energy envoys

Energy Tutorial: Energy Usage

Space and water heating systems

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The three most common types of heating systems are central heating, storage heaters and room heaters[1]. Here you will find a description of the system and their parts.

CENTRAL HEATING

These systems most commonly use a gas-fired boiler and radiators, distributing heat throughout the home. Also included in this definition are warm air systems, electric ceiling/under floor and communal heating. It is generally considered to be a cost effective and relatively efficient method of heating a home, although the cost effectiveness and level of carbon dioxide (CO_2) emissions will be closely linked to the type of fuel.

STORAGE HEATERS

These are predominately used in homes that have a significantly lower off-peak electricity tariff. Storage heaters use off-peak electricity to store heat in clay bricks or a ceramic material and the stored heat is then released throughout the day. These are more cost effective than fixed or portable room heaters, however storage heating can prove expensive if too much on peak electricity is used during the day.

ROOM HEATERS

This category includes all other types of heaters such as fixed electric or portable electric heaters. This type of heating is generally considered to be the least cost effective of the main systems and produces more CO_2 emissions.

In the pages that follow we provide an overview of the components of the above systems as well as a brief description of their principal controls.

CENTRAL HEATING SYSTEMS

A **central heating system** provides warmth to the whole interior of a building (or portion of a building) from one point to multiple rooms.

[1] Department for Communities and Local Government. (2015). *English Housing Survey 2013-14* https://www.gov.uk/government/uploads/system/uploads/attachment_data/file/406740/English_Housing_Survey_Headline_Report_2013-14.pdf

Central heating differs from local heating in that the heat generation occurs in one place, such as a furnace room in a house or a mechanical room in a large building (though not necessarily at the "central" geometric point).

There are two main groups of central heating systems, **wet central heating** and **dry central heating**:

1. **Wet central heating**: Where a central boiler heats water which flows around radiators which can also be used to heat your water. Electricity, oil, natural gas, LPG, coal or wood can be used as fuels. There are regular boilers which heat water in a cylinder and there are "combi" boilers which provide instantaneous hot water.

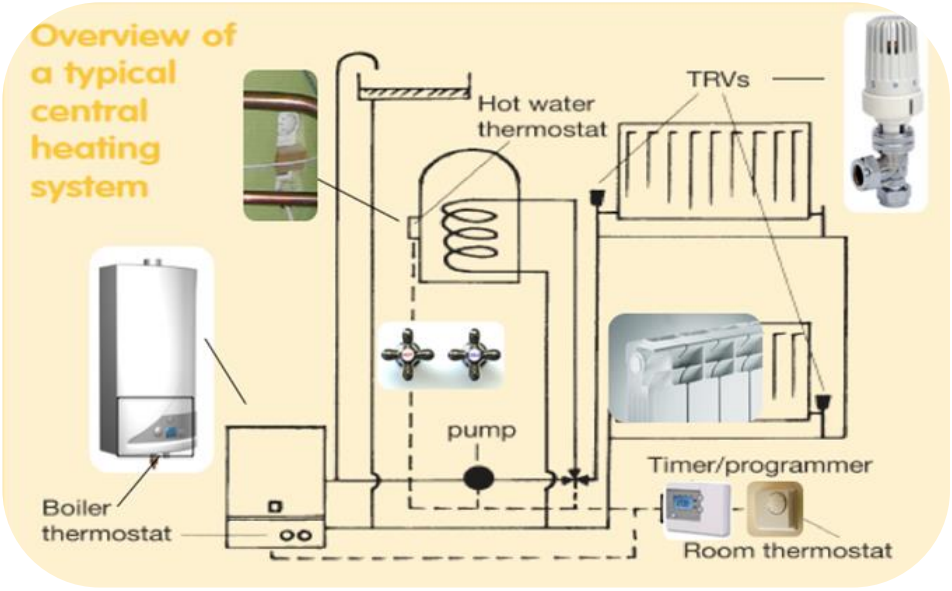
2. **Dry central heating:** Less common are dry central heating systems such as ducted warm air, electrical element heating and electrical storage heaters. Both air ducting and electrical under floor are typically installed as a property is built or renovated, storage heaters can be installed at any time. Ducted warm air systems use a furnace fuelled in a variety of options to heat the air which then naturally moves or is driven with fans around the property.

Common components of a wet central heating system using water-circulation include:

Boiler Thermostat	Timer / Programmer	Room Thermostat	Radiators & TRVs	Hot water thermostat

Figure 1: a typical central heating system

Source: EasySave booklet NEF



Generally speaking, a central heating system is the most energy and cost efficient way of heating a home, particularly in the presence of systems using fuels that are burned in a boiler. The type of fuel used will influence both costs and carbon emissions. (To see the differences between CO_2 and cost emissions of the different types of energy sources, see the information box at the end of this document one where you can find links with more information).

Boilers

Fuel (e.g. natural gas, LPG, oil or solid fuel) is burned in a combustion chamber and the heat passes to a heat exchanger. A flue pipe for the exhaust gases leads from the boiler to the outside air. There are three main types of boiler[2]: conventional, system and combination (also commonly known as a "combi" boiler).

1. Combination boilers

Combination or "combi" boilers are the most popular type of boiler in the UK and provide heat and hot water with no need for water tanks or cylinders. Combination boilers heat water just before it comes out of the tap, rather than storing it in a cylinder (although it is possible to retain a hot-water tank, with a heat-exchange coil in it which acts just like an additional radiator, but instead of heating the air surrounding the radiator, it heats the water surrounding it).

Therefore, if the boiler starts up every time a hot tap is are turned on, then it is likely to be a "combi" system, without a hot water tank. You can also tell if your boiler is a "combi" if there is no hot water tank and the boiler has five pipes coming out of it – two for the heating system, two for hot water and one for gas, with a possible sixth pipe which is mains water for 'topping up' the central heating system pressure (there may even be a seventh pipe visible: a 'condensate drain').

- ✓ **Pros**: You get unlimited space and water heating on demand; there's no need for a hot water cylinder or a cold water header tank in your loft; they don't take up much space. Additionally, both hot water and cold water is now mains-pressure.
- ✗ **Cons**: The water pressure might be reduced if you need hot water from more than one tap at the same time.

2. System boilers

System boilers - also known as sealed systems - come with a hot water cylinder (which usually sits in an airing cupboard) and no cold water tank.

- ✓ **Pros**: There's no need for a cold water tank in your loft; you can get hot water from multiple taps at the same time without a reduction in pressure.
- ✗ **Cons**: You don't get hot water instantly; the hot water can run out and you'll have to wait for it to reheat in the tank.

[2] A guide to different boilers can be found at: http://www.uswitch.com/boilers/boiler-guide/

3. Conventional boilers

Conventional boilers - also known as open vent or regular boilers - have both a hot water cylinder and a cold water tank.

✓ **Pros**: you can get hot water from multiple taps at the same time without a reduction in pressure.

✗ **Cons**: the hot water can run out and you'll have to wait for it to reheat in the tank.

CONTROLS AND TIPS

→ Your boiler will usually have a dial type control on it, usually marked 'Min' to 'Max.' This sets the temperature of the water from the boiler, which will then go through the radiators to heat the home.

→ The thermostat on the boiler controls the temperature of the water circulating around the system. The higher this is set, the quicker and more effectively the system will heat your home. In fact, if this is not set high enough when the outside temperature is very cold then the home may never reach your desired temperature.

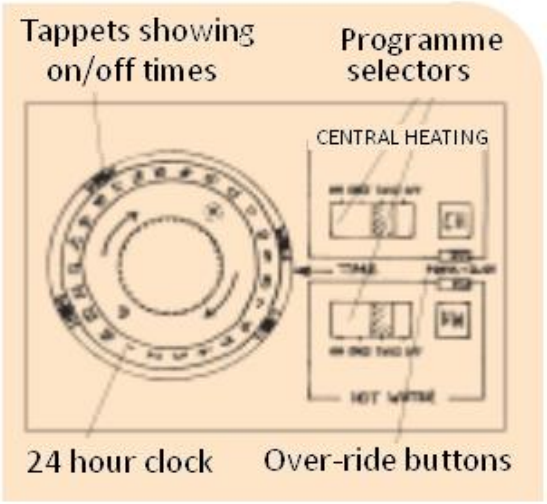
→ As long as you have a room thermostat then it is reasonable to set the boiler thermostat on a high level, letting the room controls do their job. (Note: If there are vulnerable people in the household you may wish to avoid situations where they could come into contact with very hot radiators or pipework).

Timers and Programmers

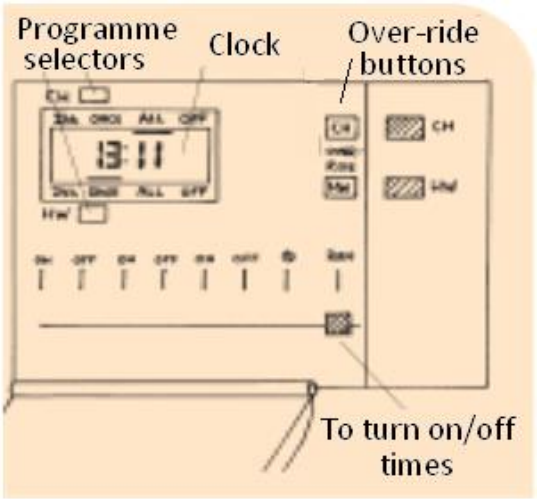
A timer or programmer allows you to set the space and water heating system to switch on and off automatically at pre-set times. Timers and programmers vary in levels of sophistication, and can be either analogue or digital (see Figure 2 and 3 below).

Figure 2 and 3: Analogue and digital programmers

Source: NEF EasySave booklet



Analogue Programmer



Digital Programmer

Some programmers only allow the user to control the space and water heating systems together, only allowing them to be turned on and off twice a day. Others are much more flexible and enable the user to set up to three on/off periods each day for space and water heating individually and different patterns for every day of the week.

CONTROLS AND TIPS

- → Check that the clock is telling the right time. You will have to remember to reset it every time the clocks change in the winter or summer, or after a power cut (if it doesn't have a battery back-up, which most modern ones do).
- → Set the system to come on about half an hour before you want the house to be warm, and off half an hour before you want it off completely; the house will remain warm for about half an hour after the system switches off.
- → It is unlikely that you need your space/water heating switched on all of the time so you should try to avoid using the '24h/On' or 'Off' settings. If you want to switch the space/water heating on or off outside programmed times it is better to use the 'override' button than to switch to '24h/On'.

Room Thermostats

A room thermostat reacts to the temperature of the air around it. It is usually in the hall or living room. For the thermostat to work efficiently it should be located in a room where the temperature is typical of the whole house. The thermostat works by switching the circulating pump and/or the boiler on and off, but it is best if it switches both.

CONTROLS AND TIPS

- → It is recommended that the thermostat be set at between 18°C and 21°C.
- → You should set it as near to 18°C as is comfortable, but stick to 21°C if you are not very active.
- → Each 1°C reduction in setting within the 18 – 21°C range can save you up to 10% on annual heating costs.

Radiators and TRVs

Thermostatic radiator valves (TRVs) allow you to keep different rooms at different temperatures and are fitted to the radiators. They work by opening or closing the valve controlling the flow of hot water through the radiator. If you have a room thermostat as well as TRVs you should not have TRVs on the radiators in the same room as the room thermostat. In any case there should always be a radiator left without a TRV to avoid damage to the circulating pump. A low setting on a TRV gives a low radiator temperature.

When your heating system is switched off for a long time - such as over the summer - you should set your TRVs at their highest setting to stop them seizing closed. If you do not have thermostatic radiator valves you can still turn a radiator off by closing the ordinary radiator valve.

CONTROLS AND TIPS

- → If your radiators never get hot enough to heat your home adequately when turned on full and the temperature across each radiator is even, then your boiler thermostat is probably set too low.
- → If your radiators are cold at the top then there is probably air trapped in them and you should 'bleed' them (letting out any air that has become trapped inside). For more information on how to bleed a radiator see: http://www.uswitch.com/energy-saving/guides/how-to-bleed-a-radiator/
- → If they are cold at the bottom it suggests sludge that needs flushing out.
- → Turning a TRV to a lower setting will result in the room being controlled at a lower temperature, saving energy.
- → TRVs need a free flow of air to sense the temperature, so they must not be covered by curtains or blocked by furniture.

Domestic Water Heating

Domestic water heating may be provided from a **central heating boiler** or through a **separate heating system** (for example an electric immersion heater).

1. Hot water cylinder linked with central heating[3]

When there is a wet central heating system in a home it is common to obtain hot water from the same boiler. The outlet pipe from the boiler generally splits two ways, one to the radiators and the other to a heat exchanger in a hot water storage cylinder. A valve diverts the water to one circuit or the other sharing the water from the boiler between the two.

2. Separate water heating system

Within separate water heating systems the water is heated either by gas or electric, for example through an electric immersion heater which is an electric heating element located inside a hot water storage cylinder.

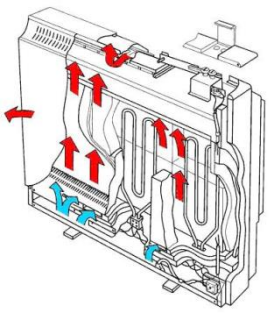
[3] Energy Advice Handbook, Energy Inform Ltd (2004)

CONTROLS AND TIPS

- → Most hot water cylinders have a thermostat. The Energy Saving Trust recommends this should be set at 60 - 65°C. This is hot enough to kill off harmful bacteria in the water.
- → To retain as much heat as possible the cylinder should have at least 75mm of insulation.
- → A timer should be fitted to the immersion heater to control when it switches on and off.
- → If water is to be heated by electricity it is advisable to use one of the "off peak" tariffs such as Economy 7 to heat the water overnight in the cheaper periods.

STORAGE HEATERS

Electric Storage Heaters



Storage heaters are insulated boxes containing bricks with electric elements running through them. When the elements are switched on the bricks heat up (this is called 'charging' the heater). Storage heaters charge up on off-peak electricity.

The insulation keeps most of this heat in the box. At the top of the box is a flap, which can be opened to let the heat out. The more this flap is opened, the faster the heat can escape from the heater into the room.

Although storage heaters are insulated, quite a lot of heat leaks out and so it is not possible to stop a heater giving off heat once it has been charged up.

Most storage heaters have two controls: an **Input** (sometimes called 'Charge' or 'Auto-set control') and an **Output** (sometimes called 'Boost' or 'Room temperature'). Some storage heaters encompass an on-peak convector heater. If this is the case, be careful to identify which controls operate each part; the convector will have an on/off switch and a temperature control, and may also have a time clock.

- **Input:** This controls how much heat is stored in the heater and therefore how much electricity it uses. A thermostat inside the heater measures the temperature of the bricks and turns off the electricity supply when the selected setting is reached. On its lowest setting a small amount of heat is stored in the heater, this setting might be in the spring or early autumn or in a cool summer. On its highest setting the maximum amount of heat possible is stored. To stop the heater storing any heat, switch it off at the wall.

- **Output:** This opens and closes the flap at the top of the heater. On its lowest setting heat leaves the heater slowly. On its highest setting heat leaves the heater quickly and so the heat stored is used up faster.

Some heaters have an automatic output control where a thermostat controls the opening and closing of the damper flap. Some may have an electric fan which makes heat leave the heater quicker. Some electricity companies have a service where they can automatically charge your storage heaters remotely according to the weather forecast in your area.

CONTROLS AND TIPS

→ Turn down the "output" control before you go to bed to stop heat being given out when you don't want it.

→ If your room is cold, turn up the "output" control until the room warms up

→ When the room is warm, turn down the "output" control to save the heat for later in the day.

→ As the weather gets warmer and you need less heat, turn down the "input" control to store less energy in the heater and therefore use less electricity.

→ If your house is warm enough in the summer, turn the heaters off at the wall and back on again when it starts to get cold.

→ It should cost less to heat your home with storage heaters than by electric fires because storage heaters use cheaper off-peak electricity.

ROOM HEATERS

Portable electric heaters are a very inefficient way of heating a room so their use is recommended only when no other form of heating is available or if temperatures pose a risk to health (if for example the temperature within the room falls below 15°C).

CONTROLS AND TIPS

→ The least efficient way of heating.

→ Portable heaters or fans are usually used in addition to central heating control.

→ Recommended only when no other form of heating is available or if temperatures pose a risk to health.

FURTHER RESOURCES AND INFORMATION

- For tips on how to save heat and fuel at home, have a look at the National Energy Foundation website here: http://www.nef.org.uk/knowledge-hub/energy-in-the-home/ways-to-save-heat-fuel-at-home
- The YouGen website has lots of extra information and advice relating to heating and hot water: http://www.yougen.co.uk/energy-saving/Heating+Hot+Water/
- For information about the carbon emissions associated with different fuels, check out these figures for the carbon or carbon dioxide emitted by full combustion of each fuel, per unit of energy: http://www.biomassenergycentre.org.uk/portal/page?_pageid=75,163182&_dad=portal&_schema=PORTAL
- For all sorts of information about energy, have a look at this website: http://www.confusedaboutenergy.co.uk/
- This website has a handy guide with information and tips about how to use electricity: http://www.electricity-guide.org.uk/