

## **Current status of ground source heat pumps and underground thermal energy storage in Europe**

**Burkhard Sanner<sup>a</sup>, Constantine Karytsas<sup>b</sup>, Dimitrios Mendrinou<sup>b</sup> and Ladislaus Rybach<sup>c</sup>**

<sup>a</sup> Institute of Applied Geosciences, Justus-Liebig-University, Diezstrasse 15, D-35390, Gießen, Germany

<sup>b</sup> Center for Renewable Energy Sources (CRES), 19th km Marathonos Ave., Pikermi, Greece

<sup>c</sup> Geowatt AG, Dohlenweg 28, CH-8050, Zürich, Switzerland

### **Abstract**

Geothermal Heat Pumps, or Ground Coupled Heat Pumps (GCHP), are systems combining a heat pump with a ground heat exchanger (closed loop systems), or fed by ground water from a well (open loop systems). They use the earth as a heat source when operating in heating mode, with a fluid (usually water or a water–antifreeze mixture) as the medium that transfers the heat from the earth to the evaporator of the heat pump, thus utilising geothermal energy. In cooling mode, they use the earth as a heat sink. With Borehole Heat Exchangers (BHE), geothermal heat pumps can offer both heating and cooling at virtually any location, with great flexibility to meet any demands. More than 20 years of R&D focusing on BHE in Europe has resulted in a well-established concept of sustainability for this technology, as well as sound design and installation criteria. Recent developments are the Thermal Response Test, which allows in-situ-determination of ground thermal properties for design purposes, and thermally enhanced grouting materials to reduce borehole thermal resistance. For cooling purposes, but also for the storage of solar or waste heat, the concept of underground thermal energy storage (UTES) could prove successful. Systems can be either open (aquifer storage) or can use BHE (borehole storage). Whereas cold storage is already established on the market, heat storage, and, in particular, high temperature heat storage (> 50 °C) is still in the demonstration phase. Despite the fact that geothermal heat pumps have been in use for over 50 years now (the first were in the USA), market penetration of this technology is still in its infancy, with fossil fuels dominating the space heating market and air-to-air heat pumps that of space cooling. In Germany, Switzerland, Austria, Sweden, Denmark, Norway, France and the USA, large numbers of geothermal heat pumps are already operational, and installation guidelines, quality control and contractor certification are now major issues of debate.

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