

# **The Plains CO<sub>2</sub> Reduction (PCOR) Partnership: Carbon Capture and Storage Demonstration Activities\***

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## **Abstract**

The PCOR Partnership is one of seven regional partnerships established by the U.S. Department of Energy National Energy Technology Laboratory to assess and develop carbon sequestration opportunities. The PCOR Partnership covers an area of over 1.4 million square miles in the central interior of North America and includes all or parts of nine states and four Canadian provinces. The PCOR Partnership is characterizing the region's stationary CO<sub>2</sub> sources and sinks and evaluating the development of CO<sub>2</sub> capture and storage (CCS) in our region by providing outreach and technical support for carbon management activities for our industrial, governmental, and other partners and conducting commercially relevant demonstrations.

The PCOR Partnership has conducted four field-validation tests thus far: 1) Apache Canada Limited hosted a combined enhanced oil recovery (EOR)/sequestration activity that injected acid gas (approximately 70% CO<sub>2</sub> and 30% H<sub>2</sub>S) into a pinnacle reef structure from the Zama, Alberta, gas plant for use as a miscible flood agent; 2) an EOR project in the Williston Basin demonstrated the potential of using CO<sub>2</sub> in a tertiary oil recovery operation in a carbonate formation at depths of approximately 8000 ft; 3) the potential for simultaneous CO<sub>2</sub> sequestration and enhanced coalbed methane production in a Williston Basin unminable lignite coal seam was investigated; and 4) a terrestrial field-validation test developed carbon offsets from the use of alternative land management of wetlands in the Prairie Pothole Region.

The PCOR Partnership has teamed with industrial partners to conduct two commercial-scale (greater than 1 million tons of CO<sub>2</sub> a year) CCS demonstrations in the region. One of the large-scale tests will demonstrate CO<sub>2</sub> storage in a saline formation. In this demonstration, sour CO<sub>2</sub> (a mixture of CO<sub>2</sub> and H<sub>2</sub>S) will be injected to a depth of approximately 7200 ft. The PCOR Partnership is providing measurement, verification, and accounting (MVA) for the project.

The second commercial-scale demonstration will be a combined CCS and EOR demonstration that will provide insight regarding the impact of miscible CO<sub>2</sub>-flood tertiary recovery on oil production and successful CO<sub>2</sub> storage within a sandstone reservoir. The sources of CO<sub>2</sub> in both demonstrations are natural gas processing facilities. The commercial-scale demonstration tests are designed to establish the technical and economic efficacy of CCS in the region, and injections are planned to begin in 2012 for both projects.



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Durango, Colorado  
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**Wes Peck**





# What Is Our Region Doing?

The PCOR Partnership is assessing the technical and economic feasibility of capturing and storing (sequestering) carbon dioxide (CO<sub>2</sub>) emissions from stationary sources in the central interior of North America.



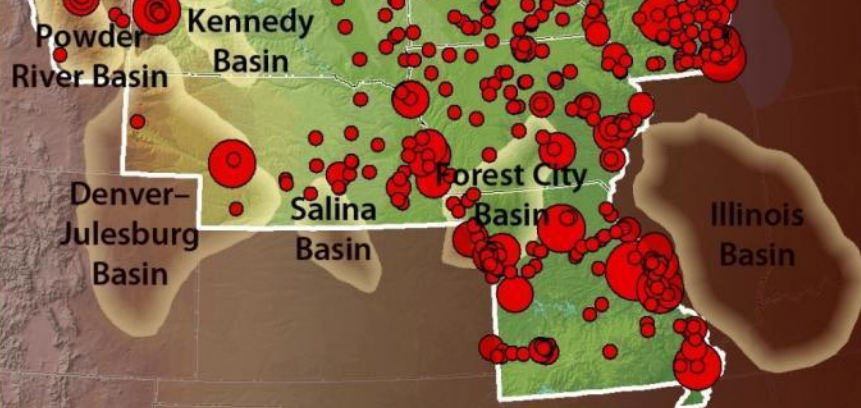


# Large Stationary Sources

927 stationary sources  
Total CO<sub>2</sub> emissions:  
≈562 millions tons/yr

## Major Stationary CO<sub>2</sub> Sources in the PCOR Partnership Region

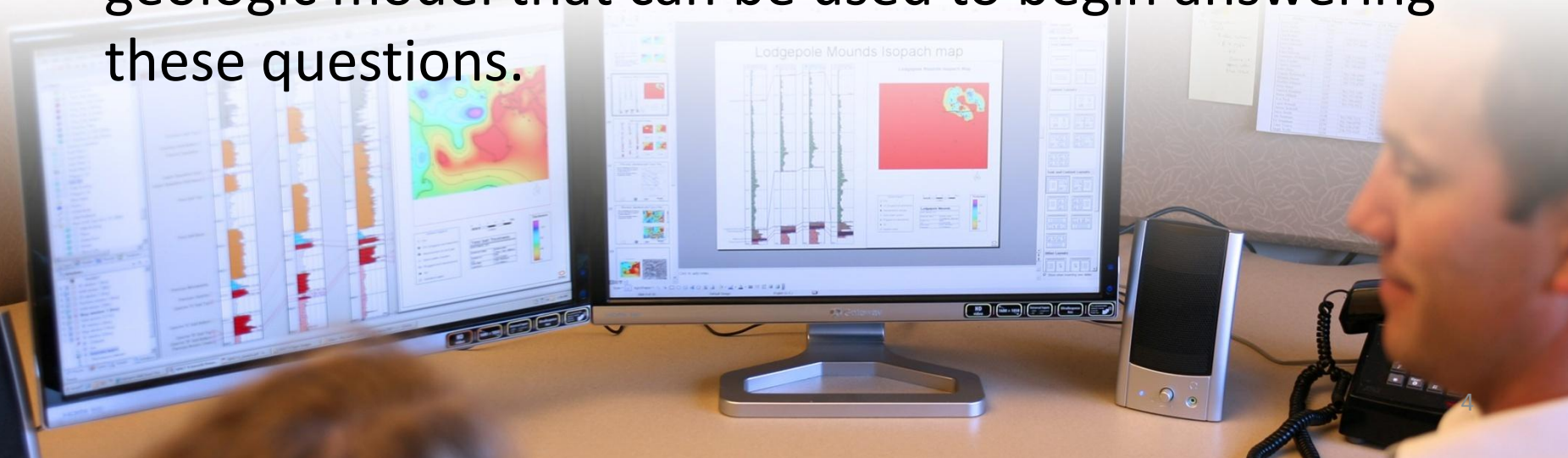
Annual CO<sub>2</sub> Output(tons)



# What Are the Key Questions?

- What is the capacity of the sink?
- What is the fate of the CO<sub>2</sub>?
- What is the potential for leakage?

Site characterization data provide the basis for a geologic model that can be used to begin answering these questions.





# Characterization Provides Baseline for Modeling and MVA

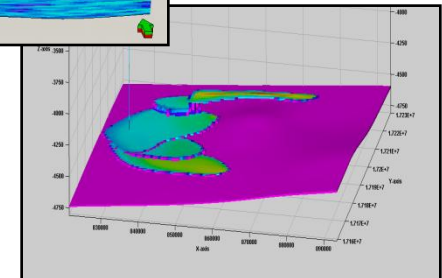
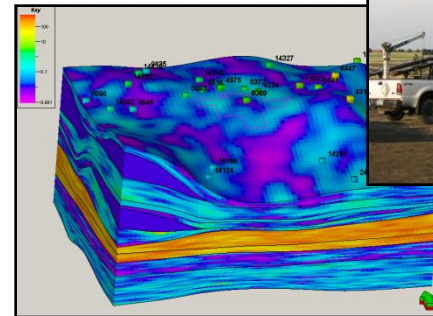
**Critical purposes are to ensure public health and safety and inform decision makers.**

## **Application of methods and technologies to:**

- Identify suitable locations.
- Develop capacity estimates.
- Provide basis for monitoring, verification, and accounting (MVA).

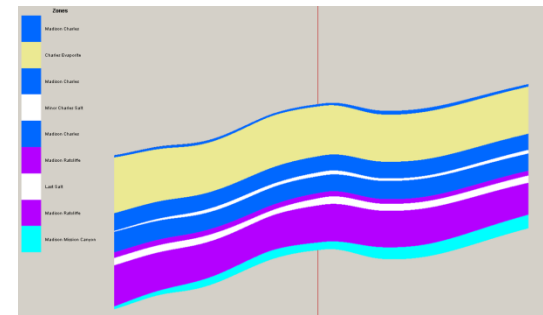
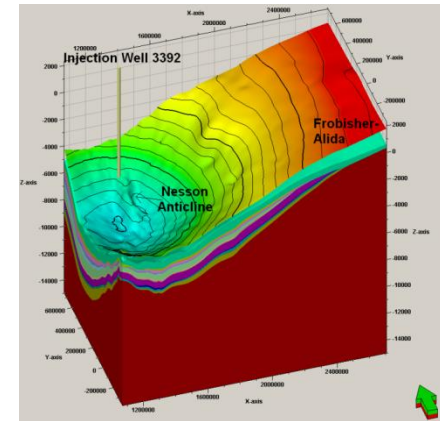
## **Methods and technologies include:**

- Collection of geological, geochemical, and geomechanical data before injection.
- Computer modeling of CO<sub>2</sub> injection, movement, and fate.



# What Are We Characterizing?

- Geology
- Hydrogeology
- Reservoir
- Cap rock and seal



Baseline characterization for commercial sites should be done at **small, medium, and large scales**.



# Field Validation Tests





# Key Results of Phase II

- Unminable lignite may represent CO<sub>2</sub> sequestration targets in the PCOR Partnership region, but more research needs to be done prior to large-scale demonstration and commercialization.
- Early exploration efforts do not support commercially viable coalbed methane potential in North Dakota lignite seams.



# Key Results of Phase II (cont.)

- The pinnacle reef structures employed in the Zama project represent significant opportunities for both enhanced oil recovery (EOR) and CO<sub>2</sub> storage.
- MVA programs can be developed that are unobtrusive to commercial operations and are both technically effective and cost-effective.





# Key Results of Phase II (cont.)

- Small-scale (huff 'n' puff-type) CO<sub>2</sub> injection into deep carbonate systems is technically feasible and has the potential to result in commercially viable EOR operations in the future.
- Tertiary-phase EOR is the primary near-term opportunity for managing CO<sub>2</sub> in the PCOR Partnership region.





# Key Results of Phase II (cont.)

Outreach activities are critical to the success of CO<sub>2</sub> storage projects and must be conducted at every level, from local communities to nationwide venues.

- Five videos (four completed, one in production)
- Over a dozen fact sheets
- Public Web site with monthly updates
- 65-page regional atlas
- Over 20 technical reports





# Key Results of Phase II (cont.)

- Regulatory and legal issues are constantly evolving in this dynamic topic area and represent key challenges to CO<sub>2</sub> storage technologies.



# Key Results of Phase II (cont.)

- A carbon management strategy is often required and always desirable for permitting major industrial sources of CO<sub>2</sub> emissions.
- Carbon management options vary significantly based on plant type, economics, geography, and geology.





# Phase III Demonstration Tests



# Fort Nelson Carbon Capture and Storage (CCS) in a Deep Saline Formation



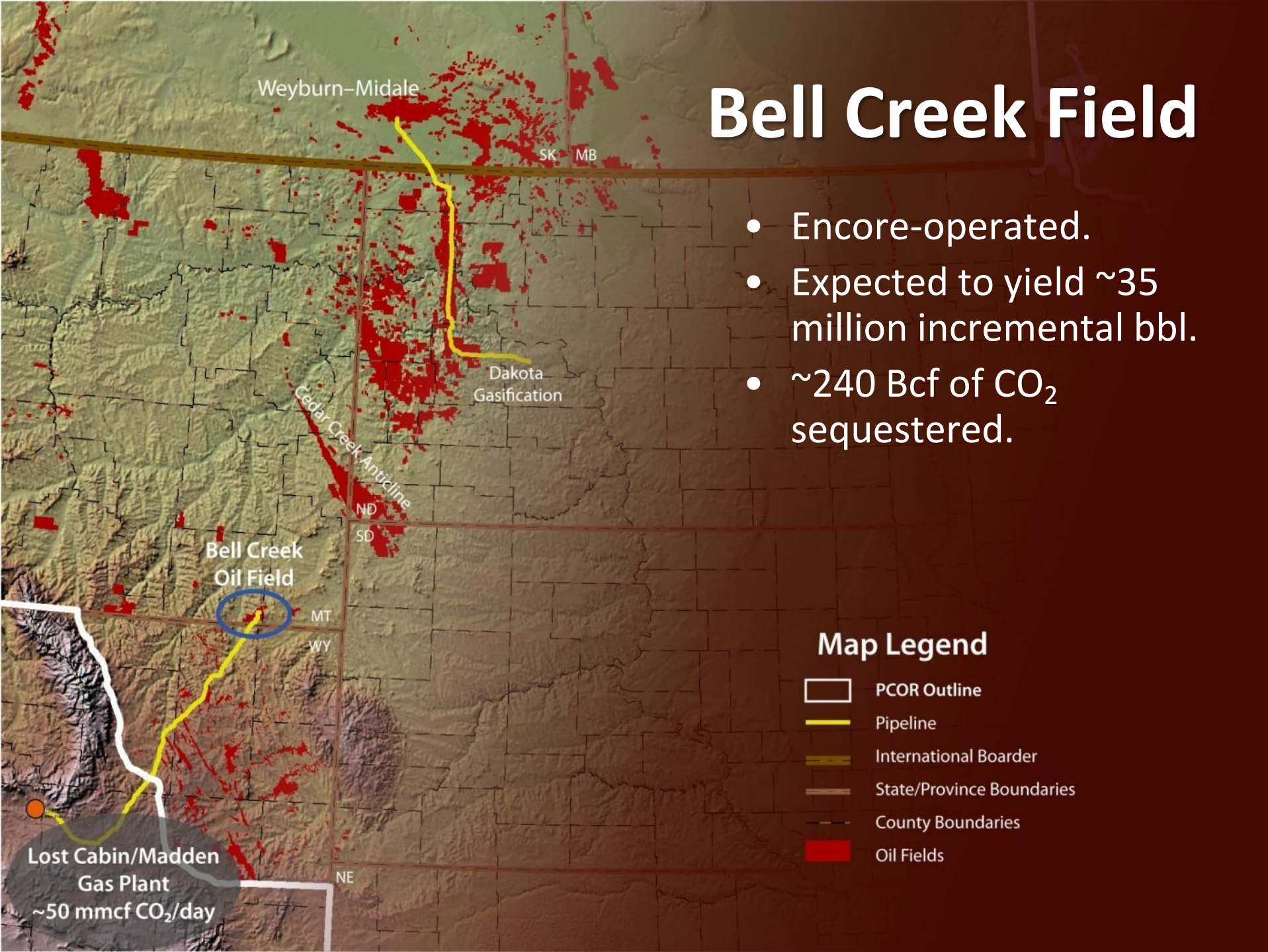
Drill rig and camp site near Fort Nelson, British Columbia, Canada





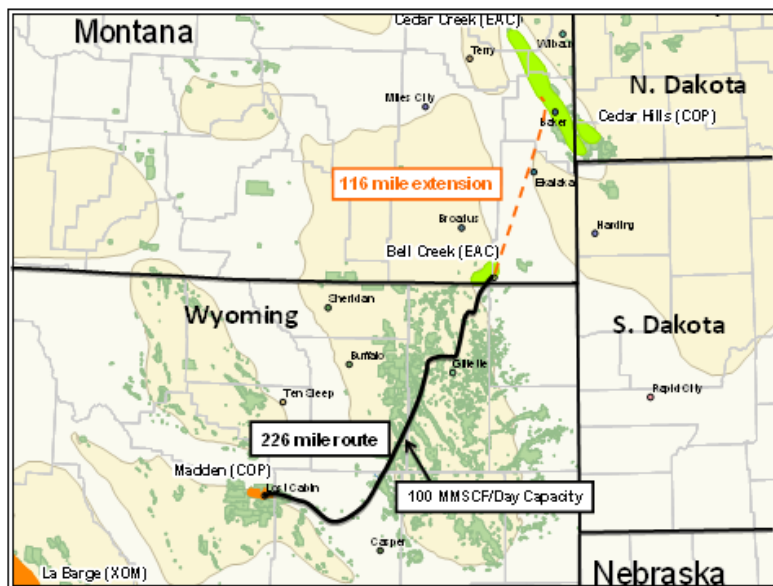
# Bell Creek Field

- Encore-operated.
- Expected to yield ~35 million incremental bbl.
- ~240 Bcf of CO<sub>2</sub> sequestered.

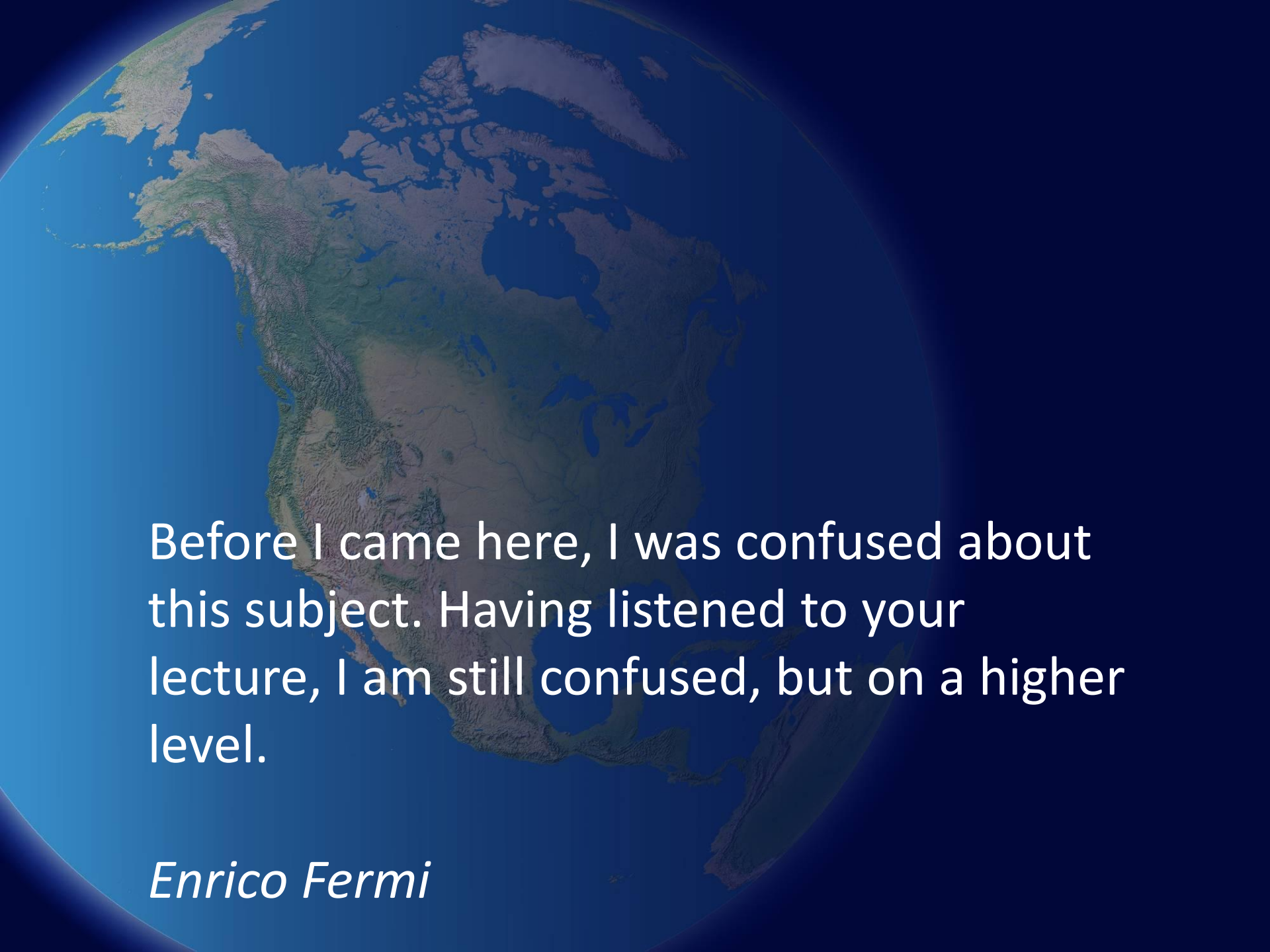


# Phase III Status

We are moving ahead with both the Bell Creek and the Fort Nelson demonstrations.







Before I came here, I was confused about this subject. Having listened to your lecture, I am still confused, but on a higher level.

*Enrico Fermi*

# Contact Information

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