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NORTH DAKOTA

Energy & Environmental Research Center (EERC)

BAKKEN PRODUCTION OPTIMIZATION PROGRAM (BPOP) 3.0 PROPOSAL

Presented to Oil & Gas Research Council
Bismarck, North Dakota
December 9, 2019

Charles Gorecki
CEO

AGENDA

- BPOP 2.0 Results
 - Products
 - Rich Gas Enhanced Oil Recovery (EOR) with Liberty Resources
- BPOP 3.0 Proposal Topic Areas
- Timeline
- Budget



U.S. DEPARTMENT OF
ENERGY



ConocoPhillips



North Dakota
oil & gas research program

Marathon Oil



equinor

WPX ENERGY

XTO
ENERGY

KEY BPOP PRODUCTS 2018-2019

Reports:

- Modeling and Simulation of the Inyan Kara Formation to Estimate Saltwater Disposal Potential: Final Report (*Partners only until 4/25/20*)
- Bakken Production Evaluation Using Multivariate Statistical Analysis (*Partners only until 5/30/20*)
- North Dakota Remediation Resource Manual (*Public*)

Presentations:

- Bakken Production Optimization Program (BPOP) 2.0 Update [Presentation to OGRC 12/18/18]
- BPOP Members' Update: Bakken Rich Gas EOR – Rich Gas–Oil Fluid Behavior and Rock Extraction Studies [WebEx] (partners only until 5/13/20)
- Liberty Pilot Update for BPOP Members [WebEx] (partners only – will not be released to public)

**MODELING AND SIMULATION OF THE INYAN KARA
FORMATION TO ESTIMATE SALTWATER DISPOSAL
POTENTIAL: FINAL REPORT**

Final Report

Prepared for:

North Dakota Industrial Commission
North Dakota Oil and Gas Research Program
Members of the Bakken Production Optimization Program Consortium (BPOP 2.0)

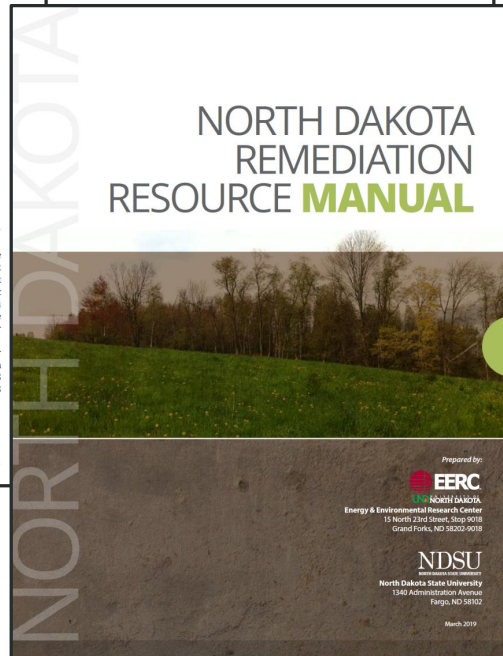
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2018-EERC-06-06

June 2018



**BAKKEN PRODUCTION EVALUATION USING
MULTIVARIATE STATISTICAL ANALYSIS**

Prepared for:

North Dakota Industrial Commission
North Dakota Oil and Gas Research Program
Members of the Bakken Production Optimization Program Consortium (BPOP 2.0)

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2019-EERC-04-16

April 2019

BAKKEN RICH GAS BAKKEN EOR

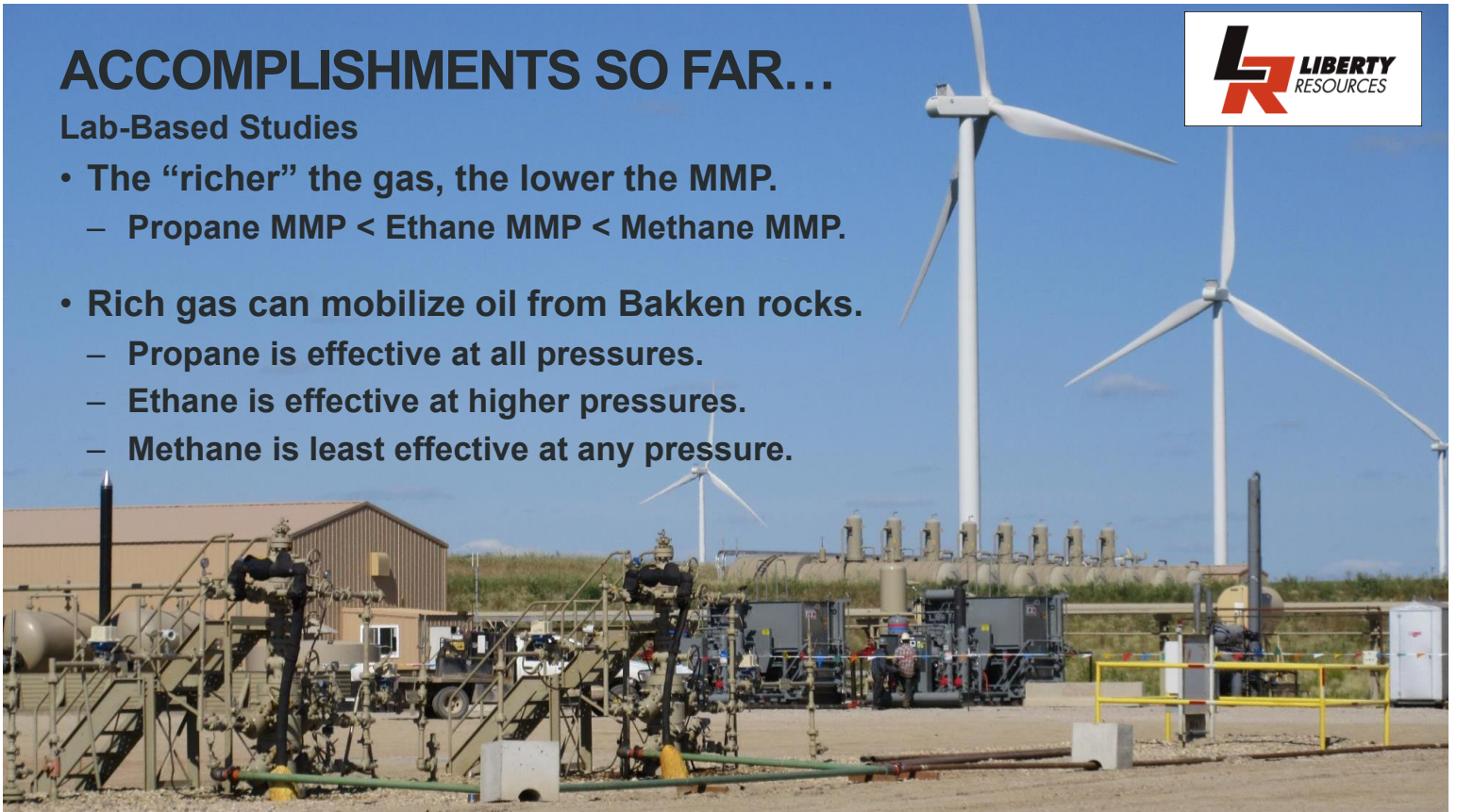
- Lab studies of rich gas interactions with fluids and rocks
- Iterative modeling of surface and subsurface components.
- Pilot performance assessment



ACCOMPLISHMENTS SO FAR...

Lab-Based Studies

- The “richer” the gas, the lower the MMP.
 - Propane MMP < Ethane MMP < Methane MMP.
- Rich gas can mobilize oil from Bakken rocks.
 - Propane is effective at all pressures.
 - Ethane is effective at higher pressures.
 - Methane is least effective at any pressure.



ACCOMPLISHMENTS SO FAR...



Field Test Activities

- Initial small scale injection Summer 2018.
- Larger scale injection started Fall 2018 and has continued through the Winter 2018-19.
- Total of 76 MMCF gas injected in 4 wells during 6 different injection periods.



BPOP 3.0 PROPOSED RESEARCH TOPIC AREAS

- Surface operations and infrastructure investigations
- Subsurface investigations
- Enhanced oil recovery (EOR)
- Machine learning (ML) and big data analytics (BDA) applied to the Bakken
- Management
 - Program oversight, document control, Web site, etc.

Oil and Gas Research Program North Dakota Industrial Commission	Application
	Program Title: Bakken Production Optimization Program 3.0 Applicant: Energy & Environmental Research Center Principal Investigator: Charles O. Gorecki Date of Application: November 3, 2019 Amount of Request: \$8,000,000 Total Amt. of Proposed Project: \$12,000,000 Duration of Project: 3 years Point of Contact (POC): Charles O. Gorecki POC Telephone: (701) 777-5355 POC E-Mail Address: cgorecki@underc.org POC Address: 15 North 23rd Street, Stop 9018 Grand Forks, ND 58202-9018

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SURFACE OPERATIONS AND INFRASTRUCTURE INVESTIGATIONS – PROCESS OPTIMIZATION

- Systematically analyze trends of data and information from multiple operators.
- Assist in defining process efficiency challenges.
- Identify technological and operational solutions through process modeling and system design.
- Continue to serve new and existing North Dakota Petroleum Council (NDPC) task force groups.
 - Flaring, vapor pressure compliance, emissions, etc.



SURFACE OPERATIONS AND INFRASTRUCTURE INVESTIGATIONS – FLUIDS CHARACTERIZATION



- Continue to maintain and expand database of fluids information.
- Coordinate data gathering and sampling and analysis to support other technical tasks.
- Use crude oil analyzer capable of providing compositional information to support modeling.

SUBSURFACE INVESTIGATIONS

- Investigation of Improved Reservoir Drainage and Production Efficiency
 - Interactions of phase behavior, well spacing, changing gas-to-oil ratio, allocation of produced oil to its source interval, and associated gas reinjection on resource recovery and system performance.
- Well Completions and Fluids Production Trend Analysis
 - Used to evaluate potential impacts to surface infrastructure, including future gas-gathering and transportation needs as well as potential future saltwater disposal (SWD) requirements.



SUBSURFACE INVESTIGATIONS (CONTINUED)

- Well Completions Optimization
 - Evaluation of parameters such as well spacing, treatment size and completion type on production of oil, gas and water from hydraulically fractured and refractured wells.
- Produced Water Management
 - Assess options for produced water management, including the feasibility of recycling and reuse, SWD into other subsurface targets, or possible reinjection into the Bakken for pressure maintenance.



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EOR – NEW PILOT LOCATION



- Conducted in collaboration with Liberty Resources, LLC.
 - Building off the lessons learned at Stomping Horse in 2018-2019.
- Rich Gas–Oil Fluid Behavior and Rock Extraction Studies
 - Determine effect of different potential injection gas mixtures on MMP (minimum miscibility pressure) of oil and examine fluid’s ability to recover oil from rock samples collected in the new pilot test area.
- Modeling of EOR Reservoir Components
 - Static geocellular modeling and dynamic simulations of potential EOR schemes to predict scheme performance and support design of new pilot test.
- Pilot Performance Assessment
 - Development of reservoir surveillance plan and processing and interpretation of generated data.

ML AND BDA APPLIED TO THE BAKKEN



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- Part of EERC's ongoing Fossil Energy Research Cooperative Agreement
- Use ML and BDA to address questions related to improving EOR operations and developing long-term strategies for overall Bakken resource development.
- Real-Time Visualization, Forecasting, and Control Tools for Improved Reservoir Surveillance
 - Efforts will yield a data-to-knowledge tool that will accelerate the process from data collection to data interpretation and through data integration so subsurface conditions can be understood more quickly.
- Virtual Learning Tools to Investigate Alternative Injection Scenarios
 - Will be used to integrate factors such as water injection, timing of injection, and coordination of operations across multiple drill spacing units into next-generation modeling of alternative injection scenarios for the Bakken.

BPOP 3.0 PROPOSED TIME LINE

	BPOP 3.0 Year 1				BPOP 3.0 Year 2				BPOP 3.0 Year 3															
	2020				2021				2022				2023											
	Q1	Q2	Q3	Q4	Q5	Q6	Q7	Q8	Q9	Q10	Q11	Q12												
	M	J	J	A	S	O	N	D	J	F	M	A	M	J	J	A	S	O	N	D	J	F	M	A
Project Management	▼ D1				▼ D1				▼ D1				▼ D1											
													D9 ▼											
Surface Operations and Infrastructure Investigations					D2 ▼				D6 ▼				D10 ▼											
Process Optimization																								
Fluids Characterization																								
Subsurface Investigations					D3 ▼				D7 ▼				D11 ▼											
Investigation of Improved Reservoir Drainage and Production Efficiency																								
Well Completions and Fluids Production Trend Analysis																								
Well Completions Optimization																								
Produced Water Management																								
Enhanced Oil Recovery (EOR)					D4 ▼				D8 ▼				D12 ▼											
Rich Gas-Oil Behavior and Rock Extraction Studies																								
Modeling of EOR Reservoir Components																								
Pilot Performance Assessment																								
Maching Learning and Big Data Analytics Applied to the Bakken					D5 ▼																			
Real-Time Visualization, Forecasting, and Control Tools for Improved Reservoir Surveillance																								
Virtual Learning Tools to Investigate Alternative Injection Scenarios																								

D1 – Quarterly Report

D2–D4, D5–D8, D10–D12 – Topical Report

D9 – Final Report

BPOP 3.0 PROPOSED BUDGET

	NDIC Share	Industry Share	Federal Share	Total Project
Total Cash Requested	\$6,000,000	\$500,000	\$1,500,000	\$8,000,000
Total In-Kind Cost Share (Liberty)		\$4,000,000		\$4,000,000
Total Project Costs	\$6,000,000	\$4,500,000	\$1,500,000	\$12,000,000



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A wide-angle photograph of a university campus at sunset. The sun is low on the horizon, creating a warm glow and long shadows. In the foreground, there are trees with some yellowing leaves. In the background, several large, multi-story brick buildings are visible, along with a parking lot filled with cars.

THANK YOU

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