



Carbon Sequestration and the Texas Class VI UIC Program

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PRESENTATION OUTLINE:



Comparison of Class II UIC and Class VI UIC in Texas

Legal / Regulatory Framework for Class VI UIC in Texas

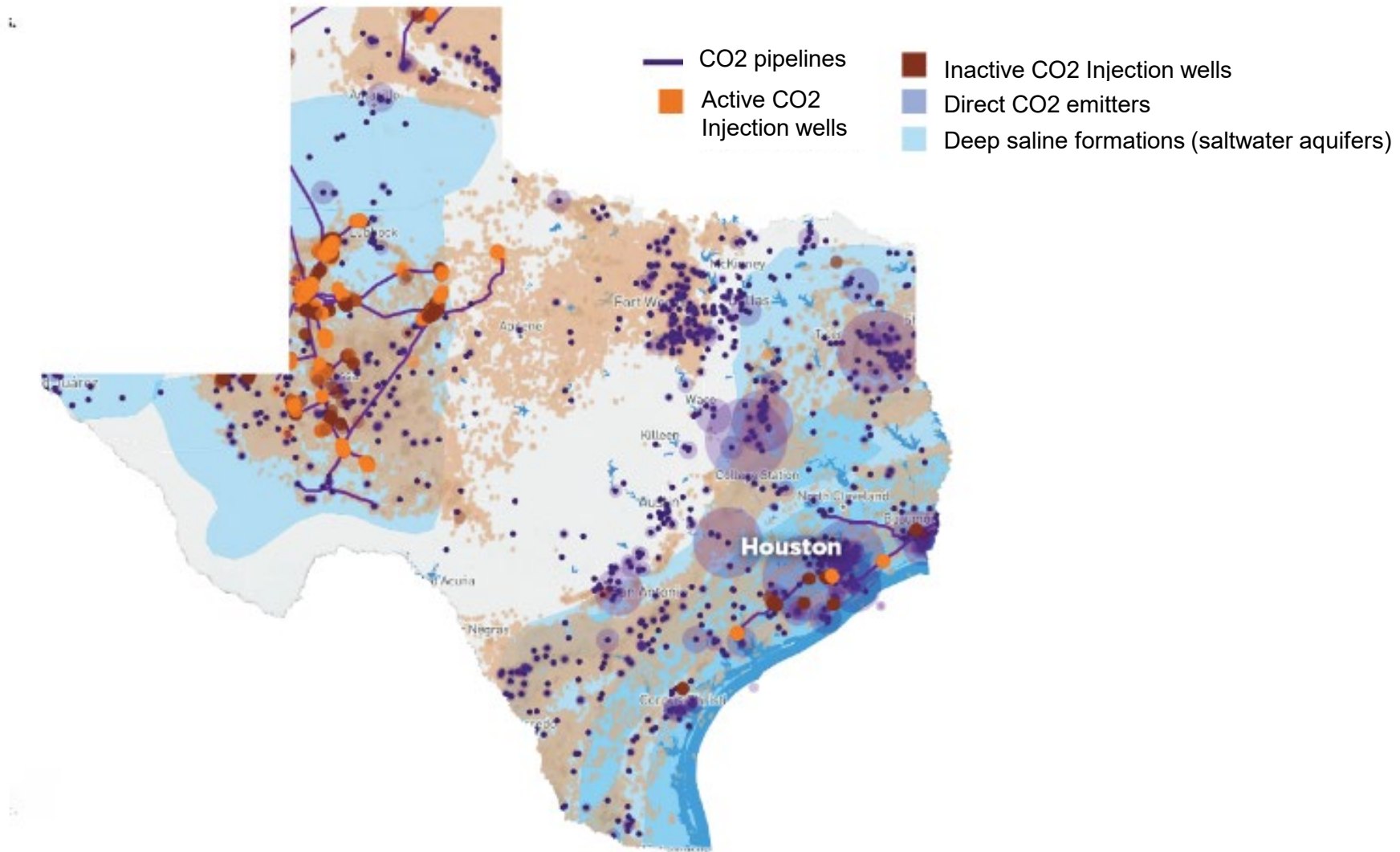
Update on Texas Class VI Regulatory Primacy

What Are Some of the “New” Aspects of a Class VI UIC Permit Application?

Examples of Carbon Sequestration Projects in Texas

Questions

Map of CO2 Emitters, Current CO2 Injection (EOR) Wells, & Onshore Storage Capacity in Saline Aquifers



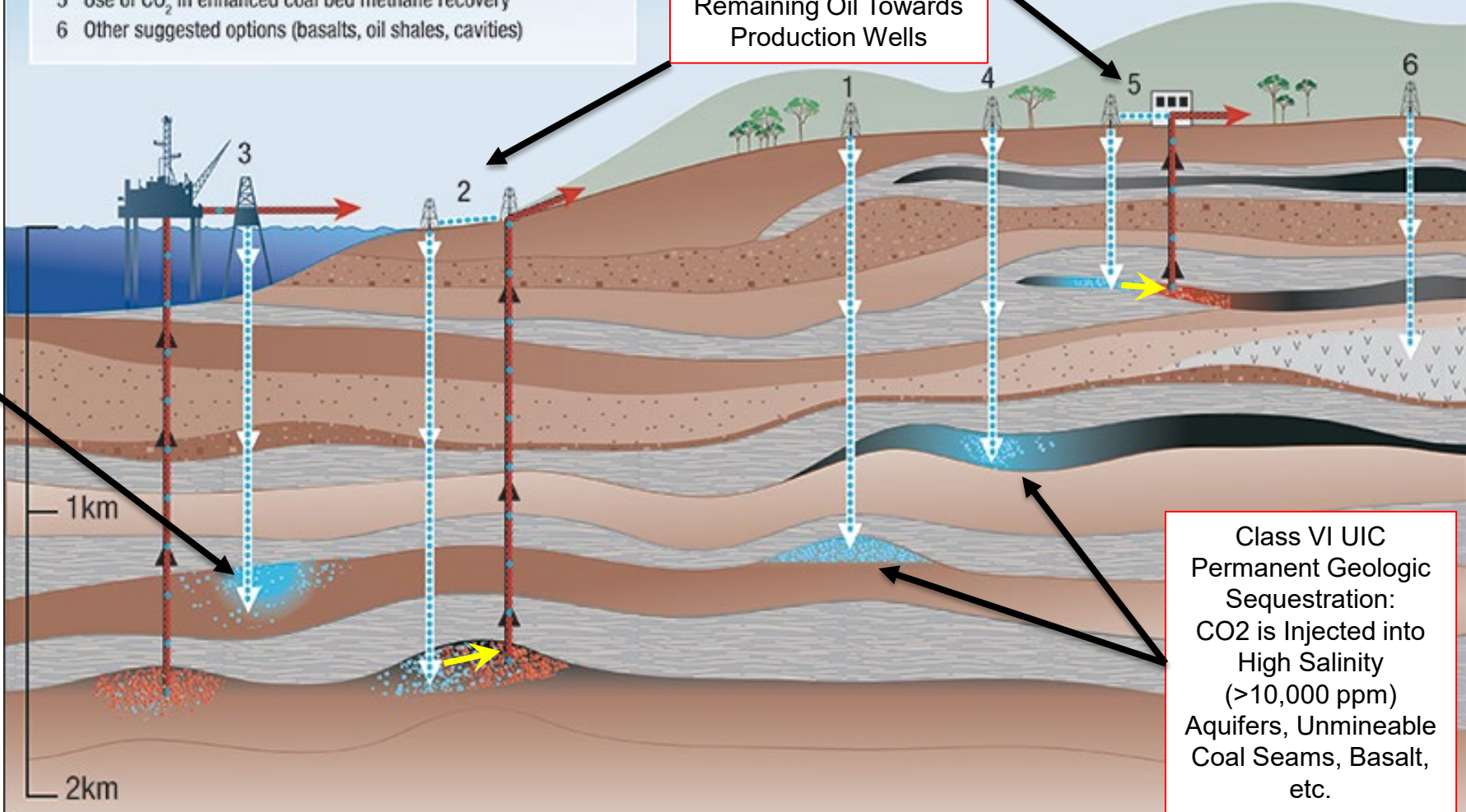
Source: Medlock and Miller (2021), with data from NETL/NATCARB and the Gulf Coast Carbon Center. See endnote 33 for more details.

Some Typical Class II and Class VI Carbon Sequestration Scenarios

Geological Storage Options for CO₂

- 1 Depleted oil and gas reservoirs
- 2 Use of CO₂ in enhanced oil recovery
- 3 Deep unused saline water-saturated reservoir rocks
- 4 Deep unmineable coal seams
- 5 Use of CO₂ in enhanced coal bed methane recovery
- 6 Other suggested options (basalts, oil shales, cavities)

Typical Class II UIC
(Type 3 – H1 Permit)
Enhanced Oil Recovery
(EOR)
CO₂ Injection into an Oil
Reservoir to “Sweep”
Remaining Oil Towards
Production Wells



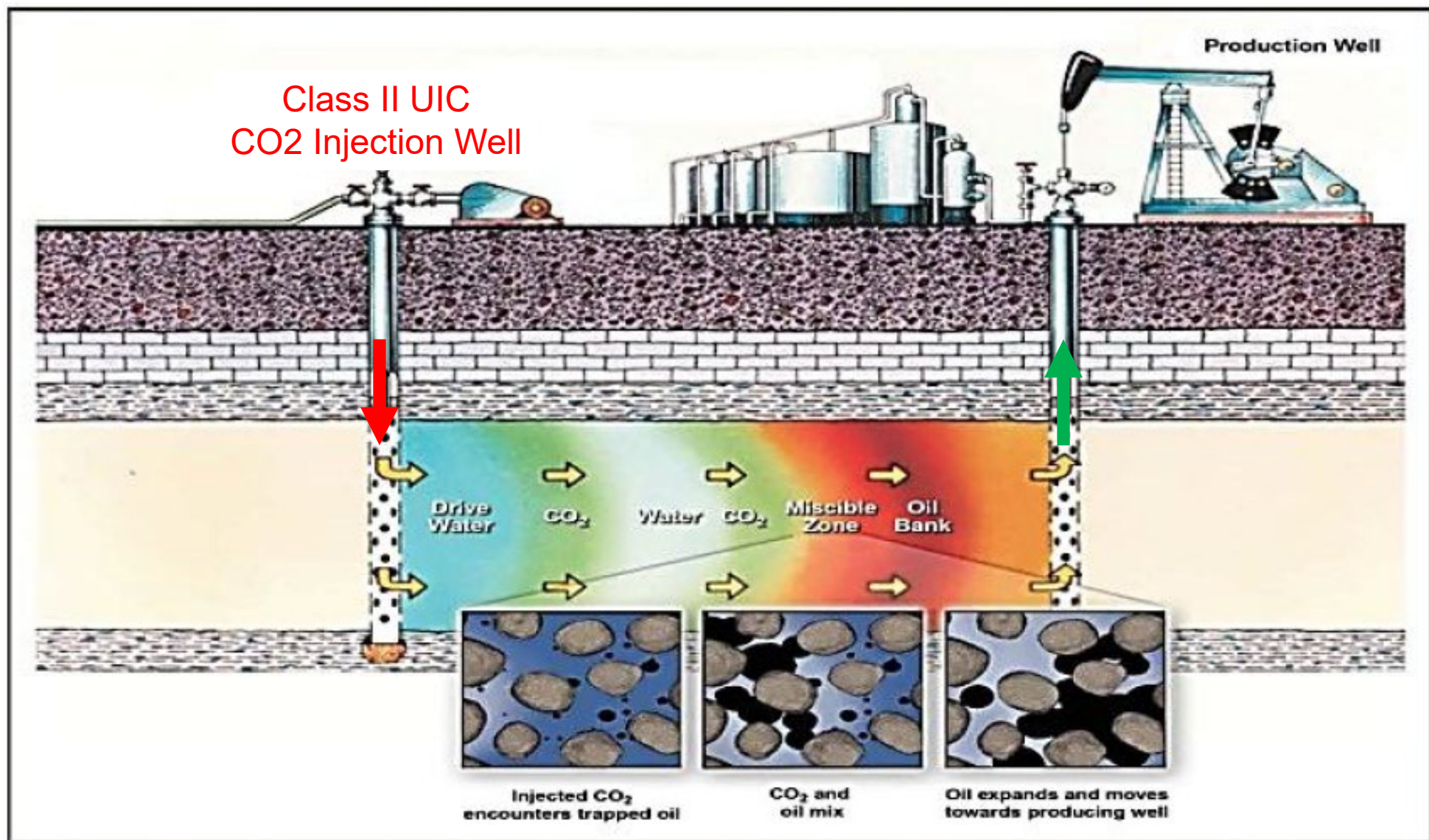
Class VI UIC
Permanent Geologic
Sequestration:
CO₂ is Injected into
High Salinity
(>10,000 ppm)
Aquifer

Class VI UIC
Permanent Geologic
Sequestration:
CO₂ is Injected into
High Salinity
(>10,000 ppm)
Aquifers, Unmineable
Coal Seams, Basalt,
etc.



- Most of the large reservoirs in the Permian Basin are carbonate formations, producing from depths between 3,000 to 7,000 feet. Typically, these oil reservoirs have already undergone extensive waterflooding in most oil fields.
- Secondary oil recovery with waterflooding can produce up to 45 percent of original oil in place (OOIP), still leaving behind relatively high residual oil saturation).
- A successful CO2 EOR project (Tertiary oil recovery) can add another 5 to 15 percent recovery of the of OOIP to the ultimate recovery.
- The Permian Basin in west Texas has already sequestered over 20 trillion cubic feet of CO2 in the form of EOR injection since the 1970's (50 years).

CO2 Sequestration by Enhanced Oil Recovery (EOR) Activities in Existing Class II UIC Wells



Cross-section illustrating how carbon dioxide and water can be used to flush residual oil from a subsurface rock formation between wells

CLASS II UIC Acid Gas Wells



- **Class II wells may sequester CO₂** and may receive federal tax credits
- Any H1 or W-14 Class II Permit applications for “**CO₂**” and “**Disposal**” are now given increased scrutiny by Texas RRC UIC permit reviewers.
- RRC UIC technical reviewers have imposed more rigorous Class II permit conditions for some Acid Gas Injection (AGI) wells to ensure wells that should be **Class VI** wells are not permitted as **Class II** wells.
- For more information on this, go to:

<https://www.rrc.texas.gov/oil-and-gas/applications-and-permits/injection-storage-permits/co2-storage/>

Components of a Class VI UIC Permit Application



1. Project Overview Narrative

2. Site Characterization

3. Area of Review (AoR) & Corrective Action

4. Injection Well Construction Plan

5. Injection Well Stimulation Plan

6. Summary of Operating Conditions

7. Environmental Justice Assessment

8. Testing and Monitoring Plan

9. Demonstration of Financial Responsibility

10. Reporting and Recordkeeping

11. Injection Well Plugging

12. Post-Injection Site Care & Site Closure

13. Emergency and Remedial Response

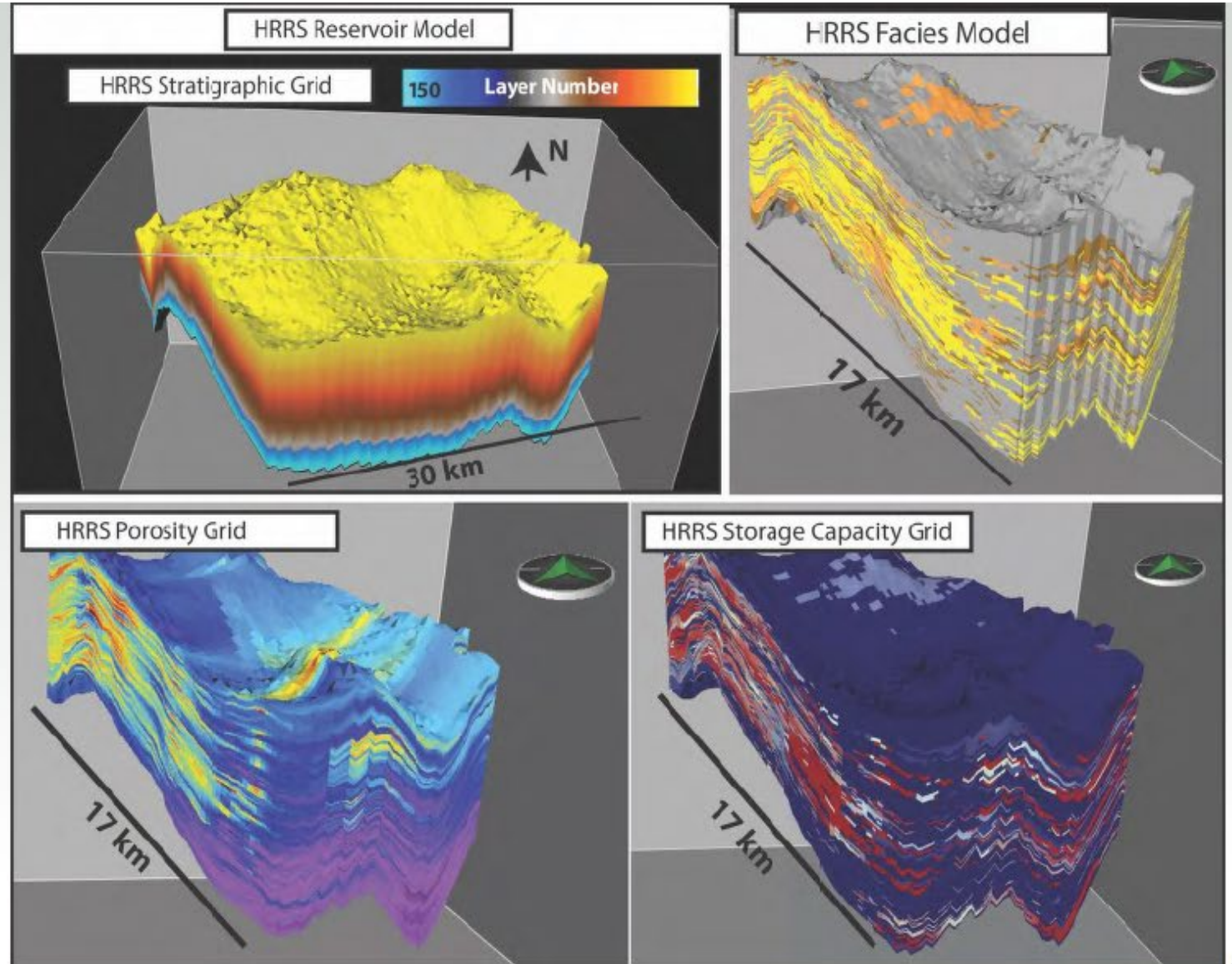
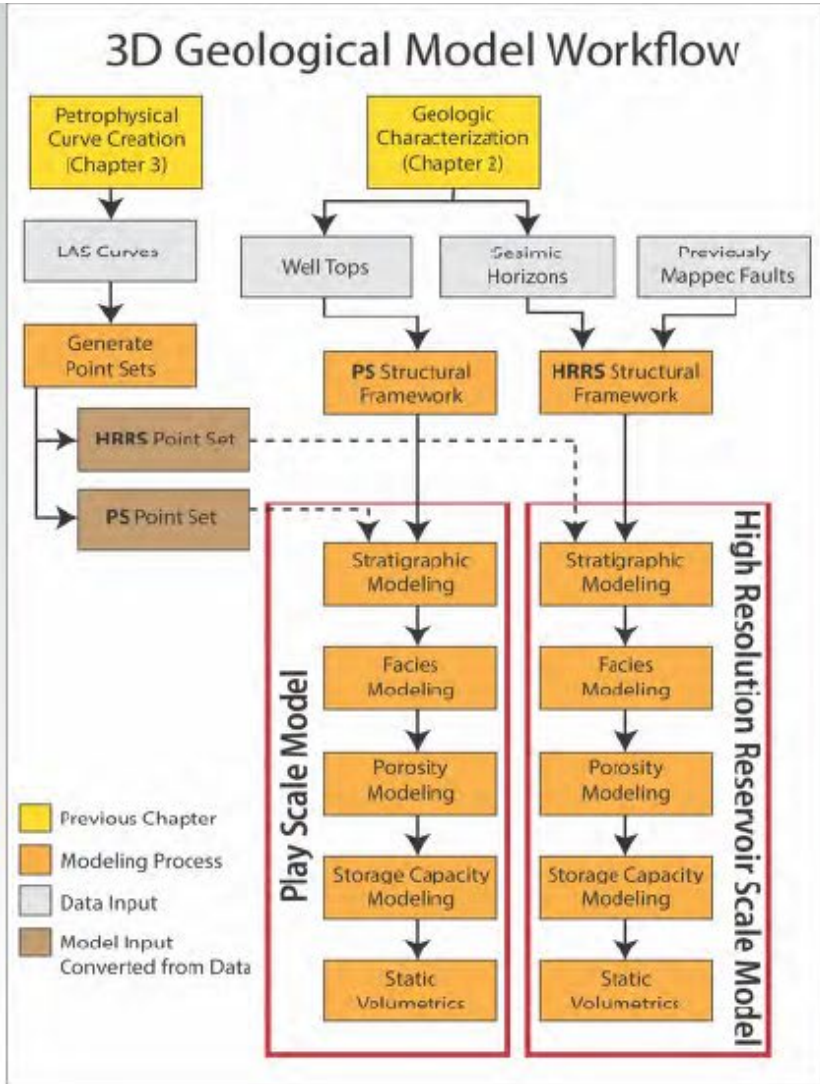
14. Quality Assurance & Surveillance Plan

Class VI UIC Permit Additional Requirements Beyond Those of a Class II UIC Permit

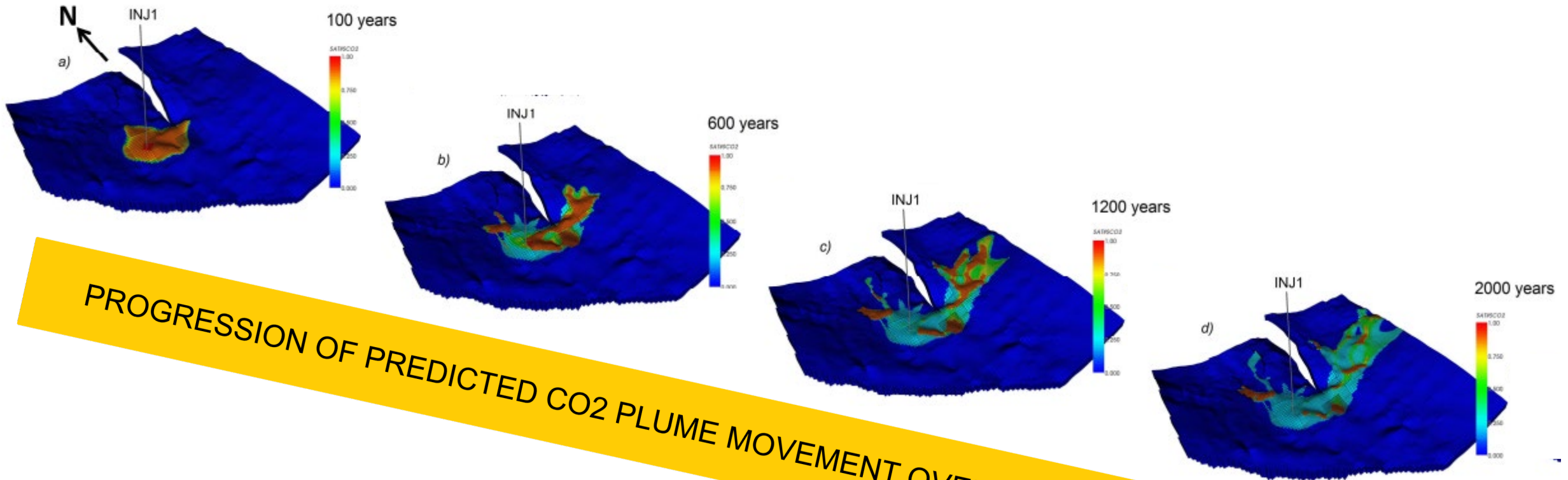


- **Environmental Justice (EJ)** or Limited English Proficiency (LEP) identification and actions
- **Public Notice** is delivered by RRC. In general, **much more public notification and outreach** is required for Class VI UIC wells
- Much more detailed **site characterization** required for Class VI projects
- An “**Area of Review**” must be determined by the applicant, defined as the 2D areal extent (in map view) of the final 3D stabilized plume of injected CO₂ in the subsurface
- **Annual** Mechanical Integrity Testing (MIT), instead of every 5 years required for Class II
- **Monitoring** of the injected CO₂ plume by direct and indirect methods
- Applicant must submit a **Post-Injection Site Care and Site Closure Plan** for Class VI projects
- Requirements for **much more frequent and detailed reporting** on all aspects of Class VI projects
- And **many others...**

'Area of Review' Modeling to Demonstrate Final Areal Extent of CO2 Plume



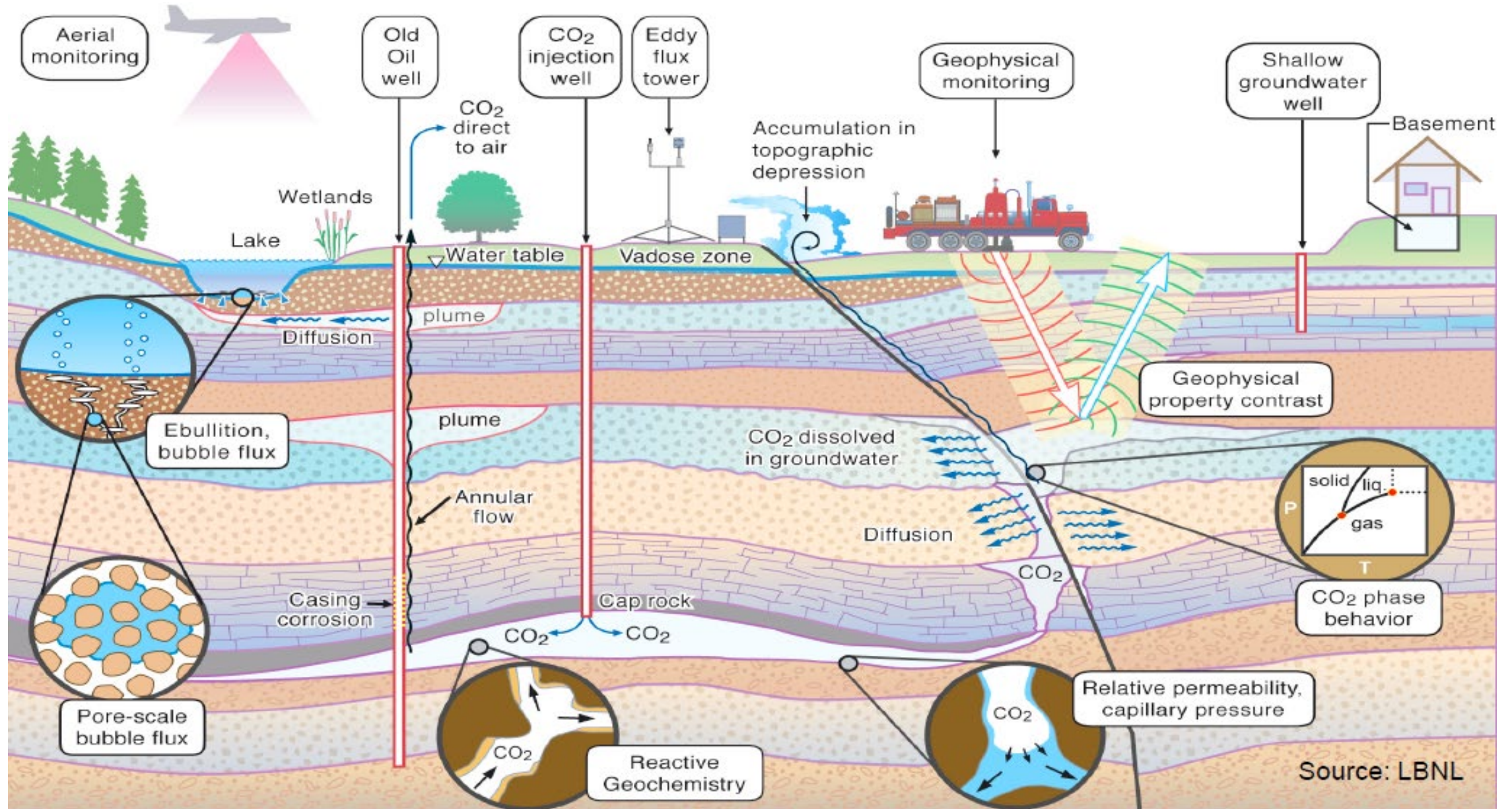
Numerical Simulation of CO2 Injection, Areal Dispersion, and Final Sequestration in a Reservoir Model



PROGRESSION OF PREDICTED CO2 PLUME MOVEMENT OVER A 2000 YEAR TIME PERIOD

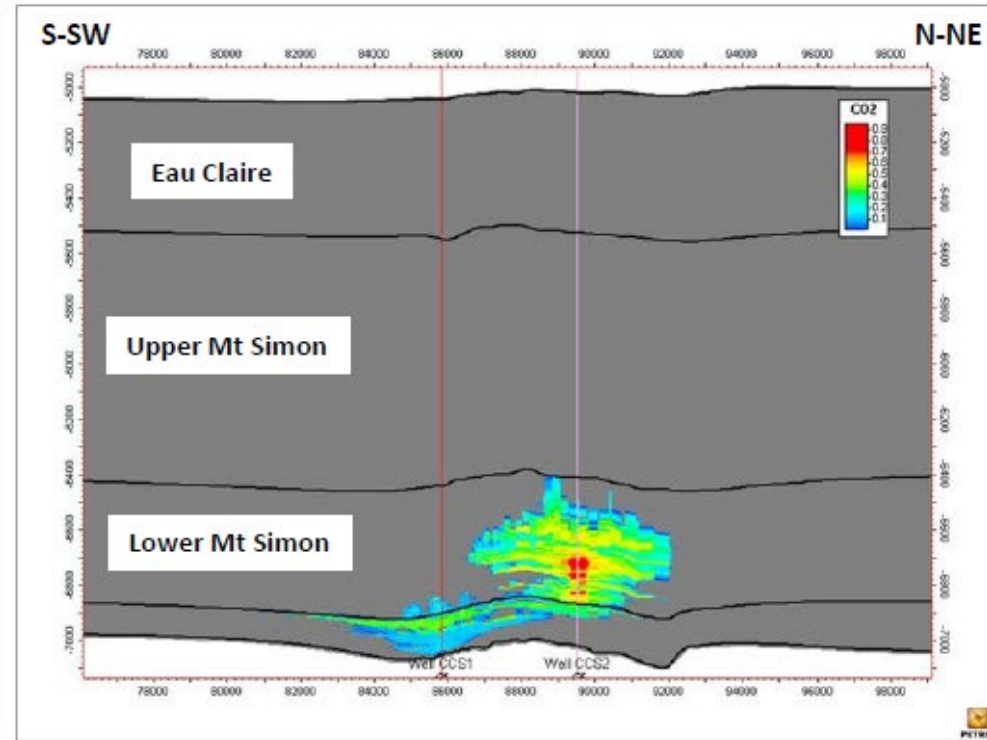
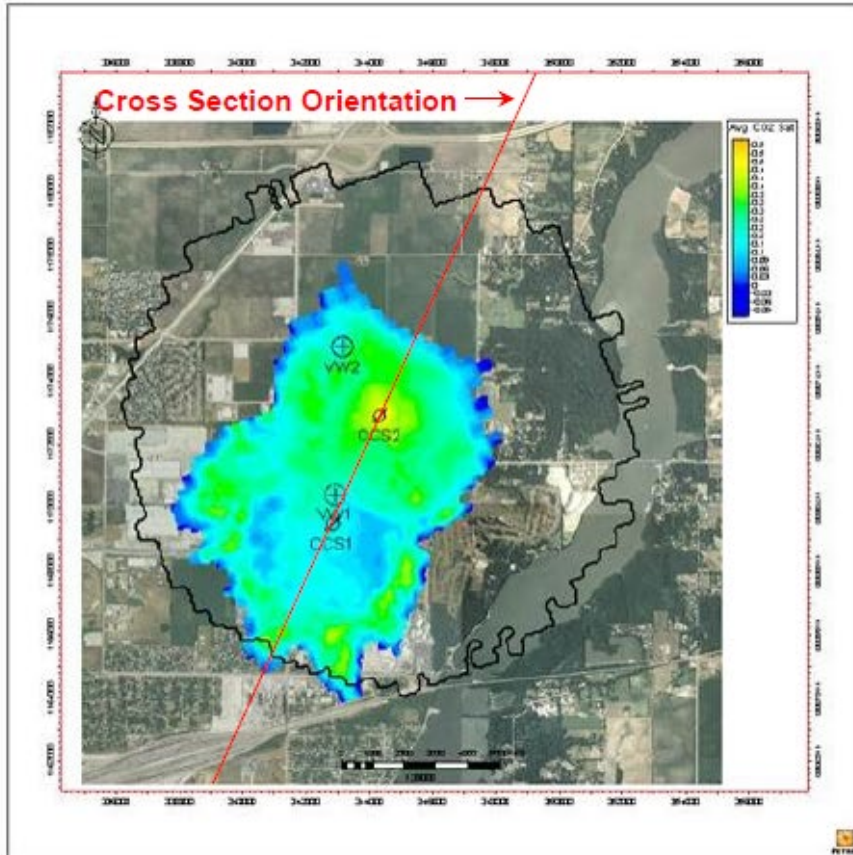
* from Andrey A. Afanasyev – *Energy Procedia* 40 (2013) pp. 365-374

Requirement for MONITORING of CO2 Storage & Potential Leakage Pathways





Geophysical Modeling *CO₂ Plume Position - 2020*





Legal / Regulatory Framework for Class VI UIC in Texas

Texas Class VI UIC Primacy: History & Current Status



2009

81st Leg. established jurisdiction for CCS wells and required agencies to seek primacy – Tx Water Code, Ch 27

2010

RRC issues rules for CCS

2011

EPA issues UIC Class VI well rules – 40 CFR § 146 Subpart H

2021

87th Leg. consolidated CCS jurisdiction under RRC

2022

Submitted Class VI UIC primacy application to EPA on December 19th, 2022.

2023

Texas adopted additional rule amendments to ensure compliance with federal regulations. Working on finalizing MOA and Program Description.

Summary of Amendments to TAC 16, Chapter 5 pertaining to Class VI UIC



- There is **no specified limit to the duration of post-injection site care monitoring**:
 - **3 years of monitoring** must demonstrate that the **CO2 plume and pressure front are stabilized**
- Closure estimates and financial assurance **must include plugging costs** of all injection and monitoring wells.
- Operator must report both injected **volume and mass**, including method of calculation
- Broader scope for draft permit comments to include **“interested persons”** not just “affected persons”
- **Safety plan for alerting the public and public safety personnel of an emergency** (e.g., a significant release of CO2)
- Seismic Monitoring may be required as a permit condition to reduce the risk of **induced seismicity**.

Legislative / Legal Impediments to Class VI UIC Activity in Texas



- There are some **overlapping and not always clearly defined classifications of UIC wells**, such as Class II EOR, Class II Acid Gas Injectors, or Class VI carbon sequestration wells,
- CO₂ is classified as a **waste** rather than a beneficial product, so eminent domain provisions regarding pipeline construction are not currently applicable to CO₂.
- Texas currently **caps civil liability for non-economic losses that arise from future releases of CO₂** at carbon capture and sequestration operations.
- While Texas law allows **unitization** for EOR / enhanced oil recovery (including CO₂ injected by Class II UIC wells), there are **no specific provisions for unitizing geologic storage of CO₂** solely for sequestration or disposal.
- There is still some legal wrangling regarding **subsurface pore-space ownership**.



Some Examples of Current Carbon Sequestration Projects in Texas

Proposed Chevron / Talos / Carbonvert Bayou Bend CCS Project



Project Type	Hub
Regional Emissions (MM MTPA CO2)	~ 30
Footprint (Acres)	40,000 +
Storage Capacity (MM MTPA CO2)	225 - 275
Annual Injection Rate (MM MTPA CO2)	5 - 15
Estimated First Injection	Late 2025
Partners	Chevron Talos Carbonvert

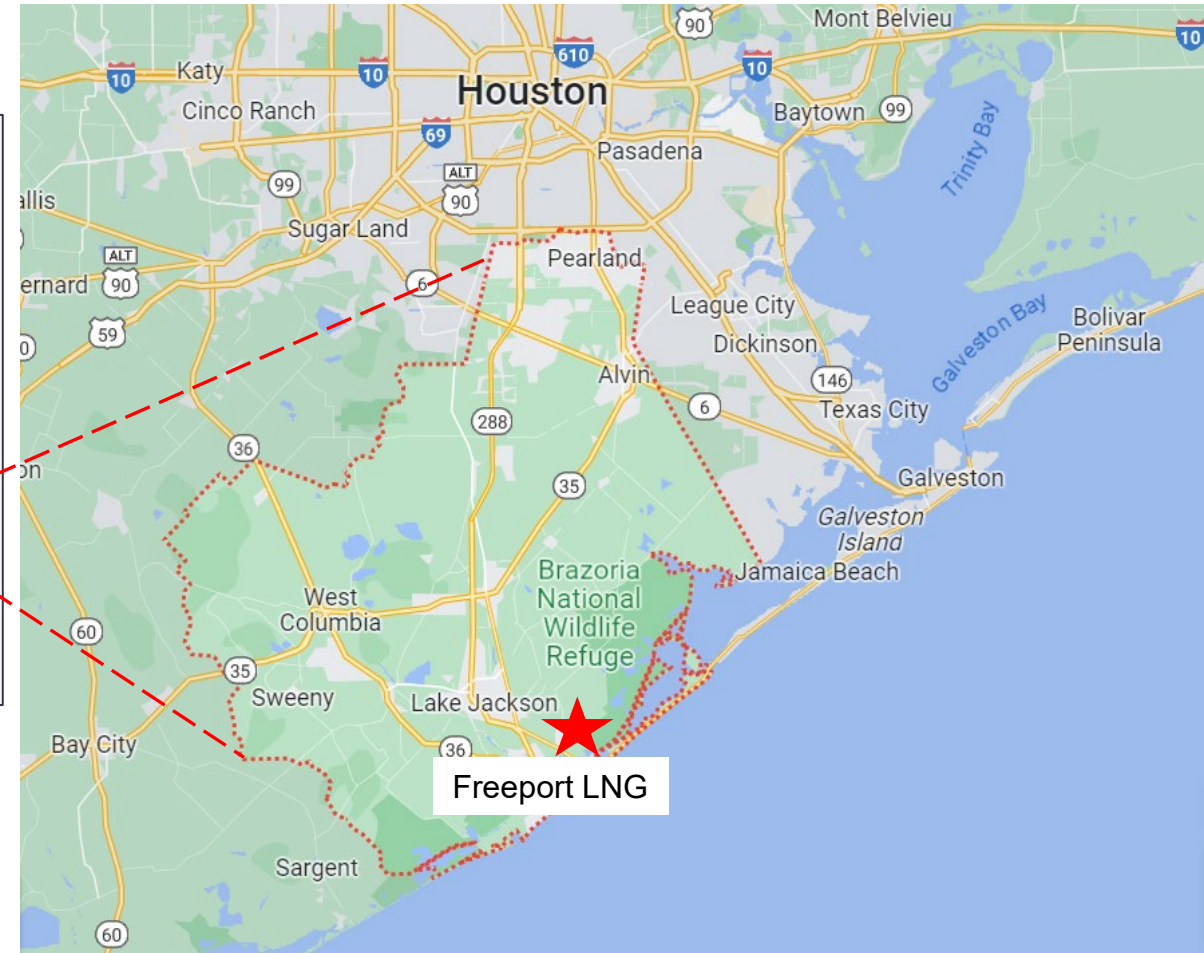
Proposed Talos Energy - Freeport LNG Carbon Sequestration Project



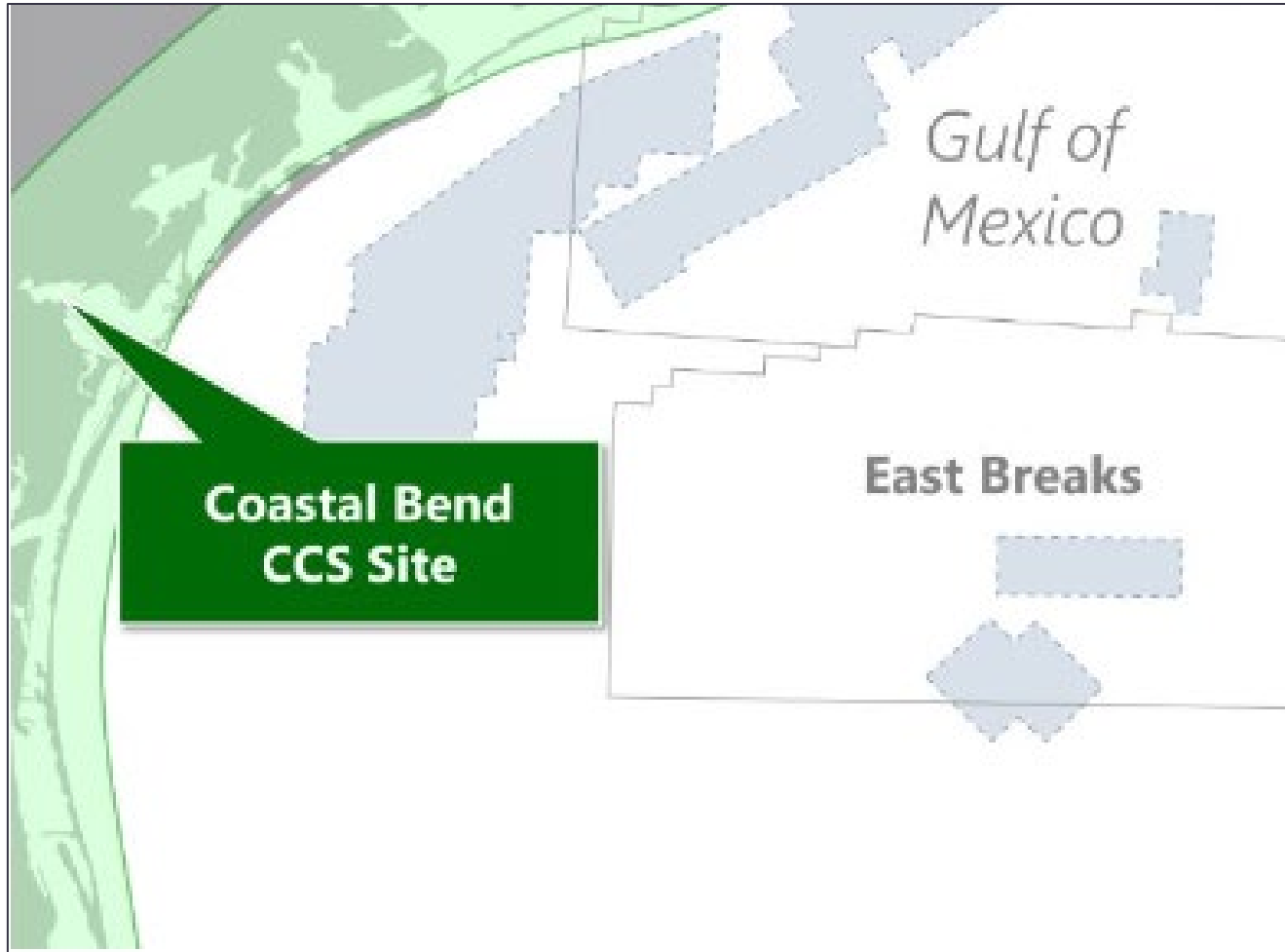
CCS POINT SOURCE PROJECT

Talos Energy Freeport LNG

- Industrial Region: Brazoria County, Texas
- Regional CO₂ Emissions: ~20 MTPA
- Project Site: ~500 Gross Acres Onshore
- Gross Storage Capacity: ~25 MM MT CO₂



Proposed Coastal Bend CCS LLC Carbon Sequestration Project



Project Type	Point Source
Regional Emissions (MM MTPA CO₂)	~ 20
Footprint (Acres)	13,000
Storage Capacity (MM MTPA CO₂)	50 - 100 +
Annual Injection Rate (MM MTPA CO₂)	1 - 1.5 +
Estimated First Injection	Late 2026
Partners	Talos Howard Energy



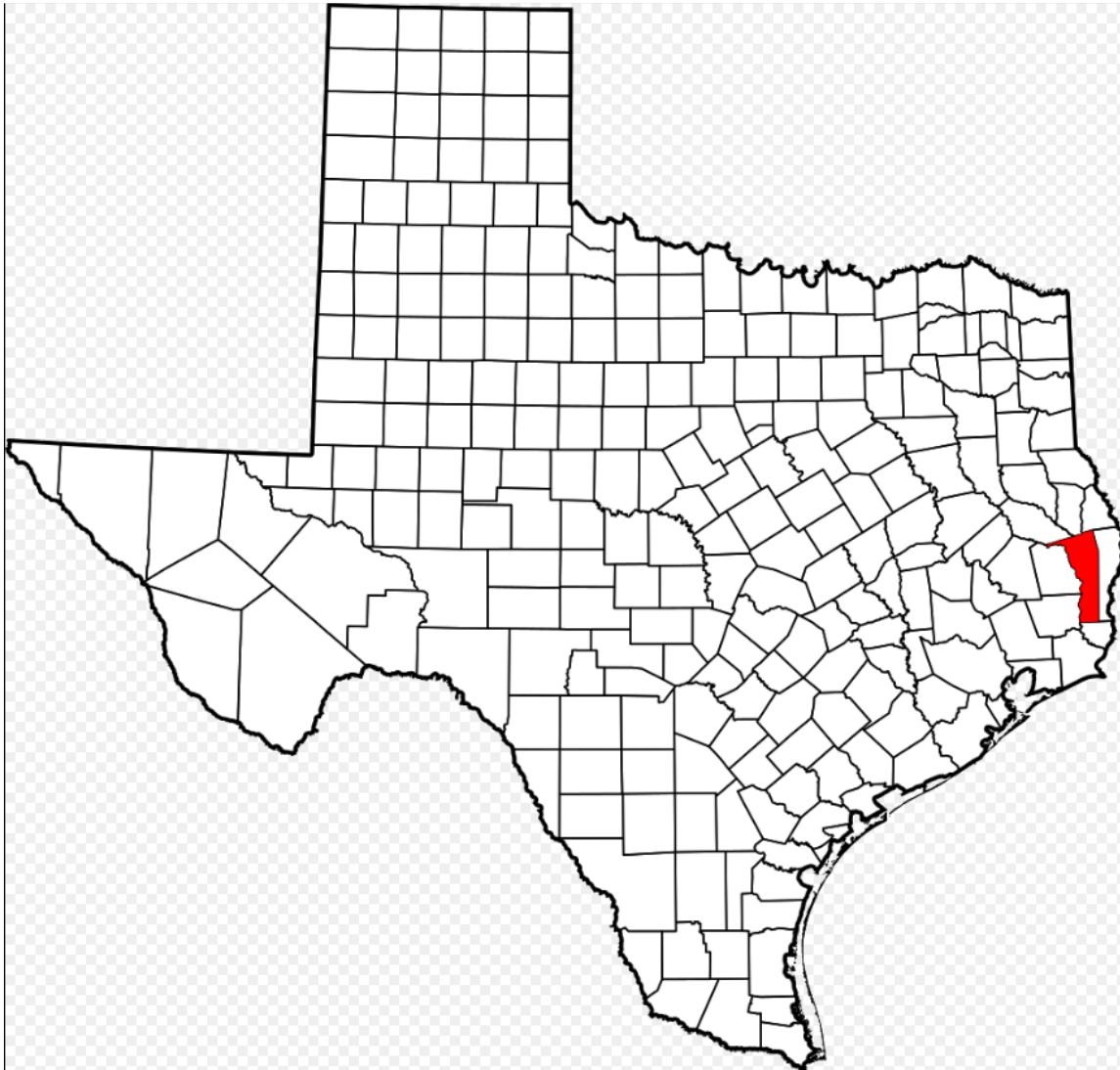
Ector County, Texas

- OLCV Brown Pelican Project
- 1st Class VI UIC Application in Texas
- Direct Air Capture & Sequestration
- 760,660 metric tons per year
- Injection into Permian-age carbonate rocks (saline aquifer)



Gaines County, Texas

- Class VI UIC permit application submitted to the US EPA.
- Class VI UIC Application not yet submitted to Texas.
- Multiple CO₂ injection wells proposed.
- Injection into Permian-age carbonate rocks (saline aquifer)



Jasper County, Texas

- Class VI UIC permit application submitted to the US EPA and Texas.
- 2nd Class VI UIC Application in Texas. First in East Texas.
- Four CO₂ injection wells proposed.
- Injection into Tertiary clastic rocks with shale top-seal (saline aquifer)

Oxy Subsidiary 1PointFive Proposed CCS Project in Kleberg County, Texas

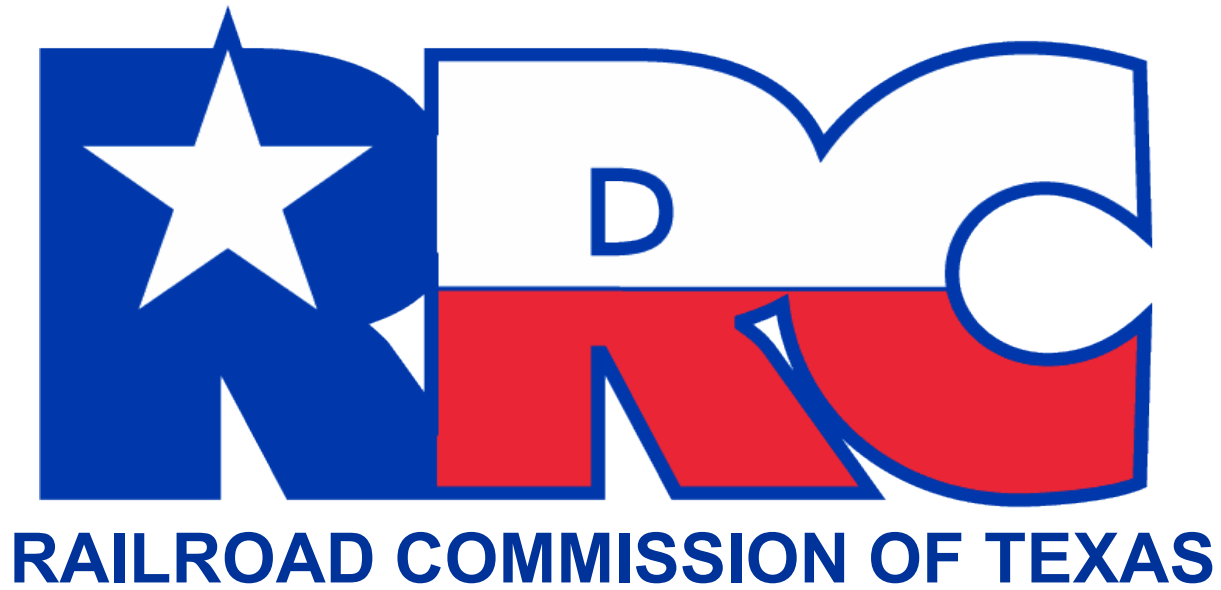


- Occidental Petroleum Corporation (Oxy) subsidiary 1PointFive has signed a lease agreement with the King Ranch for CCS.
- Have announced plans for up to 30 individual Direct Air Capture units with associated CO₂ Sequestration
- 106,000 acres under lease on the King Ranch in Kleberg County, Texas.
- Underground pore space estimated to store 3 billion metric tons of CO₂
- Estimated 30 million metric tons per year (from combined 30 individual DAC units each capturing ~ 1 million metric tons per year)





QUESTIONS?



For more information, please contact the
Carbon Sequestration / Class VI UIC Group
Oil and Gas Division - Railroad Commission of Texas
512-463-2259