

## **Interactions between soil, horizontal heat exchangers and environment: the ITER Project outcomes**

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The thermal properties of soils can be considered one of the most important parameters for many engineering projects designing. In detail, the thermal conductivity plays a fundamental role when dimensioning ground heat exchangers, especially very shallow geothermal (VSG) systems, interesting the first 2 m of depth from the ground level. However, the determination of heat transfer in soils is difficult to estimate, because depends on several factors, including, among others, particle size, density, water content, mineralogy composition, ground temperature, organic matter. The performance of a VSG system, as horizontal collectors or special forms, is strongly correlated to the kind of sediment at disposal and suddenly decreases in case of dry-unsaturated conditions in the surrounding soil. Therefore, a better knowledge of the relationship between thermal conductivity and water content is required for understanding the VSG systems behavior in saturated and unsaturated conditions. The overall aim of ITER Project (Improving Thermal Efficiency of horizontal ground heat exchangers), funded by European Union, is to ensure the sustainability of VSG systems. To enhance the performance of horizontal geothermal heat exchangers, thermally enhanced backfilling material (TEBM) have been tested in laboratory and monitored on site. In the test field the interactions between different soil mixtures, helix collectors installed in horizontal trenches and the surrounding environment have been studied. Analysis of data collected over more than one year have been processed and used in numerical simulations in order to understand the short and long term environmental impact of these technical solutions.