Hydrogen Underground Storage : Status of Technology and Perspectives

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Hydrogen will play a key role in the development and transformation of future renewable energy systems. H2 has many benefits, can be generated by well-established and emerging technologies and can be used in a variety of end-use energy and transport processes. H2, as a fuel source, has long been identified as a critical step toward a low-carbon, and eventually zero-carbon, energy society. Hydrogen storage is an essential element of an integrated energy system and hydrogen economy. As hydrogen demand and production are growing, underground storage is emerging as a relevant, large-scale solution. While in recent years a lot of attention has mainly been on hydrogen supply and transmission infrastructure, there is the need for underground hydrogen storage to balance and ensure the resilience of a future energy system that relies significantly on renewable energy sources. Hydrogen can be physically underground stored using a method which has already proven its worth and Carbon Geo Sequestration (CGS) and natural gas are essential analogs for H2 storage. Natural gas storage in underground facilities can be dated back to 1916 when it was stored in geological formations. According to many authors, Ontario gas field (Canada) is considered the first

successful underground storage project (Taylor et al., 1986). However, certain operational differences (physical and chemical properties) unique to H2 must be acknowledged for effective operation (Iglauer, 2017). Higher demand means there is going to be a need for increased storage capacity and the solution to this challenge is to utilize earth underground reservoirs. Underground reservoirs, such as salt caverns or porous rocks, offer giant capacities to store billions of cubic meters of hydrogen at high-pressures. Although the existence of few Underground Hydrogen Storage (UHS) sites, up till now, little is known about how hydrogen behaves in the subsurface and, current studies are investigating not only how it behaves in the subsurface but also what kind of environment – type of subsurface – would be the right reservoir to store it at a given quantity and scale. Also, to consider challenges of containing hydrogen tiny molecules inside the reservoirs, maintaining its purity, and operating the system within safe mechanical cyclic loading. Considering underground hydrogen storage, an integrated multidisciplinary approach is required, combining several specialists and disciplines (e.g. fluid mechanics and rock mechanics, etc.). Also, integrating laboratory discoveries with numerical modelling will provide solutions to make this technology ready for field deployment within next year