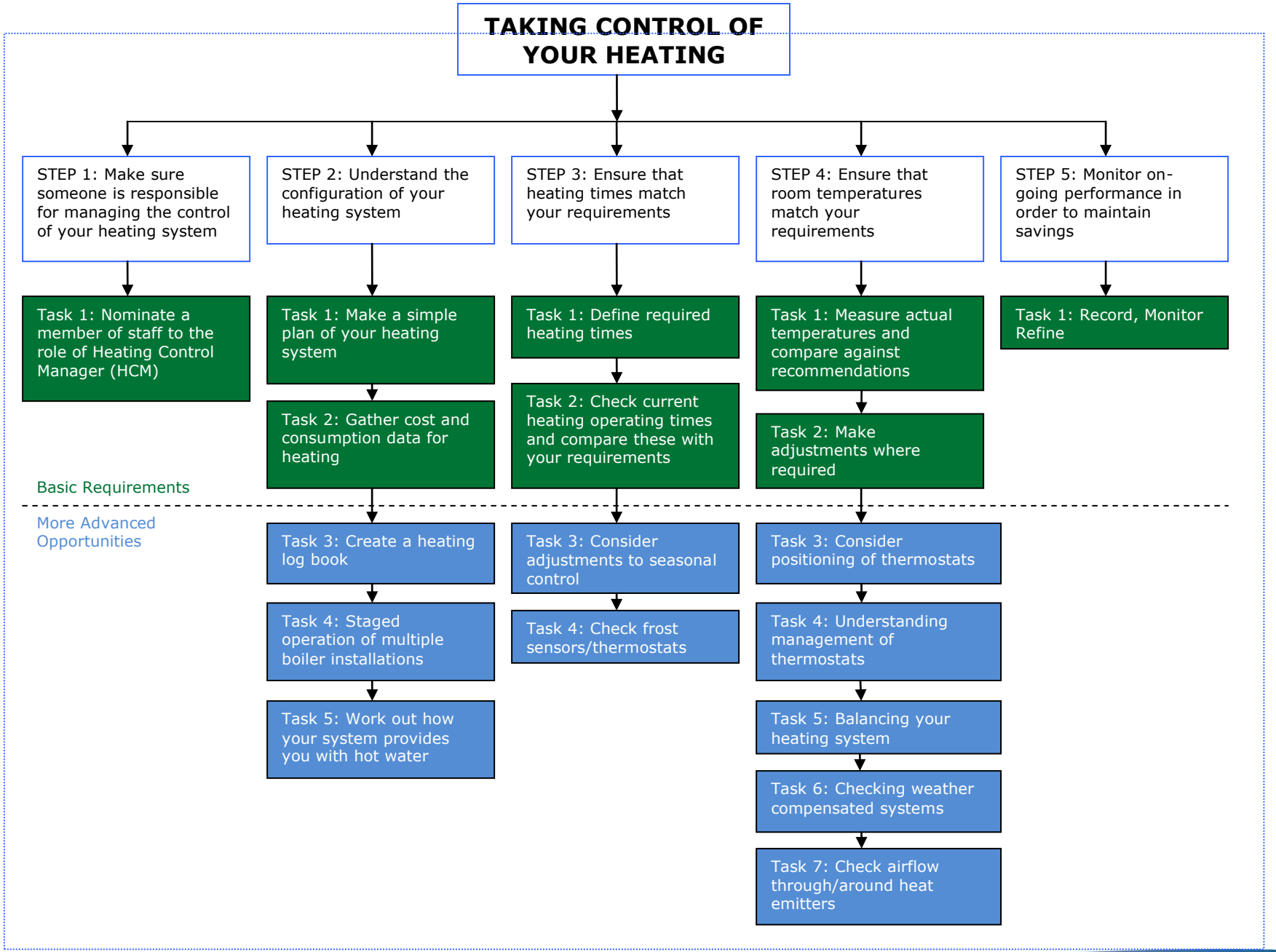
Although this document is a management guide and avoids technical issues, we have provided some advanced guidance in each section to enable those who feel confident enough to understand and address more technical issues. You may want to discuss these with an Energy Management Officer or your local heating contractor.

To make it more easy to follow we have colour and symbol coded the tasks in each step.

 **The green clipboard tasks are the basic requirements.**

 **The blue spanner tasks are more advanced opportunities**

You should try to tackle all the green clipboard tasks (across all steps) first.


TAKING CONTROL OF YOUR HEATING
STEP 1: Make sure someone is responsible for managing the control of your heating system
STEP 2: Understand the configuration of your heating system
STEP 3: Ensure that heating times match your requirements
STEP 4: Ensure that room temperatures match your requirements
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STEP 1: Make someone responsible for managing the control of your heating system

Task 1: Start by nominating members of staff to the role of Heating Control Manager (HCM)

The key responsibilities for the Heating Control Manager are:

- To identify the current cost of heating your school
- To create and maintain a schedule of your school's heating requirements (times and temperatures)
- To confirm whether or not the operation of your heating system matches your requirements
- To put in place (with appropriate technical support, if necessary) the remedial steps required to improve control of your school's heating

While the detailed adjustment of modern heating controls can require a high level of technical skill, the management of your school's heating control should not be viewed as a technical activity.

It may be that your Site Manager or Caretaker is the ideal candidate for the role of Heating Control Manager, but it is advisable not to just allocate sole responsibility here. For example, some schools have appointed a member of their teaching staff, bursar, or business manager to assist or take overall responsibility for the role, usually because they have a particular interest in financial control, environmental or sustainability issues. The important point to recognise is that the role requires a manager, not a technician and it will usually be better for two or more people to work together, so that knowledge is not lost if the responsible person leaves.

Many of the tasks involved in managing your heating controls (for example, measuring room temperatures) can link readily into curricular activities and it can be helpful to have an HCM who can recognise and promote these opportunities to the whole school.

STEP 2: Understand the configuration of your heating system

Task 1: Make a simple plan of your heating system layout

The first task for your newly appointed Heating Control Manager (HCM) should be to get a basic understanding of how your school is heated.

The HCM will need to understand:

- Where all your school's boilerhouses are located.
- Which areas of the school are served by each boilerhouse.
- Which areas can be controlled separately with regard to heating times and/or temperatures (these independently controllable areas are often referred to as "heating zones").

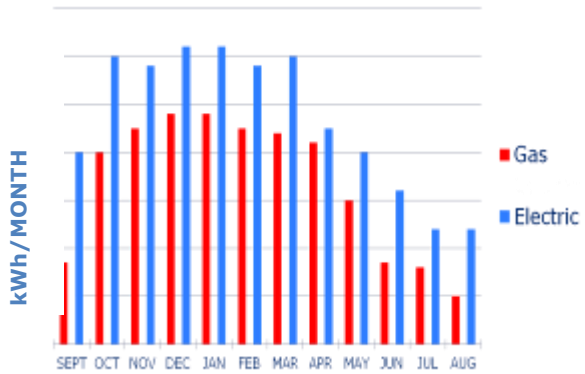
This information can often best be captured by marking up a school site plan to show the locations of your boilerhouses and the heating zones that they serve.

If you can, it is also useful to identify and mark-up the location of significant control devices such as time switches and room thermostats/sensors (although this is not essential at this stage).

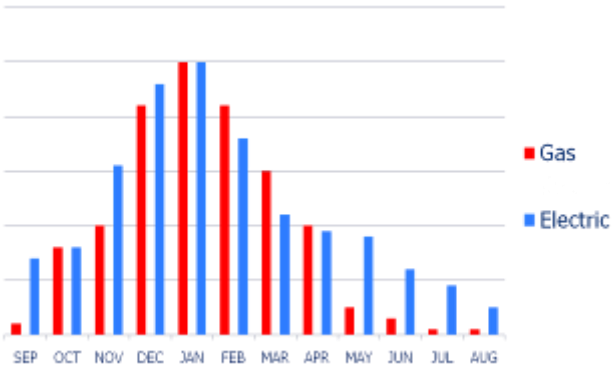
Task 2: Gather together cost and consumption data for heating

The HCM should also collect together cost and consumption data for heating fuel use in order to gain an understanding of the "value at stake" and to create a baseline against which subsequent performance can be assessed.

Ideally, monthly figures should be used, going back two years. These can be plotted to give a simple representation of fuel use. Creating a graph will give you an early indication of whether your heating system is being controlled effectively as illustrated in the bar charts below.



POOR PERFORMING SCHOOL



GOOD PERFORMING SCHOOL

A poor performing school will often show significant heating consumption over the summer months (May-Sept) and even during the holiday periods, showing boilers are being left on unnecessarily.

Poor control is also indicated when, during the heating season (Oct-Apr), the heating consumption shows little variance from month to month even though ambient temperatures may vary significantly.

A good performing school will typically show minimal heating fuel consumption over the summer months (May-Sept), and will also have significant variance in heating fuel consumption throughout the heating season with definite peaks during the colder months (Jan, Feb).

In schools which are heated by oil, or those which have quarterly-billed gas supplies, it may not be possible to get monthly figures. In these cases the HCM should make the best use they can of the available data, at least to estimate the annual fuel use, and start taking regular monthly readings at the gas meter.

If you have more than one gas meter, treat each of them separately.

Accurate data collection will lead to early identification of savings opportunities.
Refer to **Calculator 2.2 for calculation of approximate heating costs**

Task 3: Create a heating log book

Create a file, with all manufacturers' maintenance and control information (manufacturers' manuals can generally be downloaded free of charge from the manufacturers' websites, if you have the model name or number from the equipment).

You can also ask your Energy Management Officer or local heating contractor to:

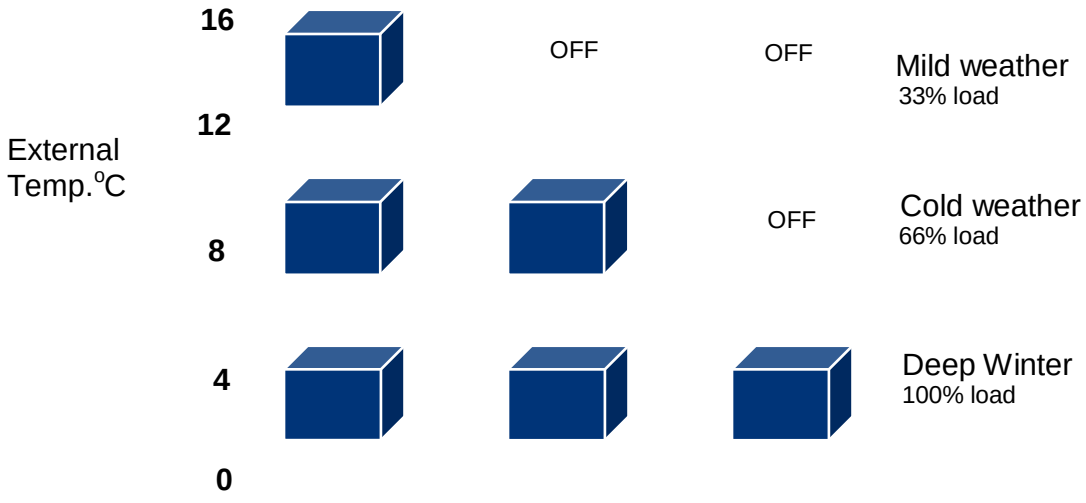
- Show you how the time and day controls are set
- Show you how to check for correct operation if you have advanced controls like weather compensation or optimum start controls
- Explain how to set summer hot water only
- Demonstrate adjustment of space temperature controls and explain their function
- Explain the layout of the heating zones
- Explain the energy saving features of the control routines applied

Keep all the information you gather in a heating log-book along with recorded performance data.

The log-book will provide you with a ready reference manual for heating systems which can be used by the Heating Control Manager in conjunction with the Site Manager to make immediate adjustments and improvements to the control of the heating system. The log-book can be used to guide and record system adjustments and performance and should be reviewed and if necessary updated each term.

Task 4: Staged operation of multiple boiler installations

If you have multiple boilers connected to the same system, ensure that as the weather gets warmer some of the boilers are turned off (as detailed in the diagram below).



One boiler operating at full or near to full capacity will operate more efficiently than multiple boilers running at part load. The Site Manager should be tasked with ensuring only the minimum necessary number of boilers is switched on, depending on external air temperatures. This may require some experimentation. If you are still unsure, consult the County Councils Property Maintenance or your local heating contractor.

Where auto sequence controls are present, check that some of the boilers are switching off and that water is not flowing through them (i.e. they are not warm), in milder weather. If this is not the case, contact your local heating contractor.

Effective staged operation of boilers could save 5% of the overall energy consumption of the boiler plant.
Refer to **Calculator 2.4 for calculation of approximate savings.**

Task 5: Work out how your system provides you with hot water

If your heating system boilers also provide hot water in the summer, ensure that the minimum number of boilers operate for hot water provision and that all heating system pumps are switched off and valves closed.

Where you have hot water storage the boilers should only be used early in the day to heat up the required amount of stored hot water.

The storage tanks should be monitored to ensure that they are "going cold" by the end of the school day, as any remaining heated water will just go cold overnight and can be considered wasted energy. This will require the site manager to either isolate the hot water system or turn off boilers (summer months), probably around mid-day, and then to check the storage tanks at the end of the day. If the tanks are still warm, then water heating hours can be reduced further.

STEP 3: Ensure that heating times match your requirements

The fine-tuning of heating times is an important issue for schools as every hour you can reduce heating operation per day will save around 10% of your heating fuel consumption.

Task 1: Define required heating times

Produce a schedule for each building or zone within your school showing the times during which it needs to be heated (a template for recording this information is provided at the back of this guidance document).

Give some careful thought to this, recognising that the reduced room temperatures that occur during warm-up in the mornings and cool-down in the evenings can still be adequate for some activities (such as cleaning). In general, we would recommend that heating should be switched off at least 30 minutes before the building is vacated.

Provide additional details for specific areas within your buildings that may have extended occupancy times (for example, specific classrooms that may be used for after school activities).

Task 2: Check current heating operating times, and compare these with your requirements

Your current heating operating times can be determined in one of two ways:

- By checking the settings on your heating controls.
- By checking what is actually being delivered.

Checking heating control settings

Identify your current heating time control settings by either:

- Checking them yourself (if you are able to).
- Asking the Energy Management Officer to show you how.
- Asking your local heating contractor to show you how.

The way that you set the "on" time for your system will vary depending on whether the controller is of the 'fixed start' or 'optimum start' type.

'Fixed start' controls are simple timeswitches, like the ones that most of us have at home. The heating system starts at the set 'on' time and so this must include an allowance for the warm-up period (so, for example, if we want our school to be up to

full temperature by 9.00 then we may set an 'on' time of 08.30. "On" times are likely to be earlier in cold weather and on Mondays).

'Optimum start' controls are more sophisticated and automatically vary the warm-up period provided, depending on the outside temperature and the residual heat in the building. The time programmed when setting the "on" time should therefore not include any allowance for warm-up – simply set the time at which you want the school to be up to full temperature.

You will probably need technical support to identify whether your heating controls incorporate an 'optimum start' function but this information is fundamental to assessing your school's current control settings.

Also take the opportunity to check that your heating controls are showing the correct date and time and that all plant selector switches are set to "automatic" (if applicable).

Checking what is actually being delivered

Checking the settings on your heating controls is important, but you also need to check that they are working correctly. You can check this by various means, including:

- Asking the Site Manager to monitor and record the status of the heating boilers particularly early in the morning and at the end of the school day
- Using a low-cost data logger to record representative room temperatures over a week or so. The movements in room temperature will indicate heating operating times.
- If you have a 'smart' gas meter (and access to the data it provides), check to see what time the gas consumption starts in the morning and finishes in the evening.

You may well identify areas which are being heated for longer than necessary. In most cases, rectifying this should simply involve re-setting the time switch (seek technical support with this, if you need to).

In some cases, however, areas may end up being heated for excessively long periods, simply because they form part of a heating zone which needs to be on in order to service other areas which are occupied at that time. In these circumstances, contact the County Councils Energy Management Section who may be able to consider the installation of additional zone controls to overcome this problem.

For each hour reduction in the operating time of the heating system, schools will save 10% on heating fuel for the associated buildings/areas.
Refer to **Calculator 3.2 for calculation of approximate savings**

Task 3: Consider adjustments to seasonal control

Think about shortening the heating season. Traditionally heating is switched on around the beginning of October. Try to delay this as long as possible and isolate the heating for summer (traditionally the beginning of May), as early in the year as possible.

You could also experiment with short bursts of heating at either end of the heating season (e.g. 30 minutes in the morning to warm the building up and then switch off). This will also help minimise pump operation and give electrical savings).

For each additional hour reduction in the operating time of heating systems schools will save 10% on heating fuel for the associated buildings/areas.
Refer to **Calculator 3.3 for calculation of approximate savings**

Task 4: Check frost sensors/thermostats

The purpose of a frost thermostat is to protect cold water pipework and the building structure from damage caused by freezing in the winter. The thermostat is the same as a room thermostat except that it works at lower temperatures and is independent of all other time switches and thermostats.

The frost stats are typically located in the boiler house and should be set at no higher than 3°C. As these thermostats operate independently of the system's time control, they can be responsible for heating systems switching on unnecessarily if set too high. The effect of this can be most accurately verified from interrogation of AMR data. If you are unsure whether you have access to AMR data, check with the Energy Management Section.

In many cases, schools have more complex controls and the frost stat control may be embedded within the system controls and use the same internal temperature sensor as the main temperature control. In this case, please consult your local heating contractor for advice.

For each additional hour reduction in the operating time of heating systems schools will save 10% on heating fuel for the associated buildings/areas.
Refer to **Calculator 3.4 for calculation of approximate savings**

STEP 4: Ensure that room temperatures match your requirements

Task 1: Measure actual temperatures and compare against recommendations

Effective temperature control is an important issue for schools as, in general, a 1°C rise in room temperature increases fuel consumption by around 10%.

The following table shows the temperatures recommended for a range of school room types.

Area	Recommended Temp (°C)
Classrooms and dining areas	18
Multi-purpose halls	15-18
Gyms and sports halls	15
Medical rooms	21
Offices and staff rooms	18
Corridors and toilets	15

(Note: It may sometimes be necessary to maintain higher temperatures, for example, in special schools)

Use a thermometer to check the temperatures actually occurring within a representative selection of rooms within your school. Checks should be regularly carried out throughout the heating season and at varying times of the day.

Also note if staff are opening windows in order to reduce room temperatures to an acceptable level (this is common in schools and indicates poor temperature control).

Task 2: Make adjustments where required

Where overheating is occurring, you may be able to make some immediate control adjustments yourself. You should be able to do this if your heating system has:

- Thermostatic radiator valves

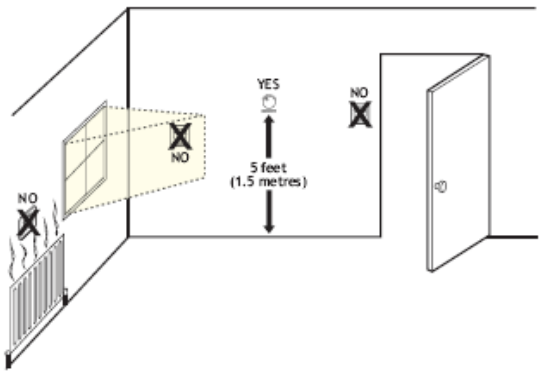
- Fan convector Thermostats (usually behind the inlet grille at the bottom of the heater)

- Adjustable room thermostats

For each 1°C reduction in the set room temperature, schools will save around 10% of the heating fuel for the associated buildings/areas.
Refer to **Calculator 4.2 for calculation of approximate savings**

Task 3: Consider positioning of thermostats

Thermostat positioning can have a dramatic effect on the control of a heating system. Check that thermostats and/or temperature sensors are away from draughts or heat sources such as sunlight, radiators or office equipment (commonly, photocopiers are found below thermostats as shown in the photograph below), as this will result in false readings and lead to under- or overheating.



Ideal thermostat location to accurately reflect genuine room temperature.

Where the school has optimum start control (see Step 3, Task 2), it is important that the indoor temperature sensor for this control is also checked for its position.

In general, thermostats or temperature sensors should be positioned in the coldest part of the building that requires heating.

The outside sensors should also be positioned on the north side of the building, out of direct sunlight and away from any opening windows or extract grilles, louvres or flues.

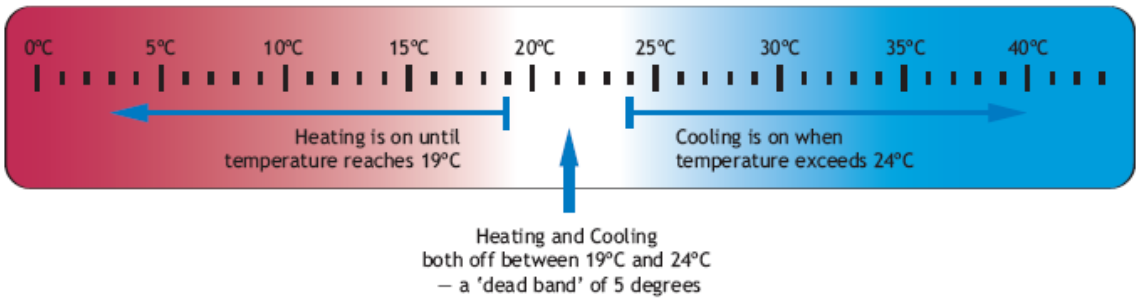
Task 4: Understanding management of thermostats

Ensure thermostats are not used as on/off switches as this will lead to overheating.

Set at recommended temperatures and adjust slightly if the area continues to over- or underheat. Once the correct setting is achieved, the thermostats should be made tamperproof and left at this correct setting.

Turning thermostats up will not make heating work any quicker. If a thermostat is set correctly and the room is cold, the thermostat will already be calling the heating ON. Turning it up will just lead to overheating and wasted energy later in the day.

Where air conditioning is present ensure there is at least a 4°C difference between heating upper limit and cooling lower limit (e.g. heating to 19°C, cooling to 24°C).



Getting the best from TRVs (thermostatic radiator valves)

- Disable or remove any TRVs on radiators near room thermostats
- Where some areas are over- or underheating, adjust TRVs with slight adjustments up or down until optimum temperatures are reached.
- Reduce the temperature settings when areas are unoccupied
- Many TRVs can be locked or limited in their adjustment (reduce tampering where appropriate) by pins inside the head. Check TRV manufacturers' guidance.

If you are still experiencing problems, ask your local heating engineer to check the calibration of the thermostats.

Task 5: Balancing your heating system

A common problem in schools is poor balancing of heating systems. This will usually reveal itself as some areas of the building (usually closest to the boiler house) overheating, while other areas (usually farthest from the boiler house) are still cold.

Windows will often be open in overheated areas and cold areas will call for the heating system to be on longer than is necessary (or require heating thermostats to be set artificially high), giving rise to the potential for large energy savings.

Carry out a quick survey of radiators or fan convectors on the same system. If heat emitters – such as radiators - on the same system are hot to the touch in overheated areas and cooler in underheated areas then this could indicate poor balancing. Please be aware of other potential issues as follows:

Sludging	Emitters, particularly on the ground floor, generally warm/hot around perimeters and at top, but cold in the centre/bottom (due to build up of sludge – ask your local heating engineer for assistance.
Venting	Emitters, particularly on upper floors, are warm/hot at bottom and cold at top (air trapped in system - bleed radiators).
Pump size	Emitters at the far end of the system are cold, but it is not a balancing issue (circulation pump undersized – ask your local heating engineer for assistance.

If poor balancing is identified as a problem in your school, this can often be rectified fairly quickly and easily. It may simply be a case of slightly closing the lock-shield valves, as shown above, on those heat emitters that feel hot, i.e. in overheated areas. This will reduce the heat output in these areas and allow more hot water to flow to the colder areas of the system. This will usually be an iterative process with slight adjustments working round the system until a "good balance" is achieved. You will need to allow the system some time to re-balance after each adjustment. Valves at the far end of the system, where radiators may feel cooler, may require opening although you would usually expect to find them fully open.

Adjusting the valves will require an adjustable wrench and possibly some lubricating oil (DO NOT FORCE IT, IF IN DOUBT ASK FOR ASSISTANCE).

A well balanced system will provide greater user comfort and usually lead to a reduction in the required temperature set-point of the system and/or operating time of the boilers and therefore energy savings.
Refer to **Calculator 4.5 for calculation of approximate savings**

Task 6: Checking weather compensated systems

Many school heating systems will include variable temperature heating water circuits (also known as weather compensated systems). These systems reduce energy consumption by reducing the water temperature flowing to the heat emitters as the outside air temperature rises.

The water temperature is modulated using one of two methods.

In more modern systems with condensing boilers, "direct acting" weather compensation allows the boiler to vary its operating flow water temperature automatically, to suit weather conditions and the temperatures inside the building. Weather compensation relies on communication between an internal sensor and one inside the boiler. The boiler's water flow temperature is varied accordingly, rather than the boiler turning on and off which wastes energy.

Weather compensation can also be achieved by a 3-way control valve, which controls the temperature of water supplied to the heat emitters by mixing a proportion of the return water to the boiler with the flow water instead of by altering the boiler temperature.

The information gathered in Step 2: Task 3 for your heating log book should tell you whether your system has weather compensated controls. If you are not sure, ask your local heating contractor.

To check if your weather compensation controls are working effectively, check that the flow temperature of water from your boilerhouse reduces as the outside temperature increases. This can be done by simply checking that, on cold days, radiators are hot to the touch and on milder days radiators are cooler. (It is best to carry out checks on radiators without TRVs if possible). You could also check by monitoring the flow water temperature (after any control valves) from your boilerhouse.

If a problem exists, you should contact your local heating contractor.

Effective weather compensation control could save 5% of the overall energy consumption of the boiler plant.
Refer to **Calculator 4.6 for calculation of approximate savings.**

Task 7: Check airflow through/around heat emitters

Ensure that all radiators and convectors are kept free of obstruction as far as possible. Furniture should not be placed directly in front of heaters (as shown by the radiator boxed in below) and care should be taken that inlet/outlet grilles are not obstructed (storage shelving in front of convector grille below).

Also note that pupils' bags or books placed against or on top of radiators will reduce heat output.

Where fan convectors are used, ensure that filters are cleaned regularly as part of routine maintenance as dirty filters will restrict airflow.

STEP 5: Monitor on-going performance in order to maintain savings

Task 1: Record, Monitor, Refine

Moving forward, continue to record your monthly fuel consumption figures onto the graph you created in Step 2. Whilst the consumption figures for individual months will vary depending on the weather, you will hopefully see a general decrease in consumption as your control adjustments take effect.

You should refer to this five step-approach and carry out the tasks at least once a term and keep a record of your findings and any adjustments made.

The appended calculation sheets and heating control assessment sheet provide a template for you to record your findings and calculate a useful estimate of approximate savings that will be achieved.

SAVINGS CALCULATORS

You can calculate your approximate savings by following these steps

The following calculators will enable you to calculate approximate savings from implementing the measures outlined in this document.

Each calculator is colour and symbol coded according to whether it is a basic or more advanced measure as in the main document.

The calculator number refers to the Step and Task in the main document (i.e. calculator 2.2 refers to Step 2, Task 2).

Note: The calculators are designed to avoid the risk of double counting of savings when more than one savings activity is carried out. Please work through each calculator in turn, putting a "zero" in the '% reduction in heating costs' box for any measure that has not been implemented.

CALCULATOR 2.2 – Annual heating cost

Record your annual gas or oil cost		£	A
Heating is typically 70% of this	0.7 x A =	£	B

CALCULATOR 2.4 – Effective staged operation of multiple boilers

What percentage of your school is affected by these systems?		%	C
% reduction in heating costs	5 x C/100 =	%	D
Reduction in annual heating cost	B x D/100 =	£	E
Remaining heating cost	B-E =	£	B_1

CALCULATOR 3.2 – Improved general time control

How many hours per day have you reduced your heating time by (on average)?		hrs	F
% reduction in heating cost	10 x F =	%	G
Reduction in annual heating cost	B_1 x G/100 =	£	H
Remaining heating cost	B_1-H =	£	B_2

CALCULATOR 3.3 – Adjustments to seasonal control

By how many hours per year have you reduced your heating time ?		hrs	I
% reduction heating cost	I/158 x 10 =	%	J
Reduction in annual heating cost	B_2 x J/100 =	£	K
Remaining heating cost	B_2 – K =	£	B_3

CALCULATOR 3.4 – Adjustments to frost thermostat

By how many hours per year have you reduced your heating time (data from AMR, if available)?		hrs	L
% reduction heating cost	L/158 x 10 =	%	M
Reduction in annual heating cost	B_3 x M/100 =	£	N
Remaining heating cost	B_3 – N =		B_4

CALCULATOR 4.2 – Adjustments to general temperature control

How many °C have you reduced your room temperatures (on average)?		°C	P
% reduction in heating cost	10 x P =	%	Q
Reduction in annual heating cost	B_4x Q/100 =	£	R
Remaining heating cost	B_4 – R =	£	B_5

CALCULATOR 4.5 – Balancing your heating system

By how many °C has this enabled average room temperatures to be reduced?		°C	S
% reduction in heating cost	10 x S =	%	T
Reduction in annual heating cost	B_5 x T/100 =	£	U
Remaining heating cost	B_5 – U =	£	B_6

CALCULATOR 4.6 – Effective weather compensation control

What percentage of your school is affected by these systems?		%	V
% reduction in heating costs	0.05 x C/100 =	%	W
Reduction in annual heating cost	B_6 x W/100 =	£	X
Remaining heating cost	B_6 – X=		B_7

TOTALS CALCULATOR

Total reduction in annual heating cost from tasks carried out	B-B_7 =	£	Y
Approximate reduction in annual CO_2 emissions	Y/165 =	tCO_2	Z

Heating Control Assessment Sheet

School | | Boilerhouse | |

Zone	Areas Served	Time Control		Temperature Control		Comments
		Required Times	Actual Times	Required (°C)	Actual (°C)	
1.						