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Critical Challenges. Practical Solutions.



Energy & Environmental Research Center (EERC)

Development of Carbon Storage

USEA Regional Decarbonization Workshop

Anchorage, Alaska

May 8, 2024

John A. Hamling

Assistant Vice President for Strategic Partnerships

PCOR PARTNERSHIP

2003 – PRESENT

The Plains CO₂ Reduction (PCOR) Partnership addresses regional capture, transport, use, and storage challenges facing commercial carbon capture and storage (CCS)/carbon capture, utilization, and storage (CCUS) deployment. The Partnership focuses on the following:

- Strengthening the technical foundation for geologic CO₂ storage and enhanced oil recovery (EOR)
- Regional characterization
- Advancing capture technology
- Improving application of monitoring technologies
- Promoting integration among capture, transportation, use, and storage industries
- Facilitating development of regulatory frameworks
- Providing scientific support to policymakers
- Enabling and advancing deployment of CCS/CCUS

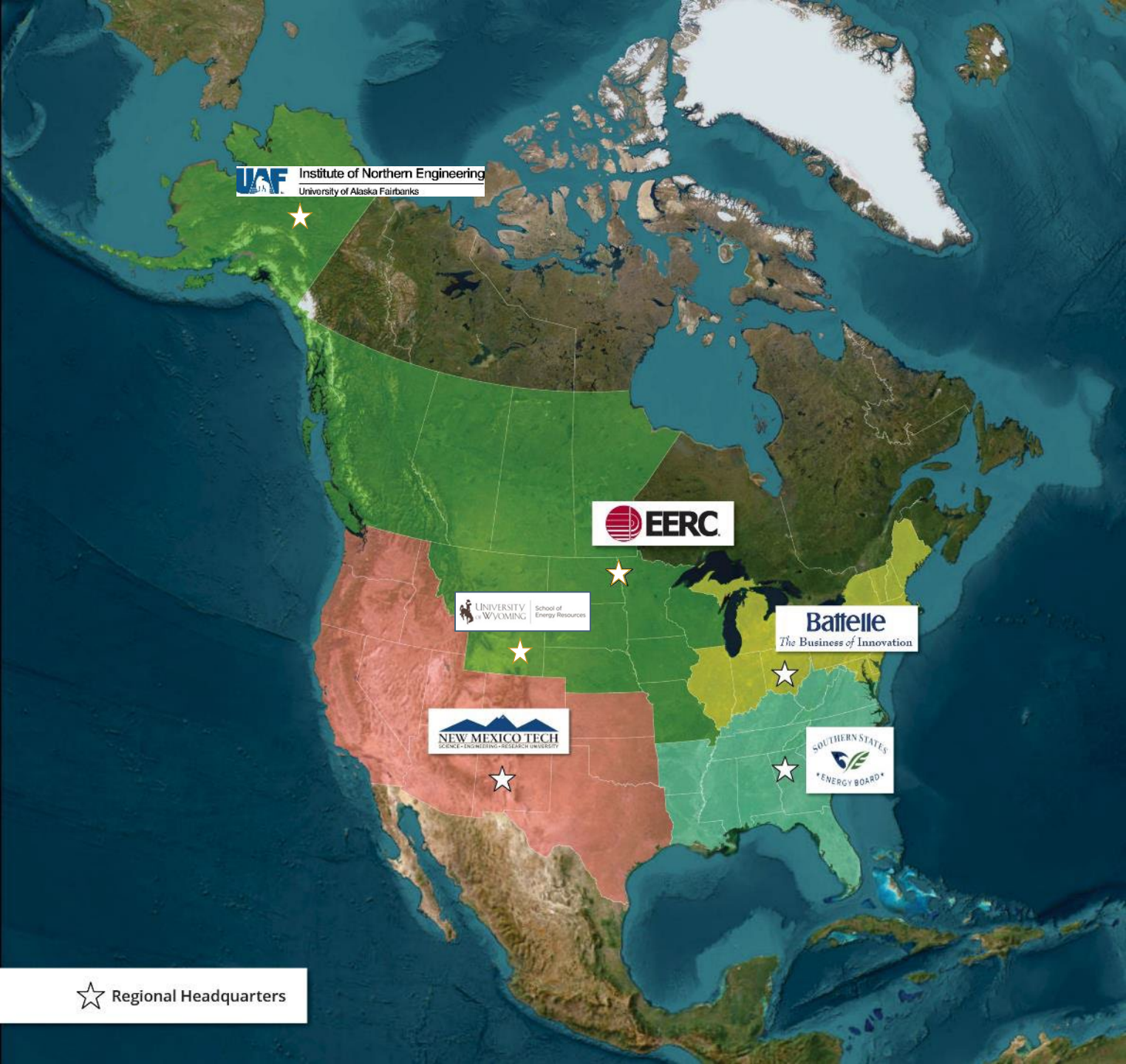
The partners inform priorities.





PARTNERSHIP MEMBERS





PCOR PARTNERSHIP REGIONAL INITIATIVE PROGRAM



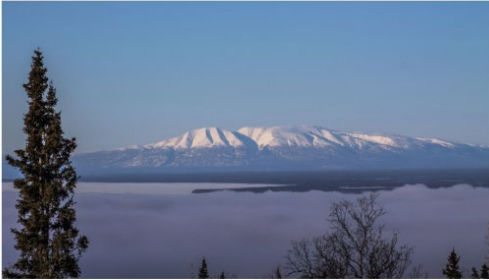
Institute of Northern Engineering

University of Alaska Fairbanks



Institute of Northern Engineering
University of Alaska Fairbanks

COOK INLET REGION LOW CARBON POWER GENERATION WITH CARBON CAPTURE, TRANSPORT, AND STORAGE FEASIBILITY STUDY



February 28, 2024

University of Alaska Fairbanks Institute of Northern Engineering

Energy & Environmental Research Center, University of North Dakota



Plains CO₂ Reduction (PCOR) Partnership
Energy & Environmental Research Center (EERC)





Distribution of Sedimentary Basins
Greater than 800 m Deep²⁸

 Sedimentary Basins

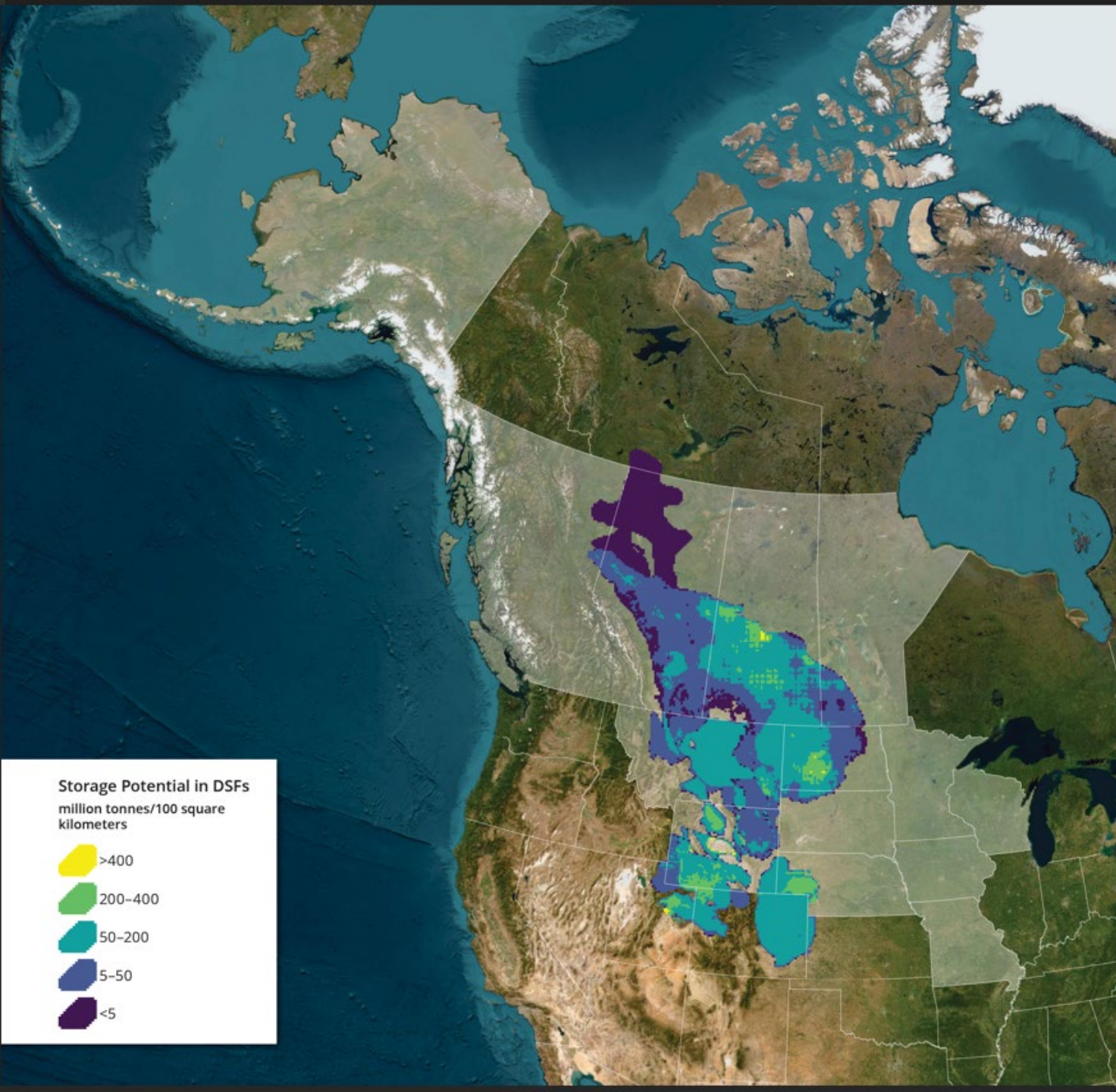
SEDIMENTARY BASINS



Classification of Large Stationary CO₂ Emission Sources in the PCOR Partnership Region^{16,17}

CO ₂ Source Type	Annual CO ₂ Output, tonnes
Agriculture Processing	100,000–500,000
Cement Plant	500,000–2,000,000
Electricity	2,000,000–5,000,000
Ethanol	5,000,000–10,000,000
Fertilizer	10,000,000–20,000,000
Industrial	10,000,000–20,000,000
Petroleum and Natural Gas	10,000,000–20,000,000
Refineries and Chemical	10,000,000–20,000,000
Sedimentary Basin (nominal extent)	

SEDIMENTARY BASINS AND LARGE STATIONARY SOURCES



ASSESSED STORAGE POTENTIAL IN DEEP SALINE FORMATIONS

*DSF = deep saline formation



North Slope

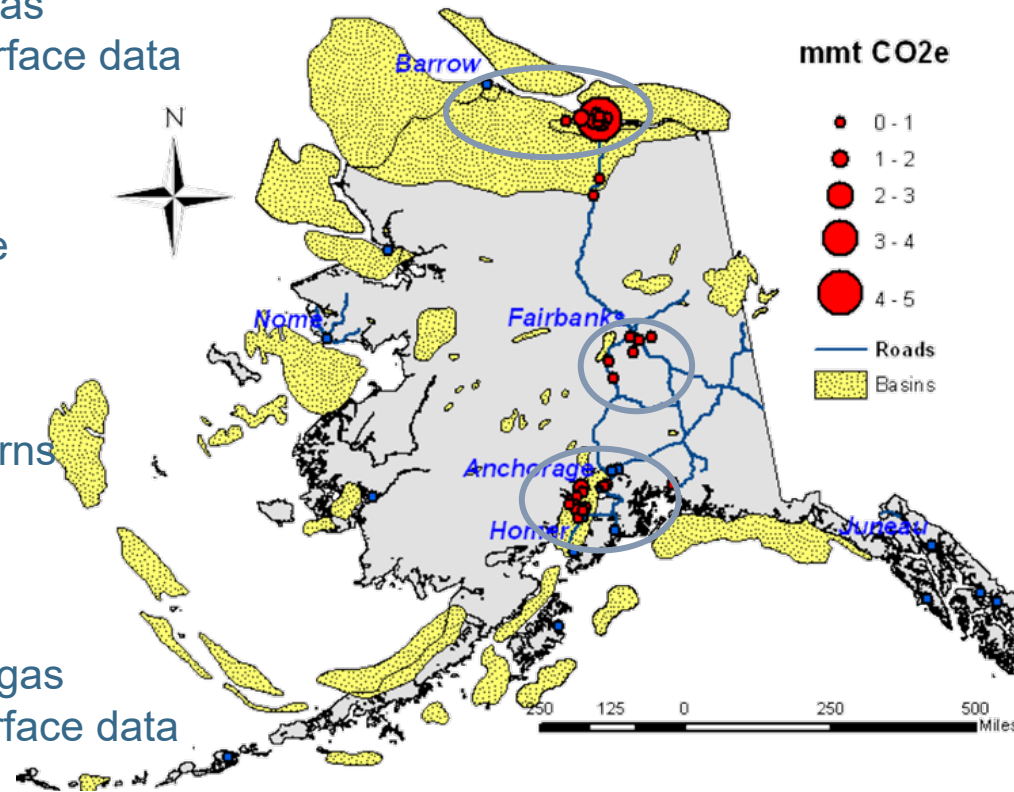
- Natural gas-fired
- Low-cost natural gas
- Oil and gas subsurface data

Interior

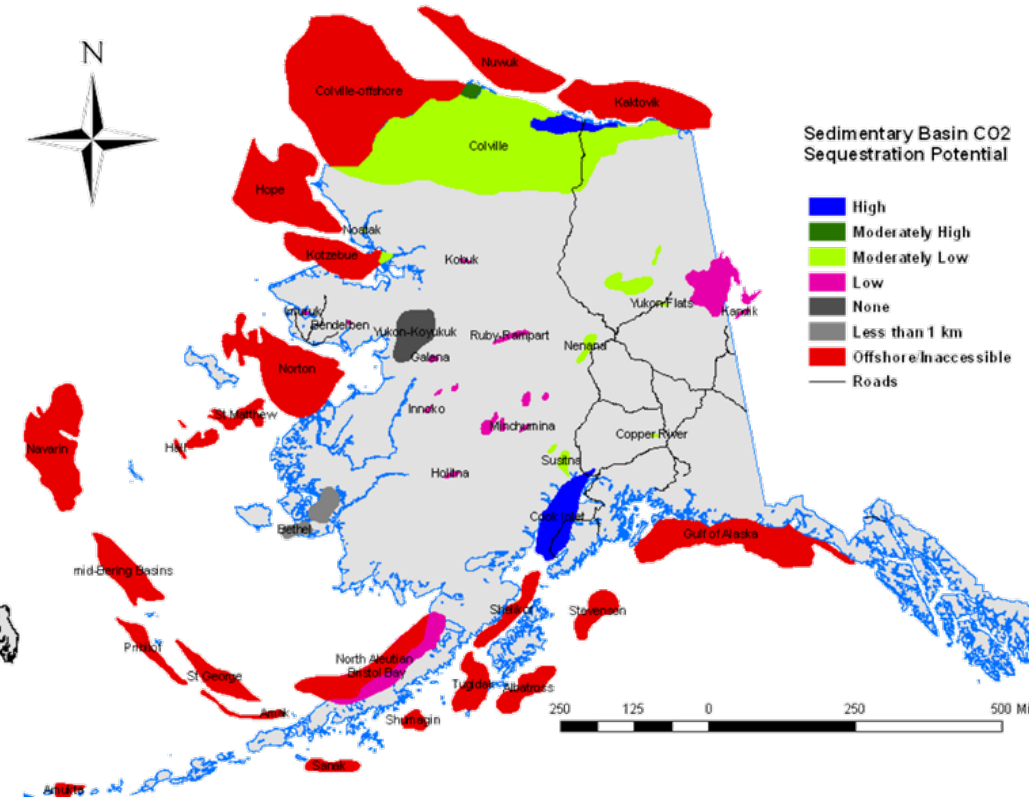
- Coal-fired
- Limited subsurface data
- Subsurface poorly understood, cap rock concerns

Southcentral

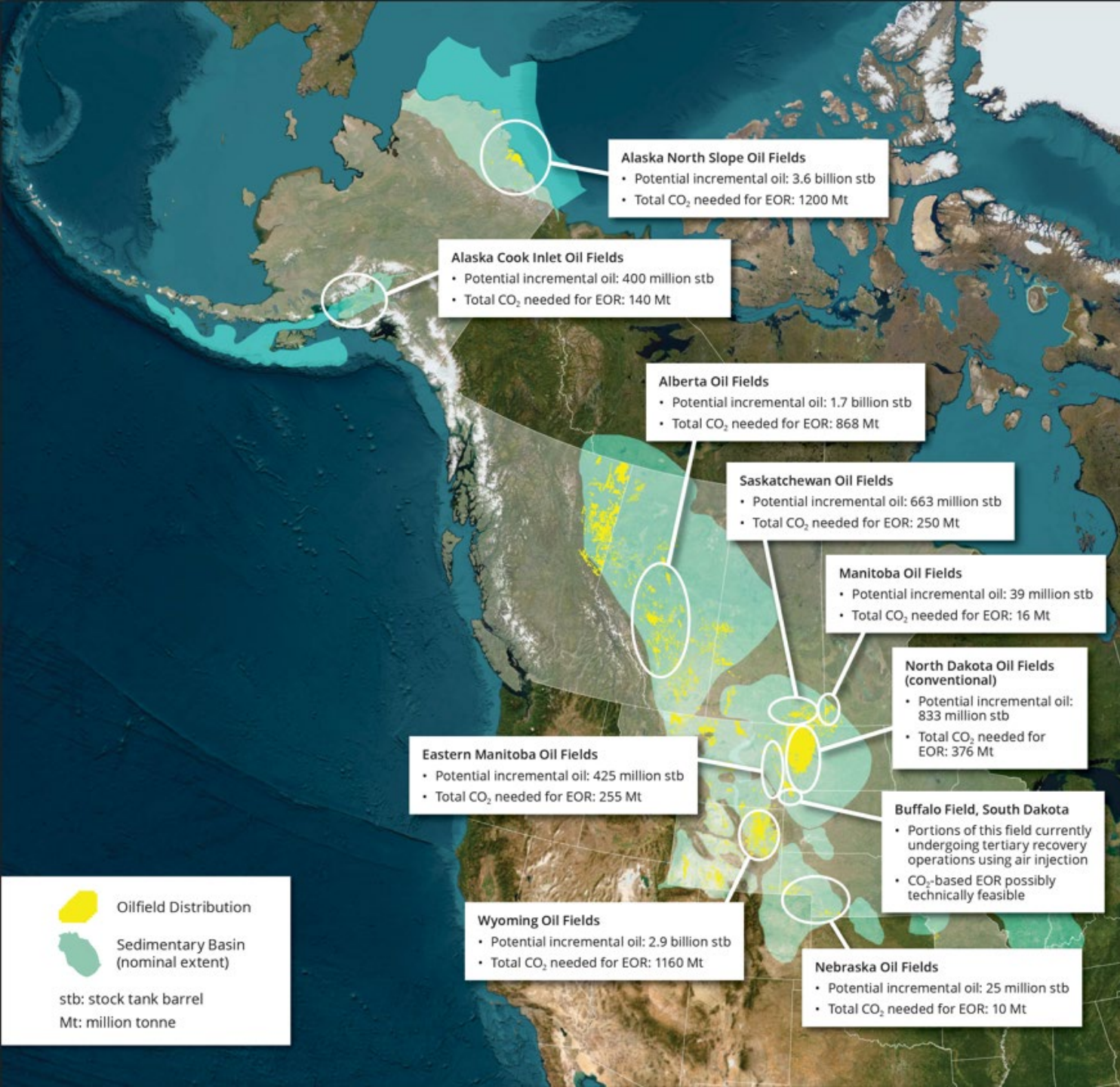
- Natural gas-fired
- High cost, scarce natural gas
- Oil and gas subsurface data
- ARCCS project proposed



CO₂ Stationary Sources (red) and Deep Sedimentary Basins (yellow)



Sedimentary Basin Sequestration Potential (Shellenbaum and Clough, DNR, 2010)



STORAGE POTENTIAL ASSOCIATED WITH OIL AND GAS FIELDS



Active and Developing CCUS Projects in the PCOR Partnership Region

- Active Capture
- ▲ Active Injection
- Developing Capture
- ▼ Developing Injection
- CO₂ Pipeline
- Active
- Planned

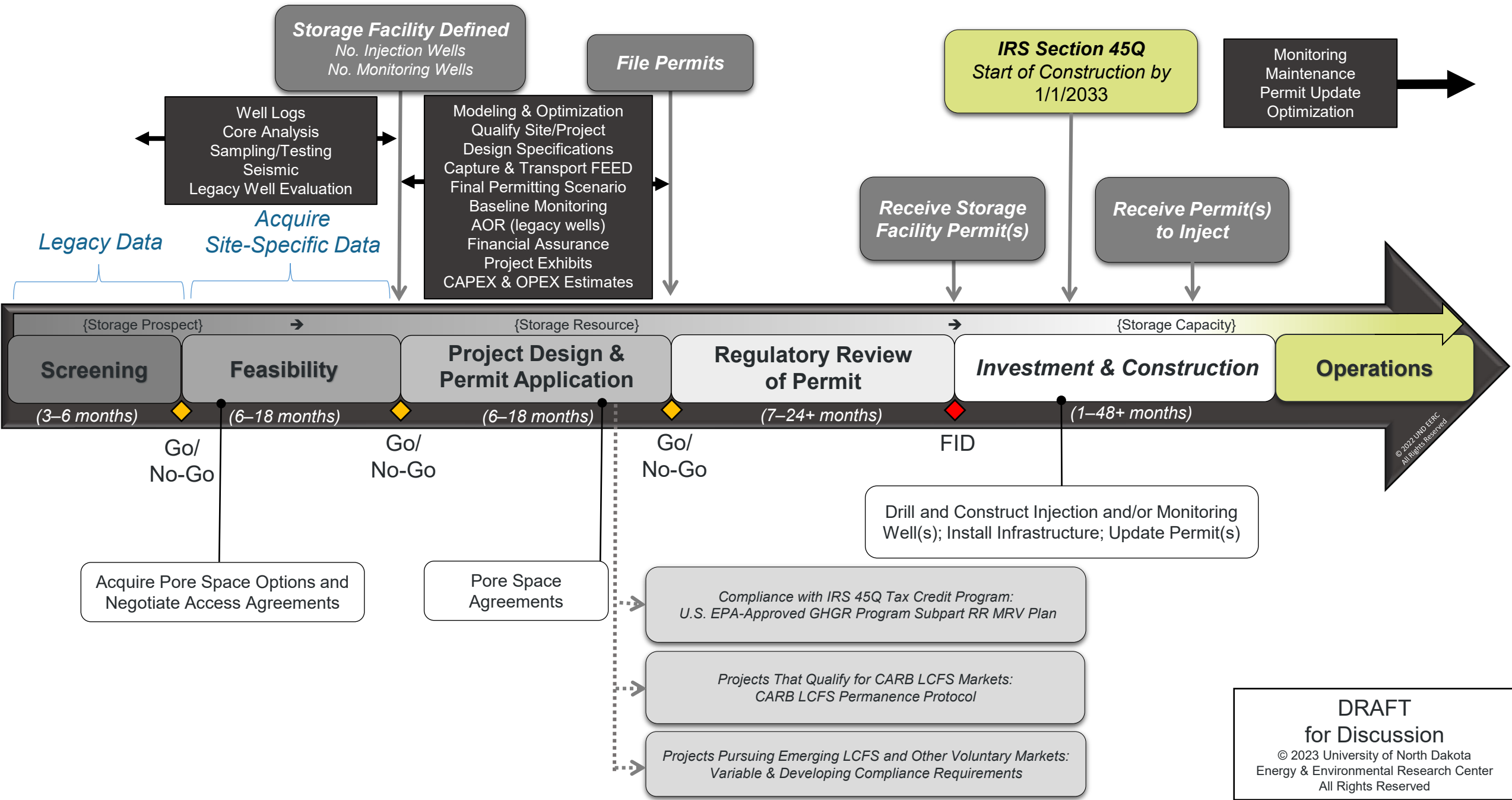
CCA = Cedar Creek Anticline (ND/MT border)

Proposed Alberta CCUS Hubs

- | | |
|---------------------------|------------------------------|
| 1. Grand Prairie Net Zero | 13. Origins |
| 2. Greenview Region | 14. Alberta Carbon Grid |
| 3. Grand Prairie CCS | 15. Atlas Carbon Sequestrian |
| 4. Maskwa | 16. World Midstream |
| 5. Athabasca Banks | 17. Battle River |
| 6. Opal Carbon | 18. Central Alberta |
| 7. Rocky Mountain | 19. Ram River |
| 8. Tourmaline Clearwater | 20. Bow River |
| 9. Brazeau | 21. Rolling Hills |
| 10. Oil Sands Pathways | 22. North Drumheller |
| 11. Meadowbrook | 23. Pincher Creek |
| 12. Open Access Wabamun | 24. Clear Horizon |

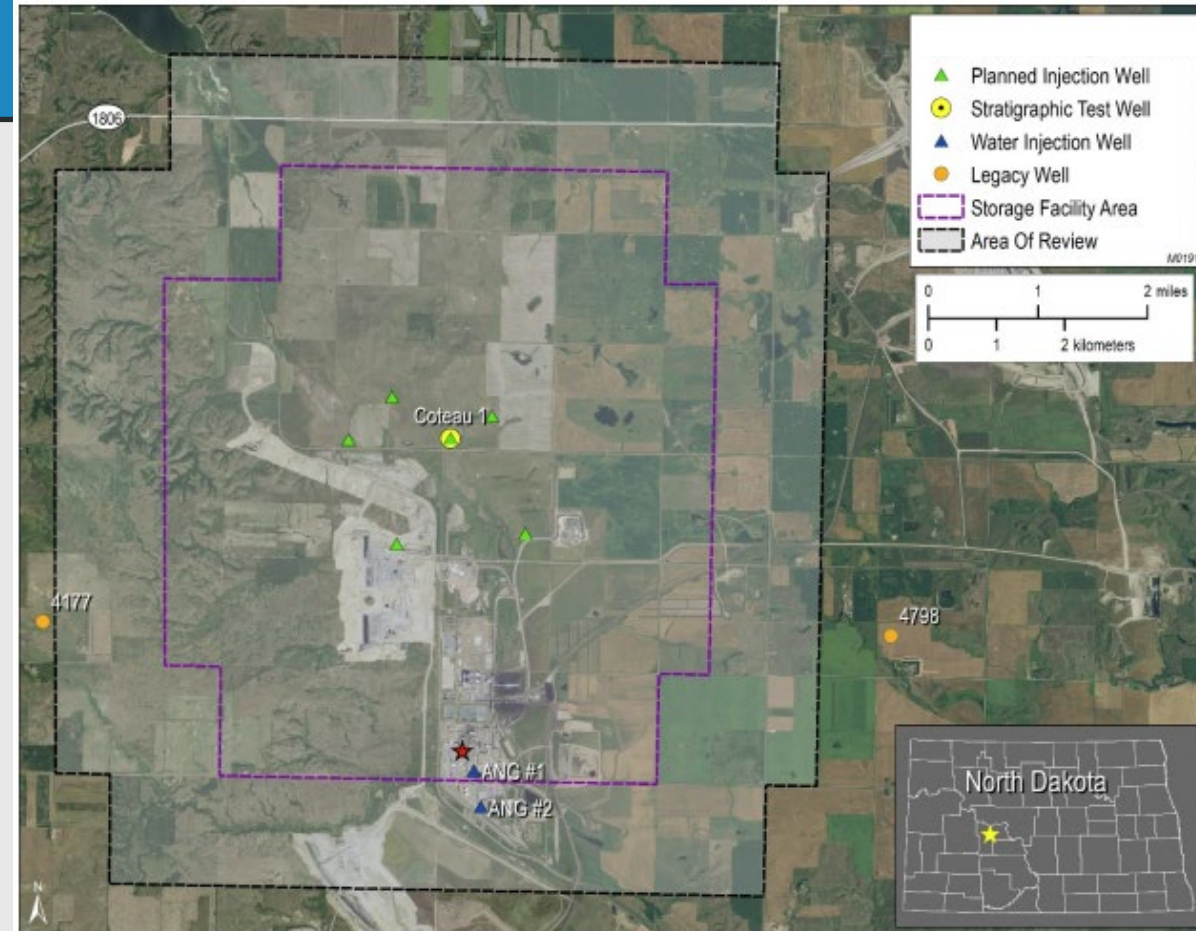
ACTIVE AND DEVELOPING CCUS PROJECTS IN THE PCOR PARTNERSHIP REGION

INDICATIVE TIMELINE TO IMPLEMENT CARBON CAPTURE AND GEOLOGIC STORAGE



CO₂ STORAGE FACILITY PERMIT (CLASS VI) CHECKLIST

- Pore space access
- Geologic exhibits**
- Area of review (AOR)**
- Supporting plans
 - Emergency and remedial response plan
 - Financial assurance demonstration plan
 - Worker safety plan
 - Testing and monitoring plan**
 - Well casing and cementing program**
 - Plugging plan
 - Postinjection site and facility closure plan**
- Injection well and storage reservoir information
- Permit appendices



GEOLOGIC STORAGE FACILITY DEVELOPMENT

EQUATION FOR SUCCESS

- 1) Appropriate geology (characterization)
- 2) Proper engineering and operations design
- 3) Comprehensive testing and monitoring plans
- 4) Stakeholder engagement



Compliance oversight through
state and/or EPA permitting
and regulatory programs

AND

Ongoing monitoring

AND

Regulatory and incentive
program reporting/compliance
through life of project

Result: CO₂ permanently stored with robust protections

ND-AK CCUS SUMMIT

Objective: Information sharing among North Dakota and Alaska legislators, regulators, and industry experts

- Tours:
 - Active Class VI injection project
 - Coal-fired power plant preparation for UIC Class VI permitting



PCOR PARTNERSHIP		20 th EERC	
December 4-5, 2023, BISMARCK, NORTH DAKOTA			
Tuesday, December 5, 2023		Epic Conference Room 335	
TIME	ACTIVITY	DISCUSSION LEADER(S)	
7:30 a.m.	Breakfast (provided)		
8:15 a.m.	Welcome and Introductions	Kevin Connors Senator Dale Patten Kevin Connors	
8:30 a.m.	Meeting Overview	Kevin Connors	
8:45 a.m.	Setting the Stage for the Day: Everything You Need to Know about North Dakota CCUS		
	• PCOR Partnership – Fostering Key Partnerships and Building the Technical Foundation	Kevin Connors	
	• North Dakota Energy R&D Program	Reice Haase	
	• North Dakota Clean Sustainable Energy Authority	Senator Dale Patten Representative Glenn Bosch	
	• North Dakota's Carbon Management Vision	Lynn Helms Senator Rich Wardner	
9:30 a.m.	Establishing the Regulatory Certainty	Lynn Helms	
	North Dakota's Legal and Regulatory Frameworks:		
	• Implementing a Resource Management Framework		
	• Class VI Well Primacy Application Process		
	• Permitting CO ₂ Storage	Kevin Connors	
10:15 a.m.	Break		
10:30 a.m.	Alaska's Road to Regulatory Framework		
	• Class VI Primacy Process Update	Commissioner Brett Huber	
	• Pending Legislation and Continued DNR Work	Haley Paine	
11:00 a.m.	Alaska Project Updates		
	• Consortium Updates on DOE Applications	Kyle Kohman, Brooke Ivy,	
	– Direct Air Capture and Point Source Capture	Liam Zsolt	
	• ARRCs Project (CarbonSAFE Phase II)	Brent Sheets, Rob Power	
12:00 Noon	Business Lunch (provided)		
1:00 p.m.	Current Opportunities and Future Challenges		
	• North Dakota Public Perceptions and Attitudes Toward Coal and CCUS	Jonathan Fortner	
	• Carbon Capture on Coal-Fired Power Plants	Mike Holmes	
2:00 p.m.	Topical Discussion	Kevin Connors	
	• Creating Value for the State, Industry, and Communities		
	• Areas of CCUS Implementation Uncertainty or Concerns for Alaska Legislators		
	• Policy and Regulatory Lessons Learned from North Dakota		
	• North Dakota CCUS Design Considerations and Approaches to Operational Flexibility		
	• Gasification Plant and Enhanced Oil Recovery		
3:00 p.m.	Adjourn		



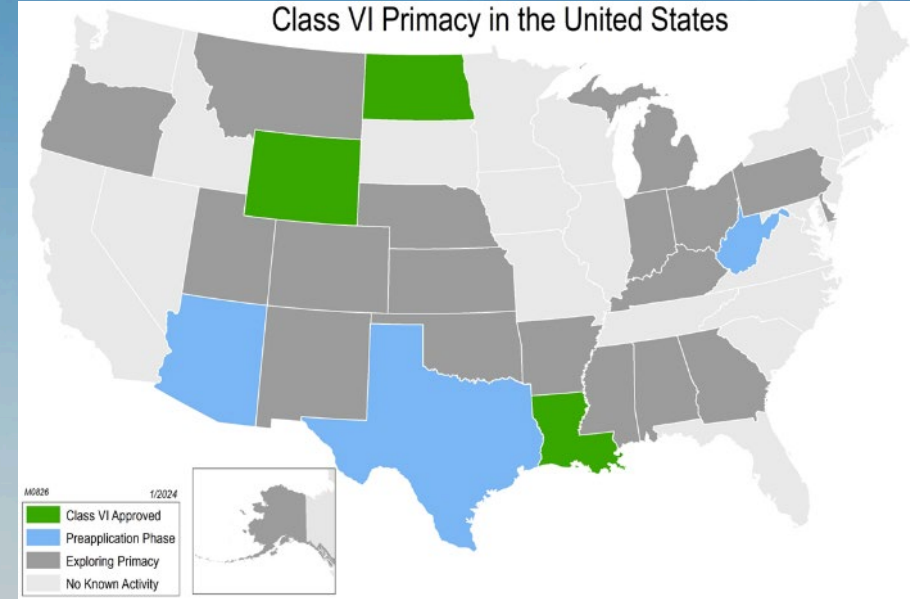
Photo from LinkedIn

REGULATORY ROUNDUP 2023

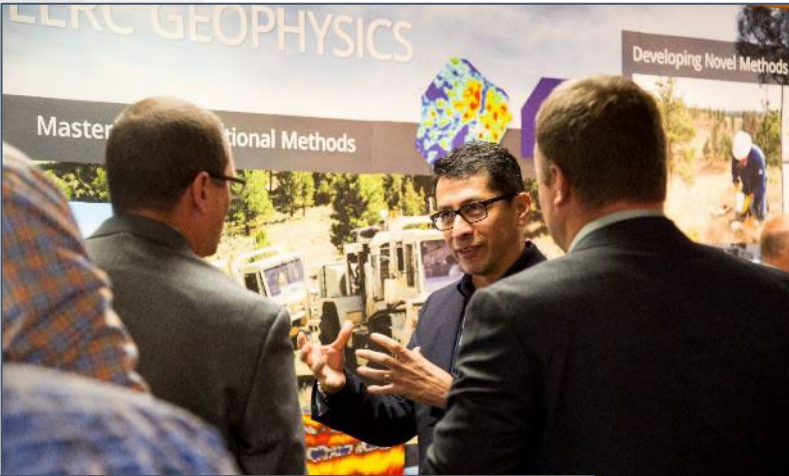
46 attendees

Regulators from 13 states and 2 Canadian provinces

Additional interest



EDUCATION AND OUTREACH



FLARING

NORM

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WATER

Where Do Producers Get the Water?

How is Water Used in Oil and Gas Production?

How Much Water Are We Talking?

Opening Water Deposits as of September 11, 2012

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PCOR PARTNERSHIP ATLAS
6TH EDITION | 2021

Making Safe, Practical Carbon Capture, Utilization, and Storage Projects a Reality

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Installing a Casing-Conveyed Permanent Downhole Monitoring System

Reducing Our Carbon Footprint: The Role of Markets

Nature in the Balance: CO₂ Sequestration

Out of the Air - Into the Soil: Land Practices That Reduce Atmospheric Carbon Levels

Global Energy and Carbon: Tracking Our Footprint

EERC





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A wide-angle photograph of a university campus at sunset. The sun is low on the horizon, casting a warm glow over the scene. In the foreground, there are large trees with some yellowing leaves. In the background, there are several large, multi-story brick buildings, likely university halls or administrative buildings. A parking lot with several cars is visible in the middle ground. The sky is a mix of orange, yellow, and blue.

THANK YOU

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