New CO_2 and Hydrogen storage site marketing: How to make your storage site unique and attractive?

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Accepted 8 August 2022
DOI https://doi.org/10.21595/bcf.2022.22840

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Baltic Carbon Forum 2022 in Kaunas, Lithuania, October 13-14, 2022

Abstract. Today we met the situation, when our knowledge and expertise are far away from marketing – an ability to sell our knowledge to the end-user (public, policymakers, governments, and small and big enterprises). This study aimed to attract stakeholders by proposing new techno-ecological synergy concept of geological storage of CO_2 (CGS) and hydrogen (UHS) in a cost-competitive, self-supporting storage site.

The "story of success" of the offshore geological structure E6 in Latvia has started from an invisible point on the European map, oil-bearing but not very promising geological structure to the unique and one of the best cost-competitive, self-supporting, conceptual techno-ecological examples of a possible synergy of storage concepts with renewables energies.

Using detailed petrophysical, mineralogical and geochemical analyses of the Cambrian Series 3 Deimena Formation reservoir sandstones in this structure, the CO_2 storage capacity was estimated with different levels of reliability from a conservative 158 Mt (106-252 Mt) up to an average optimistic average of 396 Mt (264-631 Mt). The theoretical CO_2 storage capacity in the oil-bearing limestones of the Upper Ordovician Saldus Formation was estimated at the end of the Enhanced Oil Recovery cycle using the CO_2 (CO_2-EOR) as an average of 110 Mt (65-144 Mt). The E6 structure was estimated as the most prospective and the largest for CO_2 geological storage in the Baltic Region with a total average CO_2 storage capacity of about 500 Mt.

Time-lapse numerical seismic modelling was applied to analyze the feasibility of CO_2 storage monitoring in the E6. The novelty of this approach was the coupling of the chemically induced petrophysical alteration effect of CO_2-hosting rocks, measured in the laboratory during the CO_2 injection-like experiment, with time-lapse numerical seismic modelling. According to changes in the amplitude and two-way travel times in the presence of CO_2, reflection seismic could detect CO_2 injected into the deep aquifer formations even with low CO_2 saturation values. Our results showed the effectiveness of the implemented time-lapse rock physics and seismic methods in the monitoring of the CO_2 plume evolution and migration in the E6.

The new concept of techno-ecological synergy of the CCUS project with different eco-friendly renewable energy recovery technologies, which support circular economy targets, is presented. The concept of the CCUS project includes six innovative elements of techno-ecological synergy: (1) CGS, (2) Geothermal energy recovery during CO_2 geological storage (CPG), (3) CO_2-EOR, (4) underground hydrogen storage (UHS), (5) solar energy and (6) wind energy recovery. This concept should maximise efficiency, minimize the carbon footprint of the full-chain CCUS process and demonstrate the "win^x" situation (where "x" is a number of additional benefits of the project).

We demonstrated an example of the project supporting also a win^5 global situation (that is, a win-win scenario with a minimum of five potential global outcomes): greenhouse gas emissions (GHGE) reduction, (2) economic profitability, (3) increased CO_2 storage capacity, (4) public acceptance and (5) retargeting of oil and gas businesses.

Small wind offshore floating plant installed around the rig and solar panels covering free surfaces of the rig and a compact geothermal plant using CO_2 (20 times smaller than a conventional plant)

will produce renewable energy added to the project electricity net to cover the energy needs of the project. The excess energy will be used by compact hydrogen production plant established directly on the rig. The produced hydrogen could be stored underground and when needed, transported by ship to the port. For the first time, we estimated hydrogen storage capacity in the E6-B, the smaller compartment of the E6 offshore structure as 30 Kt.

This scenario is a basis for the new concept of CO_2 and hydrogen storage site marketing: how to retarget fossil fuel business (the depleted oil and gas fields) into the storage-targeted and renewable energy business, permitted to achieve the carbon-free energy transition using principles of circular economy and sustainable use of resources and environment.

Keywords: CCUS, Hydrogen storage, Baltic sedimentary basin, CO_2 storage, Geothermal energy recovery, techno-ecological synergy.