



# GROUND SOURCE HEAT PUMPS

BUILDINGS

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## BUILDINGS

# Ground source heat pumps

### WHY?

Ground source heat pumps (GSHPs) are an eco-friendly alternative to conventional heating solutions. GSHPs do not generate electricity themselves but are considered low carbon as they take electricity from other sources such as solar PVs or the grid (100% renewable can be purchased), and improve their efficiency by generating between three and a half and five times more energy than was input.

Heat pumps work like fridges in reverse. Absorbing energy from the ground via horizontal pipes or vertical boreholes, they extract heat using vapour compression to transfer it into a heating system. A heat pump's Coefficient of Performance (CoP) is measured in terms of useful heat extracted per unit of electricity used: GSHP typically extract between 3.5kWh and 5kWh of heat for each kWh of electricity input: <https://energysavingtrust.org.uk/advice/ground-source-heat-pumps/>

### BEFORE YOU START

Ground source is just one of many low carbon heating solutions. It is important to manage the heating needs of your church before exploring heat pump solutions. Our papers on 'Quick wins', 'Insulation, double glazing and draught-proofing' and 'Lower carbon and renewable energy options' offer useful guidance.

### HOW?

#### EARLY PLANNING AND RULES OF THUMB

Heat is extracted from the ground by using either horizontal pipes or vertical boreholes. Horizontal pipes are more efficient per metre of length or depth, but the decision on which to use will depend on a number of factors, including ground conditions and unencumbered surface area available.

Horizontal pipes will typically extract around 100W/m, so if you currently have a 50kW (50,000 Watts) boiler, you need 500m of cable. The most common approach uses loose coils of pipes – called slinkies – which are laid either in a wide trench (1.2m wide by around 1.2m deep) or in a narrower, deeper trench (300mm wide by 2m deep). Ground conditions may dictate which method



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is most effective, with pipe trenches separated from each other by at least 5 metres.

Vertical boreholes allow heat to be extracted from a warmer, constant ground temperature. The effectiveness of this process, and the depth and number of boreholes needed, are dependent on the ground conditions and underlying geology. Vertical boreholes will typically yield around 30W–40W per metre depth and should be spaced at least seven metres apart and three and a half metres from buildings. A 100m borehole is not uncommon and can provide 3–4kW of heat.

In either case, a detailed professional survey will be necessary to establish a final design. However, if you have an estimate of your heat requirement, the total length of coiled horizontal pipe or number of boreholes can be estimated so you have some idea of the amount of land required.

Land for ground source heat pumps poses issues in consecrated ground, and the risks associated with excavating close to protected trees or buildings should be professionally assessed: the outcome is often insufficient land within the church grounds. However, fields or car parks attached to the church can present viable opportunities.

### COMPARISON WITH OTHER HEATING OPTIONS

Ground source heat pumps have significantly lower carbon emissions than fossil fuel boilers or direct electric heating. Compared to Air source heat pumps, a higher average CoP at higher operating temperatures can make them more effective and efficient heating solutions, although they are more expensive and complicated to install.

Apart from the external pipework, no outside plant is required, and the space needed to accommodate the heat pump itself is equivalent to a floor-standing boiler. Although space should be anticipated to accommodate the pipework, also consider space for a buffer vessel to attenuate sudden changes in heating demand and a hot water tank may be required.





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### LONGER READS & OTHER RESOURCES

The Church of England has a number of resources as part of their 'Practical Path to Net Zero' programme. They are applicable to all denominations. Here is one on the 'Basics of Heat Pumps' here: [https://www.youtube.com/watch?v=\\_2mkfUxlkzw](https://www.youtube.com/watch?v=_2mkfUxlkzw)

See also: <https://www.cse.org.uk/advice/renewable-energy/ground-source-heat-pumps>

### CASE STUDIES

See the separate case study showing how St Catherine's Church, Burbage, one of our early Gold Eco Churches, installed ground source heating in 2011.

### STRATEGIC DEVELOPMENT GOALS

Taking action on this topic will contribute to these UN Strategic Development Goals:

