



Energy & Environmental Research Center (EERC)

BAKKEN PRODUCTION OPTIMIZATION PROGRAM (BPOP) 4.0 OVERVIEW

Presented to the Oil & Gas Research Program

July 21, 2023

James Sorensen

Director for Subsurface R&D

Bakken Production Optimization Program (BPOP) 4.0

The Energy & Environmental Research Center (EERC) proposes a 3-year extension of the existing and highly successful BPOP.

- The first 9 years of BPOP were sponsored by NDIC, OGRP, USDOE, and many of the Williston Basin's premier operating companies.

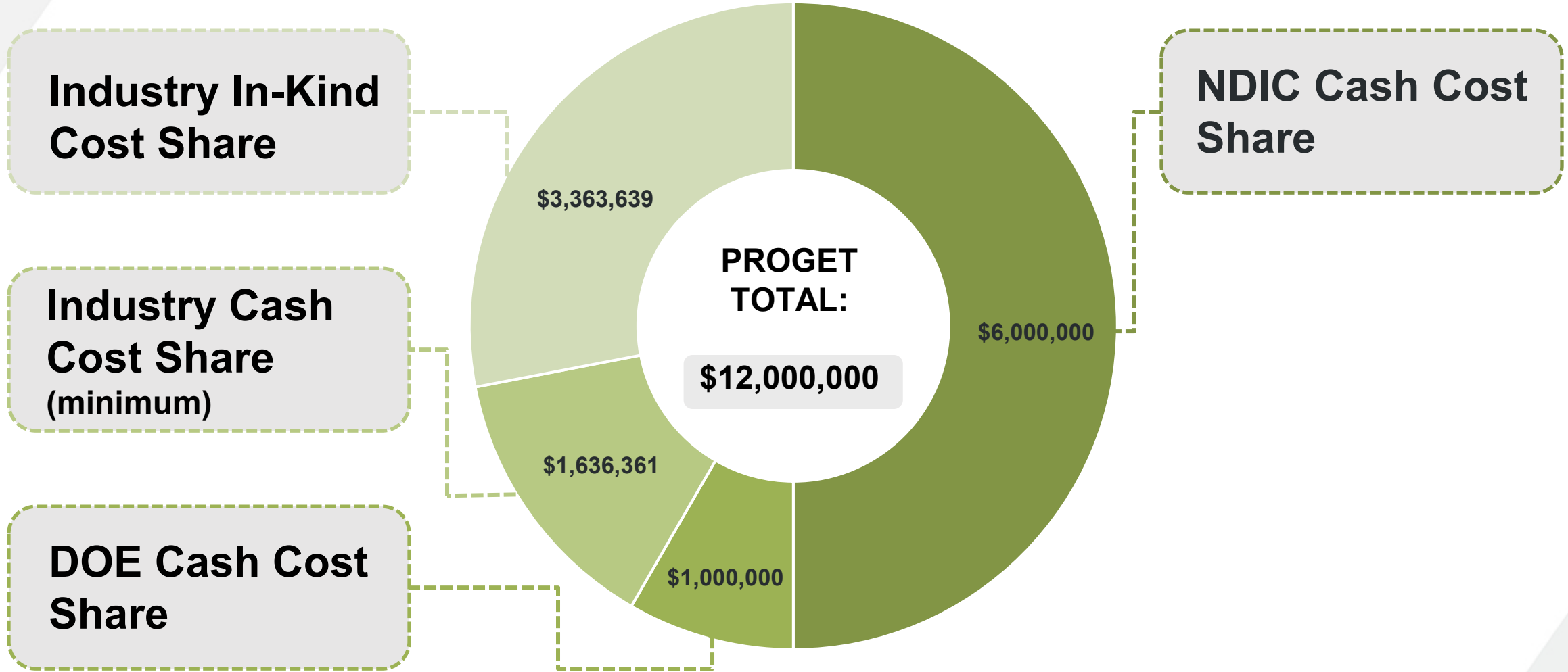


BPOP 4.0 Program Objective




- Provide technical solutions and tools that optimize oil production.
- Reduce carbon intensity through broad deployment of enhanced oil recovery (EOR), methane emission mitigation, and flare reduction technologies.
- Continue sustainable development of North Dakota's vast Bakken resources.
- Knowledge sharing through a variety of tech transfer activities and tools.

BPOP 4.0 Budget



BPOP 4.0 Letters of Support for Cost Share



June 1, 2023



Mr. John Harju
Vice President for Strategic Partnerships
Energy & Environmental Research Center
University of North Dakota
15 North 23rd Street, Stop 9018
Grand Forks, ND 58202-9018

Dear Mr. Harju:

Subject: Devon Energy Corp. – Letter of Support for the Project Entitled “Bakken Production Optimization Program (BPOP) 4.0”

Devon Energy (Devon) is...
Research Center (EERC) in the...
implementing large-scale enhanced...
carbon dioxide (CO₂) captured fr...

**\$3,000,000
Towards CO₂ EOR**



March 13, 2023

SENT VIA ELECTRONIC MAIL


Sheryl Eicholtz-Landis, Business Point of Contact
University of North Dakota
15 North 23rd Street, Stop 9018
Grand Forks, ND 58202-9018
slandis@undeerc.org

SUBJECT: Selection of Application for Negotiation Under Funding Opportunity Announcement Number DE-FOA-0002616, “Innovative Methane Measurement, Monitoring, and Mitigation Technologies (iM4 Technologies)”

Dear Ms. Eicholtz-Landis:

We are pleased to provide this update on your application. The Office of Fossil Energy Management within the Department of Energy (DOE) has completed its review of your application submitted in response to the subject Funding Opportunity Announcement (FOA). The application below has been recommended by the Office of Fossil Energy and Carbon Management for negotiation of a financial award for the project “Polar Bear & Innovative Capture of Storage Tank Vapors”, Principal Investigator: Darren D. Schmidt, Application Control Number 13740484

**\$1,000,000
Towards Polar Bear**



May 31, 2023

Mr. James Sorensen
Director of Subsurface R&D
Energy & Environmental Research Center
University of North Dakota
15 North 23rd Street, Stop 9018
Grand Forks, ND 58202-9018

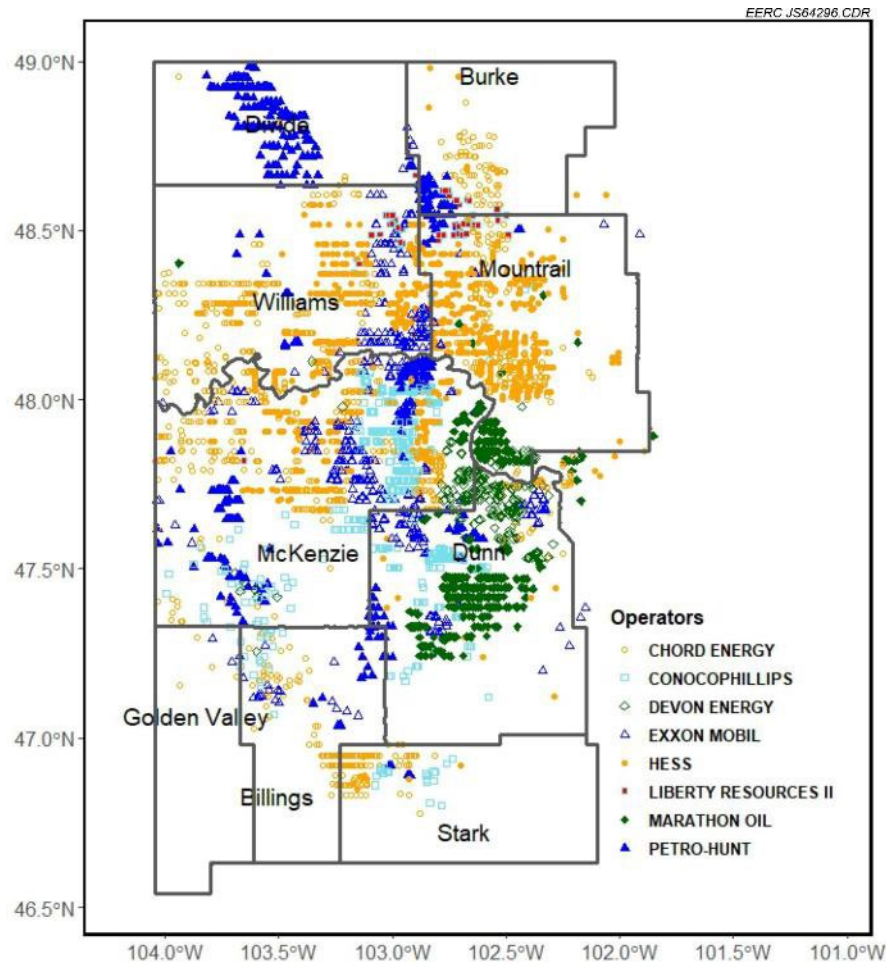
Dear Mr. Sorensen:

Subject: Liberty Resources LLC - Cost-Share Contribution for the Project Entitled "Bakken Production and Optimization Program 4.0"

Liberty Resources LLC (Liberty) is pleased to partner with the Energy & Environmental Research Center (EERC) at the University of North Dakota in the Bakken Production and Optimization Program (BPOP) 4.0 to develop knowledge that will support the optimization of oil production from the Bakken and Three Forks Formations in North Dakota.

**\$363,600
Towards rich gas EOR**

BPOP 3.0 Partners

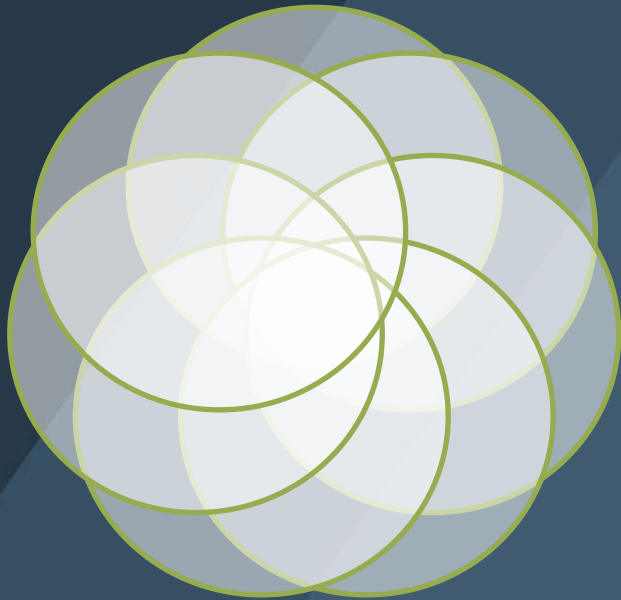


Map showing geographic distribution of BPOP partner well locations



Critical Challenges. Practical Solutions.

BPOP 4.0 MAIN TOPIC AREAS



Enhanced Oil Recovery

Methane Emission Mitigation and Flare Reduction

Completion and Production Data Analytics

Fluids Characterization

Geological and Petrophysical Evaluations

Understanding and Mitigating H₂S in Bakken Production Streams

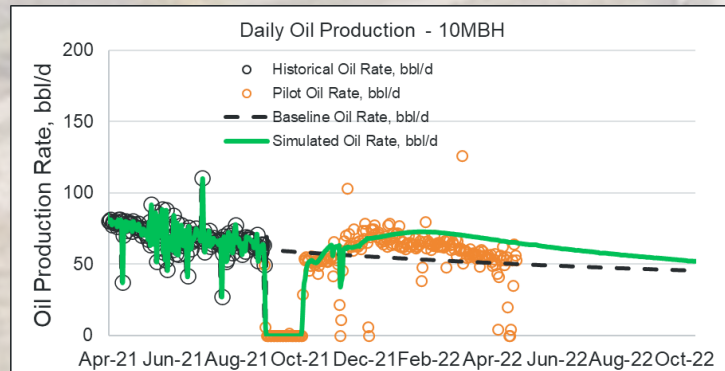
Technology Transfer – Products, Website, Webinars, Conferences

East Nesson EOR Pilot



1st cycle (fall '21 - spring '22) was a SUCCESS.

- Rich gas/freshwater with surfactant.
- EOR ETC technology pulsed water/gas reduced compression needs/costs.



8400 bbl incremental oil from 2 wells over 5 years.

2nd cycle planned for summer/fall 2023 – summer 2024.

- Rich gas/produced water with surfactant.
- More traditional WAG approach.
- Goal is to optimize ops & reduce costs.

East Nesson Bakken Enhanced Oil Recovery Pilot: Coinjection of Produced Gas and a Water-Surfactant Mixture

Gordon Pospisil; [Larry Griffin](#); Tappan Souther; Stacy Strickland; Jeromy McChesney; C. Mark Pearson; Chantsalma Dalkhaa; James Sorensen; John Hamling; Bethany Kurz; Nicholas Bosshart; Michael Warmack; Allin Assady; Jin Zhao; Brian Schwanitz; Adrian Williams; David Schechter; Abhishek Sarmah

Paper presented at the SPE/AAPG/SEG Unconventional Resources Technology Conference, Houston, Texas, USA, June 2022.

Paper Number: URTEC-3722974-MS

<https://doi.org/10.15530/urtec-2022-3722974>

Published: June 20 2022



Cite

Share

Abstract

Objectives/Scope: In 2021, Liberty Resources LLC (Liberty) deployed an enhanced oil recovery (EOR) pilot via a single huff 'n' puff (HnP) well in a 2560-acre Bakken spacing unit in Mountrail County, North Dakota. The primary goal was to demonstrate the economic viability of EOR using produced gas with water and surfactant. The pilot was designed, permitted, and conducted by Liberty in partnership with the Energy & Environmental Research Center (EERC) and EOR ETC. The objectives were to 1) repressure the reservoir above the minimum miscibility pressure (MMP), 2) prove the concept of using water coinjection to build hydrostatic pressure to inject gas at low

surface pres

recovery thr

Methods/Pr

site. Numer



Topics

ENHANCED RECOVERY

Water-Plus-Gas Injection on a Bakken Well Pad May Solve Problems That Stymied Shale EOR

Injecting gas plus water proved more effective and less costly than gas-only injection in the Bakken.

October 1, 2022 By Stephen Rassenfoss
Journal of Petroleum Technology



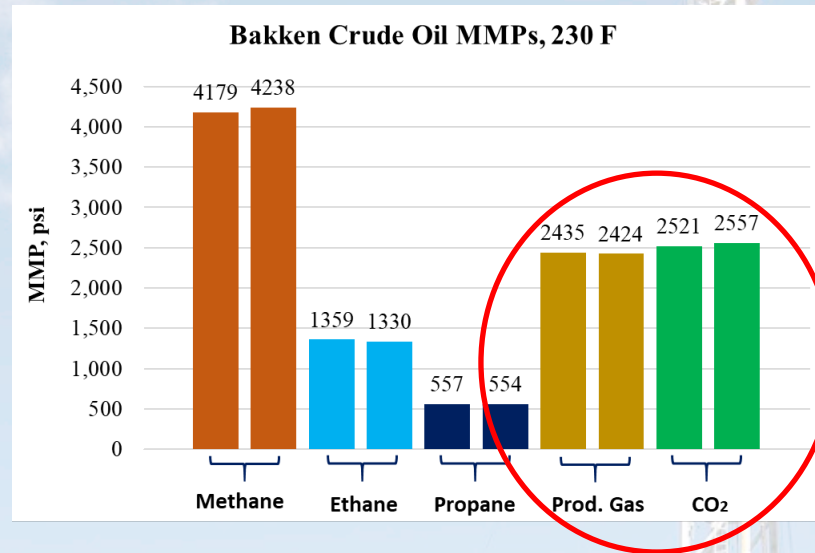
Future of Bakken EOR

Rich gas EOR deployment may be imminent because rich gas is readily available.

But rich gas supply has limitations.

- Assuming 2.6 Bcfd of rich gas supply, and 30 mmcfd/DSU for EOR, then there is only enough rich gas to supply EOR at 86 DSUs (out of >1000 Bakken DSUs in North Dakota).

Use of CO₂ from North Dakota's industrial sources is necessary to fully realize the EOR potential of the Bakken.



EOR in Bakken and Three Forks – Size of the Prize

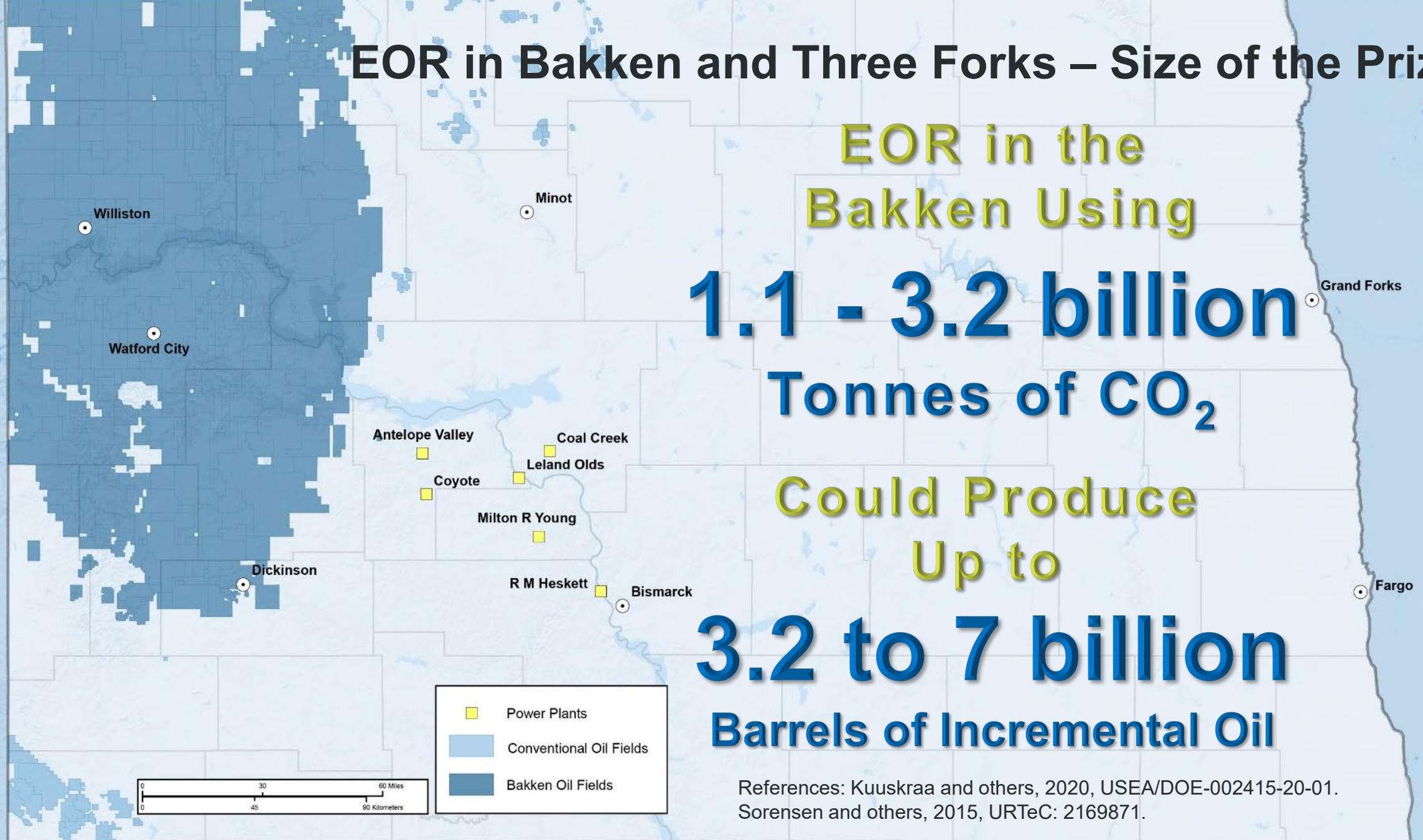
EOR in the
Bakken Using

**1.1 - 3.2 billion
Tonnes of CO₂**

Could Produce
Up to

**3.2 to 7 billion
Barrels of Incremental Oil**

References: Kuuskraa and others, 2020, USEA/DOE-002415-20-01.
Sorensen and others, 2015, URTeC: 2169871.



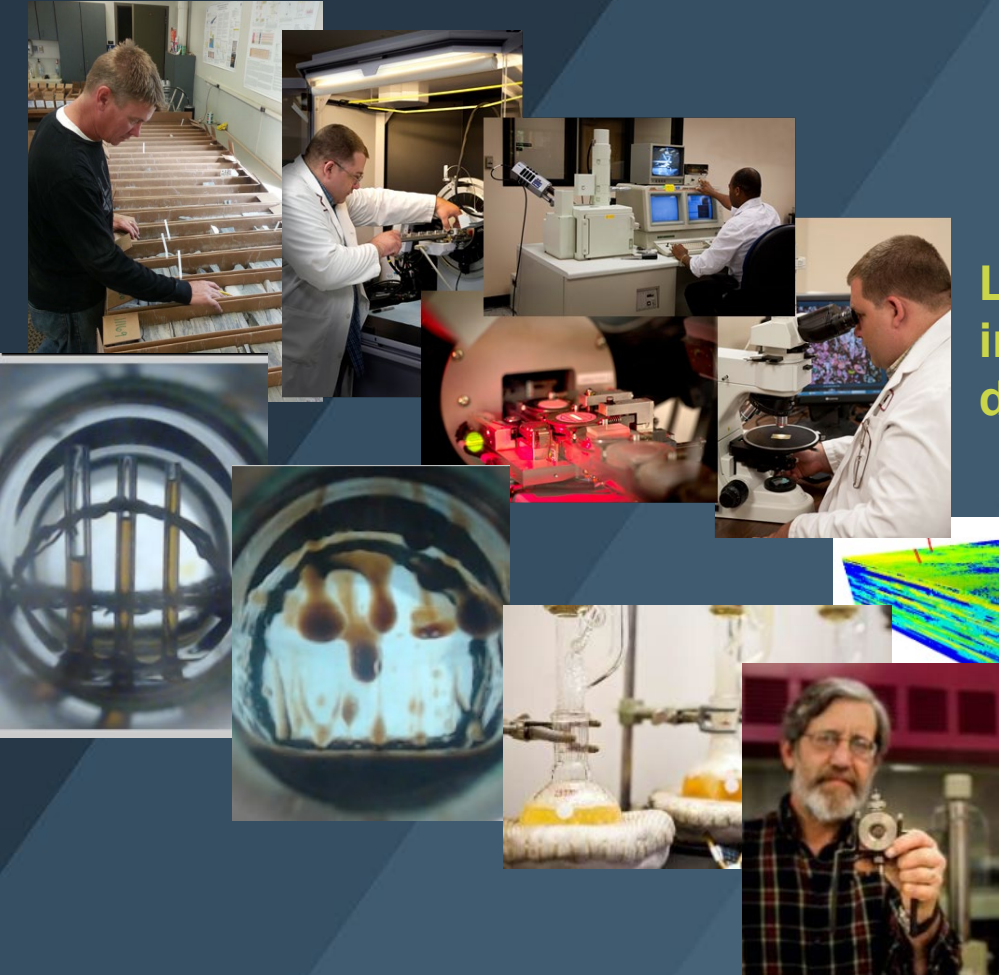
BPOP 4.0 Lab Tests and Modeling to Support Bakken CO₂ EOR



Lab-based rock and fluid interaction tests with CO₂ under depleted reservoir conditions.

Supports design of future pilot test at a Devon site.

State of the art modeling and simulation at the well, DSU, and multi-DSU scales.



Methane Emission Mitigation and Flare Reduction

BPOP 4.0

1

Develop and validate Polar BearSM technology to capture vapors from storage tanks to achieve zero or near-zero methane emissions

2

Complete engineering-scale testing of a prototype design and validate process controls, design parameters, and safety.

3

Advance Polar BearSM technology for field implementation

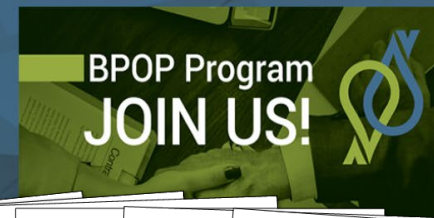
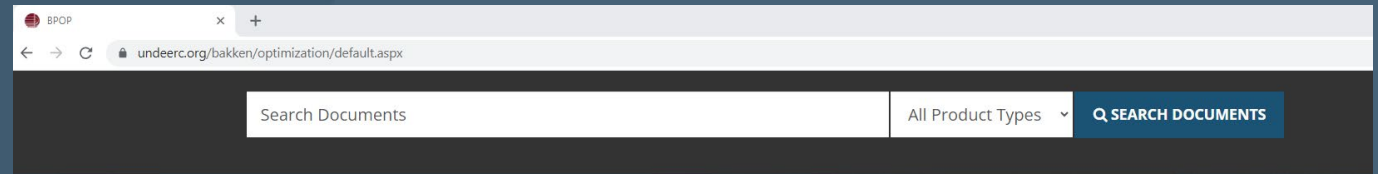


Critical Challenges. Practical Solutions.

Tech Transfer Products

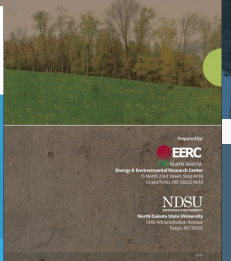
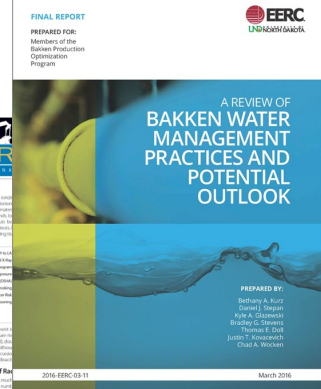
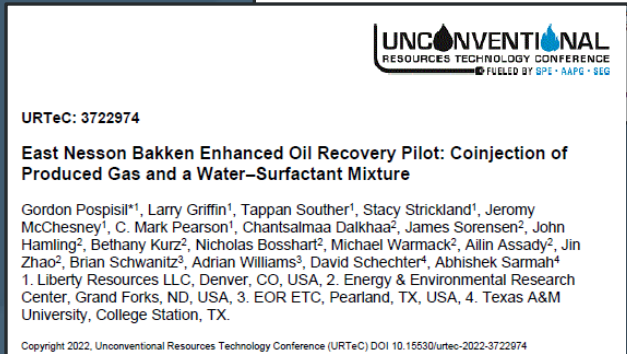
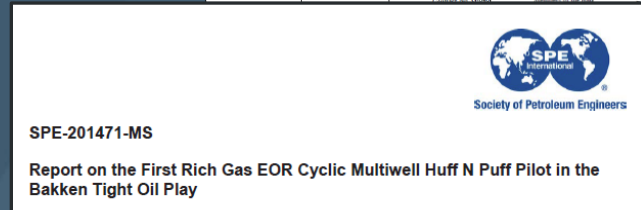
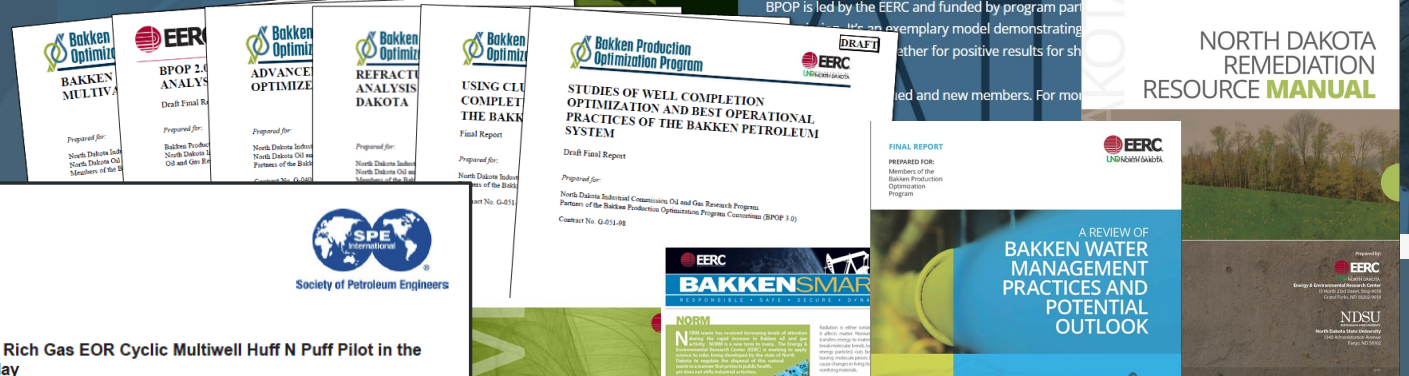
98 publicly available products on the BPOP Website, including:

- Topical reports
- PowerPoint presentations
- Fact sheets
- Resource Manuals and Primers
- Published papers
 - URTeC
 - SPE ATCE
 - AAPG



Bakken Production Optimization Program BPOP

We're working to improve Bakken system oil recovery and reduce its environmental footprint. The program's success is demonstrated in its results: we've increased well productivity and the economic output of North Dakota's oil and gas resources, decreased environmental impacts of wellsite operations, and reduced the demand for infrastructure construction and maintenance.



Tech Transfer Activities

- Webinars minimum of quarterly
 - 20 Webinars during BPOP 3.0 (~1 every 2 months)
- Conference papers and presentations
 - Williston Basin Petroleum Conference
 - Unconventional Resources Technology Conference (URTeC)
 - SPE Annual Technology Conference & Exhibit (ATCE)
- Participation in North Dakota Petroleum Council Task Forces
 - Flaring Reduction
 - TENORM
 - Crude Oil Vapor Pressure Management

- BPOP webinars and annual meetings are exclusive to BPOP industry members and NDIC.
- BPOP technical results are typically available exclusively to members for a period of 12 months, then released onto the BPOP public website.
- Results and products on time-sensitive challenges that affect the industry as a whole or the State will be released immediately after a brief member review period.
 - Ex: Flaring, crude oil vapor pressure mgmt, setbacks, proposed EPA rules, SWD pressure mgmt.

BPOP 4.0

Expected Results



**Increase productivity of
Bakken resources**



Decrease carbon Intensity

Questions?



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THANK YOU

Critical Challenges. Practical Solutions.

BPOP 4.0 Timeline

	BPOP 4.0 Year 1												BPOP 4.0 Year 2												BPOP 4.0 Year 3																											
	2023				2024								2025								2026																															
	S	O	N	D	J	F	M	A	M	J	J	A	S	O	N	D	J	F	M	A	M	J	J	A	S	O	N	D	J	F	M	A	M	J	J	A																
Project Management	D1 ▼				D1 ▼				D1 ▼				D1 ▼				D1 ▼				D1 ▼				D1 ▼				D1 ▼				D1 ▼				D1 ▼				D1 ▼				D2 ▼							
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Emerging Topics																																																				

Deliverables (D): D1 – Quarterly Progress Report; D2 – Final Report; Quarterly Topical Webinars (specific dates and topics to be determined).

Value to North Dakota

Ultimately, BPOP will provide broad technical and economic impacts. Each research task will have the potential to bolster oil and gas industry operations by improving resource recovery, decreasing costs, reducing environmental impacts, and increasing revenue.

With original oil in place (OOIP) estimates for Bakken Petroleum system ranging from 300 to 900 billion barrels, the impact of successful EOR operations alone could extend the lifetime of the play by decades, yielding billions of barrels of low-carbon-intensity incremental oil and billions of dollars of economic impact to North Dakota.

The demonstration and implementation of a technology to economically capture gas from smaller volume well locations would provide a significant economic and environmental benefit to the state and industry.