Imperial College London

Natural Environment Research Council

2024_28_ESE_SK: An evaluation of the feasibility of the global scaleup of CO_2 storage for climate change mitigation

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Description: Energy systems models analysed by the UN Intergovernmental Panel on Climate Change have suggested that CO_2 storage must achieve rates of 10's of Gt CO_2 per year by 2050, implying energy infrastructure at a scale matching that of current oil and gas infrastructure (Krevor et al., 2023). The use of CCS in these models is the leading control on the total costs of mitigating climate change. However, these models are lacking in realistic representations of CO_2 storage. They do not constrain deployment rates, either with top down limitations on technological growth (Zhang et al., 2023), or bottom up constraints from the physical limitations of the reservoir systems (De Simone et al., 2021).

The PhD project will evaluate the potential for geographic, geologic, and techno-economic constraints to lead to bottlenecks in the development of large scale CO_2 storage globally. The research will involve compiling information on historical and ongoing amounts of CO_2 stored, and developing either techno-economic, or physics based models analysing the potential for scaleup in comparison with projections. We will evaluate the feasibility of current projections of the use of CCS in future climate change mitigation, and identify plausible scaleup pathways with the geography of deployment resolved regionally around the globe. Ultimately, we will construct models for plausible development trajectories that may be incorporated into energy systems models of the type used by the IPCC to outline techno-economic pathways for mitigating climate change.

Key References:

Krevor, S., De Coninck, H., Gasda, S. E., Ghaleigh, N. S., de Gooyert, V., Hajibeygi, H., ... & Swennenhuis, F. (2023). Subsurface carbon dioxide and hydrogen storage for a sustainable energy future. Nature Reviews Earth & Environment, 4(2), 102-118.

Zhang,Y., Jackson,C., Darraj, N., Krevor,S. (2023) Feasibility of Carbon Dioxide Storage Resource Use within Climate Change Mitigation Scenarios for the United States, Environmental Science & Technology Article ASAP, DOI: 10.1021/acs.est.3c00790

De Simone, S., & Krevor, S. (2021). A tool for first order estimates and optimisation of dynamic storage resource capacity in saline aquifers. International Journal of Greenhouse Gas Control, 106, 103258.