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

August 4, 2025

Mr. Jordan Kannianen
Deputy Executive Director
North Dakota Industrial Commission
ATTN: Oil and Gas Research Program
State Capitol – 14th Floor
600 East Boulevard Avenue, Department 405
Bismarck, ND 58505-0840

Dear Mr. Kannianen:

Subject: EERC Proposal No. 2025-0153, Entitled "Development of Next-Generation Carbon Capture Technologies for Efficiency Improvement and Cost Reduction"

The Energy & Environmental Research Center (EERC) at the University of North Dakota is pleased to submit the subject proposal to the Oil and Gas Research Program. The $100 application fee is provided through ACH transaction number 291426. The EERC is committed to completing the project as described in the proposal if the commission makes the requested grant.

If you have any questions, please contact me by telephone at (701) 777-5171 or by email at tsnyder@undeerc.org.

Sincerely,

Signed by:
Tony Snyder
E676FEA3DD5342B...

Tony C. Snyder
Assistant Director for Advanced Energy Technology

Approved by:

DocuSigned by:
29499751F2B84D7...

Charles D. Gorecki, CEO
Energy & Environmental Research Center

TCS/rlo

c: Erin Stieg, North Dakota Industrial Commission

Oil and Gas Research Program

North Dakota

Industrial Commission

Application

Project Title: Development of Next-Generation Carbon Capture Technologies for Efficiency Improvement and Cost Reduction

Applicant: University of North Dakota Energy & Environmental Research Center

Principal Investigator: Tony C. Snyder

Date of Application: August 4, 2025

Amount of Request: $375,000

Total Amount of Proposed Project: $6,095,833

Duration of Project: 12 Months

Point of Contact (POC): Tony C. Snyder

POC Telephone: (701) 777-5171

POC Email Address: tsnyder@undeerc.org

POC Address: 15 North 23rd Street, Stop 9018
Grand Forks, ND 58202-9018

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ABSTRACT

Objective: The University of North Dakota (UND) Energy & Environmental Research Center's (EERC's) existing engineering-scale carbon dioxide (CO_2) capture test center will be enhanced to rapidly and cost-effectively test carbon capture (CC) technologies and evaluate the technical efficacy of advanced systems with data generated under relevant power plant operating conditions. The test center will accelerate the development of next-generation CC technologies, which will provide additional sources of low-cost CO_2 for use in enhanced oil recovery (EOR) operations in North Dakota (ND) and support the commercial demonstration and qualification of commercial technologies for installation on prospective natural gas combustion facilities in the state.

Expected Results: Existing EERC combustion units, supporting facilities, and equipment (compressors, gas cleanup systems, and infrastructure) will be designed, modified, and/or fabricated to support testing and evaluation of promising CO_2 capture technologies. Augmenting test center capabilities will increase testing capacity, reduce costs, and accelerate the deployment of cost-effective commercial-scale CC technologies applicable to natural gas combustion and power generation applications.

Duration: The period of performance for the proposed project is 12 months, which is the first year of a 5-year project for which the EERC is partnering with the U.S. Department of Energy (DOE).

Total Project Cost: For Year 1, a cash contribution of $375,000 from North Dakota Industrial Commission (NDIC) Oil and Gas Research Program (OGRP) will be paired with $1,462,500 from the NDIC Lignite Research Program (LRP) to be used as cost share toward a DOE contribution of $4,258,334 for a total budget of $6,095,833.

Participants: In addition to DOE, LRP, and OGRP, the EERC has received letters of support from at least 21 entities interested in the use of the test center after equipment upgrades are complete. The EERC has also acquired letters of commitment from the former North Dakota governor, both sitting North Dakota state senators, and the current governor (while a former North Dakota state house representative).

PROJECT DESCRIPTION

The EERC was selected for contract negotiations with DOE under Funding Opportunity Announcement DE-FOA-0003365 Carbon Capture, Removal, and Conversion Test Centers. The EERC is uniquely poised to address the DOE goal to establish CC test centers due to two decades of experience with engineering-scale demonstration and evaluation of over 200 various technologies for CC. Thousands of combined hours of testing have been conducted under industrial conditions by combusting or gasifying virtually any carbon-based fuel such as coal, natural gas, biomass, oil, biofuels, and plastics.

The proposed DOE project timeline is 5 years with a total DOE share of $15 million that requires a minimum 30% cost share. Funding availability from DOE is anticipated by October 1, 2025. This proposal to the OGRP is asking for a portion of the Year 1 cost share funding, which will be combined with funding from NDIC LRP. The EERC will also pursue additional cost share from providers such as utility partners and third-party CC technology developers as the project progresses.

OGRP investment in the proposed project to upgrade the integrated test facility at the EERC will accelerate the development and implementation of next-generation CC technologies, enabling the continued responsible use of North Dakota's oil and gas resources while complying with federal emissions regulations and corporate environmental targets. The upgrades will facilitate the development, demonstration, and qualification of commercial technologies being considered for installation on prospective North Dakota natural gas combustion and power generation facilities. The updated and expanded CC technology development and pilot demonstration facilities at the EERC will accommodate next-generation capture technologies, including those applicable to new in-state natural gas power generation facilities.

The policy changes to Section 45Q tax credit from the recently passed federal bill H.R.1, which increases the credit of captured CO_2 for EOR to $85 per metric ton, are anticipated to significantly increase commercial interest in CC for EOR. The improved financial viability will promote CO_2 as a resource and

expand investments, which heightens the importance of and creates opportunities for this proposed CC test center.

Objectives

The EERC's existing engineering-scale CO_2 capture, removal, and conversion test center has been used by more than two dozen third-party technology providers over the last 20 years. It will be enhanced to rapidly and cost-effectively test the next generation of CC technologies and evaluate the technical efficacy of advanced systems with data generated under relevant power plant operating conditions. This will include expanded testing capabilities to the lower CO_2 concentrations associated with natural gas power generation. The augmented test center will host multiple technologies simultaneously and fully support multiday, continuous, 24-hour-a-day test campaigns, providing coal- or natural gas-derived flue gas rates up to 5000 lb/hr with CO_2 concentrations between 4% and 15%, or as otherwise required.

Equipment and infrastructure will be upgraded during the first 2 years of the project. Three existing EERC combustion/gasification units—the transport reactor demonstration unit (TRDU), particulate test combustor (PTC), and combustion test facility (CTF)—will be enhanced to produce flue gas continuously at the required rate and expanded compositions, which include lower concentrations representative of natural gas combustion and power generation applications. Various equipment such as compressors, heat exchangers, gas cleanup systems, and fuel preparation systems will be designed, procured, modified, and/or constructed. Test center infrastructure and support systems, such as electrical capacity and safety features, will be augmented to simultaneously test multiple technologies. Equipment upgrades for the CTF and PTC will be completed in Year 1 and available for testing in Year 2. The TRDU upgrades and facility infrastructure will be completed in Year 2.

Third-party CC technologies will primarily be evaluated in the latter 3 years of the project. Candidate technologies will be identified, screened, and selected for integration. Engineering design reviews, hazard

and operability safety studies, environmental reviews, and test plans will be completed. After each test campaign, equipment will be decommissioned, and a summary test report will be delivered.

Utilities, coal mines, and representatives from the oil and gas industry in North Dakota and the surrounding region have expressed interest in the test center through letters of support. Technology developers have also expressed strong interest in the program (Appendix A).

Methodology

Year 1 will consist of multiple tasks, including project management and planning, environmental permitting and National Environmental Policy Act (NEPA) compliance, equipment and facility design, and equipment and facility construction. All construction will be completed by Year 2, and testing of third-party CC technologies will primarily be conducted in Years 3–5.

Task 1.0 – Project Management and Planning: EERC will ensure the project stays within budget and on schedule, while achieving all project objectives. The project management plan will be updated and the host-site agreement for the test center will be finalized. The EERC will apply financial and business plans to ensure non-DOE cost share funding remains obtainable.

Task 2.0 – Environmental Permitting and NEPA Compliance: The project team will complete the required environmental health and safety (EH&S) analyses and applications necessary to obtain permits and NEPA approval. A hazard and operability (HAZOP) study will be performed for the proposed test center, resulting in EH&S corrective action if necessary.

Task 3.0 – Equipment and Facility Design: The EERC has identified multiple pieces of equipment needing upgrades to operate the CC test center on a continuous 24/7 basis. The EERC will develop detailed designs for enhancing combustion/gasification systems (TRDU, PTC, and CTF) along with fuel preparation equipment, fuel storage units, and new multiple technology testing bays.

Task 4.0 – Equipment and Facility Construction: A preliminary analysis has determined that the following combustion equipment and test center infrastructure will need upgrades to operate 24/7 with multiple CC technologies.

Subtask 4.1 – Transport Reactor Demonstration Unit: Several unit operations on the TRDU will be upgraded, which includes compressors, cooling tower, solids heat exchanger, and pollution control devices.

Subtask 4.2 – Particulate Test Combustor and Combustion Test Facility: Equipment upgrades required include controls system modernization, fuel feed system modification, flue gas pollution control upgrades, and safety system updates.

Subtask 4.3 – Fuel Preparation and Storage Systems: Equipment additions or upgrades in the fuel preparation facility are required for the material handling and processing units, storage bunkers, coal dryer, and natural gas supply.

Subtask 4.4 – Test Center Facilities: Multiple, individual test bays with utilities, safety systems, and supporting equipment will be added.

Anticipated Results

By the end of Year 1, the engineering team will have completed the equipment and facility modification designs. Once DOE approves the design package, equipment procurement and construction will commence on the combustion units and supporting facilities. The CTF and PTC upgrades will be completed by the end of Year 1. Safety, permitting, and NEPA compliance activities will be completed as required.

Facility, Resources, and Techniques to Be Used; Their Availability and Capability

The EERC has more than 254,000 ft^2 of facility space, on a single 15-acre lot, which has analytical laboratories, technology demonstration, and offices to support the test center. Fuel processing for coal and biomass includes a max 2000 lb/hr capacity of crushing with additional ability for shredding and classifying, and the proposed infrastructure work will augment this to process, handle, and store

challenging fuels such as wet coal, biomass, and mixed waste. In addition, the EERC is constructing the 28,700-ft^2 Material Exploration (MatEx) facility, which could house and simultaneously test multiple CC technologies.

The EERC will be responsible for overall project management, safety and permitting, and test center design and equipment modification. All personnel are sufficiently available and are otherwise not overburdened with other responsibilities to complete the proposed project.

Design and Process Engineering: EERC has over 75 staff in chemical, mechanical, petroleum, and other various disciplines of engineering and sciences to design and analyze new systems and technologies. Engineers will create process flow diagrams, piping and instrumentation diagrams, and mechanical drawings, which are overseen and approved by in-house, registered, professional engineers. Engineering and operations staff will identify and mitigate risks with a rigorous HAZOP safety review. Process controls and standard operating procedures will ensure proper operation of the test equipment.

Equipment Operation and Maintenance: EERC employs operations staff that include experienced and licensed welders, plumbers, electricians, and other fabricators who both build and operate engineering-scale equipment. Along with equipment operation, this staff also performs campaign preparation activities, maintenance and repairs, and equipment decommissioning. The team of design and process engineers is available to assist the operations staff, and they regularly participate in technology demonstrations and test campaigns to assist and troubleshoot technical issues as necessary.

Facility Environmental Health and Safety: As part of UND, EERC can utilize university- and state-level support for EH&S, and EERC also directly employs a dedicated EH&S team with specializations in chemicals, processes, and other hazard concerns unique to the EERC's experimental work. Such efforts include completion of NEPA forms, tracking of allowable material on hand, safe disposal of waste materials, electrical compliance, plume modeling, continuous emissions monitoring and reporting, and others.

Environmental and Economic Impacts while Project is Underway

The EERC will perform the necessary EH&S procedures. The EERC will use in-house experts to evaluate emissions and waste streams, including those from by-product reactions. The toxicological effects of the substances will be identified and researched. Safety data sheets will be identified or created as necessary. Hazardous materials will be identified, and they will be eliminated or minimized if created. Safe handling and storage conditions will be observed.

The business model and financial prospects of the EERC depend on having robust, active test centers that attract many clients to help develop and commercialize their technologies. Examples of financially successful test centers and programs that the EERC has managed include the Partnership for CO_2 Capture (PCO_2C) program and the National Center for Hydrogen Technology. DE-FOA-0003365 has generated noteworthy interest from the EERC's existing network of clients and influential representatives from North Dakota and the federal government. Letters of support or commitment are found in Appendix A.

Ultimate Technological and Economic Impacts

Developers of CC projects in North Dakota have experienced significant cost increases with the current state-of-the-art technologies for a variety of reasons. New technologies are needed to significantly reduce the cost of CC and enable power generation utilities to move projects forward. This project will facilitate the development of next-generation CC technologies to accelerate the transition of these systems from engineering-scale to commercialization under relevant industrial conditions. Such efforts ultimately reduce development costs, while improving technology reliability and investor confidence. Targeted beneficiaries include North Dakota utilities and oil companies looking for more cost-effective CC solutions. As a common participant in these tests, the EERC is ideally suited to identify the most promising technologies and provide information to project partners.

The widespread adoption of CC technologies could generate substantial economic benefits for North Dakota. Enabling industrial-scale EOR use in the Bakken Formation through CC could unlock billions of barrels of previously inaccessible oil, increasing state oil and gas production tax revenue. Numerous jobs in construction, operation, and related industries would be increased. Furthermore, the development of CC infrastructure, including pipelines and storage facilities, represents a significant capital investment, stimulating economic activity and diversifying the state's energy portfolio.

Why the Project Is Needed

Shale formations such as the North Dakota Bakken have a relatively low primary oil recovery rate, which is why increasing recoverable oil and lifespan extending EOR techniques are being investigated for North Dakota's oil industry. However, to fully realize the potential of EOR, significantly more CO_2 is needed than is currently being produced. Lignite and natural gas-fired power plants are not only the backbone of electricity generation in North Dakota but are also potential sources of additional CO_2. Therefore, the advancement and implementation of low-cost, dependable CC technologies are essential in enabling the continued use of these power plants while simultaneously providing a stream of CO_2 for EOR.

Expanding the capabilities of the EERC pilot test center will allow the development, demonstration, and qualification of CC technologies applicable for installation on prospective natural gas combustion and power generation facilities in North Dakota. These facilities will then have qualified options that provide resilience to potential regulatory and policy changes associated with carbon emissions. The facilities will also be able to provide new, localized sources of carbon dioxide to produce incremental oil through EOR.

STANDARDS OF SUCCESS

Success will be measured by this project's ability to enhance the CC test center at the EERC to rapidly develop and validate third-party, next-generation CC technologies for commercialization. The test center will be able to produce flue gas from coal or natural gas at rates up to 5000 lb/hr on a continuous, multiday basis. Multiple third-party CC technologies will be demonstrated. Commercially viable technologies will

be identified and potentially implemented in the North Dakota fleet of carbon-based power plants, which will provide CO_2 for oil fields in North Dakota and ensure high level oil productivity for decades to come.

BACKGROUND/QUALIFICIATIONS

Background

The EERC has a proven record of leading and managing complex multi-million-dollar projects. The EERC also has decades of experience in integrating and testing third party technologies. The EERC has over 70 years of experience operating and maintaining flue gas-generating combustors/gasifiers on-site, including the CTF, PTC, and TRDU. The EERC has led the PCO_2C program and subsequent follow-on work since 2008. This program consisted of 30 private sector partners and has tested 20 commercial or near-commercial carbon capture and sequestration (CCS) technologies. The EERC assessed the operation of these technologies on actual flue gas provided by the combustors on-site. The program managed over $10,000,000 in funding. More recently, the EERC has conducted CO_2 capture tests at Minnkota Power Cooperative's Milton R. Young Station and Rainbow Energy Center's Coal Creek Station for a minimum of 3 months. This combination of pilot and full-scale testing uniquely qualifies the EERC for this type of test center. The EERC has close working relationships with many of the oil and gas producers and electric power generation utilities in North Dakota and will interface with them to assure that the expanded capabilities and the CC technologies demonstrated have relevance to North Dakota gas combustion and power generation applications.

Qualifications

Appendix B provides resumes of key personnel. Tony Snyder, Assistant Director of Advanced Energy Technology, will serve as principal investigator. Other key EERC personnel include Christin Fine, Director of Environment, Health, and Safety; Tyler Newman, Senior Research Engineer; Tyler Curran, Director of Design and Research Operations; Jace Anderson, Research Engineer; Joshua Stanislowski, Director of

Energy Systems Development; Dr. Michael Swanson, Distinguished Engineer, Fuels Conversion; and John Hamling, Assistant Vice President for Strategic Partnerships.

MANAGEMENT

The EERC has developed and applies a standard project management process through the life of a project; it identifies clear baselines in technical scope, budget, and schedule; assesses performance metrics; identifies project risks and mitigation strategies; and responds to variances. During the project, baseline scope includes staged phases of equipment procurement or modifications in the first 2 years followed by third-party technologies testing in the subsequent 3 years. The durations and budget for each task are based on extensive EERC experience in designing, building, and operating engineering-scale equipment as well as in post-run analyses. The EERC management process has established trackable metrics with various milestones and deliverables. A fully detailed, 15-page project management plan was written for the DOE proposal, and it is available upon request.

The timetable for this phase of the work in the proposal is 12 months with a tentative start date of October 1, 2025, which depends on the completion of contract negotiations with DOE. A high-level project schedule and list of deliverables and milestones are provided in Figure 1. Additional deliverables specific to the NDIC ORGP reporting requirements, including the biannual interim reports, will be added to the project timeline prior to the project start. Appendix C contains the schedule, milestones, and deliverables.

BUDGET

The total estimated cost for Year 1 of the proposed effort is $6,095,833 as shown in Table 1. The EERC is seeking $375,000 in cost share from OGRP for Year 1. The EERC has also been awarded cost share funding from LRP for the same year. The combined NDIC funding from OGRP and LRP will be used as cost share for Year 1 of DOE funding. Those funds will be used for Tasks 1–4, which include project management and EH&S activities. Laboratory fees and services for shop and operations, software fees, and engineering

TIMETABLE

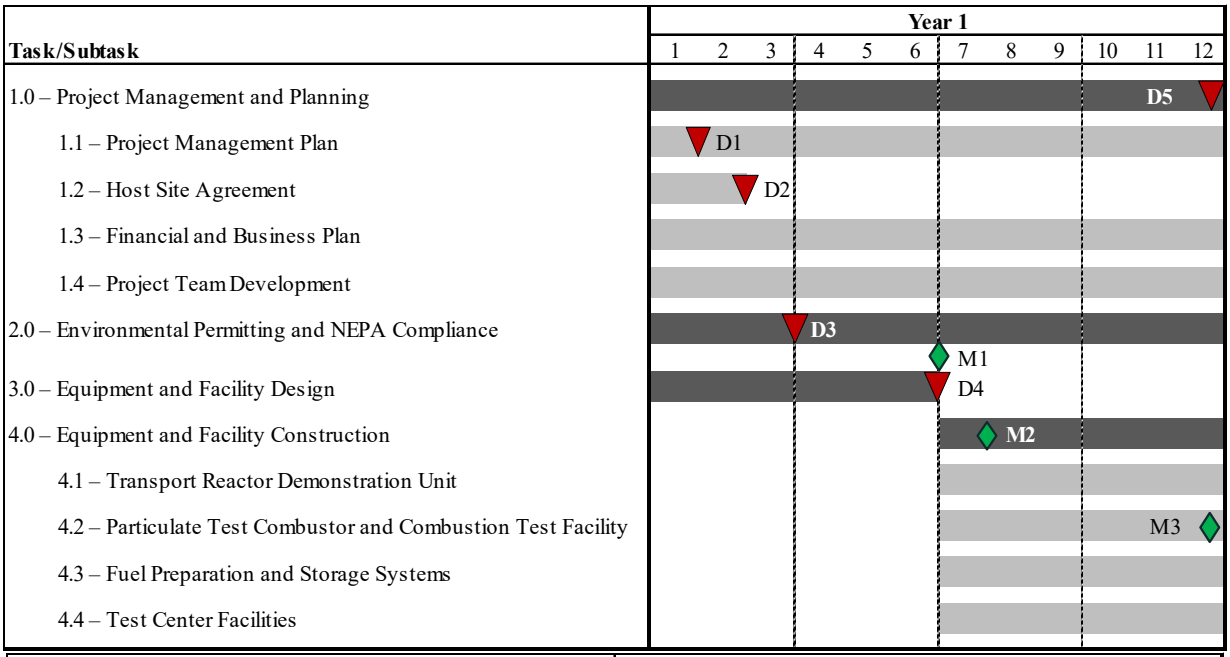

Figure 1. Year 1 Gantt chart with deliverables and milestones.

services are also included. CTF and PTC procurement and construction activities will be completed in Year 1. If less funding is available than requested, the project's objectives may be delayed.

The TRDU and facility upgrades will be completed in Year 2. The EERC anticipates submitting a supplemental proposal for cost share funding for Year 2, after meeting Year 1 objectives and milestones. For Years 3–5, the project will shift focus to testing and demonstration of third-party CC technologies. Cost share match for Years 3–5 is anticipated to be primarily sourced from vendors demonstrating at the facility. Appendix D includes budget notes.

AFFIDAVIT OF TAX LIABILITY

The EERC, a department within UND, is a state-controlled institution of higher education and is not a taxable entity; therefore, it has no tax liability.

Table 1. Budget Breakdown

Project Associated Expense	NDIC OGRP Share (cash)	NDIC LRP Share (cash)	DOE Share (cash)	Total Year 1
Labor	$232,302	$854,410	$730,085	$1,816,797
Travel	$0	$0	$14,661	$14,661
Equipment	$0	$0	$2,920,525	$2,920,525
Supplies	$0	$0	$4370	$4370
Communications	$0	$65	$806	$871
Printing and Duplicating	$0	$69	$622	$691
Food	$0	$0	$2100	$2100
Laboratory Fees and Services				
EERC Document Production Service	$0	$0	$48,449	$48,449
Shop and Operations	$11,730	$100,000	$67,389	$179,119
Technical Software Fee	$1381	$5000	$7424	$13,805
EERC Engineering Services Fee	$2933	$9000	$10,062	$21,994
Total Direct Costs	$248,345	$968,543	$3,806,491	$5,023,378
Facilities & Administration	$126,655	$493,957	$451,843	$1,072,455
Total Project Cost	**$375,000**	**$1,462,500**	**$4,258,334**	**$6,095,833**

CONFIDENTIAL INFORMATION AND PATENTS/RIGHTS TO TECHNICAL DATA

This proposal has no confidential information. No patentable technologies are expected to be created.

STATUS OF ONGOING PROJECTS

The EERC is currently engaged in seven OGRP-funded projects. These ongoing projects listed in Table 2 are current on all deliverables.

Table 2. Ongoing OGRP Projects

Project Name	Contract Award No.
BPOP 4.0 – Bakken Production Optimization Program 4.0	G-058-115
Breaking New Ground in Flaring Reduction	G-061-118
Improving EOR Performance Through Data Analytics and Next-Generation Controllable Completions	G-050-97
Injection Testing with Propane to Inform Future Bakken CO_2 EOR Pilot	G-061-121
iPIPE: The intelligent Pipeline Integrity Program	G-046-88
iPIPE 3.0: The intelligent Pipeline Integrity Program	G-059-116
PCOR Partnership Initiative to Accelerate CCUS Deployment	G-050-96

APPENDIX A

LETTERS OF SUPPORT

Table A-1. Entities that Provided Letters of Support for or Expressed Interest in the Carbon Capture Test Center

Entity	Technology Interest
Lignite Energy Council	Coal combustion with CCS
NDIC Oil and Gas Research Program	Gas combustion with CCS
Former North Dakota Governor Doug Bergum	Clean energy development
ND Senator Kevin Cramer	Clean energy development
ND Senator John Hoeven	Clean energy development
Current North Dakota Governor and Former North Dakota Representative Kelly Armstrong	Clean energy development
Basin Electric Power Cooperative	Coal and gas combustion with CCS
BNI Coal	Coal combustion with CCS
Chord Energy	Oil and gas combustion with CCS
Ion Clean Energy	CCS
Ionada	CCS
Mitsubishi Heavy Industries	CCS and CC
Minnkota Power Cooperative	Coal combustion with CCS
Membrane Technology and Research	CCS
North American Coal	Coal combustion with CCS
Otter Tail Power Company	Coal and gas combustion with CCS
Rainbow Energy Center	Coal combustion with CCS
RTI International	CCS and CC
Shell Cansolv	CCS
Susteon	CCS and CC
TC Energy	Gas combustion with CCS
TDA Research	CCS

INDUSTRIAL COMMISSION OF NORTH DAKOTA
OIL AND GAS RESEARCH COUNCIL
Brent Brannan, Director

Governor
Doug Burgum
Attorney General
Drew Wrigley
Agriculture Commissioner
Doug Goehring

October 23, 2024

Mr. Tony Snyder
Assistant Director for Advanced Energy Technology
Energy & Environmental Research Center
University of North Dakota
15 North 23rd Street, Stop 9018
Grand Forks, ND 58202-9018

Dear Mr. Snyder:

Subject: Commitment Letter for the EERC's Application to Carbon Capture, Removal, and Conversion Test Centers DE-FOA-0003365 in Support of a Test Facility Upgrade

The North Dakota Industrial Commission (NDIC) Oil and Gas Research Program (OGRP) strongly supports the Energy & Environmental Research Center's (EERC's) application to the U.S. Department of Energy's (DOE's) Funding Opportunity Announcement No. DE-FOA-0003365 to upgrade and enhance the EERC's existing coal and natural gas combustion systems to enable them to test next-generation carbon capture technologies.

NDIC was established in 1919 by the North Dakota Legislature to conduct and manage, on behalf of the state of North Dakota, certain utilities, industries, enterprises, and business projects established by law. In 2003, the Legislature established the Oil and Gas Research Program and authorized funding to "promote efficient, economic and environmentally sound exploration, development and use of North Dakota's oil and gas resources… to encourage and promote the use of new technologies and ideas that will have a positive economic and environmental impact on oil and gas exploration, development and production in North Dakota…"

Through OGRP, NDIC is pleased to offer support to the subject project in the form of cash cost share valued at up to $500,000 per year for 2 years to support the update and expansion of the EERC's carbon capture technology development and pilot demonstration facilities to accommodate next-generation capture technologies including those applicable to new in-state natural gas power generation. Furthermore, once such upgrades and expansions are successfully installed, NDIC offers potential continued support in the form of cash cost share valued at up to $500,000 per year for Years 3, 4, and 5 to support commercial development, demonstration, and qualification of commercial technologies being considered for installation on prospective North Dakota natural gas combustion facilities. OGRP understands that the EERC will work with North Dakota producers, industrial power generators, and technology developers to offset or

enhance this cost share in Years 3, 4, and 5. The cost share will be contingent upon submission of a proposal annually to NDIC OGRP and subsequent approval by OGRC and NDIC.

The existing, world-class facilities at the EERC have been supporting the development of point source carbon capture for many years. Investing in an integrated test facility at the EERC will accelerate the development and implementation of next-generation technologies, enabling the continued responsible use of North Dakota's oil and gas resources while complying with federal emissions regulations and corporate environmental targets.

We hope DOE gives careful consideration to this project and look forward to working with DOE, the EERC, and technology developers on the testing and development of advanced carbon dioxide capture technology.

Sincerely,

Brent Brannan
Director
North Dakota Oil & Gas Research Program

Lignite Energy Council

October 10, 2024

Mr. Tony Snyder
Assistant Director for Advanced Energy Technology
Energy & Environmental Research Center
University of North Dakota
15 North 23rd Street, Stop 9018
Grand Forks, ND 50202-9018

Subject: Commitment Letter for the EERC's Application to Carbon Capture, Removal, and Conversion Test Centers DE-FOA-0003365 in Support of a Test Facility Upgrade

Dear Mr. Snyder:

The Lignite Energy Council (LEC) strongly supports the EERC's application to the U.S. Department of Energy's (DOE's) Funding Opportunity Announcement No. DE-FOA-0003365 to upgrade and enhance EERC's existing coal and natural gas combustion systems to enable them to test next-generation carbon capture technologies.

The Lignite Research Program (LRP), guided by the Lignite Research Council (LRC) is committed to the development, testing, and commercial deployment of technologies that integrate power generation with postcombustion carbon capture, utilization, and storage. The development and deployment of next-generation technologies to reduce the cost and parasitic load of carbon dioxide capture technologies is a critical need for existing lignite-fired power plants and utilities.

The LRC is pleased to offer support to the proposed program in the form of cash cost share valued at up to $1,950,000 per year for the first two years of the program, followed by $735,000 per year for the final three years of the program. The LRC understands that the EERC will also work with partner utilities and technology developers to offset or enhance this cost share. The cash support would be contingent on the DOE providing an award to EERC, and review and approval by the LRP, LRC, and the North Dakota Industrial Commission. It is understood that LRC's funding for this project will provide cost share to federal funding from the DOE; therefore, LRC hereby certifies that our cost-share funding will comprise nonfederal dollars and will not be used as federal match on any other project.

We hope that DOE gives careful consideration to this project, as there is a significant need for efficiency and cost improvements for postcombustion carbon capture technologies. Again, we express our interest and support of the proposed project and look forward to working with DOE, EERC, and other participants on this project.

Sincerely,

Jason Bohrer
Lignite Research Council Chairman

NORTH Dakota | Governor Doug Burgum
Be Legendary.™

October 7, 2024

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

Subject: Support for EERC's Proposal Titled "Carbon Capture Test Facility Capital Improvement" in Response to DOE Funding Opportunity Announcement DE-FOA-0003365

Dear Dr. Harju:

We are pleased to support the Energy & Environmental Research Center's (EERC's) application to the U.S. Department of Energy's Office of Fossil Energy and Carbon Management's Carbon Capture, Removal, and Conversion Test Centers Funding Opportunity Announcement DE-FOA-0003365.

North Dakota is at the forefront of energy development and production, investigating long-term strategies that incorporate all the state's energy resources – traditional and emerging – to meet the nation's growing energy demand in an environmentally responsible manner. The EERC's proposed project will enable capital improvements at an existing carbon capture test facility for testing flue gas streams representative of a domestic electric generating unit. This project and the resulting expanded test center will provide a venue for technology developers to accelerate the commercialization of their technologies and advance the U.S. goal of a carbon-managed power sector.

Our administration strongly supports the efforts of the EERC and looks forward to the exciting opportunities this work will bring to the State of North Dakota and our country in resolving energy challenges.

Regards,

Doug Burgum
Governor

KEVIN CRAMER
NORTH DAKOTA

SUITE 313
HART BUILDING
WASHINGTON, DC 20510
202–224–2043

United States Senate

October 3, 2024

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

Subject: Support for EERC's Proposal Entitled "Carbon Capture Test Facility Capital Improvement" in Response to DOE Funding Opportunity Announcement DE-FOA-0003365

Dear Dr. Harju:

I write to express my support for the Energy & Environmental Research Center's (EERC's) application to the U.S. Department of Energy's Office of Fossil Energy and Carbon Management's Carbon Capture, Removal, and Conversion Test Centers Funding Opportunity Announcement DE-FOA-0003365.

As you know, I support our state's all-of-the-above energy industry and the EERC's world-class energy research across multiple disciplines. I have introduced and worked on multiple pieces of legislation to encourage research, development, testing, and implementation of carbon capture, utilization, and storage technologies.

I support advancing federal policy supportive of North Dakota and other energy producing states efforts to responsibly unlock the full potential of our energy resources. The EERCs proposed project is another opportunity to advance the energy sector while achieving significant reductions in CO_2 emissions.

If awarded, this project will enable capital improvements at an existing carbon capture test facility and provide a world-class venue for technology developers to accelerate commercialization of this technology and increase our competitive advantage in low-carbon energy production.

I wholeheartedly support the exciting opportunities the proposed project will bring to the state of North Dakota and the nation in resolving our energy challenges.

Sincerely,

Kevin Cramer
United States Senator

JOHN HOEVEN
NORTH DAKOTA
338 RUSSELL SENATE OFFICE BUILDING
TELEPHONE: (202) 224-2551
FAX: (202) 224-7999
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United States Senate
WASHINGTON, DC 20510

COMMITTEES:
AGRICULTURE
APPROPRIATIONS
ENERGY AND NATURAL RESOURCES
INDIAN AFFAIRS

October 1, 2024

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

Subject: Support for EERC's Proposal Entitled "Carbon Capture Test Facility Capital Improvement" in Response to DOE Funding Opportunity Announcement DE-FOA-0003365

Dear Dr. Harju:

I write to express my support for the Energy & Environmental Research Center's (EERC) application to the Capture, Removal, and Conversion Test Centers program.

As a member of the Senate Energy and Natural Resources Committee and the Senate Appropriations Energy and Water Development Subcommittee, I am working to advance a states-first, all-of-the-above approach that ensures we continue to have affordable and reliable supplies of energy to heat and cool our homes, power our businesses, and fuel our transportation systems.

Our more than two decades of effort has propelled North Dakota to the forefront of energy development and production. New technologies have been essential to this long-term growth, and the EERC has played a central role in helping bring these innovations to market. Under this proposal, the EERC will build upon its record of success by enabling capital improvements at an existing carbon capture test facility to enhance the ability to monitor flue gas streams of a domestic electric generating unit. If awarded, this test facility will provide a world-class venue for technology developers to accelerate the commercialization of new carbon capture technologies. This work is vital to advancing our nation's energy security while improving our environmental stewardship.

Accordingly, I hope the EERC's application receives favorable consideration. Thank you for your continued work toward these important goals. Please keep me informed of the review process, and feel free to contact my if you need any further assistance.

Sincerely,

John Hoeven
U.S. Senator

KELLY ARMSTRONG
AT-LARGE, NORTH DAKOTA

ENERGY AND COMMERCE COMMITTEE
VICE CHAIR
ENERGY, CLIMATE, AND GRID SECURITY
INNOVATION, DATA, AND COMMERCE
OVERSIGHT AND INVESTIGATIONS

COMMITTEE ON THE JUDICIARY
ANTITRUST, COMMERCIAL, AND ADMINISTRATIVE LAW
THE CONSTITUTION, CIVIL RIGHTS, AND CIVIL LIBERTIES
SELECT SUBCOMMITTEE ON THE WEAPONIZATION OF THE FEDERAL GOVERNMENT

Congress of the United States
House of Representatives
Washington, DC 20515

WASHINGTON OFFICE:
2235 RAYBURN HOUSE OFFICE BUILDING
WASHINGTON, DC 20515
(202) 225-2611

DISTRICT OFFICES:
3217 FIECHTNER DR, SUITE B
FARGO, ND 58103
PHONE: (701) 353-6665

U.S. FEDERAL BUILDING
220 E ROSSER AVE, ROOM 228
BISMARCK, ND 58501
(701) 354-6700

ARMSTRONG.HOUSE.GOV

October 9, 2024

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

Subject: Support for EERC's Proposal "Carbon Capture Test Facility Capital Improvement" in Response to DOE Funding Opportunity Announcement DE-FOA-0003365

Dear Dr. Harju:

I write to express my support for the Energy & Environmental Research Center's (EERC's) application to the U.S. Department of Energy's Office of Fossil Energy and Carbon Management (FECM) Carbon Capture, Removal, and Conversion Test Centers Funding Opportunity Announcement DE-FOA-0003365.

As Vice Chair of the Energy and Commerce Committee, and a member of the Subcommittee on Energy, Climate, and Grid Security, I am working to unleash North Dakota's full energy potential and the associated benefits of energy security to our nation. North Dakota is at the forefront of energy development and production, investigating long-term strategies that incorporate all the state's energy resources—traditional and emerging—to meet the nation's growing energy demand in an environmentally responsible manner.

The EERC's proposed project will enable capital improvements at an existing carbon capture test facility for testing on flue gas streams representative of a domestic electric generating unit. This project will provide a venue for technology developers to accelerate the commercialization of their technologies and, in turn, help advance our country's goal of producing affordable and reliable energy while reducing emissions.

I wholeheartedly support the exciting opportunities the proposed project will bring to the state of North Dakota and the nation in resolving our energy challenges.

Sincerely,

Kelly Armstrong
Member of Congress

SUSTEON

October 18, 2024

Mr. Tony Snyder
Assistant Director for Advanced Energy Technology
Energy & Environmental Research Center (EERC)
University of North Dakota
15 North 23rd Street, Stop 9018
Grand Forks, ND 58202-9018

Dear Mr. Snyder:

Subject: Technology Developer Support Letter for the EERC's Application to Carbon Capture, Removal, and Conversion Test Centers DE-FOA-0003365 in Support of a Test Facility Upgrade

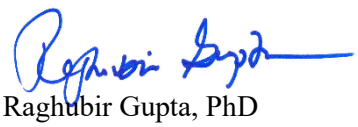
Susteon Inc. is pleased to express our support for EERC's application to the U.S. Department of Energy's (DOE's) Funding Opportunity Announcement No. DE-FOA-0003365 to upgrade and enhance EERC's existing coal and natural gas combustion systems into an integrated facility that can simultaneously test multiple carbon dioxide capture technologies.

Susteon, a pioneering technology startup located in the heart of Research Triangle, North Carolina, is at the forefront of developing and deploying revolutionary decarbonization technologies. The Susteon team has developed a portfolio of technologies tackling carbon capture, carbon utilization and hydrogen production. Susteon's mission is to mitigate the impact of climate change and advance environmental sustainability by capturing and converting emissions into value at scale.

It is critical for our industry to develop advanced technologies that significantly reduce the cost of carbon capture and can improve the efficiency of carbon capture. The existing, world class facilities at the EERC have been supporting the development of point source carbon capture for many years, and investing in a test facility at the EERC to accelerate the development and implementation of next-generation carbon capture technologies will allow the continued use of abundant carbon-based energy resources while complying with federal emissions regulations and corporate environmental targets. Susteon will consider providing cost share to the program for further development of our technology if the EERC's proposal is selected for award by DOE.

Again, we express our interest in and support of the proposed facility enhancements and look forward to working with the EERC on the testing and development of advanced carbon dioxide capture technology.

Sincerely,



Raghubir Gupta, PhD
President & CEO

PHONE (701) 355-5500

BNI energy
AN ALLETE COMPANY

FAX (701) 222-1547

October 18, 2024

Mr. Tony Snyder
Assistant Director for Advanced Energy Technology
Energy & Environmental Research Center (EERC)
University of North Dakota
15 North 23rd Street, Stop 9018
Grand Forks, ND 58202-9018

Dear Mr. Snyder:

Subject: Technology Developer Support Letter for the EERC's Application to Carbon Capture, Removal, and Conversion Test Centers DE-FOA-0003365 in Support of a Test Facility Upgrade

BNI Energy is pleased to express our support for EERC's application to the U.S. Department of Energy's (DOE's) Funding Opportunity Announcement No. DE-FOA-0003365 to upgrade and enhance EERC's existing coal and natural gas combustion systems into an integrated facility that can simultaneously test multiple carbon dioxide capture technologies.

BNI Energy is a subsidiary of ALLETE, Inc., a diversified energy company. BNI Energy, headquartered in Bismarck, North Dakota, evolved from a native North Dakota company: BNI Coal (formerly Baukol–Noonan), founded in northwestern North Dakota in 1930. BNI Energy has a rich history of responsible energy production in North Dakota, exemplified by its BNI Coal mining operations near Center, North Dakota, and its partnerships to advance transformational technologies. BNI Energy is focused on value-added services and infrastructure solutions that balance environmental and the needs of customers. The company is leveraging its talent, experience, and solid track record to advance new technology solutions for North Dakota.

It is critical for our industry to develop advanced technologies that significantly reduce the cost of carbon capture and can improve the efficiency of carbon capture at the generating stations we serve. The existing, world class facilities at the EERC have been supporting the development of point source carbon capture for many years, and investing in a test facility at the EERC to accelerate the development and implementation of next-generation carbon capture technologies will allow the continued use of abundant carbon-based energy resources while complying with federal emissions regulations and corporate environmental targets. BNI Energy will consider providing cost share to the program for further development of carbon capture technologies relevant to our operations if the EERC's proposal is selected for award by DOE.

Again, we express our interest in and support of the proposed facility enhancements and look forward to working with the EERC on the testing and development of advanced carbon dioxide capture technology.

Sincerely,

Mike Heger
President

BNI COAL
1637 Burnt Boat Dr. Bismarck, ND 58503

215 South Cascade Street
PO Box 496
Fergus Falls, Minnesota 56538-0496
218 739-8200
www.otpco.com

OTTER TAIL POWER COMPANY

October 16, 2024

Mr. Tony Snyder
Assistant Director for Advanced Energy Technology
Energy & Environmental Research Center (EERC)
University of North Dakota
15 North 23rd Street, Stop 9018
Grand Forks, ND 58202-9018

Re: Technology Developer Support Letter for the EERC's Application to Carbon Capture, Removal, and Conversion Test Centers DE-FOA-0003365 in Support of a Test Facility Upgrade

Dear Mr. Snyder:

Otter Tail Power Company (OTPC) is pleased to express our support for EERC's application to the U.S. Department of Energy's (DOE's) Funding Opportunity Announcement No. DE-FOA-0003365 to upgrade and enhance EERC's existing coal and natural gas combustion systems into an integrated facility that can simultaneously test multiple carbon dioxide capture technologies.

OTPC is an investor-owned electric utility that provides electricity and generates, transmits, and distributes electricity to approximately 133,700 customers in 422 communities across 70,000 square miles in Minnesota, North Dakota, and South Dakota. OTPC has been powering our region for more than a century. Our generation mix includes coal-fired plants, wind power, combustion turbines, solar power, and hydroelectric plants.

It is critical for our industry to develop advanced technologies that significantly reduce the cost of carbon capture and could improve the efficiency of carbon capture at coal-fired plants in which we own an interest along with neighboring electric utilities, and for which our company serves as operating agent, Coyote Station and Big Stone Plant. The existing, world class facilities at the EERC have been supporting the development of point source carbon capture for many years, and investing in a test facility at the EERC to accelerate the development and implementation of next-generation carbon capture technologies will allow the continued use of abundant carbon-based energy resources while complying with federal emissions regulations and corporate environmental targets.

Again, we express our interest in and support of the proposed facility enhancements and look forward to working with the EERC on the testing and development of advanced carbon dioxide capture technology.

Sincerely,

Mark B. Bring
Director, Public Policy & Government Affairs

RTI INTERNATIONAL

3040 E. Cornwallis Road • PO Box 12194 • Research Triangle Park, NC 27709-2194 • USA
Telephone +1.919.541.6000 • Fax +1.919.541.5985 • www.rti.org

October 18, 2024

Mr. Tony Snyder
Assistant Director for Advanced Energy Technology
Energy & Environmental Research Center (EERC)
University of North Dakota
15 North 23rd Street, Stop 9018
Grand Forks, ND 58202-9018

Subject: Technology Developer Support Letter for the EERC's Application to Carbon Capture, Removal, and Conversion Test Centers DE-FOA-0003365 in Support of a Test Facility Upgrade

Dear Mr. Snyder:

RTI International (RTI) is pleased to express our support for EERC's application to the U.S. Department of Energy's (DOE's) Funding Opportunity Announcement No. DE-FOA-0003365 to upgrade and enhance EERC's existing coal and natural gas combustion systems into an integrated facility that can simultaneously test multiple carbon dioxide capture technologies.

RTI International was founded in 1958 by universities and government and business leaders to retain local talent. We were the anchor tenant of North Carolina's Research Triangle Park, now known worldwide as a hub of research, technology, and innovation. Since then, we have grown into one of the world's leading nonprofit research institutes, with 6,000 staff in more than 90 countries working to improve the human condition by turning knowledge into practice. RTI is at the forefront of creating carbon capture solutions. For over 14 years we have studied processes for capturing carbon dioxide (CO_2) from point sources using a non-aqueous solvent (also known as carbon capture and sequestration (CCS). With funding from the U.S. Department of Energy (DOE), RTI's non-aqueous solvent (NAS) technology has proven to be a successful cost-effective solution for eliminating industrial CO_2 emissions at high CO_2 capture efficiency.

It is critical for our industry to continue to develop advanced technologies that significantly reduce the cost of carbon capture and improve efficiency. The existing facilities at the EERC have been supporting the development of point source carbon capture for many years, and investing in a test facility at the EERC to accelerate the development and implementation of next-generation carbon capture technologies will allow the continued use of abundant carbon-based energy resources while complying with federal emissions regulations and corporate environmental targets. RTI would likely propose projects to DOE for further development of our technology at the EERC if the EERC's proposal is selected for award by DOE.

Again, we express our interest in and support of the proposed facility enhancements and look forward to working with the EERC on the development of advanced carbon dioxide capture technologies in the future.

Sincerely,

Marty Lail
Senior Director, Decarbonization Sciences, RTI International

October 18, 2024

Mr. Tony Snyder
Assistant Director for Advanced Energy Technology
Energy & Environmental Research Center (EERC)
University of North Dakota
15 North 23rd Street, Stop 9018
Grand Forks, ND 58202-9018

Dear Mr. Snyder:

Subject: Technology Developer Support Letter for the EERC's Application to Carbon Capture, Removal, and Conversion Test Centers DE-FOA-0003365 in Support of a Test Facility Upgrade

TDA Research is pleased to express our support for EERC's application to the U.S. Department of Energy's (DOE's) Funding Opportunity Announcement No. DE-FOA-0003365 to upgrade and enhance EERC's existing coal and natural gas combustion systems into an integrated facility that can simultaneously test multiple carbon dioxide capture technologies.

TDA Research has been developing cutting edge chemical processes, materials and hardware for customers in the defense, aerospace, energy and chemical industries since 1987. Our highly efficient solutions for post-combustion and pre-combustion CO_2 capture processes have been scaled up from the bench-scale and to pilot scale demonstrations.

It is critical for our industry to develop advanced technologies that significantly reduce the cost of carbon capture and improve efficiency. The existing, world class facilities at the EERC have been supporting the development of point source carbon capture for many years, and investing in a test facility at the EERC to accelerate the development and implementation of next-generation carbon capture technologies will allow the continued use of abundant carbon-based energy resources while complying with federal emissions regulations and corporate environmental targets. TDA Research will consider providing cost share to the program for further development of our technology if the EERC's proposal is selected for award by DOE.

Again, we express our interest in and support of the proposed facility enhancements and look forward to working with the EERC on the testing and development of advanced carbon dioxide capture technology.

Sincerely,

Gokhan Alptekin, PhD
President
TDA Research, Inc.
+1 720 352 7919

BASIN ELECTRIC POWER COOPERATIVE
A Touchstone Energy® Cooperative

October 22, 2024

Mr. Tony Snyder
Assistant Director for Advanced Energy Technology
Energy & Environmental Research Center (EERC)
University of North Dakota
15 North 23rd Street, Stop 9018
Grand Forks, ND 58202-9018

Dear Mr. Snyder:

Subject: Technology Developer Support Letter for the EERC's Application to Carbon Capture, Removal, and Conversion Test Centers DE-FOA-0003365 in Support of a Test Facility Upgrade

Basin Electric Power Cooperative (BEPC) is pleased to express our support for EERC's application to the U.S. Department of Energy's (DOE's) Funding Opportunity Announcement No. DE-FOA-0003365 to upgrade and enhance EERC's existing coal and natural gas combustion systems into an integrated facility that can simultaneously test multiple carbon dioxide capture technologies.

BEPC is a not-for-profit generation and transmission cooperative owned by 140 member cooperative systems across nine states serving 3 million consumers. We pursue a smart and affordable energy strategy and take advantage of the benefits of renewables while maintaining baseload that ensures the reliability our members expect. BEPC, through its for-profit subsidiary, Dakota Gasification Company, owns and operates the Great Plains Synfuels Plant, an international leader in technologies that capture, compress, and transport carbon dioxide (CO_2) emissions from a coal gasification process. The Synfuels Plant captures more CO_2 from coal conversion than any facility in the world and is a participant in the world's largest carbon sequestration project.

It is critical for our industry to develop advanced technologies that significantly reduce the cost of carbon capture and could improve the efficiency for our combustion assets. The existing, world class facilities at the EERC have been supporting the development of point source carbon capture for many years, and investing in a test facility at the EERC to accelerate the development and implementation of next-generation carbon capture technologies will allow the continued use of abundant carbon-based energy resources while complying with federal emissions regulations and corporate environmental targets. BEPC will consider providing cost share to the program for further development of carbon capture technologies relevant to our operations if the EERC's proposal is selected for award by DOE.

Again, we express our interest in and support of the proposed facility enhancements and look forward to working with the EERC on the testing and development of advanced carbon dioxide capture technology.

Sincerely,

Gavin McCollam
Gavin McCollam (Oct 22, 2024 14:01 CDT)

Gavin McCollam
Senior Vice President & Chief Operating Officer
Basin Electric Power Cooperative

Shell Catalysts & Technologies
Transforming Energy Together

Shell Catalysts & Technologies Canada Inc.
500 Centre St S suite 4000
Calgary T2G 1A6 Alberta
Canada
Website: www.shell.com
Contact: Devin Shaw
+1 514 586 0350
Devin.Shaw@shell.com

October 24, 2024

Mr. Tony Snyder
Assistant Director for Advanced Energy Technology
Energy & Environmental Research Center (EERC)
University of North Dakota
15 North 23rd Street, Stop 9018
Grand Forks, ND 58202-9018

Dear Mr. Snyder:

Subject: Technology Developer Support Letter for the EERC's Application to Carbon Capture, Removal, and Conversion Test Centers DE-FOA-0003365 in Support of a Test Facility Upgrade

Shell Catalysts & Technologies is pleased to express our support for EERC's application to the U.S. Department of Energy's (DOE's) Funding Opportunity Announcement No. DE-FOA-0003365 to upgrade and enhance EERC's existing combustion systems into an integrated facility that can simultaneously test multiple carbon dioxide capture technologies.

Shell Catalysts & Technologies has developed a CO_2 capture technology, CANSOLV, utilizing a regenerable amine that offers cutting-edge performance, including low parasitic energy consumption, fast kinetics and extremely low volatility. The technology allows for the capture of CO_2 from flue gas. The CO_2 is then delivered to the client for eventual sequestration or sale into the EOR and commodity markets.

It is critical for our industry to develop advanced technologies that significantly reduce the cost of carbon capture and can improve the efficiency of carbon capture. The existing, world class facilities at the EERC have been supporting the development of point source carbon capture for many years, and investing in a test facility at the EERC to accelerate the development and implementation of next-generation carbon capture technologies will allow the continued use of abundant carbon-based energy resources while complying with federal emissions regulations and corporate environmental targets.

Again, we express our interest in and support of the proposed facility enhancements and look forward to seeing further developments of the EERC's testing and development of advanced carbon dioxide capture technology.

Yours sincerely,

Devin Shaw
Commercial Director, Decarbonization Technologies
devin.shaw@shell.com
+1 514 586 0350

North American COAL

October 18, 2024

Mr. Tony Snyder
Assistant Director for Advanced Energy Technology
Energy & Environmental Research Center (EERC)
University of North Dakota
15 North 23rd Street, Stop 9018
Grand Forks, ND 58202-9018

Subject: Technology Developer Support Letter for the EERC's Application to Carbon Capture, Removal, and Conversion Test Centers DE-FOA-0003365 in Support of a Test Facility Upgrade

Dear Mr. Snyder:

North American Coal is pleased to express our support for EERC's application to the U.S. Department of Energy's (DOE's) Funding Opportunity Announcement No. DE-FOA-0003365 to upgrade and enhance EERC's existing coal and natural gas combustion systems into an integrated facility that can simultaneously test multiple carbon dioxide capture technologies.

For more than 100 years, we have partnered with companies to provide the natural resources needed to reliably power homes, businesses, and communities across the country. North American Coal (NACoal) operates surface mines that produce coal, aggregates, and other valuable minerals throughout the United States. We operate one of the largest dragline fleets in the world and control over 160,000 surface acres. Within North Dakota, we operate the Freedom Mine, the Falkirk Mine, and the Coyote Creek Mine, serving multiple electrical generation units and the Great Plains Gasification Facility.

It is critical for our industry to develop advanced technologies that significantly reduce the cost of carbon capture and can improve the efficiency of carbon capture at the generating stations we serve. The existing, world class facilities at the EERC have been supporting the development of point source carbon capture for many years, and investing in a test facility at the EERC to accelerate the development and implementation of next-generation carbon capture technologies will allow the continued use of abundant carbon-based energy resources while complying with federal emissions regulations and corporate environmental targets. North American Coal will consider providing cost share to the program for further development of carbon capture technologies relevant to our operations if the EERC's proposal is selected for award by DOE.

North American Coal
5340 Legacy Drive, Suite #300
Plano, TX 75024
972.448.5400
NACoal.com

Again, we express our interest in and support of the proposed facility enhancements and look forward to working with the EERC on the testing and development of advanced carbon dioxide capture technology.

Sincerely,

NORTH AMERICAN COAL

George Lovland, P.E.
Engineering Manager

North American Coal
5340 Legacy Drive, Suite #300
Plano, TX 75024
972.448.5400
NACoal.com

RAINBOW
ENERGY CENTER

918 E Divide Ave.
Bismarck, North Dakota 58501
701.315.8181
rainbowenergycenter.com

October 18, 2024

Mr. Tony Snyder
Assistant Director for Advanced Energy Technology
Energy & Environmental Research Center (EERC)
University of North Dakota
15 North 23rd Street, Stop 9018
Grand Forks, ND 58202-9018

Dear Mr. Snyder:

Subject: Technology Developer Support Letter for the EERC's Application to Carbon Capture, Removal, and Conversion Test Centers DE-FOA-0003365 in Support of a Test Facility Upgrade

Rainbow Energy Center (REC) is pleased to express our support for EERC's application to the U.S. Department of Energy's (DOE's) Funding Opportunity Announcement No. DE-FOA-0003365 to upgrade and enhance EERC's existing coal and natural gas combustion systems into an integrated facility that can simultaneously test multiple carbon dioxide capture technologies.

Rainbow Energy Marketing Corporation's group of companies have over a quarter century of international experience in energy trading and asset management across the United States, Canada, and Mexico. Our diversified commodities portfolio includes wholesale electricity, natural gas and propane, and retail electricity and natural gas. Rainbow Energy's recent purchase of Coal Creek Station in North Dakota preserves jobs in the community, including jobs at the Falkirk Mine, and supports the state and local economy. Carbon capture and storage are vital to continued operation of Coal Creek Station and will be an important step toward Governor Doug Burgum's goal for the state to reach carbon neutrality by 2030.

It is critical for our industry to develop advanced technologies that significantly reduce the cost of carbon capture and can improve the efficiency of carbon capture at Coal Creek Station. The existing, world class facilities at the EERC have been supporting the development of point source carbon capture for many years, and investing in a test facility at the EERC to accelerate the development and implementation of next-generation carbon capture technologies will allow the continued use of abundant carbon-based energy resources while complying with federal emissions regulations and corporate environmental targets. REC will consider providing cost share to the program for further development of carbon capture technologies relevant to our operations if the EERC's proposal is selected for award by DOE.

Again, we express our interest in and support of the proposed facility enhancements and look forward to working with the EERC on the testing and development of advanced carbon dioxide capture technology.

Sincerely,

Conway Nelson, P. Eng, PMP
Director, Carbon Management
Rainbow Energy Center

October 25, 2024

Mr. Tony Snyder
Assistant Director for Advanced Energy Technology
Energy & Environmental Research Center (EERC)
University of North Dakota
15 North 23rd Street, Stop 9018
Grand Forks, ND 58202-9018

Dear Mr. Snyder:

Subject: Technology Developer Support Letter for the EERC's Application to Carbon Capture, Removal, and Conversion Test Centers DE-FOA-0003365 in Support of a Test Facility Upgrade

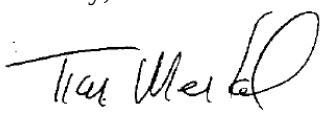
Membrane Technology and Research, Inc., (MTR) is pleased to express our support for EERC's application to the U.S. Department of Energy's (DOE's) Funding Opportunity Announcement No. DE-FOA-0003365 to upgrade and enhance EERC's existing coal and natural gas combustion systems into an integrated facility that can simultaneously test multiple carbon dioxide capture technologies.

Founded in 1982, MTR has grown into a world leader in providing innovative membrane separation solutions. MTR sold its first commercial system in 1992, and now provides a full range of gas separation solutions for petrochemical plants, refineries, and gas processing facilities. Our point source carbon capture process – developed with DOE support – is built on our proven Polaris™ polymeric membrane, using no chemicals and less water than conventional capture methods. Polaris is modular and scalable, and commercially ready today.

It is critical for our industry to have world class facilities like those at EERC to support the continued development of point source carbon capture technologies. Investing in a test facility at the EERC can accelerate the development of next-generation technologies that allow the continued use of abundant carbon-based energy resources while complying with federal emissions regulations and corporate environmental targets. MTR will consider providing cost share to the program for further development of our technology if the EERC's proposal is selected for award by DOE.

Again, we express our interest in and support of the proposed facility enhancements and look forward to working with the EERC on the testing and development of our membrane capture technology.

Sincerely,



Tim Merkel, Ph.D.
Vice President of Technology
Membrane Technology & Research, Inc.
Tim.merkel@mtrinc.com; 650-543-3362

TC Energy

October 22nd, 2024

Mr. Tony Snyder
Assistant Director for Advanced Energy Technology
Energy & Environmental Research Center (EERC)
University of North Dakota
15 North 23rd Street, Stop 9018
Grand Forks, ND 58202-9018

Dear Mr. Snyder:

Subject: Technology Developer Support Letter for the EERC's Application to Carbon Capture, Removal, and Conversion Test Centers DE-FOA-0003365 in Support of a Test Facility Upgrade

TC Energy is pleased to express our support for EERC's application to the U.S. Department of Energy's (DOE's) Funding Opportunity Announcement No. DE-FOA-0003365 to upgrade and enhance EERC's existing coal and natural gas combustion systems into an integrated facility that can simultaneously test multiple carbon dioxide capture technologies.

TC Energy has over 70 years of experience and is a leader in the responsible development and reliable operation of North American energy infrastructure, including natural gas pipelines (57,900 miles, 25% of North American natural gas pipelines), power generation (4200 MW), and gas storage facilities (653 Bcf). Among these infrastructure assets are the Northern Border Pipeline System and the Bison Pipeline System and the associated natural gas compressor stations in the state of North Dakota. As such, TC Energy has significant long-term interest in gas-fired turbine combustion and power generation in North Dakota and throughout the United States, and in associated techologies that can help reduce emissions and better meet future regulations associate with such faclities.

The existing, world class facilities at the EERC have been supporting the development of point source carbon capture for many years, a test facility at the EERC to accelerate the development and implementation of commercial scale carbon capture technologies will allow the continued use of abundant carbon-based energy resources while complying with federal emissions regulations and corporate environmental targets. TC Energy sees value in such capabilities as the natural gas transmission and power generation sectors evaluate integration of carbon capture with new and existing facilities. TC Energy is supportive of seeing the continued efforts and work by EERC to advance technologies that enables natural gas to be delivered safely and more sustainably. If the EERC's proposal is selected for award by DOE, we will consider evaluating opportunities to conduct pilot demonstration of carbon capture technologies with potential application to natural gas combustion in turbines. As per TC Energy's procurement policy which must be adhered to, commitment of funds, timing of the pilot testing and deliverables must be completed through a contractual agreement, which this letter is not. Following the development of the integrated test facility TC Energy will work collaboratively with EERC and other vendor partners to establish required agreements consistent with the TC Energy procurement policy that must be authorized and executed by all parties.

Again, we express our interest in and support of the proposed facility enhancements and look forward to collaborating with the EERC on the development of advanced carbon dioxide capture technology.

TC Energy

Sincerely,

Lee Evans
Vice President, Energy Solutions

Minnkota Power
COOPERATIVE
A Touchstone Energy® Cooperative

5301 32nd Ave S
Grand Forks, ND 58201-3312
Phone 701.795.4000
www.minnkota.com

October 25, 2024

Mr. Tony Snyder
Assistant Director for Advanced Energy Technology
Energy & Environmental Research Center (EERC)
University of North Dakota
15 North 23rd Street, Stop 9018
Grand Forks, ND 58202-9018

Dear Mr. Snyder:

Subject: Technology Developer Support Letter for the EERC's Application to Carbon Capture, Removal, and Conversion Test Centers DE-FOA-0003365 in Support of a Test Facility Upgrade

Minnkota Power Cooperative is pleased to express our support for EERC's application to the U.S. Department of Energy's (DOE's) Funding Opportunity Announcement No. DE-FOA-0003365 to upgrade and enhance EERC's existing coal and natural gas combustion systems into an integrated facility that can simultaneously test multiple carbon dioxide capture technologies.

Minnkota is a not-for-profit generation and transmission cooperative that provides wholesale electric service to 11 distribution cooperatives in eastern North Dakota and northwestern Minnesota. These cooperatives, in turn, serve more than 160,000 consumers throughout the region. For nearly a decade, Minnkota has spearheaded the development of Project Tundra—a pioneering initiative focused on constructing one of the world's largest carbon capture and storage facilities in North Dakota. Designed to significantly reduce carbon emissions from fossil fuel power generation, Project Tundra represents a monumental step forward in sustainable energy innovation. This ambitious project has progressed due to the invaluable expertise and resources of the EERC, whose collaboration has been crucial in advancing each stage, from initial concept and feasibility studies to pilot testing and advanced engineering and design studies. With EERC's support, Minnkota has also successfully permitted the largest CO2 storage facility in the United States.

EERC's world-class facilities have long been at the forefront of advancing point-source carbon capture technology. Investing in a dedicated test facility at the EERC would accelerate the development and deployment of commercial-scale carbon capture solutions, enabling the continued use of abundant carbon-based energy resources while aligning with federal emissions standards and global decarbonization goals.

We are strongly supportive of the proposed facility enhancements and are eager to collaborate with the EERC in testing and advancing cutting-edge carbon dioxide capture technologies that will pave the way for a more sustainable energy landscape.

Sincerely,

Stacey Dahl

Stacey Dahl
Vice President of External Affairs

October 18, 2024

Mr. Tony Snyder
Assistant Director for Advanced Energy Technology
Energy & Environmental Research Center (EERC)
University of North Dakota
15 North 23rd Street, Stop 9018
Grand Forks, ND 58202-9018

Dear Mr. Snyder:

Subject: Technology Developer Support Letter for the EERC's Application to Carbon Capture, Removal, and Conversion Test Centers DE-FOA-0003365 in Support of a Test Facility Upgrade

Ionada is pleased to express our support for EERC's application to the U.S. Department of Energy's (DOE's) Funding Opportunity Announcement No. DE-FOA-0003365 to upgrade and enhance EERC's existing coal and natural gas combustion systems into an integrated facility that can simultaneously test multiple carbon dioxide capture technologies.

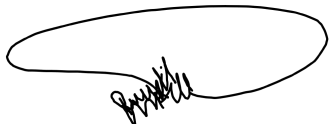
Ionada develops, manufactures, and markets exhaust gas cleaning systems that reduce emissions from the marine and power generation industries. Our sustainable solutions keep our air and waters clean for future generations. Ionada's team includes international scientists, engineers and technicians that have developed breakthroughs in technologies to reduce emissions. Ionada is the first to market with the patented compact and affordable iDeCarbon™ carbon capture technology for small to mid size carbon emitters. Ionada's containerized modular carbon capture system provides the ideal solution for the majority of industrial carbon emitters.

It is critical for our industry to develop advanced technologies that significantly reduce the cost of carbon capture and improve efficiency. The existing, world class facilities at the EERC have been supporting the development of point source carbon capture for many years, and investing in a test facility at the EERC to accelerate the development and implementation of next-generation carbon capture technologies will allow the continued use of abundant carbon-based energy resources while complying with federal emissions regulations and corporate environmental targets. Ionada will consider providing cost share to the program for further development of our technology if the EERC's proposal is selected for award by DOE.

Again, we express our interest in and support of the proposed facility enhancements and look forward to working with the EERC on the testing and development of advanced carbon dioxide capture technology.

Sincerely,

Russell Maduro
Technology Officer



Chord Energy

1001 Fannin Street, Suite 1500
Houston, TX 77002
O 281.404.9500
F 281.404.9501

October 25, 2024

Mr. Tony Snyder
Assistant Director for Advanced Energy Technology
Energy & Environmental Research Center (EERC)
University of North Dakota
15 North 23rd Street, Stop 9018
Grand Forks, ND 58202-9018

Dear Mr. Snyder:

Subject: Technology Developer Support Letter for the EERC's Application to Carbon Capture, Removal, and Conversion Test Centers DE-FOA-0003365 in Support of a Test Facility Upgrade

Chord Energy is pleased to express our support for EERC's application to the U.S. Department of Energy's (DOE's) Funding Opportunity Announcement No. DE-FOA-0003365 to upgrade and enhance EERC's existing coal and natural gas combustion systems into an integrated facility that can simultaneously test multiple carbon dioxide capture technologies.

Chord Energy is an independent E&P company engaged in the acquisition, exploration, development and production of crude oil, NGL's and natural gas with quality and sustainable long-lived assets focused in the Williston Basin. As such, Chord Energy has significant long-term interest in gas-fired power generation in North Dakota, and in associated technologies that can help reduce emissions and better meet future regulations associated with our assets.

The existing world class facilities at the EERC have been supporting the development of point source carbon capture for many years, and investing in a test facility at the EERC to accelerate the development and implementation of commercial scale carbon capture technologies will allow the continued use of abundant carbon-based energy resources while complying with federal emissions regulations and corporate environmental targets. Chord Energy sees value in the enhancement of such capabilities as we consider the application and integration of carbon capture within our extensive Williston Basin assets.

If the EERC's proposal is selected for award by DOE, we will consider providing cost share contribution to the program to use the facility to conduct pilot demonstration and qualification of capture technology that has potential application to our assets. If such capture technologies prove to be commercially viable, we will subsequently work with the EERC to consider how such carbon capture technologies could be commercially integrated into our portfolio, including CO_2 EOR applications that have the potential to store significant quantities carbon while simultaneously producing lower carbon intensity oil. We are currently assessing such applications through our DOE sponsored North Dakota CO_2 EOR and carbon storage field laboratory efforts.

Again, we express our interest in and support of the proposed facility enhancements and look forward to working with the EERC on the testing and development of advanced carbon dioxide capture technology.

Sincerely,

Victor Barcot

Victor Barcot
Vice President of New Ventures

APPENDIX B

RESUMES OF KEY PERSONNEL

TONY C. SNYDER
Assistant Director for Advanced Energy Technology
Energy & Environmental Research Center (EERC), University of North Dakota (UND)
15 North 23rd Street, Stop 9018, Grand Forks, North Dakota 58202-9018 USA
701.777.5171, tsnyder@undeerc.org

Education and Training
B.S., Chemical Engineering, University of North Dakota, 2000.

Research and Professional Experience
2024–Present: Assistant Director for Advanced Energy Technology, EERC, UND.
- Leads a team focused on advanced energy technology across applied research projects covering advanced materials, CO_2 capture, advanced power cycle technology development, and other energy-related technologies.
- Effectively executes and leads multiple concurrent projects while ensuring that project deliverables are completed according to client expectations within the established timelines and budgets.
- Develops and enhances client relations; develops, manages, and mentors personnel; manages projects, proposal development, budgets, and the preparation of technical reports, conference papers, and peer-reviewed journal articles; and delivers technical presentations.

2021–2024: Principal Engineer, Cirrus Aircraft, Grand Forks, North Dakota.
Managed high-value, critical projects to expand production capacity and capability:
- $4 million project for building expansion and installation of second autoclave cure system.
- $1.5 million facility renovation for new CNC machining center.
- Ongoing $15 million facility and manufacturing processes transformation.
- Interim plant manager during 4-month leadership transition.

2012–2021: Engineering Manager, Cirrus Aircraft, Grand Forks, North Dakota.
Managed manufacturing engineering team, production processes, material suppliers, and continuous improvement efforts:
- Recruited and trained a manufacturing engineering team of 20+ personnel that exceeded production support requirements.
- Led engineering team to continuously improve process efficiency and reduce defects, cumulatively saving millions of dollars.
- Developed and optimized production processes around a new carbon fiber-reinforced polymer system for Vision Jet.
- Designed and built a novel vacuum bag leak-detection system.
- Applied Cirrus operating system concepts to increase production throughput and reduce labor.
- Conducted design reviews of composite parts and tooling to improve manufacturability.
- Managed $1.5 million capital investment project for installing autoclave cure system.

2007–2012: Research Engineer, EERC, UND.
Research areas focused on coal gasification for hydrogen and syngas generation, syngas conversion to liquid fuels, hydrogen purification and storage, renewable and conventional energy systems, techno-economic process modeling, and biorefinery technology development, including thermochemical and fermentation processes for biomass conversion and pollution control:

- Designed and constructed a mobile reactor plant for converting biomass to methanol.
- Trained in Aspen Plus and Aspen Process Economic Analyzer process modeling systems.
- Designed and built a bench-scale Fischer–Tropsch (FT) catalyst reactor system.
- Developed an iron-based FT catalyst and chemical process for producing synthetic crude oil.
- Reformed FT synthesis crude into isoparaffinic kerosene that is compatible with JP-8 military-grade jet fuel.

2005–2007: Quality Engineer, Cirrus Design, Grand Forks, North Dakota.
Served as the lead of a multidisciplinary Six Sigma Black Belt team. Applied several statistical tools such as Gage R&R, hypothesis testing, design of experiments, and correlation and regression data analyses, which reduced composite part defects and scrap by more than $300,000 annually:

- Developed Six Sigma Green Belt training program. Candidates were taught Define-Measure-Analyze-Improve-Control problem-solving methodology along with several statistical tools.
- Trained as Level II nondestructive ultrasonic inspector for carbon laminate materials.
- Developed and maintained an internal audit system.
- Managed material suppliers to improve quality and cost.

2001–2005: Process and R&D Engineer, Innovex, Litchfield, Minnesota.

- Investigated and tested several technologies and suppliers for new photolithography equipment and created a project proposal for a $2 million capital investment.
- Purchased and installed equipment in new Thailand circuit fabrication factory.
- Received Six Sigma Black elt training.
- Responsible for the daily operation and performance of circuit chemical etching and solder mask develop/cure processes.

Publications
Has coauthored several professional publications.

CHRISTIN R. FINE
Director of Environment, Health, and Safety
Energy & Environmental Research Center (EERC), University of North Dakota (UND)
15 North 23rd Street, Stop 9018, Grand Forks, North Dakota 58202-9018 USA
701.777.5289, cfine@undeerc.org

Education and Training

M.Sc., Safety, Security & Emergency Management, Eastern Kentucky University, Richmond, Kentucky, 2020.

B.Sc., Occupational Safety and Environmental Health, University of North Dakota, Grand Forks, North Dakota, 2009.

Certifications and Training: Certified Safety Professional; Certified Instructional Trainer, First AID, CPR, AED; 40-Hour HAZWOPER; OSHA-Certified Instructor – Construction 10/30; Farm and Agricultural Safety Program at OSHA Virginia Tech; and Hazardous Material Instructor: PHMSA.

Awards: WISE Professional Education Grant, EERC – Be Professional Annual CORE Value Award, Prairie Business magazine – 40 Under 40, and North Dakota Safety Council – Duane Kuehn Outstanding Safety Professional Award.

Research and Professional Experience

2022–Present: Director of Environment, Health, and Safety (EHS), EERC, UND.

- Leads a safety culture focused on employee engagement, accomplished by continually evaluating programs for improving EHS, emergency, and security programs.
- Develops strategies for successful risk reduction program implementation through efficient operational integration, and human and organizational performance. Evaluates program efficiencies by analyzing metrics, with a focus on leading indicators.

2020–2022: Assistant Director of EHS, EERC, UND.

- Led the safety department's evolution from regulatory compliance to an employee service- focused department based on overall hazard reduction.
- Expanded EHS program development to include emergency and security management.
- Focused on internal manager and supervisor safety knowledge and developed coaching strategies within teams.
- Developed relationships with exterior partners, clients, and regulatory agencies.

2018–2020: EHS Engineer, EERC, UND.

- Responsible for understanding advanced research systems and projects for hazard identification and determining appropriate control methods for hazard reduction.
- Identified potential failures in hazard controls and performed risk assessments to initiate improvements to reduce employee risk.
- Developed internal prevention through design protocols with engineering design teams.

2011–2018: EHS Specialist, EERC, UND.

- Coached frontline employees and supervisors on hazard recognition and control methods.

- Conducted and developed EHS training specific to demonstration, laboratory, and field operations.
- Performed root-cause incident investigations and developed action plans with employees and supervisors to improve hazard controls.

2015–2016: EHS Specialist, J.R. Simplot Company, Grand Forks, North Dakota.
- Responsible for supporting plant operations in planning, collaborating, implementing, and maintaining a variety of site and corporate environmental, health, security, and safety programs to assure workplace safety for employees, as well as compliance with all related regulatory requirements.
- Specialized focus in process safety management.

2009–2011: EHS Specialist, Office of Safety, UND.
- Assisted with radiation, laboratory, and hazardous materials and waste programs.
- Conducted audits and inspections focused on life and fire safety.

2007–2009: EHS Assistant and Internship, Office of Safety, UND.

Professional Activities
Strategies for Effective Safety Committee Leadership
North Dakota Safety Council's Annual Safety Conference, February 2024

Friend or Foe: How Is Your EHS Team Viewed?
North Dakota Safety Council's Annual Safety Conference, February 2024

Hydrogen Horizons: Preparing for the Next Energy Wave
North Dakota Safety Council's Annual Safety Conference, February 2024

Lone Worker Safety in the Field: Who, What, and How?
North Dakota Safety Council's Annual Safety Conference, February 2024

Lone Worker Safety in the Field: A Research Center's Evaluation for Program Development
Campus Safety, Health, and Environmental Management Association Symposium, February 2023

Friend or Foe: How Is Your EHS Team Viewed?
The College and University Hazardous Materials Management Conference, August 2022

Materials of Trade 101 – Transport of Hazardous Materials
Northern Occupational Safety and Health Association, January 2015

TYLER K. NEWMAN
Senior Research Engineer
Energy & Environmental Research Center (EERC), University of North Dakota (UND)
15 North 23rd Street, Stop 9018, Grand Forks, North Dakota 58202-9018 USA
701.777.5079, tnewman@undeerc.org

Education and Training

M.Eng., Mechanical Engineering, University of North Dakota, 2021.
B.S., Mechanical Engineering, University of North Dakota, 2015.

Research and Professional Experience

October 2022–Present: Senior Research Engineer, EERC, UND.

- Works to advance new technologies and practical solutions to critical energy and environmental challenges in support of the EERC mission and strategic plan.
- Plans, supervises, and executes the design, fabrication, and operation of lab- and/or pilot-scale process systems.
- Analyzes and reports results from experiments.
- Prepares research proposals, interprets data, writes reports and papers, and presents project results to clients.

Principal areas of interest and expertise include design, fabrication, and operation of bench- and pilot-scale equipment for biomass and fossil fuel conversion for energy production, with an emphasis on CO_2 capture and storage in power generation and in industrial applications.

November 2017–2022: Research Engineer, EERC, UND.

- Worked on process engineering and design related to conversion of coal/biomass to fuels, chemicals, and energy and pre/postcombustion carbon capture, including creating engineering drawings and process modeling/simulations, hands-on fabrication, and oversight and operation of equipment and processes related to energy conversion.
- Assisted with preparing research proposals, interpreting data, and writing reports and papers.

June 2015–October 2017: Mechanical Engineer, Odra, LLC, Grand Forks, North Dakota.

- Served as head of research and development, technical service manager, and service parts specialist.
- Continually improved product for safety and reliability.
- Designed new factory layout to expedite workflow by 50%.
- Wrote work instructions, maintaining equal work for each stage of production.
- Designed test hardware and process to reduce electrical subassembly time by 80%.
- Reduced cost of hydraulic system for international markets by 50%.
- Oversaw quality control and product warranty.

September 2013–May 2015: Research Assistant (part-time), EERC, UND.

- Created piping and instrumentation diagrams for high-temperature, high-pressure equipment.
- Prepared shop drawings for fabrication of experimental equipment.
- Organized and maintained archive of confidential engineering documentation.

- Conducted facility maintenance tasks for safe identification of instrumentation.
- Assisted with creation of training and safety material.

Publications

Has coauthored several professional publications.

TYLER J. CURRAN
Director of Design and Research Operations
Energy & Environmental Research Center (EERC), University of North Dakota (UND)
15 North 23rd Street, Stop 9018, Grand Forks, North Dakota 58202-9018 USA
701.777.5097, tcurran@undeerc.org

Education and Training

M.S., Mechanical Engineering, University of North Dakota, 2016.
B.S., Mechanical Engineering, University of North Dakota, 2004.
Registered Professional Engineer, North Dakota.

Research and Professional Experience

October 2022–Current: Director of Design and Research Operations, EERC, UND.

- Responsible for safe conduct of research and technology development activities in on-site demonstration areas and facilities.
- Leads team of engineers and technicians in support of EERC technology development and commercialization activities in areas of fuel combustion, gasification, and reforming; emission control; CO_2 capture; renewable energy; and materials processing.
- Works with research teams to prepare and lead proposals and develop and manage work scopes, objectives, personnel, and budgets.

Principal areas of interest and expertise include fluidized systems for combustion and gasification; heat-transfer and heat exchanger design; furnace and refractory design; design of energy conversion systems; pressure piping design, process design, and modeling; parametric computer modeling and simulation; finite element analysis; fluid power systems, internal combustion engines, electric motors, and hydrogen fuel cells; mechanical power trains; design for precision machining and specialized manufacturing processes; and electronic controls, programmable logic controllers, and wireless control devices.

September 2019–October 2022: Assistant Director for Design and Research Operations, EERC, UND.

- Had oversight responsibility for safe conduct of research and technology development activities and led a team of engineers and technicians in support of technology development and commercialization activities in the areas of fuel combustion, gasification, and reforming; emission control; CO_2 capture; renewable energy; and materials processing.
- Updated policies and procedures and developed new ones pertaining to the EERC's execution of ongoing and new project activities and maintenance and repair of equipment, process systems, and capabilities.

July 2018–August 2019: Principal Engineer, Design and Operations Group Lead, EERC, UND.

- Led a team of engineers and technicians in support of a wide range of EERC technology development and commercialization activities in the areas of fuel combustion, gasification, and reforming; emission control; CO_2 capture; renewable energy; and materials processing.

2008–July 2018: Research Engineer, EERC, UND.

- Worked in the area of process engineering and design related to conversion of coal and biomass to fuels, chemicals, and energy and related CO capture systems.
- Responsibilities included designing processes and equipment for gasification, combustion, and pyrolysis of coal and biomass, optimizing syngas chemistry, developing purification methods, designing thermocatalytic reactors for conversion of syngas and thermochemical process products to fuels and chemicals, and engineering support on advanced pilot systems for testing and developing alternative fuels and energy forms.

2005–2008: Mechanical and Electrical Design Engineer, Hawkes Manufacturing, East Grand Forks, Minnesota.

- Responsibilities included design, redesign, research, and testing, evaluation of new and existing products, mechanical synthesis of mechanisms, structures, and fluid power systems programmable electronic controls, wiring harnesses, actuators, and sensors, project management, and cost analysis.

2003: Engineering Intern, American Crystal Sugar Company, East Grand Forks, Minnesota.

- Responsibilities included ultrasonic testing and visual inspection of boilers and process heat exchangers, creating detailed inspection reports for vessels tested in five factories, and creating a detailed standardized testing procedure.

JACE D. ANDERSON
Research Engineer, Energy Systems Development
Energy & Environmental Research Center (EERC), University of North Dakota (UND)
15 North 23rd Street, Stop 9018, Grand Forks, North Dakota 58202-9018 USA
701.777.5283, janderson@undeerc.org

Education and Training

B.S., Mechanical Engineering, University of North Dakota, 2018.
Proficient in the use of Microsoft Excel, Word, and PowerPoint and AutoCAD.

Research and Professional Experience

July 2018–Present: Research Engineer, Energy Systems Development, EERC, UND.

- Contributes to the design, modeling, and fabrication of experimental equipment.
- Oversees and operates equipment.
- Interprets data.
- Helps to prepare proposals, reports, and papers.
- Presents project results to clients and at national and international conferences.
- Manages an internal cost center.
- Manages and helps with management of various projects.

December 2014–December 2016: Mechanical Engineering Intern, Essar Steel, Nashwauk, Minnesota.

- Supported multiple projects with AutoCAD drafting, Excel spreadsheets, and field measurements.

Publications

Has coauthored several publications.

JOSHUA J. STANISLOWSKI
Director of Energy Systems Development
Energy & Environmental Research Center (EERC), University of North Dakota (UND)
15 North 23rd Street, Stop 9018, Grand Forks, North Dakota 58202-9018 USA
701.777.5087, jstanislowski@undeerc.org

Education and Training

M.S., Chemical Engineering, University of North Dakota, 2012.
B.S., Chemical Engineering, University of North Dakota, 2000.
Six Sigma Green Belt Certified, August 2004.

Research and Professional Experience

August 2019–Present: Director of Energy Systems Development, EERC, UND.

- Leads multidisciplinary team of scientists and engineers focused on research, development, and commercialization of innovative energy technologies as they relate to coal utilization and emissions, carbon management, and alternative fuels and renewable energy.
- Serves as co-project manager of Intelligent Pipeline Integrity Program at the EERC, an industry-led consortium whose focus is advanced near-commercial, emerging technologies to prevent and detect leaks from gathering pipelines.
- Principal areas of interest and expertise include coal and biomass gasification systems with an emphasis on novel syngas cooling, cleanup, and separation technologies.
- Has worked extensively with hydrogen separation membrane systems and liquid fuels catalysis. Proficient in process modeling and systems engineering including techno-economic studies using Aspen Plus software.
- Has significant experience with process engineering, process controls, and project management.
- Has a strong background in gauge studies, experimental design, and data analysis.

2015–July 2019: Principal Process Engineer, Energy Systems Development, EERC, UND.

- Worked closely with EERC management team to develop new programmatic directions to solve challenges in the energy industry.
- Managed projects in areas of gasification, CO_2 capture, supercritical CO_2 power cycles, and systems engineering.

2008–2015: Research Manager, EERC, UND.

- Managed projects in areas of gasification, gas cleanup, hydrogen production, liquid fuel production, and systems engineering.

2005–2008: Research Engineer, EERC, UND.

- Areas of focus included mercury control technologies and coal gasification.
- Responsibilities involved project management and aiding in completion of projects.
- Duties included design and construction of bench- and pilot-scale equipment, performing experimental design, data collection, data analysis, and report preparation.

- Also worked in the areas of low-rank coal gasification, warm-gas cleanup, and liquid fuels production modeling using Aspen Plus software.

2001–2005: Process Engineer, Innovex, Inc., Litchfield, Minnesota.

- Responsible for various process lines including copper plating, nickel plating, tin–lead plating, gold plating, polyimide etching, copper etching, chrome etching, and resist strip and lamination.
- Duties included all aspects of process line including quality control, documentation, final product yields, continuous process improvement, and operator training.
- Gained extensive knowledge of statistical process control and statistical start-up methodology.
- Proficient with MiniTab statistical software and utilized statistical analysis and experimental design as part of daily work.
- Designed and oversaw experiments as principal investigator; wrote technical reports and papers, including standard operating procedures and process control plans; presented project and experimental results to suppliers, customers, clients, and managers; created engineering designs and calculations; and performed hands-on mechanical work when troubleshooting process issues.
- Demonstrated ability to coordinate activities with varied entities through extensive project management and leadership experience.

1998–2000: Student Research Assistant, EERC, UND.

- Worked on wide variety of projects, including data entry and programming for Center for Air Toxic Metals® database, contamination cleanup program development, using aerogels for emission control, and development of nationwide mercury emission model.

Publications

Has coauthored numerous professional publications.

DR. MICHAEL L. SWANSON
Distinguished Engineer, Fuels Conversion
Energy & Environmental Research Center (EERC), University of North Dakota (UND)
15 North 23rd Street, Stop 9018, Grand Forks, North Dakota 58202-9018 USA
701.777.5239, mswanson@undeerc.org

Education and Training

Ph.D., Energy Engineering, University of North Dakota, 2000. Dissertation: Modeling of Ash Properties in Advanced Coal-Based Power Systems.
M.B.A., University of North Dakota, 1991.
M.S., Chemical Engineering, University of North Dakota, 1982.
B.S., Chemical Engineering, University of North Dakota, 1981.

Research and Professional Experience

2022–Present: Distinguished Engineer, Fuels Conversion, EERC, UND.

- Has interest and expertise in demonstration of advanced power systems such as integrated gasification combined cycle (IGCC) with warm- and cold-syngas cleanup, conversion of solid fuels to various fuel formats including hydrogen generation, precombustion CO_2 capture, and pressurized fluidized-bed combustion (PFBC).

2004–Present: Adjunct Professor, Chemical Engineering, UND.

1999–2022: Principal Engineer, Fuels Conversion, EERC, UND.

- Was involved in the demonstration of advanced power systems such as gasification with an emphasis on power, fuels, and hydrogen production from solid feedstocks while also demonstrating low-carbon-intensity technologies.

1997–1999: Research Manager, EERC, UND.

- Managed research projects involving demonstration of advanced power systems such as IGCC and PFBC focused on hot-gas cleanup issues.

1990–1997: Research Engineer, EERC, UND.

- Was involved with demonstration of advanced power systems such as IGCC and PFBC focused on hot-gas cleanup issues.

1986–1990: Research Engineer, EERC, UND.

- Supervised contract with U.S. Department of Energy (DOE) to investigate utilization of coal–water fuels in gas turbines.
- Designed, constructed, and operated research projects that evaluated higher reactivity of low-rank coals in short-residence-time gas turbines and diesel engines.

1983–1986: Research Engineer, EERC, UND.

- Designed, constructed, and operated supercritical fluid extraction (SFE) and coal liquefaction apparatus; characterized resulting organic liquids and carbonaceous chars; and prepared reports.

1982–1983: Associated Western Universities Postgraduate Fellowship, DOE Grand Forks Energy Technology Center, Grand Forks, North Dakota.

- Designed and constructed SFE apparatus.

Publications

Has authored or coauthored numerous professional publications.

JOHN A. HAMLING
Assistant Vice President for Strategic Partnerships
Energy & Environmental Research Center (EERC), University of North Dakota (UND)
15 North 23rd Street, Stop 9018, Grand Forks, North Dakota 58202-9018 USA
701.777.5472, jhamling@undeerc.org

Principal Areas of Expertise

Hamling has over 20 years of experience in the energy industry catalyzing and implementing pioneering solutions that facilitate the prudent development and use of low-carbon and fossil energy. Hamling has broadly developed and strengthened strategic business relationships and has grown an energy-focused research and development (R&D) portfolios at state, national, and global levels.

Hamling serves as a development lead and advisor for screening, risk assessment, characterization, qualification, design, permitting, incentive program compliance, installation, and monitoring aspects of multiple geologic CO_2 storage projects ranging from 1000 to over 18,000,000 tonnes per year, including several currently operating underground injection control (UIC) Class VI storage projects in the United States. Hamling also serves as an advisor and development lead for several enhanced oil recovery (EOR) pilots in both conventional and unconventional fields; produced water treatment demonstration and use projects; high-value mineral resource assessment and recovery projects; and commercial development projects focused on direct air capture and low-carbon hydrogen production, storage, and use.

Hamling has led efforts resulting in the development, proof of concept, and validation of several improved monitoring techniques applicable to both dedicated and associated geologic CO_2 storage and EOR applications. Hamling's experience extends to the design, implementation, and oversight of surface, near-surface, deep subsurface, and reservoir characterization and surveillance programs.

Hamling's experience includes well-logging principals and applications, well drilling, well completions, wellbore integrity, risk assessment, logistics, well stimulation and enhanced recovery in tight oil plays, and health, safety, and environmental (HSE) programs. Hamling has lead the formation and management of a policy and regulatory team focused on carbon capture and storage (CCS), gas storage, improved oil recovery (IOR)/EOR, and unconventional oil and gas development with extensive experience conducting risk assessments and developing monitoring, mitigation, and verification/monitoring, reporting, and verification (MRV) programs compliant with the California Air Resources Board Low Carbon Fuel Standard CCS Protocol, MRV plan provisions of the U.S. Environmental Protection Agency (EPA) greenhouse gas reporting rule Subpart RR compliant with the Internal Revenue Service (IRS) 45Q tax credit program, EPA UIC Class II and Class VI programs, state/provincial regulatory programs, and emerging carbon markets/incentive programs.
Hamling has served as project manager (PM), principal investigator (PI), and task lead for several multiyear, multimillion-dollar research and demonstration projects and has led data analytics, operations, and reservoir surveillance groups at the EERC alongside several adaptive, multidisciplinary project teams. These activities encompass both contract research and several strategic partnership programs among the state of North Dakota, the U.S. Department of Energy (DOE), and private industry

designed to propel the development and implementation of approaches that benefit practical energy development.

Education and Training
M.S. Petroleum Engineering, University of North Dakota, 2022.
B.S., Mechanical Engineering, University of North Dakota, 2007.
Associate of Science, Associate of Arts, Williston State College, 2004.
Certified Engineer in Training (EIT)

Research and Professional Experience
May 2022–Present: Assistant Vice President for Strategic Partnerships, EERC, UND. Hamling broadly develops relationships to advance technologies and concepts that enable commercial application of CCS, unconventional oil and gas production, and IOR in conventional and unconventional oil plays.

May 2021–Present: Assistant Vice President for CCUS, EERC Foundation. Hamling has actively played a key role in standing up and growing a national and international portfolio of commercial research service capabilities focused on carbon capture, utilization, and storage (CCUS) within the EERC Foundation.

May 2021–May 2022: Director of Subsurface Initiative, EERC, UND. Broadly developed and strengthened strategic business relationships and subsurface R&D portfolios at state, national, and global levels. Led multidisciplinary teams of scientists and engineers and played a lead role in working with industry partners to stand up several individual CCUS projects that exceeded $10 billion of commercial investment when fully implemented. Served as PM/PI/task lead for multiyear, multimillion-dollar, DOE-sponsored state research programs focused on carbon management and geologic storage. Hamling also led the design, implementation, and operation of an active reservoir management demonstration and brine treatment technology testbed facility.

2018–April 2021: Assistant Director of Integrated Projects, EERC, UND. In this role, Hamling advanced innovation and technologies to enable commercial application of geologic carbon storage, unconventional oil and gas production, and IOR in both conventional and unconventional oil plays.

2017–Present: Adjunct Lecturer, Department of Petroleum Engineering, UND.

2012–2018: Principal Engineer, Oilfield Operations Group Lead, EERC, UND. Hamling served as PM, PI, and task lead for several multiyear, multimillion-dollar projects, leading a multidisciplinary team of scientists and engineers working to develop and implement MVA concepts for large-scale (>1 million tons per year) CO_2 storage and EOR operations. Hamling also worked with a multidisciplinary team in the development, design, and implementation of new approaches that benefit the economical exploration, development, and production of oil and gas.

2011–2012: Research Manager, EERC, UND. Hamling's responsibilities included managing characterization and monitoring research activities and operations for large-scale (>1 million tons per year) combined EOR and CO_2 storage projects for the Plains CO_2 Reduction (PCOR) Partnership. Hamling also led various research activities related to oil and gas production, infrastructure, and development from unconventional reservoirs.

2009–2011: Research Engineer, EERC, UND. Hamling focused on the design and implementation of new approaches that benefit the exploration, development, and production of oil and gas and with the PCOR Partnership, evaluating the potential for CO_2 storage in geologic formations. Specific responsibilities included field operations design, deployment, and interpretation relating to oilfield technologies applicable to the CCS industry; laboratory functions relating to the Applied Geology Laboratory (AGL); data analysis; regulatory compliance; and communication of operations between service providers, management teams, industry partners, and governmental organizations. Additional responsibilities included investigation and/or demonstration of techniques and/or technologies that can enhance oil and gas production or economically benefit the oil and gas industry while reducing the environmental footprint of drilling and production operations.

2007–2009: Reservoir Evaluation Engineer; HSE Representative; and Loss Prevention Team Leader, Reservoir Evaluation segment, Schlumberger Limited. Hamling was responsible for providing tailored geophysical solutions for specific and unique oilfield applications, executing basic and advanced reservoir evaluations utilizing real-time wellbore measurement technologies, reservoir pressure and fluid sampling, and interpretation of reservoir measurement data. In this role, Hamling designed and oversaw all aspects of openhole and cased-hole logging operations for over 300 wells in both conventional and unconventional oil and gas plays and also served as an HSE officer, loss prevention team lead, and explosives and radiation safety officer for wellsite activities.

2004–2007: Student Research Scientist/Engineer, EERC, UND. Hamling was responsible for conducting research related to the development of new methods to join high-temperature, creep-resistant alloys and advanced processing and manufacture techniques for silicon carbide ceramic composites; materials testing in accordance with ASME (American Society of Mechanical Engineers), ASTM International, and ISO (International Organization for Standardization) standards; analyzing scanning electron microscopy micrographs; designing and fabricating composite micrometeorite shielding; and literature and patent review.

Professional Activities

Society of Petroleum Engineers International Williston Basin Section – have continuously served as a section officer and board member since 2012. Positions include Acting Chairperson, Vice-Chairperson, and Communications Chairperson.

Served as PCOR Partnership representative on the writing committee for two U.S. Department of Energy Regional Carbon Sequestration Partnership (RCSP) Program BPMs entitled *Best Practices for Monitoring, Verification, and Accounting of CO_2 Stored in Deep Geologic Formations – Version 3* and *Best Practices for Operating Carbon Storage Projects*.

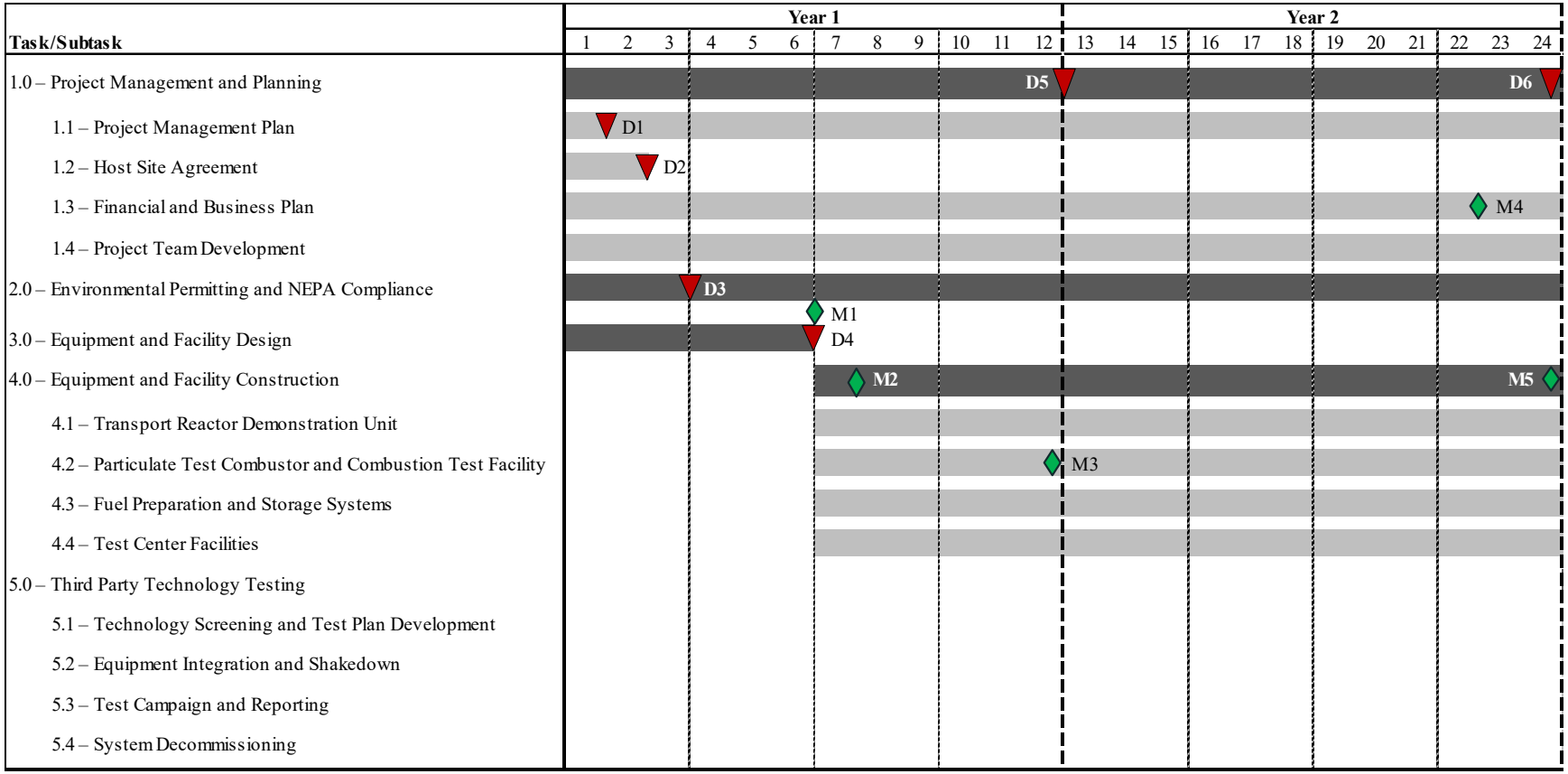
Publications

Hamling has authored and coauthored numerous technical publications.

APPENDIX C

SCHEDULE, MILESTONES, AND DELIVERABLES FOR THE ENTIRE 5-YEAR PROJECT WITH DOE

5-Year Project Schedule



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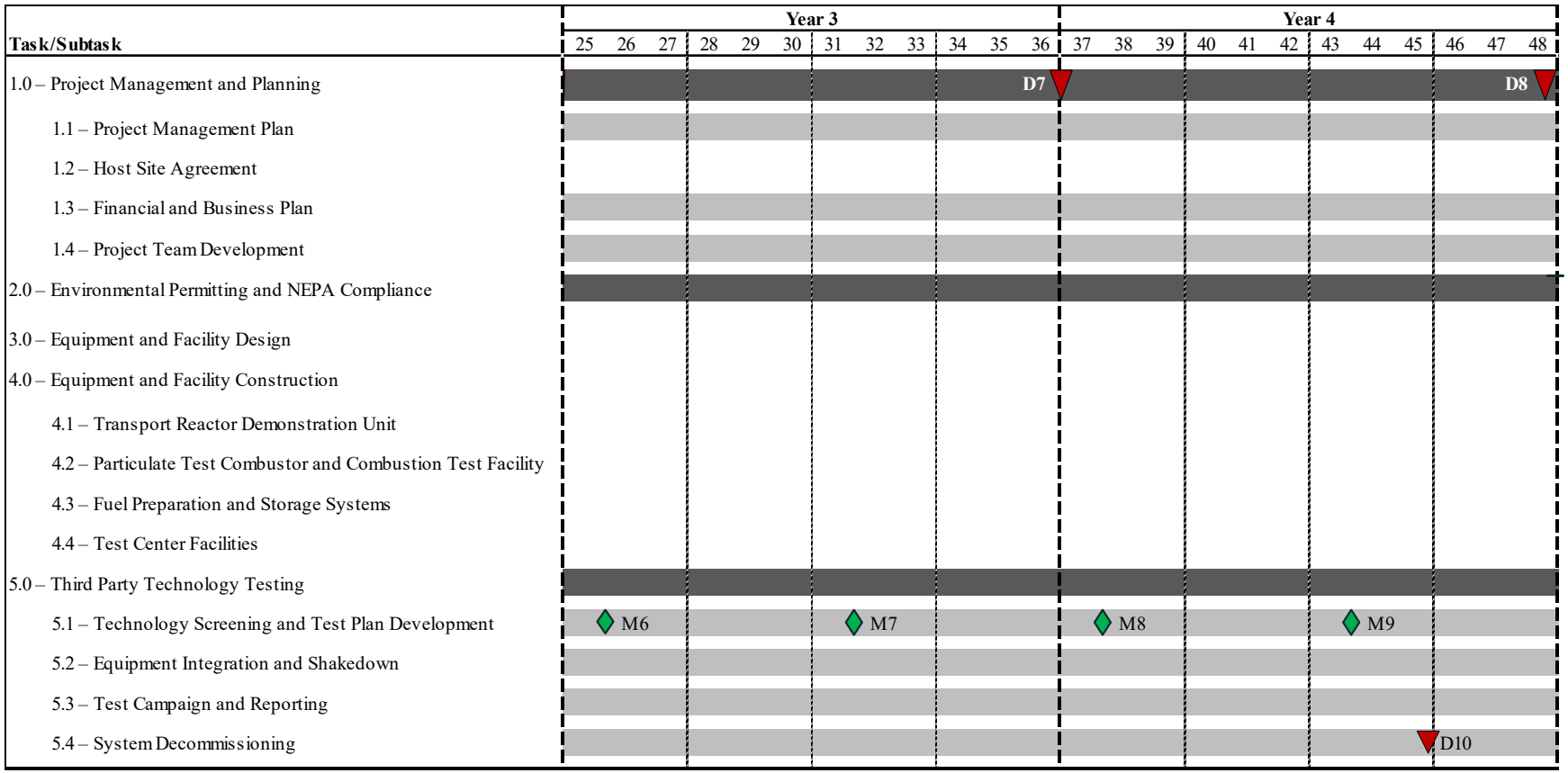

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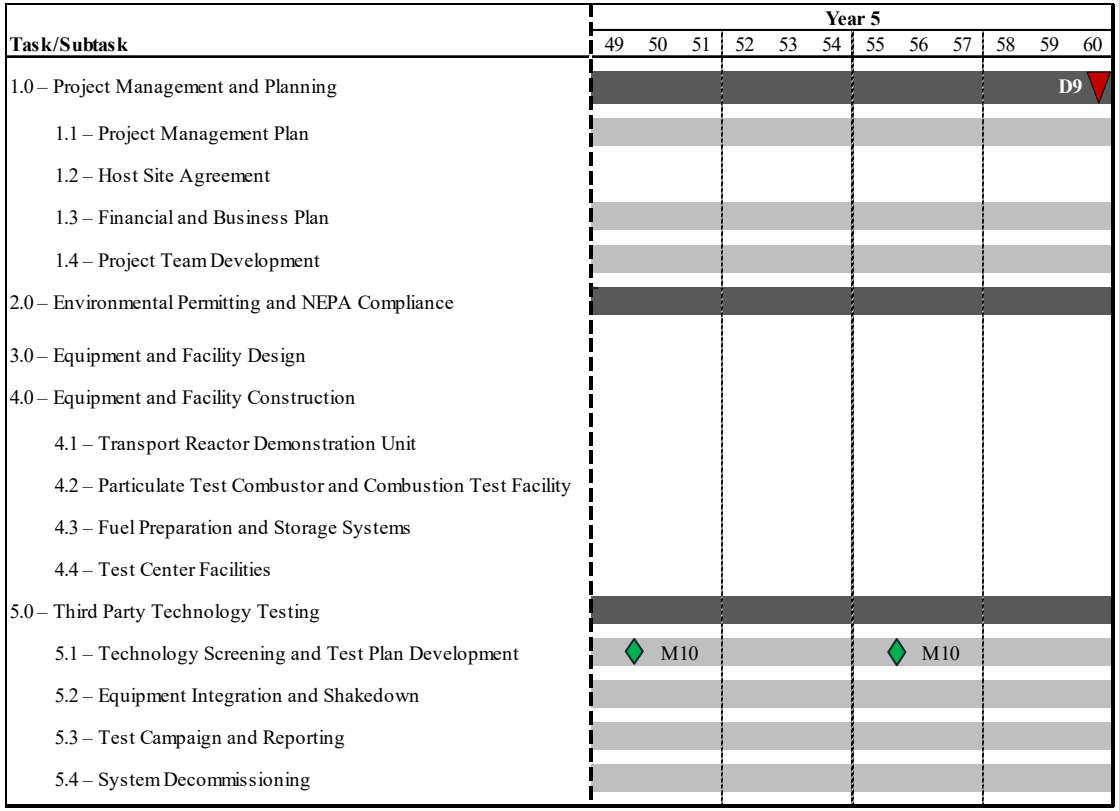

Deliverables	Milestones
D1 – Project Management Plan (updated)	M1 – Complete equipment and facility design
D2 – Host Site Agreement	M2 – Initiate construction permits
D3 – Environmental Health & Safety Analysis	M3 – Complete PTC and CTF Construction
D4 – Test Center Engineering Design Package	M4 – Financial and Business Plan Review
D5 – Year 1 Summary Report	M5 – Combustor construction activities completed
D6 – Year 2 Summary Report	M6 – Identify CC technology provider for initial round of evaluations (Year 3a)
D7 – Year 3 Summary Report	M7 – Identify CC technology provider for next round of evaluations (Year 3b)
D8 – Year 4 Summary Report	M8 – Identify CC technology provider for next round of evaluations (Year 4a)
D9 – Year 4 Summary Report	M9 – Identify CC technology provider for next round of evaluations (Year 4b)
D10 – Decontamination, Disposal, and Decommissioning (DD&D) Plan	M10 – Identify CC technology provider for next round of evaluations (Year 5a)
DX – Technology Screening and Evaluation Document*	M11 – Identify CC technology provider for next round of evaluations (Year 5b)
DX – Summary Test Reports (E.S. Due after 30 days; full report due w/i 90 days)*	
* It is expected there will be multiple test campaigns. The Recipient will work with DOE to name, number, and schedule these deliverables accordingly.	

APPENDIX D

BUDGET NOTES

BUDGET JUSTIFICATION

ENERGY & ENVIRONMENTAL RESEARCH CENTER

BACKGROUND

The Energy & Environmental Research Center (EERC) is an independently organized multidisciplinary research center within the University of North Dakota (UND). The EERC is funded through federal and nonfederal grants, contracts, and other agreements. Although the EERC is not affiliated with any one academic department, university faculty may participate in a project, depending on the scope of work and expertise required to perform the project.

INTELLECTUAL PROPERTY

The applicable federal intellectual property (IP) regulations will govern any resulting research agreement(s). If IP with the potential to generate revenue to which the EERC is entitled is developed under this project, such IP, including rights, title, interest, and obligations, may be transferred to the EERC Foundation, a separate legal entity.

BUDGET INFORMATION

The proposed work will be done on a cost-reimbursable basis. The distribution of costs among budget categories (labor, travel, supplies, equipment, etc.) and among funding sources of the same scope of work is for planning purposes only. The project manager may incur and allocate allowable project costs among the funding sources for this scope of work in accordance with Office of Management and Budget (OMB) Uniform Guidance 2 CFR 200.

Escalation of labor and EERC recharge center rates are incorporated into the budget when a project's duration extends beyond the university's current fiscal year (July 1 – June 30). Escalation is calculated by prorating an average annual increase over the anticipated life of the project.

The cost of this project is based on a specific start date indicated at the top of the EERC budget. Any delay in the start of this project may increase the budget. Budget category descriptions presented below are for informational purposes; some categories may not appear in the budget.

Salaries: Salary estimates are based on the scope of work and prior experience on projects of similar scope. The labor rate used for specifically identified personnel is the current hourly rate for that individual. The labor category rate is the average rate of a personnel group with similar job descriptions. Salary costs incurred are based on direct hourly effort on the project. Faculty who work on this project may be paid an amount over the normal base salary, creating an overload that is subject to limitation in accordance with university policy. As noted in the UND EERC Cost Accounting Standards Board Disclosure Statement, administrative salary and support costs that can be specifically identified to the project are direct-charged and not charged as facilities and administrative (F&A) costs. Costs for general support services such as contracts and IP, accounting, human resources, procurement, and clerical support of these functions are charged as F&A costs.

Fringe Benefits: Fringe benefits consist of two components, which are budgeted as a percentage of direct labor. The first component is a fixed percentage approved annually by the UND cognizant audit agency, the Department of Health and Human Services. This portion of the rate covers vacation, holiday, and sick leave (VSL) and is applied to direct labor for permanent staff eligible for VSL benefits. Only the actual approved rate will be charged to the project. The second component is estimated based on historical data

and is charged as actual expenses for items such as health, life, and unemployment insurance; social security; worker's compensation; and UND retirement contributions.

Travel: Travel may include site visits, fieldwork, meetings, and conferences. Travel costs are estimated and paid in accordance with OMB Uniform Guidance 2 CFR 200, Section 474; and UND travel policies, which can be found at https://campus.und.edu/finance/procurement-and-payment-services/travel/index.html (Policies & Procedures, A–Z Policy Index, Travel). Daily meal rates are based on U.S. General Services Administration rates unless further limited by UND travel policies; other estimates such as airfare, lodging, ground transportation, and miscellaneous costs are based on a combination of historical costs and current market prices. Miscellaneous travel costs may include parking fees, Internet charges, long-distance phone, copies, faxes, shipping, and postage.

Equipment: The equipment budget below is for the entire DOE project. Half of the BP1 equipment budget is estimated to be expensed in the first 12 months.

DETAILED BUDGET - EQUIPMENT

Equipment to be purchased – BP1 - Task 5	Qty	Unit Cost	Cost	Basis of Cost	Justification of Need
Air Compressor	1	$ 316,800	$ 316,800	Quote	Improve system reliability, redundancy, and capacity
Natural Gas Compressor	1	$ 302,000	$ 302,000	Quote	Improve system reliability, redundancy, and capacity
Heat Exchanger	1	$ 6,425	$ 6,425	Quote	Improve system reliability at higher feed rates
Cooling Tower	1	$ 41,375	$ 41,375	Quote	Improve system reliability at higher feed rates
Solids Cooling System	1	$ 1,827,200	$ 1,827,200	Engineering Estimate	Improve system reliability at higher feed rates
SCR	1	$ 681,000	$ 681,000	Engineering Estimate	Making flue gas compatible with CCS technologies
Direct Contact Cooler	1	$ 100,000	$ 100,000	Engineering Estimate	Making flue gas compatible with CCS technologies
WFGD	1	$ 819,000	$ 819,000	Engineering Estimate	Making flue gas compatible with CCS technologies
Control System Upgrade	1	$ 75,000	$ 75,000	Engineering Estimate	Modernize controls and data collection systems
Feed System	1	$ 75,000	$ 75,000	Engineering Estimate	Improve system reliability and multi-day operation
Flip to Downfire	1	$ 225,000	$ 225,000	Engineering Estimate	Allows for continuous, multi-day operation
Baghouse	1	$ 56,250	$ 56,250	Engineering Estimate	Making flue gas compatible with CCS technologies
CTF SCR	1	$ 75,000	$ 75,000	Engineering Estimate	Making flue gas compatible with CCS technologies
Flame Safety System	1	$ 75,000	$ 75,000	Engineering Estimate	Improve test center safety
Bunker Storage	1	$ 375,000	$ 375,000	Engineering Estimate	Improve multi-day fuel feed reliability at higher rates
Coal Dryer	1	$ 375,000	$ 375,000	Engineering Estimate	Allows faster processing of wet coals and biomass
Testing Bays	1	$ 208,000	$ 208,000	Engineering Estimate	Increases capacity to host multiple technology systems
Safety Upgrades	1	$ 208,000	$ 208,000	Engineering Estimate	Improve test center safety
			$ 5,841,050		

Equipment to be purchased – BP2 - Task 6	Qty	Unit Cost	Cost	Basis of Cost	Justification of Need
Misc. equipment to integrate 3rd party technologies	1	$ 18,750	$ 18,750	Engineering Estimate	Required to be able to integrate 3rd party technologies
			$ 18,750		

Equipment to be purchased – BP3 - Task 6	Qty	Unit Cost	Cost	Basis of Cost	Justification of Need
Misc. equipment to integrate 3rd party technologies	1	$ 18,750	$ 18,750	Engineering Estimate	Required to be able to integrate 3rd party technologies
			$ 18,750		

Equipment to be purchased – BP4 - Task 6	Qty	Unit Cost	Cost	Basis of Cost	Justification of Need
Misc. equipment to integrate 3rd party technologies	1	$ 18,750	$ 18,750	Engineering Estimate	Required to be able to integrate 3rd party technologies
			$ 18,750		

Supplies: Supplies include items and materials that are necessary for the research project and can be directly identified to the project. Supply and material estimates are based on prior experience with similar projects. Examples of supply items are chemicals, gases, glassware, nuts, bolts, piping, data storage, paper, memory, software, toner cartridges, maps, sample containers, minor equipment (value less than $5000), signage, safety items, subscriptions, books, and reference materials. General-purpose office supplies (pencils, pens, paper clips, staples, Post-it notes, etc.) are included in the F&A cost.

Subcontracts: Not applicable.

Professional Fees: Not applicable.

Communications: Telephone, cell phone, and fax line charges are included in the F&A cost; however, direct project costs may include line charges at remote locations, long-distance telephone charges,

postage, and other data or document transportation costs that can be directly identified to a project. Estimated costs are based on prior experience with similar projects.

Printing and Duplicating: Page rates are established annually by the university's duplicating center. Printing and duplicating costs are allocated to the appropriate funding source. Estimated costs are based on prior experience with similar projects.

Food: Expenditures for project partner meetings where the primary purpose is dissemination of technical information may include the cost of food. EERC employees in attendance will not receive per diem reimbursement for meals that are paid by project funds. The estimated cost is based on the number and location of project partner meetings.

Operating Fees: Operating fees generally include EERC recharge centers, outside laboratories, and freight.

EERC recharge center rates are established annually and approved by the university.

Laboratory and analytical recharge fees are charged on a per-sample, hourly, or daily rate. Additionally, laboratory analyses may be performed outside the university when necessary. The estimated cost is based on the test protocol required for the scope of work.

Document production services recharge fees are based on an hourly rate for production of such items as report figures; posters; and/or images for presentations, maps, schematics, website design, brochures, and photographs. The estimated cost is based on prior experience with similar projects.

Shop and operations recharge fees cover specific expenses related to the pilot plant and the required expertise of individuals who perform related activities. Fees may be incurred in the pilot plant, at remote locations, or in EERC laboratories whenever these particular skills are required. The rate includes such items as specialized safety training, personal safety items, fall protection harnesses and respirators, CPR certification, annual physicals, protective clothing/eyewear, research by-product disposal, equipment repairs, equipment safety inspections, and labor to direct these activities. The estimated cost is based on the number of hours budgeted for this group of individuals.

Technical software recharge fees cover a use fee for advanced project management tools. Costs are associated with software, data entry, maintenance, and enhancement of the system.

Engineering services recharge fees cover specific expenses related to retaining qualified and certified design and engineering personnel. The rate includes training to enhance skill sets and maintain certifications using webinars and workshops. The rate also includes specialized safety training and related physicals. The estimated cost is based on the number of hours budgeted for this group of individuals.

Freight expenditures generally occur for outgoing items and field sample shipments.

Facilities and Administrative Cost: The F&A rate proposed herein is approved by the U.S. Department of Health and Human Services and is applied to modified total direct costs (MTDCs). MTDC is defined as total direct costs less individual capital expenditures, such as equipment or software costing $5000 or more with a useful life of greater than 1 year, as well as subawards in excess of the first $25,000 for each award.