Developing Prototypes for Revitalizing Conventional Oil Fields in North Dakota

Presentation to the North Dakota Oil and Gas Research Program
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Investing in the Revitalization of North Dakota's Conventional Oil Production

Eagle Energy Partners is actively evaluating the acquisition of several North Dakota oil fields suitable for the proposed effort. Many have been screened as having a high near-term potential for EOR.

An example of one such opportunity is an ongoing evaluation of the Fryburg and Medora Fields.

Overview

Project results will enable operators, investors, regulators, and other stakeholders to make informed decisions regarding revitalization of North Dakota's vast conventional oil resources.

CO_2 enhanced oil recovery (EOR) potential in conventional fields >600 MMbbl oil.

Strategic Partnership

Eagle Energy Partners and the Energy & Environmental Research Center are committed to advancing EOR projects in North Dakota.

Goal and Objectives

GOAL:

Investigate waterflood optimization as a precursor for CO_2 EOR, and develop a prototype pathway for the revitalization of conventional oil fields in North Dakota (e.g., Tyler and Madison Formations).

OBJECTIVES:

1) Evaluate waterflood optimization and CO_2 EOR potential, and develop a pathway to implement CO_2 EOR in specific high-priority oil fields.

2) Develop cost-effective operational strategies that address key technical challenges, optimize current facilities, and consider necessary new facilities.

3) Frame the results and experiences from this project as a prototype for revitalizing unitized fields producing from Tyler and Madison Formations in North Dakota.

Benefits

- Positively affect ultimate recovery from North Dakota's conventional oil pools.
- Inform understanding of resource potential for Tyler and Madison oil fields.
- Enable the implementation of production practices not presently in use in North Dakota.
- Enable waterflood optimization in advance of first CO_2 EOR projects in conventional North Dakota fields.
- Provide education and outreach for industry and the public.
- Additional projects resulting in near-term jobs, additional tax revenues, and an increase in production/activity in areas outside of core Bakken development (i.e., diversification).
- Essential to achieving Governor Burgum's challenge of 2 MMbpd of oil and contributing to long-term economic growth in North Dakota.

EAGLE ENERGY PARTNERS LLC

- Experienced team of integrated operators, engineers, and investors who have worked in all aspects of the oil and gas industry for the past 35 years.
- Proven record of successfully applying secondary recovery techniques to multiple conventional oil fields in North Dakota.
- Technical expertise to revitalize and operate field (wells, infrastructure, etc.).
- Committed to working with the OGRP and the EERC to accomplish the goals and objectives of the project.

Strategic Partnership with the EERC

ABOUT THE Energy & Environmental Research Center (EERC)

- **The EERC manages about 300 contracts annually with over 1300 clients in 53 countries and all 50 states.**

- **Today's energy and environmental needs require the expertise of a total-systems team that can focus on technical details while retaining a broad perspective. The EERC has more than 65 years of experience providing solutions for clean, efficient energy production.**

- **The EERC's oil and gas experience is housed within its Center for Oil and Gas and the PCOR Partnership. The Center for Oil and Gas is a specialized technical group at the EERC focusing on design and implementation of new approaches to the exploration, development, and production of oil and gas.**

SERVICES AND SOLUTIONS

- **Resource assessments, CO_2 EOR, and geophysical interpretation.**
- **Petroleum engineering, geologic characterization, and reservoir simulation, including geophysics and seismic characterization.**
- **Geological analysis techniques, including petrophysical, geomechanical, geochemical, and minimum miscibility pressure testing.**
- **Produced fluids processing and pipelines.**

- Provide the investment needed to revitalize fields that can be used as a prototype to revitalize other North Dakota fields.
- Provide access to information and data.
- Provide reservoir and operational surveillance and collect new characterization data.
- Operate and update the field to accomplish objectives of study.
- Provide the practical operational know-how critical to the study.

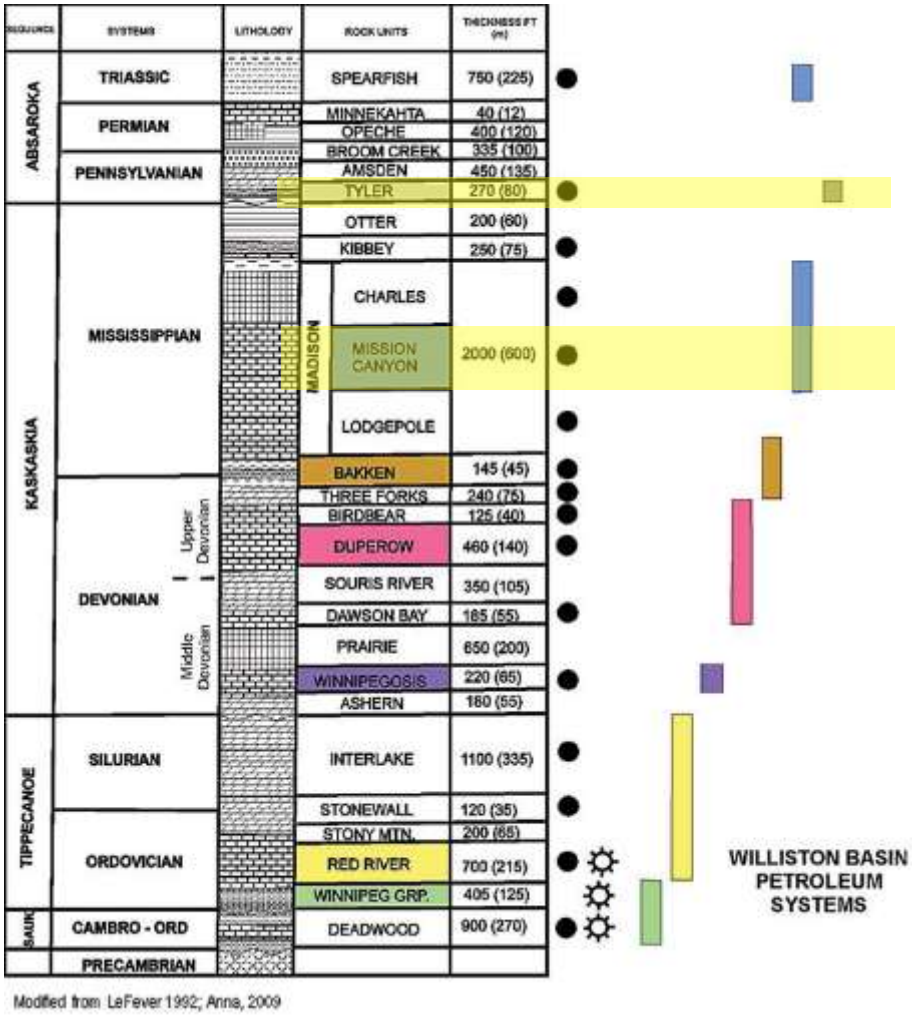
- Provide experience and proven track record for managing and reporting of OGRP projects.
- Generate geomodels and reservoir performance forecasts to support project goals.
- Conduct reservoir characterization, including new reservoir testing and laboratory-based rock and fluid studies to improve simulation performance.
- Prioritize infrastructure, operating schemes, and monitoring to optimize waterflood operations in preparation for CO_2 EOR.
- Create products that can guide stakeholders looking to revitalize conventional reservoirs in North Dakota.

Mission Canyon Waterflood Opportunity

Scale of Opportunity – A typical North Dakota field produces only 15% to 20% of the original oil in place.

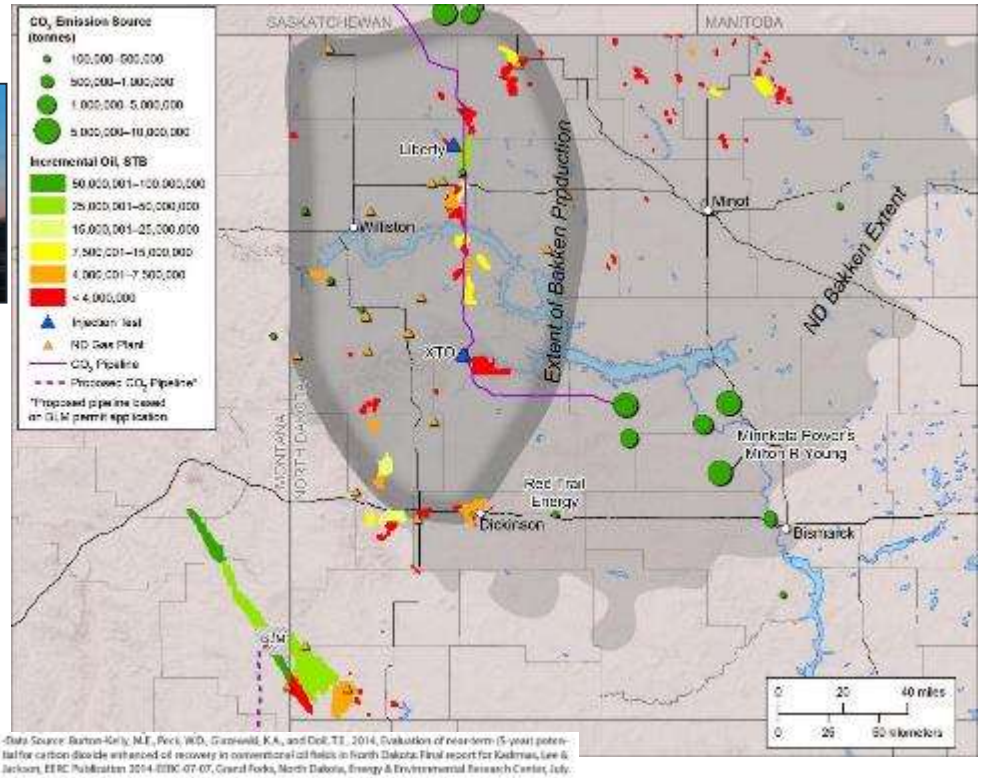
- Low-cost horizontal well development.
- High-quality reservoir does not require hydraulic fracture stimulation.
- Established production from vertical wells.
- Secondary and tertiary recovery

Targets of Proposed Research – Unitized Madison and Tyler Pools



Modified from LeFever 1992; Anna, 2009

Potential CO_2 Opportunity



In 86 conventional unitized oil fields identified as EOR targets with near-term potential:

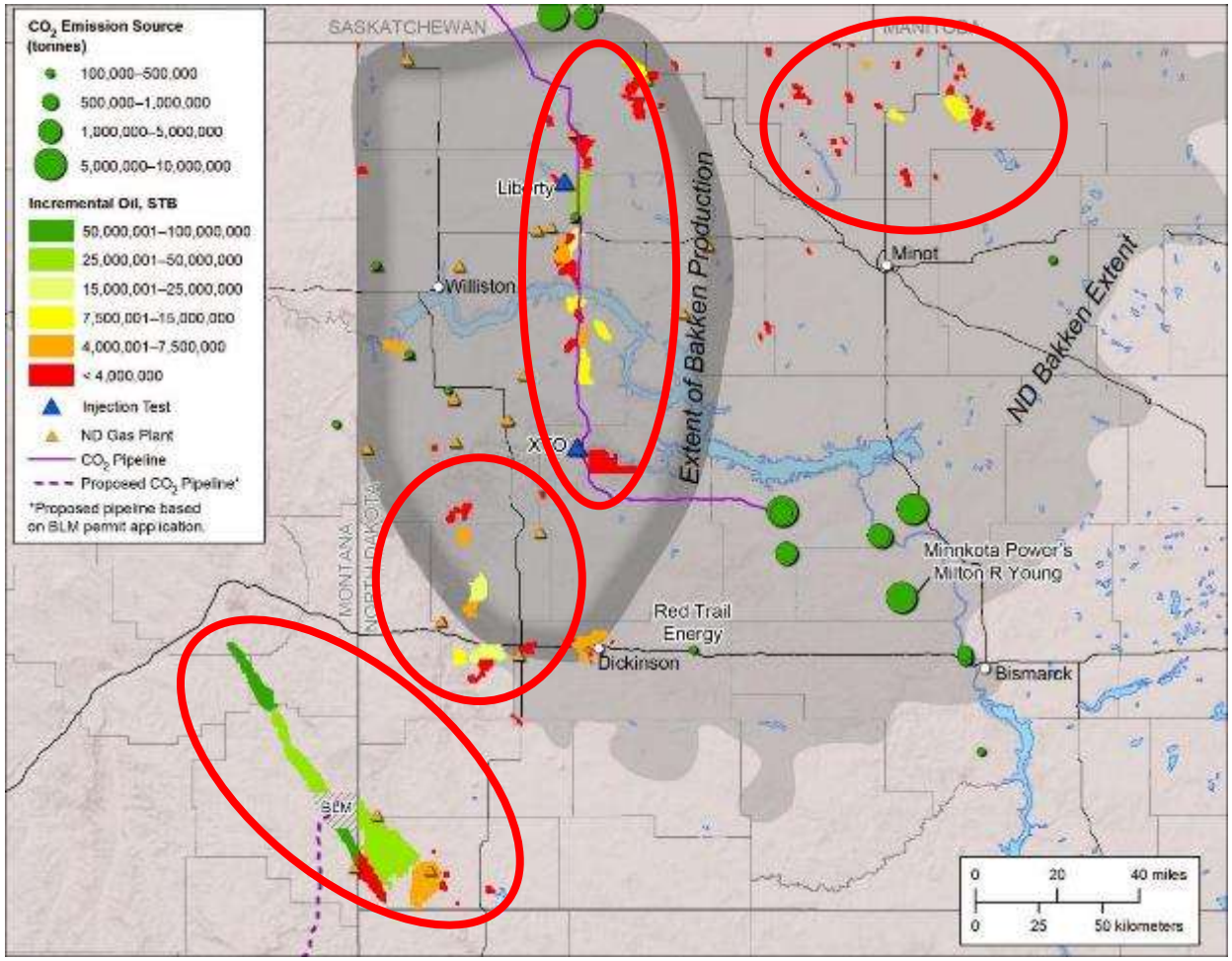
- 280 million to 630 million bbl of incremental oil
- 47 million to 283 million metric tons of CO_2 needed

- Conventionals combined with Bakken:
  - 4 Bbbl–7.6 Bbbl of incremental oil
  - 2 Btons–3.8 Btons of CO_2 needed

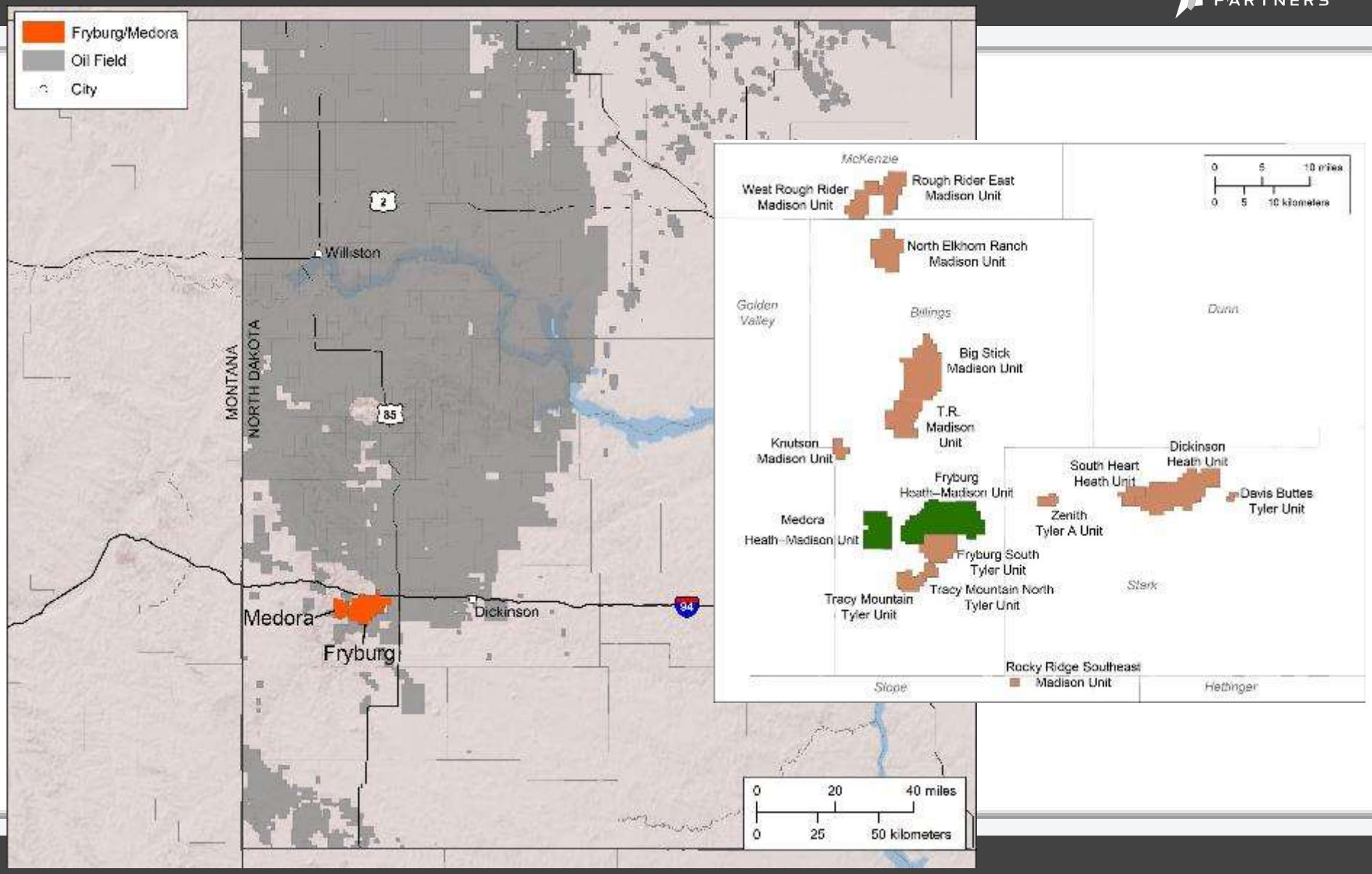
Investing in the Revitalization of North Dakota's Conventional Oil Production

Eagle Energy Partners is actively evaluating several North Dakota oil fields that have been identified as having a high near-term potential for EOR. Example of one such opportunity are the Fryburg and Medora Fields.

Several distinct populations of unitized fields have been identified as having high near-term potential for CO_2 EOR.



An Example Location and Analog Fields



Example Field Statistics and History

Formation	OOIP	Produced
Heath (Tyler)	72,470,000	19,457,262
Madison	70,000,000	16,388,736
Total	142,470,000	35,845,998

- **Fryburg Heath–Madison Unit discovered in 1953**
- **Water drive started 1973**
- **OOIP produced 25%**

Formation	OOIP	Produced
Heath (Tyler)	24,760,000	8,408,360
Madison	36,800,000	8,640,225
Total	61,560,000	16,669,768

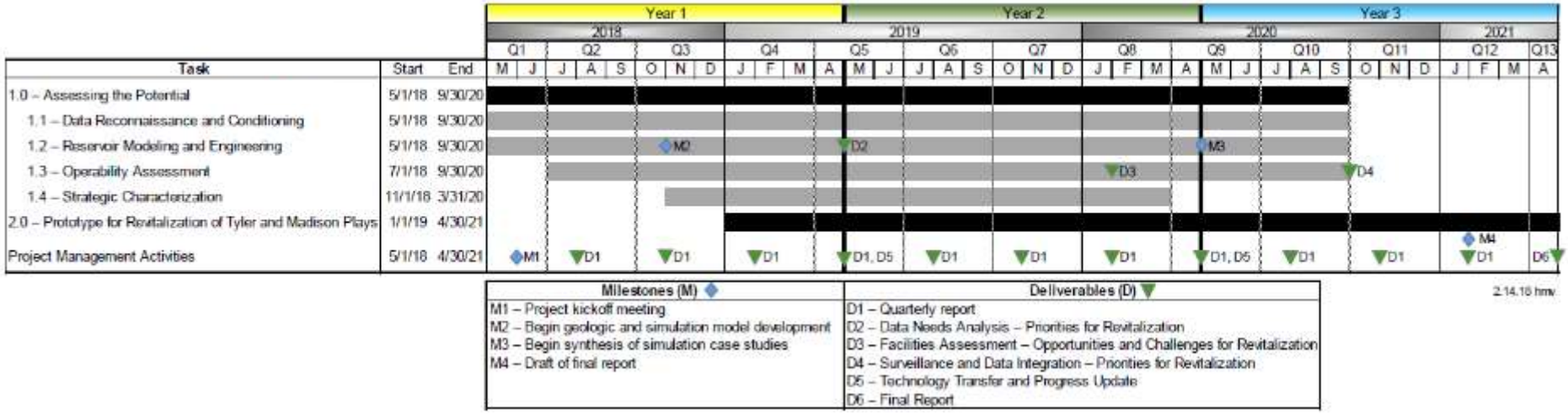
- **Medora Heath–Madison Unit discovered in 1964**
- **Water drive started 1967**
- **OOIP produced 27%**

Optimizing waterfloods in preparation for CO_2 EOR can play a role in enabling revitalization of oil fields. Fields with multiple producing horizons can provide opportunities of particular interest.

Budget

Project-Associated Expenses	NDIC Share (cash)	EEPT Share (cash)	Total Project
Labor	$1,747,601	$927,575	$2,675,176
Travel	$20,600	$5,286	$25,886
Supplies	$10,827	$3,173	$14,000
Communications	$352	$248	$600
Printing & Duplicating	$2,021	$385	$2,406
Food	$2,323	-	$2,323
Laboratory Fees & Services	$1,216,276	$563,333	$1,779,609
Total Project Costs	**$3,000,000**	**$1,500,000**	**$4,500,000**

Time Line



Milestones (M)	Deliverables (D)
M1 – Project kickoff meeting	D1 – Quarterly report
M2 – Begin geologic and simulation model development	D2 – Data Needs Analysis – Priorities for Revitalization
M3 – Begin synthesis of simulation case studies	D3 – Facilities Assessment – Opportunities and Challenges for Revitalization
M4 – Draft of final report	D4 – Surveillance and Data Integration – Priorities for Revitalization
	D5 – Technology Transfer and Progress Update
	D6 – Final Report

Request

- The estimated cost for the 3-year project is $6,000,000.
- We are requesting $3,000,000 from NDIC through its OGRP.
- EEPI is committed to providing at least $3,000,000 in cofunding as well as a substantial unenumerated value of free and ready access to wells, data, and facilities.
- Of EEPI's contribution, at least $1,500,000 will be in the form of engineering and field services (e.g., reservoir testing, well workovers, collection of fluid samples).

Amount of Request: $3,000,000
Total Amount of Proposed Project: $6,000,000
Duration of Project: 36 months

Highlights of Review Comments

The proposed project:

- Is **a necessary first step** toward developing tertiary recovery methods.
- Will clearly benefit research and education plus enhance industry viability.
- Could **spur other development** of older fields in North Dakota.
- **Will provide meaningful guidance** for CO_2 EOR in the Williston Basin (in particular the Heath/Tyler Fm.)
- Is based on a straightforward approach built on a strong method.
- Has a well thought out approach for **preparing for future EOR recovery** in North Dakota.
- Will be a good guide for future projects of this type, even if the future project is in a different reservoir.
- Is likely to produce results that **could significantly increase ultimate oil recoveries**.
- Will generate meaningful data that can be shared in the public domain.
- **Meets the goal of the OGRP mission** to promote research and education in the industry.
- Will be a good resource for future implementation of similar studies by others in the industry.
- Blends a traditional look at field development with newer technologies using the EERC's labs, equipment, and testing procedures.
- Is focused on addressing specific aspects of the petroleum present in these fields and **is worthy of significant study**.

Develop a pathway to economically revitalize North Dakota's conventional oil fields.

Incentivize new industry investment to North Dakota, resulting in the growth of oil and gas jobs, wealth, and tax revenues.

Contribute to the development of North Dakota's oil resources beyond the extent of current BPS production.

Thank You