U.S. Environmental Protection Agency Rules for Geologic Storage/EOR Greenhouse Gas Reporting Rule

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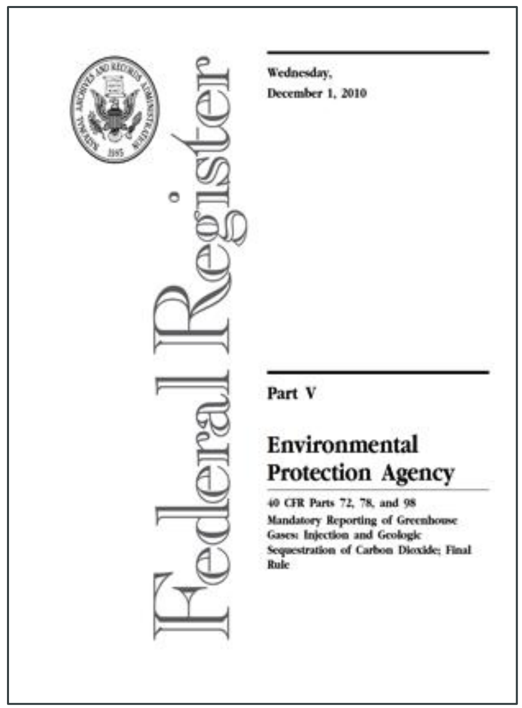
IEA, Paris, June 19, 2013



Greenhouse Gas Reporting Rule Subparts RR & UU Published in 2010.

Part of U.S. Greenhouse Gas Reporting Program (GHGRP)



Federal Register

Wednesday,
December 1, 2010

Part V

Environmental Protection Agency

40 CFR Parts 72, 78, and 98
Mandatory Reporting of Greenhouse Gases: Injection and Geologic Sequestration of Carbon Dioxide; Final Rule

Subparts RR and UU, FR V. 75 No. 230, December 1, 2010 at 75065

http://www.epa.gov/ghgreporting/reporters/subpart/rr.html

Reporting Rules *are for Reporting*

- Authority comes from the U.S. Clean Air Act.
- *Complementary to* EPA's Underground Injection Control (UIC) rules to protect water under the U.S. Safe Drinking Water Act.
- Not a comprehensive sequestration/storage rule.
- Provides accounting methodology for storage.
- Collects CO2 mass balance data from facilities injecting CO2 to track CO2 supply and movement with other GHGRP data.
- Purpose is to document permanence of stored CO2 through monitoring, reporting, verification.

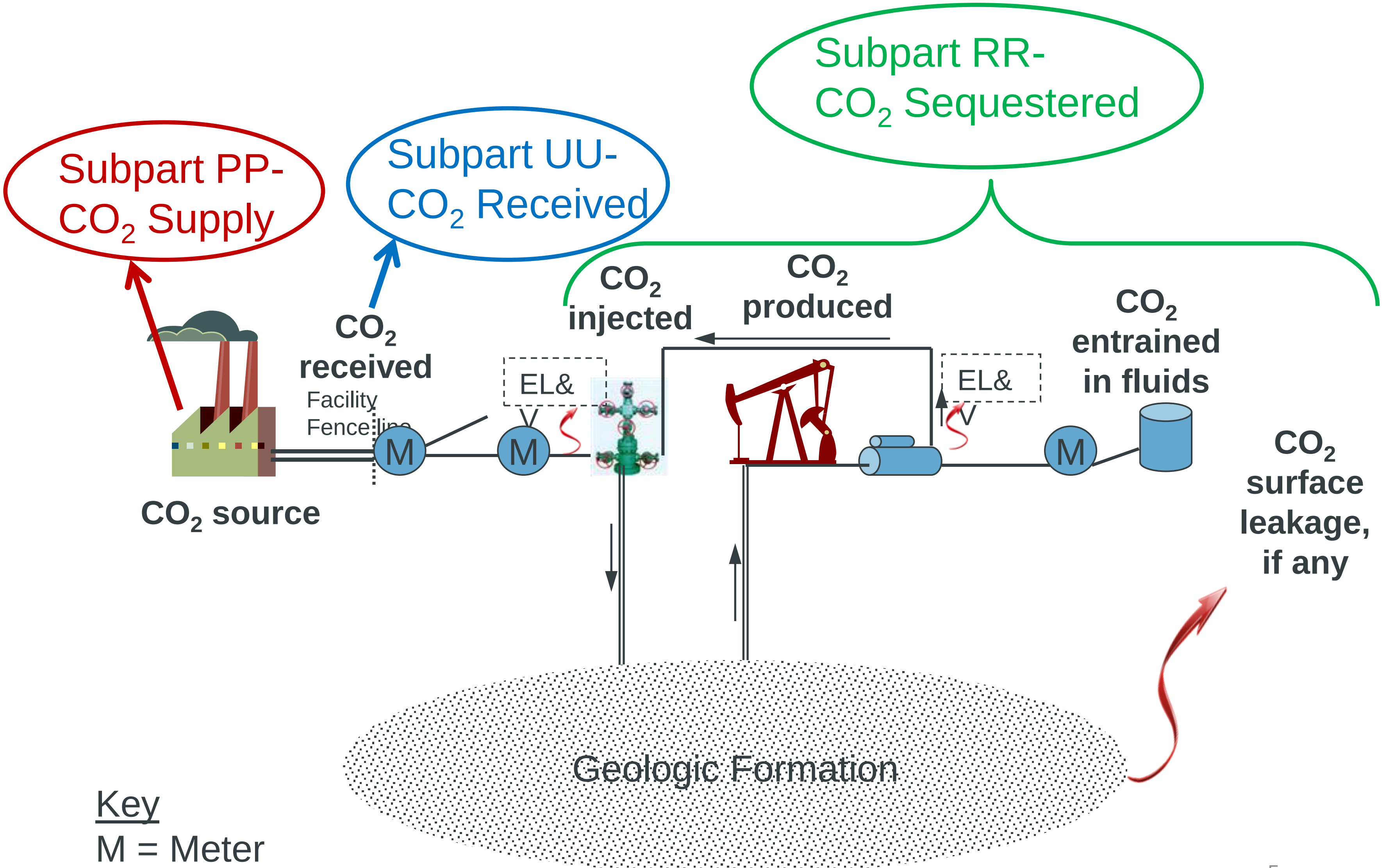
3 GHGRP “Subparts” Applicable to CO2 Storage under GHGRP

- Subpart RR requires all facilities that conduct geologic sequestration are required to submit annual reports to EPA. No threshold for reporting. “All –in”.

- Subpart UU requires all *other* facilities that inject CO2 (but not for sequestration) such as for EOR are required to report the amount of CO2 received.

- Subpart PP requires reporting from CO2 suppliers.

Schematic (EPA, 2013)



Key
M = Meter
EL&V = Equipment Leaks and Vented Emissions

Subpart RR (all storage facilities)

- Facilities must:
  - Report basic information on CO_2 received for injection.
  - Develop and implement an EPA-approved site-specific MRV (Monitoring, Reporting, Verification) plan.
  - Report the amount of CO_2 geologically sequestered (stored) using a mass balance approach and annual monitoring activities.

MRV Plan Must Include:

1. Identify *active* and *maximum* monitoring areas.
2. Identify surface leakage pathways (EOR focus should be abandoned wells).
3. Develop strategy for detection and quantification of surface CO2 leakage.
4. Baseline measurements (pre-injection).
5. Calculation methodologies and accounting.
6. Continue post injection monitoring until EPA grants site closure authorization. Monitoring and modeling must show CO2 is not expected to migrate in the future in an manner that would result in surface leakage.

Subpart RR Annual Monitoring Report

- A narrative history of the monitoring effort conducted.
- A description of changes made to the MRV plan.
- A narrative history of any monitoring anomalies that were detected & how they were investigated and resolved.
- A description of surface leakages, if any.

Current GS Projects with R&D Exemptions from Subpart RR Reporting

Final Decisions

Project Name	Type	Date of Final Decision*	Final Decision Documents
Boise White Paper LLC Wallula Basalt Carbon Dioxide Pilot Study	R&D project exemption request	May 29, 2013	Decision (PDF) (3 pp, 1.1M)
SECARB Phase III Anthropogenic Test	R&D project exemption request	June 29, 2012	Decision (PDF) (10 pp, 1.6M)
Archer Daniels Midland Company Midwest Geologic Sequestration Consortium Project	R&D project exemption request	October 12, 2011	Decision (PDF) (6 pp, 464K)
Boise White Paper LLC Wallula Basalt Carbon Dioxide Pilot Study	R&D project exemption request	August 12, 2011	Decision (PDF) (3 pp, 340K)
American Electric Power's Mountaineer Plant project	R&D project exemption request	July 29, 2011	Decision (PDF) (4 pp, 110K)

** See 40 CFR Part 78 for appeals procedures, including the requirement that appeals must be made within 30 days after EPA has issued its decision.*

Reporting to Date

- GHGRP (program) total: For reporting year (RY) 2011, approximately 8,000 facilities in nine industry sectors reported 3.3 billion tons of CO2e.
- Subpart RR: No facilities have reported to date.
- Subpart UU: Appx 75 facilities, mostly EOR, have reported 64 Mt received for injection.

Facilities Reporting under UU

Source: http://ghgdata.epa.gov/ghgp/main.do#/facility/?q=Find%20a%20Facility%20or%20Location&st=&fid=&sf=11001000&ds=I&yr=2011&tr=current&cyr=2011

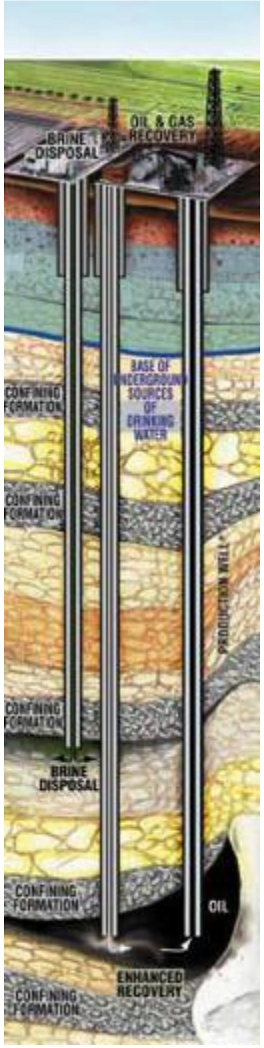
CLEAN AIR TASK FORCE

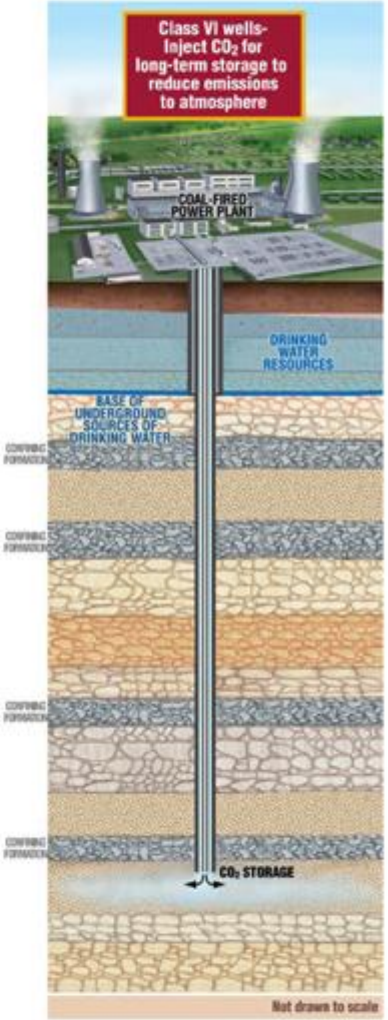
UIC Program Well Classes II, VI

Oil and Gas

151,000 EOR wells(80%)
Brine Disposal Wells (20%)

Class II
Administered by most
States
Via “Primacy”





Geologic Storage

States may also
Administer class VI
by primacy
but presently done
By EPA regions.

Integrating RR & UIC Requirements

- Storage in EOR fields can be done under UIC Class II or Class VI depending on risk to USDWs
- UIC program elements may satisfy MRV plan submitted for subpart RR.
- Operators will supplement the elements of their UIC plans, particularly under class II. (E.g. monitoring area, baseline and monitoring tools, site closure, etc.)
- EPA requires a transition to class VI from class II in EOR fields where there is an increased risk profile. Must revise MRV plan.
- Proposed guidance document on transition soon.

Rough Comparison of UIC Class II & Class VI

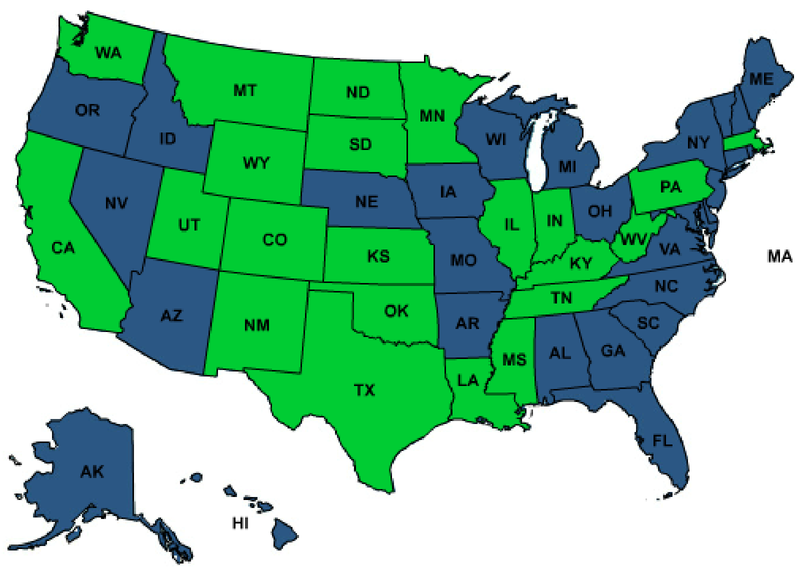
Rule Requirement	Class II	Class VI
Area of Review (AoR)	0.25 mi	Computational modeling of plume and pressure front; must be revaluated max 5 yrs.
Evaluation of AoR	Define zone of "endangering influence"	Comprehensive geologic study, identifying confining zone, identification of faults, fracture zones.
Geologic Review	Confining zone must separate injection zone from USDW & must be free of faults & fractures	Must have Suitable geologic system with a confining zone free of transmissive faults.
Legacy Wells	Review reasonably available well data	Identify & take corrective action on all wells at risk of leakage.
Mechanical Integrity Tests	Every 5 years	Every year, casing inspection log or temperature log; continuous annular pressure.
Baseline Monitoring	None	USDW/ groundwater, subsurface injection zone.
CO2 Testing & Monitoring	None.	Groundwater monitoring; tracking plume and pressure front.
Well Construction	Cased and cemented to prevent movment of fluids into USDW & Designed for life expectancy of well	Must be prevent movement of fluids into or between USDWs compatible with CO2 injectate for life of project.
Well Evaluation	Wireline logs through drinking water (USDW) zones and confining zone.	Wireline logs, including CEL.
Injection Pressure	Pressure shall not exceed frac pressure.	Must not Exceed 90% of frac pressure
Injection Monitoring	Injection rate, pressure, nature of injectate.	Injection rate, pressure, nature of injectate. Must maintain a pressure on the annulus. Alarms, downhole shut off.
Reporting	Annual	Semi Annual
Emergency Response	Must report in 24 hours.	Cease injection; carry out pre-approved remedial response plan. Report 24 hrs.
Plugging	Well plugging must be acceptable to Director	Injection well plugging plan
Post Injection Site Care/Financial Responsibility	None	Closure / monitoring plume and pressure front. 50 year presumption

Storage Regulations Gap?

- While Subpart RR and UIC program rules are complementary, no rules exists in the U.S. that would deem a volume “sequestered” or “stored.”
- Subpart RR does not enforce emissions reductions nor does it penalize facilities for releases to the atmosphere.
- Subpart RR is for reporting mass balance of stored CO2 and CO2 emitted to the atmosphere.
- Underground Injection Control (UIC) rules are for aquifer protection.
- Adding complexity: UIC class II is administered mostly by states; class VI currently administered by EPA regions but states can apply (e.g. ND).

U.S. State CCS Regulatory Development (Source: CCS Reg)

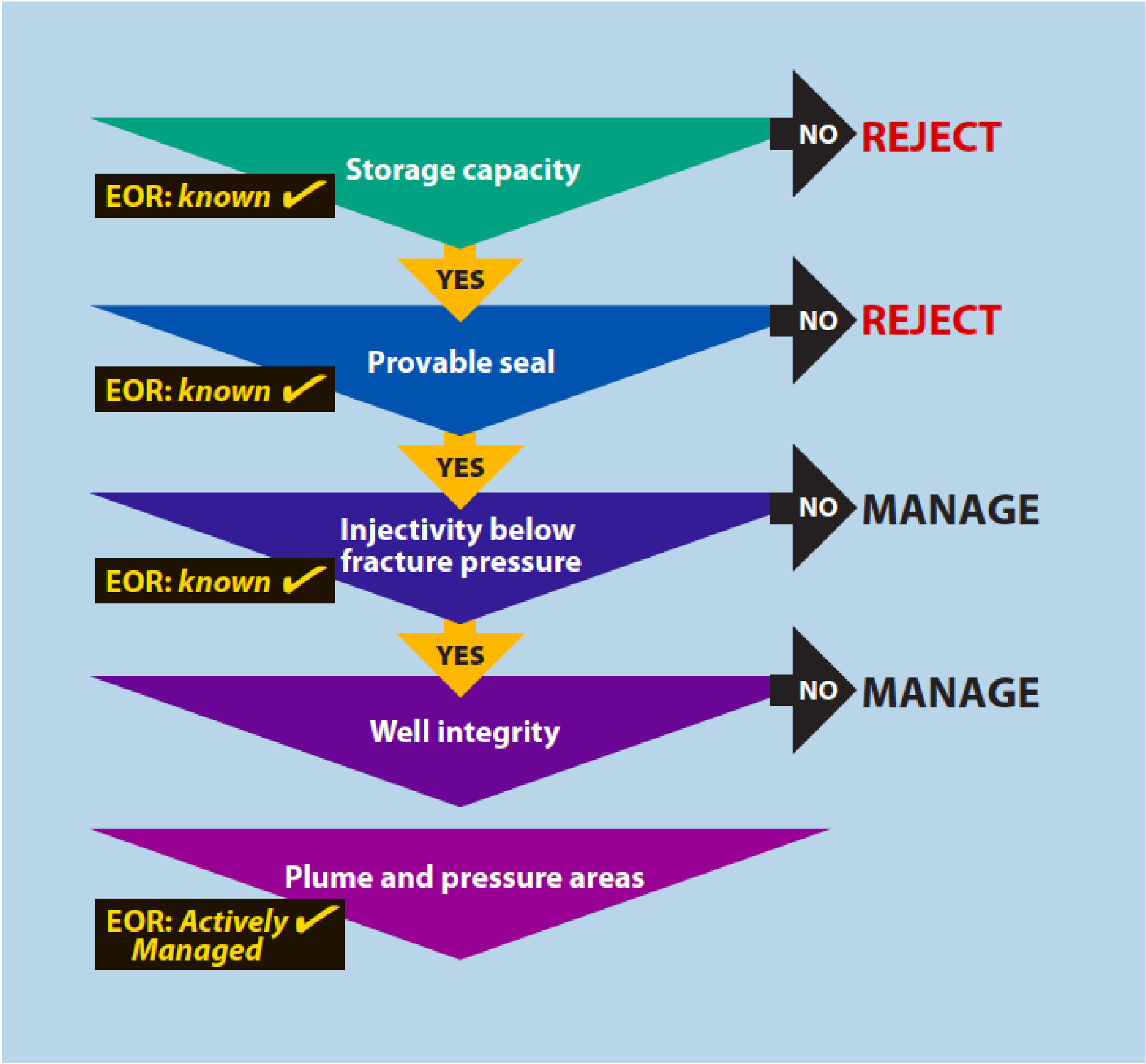
	Sequestration Site Permitting	Property Rights	Long Term Stewardship	EOR Status	Tax Incentive	Regulatory Incentive
California						
Colorado						X
Illinois		X	X	X	X	X
Kansas	X		X	X	X	
Kentucky						
Louisiana	X	X	X	X		
Massachusetts						
Minnesota						
Mississippi					X	
Montana	X	X	X	X	X	
New Mexico					X	
North Dakota	X	X	X	X	X	
Oklahoma	X	X		X		
Pennsylvania						
Texas	X	X	X	X	X	
Utah	X			X		
Washington	X					
West Virginia	X	X		X		
Wyoming	X	X	X	X		



(Information may not be fully up to date)

http://www.ccsreg.org/billtable.php?component=Sequestration

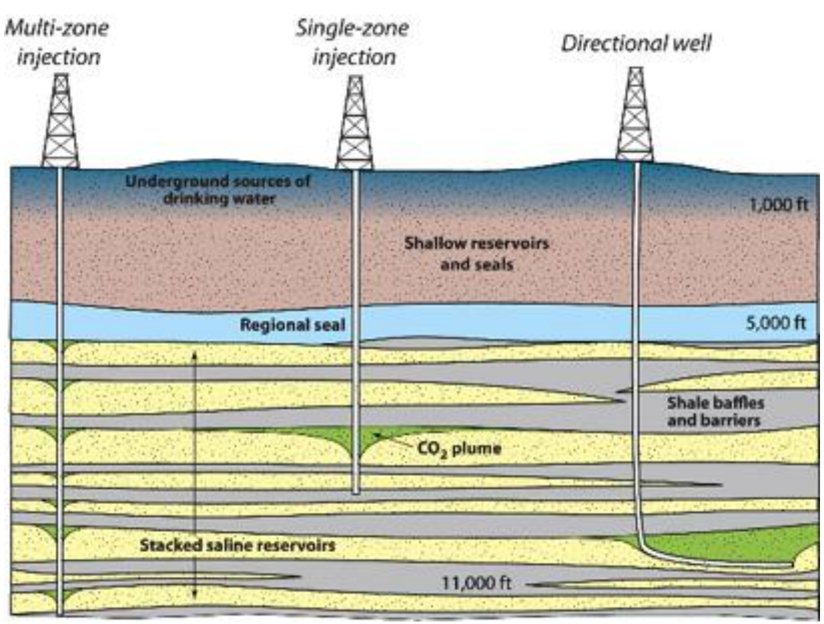
Managing MRV/Risk in EOR Settings



After Hill, Hovorka, Melzer (2012); Original chart: Sue Hovorka.

Saline and EOR at One Facility? "Stacked" Storage

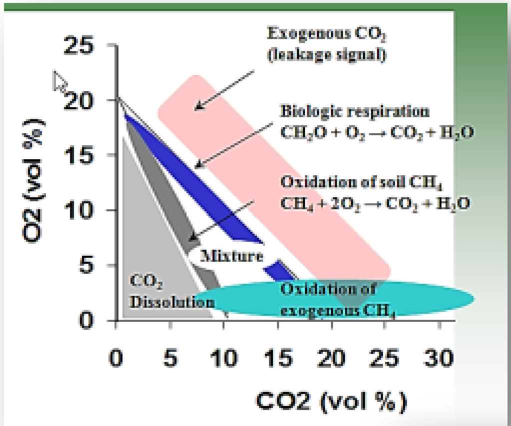
- Existing Infrastructure
- Reservoir knowledge and capacity
- Existing Surveillance tools
- Multiple caprock seals

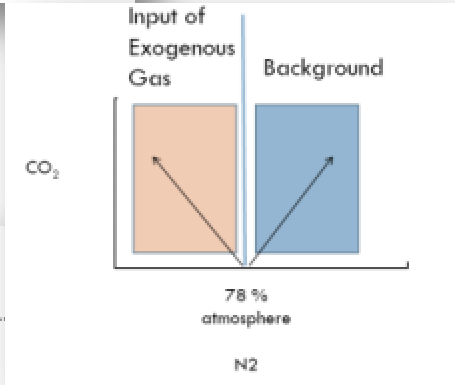


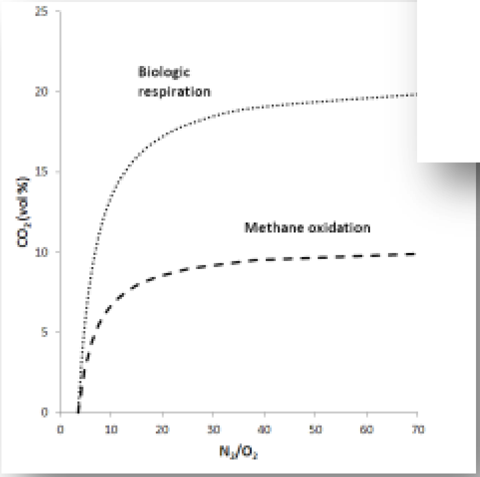
System	Series	Stratigraphic Unit	Major Sub Units	Potential Reservoirs and Confining Zones
Tertiary	Plio-Pliocene		Citronelle Formation	Freshwater Aquifer
	Miocene	Undifferentiated		Freshwater Aquifer
	Oligocene	Vicksburg Group	Chicasawhay Fm.	Base of USDW
			Bucatunna Clay	Local Confining Unit
	Eocene	Jackson Group		Minor Saline Reservoir
		Claiborne Group	Talahatta Fm.	Saline Reservoir
		Wilcox Group	Hatchetigbee Sand	Saline Reservoir
	Paleocene		Bashi Marl	
			Salt Mountain LS	
		Midway Group	Porters Creek Clay	Confining Unit
Cretaceous	Upper	Selma Group		Confining Unit
		Eutaw Formation		Minor Saline Reservoir
		Tuscaloosa Group	Upper Tusc.	Minor Saline Reservoir
			Mid. Tusc. Marine Shale	Confining Unit
			Lower Tusc. Pilot Sand Massive sand	Saline Reservoir
Cretaceous	Lower	Washita-Fredericksburg	Dantzler sand	Saline Reservoir
			Basal Shale	Primary Confining Unit
		Paluxy Formation	'Upper' 'Middle' 'Lower'	Proposed Injection Zone
		Mooringsport Formation		Confining Unit
		Ferry Lake Anhydrite		Confining Unit
		Donovan Sand	Rodessa Fm. 'Upper'	Oil Reservoir
			'Middle'	Minor Saline Reservoir
			'Lower'	Oil Reservoir

No Baseline Needed.
Process-Based Soil Gas Method (K. Romanak / BEG)

- Important for EOR settings (brownfields)
- Method pioneered at Kerr Farm/alleged Leakage at Weyburn
- Does not rely on background CO_2 measurements
- Uses ratios among simple gases (CO_2, CH_4, N_2, O_2)







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GHGT-11

Geologic carbon storage through enhanced oil recovery.

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Abstract

The advancement of carbon capture technology combined with carbon dioxide (CO_2) enhanced oil recovery (EOR) holds the promise of reducing the carbon footprint of coal-fired power plants and other industrial sources, while at the same time boosting production of oil. CO_2 injection in deep formations has a long track record. Tertiary EOR with CO_2 has its origins in West Texas in the 1970's, when CO_2 was first used at large scale at the SACROC field to produce stranded oil following primary and secondary production (water flooding). Because CO_2 mixes with oil and changes oil properties, CO_2 floods are effective at producing additional oil following water flooding. Carbon dioxide is a valuable commodity both because of its ability to stimulate oil production from depleted reservoirs, and because of the limited volumes of naturally-sourced CO_2 in the U.S. Therefore, during large-scale commercial floods, CO_2 that is produced with oil during EOR is separated, compressed and re-injected and recycled numerous times. Venting to the atmosphere is a rare event, quantifiable, and constitutes an insignificant fraction of the injected CO_2. The CO_2 purchased mass, net any venting during EOR activity is sequestered in the reservoir by a combination of capillary, solution and physical trapping mechanisms. Approximately 600 million metric tonnes of purchased CO_2 have been utilized in the southwest U.S. Permian Basin (PB) alone, the rough equivalent of 30 years worth of CO_2 from a half dozen medium-sized coal-fired power plants.

Although CO_2 EOR technology is mature in the U.S., many reservoir targets have not been flooded because of limited CO_2 supply. Moreover, very large newly discovered EOR resources, known as "residual oil zones" (ROZs) occur in naturally water-flooded intervals below the oil-water contact in reservoirs that possess pore space containing immobile oil. ROZs are also now being documented in geologic settings without overlying conventional oil and gas accumulations. ROZ exploration and production using CO_2 promises the supplemental capacity to accept very large volumes of CO_2 in order to access and produce the remaining immobilized oil.

Many existing EOR sites may be ideal for sequestration because they: 1) provide known traps that have held hydrocarbons over geologic time, 2) provide existing CO_2 transportation and injection infrastructure, 3) occur in areas where the general public widely accepts injection projects, 4) provide CO_2