2025 NAPCA Convention

CO_2 Pipeline Presentation

April 17, 2025

Presented by Gary Vogt

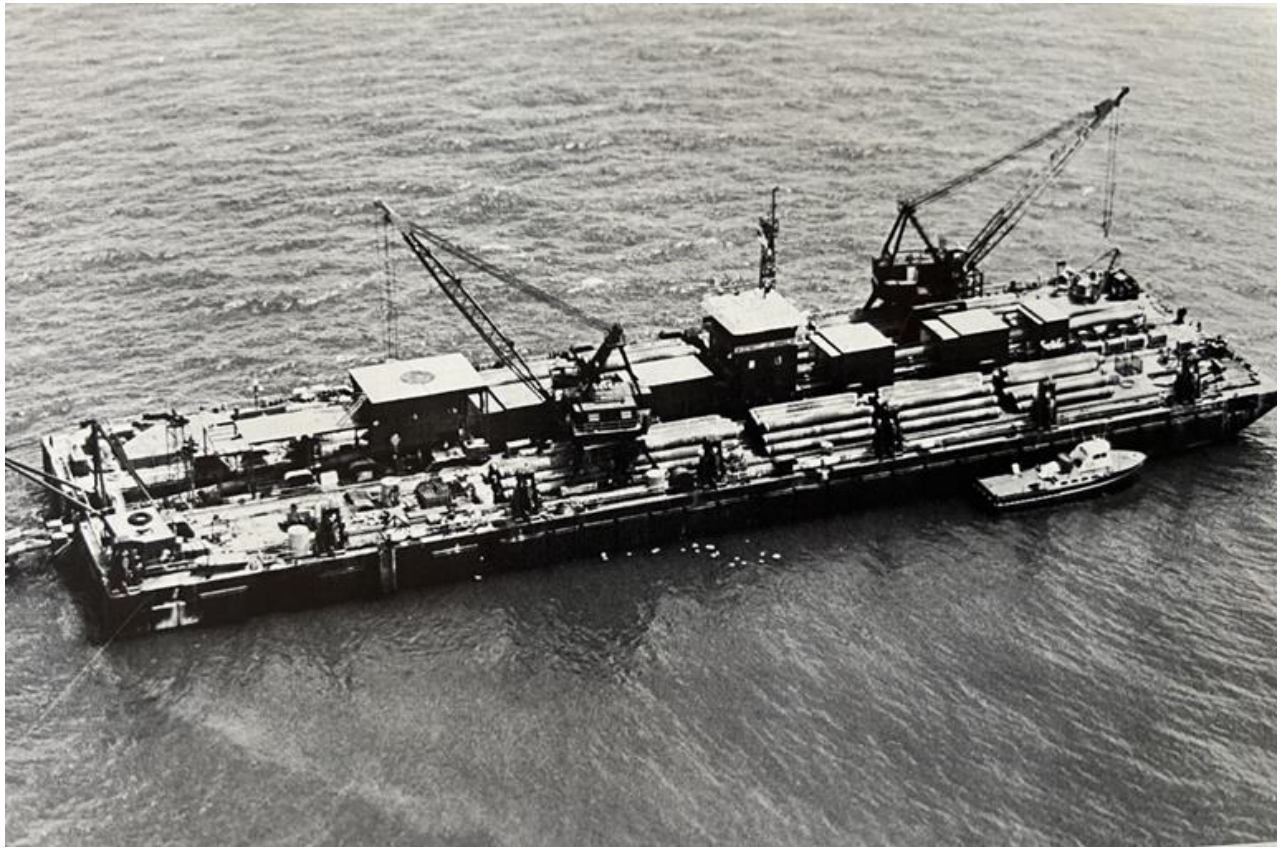
Presentation Topics

- Introduction
- CCS or CCUS
- CO_2 Transportation Utilizing Existing Pipelines
- CO_2 Transportation Utilizing New Pipelines
- Potential New CO_2 Pipeline Network Projections
- CO_2 Pipeline Construction Update

Introduction

Courtesy of H.C. Price

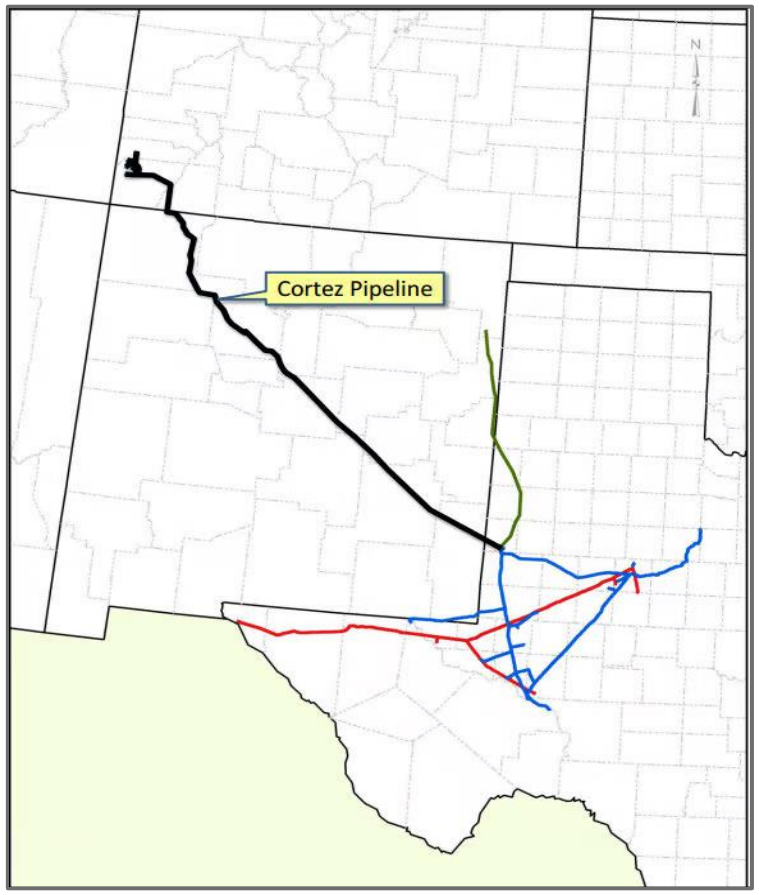
1978 Gulf of Mexico/America



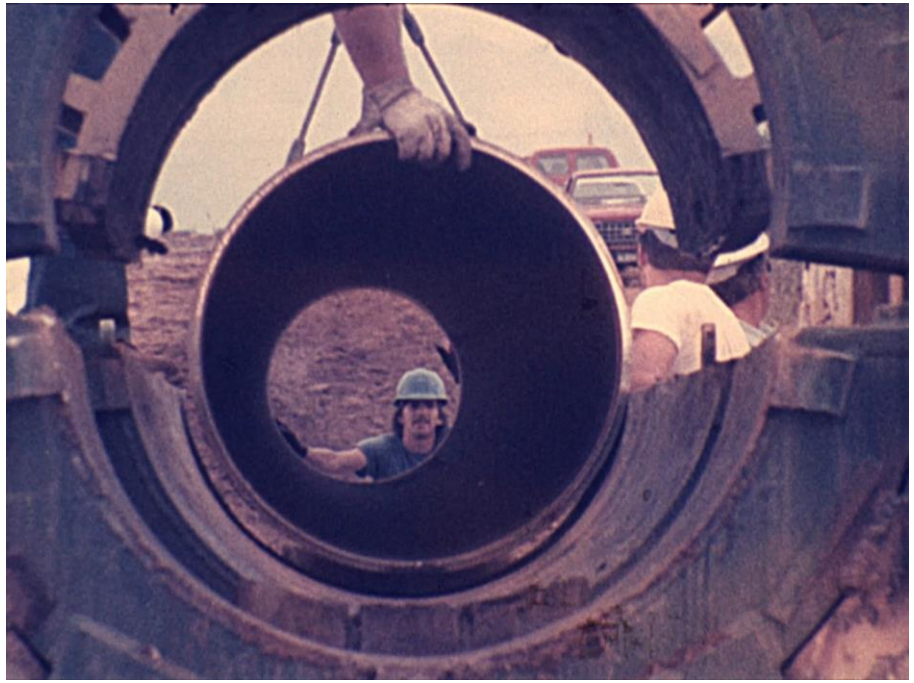
Lay Barge 22

Lay Barge 22 Stinger

1978 Permian Basin



1978-79 Cortez, Bravo Dome and Sheep Mtn PLs Planned and ROW Acquired



Cortez CO2 Pipeline

CCS or CCUS?

CCS or CCUS?

Carbon **C**apture and **S**torage **(CCS)**
Carbon **C**apture, **U**se and **S**torage **(CCUS)**

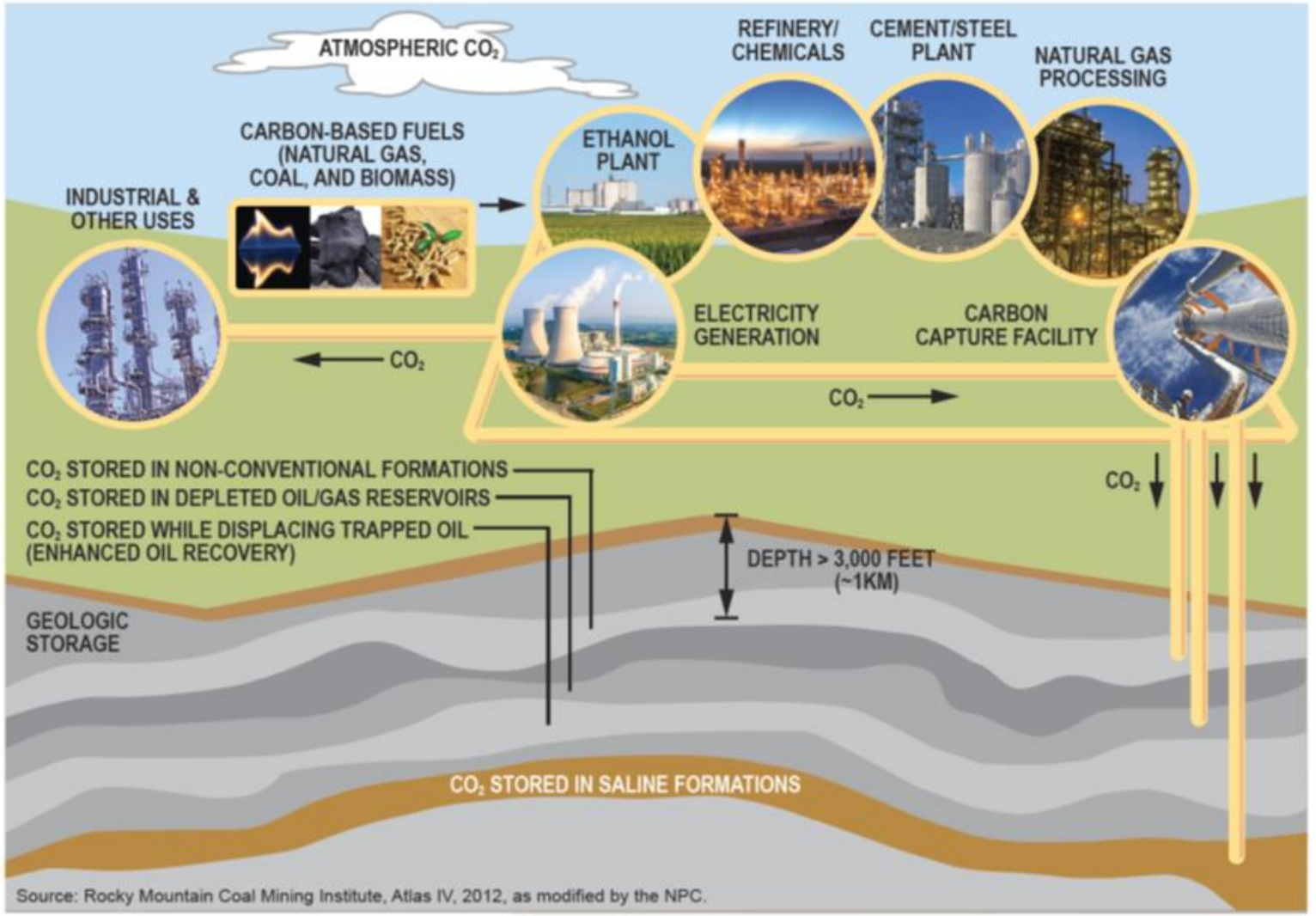
CCS is the capture, transportation and permanent storage (sequestration) of CO_2

- The main revenue is based on **tax** credits

CCUS is the capture, transportation, **use** and permanent storage of CO_2
The revenue is derived from **utilizing** the CO_2 for various uses such as:

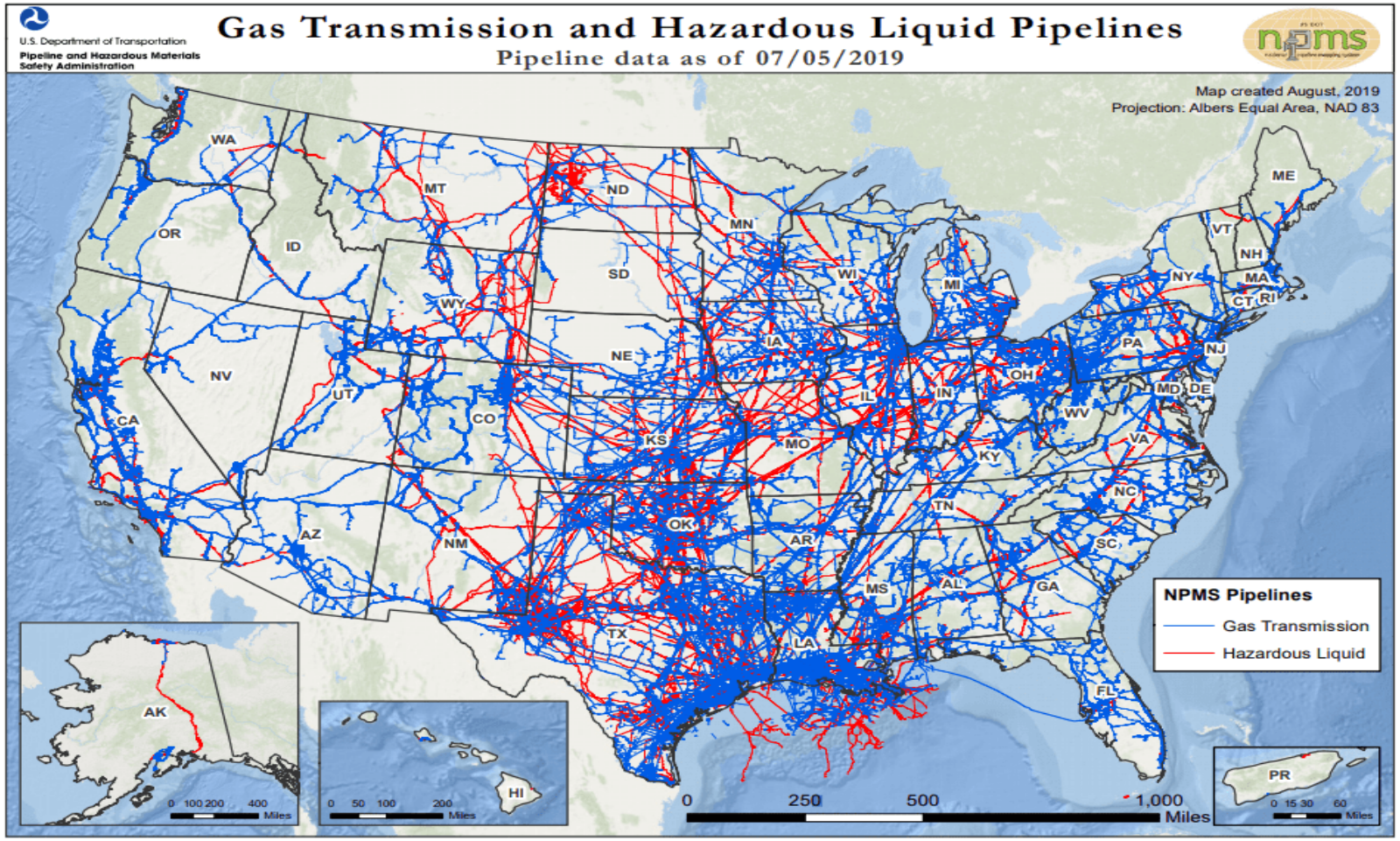
- **E**nhanced **O**il **R**ecovery (EOR)
- Synthetic liquid fuels and gas
- Chemicals and Plastics
- The remaining CO_2 is then stored in the depleted reservoir or sequestration well

Carbon Capture, Use and Storage (CCUS)



CO_2 Transport Utilizing Existing Pipelines

Gas and Liquids Pipelines



CO_2 Transport Utilizing Existing Pipelines

The <u>opportunities</u> of repurposing existing gas pipelines for CO_2 service:

- **Utilizing the existing R.O.W. and infrastructure**
- **Known land-owner relationships**
- **Reduced land/environmental impacts**
- **Lower initial cost**
- **Typically, a faster installation schedule**

CO_2 Transportation Utilizing Existing Pipelines

The challenges of repurposing existing gas pipelines for CO_2 service:

- **Conversion of service**: From Part 192 natural gas to Part 195 hazardous liquid for a supercritical design
- **Material compatibility**: Polymer gaskets, lubricants and grease used in valves, pumps, etc.
- **Fracture control**: Line pipe needs to have sufficient toughness & wall thickness
- **Integrity of existing pipe/materials**: Pipe and other materials may need to be replaced
- **Hydraulic design**: Most existing lines are designed for a lower pressure than required for supercritical/dense phase CO_2 therefore the CO_2 will have to be transported as a gas, thus, reducing the throughput and requiring compression rather than pumps.

CO_2 Transport Utilizing New Pipelines

CO_2 Transportation Utilizing New Pipelines

The <u>opportunities</u> of new pipelines for CO_2 service:

- **No conversion of service**: Designed specifically for Part 195 hazardous liquid for a supercritical CO_2
- **Material compatibility**: Considered in the design
- **Fracture control**: Line pipe designed to have sufficient toughness & wall thickness
- **Hydraulic design**: New pipeline designed for high pressure therefore, the CO_2 can be transported in the supercritical/dense phase thus, increasing the throughput and pumps can be utilized which are more efficient than compressors.

CO_2 Transportation Utilizing New Pipelines

The challenges of new pipelines for CO_2 service:

- **New R.O.W. must be purchased**
- **All new pipelines and infrastructure needs to be built**
- **Increased land/environmental impacts**
- **Higher capital cost**
- **More permitting and environmental mitigation**
- **Typically, a longer installation schedule**

Bipartisan Infrastructure Law Overview

$12 billion in new carbon management RD&D: $7 billion managed directly by Federal Energy Carbon Management FECM

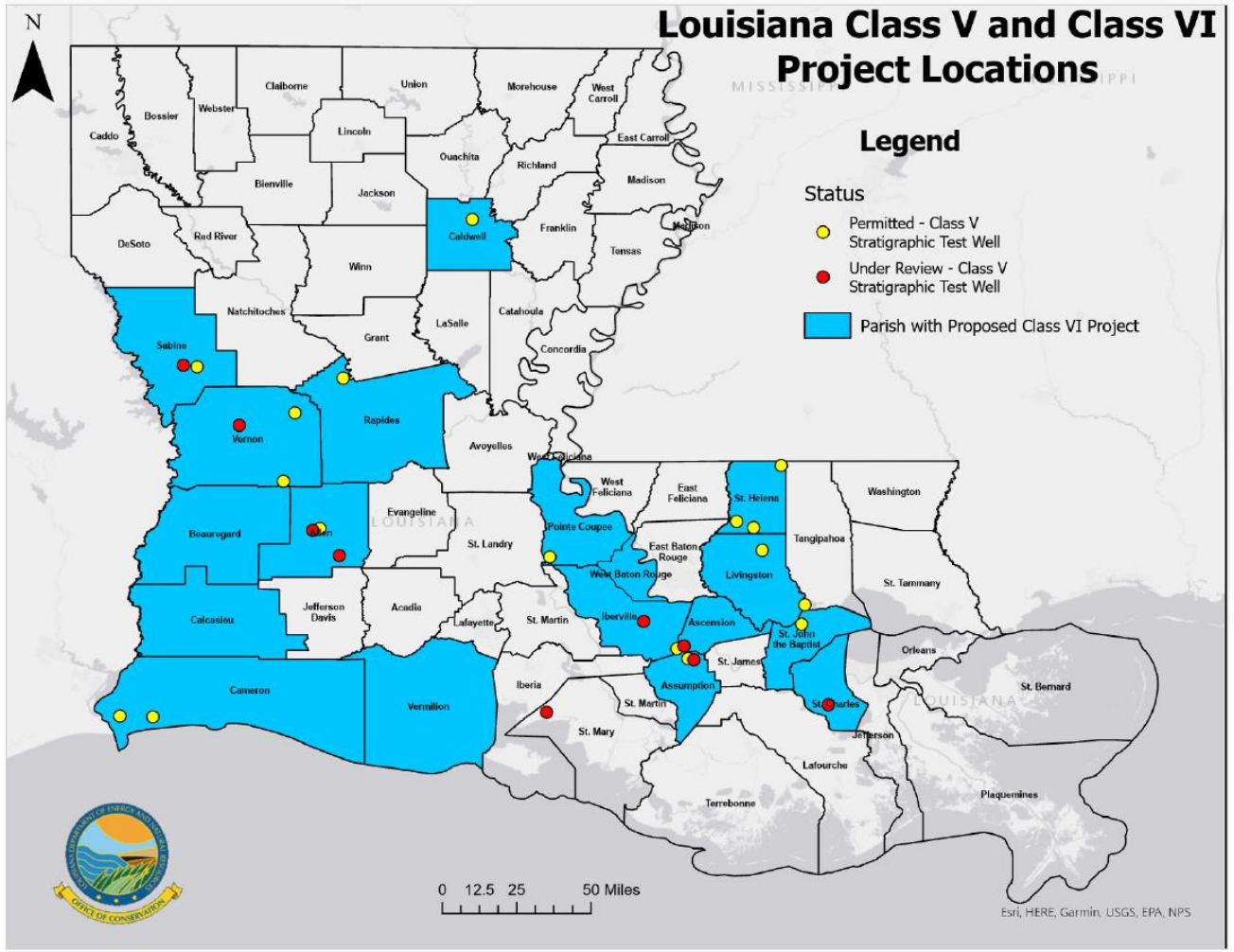
Generally, cost share is 80% government/20% applicant for early R&D and 50%/50& for demonstration projects

Active CO_2 Projects Under Review at EPA

- 55 Projects currently under review
- 164 Well applications currently under review
- 11 Final permit decisions issued

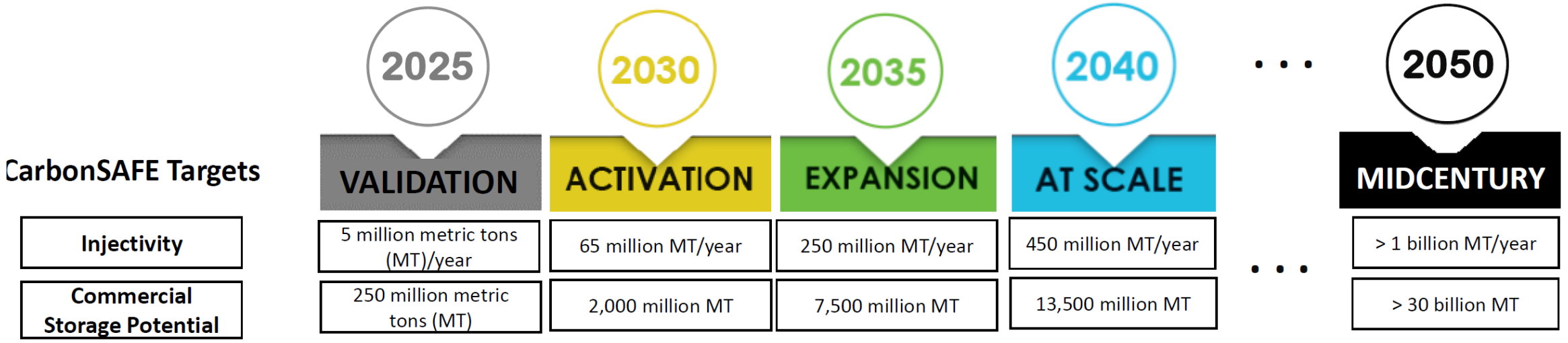
Active CO2 Projects Under Review in Louisiana

16 Parishes have active CO2 Projects

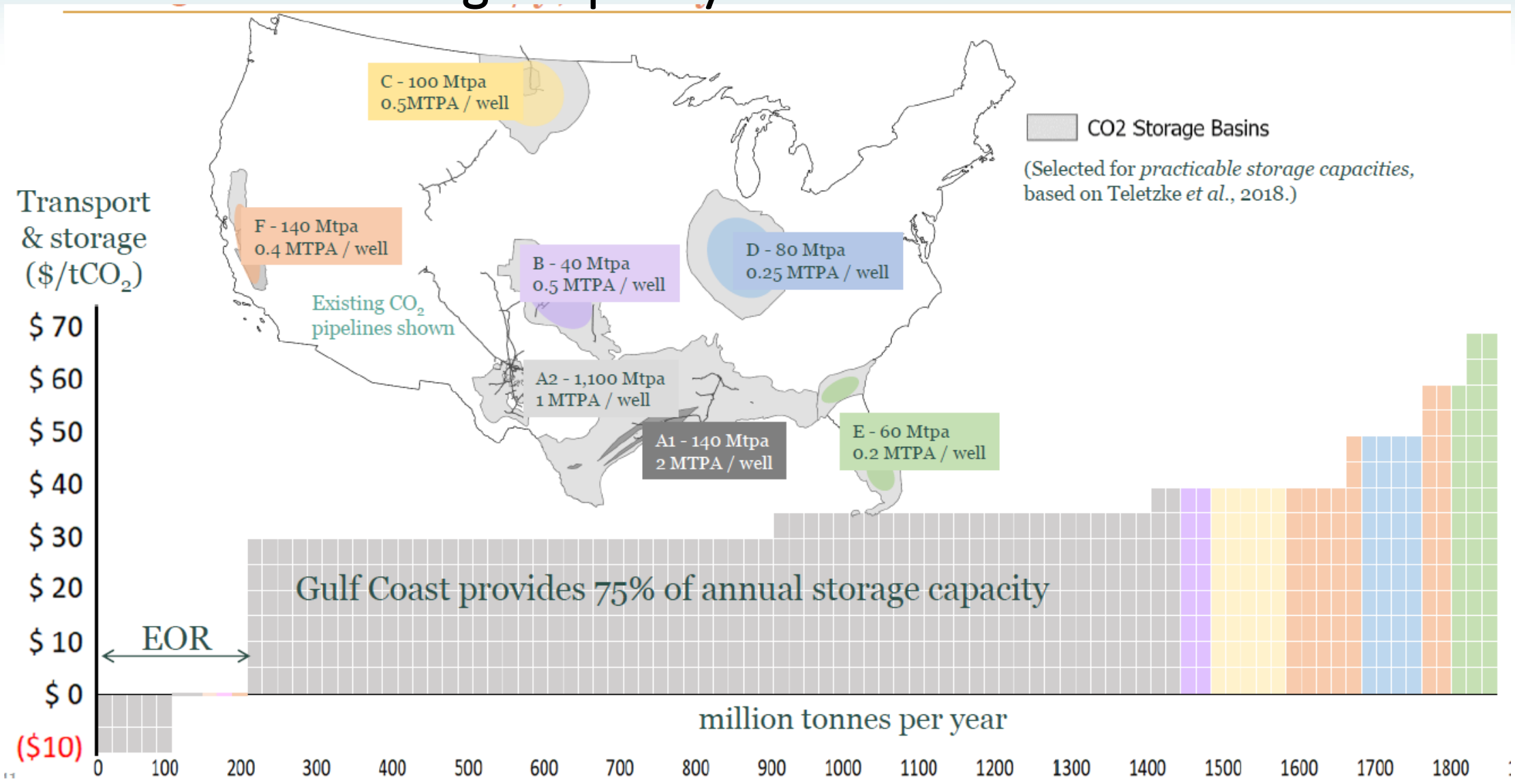


CO_2 Transport Projects Requiring New Pipelines

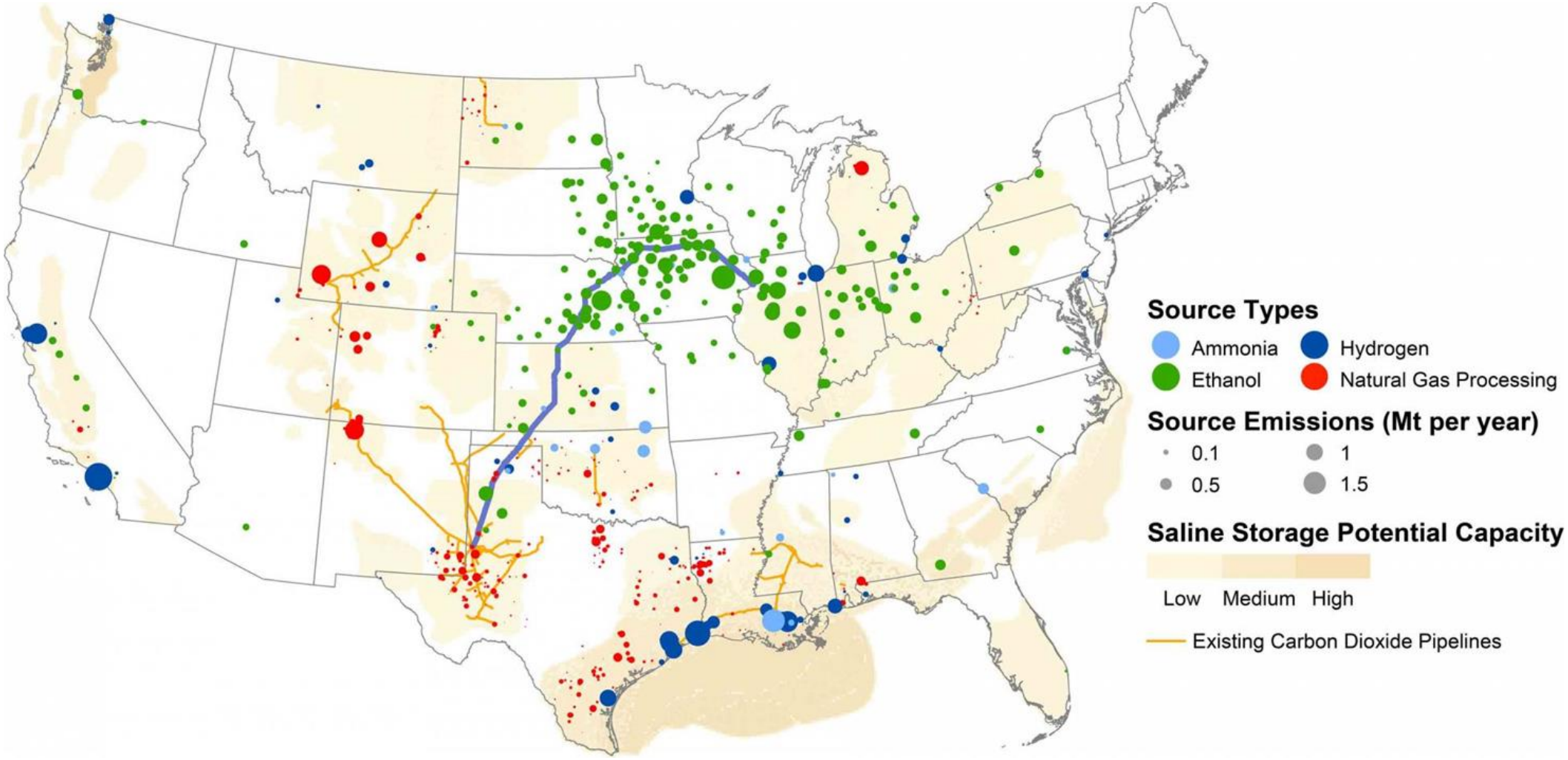
Rapid CCUS Industry Growth Needed for Achieving U.S. Decarbonization Goals



2050 Potential Storage Capacity



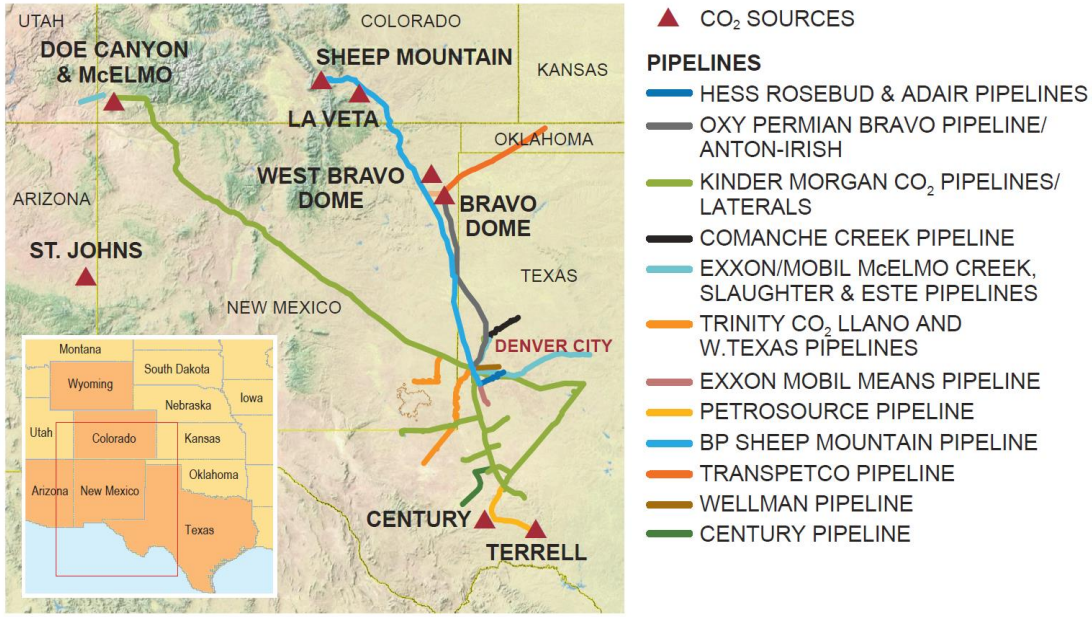
Source Types, Emissions Quantities and Saline Potential Storage



Existing CO_2 Pipelines in the U.S.

Today: 5,300 miles of pipelines

Existing Permian Basin CO2 Pipelines

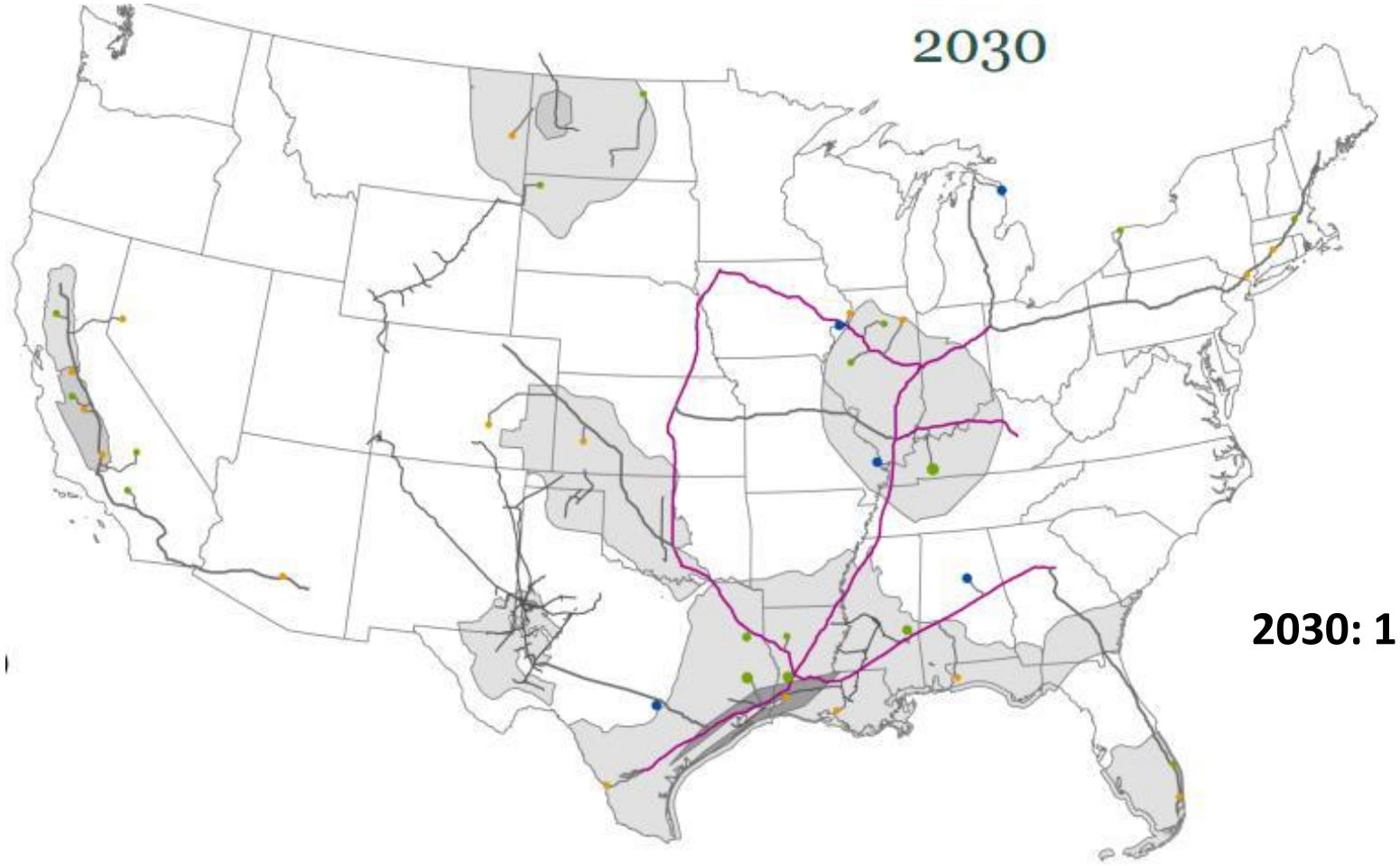


Source: Kinder Morgan and Occidental Petroleum.

PRINCETON UNIVERSITY

National Petroleum Council

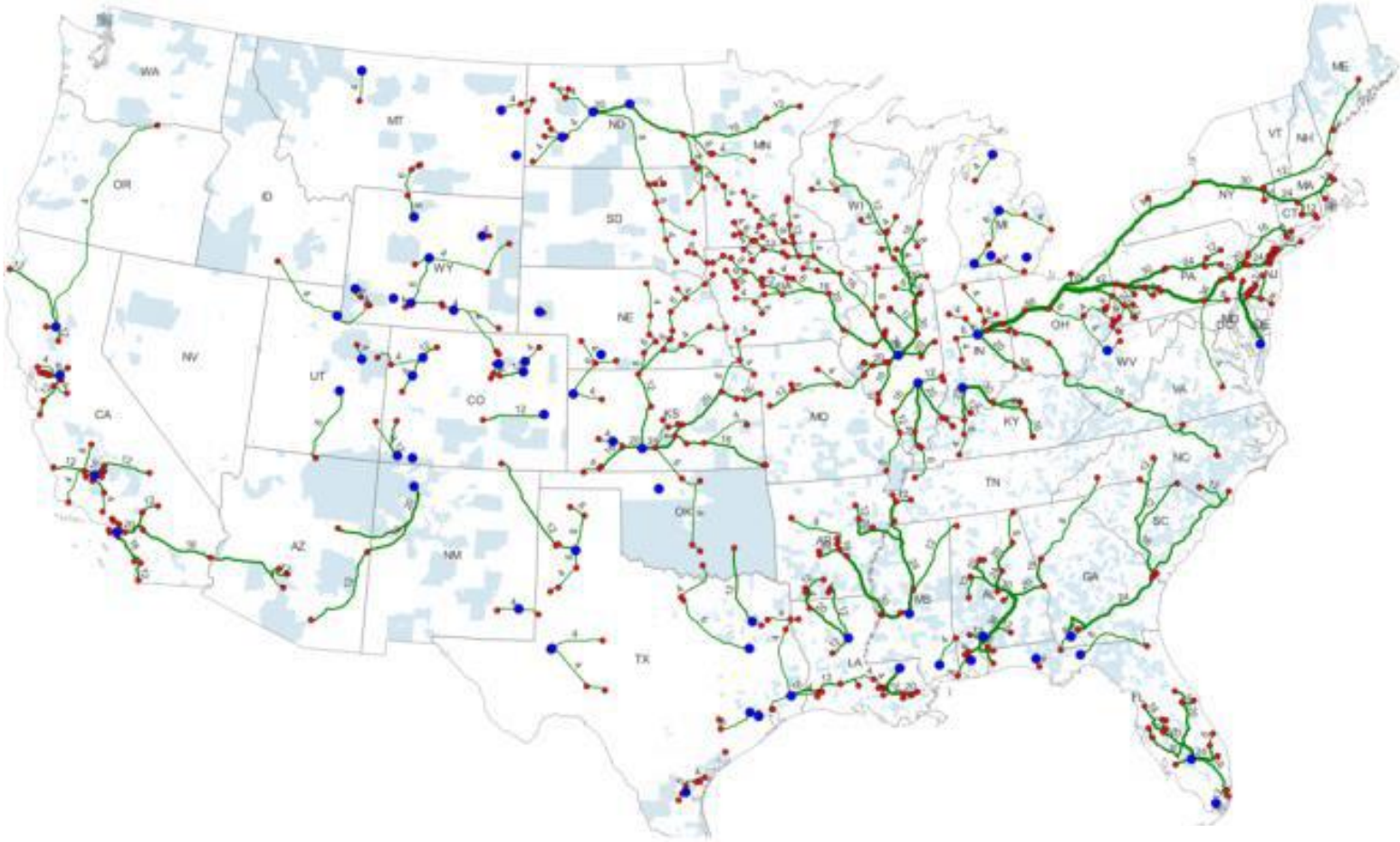
Potential New CO_2 Pipeline Network Projections to Meet Decarb Goals



2030: 11,000+ miles of pipelines

Potential New CO_2 Pipeline Network Projections to Meet Decarb Goals

2050: 25,000+ miles of pipelines

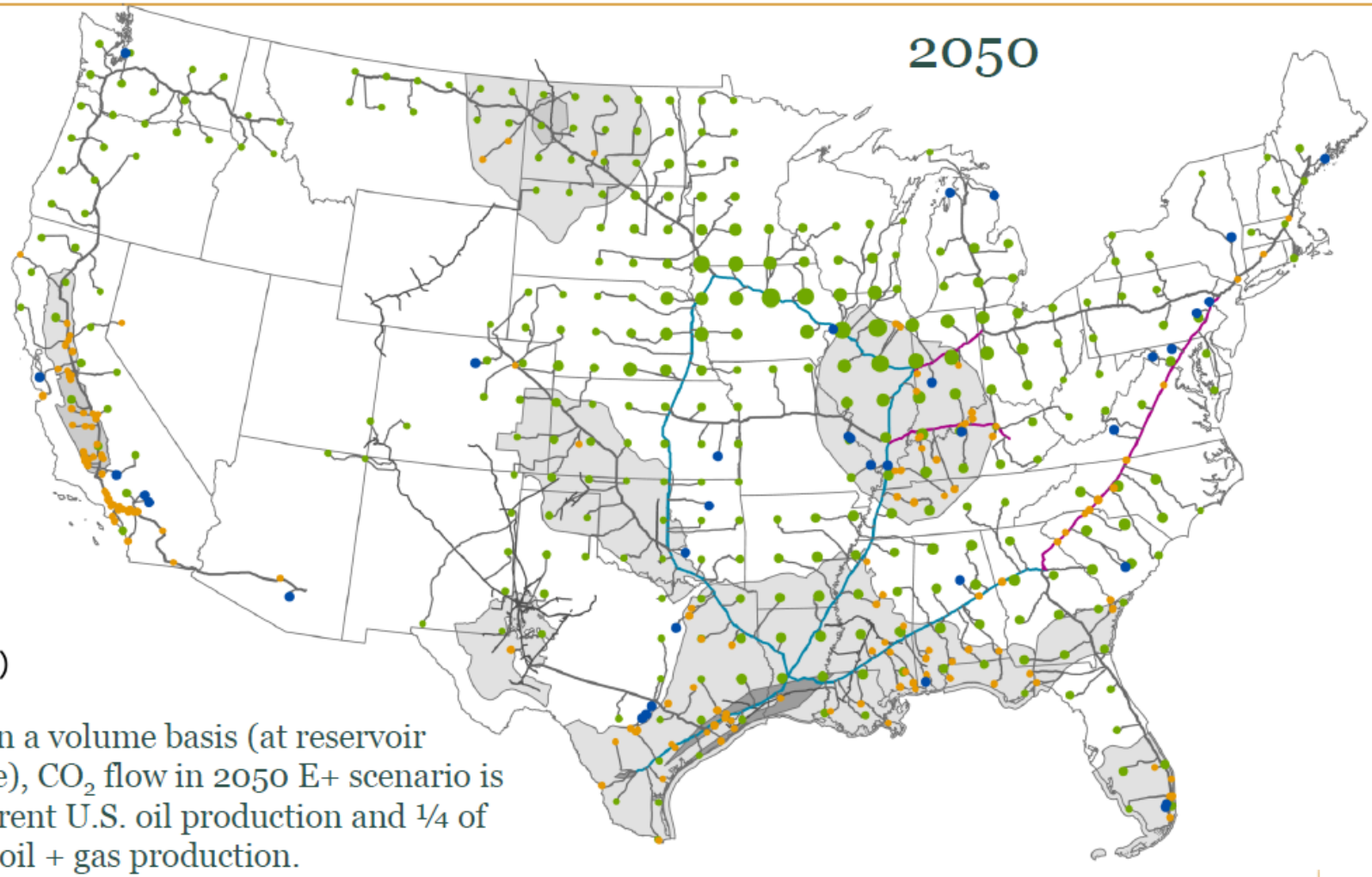


Modeling from Los Alamos National Laboratory (2023)

2050 Potential Pipeline Network 65,000+ miles of pipelines

E+ scenario

929 million tCO_2/y
106,000 km pipelines
Capital in service: $170B



Note: On a volume basis (at reservoir pressure), CO_2 flow in 2050 E+ scenario is 1.3x current U.S. oil production and ¼ of current oil + gas production.

2050 Potential Pipeline Network: 65,000+ miles of pipelines

Estimated capital cost of $170 billion to $230 billion

An investment of 13 B$ is estimated for stakeholder engagement plus characterization, appraisal and permitting across multiple storage basins and sites before 2035 to enable rapid expansion thereafter.

The CO_2 capture utilization and storage (CCUS) industry is enabled by > 100,000 km of new CO_2 pipelines having an estimated capital cost of $170 billion (for E+) to $230 billion (for E-B+).

The scale of CO_2 transport and storage in 2050 in these scenarios ranges from 1.3 to 2.4 times current US oil production on a volume-equivalent basis.

CCS Projects Under Construction

Worldwide CCS Project Update

The State of CCS in 2024
The CCS sector saw remarkable growth last year, driven by policy shifts, investment acceleration, and project milestones:

✅ **50 commercial CCS facilities are now operational (+21% YoY).**

🏗️ **44 projects are under construction (+70% YoY).**

📈 **222 projects are in various stages of development.**

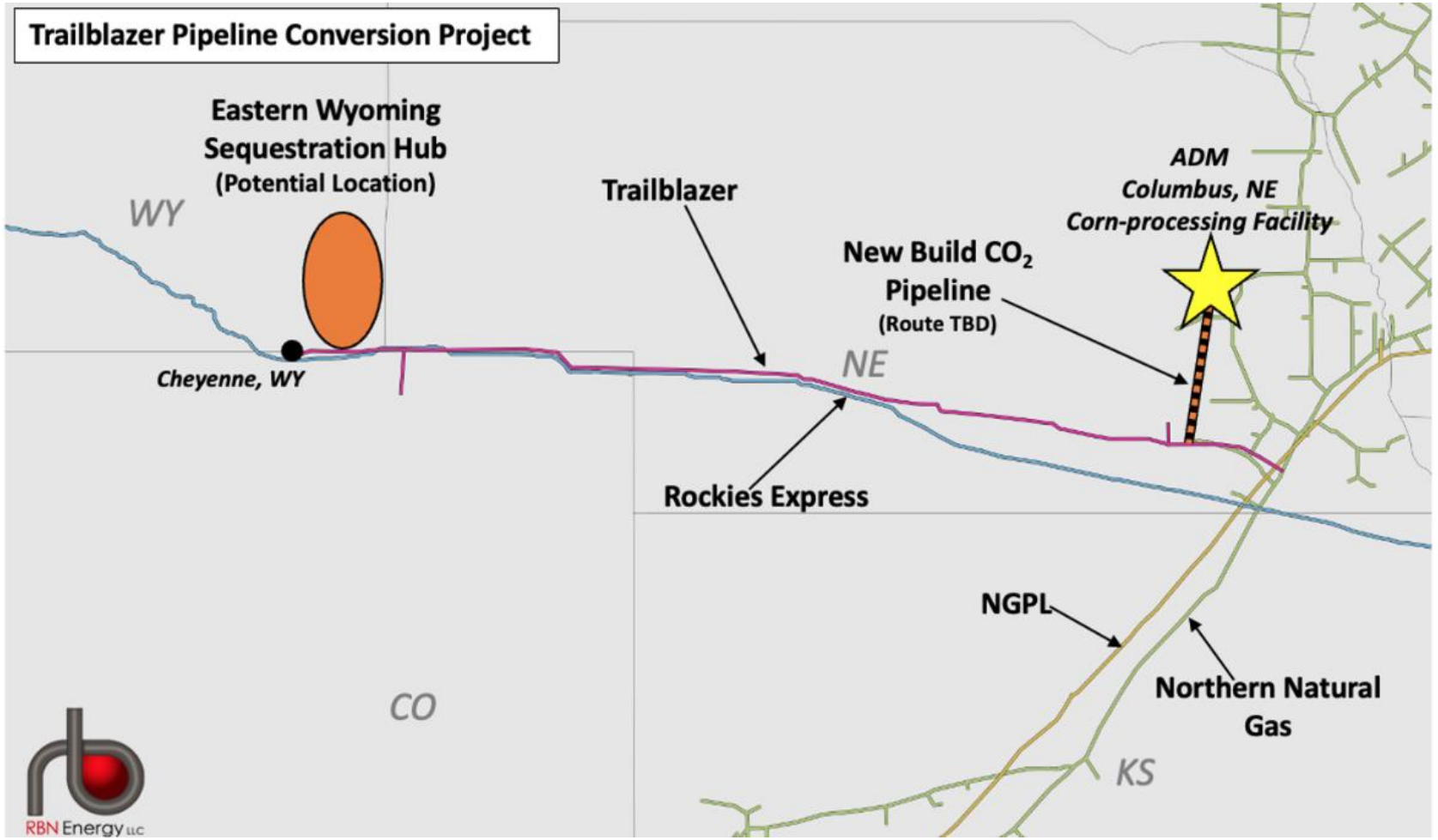
⚡ **7 large-scale CO_2 storage sites are actively being built.**

Key regions driving this growth include:
North America: The US & Canada are expanding CO_2 storage but face permitting bottlenecks.

Europe: Norway's Northern Lights project is live, and cross-border CO_2 transport is gaining momentum.

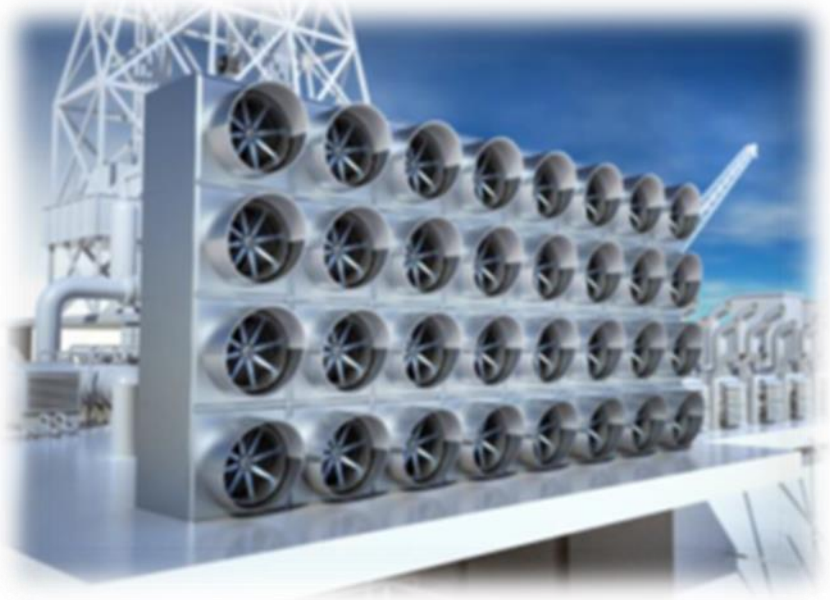
U.S. CCS Pipeline Project Under Construction

Trailblazer Conversion



CCS Projects Under Construction

1PointFive and Carbon Engineering are deploying a module Direct Air Capture (DAC) plant in Texas



CCS Projects Under Construction

Project Poseidon – North Sea

- The first CO_2 injection test in the North Sea into a depleted natural gas reservoir
- Proved that it is possible to reuse petroleum production infrastructure

NAPCA
National Association of Pipe Coating Applicators

Questions?