

Underground Hydrogen Storage (UHS): A new opportunity for Energy Transition

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According to the climate & energy framework defined in the Paris Agreement, the targets for 2030 are to cut greenhouse gas emissions by at least 40% compared to the 1990 levels and to achieve at least a 32% share of renewable energy and a 32.5% improvement in energy efficiency. Renewable sources are considered key to decarbonize energy systems and reduce dependency on fossil fuels. However, despite the availability of solar energy and wind power, technologies relying on these sources – which are unstable and intermittent by nature – are not fully viable yet. Therefore, solutions to match the high-frequency variation of renewable energy production with the electricity demand are fundamental for energy transition. In this view, large-scale energy storage can provide means for balancing supply and demand, increasing energy security, promoting a better management of the grid, and allowing convergence towards a low carbon economy. Within this context, underground storage systems can play a fundamental role in the transition to a decarbonized and more sustainable energy future.

The presentation provides an overview of the several scientific issues and technical challenges to be addressed for underground fluid storage, with a particular focus on hydrogen and mixtures of hydrogen and natural gas. The technical experience historically gained on underground energy systems by operators, service companies and research institutes, is now being complemented by new competences to adequately respond to the new needs raised by transition from fossil fuels to renewables. The experimental characterization and modeling of geological formations, fluids and fluid-flow behavior and the mutual interactions of all the systems components at the thermodynamic conditions typical of underground systems require a deeply integrated teamwork and fit-for-purpose laboratories to support theoretical research. To this end, the research group dealing with large-scale underground energy storage systems of Politecnico di Torino has joined forces with the Center for Sustainable Future Technologies of the Italian Institute of Technology (IIT), also based in Torino, and with industrial partners to meet these new challenges of the energy transition era and new dedicated laboratories have been set up within the Competence Center SEASTAR - Sustainable Energy Applied Sciences, Technology & Advanced Research, established in 2018 together with the Ministry of Economic Development and now supported by the Ministry for Ecologic Transition.