Stanford
School of Earth, Energy & Environmental Resources

Stanford Center For Carbon Storage

April, 2022

Greetings!

We hope that our winter newsletter finds you all well.

We had a busy winter quarter at Stanford, especially now that we have returned to campus. Some of the ***new*** projects we are working on that were not reported out on at the November annual meeting include:

- Understanding the parasitic loads associated with carbon capture retrofit projects
- Coupled flow and geomechanical simulations to assess if surface deformation measurements can be used to understand plume migration
- Developing deep-neural-network surrogate models to predict CO2 saturation and pressure fields and surface displacements
- Optimizing well locations and injection strategies for CO2 storage
- Assessing pathways to decarbonizing California (more on this below)

Stay tuned for research results on the projects listed above, as well as the myriad of other research activities already underway at the SCCS.

Thanks to everyone for your continued support of our program. A summary of recent activities and publications can be found below.

Sarah Saltzer, SCCS Managing Director

Recent Events

Professor Lou Durlofsky, co-director of SCCS, was recently named to the National Academy of Engineering. Lou was recognized for the development of innovative modeling and optimization techniques to enable the recovery of hydrocarbon and water resources. His research involves the development of computational methods for the effective management of subsurface flow operations, with applications ranging from the recovery of oil and gas to the geological storage of CO_2.

Professor Mark Zoback, co-director of SCCS, hosted a SCCS webinar on Geomechanical Issues Affecting Long-Term Storage of CO_2. A recording of the event can be found here.

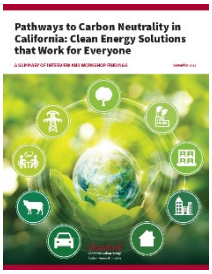
Project Spotlight : Pathways to Decarbonization in California

The Stanford Center for Carbon Storage (SCCS) and the Stanford Carbon Removal Initiative (SCRI) are jointly working on a project to “inform the discussion” on pathways to Carbon Neutrality in California through an assessment of energy system options that encompass a broad range of technologies, including CCS, natural gas sourced H2, negative emissions, and other technologies and technology transformations.

This project has 3 major components:

Interviews and Workshop: Clean Energy Solutions that Work for Everyone
Workstream 1: Sector- and decarbonized fuel-based Deep Dives
Workstream 2: Integrated Economy-wide Modeling

This is a 2 year project with many deliverables, a few of which have been completed including:



This report summarizes insights from a series of interviews conducted in the spring of 2021 as well as a workshop conducted in June 2021. This report does not represent the views of Stanford University or the project sponsors. The intent of the Stanford project team was to obtain perspectives from across a wide range of organizations in government, the private sector, and academia. The full report and 6 short 1-page briefs can be downloaded here.

While hydrogen has the potential to play a significant role as California strives to decarbonize, a decision must be made whether it is worth large-scale investment. This report by Justin Bracci, Adam Brandt, and Sally Benson highlights the opportunity for new hydrogen plants in California. The full report and 1-page summary brief can be downloaded here.

Recent Publications

Kim, T., Callas, C., Saltzer, S., & Kovscek, A. (2022). **Assessment of oil and gas fields in California as potential CO2 storage sites**. *International Journal of Greenhouse Gas Control*, *114*, 103579. https://doi.org/10.1016/j.ijggc.2022.103579

Hashemi, S., & Zobak, M. (2021). **Permeability Evolution of Fractures in Shale in the Presence of Supercritical CO2**. *JGR Solid Earth*, *126*(8), e2021JB022266. https://doi.org/10.1029/2021JB022266

Dvory, N., & Zoback, M. (2021). **Prior oil and gas production can limit the occurrence of injection-induced seismicity: A case study in the Delaware Basin of western Texas and southeastern New Mexico, USA**. *Geology*, *49*(10), 1198–1203. https://doi.org/10.1130/G49015.1

Chapman, S., Borgomano, J., Quintal, B., Benson, S., & Fortin, J. (2022). **Mass transfer between fluids as a mechanism for seismic wave attenuation: experimental evidence from water–CO2 saturated sandstones**. *Geophysical Journal International*, *230*(1), 216–234. https://doi.org/10.1093/gji/ggac067

Huang, Z., Kurotori, T., Pini, R., Benson, S., & Zahasky, C. (2022). **Three-Dimensional Permeability Inversion Using Convolutional Neural Networks and Positron Emission Tomography**. *Water Resources Research*, *58*(3), e2021WR031554. https://doi.org/10.1029/2021WR031554

Boon, M., Matthäi, S., Shao, Q., Youssef, A., Mishra, A., & Benson, S. (2022). **Anisotropic rate-dependent saturation functions for compositional simulation of sandstone composites**. *Journal of Petroleum Science and Engineering*, *209*, 109934. https://doi.org/10.1016/j.petrol.2021.109934

Zahasky, C., & Benson, S. (2022). **Preferential Solute Transport in Low Permeability Zones During Spontaneous Imbibition in Heterogeneous Porous Media**. *Water Resources Research*, *58*(1), e2020WR029460. https://doi.org/10.1029/2020WR029460

Baik, E., Siala, K., Hamacher, T., & Benson, S. (2022). **California's approach to decarbonizing the electricity sector and the role of dispatchable, low-carbon technologies**. *International Journal of Greenhouse Gas Control*, *113*, 103527. https://doi.org/10.1016/j.ijggc.2021.103527v

Li, Y., Orr, Jr., F., & Benson, S. (2021). **Long-Term Redistribution of Residual Gas Due to Non-convective Transport in the Aqueous Phase**. *Transport in Porous Media*, *141*, 231–253. https://doi.org/10.1007/s11242-021-01722-y

Benali, B., Føyen, T., Alcorn, Z., Haugen, M., Gauteplass, J., Kovscek, A., & Fernø, M. (2021). **Pore-scale Bubble Population Dynamics of CO2-Foam at Reservoir Pressure**. *Earth and Space Science Open Archive*, 22. https://doi.org/10.1002/essoar.10506876.1