#### Developing CO<sub>2</sub>-EOR and Associated Storage within the Residual Oil Zone Fairways of the Powder River Basin, Wyoming

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# **Presentation Outline**

- The Project
- The Site
- The Team
- Next Steps

Goals and Objectives

The primary purpose is to establish a field laboratory to assess the **technical** and **economic** viability of enhanced oil recovery and associated  $CO_2$  storage in the greenfield ("fairway") residual oil zones (**ROZ**s) of the **Powder River Basin**. Accomplished through four (4) objectives:

1. Characterize the ROZ Fairway Resource Adjacent to the Salt Creek Oil Field, Powder River Basin

Goals and Objectives

- Undertake Detailed Review of Mechanisms
  Influencing the Efficiency and Permanence of ROZ-Associated CO<sub>2</sub> Storage
- Examine Alternative CO<sub>2</sub> Injection and Storage Strategies for Optimizing Both Oil Recovery and CO<sub>2</sub> Storage
- Establish the Commercial Viability of Enhanced Oil Recovery and Associated CO<sub>2</sub> Storage for the ROZ Fairway at Salt Creek



Development History



- Discovered in 1908
- Average well depth is 1,200'-3,000'
- 16,800 net acres of contiguous unit-hold
- Frontier & Sundance are main producing horizons
- Currently producing ~12,000 BOPD
- $CO_2$  flood initiated in 2003
- •18 Phases planned
- 12 phases implemented to date

Geologic Structure



- Laramide-aged asymmetric anticline
- Large conventional trap(s) on the margins of the PRB (Teapot Dome, Sage Spring Creek, & Cole Creek Field)
- Max dip:  $\sim 30^{\circ}$  west/ $\sim 10^{\circ}$  east
- 1,500' of closure at the Wall Creek 2 (22,000 acres)
  - N-S trending backthrust forms Western margin of the field
  - E-W trending extensional faults present

#### Frontier Sandstones



- Wall Creek 1 & 2 are part of the Upper Cretaceous Frontier System
- Wall Creek 2 sand equivalent to the Belle Fourche Member
- Wall Creek 1 sand equivalent to Wall Creek Sand (Frontier 1 and Turner SS)
- Eastward progradation into the Western Interior Seaway
- Mixed depositional settings result in varied facies distribution across the Salt Creek Field



Proposed Field Laboratory



#### Site Host Provided Data



#### Extensive Log Inventory

- Dielectric logging program
- Lithology Tools
- NMR logging
- Log inventory for robust core-log ties in order to develop facies and flow unit models across the field

#### Robust Core Inventory & Data

- Most recent core acquired 2012 as part of Minor Horizons assessment
- 3rd party & academic core studies as recent as 2017
- Subset of special core work: Cap pressure, wettability, electrical properties, and rel K

#### <u>Seismic</u>

- 3D seismic shot across the entire Salt Creek structure
- 4D Shot Pilot undertaken in 2013 across Phase 5 Wall Creek 2
- Seismic monitoring during fill up of Phase 5
- All data in house at FDL

The Project Team



# Accomplishments to Date

- Project Kick Off occurred July 24, 2019
- Received large data set from FDL
- -Digesting data & planning next steps:
  - Finalize site for field laboratory
  - Future data acquisition strategy
  - Plausibility of seismic shoot
  - New drill data collection

### Lessons Learned

-Too early to have identified any

# Synergy Opportunities

 Analogs directly applicable to the large ROZ in the PRB, exemplified by 10 large oil fields with tilted oilwater contacts in the 54-mile Salt Creek/Teapot Dome to South Glenrock/Big Muddy "trend" with
 >3 billion bbls OOIP & >1 billion bbls produced



 Address clastic/sandstone oil formations that face more challenging residual oil saturation settings, unlike the carbonate/dolomite ROZs in the Permian, and applicable to the Gulf Coast, Mid-Continent, and in Appalachia

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