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Cost of qualifying a storage site for permitting

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Abstract

As interest in geologic storage increases in response to incentives such as those provided by the US 45Q tax credit and California Low Carbon Fuel Standard, more industries with potential to capture large volumes of CO_2 are considering prospective business ventures. One question that needs an early answer during project scoping is "how much investment in the storage option is needed and when?" In our example cases, investment in assessment of the storage option(s) has been staged. An initial feasibility assessment is required to demonstrate that full chain CCS is possible considering variables such as volume of CO_2 to be captured and transport distances to storage. At this stage, an activity matching sources and sinks may be needed to either aggregate smaller sources to create sufficient project value to support investment or to split a large flow of CO_2 into multiple wells separated sufficiently to avoid pressure interference in the injection zone(s). Regional assessments and pipeline scoping models are valuable at this stage. A positive feasibility assessment may be used to obtain corporate permission to proceed. A more formal study with documentation that can be used to engage investors or explore public acceptance for the project may be needed next, this focuses in on one or more prospective sites. A following stage of assessment includes obtaining sufficient detail about the geology and engineered modifications (past operations and existing well penetrations) that is used as input into initial fluid flow models of plume evolution that can be used to lease storage rights and plan needed surface access. If the storage is based in part on CO_2 enhanced oil recovery, a focus of the workflow at this stage is to collect data on miscibility, pressure distribution, and remaining oil saturation to model oil recovery and add this into an economic forecast. As this stage of assessment is favorable concluded, additional characterization specific to the site(s) is likely needed to obtain data needed to permit the injection well(s). These data are used to create detailed and probabilistic fluid flow models needed to conduct risk analysis and design the monitoring strategy to manage risk. The final investments are preparation of the permits and any other needed plans and working them through the regulatory approval process.

The cost and cost-based risk of conducting each stage of the storage assessment depends mainly on two factors: 1) the complexity and associated risk and uncertainty of the geologic setting and 2) the ratio of existing data to newly collected data that is needed to reduce this uncertainty. For example, in a structurally and stratigraphically simple setting, it may be acceptable for much or all of the study to assume that the rock characteristics observed at one characterization well are extrapolated over an area around that well. In a setting that is more complex in reservoir or confining system properties or geometries, additional data are needed to sufficiently constrain the heterogeneity. The density of existing data is also a major consideration; for example it is much less expensive to purchase and interpret

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an existing seismic survey than to collect a new one and much less expensive to interpret existing wireline logs than to drill additional data wells. The cost of assessment of the condition of existing wells can vary greatly, depending largely on the quality of records available. A site with many wells and good records of past well management can be lower cost and risk-based risk than a site with only a few wells if those old wells are “wildcats” with poor records that require well tie back and re-entry for assessment.

We have begun developing a storage assessment-unit-based order-of-magnitude cost estimator to constrain how much investment in the storage option is needed and at each point in the project development cycle. This is valuable to industries at project inception and approval to predict the capital needs as well as capital risk if the project does not proceed. The estimator considers first the expected reservoir, seal, and overburden complexity for representative project sites that can be extrapolated at a play scale and provides context to consider how much characterization data is required at each project stage to de-risk the project sufficiently to advance to the next stage. The second element of the estimator is more site-specific, however it provides guidance on quantifying current data density at representative sites that constrain reasonable expectations for sites within the play.

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