



TETRA TECH

# Early Phase Execution for Carbon Sequestration Projects Today

GWPC Annual Conference, Salt Lake City – June 22, 2022  
by Lloyd Hetrick and Grant Billings



# People (included but not limited to)

## Scientists

- Geophysicists
- Geologists
- Geochemists
- Seismologists
- Petrophysicists
- Hydrogeologists
- Environmental
- GIS Mapping
- Data Management

## Engineers

- Reservoir
- Drilling
- Chemical
- Mechanical
- Process
- Safety
- Automation
- Operations

## Legal

- Regulatory
- Property
- Contract
- Tax
- Partnership
- Tort

## Commercial

- Finance
- Accounting
- Audit
- Tax
- Insurance
- Public Relations



# Funding

**Private Funding** expects commercial success that includes a firm schedule and Rate of Return

**Federal Funding** expects shared learnings, typically less concerned with schedule and Rate of Return



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# CO<sub>2</sub> Source

- Sufficient Quantity and Predictable Quality of CO<sub>2</sub>
- Contractually Secure and Includes the “what ifs”
- Priced Right
- Relatively Near the Geologic Storage Site
- Willing to Change and Accepting of *Additional*
  - Operational Risk
  - CAPEX Cost
  - OPEX Costs





# CO<sub>2</sub> Capture, Processing and Transportation

## Mechanical Equipment

- Capture the CO<sub>2</sub> that was previously vented
- Remove contaminants
- Transform CO<sub>2</sub> from gas, to liquid, or supercritical fluid
- Transport via pipeline to the Geologic Storage Site



Trimeric Corporation

# Geologic Storage Site



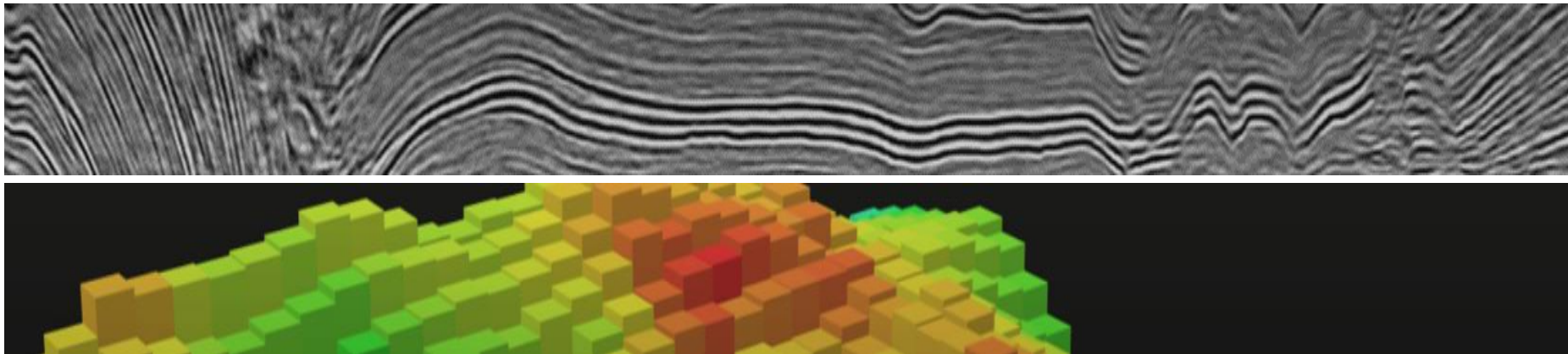
Unsplash.com





# Geologic Storage Site Fully Described

- Sufficient storage capacity, without leakage
- Supported by high quality data, which is typically available with oil and gas operations



- Carefully describe the geologic “storage tank” in context of nearby faults, oil and gas wells, plus potential for induced seismicity that may compromise geologic barriers, or integrity of the tank



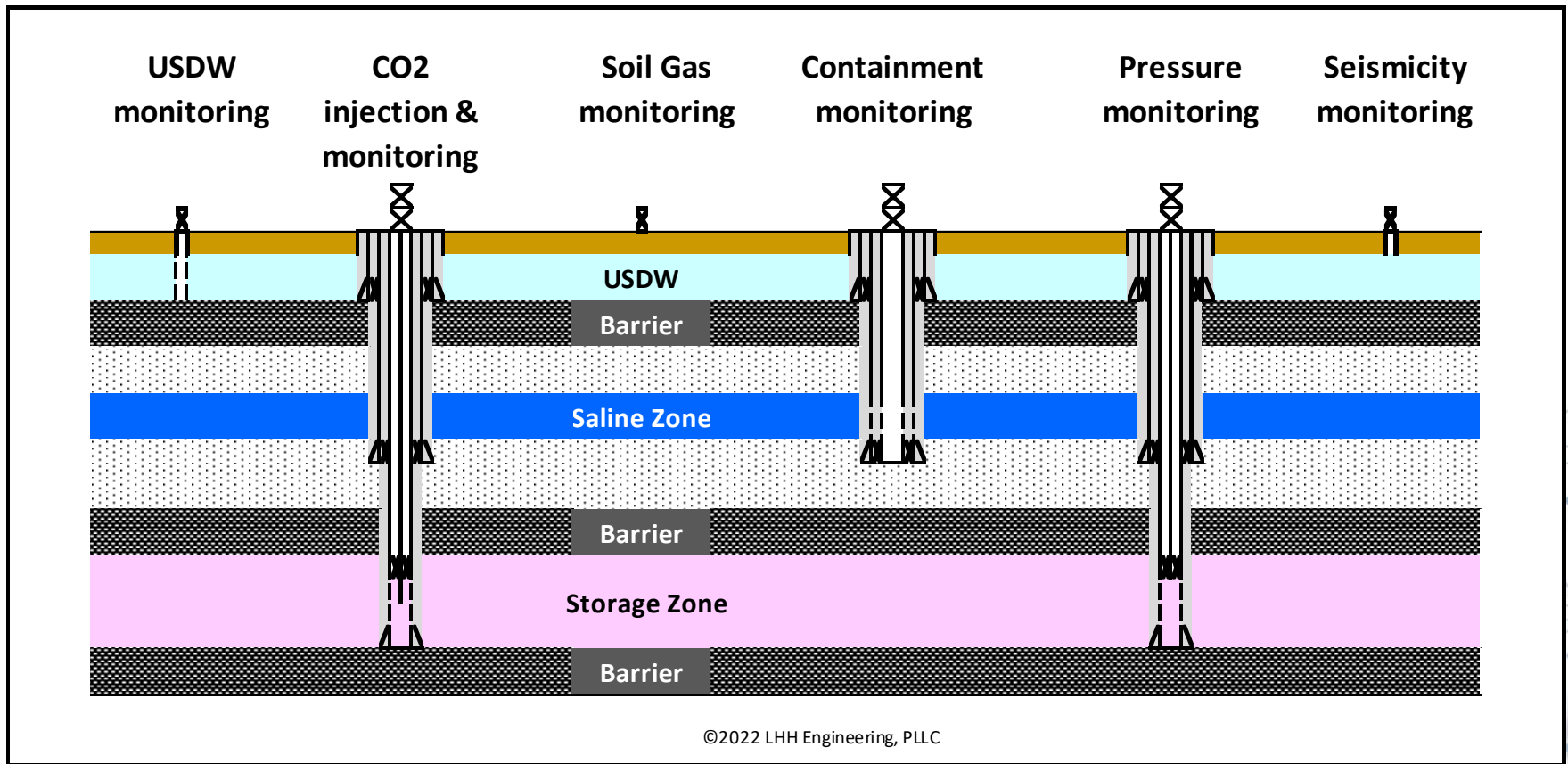
# Potential Legal Questions

- Federal, Tribal, State Law and Judicial Interpretation for
  - Surface rights and pore space ownership
  - Mineral rights and trespass
  - Pipeline right of way
  - Ultimate liability for the sequestered CO<sub>2</sub>





# UIC Class VI is a System of Wells and Monitoring



# How Many Approved Class VI Permits Exist?

## 9 total Approved Class VI Permits as of June 2022 \*

Project Name	Future Gen Alliance	Illinois Decatur Basin	Illinois Decatur Basin	Red Trail Energy	Project Tundra
Well Name	Future Gen well 1,2,3,4	ADM CCS #1	ADM CCS #2	RTE-10	Liberty #1, Unity #1
EPA Region (Delegate)	5	5	5	8 (North Dakota)	8 (North Dakota)
County, State	Morgan, IL	Macon, IL	Macon, IL	Stark, ND	Oliver, ND
current status	project cancelled 2016	post-injection	injection & monitoring	injection & monitoring	construction

## 15 total Pending Class VI Permits as of June 2022 \*

<https://www.epa.gov/uic/class-vi-wells-permitted-epa#table>

### Three Wells Pending Approval Region 5

Project Name	Wabash Carbon	Lorain Carbon Zero
wells anticipated	two	one
County, State	Vigo, IN	Lorain, OH

### Seven Wells Pending Approval Region 6

Project Name	Oxy Low Carbon	Gulf Coast Seq	Hackberry Carbon Seq
wells anticipated	two	four	one
County, State	Allen, LA	Cameron, Calcasieu, LA	Cameron, LA

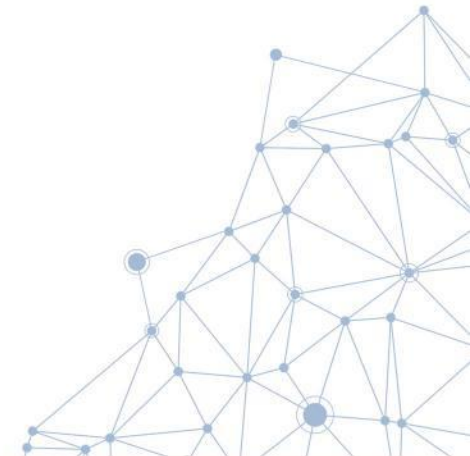
### Four Wells Pending Approval Region 9

Project Name	Carbon TerraVault 1	San Joaquin Ren'bles
wells anticipated	three	one
County, State	Kern, CA	Kern, CA

### Pending Approval Delegate States WY and ND

Project Name	North Shore Energy
wells anticipated	one
County, State	Uinta, WY

\* using best available public data

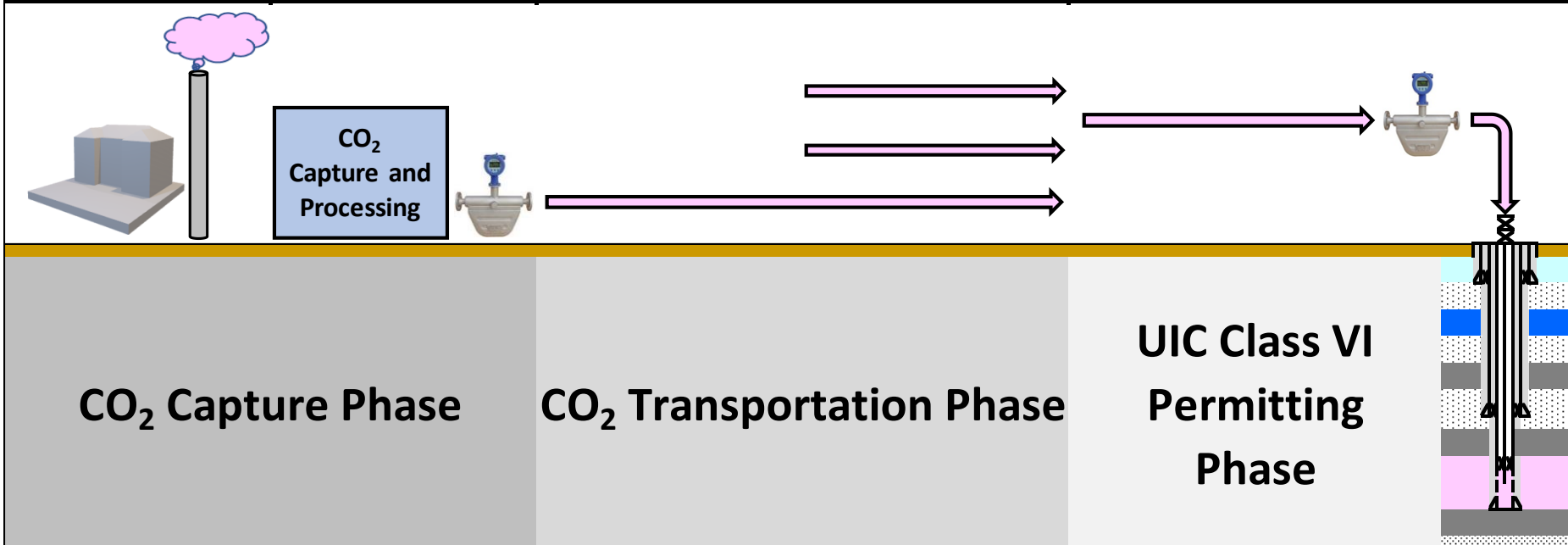


# Why so Few in Operation?

## CO<sub>2</sub> from the Flue Stack to the Geologic Storage Reservoir

### I. Technical Challenges

← Emissions Source → ← Emissions Capture → ← Midstream Gathering System → ← UIC Injection Well and the Reservoir →



### II. Commercial Challenges

Agreement for CO <sub>2</sub> Source and Capture, IRS 45Q pays (credits) here	Agreement for CO <sub>2</sub> gathering system	Agreements for Cost and Revenue Sharing, Pore Space, Minerals Estate, Surface Use
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### III. Public Engagement Challenges

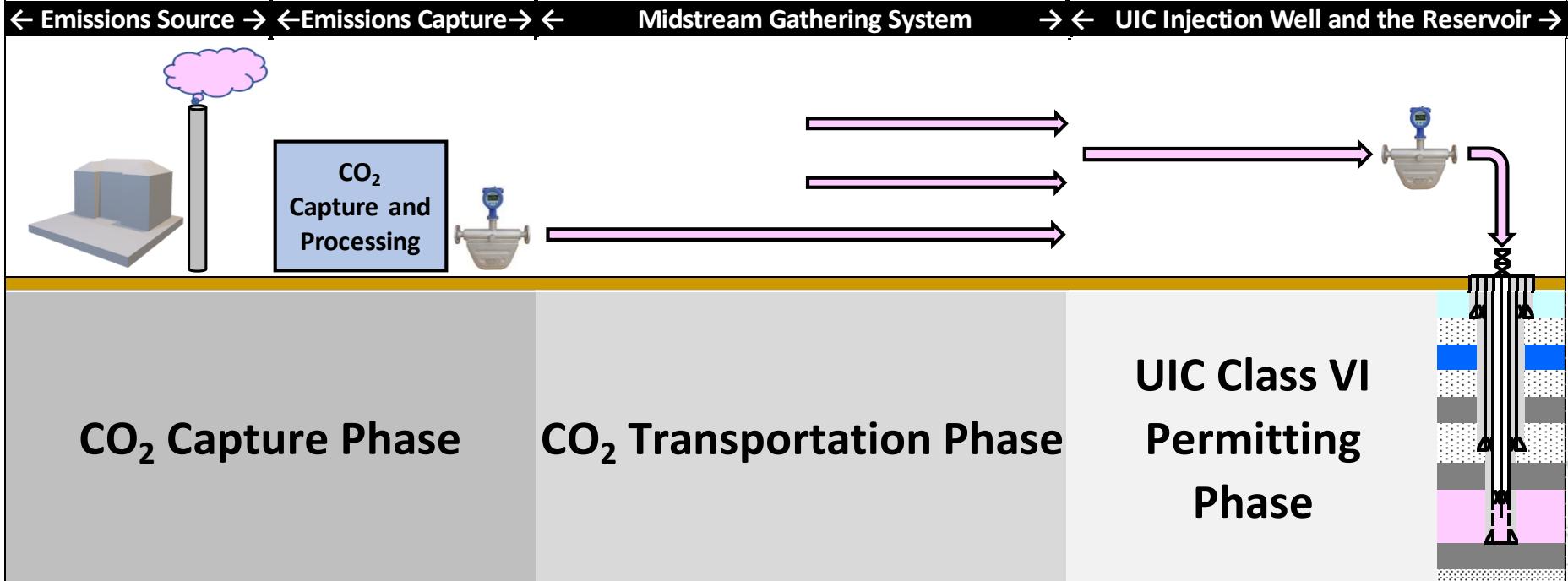
Air Permitting	Pipeline Right of Way Process	Community Engagement and EJ Process
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# It's a Three Legged Stool

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### II. Commercial Challenges

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Agreement for CO<sub>2</sub> gathering system

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Air Permitting

Pipeline Right of Way Process

Community Engagement and EJ Process

# Summary and Conclusions

**The private sector is figuring things out and will be successful**

- Legal, Regulatory, Technical, Commercial Challenges Remain
- NASA's transition to the private sector is our example



Official SpaceX Photos flickr.com

