Shallow geothermal energy is a local, renewable, efficient and versatile source which can provide buildings and industry with clean and competitive heating and cooling. Available across Europe, shallow geothermal energy systems use the heat from the top layers of the earth (up to 400m) to supply heating, cooling and hot water to homes and businesses. More than 1 million ground source heat pumps are installed in the EU, with average energy savings of as much as 50% in winter and 40% in summer. For cooling, savings of up to 90% are possible.

At a city zone level, there are several different aspects of shallow geothermal energy use to be considered, dependent on the area and its use. As an example, a small visual footprint and a low noise level (neither chimneys nor fan-coolers) is a benefit of shallow geothermal systems in general, however it is more important in areas where preservation is a key issue like an old town than it is for a new commercial centre. Other benefits in addition to low outdoor noise level and small visual impact are the lack of air polluting emissions elimination of the risks from legionella in evaporative roof coolers.

In denser areas, large geothermal seasonal storage systems are more competitive or even necessary to grant everyone access to underground heat/cold. Large systems can also be shared between buildings. In dense zones with large buildings/ systems less densely built zones nearby like parks can be used for the underground part of the shallow geothermal installation.

In sparse urban settlements there is enough space between individual systems for a natural thermal recovery, while large systems needs to be thermally balanced for example by annually using as much heat as cold, or by recharging with a free source like a solar collector.

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Different processes for small Authorities involved

Concerns qualification and monitoring (ATM)

The low temperature in the ground can also be used for space heating and domestic hot water.

There are two main types of system for heating and cooling: heat pumps and storage systems. There are two types of UTES: Borehole Thermal Energy Storage (BTES) and Aquifer Thermal Energy Storage (ATES).

Groundwater wells can deliver much higher thermal output per well however they require specific geological site conditions and diligent well management.

The installation cost of shallow geothermal systems varies slightly depending on site conditions, whilst operational costs are affected by electricity and fuel prices, as well as the efficiency of the system.

The operation and maintenance costs are lower than those of conventional systems, however the initial installation cost is often high. Overcoming this usual expenditure curve, where most costs are concentrated at the beginning of a project, has been a barrier to shallow geothermal development.

Costs and financing

The heat pumps used in shallow geothermal systems have the lowest number of failures per installed unit compared to similar technologies, making systems easy and simple to maintain.

The end uses of shallow geothermal systems are varied: they can provide space heating and cooling, hot water, and energy storage. They can also be installed in buildings of various sizes and uses.

Benefits

Shallow geothermal energy systems are...

- Renewable
- Using the clean, inexhaustible and local heat from the earth, shallow geothermal systems can supply heating and cooling 24 hours a day without producing emissions.
- Efficient
Geothermal heat pumps are one of the few heat pump technologies that are known as UTES, Underground Thermal Energy Storage. These UTES can be tailored for both individual, residential houses, and large installations.

The highest storage temperature achieved in geothermal energy systems is about 90°C, the lowest ca. 5°C.

Residential houses for small houses, 1-2 borehole heat exchangers (BHE) or horizontal collectors (brine or direct expansion) are the best suited options. The installation is not visible from the outside, and the heat pumps do not require much space.

Offices and commercial buildings

For applications in the commercial sector, large borehole heat exchanger (BHE) fields or groundwater wells are the preferred groundside alternative. BHE are feasible virtually everywhere and promise maintenance-free operation, however their individual capacity is limited, so sometimes large fields are required if more than 100 BHE are used.

There are two main types of system for heating and cooling, residential and commercial. In residential heating and cooling the heat is delivered directly to the building floor slab. In commercial applications the heat is delivered to building areas using a distribution system that can be connected to multiple heat pumps.

The heat pumps used in shallow geothermal systems have the lowest number of failures per installed unit compared to similar technologies, making systems easy and simple to maintain.

- Competitive
Geothermal systems are competitive with other renewable energy systems, such as photovoltaics and wind, and can deliver much higher thermal output per unit cost than fossil fuels.

- Versatile
Geothermal systems can supply heating and cooling 24 hours a day, making systems easy and simple to maintain.

Financial incentives schemes for geothermal heat pumps are not available in all European countries, although competition in the heating sector can be considered unfair with fossil fuels still receiving subsidies. Political and financial support for geothermal heat pumps is, at present, complex and fragmentary.

Geothermal energy in Europe.

The regulatory system for shallow geothermal systems is complex and fragmented. In many EU countries there is over regulation, in others there is none, whilst still more areas have disjointed procedures which need to be streamlined.

A number of studies have now been conducted, establishing where problems lie and how national, local, and regional authorities can improve and develop their regulatory regimes.

Detailed information about each stage of the regulation process and full recommendations can be found at regocities.eu.

Market

There are more than 1.1 Million GSHP installations in the EU, with a capacity of at least 17,700 MWth. The overall installation growth is steady for both UTES and GSHP. The countries with the highest amount of geothermal heat pumps are Sweden, Germany, France and Switzerland. These four countries alone account for ca. 65% of all installed capacity for shallow geothermal energy in Europe.

Looking at the time period 2010-2015, these four big players will have the greatest increase in terms of number of installations. In relative terms, Italy, Poland and the Czech Republic are among the countries with the highest growth rate.

Regulation

The regulatory system for shallow geothermal systems is complex and fragmented. In many EU countries there is over regulation, in others there is none, whilst still more areas have disjointed procedures which need to be streamlined.