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Assuring long-term storage of captured CO_2: technical-legal-policy-business models

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Abstract

Storage of CO_2 as a greenhouse gas reduction method implies a commitment to retain CO_2 for centuries. This long time frame challenges existing paradigms. Traditional energy investment requires short predictive timelines (less than 10 years to payout) and a strategy can be adapted as conditions change. How can we manage the non-zero risk of storage failure in the distant future? While the technologies used in geologic storage are mature and provide high technical confidence that stored CO_2 is trapped in the deep subsurface over long time frames, translating this into certainty that can be used to underpin a large business investment hosted by a new cooperative business community is a new challenge that must be met during the transition to low-carbon energy.

We are working on three intersecting strands to map the route to investible assurance of long term storage of CO_2 in the subsurface: 1) improve methods to confirm CO_2 plume stabilization predictions, 2) address the policy mechanisms that could be used to translate our increased technical confidence in long term isolation of CO_2 in the subsurface into actionable business, policy and regulatory models, and 3) research in CCS risk communication to make these elements accessible to key stakeholders. This paper will present in progress report and seek feedback on this project near its midpoint.

In comparison to well-validated physics relevant to production, field validation of the physics relevant to long-term plume stabilization is a new need. Pressure drop and viscus flow are not relevant under these conditions and capillary and buoyancy forces observable at very small scales are dominant in flow and trapping of CO_2. Evaluating capillary and buoyancy-dominated trapping mechanisms of CO_2 in micromodels and comparing the results with a comprehensive simulation approach is at the frontier of knowledge in this domain. Coupled experimental and numerical study will enhance our ability to predict CO_2 plume stabilization and secure entrapment during the post-injection stage of storage. This increased confidence is a key element to be communicated to the other intersecting project stands.

CCS involves conversion of common risk (from all CO_2 accumulating in the atmosphere with risk to everyone) to a corporate risk (by emitters instead storing CO_2 in the subsurface). Most current thinking to increase confidence in predicted long term storage lies in either a technical fix (e.g. long term monitoring) or policy fix (e.g. a performance

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bond to assure against future risk of loss or governmental assumption of risk after closure). A unified exploration of the technical uncertainty (low and reducible) and business case (mechanisms to offset risk with benefit) with effective communication (based in information seeking and trusted sources) is our goal to seek the pathway toward optimizing policy options to allow rapid and confident use of the needed technological tools for greenhouse gas reduction. We are considering prototype mechanisms that would allow "translation" of technical language involving the uncertainties of predictive modeling into the appropriate commercial and regulatory uncertainties and communications, considering treatment of financial assurance and long-term risk in analog sites already in operation.

Benefit perceptions about CCS – such as climate change mitigation – are positively linked to greater support for CCS, while risk perceptions about CCS – such as CO2 leakage, blowouts and earthquakes – are negatively linked to support for CCS. Our communication goals include: linking climate change (the problem) and carbon capture and storage (part of the solution portfolio) and explore benefit perceptions in relation to processing information about the risks associated with CCS.

Keywords: long term storage, phycial and numerical models, legal and business models, and public acceptence