# Underground Thermal Energy Storage

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The possibility to meet the thermal energy availability and production with the user requests is a concrete and interesting solution voted to maximize the efficiency and to reduce the energy losses and greenhouse emissions. The possibility to store the waste heat and the excessive heat production in the underground in the warm season to recover it during cold periods enables energy cost saving and environmental protection. During the last decades, the increasing number of biomass co-generation power plants and solar thermal system developed worldwide and the growing needs for more efficient energy use in buildings due to heating and cooling made the employment of Underground Thermal Energy Storage (UTES) systems increasingly interesting.
UTES technologies include borehole Thermal Energy storage, aquifer storage, cavern storage and pit storage. Which of these technologies is selected strongly depends on the local geological conditions.
The geological component in these systems constitutes the fundamental and invariant element for the evaluation of the potential of such solutions, will then be studied integrated systems of thermal accumulation in the subsoil, using both matrices water, that ground, and clayey or cementitious materials.
The Phd topic is focused on the studies regarding underground thermal storage, which ensure the transfer of thermal energy to and from the ground layers (e.g. clay, sand, rock).
In case of low storing temperature. For medium high-temperature the thermal storage capabilities of solid materials (e.g. ceramics, concrete) will be analysed, in different composition and operational conditions, in order to evaluate the best materials in terms of best composition, performance, efficiency, availability and costs.
However, most of such high-temperature-sensible UTES options will be studies, such as rocks masses in place, considering the fundamental thermal properties and mechanical stresses induced by temperature alterations, on different alpine lithologies, and the heat transfer processes involved, by means of FEM codes analyses.
The research project is characterized by a high level of innovation and potential important applicative effects, and is based on laboratory and on-site tests as well as coupled applications of physical and numerical modelling for the analytical study of the studied processes. Experiences abroad are expected to complete the scientific education of the PhD student.

The partners involved in the research are: prof. G Artioli (Dept. Geoscienze-Circe), Prof. M. De Carli (DII), Prof. Simonini and Prof. S. Cola (DICEA).

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