Plains CO_2 Reduction (PCOR) Partnership
Practical, Environmentally Sound CO_2 Sequestration

EERC
Energy & Environmental Research Center®
Putting Research into Practice

Plains CO_2 Reduction (PCOR) Partnership
Phase III Prospectus

THE UNIVERSITY OF NORTH DAKOTA

What Is the PCOR Partnership?

The Plains CO_2 Reduction (PCOR) Partnership is one of seven regional partnerships operating under the U.S. Department of Energy (DOE) 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 RCSP Program comprises a significant portion of NETL's Carbon Sequestration Program and is a government–industry effort tasked with determining the most suitable technologies, regulations, and infrastructure needs for carbon capture and storage (CCS) on the North American continent.

The RCSP Program initiative is being implemented in three phases:

Phase I – Characterization Phase (2003–2005) characterized opportunities for carbon sequestration.

Phase II – Validation Phase (2005–2009) comprised small-scale field validation tests.

Phase III – Development Phase (2007–2017) comprises large-volume carbon storage demonstration tests

What Has the PCOR Partnership Accomplished?

Characterization, Phase I (2003–2005)

During Phase I, the PCOR Partnership 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)

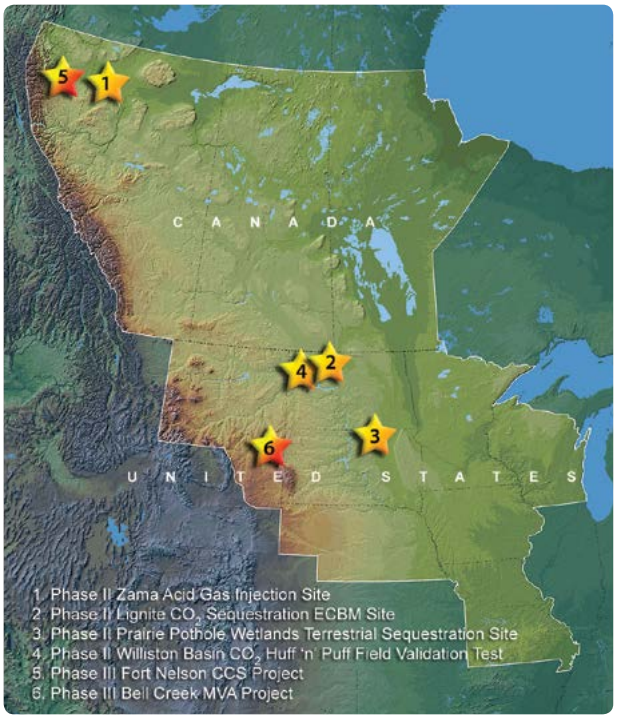
The overall goal of Phase II was to validate technologies and to demonstrate CCS in locations in the partnership region that could support future full-scale geological and terrestrial sequestration opportunities.

These activities included four field validation tests (three geological and one terrestrial) along with several supporting activities, including 1) continued refinement of regional characterization of sequestration opportunities, 2) elucidation and clarification of the regulatory and permitting requirements for sequestration, 3) identification of commercially available carbon dioxide (CO_2) capture technologies, 4) integration of regional efforts with other DOE RCSPs, and 5) continuation of local and regional public outreach initiatives.

The CO_2 sequestration potential of deep carbonate formations, lignites, and pinnacle reef structures was successfully demonstrated. The terrestrial sequestration potential of prairie pothole wetlands was also successfully demonstrated.

Results of the Phase II activities indicate that the PCOR Partnership region has tremendous opportunities for geologic CCS and carbon sequestration in terrestrial settings.

What's Ahead for the PCOR Partnership?



PCOR Partnership Phase II validation test sites and Phase III demonstration sites.

Phase III (2007–2017)

In Phase III, the PCOR Partnership is building on the information generated in its characterization (Phase I) and validation (Phase II) phases. The PCOR Partnership plans to fully utilize the infrastructure of its region to maximize CO_2 injection volumes.

A programmatic RCSP Phase III goal is the injection of approximately 1 million tons of CO_2 a year into at least one regionally significant geologic formation. Each of the RCSP large-volume injection tests is designed to demonstrate that the CO_2 storage sites have the potential to store regional CO_2 emissions safely, permanently, and economically for hundreds of years.

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 verify the ability of target formations to store CO_2, 2) facilitate the development of the infrastructure required to transport CO_2 from the source to the injection site, 3) facilitate development of the rapidly evolving North American regulatory and permitting framework for CO_2 storage, 4) develop opportunities for PCOR

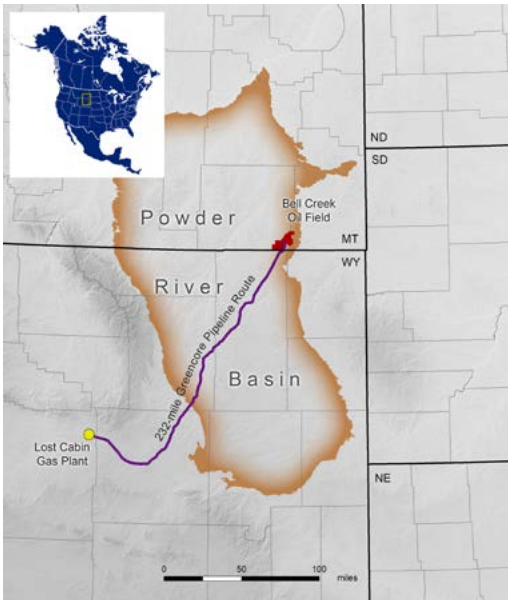
Partnership partners to capture and store CO_2, 5) continue collaboration with the other RCSP Program partnerships, and 6) provide outreach and education for CO_2 sequestration stakeholders and the general public.

The PCOR Partnership is working toward the establishment of two demonstration sites: 1) the Bell Creek oil field in Powder River County, southeastern Montana and 2) near Spectra Energy's Fort Nelson gas-processing facility, situated near Fort Nelson, British Columbia, Canada.

Bell Creek Combined CO_2 EOR and CO_2 Storage Project

The PCOR Partnership is working with Denbury Onshore LLC (Denbury) to determine the effect of a large-scale injection of CO_2 into a deep clastic reservoir for the purpose of simultaneous CO_2 enhanced oil recovery (EOR) and CO_2 storage at the Denbury-owned Bell Creek oil field. Denbury, which will carry out the injection and production operations, will source approximately 50 million cubic feet of CO_2 a day from the ConocoPhillips-owned Lost Cabin gas-processing plant in Fremont County, Wyoming. The CO_2 will be transported to the Bell Creek oil field via the 232-mile (373-km)-long Greencore pipeline and then injected into an oil-bearing sandstone reservoir in the Lower Cretaceous Muddy Formation at a depth of approximately 4500 feet (1372 meters). The activities at Bell Creek will inject an estimated 1 million tons of CO_2 annually beginning in May 2013, much of which will be permanently stored.

The PCOR Partnership will evaluate the potential for combined CO_2 EOR and CO_2 storage, which will reduce net CO_2 emissions while simultaneously recovering an anticipated 40–50 million barrels of incremental oil. To accomplish this objective, the PCOR Partnership has developed an approach that integrates site characterization; modeling and simulation; risk assessment; and monitoring, verification, and accounting (MVA) into an iterative process to produce meaningful results for large-scale CO_2 storage projects. Based on this approach, site characterization, modeling and simulation, risk assessment, and MVA activities will be continually refined throughout the lifetime of the project based on the results of the other activities, improving the overall program.



Map showing planned CO_2 pipeline route.

Fort Nelson CCS Feasibility Project

If determined feasible, the Fort Nelson project plans to inject up to 2 million tons of CO_2 (mixture of CO_2 and hydrogen sulfide [H_2S]) a year into a deep saline formation. The CO_2 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 carbonate rock (limestone and dolomite) group at a depth of >7200 feet.

Spectra Energy's project site in the remote northeastern corner of British Columbia, Canada.

The thickest and most comprehensive seal for the carbonate rock formations under consideration would be provided by the massive and extensive shales 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 CO_2 to a proposed injection site, including construction of compressors, a dehydration system, a pipeline for the CO_2 stream, and a pumping system.

Simulation and Monitoring of CO_2 Behavior in the Subsurface

An emphasis on cost-effectiveness and integration with routine oil field activities is the driving 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 CO_2 measurements, ion chemistry and isotopes of sampled fluids, and tracer (e.g., perfluorocarbon) monitoring. Extensive reservoir simulation modeling that includes geochemical and geomechanical processes is also part of the Phase III MVA protocols.

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.

CHAIRMAN'S STEWARDSHIP AWARDS

International Recognition

Two PCOR Partnership projects have received Carbon Sequestration Leadership Forum recognition. The Zama Acid Gas EOR, CO_2 Sequestration, and Monitoring Project and the Fort Nelson CCS Project received recognition in 2007 and 2009, respectively.

carbon sequestration leadership forum

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.

2013 PCOR Partnership Annual Meeting, September 25–26, 2013, in Minneapolis, Minnesota

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:

Charles D. Gorecki, Senior Research Manager, (701) 777-5355; cgorecki@undeerc.org
Edward N. Steadman, Deputy Associate Director for Research, (701) 777-5279; esteadman@undeerc.org
John A. Harju, Associate Director for Research, (701) 777-5157; jharju@undeerc.org

Please visit the PCOR Partnership Web site at www.undeerc.org/PCOR.

Sponsored in Part by the U.S. Department of Energy
NETL