

Plains CO₂ Reduction (PCOR) Partnership

Fact Sheet

Practical, Environmentally Sound CO₂ Sequestration

Geologic Storage of Sour CO₂ from a Natural Gas-Processing Plant – A Proposed Commercial Demonstration

Nearly 1600 facilities around the world remove impurities such as carbon dioxide (CO₂) from raw natural gas, and Spectra Energy's Fort Nelson gas plant is among the largest. For this reason, Spectra Energy and the Plains CO₂ Reduction (PCOR) Partnership are leading a collaborative venture involving government, industry, technologists, and researchers that plans to fully demonstrate the concept of carbon capture and storage (CCS) to manage the CO₂ emissions of natural gas-processing facilities. In this proposed demonstration, up to 2 million tons a year of sour CO₂ (mixture of CO₂ and hydrogen sulfide [H₂S]) would be injected into a saline formation deep underground. The behavior of the sour CO₂ in the subsurface would then be closely monitored to ensure the safe and effective operation of regional geologic storage. The proposed demonstration project has the potential to store 20 million tons of CO₂, which would otherwise enter the atmosphere over a period of just 10 years. This proposed demonstration is included in the U.S. Department of Energy National Energy Technology Laboratory's Regional Carbon Sequestration Partnership (RCSP) Initiative. The PCOR Partnership, led by the Energy & Environmental Research Center, is one of seven RCSPs.



Spectra Energy's Fort Nelson Gas-Processing Plant, northeastern British Columbia, Canada.

Natural Gas, Gas Processing, and Carbon Capture Before raw natural gas can be used, it must be purified. In many cases, this means removing CO₂, H₂S, nitrogen, and natural gas liquids like butane and propane. These impurities are removed at large facilities called natural gas-processing plants. At many locations where the raw natural gas naturally contains H₂S, one of the by-products of gas processing is "sour CO₂" – a combination of CO₂ and H₂S. There are more than 1300 natural gas-processing plants in the United States and Canada and nearly 1600 worldwide (1). Because they are among the few sources of relatively pure streams of CO₂, natural gas-processing plants are viewed as good candidates for developing CCS projects that feature geologic CO₂ sequestration (2).

Project Description

Spectra Energy is currently conducting a feasibility study to evaluate a proposed project that would pipe the sour CO₂ stream from Spectra Energy's Fort Nelson gas-processing facility, located near Fort Nelson, British Columbia, Canada, to a nearby site where it would be injected over 7200 feet underground for permanent storage in a rock formation containing very salty water ("saline" formation).

The sour CO₂ stream (approximately 95% CO₂ and 5% H₂S) would first need to be compressed to a supercritical state. This means that the CO₂-rich gas would be pressurized to meet the conditions it would likely encounter in the underground injection zone. Supercritical sour CO₂ has a density like a liquid but still behaves like a gas. The supercritical fluid would be transported via pipeline approximately 9 miles (15 km) to an injection site.

The supercritical fluid would then be injected into the carbonate rocks (limestone and dolomite) of a rock formation in the Elk Point Group, where some of the sour CO₂ is predicted to dissolve into the highly saline water that fills the pores of the rock, while some would most likely precipitate as new carbonate minerals. Some of the sour CO₂ would remain in the pores of the carbonate rocks, and the naturally high-pressure and high-temperature conditions would help maintain that sour CO₂ in the supercritical state. The proposed injection zone is capped by 1800-foot (550-meter)-thick Fort Simpson and Muskwa shale, which is expected to function as an impermeable seal. Characterization studies of the geology of the region show there are potentially many suitable sites for CO₂ storage there.

“Carbon capture and storage represents an important opportunity to help achieve the emission cuts that will reduce B.C.’s greenhouse gas emissions by 33% by 2020,” Senator Richard Neufeld, former British Columbia Minister of Energy, Mines, and Petroleum Resources, May 2008 (3).

Utilizing Proven Natural Underground Storage

Oil has been commercially produced in the PCOR Partnership region since the early 1900s. Throughout that century, thousands of underground deposits of oil and natural gas were found and characterized. Geologists call these underground deposits “reservoirs” or “traps.” Other gases, like CO₂ and helium, can also occur in natural underground deposits, just like oil and natural gas. The fact that these fluids and gases have been held in place underground for millions of years indicates that CO₂ should be able to be securely stored under similar geologic conditions.

Research Objectives

The primary objectives of the PCOR Partnership Phase III Fort Nelson demonstration are to verify and validate the concept of utilizing the region’s large number of saline formations for large-scale injection of anthropogenic CO₂ for permanent storage. Specific goals include:

- Development of cost-effective risk management; simulation; and monitoring, verification, and accounting (MVA) strategies for large-scale CO₂ sequestration in deep brine reservoirs.
- Testing and refinement of reservoir modeling intended to predict and estimate CO₂ injectivity (the potential for placing CO₂ into the reservoir), areal extent and mobility of the supercritical CO₂ plume in the reservoir, and improved

methodologies to ensure that site characterization and MVA results better support risk management objectives and modeling efforts.

- Development of testing strategies to predict the effects of CO₂ on the integrity of overlying sealing formations, including the testing and modeling of key geomechanical and geochemical parameters.

Schedule

The PCOR Partnership’s role in the Fort Nelson CCS Feasibility Project is designed to run from the fall of 2007 to the fall of 2017. A potential injection site was chosen in 2008, and an exploration well and shallow groundwater-monitoring wells were completed in the spring of 2009. If proven feasible from a technical, geological, and economic point of view, a full project could commence as early as 2014. An MVA plan would be implemented to monitor the underground movement of CO₂. The MVA data may also be used to modify and improve the injection design, if needed. A PCOR Partnership comprehensive report is planned for the fall of 2017.

Notes

1. PennWell, 2008, Worldwide gas-processing database.
2. Gale, J.J., 2003, IEA (International Energy Agency) Greenhouse Gas R&D Programme file note, in Opportunities for early application of CO₂ sequestration technology: www.cslforum.org/publications/documents/EarlyOppsFile.pdf (accessed May 2009).
3. Ministry of Energy, Mines, and Petroleum Resources, 2008, \$12.1 million carbon capture project to cut emissions: www2.news.gov.bc.ca/news_releases_2005-2009/2008EMPR0036-000814.htm (accessed April 2009).

Examples of MVA Techniques

| Measurement Technique | Measurement Parameters | Application |
|--------------------------------|--|--|
| Introduced and Natural Tracers | Travel time Partitioning of CO ₂ and H ₂ S into brine Identification of sources of CO ₂ | Tracing movement of CO ₂ in the storage formation Quantifying solubility trapping Verifying that no leakage is occurring |
| Water Composition | CO ₂ , bicarbonate, carbonate Major ions Trace elements Salinity | Quantifying solubility and mineral trapping Quantifying CO ₂ -water-rock interactions Verifying that no leakage is occurring |
| Subsurface Pressure | Formation pressure Annulus pressure Groundwater aquifer pressure | Controlling formation pressure below fracture gradient Monitoring wellbore and injection tubing integrity Verifying that no leakage is occurring |
| Well Logs | Brine salinity Sonic velocity CO ₂ saturation | Tracking CO ₂ movement Tracking migration of brine Calibrating seismic velocities for 3-D seismic surveys |

The Plains CO₂ Reduction (PCOR) Partnership is a group of public and private sector stakeholders working together to better understand the technical and economic feasibility of sequestering CO₂ emissions from stationary sources in the central interior of North America. The PCOR Partnership is led by the Energy & Environmental Research Center (EERC) at the University of North Dakota and is one of seven regional partnerships under the U.S. Department of Energy’s National Energy Technology Laboratory Regional Carbon Sequestration Partnership Initiative. To learn more, contact:

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Visit the PCOR Partnership Web site at www.undeerc.org/PCOR. New members are welcome.



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