Air Source Heat Pumps

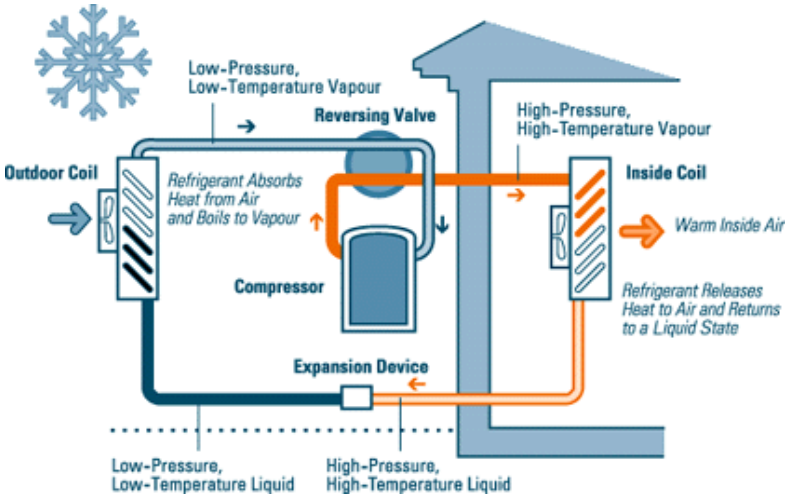
Installed cost: from £5,000
Annual Fuel bill saving: If you are on mains gas there is a marginal financial benefit but sometimes no benefit, please call us for a more detailed explanation if you are using all electricity, oil or solid fuel for heating.
Carbon saving: If you are on mains gas there is no carbon saving, please call us for a more detailed explanation if you are using all electricity, oil or solid fuel for heating.
Premium Heat Payment (Grant): £850
Renewable Heat Incentive (payments for generating renewable heat): expected to be introduced in the summer of 2013 following a UK Government consultation in September 2012. Government has confirmed that renewable heat installations installed in homes since 15 July 2009 will get the RHI once it comes in, provided they meet the eligibility criteria. TBC if Air Source Heat Pump will be eligible for RHI.

What is an air source heat pump?

Air source heat pumps extract heat from the outside air. Even if the air temperature is very cold, there is still useful energy that can be extracted from it to heat a home.

How does a heat pump work?

The best way to think about a heat pump is to imagine a bicycle pump – when you pump a bicycle pump it heats up as air inside gets compressed whilst the air that is being expelled is cold. The same principle can be applied to an air source heat pump. The refrigerant gas is passed around a series of pipes that compresses the gas, heating it before it enters the inside the house via heat exchangers, the refrigerant is then allowed to expand through an expansion device eventually expelling cold air outside (see figure 1). Another analogy is to imagine a fridge but the other way around – with the cooler air being pumped outside and the warm air going inside. Heat pumps can also be reversed to pump cold air into a house during the summer.



The heat generated by a heat pump can enter the home via a hot water tank that can feed an underfloor heating system or radiators (air-water) or be circulated via a fan (air-to-air).

Performance of air source heat pumps

The efficiency of a ground source heat pump system is measured by what is called the coefficient of performance (CoP). This is the ratio of units of heat output for each unit of electricity used to drive the pump. A typical CoP for a heat pump is around 2.5, which means that for every 1 unit of energy consumed by the pump 2.5 units of heat is produced.

It is worth considering that the outside temperature and the desired inside temperature will largely dictate how efficient the heat pump is. In the winter, the time of year when heat demand is at its highest, is also when there is the least amount of heat in the outside air – increasing the temperature difference and requiring the heat pump to work harder.

Energy ratings of domestic air source heat pumps range from around 5kW upwards.

What are the benefits of installing a heat pump?

- Having a heat pump could eliminate the need for a gas boiler and your gas bills because heat pumps run on electricity
- Heat pumps can be used for both heating and cooling a house
- If run on renewable energy, they can be very environmentally friendly

Do I need planning permission?

If you want to have an air source heat pump installed you will need to get planning permission. Please contact your Local Authority's planning department.

Things to consider

- Before you consider installing an air source heat pump your house should be very well insulated and your energy demand minimised or made as efficient as possible. This will ensure that the heat pump operates efficiently and any cost savings are maximised.
- A significant amount of water can be generated from air source heat pumps so some sort of drainage may need to be considered
- Air source heat pumps can generate noise almost all of the time (as they are not switched on and off)
- You will need a space outside for the pump to be located against the wall of the house
- Despite some claims, air source heat pumps are not fully renewable technologies – although they make use of solar energy, they require electricity to power the pump –

unless this comes from a renewable source the heat pump does not really qualify as a 'renewable technology'.

- If you are on mains gas: Mains gas is significantly cheaper than electricity at present and because heat pumps use electricity, homeowners can find that this leads to a significant increase in energy bills when using a heat pump
- Heat pumps are needed most in winter when there is least heat to be extracted from the air therefore requiring them to work harder which reduces their efficiency.

More information on heat pumps

Below is a link to a good article written by author and consultant, Chris Goodall. It is worth reading if you are considering installing a heat pump.

http://www.carboncommentary.com/2009/06/12/663#more-663

The Green Building Forum provides a large resource of information on all types of renewable including air source heat pumps. Follow the link below and search the forum discussions on heat pumps. www.greenbuildingforum.co.uk/

Ground Source Heat Pumps (GSHPs)

Installed cost: from £8,000
Annual Fuel bill saving: If you are on mains gas there is a marginal financial benefit but sometimes no benefit, please call us for a more detailed explanation if you are using all electricity, oil or solid fuel for heating.
Carbon saving: If you are on mains gas there is no carbon saving, please call us for a more detailed explanation if you are using all electricity, oil or solid fuel for heating.
Premium Heat Payment (Grant): £1,250
Renewable Heat Incentive (payments for generating renewable heat): expected to be introduced in the summer of 2013 following a UK Government consultation in September 2012. Government has confirmed that renewable heat installations installed in homes since 15 July 2009 will get the RHI once it comes in, provided they meet the eligibility criteria. Owner of the technology expected to be paid 4.3p/kWth generated for 20 years.

What are GSHPs?

GSHPs extract low temperature heat from the ground and convert it into higher temperature heat that can be used for space and water heating.

How do they work?

Ground source heat pumps work by passing a refrigerant (or an alternative gas/liquid) through a series of pipes that are laid underground outside the house. This heats the refrigerant by a few degrees before being compressed and heated to a higher more desirable temperature by a compressor/heat pump. This heat is then distributed around the house via the chosen heating system (usually underfloor heating (the ideal solution) or radiators). The cold refrigerant then passes back outside underground to be heated again. Ground source heat pumps are powered by electricity which can derive from renewable or non-renewable fuels.


GSHP compression unit (size of a large fridge freezer)

GSHPs should not be confused with geothermal heating systems that tap into the higher temperatures at greater depths or hot springs. GSHPs usually extract 3-5°C from the ground and then feed this heat into a compressor which then boosts this to the desired temperature. The higher efficiency of GSHPs are achieved because of the few extra degrees that are gained from the ground heat.

Performance of GSHPs

The efficiency of a ground source heat pump system is measured by what is called the coefficient of performance (CoP). This is the ratio of units of heat output for each unit of electricity used to drive the pump. Average CoP over the year is around 1:2.5 or 1:3 although this can vary between systems. In practice, this means that for every unit of electricity used to pump the heat, 3 or 4 units of heat are produced. Some systems are able to achieve a higher CoP, however this rating is often dependant on specific test conditions.

Types of GSHP loops

The type and design of the loop system will depend on the nature of the subsoil and geology and available space. An investigation to establish the geo-technical and ground water conditions should therefore be undertaken. The two main types of loop system available are:

- Horizontal Loops– are laid out in silt trenches which are then filled with soil. As there are no installation standards at present there a no guidelines that must be followed. However, trenches need to be at least 2 metres deep to ensure a consistent heat is achieved. As a rough guide, 50-80 metres of pipe-work is required per kW or 10 metres of 'slinky' pipe per kW (a typical installation is 7-8kW).

- Vertical Loops – are lowered into deep boreholes which are then filled with grout to prevent groundwater migration and to ensure that the piping can conduct the heat from the ground. Bore holes are suitable for urban properties with limited plots. You normally need around 20-50 metres of piping per kW and the bore hole will normally be 100-150 metres deep. The piping is usually 20-40mm in diameter for best performance.

Is my house suitable and what should I consider before installation?

- Before you consider installing a GSHP your house should be very well insulated and your energy demand minimised or made as efficient as possible. This will ensure that the heat pump operates efficiently and any cost savings are maximised.

- GSHPs work best on low temperature heating systems such as underfloor heating which operate at around 35°C. This will allow the CoP to be maximised as the temperature difference between the heat source and heat demand is minimised. If radiators are used which demand heat at 75°C-/+ this can reduce the CoP making the GSHP inefficient and therefore more expensive to run.

- A surveyor should be consulted to assess whether there is enough space to accommodate the necessary trench or boreholes and whether the ground is suitable.

- If you also have a back up heat source e.g. a conventional boiler, the control of this source must be interlocked so that it doesn't operate as the 'lead' device. This

means that your power will always come from the GSHP in the first instance and will only draw on your backup source, should the GSHP not be operating.

- Positioning of the equipment should be carefully considered to ensure adequate space and access for maintenance.
- You will need space for the pump/compressor unit which is a similar size to an up-right fridge-freezer (however, smaller units are available)
- Installation can be messy so installation of pipe work at an early stage of construction is recommended.
- As for environmental benefit, this depends on whether the heat pump is powered by electricity generated from a renewable technology (e.g. solar photovoltaics). It is worth considering that in the UK, grid electricity is currently generated by burning fossil fuels which is very environmentally damaging.

Benefits

GSHPs are a good option if you are building a new home or undergoing substantial groundwork/landscaping as the equipment can be installed before the foundations are laid or when the earth has been dug. The underground nature of the technology makes them particularly good if you are planning on installing certain domestic features such as underfloor heating.

- GSHPs have a long operational lifetime with some components lasting in excess of 50 years
- There are no safety or pollution issues relating to the combustion of fuel for heat
- Heat pumps are very efficient. For every unit of energy used to drive the system, they produce between 3 and 4 units of heat.
- GSHPs can produce both heating and cooling
- Underfloor heating is more efficient than radiators and heats rooms more evenly. The air just above the floor is heated and that warm air then rises through the living space cooling as it rises creating a comfortable room temperature.

Do I need planning permission?

Ground source heat pumps fall under Permitted Development Rights, however it may be worth contacting your Local Authority's planning department.

Cost & cost saving

It is important to realise that all heat pumps, including ground source heat pumps, use electricity in their operation. Many manufactures claim that heat pumps are a renewable technology – this is partly true as heat pumps are able to make use of solar energy (stored in ambient air temperatures or earth heated by the sun) but the pumps themselves often consume large quantities of electricity. Residents with heat pumps may well experience a reduction in heating bills but they find that their electricity bill has increased. According to the UK Heat Pump Network, GSHP can account for a 15-50% increase in electricity bills (depending on whether the pump is used for heating as well as hot water or just heating). As electricity is more expensive than gas, a resident switching from using mains gas to heat their homes to a heat pump may find that they actually end up paying more each month for energy.

Capital costs

The financial outlay of a GSHP ranges quite considerably, however for the whole system approximately £1000 per kW installed can be used as a rough guide.

- Maintenance costs are minimal and there is no requirement for an annual inspection as there is for other forms of technology. The compressor component has a life of up to 15 years and the ground loop of between 30 and 50 years (with low maintenance). However, it is wise to have the system serviced every 5 years.
- Annual savings will depend on what fuel you are replacing. This could be a particularly cost effective option if you are not connected to the gas network.
- The table below includes the Energy Saving Trust's estimations on financial savings from installing heat pumps

Additional costs information

- Vertical ground loop systems are also significantly more expensive to install than horizontal ground loops, due to the higher cost of drilling a borehole. Costs will be dependent on specific ground conditions so an installer should be consulted. The geology of the area can also impact on the costs of drilling boreholes.
- If your pump is to be driven by electricity supplied from the national grid, you should consult a range of energy suppliers to benefit from the lowest running costs, for

example by choosing an economy 10 or economy 7 tariff. You should also consider moving over to a renewable energy supplier such as Good Energy.

Alternative to Refrigerants

Heat pumps use refrigerants in their operations which are also potent green house gases. However, there are alternative forms of GSHPs that use hydrocarbon refrigerants which are much less damaging to the environment.

http://www.earthcareproducts.co.uk/

Additional sources of information

http://greenbuildingelements.com/2008/03/06/geothermal-energy-and-ground-source-heat-pumps/

http://www.gshp.org.uk/gshp.htm

http://www.heatpumpnet.org.uk/

If you would like further information on heat pumps or like a recommended installer; please contact the Action Surrey on 0800 783 2503.