



Informational Workshop: Long-term Underground Storage of Carbon Dioxide

Welcome!



EXITS / FACILITIES

INTERPRETATION SERVICES

MEETING PURPOSE

AGENDA OVERVIEW

WORKSHOP AGENDA

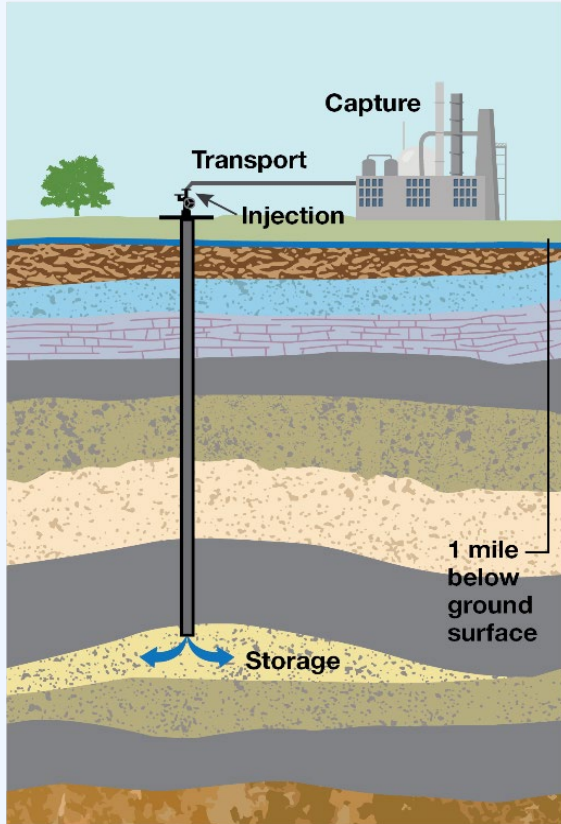


- 6:00 Welcome
- 6:10 Panelist Introductions
- 6:20 Geologic Sequestration Basics
- 6:35 Drinking Water Protections
- 6:50 Safety
- 7:05 The Public Comment Process
- 7:20 BREAK
- 7:30 Texas' Role in Permitting
- 7:45 Tech Talk Stations



Carbon Capture and Underground Storage Projects

Geologic Sequestration of CO₂ and the Safe Drinking Water Act (SDWA)



What is Geologic Sequestration of CO₂?

GS is the practice of injecting and storing CO₂ underground into deep rock formations. This process is also referred to as carbon capture and underground storage. Injection wells used to do this are called Class VI wells and regulated by the SDWA.

Why do it?

Geologic Sequestration of CO₂ is vital to tackling climate change and must be scaled up dramatically in the coming decades to reduce greenhouse gas emissions and meet international climate goals.

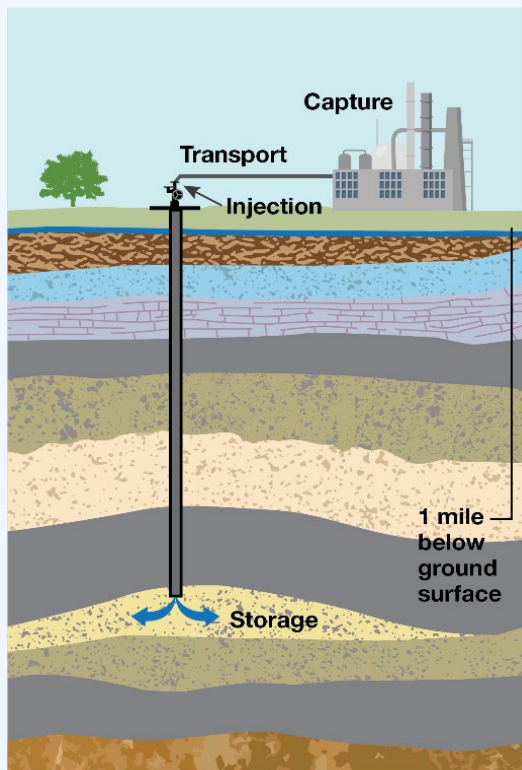
Has it been done before?

CO₂ has been geologically sequestered naturally for millions of years in ancient volcanic domes.

CO₂ has been geologically sequestered through enhanced oil and gas recovery (EOR) since the 1970s (more than 260 million tons).

CO₂ Underground Injection wells operating globally since 1996.

Geologic Sequestration of CO₂ and the Safe Drinking Water Act



The Safe Drinking Water Act requires permits with protection and mitigation measures for the Geologic Sequestration of CO₂

UIC Class VI regulations are designed to protect underground sources of drinking water (USDWs) by preventing movement of CO₂ out of the injection formation

Protective aspects of UIC Class VI regulations include:

- Multiple safeguards to protect USDWs (described later in this presentation).
- Development of written plans for operating a GS project based on EPA technical guidance.
- Adaptable and evolving - revisions made to plans if new data indicate the need.
- Tracking the movement of the “plume” of CO₂ and any other potential changes in the subsurface

Class VI Program - Elements to Safeguard USDWs

This presentation discusses the following:

- Public Participation
- Siting
- Area of Review (AoR)
- Injection Well Construction
- Safe Operations: Injection Rates and Pressure
- Testing and Monitoring
- Emergency Response
- Post Injection and Site Closure
- Financial Responsibility



Siting (Selecting Project Location)

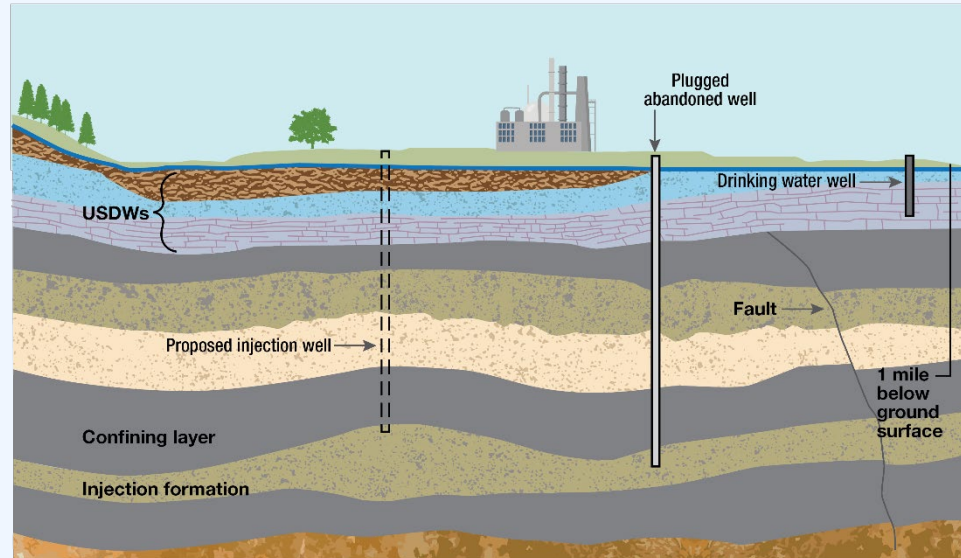
Proper site characterization and selection focuses on the geologic setting of the injection well.

Goals: Protect USDWs by confirming that the site is suitable for GS – that it can hold the CO₂ and that CO₂ will not leak through geologic pathways.

How this is done:

Testing, data collection, and analysis to show the following:

- **Injection Zone**—can hold the injected CO₂. Thousands of feet deep.
- **Confining Layer**—prevents CO₂ from moving upward.
- **Faults**—if present, test to verify they are inactive and will not allow movement of CO₂.
- **Seismic history**—confirm seismic stability in the area.
- **Compatibility**—verify that there will be no unanticipated reactions between the CO₂ and the existing chemical composition in injection zone.



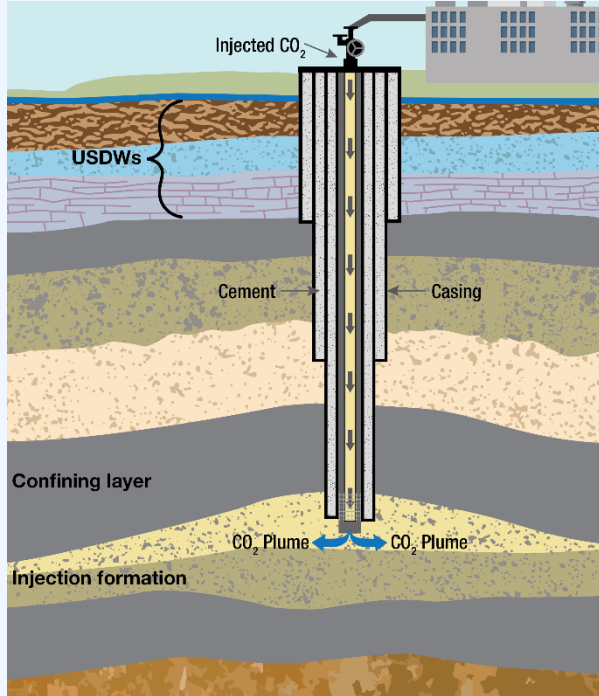
Injection Well Construction

Class VI wells are constructed to protect USDWs.

Goals: Protect USDWs by preventing injected CO₂ or other naturally occurring fluids in deep formations from reaching USDWs. Isolate geologic formations from each other. Ensure the well will tolerate the subsurface conditions it will encounter.

How this is done:

- To prevent fluids from entering USDWs, wells are constructed with multiple protective layers of casing and cement to ensure:
 - Injected CO₂ does not leak from injection wells.
 - Deep formation fluids do not move along the outside of the well casing and migrate upwards.
- High-quality cementing is key to preventing fluid movement and protecting USDWs.
- Well materials are corrosion-resistant.
- Cement around the long metal tube ('long strong casing') must extend all the way from surface to the bottom of the well to isolate formations and prevent CO₂ movement between formations along the well.
- After construction and before injection, wells are tested to:
 - Verify structural soundness.
 - Check cement quality.
 - Check for leaks in tubing and casing.



Defining the Area of Review (AoR)

The AoR defines the area surrounding a project where USDWs are to be protected .

Goals: Identify the surface footprint of the subsurface area that could be influenced by CO₂ injection. Take measures to protect USDWs in that area during and after injection.

How this is done:

- Computer modeling helps predict where the CO₂ is expected to spread and where pressure in the formation will increase.
- The AoR is checked for all existing wells, including old and abandoned wells that could be conduits for CO₂ leakage.
- Improperly abandoned wells may need remediation.
- AoR is used in planning monitoring and can be revised based on monitoring data during injection.
- Guided by plan approved by UIC Director.



Adapted from: U.S. EPA, 2013. Geologic Sequestration of Carbon Dioxide Underground Injection Control (UIC) Program Class VI Well Area of Review Evaluation and Corrective Action Guidance. <https://www.epa.gov/uic/final-class-vi-guidance-documents>.

Safe Operations: Injection Rate and Pressure

Safe operations protect against CO₂ leakage out of the injection formation.

Goals: Avoid fracturing the injection formation or confining layer to ensure that injected CO₂ remains where intended and does not migrate to other formations, including USDWs.

How this is done:

- Testing to determine a safe maximum allowable injection pressure that includes a safety margin.
- Maximum Injection set pressure below the pressure that would fracture the injection formation or confining layer.
- Flow rate and injection pressure continuously monitored at the wellhead during injection.

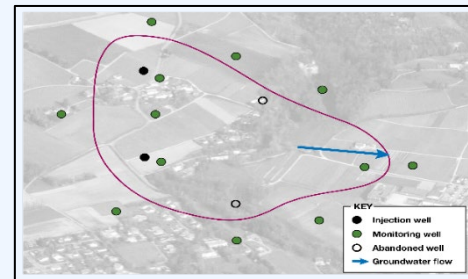


<https://www.usgs.gov/media/images/co2-injection-well-mississippi>

Testing and Monitoring

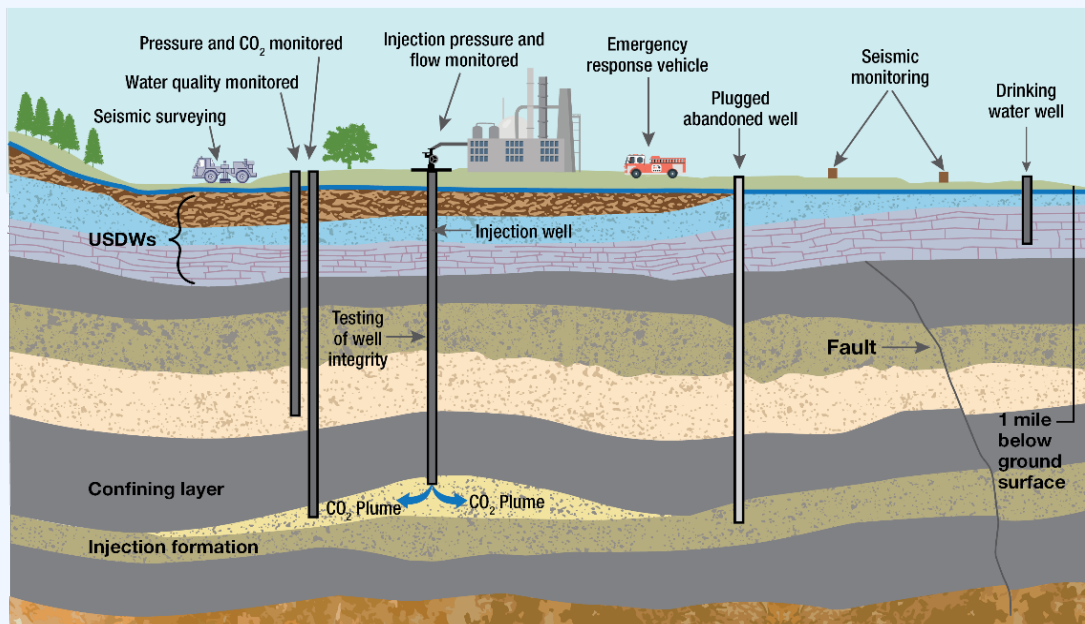
Multiple types of testing and monitoring are done to support safe injection and storage of CO₂ during injection and through to site closure.

Goals: Track CO₂ injection, CO₂ movement, and pressure. Be alerted to leakage, problems with the injection well, or other unexpected changes in the subsurface.



How this is done:

- Pressure and CO₂ tracked in the injection formation.
- Groundwater quality monitored above the confining zone.
- Seismic surveys done to image the location and size of the CO₂ plume.
- Physical integrity of the well tested routinely.
- Testing for corrosion of the well required.
- Records retained for 10 years after site closure.
- Guided by plan approved by the UIC Director.



Emergency Response

Emergency response plans are in place before injection begins.

Goal: Respond quickly to any events that could pose a danger to a USDW.



How this is done:

- Approved emergency response plan.
- Quick identification of any potential dangers to USDWs, such as:
 - Evidence of CO₂ leakage.
 - Noncompliance with permit conditions.
 - Malfunction of the injection system.
- Well owners/operators are required to report any evidence of potential dangers to a USDW within 24 hours.
- Emergency notifications will be initiated by phone or email.
- Subsequent steps include:
 - Formulating an appropriate owner/operator response.
 - Follow-up monitoring and testing.
 - Authorization to resume injection.

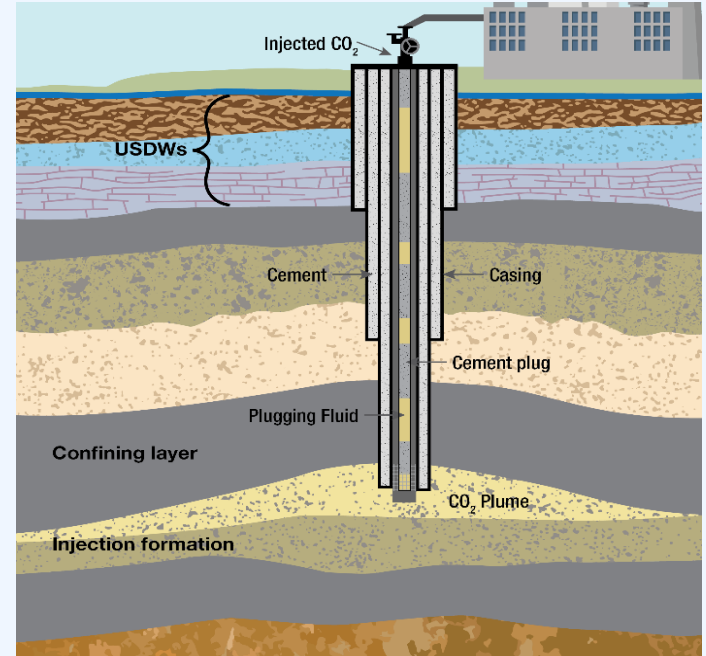
Post-Injection and Site Closure

Project sites must pose no danger to USDWs in order to be closed.

Goals: Demonstrate to the UIC Director that the project site will pose no danger to USDWs in the future. Close and restore the project site.

How this is done:

- After injection ceases, monitoring continues according to approved post-injection site care plan.
- Well is plugged according to approved well plugging plan:
 - Long-term prevention of CO₂ moving into USDWs.
 - Keeping formations isolated.
- To prepare to close the project site:
 - Demonstrate the plume and pressure in the injection formation are stable.
- Site closure—remove surface equipment and restore site to condition approved by UIC Director.



Adapted from: U.S. EPA, 2016. Geologic Sequestration of Carbon Dioxide Underground Injection Control (UIC) Program Class VI Well Plugging, Post-Injection Site Care, and Site Closure Guidance. <https://www.epa.gov/uic/final-class-vi-guidance-documents>.

Financial Responsibility

Financial responsibility is demonstrated before a project is approved.

Goal: Ensure that the private costs of GS – including possible costs after the well is plugged – are not passed along to the public.

How this is done:

- Part of the permitting process is a demonstration of financial responsibility.
- Well owners/operators must provide documentation to the UIC Director showing that they have established a financial instrument with a third-party or have self-insurance.



How the Public Can Participate

Opportunities for public participation are an important part of the UIC regulatory framework.

Goals: Project transparency, publicly available information, and opportunities for stakeholder input on concerns regarding risks to USDWs. Develop a robust permit that addresses such concerns.

How is this done?

- Draft permits published for public viewing and comment period (at least 30 days).
- Public can request a hearing in writing during public comment period.
- Appeals
- Individuals that have filed comments on a draft permit or have participated in a public hearing may file an appeal on a final permit with the Environmental Appeals Board.
 - Individuals that did not participate in public comments or hearing can appeal changes between draft and final permit.



<http://clipart-library.com/participation-cliparts.html>

Additional Information

For more information on the UIC program, please visit:

<https://www.epa.gov/uic>

<https://www.epa.gov/uic/class-vi-wells-used-geologic-sequestration-carbon-dioxide>

https://www.epa.gov/sites/default/files/2020-04/documents/uic_fact_sheet.pdf

Who to contact with questions:

For *general UIC questions*, email safewater@epa.gov

For *Class VI questions*, email UIC-ClassVI@epa.gov



Railroad Commission of Texas Jurisdiction over CO₂ Geologic Sequestration and Additional State Requirements

July 2024



RRC Jurisdiction over CO₂ Geologic Storage



- RRC has jurisdiction over:
 - Resource conservation, safety and environmental protection
 - Safe intrastate pipeline transportation of natural gas and hazardous liquid
- RRC does not have jurisdiction over:
 - Roads and traffic
 - Noise, odors and lighting
 - Air quality (Capture of CO₂)
 - Mineral interests/leases
 - Pipeline siting
 - Property damages

Add'l State Requirements for Class VI Wells (1 of 3)



Railroad Commission Organization Report

- Identify company, contact information, and officers

Drilling permit

- To ensure wells are placed on computerized schedule and in Public GIS mapping system

Fees

- Base application fee.
 - An application fee of \$50,000 for each permit application for a geologic storage facility.
 - An application fee of \$25,000 for each application to amend a permit for a geologic storage facility.
- Annual injection fee of \$0.025 per metric ton of CO₂ injected into the storage facility.
- An annual \$50,000 post-injection care fee until the director has authorized storage facility closure.

Letter from Texas Commission on Environmental Quality (TCEQ)

- Confirming that the geologic storage facility will not impact or interfere with any previous or existing Class I injection well, including any associated waste plume.

Letter from the Geologic Advisory Unit of the Oil and Gas Division

- Indicating the depth of the deepest stratum containing a Underground Source of Drinking Water

Add'l State Requirements for Class VI Wells (2 of 3)



Requirements regarding pore space and mineral interests

- Applicant must have a good faith claim to the necessary and sufficient property rights for construction and operation of the geologic storage facility, including a possessory right in pore space
- Injection and geologic storage of CO₂ cannot endanger or injure any existing or prospective oil, gas, geothermal, or other mineral resource.
 - Permittee must coordinate with any operator planning to drill through the area of review to explore for oil and gas or geothermal resources and take all reasonable steps necessary to minimize any adverse impact on the operator's ability to drill for and produce oil and gas or geothermal resources from above or below the geologic storage facility.
- Notice of draft permit or a public hearing to:
 - each adjoining mineral interest owner, other than the applicant, of the outermost boundary of the proposed geologic storage facility;
 - each leaseholder and interest owner of minerals lying above or below the proposed facility;
 - each adjoining leaseholder of minerals offsetting the outermost boundary of the proposed facility;
 - each owner or leaseholder of any portion of the surface overlying the proposed geologic storage facility and the adjoining area of the outermost boundary of the proposed facility;

Add'l State Requirements for Class VI Wells (3 of 3)



Safety Plan as part of the Emergency and Remedial Response Plan:

- Emergency response procedures
- Provisions to provide security against unauthorized activity
- Provisions for advance briefing of the public within the AOR on subjects such as the hazards and characteristics of CO₂
- Instructions and procedures for alerting the general public and public safety personnel of an emergency
- Procedures for requesting assistance and for follow-up action to remove the public from an area of exposure
- The manner in which the public will be notified of an emergency and steps to be taken in case of an emergency

RRC Contact Information



- O&G District Office
 - Emergency & Enforcement
 - Houston: 713-869-5001
 - Midland: 432-684-5581
 - Corpus Christi: 361-242-3113
- Special Injection Permits
 - Permits & Monitoring
Carbon Sequestration
(UIC Class VI)
 - SIP@rrc.texas.gov
- Pipeline Safety
 - Permits & Enforcement
 - safety@rrc.texas.gov
- Office of Public Engagement
 - PublicAssist@rrc.texas.gov

Tech Talk Stations



- *Specific Draft Permit in UIC permit program*
- *Class VI Permits – Focus on Carbon Dioxide Sequestration with EPA*
- *Key Measures for Protecting Drinking Water Sources with EPA*
- *Testing and Monitoring with EPA*
- *Examples of similar projects: in the U. S. and Internationally with EPA*

Additional Information

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