



April 26, 2018

Ms. Karlene Fine  
Executive Director  
North Dakota Industrial Commission  
State Capitol, 10th Floor  
600 East Boulevard Avenue  
Bismarck, ND 58505-0310

Dear Ms. Fine:

Subject: Quarterly Progress Report Entitled “Integrated Carbon Capture and Storage for North Dakota Ethanol Production – Phase II”; Contract No. R-034-043

Attached is the subject report for the period of January 1, 2018, through March 31, 2018, that shows the progress that has been made with partners of this project.

Thank you for funding this work. If you have any questions, please contact me by phone at (701) 777-5013 or by e-mail at [kleroux@undeerc.org](mailto:kleroux@undeerc.org).

Sincerely,

Kerryanne M. Leroux  
Senior Chemical Engineer, Oilfield Operations  
Team Lead

KML/kal

Attachment

c/att: Michael Holmes, LEC



---

# INTEGRATED CARBON CAPTURE AND STORAGE FOR NORTH DAKOTA ETHANOL PRODUCTION – PHASE II

Quarterly Progress Report

*(for the period of January 1, 2018, through March 31, 2018)*

*Prepared for:*

Karlene Fine

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

Project Period: November 1, 2016 – May 31, 2020  
Contract No. R028-039

*Prepared by:*

Kerryanne M. Leroux

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

April 2018

## **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 North Dakota Industrial Commission. 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 Energy & Environmental Research Center (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 ..... i

ACCOMPLISHMENTS ..... 1

    Major Goals of the Project ..... 1

    Accomplishments under These Goals ..... 1

        Task 1.0 – Establish Permitting Pathways..... 1

        Task 2.0 – Update Infrastructure Design..... 2

        Task 3.0 – Update Economic Analysis..... 3

        Task 4.0 – Develop Community Outreach Plan ..... 3

    Plan for the Next Reporting Period to Accomplish the Goals ..... 4

PARTNERS AND FINANCIAL INFORMATION..... 4

PRODUCTS..... 4

    Publications, Conference Papers, and Presentations..... 4

    Web Site(s) or other Internet Site(s), Technologies or Techniques, Patent Applications, and/or Licenses ..... 5

CHANGES/PROBLEMS ..... 5

**LIST OF TABLES**

1 Budget and Expenses Through the Reporting Period ..... 4

# INTEGRATED CARBON CAPTURE AND STORAGE FOR NORTH DAKOTA ETHANOL PRODUCTION – PHASE II

## ACCOMPLISHMENTS

### Major Goals of the Project

The ultimate goal of this effort is implementation of a small-scale (<200,000 metric tons, or tonnes, CO<sub>2</sub> per year) commercial carbon capture and storage (CCS) system at an industrial fuel production facility to generate a reduced-carbon ethanol fuel applicable for low-carbon fuel programs. To achieve that goal, the Energy & Environmental Research Center (EERC), in partnership with the North Dakota Industrial Commission (NDIC); North Dakota ethanol producer, Red Trail Energy (RTE); and the U.S. Department of Energy (DOE), is conducting a continuation study to reduce knowledge gaps in regulatory, processing, and financial requirements for implementing commercial CCS at a North Dakota ethanol production facility and proximate geologic injection site.

### Accomplishments under These Goals (for the reporting period)

Specific research objectives are to 1) establish the permitting pathway for geologic storage of CO<sub>2</sub> for a North Dakota ethanol producer, 2) understand low-carbon fuel (LCF) program approval pathways for CCS (and any anticipated future guidelines), 3) collect and analyze gas composition data, 4) refine the Phase I project design, 5) improve the Phase I economic analysis, and 6) develop a community outreach plan for a CCS project at the RTE facility.

#### *Task 1.0 – Establish Permitting Pathways*

This task will continue collaboration with the California Air Resources Board (ARB) and the Oregon Department of Environmental Quality (DEQ) to understand qualification requirements for their respective LCF programs, using CCS as a means to reduce CO<sub>2</sub> emissions, as well as work with the North Dakota Department of Mineral Resources (DMR) to establish the appropriate compliance criteria for a Class VI injection well permit under North Dakota primacy. Permitting time lines and activities outlined in the FIP developed during Phase I will be revised if needed.

Significant accomplishments for Task 1.0 during the reporting period include the following.

#### *LCF Programs*

- Reviewed California ARB's draft CCS protocol document released for public comment, which details the proposed requirements for including CCS into a potential LCF pathway for generating carbon credits.

- Participated in Oregon DEQ's first Advisory Board Meeting on February 1, 2018, via Webinar, discussing the development of its Clean Fuels Program (CFP).
- Traveled to Portland, Oregon, March 21–22, 2018, to discuss the draft CCS monitoring plan and CFP time line/direction with Oregon DEQ.
- Identified contacts within British Columbia's LCF Program and compiled/reviewed current program documents.

#### *North Dakota Class VI Program*

- Continued communication with DMR regarding the public comment and hearing schedule for California ARB's draft CCS document, noting significant differences from the North Dakota CCS program, particularly with regard to monitoring and reporting requirements.
- Communication with DMR regarding CFP development by Oregon DEQ to potentially incorporate CCS requirements into permit.
- Potential complexities with regard to regulating CCS between state entities are being identified.

#### *Update Phase I FIP*

- No significant accomplishments for this activity have been conducted during the reporting period, as they will begin in the next quarter.

#### ***Task 2.0 – Update Infrastructure Design***

The focus of this task is to reduce uncertainty in the designs of capture technology, pipeline, and injection wells through sampling and analysis of fermenter gas. A gas-sampling program will be conducted to define variability in the CO<sub>2</sub> stream. The results of the gas composition measured will be used to inform and revise project infrastructure design. The life cycle analysis (LCA) conducted during Phase I will be revised if needed.

Significant accomplishments for Task 2.0 during the reporting period include the following.

#### *Collect and Analyze Fermentation Exhaust Gases*

- The EERC traveled to the RTE facility in Richardton, North Dakota, on March 20, 2018, to conduct sampling of the CO<sub>2</sub> stream for compositional analysis. Successfully collected nine samples through the duration of the fermentation process.
- Completed RTE CO<sub>2</sub> stream sampling analyses of all samples collected, which showed no oxygen content down to 100-ppm detection.

### *Modify Design*

- Results of the CO<sub>2</sub> analysis indicate that a capture system designed for dedicated geologic storage would not require oxygen removal; therefore, no design changes are anticipated.

### *Refine LCA*

- No significant accomplishments for this activity have been conducted during the reporting period, as they will begin in the next quarter.

### ***Task 3.0 – Update Economic Analysis***

Revision of the economic assessment refines the estimated costs and benefits of combining commercial CCS with ethanol production at the RTE site conducted during Phase I. These updates will be based on any changes in CCS implementation requirements and related costs or potential revenue through developing LCF Programs, derived from the outcomes of Tasks 1.0 and 2.0, as well as detailed costs not considered during Phase I.

Significant accomplishments for Task 3.0 during the reporting period include the following:

- Reviewed the revised 45Q tax credit (from the Bipartisan Budget Act of 2018) to incorporate in the project's estimated economics.
- Updated potential revenue estimates from Phase I with current carbon market values from California and Oregon LCF Programs.

### ***Task 4.0 – Develop Community Outreach Plan***

This task will assess the population characteristics in and around the RTE site to develop a project-specific outreach plan. These efforts will provide a model for outreach that can be applied at other facilities and, when carried out, will contribute to public understanding and acceptance of CCS implementation.

Significant accomplishments for Task 4.0 during the reporting period include the following:

- Completed compilation and preliminary review of social characterization information/background for Stark County, North Dakota.
- Catalogued RTE CCS public media coverage (2016 to present) to assess level and frequency of reporting and exposure to information thus far.
- Held Webinar with RTE February 21, 2018, to review and discuss the outreach planning approach.

- Completed the first draft of the outreach plan (in five “batches”) for internal review and subsequent RTE review; first and second draft batches now completed with RTE review.
- Updated fact sheet generated during Phase I to include Phase II efforts.

**Plan for the Next Reporting Period to Accomplish the Goals**

Complete all technical work or near completion to begin the outcomes assessment. Specifically, explicit data needs will be determined, including but not limited to North Dakota’s pore space amalgamation rules, site characterization, baseline monitoring acquisition, permitting, site preparation and, as appropriate, ARB and DEQ monitoring and accounting requirements. In addition, cost estimates will incorporate these findings and include detailed costs such as electrical upgrade and ancillary storage expenses (as applicable). Refinement of results generated thus far may also be performed as more information becomes available from these activities.

**PARTNERS AND FINANCIAL INFORMATION**

This project is sponsored by the NDIC Renewable Energy Program, DOE, and RTE. Table 1 shows the budget of \$690,000 for this project and expenses through the reporting period.

**Table 1. Budget and Expenses Through the Reporting Period**

<b>Sponsor</b>	<b>Budget</b>	<b>Expenses</b>	<b>Remaining</b>
NDIC Cash	\$345,000	\$39,687	\$305,313
DOE Cash	\$200,000	\$47,420	\$152,580
RTE In-Kind	\$145,000	\$–	\$145,000
<b>Total Project</b>	<b>\$690,000</b>	<b>\$87,107</b>	<b>\$602,893</b>

**PRODUCTS**

**Publications, Conference Papers, and Presentations**

- An abstract was submitted January 5, 2018, to the International Conference Greenhouse Gas Control Technologies (GHGT-14) panel for consideration to present at the Melbourne conference in October 2018.
- An update of the project was presented to the Oregon DEQ in relation to the emerging CFP developments; the updated fact sheet was also distributed.

**Web Site(s) or other Internet Site(s), Technologies or Techniques, Inventions, Patent Applications, and/or Licenses**

- The project now has a dedicated Web page on EERC's Plains CO<sub>2</sub> Reduction (PCOR) Partnership site, summarizing the overall effort:  
[www.undeerc.org/pcor/CO2SequestrationProjects/RedTrail.aspx](http://www.undeerc.org/pcor/CO2SequestrationProjects/RedTrail.aspx)
- The University of North Dakota online news, UND Today, published an article March 22, 2018, focused on the project: <http://blogs.und.edu/und-today/2018/03/catch-and-decrease/>

**CHANGES/PROBLEMS**

None.