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Energy & Environmental Research Center (EERC)

CLARIFYING THE RELATIONSHIP OF ENHANCED OIL RECOVERY WITH ASSOCIATED STORAGE OF CO₂

2019 Carbon Management Technology Conference

Houston, Texas

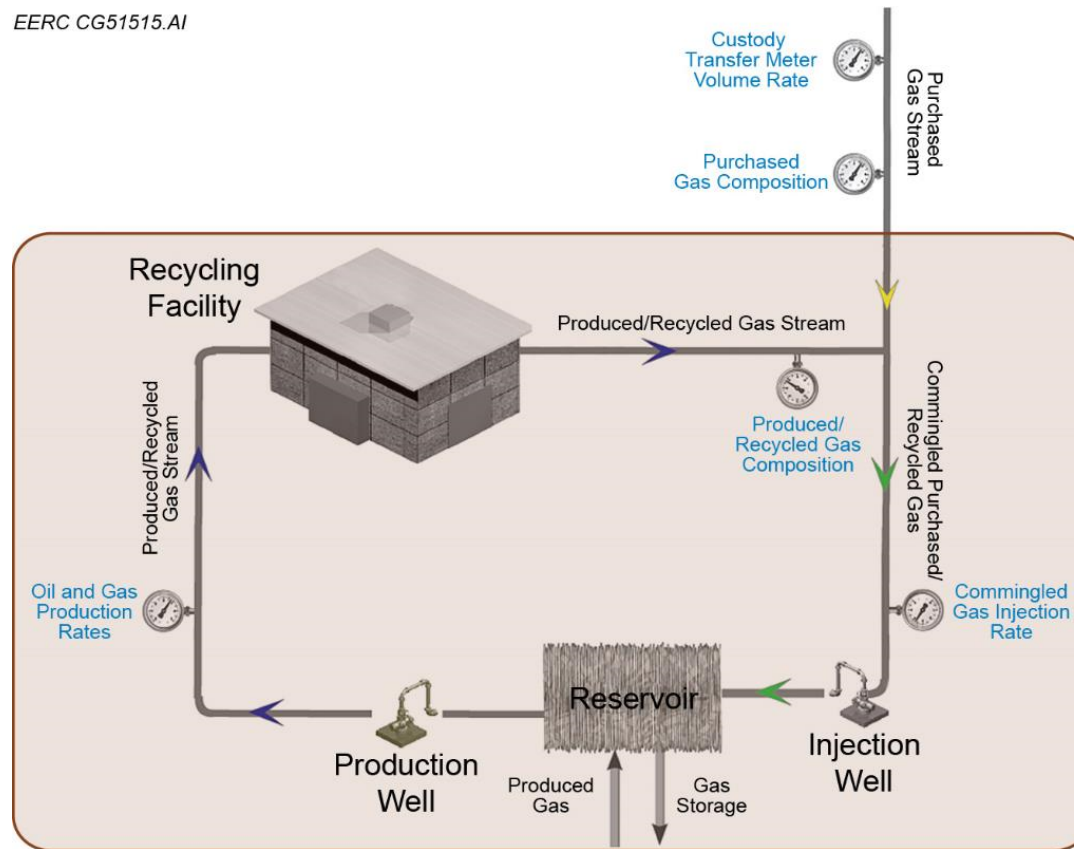
July 15–18, 2019

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ENHANCED OIL RECOVERY (EOR) PROCESS

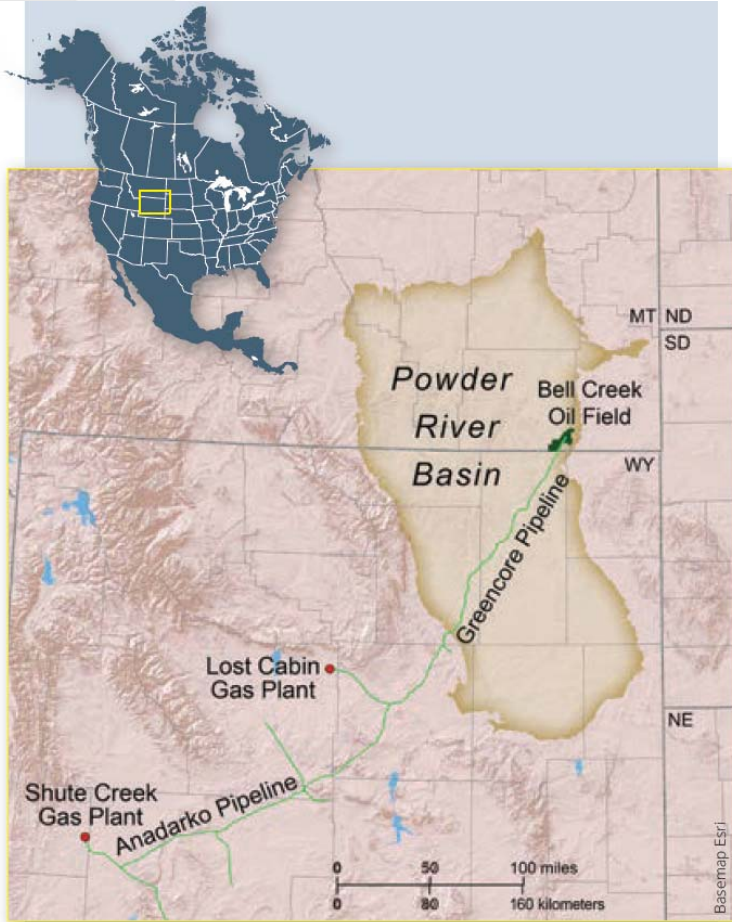
EERC CG51515.AI



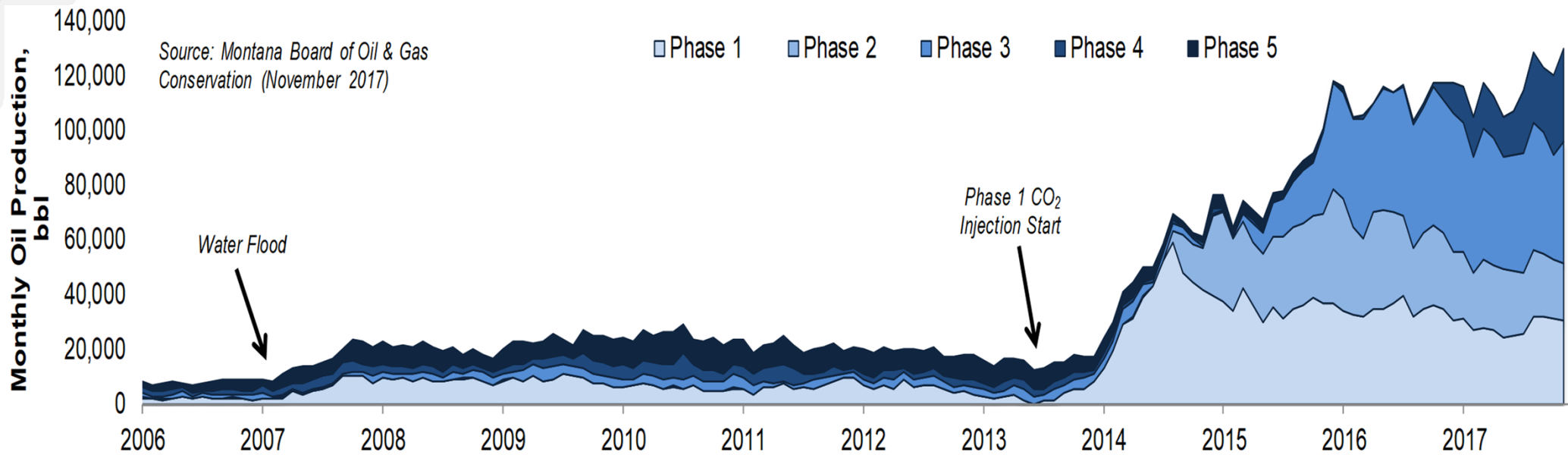
Associated CO₂ Storage, Incidental to the Bell Creek CO₂ EOR Project

- The PCOR Partnership has worked with Denbury Resources to study EOR and associated CO₂ storage
- OOIP was estimated to be ~350 MMbbl; one of the most significant oil fields in Montana
- CO₂ flooding was selected to recover an estimated 20 to 40 MMbbl of incremental oil

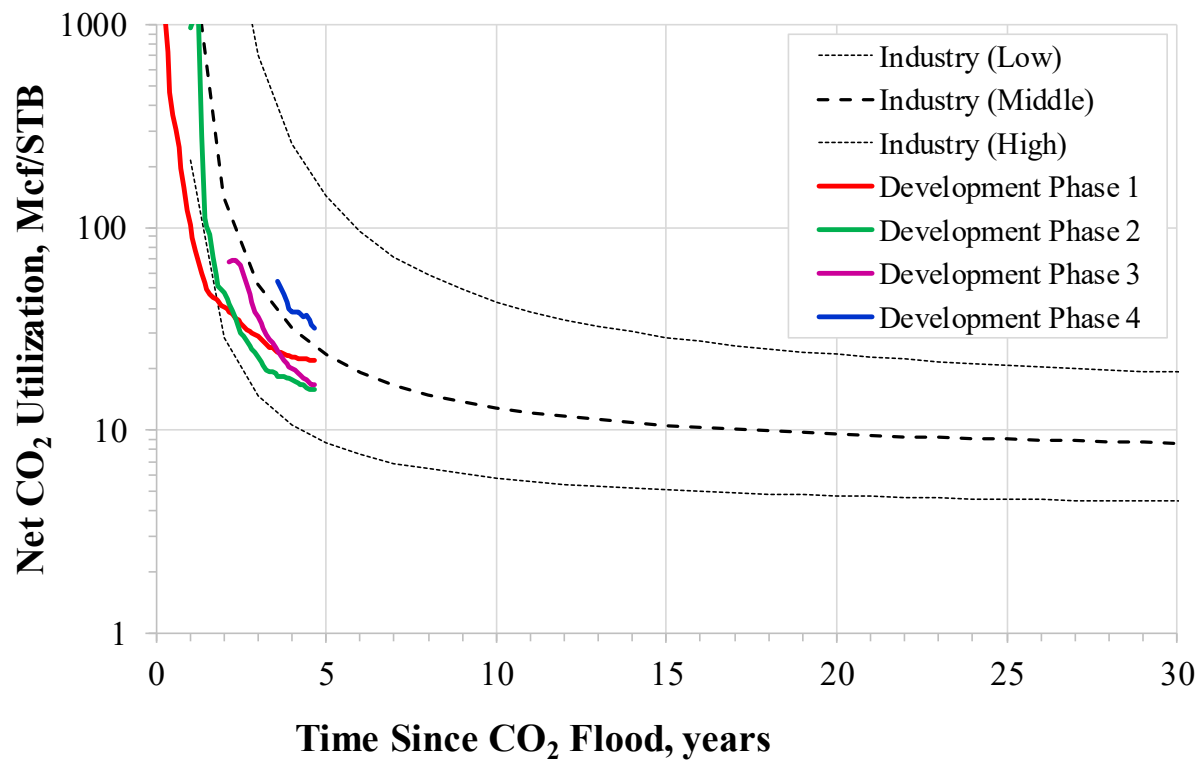
¹ J.P. Morgan 2018 Energy Conference – estimated proved plus potential tertiary reserves.



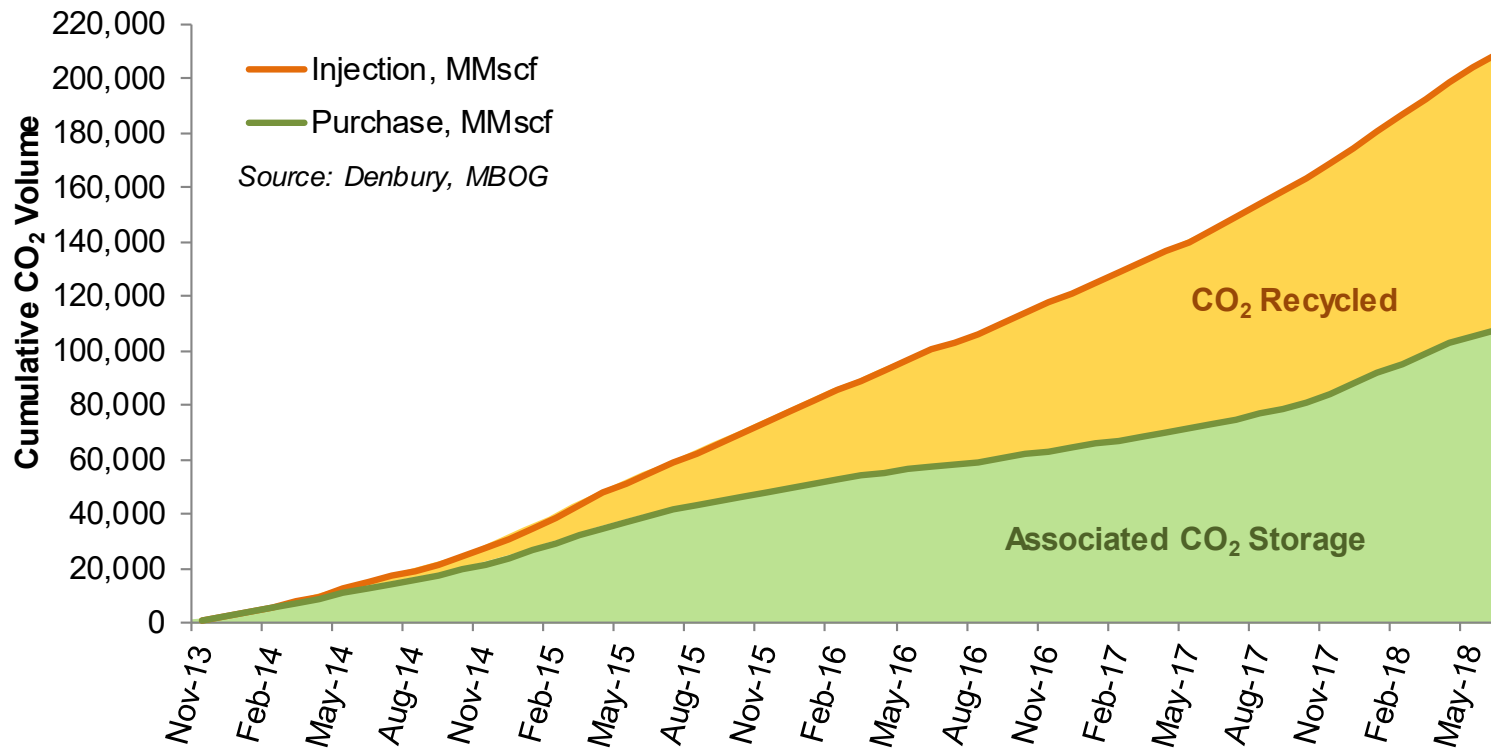
BELL CREEK INCREMENTAL OIL PRODUCTION



BELL CREEK NET UTILIZATION RATES ARE CONSISTENT WITH INDUSTRY RANGES

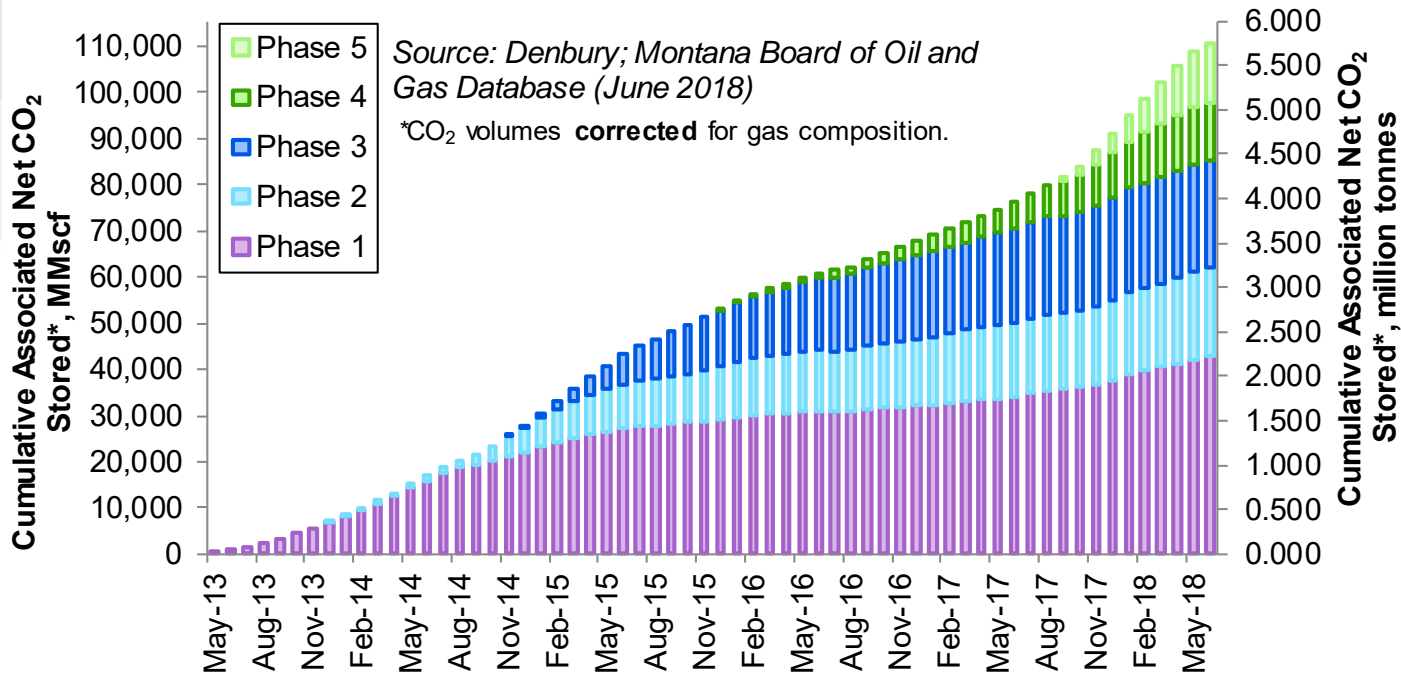


INJECTED AND RECYCLED CO₂ QUANTITIES



Source: Denbury, MBOG

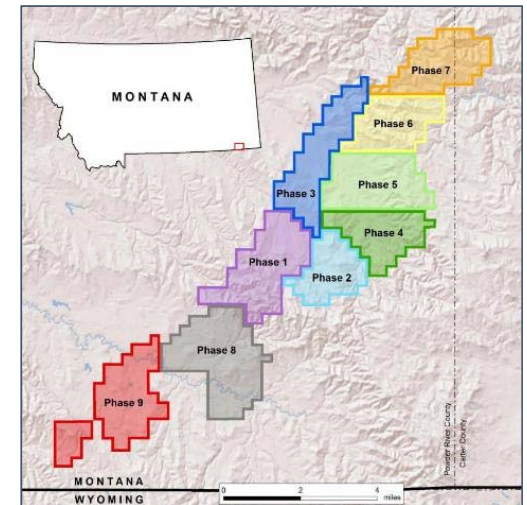
ASSOCIATED CO₂ STORAGE AT BELL CREEK BY DEVELOPMENT PHASE



Total storage values estimated using Denbury purchase volumes;
 delineation by phase calculated using MBOG injection/production data

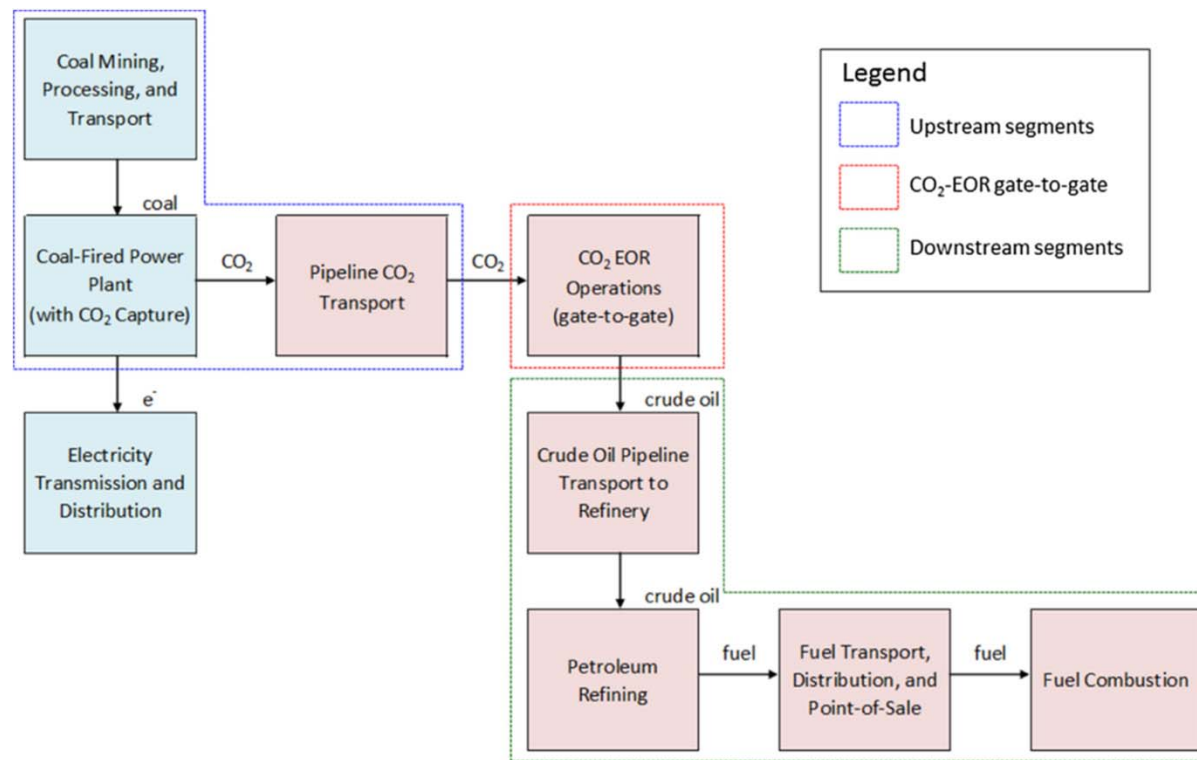
Development Phase	Injection Start*
1	May 2013
2	December 2013
3	November 2014
4	December 2015
5	September 2017

*Estimated start date for commercial EOR operations by development phase.

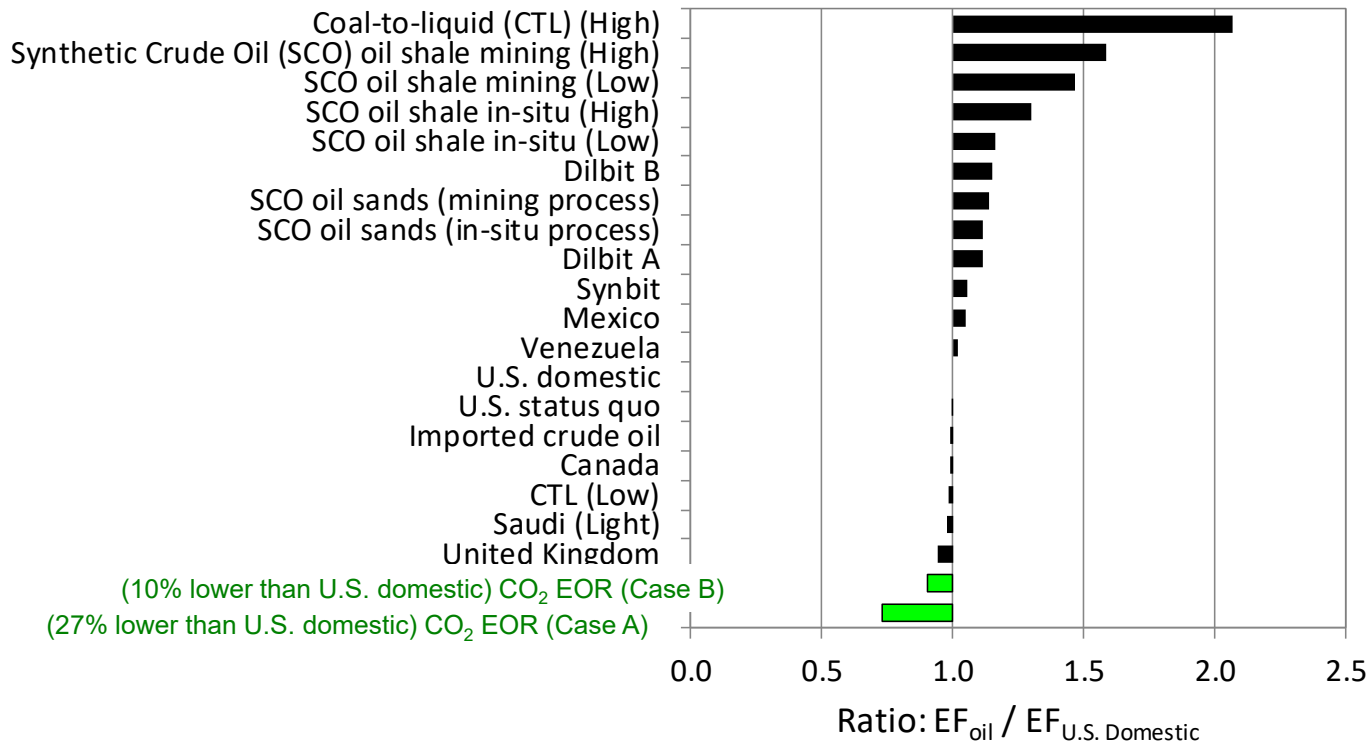


As of July 2018: Associated CO₂ storage incidental to EOR is about 5.9 million metric tons.

LCA SYSTEM BOUNDARIES INCLUDE UPSTREAM, GATE-TO-GATE, AND DOWNSTREAM SEGMENTS



LIFE CYCLE ANALYSIS SHOWS THAT EOR WITH CAPTURED CO₂ RESULTS IN LOWER-CARBON-INTENSITY OIL



Adapted from:

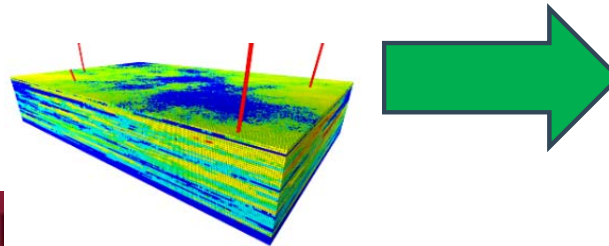
Mangmeechai, A. (2009) *Life Cycle Greenhouse Gas Emissions, Consumptive Water Use and Levelized Costs of Unconventional Oil in N. America*. Dissertation, Carnegie Mellon University: Pittsburgh, PA.

Azzolina, N.A.; Peck, W.D.; Hamling, J.A.; Gorecki, C.D.; Ayash, S.C.; Doll, T.E.; Nakles, D.V.; and Melzer, L.S. (2016) How green is my oil? A detailed look at greenhouse gas accounting for CO₂-enhanced oil recovery (CO₂-EOR) sites. *International Journal of Greenhouse Gas Control*, 51:369–379.

BAKKEN CO₂ STORAGE AND ENHANCED RECOVERY PROGRAM – 2017 FIELD INJECTION TEST



XTO
ENERGY



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THOUGHTS ON THE FUTURE OF BAKKEN EOR

- The potential size of the prize for EOR is enormous!
 - Lessons learned from rich gas EOR can be directly applied to CO₂ EOR
 - Widespread deployment may be a decade away
- Rich gas is available, CO₂ capture has traction
 - Industry partners highly engaged



ACKNOWLEDGMENT

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A wide-angle photograph of a university campus. In the foreground, there is a large green lawn. In the middle ground, there are several multi-story brick buildings with windows. In the background, there are more buildings and a clear sky. The sun is low on the horizon, creating a warm glow and long shadows. The trees have some yellow leaves, suggesting autumn.

THANK YOU

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