

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

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





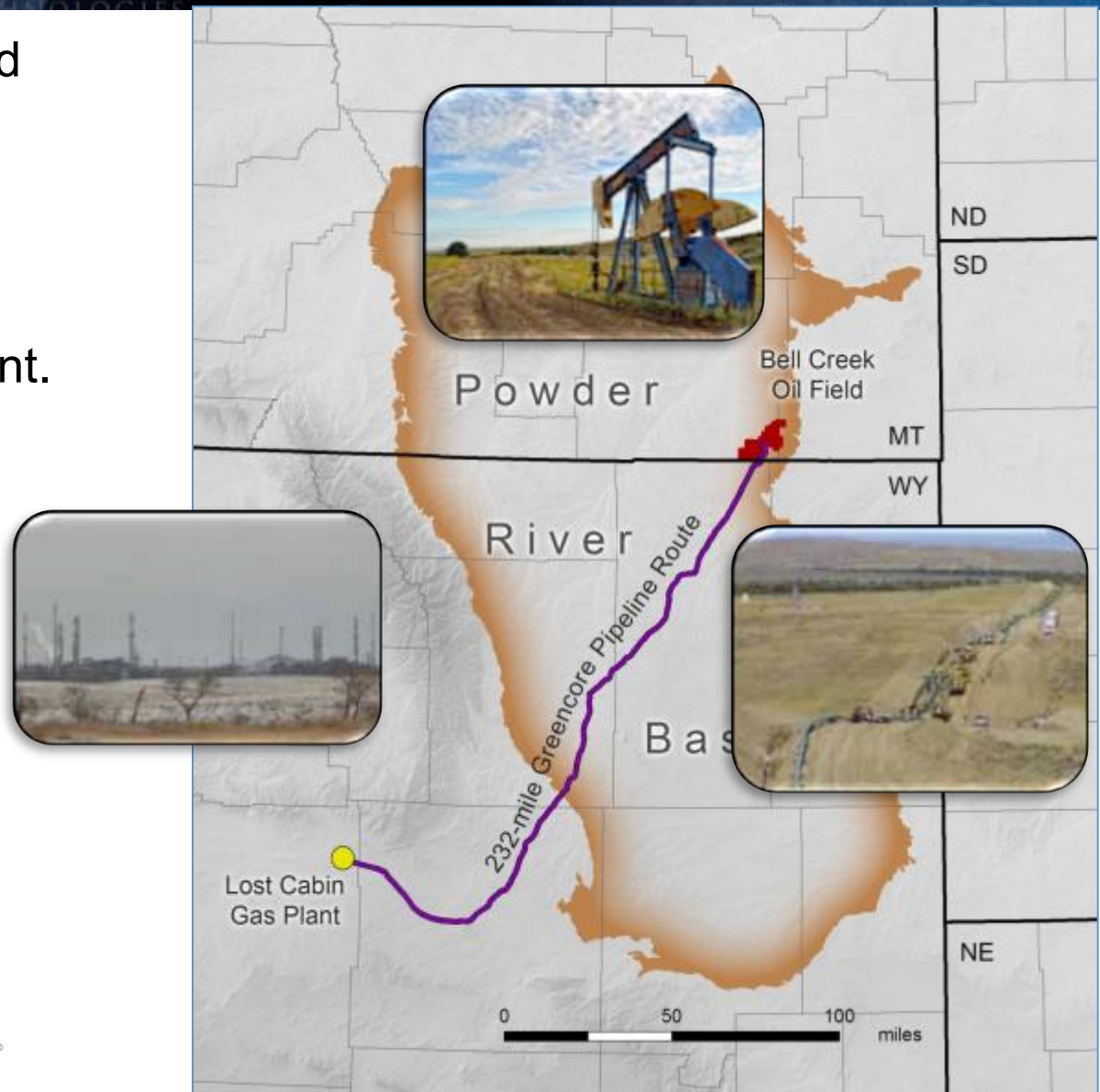
# Commercial-Scale Demonstration Phase

- Two 1-million-ton/year-or-greater-scale demonstrations:
  - Enhanced oil recovery (EOR)
  - Saline
- Ongoing and effective public outreach
- Continued regional characterization
- Continued involvement in other carbon dioxide (CO<sub>2</sub>) storage projects in the region
- Continued involvement in carbon capture and storage (CCS) and CO<sub>2</sub>/EOR regulations



# Bell Creek Combined CO<sub>2</sub> EOR and Storage Project

- Bell Creek oil field is owned and operated by Denbury Resources Inc. (Denbury).
- CO<sub>2</sub> is sourced from ConocoPhillips' Lost Cabin natural gas-processing plant.





# Bell Creek Project – PCOR Partnership Perspectives

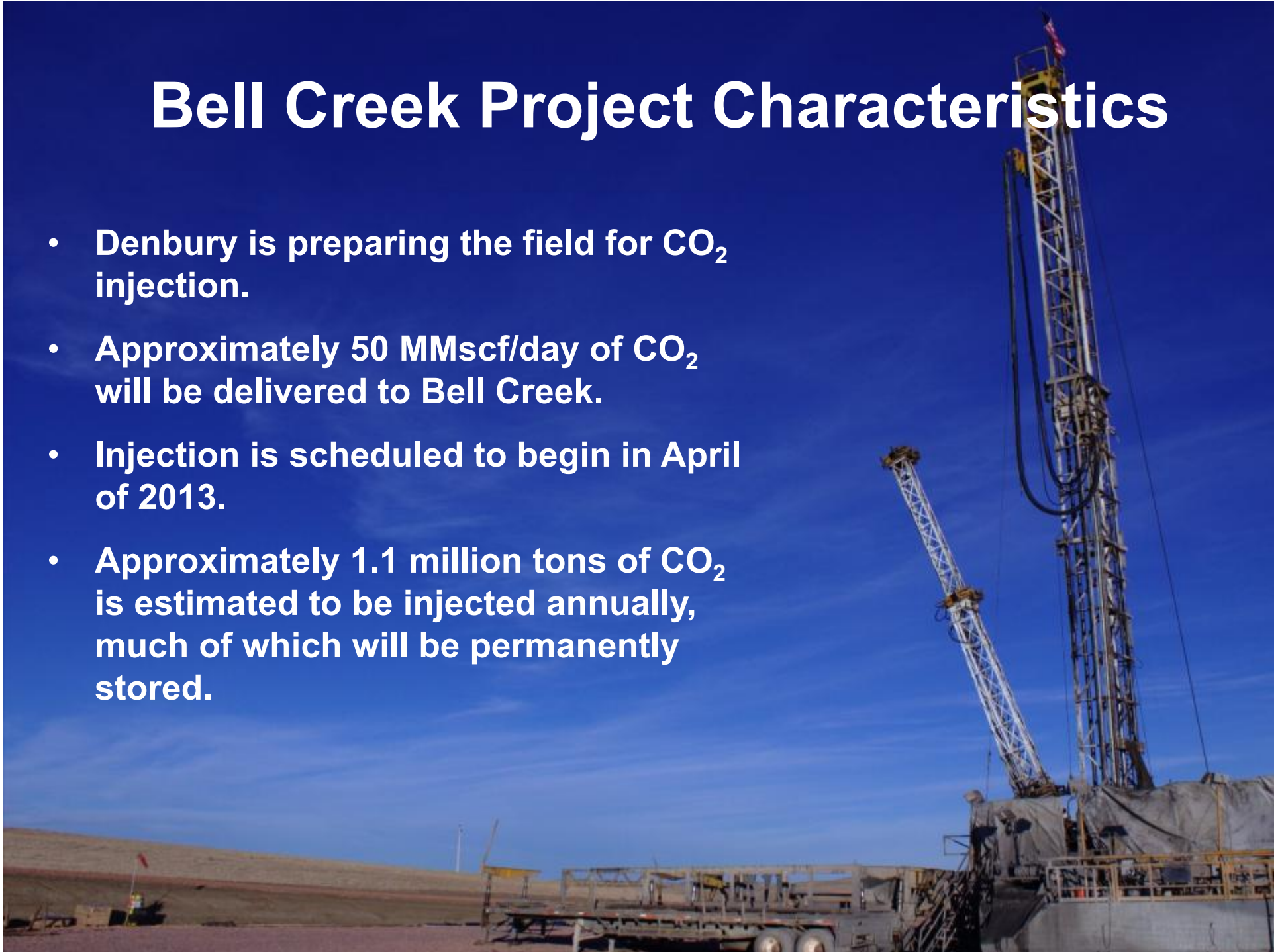
## Demonstrate

- CO<sub>2</sub> storage can be safely and permanently achieved on a commercial scale in conjunction with EOR.
- Monitoring, verification, and accounting (MVA) methods can be established to safely and effectively monitor commercial-scale simultaneous CO<sub>2</sub> EOR and CO<sub>2</sub> storage projects.
- Provide a technical framework for accounting of CO<sub>2</sub>.
- Lessons learned can benefit similar projects across the region.
- Establish a relationship between the CO<sub>2</sub> EOR process and long-term storage of CO<sub>2</sub>.



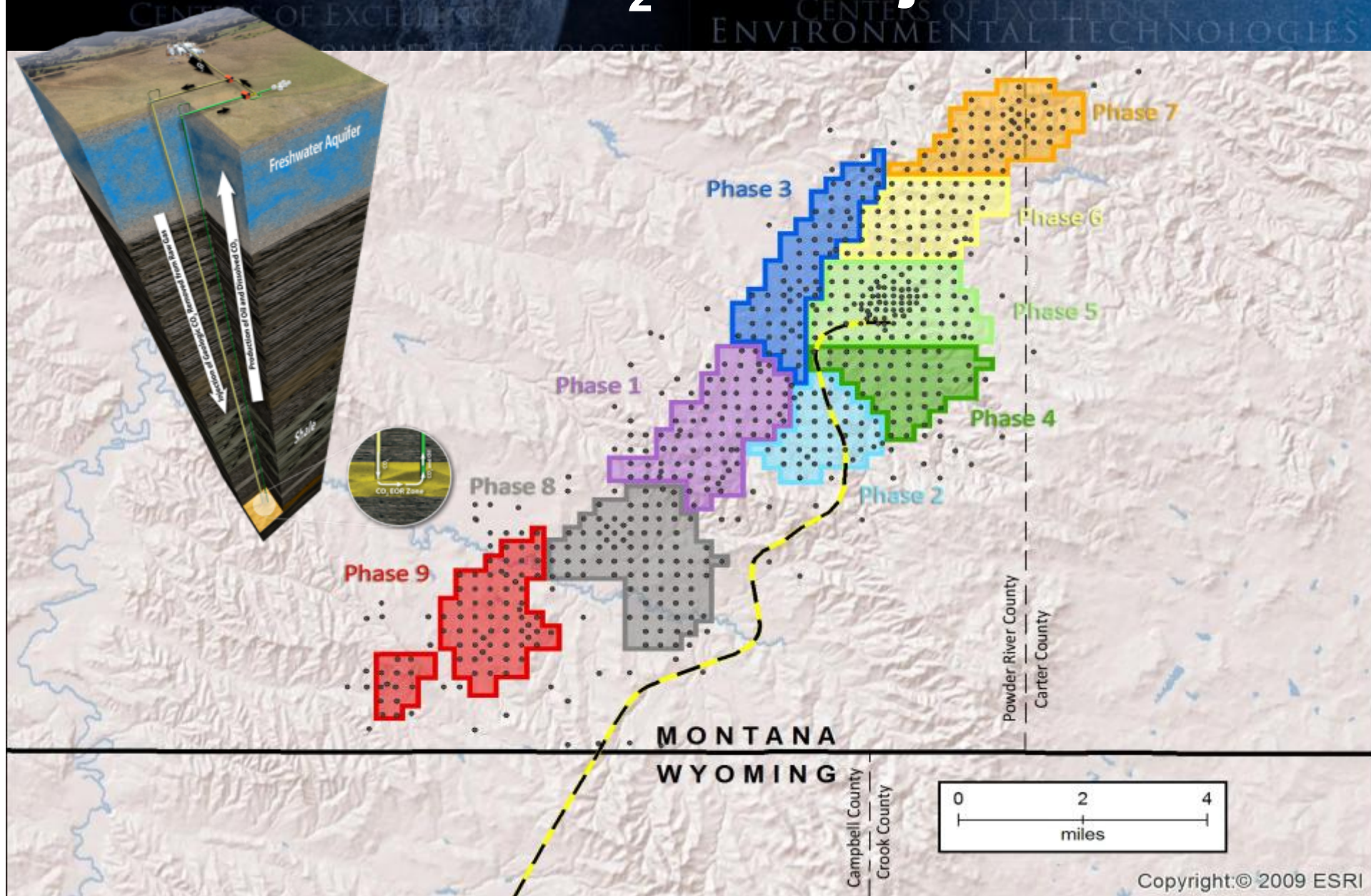
# Bell Creek Project Characteristics

- Denbury is preparing the field for CO<sub>2</sub> injection.
- Approximately 50 MMscf/day of CO<sub>2</sub> will be delivered to Bell Creek.
- Injection is scheduled to begin in April of 2013.
- Approximately 1.1 million tons of CO<sub>2</sub> is estimated to be injected annually, much of which will be permanently stored.





# Phased CO<sub>2</sub> EOR Injection





# PCOR Partnership Activities at Bell Creek

- Developing an integrated approach to MVA.
- Focused on site characterization, modeling and simulation, and risk assessment as a guide for developing an MVA strategy.





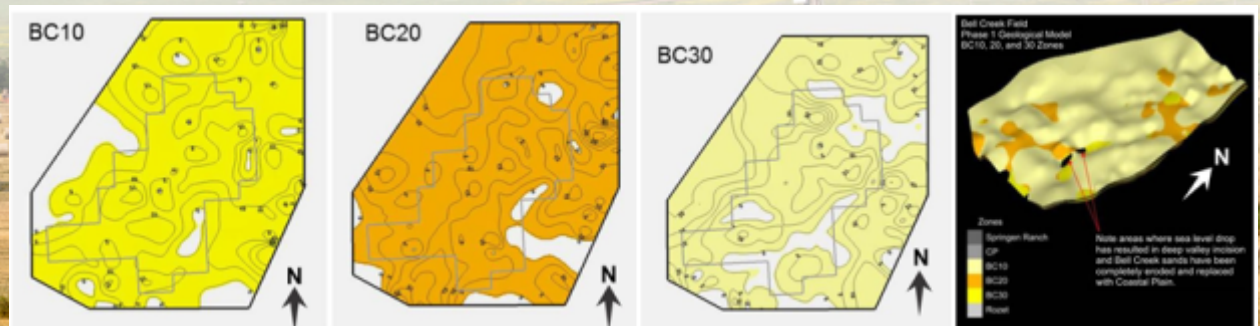
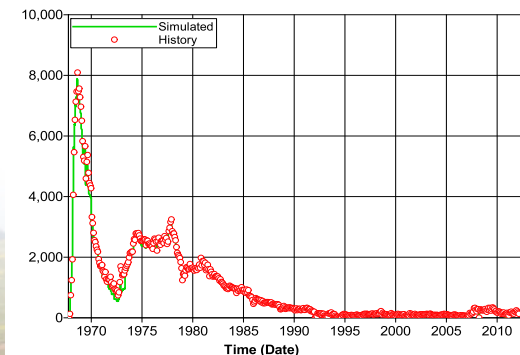
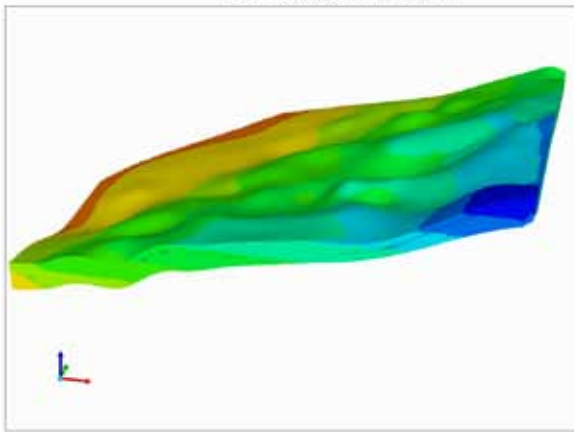
# Site Characterization

- Outcrop
- Core libraries (U.S. Geological Survey and Bureau of Economic Geology)
- Historic data (well files, well logs, core analysis)
- Light detection and ranging (LIDAR)
- Dedicated data collection and monitoring well (December 2011)
  - Downhole pressure and temperature
  - Core
  - Modern well logs
- 3-D surface seismic survey
- Vertical seismic profile (VSP)
- Pulsed neutron logs
- 0506OW Log Suite



# Modeling and Simulation

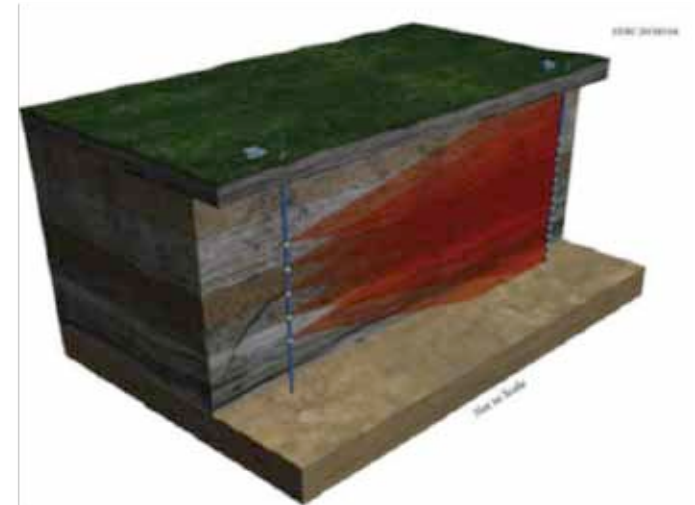
- Evaluate injection scenarios
- Predict fluid migration pathways and area of influence at discrete time steps
- Determine EOR and CO<sub>2</sub> storage efficiencies
- Predict reservoir response to injection
- Aid in risk assessment
- **Guide MVA program**





# Bell Creek MVA Program

- **CO<sub>2</sub> MVA program overlaid on a commercial EOR project**
  - Guided by site characterization, modeling, simulation, and risk assessment
  - Compatibility with commercial project
  - Opportunity to supplement MVA program with commercial data
  - Focused on Phase 1 injection area
- **Two-pronged approach:**
  - Surface and near surface
  - Reservoir



# Bell Creek Next Steps

- Install additional groundwater-monitoring well and conduct baseline sampling.
- Conduct baseline pulsed-neutron log surveys for additional wells.
- Redrill new wells, including potential logging and core analysis.
- Prepare mitigation and remediation plan.
- Shoot baseline 3-D VSP surveys.
- Complete first round of geomechanical and geochemical modeling.
- Complete second round of characterization, modeling, simulation, and risk assessment.
- **Injection is anticipated to begin in April 2013.**
- Begin injection monitoring.



# Fort Nelson: CCS in a Deep Saline Formation



Drill rig and camp site near Fort Nelson, British Columbia, Canada

# Fort Nelson Status

- Working to compile a comprehensive report on what has been done to date.
- Spectra decided not to drill or acquire seismic data in winter 2012–2013.
- Acquired existing 2-D and 3-D seismic data.
- Completed two rounds of modeling.
- Completed two rounds of risk assessment.
- Developed surface and shallow subsurface MVA plan.
- Laboratory analysis of core.
- Cored and logged test well.
- Drilled test well in winter 2008–2009.



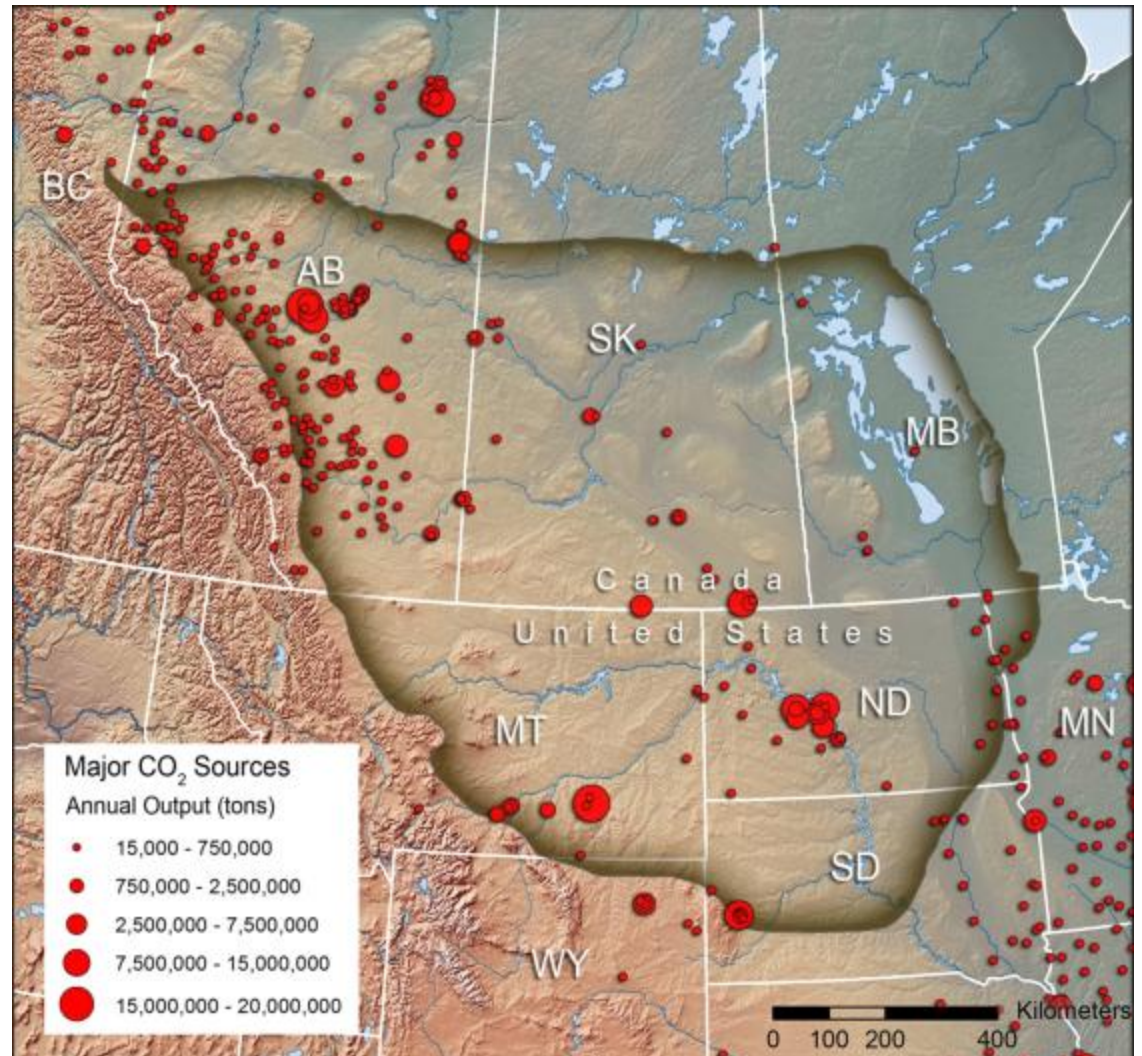
# Additional PCOR Partnership Activities

- ✓ Regional Characterization
- ✓ Basal Cambrian
- ✓ Aquistore
- ✓ Zama
- ✓ Water Working Group
- ✓ Outreach
- ✓ Regulatory Involvement



# Basal Cambrian Project

- Joint U.S.–Canada project.
- Characterize the Cambro–Ordovician Saline System.
- Estimate the volumetric storage capacity of this rock system.
- Assess the dynamic storage capacity through simulations, assuming that all large emitters will choose to store CO<sub>2</sub> in this system.
- Assess the effect of injecting CO<sub>2</sub> on resident brine and on shallow groundwater aquifers as a result of brine displacement.

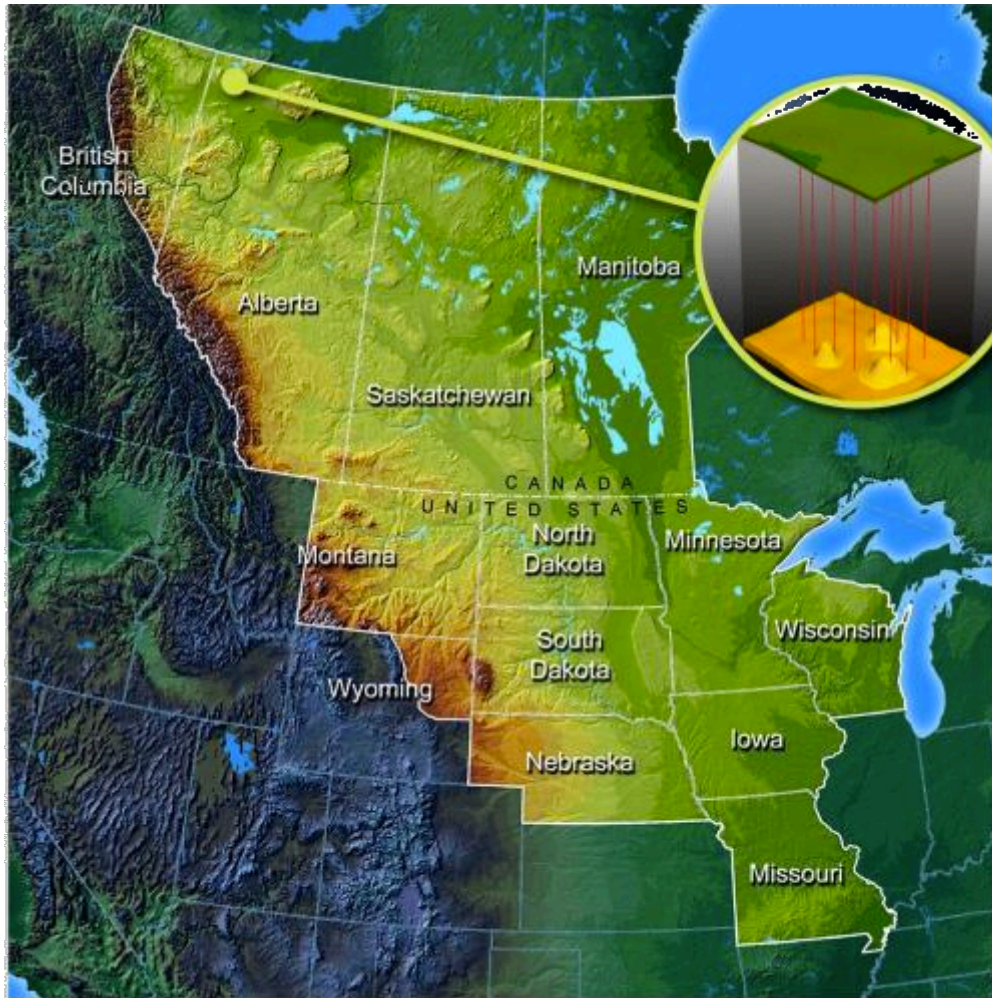




# Participation in the Aquistore Project

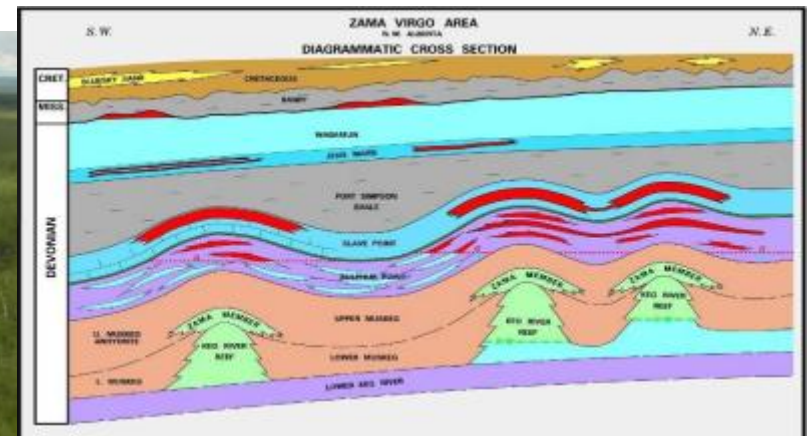
- CO<sub>2</sub> will be injected into a saline formation:
  - Deadwood Formation
  - Target depth of 3200 m (10,500 ft)
  - >50 m (>150 ft) in thickness
- Drilled two wells near Estevan, Saskatchewan, in 2012.
- Anticipate CO<sub>2</sub> delivery via pipeline from Boundary Dam power plant near Estevan, Saskatchewan.





# Zama EOR and CCS Project

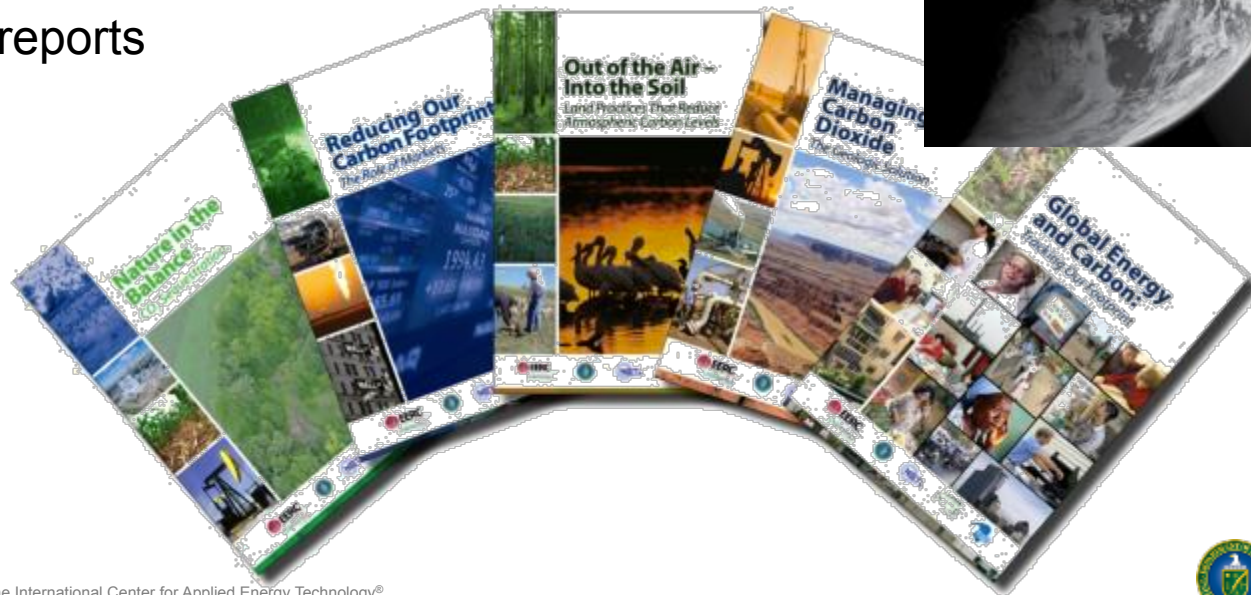
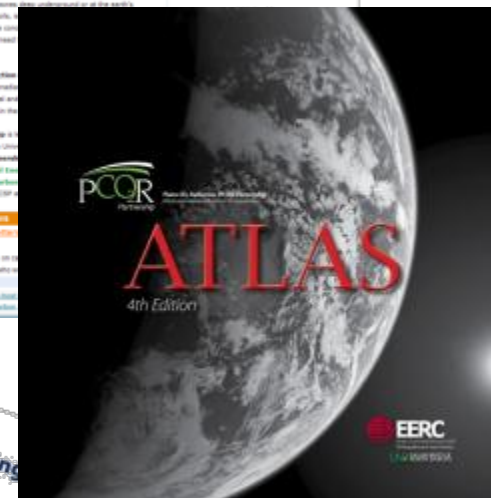
- Operated by Apache Canada Ltd.
- Injection of acid gas is ongoing and will continue as an EOR scheme.
- Implement a cost-effective approach for MVA.
- Pinnacle reef structure.
- Similar lithology found in the Williston and Powder River Basins.





# PCOR Partnership Outreach Support

- 122-page regional sequestration atlas
- Fact sheets on key topics and projects
- Variety of PowerPoint presentations
- Public Web site with streaming and downloadable materials
- Sequestration documentaries (television broadcasts, Web streaming, and DVDs)
- Video clips
- Technical reports



# Contact Information

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