Compressed Air & Hydrogen Subsurface Energy Storage Potential evaluation

(*Proposer: Prof. Antonio Galgaro*)

The energy transition and low-carbon energy generation is a critical element for the zero-carbon economy target in 2050. A particular challenge for the massive development of renewable energy sources is the storage of intermittent renewable energy generated by renewable energy sources. The required energy storage capacity in the GW range is far beyond battery storage capacity and only comparable to hydro-electrical storage. Solution as caverns structures could be used as subsurface energy storage for subsurface energy storage in the form of compressed air or green hydrogen (CAES & HES). This opportunity requires a deep study about the feasibility of this solution in terms of geo-mechanical, fluid-dynamics and thermal effects compatibility of the host rocky subsoil environment.
However, with huge economic potential of intermittent solar and wind energy storage greatly increasing continuity and peak delivery of zero-carbon electricity.
This project will focus on: (I) Subsurface mapping and geological characterisation of the targeted structures including their geological context, compositional variations, faults structures in the overburden and shallow subsurface features. (II) Geo-mechanical and petro-physical assessment of operational CAES/HES storage potential, including (a) numbers of caverns and total cavern volume, (b) working gas volume (min-max; P range) and (c) cushion gas volumes. (III) Seal integrity assessment for potential shallow hazards for infrastructure. (IV) cavern sealing technologies.

A particular focus will be concentrated on the study of the thermal effects connected to the charge and discharge phases of the underground compressed air and/or hydrogen storage environment.

The student will apply foreign experiences on existing or currently underway pilot sites of compressed air and hydrogen underground energy storage in the Silver Pit High and Sole Pit Basin of the UK. The results of this study can be compared to other onshore gas storage facilities and existing CAES sites in Canada and Germany. This project has strong connections with similar studies in the Dutch sector. The project will train the student in geospatial analysis, seismic interpretation, subsurface characterisation and geomechanical analysis of geospatial, geological and geophysical data using software packages for GIS, seismic, well and geomechanical analysis.

The student will be part of working alongside researchers on subsurface energy storage projects. Working with other European researchers, can introduce the student to international collaborators.

Possible scientific collaborations will be the Royal Holloway University of London and other research groups from Canada (Polytechnic of Montreal) and University of Trento (Italy)

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