

## Geothermal heat pumps: The heat under your Feet

### INTRODUCTION

Shallow geothermal energy systems, also known as Geothermal or Ground Source Heat Pump Systems, use the temperature underground at depths ranging from 1m to 400m to provide space heating, domestic hot water (DHW) and, if desired, space cooling. All that without the need for back-up gas or oil boilers.

In the winter, heat from the earth is delivered to buildings via the heat pump. The transformation happens via the refrigerant cycle, the same cycle which is used in fridges and freezers. In the summer, the process can be reversed so the system extracts heat from the building and transfers it to the ground.

Typical capacities range from 5 kW for single family buildings up to 100kW for multi-family houses and small commercial applications. Larger systems are possible for large commercial and industrial applications.

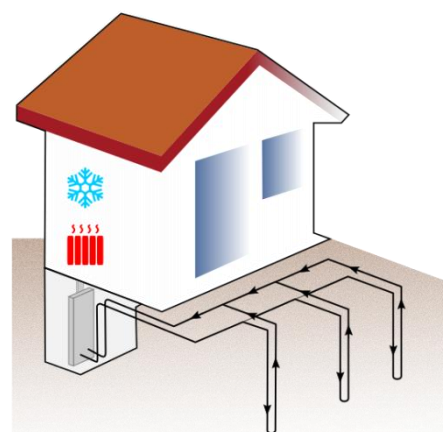
### THE TECHNOLOGY

There are three parts to a shallow geothermal system:

- **The ground side**, a heat exchanger which connects the underground temperatures to the rest of the system.
- **The heat pump**, the device that alters the temperature to an appropriate level.
- **The Building side**, the heat distribution system which delivers the heat or cold into the rooms.

The climatic zone of the building, the on-site environment, and the heating and cooling characteristics of the building influence the design of the component parts.

**Systems in the residential sector are usually closed loop systems with 1- 2 borehole heat exchangers or horizontal collectors.**



Copyright: EGEC

### BENEFITS AND CONSIDERATIONS

Geothermal systems have several benefits:

**Clean, Local and Renewable** - Geothermal energy is local, renewable, and inexhaustible. It can replace fossil fuel, thereby contributing to reduce energy demand and import.

**Efficient** - Geothermal heat pumps fulfil the requirements of the highest category of the new EU energy label system (A++ until 2019 and A+++ from 2019). The typical efficiency of a geothermal heat pump, expressed as Seasonal Coefficient of Performance (the ratio of the heat delivered to the total electrical energy supplied over the year), is today well above 4, and 5 is expected soon. That means that for every 1kW of electricity used, more than 4kW of thermal energy is delivered.

**Comfort** - Geothermal systems are almost silent, providing a pleasant environment inside and outside the building. Because most of the installation is underground, there is no visual impact, which makes them suitable for row houses as well as for historical or scenic settings demanding architectural design. They also offer the possibility to install underfloor heating, an efficient method of distributing heat evenly into a building to provide comfortable space heating.

**Reliable** - Shallow Geothermal systems are not affected by changes in season, climatic conditions and time of day. They deliver affordable energy constantly, all over Europe.

**Competitive** - The underground part of the system lasts for at least 50 years, while the heat pump has an expected useful life of around 20 years. The operation and maintenance costs of geothermal heat pump systems are low. This means that the payback time of the initial investment can be quite fast. Because of the long term benefits, these systems increase the value of the buildings.

**Land requirements** - The minimum land requirement for drilling operations is 20 m<sup>2</sup> for vertical systems and 150m<sup>2</sup> for horizontal systems. The exact area, however, depends on the geology, the demand, the efficiency of the heat pump, and on whether the system provides cooling or only heating and DHW.

The land required for drilling operations will not be needed once the system has been realised as all of it disappears underground. For new buildings, this area may be under the building with drilling and installation taking place before construction.

## COSTS OF USING THE TECHNOLOGY

Shallow geothermal systems are available virtually everywhere, but local geology as well as administrative requirements affect the costs of installation. The cost of operating a system depends on the cost of the electricity supplying the heat pump and its efficiency. Another factor which affects the costs is the final use, as systems which deliver both heating and hot water are generally more competitive than systems delivering hot water only. If cooling is added, then shallow geothermal systems are very competitive.

The initial cost of installing a heat pump can be higher than installing a traditional gas boiler, however after installation the operational costs of a Ground Source Heat Pump are stable and low, meaning that the initial cost is paid back relatively quickly.

## ENERGY LABELS

Since 26 September 2015, all new heat pumps with a thermal capacity of less than 400kW must comply with European 'Ecodesign' regulations, which establish minimum requirements for the efficiency of various commonly used products. All units with a capacity of less than 70kW must carry an energy label. The label provides information on the efficiency of the product, noise emissions, and its capacity in different climate zones. Installers that combine different products in one installation must provide a 'package label'.

**For more information about  
Geothermal Heat Pumps, visit  
[www.heatunderyourfeet.eu](http://www.heatunderyourfeet.eu).**



Co-funded by the Intelligent Energy Europe  
Programme of the European Union

*The sole responsibility for the content of this publication lies with the authors. It does not necessarily reflect the opinion of the European Union. Neither the EASME nor the European Commission are responsible for any use that may be made of the information contained therein.*