Plains CO_2 Reduction (PCOR) Partnership
Energy & Environmental Research Center (EERC)

PCOR INITIATIVE TO ACCELERATE CCUS DEPLOYMENT

Research Performance Progress Report (quarterly)

(for the period January 1 – March 31, 2020)

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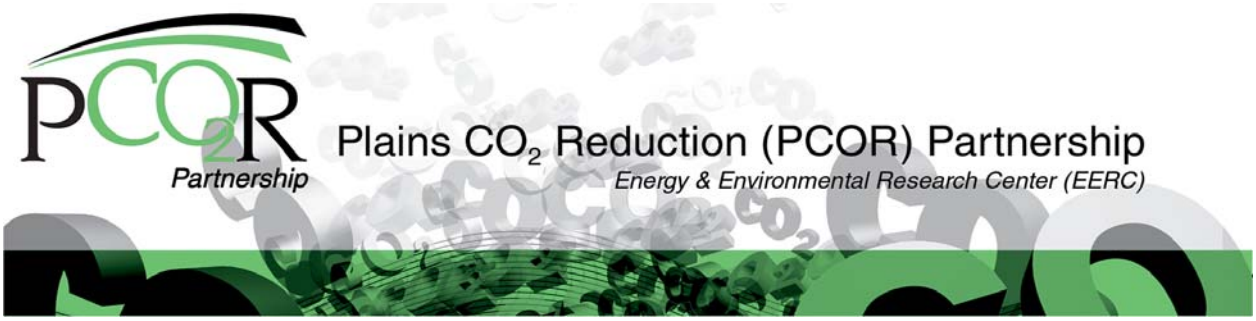


PCOR INITIATIVE TO ACCELERATE CCUS DEPLOYMENT
Quarterly Progress Report
January 1 – March 31, 2020

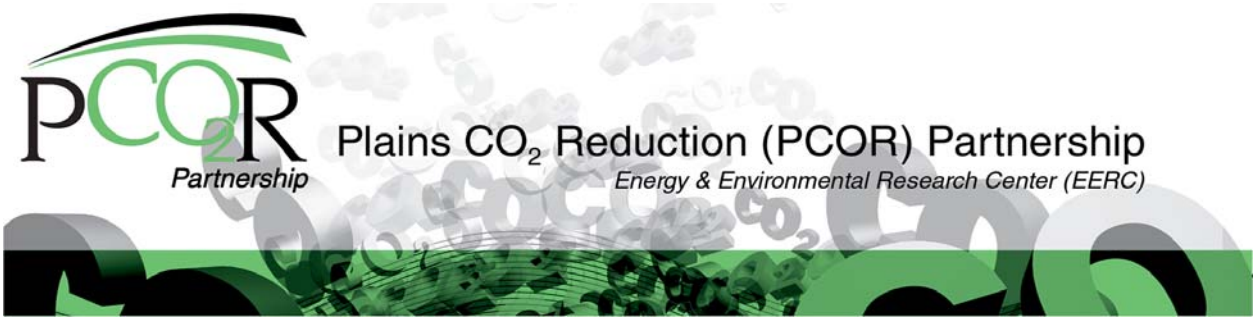
EXECUTIVE SUMMARY

The Plains CO_2 Reduction (PCOR) Partnership Initiative is one of four projects competitively awarded by the U.S. Department of Energy (DOE) National Energy Technology Laboratory (NETL) under the Regional Initiative to Accelerate CCUS (carbon capture, utilization, and storage). The PCOR Partnership Initiative is led by the Energy & Environmental Research Center (EERC) with support from the University of Wyoming (UW) and the University of Alaska Fairbanks (UAF) and includes stakeholders from the public and private sectors. The PCOR Partnership Initiative region includes all or part of ten U.S. states and four Canadian provinces.

Contracts with DOE and cost-share partner North Dakota Industrial Commission through the Lignite Research and Oil and Gas Research Programs were finalized. The updated project management plan was submitted to the DOE Project Manager on February 21, 2020. Discussions on scopes of work and contracting efforts continued with subrecipients UW and UAF.

Milestone 1 – Regulatory Roundup Scheduled was completed March 31, 2020. A WebEx will be held June 9, 2020, to discuss the best format to eventually hold an in-person Regulatory Roundup meeting. Planning continued for the PCOR Partnership Initiative annual membership meeting, which is planned to be held in 2020. Internal discussions were held to discuss task activities. PCOR Partnership Initiative representatives participated in the National Risk Assessment Partnership (NRAP) webinar series to learn about existing and forthcoming NRAP tools. The EERC supported activities in the SMART (Science-Informed Machine Learning for Accelerating Real Time Decisions in Subsurface Applications) Initiative, which are synergistic with PCOR Partnership Initiative machine learning activities. Progress was made on the techno-economic framework.

The EERC holds an unwavering commitment to the health and well-being of its employees, partners and clients, and our global community. As such, precautionary measures have been implemented in response to COVID-19. Staff continue to carry out project-related activities remotely, and personnel supporting essential on-site laboratory and testing activities are proceeding under firm safety guidelines. Travel has been minimized, and protective measures are being undertaken for those who are required to travel. At this time, work conducted by EERC employees is anticipated to progress with minimal disruption. Challenges posed by economic variability will be met with open discussion between the EERC, the DOE Project Manager, and other partners to identify solutions. The EERC is monitoring developments across the nation and abroad to minimize risks, achieve project goals, and ensure the success of our partners and clients.



PCOR INITIATIVE TO ACCELERATE CCUS DEPLOYMENT
Quarterly Progress Report
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INTRODUCTION

The Plains CO_2 Reduction (PCOR) Partnership Initiative is one of four projects operating under the U.S. Department of Energy (DOE) National Energy Technology Laboratory (NETL) Regional Initiative to Accelerate CCUS (carbon capture, utilization, and storage). The PCOR Partnership Initiative is led by the Energy & Environmental Research Center (EERC) with support from the University of Wyoming (UW) and the University of Alaska Fairbanks (UAF) and includes stakeholders from the public and private sectors. The membership, as of March 31, 2020, is 186 members. The PCOR Partnership Initiative region includes all or part of ten states (Alaska, Iowa, Minnesota, Missouri, Montana, Nebraska, North Dakota, South Dakota, Wisconsin, and Wyoming) and four Canadian provinces (Alberta, British Columbia, Manitoba, and Saskatchewan).

The goal of the PCOR Partnership Initiative is to identify and address onshore regional storage and transport challenges facing commercial deployment of CCUS in an expanded region, compared to past initiatives. To achieve this goal, the PCOR Partnership Initiative 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 and needs
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. Existing data sets and technologies will be analyzed and evaluated to highlight current challenges limiting commercial adoption of CCUS, as well as to identify potential solutions. The project team will support the DOE National Risk Assessment Partnership (NRAP) and machine-learning (ML) initiatives by drawing on data sets 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 Initiative region. Potential business case scenarios will be evaluated, taking into account current economic incentives to identify opportunities in CCUS project development. Technology transfer activities will inform and educate CCUS stakeholders of

project learnings through annual membership meetings, regulatory roundup meetings, technical advisory board 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 project 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:

- Completed contract negotiations with DOE to fully award the project on January 23, 2020, in Modification 0001. The changes included the following:
  - Updated definitized budget numbers.
  - Revised the Principal Investigator (PI) from Neil Wildgust to Kevin Connors, which was formally requested January 17, 2020.
  - Revised the terms and agreements, including removing the conditional award on definitization.
  - Incorporated Attachment 1 – Intellectual Property Provisions.
  - Incorporated Attachment 2 – Statement of Project Objectives (SOPO) with changes made by DOE.
  - Incorporated Attachment 4 – Budget Pages.
  - Incorporated Attachment 5 – Data Management Plan (DMP). This revised DMP was submitted to the DOE Project Manager (PM) on January 9, 2020.

- Submitted the updated PMP (Deliverable [D] 1) to the DOE PM on February 21, 2020, within 30 days of contract definitization. Updated deliverable and milestone (M) dates are provided in Tables 1 and 2.

- Worked with UW and UAF on subrecipient scopes of work and contracting efforts.

- Continued planning the annual membership meeting. Activities included the following:
  - Selected a June 2020 date in Jackson, Wyoming, and secured a contract with a hotel for the venue.
  - Discussed alternative dates in September 2020 because of the COVID-19 situation.

- Engaged in conversations with current and prospective partners regarding their continued involvement in the PCOR Partnership.

- Contracts for cost-share funding from the North Dakota Industrial Commission's (NDIC's) Lignite Research and Oil and Gas Research Programs were completed. The period of performance for each is from February 1, 2020, through a contractual ending date of September 30, 2024.

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

- Continue contracting efforts with UW and UAF.

- Continue annual membership meeting planning, including discussion of moving the meeting from June to September or another date.

- Track progress on project deliverables and milestones (see Tables 1 and 2).

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 Initiative region related to stacked storage opportunities; storage performance; monitoring, verification, and accounting (MVA) technology; and subsurface integrity. The EERC will collaborate with PCOR Partnership Initiative members to identify knowledge gaps and address regional challenges through targeted webinars, workshops, reports, and papers.

Progress on Task 2.0 is as follows:

- Held internal discussions to discuss task activities.

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

- Continue discussions and begin collaboration with UW on technical activities.

Task 3.0 – Data Collection, Sharing, and Analysis

In Task 3.0, the project team will collaborate with other DOE Fossil Energy (FE)-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.

Table 1. Project Deliverables

Deliverable (D) No. and Title	Planned Completion Date	Actual Completion Date	Verification Method	Comments
D1 – Project Management Plan	30 days after contract definitization	2/21/2020	PMP file submitted to DOE PM	
D2 – Report – Storage Optimization	12/31/2020		Topical report submitted to DOE PM	
D3 – Report – Stacked Storage Opportunity Assessment	6/30/2021		Topical report submitted to DOE PM	
D4 – Report – Regional Business Case Assessment	3/31/2021		Topical report submitted to DOE PM	
D5 – Report – Subsurface and Legacy Well Integrity	12/31/2021		Topical report submitted to DOE PM	
D6 – Report – MVA Strategies	6/30/2022		Topical report submitted to DOE PM	
D7 – Report – Evaluation of Risk Management	9/30/2022		Topical report submitted to DOE PM	
D8 – Report – Regional Permitting Guidance	9/30/2022		Topical report submitted to DOE PM	
D9 – Report – Infrastructure, Scale-Up, and Techno-Economic Assessments	12/31/2022		Topical report submitted to DOE PM	
D10 – Report – NRAP Testing and Validation	3/31/2023		Topical report submitted to DOE PM	
D11 – Report – Basement Faulting and Stress State, Induced Seismicity	9/30/2023		Topical report submitted to DOE PM	
D12 – Report – Regional Socioeconomic Assessments	9/30/2023		Topical report submitted to DOE PM	
D13 – Report – Updated Regional Business Case Assessment	12/31/2023		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		Reported in subsequent quarterly report	
M3 –Annual Meeting Scheduled	3/31/2021		Reported in subsequent quarterly report	
M4 – Regulatory Roundup Scheduled	3/31/2021		Reported in subsequent quarterly report	
M5 – Data Share with National Lab for NRAP Assessment	6/30/2021		Reported in subsequent quarterly report	
M6 – GHGT-16[1] Abstract Submitted	1/31/2022		Reported in subsequent quarterly report	
M7 – BP1 EDX[2] Submitted	3/31/2022		Reported in subsequent quarterly report	
M8 – Draft Journal Article Completed	11/30/2022		Reported in subsequent quarterly report	
M9 – Regulatory Roundup Scheduled	3/31/2023		Reported in subsequent quarterly report	
M10 – GHGT-17 Abstract Submitted	1/31/2024		Reported in subsequent quarterly report	
M11 – Annual Meeting Scheduled	3/31/2024		Reported in subsequent quarterly report	
M12 – BP2 EDX Submitted	6/30/2024		Reported in subsequent quarterly report	

[1] GHGT-16 = 16th International Conference on Greenhouse Gas Control Technologies
[2] EDX = Energy Data eXchange

Progress on Task 3.0 is as follows:

- Held internal discussions to discuss task activities.

- Held a conference call on February 3, 2020, with representatives from DOE and select members of the NRAP tools development team from DOE NETL, Pacific Northwest National Laboratory, and Penn State University to discuss the EERC's experience with the NRAP tools on the North Dakota CarbonSAFE (Carbon Storage Assurance and Facility Enterprise) project.
- Participated in the NRAP webinar series to learn about existing and forthcoming NRAP tools.

- Attended a SMART (Science-Informed Machine Learning for Accelerating Real Time Decisions in Subsurface Applications) Initiative meeting held January 12–14, 2020, in Columbus, Ohio. The SMART Initiative is a DOE-led initiative focused on machine-learning. The information gained will be utilized in Task 3.0.

- Supported near-term activities of the SMART Initiative. Supporting the SMART Initiative is part of PCOR Partnership Initiative Subtask 3.3 – Machine Learning. Activities during the reporting period included:
  - Generated 100 geomodels representing a clastic slope depositional environment and properties distribution. All 100 models and related files have been uploaded to EDX (https://edx.netl.doe.gov/workspace/resources/smart-initiative).
  - The EERC is leading SMART Initiative Task 4, which is focused on using ML to forecast and history-match predictions of CO_2 saturation and pressure in the subsurface in response to CO_2 injection.

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

- Continue to track SMART Initiative activities to identify opportunities to leverage CO_2 storage project data sets for the validation and testing of ML-based approaches to modeling CO_2 and/or pressure in the subsurface.

- Identify other synergistic storage projects that could provide opportunities for data sharing (Subtask 3.1), NRAP validation (Subtask 3.2), or ML algorithm testing (Subtask 3.3).

- Continue to participate in the NRAP webinar series to learn about existing and forthcoming NRAP tools.

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 Initiative region and will be communicated through outreach activities.

Progress on Task 4.0 is as follows:

- Held internal discussions to discuss task activities.

- Worked on techno-economic framework literature review and outline.

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

- Complete M2 – Initial Techno-Economic Framework Established by April 30, 2020.

- Develop a preliminary plan for acquiring input data for statewide economic models within the PCOR Partnership Initiative region.

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 Initiative 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 FE program goals.

Progress on Task 5.0 is as follows:

- M1 – Regulatory Roundup Scheduled was completed March 31, 2020. A WebEx will be held June 9, 2020, to discuss the best format to hold an eventual in-person regulatory roundup meeting.

- Presented "Permitting Commercial-Scale Carbon Dioxide Geological Storage" at the Energy Generation Conference held January 29–30, 2020, in Bismarck, North Dakota.

- Presented "Permitting Commercial-Scale Carbon Dioxide Geological Storage" at the Underground Injection Control Conference hosted by the Groundwater Protection Council held February 16–19, 2020, in San Antonio, Texas. The PCOR Partnership Initiative PI moderated the session entitled "CCUS: Case Studies."

- Discussed plan for website content and functionality updates.

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

- Hold a Regulatory Roundup WebEx on June 9, 2020.

- Initiate website content and functionality updates.

CHANGES/PROBLEMS

The EERC is operational and open for business. Personnel that are not essential for on-site operations have transitioned to working from home. Essential project, laboratory, and field-based activities are proceeding with the incorporation of the Centers for Disease Control and Prevention (CDC), the State of North Dakota, and the University of North Dakota (UND) guidelines associated with COVID-19, and mitigation measures have been implemented.

In collaboration with project partners, the EERC is continually assessing potential impacts to project activities resulting from COVID-19 and/or the U.S. economic situation.

The situation has impacted planning efforts for the PCOR Partnership Initiative annual meeting. September 2020 dates are being explored as keeping the June 2020 date is

contemplated. Planning for the Regulatory Roundup shifted course; a WebEx will be held next quarter to determine the best format for an eventual in-person meeting.

In the event that any potential impacts to reporting, scope of work, schedule, or cost are identified, they will be discussed and addressed in cooperation with the DOE PM.

SPECIAL REPORTING REQUIREMENTS

None.

BUDGETARY INFORMATION

ENERGY & ENVIRONMENTAL RESEARCH CENTER

PLAINS CO_2 REDUCTION PARTNERSHIP INITIATIVE TO ACCELERATE CARBON CAPTURE, UTILIZATION, AND STORAGE DEPLOYMENT

DE-FE0031838

Project-to-Date Financial Report at March 31, 2020

($K)	Q4 Oct - Dec 2019	Q1 Jan-Mar 2020	Q2 Apr - Jun 2020	Q3 Jul - Sep 2020	Q4 Oct - Dec 2020	Q1 Jan-Mar 2021	Q2 Apr - Jun 2021	Q3 Jul - Sep 2021	Q4 Oct - Dec 2021	Q1 Jan-Mar 2022	Q2 Apr - Jun 2022	Q3 Jul - Sep 2022	Q4 Oct - Dec 2022	Q1 Jan-Mar 2023	Q2 Apr - Jun 2023	Q3 Jul - Sep 2023	Q4 Oct - Dec 2023	Q1 Jan-Mar 2024	Q2 Apr - Jun 2024	Q3 Jul - Sep 2024
Baseline Cost Plan																				
Federal Share	256.5	338.8	338.8	339.0	339.0	338.8	338.8	338.8	338.8	338.8	182.4	182.4	182.4	182.4	182.4	182.4	182.4	182.4	182.4	52.3
Nonfederal Share	82.8	82.8	82.8	82.8	82.8	82.8	82.8	82.8	82.8	82.7	47.3	47.3	47.4	47.4	47.4	47.4	47.3	47.3	47.3	
Total Planned	339.3	421.6	421.6	421.8	421.8	421.6	421.6	421.6	421.6	421.5	229.7	229.7	229.8	229.8	229.8	229.8	229.7	229.7	229.7	52.3
Cumulative Federal	256.5	595.3	934.1	1273.1	1612.1	1950.9	2289.7	2628.5	2967.3	3306.1	3488.5	3670.9	3853.3	4035.7	4218.1	4400.5	4582.9	4765.3	4947.7	5000.0
Cumulative Nonfederal	82.8	165.6	248.4	331.2	414.0	496.8	579.6	662.4	745.2	827.9	875.2	922.5	969.9	1017.3	1064.7	1112.1	1159.4	1206.7	1254.0	1254.0
Cumulative Baseline Costs	339.3	760.9	1182.5	1604.3	2026.1	2447.7	2869.3	3290.9	3712.5	4134.0	4363.7	4593.4	4823.2	5053.0	5282.8	5512.6	5742.3	5972.0	6201.7	6254.0
Actual Incurred Cost																				
Federal Share	63.8	81.4																		
Nonfederal Share	0.0	6.5																		
Total Incurred Costs	63.8	87.9																		
Cumulative Federal	63.8	145.2																		
Cumulative Nonfederal	0.0	6.5																		
Cumulative Incurred Costs	63.8	151.7																		
Variance																				
Federal Share	192.7	257.4																		
Nonfederal Share	82.8	76.3																		
Total Variance	275.5	333.7																		
Cumulative Federal	192.7	450.1																		
Cumulative Nonfederal	82.8	159.1																		
Cumulative Variance	275.5	609.2																		