ENER-G designs and installs ground source heat pump (GSHP) technology that provides renewable heating and cooling systems for public and private buildings of all types.

The earth is a huge energy storage resource that absorbs around 47% of the sun's energy and retains it at a moderate constant temperature.

By harnessing this constant temperature, the GSHP absorbs energy from the earth and transfers it to the building.

In winter, heat from the earth is upgraded to a higher temperature via a GSHP and transferred into the building. In summer the GSHP system is reversed, moving heat from inside the building into the cooler earth.

### Coefficient of performance

The coefficient of performance (COP) is the ratio of the amount of heating or cooling provided by the system, compared to the amount of actual energy consumed by the GSHP, as per the example below.

#### Operational benefits

- High efficiency - typically a coefficient of performance (COP) of between 4 and 5
- Renewable energy available 24/7
- Low noise levels
- Less space usage in the building
- Long system lifespan expected in excess of 25 years
- No requirement for on-site fuel storage

#### Environmental benefits

- Reduced harmful refrigerant usage
- Zero on site emissions
- No visual impact
- Reduced use of fossil fuels (zero when used with green electricity)

#### Financial benefits

- Savings of around 40% in heating and cooling costs
- Reduced maintenance costs
- Reduced whole life costs
- Potential grants available
- Eligible for RHI scheme

#### Legislative benefits

- Enables clients to meet European and UK legislation
- Helps compliance with CSR policy aimed at reducing carbon footprint
- Improves Building Energy Performance Ratings
- No need for planning permission
The technology

Exploiting stable underground temperatures throughout the year, GSHP systems use a buried ground loop to transfer this heat from the ground into buildings to supply heating and hot water, providing one of the most energy efficient ways of heating buildings.

A GSHP system can also be used in summer to cool the building mass, transferring excess heat from the building back to the cooler ground.

Ground loop

A closed loop pipework system is buried in the ground, filled with a mixture of water and antifreeze, which is pumped around the pipework system absorbing heat from the ground.

Types of ground loop are:

- Vertical, for use in boreholes
- Energy piles
- Spiral or slink for use in trenches
- Horizontal for use in trenches
- Closed pond or lake loops

A vertical closed loop field is composed of pipes that run vertically in the ground. A hole is bored into the ground into which a U Tube is inserted. A number of boreholes can be connected together to form the ground loop heat exchanger.

Vertical loop fields are typically used when there is a limited square meterage of land available. Boreholes are spaced 5-6 metres apart and drilled to a depth of between 70-120 metres. They benefit from higher ground temperatures than trenches and are more efficient.

Structural building piles offer an alternative low cost ground source solution. Flexible plastic ground loop pipe work is placed within the structural pile during the piling process. The pipe can be attached to the piling cage or inserted directly into the wet concrete that forms the structural pile during the piling process.

The concrete provides an ideal energy transfer medium, which allows the energy derived from the ground to be used in conjunction with a heat pump to heat and cool the building.

The process of inserting the pipe within the structural pile is undertaken by the piling specialist, while the remaining works are undertaken by ENER-G in a similar fashion to that of a vertical closed loop borehole solution.
### The technology

**c. Spiral or slinky, for use in trenches**

A slinky closed loop field is installed in the horizontal orientation where the pipes overlay each other.

Where there is not adequate room for a true horizontal system, a slinky loop field is an ideal solution.

Slinky loop installations should only be utilised below permeable surfaces.

**d. Horizontal, for use in trenches**

A horizontal closed loop is composed of pipes that run horizontally in the ground. A long horizontal trench, deeper than the frost line, is dug and U-shaped coils are placed horizontally inside the same trench.

Horizontal trenches are dug 1.5-2 metres below ground level and are ideal for smaller systems.

Horizontal installations should only be utilised below permeable surfaces.

**e. Closed pond or lake loops**

In a pond loop, coils of pipes are installed at the bottom of an appropriately sized pond or water source and the loop is attached to a frame.

Our extensive experience and specialist technical knowledge means we can identify the type of loop system that is best suited for your building.

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**How does a heat pump work?**

1) Low grade energy absorbed from the ground is transferred to the refrigerant. This causes the temperature of the refrigerant to rise changing it from a liquid to a gaseous state.

2) The refrigerant is then compressed, reducing its volume by causing its temperature to rise significantly.

3) A heat exchanger then extracts the heat from the refrigerant to heat water for the chosen heat distribution system.

4) After giving up its heat energy the refrigerant turns back into a liquid and can once again absorb energy from the ground, allowing the cycle to begin again.

**Heat pump**

A GSHP is operated by electricity or gas to extract heat from the ground during cold periods or to return heat to the ground when the temperature is high. ENER-G supplies a range of heat pumps between 5kW and 1MW. These can be used to supply heat distribution systems such as radiators, fan coils, chilled beams or under floor heating.

ENER-G is also experienced in the supply and installation of hybrid systems which see the integration of GSHPs with other technologies such as solar thermal, CHP, condensing boilers or chillers.
The graph shows the grams of CO₂ produced per kWh from six different heat generating technologies based on average operating conditions (data available to BS EN 14511 conditions on request). This clearly shows the emissions reduction from using heat pump technologies.

**Renewable energy systems comparison**

<table>
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<th>Technology</th>
<th>Provides heating and cooling</th>
<th>Available 24 hours</th>
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*GSHP meaning ground source heat pump  
* ASHP meaning air source heat pump

*Figures based on heating water to 45°C from an average source temperature. Emissions will alter dependent on source and load temperatures.