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July 26, 2024

Mr. Reice Haase
Deputy Director
North Dakota Industrial Commission
600 East Boulevard Avenue, Department 405
State Capitol, 14th Floor
Bismarck, ND 58505-0840

Dear Mr. Haase:

Subject: Quarterly Progress Report for the Period of April 1 – June 30, 2024, "PCOR Partnership Initiative to Accelerate CCUS Deployment"; Contract Nos. FY20-XCI-226 and G-050-096

Attached please find the Energy & Environmental Research Center (EERC) quarterly progress report for the subject project. If you have any questions, please contact me by phone at (701) 777-5236 or by email at kconnors@undeerc.org.

Sincerely,

DocuSigned by:
Kevin Connors
1D14EF7CF3CD456...

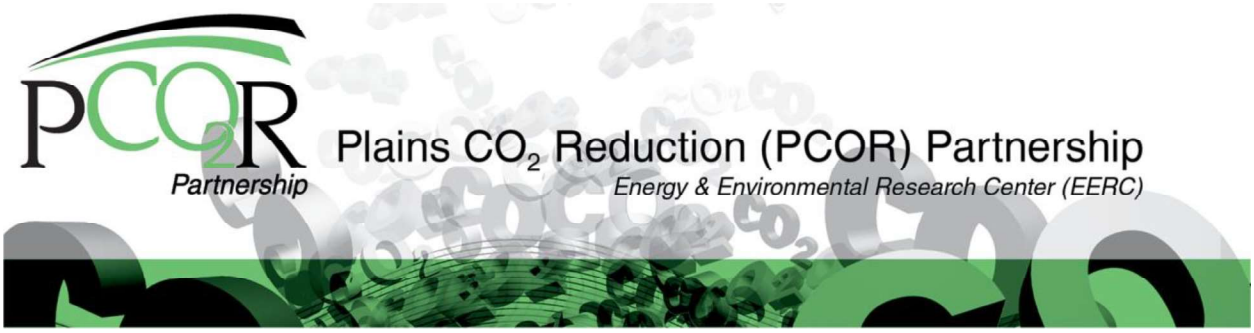
Kevin C. Connors
Assistant Director for Regulatory Compliance and Energy Policy
PCOR Partnership Program Manager

KCC/bjr

Attachment

c/att: Michael Holmes, Lignite Energy Council
Brent Brannan, North Dakota Industrial Commission (NDIC) Department of Mineral Resources, Oil and Gas Division
Erin Stieg, NDIC

c: Jamie Mitzel, EERC



PCOR PARTNERSHIP INITIATIVE TO ACCELERATE CCUS DEPLOYMENT

Quarterly Technical Progress Report

(for the period April 1 – June 30, 2024)

Prepared for:

Reice Haase

North Dakota Industrial Commission
600 East Boulevard Avenue, Department 405
State Capitol, 14th Floor
Bismarck, ND 58505-0840

Contract Nos. FY20-XCI-226 and G-050-96

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July 26, 2024

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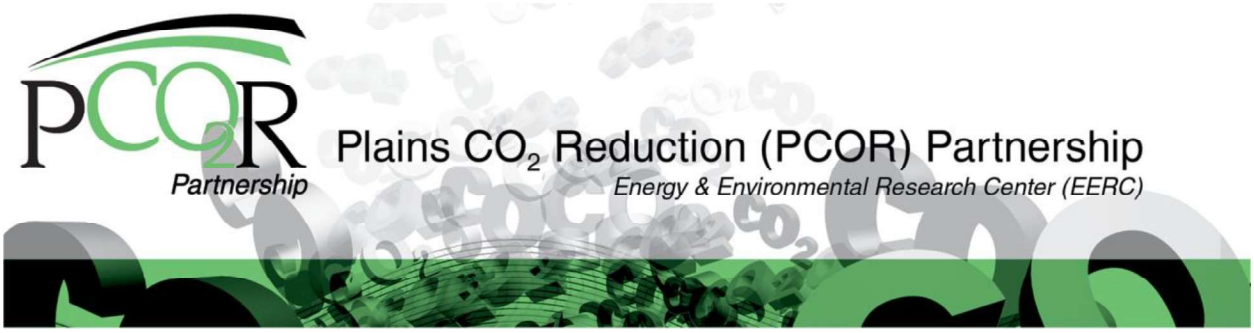


PCOR PARTNERSHIP INITIATIVE TO ACCELERATE CCUS DEPLOYMENT
Quarterly Progress Report
April 1 – June 30, 2024

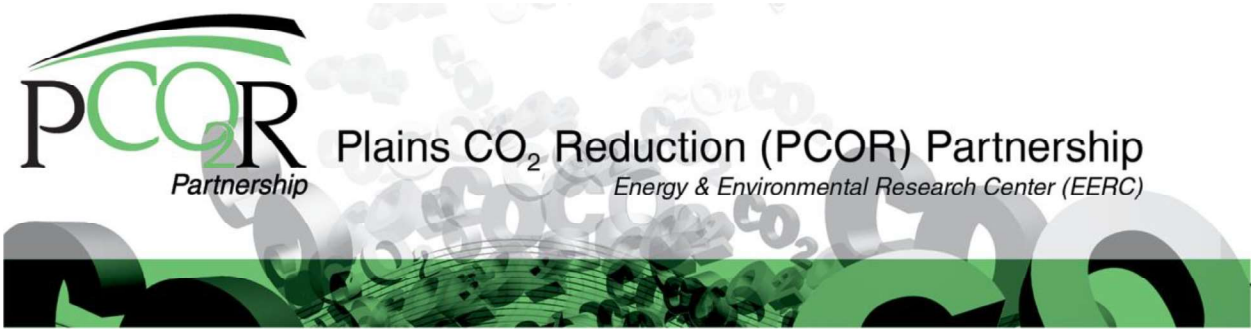
EXECUTIVE SUMMARY

The Plains CO_2 Reduction (PCOR) Partnership, funded by the U.S. Department of Energy National Energy Technology Laboratory, the North Dakota Industrial Commission Oil and Gas Research Program and Lignite Research Program, and more than 250 public and private partners, is accelerating the deployment of carbon capture, utilization, and storage (CCUS) technology. The PCOR Partnership is focused on a region comprising ten U.S. states and four Canadian provinces in the upper Great Plains and northwestern regions of North America and is led by the University of North Dakota Energy & Environmental Research Center (EERC), with support from the University of Wyoming (UW) and the University of Alaska Fairbanks (UAF).

The EERC welcomed one new member, Mitsui E&P USA LLC, to the PCOR Partnership this quarter, bringing the membership to 263. The PCOR Partnership held introductory meetings for Mitsui E&P USA LLC on April 2, 2024; Carbon Management Canada on April 8, 2024; Sterling Seismic & Reservoir Services on April 12, 2024; Engineering Design Group and Instrumental Software Technologies, Inc. on April 15, 2024; Paroscientific on May 3, 2024; Climeworks on May 13, 2024; Meriden Carbon on May 24, 2024; and Simplot Agribusiness on June 3, 2024.

Work was executed, finalized, and submitted for Deliverable (D) 16 – Enabling Sustainable Monitoring for CCUS and D17 – PCOR Partnership Initiative Road Map. Milestone (M) 10 – BP2 EDX Submitted was achieved.

The PCOR Partnership issued its sixth newsletter to project partners on April 25, 2024. The focus this quarter was on the partner spotlight for Air Products and testing a novel seismic source at the Red Trail Energy site.



PCOR PARTNERSHIP INITIATIVE TO ACCELERATE CCUS DEPLOYMENT
Quarterly Progress Report
April 1 – June 30, 2024

INTRODUCTION

The Plains CO_2 Reduction (PCOR) Partnership, funded by the U.S. Department of Energy (DOE) National Energy Technology Laboratory (NETL), the North Dakota Industrial Commission (NDIC) Oil and Gas Research Program and Lignite Research Program, and more than 250 public and private partners, is accelerating the deployment of carbon capture, utilization, and storage (CCUS) technology. The PCOR Partnership is focused on a region comprising ten U.S. states and four Canadian provinces in the upper Great Plains and northwestern regions of North America and is led by the University of North Dakota Energy & Environmental Research Center (EERC), with support from the University of Wyoming (UW) and the University of Alaska Fairbanks (UAF).

The goal of the PCOR Partnership is to identify and address regional capture, transport, and storage challenges facing commercial deployment of CCUS in an expanded region, compared to past Regional Carbon Sequestration Partnership project phases. To achieve this goal, the PCOR Partnership will meet the following objectives:

1. Address key technical challenges by advancing critical knowledge and capabilities.

2. Facilitate data collection, sharing, analysis, and collaboration.

3. Evaluate regional infrastructure challenges/needs and promote infrastructure development.

4. Promote regional technology transfer.

The project goal and objectives will be accomplished through five tasks over two budget periods (BPs), corresponding to a 5-year period of performance. The EERC and project partners will collaborate to identify and address technical challenges facing deployment of CCUS in multiple categories, including stacked storage opportunities, CO_2 storage performance and monitoring, and risk assessment. The EERC will work with PCOR Partnership members and regional stakeholders to promote the development of infrastructure and large projects within the PCOR Partnership region. This development will then provide best practices throughout the United States for wide-scale deployment of CCUS technologies. Existing datasets and technologies will be analyzed and evaluated to highlight current challenges limiting commercial

adoption of CCUS as well as identify potential solutions. The project team will support DOE's National Risk Assessment Partnership (NRAP) and machine learning (ML) initiatives by drawing on datasets and experience available through the team. Assessments of infrastructure, site readiness, techno-economics, and socioeconomics will provide an overview of the CCUS landscape within the defined PCOR Partnership region. Potential business case scenarios will be evaluated, accounting for current economic incentives, to identify opportunities in CCUS project development. Technology transfer activities will inform and educate CCUS stakeholders of project learnings through annual meetings, regulatory roundup meetings, technical advisory board (TAB) meetings, webinars, reports, and conference presentations/papers. These activities will facilitate knowledge sharing and support DOE program goals.

ACCOMPLISHMENTS

Task 1.0 – Project Management and Planning

The objective of Task 1.0 is to manage and direct the project in accordance with a project management plan (PMP) to meet all technical, schedule, and budget objectives and requirements. Activities will be coordinated in order to effectively accomplish the work. The program manager will ensure that project plans, results, and decisions are appropriately documented and project reporting and briefing requirements are satisfied.

Significant accomplishments for Task 1.0 during the reporting period include the following:

- Held progress meetings with subrecipients UAF and UW.
- Held regular progress update meetings with the DOE project manager (PM).
- Issued the sixth newsletter to project partners on April 25, 2024.
- Prepared and submitted the quarterly research performance report for the period of January 1 – March 31, 2024, on April 26, 2024.
- Held discussions with prospective members on a regular basis. The PCOR Partnership currently has 263 members. Mitsui E&P USA LLC was added as a new member, and introductory meetings were held as follows:
  - Mitsui E&P USA LLC on April 2, 2024
  - Carbon Management Canada on April 8, 2024
  - Sterling Seismic & Reservoir Services on April 12, 2024
  - Engineering Design Group and Instrumental Software Technologies, Inc. on April 15, 2024
  - Paroscientific on May 3, 2024
  - Climeworks on May 13, 2024
  - Meriden Carbon on May 24, 2024
  - Simplot Agribusiness on June 3, 2024.

- Prepared and submitted a manuscript for the Clearwater Clean Energy Conference. The EERC program manager traveled to and presented on the panel for the conference on June 19, 2024.

- Continued planning the 2024 PCOR Partnership Annual Meeting and Regulatory Roundup Meeting to be held in August in Bismarck, North Dakota, the week of August 26, 2024. Eblasts were sent to members with registration and hotel block links on May 30, 2024, and details of agenda topics and a reminder to register on June 27, 2024.

Next steps to accomplish the goals under Task 1.0 include the following:

- Continue tracking progress on project deliverables and milestones (Tables 1 and 2).

Table 1. Project Deliverables

Deliverable (D) No. and Title	Planned Completion Date	Actual Completion Date	Verification Method	Comments
D1 – PMP	30 days after contract definitization	2/21/2020	PMP file submitted to DOE PM	
D2 – Report – Storage Optimization	4/30/2021	4/30/2021	Topical report submitted to DOE PM	Moved from 12/31/2020.
D3.A – Report – Stacked Storage Opportunity Assessment	8/31/2021	8/31/2021 (E.S.) 11/12/2021 (full report)	Topical report submitted to DOE PM	Moved from 6/30/2021.
D3.B – Report – Stacked Storage Scenario Geomechanical Modeling	3/31/2022	3/31/2022	Topical report submitted to DOE PM	Created a second D3 report.
D4 – Report – Regional Business Case Assessment	12/31/2021	12/17/2021	Topical report submitted to DOE PM	Moved from 3/31/2021.
D5 – Report – Subsurface and Legacy Well Integrity	12/31/2021	12/30/2021	Topical report submitted to DOE PM	
D6 – Report – MVA Strategies	6/30/2022	6/30/2022	Topical report submitted to DOE PM	
D7 – Report – Evaluation of Risk Management	9/30/2022	9/30/2022	Topical report submitted to DOE PM	
D8 – Report – Regional Permitting Guidance	9/30/2022	9/30/2022	Topical report submitted to DOE PM	Two reports submitted for D8.
D9 – Report – Infrastructure, Scale-Up, and Techno-Economic Assessments	3/31/2023	3/31/2023	Topical report submitted to DOE PM	
D10 – Report – NRAP Testing and Validation	3/31/2023	12/17/2021 (Part 1) 3/31/2023 (Part 2)	Topical report submitted to DOE PM	Provided in two parts.
D11 – Report – Basement Faulting and Stress State, Induced Seismicity	12/1/2023	11/27/2023 (original) 2/7/2024 (revised)	Topical report submitted to DOE PM	A revised D11 was resubmitted on 2/7/24 to account for updated figures and tables.
D12 – Report – Regional Socioeconomic Assessments	12/1/2023	11/27/2023	Topical report submitted to DOE PM	A request to move the due date to 12/1/23 was made; a revised PMP was submitted to DOE on 9/29/23.
D13 – Report – Updated Regional Business Case Assessment	12/31/2023	12/22/2023	Topical report submitted to DOE PM	
D14 – Report – Risk-Based Area of Review	1/31/2021	1/29/2021	Topical report submitted to DOE PM	Moved from 12/31/2020.
D15 – PCOR Partnership Atlas	6/30/2021 and 3/31/2024	6/30/2021 (BP1) 3/28/2024 (BP2 update)	Atlas submitted to DOE PM	
D16 – Enabling Sustainable Monitoring for CCUS	6/30/2024	6/28/2024	Topical report submitted to DOE PM	
D17 – PCOR Partnership Initiative Road Map	5/31/2024	5/31/2024	Topical report submitted to DOE PM	

Table 2. Milestone Status Report

Milestone (M) No. and Title	Planned Completion Date	Actual Completion Date	Verification Method	Comments
M1 – Regulatory Roundup Scheduled	2/29/2020	3/31/2020	Reported in subsequent quarterly report	
M2 – Initial Techno-Economic Framework Established	4/30/2020	4/28/2020	Reported in subsequent quarterly report	
M3 –Annual Meeting Scheduled	3/31/2021	3/29/2021	Reported in subsequent quarterly report	
M4 – Regulatory Roundup Scheduled	3/31/2021	3/29/2021	Reported in subsequent quarterly report	
M5 – Data Share with National Lab for NRAP Assessment	6/30/2021	6/30/2021	Reported in subsequent quarterly report	Files added to EDX.[1]
M6 – GHGT[2]-16 Abstract Submitted	1/31/2022	1/14/2022	Reported in subsequent quarterly report	
M7 – BP1 EDX Submitted	3/31/2022	3/31/2022	Reported in subsequent quarterly report	
M8 – Draft Journal Article Completed	11/30/2022	9/30/2022	Reported in subsequent quarterly report	
M9 – Regulatory Roundup Scheduled	3/31/2023	3/31/2023	Reported in subsequent quarterly report	
M10 – GHGT-17 Abstract Submitted	1/31/2024	1/15/2024	Reported in subsequent quarterly report	
M11 – Annual Meeting Scheduled	3/31/2024	3/26/2024	Reported in subsequent quarterly report	
M12 – BP2 EDX Submitted	6/30/2024	6/28/2024	Reported in subsequent quarterly report	

[1] Energy Data eXchange.
[2] International Conference on Greenhouse Gas Control Technologies.

Task 2.0 – Technical Challenges

In Task 2.0, the project team will support regional deployment of CCUS programs by focusing on key technical challenges in the PCOR Partnership region related to stacked storage opportunities; storage performance; monitoring, verification, and accounting (MVA) technology; and subsurface integrity. The EERC will collaborate with PCOR Partnership members to identify knowledge gaps and address regional challenges through targeted webinars, workshops, reports, and papers.

Progress on Task 2.0 is as follows:

- Continued collaboration for the field effort at the Red Trail Energy (RTE) carbon capture and storage (CCS) site. Activities included the following:
  - Data harvesting continued from the Instrumentation Software Technologies, Inc., 6C seismic station to complement the scalable, automated, sparse seismic array processing effort.
  - Picked up the ZLand nodes is scheduled during the week of June 24, 2024.
  - The EERC completed and submitted D16 – Enabling Sustainable Monitoring for CCUS on June 28, 2024.

Next steps to accomplish the goals under Task 2.0 include the following:

- Submit a 1-year no-cost time extension to continue testing and demonstrating sustainable monitoring approaches at the RTE site.

- Finalize white papers.

Task 3.0 – Data Collection, Sharing, and Analysis

In Task 3.0, the project team will collaborate with other DOE Fossil Energy Carbon Management (FECM)-funded researchers to improve understanding of CO_2 injection and storage impacts. The project team will work with national laboratories to facilitate data sharing, support the development and validation of NRAP tools with site-specific data, and participate in development of ML-based tools/methods in a commercial setting.

Progress on Task 3.0 is as follows:

- Subtask 3.1 – Data Sharing
  - The EERC uploaded datasets through the PCOR Partnership to the EDX and achieved M12 – BP2 EDX Submitted on June 28, 2024.
  - The EDX datasets consisted of developed geomodels and reservoir simulations estimating the accuracy of the predicted 5-year CO_2 and pressure buildup plumes for a hypothetical storage project injecting CO_2 into the Broom Creek Formation near central North Dakota.
  - The EERC prepared and submitted a milestone report to summarize the geologic modeling and simulation datasets and formats.

- Subtask 3.3 – Machine Learning
  - The EERC continues to track ongoing work conducted under the SMART (Science-informed Machine learning for Accelerating Real-Time decisions in subsurface applications) Initiative and look for ways to incorporate these learnings into the PCOR Partnership region.

Next steps to accomplish the goals under Task 3.0 include the following:

- Upload datasets to the EDX to satisfy M12, informing the DOE PM once complete.

Task 4.0 – Regional Infrastructure

The objective of Task 4.0 is to evaluate the regional needs, challenges, and potential economic impacts related to the development of safe and environmentally sound CO_2 transportation infrastructure to accelerate commercial CCUS project deployment. This evaluation will be accomplished by assessing existing infrastructure, scale-up challenges and needs, and techno-economic and socioeconomic impacts in the PCOR Partnership region and will be communicated through outreach activities.

Progress on Task 4.0 is as follows:

- The EERC advised on the Stress Engineering Services, Inc. (Stress Engineering) white paper, "Repurposing Pipelines for CCS and CCUS," to be presented at the GHGT-17 conference. Stress Engineering was informed that the paper was accepted as an e-poster and, therefore, has decided to withdraw it and investigate other venues in which to present the paper.

- UW continued work on draft documents to advance PCOR Partnership knowledge in topics under Task 4.0, including the following:
  - Updated Wyoming Pipeline Initiative Summary – This deliverable will include an assessment of steps for operators seeking to develop pipelines within the Wyoming Pipeline Corridor to obtain the necessary permits and regulatory review. Work on this deliverable has begun, and UW has partnered with the Enhanced Oil Recovery Institute on this task. The expected timeline for completion is September 1, 2024.

- UAF continued work to advance PCOR Partnership knowledge in topics under Task 4.0, including the following:
  - Laboratory experiments on CO_2-induced corrosion. A report with the data collected in the experiments will be delivered to the EERC.
  - Investigation on a new set of corefloods for CO_2 storage in an oil reservoir following oil production. The study will be designed to develop a correlation for predicting CO_2 storage efficiency in oil reservoirs.
  - Participated and presented at a Regional Decarbonization orkshop in Anchorage, Alaska, on May 7, 2024, hosted by the U.S. Energy Association in cooperation with FECM, DOE's Arctic Energy Office and Grid Development Office, and the National Rural Electric Cooperatives Association.
  - Participated and presented at the Alaska Sustainable Energy Conference on May 22, 2024.
  - Participated on a panel at the Alaska Sustainable Energy Conference and shared CCUS opportunities and needs. Alaska's abundant coal resources and how CCUS puts them back on the table as a decarbonized energy supply were highlighted as well as efforts by the Alaska CCUS Workshop and PCOR Partnership to bring CCUS to Alaska.
  - Shared the road map for deploying commercial CCUS in Alaska with the Alaska Commercial Carbon Capture Committee.
  - Met with DOE FECM representatives to review their planned DOE–Japan import techno-economic feasibility study of CO_2 import into Alaska's Cook Inlet for storage.

Next steps to accomplish the goals under Task 4.0 include the following:

- Continue to track progress on white papers and UW and UAF products.

Task 5.0 – Technology Transfer

Task 5.0 will inform and educate stakeholders about CCUS technologies. Nontechnical challenges to CCUS deployment in the PCOR Partnership region will be identified and assessed, with an emphasis on regulatory issues and solutions. Business case scenarios for CCUS projects will be identified, reviewed, and developed. Outcomes of this task will be transferred to stakeholders through meetings, presentations, and webinars. Developed materials will be shared with DOE to support its broader FECM program goals.

Progress on Task 5.0 is as follows:

- Development of new fact sheets continued, covering the following topics:
  - The importance of regulatory frameworks and Class VI primacy
  - Pore space ownership and CCS projects

- Work progressed toward the next PCOR Pioneer newsletter; issuance is planned for July 2024.

- Completed and submitted D17 – PCOR Road Map on May 31, 2024.

- The EERC accepted the UW deliverable "Regulatory Considerations for Carbon Dioxide Storage and Plume Migration on Interstate and Federal Lands." UW published this report on its Center for Energy Regulation & Policy Analysis website.

Next steps to accomplish the goals under Task 5.0 include the following:

- Continue progress on fact sheets, covering the following topics:
  - The importance of regulatory frameworks and Class VI primacy
  - Pore space ownership and CCS projects

- Continue reviews and development of white papers focusing on lessons learned through PCOR Partnership efforts, with topics on North Dakota reporting requirements and pipeline specifications through the UW School of Energy Resources.

- Continue UW and EERC collaborative activities.

CHANGES/PROBLEMS

No changes or problems at this time.

SPECIAL REPORTING REQUIREMENTS

None.