USGS Methods for Evaluating Technically Accessible CO_2 Storage Resources with Minimum Storage Size Criteria

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The U.S. Geological Survey has developed geologically-based probabilistic methods for assessing potential CO_2 storage resources within a storage assessment unit (SAU, consisting of storage and seal formations) at the regional scale. We define the storage resource as a technically-accessible volume that could be exploited with existing technology, engineering, and geologic knowledge. Assessment of the potential storage resource of an SAU is based on the volume of physical traps (PTs, e.g. oil and gas reservoirs) as well as the volume of the saline formation (SF, the porous flow unit between PTs within an SAU).

A key component of the CO_2 storage assessment methodology is the definition of a minimum storage size. The minimum storage size allows for the comparison of SAUs based on both the total storage resource volume and on the probability of occurrence of at least one storage site greater than the minimum. The minimum size can be determined using an estimate of the total storage required by a CCS project. For example, a 20 year project designed to store 1 million tons per year requires a site that can retain at least 20 million tons of buoyant, supercritical CO_2. Similarly, a 50 year project to capture and store the emissions of a 1000 megawatt, coal-fired power plant (8 million tons CO_2 per year) requires storage for at least 400 million tons of CO_2. When the mass of CO2 to be stored is converted to volume at subsurface conditions (depths from 3000 to 13,000 ft), 20 million tons is equivalent to about 160 to 220 million barrels and 400 million tons is equivalent to about 3.2 to 4.5 billion barrels of pore space. Individual traps of this size are relatively limited in number.

Probabilistic ranges of storage resources volumes within an SAU are calculated using Monte Carlo simulations of potential storage within individual PTs and the SF. The inputs to these calculations include the full range of uncertainty for all fluid flow and volumetric parameters, such as net fluid extracted per field, thickness, porosity, etc. Monte Carlo methods are also used to aggregate the resource volumes in all PTs and to evaluate the probability of successful storage. The term successful storage is defined, for both PTs and the SF, as storage of a volume of CO_2 that is greater than a prescribed minimum storage size.