Plains CO₂ Reduction (PCOR) Partnership

Phase III Prospectus
What is the PCOR Partnership?
The Plains CO2 Reduction (PCOR) Partnership is one of seven Regional Carbon Sequestration Partnerships (RCSP) Program initiatives being implemented in the United States.

What's Ahead for the PCOR Partnership?

1. Phase II Zama Acid Gas Injection Site
2. Phase II Lignite CO2 Sequestration ECBM Site
3. Phase II Prairie Pothole Wetlands Terrestrial Sequestration Site
4. Phase II Williston Basin CO2 Huff ‘n’ Puff Field Validation Test
5. Phase II/III Fort Nelson CCS Feasibility Study
6. Phase III Bell Creek MVA Project

Phase III Objectives
The overall mission of the Phase III program is to 1) build upon Phase I and II assessments of regional sequestration data to determine the most suitable technologies, regulations, and infrastructure needs for carbon capture and storage (CCS) on the North American continent.

Comprised small-scale field validation tests.

Validation, Phase II (2005–2009)
The overall goal of Phase II was to validate technologies and demonstrate CCS in locations in the Partnership region that could support future full-scale geological and terrestrial sequestration opportunities.

Validation, Phase II
- Phase II Lignite CO2 Sequestration Project
- Phase II Prairie Pothole Wetlands Terrestrial Sequestration Project
- Phase II Williston Basin CO2 Huff ‘n’ Puff Field Validation Test
- Phase III Fort Nelson CCS Feasibility Study
- Phase III Bell Creek MVA Project

What Has the PCOR Partnership Accomplished?
- Assessed and prioritized opportunities for sequestration in the region and helped address the technical, regulatory, and environmental barriers to the most promising sequestration opportunities.

Validation, Phase II (2005–2009)
- Validation of CCS technologies and terrestrial storage opportunities.

The PCOR Partnership
- Partners to capture and store CO2.
- Continues collaboration with other RCSPs.
- Provides outreach and education for CO2 sequestration stakeholders and the general public.

What’s Ahead for the PCOR Partnership?
- Build upon Phase I and II assessments of regional sequestration data to determine the most suitable technologies, regulations, and infrastructure needs for carbon capture and storage (CCS) on the North American continent.
- Validate technologies and to study CO2 storage associated with a commercial enhanced oil recovery (EOR) project at the Denbury-operated Bell Creek oil field.
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- Generate project plans to fully utilize the infrastructure developed in its characterization (Phase I) and validation (Phase II) phases.
- Evaluate CO2 sequestration opportunities in the region.

Simulation and Monitoring of CO2 Behavior in the Subsurface
An emphasis on cost-effectiveness and integration with routine oilfield activities is driving the philosophical basis for developing the MVA plans to be implemented as part of the development phase. Potential MVA techniques will include the following:
- Pressure monitoring, fluid sampling (oil, gas, water), pressure and geochemical monitoring of overlying formations, downhole geophysical monitors (passive microseismic and/or tiltmeters), vertical seismic profile (VSP) surface CO2 measurements, ion chemistry and isotopes of sampled fluids, and tracer (e.g., perfluorocarbon) monitoring. Extensive reservoir simulation modeling that includes geochemical and geological processes is also part of the Phase II MVA protocols.

The Plains CO2 Reduction (PCOR) Partnership is one of seven regional partnerships operating under the U.S. Department of Energy’s National Energy Technology Laboratory (NETL) Regional Carbon Sequestration Partnership (RCSP) Program. The PCOR Partnership is led by the Energy & Environmental Research Center (EERC) at the University of North Dakota in Grand Forks, North Dakota, and includes numerous public and private sector stakeholders.

The PCOR Partnership region includes all or part of nine states (Iowa, Minnesota, Missouri, Montana, Nebraska, North Dakota, South Dakota, Wisconsin, and Wyoming) and four Canadian provinces (Alberta, British Columbia, Manitoba, and Saskatchewan).

The PCOR Partnership
- Partners to capture and store CO2.
- Continues collaboration with other RCSPs.
- Provides outreach and education for CO2 sequestration stakeholders and the general public.

The overall goal of Phase III was to validate technologies and to study CO2 storage associated with a commercial enhanced oil recovery (EOR) project at the Denbury-operated Bell Creek oil field. The Bell Creek Field is an oil-bearing, Lower Cretaceous sandstone reservoir located at a depth of approximately 4550 feet (1372 meters) in southeastern Montana. CO2 is being sourced from the ConocoPhillips-operated Lost Cabin and the ExxonMobil-operated Shute Creek gas-processing facilities, both located in Wyoming. The CO2 is transported to the Bell Creek Field from the Lost Cabin facility via the Denbury-operated Greencore pipeline and from the Shute Creek facility via a tie-in of the Anadarko-operated pipeline into the Greencore pipeline. As of June 2016, 3.2 million tonnes of associated CO2 storage has been injected in the Bell Creek Field since the EOR process began in May 2013.

To aid in the development and monitoring of the Bell Creek CO2 EOR project, the PCOR Partnership applied an adaptive management approach that integrates site characterization, modeling and simulation, risk assessment, and monitoring verification, and accounting (MVA) activities. This iterative process was designed specifically for large-scale CO2 injection projects to continually improve the accuracy of each activity throughout the project’s life cycle. This approach provides valuable data that can be used to improve storage performance. Through this approach, the PCOR Partnership has successfully proven practices and technologies that support informed decisions regarding site selection, injection programs, operations, and monitoring strategies with applicability at potential commercial-scale injection sites throughout the region.

Simulation and Monitoring of CO2 Behavior in the Subsurface
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Fort Nelson CCS Feasibility Study
If determined feasible, the Fort Nelson project plans to inject up to 2 million tons of CO2 (mixture of CO2 and hydrogen sulfide [H2S]) a year into a deep saline formation. The CO2 would be captured from one of the largest gas-processing plants in North America and transported approximately 10 miles in a supercritical state via pipeline to the target injection location. The target zone is the Devonian-age Elk Point carbon reservoir (limestone and dolomite) group at a depth of 3700 feet.

What’s Ahead for the PCOR Partnership?

- Build upon Phase I and II assessments of regional sequestration data to determine the most suitable technologies, regulations, and infrastructure needs for geologic CCS and carbon sequestration in terrestrial settings.

The overall mission of the Phase III program is to 1) build upon Phase I and II assessments of regional sequestration data to verify the ability of target formations to store CO2, 2) facilitate the development of the infrastructure required to transport CO2 from the source to the injection site, 3) facilitate development of the rapidly evolving North American regulatory and permitting framework for CO2 storage, 4) develop opportunities for PCOR Partnership partners to capture and store CO2, 5) continue collaboration with the other RCSPs, and 6) provide outreach and education for CO2 sequestration stakeholders and the general public.

The PCOR Partnership is working toward the establishment of the Bell Creek oil field in Powder River County, southeastern Montana.

Bell Creek Combined CO2 EOR and CO2 Storage Project
The PCOR Partnership is working with Denbury Onshore LLC. (Denbury) to study CO2 storage associated with a commercial enhanced oil recovery (EOR) project at the Denbury-operated Bell Creek oil field. The Bell Creek Field is an oil-bearing, Lower Cretaceous sandstone reservoir located at a depth of approximately 4550 feet (1372 meters) in southeastern Montana. CO2 is being sourced from the ConocoPhillips-operated Lost Cabin and the ExxonMobil-operated Shute Creek gas-processing facilities, both located in Wyoming. The CO2 is transported to the Bell Creek Field from the Lost Cabin facility via the Denbury-operated Greencore pipeline and from the Shute Creek facility via a tie-in of the Anadarko-operated pipeline into the Greencore pipeline. As of June 2016, 3.2 million tonnes of associated CO2 storage has been injected in the Bell Creek Field since the EOR process began in May 2013.

The thickest and most comprehensive seal for the carbonate rock formations under consideration would be provided by the massive and extensive shale of the Fort Simpson and Muskwa Formations, which are characterized by low permeability and high geomechanical strength. This cap provides a very competent seal for underlying brine-saturated formations. The cumulative average thickness of the Fort Simpson and Muskwa shale is approximately 1800 feet, and in some areas, the thickness can be in excess of 3300 feet.

For the Fort Nelson demonstration, Spectra Energy is determining the feasibility of installing significant infrastructure to transport the supercritical CO2 to a proposed injection site, including construction of compression, a dehydration system, a pipeline for the CO2 stream, and a pumping system.

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Why Should You Be a Partner?

Award-Winning Efforts
PCOR Partnership products, e.g., a series of documentaries broadcast on public television, have won numerous awards, including the Aurora Awards, the Telly Award, and Communicator Awards for Excellence.

PCOR Partnership leaders have received recognition from partners and peers, including the Interstate Oil and Gas Compact Commission Chairman’s Stewardship Award for Environmental Partnership and the Lignite Energy Council’s Distinguished Service Awards.

Shaping CCS Regulations
The PCOR Partnership monitors proposed environmental regulations, participates on CCS and pipeline task forces, testifies before state legislatures, and works closely with governing entities throughout its region and nationwide.

Regulatory and Annual Meetings
The PCOR Partnership holds a meeting each year to update its partners on the project and to seek input on future activities.

The PCOR Partnership is holding regulatory meetings to gain an understanding of existing and pending CCS regulations within its region to ensure that regulatory strategies will be better coordinated such that, ultimately, the coordination will enhance opportunities for CCS.

International Recognition
Two PCOR Partnership projects have received Carbon Sequestration Leadership Forum recognition. The Zama Acid Gas EOR, CO₂ Sequestration, and Monitoring Project and the Fort Nelson CCS Feasibility Study received recognition in 2007 and 2009, respectively.

Support and Products You Need
We are always willing to provide assistance to our partners and continually generate products that inform and educate. The partners-only Decision Support System (DSS) is continually updated to provide current information, access to products, headline news, and regulatory information. The geographic information system (GIS) portion of the DSS contains information on the region’s sources and geologic sinks in a map-based format for in-depth data analysis. Call or e-mail if you are interested in a DSS tutorial.

How can you be involved in Phase III?
We are currently seeking ongoing commitments to Phase III as well as additional partners for sponsorship of PCOR Partnership activities.

To learn more, contact:
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Visit the PCOR Partnership Web site at www.undeerc.org/PCOR.

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