PCOR Partnership

Energy & Environmental Research Center

PCOR PARTNERSHIP INITIATIVE TO ACCELERATE CCUS DEPLOYMENT

Research Performance Progress Report (quarterly)

(for the period April 1 – June 30, 2022)

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EXECUTIVE SUMMARY

The Plains CO_2 Reduction (PCOR) Partnership is one of four Regional Carbon Sequestration Partnership 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 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 region includes all or part of ten U.S. states and four Canadian provinces.

Contract Modification 6 approving Budget Period 2 (April 1, 2022 – September 30, 2024) was received April 8, 2022. A letter proposal was submitted to the DOE Project Manager on April 26, 2022, requesting $5 million in FY2022 funding from DOE. The letter proposal included an additional funding request in the amount of $4 million should additional funding from DOE be available beyond the $5 million FY2022 funding. The additional funding would allow the PCOR Partnership to enhance the current scope of work beyond the current changes proposed in the statement of project objectives.

Presentations on the PCOR Partnership were given to nine prospective partners. Twelve new members were welcomed to the PCOR Partnership, bringing the membership to 230 as of June 30, 2022: Aramco Americas, Barr Engineering, BKV Corporation, Carbon Alpha, CO_2SeQure (a MicroSeismic Company), Enerplus, Halliburton Energy Services, Hydrogen Naturally, Inc., Marathon Petroleum Corporation, Neset Consulting Service, Inc., Rainbow Energy Center, and STRYDE Limited.

The 2022 PCOR Partnership Annual Meeting was held May 24–25, 2022, in Anchorage, Alaska, with record-breaking attendance of 129 participants. The agenda included a half-day workshop on May 24, 2022, entitled “PCOR Partnership: Breaking Down the Barriers in CCUS” and a full day Annual Meeting consisting of presentations and panel sessions on May 25, 2022. A Technical Advisory Board (TAB) meeting was held in conjunction with the PCOR Partnership Annual Meeting, with seven of the eight TAB members in attendance. The Regulatory Roundup meeting has been scheduled for September 13–14, 2022.

One deliverable (D) was submitted for review. D6 entitled “Monitoring, Verification, and Accounting (MVA) Strategies: A Plains CO_2 Reduction (PCOR) Partnership Regional Perspective.” In addition, one deliverable was finalized following review. D3.B entitled

"Technical Approaches to Stacked Storage: Geomechanics Supplement" was revised and approved. Two white papers entitled "Characterization and Monitoring Technologies for Geologic Carbon Storage" and "Pressure Interference Evaluation to Support Storage Resource Planning in the Plains CO_2 Reduction (PCOR) Partnership Region" were completed and provided to the DOE Project Manager and the North Dakota Industrial Commission.

Activities continued related to the field effort at the Red Trail Energy CCS (carbon capture and storage) site. Fieldwork was conducted April 4–11, 2022, to install SASSA (semiautonomous sparse seismic array) sensors and collect baseline data using the four surface orbital vibrators (SOVs). SASSA is currently recording baseline seismic data from all SOVs. The team collected drone imagery to support ongoing field efforts related to locating feasible equipment deployment locations for NETL seismometers and preliminary planning for potential artificial reflector installation.

Numerous presentations and posters were presented to a variety of audiences. One outreach activity was participation at a Science Day event for local middle and high school students comprising an introductory presentation followed by rotation through five stations where students learned about the greenhouse effect, the role of CO_2 in the greenhouse effect, the geology needed for CO_2 sequestration, the elements of CCS, and the concept of mineral trapping.

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 evaluations; 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; CO_2 specifications for pipeline transport; operational lessons learned from stratigraphic well drilling in Wyoming; pore space leasing considerations on federal lands; Wyoming geologic storage formation outlines; and technical and legal considerations for pore space leasing in general.

PCOR Partnership
Energy & Environmental Research Center

PCOR PARTNERSHIP INITIATIVE TO ACCELERATE CCUS DEPLOYMENT
Quarterly Progress Report
April 1 – June 30, 2022

INTRODUCTION

The Plains CO_2 Reduction (PCOR) Partnership is one of four Regional Carbon Sequestration Partnership (RCSP) 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 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 June 30, 2022, is at 230 members. The PCOR Partnership 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 is to identify and address regional capture, transport, and storage challenges facing commercial deployment of CCUS in an expanded region, compared to past RCSP 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 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 DOE's

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 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:

- Received Contract Modification 6 approving BP2 (April 1, 2022 – September 30, 2024) April 8, 2022.

- Submitted a letter proposal to the DOE PM requesting $5 million in FY22 funding from DOE on April 26, 2022. A draft SOPO (statement of project objectives) that includes expanded scope activities was submitted with the letter proposal. The letter proposal included an additional funding request in the amount of $4 million should additional funding from DOE be available beyond the $5 million FY2022 funding. The additional funding would allow the PCOR Partnership to enhance the current scope of work beyond the current changes proposed in the SOPO.

- Submitted an updated PMP to the DOE PM on June 16, 2022. The task leads and spend plan were updated. Wes Peck is now leading Task 2, Kyle Glazewski is leading Task 4, and Katherine Anagnost is leading Task 5. The spend plan was updated to reflect the approval of Contract Modification 6.

- Provided the DOE PM with updated text for the PCOR Partnership Initiative Project Landing Page on NETL's website.

- Held the 2022 PCOR Partnership Annual Meeting May 24–25, 2022, in Anchorage, Alaska, with record-breaking attendance of 129 participants representing 63 companies from 13 states, Washington, D.C., and three Canadian provinces. Participants are

pictured in Figure 1. The agenda included the following presentations and panel sessions; asterisk (*) indicates presentations uploaded to the PCOR Partnership partners-only website:

- A half-day interactive workshop entitled "PCOR Partnership: Breaking Down the Barriers in CCUS" was held May 24, 2022.
  - *Breaking Down the Barriers in CCUS – presented by Wes Peck, EERC
  - *2022 PCOR Partnership Annual Meeting Interactive Workshop – presented and facilitated by Dave Nakles, EERC
    - Began summarizing the polling data collected during the workshop.
- Welcome – provided by Senator John Hoeven via video recording
- Welcome to Alaska – provided by Senator Lisa Murkowski via video recording
- *PCOR Partnership Initiative: Building Momentum – presented by Kevin Connors, EERC
- *Alaska: The Next Frontier for CCUS – presented by Corri Feige, Alaska Department of Natural Resources
- *Wyoming Vision for Carbon Management – presented by Holly Krutka, UW School of Energy Resources
- *Federal Perspective: An Overview of DOE's Fossil Energy and Carbon Management – presented by Sarah Leung, DOE
- Panel: CCUS Supports Existing Energy Infrastructure
  - Moderator: Charlie Gorecki, EERC
  - Stacey Dahl, Minnkota Power Cooperative

Figure 1. PCOR Partnership members, speakers, and guests in attendance at the 2022 PCOR Partnership annual meeting.

    - Tyler Hamman, Basin Electric Power Cooperative
    - Simon O'Brien, Shell
    - Kyle Quackenbush, Tallgrass Energy
  - Pioneer Award presentation – presented by Charles Gorecki, EERC
    - Presented to Wade Boeshans, Summit Carbon Solutions
    - Presented to Mike Holmes, Lignite Energy Council
  - *Evolution of Carbon Capture – presented by Lynn Brickett, DOE
  - Panel: Low-Carbon Energy Production Platforms
    - Moderator: Lynn Helms, NDIC
    - Jeff Jonson, Rainbow Energy Center
    - Kate Ryan, Denbury, Inc.
    - Dan Bermingham, North Shore Energy
  - Panel: Stimulate Private Investment in CCUS
    - Moderator: John Harju, EERC
    - Wade Boeshans, Summit Carbon Solutions
    - Brent Lewis, Carbon America
    - Roger Tullberg, Liberty Media

- Held TAB meeting in conjunction with the PCOR Partnership Annual Meeting with seven of the eight TAB members in attendance.

- Held progress meetings with UW and UAF. Traveled to Laramie, Wyoming, on June 6–7, 2022, to meet with representatives of UW to discuss collaborative efforts.

- Began preparing the presentation for the DOE Annual Review Meeting in August 2022.

- Engaged in conversations with current and prospective partners regarding their continued involvement in the PCOR Partnership:
  - Made contact with 27 prospective partners.
  - Gave presentations on the PCOR Partnership to nine prospective partners.
  - Welcomed new members:
    - Aramco Americas
    - Barr Engineering
    - BKV Corporation
    - Carbon Alpha
    - CO_2SeQure (a MicroSeismic Company)
    - Enerplus
    - Halliburton Energy Services
    - Hydrogen Naturally, Inc.
    - Marathon Petroleum Corporation
    - Neset Consulting Service, Inc.
    - Rainbow Energy Center
    - STRYDE Limited
  - Invoiced five prospective partners of which four have joined as of June 30, 2022. Another nine partners joined from invoices issued prior to April 1, 2022.

  - Received 12 requests for information on how to join via the PCOR Partnership public website.
  - The PCOR Partnership currently has 230 members.

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

- Begin planning the next PCOR Partnership Invitational with UAF and UW.

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

- EERC staff, including members of the project team, will participate in a multi-day event during the week of July 25–29, 2022. This in-person-only event will occur at the EERC facility in Grand Forks, North Dakota, and will comprise training on EERC functions related to research management and execution, team meetings, and team building.

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:

- Following submission and approval of D3.B entitled "Technical Approaches to Stacked Storage: Geomechanics Supplement," the project team identified additional information to strengthen the report. The document was updated and resubmitted to the DOE PM May 17, 2022.

- Submitted D6 entitled "Monitoring, Verification, and Accounting (MVA) Strategies: A Plains CO_2 Reduction (PCOR) Partnership Regional Perspective" to the DOE PM for review on June 30, 2022.

- Submitted a white paper entitled, "Characterization and Monitoring Technologies for Geologic Carbon Storage," to the DOE PM on May 11, 2022. This report gives an overview of many geophysical technologies and their applicability to site characterization and monitoring for geologic CO_2 storage projects. The DOE PM provided comments for consideration on June 30, 2022.

- Progress was made on the development of D7, a report on the evaluation of risk management.

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	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	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	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		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.

- Continued collaboration and planning for the field effort at the Red Trail Energy (RTE) carbon capture and storage (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:
  - Fieldwork was conducted April 4–11, 2022, to install SASSA (semiautonomous sparse seismic array) sensors and collect baseline data using the four surface orbital vibrators (SOVs). SASSA is currently recording baseline seismic data from all SOVs. The geophysics team started software development for data analysis and processing of SASSA seismic data acquired in April 2022.
  - Eight DOE NETL seismometers with recording boxes have been made available for the effort. The NETL seismometers will be used for monitoring potential induced seismic activity. The technical seismometer characteristics will allow the PCOR Partnership to complement the SASSA monitoring of the CO_2 plume. They will be deployed at locations with SASSA sensors. The seismometers will be deployed in July 2022.

  - InSAR (interferometric synthetic aperture radar) analysis includes review of historical Sentinel and TerraSARX satellite imagery and surface deformation modeling to inform decision for installing artificial reflectors.
  - In addition to the SASSA deployment effort in early June 2022, the team collected drone imagery to support ongoing field efforts related to locating feasible equipment deployment locations for the NETL seismometers and preliminary planning for potential artificial reflector installation.
- Worked on white papers on approaches to geomechanical evaluations.

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

- Additional RTE field activities: install SASSA sensors and collect baseline data using SOVs and InSAR data analysis. Meet weekly with contractor SkyGeo to review InSAR data for historical analysis and modeling to inform decision making for artificial reflector installation.

- Continue work on 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 continues to identify and catalog data sets that will be generated through the PCOR Partnership and available for upload to the EDX for M12 – BP2 EDX Submitted.

- Subtask 3.2 – NRAP Validation:
  - Continued testing of the NRAP Open-Source Integrated Assessment Model (Open-IAM). The project team is comparing the results from NRAP-Open-IAM against the results for an identical storage complex and overburden stratigraphy in the Analytical Solution for Leakage in Multilayered Aquifers (ASLMA) FORTRAN-based semianalytical model.
  - Testing of the DREAM (Designs for Risk Evaluation and Management Tool, Version 2020.01-2.0) tool has been placed on hold until further notice from the DREAM development team that the tool is ready for commercial application and testing.

- Subtask 3.3 – Machine Learning:
  - Continued to explore 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. Collaborating with UW on this effort.
  - Analyzing the results of numerical reservoir simulations to quantify the impacts to injectivity at Storage Site A when a second Storage Site B is located 10 to 25 miles away, both sites are injecting 0.5 to 4 $MtCO_2$/year, and different injection constraints are applied to the simulations.
  - A white paper entitled "Pressure Interference Evaluation to Support Storage Resource Planning in the Plains CO_2 Reduction (PCOR) Partnership Region" was provided to the DOE PM on June 2, 2022. The work in this paper uses simplified analytical and semianalytical models to examine the nature and extent of pressure interference between two or more storage projects using parameters describing a representative storage complex in North Dakota.

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

- Continue to explore the use of ML-based predictive modeling techniques to use geophysical well logs to classify aquifers located throughout the PCOR Partnership region.

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:

- Four abstracts submitted to GHGT-16 had previously been invited to present at the conference (a mix of oral and poster presentations). The decision was made to accept all four invitations. Drafting of papers to accompany the presentations was initiated. The abstract titles and their status at the conference are listed below:
  - PCOR Partnership: Breaking Down the Barriers in CCUS (initially invited as a poster but changed to oral presentation by the conference)
  - Risk-Based Area of Review Estimation in Overpressured Reservoirs to Support Injection Well Storage Facility Permit Requirements for CO_2 Storage Projects (oral presentation)

  - Stacked Carbon Dioxide Storage: Technical and Geomechanical Considerations (oral presentation)
  - Demonstration of Novel Monitoring Techniques for a North Dakota Carbon Capture and Storage Project (content includes activities under a complementary project) (poster)

- A member of the UAF team was asked to lead a work group to chart a road map to CCUS in Alaska.

- Continued preparation of a white paper focused on CCUS and grid reliability of the North Dakota regional electric grid. Provided the white paper to a PCOR Partnership member for external review.

- Jackson Walker, LLP, finalized its case study on CCUS and grid reliability. The report was delivered to the EERC.

- Completed writing initial draft of a high-level road map that summarizes the near-term, midterm, and long-term opportunities for hydrogen with CCS in the PCOR Partnership region.

- Summarized the PCOR Partnership hydrogen CCUS road map research in a draft white paper, which is under internal review.

- Reviewed information on the CO_2 streams generated by combustion processes (precombustion, postcombustion and oxyfuels), ethanol, and cement plants. Prepared a white paper on findings concerning pipeline specifications for the system to handle the various streams from capture through injection, including the need for detailed review of the interaction of the stream with the reservoir rock and fluids contained within the injection horizon. In addition, a review of the effects that the CO_2 stream and reservoir properties (including fluids contained in the wellbore) would pose on the metallurgy required for the tubulars of the injection well was performed. The white paper is currently under internal review.

- Stress Engineering Services, Inc., is working as a subcontractor to provide PCOR Partnership membership with a basic guideline on considerations for selecting corrosion-resistant alloys material for use in CO_2 storage and utilization applications. The guidelines were provided to the EERC on May 24, 2022, for review. A white paper associated with the guidelines is in preparation by Stress Engineering Services, Inc.

- Began development of education content and materials to facilitate and supplement outreach to middle and high school students on topics related to CCUS. Initial round of draft content included an introductory presentation and small-group activities focused on the greenhouse effect, the role of CO_2 in the greenhouse effect, the advantage of incorporating CCS on fossil fuel-fired power stations, the geology needed for CO_2 sequestration, the elements of CCS, and the concept of mineral trapping.

- Participated in a Science Day event for local middle and high school students on May 6, 2022. The activity comprised an introductory presentation following by rotation through five stations where students learned about the greenhouse effect, the role of CO_2 in the greenhouse effect, the geology needed for CO_2 sequestration, the elements of CCS, and the concept of mineral trapping. A total of 45 middle and high school students and five teachers participated in the event.

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

- Continue to ship the PCOR Partnership Atlas (D15) to PCOR Partnership members when stock is replenished.

- Continue development of secondary education content and beta-testing material.

- Complete white papers on the North Dakota CCUS grid impact study, Jackson Walker, LLP, CCUS and grid stability study, and corrosion-resistant alloys material guidelines and provide to DOE and PCOR Partnership members.

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:

- Presented “Monitoring, Verification, and Accounting (MVA) Strategy for a North Dakota Carbon Capture and Storage Project Integrated with Ethanol Production” focused on geophysics and monitoring activities at the AAPG (American Association of Petroleum Engineers) CCUS Conference on March 29, 2022.

- Presented “Regulating Geologic Storage of Carbon Dioxide Class VI Primacy” to DOE NETL representatives via videoconference on April 6, 2022.

- Presented “First Wave of Incentive-Driven CCS Projects in North Dakota” at the UW School of Energy Resources Distinguished Speaker Series on April 8, 2022. A recording is available at https://www.youtube.com/watch?v=Bd7a-2s-vPw.

- Presented at the 2022 CUSP (Carbon Utilization and Storage Partnership) Annual Meeting held in Las Vegas, Nevada, on June 1, 2022.

- Presented "The Plains CO_2 Reduction (PCOR) Partnership" at the Final Results from STRATEGY CCUS meeting in Brussels, Belgium, on June 15, 2022.

- Regulatory staff attended the Groundwater Protection Council 2022 Annual Forum & UIC Conference on June 21–23, 2022, in Salt Lake City, Utah.

- Presented "Monitoring, Verification, and Accounting (MVA) Strategy for a North Dakota Carbon Capture and Storage Project Integrated with Ethanol Production" at Society of Exploration Geophysicists (SEG) "Toward Gigatonnes CO_2 Storage – Grand Geophysical Challenge" Workshop on June 29, 2022.

- Scheduled the Regulatory Roundup meeting for September 13–14, 2022. Surveyed regulators and other potential attendees of the Regulatory Roundup to inform meeting planning and topics of discussion. Current registration indicates a possible record attendance.

- Progress was made on the development of D8, a report on regional permitting guidance.

- Reviewed products from UAF and UW and worked with the teams on updates.

- Continued efforts to populate both the public website (undeerc.org/pcor) and the partners-only website (undeerc.org/pcorpartners) with new and updated information, as well as enhance the user experience, including:
  - Added a button to the public website navigation bar for easy connection to the partners-only site.
  - Made significant improvements to the Searchable Product Directory search functionality on the partners-only site.

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

- Continued work on a regulatory crosswalk between the U.S. Environmental Protection Agency (EPA) underground injection control (UIC) for CO_2 geologic sequestration, the North Dakota Administrative Code for Geologic Storage of Carbon Dioxide, and CARB (California Air Resources Board) to help streamline necessary data acquisition for storage facility permitting efforts.

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

- Continue updating the PCOR Partnership public and partner websites.

- White papers are expected to be completed on the topics of Class VI wellbore construction and design; lessons learned from coring programs, wireline logging, and seismic surveys; pore space leasing considerations; 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 June 30, 2022

($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	239.7	296.8	376.4	1230.8	1402.3	814.6	1388.5
Nonfederal Share	0.0	6.5	49.7	40.6	83.0	81.9	179.0	82.8	488.5	495.0
Total Planned	63.8	87.9	263.6	280.3	379.8	458.3	1409.8	1485.1	1303.1	1883.5
Cumulative Federal	63.8	145.2	359.1	598.8	895.6	1272.0	2502.8	3905.1	4719.7	6108.2
Cumulative Nonfederal	0.0	6.5	56.2	96.8	179.8	261.7	440.7	523.5	1012.0	1507.0
Cumulative Baseline Costs	63.8	151.7	415.3	695.6	1075.4	1533.7	2943.5	4428.6	5731.7	7615.2
Actual Incurred Cost										
Federal Share	63.8	81.4	213.9	239.6	296.8	376.4	1230.8	1402.3	814.6	1388.5
Nonfederal Share	0.0	6.5	49.7	40.6	83.0	81.9	179.1	82.8	488.4	495.0
Total Incurred Costs	63.8	87.9	263.6	280.2	379.8	458.3	1409.9	1485.1	1303.1	1883.5
Cumulative Federal	63.8	145.2	359.2	598.8	895.6	1272.0	2502.8	3905.1	4719.7	6108.2
Cumulative Nonfederal	0.0	6.5	56.2	96.7	179.8	261.6	440.7	523.5	1011.9	1506.9
Cumulative Incurred Costs	63.8	151.7	415.4	695.5	1075.3	1533.6	2943.5	4428.6	5731.7	7615.2
Variance										
Federal Share	0.0	(0.0)	(0.0)	0.1	0.0	(0.0)	(0.0)	0.0	(0.0)	0.0
Nonfederal Share	0.0	0.0	0.0	0.0	(0.0)	0.0	(0.1)	0.0	0.1	(0.0)
Total Variance	0.0	(0.0)	(0.0)	0.1	0.0	0.0	(0.1)	0.0	0.0	0.0
Cumulative Federal	0.0	(0.0)	(0.1)	0.0	0.0	0.0	(0.0)	0.0	(0.0)	(0.0)
Cumulative Nonfederal	0.0	0.0	0.0	0.1	0.0	0.1	0.0	0.0	0.1	0.1
Cumulative Variance	0.0	(0.0)	(0.1)	0.1	0.1	0.1	(0.0)	0.0	0.0	0.0

ENERGY & ENVIRONMENTAL RESEARCH CENTER

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DE-FE0031838

Project-to-Date Financial Report at June 30, 2022

($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	889.2	889.2	889.2	889.2	889.2	889.2	889.2	889.2	889.1	889.1
Nonfederal Share	224.6	224.6	224.6	224.6	224.6	224.6	224.6	224.6	224.6	224.5
Total Planned	1113.8	1113.8	1113.8	1113.8	1113.8	1113.8	1113.8	1113.8	1113.7	1113.6
Cumulative Federal	6997.4	7886.6	8775.8	9665.0	10554.2	11443.4	12332.6	13221.8	14110.9	15000.0
Cumulative Nonfederal	1731.6	1956.2	2180.8	2405.4	2630.0	2854.6	3079.2	3303.8	3528.4	3752.9
Cumulative Baseline Costs	8729.0	9842.8	10956.6	12070.4	13184.2	14298.0	15411.8	16525.6	17639.3	18752.9
Actual Incurred Cost										
Federal Share	1823.3									
Nonfederal Share	335.8									
Total Incurred Costs	2159.1									
Cumulative Federal	7931.5									
Cumulative Nonfederal	1842.7									
Cumulative Incurred Costs	9774.2									
Variance										
Federal Share	(934.1)									
Nonfederal Share	(111.2)									
Total Variance	(1045.3)									
Cumulative Federal	(934.1)									
Cumulative Nonfederal	(111.1)									
Cumulative Variance	(1045.2)									