Energy & Environmental Research Center
15 North 23rd Street, Stop 9018 • Grand Forks, ND 58202-9018 • P. 701.777.5000 • F. 701.777.5181
www.undeerc.org

July 25, 2022

Ms. Karlene Fine
Executive Director
North Dakota Industrial Commission
600 East Boulevard Avenue, Department 405
State Capitol, 14th Floor
Bismarck, ND 58505-0840

Dear Ms. Fine:

Subject: Quarterly Progress Report for the Period of April 1 – June 30, 2022 "Underground Storage of Produced Natural Gas – Conceptual Evaluation and Pilot Project(s) (HB 1014)"; Contract No. G-049-092; EERC Fund 23984

Attached please find the Energy & Environmental Research Center (EERC) Quarterly Progress Report for the subject project. If you have any questions, please contact me by phone at (701) 777-5050 or by e-mail at bkurz@undeerc.org.

Sincerely,

DocuSigned by:
Bethany Kurz
1518154149DD485...

Bethany A. Kurz
Director of Analytical Solutions

BAK/rlo

Attachment

c: Brent Brannan, North Dakota Industrial Commission

UNDERGROUND STORAGE OF PRODUCED NATURAL GAS – CONCEPTUAL EVALUATION AND PILOT PROJECT(S) (HB 1014)

Quarterly Progress Report

(for the period April 1 – June 30, 2022)

Prepared for:

Karlene Fine

North Dakota Industrial Commission
600 East Boulevard Avenue, Department 405
State Capitol, 14th Floor
Bismarck, ND 58505-0840

Prepared by:

Bethany A. Kurz
Matthew L. Belobraydic
Trevor L. Richards
Todd Jiang
Kevin C. Connors
Nicholas W. Bosshart
Jun He
Chantsalmaa Dalkhaa
Aldjia Boualam Djezzar
Neil W. Dotzenrod
Thomas P. McGuire
Chad A. Wocken
Joshua R. Strege
Merry D. Tesfu
Jin Zhao
Michael P. Warmack
John A. Harju
Charles D. Gorecki
James A. Sorensen
Ailin Assady
Teresa A. Bonev

Energy & Environmental Research Center
University of North Dakota
15 North 23rd Street, Stop 9018
Grand Forks, ND 58202-9018

July 2022

EERC DISCLAIMER

LEGAL NOTICE This research report was prepared by the Energy & Environmental Research Center (EERC), an agency of the University of North Dakota, as an account of work sponsored by the North Dakota Industrial Commission (NDIC). Because of the research nature of the work performed, neither the EERC nor any of its employees makes any warranty, express or implied, or assumes any legal liability or responsibility for the accuracy, completeness, or usefulness of any information, apparatus, product, or process disclosed or represents that its use would not infringe privately owned rights. Reference herein to any specific commercial product, process, or service by trade name, trademark, manufacturer, or otherwise does not necessarily constitute or imply its endorsement or recommendation by the EERC.

NDIC DISCLAIMER

This report was prepared by the EERC pursuant to an agreement partially funded by the Industrial Commission of North Dakota, and neither the EERC nor any of its subcontractors nor the North Dakota Industrial Commission nor any person acting on behalf of either:

(A) Makes any warranty or representation, express or implied, with respect to the accuracy, completeness, or usefulness of the information contained in this report, or that the use of any information, apparatus, method, or process disclosed in this report may not infringe privately owned rights; or

(B) Assumes any liabilities with respect to the use of, or for damages resulting from the use of, any information, apparatus, method, or process disclosed in this report.

Reference herein to any specific commercial product, process, or service by trade name, trademark, manufacturer, or otherwise does not necessarily constitute or imply its endorsement, recommendation, or favoring by the North Dakota Industrial Commission. The views and opinions of authors expressed herein do not necessarily state or reflect those of the North Dakota Industrial Commission.

TABLE OF CONTENTS

LIST OF TABLES

UNDERGROUND STORAGE OF PRODUCED NATURAL GAS – CONCEPTUAL EVALUATION AND PILOT PROJECT(S) (HB 1014)
Quarterly Progress Report
April 1 – June 30, 2022

EXECUTIVE SUMMARY

The Energy & Environmental Research Center (EERC) is performing a project to directly address the intent of Section 25 of House Bill 1014 of the Sixty-Sixth Legislative Assembly of North Dakota as signed into law by Governor Burgum, which states that funding will be made available to the EERC for "pilot projects relating to the underground storage of produced natural gas." The overall goal of the proposed effort is to demonstrate the techno-economic feasibility of produced natural gas ("produced gas") injection into non-hydrocarbon-producing subsurface formations in the Williston Basin for future recovery and use or for pressure maintenance and/or enhanced oil recovery (EOR) in a conventional or unconventional oil reservoir. To achieve the project goal, the EERC will partner with North Dakota oilfield producers on up to three pilot project efforts to define and assess the key technical, economic, and regulatory components of each approach.

A report highlighting the activities performed in conjunction with Marathon Oil Company (Marathon) to evaluate a larger-scale gas injection project was prepared and is currently under internal review. Regulatory discussions and modeling and simulation activities continued with Marathon regarding a smaller-scale pilot project.

The Maroon Bells Partners, LLC (Maroon Bells) collaboration with the EERC on the evaluation and potential implementation of a produced gas pilot program was finalized. Technical work was completed and summarized in a draft interim report as described in the Maroon Bells Gas Storage Pilot section.

The East Nesson Rich Gas EOR Pilot project continued with project partners Liberty Resources, LLC, and EOR ETC, LLC. Weekly and biweekly project meetings have been ongoing to update the project partners on the pilot planning, execution, operation, modeling, and simulation work throughout the quarter. Continuous and periodic data collected from the pilot as part of the reservoir surveillance program continued to be monitored, processed, and analyzed to evaluate the performance of the ongoing pilot test at the site. Additional new, post-pilot producing pressure data of the offset wells at the East Nesson EOR Pilot site were collected and integrated into the simulation model.

Liberty Resource is making plans for a second EOR injection cycle at the East Nesson EOR Pilot site with a goal of applying the lessons learned in the first cycle to optimize EOR operations. A water alternating gas (WAG) injection scenario and possibly a foam injection are being considered as part of the second injection cycle. The next injection cycle will use a standard gas compressor, not EOR ETC's water-assisted gas injection technology, thus it will allow for a direct comparison of costs and efficacy of both technologies for subsurface gas injection.

The EERC continues work on a comprehensive summary of gas capture policy changes over the last 15 years and an underground gas storage-permitting template to accompany the new underground gas storage rules adopted by the North Dakota Industrial Commission in April 2022.

UNDERGROUND STORAGE OF PRODUCED NATURAL GAS – CONCEPTUAL EVALUATION AND PILOT PROJECT(S) (HB 1014)
Quarterly Progress Report
April 1 – June 30, 2022

INTRODUCTION

The Energy & Environmental Research Center (EERC) is performing a project to directly address the intent of Section 25 of House Bill (HB) 1014 of the Sixty-Sixth Legislative Assembly of North Dakota as signed into law by Governor Burgum, which states that funding will be made available to the EERC for "pilot projects relating to the underground storage of produced natural gas." The overall goal of the proposed effort is to demonstrate the techno-economic feasibility of produced natural gas ("produced gas") injection into non-hydrocarbon-producing subsurface formations in the Williston Basin for future recovery and use or for pressure maintenance and/or enhanced oil recovery (EOR) in a conventional or unconventional oil reservoir. To achieve the project goal, the EERC will partner with North Dakota oilfield producers on up to three pilot project efforts to define and assess the key technical, economic, and regulatory components of each approach.

The primary project objectives are to evaluate the viability of various subsurface formations as storage and/or injection targets, document the facilities and equipment needs and costs for produced gas injection, predict the subsurface storage footprint of the injected gas plume over time, predict gas recovery efficiencies, develop a monitoring plan, and summarize the required regulatory considerations for different injection/storage scenarios. The above information will be obtained from a combination of research activities performed at the EERC and from up to three pilot projects performed in partnership with and including substantial financial investment from oilfield operating companies.

ACCOMPLISHMENTS DURING REPORTING PERIOD

Program Management and Reporting

Marathon Oil Corporation (MRO) continued to partner with the EERC on the project, participating in exploratory activities to evaluate the potential implementation of produced gas injection pilot project. Marathon is still working in conjunction with the EERC to evaluate potential options for a gas storage pilot project. Technical work is ongoing as described in the Marathon Gas Storage Pilot section.

Work has continued compiling research and information for a white paper and information primer on flaring, gas capture, and infrastructure development in western North Dakota (associated with Bakken development).

Maroon Bells Partners, LLC (Maroon Bells) collaboration with the EERC on the evaluation and potential implementation of a produced gas pilot program was finalized.

Technical work was completed and summarized in a draft interim report as described in the Maroon Bells Gas Storage Pilot section.

Regulatory Considerations

The EERC will work closely with the project partners and the North Dakota Industrial Commission (NDIC) Department of Mineral Resources to define key regulatory considerations for each pilot. The EERC will work with project partners to obtain the necessary permits for each pilot project and to review and implement any site-monitoring requirements

New gas storage rules based on language contained in Senate Bill (SB) 2065 (2021 legislative session) went into effect on April 1, 2022. Based on the new rules and guidance, the EERC is currently compiling a summary of the key permitting requirements needed for temporary subsurface gas storage.

The EERC is working on a comprehensive summary of flaring and gas capture policy changes over the last 15 years. The white paper will summarize flaring, gas capture, and infrastructure development in western North Dakota (associated with Bakken development) and the policies North Dakota has put in place in response to increased production and subsequent flaring of gas.

Marathon Gas Storage Pilot

Specific progress and activities during the reporting quarterly period include the following:

Evaluated additional area of interest (AOI) per MRO's request. Different injection scenarios have been evaluated, including injection locations, injection rates, injection pressure and injection duration.

Completed all technical assessments. Discussed the results with MRO regarding the differences between the two AOIs and different injection scenarios. Provided MRO with all the technical assessment results for their internal decision-making process.

The draft interim report summarizing key findings from the simulation activities will be finalized for internal review

East Nesson Pilot

Specific progress and activities during the reporting quarterly period include the following:

Weekly and biweekly project meetings have been ongoing to update the project partners on the pilot planning, execution, operation, modeling, and simulation work throughout the quarter.

Continuous and periodic data from the East Nesson pilot site as part of the reservoir surveillance program is still being collected, processed, and analyzed to evaluate the performance of the ongoing pilot test at the site.

Liberty Resource is making plans for a second EOR injection cycle at the East Nesson EOR Pilot site with a goal of applying the lessons learned in the first cycle to optimize EOR operations. During this injection cycle, standard gas compression will be used to inject the rich gas into the subsurface. This will allow for a direct comparison of the costs and performance of EOR ETC's gas injection technology with traditional gas compression techniques.

A report summarizing the performance of EOR ETC's gas injection technology was prepared and is undergoing internal review. The results and data that we derive from the second injection cycle at the East Nesson pilot site using standard gas compression techniques will be used as a point of comparison to best assess the cost and performance of both technologies for subsurface gas injection.

FUTURE ACTIVITIES

The planned activities for the next quarter are detailed as follows.

Program Management and Reporting

The interim report highlighting the key findings and lessons learned from the evaluation of the Marathon full-scale pilot project is complete and in internal review.

The Maroon Bells draft interim report summarizing key findings from the simulation activities is completed.

The white paper and information primer on flaring, gas capture, and infrastructure development in western North Dakota (associated with Bakken development) will be complete and will undergo internal review.

The document summarizing the key permitting requirements needed for temporary subsurface gas storage will be completed and will undergo internal review.

EERC staff, including members of the project team, will participate in a multiday event during the week of July 25–29. This in-person-only event will occur at the EERC facility in Grand Forks, North Dakota, and will comprise training on EERC functions related to research management and execution, team meetings, and team building.

East Nesson Pilot

The modeling and simulation work of WAG injection scenarios will continue for design optimization.

The compressor required for gas injection will be moved on-site and the surface facilities will be prepared for the second gas injection cycle.

PARTNERS AND FINANCIAL INFORMATION

The project is sponsored by NDIC's Oil and Gas Research Program. Table 1 shows the budget of $6,000,000 from NDIC, as listed in HB 1014, and expenses through the reporting period. Once specific pilot project(s) are identified, attendant detailed budgets will be developed. It is expected that pilot project partner(s) will provide substantial cost share that will be documented to the greatest degree possible.

Table 1. Budget and Expenses to Date

Sponsors	Budget	Actual Expenses as of 6/30/22	Balance
NDIC	$6,000,000	$2,821,421	$3,178,579
Industry Share – In-Kind	$6,000,000	$2,602,127	$3,397,873
Total	**$12,000,000**	**$5,423,548**	**$6,576,452**