

Ground source heat pumps

Extracting warmth from the earth

Just 2 meters below the surface the temperature of the ground is a fairly constant 11-12°C. We can capture this warmth and use it as a reliable, renewable heat source to run central heating systems for our homes.

The soil, clay and stones found 2m underground may not feel warm to the touch, but there is enough heat in there – absorbed in the first place from the sun – for **ground source heat pumps** to utilise and to release into homes and other buildings. This is done by means of a buried network of fluid-filled pipes connected to a compressor and pump unit.

If you're thinking of installing a ground source heat pump it is definitely worth knowing how one works. The most distinctive feature is the pipework, usually about 100m of it, which is buried in loops in trenches (photo, right) or in one or more vertical boreholes. Once the pipework is buried the surface of the ground can return to being a field, garden, drive etc, and you wouldn't know it was there.

A liquid – typically water with antifreeze – is pumped through the pipework and absorbs the warmth of the ground. A compressor in the main unit of the heat pump raises the the temperature of this fluid, and a heat exchanger transfers the warmth to a separate body of water which circulates round the central heating system. The now-cooled water is pumped back out to the buried pipework and the cycle begins again.

The whole system is powered by electricity, so unless this comes from a renewable source such as a wind turbine, a ground source heat pump still generates carbon emissions, though less than those associated with conventional types of heating, and with no on-site emissions.



A newly dug trench, lined with fine material to avoid damaging the pipework

Photos: trench digging, Geoscience; underfloor heating, Irish Typepad; pump unit, Rob Baxter

Is my property suitable?

If you are considering a heat pump it is very important to make sure your home is well insulated as heat pumps work best in buildings that require little energy to maintain a temperature once it has been reached.

Heat pumps operate more efficiently the smaller the temperature difference between the collectors (the pipes in the ground) and the emitters (the heat distribution system). Consequently, heat pumps produce heat at a lower temperature than a conventional central heating system and so a larger area is required for the heat distribution. Underfloor heating is ideal but heat pump specific large radiators can also be used. Heat pumps also work more efficiently when there are gradual rather than sudden demands on the system.



Ground source heat pumps work best with underfloor heating

Ground source heat pumps use energy that comes indirectly from the sun. This is different altogether from 'geothermal energy' which is heat from the molten core of the earth



The efficiency of a heat pump is calculated in a ratio called the 'Coefficient of Performance' (CoP). So, for example, if your heat pump produces 4 units (kW) of heat for every 1 unit (kW) of electricity used, the CoP will be 4. The CoP is dependent on factors such as correct sizing of the system, type of heat distribution system, energy efficiency of the property, ground temperature and required room temperature. As a heat pump will not always operate at its maximum efficiency the quoted CoP will always be higher than the actual efficiency of the system over the year.

A typical domestic pump is the size of a large fridge (right) and you may wish to have it installed in an outbuilding or basement. It is preferable to site it close to the collector pipes.



A good installer will make sure that the heat pump, collector and heat distribution system are sized correctly. Under or over sizing the component parts will lead to a drop in efficiency and could result in excess expense, frozen ground or a poorly heated home. Make sure that both your products and installer are registered with the **Microgeneration Certification Scheme (MCS)** and ideally look for an installer that is a member of the **Renewable Energy Consumer Code** scheme. We recommend obtaining at least three quotes for comparison.

Costs and savings

A ground source heat pump costs around £655 a year to run and around £13,000 to install, though prices vary considerably depending on the size of the system and the additional work required (e.g. fitting underfloor heating).

The type of fuel you are replacing will determine how much you save, as will the CoP of the system. Based on a 4-bedroom detached property the potential savings are:

Fuel replaced	Savings £/year	Savings CO ₂ /year
LPG	£1,260	2600kg
Electricity	£1,420	4700kg
Oil	£620	4600kg
Solid fuel	£230	7200kg

➔ See our other factsheets on domestic renewable energy: small-scale wind, solar PV, air source heat pumps, feed-in tariffs, Renewable Heat Incentive, rent-a-roof PV schemes, making the most of your solar panels.

These and many others are freely downloadable at www.cse.org.uk/loveyourhome

The initial capital cost will be offset by reduced fuel bills and there is little need for service or maintenance. The majority of the energy you use for heating will come from the ground so you will be less subject to price fluctuations and will have a secure energy supply for your home.

If you have renewable electricity generation the running costs will be lower, particularly with a wind turbine as more generation will occur during winter when you require heating, rather than solar electric which produces more energy in the summer. If all the electricity used for the heat pump is renewable then you'll have zero-carbon heating.

Maintenance

As the system is closed and hermetically sealed (airtight), very little maintenance is required. An annual service of the pump is advisable and you should ask your installer to show you how to adjust the controls and provide you with a manual. Heat pumps last around 20 years and the ground collectors are expected to last for 70 years so little needs replacing. If something does go wrong, for example a leak of the refrigerant, you would require an engineer with F Gas certification.



Useful websites

Microgeneration Certification Scheme
www.microgenerationcertification.org

Renewable Energy Consumer Code
www.recc.org.uk

Ground Source Heat Pump Association
www.gshp.org.uk

Heat Pump Association www.heatpumps.org.uk

The Centre for Sustainable Energy's **Home Energy Team** offers free advice on domestic energy use to householders in Bristol and Somerset (including the unitary authorities of North Somerset and Bath & North East Somerset).

Call free: **0800 082 2234**

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