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EERC. NORTH DAKOTA. Energy & Environmental Research Center (EERC)

Plains CO₂ Reduction Partnership Initiative to Accelerate Carbon Capture, Utilization, and Storage Deployment (FE0031838)

> U.S. Department of Energy National Energy Technology Laboratory Carbon Management Project Review Meeting August 15–19, 2022

> > Kevin C. Connors PCOR Partnership Project Manager

REGIONAL CARBON SEQUESTRATION PARTNERSHIP PROGRAM

- Wisconsin, Iowa: Coordinating with Battelle.
- Montana: Coordinating with New Mexico Institute of Technology.
- Missouri: Coordinating with Battelle and the Southern States Energy Board.





PCOR Partnership

- 2003–2005: Phase | Characterization
- 2005–2009: Phase II Field Validation
- 2007–2018: Phase III Demonstration
- 2019–2024: Initiative Deployment

(PCOR region expanded to include AK + all of BC, WY, and MT)







PCOR Initiative PCOR Partnership

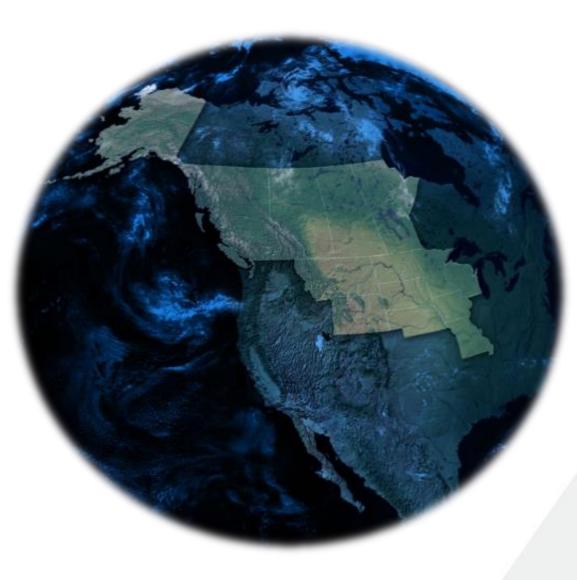
PCOR PARTNERSHIP

The PCOR Partnership Initiative is addressing regional capture, transport, use, and storage challenges facing commercial CCUS deployment. The Initiative is focusing on:

- Strengthening the technical foundation for geologic CO₂ storage and enhanced oil recovery (EOR).
- Advancing capture technology.
- Improving application of monitoring technologies.
- Promoting integration between capture, transportation, use, and storage industries.
- Facilitating regulatory frameworks.
- Providing scientific support to policy makers.

Our Partners inform our priorities

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New Partners – PCOR Partnership Initiative



2021 AND 2022 HIGHLIGHTS

- PCOR Partnership annual meetings held in Jackson, WY (106 participants) and Anchorage, AK (129 participants)
- Over 230 members; 55 new since 2019
- 2021 Regulatory Roundup held in Deadwood, SD; 2022 scheduled for September 2022 (expecting record attendance)
- TAB meetings held in Jackson, WY (2021), Houston, TX (2022), and Anchorage, AK (2022)
- Field effort initiated at the Red Trail Energy (RTE) CCS site
- Collaboration with UAF and UW
- New PCOR Partnership public and partner websites
- Several products (deliverables and white papers) published
- Numerous white papers in development





Active and Developing CCUS Projects in the PCOR Partnership Region

- Active Capture
- Active Injection
- O Developing Capture
- Developing Injection
- ---- Proposed CO₂ Pipeline

EOR Fields for ACTL Boundary Dam Aquistore Weyburn Great Plains Synfuels Plant Carbon Vault **Red Trail Energy** Coal Creek Station Midwest CCA Milton R. Young Station Bell-Creek Summit Lost Cabin Dry Fork Station-Riley Ridge Summit Shute Creek-Navigator Tallgrass Project Phoenix-Gerald Gentleman

ACTL Nutrien

and Sturgeon

Quest

CO₂ Pressure Plume and Saturation Plume Monitoring

- Research Institute of Innovative Technology for the Earth (RITE)
- Red Trail Energy (RTE)
- Energy & Environmental Research Center (EERC)
- Plains CO₂ Reduction (PCOR) Partnership
- U.S. Department of Energy (DOE) National Energy Technology Laboratory (NETL)

The Challenge: Monitoring requirements for geologic CO₂ storage projects are substantial.

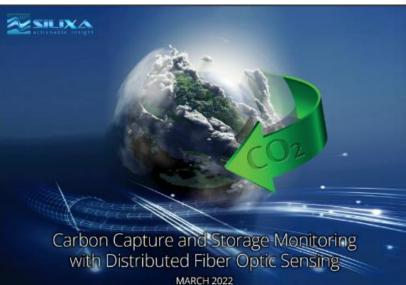
The Objective: Develop the next generation of cost-efficient long-term monitoring tools and validate them against established methods for monitoring carbon capture and storage (CCS). Develop an approach for more frequent data acquisition and processing while maintaining a reduced surface impact.

Desired result: New monitoring tools that are qualified with CCS regulatory and incentive programs and are available for use by CCS projects that can incorporate them into their monitoring strategies.



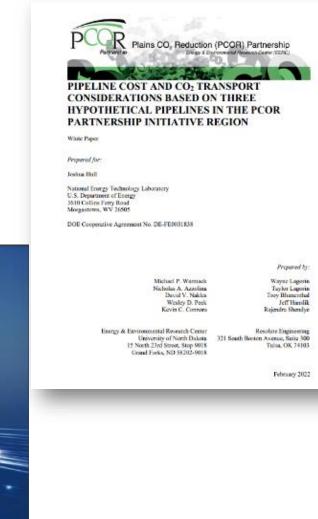


Expanded Partnership Expertise



Monitoring advancements

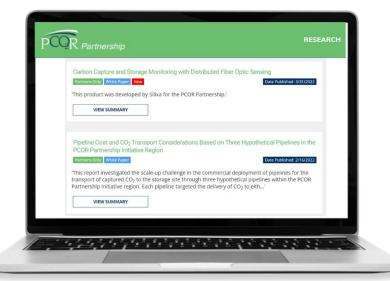




Infrastructure considerations



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Available online to all partners at undeerc.org/PCORPartners





GREENHOUSE GASES SCIENCE AND TECHNOLOGY

Original Research Article

SCI where science meets business

Risk-based area of review estimation in overpressured reservoirs to support injection well storage facility permit requirements for CO₂ storage projects

Volume 11, Number 5, October 2021

SC

Matthew E. Burton-Kelly 🔀 Nicholas A. Azzolina, Kevin C. Connors, Wesley D. Peck, David V. Nakles, Tao Jiang

First published: 18 June 2021 | https://doi.org/10.1002/ghg.2098

PERMITS

NORTH DAKOTA CarbonSAFE CIENCE AND TECHNOLOGY



POLICY AND REGULATORY DEVELOPMENTS

- Pore space Law
- Long-term liability
- Class VI primacy
- Regulatory program
 implementation
- Pathways to permit approval
- Policy/Regulatory Barriers



Regulatory Roundup Meeting August 17–18, 2021 EERC. UND NORTH DAKOTA. OD US. DEPARTMENT OF EERCY I NORTH DAKOTA.



PRODUCTS COMING SOON

- Class VI wellbore construction and design using corrosion resistant alloys
- Class VI injection well pressure transient analysis
- Pore space leasing considerations
- Pressure interference
- Approaches to predicting plume stabilization
- CCUS and grid stability
- CO₂ purity specifications and compatibility with pipeline materials
- Repurposing existing carbon steel pipelines
- CCS Hydrogen Roadmap: Optimal integration of CCS and hydrogen
- Lessons learned from coring, wireline logging, and seismic surveys





PCOR PARTNERSHIP

- Building on over 19 years of applied research in CCUS.
- Active region developing commercial CCUS projects.
- Engaged and motivated partners.
- Engaged regulators.
- PCOR is a catalyst for CCUS projects in the region.
- Focused on infrastructure development strategies.
- Ethanol industry in the region accelerating CCUS.
- Expanding CO₂ EOR opportunities in the region.





WHAT'S NEXT?

- Enabling Sustainable Monitoring for CCUS
- Storage optimization and active reservoir management
- Pressure interference study
- Injectivity interference study
- ML-based classifications of aquifer salinity
- Pore space resource competition
- Storage hubs and blue hydrogen
- CO₂-EOR Business Case and Messaging
- Develop strategies to address broad carbon management goals of states/provinces/regions
- Public and industry outreach





Celebrating



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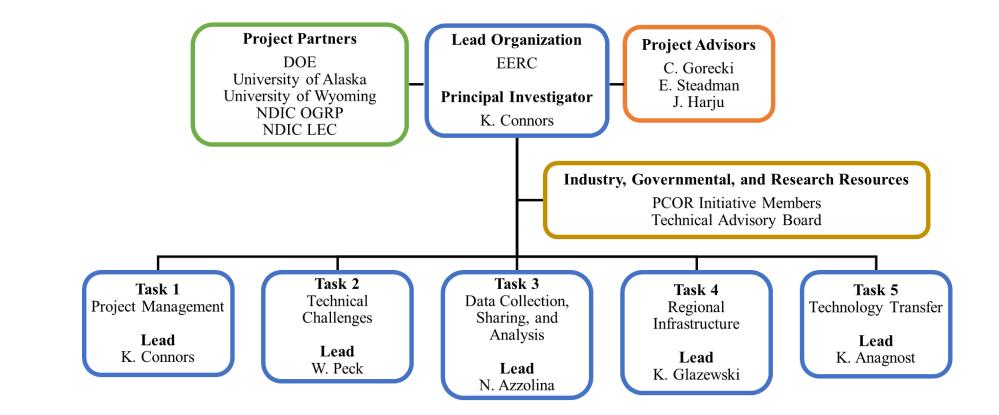


Funding and Project Performance Dates

| | BF 10/1/2019- | P1 -3/31/2022 | | P2 ∙9/30/2024 | Total | | | | |
|------------------|------------------|------------------|-------------|------------------|--------------|-------------|--|--|--|
| | Federal | Nonfederal | Federal | Nonfederal | Federal | Nonfederal | | | |
| DOE | \$7,592,000 | \$— | \$7,408,000 | \$— | \$15,000,000 | \$— | | | |
| NDIC | \$— | \$1,630,424 | \$— | \$1,369,576 | \$— | \$3,000,000 | | | |
| UW | \$— | \$135,284 | \$— | \$242,140 | \$— | \$377,424 | | | |
| UAF | \$— | \$133,648 | \$— | \$241,802 | \$— | \$375,450 | | | |
| Total | \$7,592,000 | \$1,899,356 | \$7,408,000 | \$1,853,518 | \$15,000,000 | \$3,752,874 | | | |
| Total Cost Share | 80% | 20% | 80% | 20% | 80% | 20% | | | |



PCOR Partnership Organization Chart





PCOR Partnership Gantt Chart

| | | | Budget P | | | | | get Period 1 | | | | | | | | | | Budget Period 2 | | | | | |
|--|----------|-------------------------------|---|------------|--------------------|---------------|--------------|--------------|---------|--------------|--|------------|-------------|------|---------------|-------------|--------------|-----------------|--------------|-------------|-------------|-----|--|
| | | | | Ye | ar 1 | | Year 2 | | | | | Ye | | | Year 4 | | | | | Year 5 | | | |
| | Start | End | 2019 Q1 | Q2 | 2 Q3 | 020 Q4 | Q5 | Q6 | 2 Q7 | 021 Q8 | Q9 | Q10 | 2 Q11 | Q12 | Q13 | Q14 | 20 Q15 | 023 Q16 | Q17 | Q18 | 2024 Q19 | Q20 | |
| Task | Date | Date | | | | n Jul Aug Sep | | | | n Jul Aug Se | | | | | p Oct Nov Dec | | | | | | | | |
| ask 1.0 – Project Management and Planning | 10/1/19 | 9/30/24 | | V D1 | | | | | 🔶 МЗ | | | | | | 1 | i | | | | | M11 | | |
| isk 2.0 – Technical Challenges | 1/23/20 | 6/30/24 | xx xx xx | x | | | | | Ú. | | | | | | | | | | | M 10 | | | |
| 2.1 – Characterization | 1/23/20 | 6/30/24 | xx xx xx | x | | | | | | | 03.A | D3.B | 7 | | | | | 7 | 7 D11 | | | | |
| 2.2 – Technology Validation – Collaboration | 1/23/20 | 6/30/24 | xx xx xx | x | | | | | V D2 | | 7 | 7 D5 | | | | | | | | | | | |
| 2.3 – MVA Strategies | 1/23/20 | 6/30/24 | xx xx xx | x | | | | | | | | | | V D6 | | | | | | | 7 | D16 | |
| 2.4 – Risk Management | 1/23/20 | 6/30/24 | | x | | | | | | | | | | | 💙 D7 | | | | | | | | |
| ask 3.0 – Data Collection, Sharing, and Analysis | 10/25/19 | 6/30/24 | | | | | | | | | | | | | | | | | | | | | |
| 3.1 – Data Sharing | 10/25/19 | 6/30/24 | | | | | | | | 🔶 М5 | | • | M7 | | | | | | | | | M12 | |
| 3.2 – NRAP Validation | 4/1/20 | 3/31/24 | | | | | | 🔻 D14 | | | | | | | | 7 | D10 | | | | | | |
| 3.3 – Machine Learning | 4/1/20 | 6/30/24 | | | | | | | | | | | | | | | | | | | | | |
| Task 4.0 – Regional Infrastructure | 1/23/20 | 6/30/24 | xx xx xx | x | | | | | | | | 🔶 Мб | | | | | | | | | | | |
| 4.1 – Assessment and Techno-Economic Analysis | 1/23/20 | 6/30/24 | | x | [⁻ ◆M2 | | | | | | | | | | 7 | 🗸 D9 | | | | | | | |
| 4.2 – Promotion of Infrastructure and Scale-Up for Large Projects | 1/23/20 | 6/30/24 | xx xx xx | x | | | | | | | | | | | | | | | | | | | |
| 4.3 – Socioeconomic Impacts | 5/1/20 | 3/31/24 | | | -+ | | | | | | | | | | | | | 7 | 🗸 D12 | | | | |
| 4.4 – Public and Industry Outreach | 1/23/20 | 6/30/24 | | x | | | | | | 💙 D15 | | | | | | , | V D15 | | | | | | |
| ask 5.0 – Technology Transfer | 1/23/20 | 6/30/24 | xx xx xx | x | | | | | | | | | | | • • | W8 | | | | | | | |
| 5.1 – Nontechnical Challenges | 1/23/20 | 6/30/24 | xx xx xx | X M1 | 4 | | | | 🔶 М4 | | | | | | V D8 | • | 🔶 М9 | | | | | | |
| 5.2 – Global CCUS Leadership | 1/23/20 | 6/30/24 | xx xx xx | x | | | | | | | | | | | | | | | | | | | |
| 5.3 – Business Models | 5/1/20 | 6/30/24 | | | L-> | | | | | | 7 | 7 D4 | | | | | | | 7 | 🗸 D13 | | | |
| 5.4 – Pathways to CCUS Commercial Scaling and Deployment | 9/4/20 | 6/30/24 | | | | | | | | | | | | | | | | | | | ∀ D | 117 | |
| | | | | | | Milestone | s (M) 🔶 | | | | | | | | De | oliverable | es (D) 🔻 | | | | | | |
| Summary Task | | | M1 – Regu | latory Rou | ndup Scheo | duled (3/31/2 | 20) | | | D1 – I | Project Mana | agement Pl | ın (2/21/20 |)) | | | | | | | | | |
| Activity Bar | | | | | | amework E | stablished (| 4/30/20) | | | opical Rep | - | | | | | | | | | | | |
| Milestone (M) Deliverable (D) | | | M3 – Annual Meeting Scheduled (3/31/21) M4 – Regulatory Roundup Scheduled (3/31/21) | | | | | | | | | | | | nity Assessn | | , | 2) | | | | | |
| Critical Path | | | - | • | | Lab for NRA | | ment (6/30/ | 21) | | D3.B – Topical Report – Stacked Storage Scenario Geomechanical Modeling (3/31/22) D4 – Topical Report – Regional Business Model Assessment (12/31/21) | | | | | | | | | | | | |
| ÷ , | | | | | | ted (1/31/22 | | (| , | | D5 – Topical Report – Subsurface and Legacy Well Integrity (12/31/21) | | | | | | | | | | | | |
| Definitization 1/23/2020 | | | M7 – BP1 EDX Submitted (3/31/22) | | | | | | | | D6 – Topical Report – MVA Strategies (6/30/22) | | | | | | | | | | | | |
| No Activity Prior to Definitization XX XX | | | M8 – Draft | | - | | | | | | | | | - | ent (9/30/22 | 2) | | | | | | | |
| No Activity Prior to Definitization XX XX No Activity Prior to Definitization XX XX | | | M9 – Regulatory Roundup Scheduled (3/31/23) M10 – GHGT-17 Abstract Submitted (1/31/24) | | | | | | | | D8 – Topical Report – Regional Permitting Guidance (9/30/22) D9 – Topical Report – Infrastructure, Scale-Up, and Techno-Economic Assessments (12/31/22) | | | | | | | | | | | | |
| | | | | | | d (3/31/24) | | | | | | | | | on (3/31/23) | | | , | | | | | |
| | | | M12 – BP2 | EDX Sub | mitted (6/3 | 0/24) | | | | | | | | | ess State, In | | micity (9/30 | 0/23) | | | | | |
| | | | | | | | | | | | | - | | | ssessments | | | | | | | | |
| | | | | | | | | | | | | | - | | s Model Ass | sessment (1 | 2/31/23) | | | | | | |
| | NAT | ONAL | | - | | | | | | | Topical Re PCOR Part | | | | . , | | | 1200 | - 62 | <u>_</u> | 5 | | |
| MENEDCY L | TECH | IONAL GY HNOLO DRATO | ey F | | R | | | | | | Enabling S | | | | , | | | Crit | ical | Chal | leng | es. | |
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