FACT SHEET FOR PARTNERSHIP FIELD VALIDATION TEST

Partnership Name	Plains CO_2 Reduction (PCOR) Partnership – Phase II	
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Principal Investigator	Edward Steadman	
Field Test Information: Field Test Name	Lignite in North Dakota Field Validation Test	
Test Location	Section 36-T159N-R90W in Burke County, North Dakota	
Amount and Source of CO_2	Tons Less than 500 tons for the project	Source Commercial source – Praxair
Field Test Partners (Primary Sponsors)	Flatland Exploration Company, subsidiary of Fischer Oil and Gas	
	ND State Land Department	
	Eagle Operating, Inc.	
	Schlumberger	
	Praxair	

Summary of Field Test Site and Operations:

CO_2 in an Unminable Lignite Seam – The site for the pilot-scale CO_2 sequestration–enhanced coalbed methane (ECBM) project operated by the Energy & Environmental Research Center is located in Section 36, Township 159 North, Range 90 West in southeastern Burke County, North Dakota (Figure 1). Approximately 4 acres are being used for the project, and it is a rural, grassland area. The regional soil is silt to sandy loams. The project site is mixed-grass prairie, with the dominating grasses being western wheatgrass and green needlegrass. Burke County's economy is primarily agricultural, with additional influence from the oil and gas industry.

In the Burke County project area, the coal seam that is the focus of this study is approximately 10 ft thick. Lateral continuities of lignite seams vary greatly; in general, thicker seams are more continuous than thinner beds. According to well log data obtained from the North Dakota Department of Mineral Resources, the coal seam of interest can be traced within a 4-mile radius of the project site. The targeted coal seam is a part of the lower Fort Union Formation at an approximate depth of 1100 ft. The composite stratigraphic column of the section is shown in Figure 2. The test is designed in a five-spot configuration, allowing for an effective data collection and monitoring program. The study of the lignite and its properties is being conducted at the laboratory and field scale.

Figure 1. Location of the lignite ECBM site.

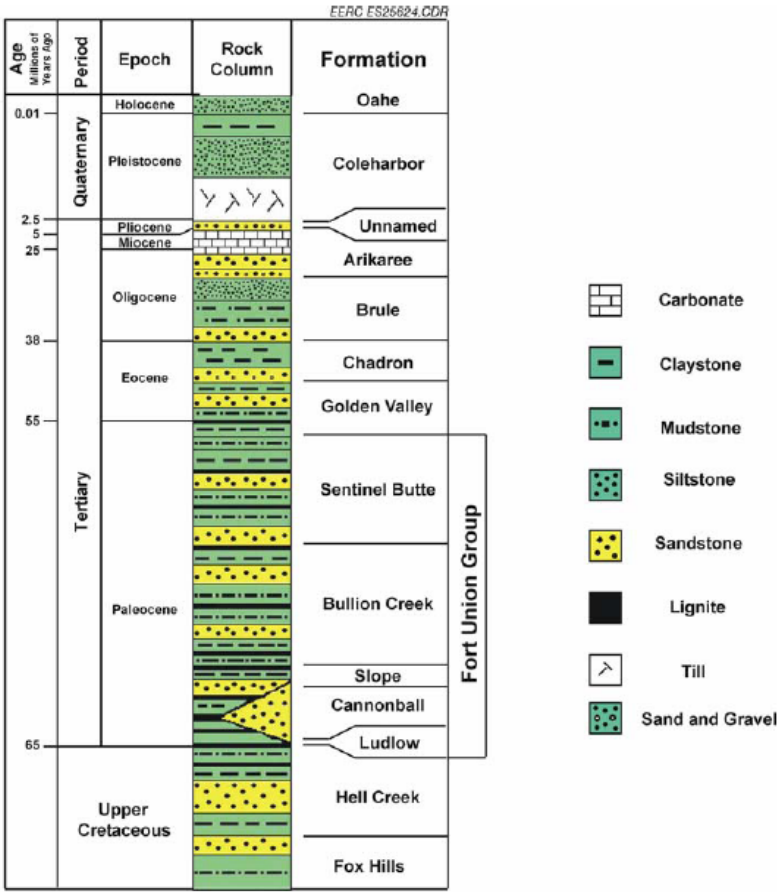


Figure 2. Composite stratigraphic column (Upper Cretaceous to Quaternary) in North Dakota.

Research Objectives:

CO_2 will be injected into an unminable lignite seam in northwestern North Dakota. The working hypothesis is that the injected CO_2 will naturally bond to the surfaces of the fractured lignite and be held there by hydrostatic pressure. The injected CO_2 also has the potential to displace methane occupying the coal fractures. This validation test will provide valuable information regarding lignite for both CO_2 sequestration and ECBM production.

The objectives of this demonstration are to 1) determine the accuracy with which CO_2 storage capacity in lignite coal can be predicted; 2) develop a robust data set regarding the potential for ECBM to be produced from lignite coal as a by-product of CO_2 injection; 3) demonstrate cost-effective monitoring, mitigation, and verification (MMV) technologies and protocols for CO_2 sequestration and ECBM in a lignite coal seam; and 4) provide field validation testing of sequestration technologies and infrastructure approaches that can lead to wide-scale deployment in coal fields throughout the PCOR Partnership region.

Summary of Modeling and MMV Efforts:

Geophysical logs have been used to delineate stratigraphy, structure, and petrophysical properties. Stochastic simulation and deterministic estimation of geostatistical methods have been employed to populate the subsurface geologic model with structural, physical, and chemical properties. This model will be used to estimate the reservoir capacity with respect to CO_2 storage or sequestration ability.

MMV activities are designed to fit the overall purpose of the test, namely to estimate natural gas content and ensure feasibility of CO_2 storage within lignite beds. It is planned that pressure, temperature, and pH will be measured in the monitoring wells continuously during the development of the wells and during and after the injection of CO_2. Additionally, time-lapse crosswell seismic surveys will be conducted in order to monitor CO_2 plume extent and to help in understanding the structure of the lignite. Moreover, microseismic monitoring with simultaneous tilt measurements is planned to complement plume monitoring and for early warning in case of fracturing of the formation in response to injection. A tracer study is intended for detecting possible leaks into the adjacent strata. Finally, surface gas flux monitoring is being considered to assure the public that no surface leakage is occurring.

Summary of Monitoring Methods Being Considered

Measurement Technique	Measurement Parameters	Application
Introduced and Natural Tracers	Travel time Identification sources of CO_2	Tracing movement of CO_2 in the storage formation Quantifying solubility trapping Tracing leakage
Water Composition	CO_2, HCO_3, CO_3^{2-} Major ions Trace elements Salinity	Quantifying solubility and mineral trapping Quantifying CO_2–water–rock interactions Detecting leakage into shallow groundwater aquifers
Subsurface Pressure	Formation pressure Annulus pressure Groundwater aquifer pressure	Controlling of formation pressure below fracture gradient Wellbore and injection tubing condition Leakage out of the storage formation
Well Logs	Brine salinity Sonic velocity CO_2 saturation	Tracking CO_2 movement in and above storage formation Tracking migration of brine into shallow aquifers Calibrating seismic velocities for 3-D seismic surveys
Vertical Seismic Profiling and Crosswell Seismic Imaging	P and S wave velocity Reflection horizons Seismic amplitude attenuation	Detecting detailed distribution of CO_2 in the storage formation Detecting leakage through faults and fractures
Passive Seismic Monitoring	Location, magnitude, and source characteristics of seismic events	Development of microfractures in formation or cap rock CO_2 migration pathways
Tiltmeter	Detect and monitor changes in the surface inclination	Detecting CO_2 movement in and above storage formation Locating CO_2 migration pathways

Accomplishments to Date:

- Well drilling is completed.
- Logging is completed and processed.
- Core is collected and analyzed.
- Drill cuttings have been collected and described.

- All five wells have been perforated (Figure 3), acidized, and swabbed.
- A nitrogen fracture injection/fall-off test was conducted to derive in situ aquifer parameters of the lignite.
- CO_2 for injection has been procured.
- Permit applications have been submitted.
- Two public meetings have been conducted.
- Initial geological and numerical models have been created.
- Preliminary simulations have been run which provide guidance for the possible outcome of CO_2 injection activities in the coal seam.

Figure 3. Perforation job on a well at the lignite field site.

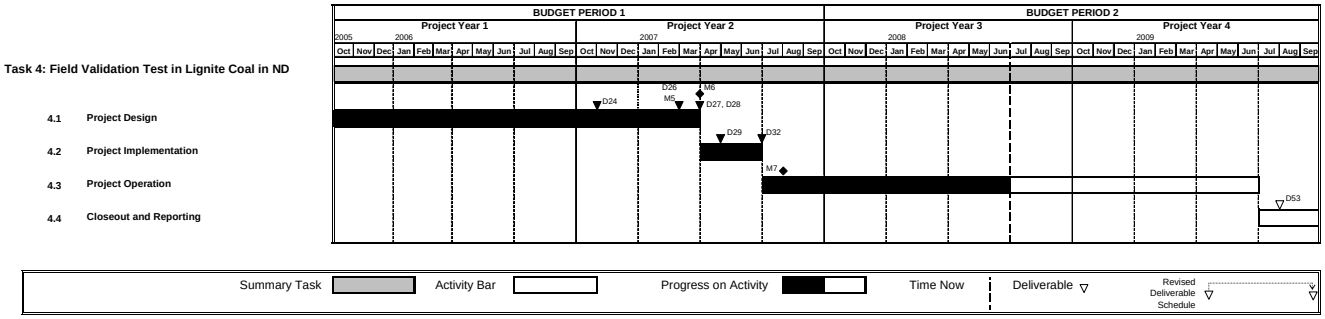
Summarize Target Sink Storage Opportunities and Benefits to the Region:

The results of Phase I reconnaissance-level characterization activities indicated that low-rank coal seams (such as lignite) in the region may have the capacity to store 8360 million tons of CO_2. Phase I results also suggested that there may be over 17 trillion cubic feet of methane that could be produced from low-rank coal seams. To date, no field studies have been conducted on the ability of lignite coal seams to store CO_2. The field-based investigations conducted under this activity will provide previously unavailable insight regarding the sequestration of CO_2 in low-rank coals. This insight can be broadly applicable in the region, as low-rank coal seams are known to occur in many portions of western North America.

Cost:		**Field Project Key Dates:**
Total Field Project Cost: $4,596,909		**Baseline Completed:** Ongoing
DOE Share: $2,829,208	**62%**	**Drilling Operations Begin:** August 2007
Non-Doe Share: $1,767,701	**38%**	**Injection Operations Begin:** Fall 2008
		MMV Events: Fall 2008

Field Test Schedule and Milestones (Gantt Chart):

- National Environmental Policy Act Compliance document due November 30, 2006 – completed on schedule
- Experimental Design Package due February 28, 2007 – completed on schedule
- Site Health and Safety Plan due March 31, 2007 – completed on schedule
- Regulatory Permitting Action Plan due March 31, 2007 – completed on schedule
- Outreach Action Plan due April 30, 2007 – completed on schedule
- Sampling Protocols due June 30, 2007 – completed on schedule
- Regional Technology Implementation Plan due July 31, 2009



Key for Deliverables	Key for Milestones
D24 Lignite Field Validation Test Site – NEPA Compliance Document	M5 Identification of Specific Well Location at the Lignite Field Validation Test
D26 Lignite Field Validation Test Site – Experimental Design Package	M6 Finalized Drilling Prognosis for the Five-Spot Research Wells for the Lignite Field Validation Test
D27 Lignite Field Validation Test Site – Site Health & Safety Plan	M7 White Paper on CO_2 Flood Design for CO_2 Sequestration and ECBM Recovery Completed
D28 Lignite Field Validation Test Site – Regulatory Permitting Action Plan	
D29 Lignite Field Validation Test Site – Outreach Action Plan	
D32 Lignite Field Validation Test Site – Sampling Protocols	
D53 Lignite Field Validation Test Site – Regional Technology Implementation Plan	

Additional Information

In the upcoming months, well stimulation will continue as necessary to ready the wells for CO_2 injection. The wells will be instrumented with real-time, continuous pressure, pH, conductivity, and temperature-monitoring gauges. Pending permit approval, CO_2 injection is anticipated for late fall 2008. At that time, the MMV program will be implemented.