GULF COAST CARBON CENTER

TXLA CMC Texas-Louisiana Carbon Management Community

NEWSLETTER

Q1 2026 JAN–MAR

Sue Hovorka and Vanessa Nuñez-López at a Powerhouse Texas meeting. Sue Hovorka is a member of the 2026–2028 Energy Policy Advisory Council (EPAC), providing nonpartisan expertise to support discussions on Texas energy policy.

Education, Outreach, and Community Engagement

The first quarter of 2026 was marked by a wide range of activities supporting carbon capture and storage (CCS) research, education, outreach, and stakeholder engagement. Throughout the quarter, our team participated in conferences, policy discussions, technical training, student mentoring, and collaborative research efforts aimed at advancing understanding of CCS technologies and their role in the energy transition.

A key focus of our project is responding to questions and concerns we have heard from community members and stakeholders. To support these conversations, we have included two new factsheets that provide accessible information on topics frequently raised during engagement activities. We hope these resources help foster informed discussions and contribute to a broader understanding of CCS.

SCAN ME

Join our Phonebook

Click or Scan

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.

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

New Factsheets

- CO_2 Storage - Environmental Monitoring
- CO_2 Sequestration in Legacy Oil Wells: Well Integrity

Project Information

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

Activities

Webseries: Meet a Geoscientist

The Bureau of Economic Geology's "Meet a Geoscientist" video series is designed to encourage students to consider careers in geoscience by highlighting the personal stories and career paths of Earth scientists. Videos showcase how curiosity, education, and life experience shape diverse journeys into the field, helping students better understand the range of opportunities within geoscience and related energy and climate work.

This quarter's feature includes Environmental Geochemist Dr. Katherine Romanak, who shares her transition from volcanology into environmental geochemistry and carbon storage research, as well as Program Manager Ramón Treviño, who describes his non-linear career shaped by industry downturns and further training through an MBA.

Advancing CCS Research

Research efforts this quarter continued across a range of technical topics. Ongoing work included:

- Computational fluid dynamics simulations of CO_2 releases into the water column and atmosphere,
- Stress changes associated with swelling clay minerals in caprock formations from CO_2 adsorption,
- Integration of CCS storymaps into the GeoRED geospatial tool,
- Well integrity considerations in mature fields,
- Subsurface CO_2–brine and thermal system characterization, and
- Environmental monitoring in aqueous systems.

Engaging with Policymakers & Stakeholders

Building public understanding and supporting informed decision-making remain key priorities. Team members participated in discussions with policymakers, industry leaders, regulators, and community stakeholders on topics ranging from Class VI permitting and offshore carbon storage to workforce development and the expansion of CCS infrastructure across Southeast Texas.

Activities included participation in the public hearing process for a proposed Class VI permit, regulator training at the Groundwater Protection Council UIC Conference in Fort Worth, engagement with ExxonMobil's Low Carbon Solutions on regional CCS opportunities, and contributions to energy policy discussions through the Energy Policy Advisory Council.

Supporting the Next Generation of CCS Professionals

Workforce development remained a major focus this quarter. The inaugural CCUS Certificate Program, offered through the College of Engineering and the College of Natural Sciences and Mathematics at the University of Houston, was successfully completed, providing students with interdisciplinary training in carbon capture, utilization, and storage.

University teams also mentored graduate students as they continued towards completing research projects on a wide range of CCS topics, including advanced finite element modeling of geomechanical processes relevant to carbon storage, CO_2–brine gravity-driven displacement estimation using numerical methods and machine learning CO_2 storage resources, legacy well risk assessment, and offshore storage and transportation opportunities. Students received support in technical communication, presentation development, and conference preparation to help advance their professional careers.

Continued faculty-student collaboration advanced both technical research and professional development opportunities, while student-led research was presented at major technical conferences, including the SPE Annual Technical Conference and Exhibition in Houston. The team also continued efforts to introduce service learning as a component of technical education, connecting CCS research and workforce development with broader community engagement and outreach activities.

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

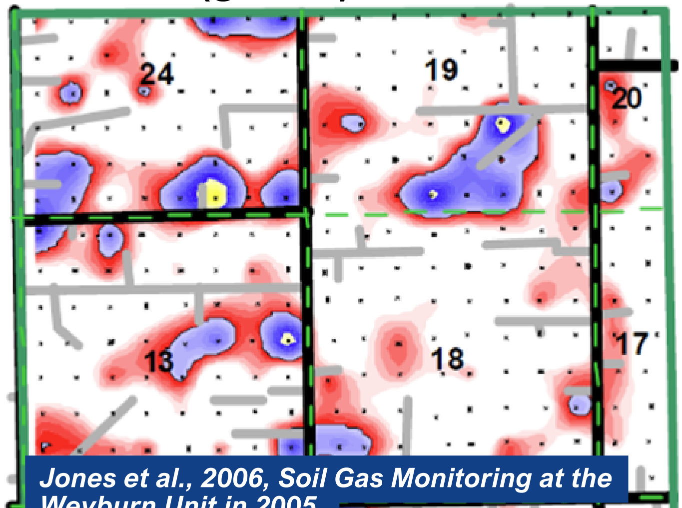
CO_2 Storage - Environmental Monitoring

Introduction

Before a carbon storage site begins operation, scientists spend significant time measuring various parameters in the surrounding environment, including natural CO_2 conditions. These measurements establish a "baseline" that can be compared against future observations. Baseline monitoring is an important safety practice because it helps identify whether changes in environmental CO_2 could indicate an unexpected release from storage. However, establishing a baseline is more challenging than it may sound. **Environmental CO_2 is not a fixed value**. It is constantly influenced by natural processes, causing concentrations to rise and fall from hour to hour, season to season, and year to year.

CO_2 measurements vary spatially and temporally

CO_2 flux (g/m²/d) - October 2005



Jones et al., 2006, Soil Gas Monitoring at the Weyburn Unit in 2005

Weyburn soil-gas grid: 14 km², 200 m spacing. This baseline survey shows that CO_2 concentrations (blue/red) vary across the landscape and can change over time due to natural environmental processes.

Challenges with baseline monitoring

Baseline inconsistency

Baseline CO_2 concentrations often vary across locations, seasons, and environmental conditions. Natural fluctuations in biological activity, weather patterns, and land use can make it difficult to establish a single reference condition against which future changes can be assessed.

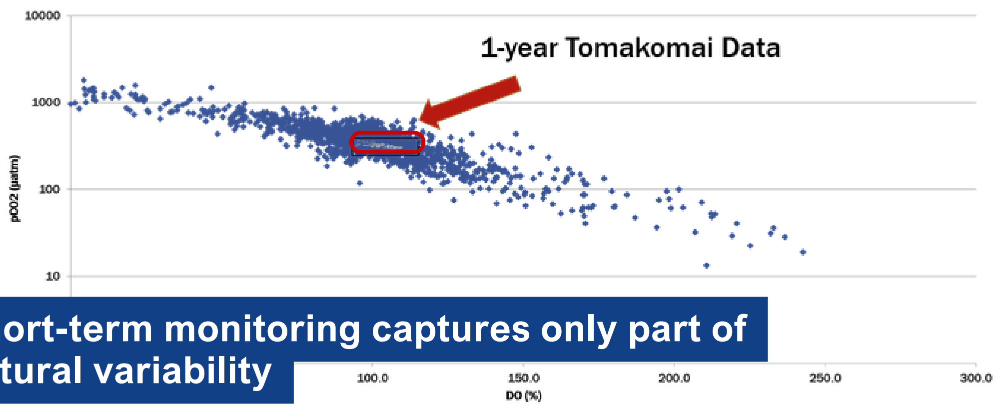
Changing climate = Changing baselines

Increased greenhouse gas emissions are altering atmospheric, soil, groundwater, seawater, and ecosystem carbon dynamics, causing baseline CO_2 levels to shift over time. As a result, historical baseline conditions may no longer represent current or future environmental states, complicating long-term monitoring and leakage detection based on baselines.

Natural anomalies and attribution

Natural processes such as soil respiration, groundwater fluctuations, and weather patterns can cause CO_2 levels to change. Because these natural changes can resemble a CO_2 leak, accurately attributing elevated CO_2 concentrations to either natural processes or leakage can be challenging.

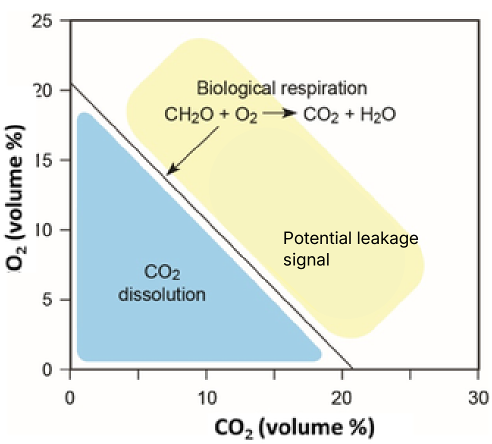
Real-life data collection: One year of data overlain on 10 years



Short-term monitoring captures only part of natural variability

Natural variability can be difficult to predict. At the Tomakomai CCS project in Japan, elevated CO_2 measurements observed after injection began were initially investigated as a potential leakage signal. Further analysis showed that the measurements were within the range of natural environmental variability, showing how challenging it can be to distinguish natural fluctuations from potential leakage using concentration measurements alone.

Process-based attribution using natural gas relationships



Process-based attribution uses geochemical relationships rather than concentration thresholds alone. Rather than asking “Is CO_2 elevated?,”process-based attribution asks “Why is CO_2 elevated?” By examining relationships among naturally occurring gases, scientists can distinguish normal environmental processes from potential leakage and improve confidence in monitoring results.

Challenges

- ✔ CO_2 is not a conventional contaminant—it is part of a dynamic natural system.
- ✔ Climate change is shifting baselines and increasing environmental variability.
- ✔ The key monitoring question is not "Is CO_2 elevated?" but "Why is CO_2 elevated?"
- ✔ Distinguishing natural fluctuations from potential leakage is necessary to avoid false alarms.

Solutions

- ✔ Move from concentration-based detection to process-based attribution.
- ✔ Use geochemical relationships to distinguish natural processes from leakage.
- ✔ Improve confidence in monitoring results while reducing false alarms.
- ✔ Align monitoring practices with emerging regulatory expectations.

Center for Carbon Management in Energy
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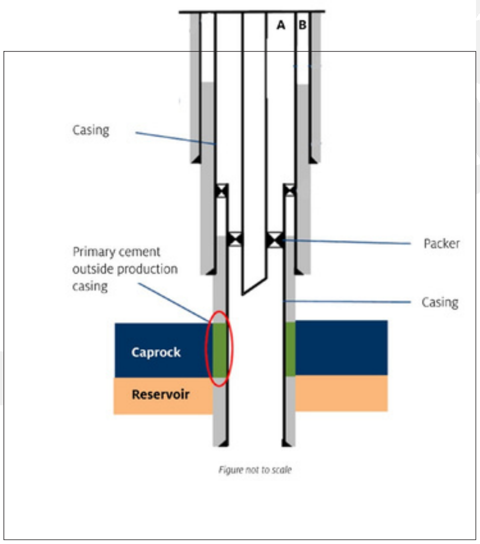
CO_2 Sequestration in Legacy Oil Wells: Well Integrity

Overview and Importance

In September 2024, Archer-Daniels-Midland (ADM) paused work at its CO_2 injection well at the Decatur, IL, storage facility after tests revealed a potential fluid leak. The news prompted advocacy and environmental groups to question the safety of CCUS projects.

Many older oil wells are being considered for carbon sequestration projects as they present an opportunity to reuse existing infrastructure. However, as these legacy wells were not originally designed for long-term CO_2 storage, it is critical to ensure that they can safely contain injected CO_2 over time. This makes their proper maintenance, reliable sealing, and continuous monitoring essential.

Well integrity is maintained using technical, operational, and organizational solutions, which keep the well fluids from leaking. In CO_2 sequestration and CO_2 – EOR projects, where the goal is the permanent storage of CO_2, maintaining a hydraulic seal is vital to avoid blowouts, and ensure the injected CO_2 remains securely trapped over the well's life.



Wellbore cement and casing

CO_2–Cement Interactions and Degradation

When CO_2 mixes with water in the underground reservoir, it forms carbonic acid. This acid interacts with the wellbore cement (especially Portland cements), through a sequence of chemical reactions:

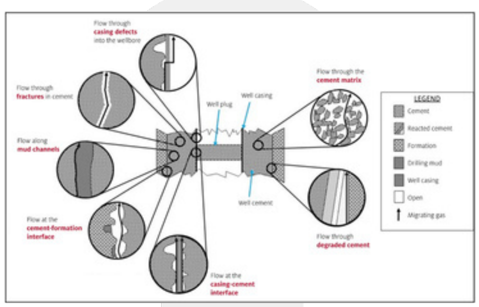
- Stage 1: Dissolution – Portlandite within the cement dissolves, initially reducing the cement's porosity and maybe even increasing its strength.
- Stage 2: Carbonation – The dissolved portlandite reacts with carbonic acid and precipitates as calcium carbonate.
- Stage 3: Bicarbonation and Leaching – The calcium carbonate eventually dissolves in a bicarbonation process, leaving behind an amorphous, porous silica zone.

Impact: The cement becomes permeable and prone to developing tiny cracks, ultimately compromising well integrity.

Potential Wellbore Leakage Pathways

Fluids in the well can leak through weakness in the wellbore structure:

- Fractures within the cement itself or through a degraded cement matrix.
- Flow along mud channels left behind during primary cementing.
- Micro-annuli at the cement-formation interface or the casing-cement interface.
- Direct flow through casing defects, washouts, or failures at the well plug.



Leakage pathways at wellbore

Mitigation Strategies and Best Practices

Specialized materials and practices are used in the CO_2-rich environment of wells to prevent corrosion:

- Advanced Formulations: Cements mixed with expanding agents and engineered pozzolans (such as artificial fly ash or natural volcanic ash) have lower permeability and better sealing capability.
- Alternative Materials: High-temperature durable epoxies are used in Class VI CO_2 injection wells.
- Risk Reduction: Using appropriate casing vs. bit size, achieving a sufficient cement bond, and ensuring adequate cement thickness extending through the reservoir's caprock minimize risk.

Measurement, Monitoring, and Verification (MMV)

Continuous long-term monitoring of downhole cement integrity is required to detect anomalies and prevent catastrophic failure.

Cement Bond Logging (CBL): Assesses quality of the primary cement job, detects poor cement coupling, and monitors for degradation over time.

- Fiber Optics: Distributed Acoustic Sensing (DAS) and Distributed Temperature Sensing (DTS) lines in the wellbore track acoustic/strain variations and temperature anomalies in real-time to find leakage.
- Other Methods: Pressure testing, microseismic data, and quasi-distributed pressure sensing (DPS) are also vital for overall integrity mapping.

Real-World Field Examples

- SACROC (Permian): The Well Integrity Assessment Report from the Peterhead CCS Project highlights that Portland cement can remain viable in CO_2-rich environments for decades, effectively preventing CO_2 migration from reservoirs.
- Sleipner (Norway): In the longest-running offshore CO_2 storage project, Class G Portland cement used has undergone carbonation; however, this has actually plugged the pores and reduced permeability, keeping the CO_2 plume safely trapped, as verified by 4D seismic monitoring.
- ADM Decatur (Illinois): Standard Portland-based cement with high-performance additives was used. In 2024, a leak was detected in a deep monitoring well, a result of the well completion being corroded. Over time, the multi-zone sampling system installed inside the well failed to operate correctly, allowing fluids to migrate from the perforated zone in the injection interval to another zone above the confining zone.

Portland cement, or any type of modified recipe, must ensure long-term permanence and diligent monitoring must be deployed. This will make certain that defects are identified and resulting mitigation remedies any potential leakage.

If you have feedback or need clarification, please let us know at uhenergy@uh.edu.

Additional Resources

Read About UH Energy Research on CCUS

Find all Reports at
https://www.uh.edu/energy/research/papers-reports.php

A Pivotal Moment for Enhanced Oil Recovery & CCUS

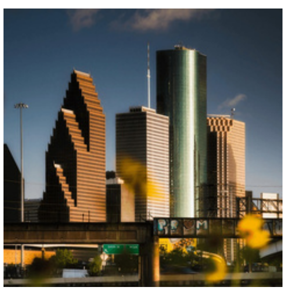
How combining carbon capture, utilization, and storage (CCUS) with enhanced oil recovery (EOR) can expand U.S. energy production while advancing carbon management.

Charles McConnell

CCUS Infrastructure: Preparing for the Future of Houston

CCUS is a lynchpin to the energy transition, and Houston is at the center of commercialization aspirations. However, this isn't possible without needed investment in infrastructure, as well as a keen understanding of the road ahead.

Charles McConnell



Carbon Capture, Utilization and Storage - Lynchpin for the Energy Transition

The Energy Capital of the World is poised to be the CCUS Capital of the World as well. This paper explores the Greater Houston region's unmatched advantages in leading carbon capture efforts.

UH Energy in collaboration with the Gutierrez Energy Management Institute and the Center for Houston's Future

Carbon Dioxide Pipelines Explained

Researchers are exploring cutting-edge solutions to capture and transport CO_2 , tackling one of the biggest challenges in the building resilience.

Paul Doucette and Mohan Vedala

Carbon Dioxide Pipelines: Role in Responding to Carbon Emissions

Several CCUS projects are poised to begin, which calls for a related growth in transport pipelines. But it must be done safely to protect the environment and surrounding communities. Here's how to do it.

Paul Doucette and Mohan Vedala

Contact Us

Questions or Comments?

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

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