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What's An Acre Worth?

Perspectives on Pore Space Value for CCS

SPEE Houston Chapter Meeting

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Overview

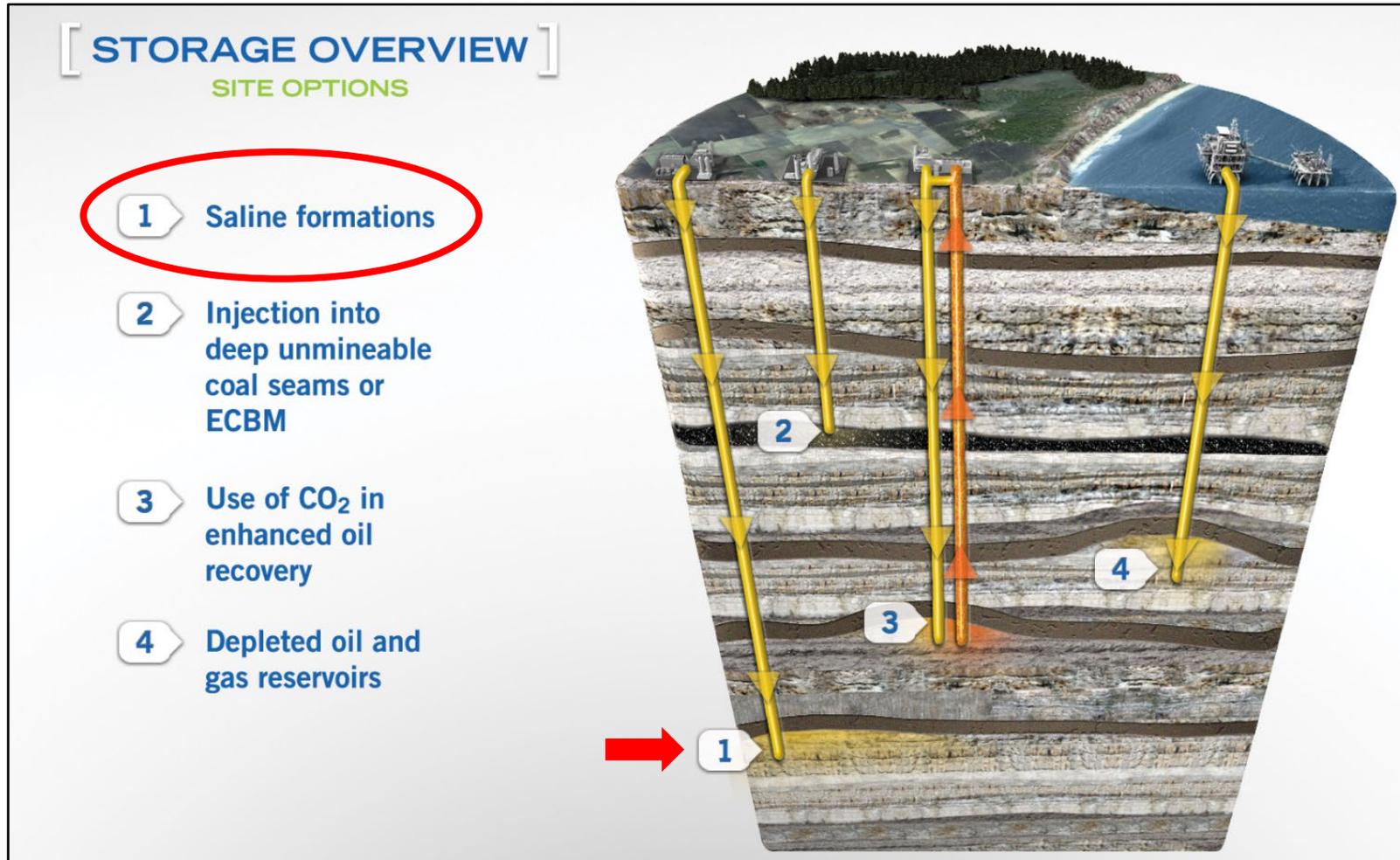
- Introduction to CCS Projects
- Pore space lease terms
- Potential acreage value drivers
- Discounted cash flow approach to valuing pore space
- Conclusions
- Q&A

INTRODUCTION TO CCS PROJECTS



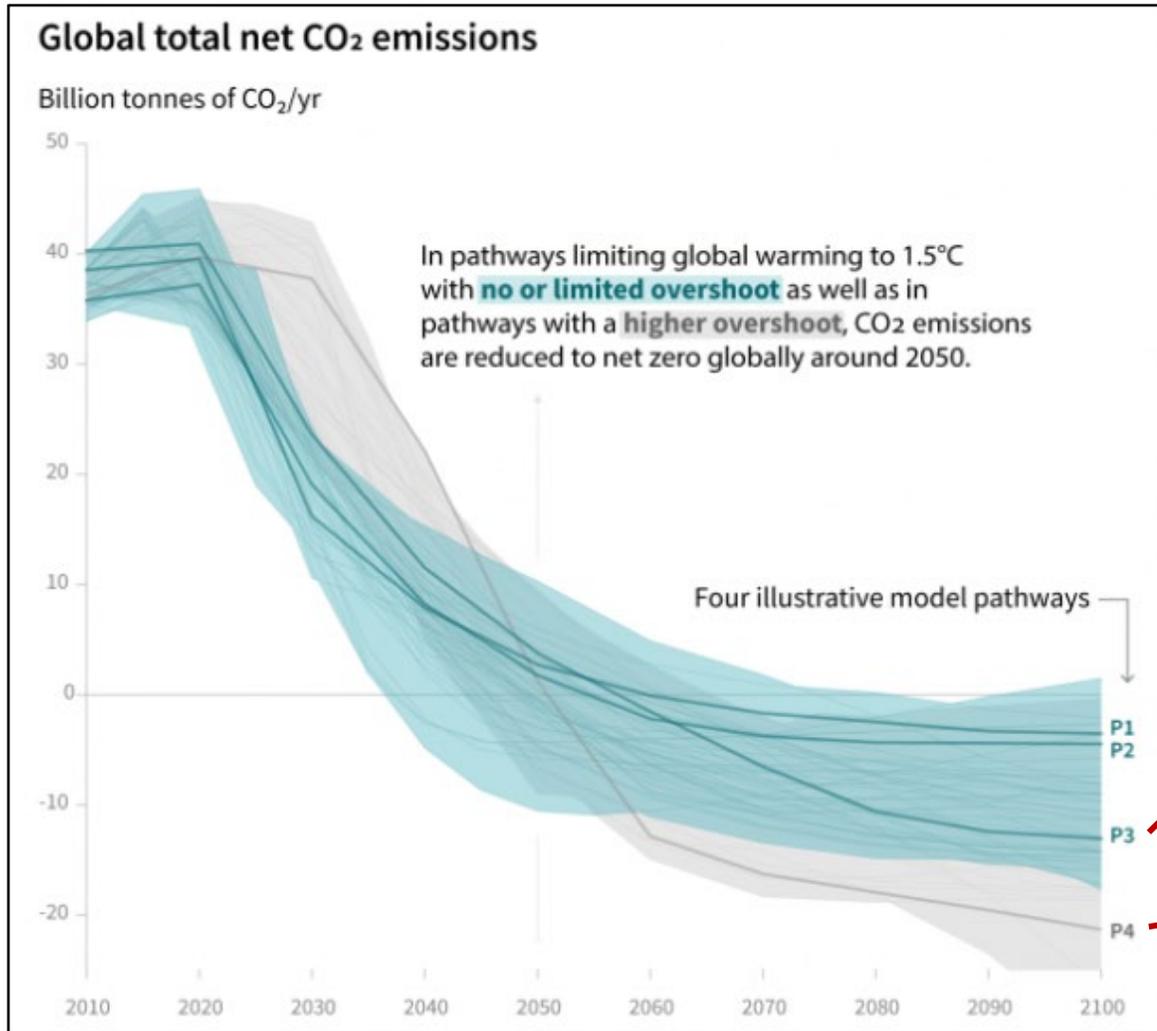
What is CCS?

- Carbon Capture and Sequestration

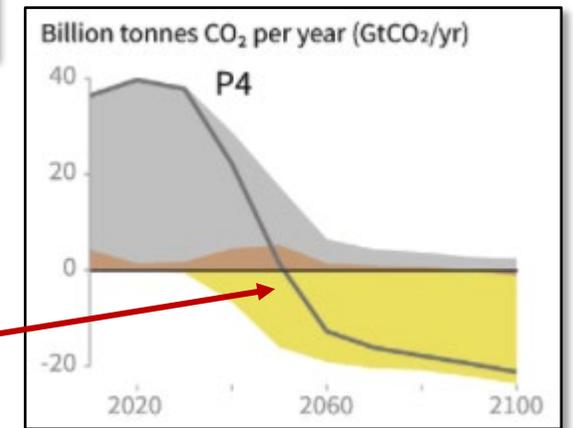
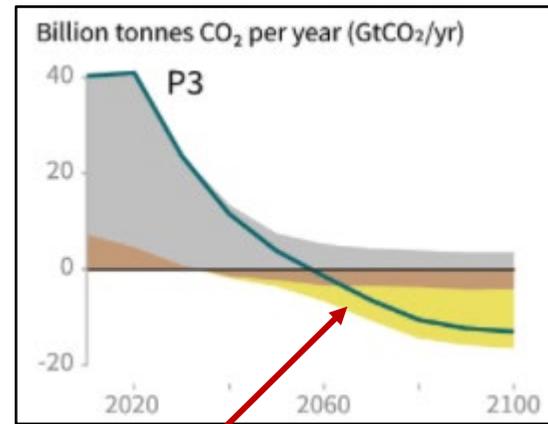




There Are Many Potential Paths to Net Zero...



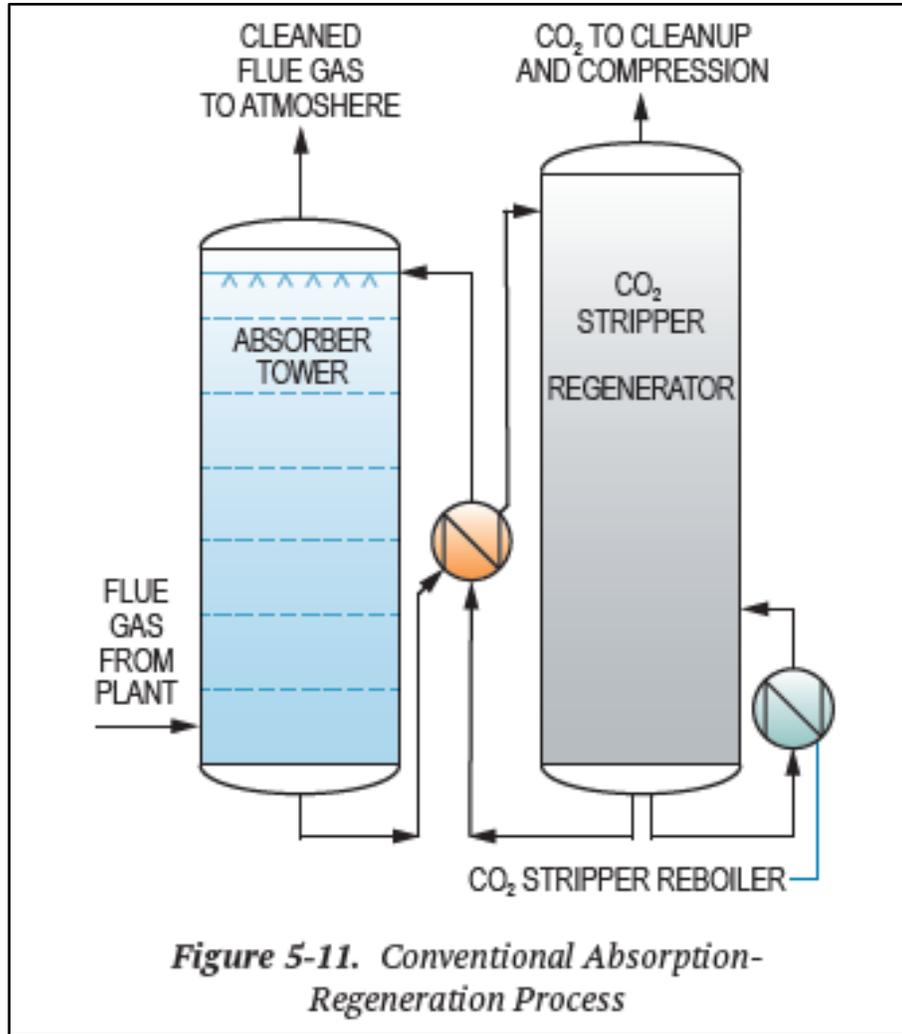
Source: Summary for Policymakers, IPCC



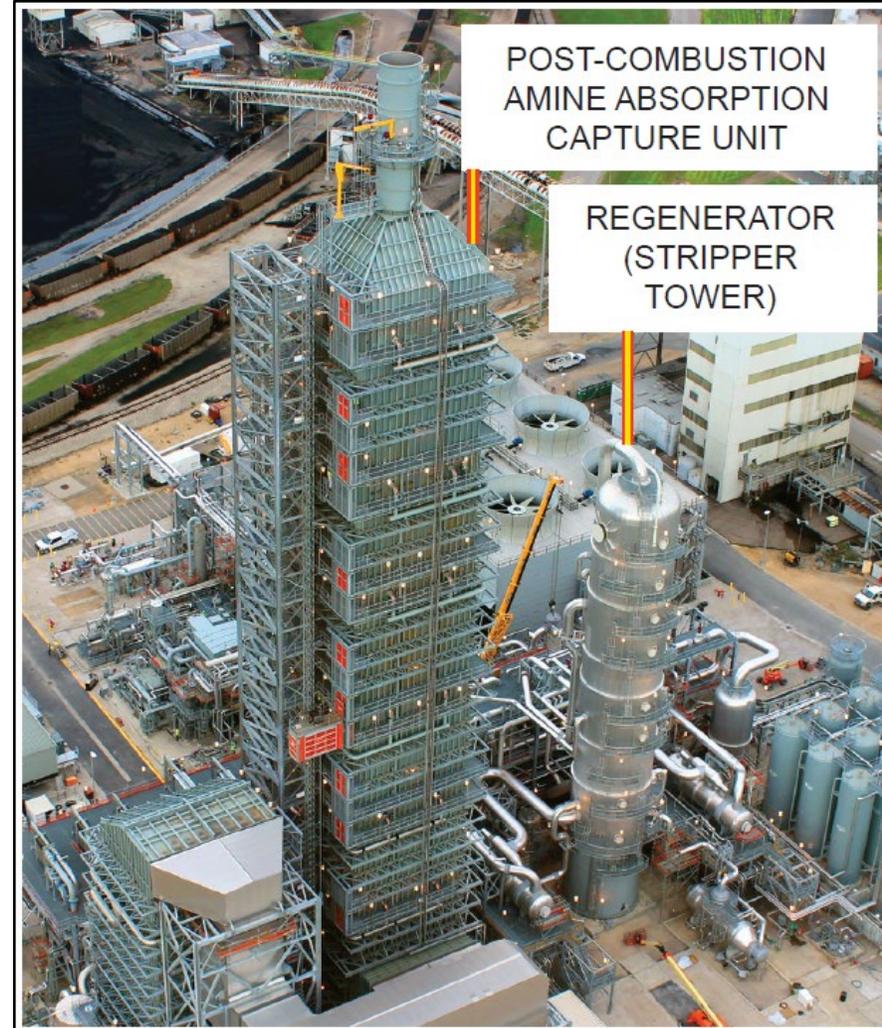
...but CCS is likely to play a key role in the path society ultimately follows



Amine Absorption CO₂ Capture Technology



Source: NPC, "Meeting the Dual Challenge" Ch. 2

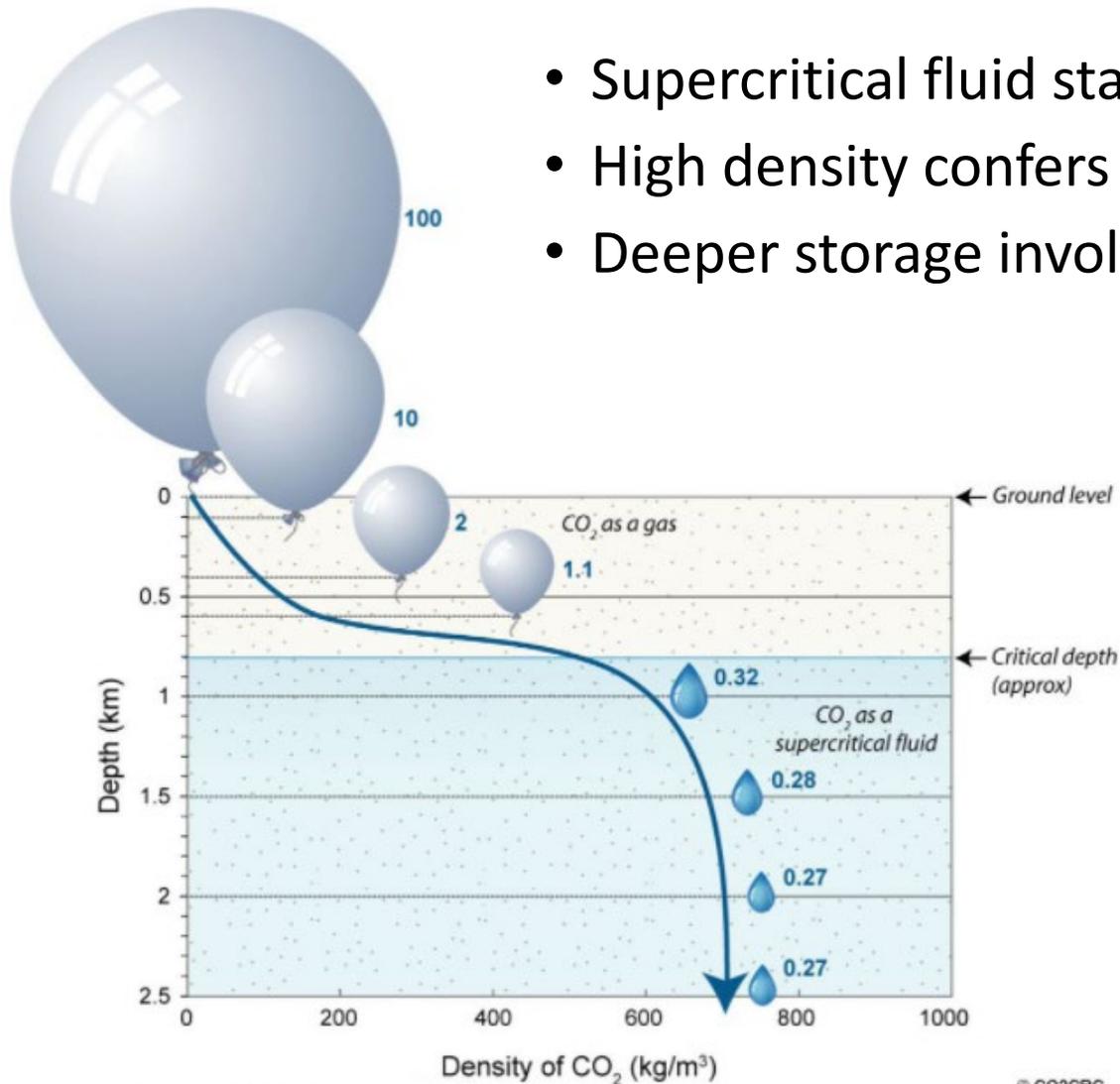


Source: NPC, "Meeting the Dual Challenge" Ch. 2



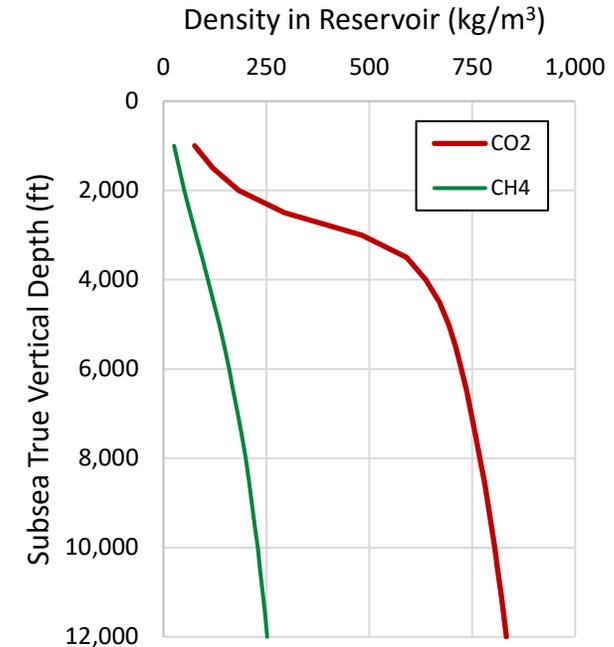
CO₂ Has Unique Properties With Geologic Storage

- Supercritical fluid state enables very dense storage below ~3,000'
- High density confers benefits in storage and transport
- Deeper storage involves higher costs



Source: CO2CRC

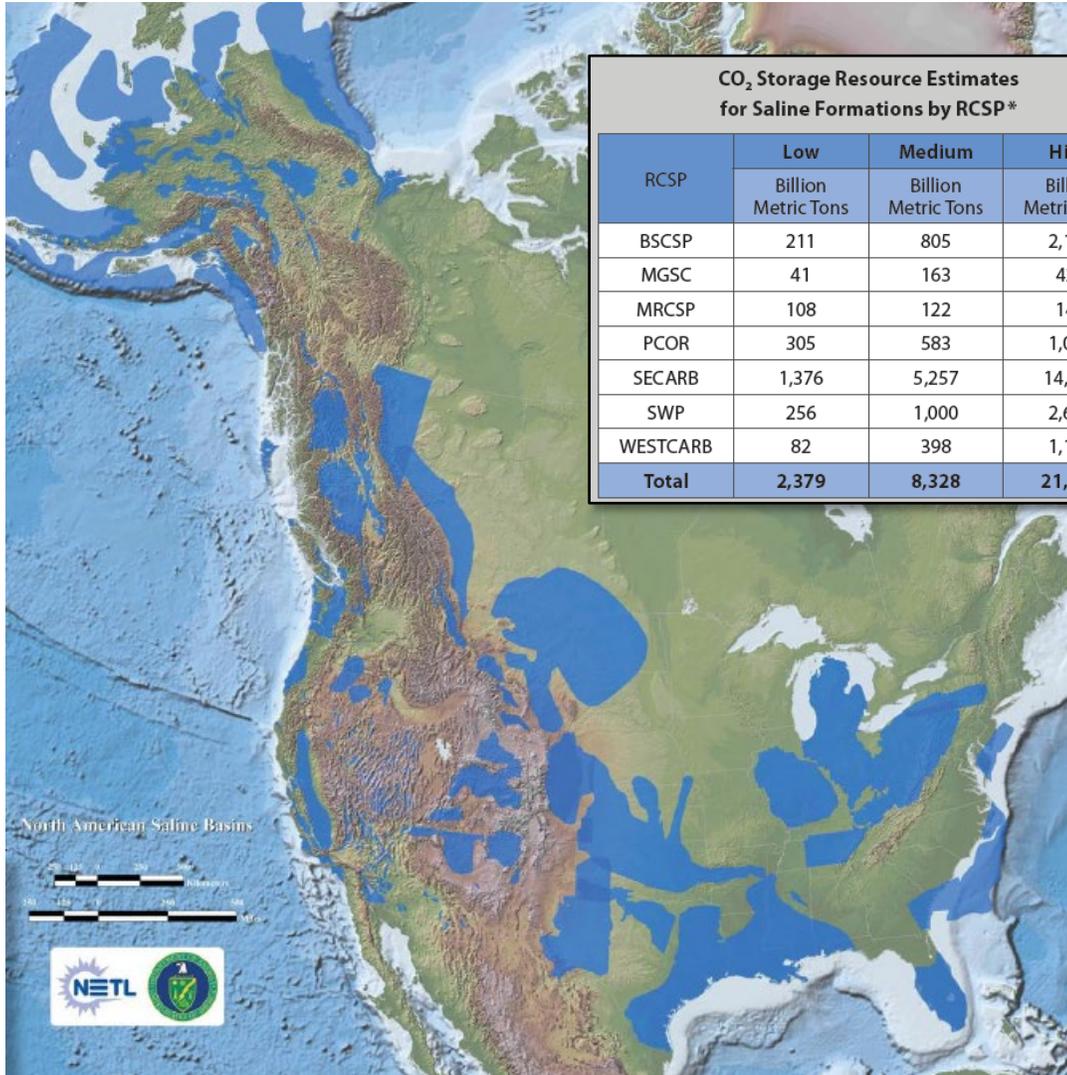
© CO2CRC



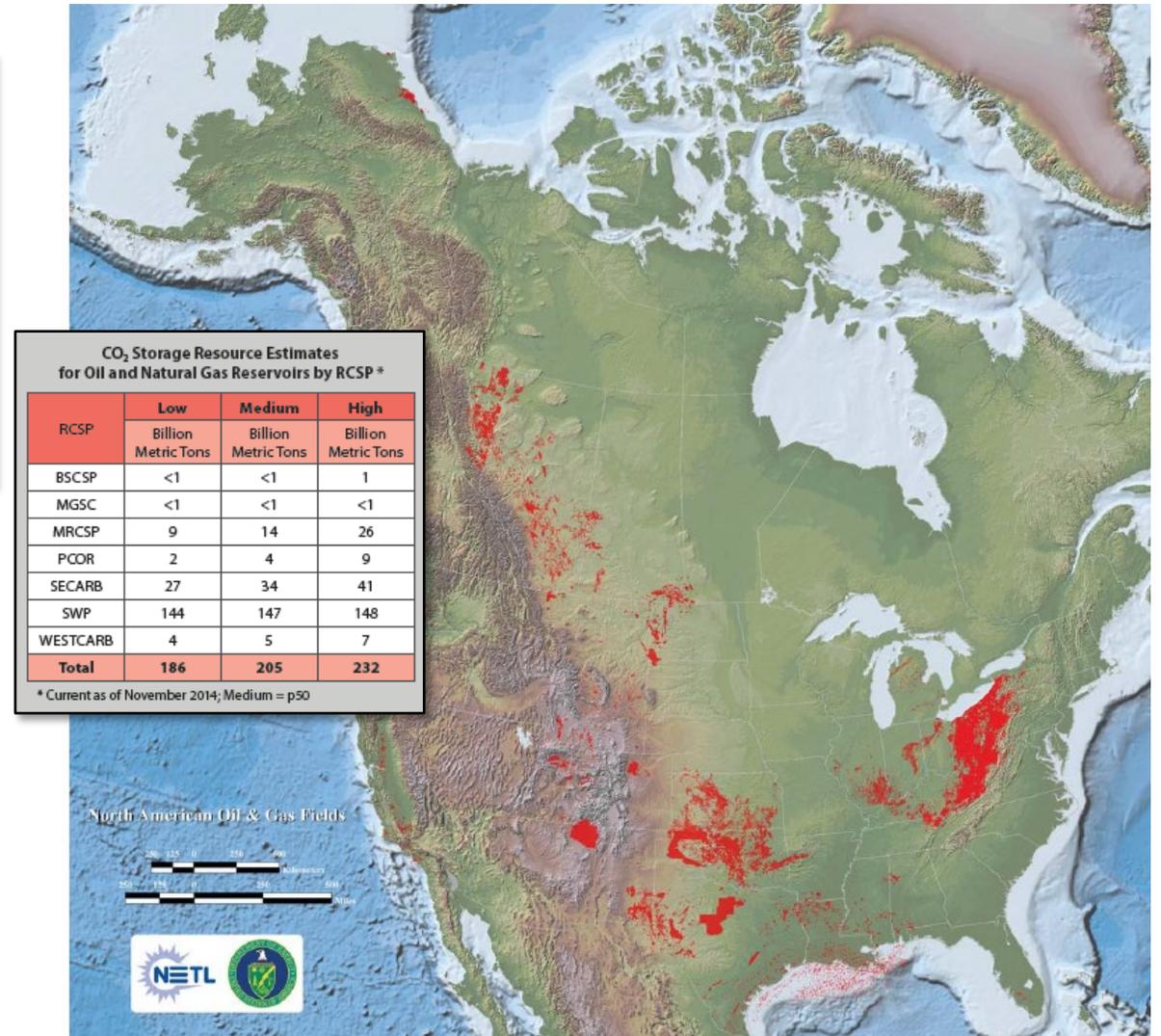
Example based on coastal Louisiana pressure and temperature trends



Regional Aquifer Prevalence



Carbon Sequestration Atlas of the US (DOE, 2015)

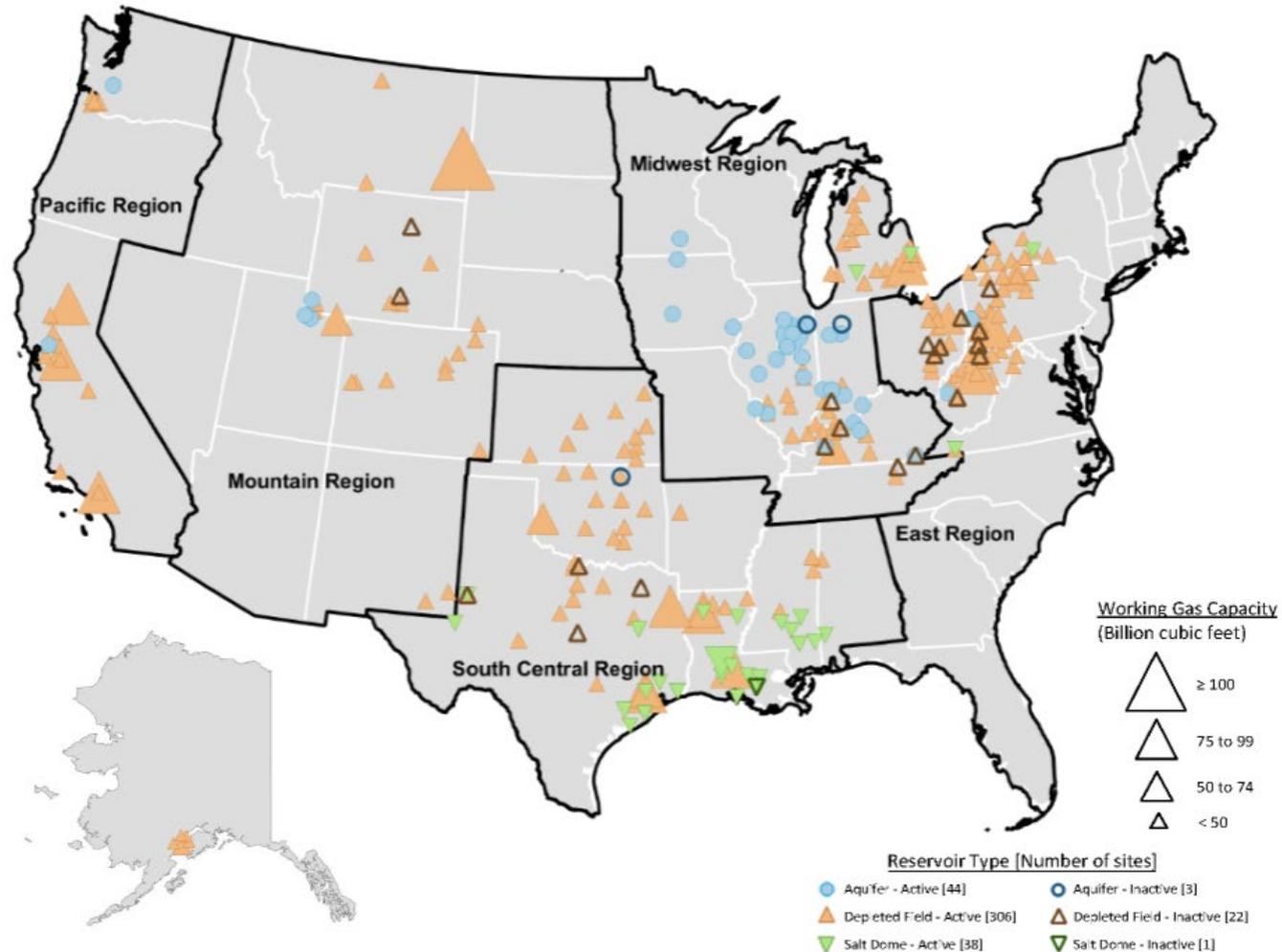


Carbon Sequestration Atlas of the US (DOE, 2015)



Underground Storage in the US

U.S. Underground Natural Gas Storage Facility, by Type (December 2017)

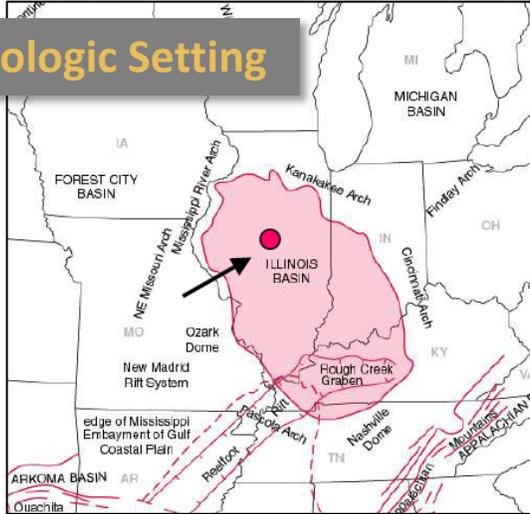


Source: U.S. Energy Information Administration



Characteristics of an Ideal Project

Geologic Setting

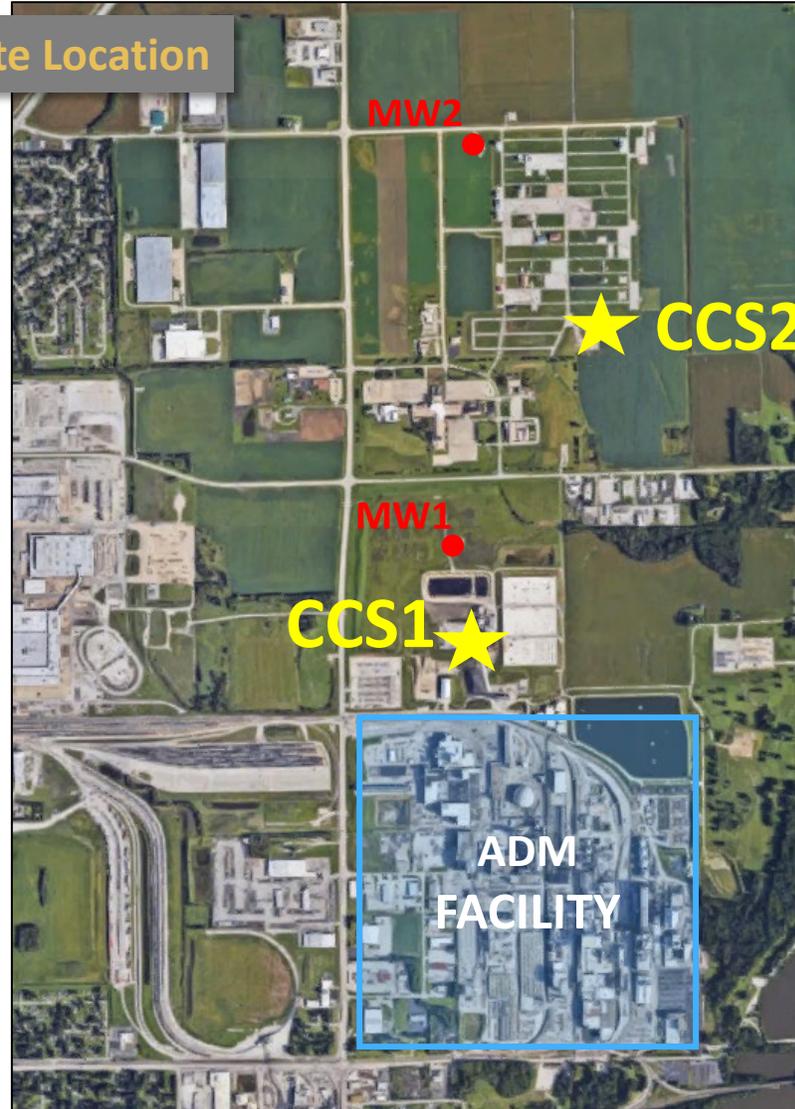


Source: Illinois Industrial Carbon Capture & Storage

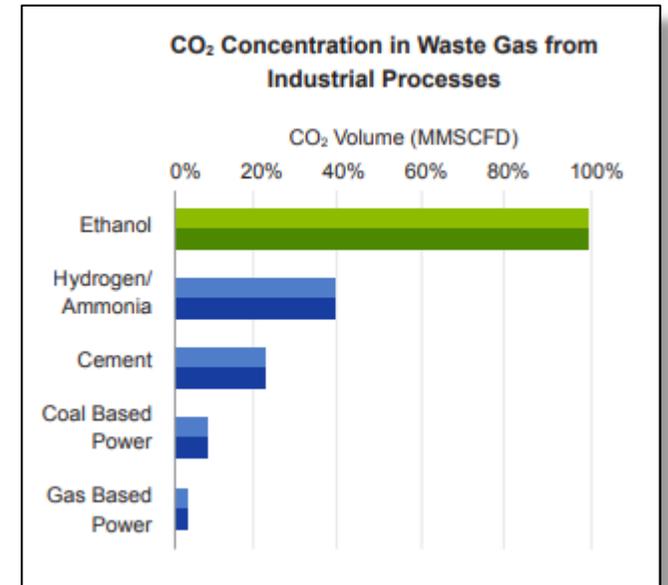
SYSTEM	GROUP	FORMATION	Storage Elements
Ordovician	Maquoketa	Brainard	Secondary Seal
		Ft. Atkinson	
		Scales	
	Galena	Kimmswick	Potential target
		Decorah	
	Ansell	Joachim	Secondary Seal/ Reservoir
St. Peter			
Cambrian	Knox	Shakoppee	Potential target
		New Richmond	
		Oneota	
		Gunter	
		Eminence	
Precambrian		Potosi	Primary Seal
		Franconia	
		Ironton-Galesville	Target reservoir
		Eau Claire	
		Mt. Simon	

Source: Illinois State Geological Survey

Site Location



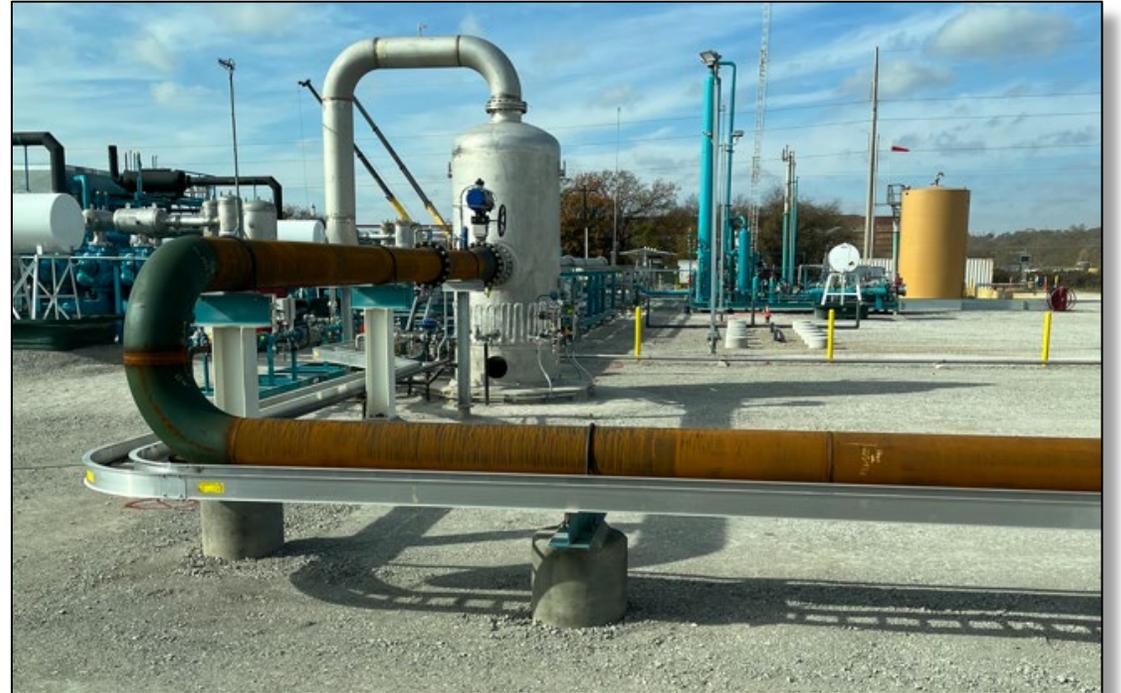
CO₂ Source



Source: DOE, "Capturing and Utilizing CO₂ from Ethanol"



Smaller Scale Project Example





SPE Storage Resources Management System Definitions

- Most language, logic, and methods follow PRMS
- "Capacity" replaces reserves
- Must be commercial
 - Storage fees
 - Tax credits
 - Government subsidies
 - **Coupled with revenue- and CO₂-generating project**
- Independent project evaluations with standard definitions protect capital

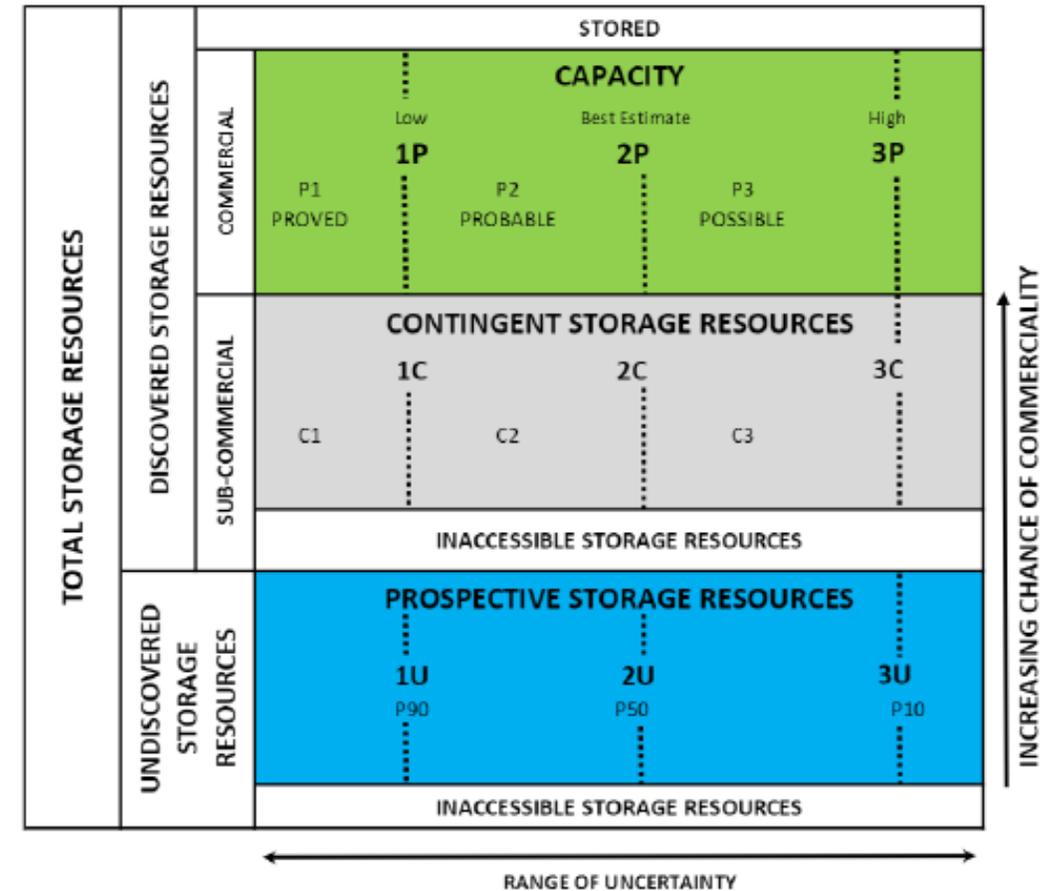
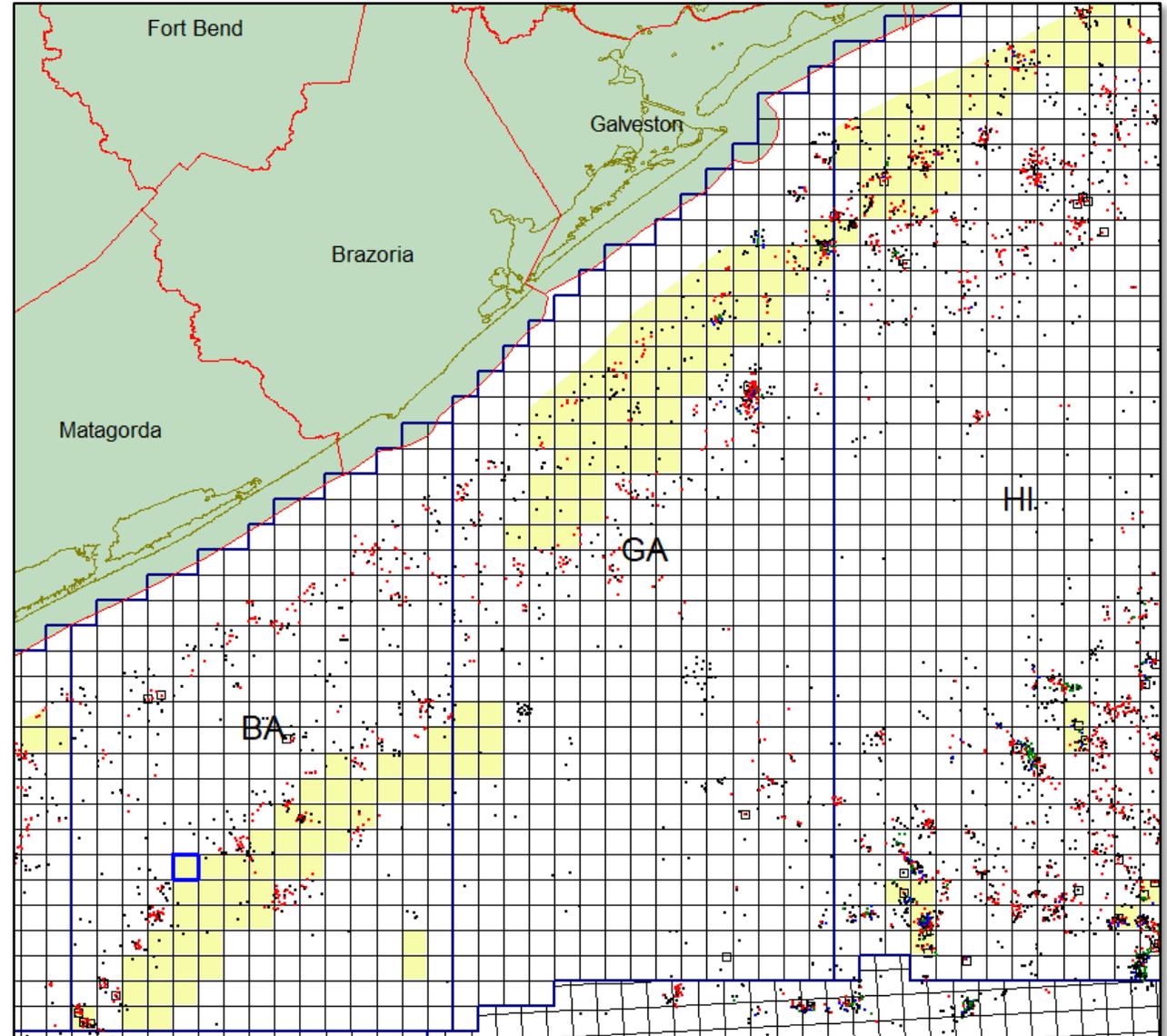


Fig. 1.1 – Resources Classification Framework

PORE SPACE LEASE TERMS

Pore Volume Leases – Federal Offshore Leases

- ExxonMobil leased several large tracts in shallow water
- BOEM royalty rules for CCS not finalized as of February 2025 (was expected last year)



Source: OWL

Lease Year	Acres	Bonus (\$)	Bonus Rate (\$/acre)
2021	541,440	14,889,600	27.5
2023	307,946	9,779,750	31.8



Pore Volume Leases – Gulf Coast State Leases

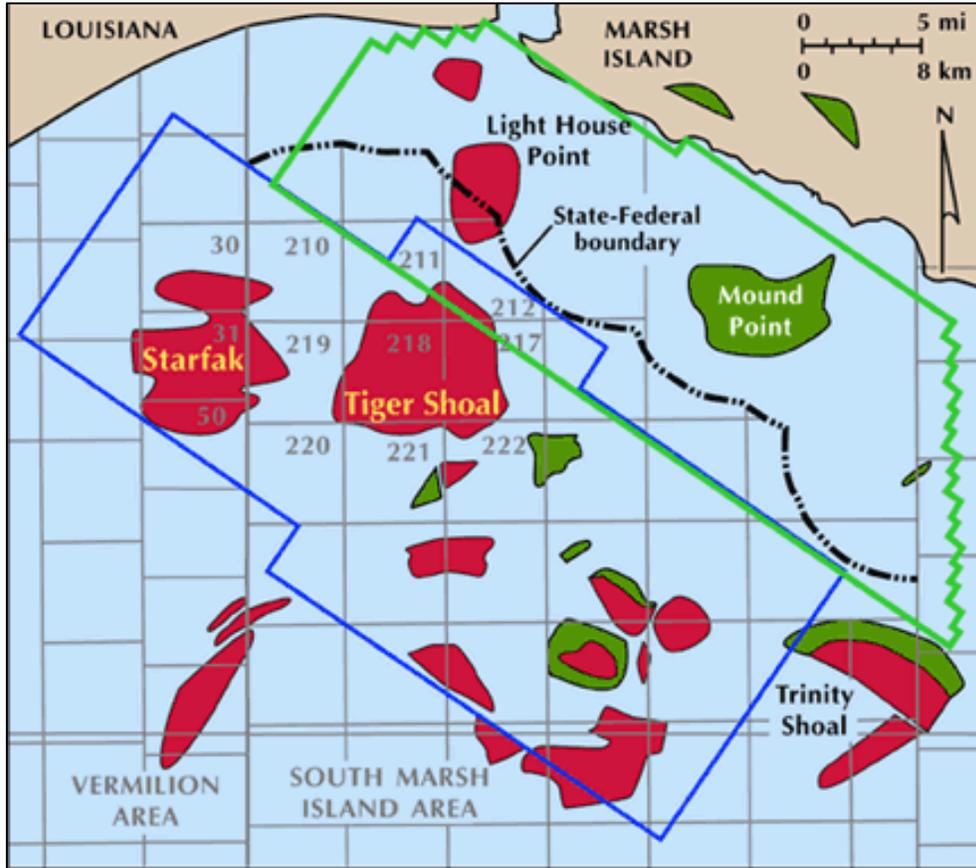
- Louisiana and Texas have issued several CCS leases covering state waters and onshore areas with details in the public domain
 - Include bonus and annual rental components
 - TX royalty is a % of revenue
 - LA fixed rates scale up but not down with federal tax incentive changes

Year	State	Lessee	Leased Area	Acres	Bonus \$/acre	Royalty \$/tonne*
2021	LA	Capio	Maurepas WMA	32,711	39	3.35
2021	LA	Capio	Sherburn WMA	11,800	21	3.35
2021	LA	Air Products	Maurepas, Sabine Lake	122,455	50	4.65
2022	TX	Bayou Bend	Jefferson GOM	40,380	334	2.55 - 5.10
2022	LA	Venture Global	Plaquemine	9,103	100	6.5
2022	LA	Venture Global	Cameron GOM	18,023	171	6.5
2023	LA	High West Sequestration	Salvador WMA	21,079	425	7.5
2023	LA	Castex Carbon	Cameron GOM	24,181	300	7.5

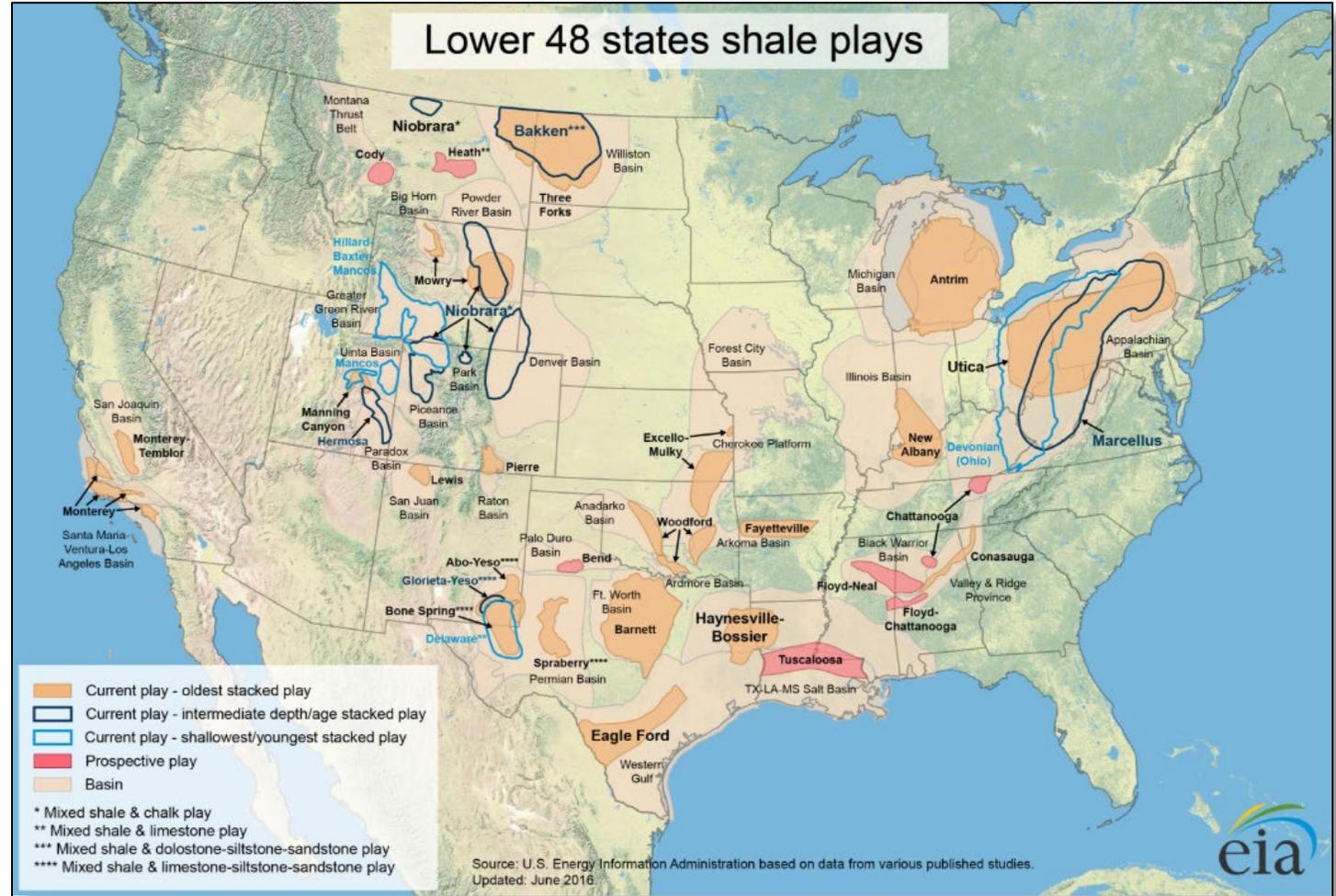
POTENTIAL ACREAGE VALUE DRIVERS



Comparison to Oil & Gas Acreage



Source: UT Bureau of Economic Geology

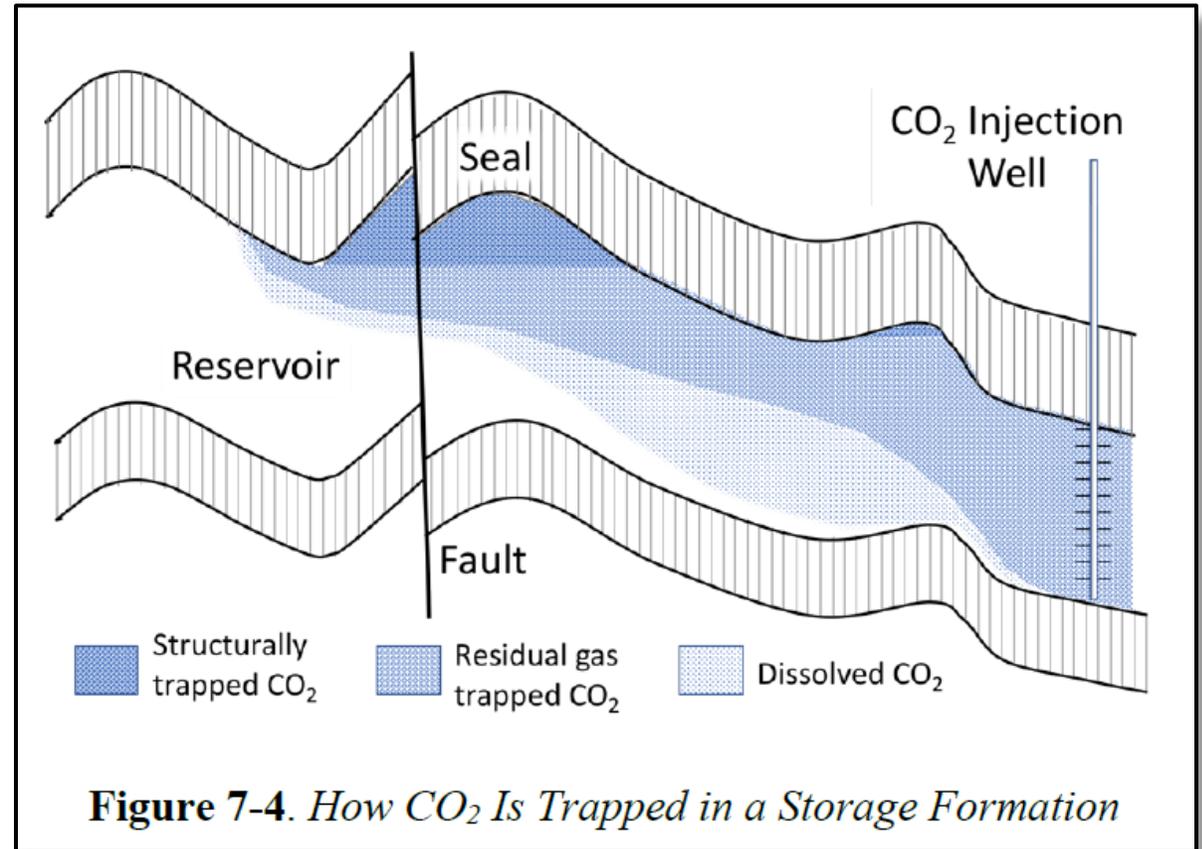


Source: US Energy Information Administration



Geologic Factors Define Storage Resources Per Acre

- High confidence confining layer
- Rock properties influence **storage efficiency (tonnes/acre)** of target interval
 - Porosity
 - Permeability, homogeneity
 - Net-to-gross ratio
 - Thickness
 - Aerial continuity
- Faulting/Structure
- Storage interval depth determines compression costs
- Lack of seismic activity

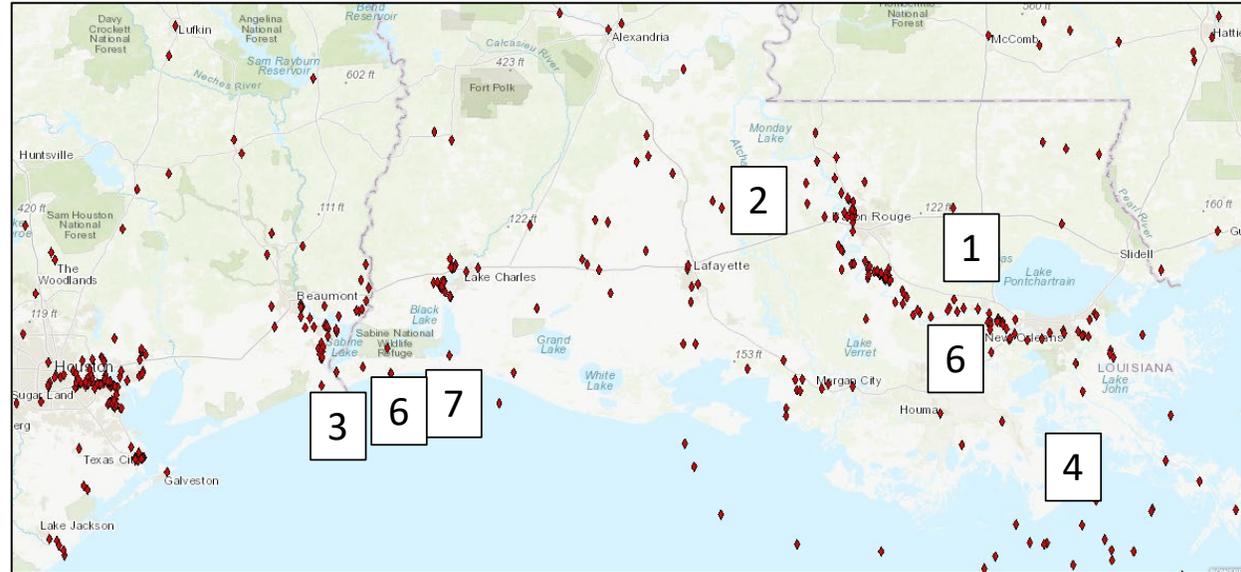


Source: Meeting the Dual Challenge (NPC)



Location, Location, Location

- Proximity to emission sources increases value (reduces transportation costs)

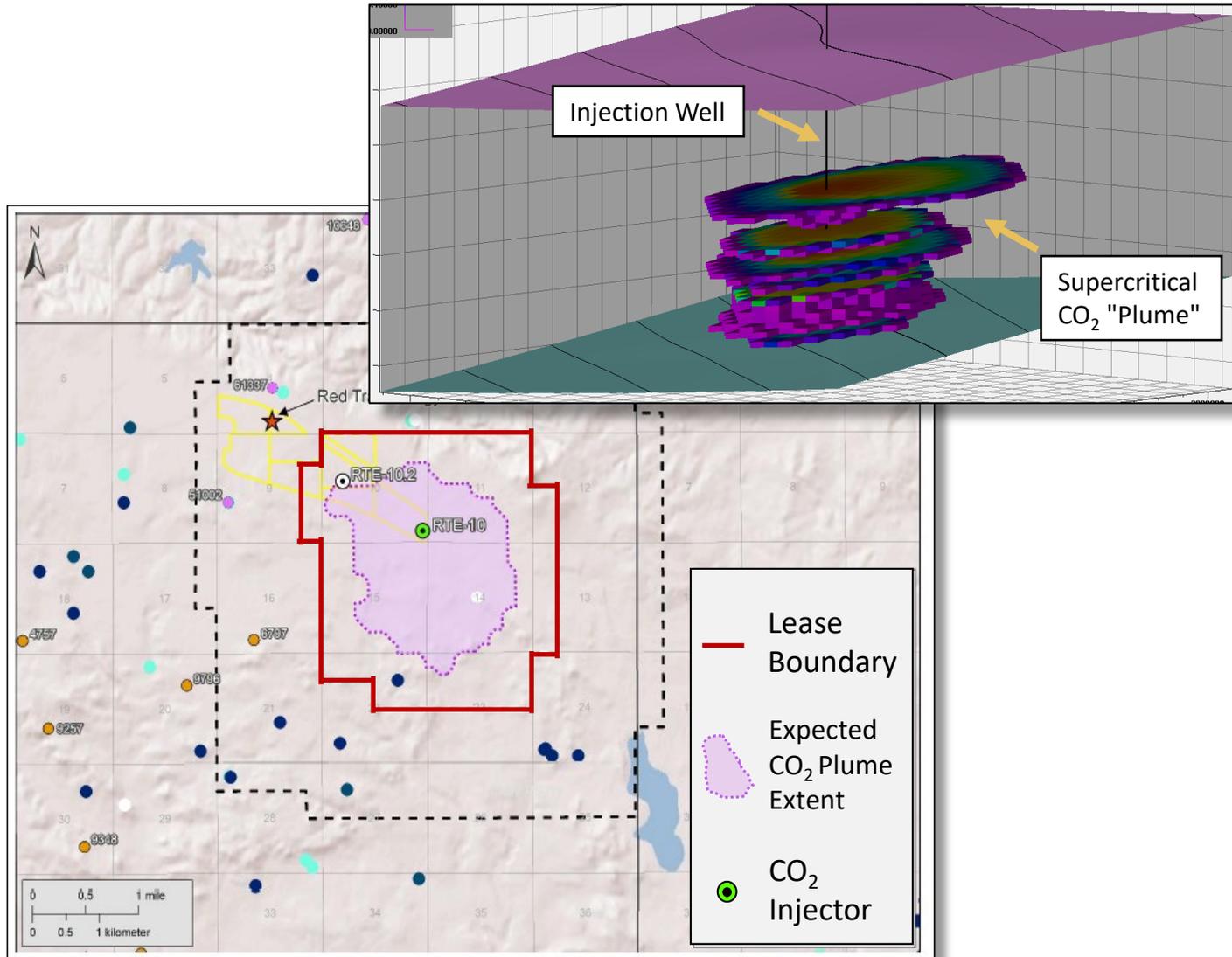


- Operating and development well expenses vary significantly by environment
 - Costs impact project economics & likelihood of development

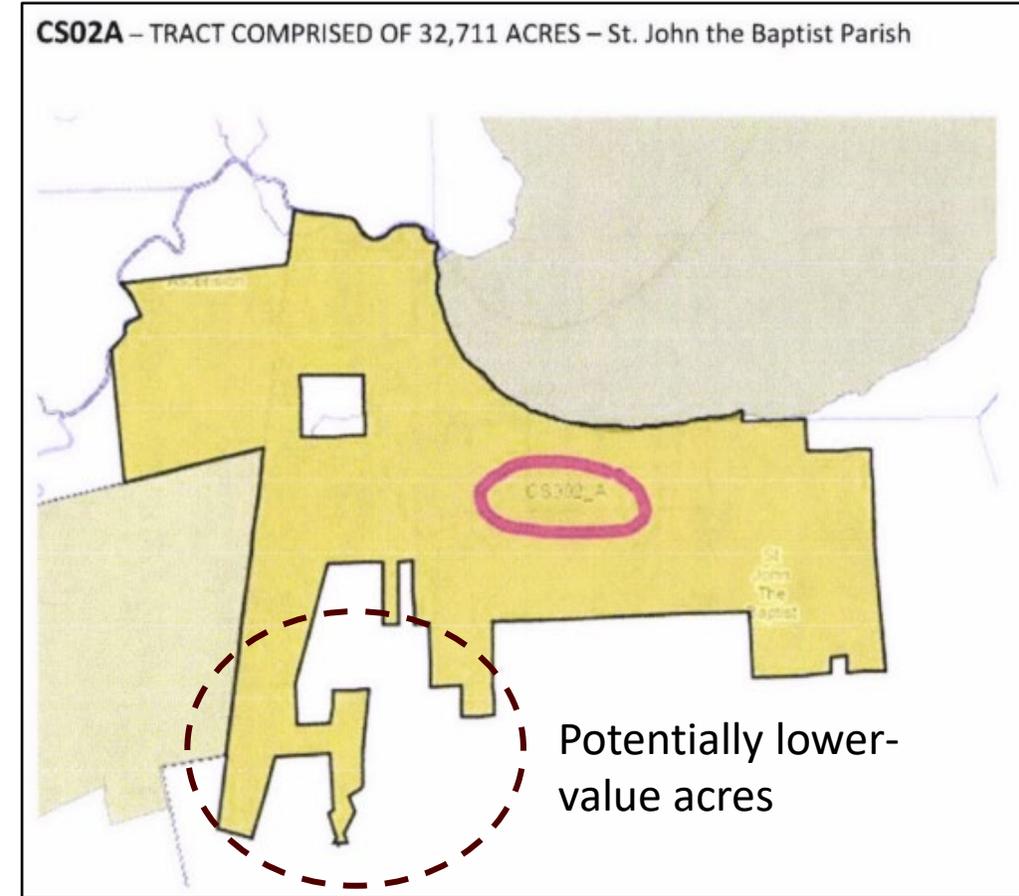




Lease Geometry & CO₂ Plume



Modified from Red Trail Energy Class VI Permit



Source: LA Carbon-Dioxide Storage Agreement CS02A



Land Complexity

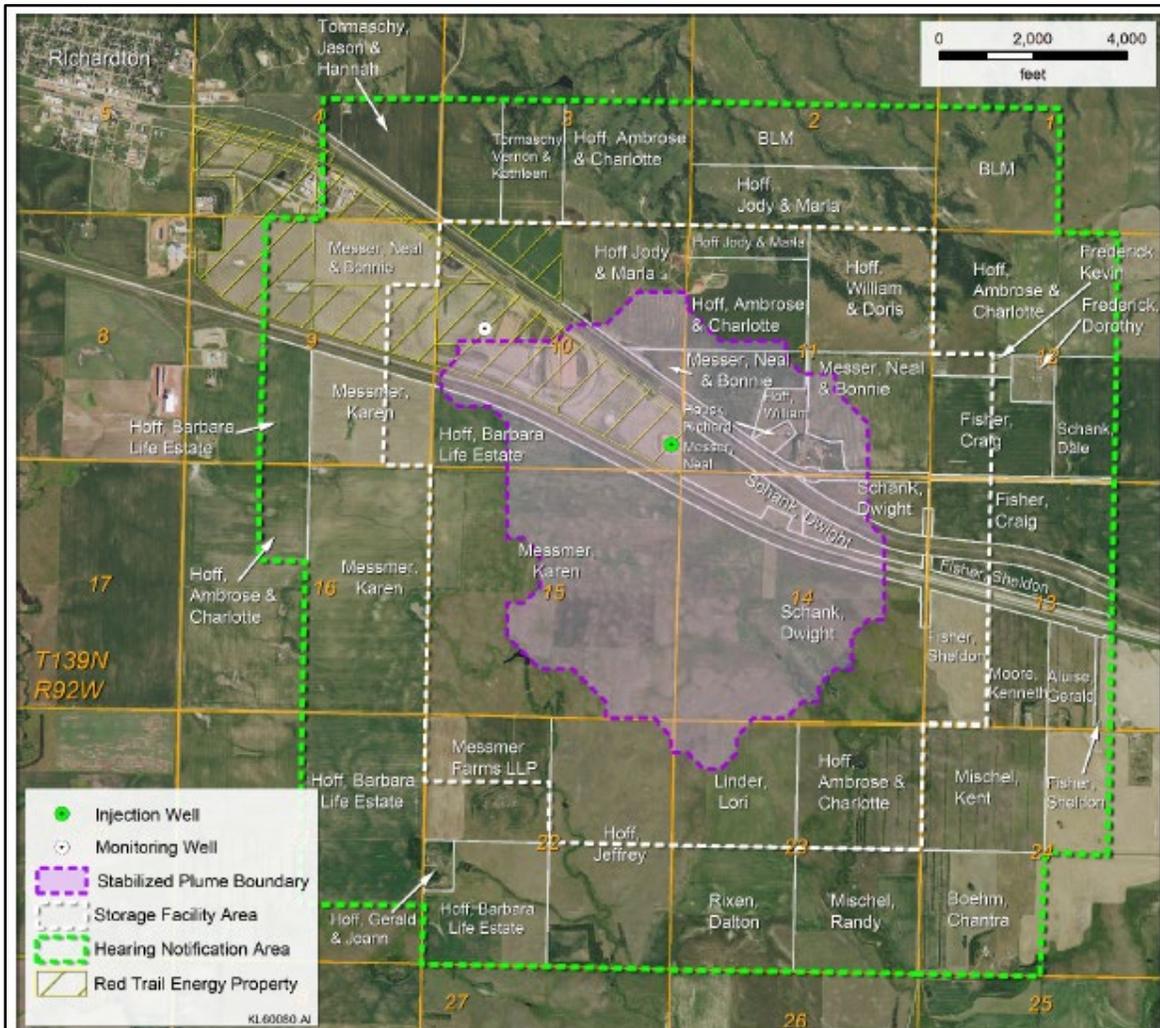
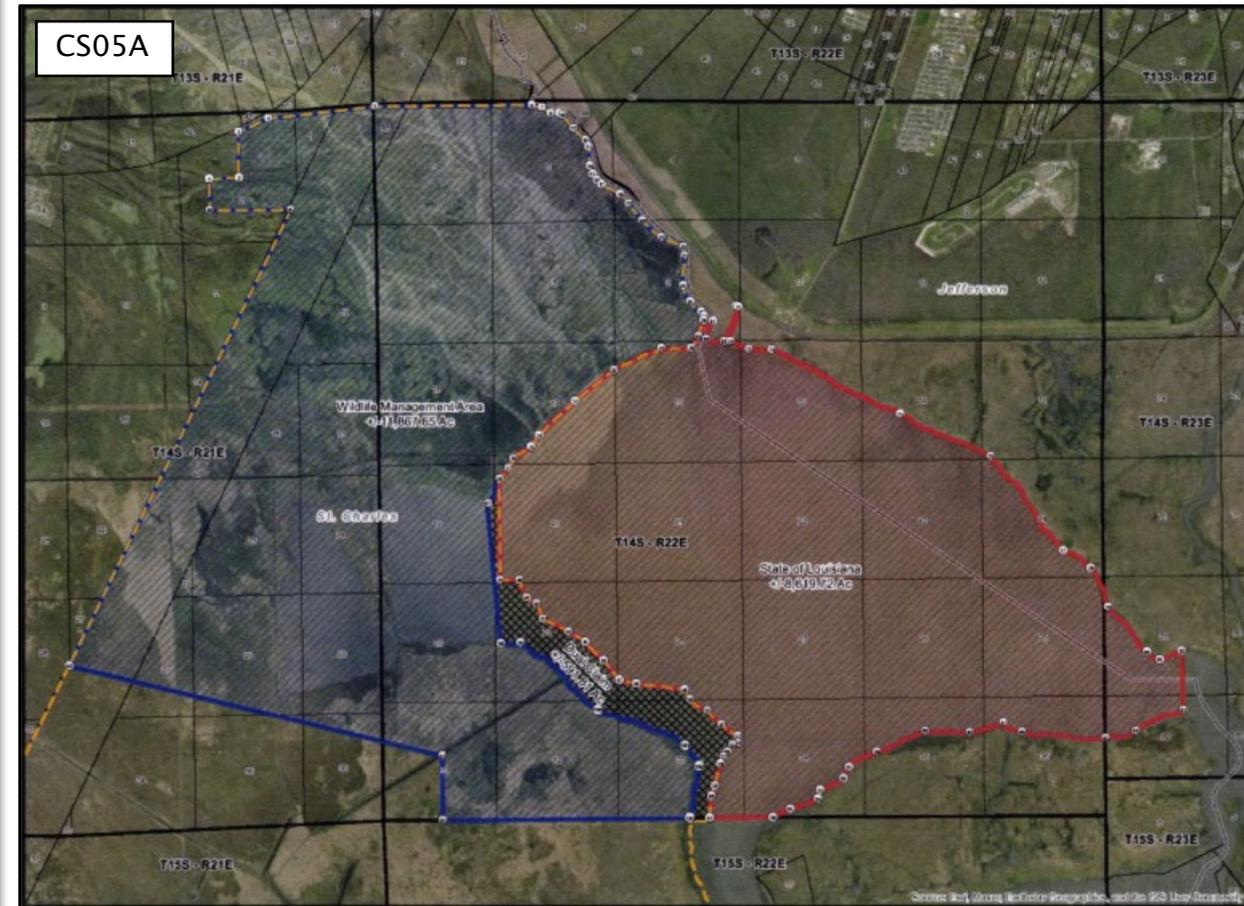


Figure 1-2. Hearing notification area for landowners within 1/2 mile of the storage facility area.

Source: Red Trail Energy Class VI Permit



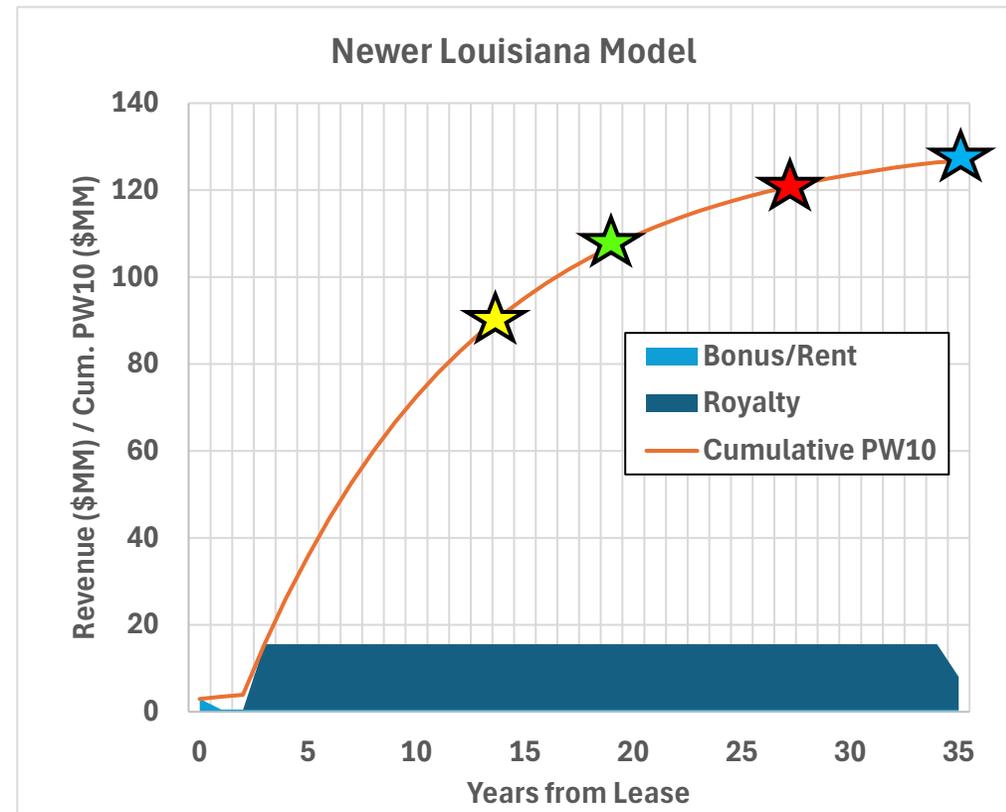
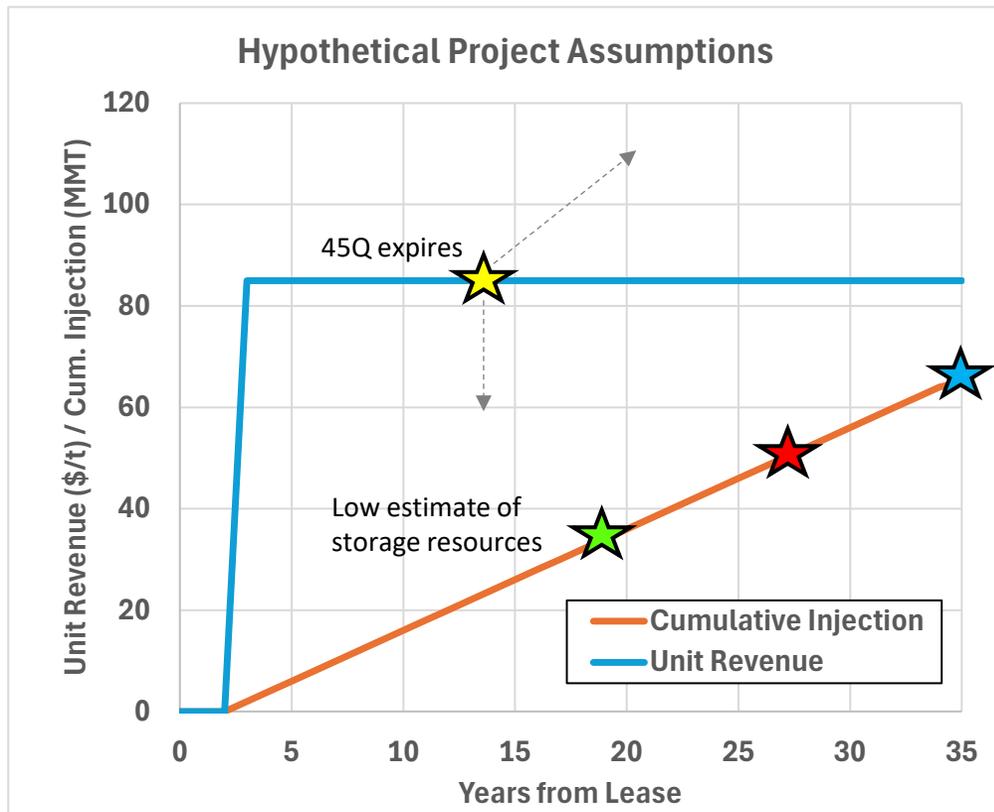
Source: LA Carbon-Dioxide Storage Agreement CS05A

DISCOUNTED CASH FLOW APPROACH TO VALUING PORE SPACE



Hypothetical Example

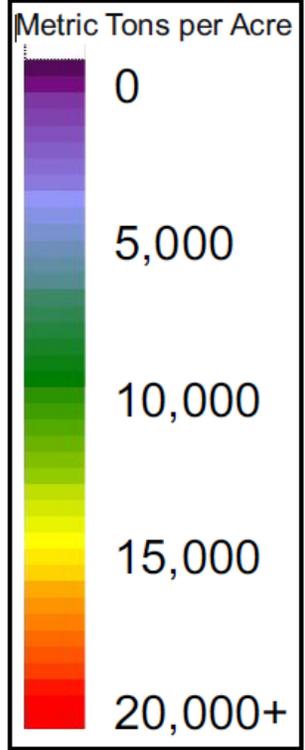
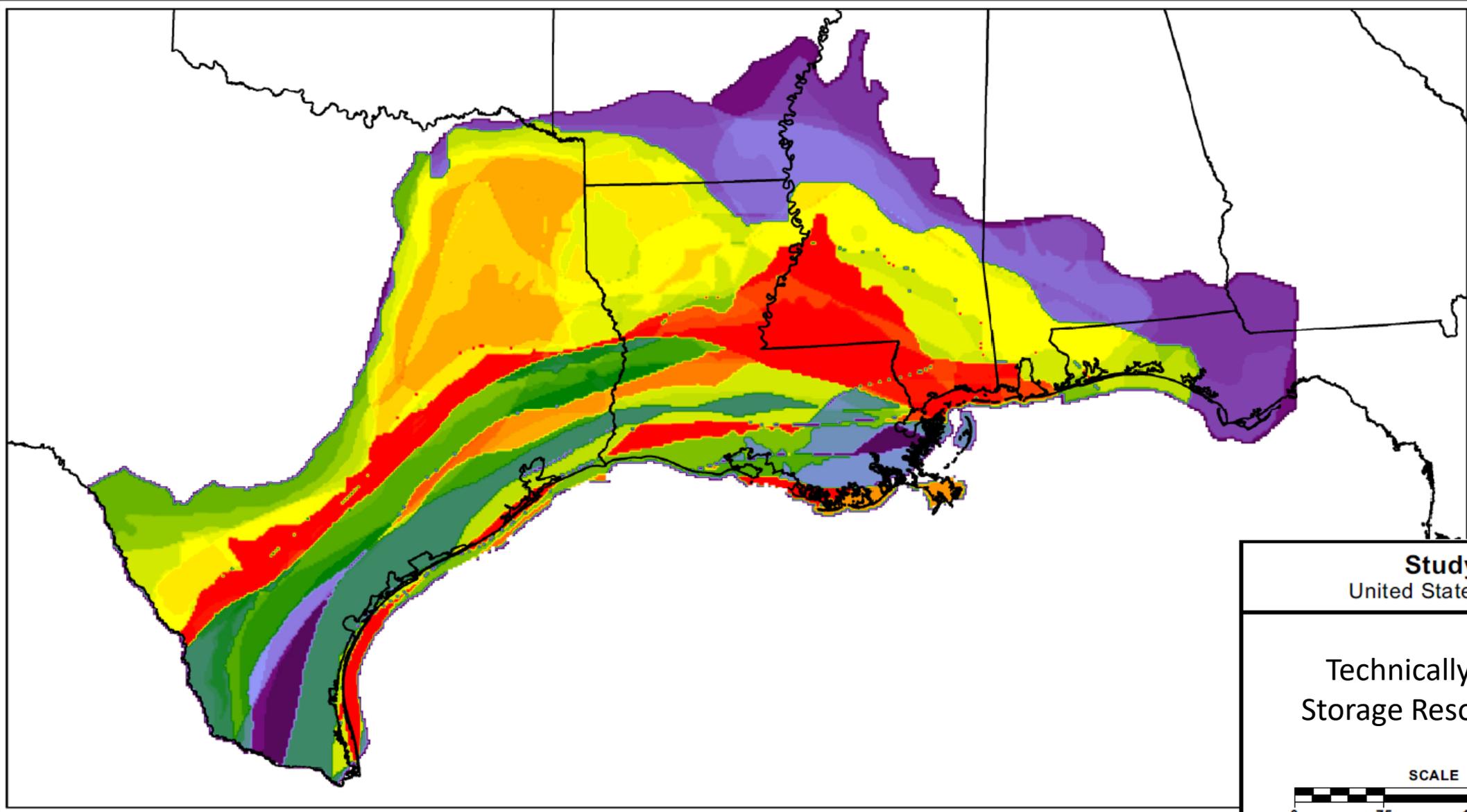
- 10,000 acres; best estimate of 5,000 tonnes/acre contingent storage resources (low estimate 3,500, high estimate 6,500)
- High quality reservoir, operator plans to inject 2 MMT/yr with several wells





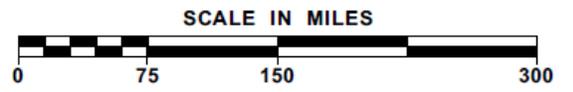
Discount Rate / Risk Factor Considerations

- Most US projects are still contingent resources pending key milestones:
 - Emissions offtake agreement(s)
 - Demonstration of economic viability
 - Pore space unitization or lease agreements
 - Key regulatory approvals / permits
 - Project financing
 - Final investment decisions (FID)
- Projects are potentially subject to delays, cancellations, and suspensions
 - Navigator – regulatory challenges
 - Gorgon – surface and subsurface technical challenges
 - PetraNova – economic challenges (coal fired power)
- Well designed projects may have more certainty than oil & gas, **once online**
 - Price stability (for at least 12 years)
 - Relatively certain & stable profile if injectivity and storage resources >> emissions



Study Area
United States Gulf Coast

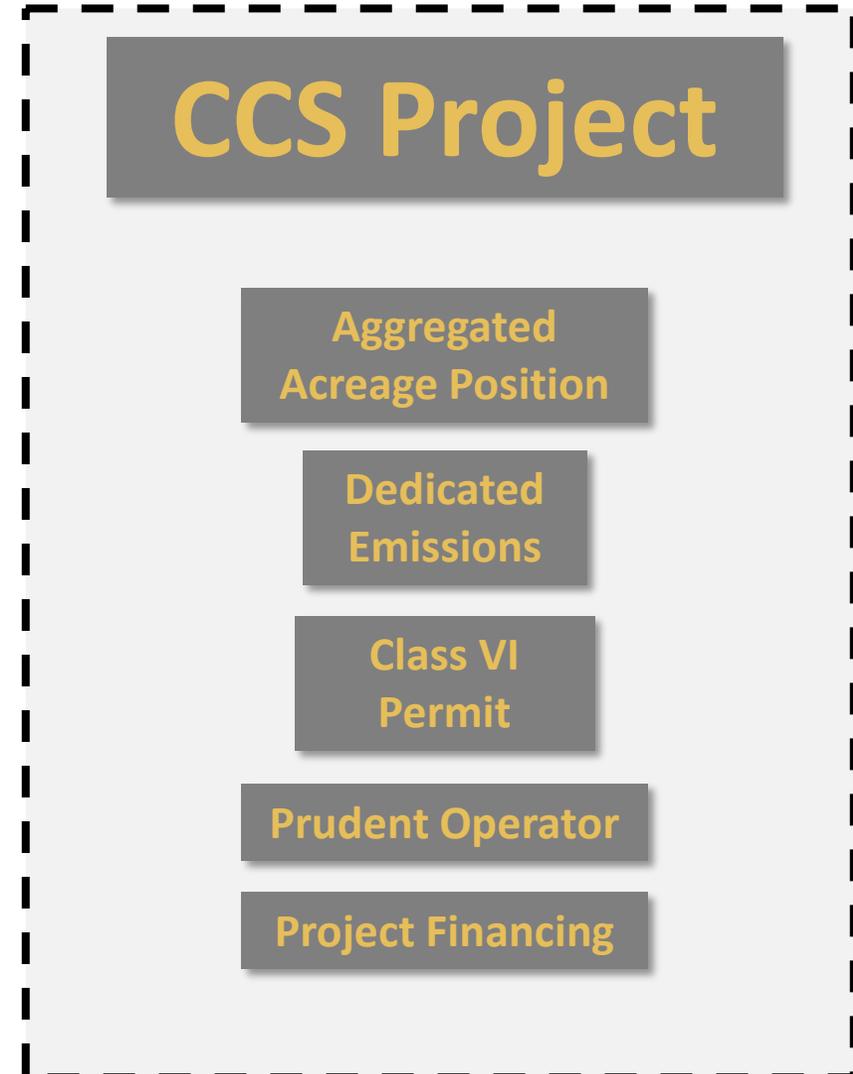
Technically Accessible
Storage Resource Density





What's an Acre Worth?

- Estimates of storage resources, development plans can be used to make cash flow estimates
- US saline storage resources are vast relative to demand
 - Qualities that make acreage desirable also tend to make it fungible
- Suggest that **CCS projects create value for acreage**
- Pore space acreage has little/no intrinsic value absent a development project
- Value of acreage grows as projects mature (risk decreases)



Q&A