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Conservative Assessment of Geological CO₂ Storage Capacity for Germany

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SUMMARY

When it comes to geological CO₂ storage, it is rather difficult to deliver a specific number of CO₂ storage capacity because estimates suffer from huge uncertainty. Nevertheless it is crucial for political decision makers and industrial investors to know at least the minimum amount of CO₂ that can be stored in the underground. For reasons of land-use regulation and planning of a relevant CO₂ - pipeline network, such a conservative estimate is needed by authorities to provide sufficient information for the overall political implementation of the CCS technology in Germany.

Therefore, this study selects conservative assumptions and provides a conservative CO₂ storage capacity calculation for Germany. It is based on existing concepts and methods to estimate the capacity for CO₂ sequestration in deep saline aquifers onshore and offshore Germany as well as in gas fields. The capacity in aquifers is calculated using a top-down volumetric approach and general parameter values. Gas fields are derived by the bottom-up method based on cumulative recovery.

Several existing studies based on these methods were reviewed to compare the different parameters applied for calculations. The results are discussed to clarify the differences and the difficulties of storage capacity estimates. The most varying parameter is the efficiency factor, applied in a range from 0.1% to 40%. For saline aquifers a reasonable efficiency of 1% is selected in the authors' estimate, taking into account a maximum pressure increase and compressibility of subsurface rock and water. Another relevant factor, the replacement of natural gas in depleted fields (sweep efficiency), is supposed to be possible to an amount of 75%, as it can be considered unrealistic that the entire amount of only produced hydrocarbons can be replaced. Furthermore, the effects of impurities within the CO₂ stream towards density are considered and conservative average CO₂ density values of 600 kg/m³ are selected. These values undercut or stay in the lower range of most of the existing national estimates for Germany.

Therefore, the conservative authors' estimate of the total CO₂ storage capacity for Germany, which results in 2 Gt, lies considerably under the available published estimations (18 - 44 Gt CO₂). It shows that many authors assessed theoretical capacities with an unrealistic high capacity of CO₂ sequestration due to optimistic selection of parameters. These findings form the scope on which the mentioned stakeholders can base their regional selection of suitable emitters and the consideration of an appropriate infrastructure.