Jan–Mar

QUARTERLY NEWSLETTER

TXLA CMC UNIVERSITIES

Lamar University
Louisiana State University
Texas A&M University-Corpus Christi
Texas A&M University-Kingsville
The University of Texas at Austin
University of Houston

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Our phonebook connects you to others in the CCS community, enabling meaningful outreach and collaboration. Please feel free to share our newsletter with anyone interested in joining the directory to foster connections.

This project is funded for 2024–2026 by Department of Energy's (DOE's) National Energy Technology Laboratory (NETL) project DE-FE32361.

Welcome to the first newsletter for 2025!

We started the year strong with a TXLA CMC joint university workshop on January 9-10 hosted by the Harte Institute at Texas A&M-Corpus Christi. This collaborative event brought together teams from each participating university to share outreach tools, learning resources, and communication strategies for engaging and educating the public on CCS.

A key focus of the workshop was developing clear, actionable messaging that makes CCS concepts accessible to all audiences, especially to those with little background in the topic. Emphasis was placed on eliminating jargon, ensuring information is easy to understand, relevant, and engaging for the general public, and addressing questions from social scientists new to the CCS industry. Topics ranged from simple foundational questions—like why we need to reduce CO_2 emissions—to exploring the benefits and impacts of CCS and whether it offers a viable solution for addressing climate challenges.

In this quarter's newsletter, we highlight the valuable insights gained from GCCC's monitoring expert and geochemist, whose understanding of environmental impacts is built on project experience and over 25 years of research. For an overview, please see the accompanying factsheet.

CCS Safety and Environmental Impacts

Global Efforts

Since 2006, there have been many field experiments across the globe simulating a CO_2 leak in order to understand potential environmental impacts.

Click/Scan QR code for more info.

25 years of lab and field research and deployment show that CCS sites are unlikely to leak, but if they did, we have to understand and consider potential risks. Here is an overview.

Human Health

Potential CO_2 impacts include contamination of drinking water, displacement of oxygen in low-lying areas, and threats to ecosystem health. While CO_2 is not explosive or toxic, it can displace oxygen, posing a risk to health via oxygen deprivation. However, the overall risk is lower than everyday risks such as car crashes or being struck by lightning.

Potential Groundwater Impacts

CO_2 can potentially impact groundwater by causing the mobilization of heavy metals due to mineral dissolution or detachment from the grain surface, leading to contamination. Additionally, brine, which is difficult to clean up, can render water undrinkable due to its salt content.

Metal Mobilization

Research in both lab and in field experiments show that while CO_2 can mobilize metals in groundwater, the effect is often minimal and transient. The mobilized metals usually fall back out once the CO_2 or the groundwater moves away, and the amount is typically not enough to affect drinking water standards. Therefore, metal mobilization is no longer a major concern.

Brine Migration Potential

The main concern is brine contamination in groundwater, which is difficult to remedy. This risk is associated with closure and boundary conditions, and abandoned wells. It's crucial to manage injection pressure and ensure abandoned wells are properly plugged to prevent brine from being pushed into the aquifer.

Terrestrial Ecosystem

Ecosystem impacts of CO_2 are spatially limited and ecosystems have existing uptake mechanisms for CO_2, as it is not a toxic contaminant but a natural ecosystem component that has been encountered before. Certain plants can tolerate high levels of CO_2. Over time there may be a shift to more acid-tolerant species.

Marine Ecosystem

Marine ecosystems exhibit resilience to CO_2 leaks, with most organisms able to tolerate or escape the effects. The main damage is to organisms with calcium shells, particularly in their larval stage. However, the ecosystem's familiarity with CO_2 reduces the overall impact.

Did you Know?

There have been no instances of carbon dioxide leakage from a deep storage formation to the groundwater or to the surface.

Controlled release experiments around the world have shown that CO_2 leakage would not be as disastrous as once thought, with impacts being short-lived and spatially small.

Controlled Release Projects

Read: *What have we learnt about CO_2 leakage from CO_2 release field experiments, and what are the gaps for the future?*

J. Roberts and L. Stalker (2020)

Secure Storage–Why CO_2 Doesn't Leak

CO_2 is stored in liquid-like form at least 2600 ft (800 m) deep. It is trapped in the pores of the rock like a stain is trapped in your clothing.

The main avenue for leakage is wells, often referred to as artificial penetrations, which provide a path for migration.

Source: Dr. Katherine Romanak

TEXAS Geosciences
The University of Texas at Austin
Jackson School of Geosciences
Bureau of Economic Geology

GCCC
GULF COAST CARBON CENTER

TXLA CMC
Texas-Louisiana Carbon Management Community

Outreach

Texas A&M University–Kingsville

Engineers Week (E-Week) 2025

02/19/2025

As a part of Texas A&M-Kingsville's Engineers Week, Dr. Jong-Won Choi and Dr. Jingbo Louise Liu joined Explore Engineering Day, an event aimed at inspiring young students near Kingsville by introducing them to the world of engineering through engaging, hands-on experiences. They explained the outcomes of rising CO_2 concentrations in the atmosphere and demonstrated how CO_2 can be injected into porous media like sandstone. Using outreach materials designed to help visualize fluid movement through porous media, they helped students understand the geologic phenomena of CCS and how CO_2 can be safely trapped underground over long periods.

Think Like an Engineer

03/29/2025

Dr. Jong-Won Choi also led a hands-on session for local Girl Scouts in the Kingsville area, introducing them to real-world environmental science concepts and CCS technologies.

They discussed how carbon dioxide can be injected and stored underground in porous formations. Through interactive models using glass marbles and lamp oil, the scouts observed how CO_2 might move through rock layers, providing a fun and educational look into climate solutions and carbon storage.

Additionally, the Texas A&M University-Kingsville team is working hard to deliver three courses over the next summer and fall semesters, developing new and modifying current courses. The courses taught by Dr. Choi include CEEN 5303 Adv. T: Geomechanics, focused on CO_2 injection and its impacts on the subsurface pressure and stress field, as well as CEEN 5303 Adv T: Carbon Capture & Storage, a new course covering a wide range of topics on CCS. Dr. Liu will be teaching Environmental Chemistry, a long-standing course that delves into sustainable energy solutions with carbon capture and utilization as one of the key components.

Dr. Liu has also submitted an abstract which has been accepted into the Pacific Chem 2025 meeting. This paper evaluates how CO_2 uptake by swelling clays impacts caprock integrity in geologic carbon storage. Using experiments and molecular simulations, the study explored structural changes in clay minerals and identified cost-effective materials that support scalable, safe carbon capture solutions. She has also delivered a keynote talk at the 127th TAS annual summit and has been invited to include her work in a book about carbon capture.

Houston-area middle schoolers to learn about carbon capture through new grassroots initiative

01/13/2025

Source: Houston Public Media

Julia Dolive, an 8th grade science teacher from Fort Bend ISD, demonstrates to her students that sandstones are permeable and porous. Julia was one of three teachers invited by the Gulf Coast Carbon Center last summer to explore carbon capture and storage as part of an initiative to integrate this vital topic into middle school curricula. The goal of the program is to help educators teach students about the carbon cycle and its human impacts through hands-on lessons, while also introducing elements of CCS by exploring key scientific phenomena.

The Houston Public Media has helped bring attention to the initiative, and we are working to expand awareness in classrooms in the Gulf Coast region. To build on this momentum, a webinar will be hosted by Julia, offering other educators the chance to learn how to incorporate CCS lessons into their own curricula.

The program aims to provide students with a deeper understanding of CCS technologies and their role in combating climate change, while also preparing the next generation for careers in the energy sector.

Denham Springs students develop carbon-capture monitoring device and app for the community

02/24/2025

Source: The Advocate

Dr. Katherine Romanak, a GCCC CCS monitoring expert, helped mentor the Denham Sharks, a student STEM team at Denham Springs High School in Louisiana. The team is collaborating with various stakeholders to study the local environmental impact of carbon capture initiatives, as part of the Samsung Solve for Tomorrow contest. To address concerns from area residents, their project focuses on public perception, data accessibility, and the overall sustainability of their local ecosystem, specifically in relation to a planned CCS project beneath Lake Maurepas.

The team used live-streamed monitoring data from lake sites and worked with research professors to monitor the health of the lake and to detect potential leaks using AI and IoT sensors to provide real-time alerts and educational modules. During the Reveal Event (click video) their work was praised by Congressman Troy Carter, who called their work, which integrated engineering, data science, and public safety, "exactly the kind of solution and focused-thinking that our country needs."

Watch the Sharks' 5-min pitch at 33 min

Source: Samsung U.S. Newsroom

Activities

Louisiana State University

Dr. Mehdi Zeidouni attended the 2025 CCUS Conference in Houston, presenting three papers during the three-day event, covering cost-effective methods for injecting CO_2 into deep aquifers, innovative surface heat mapping to detect potential leaks, and streamlined analytical approaches for estimating CO_2 dissolution in brine—all aimed at advancing safe and efficient carbon storage. See below for details:

(1) Pauyac, J., Zeidouni, M. (2025), "Cost-Effective Carbon Sequestration: Evaluating Liquid vs. Supercritical CO_2 in Deep Aquifers," Carbon Capture, Utilization, and Storage Conference, March 3–5th, Houston, Texas.

(2) Zeidouni, M., Pauyac, J. (2025), "Non-Intrusive Surface Heat Mapping for Detecting CO_2 Leakage in P&A Wells," Carbon Capture, Utilization, and Storage Conference, March 3–5th, Houston, Texas.

(3) Zeidouni, M. (2025), "Closed-form Analytical Approaches to Constrain Fraction of Injected CO_2 Dissolving in Brine During CO2 Storage in Saline Aquifers," Carbon Capture, Utilization, and Storage Conference, March 3–5th, Houston, Texas.

Additionally, LSU has organized with advocacy groups and organizations, meeting with the National Wildlife Foundation for potential partnership in future Petroleum Engineering courses.

Lamar University

Dr. Daniel Chen has made significant progress in Computational Fluid Dynamics (CFD) modeling to assess the impact of accidental CO_2 releases, taking into account the effects of CO_2 dissolution on aquatic life and safety concerns for people near release sites from pipeline, barge, and truck transport operations. He is finalizing the manuscript "CFD modeling of hypothetical CO_2 pipeline release at High Island 10L, Gulf of Mexico," to be submitted to the *International Journal of Greenhouse Gas Control*.

Continuing to advance local engagement efforts, Dr. Tracy Benson and Dr. Chen have been actively involved in a series of meetings, informal discussions, and community-focused events with both industry representatives and local residents interested in CCS.

Dr. Benson introduced faculty members from Lamar University to Woodside Energy's clean ammonia facility in Beaumont, Texas, which plans to capture and store 95% of its CO_2 emissions. Discussions on CCS were also held with Port Arthur residents regarding 8 Rivers' upcoming low-carbon ammonia facility. Further strengthening academic-industry collaboration, Dr. Chen reached out to Bayou Bend CCS, part of Chevron New Energies, to explore potential partnerships with Lamar University around CCUS-focused education and research initiatives.

The University of Texas at Austin

GCCC has continued its commitment to stakeholder engagement and knowledge sharing through diverse platforms. Most recently, Dr. Tip Meckel provided expert testimony as a neutral resource witness before the Texas House of Representatives on HB 2612, which proposes the creation of the Texas Carbon Dioxide Sequestration Policy Council. His participation underscores GCCC's role in informing state-level CCS policy with science-based insight.

Additionally, GCCC graduate students have played an ongoing role in a range of outreach and professional development events.

Previna Arumugam participated as a panelist for an International Women's Day event titled "Women Leading Change! Breaking Barriers, Building Dreams," hosted by the National Malaysian Indian Youth Council. At the Austin Geological Society meeting, Sean Avitt presented on the freshwater impacts of CO_2 migration in the Wilcox Group, while Argenis Pelayo discussed subsurface leakage risk and its implications for CCS financial responsibility. Bimar Maulana joined the Global Professional Training Symposium at UT Austin, where he shared his experiences studying and working in Indonesia. These opportunities not only allow students to engage with broader audiences, but also help build a new generation of CCS professionals.

Links

Overview of Controlled CO_2 Release Projects

Discover key insights gathered from a global review of 41 controlled shallow CO_2 release experiments conducted over 14 field sites in order to increase understanding of the environmental impacts of CO_2 and identify knowledge gaps.

https://www.sciencedirect.com/science/article/pii/S0012825218304264

Here is a short list of some controlled release projects:

QICS
Read about a sub-seabed CO_2 release experiment designed to improve monitoring strategies and assess potential environmental impacts, here: https://www.sciencedirect.com/science/article/pii/S1750583614002564

ZERT
Explore how near-surface monitoring techniques were tested and validated during controlled shallow CO_2 release experiment, here: https://www.sciencedirect.com/science/article/pii/S1750583609000796

STEMM-CCS
Discover how a controlled sub-seafloor CO_2 release in the North Sea was used to evaluate monitoring techniques for detecting and quantifying potential offshore CO_2 leakage, here: https://www.sciencedirect.com/science/article/pii/S1750583620306629?via%3Dihub

CO2CRC Otway
This multidisciplinary study investigates how a shallow CO_2 injection into the Brumbys Fault zone influences vertical CO_2 migration, evaluates the effectiveness of geophysical techniques for near real-time monitoring, and provides rare field measurements on vertical fault permeability. Read here: https://www.sciencedirect.com/science/article/pii/S1750583622000858

Natural CO_2 seeps in Italy

Natural CO_2 seeps in Italy emit millions of metric tons annually, providing a valuable opportunity to assess risks, potential health impacts, and broader implications of such releases as proxies for potential leakage from carbon storage sites.

Read about how CO_2 release risk compares to daily hazards: https://www.scientificamerican.com/article/fatal-risk-from-stored-co2-leakage-appear-remote/

Read about potential health risks: https://pmc.ncbi.nlm.nih.gov/articles/PMC3189059/

Read about the role of overburden pressure, fractures, and faults for risk management: https://www.lyellcollection.org/doi/full/10.1144/sp458.14

Read about the modeling of CO_2 releases for monitoring best-practices in the sub-seabed: https://pubs.acs.org/doi/10.1021/acs.est.9b02131

QUESTIONS/COMMENTS

Reach us at the Gulf Coast Carbon Center at the Bureau of Economic Geology

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Leave a Comment:
https://forms.office.com/r/xAGXyxRtJt?origin=lprLink

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