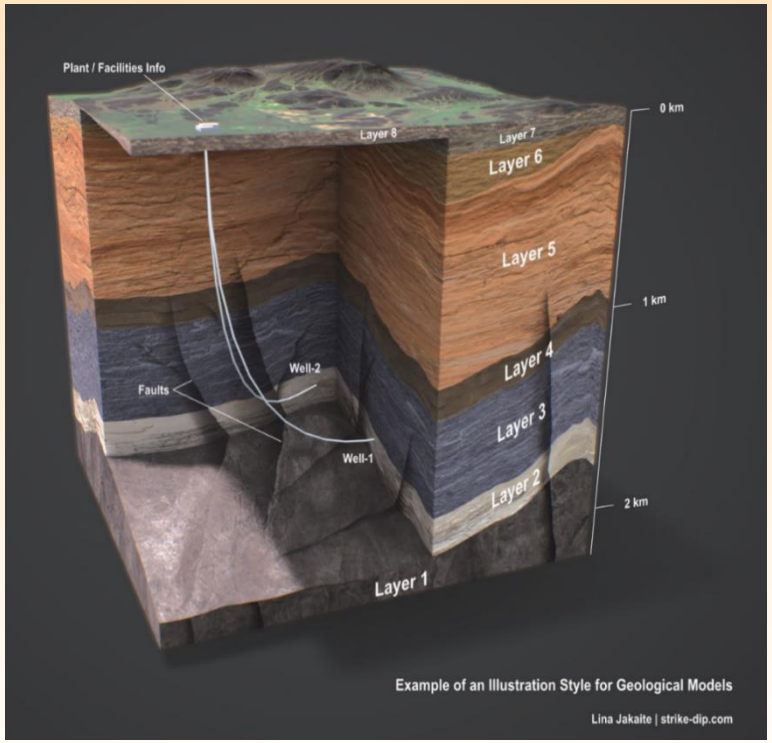
CCS Landscape – Gulf Coast



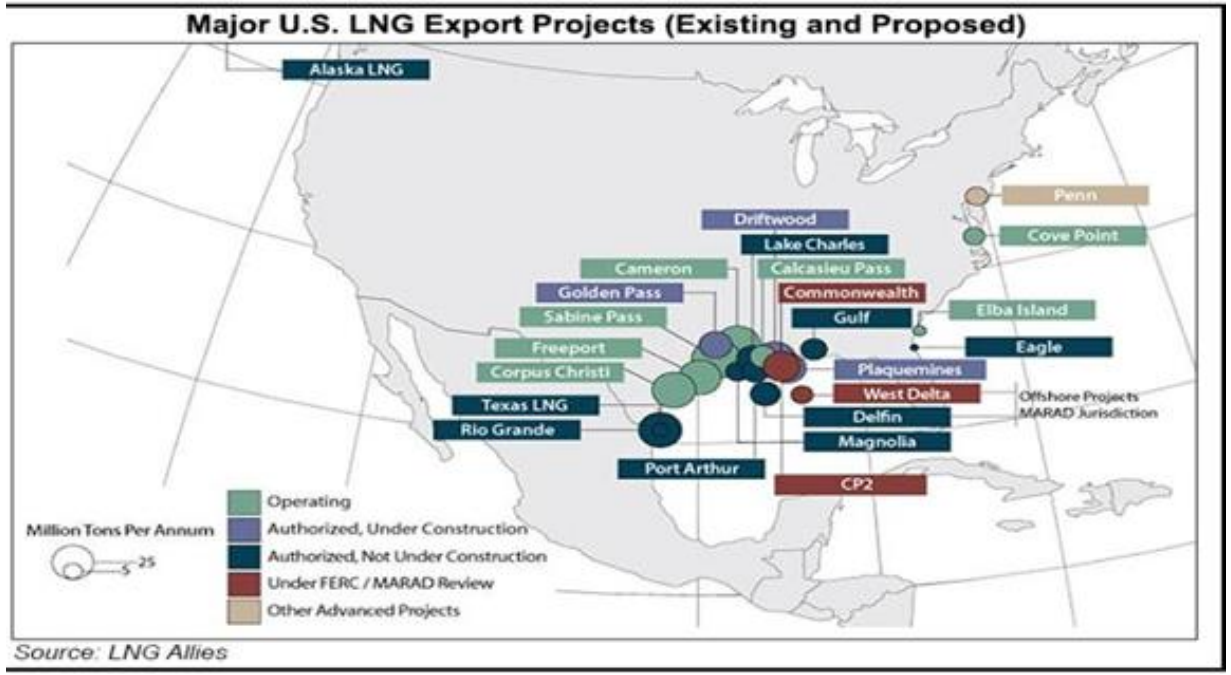
Dr. Tip Meckel
Senior Research Scientist

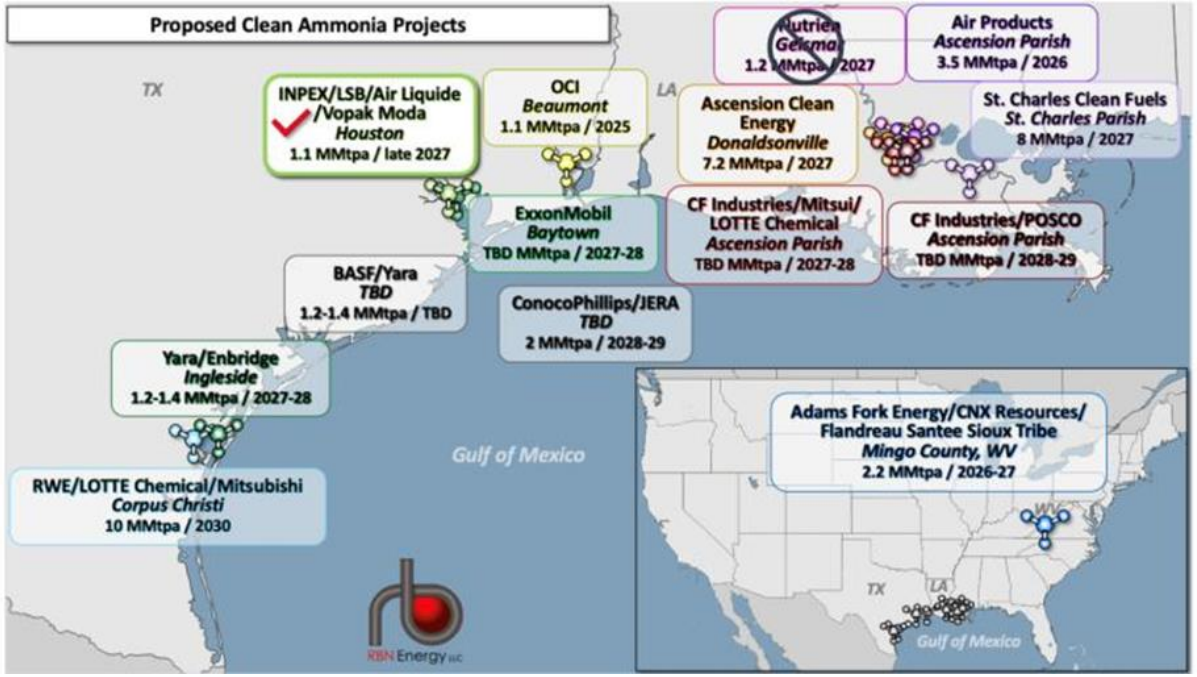
GCCC
GULF COAST CARBON CENTER

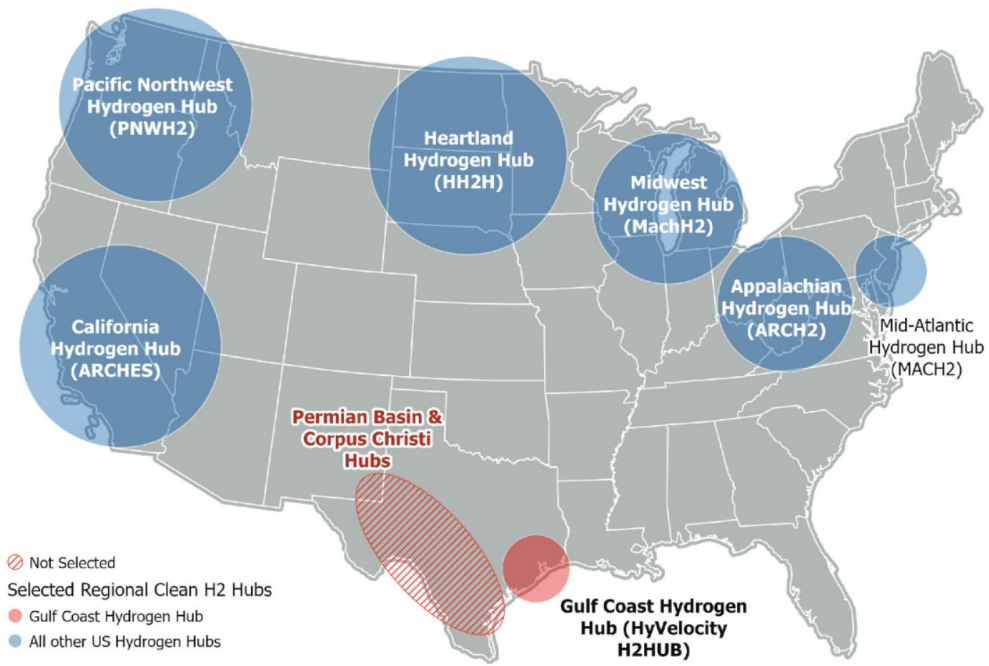
Bureau of Economic Geology

September 17, 2024

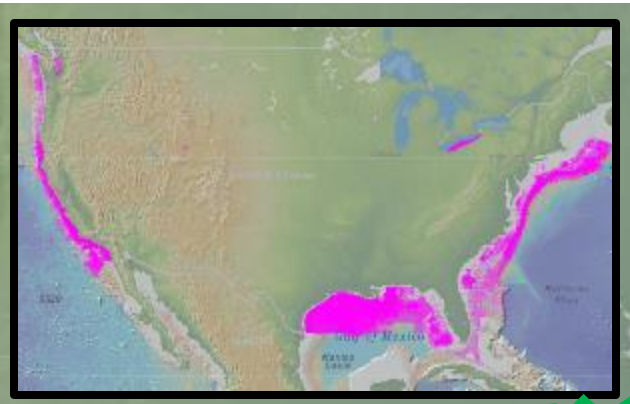
Bureau of Economic Geology


Major U.S. LNG Export Projects (Existing and Proposed)
Alaska LNG
Penn
Cove Point
Driftwood
Lake Charles
Cameron
Calcasieu Pass
Golden Pass
Commonwealth
Sabine Pass
Gulf
Elba Island
Freeport
Eagle
Corpus Christi
Plaquemines
West Delta
Texas LNG
Offshore Projects
MARAD Jurisdiction
Rio Grande
Delfin
Magnolia
Port Arthur
CP2
Million Tons Per Annum
5
25
Operating
Authorized, Under Construction
Authorized, Not Under Construction
Under FERC / MARAD Review
Other Advanced Projects
Source: LNG Allies


Proposed Clean Ammonia Projects
TX
LA
Nutrien
Geisma
1.2 MMtpa / 2027
Air Products
Ascension Parish
3.5 MMtpa / 2026
INPEX/LSB/Air Liquide
/Vopak Moda
Houston
1.1 MMtpa / late 2027
OCI
Beaumont
1.1 MMtpa / 2025
Ascension Clean
Energy
Donaldsonville
7.2 MMtpa / 2027
St. Charles Clean Fuels
St. Charles Parish
8 MMtpa / 2027
ExxonMobil
Baytown
TBD MMtpa / 2027-28
CF Industries/Mitsui/
LOTTE Chemical
Ascension Parish
TBD MMtpa / 2027-28
CF Industries/POSCO
Ascension Parish
TBD MMtpa / 2028-29
BASF/Yara
TBD
1.2-1.4 MMtpa / TBD
ConocoPhillips/JERA
TBD
2 MMtpa / 2028-29
Yara/Enbridge
Ingleside
1.2-1.4 MMtpa / 2027-28
Gulf of Mexico
Adams Fork Energy/CNX Resources/
Flandreau Santee Sioux Tribe
Mingo County, WV
2.2 MMtpa / 2026-27
WV
TX
LA
Gulf of Mexico
RWE/LOTTE Chemical/Mitsubishi
Corpus Christi
10 MMtpa / 2030
RBN Energy LLC


Pacific Northwest
Hydrogen Hub
(PNWH2)
Heartland
Hydrogen Hub
(HH2H)
Midwest
Hydrogen Hub
(MachH2)
Appalachian
Hydrogen Hub
(ARCH2)
Mid-Atlantic
Hydrogen Hub
(MACH2)
California
Hydrogen Hub
(ARCHES)
Permian Basin &
Corpus Christi
Hubs
Not Selected
Selected Regional Clean H2 Hubs
Gulf Coast Hydrogen Hub
All other US Hydrogen Hubs
Gulf Coast Hydrogen
Hub (HyVelocity
H2HUB)

Gulf Coast CCS toward 2050: LNG/NH_3 + CCS

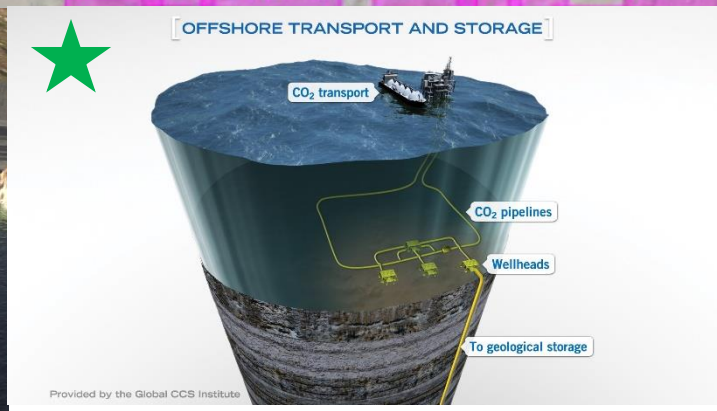


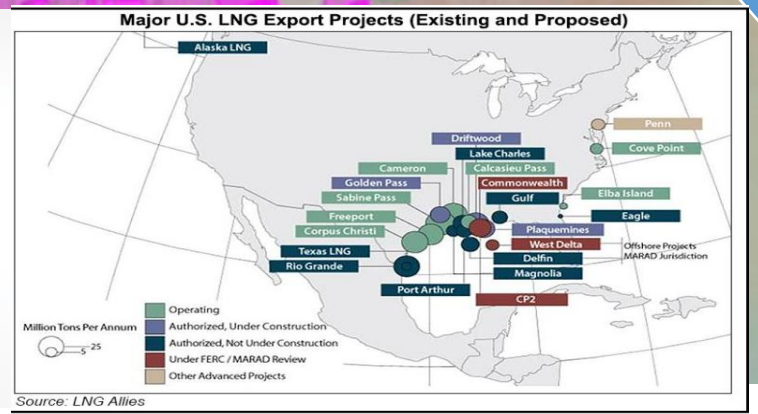
NAMMS Data

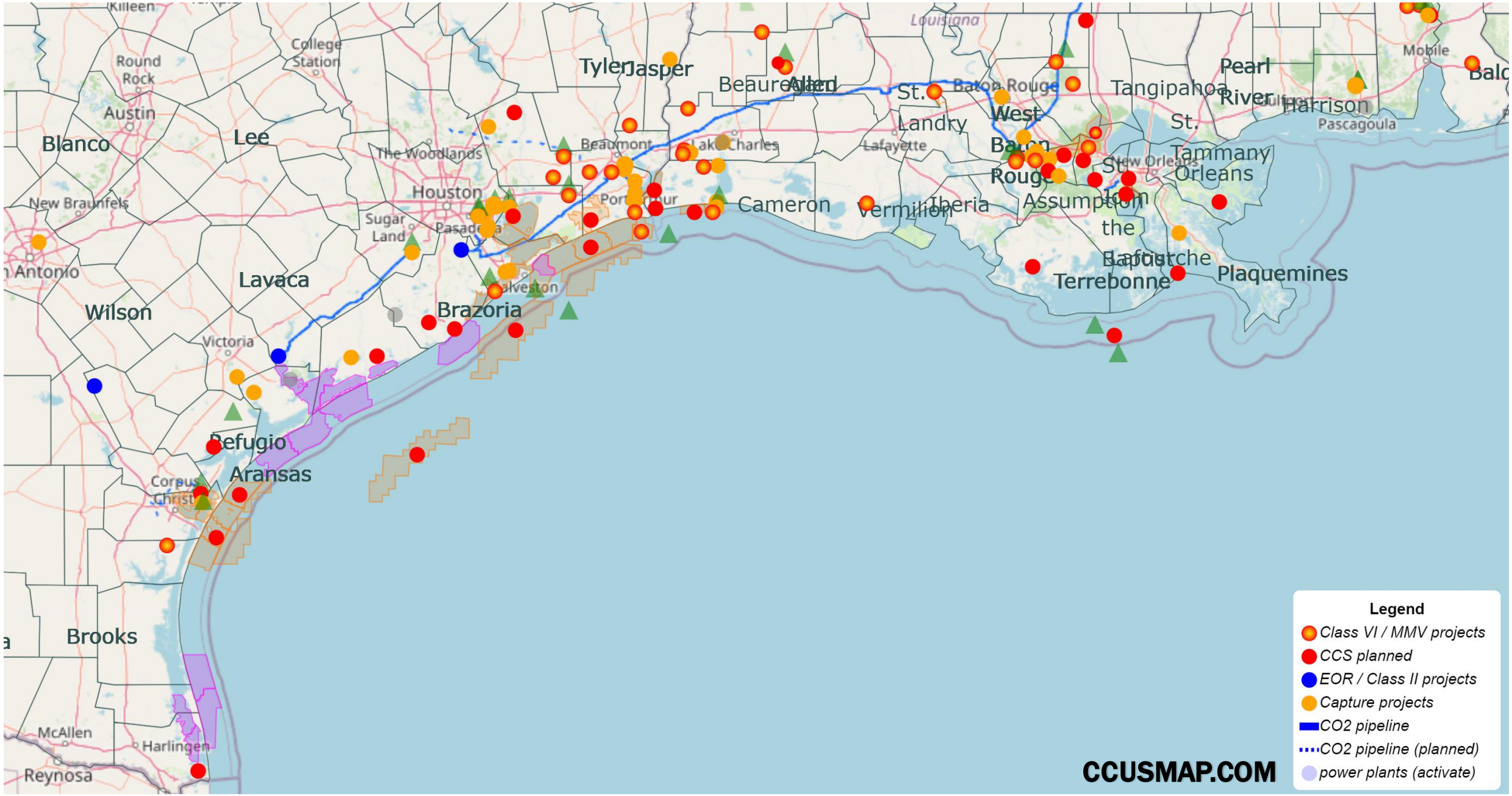
Publicly Available

LNG + NH3 EXPORT

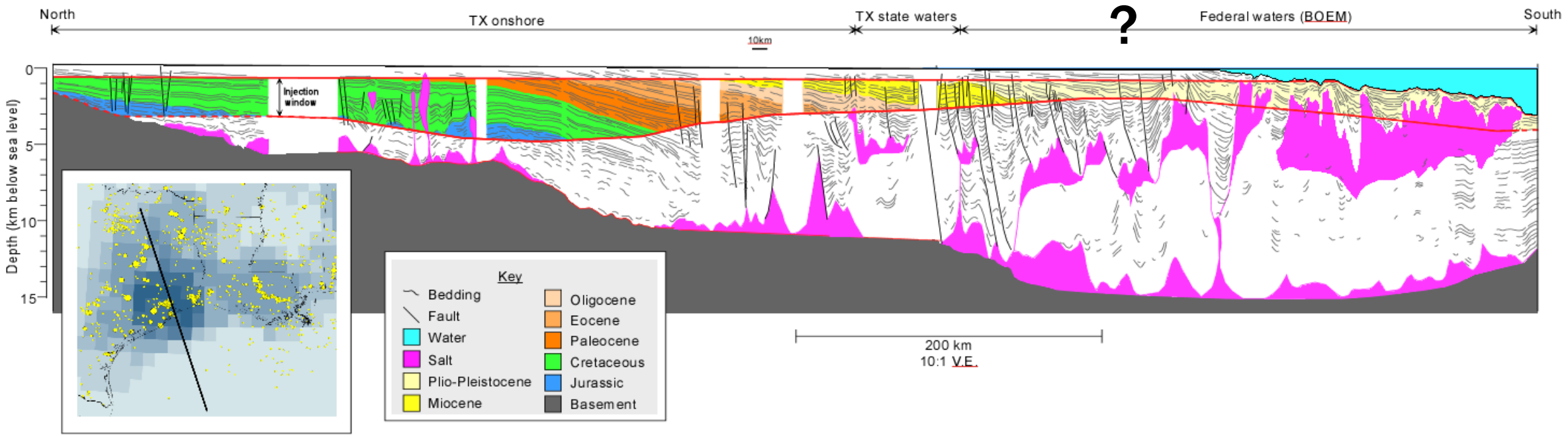
CO_2 IMPORT






Killeen
Round Rock
College Station
Austin
Blanco
Lee
Tyler
Jasper
Beaumont
Lake Charles
Lafayette
Louisiana
Mobile
Pearl River
Harrison
Pascagoula
Tangipahoa
St. Tammany
Orleans
New Orleans
Baton Rouge
West Baton Rouge
St. Landry
Iberia
Vermilion
Cameron
Assumption
Lafourche
Terrebonne
Plaquemines
The Woodlands
Houston
Sugar Land
Pasadena
Galveston
New Braunfels
Antonio
Lavaca
Wilson
Brazoria
Victoria
Refugio
Aransas
Corpus Christi
Brooks
McAllen
Harlingen
Reynosa
Legend
Class VI / MMV projects
CCS planned
EOR / Class II projects
Capture projects
CO2 pipeline
CO2 pipeline (planned)
power plants (activate)
CCUSMAP.COM

Geology Available for Carbon Storage



Top of overpressure: Burke et al, 2012

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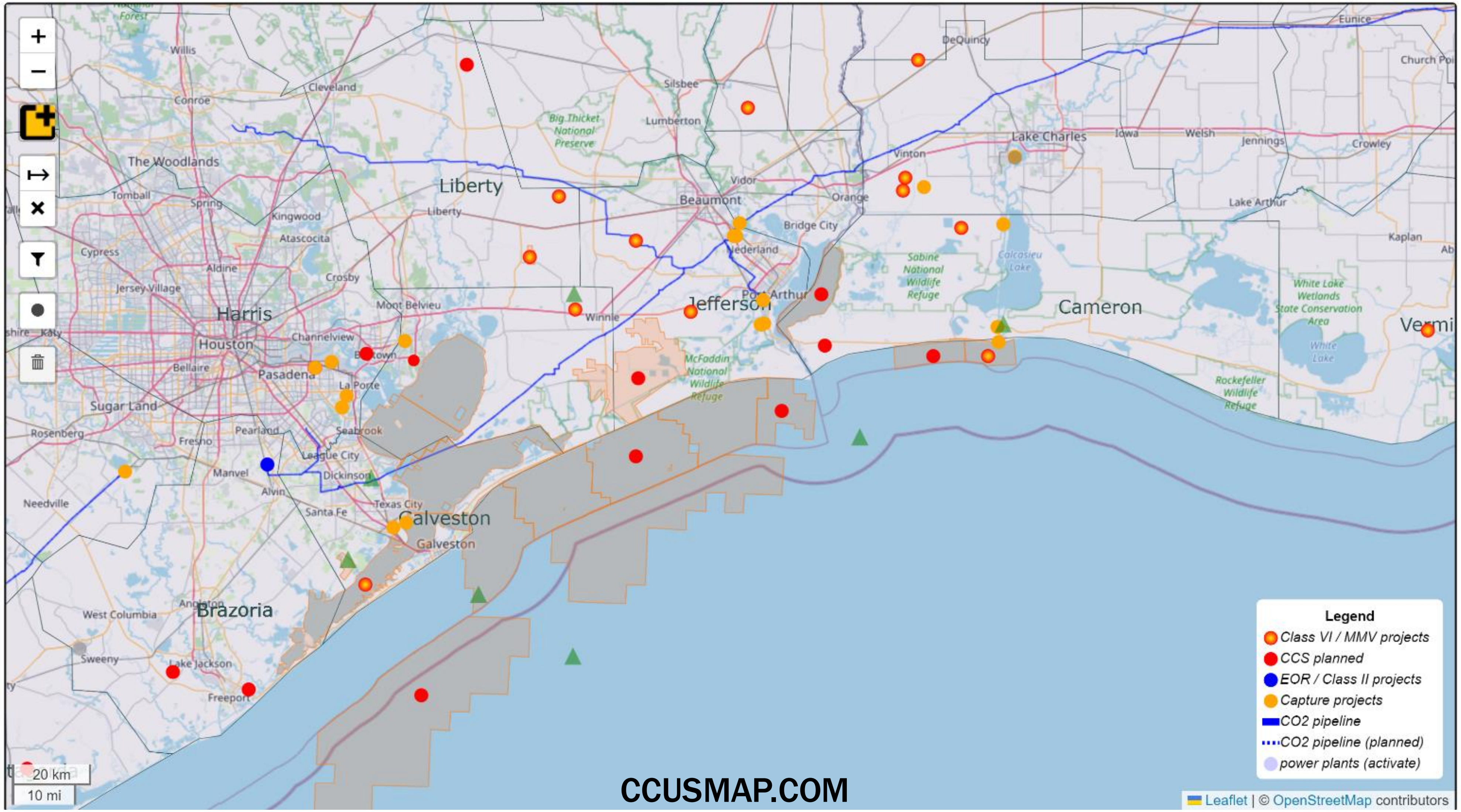
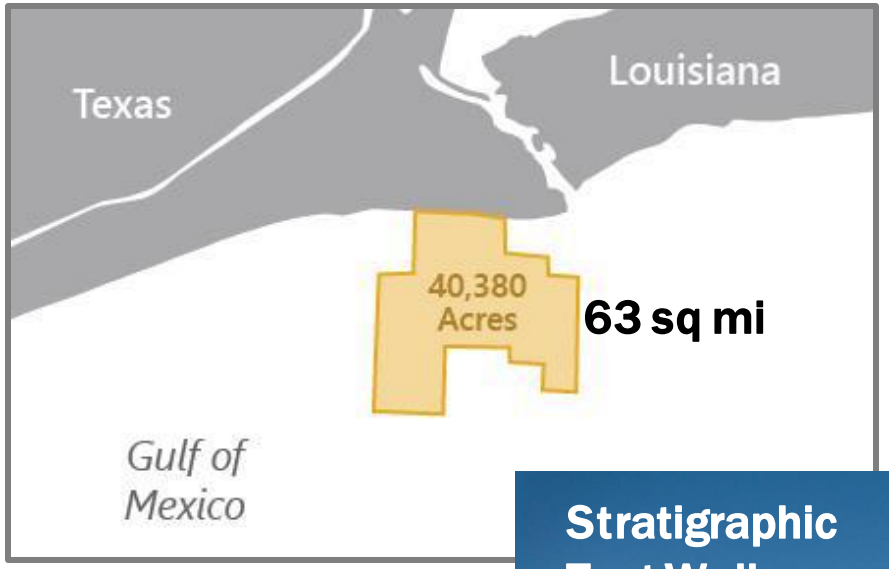

Legend
Class VI / MMV projects
CCS planned
EOR / Class II projects
Capture projects
CO2 pipeline
CO2 pipeline (planned)
power plants (activate)
Harris
Houston
Liberty
Jefferson
Beaumont
Port Arthur
Galveston
Brazoria
Cameron
Lake Charles
Orange
Pasadena
Sugar Land
The Woodlands
Conroe
Texas City
Freeport
Big Thicket National Preserve
Sabine National Wildlife Refuge
McFaddin National Wildlife Refuge
White Lake Wetlands Conservation Area
Rockefeller Wildlife Refuge
20 km
10 mi
Leaflet | © OpenStreetMap contributors

CCUSMAP.COM

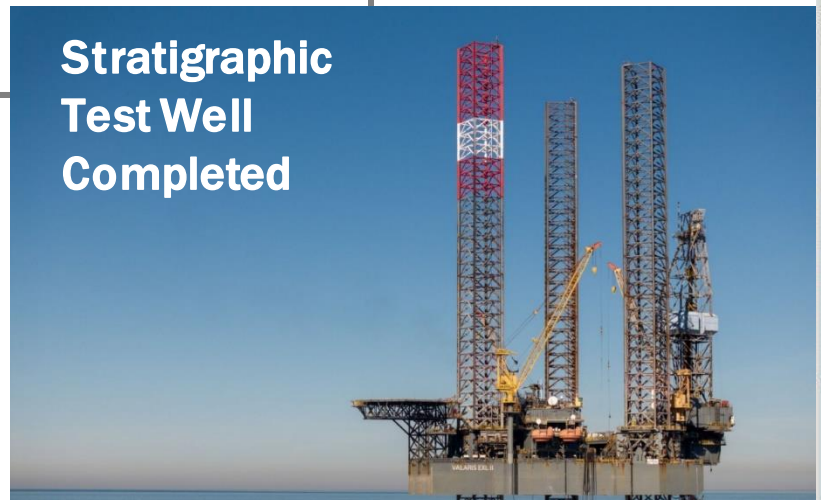
BAYOU BEND PROJECT

First Offshore CCS Project Developed in US

Chevron, Equinor, TotalEnergies



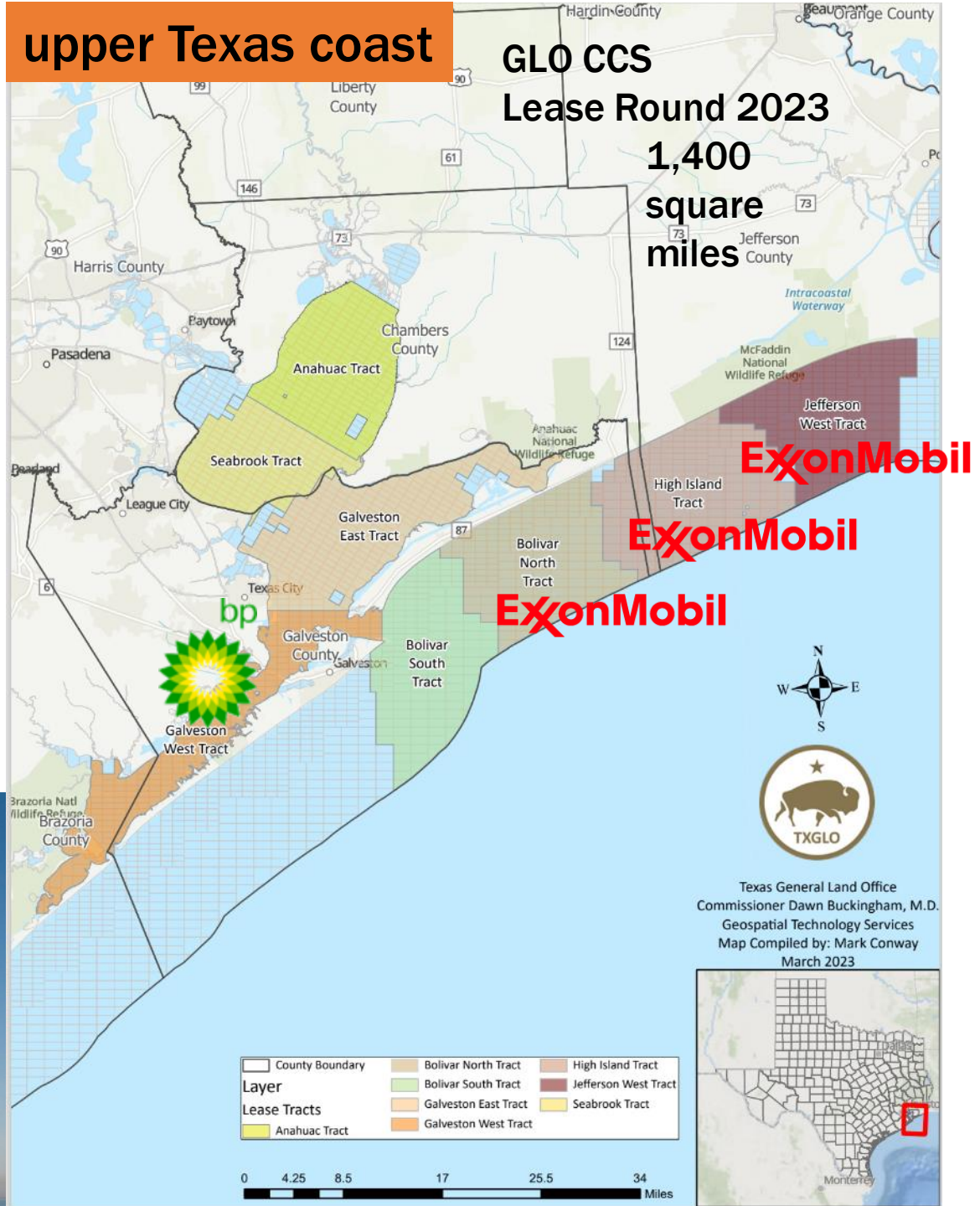
GLO LEASE 2022



upper Texas coast

GLO CCS Lease Round 2023

1,400 square miles



ConocoPhillips Texas Gulf Coast CCS LLC, ConocoPhillips Company
6 wells planned

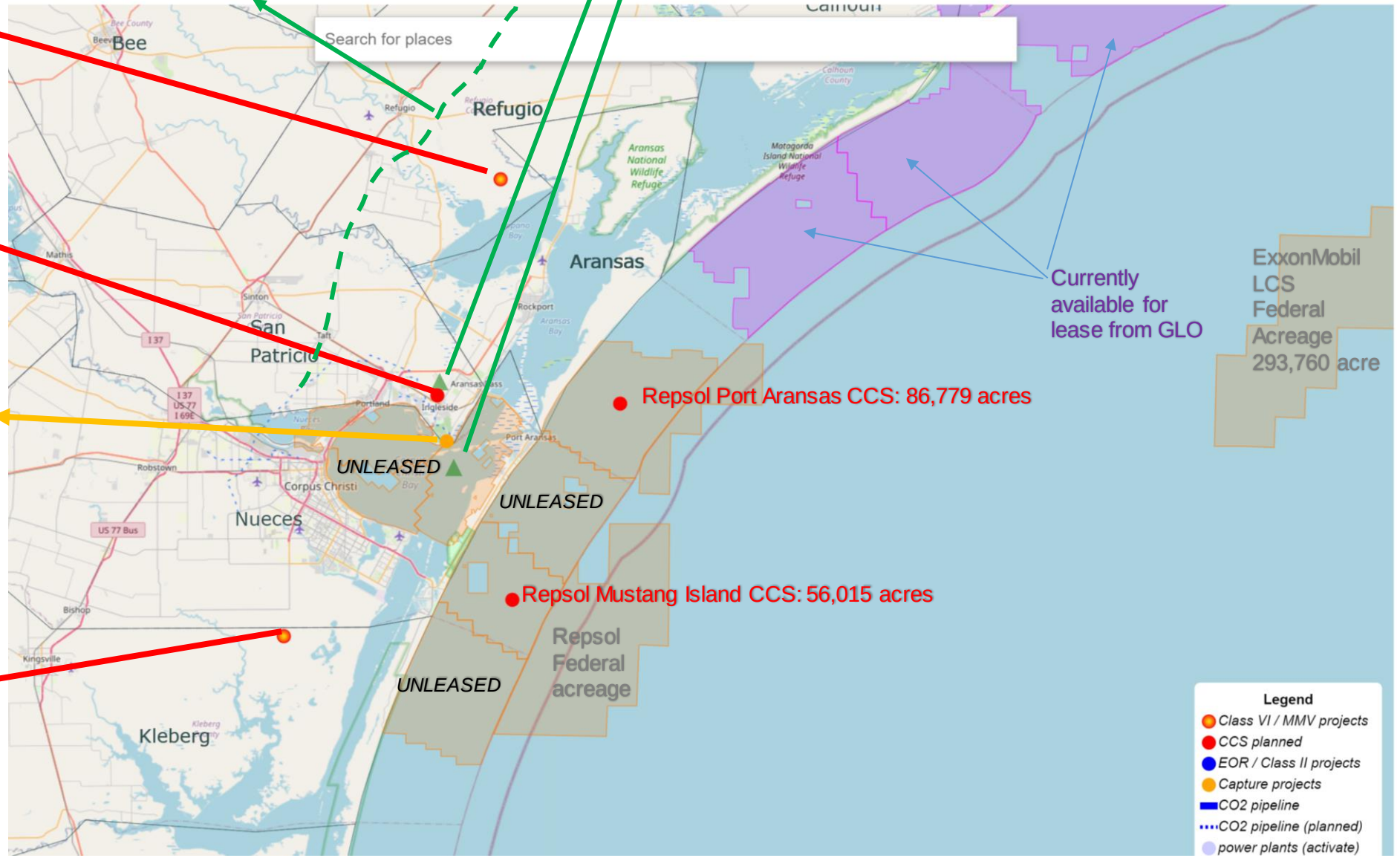
Gulf Coast Decarb Pipeline System
DOE FEED STUDY
Howard Midstream Energy Partners

DOE Onshore and Offshore CCS Feasibility Studies
The triangle in the bay is a placeholder for offshore – that is not the proposed side.

Coastal Bend CCS- Class VI planned
TotalEnergies E&P USA, Inc., Howard Energy Partners, Corpus Christi Port Authority, Javelina
13,000 acres
DOE-NETL Phase 2 Onshore Project

Ingleside Clean Ammonia Partners LLC, Enbridge, Yara Clean Ammonia

South Texas DAC Hub
1PointFive, Oxy Low Carbon Ventures LLC, Port Aransas CCS
106,000 acres

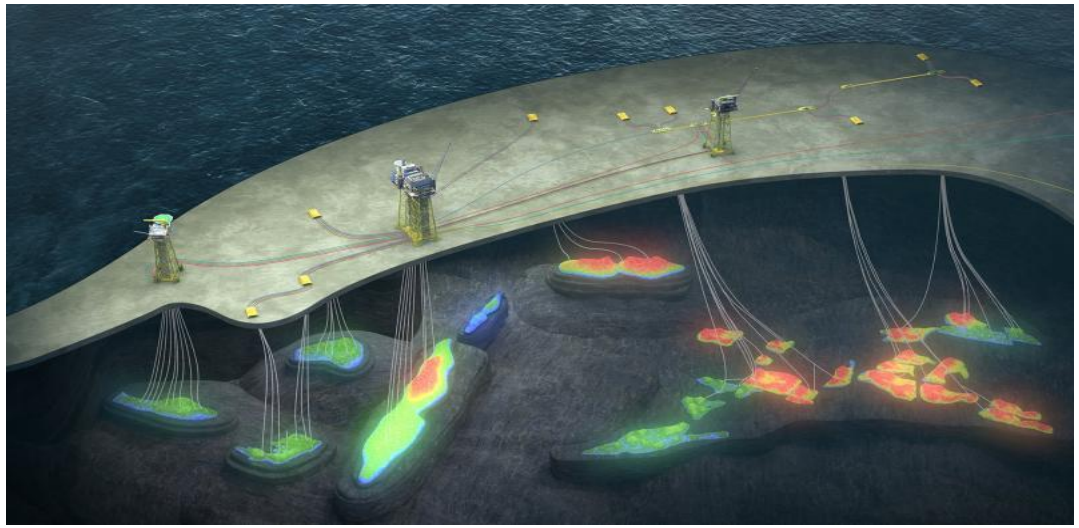


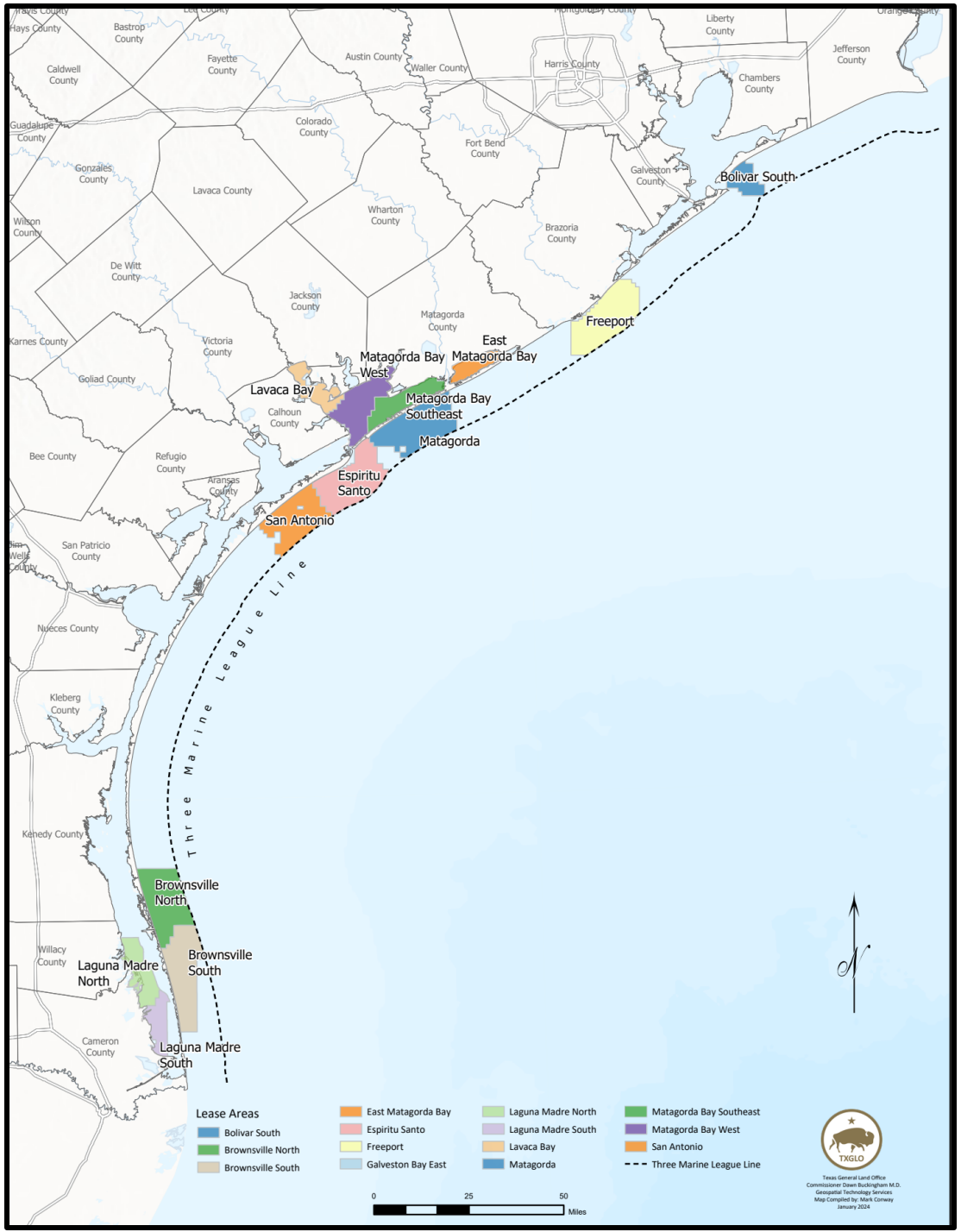
GLO Lease Fees and Projected Royalties - 2023

Lease Bonus Payments: ~$140M since 2022;

7 leases (Chevron, ExxonMobil, BP, Repsol)

GLO estimates $10B in royalty revenue for injected CO_2 in coming decades. Permanent School Fund vs. Property Tax





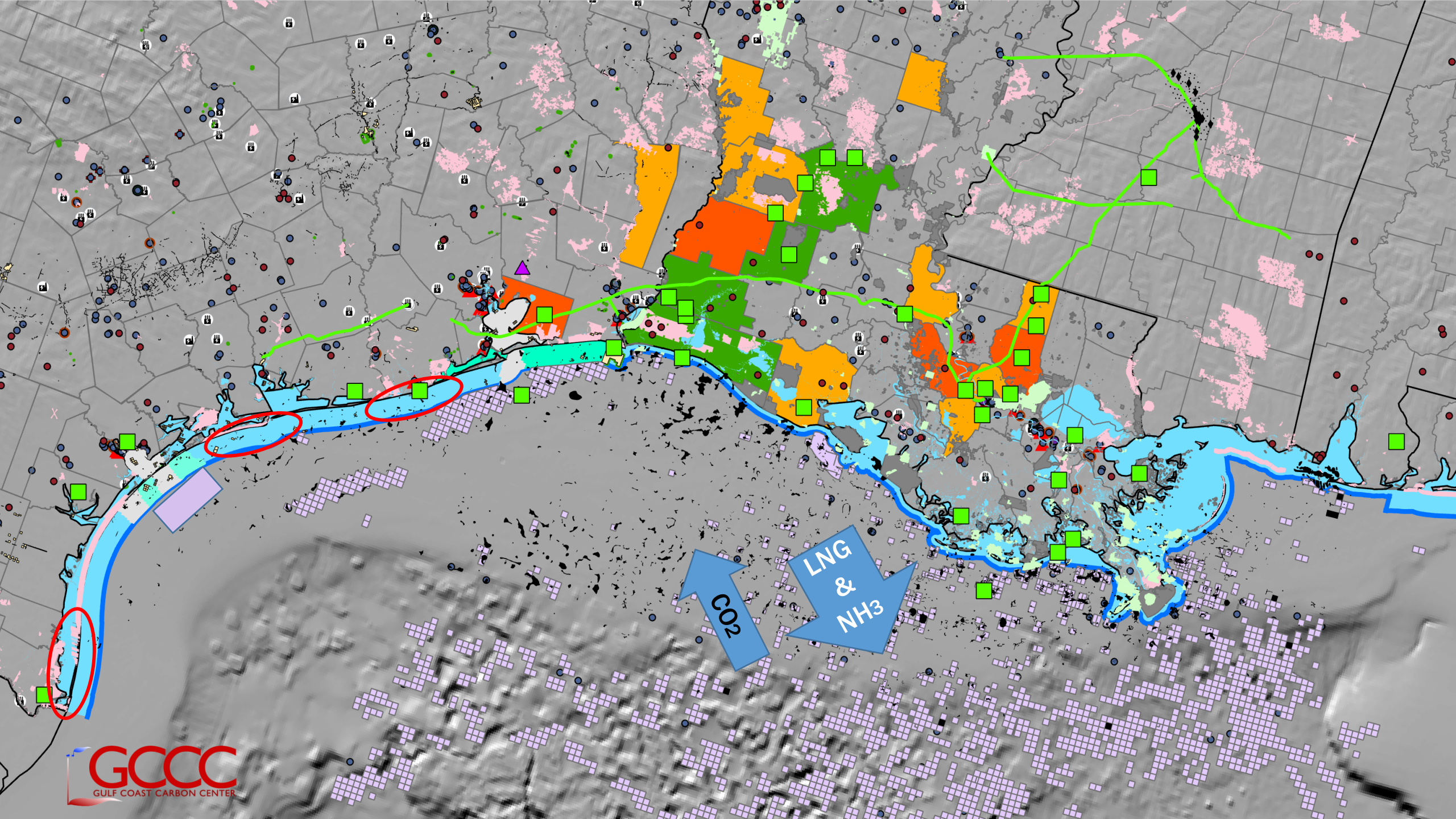
GLO CCS Lease Round 2024

13 tracts totaling over 1 million acres
~ 1,562 square miles.

- **Signature Bonus** $50/acre minimum
- **Development Phase Rental** $50/acre minimum
- **Construction Phase Rental** $50/acre minimum
- **Operations Phase Rental** $50/acre minimum

- **Injection Fee $4/Tonne minimum with future increase tied to any 45Q base level increases and 45Q/CPI inflation rate**
- **Injection Fee Uplift based on Injection Volume/Injection Rate/Other (e.g. future T&S fees)**

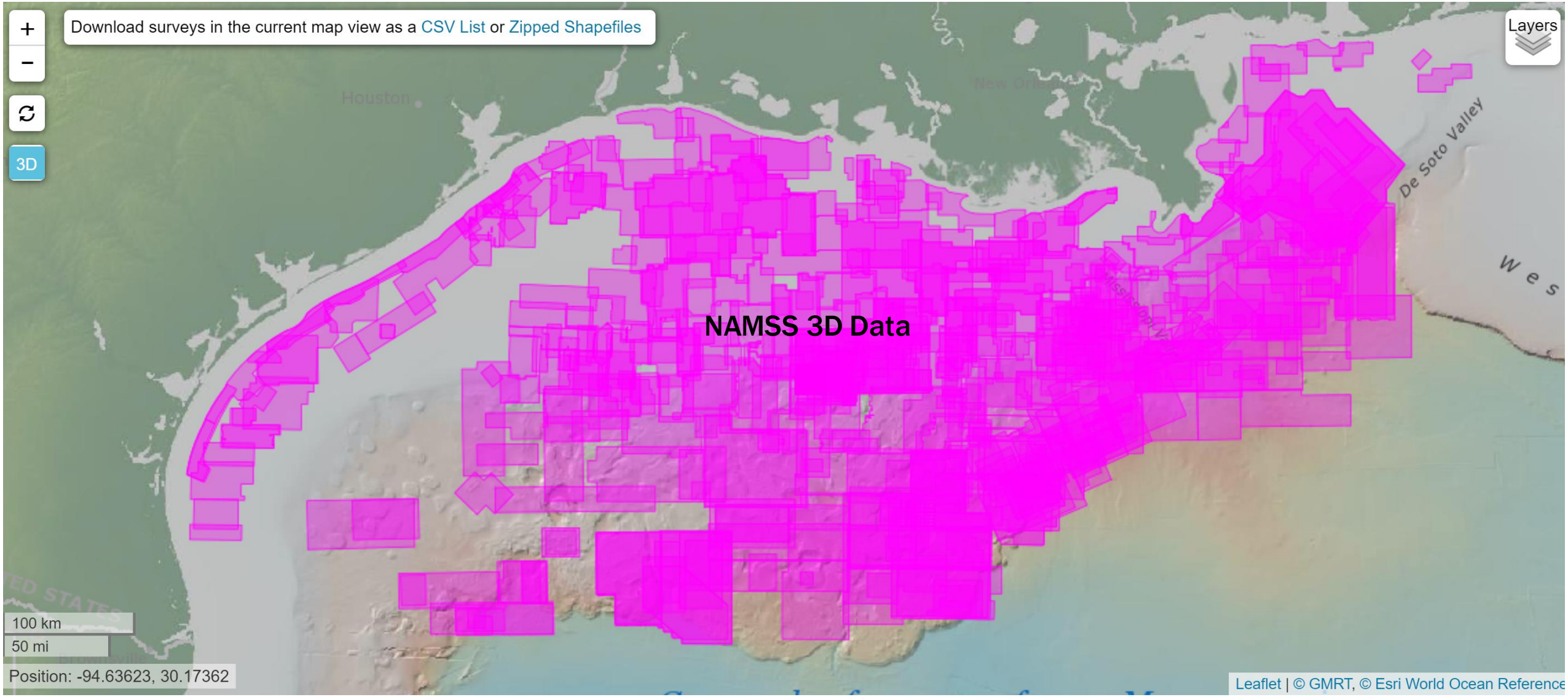
- **Additional Non-45Q Value % Future Value A minimum 6% PSF share of e.g. the value of any Carbon credits or offsets originating from the Leas**


CO2
LNG
&
NH3
GCCC
GULF COAST CARBON CENTER

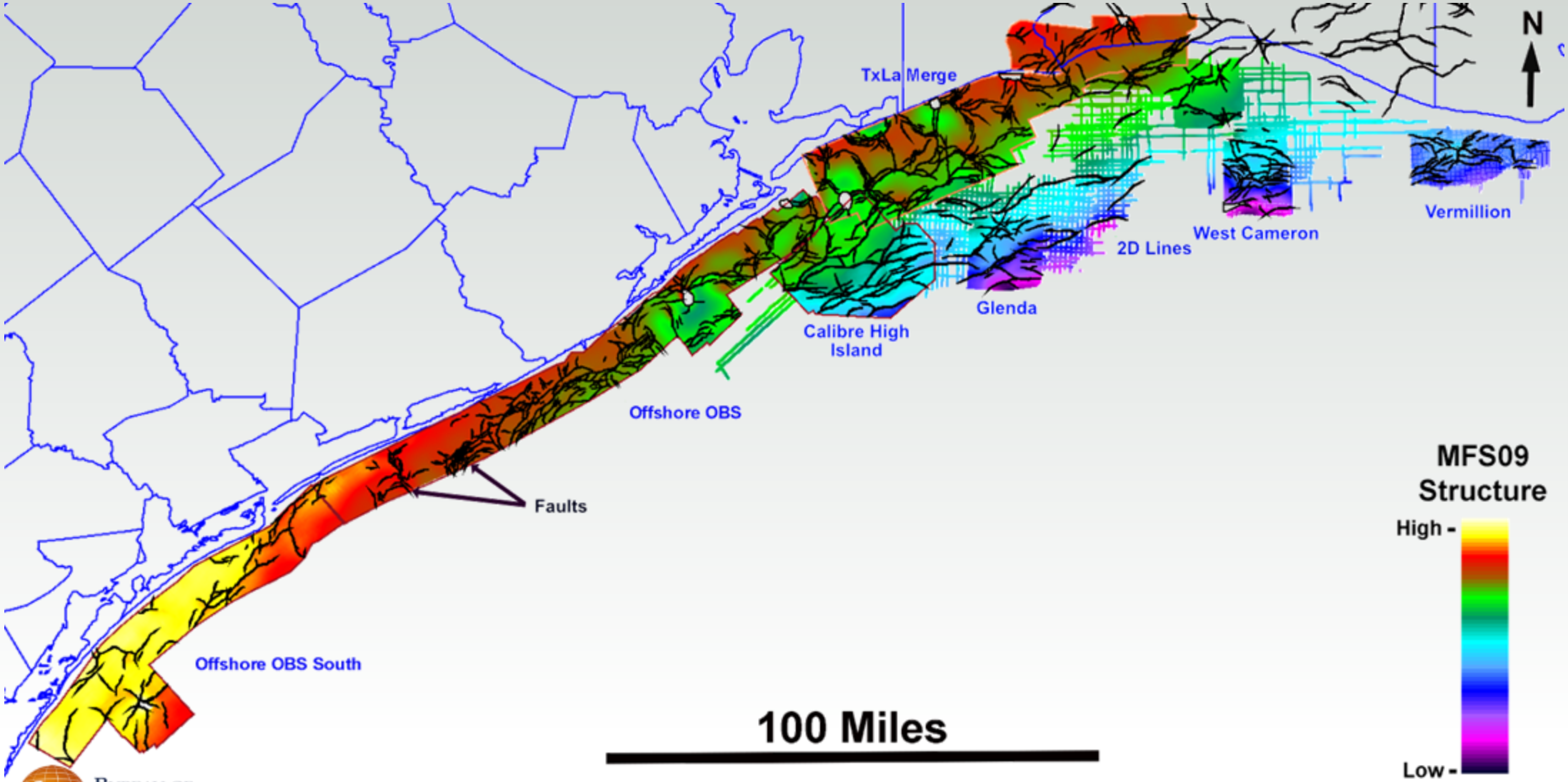
THANK YOU

- Questions?

3D subsurface data is becoming available exactly when we need it for large-scale CCS. A new era of GoM CCS development awaits....



Regional Conventional 3D Seismic Mapping



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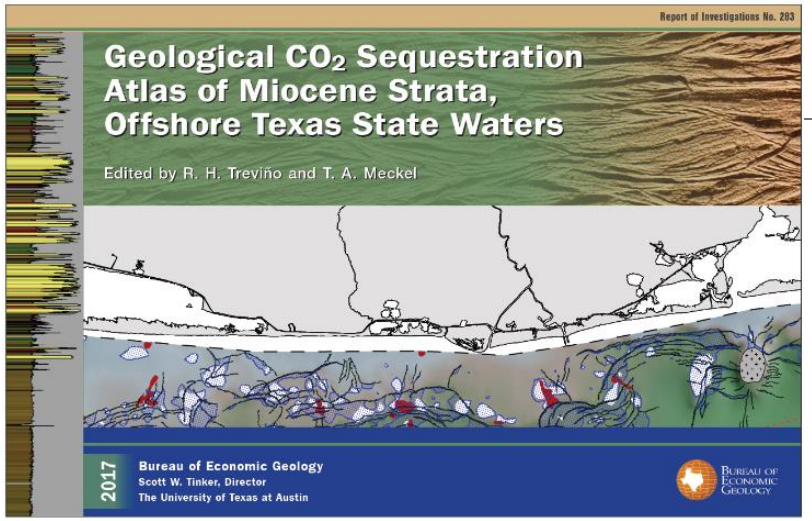
Interpretation: Mike DeAngelo and GCCC – Available from Seismic Exchange, Inc.

Application of Static Capacity to CCS



Great for showing big numbers....

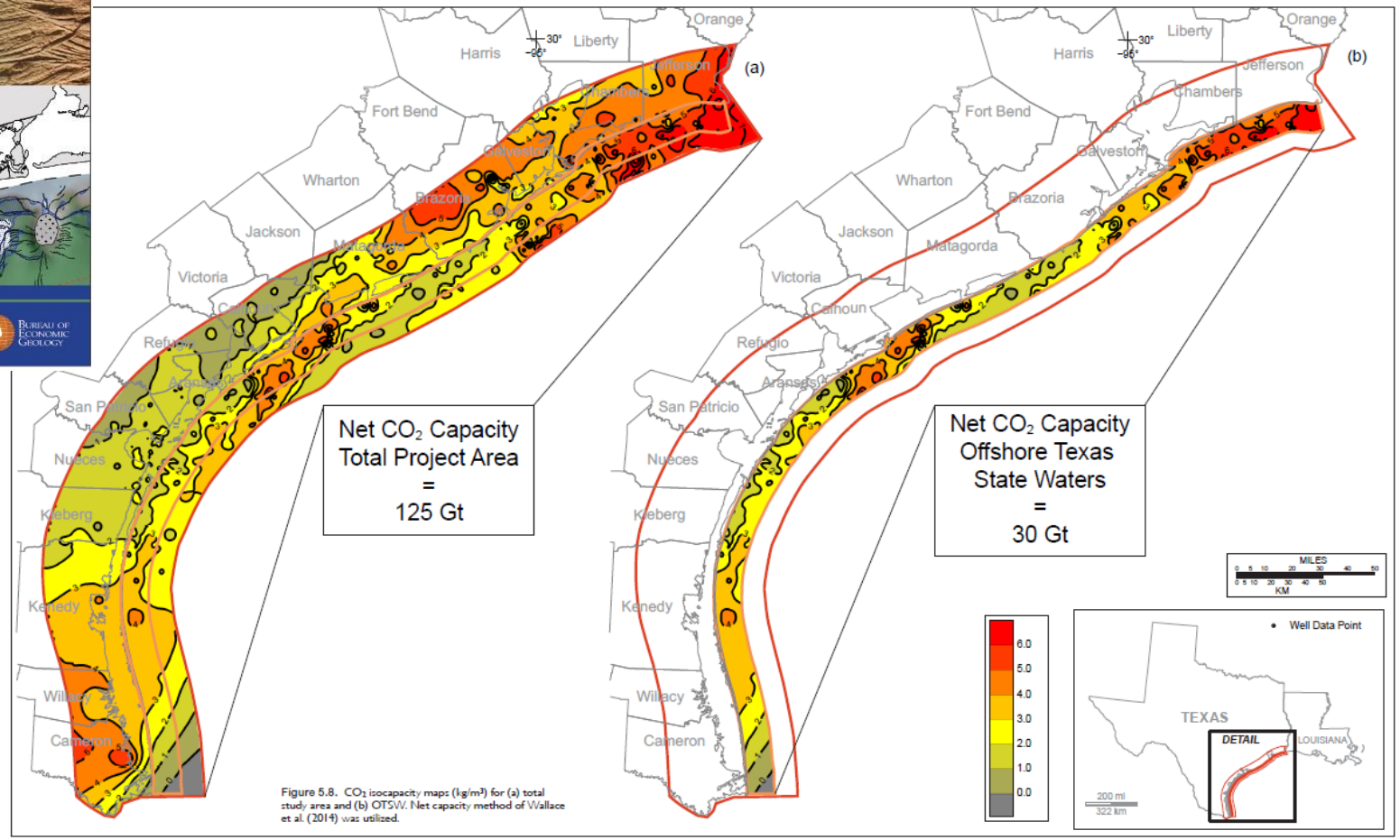


Figure 5.8. CO_2 isocapacity maps (kg/m³) for (a) total study area and (b) OTSW. Net capacity method of Wallace et al. (2014) was utilized.

...but not realistic ones

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TEXAS RESPONSIBILITY FOR LONG-TERM LIABILITY OF CARBON DIOXIDE.

- Sec. 124.003. APPLICATION FOR TRANSFER OF TITLE AND CUSTODY TO THE STATE – Certificate of Closure. State has 60 days to respond or approve.
- APPROVAL Conditions:
  - Waiting period of at least 10 years after receiving certificate.
    - Commission may require less than a ten-year waiting period under Subsection (b)(1)
  - Operator in full compliance (Section 27.047(1) (I)
  - Stored carbon dioxide and geologic storage facility are stable and not expected to endanger USDW;
  - Fee - Section 124.005 – additional per-ton fee into Trust Fund for addressing Section 124.003(d)(8)
    - Amount that is commensurate with obligation reasonably expected to be incurred by the state.
- All responsibility and potential liability associated with stored CO2 and the geologic storage facility is transferred to the state.
- Release from regulatory requirements and liability.
- Release of any remaining performance bond or other financial security.
- State shall assume responsibility to monitor until federal government assumes responsibility.

TEXAS INTEGRATION OF PORE SPACE FOR DEVELOPMENT OF A GEOLOGIC STORAGE FACILITY

- Protect correlative rights, conserve natural resources, enforce compliance with state and federal law to facilitate and optimize energy resources, including pore space for sequestration.
- Pore space owner may integrate its interests
- Owners who do not agree to integrate – storage operator or pore space owner can file an application with Commission requesting an order for the integration
  - Hearing within 60 days
  - will not endanger or injure any oil, gas, or other mineral formation in any material respect (or has been addressed in arrangement)
  - 60% owner agreement or consent; fair and reasonable offer; equitably compensated for the appurtenant and reasonable use of the pore space and surface.
- Surface estate is owner of pore space; Existing relationships between surface and mineral estate unchanged.

LOUISIANA
CURRENT BILLS & STATUS (06/12/2024)

BILL NAME	STATUS
HB 73: Authorize parish tax levy	Original text, First reading 03/11
HB 169: Limits payment for non-economic damages	Signed 06/03 by the Governor. Becomes Act No. 415
HB 276: Compliance with local land use & zoning	Original text, first reading 03/11
HB 280: Prohibits structures above Lakes Maurepas	Original text, First reading 03/11
HB 389: Moratorium below lakes Maurepaus etc.	Original text, First reading 03/11
HB 492: Eminent domain provisions	Sent to the Governor for executive approval 06/04
HB 516: Additional Requirements for CCS projects	Sent to the Governor for executive approval 06/04
HB 696: Authorizes CCS unitization	Becomes HB 966; Sent to the Governor for executive approval 06/04
HB 729: Repeals expropriation/eminent domain	Original text, First reading 03/12

LA HB 492: Eminent domain provisions

- Property located in Louisiana may be **expropriated for the transportation** of carbon dioxide for underground injection in connection with such projects located in Louisiana or in other states or jurisdictions (provisions in R.S. 30:1107(A))
  - Including but not limited to **surface and subsurface rights**, **mineral rights**, and **other property interests** necessary or useful for the purpose of constructing, operating, or modifying a carbon dioxide storage facility
    - R.S. 30:1108(B)(2) must be applicable
- 'certificate of public convenience and necessity'
  - commissioner shall issue a certificate of public convenience and necessity or a certificate of completion of injection operations
- No forced 'common carrier' or 'public utility' status.

LA HB 492: Eminent domain provisions

- The exercise of eminent domain or expropriation powers under this Section shall **not allow for the expropriation of reservoir storage rights for geologic storage.**
  - Except if R.S. 30:1108(B)(2) is applicable: Caldwell Parish.
    - The exercise of the right of eminent domain granted in this Section **may prohibit** persons having the right to do so from **drilling through the storage facility** located in **Caldwell Parish** only when the following requirements are satisfied…
- The exercise of the right of **eminent domain** granted in this Chapter **shall not prevent** persons having the right to do so from **drilling through the storage facility** in such manner as shall comply with the rules of the commissioner issued for the purpose of protecting the storage facility against pollution or invasion and against the escape or migration of carbon dioxide.

LA HB 696: Authorizes CCS unitization

- The **Commissioner** upon the application of a proposed storage operator is authorized and empowered to enter an **order requiring the unit operation of a reservoir or portion thereof** for geologic storage.
  - The commissioner shall have the **right to unitize, pool, and consolidate all separately owned tracts and other property interests** within the portion of the proposed reservoir sought to be used for storage.
  - Proposed storage reservoir meets the requirements of R.S. 4 30:1104© - CoC
- At the time of the hearing, **at least three-fourths of the owners** of the total undivided interest in the storage unit *regardless of the number of individual owners* thereof and not based on three-fourths of the total number of individual owners in the storage unit.
  - Fair and equitable compensation to any owner with an interest (methodology)

Gulf Coast injectivity

15th International Conference on Greenhouse Gas Control Technologies, GHGT-15

15th - 18th March 2021, Abu Dhabi, UAE

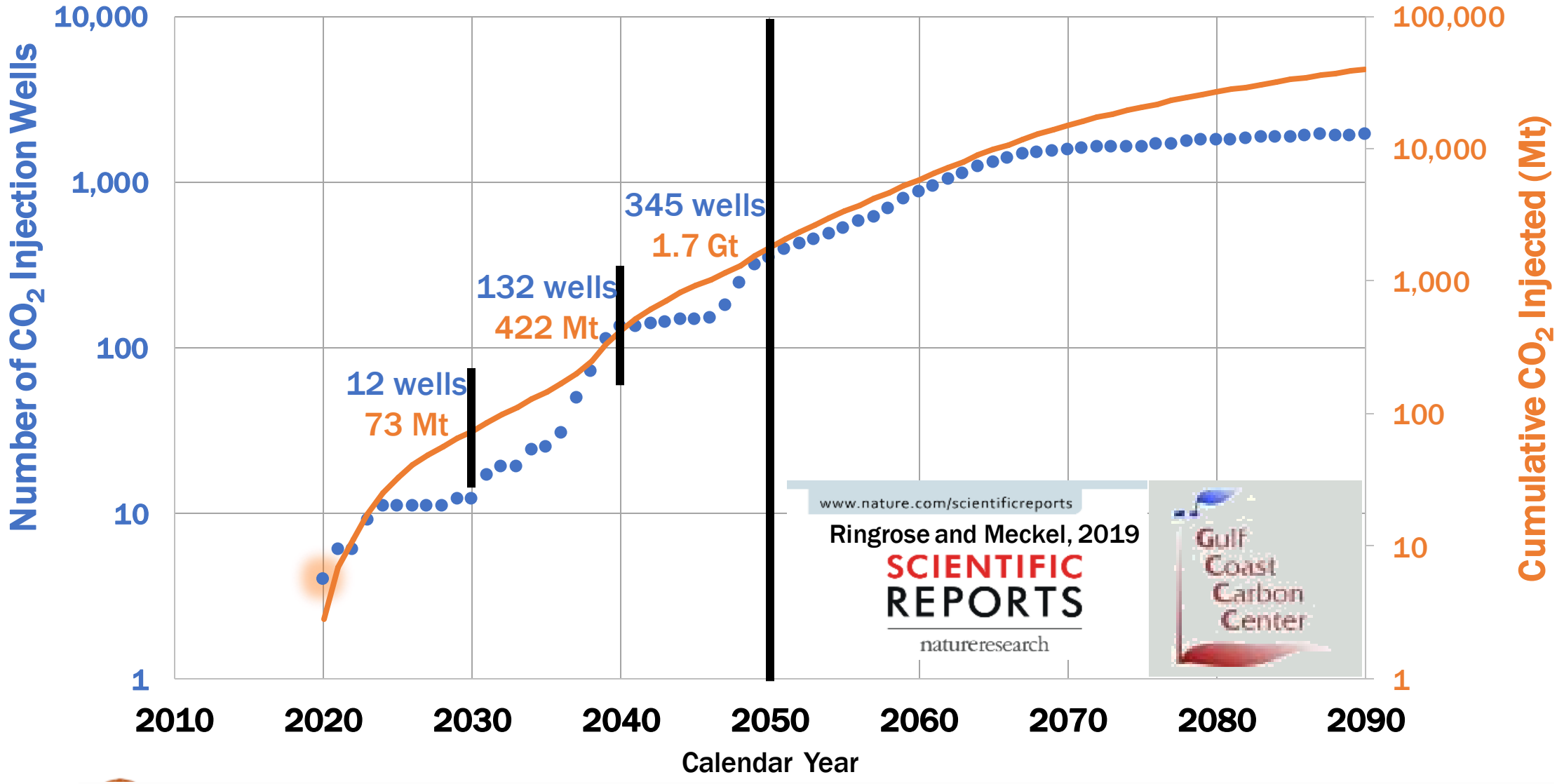
Evaluating technical feasibility of gigaton scale CO_2 storage using produced water disposal data in US Gulf Coast

Hailun Ni[a], Ganeswara Dasari[b,*], Gary Teletzke[b], Apostolos Saris[b]

[a]*Bureau of Economic Geology, The University of Texas at Austin, Austin, TX 78758*
[b]*ExxonMobil Upstream Research Company, Spring, TX 77389*

- In the **Gulf Coast region, 1500** currently active **produced water disposal wells** can inject the volume equivalent of more than **1 GtCO2/yr** with an average injection rate of 20,000 bbl/day (**0.8 MtCO2/yr**) per well.
- Produced water injection wells with injection rates equivalent to **1 MtCO2/yr** already exist.
- **Low pressure buildup is expected**, even for high-rate injection wells in suitable storage/disposal formations. Lack of induced seismicity.

Realistic Growth? Yes, based on historical well development rates



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