



**EERC**

*EERC Technology... Putting Research into Practice*

# The Plains CO<sub>2</sub> Reduction (PCOR) Partnership

## Phase II and III Overview

Ed Steadman

Energy & Environmental Research Center  
Regional Carbon Sequestration Partnerships Initiative  
Review Meeting  
December 12, 2007



# The PCOR Partnership currently has over 70 partners representing public agencies, utilities, oil and gas companies, engineering firms, associations and nonprofit organizations, and universities.



# Field Validation Tests



# Williston Basin CO<sub>2</sub> Sequestration and EOR Test



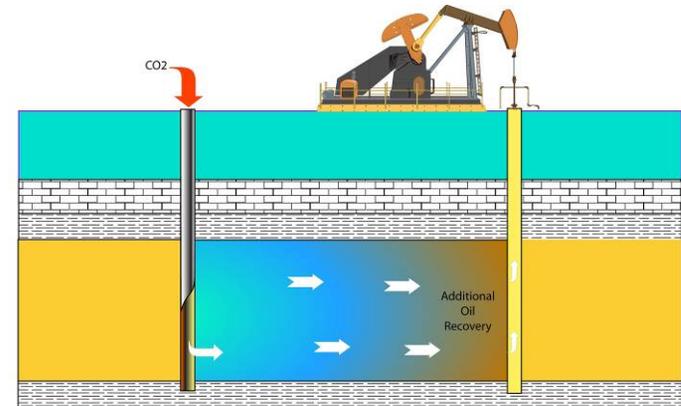
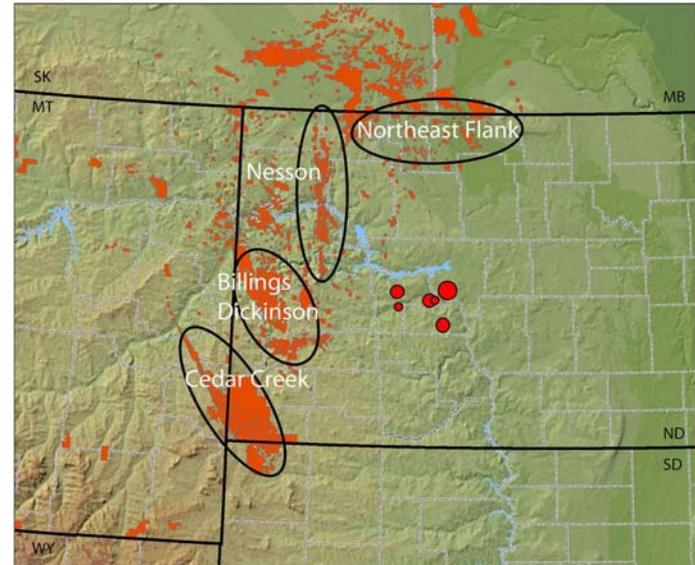
# Williston Basin Test Goals and Objectives

## Goal

- To validate the sequestration of CO<sub>2</sub> in deep (>10,000 ft) carbonate oil reservoirs using cost-effective monitoring, mitigation, and verification (MMV) approaches.

## Objectives

- Inject pure CO<sub>2</sub> into a deep carbonate oil reservoir for simultaneous sequestration and enhanced oil recovery (EOR).
- Determine the effects of high pressure and temperature on sequestration, EOR, and MMV.
- Implement a cost-effective approach for MMV in a deep oil field.



# Zama Acid Gas EOR, CO<sub>2</sub> Sequestration, and Monitoring Project



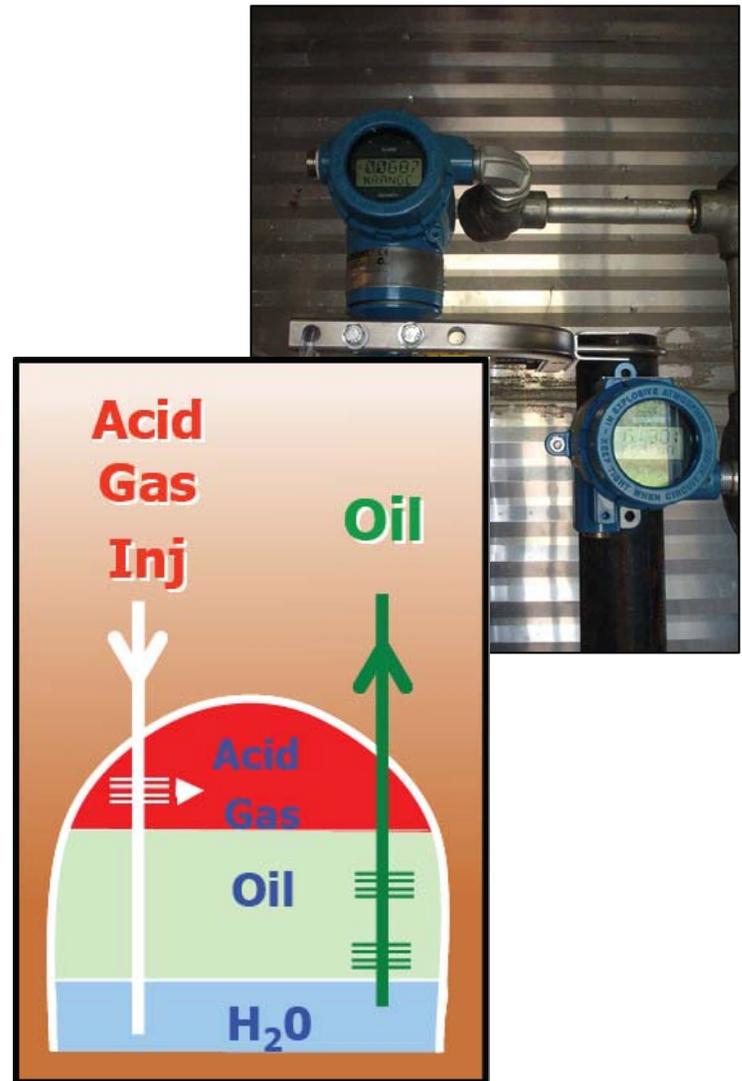
# Zama Project Goals and Objectives

## Goal

- To validate the sequestration of CO<sub>2</sub>-rich acid gas in an oil reservoir.

## Objectives

- Inject a stream of acid gas (70% CO<sub>2</sub>–30% H<sub>2</sub>S) for simultaneous acid gas disposal, CO<sub>2</sub> sequestration, and EOR.
- Determine the effects of acid gas injection on target reservoir and caprock formations.
- Implement a cost-effective approach for MMV for sequestration of a CO<sub>2</sub>-rich acid gas stream.



# MMV Operations

## Monitor the CO<sub>2</sub>/H<sub>2</sub>S plume through:

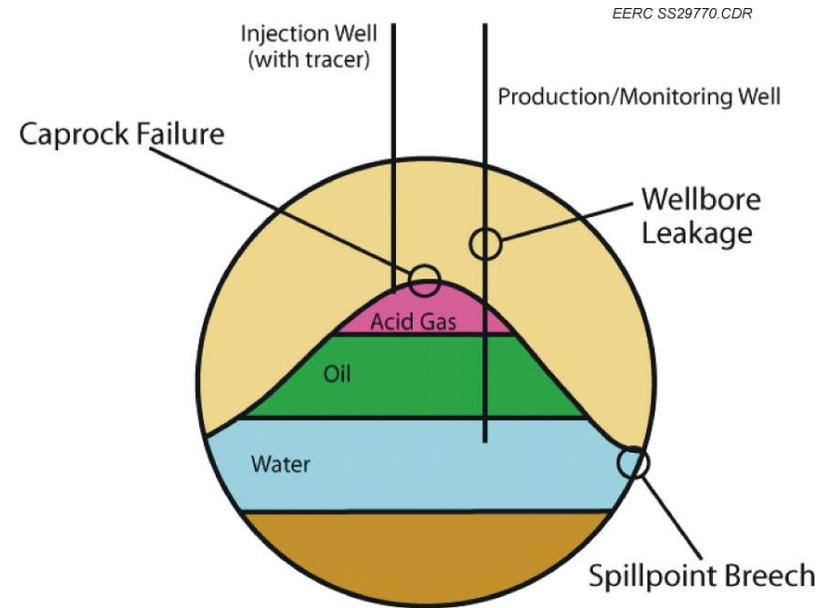
- Perfluorocarbon tracer injection.
- Reservoir pressure monitoring.
- Wellhead and formation fluid sampling (oil, water, gas).

## Monitor for early warning of reservoir failure through:

- Pressure measurements of injection well, reservoir, and overlying formations.
- Fluid sampling of overlying formations.

## Determine injection well conditions through:

- Wellhead pressure gauges.
- Well integrity tests.
- Wellbore annulus pressure measurements.



# Zama Acid Gas Field Injection Volumes

---

- Pilot project
  - Currently injecting 3.4 mmcf/d (166 ton/d)
  - Cumulative net CO<sub>2</sub> stored to date: 0.3 Bcf (14,500 tons)
- Fieldwide expansion project planned
- Projected daily injection rate 50 mmcf/d (2418 ton/d)
  - Estimated cumulative CO<sub>2</sub> storage potential over 15 years: 220 Bcf (13.2 E6 tons)



# Lignite for CO<sub>2</sub> Sequestration and Enhanced Coalbed Methane



# Field-Based Characterization Activities

- Last well drilled August 29, 2007.
- Geophysical logging suite.
- Core and cuttings collection and description.



# Core Evaluation Activities

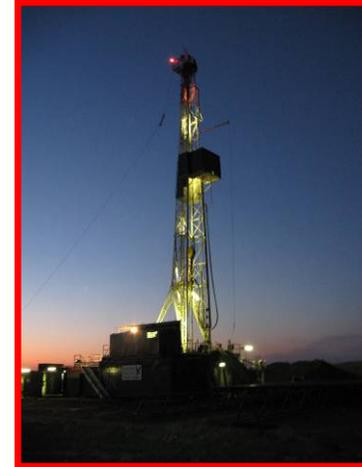
Lab studies on the recently collected core are being conducted by TerraTek, Inc., the EERC, and NETL.

- Gas content
- Gas specific gravity
- CH<sub>4</sub> and CO<sub>2</sub> isotherms
- Diffusion coefficient
- Gas desorption time
- Coal ash and moisture contents
- Coal density and compressibility
- Rock porosity and permeability



# Key Results

- Well drilling is completed.
- Logging is completed, and logs are being processed in collaboration with Schlumberger.
- Core is collected, and its analysis by TerraTek is in progress. Samples are being sent to NETL today.
- All five wells have been perforated, and initial swabbing has occurred.
- Canister tests are under way.



# Path Forward

- Complete log processing and laboratory- and field-scale tests.
- Anticipated field-scale experiments
  - Pump test
- Conduct well stimulation if appropriate.
- Use acquired log data, core analysis, and in situ monitoring data to create simulation model and begin modeling CO<sub>2</sub> fate.
- Begin CO<sub>2</sub> injection.
- Implement MMV program.
- Develop Regional Technology Implementation Plan.



# Prairie Pothole Wetlands/Grasslands Field Validation Test

---



# Prairie Pothole Wetlands/Grasslands Goal and Objectives

---

## Goal

- Validate and quantify carbon sequestration potential in the Prairie Pothole Region (PPR) wetlands and grasslands.

## Objectives

- Develop the technical capacity to systematically identify, develop, and apply alternate land use management practices to the prairie pothole ecosystem that will result in greenhouse gas (GHG) reductions.
- Quantify the amount of carbon sequestered in restored wetland and surrounding grassland systems.
- Define best management practices for sequestering carbon and reducing GHGs in wetlands and grasslands.



# Key Results of Phases I and II

---

- Tertiary-phase EOR is the primary near-term opportunity for managing CO<sub>2</sub> in the PCOR Partnership region.
- Demand for CO<sub>2</sub> exceeds near-term supply.
- When CO<sub>2</sub> supply surpasses EOR demand, saline formations are available throughout the region to meet sequestration demand.
- Significant accumulations of unminable coal also represent potential opportunities for sequestration.
- Terrestrial opportunities represent a key near-term strategy to offset emissions, and the PPR represents a unique opportunity therein.



# We Are Conducting Two Phase III Efforts

Saline Formation Injection in Canada

Williston Basin Project



# Why the Williston Basin?

---

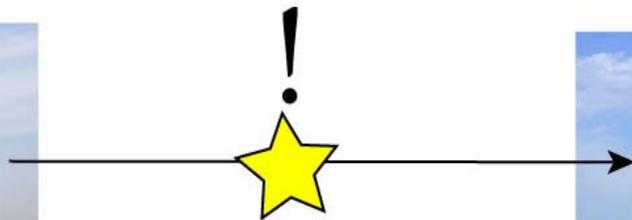
- We have great Partners!
- The Williston Basin is perfect (both geologically and socioeconomically) for this demonstration.
- One of the first commercial-scale projects to capture CO<sub>2</sub> from a retrofitted coal-fired power plant (CFPP).
- Develop supporting evidence for the hypothesis that effective MMV need not be intrusive to field operations nor expensive to implement.



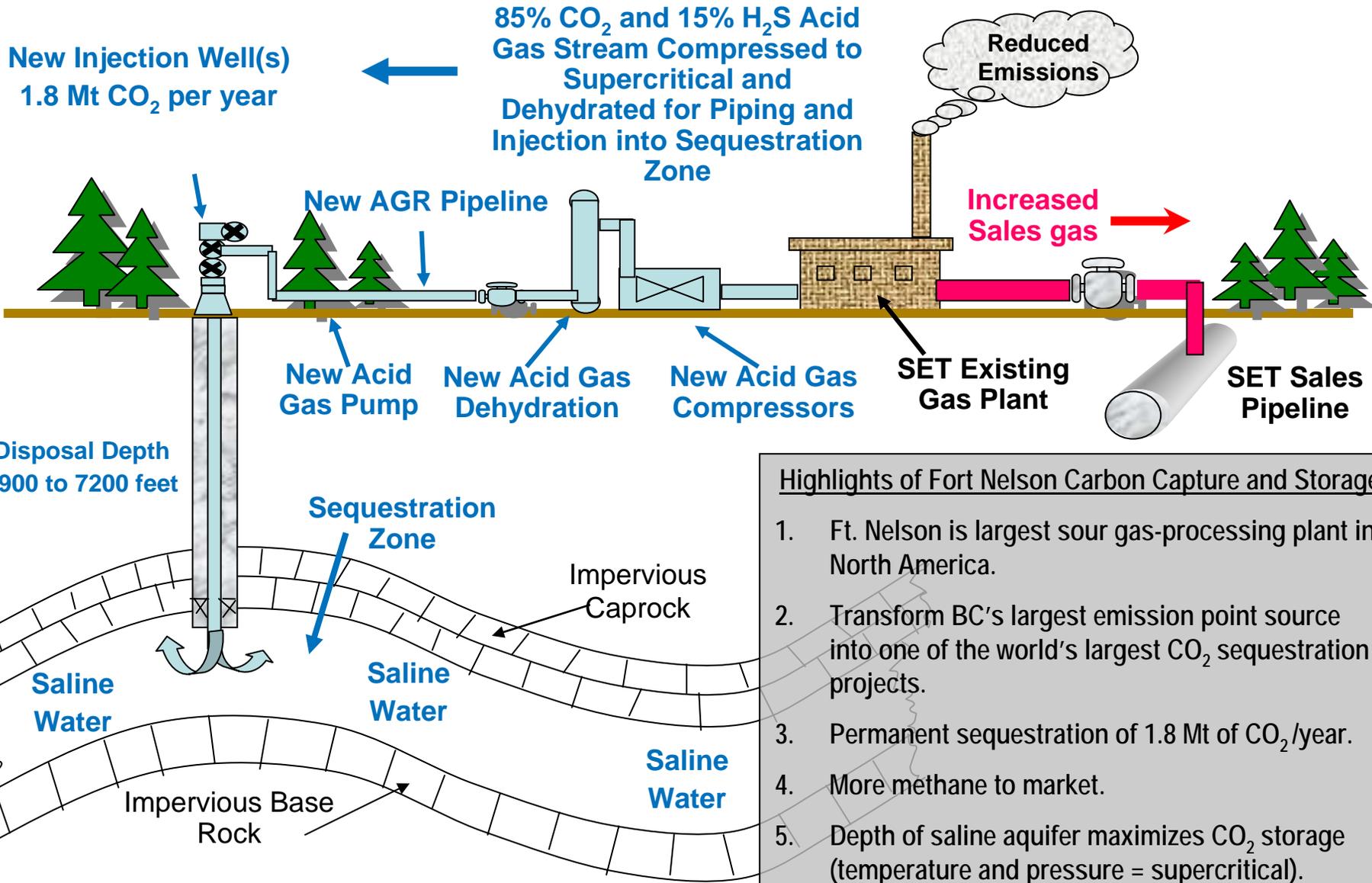
# Williston Basin Phase III – Concept

---

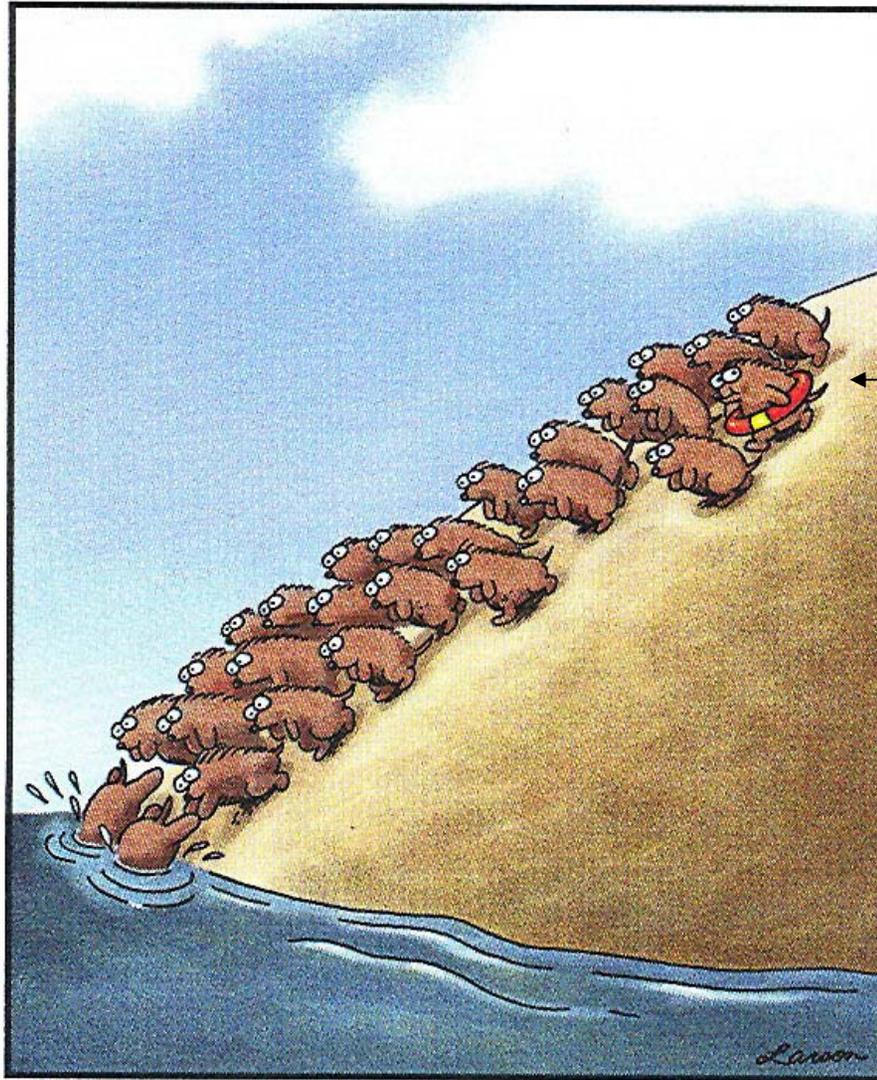
- Capture at least 500,000 t/yr of CO<sub>2</sub> at existing CFPP in central North Dakota.
- Transport via pipeline to Williston Basin oil field.
- Meet or exceed all of the DOE Phase III objectives.
- Conduct MMV activities to document integrity of storage.
- Ultimately monetize credits.



# Fort Nelson CO<sub>2</sub> Sequestration Project



# Where Is the PCOR Partnership Heading?



The PCOR Partnership is working to ensure that its **members are well equipped** to face the dynamic future of the energy industry. Our **shared vision** for carbon management includes the potential that our region will enjoy a competitive advantage in the future.

# Contact Information

**Energy & Environmental Research Center**  
University of North Dakota  
15 North 23rd Street, Stop 9018  
Grand Forks, North Dakota 58202-9018  
Fax No. (701) 777-5181

Ed Steadman  
esteadman@undeerc.org  
(701) 777-5279

