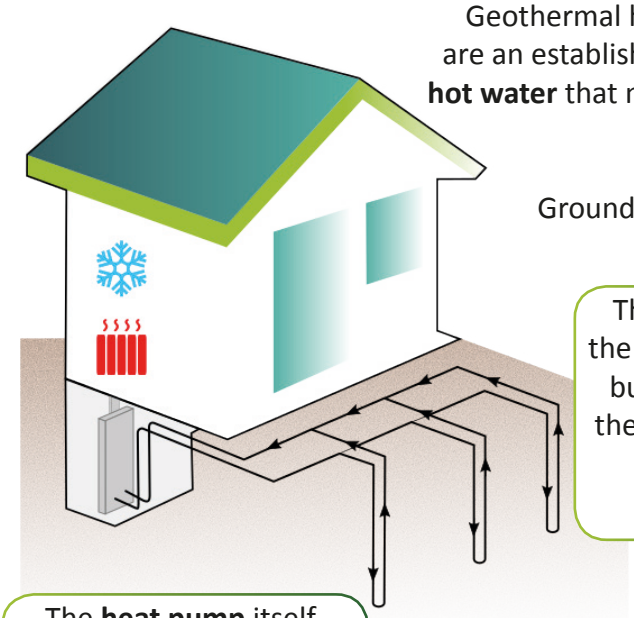
THE TECHNOLOGY

REGEOCITIES
Factsheets on geothermal heat pumps



Geothermal heat pumps (also called Ground Source Heat Pumps, GSHP) are an established technology **for space heating and cooling and sanitary hot water** that makes use of shallow geothermal energy, meaning the heat stored beneath the earth's surface.

Ground source heat pumps systems have three main components:

The **building side**, i.e. the equipment inside the building that transfers the heat or cold into the rooms.

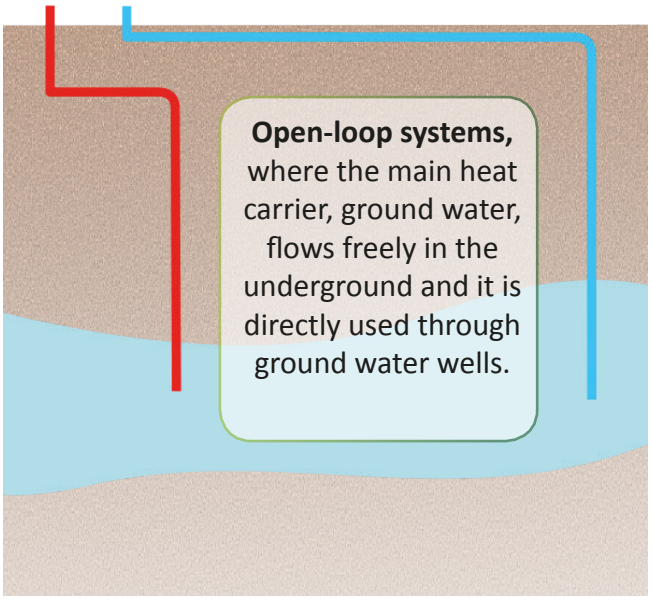
The **heat pump** itself, to convert that heat to a suitable temperature level.

The **ground side**, to get heat out of or into the ground.

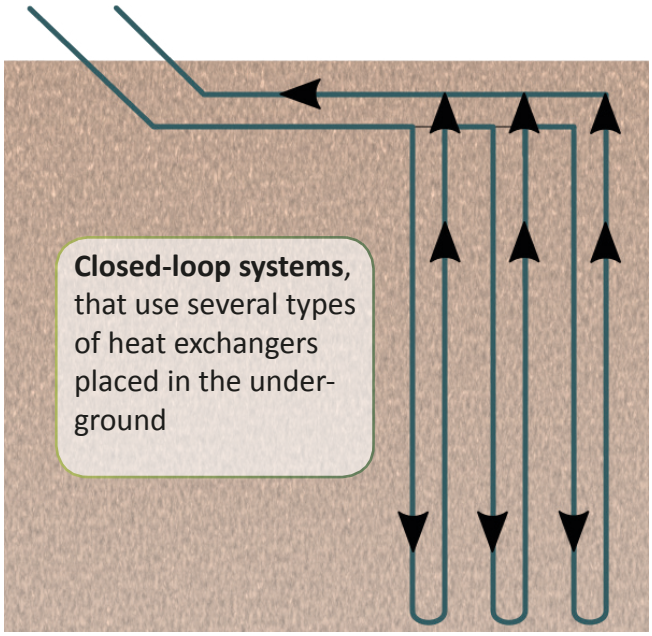
A good design must take care of the whole system, matching the components in such a way that the most effective operation and the highest level of comfort can be achieved. To choose the right system for a specific installation, several factors have to be considered, mainly:

- the climatic zone the site is in;
- the thermal and hydraulic parameters on site;
- the heating and cooling characteristics of the building(s).

There are two main types of systems used to connect the underground heat to the building system:



Open-loop systems, where the main heat carrier, ground water, flows freely in the underground and it is directly used through ground water wells.



Closed-loop systems, that use several types of heat exchangers placed in the under-ground

There are several types of closed loops systems, such as: horizontal loops; borehole heat exchangers (BHE); compact forms of ground heat exchangers; thermo-active structures (pipes in any kind of building element in contact with the ground); etc.

The different natural ground temperatures throughout Europe, from 2-3° near the polar circle to about 20° in the very south of Europe, have a great influence on the options and design for shallow geothermal installations.

APPLICATIONS

A high performance technology, adaptable for heating, cooling, hot water and energy storage.

Shallow geothermal systems are very versatile and can be adapted to almost every subsurface condition. They can be used in different kind of structures, from small, residential houses to large individual buildings or complexes of buildings, such as offices, hotels, schools, shopping centres, and so on.

The **residential sector** generally employs heat pumps produced in larger series and with standard heating capacities from ca. 5 to 20 kW, while for the **commercial sector** the installation tends to be much larger. For **large complexes**, heat pumps with capacities from ca. 50 kW upwards are usually constructed individually or in smaller numbers, and adapted to the specific site conditions.

Often buildings have a rather unbalanced heating and cooling demand, either due to their climatic surroundings, or to the specific use of the building. In these cases, **hybrid systems** are designed to cover as much load as possible from the geothermal system and to use separate sources (like cold air in winter or at night time, waste heat, solar heat, and so on) to balance the heat in the underground.

Using all the different options available to geothermal design allows for small and large, energy efficient, economic, and reliable installations all over Europe.

OFFICES AND COMMERCIAL BUILDINGS

For applications in the commercial sector, large borehole heat exchanger (BHE) fields or groundwater wells are the preferred groundside alternative. While BHE are feasible virtually everywhere, and promise maintenance-free operation, their individual capacity is limited, resulting in huge BHE fields for systems with high heating/cooling demand.

Groundwater wells, on the other hand, require specific geological site conditions and diligent managing of the wells, but can deliver much higher thermal output per well. So for large installations, ground water use is a favourable option.

For large projects, two basic configurations are possible:

- One or a few large heat pump(s) with high thermal output, delivering heat or cold through hydronic circuits to radiators, fancoil units, etc;
- A large number of smaller heat pumps, connected via a common fluid loop to the ground system, and providing heat or cold individually to shops, rooms or zones, while extracting or rejecting heat from or to the fluid loop.

RESIDENTIAL HOUSES

For small houses, 1-2 borehole heat exchangers or a horizontal collectors (brine or direct expansion) are the best suited options.

The installation is not visible from the outside, the heat pumps do not require much space, and a fuel oil tank or connection to the gas grid is not required.