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Abstract

In recent years more and more salt cavern projects for hydrogen storage have been launched in European countries, most of them addressing research or demonstration objectives. Nevertheless, with the announced projects the European storage industry is still far from reaching the capacity targets for the next decades that are communicated in government strategies or studies about meeting climate goals. On the other hand, significant geological potential for the development of salt caverns is known in several European countries. For some countries, studies about the theoretical hydrogen storage capacity based on technical limitations exist, but up to now, there is no evaluation of the additional constraints by the need to connect the storage sites with the relevant infrastructure, especially for the stored hydrogen and for the brine produced in the leaching process. The joint project HyPSTER, that targets the demonstration of hydrogen cycling in an existing salt cavern in Étrez, France, as well as the development and validation of cavern modelling tools, also includes the application of these tools for optimizing salt cavern configurations for hydrogen storage in Europe. To support the assessment of potential storage sites and inform investment decisions for the development of further hydrogen storage projects, these modeling tools have been used to re-evaluate realistic hydrogen storage potentials in several European countries considering the impact of infrastructural constraints. At first, a set of cavern configurations representative of existing gas storages in Europe was defined and compared regarding their hydrogen storage performance using a modelling tool mainly regarding cavern thermodynamics, but also including creep closure. In the next step, literature data on the occurrence and properties of salt deposits in Germany, France, Denmark, Netherlands and United Kingdom as major European cavern storage operating countries has been evaluated regarding their potential for the leaching of storage caverns and the resulting hydrogen storage capacities. Finally, the potential sites have been restricted to those within certain corridors along the planned European Hydrogen Backbone representing the hydrogen infrastructure and around certain industrial centers for brine offtake or along the coastline. This work now presents an overview of the impact of the applied constraints on the storage potential. The result is a set of more realistic figures of storage potentials for the evaluated countries than the pure geological potential. These numbers are compared with storage demand forecasts from literature, which shows that even under the applied restrictions there is still sufficient potential to meet the expected demand for the next decades.

Key words: hydrogen storage, salt caverns, geological potential, infrastructure, brine disposal, chemical industry, European hydrogen backbone