Ground source heat pumps

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 temperature of this fluid slightly, 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 or solar panel, 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.

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.

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

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 large heat pump specific radiators can also be used. Heat pumps also work more efficiently when there are gradual rather than sudden temperature demands on the system and therefore need to be controlled differently to traditional central heating systems.

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.

Ground source heat pumps use energy that comes indirectly from the sun. This is altogether different to 'geothermal energy' which uses heat from deep underground.

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A typical domestic pump is the size of a large fridge (see photo) 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.

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Costs and savings

Installing a typical system costs around £10,000-£18,000, with the cost varying 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 yearly savings are:

System being replaced	Old (G-rated)	New (A-rated)
Gas boiler	£475–£535	£175–£185
Oil boiler	£695–£805	£260–£300
LPG boiler	£995–£1145	£455–£520
Night storage heater	£1210–£1485	£840–£985
Coal	£540–£665	n/a

Figures from Energy Saving Trust

The initial capital cost will be offset by these reduced fuel bills, and there is little need for service or maintenance (see box). The majority of the energy you use for heating will come from the ground so you will be less subject to market price fluctuations and will have a secure energy supply for your home. What's more, once you have installed your heat pump you will be eligible for payments of between £2,405 and £2,830 per year under the Renewable Heat Incentive.

If you use some form of 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 panels which produce more energy in the summer. However,the emergence of ever improving battery storage options means there is now the potential to store this generated electricity for use at a later point, to power the heat pump at a time when the solar panels or wind turbine are not generating. Although there is an upfront cost, this could drastically decrease (and at certain times eliminate) the running costs of a heat pump and greatly improve a home's environmental impact.

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.

More information

For more technical information see the website of the Heat Pump Association **www.heatpumps.org.uk** and the Ground Source Heat Pump Association **www.gshp.org.uk**

And to find approved installers, see the website of the Microgeneration Certification Scheme (MCS) **www.microgenerationcertification.org** and the Renewable Energy Consumer Code **www.recc.org.uk**

See also our factsheets on how to cost-effectively control heat pumps (coming soon), battery storage and Renewable Heat Incentive downloadable from **www.cse.org.uk/resources/category:advice-leaflets**

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The Centre for Sustainable Energy is a national charity that helps people change the way they think and act on energy.

Our Home Energy Team offers free advice on domestic energy use to people in Bristol, Somerset, Wiltshire, South Gloucestershire and Dorset.

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