Zama Acid Gas EOR, CO_2 Sequestration, and Monitoring Project

For nearly 40 years, carbon dioxide (CO_2) has been successfully injected into underground oil formations to improve oil production. This standard oil field practice is called CO_2 flooding or CO_2 enhanced oil recovery (EOR). The injection of CO_2 into geological formations, such as oil fields, may also be a means of reducing greenhouse gas (GHG) emissions into the atmosphere. Through the Plains CO_2 Reduction (PCOR) Partnership, the Energy & Environmental Research Center (EERC) is partnering with Apache Canada Ltd. to simultaneously demonstrate the use of acid gas for oil field flooding and the use of underground pinnacle reef structures for the long-term storage of the CO_2-rich acid gas. Additional key project participants include Natural Resources Canada, the Alberta Department of Energy, the Alberta Energy and Utilities Board, and Alberta Geological Survey.

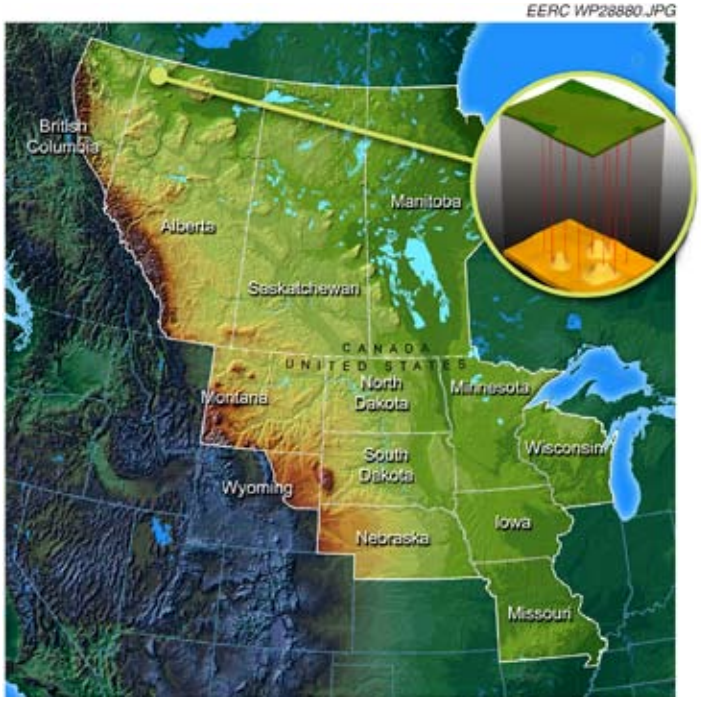

Figure 1. Map showing the PCOR Partnership region and the location of the Zama acid gas project where acid gas from natural gas processing plants in northern Alberta, Canada, will be injected into an oil-producing zone in an underground pinnacle reef structure.

The Zama Field demonstration (Figure 1) is one of four PCOR Partnership CO_2 sequestration validation projects and is one of several projects being conducted under Phase II of the overall U.S. Department of Energy National Energy Technology Laboratory's Regional Carbon Sequestration Partnership Program.

Background

Atmospheric concentrations of CO_2, a GHG, have been increasing for the last 100 years. Controlling CO_2 from human activities is an important means of addressing global climate change.

Both CO_2 and hydrogen sulfide (H_2S) are coproduced with solution gas and nonassociated natural gas from pinnacle reef structures of the Zama Field operated by Apache Canada Ltd. in northwestern Alberta, Canada. Treating this natural gas for downstream marketing results in the production of an acid gas by-product stream largely composed of CO_2 and H_2S. In the past, a portion of this acid gas, not disposed of in underground formations, was processed to convert the H_2S to elemental sulfur. The CO_2 from this portion of the acid gas was then vented to the atmosphere. The Zama Field demonstration will simultaneously 1) improve oil recovery in the Zama Field, 2) sequester CO_2, and 3) eliminate the accumulation of elemental sulfur on the surface.

Project Details

Apache Canada Ltd. is providing the acid gas and the injection wells for the demonstration and is responsible for initial injection, continual recovery and reinjection of acid gas during the demonstration, separation and recovery of the produced hydrocarbons, and monitoring after the demonstration phase.

The EERC is conducting the monitoring, mitigation, and verification (MMV) procedures that will provide a road map for the development of further CO_2 and acid gas injection projects. The geology of the pinnacle reef (Figure 2) is well understood and offers an excellent opportunity to test and refine geologic CO_2 sequestration MMV protocols that can be applied to CO_2 and acid gas sequestration opportunities in the future.

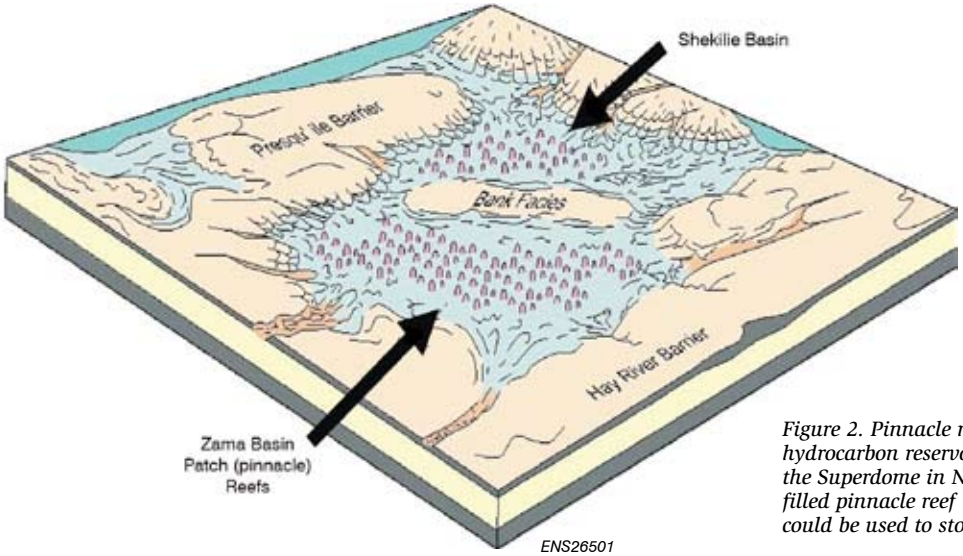

Figure 2. Pinnacle reefs are self-contained underground hydrocarbon reservoirs each similar in size and shape to the Superdome in New Orleans. There are nearly 700 oil-filled pinnacle reef "superdomes" in the Zama area that could be used to store CO_2-rich gas.

Accomplishments to Date

Significant progress has been made on the Zama Field validation test. Injection of acid gas began in December of 2006 and has been proceeding according to plan. This field validation test was recognized by the Carbon Sequestration Leadership Forum for the MMV strategy employed at the site.

Project Benefits

The natural gas production and processing operations in the Zama oil and gas field currently release about 64,000 tons of CO_2 to the atmosphere each year. If the entire acid gas stream produced at Zama were to be injected, these emissions could be reduced to near zero. In addition, acid gas injection will increase the production of oil from the Zama Field and add additional years of productivity from infrastructure that is largely in place.

The injection zone is well monitored to ensure protection of groundwater resources. The current Zama natural gas operation has resulted in significant reduction of the operating costs that were associated with the sulfur plant. Further revenue is generated from the EOR project.

This value-added approach could be used to manage CO_2-rich acid gas streams at many of the more than 1300 gas processing plants in North America as well as others worldwide. A demonstration of this scale will result in a win-win situation for researchers, PCOR Partnership partners and, most importantly, the environment.

EERC ES27044

Figure 3. Apache Canada Ltd. gas injection site in Zama, Alberta, Canada.

The Plains CO_2 Reduction (PCOR) Partnership is a group of public and private sector stakeholders working together to better understand the technical and economic feasibility of sequestering CO_2 emissions from stationary sources in the central interior of North America. The PCOR Partnership is managed 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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