Synergy scenario for renewable energy production, CO_2 and H_2 storage in the Baltic offshore structure

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Abstract. CO_2 Capture, Transport, Use and Storage (CCUS) is one of the core technologies to mitigate climate change. New techno-economic and techno-ecological concept of a synergy of CO_2 geological storage (CGS), CO_2 use, hydrogen (H_2) production from different eco-friendly renewable energy recovery technologies and underground H_2 storage (UHS), which we call here Geological Power Bank (Geo-PB), in Cambrian Deimena Formation sandstones in different compartments of the E6 structure offshore Latvia is presented for the first time.

A five-phase circular economy concept of E6 geological structure energy and CO_2 storage hub was developed in this study. The workflow is techno-ecological, eco-friendly, self-supporting, cost-competitive, and economically feasible. It consists of (1) CO_2 transport by ships to the rig, (2) CO_2 injection for CGS and CO_2 Plume Geothermal technology (CPG), (3) H_2 production, (4) Geo-PB, and (5) H_2 transport by the same ships to the customers. The concept is supporting a win[8] situation - innovative elements of techno-ecological synergy in one site: (1) CGS, (2) CPG, (3) solar energy, (4) wind energy, (5) sea currents energy, (6) H_2 production (7) Geo-PB and (8) H_2 transport to consumers. The proposed cycle is closed, demonstrating the principles of circular economy, which will increase the total efficiency of the concept. CGS and CPG are planned in the E6-A compartment of the E6 geological structure with an average CO_2 storage capacity of 365 Mt in an optimistic approach and Geo-PB is planned in E6-B with an H_2 storage capacity of 119 kt.

The Baltic offshore scenario is ambitious and innovative, proposed new technologies, synergy with renewable energy (geothermal, solar, wind and sea current), large storage capacity, including CO_2 storage and use captured by a CCUS clusters of emission sources from energy production, cement industry and bio-emissions from Estonia, Latvia and Lithuania. The concept aimed to decrease the artificial impact of climate change by avoiding CO_2 emissions to the atmosphere and implementing circular economy principles. It will increase public and policymakers' acceptance of new underground CO_2 and energy storage technologies. The proposed synergy solution for CGS and energy storage projects will make such a business economically feasible and attractive for investors. Our study demonstrates a new era, the next generation of cost-competitive, self-supporting conceptual techno-ecological examples of a possible synergy of storage concepts with renewable energies combined using circular economy approaches.

Keywords: CO_2 geological storage, CO_2 use, hydrogen production, renewable energy recovery, underground H2 storage, Geological Power Bank, hydrogen transport, E6 geological structure, Baltic offshore scenario, techno-economic, techno-ecological, synergy concept.

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