CCS Risk Management

Fred Eames, Partner

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CCS Risk Management Experience

- Co-Founder, CCS Alliance
- Drafted federal and State CCS risk legislation
- Advocacy on Class VI financial responsibility regulations/guidance
- Co-Author, The Layered Approach to Risk Management for Geologic Sequestration of CO2

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Why Are We Discussing Risk Management?

- Significant industry interest in initiating Class VI storage projects
- Major focus from Congress in fostering Class VI storage
  - $2.5 billion in Bipartisan Infrastructure Bill for carbon storage projects
- 2019 National Petroleum Council report *Meeting the Dual Challenge* identified CCS risk management as a key priority

MEETING THE
DUAL CHALLENGE

A Roadmap to At-Scale Deployment of CARBON CAPTURE, USE, AND STORAGE

CHAPTER THREE – POLICY, REGULATORY, AND LEGAL ENABLERS

6. Long-Term Liability

Two of the most important questions that must be answered if CCUS is to become a large-scale commercially viable technology are:

- What will be the liability of CCUS operators for personal injury, property damage, trespass, and nuisance claims that could arise over the lifetime of a geologic storage project, which could be measured in centuries?
- What is the appropriate institutional framework for managing CCUS sites after closure?

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EOR and Dedicated Storage

EOR

- Known history of containment in the formation
- Extensive industry experience
- Comparatively small areal extent
- Pressure equilibrium generally maintained
- Brines produced, reinjected
- Fewer property owners

Dedicated Storage

- Less known or unknown history of containment in formation
- Less mature industry experience
- Comparatively large areal extent
- Potential pressure management issues
- Brine management tbd
- More property owners

Oil Field Utilization versus Dedicated CCS

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BASE CASE

- **Single gasification project producing 200 MMcf/d of CO_2**
- **30 year life**
- **Total CO_2 Utilization : 2.2 Tcf of CO_2**

CO_2 ENHANCED OIL RECOVERY OPERATIONS

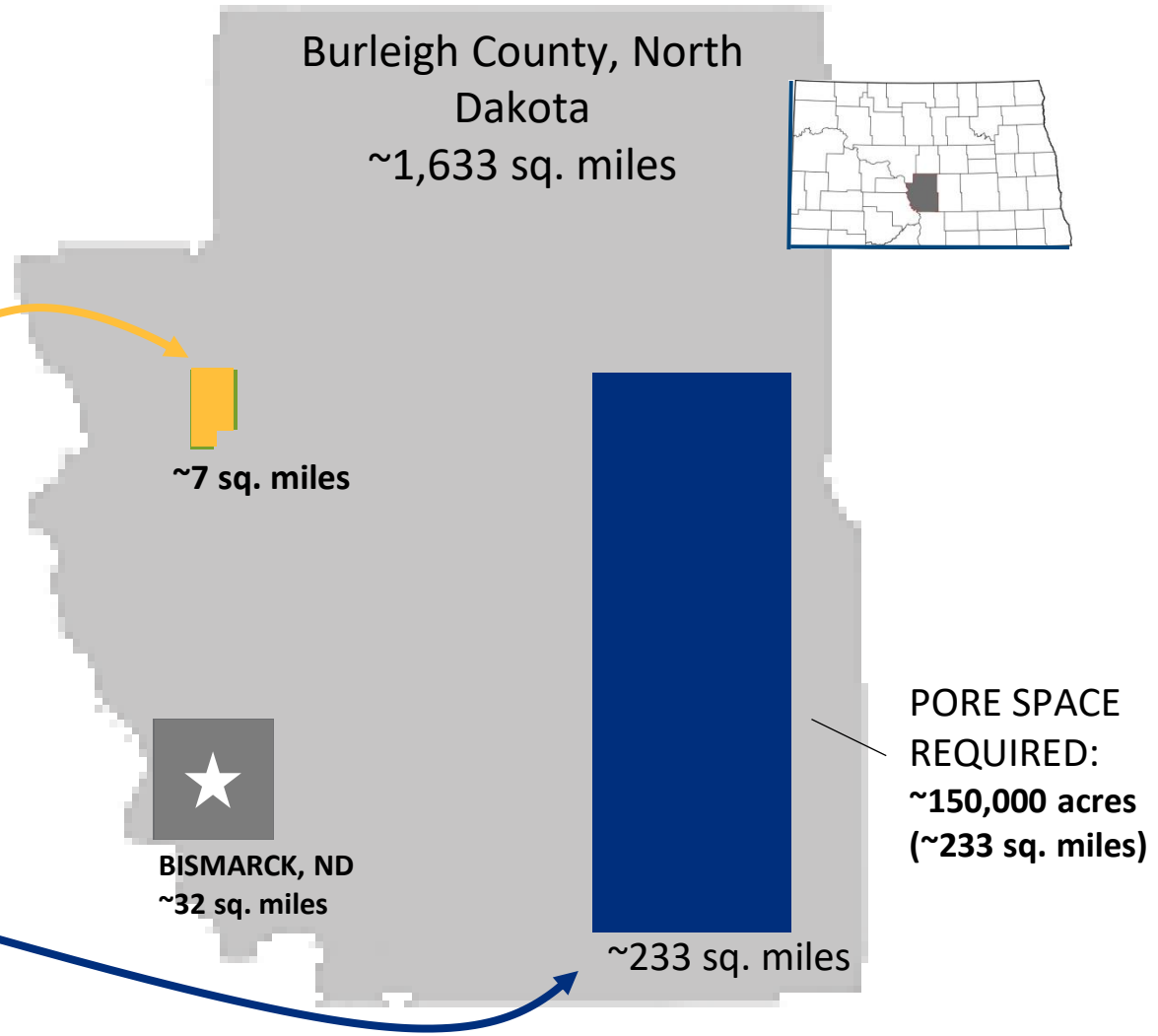
Oil Field Example (approximate values)

- 5,500'
- Reservoir Pressure: 2,500 psi
- Areal Extent: 4,600 acres
- Max CO_2 Utilization: 1.0 Tcf

DEDICATED CARBON CAPTURE & STORAGE

Saline Reservoir (approximate values)

- CO_2 to be stored: 2.2 Tcf
- 6,500'
- Reservoir Pressure: 3,000 psi
- Thickness: 125'
- Porosity: 20%
- Percent of pore space utilized: 4% (versus avg. 40% for EOR)



CCS or CCUS?

CCS

Pros

- Higher 45Q tax credit amount ($50/ton vs. $35/ton)
- Broader support from environmental community
- Less interconnected project risk (offtakers don't need CO2, facility is down, etc.)

Cons

- More difficult regulatory structure; EPA lead
- Larger project footprint – property rights, public intervention
- Less well-known containment – liability risk?

CCUS

Pros

- Well-known low containment risks
- Much smaller storage footprint
- Lighter-handed regulatory structure (Class II vs. Class VI UIC program); State regulatory lead

Cons

- Interconnected project risk
- Lower 45Q tax credit amount (balanced by fee for CO2)
- Environmental community resistance
- Future fossil fuel production risk?

Offtakers may have dual capability

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Necessity of Risk Management for Class VI Storage

- **UIC program requires Financial Responsibility** – 40 CFR 146.85
  - Purpose of UIC program is to protect USDWs
  - Must be sufficient to cover cost of corrective action, injection well plugging, post-injection site care and site closure, emergency and remedial response
  - Variety of mechanisms approved for use
- **Market will require risk management**
  - Risk management likely required for financing
  - Market may distinguish between storage options based on credibility of risk management

Key Class VI Requirements – 40 CFR 146.85

- Specifies types of instruments allowed:
  - trust funds, surety bonds, letter of credit, insurance, self-insurance, escrow account, other "acceptable to the Director"
- "[M]ust be sufficient to address endangerment of underground sources of drinking water"
- Must maintain coverage "for the entire term of the geologic sequestration project" (essentially, until closure)
  - Certain restrictions on cancellation and renewal of instruments
- Risk management must be based on an estimate of costs of corrective action on wells in the AoR, plugging, PISC, closure, and emergency/remedial response (adjusted annually for inflation)
  - Director must approve estimate increases/decreases
- Must notify Director if "adverse financial conditions . . . May affect the ability to carry out injection well plugging and [PISC] and site closure"

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Types of Risk Management Instruments

Trust Fund	Insurance	Surety Bond
Letter of Credit	Self Insurance	Escrow

Or any other instrument acceptable to the Director (EPA or the State)

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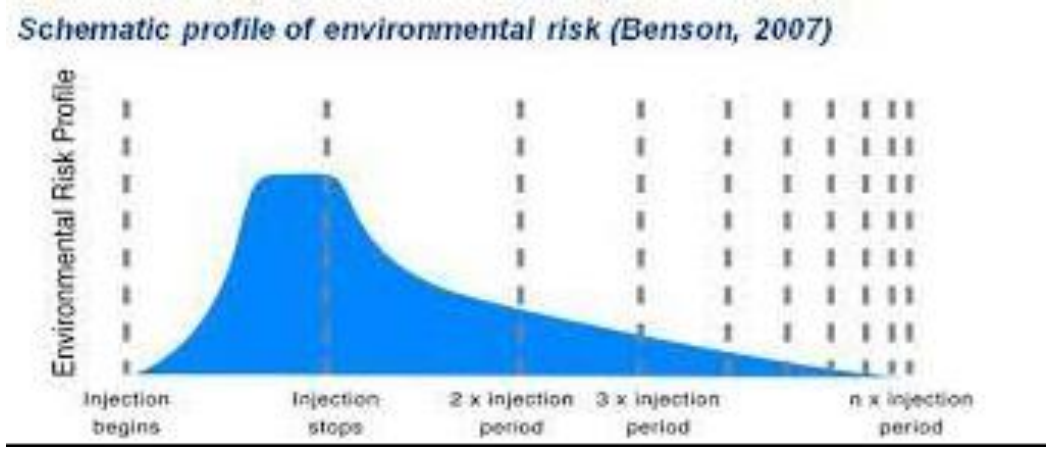
Risk and the Storage Site Timeline



- Pre-injection
- Injection
- Post-injection site care (PISC)
- Post-PISC (long-term)

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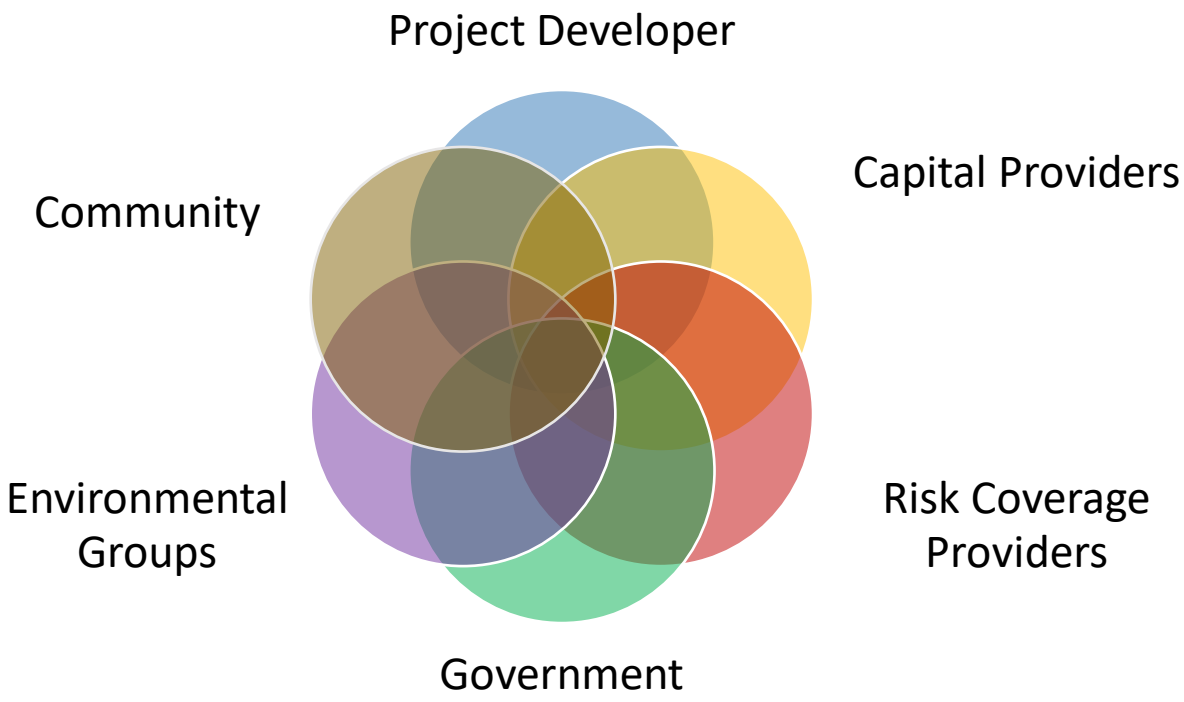
Risk Management Considerations

Considerations in Risk Management

- Protecting human health and the environment, including USDWs
- Cost of risk management
- Encouraging a proper level of caution (moral hazard)
- Regulatory capture
- Assurance over a long term
- Market-driven solutions, not government-driven solutions
- Ability of society to put risk capital to work (dead capital problem)



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Next Steps

Contact

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Fred Eames
Hunton Andrews Kurth LLP
2200 Pennsylvania Avenue, N.W.
Washington, D.C. 20037
feames@hunton.com
202-778-2245