

# 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.arnsidesilverdaleaonb.org.uk/AONB/Support/Bittern-Countryside-CIC.html>

## **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. The series will eventually cover solar hot water systems, woodpellet and woodchip central heating boilers.*

## **How Do Heat Pumps Work?**

Heat pumps work in the same way as refrigerators that use a refrigeration cycle which alternately evaporates and condenses a liquid within a closed system. When this liquid condenses it gives up its energy in the form of heat and similarly when it evaporates, it loses energy and so, cools. Thus a heat pump can draw low grade heat from the air or ground and, using very little energy, convert it into high grade heat for warming a building. The same system can also be used in reverse to act as an air-conditioner.

The key to the whole process is a liquid refrigerant that is pumped round the system and the heat exchange coils that work in the same way as in a refrigerator.

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.

Unlike gas or oil boilers, heat pumps deliver heat at lower temperatures over much longer periods. 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 somewhat less expensive.

## Air Source Heat Pumps

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

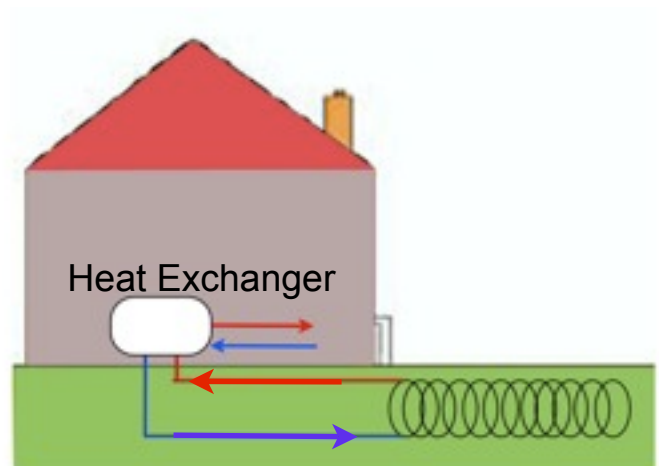
The Energy Saving Trust defines two main types of air source heat pump system:

- 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. 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 up to 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 practical. 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.



Ground Source Heat Pump

## **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 heating system, i.e. in off-gas areas. At the moment, heat pumps are not recommended for homes on the gas network.
- What type of heating system will you use? Air source heat pumps can perform better with underfloor heating systems or warm air heating than radiator-based systems because of the lower water temperatures required.
- Is the system intended 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 installing a typical Air Source Heat Pump system suitable for a detached home range from about £6,000 to £10,000 whereas the costs of a typical Ground Source system range from about £9,000 to £17,000.

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 using solar water heating to provide hot water in the summer months.

### **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 Renewable Heat Incentive (RHI) will help accelerate deployment by providing a financial incentive to install renewable heating in place of fossil fuels. Details were published in March 2011 and can be accessed on the Department of Energy and Climate Change website. [http://www.decc.gov.uk/en/content/cms/meeting\\_energy/Renewable\\_ener/incentive/incentive.aspx](http://www.decc.gov.uk/en/content/cms/meeting_energy/Renewable_ener/incentive/incentive.aspx)

To start with, the Government is giving priority to the larger scale heat users and therefore as a first phase the scheme will provide a subsidy payment for non-domestic heat users such as large scale industry and small businesses. For domestic users, the Renewable Heat Premium Scheme was launched in August. This scheme that will only run to 31 March 2012, offers a one-off payment to assist in developing a renewable energy scheme in your home. Payment vouchers are issued and the amount received depends on the technology used. For heat pump technology, the amounts are;

**Air Source Heat Pump £850**

**Ground Source Heat Pump £1250**

<http://www.energysavingtrust.org.uk/Generate-your-own-energy/Sell-your-own-energy/Renewable-Heat-Premium-Payment>

## Possible Savings for Heat Pumps

Using typical system efficiencies from the field trial the following savings have been modelled for ground source and air source heat pumps when replacing an existing heating system in a 3 bed semi- detached home.

Present System		Ground Source Heat Pump	
		Savings from a typical performing system 250%*	Savings from a typical performing system 300%*
Gas (at 3.67p per kWh)	£/yr	-£40	£70
	kgCO <sub>2</sub> /yr	280	750
Electric (at 12.5p per kWh)	£/yr	£420	£530
	kgCO <sub>2</sub> /yr	4985	5455
Oil (at 4.42p per kWh)	£/yr	£50	£160
	kgCO <sub>2</sub> /yr	1085	1560
Solid (at 3.53p per kWh)	£/yr	£260	£370
	kgCO <sub>2</sub> /yr	4860	5330

<http://www.energysavingtrust.org.uk/Generate-your-own-energy/Ground-source-heat-pumps>

Present System		Air Source Heat Pump	
		Savings from a typical performing system 220%*	Savings from a typical performing system 300%*
Gas (at 3.67p per kWh)	£/yr	-£130	£70
	kgCO <sub>2</sub> /yr	-105	750
Electric (at 12.5p per kWh)	£/yr	£330	£530
	kgCO <sub>2</sub> /yr	4600	5455
Oil (at 4.42p per kWh)	£/yr	-£40	£160
	kgCO <sub>2</sub> /yr	700	1560
Solid (at 3.53p per kWh)	£/yr	£175	£370
	kgCO <sub>2</sub> /yr	4475	5330

<http://www.energysavingtrust.org.uk/Generate-your-own-energy/Air-source-heat-pumps>

\*% of energy output to electrical energy used to power the system.



## **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?**

A heat pump with a mid-range efficiency can be expected to use only a third of the energy of an average existing gas boiler (78% efficient) or oil boiler (82% efficient) to produce the same amount of heat. A heat pump draws on a small amount of electricity to power it, which is more carbon-intensive than gas and oil. Taking these factors into account, and based on Government projections for grid electricity carbon factors, a heat pump installed in 2010 produces 9% less carbon dioxide than an average gas boiler and 28% less than 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.

Manufacturers claim that the efficiency of air source heat pumps to provide heat, as with all types of heat pumps, 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.

### **How long is the pay-back time?**

Assuming a mid-range system efficiency, at current electricity prices a ground source heat pump will provide a payback on the marginal installation costs compared with direct electric heating in 18 years. This payback period increases to 29 and 47 years when compared with new oil and gas boilers, respectively. At current electricity prices an air source heat pump will provide a payback on the marginal installation costs compared with direct electric heating in 10 years. This payback period increases to 16 and 31 years when compared with new oil and gas boilers, respectively. The difference in payback is due to differences in capital costs of different heating technologies and fuel prices. If energy prices increase, as is being predicted; the Renewable Heat Incentive (RHI) is enacted; and as heat pumps become cheaper due to wider adoption and economies of scale, payback periods could become shorter. Because of the long payback time, the RHPS will not be available if you currently heat your house with a gas boiler. Details of the scheme can be found on the Energy Savings Trust website.

### **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.

## Further Information

Further information can be obtained from the following 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](http://www.decc.gov.uk/en/content/cms/meeting_energy/microgen/microgen.aspx)

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

Home Heating Solutions and Systems (this website- based in New Zealand - has useful technical information on heat pumps and other renewable energy sources).

Address: <http://www.home-heating-systems-and-solutions.com/>

## Can You help us?

Unlike other forms of renewable energy, we have not been able to find anyone in our area who has had an air or ground heat pump installed other than the Leeds Children's Holiday Association at Silverdale who have an air pump installed to heat their swimming pool. It has been a great success in reducing their fuel bills but it is used mainly in the warmer months. Do you know of anyone who could act as a case study for us in our area. We would love to hear from you if so.

## 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: [bitterncic@arnsidesilverdaleaonb.org.uk](mailto:bitterncic@arnsidesilverdaleaonb.org.uk) or by telephone on 01524 761034 for more information.

