

# A buyer's guide to heat pumps



To find out more about installing a heat pump call 0800 512 012 or visit [energysavingtrust.org.uk](http://energysavingtrust.org.uk)



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## What are heat pumps?

Heat pumps extract available heat from a natural source such as the ground or air and release it in another location at a higher temperature. Heat pumps can be used to heat your home or hot water.

There are different types of heat pumps that can take heat from the ground, the air or from water – known as ground source, air source and water source respectively. Heat pumps have some impact on the environment as they need electricity to run (just like your fridge requires electricity to operate) but the heat they extract is from a renewable source.

## How do heat pumps work?

Heat naturally flows from a warmer place to a cooler place. However, heat pumps use a special fluid that constantly evaporates and condenses in a closed circuit controlled by valves and a compressor in order to reverse this natural process. In heating applications, heat is removed from ambient air or from water, soil or bedrock using a heat 'collection loop' and delivered to where it is needed, usually into the heating and hot water systems of the house.

Heat pumps need electricity to run but they use less electrical energy than the heat energy they generate.

This makes them much more efficient than other electrical heating options. Typically you only need one unit of electricity to deliver two to three units of heat with a heat pump. Because heat pumps need electricity to run there will still be some resulting carbon dioxide emissions, although these can be lower than for other heating systems.

## What are the key benefits of heat pumps?

Heat pumps are well established in other EU countries and are becoming more popular in the UK. As well as the lower running costs and reduced carbon dioxide emissions heat pumps have other benefits:

### Integration

Heat pumps can be incorporated into many UK homes. They are more suited to newer highly insulated properties and are not always suitable for flats. Once installed and connected to the heating and hot water circuits they are fully automatic. Heat pumps are also easily integrated with solar hot water systems to provide a comprehensive heating and hot water system.

### Versatility

The collection loop for ground source heat pumps can be installed horizontally or vertically into the ground. Water source heat pumps need a source of water such as a lake, river or stream and air source heat pumps simply need the outside air. There is, therefore, a type of heat pump suitable for almost every type of house.

## Fit and forget

Very little maintenance is required if a well designed heat pump system is installed properly. Equipment should operate automatically with very little noise.

Heat pump system components have long life expectancies and high reliability. Life expectancy for the pump is around 20 years, while a ground loop could last around 40 years if designed and installed properly. In addition the system can offer the following benefits over oil or gas fired systems:

- No boiler or fuel tank.
- No flue or ventilation requirements.
- No combustion or explosive gases in the dwelling.

Heat pumps can be used to provide all the heating and hot water needs for your home, or they can be installed to provide only some of your home's heating and hot water to work alongside an additional heat source for example a boiler, electric immersion heater or wood stove for the coldest days.

## Is a heat pump suitable for my home?

Heat pump systems can be integrated into most heating systems but will be more cost effective in some homes than others. Before choosing to install a heat pump consider:

### Energy efficiency first

Make sure you improve the energy efficiency of your home first. Focus on improving insulation and tackling draughts. Heat pumps are most efficient when used in highly insulated buildings.

### Your current heating system

Heat pumps are most likely to save money and carbon dioxide when they are used to replace electric, LPG or coal heating systems, so if you have gas or oil heating you may want to do your sums carefully before proceeding. Heat pumps work better with slow response, low



temperature heating systems such as under-floor heating rather than conventional wet radiator systems. But low temperature heating systems work better in buildings with a high 'thermal mass'. If your home heats up and cools down quickly, a low temperature heating system is unlikely to provide the heating you require and a heat pump may not be the best option for your home.

### Choosing a heat collection system

Most domestic systems use either a ground source or an air source system. Ground source heat pumps require a borehole or a trench for heat collection. A loop buried in a trench can need a lot of ground space: usually around 100-200 metres is required depending on the type of ground loop for a typical domestic insulation. If you do not have enough land for a large trench you can use a borehole but this tends to be more expensive to install – this will require a depth of around 80-100 metres in total for a typical domestic installation. This doesn't have to be a single borehole of 100 metres; it can be a number of shallow boreholes which together total 100 metres.

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Alternatively an air source heat pump doesn't need any of these ground works and is therefore appropriate for a wider range of properties. Capital costs are generally lower too, although system efficiency tends to be lower.

#### **Disruption and mess**

Digging trenches or boreholes is a dirty job and can be disruptive to you and to your neighbours. Bear in mind that a trench will disrupt the appearance of your garden and this may take some time to recover.

#### **Get connected**

Heat pumps need high electrical currents to start up. Check that your electrical supply is up to the job by speaking to your electricity supplier about any limitations at your point of supply. Some heat pumps are available with a "soft start" option to minimise this effect. A heat pump system should be connected to its own breaker in the fuse board.

## **Types of heat collection systems**

### **Ground source heat pumps**

Use buried lengths of plastic pipe either in a borehole or a horizontal trench. The pipe is filled with a water/antifreeze mixture which

circulates through the pipe absorbing heat from the ground. Horizontal trenches dug to a depth of 1–2 metres can cost less but need more land than boreholes. Using coiled piping (known as a slinky) reduces the amount of land needed. The borehole method involves drilling to a depth of around 80–100 metres or a number of shallow boreholes which together total 100 metres. It will benefit from higher ground temperatures than the horizontal trench although installation costs will be greater.

In both cases once your ground source heat pump is installed there should be nothing visible above ground.

### **Air source heat pumps**

Use air as the source of ambient heat energy. They do not rely on a collection system and simply extract the heat from the source at the point of use. Air source heat pumps can be fitted outside a house or in the roof space and generally perform better at slightly warmer air temperatures.

## **Integrating with existing heating systems**

Heat pumps are most efficient if they provide heat over a long period of time to a heating circuit that runs at a lower temperature (usually around 35–55°C) than conventional systems. To benefit from this lower temperature output your home will need to be reasonably 'air tight' and well insulated. The Energy Saving Trust can offer you free advice on how best to insulate your home as well as tell you about any grants available for energy efficiency measures, call **0800 512 012**.

Heat pump systems can be particularly effective when used to run under-floor heating. This will allow the pump to work at a consistent level over a period of time and to provide sufficient heat while operating at a lower temperature.

If necessary you can use a secondary heating source to raise the temperature in some rooms such as the living room or throughout your home. This could be done by using a conventional central heating system or individual room heaters. A wood pellet stove or traditional log burner would do this without adding to your carbon footprint.

It is important that the installer sizes the heat pump to match the buildings heat demand. Over sizing or under sizing the heat pump can increase running costs and reduce operating efficiency. This will mean the pump may be prevented from operating continuously resulting in more energy intensive 'stop-start' heating, which will in turn increase running costs. Speak to your installer about sizing and ask them to explain how they have identified the size you will need.

Heat pumps can be combined with a solar hot water system to provide hot water. However you may still need additional top-up heating from, for example an immersion heater to heat the hot water to the required temperature in winter.

## Heat pump efficiencies

Heat pumps give out more energy (heat) than they use (electricity), sometimes much more. If a heat pump has a 'coefficient of performance' (CoP) of four that means at a given point in time it is generating four units of heat energy for every unit of electrical energy used. However the average system efficiency of the whole system over the year, including any top-up electricity for water heating will be less than the quoted CoP.

Good quality domestic heat pump installations in the UK can have a system efficiency of 300%. The Energy Saving Trust heat pump field trials showed that in a sample of existing installations monitored in the UK a typical ground source system has an efficiency of 250%, and air source systems efficiency is 220%.



## What does a heat pump need to provide heating?

There are three main parts to any heat pump system:

- A heat source and the means of extracting heat e.g. a ground loop.
- A circuit of fluid in the heat pump and a power source.
- A heat distribution system in the home e.g. the under-floor heating system.

## How is the heat generated?

The central component of a heat pump is the compressor. This is usually driven by an electric motor, although gas engine driven compressors are also available. As heat is absorbed from the heat source the 'working' circulating fluid evaporates changing from liquid to gas. This vapour is then compressed causing it to heat up. The heat from this process is absorbed via a 'heat exchanger' into your home's heating system which means the vapour loses its heat

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and condenses back into a liquid. This is then circulated through the heat source once more. A heat pump can also be used for cooling with the addition of a valve to reverse the direction of the working fluid.

## Costs and savings

The cost of a professionally installed heat pump system can vary significantly so it is important to do as much research as possible. This should include obtaining at least three quotes from certified installers.

Typical costs range from £9,000 to £17,000 for a ground source or £6,000 to £10,000 for an air source system, not including the cost of the heat distribution system.

The running cost will depend very much on the size, insulation levels and heating pattern of the house. For a typical three bedroom semi-detached house with reasonable insulation levels, the annual cost of providing space and water heating with a ground source heat pump would be around £650 or £750 for an air source system. This is based on current electricity prices and a standard tariff. Using an Economy 10 or Economy 7 tariff may give slightly lower running costs depending on the heating pattern, the control strategy and the thermal performance of the building.

At current fuel prices, these running costs are unlikely to deliver financial savings compared to most gas or oil heated systems. Savings are much more favourable when replacing a coal, LPG, or electric heating system, although the payback period will still be long.

Purchase and installation costs can be quite high when compared to other home heating options so make sure you obtain full quotations from manufacturers and installers. In particular, drilling the bore or digging the trench can be costly. Make sure you know exactly what any quote covers before going ahead.

There are plans to introduce a Renewable Heat Incentive (RHI) scheme in 2011 for heat generating technologies. Owners of eligible heat technologies will be paid an annual sum to reflect the amount of renewable heat they are deemed to have used. For the latest information on RHI visit [energysavingtrust.org.uk](http://energysavingtrust.org.uk)

## Maintenance

Heat pump systems typically come with a 10 year warranty. You can expect them to operate for 20 years or more, however they do require regular scheduled maintenance. A yearly check by you and a more detailed check by a professional installer every 3-5 years should be sufficient. The installer should leave written details of any maintenance checks you should undertake to ensure everything is working properly. Consult with your supplier for exact maintenance requirements before you commit to installing a heat pump.

## Local impact

Ground source heat pump installations are generally unobtrusive and extremely quiet in operation. Usually, the only system noise is from the small circulation pump which, if audible at all, should be no louder than a modern central heating pump. Ground collectors are buried so they are not visible. Usually the heat pump will be installed in a cupboard area, so that is out of sight as well.

## What to look for in an installer

The Energy Saving Trust recommends you choose an installer certified under the Microgeneration Certification Scheme. Only systems installed by certified installers will be eligible for RHI payments. You can find certified installers at [microgenerationcertification.org](http://microgenerationcertification.org)

All suppliers should be able to provide a detailed breakdown of the specification and costs of their proposed system. They should also explain how they have calculated the size of the system, supply good quality instructions and operating manuals, as well as provide an estimate of how much heat will be provided as a proportion of your current needs. Get at least three quotes.

Use the checklist below to help you select the right installer for your needs. Pick a supplier with experience. Ask:

- How many years they have been installing systems?
- How long they have been in business?

Choose local where possible. Ask:

- For a list of references and local installations and check them out.

Check any professional credentials being quoted. Many competent and experienced installers may not have any relevant professional qualifications. Ask:

- If they are a member of appropriate trade organisations?
- Check that they are suitably certified.

Gets lots of information on system options and potential problems so you can talk confidently to installers. Ask:

- For recent manuals and brochures.
- For any background information and test data.

Check the time limits of any guarantees and warranties and find out what they cover.

Ask about:

- After-installation services offered.
- Warranties: all installers should provide a minimum one year warranty on the installation.

- Details of what the warranty covers and over what time periods.

Do not compare installers on cost alone; the cheapest may not be the most appropriate. Ask:

- For details on available options e.g. size, pipe requirements and maintenance cycles.
- About system efficiency of the installation (not the CoP of the heat pump) and how it has been calculated. Generally, the higher the figure, the better but only if correctly calculated.
- If the company will project manage the whole job and coordinate the drilling/ trenching. This is very important indeed. It will make the process much easier for you but it will also help to deliver a properly matched and balanced system that will operate at a higher efficiency.
- If the company will liaise directly with the installers of any new heating system such as under-floor heating. This is critically important that these two systems are designed with each other in mind.
- For information on applicable regulations, including health and safety guidelines and how they will address them:
- About independent testing of their system to verify any stated efficiencies. There is a recognised testing and certification system for heat pump technology. If these tests have been carried out ask for a copy of the full report.

Check quotations for detail. Ask:

- About government incentives – it is the installer's responsibility to ensure that your system will be eligible for RHI payments.
- About payment options.
- About what is included – prices should cover safe removal and disposal of any existing equipment.
  - Is the price of the drilling/trenching included?
  - Is the cost of integration with your homes heating system – or a proposed heating system – included?

# How the Energy Saving Trust can help

The Energy Saving Trust is a non-profit organisation providing free, impartial advice to help you stop wasting energy and money and help fight climate change. To find out what you can do to generate your own energy visit [energysavingtrust.org.uk](http://energysavingtrust.org.uk) or call us free on **0800 512 012**.

Our advisors will:

- Give you personalised advice on what's practical for your home.
- Put you in touch with local certified installers.
- Tell you about grants and offers available.

All measure costs and savings are correct at time of printing. However financial savings will change as energy prices rise or fall. Please refer to our website for the most recent measure costs and savings.

Energy Saving Trust

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[energysavingtrust.org.uk](http://energysavingtrust.org.uk)

**Microgeneration Certification Scheme**

[microgenerationcertification.org](http://microgenerationcertification.org)

**REAL Assurance Scheme**

[realassurance.org.uk](http://realassurance.org.uk)

**The Heat Pump Association**

[heatpumps.org.uk](http://heatpumps.org.uk)

**Ground Source Heat Pump Association**

[gshp.org.uk](http://gshp.org.uk)



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