



Plains CO₂ Reduction (PCOR) Partnership
Energy & Environmental Research Center (EERC)

Plains CO₂ Reduction (PCOR) Partnership Monthly Update November 1–30, 2017

PHASE III ACTIVITIES

Task 1 – Regional Characterization (Wesley D. Peck)

Highlights

- Continued activities to update the content of the **PCOR Partnership partners-only Decision Support System (DSS) Web site**, including the following:
 - Placed the 2017 PCOR Partnership Annual Membership Meeting and Workshop posters and final agendas on the PCOR Partnership members-only DSS.
- Continued work on regional models, including the following:
 - Compiled characterization data for the Fryburg and Medora Heath–Madison Fields.
 - Continued work on the Lodgepole static model, including loading well data and picking tops.
 - Continued work on a Nebraska regional model.
 - Revised pressure and fluid saturation property distributions in the Gooseneck Field model in preparation for CO₂ storage simulations.
- With regard to **Williston Basin** CO₂ Storage Sink Relative Permeability Laboratory Characterization:
 - Continued modification to the value-added report based on internal review.
- With regard to the **Aquistore** project’s static modeling and dynamic predictive simulations effort:
 - Sent a draft abstract for Greenhouse Gas Control Technologies (GHGT)-14 (to be held October 21–26, 2018, in Melbourne, Australia) to Petroleum Technology Research Centre (PTRC) for review.
 - Processed newly received injection data for October 2017.

Task 2 – Public Outreach and Education (Daniel J. Daly)

Highlights

- Submitted value-added reports entitled “Household Energy and Carbon Web Pages Report” for the periods of April 1 – June 30, 2017, and July 1 – September 30, 2017, to the U.S. Department of Energy (DOE) National Energy Technology Laboratory (NETL) for review on November 16, 2017. Received approval on November 17, 2017.
- Held conference calls with Prairie Public Broadcasting (PPB) on November 3 and 27, 2017, to discuss progress on Task 2 activities and the path forward.
- With regard to **Documentary Deliverable (D) 22** (Coal Powered):

- Continued to prepare edits to finalize the product. Completed preliminary review and revision of images and narration for the first 28 minutes. Addressed reviewer comments and technical issues for narrator content, interview statement content, and cover images.
- Received a request from PCOR Partnership partner Lignite Energy Council (LEC) for a screening of the draft D22 product.
- With regard to **Documentary D21** (The Bell Creek Story – CO₂ in Action):
 - Performed an internal review of video clips for use on the PCOR Partnership public Web site and in presentations. Forwarded the clips to Energy & Environmental Research Center (EERC) senior PCOR Partnership managers for internal review.
- Continued writing text and revising layout for the draft updated Phase II Zama fact sheet.
- Participated in the monthly Outreach Working Group (OWG) conference call on November 16, 2017. Topics included discussion and assessment of comments from OWG members regarding the review of a draft summary of OWG activities and accomplishments since 2003, intended as input for a final activity report.
- Continued work on the PCOR Partnership public Web site for D13 (Public Site Updates) due January 2018, including reviewing and revising the content update plan.

Task 3 – Permitting and NEPA (National Environmental Policy Act) Compliance (Charles D. Gorecki)

Highlights

- Reviewed and edited the Task 3 section of the annual project assessment (D57).

Task 4 – Site Characterization and Modeling (Charles D. Gorecki)

This task ended in Quarter 1 – Budget Period (BP) 5, Year 10 (March 2017).

Task 5 – Well Drilling and Completion (John A. Hamling)

This task ended in Quarter 3 – BP4, Year 7 (June 2014).

Task 6 – Infrastructure Development (Melanie D. Jensen)

Highlights

- Reviewed and edited the Task 6 section of the annual project assessment (D57).

Task 7 – CO₂ Procurement (John A. Harju)

This task ended in Quarter 4 – BP4, Year 6 (September 2013).

Task 8 – Transportation and Injection Operations (Melanie D. Jensen)

This task ended in Quarter 4 – BP4, Year 8 (September 2015).

Task 9 – Operational Monitoring and Modeling (John A. Hamling and Larry J. Pekot)

Highlights

- Based on mutual agreement with the DOE NETL project manager, the PCOR Partnership plans to submit an update to D69 (Best Practices for Modeling and Simulation of CO₂ Storage), which was submitted May 31, 2017, that incorporates additional reviewer perspectives and findings. Continued work on revisions to lessons learned, recommended best practices, case studies, and text.
- Based on mutual agreement with the DOE NETL project manager, the PCOR Partnership plans to submit an update to D51 (Best Practices Manual – Monitoring for CO₂ Storage), which was submitted October 31, 2017, that incorporates additional technical expert reviewer perspectives and findings. Continued work on revisions based on feedback.
- Met internally to discuss plan to upload PCOR Partnership data to the NETL's Energy Data eXchange (EDX) in 2018.
- **Bell Creek** injection-phase site activities included the following:
 - Continued reservoir pressure and distributed temperature monitoring of 05-06 OW (observation well) from the permanent downhole monitoring system using the casing-conveyed pressure-temperature gauges and fiber-optic distributed temperature system:
 - ◆ Near-continuous operation since April 2012.
 - Continued dynamic reservoir pressure and multiphase fluid flow simulation efforts. The modeling and simulation focus remains on Bell Creek Field Phase Areas 1–4. Accomplishments and activities include the following:
 - ◆ History matching of the simulation model is complete for Phase Areas 1–3 using the simulation model based on the Version 2 geologic model. Predictive simulation is complete for Phase Areas 1 and 2. Simulations to investigate long-term CO₂ migration are complete for Phase Areas 3–7.
 - ◆ History matching of the simulation model is complete for the waterflooding and CO₂-flooding stages for Phase Area 4 using the simulation model based on the Version 3 geologic model.
 - ◆ Updated the production data in the Bell Creek Phase Area 4 simulation model to October 2017 and predicted the CO₂ plume distribution in Phase Area 4 to December 2017.
 - ◆ Continued work on matching the simulation model to measured saturation values from pulsed-neutron logs (PNLs).
 - Continued coordination with Denbury Onshore (Denbury) and Schlumberger on the potential acquisition of time-lapse PNL saturation logs in three wells that have seen gas breakthrough. The acquisition is planned to be concurrent with a time-lapse 3-D seismic survey and could aid in building a seismic amplitude change to CO₂ saturation correlation. Used predicted CO₂ saturation thickness (from the simulation results) and calculated bottomhole pressure for various wells in Phase Area 4 to help select wells for the PNL campaign.
 - Continued work on updating the microseismic velocity model and refining parameters for magnitude and focal mechanism estimation.
 - Continued evaluating InSAR (interferometric synthetic aperture radar) data in conjunction with pressure history data of an injection well. Worked on estimating ground surface deformation through geomechanical forward modeling, and began comparison to InSAR data.

- Used the most recent publicly available data to determine that cumulative CO₂ gas injection is 8,236,960 tonnes through August 31, 2017. This value represents the total gas injected, which includes purchase and recycle streams and is NOT corrected for a gas composition of approximately 98% CO₂ (Table 1).
- As of August 31, 2017, the most recent month of record, 4.220 million tonnes of total gas (composition of approximately 98% CO₂) has been purchased for injection into the Bell Creek Field, equating to an estimated 4.158 million tonnes of CO₂ stored (Table 2), with the difference comprising other trace gases in the purchase gas stream. A separate method from that used to calculate estimated total gas injected was used to calculate a cumulative associated CO₂ storage by correcting the gas purchase volume (approximately 98% CO₂) obtained from Denbury's custody transfer meter with gas compositional data.

Table 1. Bell Creek CO₂ Gas Injection Totals for August 2017 (cumulative totals May 2013 to August 2017)¹

	August 2017 Injection
Total, Mscf	5,178,776
Total, tons ²	296,218
Total, tonnes ³	268,985
Cumulative Total, Mscf ⁴	158,586,186
Cumulative Total, tons ^{2,4}	9,070,879
Cumulative Total, tonnes ^{3,4}	8,236,960

Source: Montana Board of Oil and Gas database.

¹ Total gas injection quantities are **NOT CORRECTED** for gas composition and include the combined purchased and recycled gas streams.

² Calculated utilizing a conversion of 17.483 Mscf/ton.

³ Calculated utilizing a conversion of 19.253 Mscf/tonne.

⁴ Cumulative totals are for the period from May 2013 to the month listed.

Table 2. Cumulative Total Gas Purchased and Estimated Associated CO₂ Storage for the Bell Creek Field¹

	August 2017 Gas Totals
Monthly Total Gas Purchased, MMscf ²	2053
Monthly Total Gas Purchased, million tons ²	0.117
Monthly Total Gas Purchased, million tonnes ²	0.107
Cumulative Total Gas Purchased, MMscf ^{2,3}	81,243
Cumulative Total Gas Purchased, million tons ^{2,3}	4.647
Cumulative Total Gas Purchased, million tonnes ^{2,3}	4.220
Cumulative Total CO ₂ Stored, MMscf ^{3,4}	80,056
Cumulative Total CO ₂ Stored, million tons ^{3,4}	4.579
Cumulative Total CO ₂ Stored, million tonnes ^{3,4}	4.158

¹ Conversion factors of 17.483 Mscf/ton and 19.253 Mscf/tonne were used to calculate equivalent purchase and storage quantities.

² Total gas purchased **NOT CORRECTED** for gas composition.

³ Cumulative totals are for the period from May 2013 to the month listed.

⁴ Total CO₂ stored **CORRECTED** for gas composition.

- Completed collection of the eighth round of oil samples from a select group of wells in the Bell Creek Field on November 8, 2017. Working with Denbury on sample receipt to the EERC.
- A summary of all oil and CO₂ gas stream samples collected for analyses to date is provided in Table 3.

Table 3. Oil and CO₂ Gas Stream Sampling and Analyses

		Production Stream by Development Phase, Well ¹									
	Purchase/ Recycle ¹	Phase 1				Phase 3			Phase 4		
Date Sampled		56-14R	32-02	05-06	04-04	28-02	21-10	21-14	34-09	34-07	34-03
Jan 2014		O	O	O							
Mar 2014		O	O								
May 2014	P	O	O	O							
Jun 2014	PR	O	O	O							
Jul 2014	PR	O	O	O							
Sep 2014	PR	OG	OG	O							
Oct 2014	PR	O	O								
Nov/Dec 2014		OG	OG	G							
Jan 2015			O	OG							
Mar 2015		G	G	G							
Apr 2015	PR										
Jun 2015		O	O	O							
Jul 2015	PR	G	G	G							
Sep 2015	PR										
Nov 2015		O		O							
Jan 2016	PR										
Apr/May 2016		O	O	O	O	O	O	O			
Jun/Jul 2016	PR	O		O	O	O	O	O			
Aug/Sep 2016		O	O		O	O	O	O	O		
Oct 2016				O							
Nov/Dec 2016 ²	PR	O	O	O	O	O	O	O	O	O	O
Feb 2017 ²		O	O		O	O	O	O	O	O	O
May 2017 ²	PR	O	O	O	O	O	O	O	O	O	O
July 2017 ²		O			O	O	O	O	O	O	O
Oct 2017				O			O	O	O	O	O
Nov 2017		O	O		O	O					

¹ P = purchase CO₂ gas stream, R = recycle CO₂ gas stream, O = produced oil stream, and G = produced CO₂ gas stream.

² Oil samples collected but not yet analyzed.

Task 10 – Site Closure (John A. Hamling)

Highlights

- Began writing D54 (Site Closure Procedures).

Task 11 – Postinjection Monitoring and Modeling (John A. Hamling and Larry J. Pekot)

Highlights

- Completed draft abstract and outline for D73 (Monitoring and Modeling Fate of Stored CO₂).

Task 12 – Project Assessment (Loreal V. Heebink)

Highlights

- Continued updating sections in the BP5 Program Year 10 project assessment annual report based on quarterly reports, deliverables, and milestones.
- Initiated internal review process for sections of the report.

Task 13 – Project Management (Charles D. Gorecki)

Highlights

- Statoil has joined the PCOR Partnership.
- Attended the American Institute of Chemical Engineers (AIChE) Annual Meeting held October 29 – November 3, 2017, in Minneapolis, Minnesota. Presented “Geologic Storage of Carbon Dioxide in the Central Plains of North America.”
- Completed preparation of draft responses to recommendations resulting from the IEA Greenhouse Gas R&D Programme (IEAGHG) peer review of the Regional Carbon Sequestration Partnership Initiative Development Phase (Phase III) performed January 23–27, 2017. Submitted to the DOE NETL project manager for review.
- Continued work on a planned special issue of *International Journal of Greenhouse Gas Control*. Team members continued writing text for potential papers related to all active tasks.
- Continued to develop a list of potential abstracts for submission to GHGT-14 to be held October 21–26, 2018, in Melbourne, Australia.
- Responded to several partner requests for PCOR Partnership Annual Membership Meeting and Workshop presentations and the participant list.
- Began compiling a list of potential conflicts/dates in preparation of planning for the 2018 PCOR Partnership Annual Membership Meeting and Workshop.
- Worked on finding date and location options for the 2018 Technical Advisory Board (TAB) meeting. TAB members were contacted for their availability.
- Held a task leader meeting November 29, 2017. Topics discussed included deliverables, planned journal articles and conference papers, recent and upcoming meeting attendance, and task updates.
- Completed reporting in November:
 - October monthly update.

Task 14 – RCSP Water Working Group (WWG) Coordination (Ryan J. Klapperich)

Highlights

- Attended the Asia–Pacific Economic Cooperation (APEC) Water–Energy Nexus Expert workshop held October 31 – November 1, 2017, in Atlanta, Georgia. The workshop was created to foster communication among APEC member nations on water–energy issues. Most attendees had background/expertise in the power generation industry. Topics discussed included water availability, alternate water sourcing, diverse regulatory regimes, and the presence or absence of national energy policy. Potential paths forward discussed included the development of an APEC-sponsored water–energy nexus working group, development of international training centers, or development of decision support tools.
- Continued development of the draft D107 (Journal Article or Topical Report – Major Research Focuses for Water and CCS [Carbon Capture and Storage]).

- Held the quarterly conference call for November 9, 2017. An update on the status of the final report/paper (D107) was provided, and other business was discussed.

Task 15 – Further Characterization of the Zama Acid Gas EOR, CO₂ Storage, and Monitoring Project (Charles D. Gorecki)

This task ended in Quarter 2 – BP4, Year 7 (February 2014).

Task 16 – Characterization of the Basal Cambrian System (Wesley D. Peck)

This task ended in Quarter 2 – BP4, Year 7 (March 2014).

Travel/Meetings

- October 30 – November 1, 2017: traveled to Atlanta, Georgia, to attend the APEC Water–Energy Nexus Expert Workshop.
- October 31 – November 3, 2017: traveled to Washington, D.C., to attend the Midwest Regional Carbon Sequestration Partnership Meeting and events.
- November 6–7, 2017: extended trip in Washington, D.C., to attend the Carbon Sequestration Leadership Forum (CSLF) Financing Task Force meeting.
- November 2–4, 2017: traveled to Minneapolis, Minnesota, to attend the AIChE 2017 annual meeting.
- November 30 – December 7, 2017: traveled to Abu Dhabi, United Arab Emirates, to present at and attend the CSLF 7th Ministerial Meeting.

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