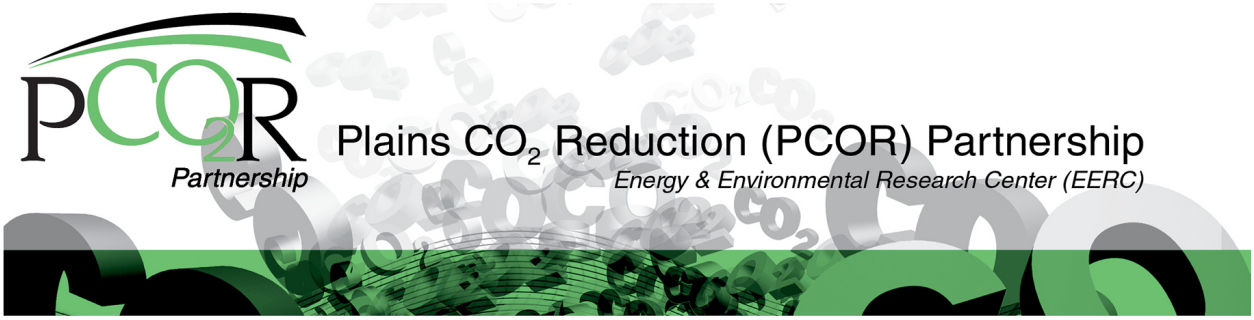

PCOR PARTNERSHIP INITIATIVE TO ACCELERATE CCUS DEPLOYMENT

Research Performance Progress Report (quarterly)

(for the period October 1 – December 31, 2021)

Prepared for:

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January 28, 2022

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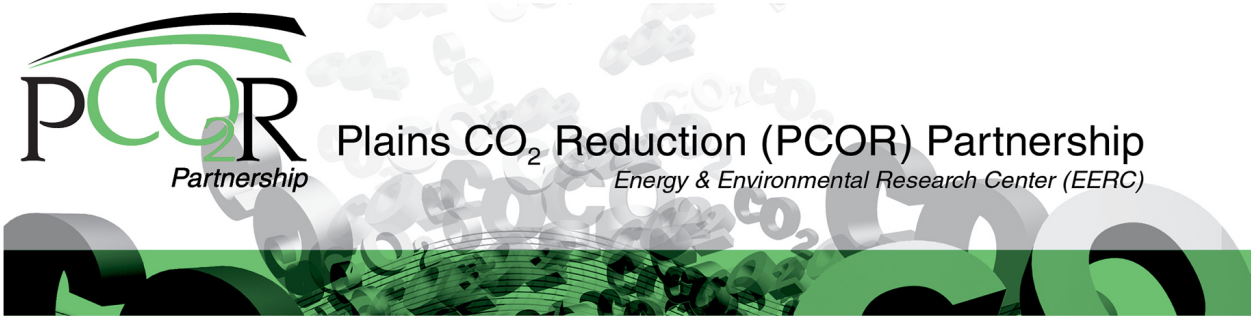


PCOR PARTNERSHIP INITIATIVE TO ACCELERATE CCUS DEPLOYMENT
Quarterly Progress Report
October 1 – December 31, 2021

EXECUTIVE SUMMARY

The Plains CO_2 Reduction (PCOR) Partnership Initiative is one of four Regional Carbon Sequestration Partnership projects competitively awarded by the U.S. Department of Energy (DOE) National Energy Technology Laboratory 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. Two new members were welcomed to the PCOR Partnership Initiative, bringing the membership to 215: Repsol and Burns & McDonnell.

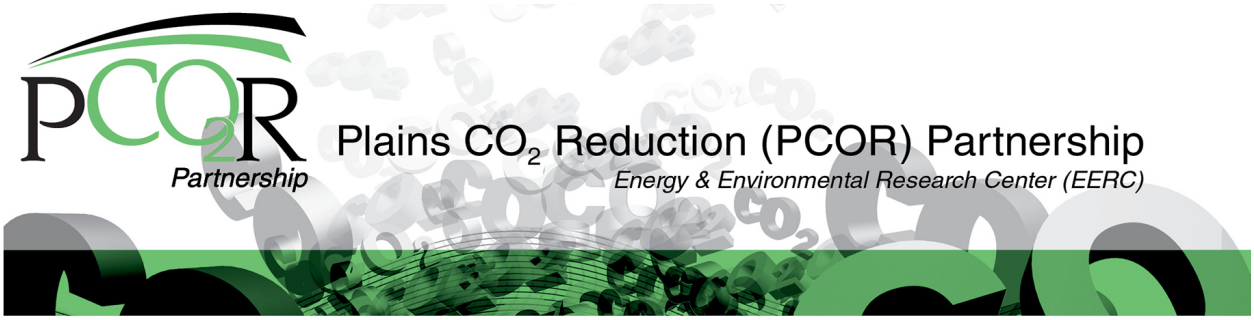
The Budget Period (BP) 2 continuation application was submitted December 29, 2021. Planning continued for the 2022 PCOR Partnership Initiative Annual Membership Meeting, which will be held in Anchorage, Alaska, with tentative dates in May 2022. Many members have expressed interest in attending the annual meeting.

Several deliverables (Ds) were submitted this reporting period. D3.A entitled "Technical Approaches to Stacked Storage" was submitted and approved. D5 entitled "Strategies for Storage Permanence: Well Integrity and Legacy Well Evaluations" was submitted for review. D10 entitled "National Risk Assessment Partnership (NRAP) Testing and Validation: Part 1 – NRAP Open-Source Integrated Assessment Model (OPEN-IAM)" with attachments was submitted for review. D4 entitled "CCUS Business Models in the PCOR Partnership Region" was submitted for review. A white paper entitled "Matching Capture Technologies with Point Sources in the PCOR Partnership Region" was submitted. Each of the deliverables were added to the PCOR Partnership partners-only website.

Activities continued related to the field effort at the Red Trail Energy (RTE) CCS (carbon capture and storage) site. RTE was awarded the first CO_2 storage facility permit in North Dakota on October 19, 2021, from the North Dakota Industrial Commission (NDIC). The PCOR Partnership principal investigator attended the NDIC meeting. The EERC geophysics team performed the baseline scalable, automated, sparse seismic array (SASSA) noise and near-surface characterization study.

A contract for printing the PCOR Partnership Atlas (D15) was finalized. Printing is anticipated to be completed in January 2022. Numerous presentations were presented to a variety of audiences. UAF provided a draft report on a regional business case assessment for CCUS on the Orion Oil Pool, Alaska North Slope, to the EERC team, and updates are in progress.

Numerous white papers continue to be under development by the EERC team as well as the subrecipient teams at UW and UAF. Topics include geomechanical and geochemical evaluations; a summary of findings from reports from PCOR Partnership partner Resolute Engineering on cost analyses of multiple pipeline routes with variable pipeline diameters; CCUS and grid reliability, including a case study by Jackson Walker, LLP; a high-level road map that will summarize the near-term, midterm, and long-term opportunities for hydrogen with CCS; pipeline specifications; potential pressure interference; operational lessons learned from Wyoming CarbonSAFE Phase II; federal lands permitting; geologic formation outlines; lessons learned from enhanced oil recovery; and pore space-leasing considerations. Many of the white papers are anticipated to be provided to DOE and the PCOR Partnership members by the end of the next reporting period (end of BP1).



PCOR PARTNERSHIP INITIATIVE TO ACCELERATE CCUS DEPLOYMENT
Quarterly Progress Report
October 1 – December 31, 2021

INTRODUCTION

The Plains CO_2 Reduction (PCOR) Partnership Initiative is one of four Regional Carbon Sequestration Partnership 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 December 31, 2021, is at 215 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 regional capture, transport, and storage 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/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 Initiative members and regional stakeholders to promote the development of infrastructure and large projects within the PCOR Partnership Initiative region. This development will then provide best practices throughout the United States for wide-scale deployment of CCUS technologies. 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, 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 membership 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 project manager (PM) 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:

- Attended DOE meetings pertaining to the regional initiatives.
- Updated the PMP, incorporating changes related to the additional scope of work approved in Modification 005 and submitted to the DOE PM on December 10, 2021.
- Submitted requests for the release of incremental funding following the second DOE award increase (Contract Modification 005) to project sponsors, the North Dakota Industrial Commission (NDIC) Lignite Research, Development, and Marketing Program and NDIC Oil and Gas Research Program. The PCOR Partnership is waiting to present to the two groups.
- Submitted the BP2 continuation application on December 29, 2021.
- Continued planning for the 2022 PCOR Partnership Initiative Annual Membership Meeting, which will be held in Anchorage, Alaska. Tentative dates are in May 2022.
- Held progress meetings with UW and UAF. Discussed additional scope of work following receipt of the FY21 add-on funding.
- Continued planning for the TAB meeting to be held February 15–17, 2022, in Houston, Texas.

- Engaged in conversations with current and prospective partners regarding their continued involvement in the PCOR Partnership Initiative.
  - New members were welcomed:
    - Repsol
    - Burns & McDonnell
  - The PCOR Partnership currently has 215 members.
  - Several presentations on the PCOR Partnership Initiative were given to prospective partners.

- Attended the regional initiatives discussion on DOE Communities LEAP (Local Energy Action Program) on October 12, 2021.

- Participated in the CCS (carbon capture and storage) Regional Initiatives equity engagement discussion held by DOE on November 13, 2021.

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

- Complete contract modifications for the release of incremental cost-share funding from NDIC's Lignite Research, Development, and Marketing and Oil and Gas Research Programs. The presentation containing status updates on the PCOR Partnership to the NDIC Lignite Research Council is scheduled for January 20, 2022. A date to present to the NDIC Oil and Gas Research Council is pending.

- Complete contract modifications with UW and UAF to incorporate a revised scope and update the in-kind cost-share and subrecipient funding following the second DOE award increase (Contract Modification 005).

- Hold the next TAB meeting February 15–17, 2022, in Houston, Texas.

- Continue planning for the 2022 annual membership meeting.

- Continue progress on project deliverables (Ds) and milestones (Ms) (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.

Table 1. Project Deliverables

Deliverable 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 (Executive Summary) 11/12/2021 (Full report)	Topical report submitted to DOE PM	Moved from 6/30/2021. Full report due 11/1/2021 as discussed with DOE PM.
D3.B – Report – Stacked Storage Scenario Geomechanical Modeling	3/31/2022		Topical report submitted to DOE PM	Created as 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		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	12/17/2021 (Part 1)	Topical report submitted to DOE PM	To be provided in two parts.
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	
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 3/31/2023	6/30/2021	Atlas submitted to DOE PM	Moved from 3/31/2021.
D16 – Enabling Sustainable Monitoring for CCUS	6/30/2024		Topical report submitted to DOE PM	
D17 – PCOR Partnership Initiative Road Map	5/31/2024		Topical report submitted to DOE PM	

Table 2. Milestone Status Report

Milestone 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-16[2] Abstract Submitted	1/31/2022		Reported in subsequent quarterly report	
M7 – BP1 EDX 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] Energy Data eXchange.
[2] 16th International Conference on Greenhouse Gas Control Technologies.

Progress on Task 2.0 is as follows:

- Continued work on the two divisions of D3 – Stacked Storage Opportunity Assessment. D3.A is a focused stacked storage opportunity assessment in the PCOR Partnership region, and D3.B is an evaluation of geomechanical modeling in stacked storage scenarios.
  - D3.A entitled "Technical Approaches to Stacked Storage" was submitted on October 29, 2021, to DOE and NDIC for review. It was approved by DOE on November 12, 2021. The final deliverable was added to the PCOR Partnership partners-only website.
  - D3.B – a report detailing the stacked storage scenario geomechanical modeling will be delivered by March 31, 2022:
    - Continued 3D mechanical earth model (MEM) simulations.

- Submitted D5 entitled "Strategies for Storage Permanence: Well Integrity and Legacy Well Evaluations" on December 30, 2021, to the DOE PM for review.

- UW researchers traveled to Casper, Wyoming, at the beginning of October 2021 to meet with an EERC researcher at the Wyoming Oil and Gas Conservation Commission related to research for D5.

- Continued collaboration and planning for the field effort at the RTE CCS site near Richardton, North Dakota, to evaluate monitoring strategies with a focus on remote or autonomous operation as well as more frequent data acquisition and faster processing/interpretation. Activities included the following:
  - Met with representatives from RTE to present plans for fieldwork activities.
  - Met with the NDIC Department of Mineral Resources (DMR) on October 14, 2021, to discuss permitting procedures for the upcoming scalable, automated, sparse seismic array (SASSA) fieldwork. The North Dakota geophysical permit was issued for initial SASSA efforts to be completed by December 13, 2021.
  - Presented information on the planned field project to DOE on October 20, 2021.
  - Red Trail Energy (RTE) was awarded the first CO_2 storage facility permit in North Dakota on October 19, 2021, from NDIC. The PCOR Partnership principal investigator (PI) attended the NDIC meeting.
  - Disseminated an informational packet to landowners near the field site for land access discussions in November 2021 as part of the permission and notification process for sensor placement.
  - The EERC geophysics team performed the baseline SASSA noise and near-surface characterization study the week of November 29, 2021.
  - Requested approval of subcontractor SkyGeo Inc. to provide InSAR (interferometric synthetic aperture radar)-processed ground deformation deliverables for the duration of the subject project's monitoring task.
  - Met with project representatives to provide an update on activities.

- Worked on the MVA strategies report (D6).

- Worked on white papers on approaches to geomechanical and geochemical evaluations.

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

- UW researchers will prepare stacked storage reports for the Powder River Basin and the Rock Springs Uplift.

- Additional RTE field activities anticipated to occur include InSAR data acquisition and processing.

- Work will continue on the MVA strategies report (D6) and white papers.

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.

Progress on Task 3.0 is as follows:

- Subtask 3.1 – Data Sharing:
  - Continued to upload geologic models and reservoir simulations to the EERC workspace PCOR Partnership folder on the EDX. Completion of the upload will satisfy Milestone M7 – BP1 EDX Submitted (due March 31, 2022). The set includes geologic models and reservoir simulations that were supported by NETL under Award No. DE-FE0009114 for i) dedicated storage in deep saline formations and ii) associated storage through CO_2 enhanced oil recovery (EOR) in clastic and carbonate reservoirs. In addition, the set includes 130 realizations of the SMART (Science-Informed Machine Learning for Accelerating Real Time Decisions in Subsurface Applications) Initiative clastic shelf models that were supported by NETL under Contract No. 89243318CFE000003, passed through Leidos Inc., Subcontract No. P010227025, Task Order Release No. 7. The set of geologic models and reservoir simulations will provide a valuable resource to other DOE researchers studying geologic carbon storage or EOR.
  - Began identifying synthetic data sets that will be generated through the PCOR Partnership and available for upload to the EDX for M12 – BP2 EDX Submitted (due June 30, 2024).

- Subtask 3.2 – NRAP Validation:
  - Submitted D10 entitled "National Risk Assessment Partnership (NRAP) Testing and Validation: Part 1 – NRAP Open-Source Integrated Assessment Model (OPEN-IAM)" with attachments for DOE PM review on December 17, 2021.
  - Began additional testing of NRAP-Open-IAM using a set of geologic model realizations and numerical reservoir simulations to quantify the effect of uncertainty in facies and petrophysical properties (porosity and permeability) on estimates of formation fluid (brine) leakage up legacy wellbores. The NRAP-Open-IAM results will be compared against the results for an identical storage complex and overburden stratigraphy in the Analytical Solution for Leakage in Multilayered Aquifers (ASLMA) FORTRAN-based semi-analytical model.[1, 2]
  - Additional testing of the DREAM (Designs for Risk Evaluation and Management Tool, Version 2020.01-2.0) tool is ongoing and will be documented as part of a second NRAP testing report.

[1] Cihan, A., Zhou, Q., and Birkholzer, J.T., 2011, Analytical solutions for pressure perturbation and fluid leakage through aquitards and wells in multilayered aquifer systems: Water Resources Research, v. 47, p. W10504.
[2] Cihan, A., Birkholzer, J.T., and Zhou, Q., 2012, Pressure buildup and brine migration during CO_2 storage in multilayered aquifers: Ground Water, v. 51, no. 2, p. 252–267.

- Subtask 3.3 – Machine Learning:
  - The EERC continues to support the SMART Initiative through the PCOR Partnership Initiative. The EERC is directly involved in Tasks 1, 2, 4, 5 (Carbon Storage Program), and 6 (Oil and Gas Program) of the SMART Initiative and is participating in the crosscutting groups for algorithms and data.
  - The EERC continued to apply ML-based predictive modeling techniques (e.g., random forest, gradient boost, and neural network) to evaluate reservoir simulations for storage projects. The techniques are an improvement over traditional response surface modeling and can be used to extend a set of reservoir simulations into broader decision regions for optimizing storage performance.
  - Exploring the use of ML-based predictive modeling techniques to use geophysical well logs to classify aquifers located throughout the PCOR Partnership region into three groups based on their estimated total dissolved solids (TDS) concentrations: i) confidently less than 10,000 mg/L TDS, ii) confidently greater than 10,000 mg/L TDS, or iii) uncertain classification – not i or ii.

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

- Complete the EDX upload of geologic models and reservoir simulations.

- The EERC plans to continue participating in SMART Phase 2.

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:

- Submitted a white paper entitled "Matching Capture Technologies with Point Sources in the PCOR Partnership Region" on December 17, 2021.

- Finalized a contract for printing the PCOR Partnership Atlas (D15). The atlas is under a final review prior to printing and publishing on the PCOR Partnership website.

- Drafted a summary of findings from reports from PCOR Partnership partner Resolute Engineering on cost analyses of multiple pipeline routes with variable pipeline diameters to provide insight to the PCOR Partnership members. The summary is under internal review.

- Continued a study on CCUS and grid reliability in the PCOR Partnership region. An initial white paper has been prepared that includes an extensive literature review that discusses the North Dakota regional electric grid's historical, current, and future generation and transmission trends as well as the likely grid impacts of CCUS from a variety of perspectives, including renewable energy, technological limitations, and severe weather patterns. To understand the effect of CCUS on grid operation, preliminary simulations on unit commitment and economic dispatch models were performed using Hitachi Energy PROMOD software.

- Finalized the contract with Jackson Walker, LLP, to contribute to a study on CCUS and grid reliability in the PCOR Partnership region. Activities were initiated.

- Began preparation of a high-level road map that will summarize the near-term, midterm, and long-term opportunities for hydrogen with CCS in the PCOR Partnership region. Specific activities include the following:
  - Developed a list of existing industrial hydrogen producers and consumers within the PCOR Partnership region that includes location, scale, and overall CO_2 emissions. These are being mapped by hydrogen generation capacity and CO_2 emissions overlaid with potential CO_2 storage reservoirs. This will help to identify near-term opportunities for blue hydrogen production in the PCOR Partnership region and likely midterm hubs where long-term CO_2 storage is in close geographical proximity to ready sources of hydrogen.
  - Worked on development of mass and energy balances around plants of different designs and scales. Depending on how hydrogen is produced, some of the CO_2 can be readily captured at high purity from pressurized process streams, while other CO_2 emissions would be considerably more difficult and expensive to capture. The mass and energy balance data will be used to estimate how different levels of CO_2 capture and different plant scales might affect the cost of blue hydrogen, which in turn will advise both the best near-term opportunities for implementing blue hydrogen and the optimum long-term opportunities for cost-effective hydrogen with minimal carbon footprint.

- A study is underway to collect relevant information about pipeline regulations, examine the allowable levels of other constituents in a CO_2 stream generated from carbon capture, and examine the changes in notional capital costs if the CO_2 specification is different from the "Kinder Morgan pipeline specification" and the applicability of those differences in EOR and subsurface injection requirements. The Kinder Morgan pipeline specification is the default specification that is assumed to be relevant and is truly aimed at a specific underground storage location in Texas, which may not be applicable throughout North America.

- Began internal review of a white paper on the concept of potential pressure interference during CO_2 injection and storage.

- Prepared materials for landowner relations. The "Geophysical Surveys for CCS Projects in North Dakota" fact sheet was updated to include using dynamite as a seismic source,

which has been effective in reclaimed lands. The new fact sheet "Low-Impact Geophysical Research near Richardton, North Dakota" was developed for the SASSA activity at the RTE CCS site. The fact sheet was disseminated in the packet to landowners contacted in November 2021 as part of the permission and notification process for sensor placement under that activity (see Task 2.0).

- PCOR Partnership outreach responded to an invitation by the Midwest Regional Carbon Initiative (MRCI) to participate in an episode of the eGeos podcast series. The recording session and podcast upload will take place next quarter.

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

- Finalize the PCOR Partnership Atlas (D15) to be available in electronic and printed form.

- Submit abstracts to GHGT-16.

- Complete white papers on the Resolute Engineering pipeline study, North Dakota CCUS grid impact study, Jackson Walker LLP CCUS and grid stability study, and pressure interference, and provide to DOE and PCOR Partnership members.

- Develop a high-level road map summarizing the near-term, midterm, and long-term opportunities for hydrogen with CCUS in the PCOR Partnership region.

- At the invitation of MRCI, the PCOR Partnership will participate in a recording on January 18, 2022, in an eGeos podcast series episode focused on describing the regional programs and challenges and opportunities within each 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:

- Submitted D4 entitled "CCUS Business Models in the PCOR Partnership Region" on December 17, 2021, to the DOE PM for review.

- Presented "Role of Geophysics in CCUS: Examples from the PCOR Partnership" at the University of Oklahoma (OU) to the OU Society of Exploration Geophysicists on October 18, 2021.

- Attended the Interstate Oil and Gas Compact Commission (IOGCC) Annual Conference held November 7–9, 2021, in Santa Fe, New Mexico.

- On November 16, 2021, the PCOR Partnership PI participated in the Nebraska Oil and Gas Conservation Commission (NOGCC) rulemaking committee of experts to advise on the development of geologic storage of CO_2 regulations. The rulemaking committee participated in a series of meetings and review cycles from September 2021 through November 2021. The committee supported NOGCC staff as they developed draft regulations based on legislative authority granted to NOGCC during the 2021 Nebraska Legislature. The geologic storage regulations have been filed, and NOGCC has begun the Nebraska administrative rulemaking process.

- On November 18, 2021, the PCOR Partnership PI presented on Class VI primacy to the Alaska Department of Natural Resources.

- Participated in a panel discussion entitled "North Dakota Clusters & Hubs CO_2, H_2, Carbon Credits and Technology" and presented "North Dakota Permitting Timelines: Comparing CCS and CO_2 EOR with Storage" at the 2021 Midland CO_2 Conference held December 6–9, 2021, in Midland, Texas.

- On December 15, 2021, the PCOR Partnership PI presented "North Dakota's Approach to Regulating Geologic Storage of Carbon Dioxide" to the Kansas CCUS Task Force.

- The PCOR Partnership was recognized for contributions to the Colorado Oil & Gas Conservation Commission Department of Natural Resources report entitled "Requirements, Resources, Considerations, and Recommendations for the State of Colorado to Implement a Safe and Effective UIC Class VI Program," which was provided to the Colorado Governor and Legislature on December 1, 2021.

- Submitted four abstracts to the AAPG (American Association of Petroleum Geologists) CCUS conference to be held March 29–31, 2022:
  - "Low-Environmental-Impact Seismic CO_2 Monitoring in a North Dakota Carbon Capture and Storage Project Integrated with Ethanol Production"
  - "Monitoring, Verification, and Accounting (MVA) Strategy for a North Dakota Carbon Capture and Storage Project Integrated with Ethanol Production"
  - "Stacked Storage: Technical Considerations and Examples of Potential Reservoirs"
  - "Balancing CO_2 Pipeline Infrastructure Challenges"

- The UAF team provided a draft report on its work on a regional business case assessment for CCUS on the Orion Oil Pool, Alaska North Slope, to the EERC team. The business case assessment for CCUS balances EOR benefits with the increased operational costs associated with injecting high-concentration CO_2 into the Orion Oil Pool. Reservoir simulations were conducted to evaluate CO_2 EOR and sequestration. Economic analyses were performed in collaboration with the Alaska Department of Natural Resources. The report was reviewed by the EERC. Updates are in progress.

- The UW team submitted a draft product entitled "Operational Lessons Learned from Wyoming CarbonSAFE Phase II" to the EERC team. This product is currently under review.

- The UW team submitted a draft white paper entitled "The Impact of Federal Lands on Permitting Geologic Storage Projects in Wyoming" to the EERC team. This white paper is currently under review.

- The UW team is drafting formation outlines for the Minnelusa, Hulett, and Lakota Formations which will be submitted to the EERC and made available to PCOR Partnership members and DOE.

- UW is creating a draft white paper entitled "Lessons Learned from Decades of Enhanced Oil Recovery in Wyoming," which will be submitted to the EERC and made available to PCOR Partnership members and DOE.

- Continued efforts to upgrade the functionality and update content on the PCOR Partnership Initiative partner website.

- Received the DOE Class VI Rules and Tools crosswalk draft on November 30, 2021, for which the PCOR Partnership had provided information. Provided review comments on December 29, 2021.

- Continued development of a white paper on pore space-leasing considerations and several white papers focused on various lessons learned through the PCOR Partnership.

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

- Complete M7 – BP1 EDX Submitted.

- Present at the 2022 Touchstone Energy Cooperative NEXT Conference to be held January 31 – February 2, 2022.

- Present at the 2022 Energy Transition e-meeting organized by the EAGE Local Chapter Houston and EAGE Local Chapter London on February 15, 2022. The scheduled presentation is entitled "The Role of Geophysics in Carbon Capture Utilization, and Storage: Examples from Plains CO_2 Reduction Partnership."

- Attend the AAPG CCUS Conference to be held March 29–31, 2022, in Houston, Texas.

- Continue updating the PCOR Partnership Initiative public and partner websites. Release of the searchable database on the public website is planned for the first quarter of 2022. Began updates to the public website based on the most recent version of the PCOR Partnership Atlas.

- White papers are expected to be completed on the topics of capillary entry pressure; Class VI wellbore construction and design; lessons learned from coring programs, wireline logging, and seismic surveys; pore space-leasing considerations; evaluation of geophysical technologies; corrosion-resistant materials; and stabilized plume evaluations.

CHANGES/PROBLEMS

No changes or problems at this time.

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 December 31st, 2021

($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
Baseline Cost Plan										
Federal Share	63.8	81.4	213.9	239.6	914.0	914.0	914.0	914.0	914.0	914.0
Nonfederal Share	0.0	6.5	49.7	40.6	237.5	237.5	237.5	237.5	237.5	237.6
Total Planned	63.8	87.9	263.6	280.2	1151.5	1151.5	1151.5	1151.5	1151.5	1151.6
Cumulative Federal	63.8	145.2	359.1	598.7	1512.7	2426.7	3340.7	4254.7	5168.7	6082.7
Cumulative Nonfederal	0.0	6.5	56.2	96.8	334.3	571.8	809.3	1046.8	1284.3	1521.9
Cumulative Baseline Costs	63.8	151.7	415.3	695.5	1847.0	2998.5	4150.0	5301.5	6453.0	7604.6
Actual Incurred Cost										
Federal Share	63.8	81.4	213.9	239.6	296.8	376.4	1230.8	1402.3	814.6	
Nonfederal Share	0.0	6.5	49.7	40.6	83.0	81.9	179.1	82.8	488.4	
Total Incurred Costs	63.8	87.9	263.6	280.2	379.8	458.3	1409.9	1485.1	1303.1	
Cumulative Federal	63.8	145.2	359.2	598.8	895.6	1272.0	2502.8	3905.1	4719.7	
Cumulative Nonfederal	0.0	6.5	56.2	96.7	179.8	261.6	440.7	523.5	1011.9	
Cumulative Incurred Costs	63.8	151.7	415.4	695.5	1075.3	1533.6	2943.5	4428.6	5731.7	
Variance										
Federal Share	0.0	(0.0)	(0.0)	0.0	617.2	537.6	(316.8)	(488.3)	99.4	
Nonfederal Share	0.0	0.0	0.0	0.0	154.5	155.6	58.4	154.7	(250.9)	
Total Variance	0.0	(0.0)	(0.0)	0.0	771.7	693.2	(258.4)	(333.6)	(151.6)	
Cumulative Federal	0.0	(0.0)	(0.1)	(0.1)	617.1	1154.7	837.9	349.6	449.0	
Cumulative Nonfederal	0.0	0.0	0.0	0.1	154.5	310.2	368.6	523.3	272.4	
Cumulative Variance	0.0	(0.0)	(0.1)	(0.0)	771.7	1464.9	1206.5	872.9	721.3	

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 December 31st, 2021

($K)	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	424.3	424.3	424.3	424.3	424.3	424.3	343.1	342.9	342.9	342.9
Nonfederal Share	109.2	109.2	109.2	109.2	109.2	109.0	81.8	81.9	81.9	81.9
Total Planned	533.5	533.5	533.5	533.5	533.5	533.3	424.9	424.8	424.8	424.8
Cumulative Federal	6507.0	6931.2	7355.5	7779.7	8204.0	8628.2	8971.3	9314.2	9657.1	10000.0
Cumulative Nonfederal	1631.1	1740.3	1849.5	1958.7	2067.9	2176.9	2258.7	2340.6	2422.5	2504.4
Cumulative Baseline Costs	8138.1	8671.5	9205.0	9738.4	10271.9	10805.1	11230.0	11654.8	12079.6	12504.4
Actual Incurred Cost										
Federal Share										
Nonfederal Share										
Total Incurred Costs										
Cumulative Federal										
Cumulative Nonfederal										
Cumulative Incurred Costs										
Variance										
Federal Share										
Nonfederal Share										
Total Variance										
Cumulative Federal										
Cumulative Nonfederal										
Cumulative Variance										