

A Nonconventional CO₂-Enhanced Oil Recovery Target in the Illinois Basin: Oil Reservoirs of the Thick Cypress Sandstone

Award Number: DE-FE0024431

Project Summary:

The goal of this project was to identify and quantify nonconventional carbon dioxide (CO₂) enhanced oil recovery (EOR) target opportunities within the thick Cypress Sandstone in the Illinois basin. An integrated approach of detailed site-specific geologic reservoir characterization, 3D geocellular modeling, and reservoir simulation of multiple development cases at Noble Field was employed to determine development strategies for CO₂-EOR and storage. The findings of the Noble Field research were leveraged to assess the regional CO₂-EOR and associated storage resource within the nonconventional reservoirs of the thick Cypress Sandstone in the Illinois Basin.

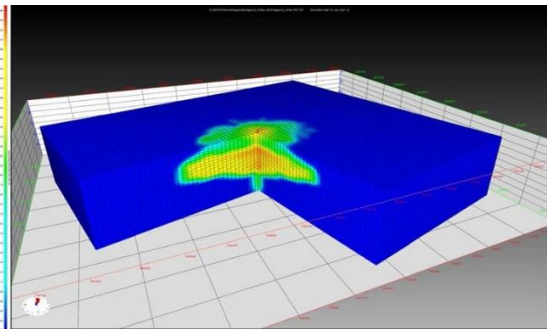


Figure 1: Simulating injection scenarios using calibrated reservoir models is being used to identify injection scenarios that lead to improvement in CO₂ sweep efficiency and improved understanding of CO₂ storage and water management plans.

Project Outcomes:

A prospective residual oil zone (ROZ) resource has been identified within the thick, fluvial facies of the Cypress Sandstone. Based on well log analyses, 27 brownfield and greenfield ROZ prospects have been defined with 1.8 billion barrels of oil in place. Geological characterization of the Cypress Sandstone showed that the thick, relatively widespread sandstone bodies have characteristics (e.g., high lateral and vertical permeability, limited compartmentalization, and large pore volumes) that are favorable for CO₂ storage.

The choice of specific development strategies depends on the goals of the project (prioritizing EOR performance vs. storage performance), geologic setting (brownfield vs greenfield), and the company's business strategies. As such, this research highlighted three example development strategies for Noble Field: continuous high injection rate strategy, water alternating gas (WAG) strategy, and ROZ-only continuous high injection rate strategy. For the ROZ prospects identified, 196 million barrels of oil is estimated to be recoverable using the 80-acre blanket WAG development strategy (which favors EOR and economic metrics, but is carbon positive) whereas 144 million barrels of oil is estimated to be recoverable using the 40-acre high CO₂ injection rate development strategy (which favors storage and economic metrics and results in net carbon negative oil production). Storage of CO₂ associated with EOR in these ROZ prospects alone, not accounting for associated main pay zones or underlying brine formation, is estimated to be up to 10.4 billion metric tons.

Presentations, Papers, and Publications

[Final Report: A Nonconventional CO₂-EOR Target in the Illinois Basin: Oil Reservoirs of the Thick Cypress Sandstone](#) (July 2019) – Nathan Webb

Prime Performer:
Illinois State Geological Survey

Principal Investigator:
Nathan Webb

Project Duration:
11/1/2014 – 4/30/2019

Performer Location:
Champaign, Illinois

Field Sites:
Noble Field, Illinois Basin

Program:
Carbon Storage