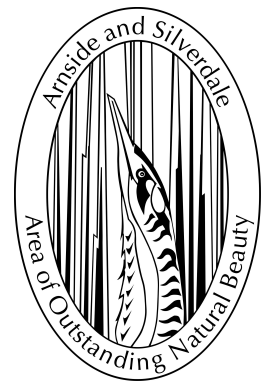


Bittern Countryside

Community Interest Company



Energy Fact Sheet 5.

“Heat from Ground and Air”

Air and Ground Source Heat Pumps

Save energy, Save money
Save the environment!



Supporting the

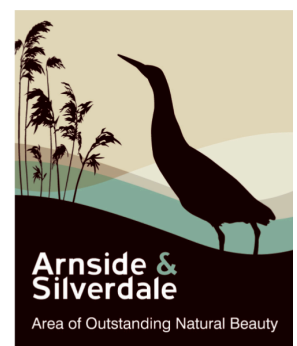
Arnside Silverdale AONB

Low Carbon Landscape Initiative

Bittern Countryside Community Interest Company
Registered Office: The Old Station Building, Arnside, LA5 0HG
Registered number 6363720

Website: <http://www.bitterncountrysidecic.org.uk>

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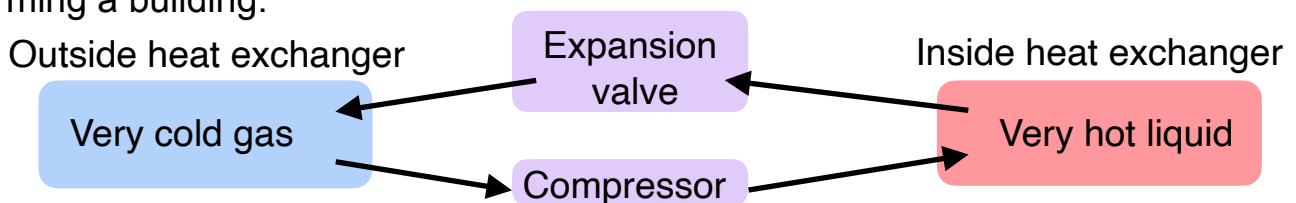
Introduction

This is the fifth in a series of leaflets prepared by the Bittern Countryside Community Interest Company to help local residents and others understand what options are available for those wishing to convert to a greener or more sustainable energy source and to save money on fuel or energy bills. It deals with the two main types of Heat Pumps: those which derive heat from the ground and those that can extract heat from the surrounding air.

** Fact Sheet 1 deals with solar electricity. Fact Sheet 2 deals with woodburning and multifuel stoves. Fact Sheet 3 deals with buying, using and storing wood. Fact Sheet 4 "Avoiding Waste" deals with energy and resource conservation. Fact Sheet 6 deals with plastic.*

How Do Heat Pumps Work?

Heat pumps are a well-developed technology and have been in use for many decades. In many European countries they are the main source of domestic heating. Heat pumps have some impact on the environment as they need electricity to run, but the heat they extract from the ground, air, or water is constantly being renewed naturally. Air source heat pumps use a gas refrigerant which can be liquified at high pressure. This passes through a compressor which turns it into a liquid. In the process the liquid gets very hot. This heat is used in the inside heat exchanger to heat your hot water. The refrigerant then passes through an expansion valve where it turns back into a gas using heat energy to do so. The gas is then much colder than the air outside so it absorbs energy as it passes through the outside heat exchanger. The process is then repeated. Thus a heat pump can draw low grade heat from the air and, using very little energy, convert it into high grade heat for warming a building.



Ground source heat pumps use a water and antifreeze mixture that stays liquid the whole time but is compressed and then returned to normal pressure. Unlike gas or oil boilers, heat pumps deliver heat at lower temperatures. This means that during the winter they may need to be left on constantly to heat your home efficiently.

The benefits of heat pumps

- Can lower fuel bills, especially if you are currently using conventional electric heating.
- Can reduce your carbon footprint: heat pumps can lower your home's carbon emissions, depending on which fuel you are replacing.
- No fuel deliveries required.
- Can provide space heating and hot water
- It's often classed as a 'fit and forget' technology because it needs little maintenance.

There are two main types of Heat Pump: Air Source and Ground Source.

Air source heat pumps absorb heat from the air outside while ground source heat pumps extract heat from the ground. While the principles of operation are essentially the same, air source heat pumps are generally simpler to install and thus much less expensive.

All heat pumps have a COP rating (Co-efficient of performance). This gives the energy taken from the surroundings as a ratio of the amount of energy used.

So a COP of 4 means that you get 4 times more heat than you would have got if you used an electric heater. The COP is usually measured with an outside temperature of 5°C and a radiator water temperature of 35°C.

However although most pumps just give one COP measurement, the actual performance varies greatly compared to the outside temperature. So a COP of 4 at 5°C may reduce to a COP of 2 if the outside temperature is below -5°C.

Also the COP will decrease as you heat the water to over 35°C. Thus a COP of 4 will reduce to around 3 if you heat the water to 45°C and 2 if you heat the water to 60°C for your domestic hot water. This affects both the cost of running the system and the size of pump you will need. Too small a pump and you will struggle to heat your house on the coldest winter days: too big and your energy costs will be higher than they need to be. You will need room inside for a large, well insulated hotwater tank for your domestic hot water, a compressor and a heat exchanger.

Most heat pumps are set to heat your domestic hot water to 50°C. Once a fortnight the immersion heater will come on and boost that to 60°C to guard against Legionella.

Air Source Heat Pumps

These stand outside and heat from the air is absorbed into a liquid refrigerant which is pumped through a heat exchanger in the heat pump. Low grade heat is then extracted by the refrigeration system and, after passing through the heat pump compressor, is concentrated into a higher temperature. This then provides useful heat capable of heating a house.



Air Source Heat Pump

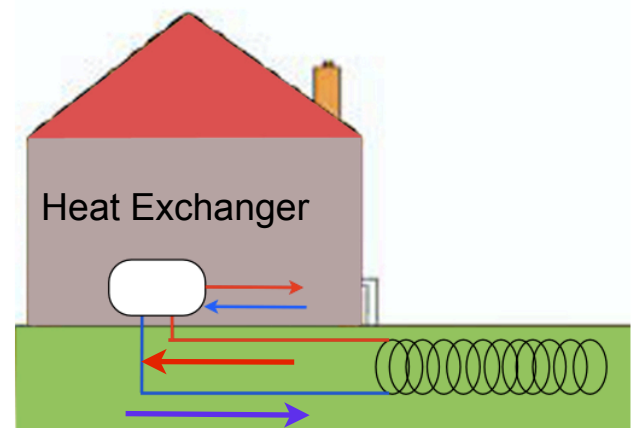
The Energy Saving Trust defines two main types of air source heat pump system:

- An air-to-water system distributes heat via your wet central heating system. Heat pumps work much more efficiently at a lower temperature than a standard boiler system would. This means that they are more suitable for under floor heating systems or larger radiators, which give out heat at lower temperatures over longer periods of time.

- An air-to-air system produces warm air which is circulated by fans to heat your home. They are unlikely to provide you with hot water as well.

Ground Source Heat Pumps

A ground source heat pump circulates a mixture of water and antifreeze around a loop of pipe - called a ground loop - which is buried in the garden. Heat from the ground is absorbed into this fluid and is pumped through a heat exchanger in the heat pump. Low grade heat passes through the heat pump compressor which concentrates it into a higher temperature. Thus useful heat is produced capable of heating a house. The fluid, now cooler, passes back into the ground where it absorbs further energy in a continuous process while heating is required.



Ground Source Heat Pump

The length of the ground loop depends on the size of your home and the amount of heat you need - longer loops can draw more heat from the ground, but need more space to be buried in.

Normally the loop is laid flat, or coiled in trenches about two metres deep, but if there is not enough space in your garden you can install a vertical loop down into the ground to a depth of around 100 metres for a typical domestic home. However in view of the underlying geology in areas such as the Arnside Silverdale AONB, it is unlikely that a vertical loop would be cost effective.

What Type of Heat Pump would be suitable for me?

To tell whether an air source or ground source heat pump is right for you, there are a few key questions to consider:

- For an Air Source Heat Pump - Do you have somewhere to put it? You'll need a place outside your property where a unit can be fitted to a wall or placed on the ground while, at the same time, being unobtrusive. It will need plenty of space around it to get a good flow of air; however it should not be exposed to high winds. A sunny wall is ideal. Another point to bear in mind is that the fans and compressors in the unit do make some noise.
- For a Ground Source Heat Pump: Is your garden suitable for burying the ground loop? It doesn't have to be particularly large, but the ground needs to be suitable for digging a trench or a borehole and accessible to digging machinery. Also you will need an indoor space for the pump installation.
- Is your home well insulated? Since both types of heat pump work best

when producing heat at a lower temperature than traditional boilers, it's essential that your home is insulated and draught proofed well for the heating system to be effective.

- What fuel will you be replacing? The system will pay for itself much more quickly if it's replacing an electricity or coal/oil heating system, i.e. in off-gas areas. At the moment, heat pumps are not recommended for poorly insulated homes on the gas network.
- What type of heating system will you use? Air source heat pumps may perform better with underfloor heating systems or warm air heating than systems using existing radiators because of the lower water temperatures required.
- Is the system intended only for a new development? Not necessarily, but combining the installation with other building work can reduce the cost of installing the system.

Costs and Savings

The total costs for replacing a gas or oil boiler with a typical Air Source Heat Pump system suitable for a detached home range from about £8,000 to £14,000 whereas the costs of a typical Ground Source system range from about £9,000 to £27,000. Some heat pumps are much quieter than others but cost more and water tanks need to be really well insulated. Installing underfloor heating or new radiators can add to this.

Running costs will vary depending on a number of factors - including the size of your home and how well insulated it is. The savings will vary depending on many factors, some of which are outlined below. For either system, it is important that it is controlled appropriately for your needs, including temperature settings. Actual savings figures will also depend on existing and future fuel prices.

- The heat distribution system: If you have the opportunity, underfloor heating can provide greater efficiencies than radiators because the water doesn't need to be heated to such a high temperature. If underfloor heating isn't possible, then the radiators should be as large as possible. Your installer should be able to advise on this.
- Electricity costs: you will still have to pay utility bills because heat pumps are powered by electricity. Thus the saving you achieve can be affected by the price of the fuel you are replacing and the price of the electricity for the heat pump.
- Efficiency of old and new system: the efficiency of the old heating system will affect how much you spent on heating bills previously. If the old heating system was inefficient, heating bills could have been high and the difference between the new running costs and the old running costs will be greater, therefore providing a greater saving.

- Hot water: if the system is providing hot water as well as space heating: the provision of hot water can lower system efficiencies, therefore making running costs higher.
- Using the controls: learn how to control the system so you can get the most out of it. Your installer should explain to you how to control the system so you can use it most effectively.

In order to reduce your home's CO₂ emissions further, you might consider installing solar photo voltaic panels on your roof (See fact sheet 1). The electricity produced during the summer will be more than enough to cover the electricity used by the heat pump to heat your water. It will also reduce your costs during the winter.

Can I Get Help with Costs?

The Government sees that increasing renewable heat is key to the UK meeting its renewable energy targets, reducing carbon emissions, ensuring energy security and helping to build a low carbon economy.

The Boiler Upgrade Scheme was introduced in April 2022. This gives a grant of £5,000 if you replace a fossil fuel heating system with an air source heat pump or £6,000 for a ground source heat pump.

However you must have an energy performance certificate for your house with no outstanding requirements for wall or loft insulation.

In addition you must use an Micro-generation Certified Scheme (MCS) certified installer who will apply for the grant for you. There are a limited number of grants available and the scheme will run until 2025.

Will I save money using a Heat Pump

This will depend greatly on the fuel you are replacing, the efficiency of your present boiler and the cost of the fuel. Prices of gas are increasing and it may soon approach the price of electricity per Kwh. In addition we need to get away from using fossil fuels for heating and as more and more electricity is from renewables it makes sense to use this.

How Do I Go About Installing a Heat Pump?

The Energy Saving Trust strongly recommends that you use an installer certified through the Micro-generation Certified Scheme (MCS), which is currently the most robust installer standard in the UK. A list of approved local suppliers of both technologies can be accessed on the MCS Website.

Other Questions

How efficient is a Heat Pump?

Manufacturers claim that the efficiency of both air and ground source heat pumps to provide heat, far exceed traditional types of heating systems. However, the efficiency of the air heat pump is less than that of the ground source heat pump due to seasonal and other fluctuations in the external air temperature. Efficiency can also be reduced in moments of reduced air-flow and high wind conditions, unlike the more constant ground and water temperature.

An efficient air source heat pump can be expected to use around a quarter of the energy of an average existing gas boiler (78% efficient) or oil boiler (82% efficient) to produce the same amount of heat. A good ground source heat pump will be even better and use about a fifth of the energy.

If the heat pump uses electricity from renewable sources to power it, it can be almost carbon neutral. Even if your electricity comes from gas or coal, the electricity needed to run your heat pump will have produced much less carbon dioxide than either an average gas boiler or an average oil boiler does per unit of heat. The potential for carbon savings will increase in future under the UK Government's plan to decarbonise the electricity grid.

How long is the pay-back time?

At the present time of energy cost fluctuations it is difficult to say. However it is likely that in the future gas and oil prices will rise much more rapidly than electricity prices. If you already have solar panels then using the excess free energy from them to run your heating rather than exporting it back to the grid will bring down the cost.

How expensive is a heat pump to service.

Costs are low. Not much can go wrong and you can expect a life of between 20 and 30 years. Keep to the recommended service regime.

What Experience of Heat Pumps is there in the UK?

The Energy Saving Trust has recently completed field trials of ground and air source heat pumps in use in different parts of the UK, in order to get a better idea of how they perform, and the saving they achieve, in real life environments. The final report: Getting Warmer: a Field Trial of Heat Pumps is available on the EST website.

There are several houses with either air source heat pumps or ground source heat pumps in the AONB. All the owners seem happy with their installations.

Ken and Ann Kitchen who live in Arnside have had an 8.5 kw Ecodan air source heat pump installed in June 2022 and are happy to answer questions. Just email them via BCCIC.

Finding an installer

There are very few installers yet in the area. The Kitchens used Mawson Energy * from Stavely and can recommend them. Make sure any installer you use is MCS approved. They should be able to show you examples of their work.

Further Information

Further information can be obtained from the following independent sources:

Energy Saving Trust Advice Centre: Tel: 0800 512 012.

Website: <http://www.energysavingtrust.org.uk/>

The EST has produced a 'Buyers Guide to Heat Pumps'; available on-line or through the Advice Centre. Website: <http://www.energysavingtrust.org.uk/Resources/Publications/Renewables/A-buyer-s-guide-to-heat-pumps>

The Department of Energy and Climate Change Website:

http://www.decc.gov.uk/en/content/cms/meeting_energy/microgen/microgen.aspx

Heat Pump Association Website: <http://www.heatpumps.org.uk>

Which: www.which.co.uk

Can you help us?

Unlike other forms of renewable energy, heat pumps are not yet common in our area. However we have talked to several people who have installed them and all been satisfied. All the houses were well insulated though.

If you have had a heat pump installed recently we would love to hear from you.

* Mawson Energy web site www.mawsonenergy.co.uk

Where did the CIC get its information from?

All the information is drawn from recognised official websites, publications and from practical experience - contact us by email: info@bitterncountrysidecic.org.uk for more information.

