### EERC. UNIVERSITYOF NORTH DAKOTA.



**Critical Challenges. Practical Solutions.** 

# EERC. UN NORTH DAKOTA.

Energy & Environmental Research Center (EERC)

### **Development of Carbon Storage**

USEA Regional Decarbonization Workshop Anchorage, Alaska May 8, 2024

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# **PCOR PARTNERSHIP**

#### 2003-PRESENT

The Plains CO<sub>2</sub> 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 CO<sub>2</sub> 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.



Critical Challenges. Practical Solutions.

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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





# SEDIMENTARY BASINS

#### Classification of Large Stationary $CO_2$ Emission Sources in the PCOR Partnership Region<sup>16,17</sup>

O <sub>2</sub> Source Type	Annual CO <sub>2</sub> Output, tonnes
Agriculture Processing	<ul> <li>100,000-500,000</li> </ul>
Cement Plant	o 500,000-2,000,000
Electricity	○ 2 000 000-5 000 000
Ethanol	
Fertilizer	5,000,000-10,000,000
Industrial	0 10,000,000-20,000,000
Petroleum and Natural Gas	Sedimentary Basin

Refineries and Chemical

Sas Sedimentary Bas (nominal extent)



# SEDIMENTARY BASINS AND LARGE STATIONARY SOURCES



# ASSESSED STORAGE POTENTIAL IN DEEP SALINE FORMATIONS



mmt CO2e

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#### **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

CO<sub>2</sub> Stationary Sources (red) and Deep Sedimentary Basins (yellow)

(Shellenbaum and Clough, DNR, 2010)





Eastern Manitoba Oil Fields

Potential incremental oil: 425 million stb
 Total CO<sub>2</sub> needed for EOR: 255 Mt

Wyoming Oil Fields

· Potential incremental oil: 2.9 billion stb

Total CO<sub>2</sub> needed for EOR: 1160 Mt

Saskatchewan Oil Fields

Potential incremental oil: 663 million stb
Total CO<sub>2</sub> needed for EOR: 250 Mt

Manitoba Oil Fields

Potential incremental oil: 39 million stb
 Total CO<sub>2</sub> needed for EOR: 16 Mt

North Dakota Oil Fields (conventional) • Potential incremental oil: 833 million stb • Total CO<sub>2</sub> needed for

EOR: 376 Mt

 Buffalo Field, South Dakota
 Portions of this field currently undergoing tertiary recovery operations using air injection

 CO<sub>2</sub>-based EOR possibly technically feasible

Nebraska Oil Fields

Potential incremental oil: 25 million stb
 Total CO<sub>2</sub> needed for EOR: 10 Mt

STORAGE POTENTIAL ASSOCIATED WITH OIL AND GAS FIELDS

Sedimentary Basin (nominal extent) stb: stock tank barrel

**Oilfield Distribution** 

stb: stock tank barre Mt: million tonne

Active and Developing CCUS Projects in the PCOR Partnership Region Proposed Power Plant

Active Capture
 Active Injection
 Active
 Developing Capture
 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



### CO<sub>2</sub> 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





# NORTH DAKOTA Critical Challenges. Practical Solutions.

# 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: CO<sub>2</sub> 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

PC	December 4-5, 2023, BISN	
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
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	
	<ul> <li>PCOR Partnership – Fostering Key Partnerships and Building the Technical Foundation</li> </ul>	Kevin Connors
	<ul> <li>North Dakota Energy R&amp;D Program</li> </ul>	Reice Haase
	North Dakota Clean Sustainable Energy Authority	Senator Dale Patten Representative Glenn Bosch
	<ul> <li>North Dakota's Carbon Management Vision</li> </ul>	Lynn Helms Senator Rich Wardner
9:30 a.m.	Establishing the Regulatory Certainty	
	North Dakota's Legal and Regulatory Frameworks:	Lynn Helms
	<ul> <li>Implementing a Resource Management Framework</li> </ul>	
	Class VI Well Primacy Application Process	
10:15 a.m	Permitting CO <sub>2</sub> Storage	Kevin Connors
10:30 a.m.	Alaska's Road to Regulatory Framework	
	Class VI Primacy Process Update	Commissioner Brett Huber
	<ul> <li>Pending Legislation and Continued DNR Work</li> </ul>	Haley Paine
11:00 a.m.	Alaska Project Updates	
	Consortium Updates on DOE Applications     Direct Air Capture and Point Source Capture     APPCS Project (CarbonSAEE Phase II)	Kyle Kohman, Brooke Ivy, Liam Zsolt Breat Sheets, Bob Bower
12:00 Noon	Business Lunch (provided)	prent sileets, Rob Fower
1:00 p.m.	Current Opportunities and Future Challenges	
	<ul> <li>North Dakota Public Perceptions and Attitudes Toward Coal and CCUS</li> </ul>	Jonathan Fortner
	Carbon Capture on Coal-Fired Power Plants	Mike Holmes
2:00 p.m.	Topical Discussion	Kevin Connors
	<ul> <li>Creating Value for the State, Industry, and Communities</li> </ul>	
	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 Expansion Oil Becomest	
3:00 p.m.	Adjourn	



### **REGULATORY ROUNDUP 2023**

46 attendees Regulators from 13 states and 2 Canadian provinces Additional interest



### **EDUCATION AND OUTREACH**



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