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

October 2, 2023

Mr. Reice Haase
Deputy Executive Director
North Dakota Industrial Commission
State Capitol – 14th Floor
600 East Boulevard Avenue, Department 405
Bismarck, ND 58505-0840

Dear Mr. Haase:

Subject: EERC Proposal No. 2024-0035 Entitled "Prairie Horizon Carbon Management Hub"

The Energy & Environmental Research Center (EERC) of the University of North Dakota (UND) is pleased to submit the subject proposal to the North Dakota Industrial Commission Renewable Energy Program.

The EERC, a research organization within UND, an institution of higher education within the state of North Dakota, is not a taxable entity; therefore, it has no tax liability. The EERC is committed to completing the project on schedule and within budget should the Commission approve the requested grant.

The $100 application fee for this proposal is provided through ACH Transaction Number 262355. If you have any questions, please contact me by telephone at (701) 777-5236 or by email at kconnors@undeerc.org.

Sincerely,

DocuSigned by:
Kevin Connors
1D14EF7CF3CD456...

Kevin C. Connors
Assistant Director for Regulatory Compliance
and Energy Policy

Approved by:

DocuSigned by:
Brian Kalk for
C7560BF2E06C43B...

Charles D. Gorecki, CEO
Energy & Environmental Research Center

c: Karen Tyler, North Dakota Industrial Commission

Renewable Energy Program

North Dakota Industrial Commission

Application

Project Title: Prairie Horizon Carbon Management Hub

Applicant: Energy & Environmental Research Center (EERC), University of North Dakota; *EERC Proposal No. 2024-0035*

Principal Investigator: Kevin C. Connors

Date of Application: October 2, 2023

Amount of Request: $100,000

Total Amount of Proposed Project: $3,225,000

Duration of Project: 24 months

Point of Contact (POC): Kevin C. Connors

POC Telephone: (701) 777-5236

POC Email: kconnors@undeerc.org

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

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ABSTRACT

The project team has defined a regional carbon management (CM) hub area in southwestern North Dakota—the Prairie Horizon Carbon Management Hub (PHCMH)—with a prospective stacked CO_2 storage resource of at least 100 million tonnes (Mt). Two stationary CO_2 sources with a combined annual total emission of over 5 Mt are identified as potential contributors to the CO_2 storage hub. The sources include an existing renewable diesel facility and a planned H_2 production facility. The PHCMH is needed to catalyze meaningful investment in new, clean H_2 energy technology that can diversify North Dakota's economy, leverage and expand use of North Dakota's vast natural and agricultural resources, and materially reduce the carbon intensity of the state's economy.

Objective: The primary objective of this proposed effort is to provide technical assistance and engagement for a prospective large-scale CO_2 storage hub, with emphasis on community outreach and public engagement activities that will support better understanding of the social landscape of the region in which the storage hub would be developed. **Expected Results:** The project will support the Renewable Energy Program's (REP's) mission to foster the development of renewable energy and related industrial use technologies through research, development, demonstration, and commercialization. The proposed

project will provide the technical assistance and stakeholder engagement for a large-scale CO_2 storage hub with emphasis on improved understanding of stakeholder concerns, community attitudes, and public acceptance of carbon capture, utilization, and storage associated with the existing renewable diesel facility and a planned H_2 production facility. The proposed hub would store CO_2 captured from these two facilities and would assist in the commercial deployment of clean H_2 energy that can diversify North Dakota's economy, leverage existing energy resources, create sustainable jobs, and reduce the environmental footprint of energy production and use in the region and beyond.

Duration: 24 months, with an anticipated start date of November 1, 2023. **Total Project Cost:** $3,225,000, with $100,000 from the North Dakota Industrial Commission Renewable Energy Program, up to $625,000 in cash cost share from Prairie Horizon Hydrogen (Marathon Petroleum Corporation and TC Energy), and $2.5M from the U.S. Department of Energy (DOE) National Energy Technology Laboratory (NETL). **Participants:** North Dakota Industrial Commission Renewable Energy Program, UND EERC, Marathon Petroleum Corporation, TC Energy, DOE NETL, and UND Nistler College of Business and Public Administration.

PROJECT DESCRIPTION

Introduction: The Energy & Environmental Research Center (EERC) has worked in collaboration with Marathon Petroleum Corporation (MPC) and TC Energy (TCE) to leverage U.S. Department of Energy (DOE) funds to help facilitate carbon reduction strategies across their portfolio, which includes energy transport, petroleum refining, renewable fuel manufacture, and hydrogen production. MPC and TCE, partnering as Prairie Horizon Hydrogen, are conducting a front-end engineering design (FEED) for a clean hydrogen (H_2) production facility and assessing the opportunity for a regional H_2 hub. This proposed project would assess the viability of a carbon dioxide (CO_2) storage hub to support Prairie Horizon Hydrogen's decarbonization goals.

North Dakota is an ideal candidate for this proposed project. As of September 2023, the North Dakota Industrial Commission (NDIC) has approved five CO_2 storage facility permit applications (one for the Red Trail Energy [RTE] ethanol plant, two for Minnkota Power Cooperative's Project Tundra, one for Dakota Gasification Company's Great Plains Synfuels Plant, and one for Blue Flint Sequester Company, LLC), with an additional permit application pending. Several other announced projects will be pursuing CO_2 storage permits to manage emissions from existing ethanol plants and a coal-fired power plant as well as a H_2 production hub that is in the early planning stages of development. In addition to being a key technology in addressing global CO_2 emissions, carbon capture, utilization, and storage (CCUS) will provide significant economic opportunities for the state of North Dakota. Deployment of CCUS technology is an emerging opportunity that has the potential to create tens of thousands of skilled, high-paying jobs in the state while securing the future of North Dakota's energy and agriculture economies.

Objectives: The primary objective of this proposed effort is to provide technical assistance and stakeholder engagement for a prospective large-scale CO_2 storage hub, with emphasis on community outreach and public engagement activities that will support improved understanding of stakeholder concerns, community attitudes, and public acceptance of CCUS. The project team has defined a regional carbon management (CM) hub area in southwestern North Dakota—the Prairie Horizon Carbon Management Hub (PHCMH)—with a prospective CO_2 stacked storage resource of at least 100 million tonnes (Mt). The proposed hub would store CO_2 captured from an existing renewable diesel facility and a planned H_2 production facility, further decarbonize both renewable diesel and hydrogen, strengthen demand for oil-seed crops, and create a framework for future carbon storage in North Dakota.

Although CCUS deployment has momentum in North Dakota, a variety of technical, policy, and stakeholder engagement aspects still need to be addressed. In the technical realm, there are questions about how operators can optimize CO_2 storage and account for potential pressure impacts from neighboring projects. From a policy standpoint, outstanding questions focus on how mineral rights and

pore space rights can be reconciled in areas where both CO_2 storage and oil and gas production are technically feasible. Other questions about federal policies and regulations will come into play for CCUS development on federal lands. In the area of public perception, the concept of CCUS deployment in North Dakota has recently been getting more attention in the media, highlighting knowledge gaps and misconceptions regarding the safety and effectiveness of CCUS, the role of government in its development and regulation, and the overall benefits of CCUS for all North Dakota citizens.

With these factors in mind, the project team proposes to conduct activities to 1) thoroughly examine local, state, and federal policies, as well as legal frameworks, that may be applied to questions of mineral rights and pore space ownership; 2) engage stakeholders through the development and implementation of a community benefits plan (CBP) that supports public engagement and dialogue activities, including providing technical assistance and resources to communities related to CM; and 3) address technical issues that could facilitate the eventual deployment of the PHCMH.

Methodology: The project will be organized into five tasks. The task structure is identical to that in the matching proposal that was awarded by DOE's Office of Fossil Energy and Carbon Management (FECM).

Task 1 – Project Management and Reporting

This effort is expected to require significant oversight by EERC personnel throughout the project duration to coordinate each part of the overall study so that results from each task best inform the next. Task 1 will include all reporting to project sponsors, including quarterly reports and the final report. Results will be provided in project reports and meetings with NDIC and will be shared at one or more technical conferences.

Task 2.0 – Community Benefits Plan

Task 2 work will focus on compliance with the mandatory components of the leveraged DOE funding and will address them in a manner that is most relevant and meaningful for North Dakota communities, businesses, and workforce. The CBP contains four actionable sections: Community and Labor

Engagement; Investing in Job Quality and a Skilled Workforce; Diversity, Equity, Inclusion, and Accessibility (DEIA); and Justice40 (J40) Initiative. The subtasks discussed in Task 2.0 each have a unique community or stakeholder focus but are all components of the overarching CBP and will be implemented concurrently. This approach will not only maximize efficiency and use of materials and resources but also provide consistent trustworthy messaging to enhance existing community relationships and foster new ones. A project webpage hosted on the EERC website will be developed and will incorporate principles of DEIA and environmental justice while providing project objectives, status, fact sheets, project partners, and contact information.

Key elements of public engagement will be listening sessions and a stakeholder network. Through listening sessions, the project team anticipates learning about stakeholder needs and concerns. Perceived risks expressed in these sessions will be integrated into Subtask 4.4 and will guide future messaging and materials development. The project team will work toward developing a network of stakeholder representatives to guide and advise project activities, build trustworthy relationships, and help engage the public.

Subtask 2.1 – Community and Labor Engagement (CLE) – This subtask will include all activities necessary to execute the Community and Labor Engagement section of the CBP. This subtask will include in-depth social characterization of the project area in the context of the greater region; identifying audiences, including communities with environmental justice concerns, disadvantaged communities, and tribes; developing messaging goals and content; selecting methods for engaging stakeholders (e.g., media campaigns, one-on-one contact, listening sessions, open houses, etc.); strategies for incorporating stakeholder feedback; materials development; developing a timeline for implementation of the plan; and creating a system for tracking engagement outcomes and gauging impact.

Subtask 2.2 – Investing in Job Quality and a Skilled Workforce – This subtask will include all activities necessary to execute the Investing in Job Quality and a Skilled Workforce section of the CBP.

Subtask 2.3 – Diversity, Equity, Inclusion, and Accessibility – This subtask will include all activities necessary to execute the DEIA section of the CBP. The DEIA subtask includes the actions that will be implemented throughout the project to foster a welcoming and inclusive environment; support people from groups traditionally underrepresented in STEM (science, technology, engineering, and math) and/or applicable workforces; advance equity; and encourage the inclusion of individuals from these groups in future phases of the project.

Subtask 2.4 – Justice40 – This subtask will include all activities necessary to execute the J40 section of the CBP. The J40 subtask will consist of two parts. Part 1 will begin with an in-depth energy and environmental justice assessment (EEJA) that will assess the project benefits and impacts. Learnings from the EEJA will be used to inform and develop Part 2, the J40 implementation strategy that will describe actions the project team will take to maximize benefits and minimize negative impacts in areas identified in the EEJA.

Task 3.0 – Regional Technology Transfer and Engagement

Subtask 3.1 – Technology Transfer – Work in Subtask 3.1 will inform and educate stakeholders about CCUS technologies. Nontechnical challenges to CCUS deployment in the region will be identified and assessed. A carbon hub advisory team (CHAT) will be formed to discuss key CCUS topics and guide engagement efforts. Developments from the CHAT will provide industry and regulatory stakeholders with tools to inform decision-making. The outcomes of this subtask will be transferred to stakeholders through meetings, presentations, and webinars. Developed materials will be shared with project sponsors to support its broader program goals. These activities will be planned in coordination with project partners and subject to their approval.

Subtask 3.2 – State and Federal Government Engagement – Subtask 3.2 will engage and inform state and federal government stakeholders about CCUS technologies and project development. Nontechnical challenges to CCUS deployment in the region, addressed in Task 4.0, will be identified and assessed. The

outcomes of this subtask will be transferred to stakeholders through meetings, presentations, and webinars. Developed materials will be shared with project sponsors. These activities will be planned in coordination with project partners and subject to their approval.

Task 4.0 – Technical and Nontechnical Challenges

Work in Task 4.0 will focus on identifying technical and nontechnical challenges for the prospective PHCMH, including conducting a feasibility study, investigating legacy well integrity in the project area, identifying and addressing pore space competition, and conducting a risk assessment.

Subtask 4.1 – Road Map to Prove Feasibility – This subtask will evaluate the PHCMH from the perspective of a prefeasibility study. Criteria for DOE's CarbonSAFE (Storage Assurance Facility Enterprise) Phases II and III will be used as the standard for comparison in evaluating the feasibility of the PHCMH. The project team will review and identify existing datasets within the defined project area to inform recommendation for additional data acquisition, such as acquiring additional seismic data and the location of a stratigraphic test well, aka the well of knowledge. A report (deliverable) will be developed with recommendations for a commercial project developer to collect all necessary data, including the location of stratigraphic test well and a well coring, testing, and sampling program to ensure compliance with North Dakota CO_2 storage facility permitting requirements. New and existing datasets can be used to inform final project design (i.e., number and location of injection wells and monitoring wells) and incorporated into a geologic model needed for meeting computational simulation requirements.

Subtask 4.2 – Legacy Well Integrity – Efforts in this subtask will be directed toward a legacy wellbore integrity assessment. This assessment will characterize the 400+ existing wellbores from the standpoint of long-term CO_2 storage security. The inventory of wells will be classified in a manner that will provide future hub developers with a foundational knowledge of wellbore mitigation challenges that may lie ahead (deliverable).

Subtask 4.3 – Pore Space Competition – As pore space resource demand increases, there will be increasing chances for a CO_2 storage developer to encounter competition for the subsurface storage resource. A paper (deliverable) will be developed to discuss the various types of storage opportunities (e.g., short-term vs. long-term), by-product to be stored (e.g., CO_2, H_2, saltwater, methane), formation types (e.g., nonproductive oil-bearing, geothermal resource), and associated laws and regulations in the broader area surrounding the PHCMH.

Subtask 4.4 – Risk Assessment – Activities within this subtask will be directed to conducting a risk assessment in conjunction with the engagement activities in Tasks 2.0 and 3.0. The goal will be to catalog risks identified by the area stakeholders. Risk identification will be conducted to identify both technical and nontechnical risks that may prevent or hinder potential candidate storage reservoirs within the hub area from serving as commercial CO_2 storage sites. Once the risk assessment has been completed, a risk treatment strategy will be formulated. Risk treatment includes several different strategies for negative risks, including avoidance, transfer, mitigation, and acceptance, and for positive risks, including exploitation, sharing, enhancing, and acceptance. Communication is necessary during every step of the risk assessment process to assure stakeholders that the identified risks are being addressed formally and suggested mitigation strategies are vetted during public engagement sessions. A report (deliverable) describing the identified risks and mitigation strategies will be submitted.

Task 5.0 – Regional Infrastructure Development

Work in Task 5.0 will evaluate regional infrastructure development by assessing potential transportation and infrastructure needs in the project area as well as identifying regional scale-up challenges and developing site readiness factors for the hub.

Subtask 5.1 – CO_2 Pipeline Rights-of-Way (ROWs) – This subtask will acquire available datasets that relate to land surface use and ownership within the broader study area to identify pertinent geopolitical characterization, environmentally sensitive areas, and various existing ROWs (including pipelines). This

information will be used to identify conflicts or opportunities for project development within the study area and summarized in a report (deliverable).

Subtask 5.2 – Site-Readiness Factors – The project team will create a prototype template (deliverable) for documenting site-readiness factors for commercial development of a carbon storage facility or hub. Site-readiness factors will be guided by the development of a commercial deployment matrix that will encompass CO_2 transport, utilization, and storage.

Anticipated Results: The proposed project will support North Dakota's vision to develop and deploy large-scale commercial CO_2 storage projects that reduce environmental impacts and increase the sustainability of energy production. The proposed project will provide the information needed for the project team to confidently invest in commercial deployment of clean H_2 energy that can diversify North Dakota's economy, leverage existing energy resources, and create sustainable jobs.

Facilities: The EERC research complex comprises 254,000 ft^2 of laboratories, fabrication facilities, technology demonstration facilities, and offices. The EERC has established working relationships with over 1300 clients, including federal and state agencies, universities, energy exploration and production companies, utilities, research and development firms, equipment vendors, architecture and engineering firms, chemical companies, and other organizations in all 50 states and 53 countries.

Resources: As a result of a long history of exploration and production in North Dakota, extensive oil and gas datasets are available. Most notably, the datasets are publicly available for free from NDIC with data from over 30,000 wells. These datasets consist of both spatial and tabular databases. Other available data (for free and/or purchase) include seismic surveys (2D and 3D), geophysical well logs, core data, water quality data, groundwater well locations, and water salinity.

The North Dakota Geological Survey's Wilson M. Laird Core and Sample Library is located less than 1 mile from the EERC. The climate-controlled facility currently houses over 375,000 feet of core and 30,000 boxes of drill cuttings obtained from oil and gas wells, which represents about 75% of the cores

cut in the North Dakota portion of the Williston Basin and about 95% of the samples collected. Use of the facility is free of charge.

No equipment is expected to be purchased for this project.

Techniques To Be Used, Their Availability and Capability: The proposed team has committed to the project and has ensured the availability of key personnel for the time frame of this project. The NDIC Oil and Gas Division provides online access to all geophysical logs related to deep well drilling in North Dakota. Any and all relevant publicly available data will be used for the project.

Environmental and Economic Impacts while Project Is Underway: Funding through NDIC will help offset initial development costs of CO_2 storage projects, and incentives such as 45Q will provide tax credits that make CO_2 capture, transportation, and storage economically viable. The project team believes that as more CCS projects are developed, the costs of the technologies employed will continue to fall and projects such as this will become more economically and socially attractive.

Ultimate Technological and Economic Impacts: The proposed project will support North Dakota's vision to develop and deploy large-scale commercial CO_2 storage projects that reduce environmental impacts and increase the sustainability of energy production. The proposed project will provide the information needed for the project team to confidently invest in commercial deployment of clean H_2 energy that can diversify North Dakota's economy, leverage existing energy resources, and create sustainable jobs.

Why the Project Is Needed: Although CCUS deployment has momentum in North Dakota, a variety of technical, policy, and stakeholder engagement aspects still need to be addressed. In the technical realm, there are questions about how operators can optimize CO_2 storage and account for potential pressure impacts from neighboring projects. From a policy standpoint, outstanding questions focus on how mineral rights and pore space rights can be reconciled in areas where both CO_2 storage and oil and gas production are technically feasible. Other questions about federal policies and regulations will come into play for CCUS development on federal lands. In the area of public perception, the concept of CCUS

deployment in North Dakota has recently been getting more attention in the media, highlighting knowledge gaps and misconceptions regarding the safety and effectiveness of CCUS, the role of government in its development and regulation, and the overall benefits of CCUS for all North Dakota citizens. The questions and challenges being addressed by this project will be valuable to all stakeholders as North Dakota continues to pursue carbon reduction strategies for our energy and agricultural sectors and the diversification of our economy that will follow.

STANDARDS OF SUCCESS: Ultimately, this project will be considered successful if the project activities can 1) promote public engagement and support in North Dakota, 2) promote regional technology transfer, 3) address key technical and nontechnical challenges by advancing critical knowledge and capabilities, and 4) evaluate regional infrastructure challenges and needs. Accomplishment of this project and subsequent investments enables the commercial deployment of clean H_2 energy technology in North Dakota, resulting in economic and environmental benefits consistent with REP goals.

BACKGROUND/QUALIFICATIONS: The EERC will lead the proposed project. The principal investigator (PI) and lead for Task 1.0 is Mr. Kevin Connors, Assistant Director for Regulatory Compliance and Energy Policy at the EERC. Mr. Connors will handle project management, planning, and reporting activities. He will ensure successful completion of the project on schedule and budget, coordinate and direct consultant activities, and ensure transfer of data and products to project sponsors. Ms. Charlene Crocker, EERC Senior Research Scientist and Outreach Team Lead, will lead Task 2.0 and be responsible for updating and implementing the CBP along with coordinating public engagement and support. Ms. Katherine Anagnost, EERC Senior Regulatory and Permitting Specialist, will lead Task 3.0 and be responsible for overall regional technology transfer, managing the advisory team (CHAT), and engagement. Mr. Wesley Peck, EERC Assistant Director for Subsurface Strategies, will lead Task 4.0 and be responsible for leading the technical and nontechnical challenges investigation. Mr. Kyle Glazewski, EERC Principal Analyst and Data/GIS Team Lead, will serve as Task 5.0 lead and direct the regional

infrastructure evaluation. Dr. Sheila Hanson, Associate Professor of Entrepreneurship & Management at the University of North Dakota (UND) Nistler College of Business & Public Administration, is a psychologist who will conduct social science research under Task 2.0. MPC and TCE will be providing cost share. Representatives of MPC, TCE, and REP will serve on the CHAT to guide CBP implementation and engagement activities. In addition, MPC and TCE will lead governmental, tribal, and public engagement efforts; they will also have final approval on all aspects of stakeholder engagement activities.

MANAGEMENT: The EERC will oversee all tasks, schedule regular internal and external meetings with project participants, and ensure that the project is conducted using acceptable scientific methodologies and practices in accordance with the project plan (budget, schedule, deliverables, and milestones) and is meeting quality objectives. The EERC will keep all partners informed of project progress, coordinate activities as necessary for the execution of a successful project, and will be responsible for timely submission of all project deliverables and transfer of data and products to the project team.

TIMETABLE: This project is proposed to be performed over a 24-month period, with an anticipated start date of November 1, 2023. Quarterly progress reports will be submitted within 30 days after the end of each calendar quarter. Figure 1 depicts the proposed schedule.

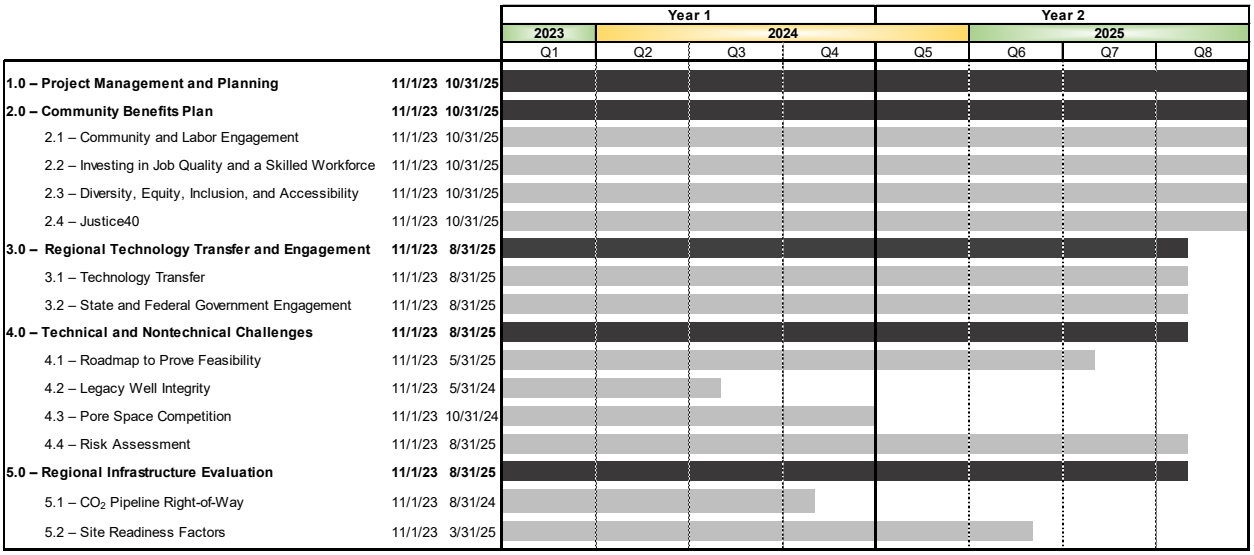

Figure 1. Proposed project schedule.

BUDGET: The total estimated cost for the proposed work is $3,225,000, as presented in Table 1. The EERC requests $100,000 from REP to be matched with $2,500,000 from DOE's FECM and up to $625,000 cash cost share from MPC and TCE. A letter of support is provided in Appendix A. Budget notes can be found in Appendix C.

Table 1. Budget Breakdown

Project Associated Expense	NDIC Share (Cash)	DOE Share (Cash)	Industry Share (Cash)	Total Project
Labor	$66,200	$1,366,309	$337,167	$1,769,676
Travel	$0	$174,346	$10,000	$184,346
Supplies	$0	$5,610	$0	$5,610
Subcontractor - TBD Graphic Design	$0	$30,000	$0	$30,000
Subcontractor - TBD Workshop Partner	$0	$8,000	$0	$8,000
Communications	$0	$6,456	$5,000	$11,456
Printing & Duplicating	$25	$2,131	$1,500	$3,656
Food	$0	$1,475	$0	$1,475
Rent & Leases - Venue	$0	$2,800	$2,600	$5,400
Honorarium	$0	$4,800	$0	$4,800
Laboratory Fees & Services				
Document Production Services	$0	$54,812	$34,358	$89,170
Engineering Services Fee	$0	$2,600	$0	$2,600
Geoscience Services Fee	$0	$2,940	$0	$2,940
Total Direct Costs	$66,225	$1,662,279	$390,625	$2,119,129
Facilities & Administration	$33,775	$837,721	$234,375	$1,105,871
Total Project Costs	**$100,000**	**$2,500,000**	**$625,000**	**$3,225,000**

TAX LIABILITY: The EERC is a business unit within UND, which is a state-controlled institution of higher education and is not a taxable entity; therefore, the EERC has no tax liability.

CONFIDENTIAL INFORMATION: No confidential information is included in this proposal.

PATENTS/RIGHTS TO TECHNICAL DATA: It is not anticipated that any patents will be generated during this project. The rights to technical data generated will be held jointly by the EERC and project sponsors.

STATE PROGRAMS AND INCENTIVES: A listing of EERC projects funded by NDIC in the last 5 years can be found in Appendix D.

APPENDIX A

LETTERS OF SUPPORT

February 10, 2023

Mr. Kevin C. Connors
Assistant Director for Regulatory Compliance and Energy Policy
Energy & Environmental Research Center
15 North 23rd Street, Stop 9018
Grand Forks, ND 58202-9018

Subject: Cost Share Commitment for EERC Proposal Entitled "Liberty Carbon Management Hub"; U.S. Department of Energy's Funding Opportunity Announcement No. DE-FOA-0002799

Dear Mr. Connors:

MPLX Operations LLC (together with its affiliates, "MPLX") and TC Energy Development Holdings Inc. ("TCEDH") are writing to express our cost share commitment and support for the efforts of the Energy & Environmental Research Center ("EERC") to secure funding through the U.S. Department of Energy's Regional Initiative to Accelerate Carbon Capture, Utilization, and Storage (CCUS) Deployment: Technical Assistance for Large-Scale Storage Facilities and Regional Carbon Management Hubs funding opportunity DE-FOA-0002799 ("Funding Opportunity").

The EERC's proposed project, the Liberty Carbon Management Hub, will investigate the potential for a carbon management hub near Dickinson, North Dakota. MPLX, TCEDH, and the EERC are in the process of evaluating the development of the Liberty Hydrogen Hub ("LHH") in North Dakota as a related complementary project. The separately-funded LHH will advance critical development scope to progress consummation of a large-scale project that would be a major infrastructure investment in clean hydrogen production, storage and transportation along with carbon capture and sequestration to result in low-carbon energy solutions. With MPLX, TCEDH, and EERC partnered on the LHH, the investigation of the Liberty Carbon Management Hub and the related public engagement will further the development of carbon capture and storage for the LHH.

We plan to explore strategic partnerships with various entities who currently serve the region in industrial and energy solutions through these unique hubs. The Liberty Carbon Management Hub, along with the LHH, will allow local industries to advance their sustainability goals in reducing CO_2 emissions while continuing to meet the nation's energy demands. With financial incentives such as grants and the 45Q tax credit, we strive to demonstrate that a strong business case exists to undertake a larger exciting opportunity with further development and deployment as outlined in EERC's proposal responsive to the Funding Opportunity.

MPLX is a diversified, large-cap master limited partnership that owns and operates midstream energy infrastructure and logistics assets and provides fuels distribution services. MPLX's assets include a network of crude oil and refined product pipelines; an inland marine business; light-product terminals; storage caverns; refinery tanks, docks, loading racks, and associated piping; and crude and light-product marine terminals. MPLX also owns crude oil and natural gas gathering systems and pipelines as well as natural gas and natural gas liquids (NGL) processing and fractionation facilities in key U.S. supply basins.

TCEDH is an indirect wholly-owned subsidiary of TC Energy Corporation, a premier North American energy infrastructure company with a network of wholly-owned natural gas pipelines that extends more

than 57,900 miles and moves approximately 25% of natural gas in North America and is one of the continent's largest providers of gas storage with approximately 653 billion cubic feet of storage capacity. A growing independent power producer, TC Energy Corporation has investments in over 4,200 MW of power generation in North America, including Bruce Power (one of the largest nuclear facilities in North America). TC Energy Corporation also moves approximately 20% of Alberta crude oil to U.S. markets through one of North America's largest oil delivery systems with a 3,000-mile pipeline network.

As outlined in the Funding Opportunity, and in support of the EERC's proposal, MPLX and TCEDH commit to provide combined cash cost share of at least twenty percent (20%) of the allowable costs associated with EERC's proposal related to the Liberty Carbon Management Hub, totaling $625,000.

We believe the investigation of carbon capture and storage for the complimentary hydrogen production hub meets the DOE's objective to safely and equitably accelerate the deployment of CCUS. We look forward to working with DOE, EERC, and other project partners to further the development of this exciting work.

TC Energy Development Holdings Inc.

DocuSigned by:
Corey Hessen
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By: Corey N. Hessen
Title: President

DocuSigned by:
Omar Khayum
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By: Omar Khayum
Title: Vice President

MPLX Operations LLC

By: David R. Heppner
Title: Senior Vice President

WA
Approved as to Form

June 26, 2023

SENT VIA ELECTRONIC MAIL

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

SUBJECT: Selection of Application for Negotiation Under Funding Opportunity Announcement Number DE-FOA-0002799, Regional Initiative to Accelerate Carbon Capture, Utilization, and Storage (CCUS) Deployment: Technical Assistance for Large-Scale Storage Facilities and Regional Carbon Management Hubs

Dear Sheryl Eicholtz-Landis:

We are pleased to provide this update on your application. The Office of Fossil Energy and Carbon Management within the Department of Energy (DOE) has completed its evaluation of your application submitted in response to the subject Funding Opportunity Announcement (FOA). The application below has been recommended by the Office of Fossil Energy and Carbon Management for negotiation of a financial award (*Note: This notification does not guarantee Federal Government funding, as funding will only be obligated upon completion of successful negotiations.*)

Application: Liberty Carbon Management Hub, Kevin Conners, GRANT13801150

DOE has embargoed any public announcement of your selection until further notice. You must refrain from making any public announcements – through press releases, social media, or any other public communication platform – until DOE has made the selection announcement. At the time of the announcement, we will provide you with a link to the announcement and inform you that the embargo has officially been lifted via subsequent email. You will then be free (and encouraged) to announce your selection for negotiation leading to an award publicly.

Receipt of this letter does not authorize you to commence with performance of the project. DOE makes no commitment to issue an award and assumes no financial obligation with the issuance of this letter. Applicants do not receive an award until award negotiations are complete and the Contracting Officer executes the funding agreement. Only an award document signed by the Contracting Officer obligates DOE to support a project.

The award negotiation process may take up to **180** days. You must be responsive during award negotiations (*i.e., provide requested documentation*) and meet the stated negotiation

deadlines. Failure to submit the requested information and forms by the stated due date, or any failure to conduct award negotiations in a timely and responsive manner, may cause DOE to cancel award negotiations and rescind this selection. DOE reserves the right to terminate award negotiations at any time for any reason.

Please complete the following items and submit to DOE no later than July 12th, 2023:

- Pre-Award Information Sheet (attached);
- Copy of indirect rate agreement(s) for you and any sub-recipient(s), if applicable;
- Updated environmental questionnaire(s), as applicable (available at: Environmental Questionnaire).

If your organization, including any subrecipient or contractor, anticipates involving foreign nationals (FNs) in the performance of the award, your organization is required to provide a list of all FNs planned to participate on the award along with basic information about each. You must download and complete the "Foreign National Participation Document" located at https://www.netl.doe.gov/business/business-forms/financial-assistance under Post Selection Forms/Information and submit the completed document to basicinfo@netl.doe.gov with a courtesy copy to the assigned Project Manager (PM) and Contract Specialist.

Upon receipt of the completed "Foreign National Participation Document," we will create a secured file sharing drop box folder(s) for **FNs in Principal Investigator (PI)/Co-PI roles and for FNs from countries identified on the U.S. Department of State's list of State Sponsors of Terrorism located at https://www.state.gov/state-sponsors-of-terrorism/ for submission of additional information.** The additional information will NOT be required for any of the other FNs planned to participate on the award, and therefore, a folder(s) will not be created.

As part of the requirement to submit additional information for PIs/Co-PIs and for FNs from countries identified as State Sponsors of Terrorism, your organization must ensure completion of the "Foreign National Participation **Data** Document" also located at https://www.netl.doe.gov/business/business-forms/financial-assistance. The document and all required attachments must be uploaded to the secured file sharing drop box folder(s) provided by DOE's FN Request Coordinator. The assigned PM will contact the appropriate FN Data Entry POC in the event there are issues with the submission.

Please note that all FNs identified on the "Foreign National Participation Document," **except for FNs from countries identified on the U.S. Department of State's list of State Sponsors of Terrorism, are authorized to commence work as of the award effective date unless determined otherwise by DOE.** FNs from countries identified on the U.S. Department of State's list of State Sponsors of Terrorism are **NOT** permitted to participate on the award until written authorization is received from the Contracting Officer.

The Contracting Officer will notify your organization of DOE's decision regarding participation of FNs from countries identified on the U.S. Department of State's list of

State Sponsors of Terrorism. The DOE reserves the right to request additional information or deny participation of any FN at any time.

Please provide the requested documents to the attention of Ursula Drake, who is the Contract Specialist from the Finance and Acquisition Center handling the administrative portion of your application. Ms. Ursula Drake can be reached at ursula.drake@netl.doe.gov. Johnathan Moore is the DOE Project Manager from the Project Management Division handling the technical portion of your application and can be reached at 304-285-0297 or johnathan.moore@netl.doe.gov.

Sincerely,

ANGELA HARSHMAN

Digitally signed by ANGELA HARSHMAN
Date: 2023.06.26 15:03:57 -04'00'

Angela Harshman
Contracting Officer
Finance and Acquisition Center

cc: FOA File
Basicinfo@netl.doe.gov
kconnors@undeerc.org
johnathan.moore@netl.doe.gov
ursula.drake@netl.doe.gov

February 10, 2023

Mr. Kevin C. Connors
Assistant Director for Regulatory Compliance and Energy Policy
Energy & Environmental Research Center
15 North 23rd Street, Stop 9018
Grand Forks, ND 58202-9018

Corey N. Hessen
President
TC Energy Development Holdings Inc.
700 Louisiana Street
Suite 1300
Houston, TX 77002

RE: Letter Agreement – Conditions for EERC's Proposal

All:

MPLX Operations LLC ("MPLX") is pleased to offer this letter agreement to the Energy & Environmental Research Center ("EERC") and TC Energy Development Holdings Inc. ("TCEDH") in furtherance of the EERC's grant application titled *"Liberty Carbon Management Hub"* (the "Proposal") in response to the U.S. Department of Energy ("DOE") Regional Initiative to Accelerate Carbon Capture, Utilization, and Storage (CCUS) Deployment: Technical Assistance for Large-Scale Storage Facilities and Regional Carbon Management Hubs funding opportunity DE-FOA-0002799.

The Proposal aligns with the interests of MPLX and TCEDH, including the EERC's stated intent to advance critical development toward a large-scale project in North Dakota involving clean hydrogen production, storage and transportation coupled with carbon capture and sequestration ("Scope of Work"). MPLX and TCEDH are providing a cost share commitment letter associated with the Proposal, and this letter includes a commitment of twenty percent of allowable costs associated with the Proposal up to $625,000. Such commitment is conditioned on the following items:

(i) The EERC's final Proposal project plan being acceptable to MPLX and TCEDH;
(ii) DOE's award of the Proposal; *and*
(iii) The EERC's grant to MPLX and TCEDH and its affiliates of all licenses, authorizations, and similar rights, including rights to any intellectual property, related to the Scope of Work under the Proposal as those granted to the DOE under any cooperative agreement contemplated by the FOA or any third party.

MPLX looks forward to joining TCEDH and the EERC in this effort.

Sincerely,

David R. Heppner
Senior Vice President

WA
Approved as to Form

[acknowledgement page follows]

Acknowledged and agreed to as of the date first written above:

TC Energy Development Holdings Inc.

DocuSigned by:
Corey Hessen
7A1ADE4AD402455...

By: Corey N. Hessen
Title: President

DocuSigned by:
Omar Khayum
2FA6FBB5A9B64F5...

DS TH DS JG

By: Omar Khayum
Title: Vice President

Energy & Environmental Research Center

By: Kevin C. Connors
Title: Assistant Director for Regulatory Compliance and Energy Policy

INDUSTRIAL COMMISSION OF NORTH DAKOTA

Doug Burgum
Governor

Drew H. Wrigley
Attorney General

Doug Goehring
Agriculture Commissioner

February 6, 2023

Mr. Kevin C. Connors
Assistant Director for Regulatory Compliance and Energy Policy
Energy & Environmental Research Center
15 North 23rd Street, Stop 9018
Grand Forks, ND 58202-9018

Subject: Support for EERC Proposal Entitled "Liberty Dakota Carbon Management Hub"

Dear Mr. Connors:

Please accept this support letter for the Energy & Environmental Research Center's (EERC's) proposed project to investigate the geologic storage of CO_2 in western North Dakota in response to U.S. Department of Energy's Regional Initiative to Accelerate Carbon Capture, Utilization, and Storage (CCUS) Deployment: Technical Assistance for Large-Scale Storage Facilities and Regional Carbon Management Hubs Funding Opportunity Announcement DE-FOA-0002799.

The mission of the North Dakota Industrial Commission's Renewable Energy Program (REP) is to promote the growth of North Dakota's renewable energy industries through research, development, marketing, and education. The development and deployment of CCUS in pursuit of achieving zero or negative CO2 emissions for a renewable diesel facility aligns well with the REP's mission and goals.

This project would be eligible for a cash cost share of up to $100,000 from the REP. Availability of this cost share is contingent upon submission of a proposal to the Renewable Energy Council, approval by the Council and the Industrial Commission, and the execution of a mutually negotiated agreement of acceptable terms and conditions with all project sponsors. REP funds will comprise of nonfederal dollars and would not be used as federal match on any other project.

We hope that DOE gives careful consideration to this project, as there is significant need for projects that promote the continued development and support of renewable fuels. Again, we express our interest and support of the proposed project and look forward to working with the EERC, DOE, and the entire team.

Sincerely,

Reice Haase

Deputy Director, North Dakota Industrial Commission

JOHN HOEVEN
NORTH DAKOTA
338 RUSSELL SENATE OFFICE BUILDING
TELEPHONE: (202) 224-2551
FAX: (202) 224-7999
hoeven.senate.gov

United States Senate
WASHINGTON, DC 20510

COMMITTEES:
AGRICULTURE
APPROPRIATIONS
ENERGY AND NATURAL RESOURCES
INDIAN AFFAIRS

February 6, 2023

Mr. Kevin C. Connors
Assistant Director for Regulatory Compliance and Energy Policy
Energy & Environmental Research Center
15 North 23rd Street, Stop 9018
Grand Forks, ND 58202-9018

Subject: Support for EERC Proposal Entitled "Liberty Carbon Management Hub"

Dear Mr. Connors:

I am writing to express my support for the application submitted by the Energy & Environmental Research Center (EERC) to the U.S. Department of Energy's Regional Initiative to Accelerate Carbon Capture, Utilization, and Storage (CCUS) Deployment: Technical Assistance for Large-Scale Storage Facilities and Regional Carbon Management Hubs funding opportunity (DE-FOA-0002799).

After nearly 15 years, we have successfully placed North Dakota at the forefront of energy development. Our state not only serves as an energy powerhouse for our nation, but we are also leading the way in innovative new technologies, like carbon capture, utilization, and storage (CCUS), which will empower the United States to continue utilizing all of our abundant energy resources with better environmental stewardship. In particular, we:

- Developed and passed through the North Dakota legislature, a regulatory framework for long-term carbon sequestration in the state.
- Established trust funds for state oversight and for long-term liability.
- Secured approval from the Environmental Protection Agency to give North Dakota regulatory primacy over Class VI wells.

These are among the critical elements that set our state apart in making geologic sequestration a reality, and the EERC has been a central player throughout these efforts. Now, under this proposal, the EERC will accelerate the commercial deployment of CCUS in North Dakota as well as continue to inform and educate through public outreach and support.

Accordingly, I hope this application receives favorable consideration. Please keep me informed of the review process, and feel free to contact my office with any updates or inquiries you may have.

Sincerely,

John Hoeven
U.S. Senator

KEVIN CRAMER
NORTH DAKOTA

SUITE 330
HART BUILDING
WASHINGTON, DC 20510
202–224–2043

United States Senate

COMMITTEES
ARMED SERVICES
BANKING, HOUSING, AND URBAN AFFAIRS
THE BUDGET
ENVIRONMENT AND PUBLIC WORKS
VETERANS' AFFAIRS

February 6, 2023

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

Dear John:

Subject: Support for EERC Proposal Entitled "Liberty Carbon Management Hub"

I am writing to express my support for the Energy & Environmental Research Center's (EERC's) efforts to secure funding through the U.S. Department of Energy's Regional Initiative to Accelerate Carbon Capture, Utilization, and Storage (CCUS) Deployment: Technical Assistance for Large-Scale Storage Facilities and Regional Carbon Management Hubs funding opportunity DE-FOA-0002799.

As you know, I have been relentless in my support for our state's all-the-above energy industry and for the world-class energy research across multiple disciplines undertaken by the EERC. I have introduced and worked on multiple pieces of legislation to encourage research, development, and implementation of CCUS technologies.

North Dakota is among the nation's premier states in energy production and environmental conservation. I am a proponent of development and production of all of the state's energy resources—conventional and renewable—and believe North Dakota's energy research and policies should serve as a model for the rest of the country. The EERC's proposed efforts will accelerate the commercial deployment of CCUS in North Dakota, which will lead to an expansion of the opportunities for our nation's energy industries, and further inform and educate with public outreach and support.

I am a strong advocate for the work being done at the EERC and remain supportive and committed to the opportunities being pursued, including this geologic carbon storage project, and the promise they provide for the state of North Dakota and the nation.

Sincerely,

Kevin Cramer
United States Senator

KELLY ARMSTRONG
AT-LARGE, NORTH DAKOTA

ENERGY AND COMMERCE COMMITTEE
CONSUMER PROTECTION AND COMMERCE
ENERGY

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

WASHINGTON OFFICE:
1740 LONGWORTH 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

February 7, 2023

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

Dear Mr. Harju:

Subject: Support for EERC Proposal Entitled "Liberty Carbon Management Hub"

I write to express my support for the Energy & Environmental Research Center's (EERC's) efforts to secure funding through the U.S. Department of Energy's Regional Initiative to Accelerate Carbon Capture, Utilization, and Storage (CCUS) Deployment: Technical Assistance for Large-Scale Storage Facilities and Regional Carbon Management Hubs funding opportunity DE-FOA-0002799.

In my role as North Dakota's lone member of the U.S. House of Representatives, I have the privilege to showcase our state's vibrant energy resources and those enterprises who lead their environmentally responsible production and development. I am particularly proud of my frequent opportunities to highlight the ongoing leadership of the EERC in formulating an economically viable low-carbon future for our nation and world.

This project will examine the potential for a carbon storage hub in western North Dakota along with the important work of public outreach and support. I am confident that this will further propel North Dakota's leadership in the pursuit of long-term energy solutions.

I strongly support the EERC's efforts, which will lead to exciting opportunities for the state of North Dakota and the nation in resolving near- and long-term energy challenges.

Sincerely,

Kelly Armstrong
Congressman

NORTH Dakota | Governor Doug Burgum

Be Legendary.™

February 3, 2023

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

Dear John:

Subject: Support for EERC Proposal Titled "Liberty Carbon Management Hub"

We strongly support the Energy & Environmental Research Center's (EERC's) efforts to secure funding through the U.S. Department of Energy's Regional Initiative to Accelerate Carbon Capture, Utilization, and Storage (CCUS) Deployment: Technical Assistance for Large-Scale Storage Facilities and Regional Carbon Management Hubs funding opportunity DE-FOA-0002799.

North Dakota has a long history of responsible energy development and environmental leadership. We commend the EERC for its long-term commitment to making geologic storage and utilization of carbon dioxide a viable option in our quest for low-carbon solutions.

North Dakota's energy industries are global leaders in energy development and production. They continue to implement long-term strategies that provide meaningful and abundant contributions to our nation's energy needs. The project proposed by the EERC will accelerate the safe and socially equitable deployment of CCUS within our state by establishing an experienced technical team and providing technical and community outreach and information sharing.

We strongly support the efforts of the EERC and look forward to the exciting opportunities this work will bring to the state of North Dakota and our country in resolving our energy challenges.

Regards,

Doug Burgum
Governor

NORTH DAKOTA
PETROLEUM
COUNCIL

100 West Broadway, Ste. 200 | P.O. Box 1395 | Bismarck, ND 58501-1395
701.223.6380 | ndpc@ndoil.org | www.NDOil.org

February 1, 2023

Mr. Kevin C. Connors
Assistant Director for Regulatory Compliance and Energy Policy
Energy & Environmental Research Center
15 North 23rd Street, Stop 9018
Grand Forks, ND 58202-9018

Dear Mr. Connors:

Subject: Support for EERC Proposal Entitled "Liberty Carbon Management Hub"

The North Dakota Petroleum Council (NDPC) is pleased to submit this letter of support for the team being assembled by the Energy & Environmental Research Center (EERC) to accelerate the commercial deployment of CCUS in western North Dakota in response U.S. Department of Energy's Funding Opportunity Announcement No. DE-FOA-0002799.

NDPC's mission is to promote and enhance the discovery, development, production, transportation, refining, conservation, and marketing of oil and gas in North Dakota, South Dakota, and the Rocky Mountain region; to promote opportunities for open discussion, lawful interchange of information, and education concerning the petroleum industry; to monitor and influence legislative and regulatory activities on the state and national level; and to accumulate and disseminate information concerning the petroleum industry to foster the best interests of the public and industry.

NDPC provides support to the more than 500 members it represents who are involved in all aspects of the oil and gas industry including oil and gas production, refining, pipeline, mineral leasing, consulting, legal work, and oilfield service activities in North Dakota, South Dakota, and the Rocky Mountain region. I would be pleased to provide outreach advisement for this proposed project.

We strongly encourage consideration of the EERC proposal and look forward to the results of this important project.

Sincerely,

Ron Ness
President

WESTERN DAKOTA ENERGY ASSOCIATION

February 1, 2023

Mr. Kevin C. Connors
Assistant Director for Regulatory Compliance and Energy Policy
Energy & Environmental Research Center
15 North 23rd Street, Stop 9018
Grand Forks, ND 58202-9018

Dear Mr. Connors:

Subject: Support for EERC Proposal Entitled "Liberty Carbon Management Hub"

The Western Dakota Energy Association is a membership organization comprised of the cities, counties, and school districts in the energy-producing region of western North Dakota. WDEA is pleased to provide the EERC with this letter of support for the proposed studies to investigate a commercial-scale geologic carbon storage hub in western North Dakota in response to the U.S. Department of Energy's Funding Opportunity DE-FOA-0002799.

WDEA's advocacy goals include ensuring a solid economic future for our communities, strong infrastructure which promotes safety for our citizens, and sensible management of our natural resources to ensure their viability for generations to come.

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 project proposed by the EERC will investigate the potential for a carbon management hub in North Dakota, leading to expanded opportunities for the state's energy industries, its communities, and its citizens.

We look forward to working with the EERC team on this important project.

Sincerely,

Geoff Simon
Executive Director

Western Dakota Energy Association
1661 Capitol Way, Bismarck ND 58501
www.ndenergy.org • 701-527-1832

APPENDIX B

RESUMES OF KEY PERSONNEL

KEVIN C. CONNORS
Assistant Director for Regulatory Compliance and Energy Policy
701.777.5236 (phone), 701.777.5181 (fax), kconnors@undeerc.org

Education and Training

B.S., Geology, University of Montana, 2009.

Research and Professional Experience

November 2021–Present: Assistant Director for Regulatory Compliance and Energy Policy, Energy & Environmental Research Center (EERC), University of North Dakota (UND), Grand Forks, ND. Works with a multidisciplinary team of scientists, engineers, and business professionals to integrate legal and regulatory policy, permitting, economics, and tax perspectives with applied research related to incremental oil recovery, unconventional oil recovery, and CO_2 capture and geologic storage. He also manages the Plains CO_2 Reduction (PCOR) Partnership focused on commercial deployment of carbon capture, utilization, and storage (CCUS).

July 2019–October 2021: Principal Policy & Regulatory Strategist, EERC, UND. Worked with a multidisciplinary team of scientists, engineers, and business professionals to integrate legal and regulatory policy, economics, and tax perspectives with applied research related to incremental oil recovery, unconventional oil recovery, and CO_2 capture and geologic storage.

November 2018–June 2019: Principal Consultant Drilling and Well Operations, Equinor Energy, Austin, TX. Worked as a regulatory advisor for Equinor's Williston Basin Bakken asset securing federal and state permits to drill, advising Equinor stakeholders on regulatory issues, and maintaining compliance in a multi-jurisdictional regulatory environment. Worked on special projects with Equinor's research and technology teams as the lead regulatory advisor in developing solutions to gas flaring and CO_2 emissions in the Bakken.

October 2010–October 2018: North Dakota Industrial Commission Oil and Gas Division, Bismarck, ND.
October 2015–October 2018: Pipeline Program Supervisor. This position was created by the North Dakota Legislature to develop North Dakota's first Underground Gathering Pipeline Program to improve pipeline integrity. The development of the pipeline program included administrative rule making, hiring and managing office and field staff, developing a data management system (database), and meeting with industry leaders and academic researchers. Mr. Connors created guidance documents for program staff, regulatory inspectors, and the regulated community; testified before the North Dakota Legislature; and presented at public events throughout western North Dakota.
July 2011–October 2018: CCS Supervisor. This position was created by the North Dakota Legislature to provide a timely response to the U.S. Environmental Protection Agency (EPA) rules relating to the geologic sequestration of CO_2 (Class VI). Mr. Connors successfully led North Dakota's efforts to obtain Class VI primacy for the state of North Dakota. He gained expertise in the EPA Underground Injection Control (UIC) Program and North Dakota's geologic storage of CO_2 statutes and authored and adopted North Dakota's CO_2 storage rules through the administrative rule-making process. In this position, he participated in the North Dakota Carbon Dioxide Storage Workgroup, testified before the North Dakota Administrative Rules Committee, authored publications, and presented at technical conferences on carbon capture and storage regulatory frameworks. He also has expertise in North Dakota's pore space amalgamation process for CO_2 storage and gas storage. In 2018, he developed guidelines for gas storage in North Dakota. The guidance document was intended to provide a pathway forward for permitting and storing Bakken produced gas to mitigate flaring.
October 2013–October 2015: UIC Supervisor. Administered the North Dakota Class II UIC Program. As UIC Supervisor, he issued over 100 UIC permits, revised and updated program technical guidelines, evaluated regulatory filings, performed technical evaluations of UIC permit applications, and processed well completion reports, workover reports, and various other regulatory filings. He prepared and

submitted quarterly reports to EPA as part of the UIC program primacy agreement between North Dakota and EPA. Mr. Connors created a regulatory comparison table using North Dakota Statutes and regulations in comparison to the Bureau of Land Management (BLM) proposed rules on hydraulic fracturing. The regulatory comparison was key evidence in the state of North Dakota's lawsuit against the BLM.

October 2010–July 2011: Petroleum Engineer. Conducted enforcement and compliance inspections in the field during a time of increasing oil and gas activity.

January–September 2010: Wellsite Geologist, Weatherford. Provided geological services for the drilling and completion of horizontal wells in the Bakken and Three Forks Formations.

Relevant Publications

Warmack, M.P., Azzolina, N.A., Nakles, D.V., Peck, W.D., Connors, K.C., Lagorin, W., Lagorin, T., Blumenthal, T., Hanslik, J., and Shendye, R., 2022, Pipeline cost and CO_2 transport considerations based on three hypothetical pipelines in the PCOR Partnership Initiative region: White paper for U.S. Department of Energy National Energy Technology Laboratory Cooperative Agreement No. DE-FE0031838 and North Dakota Industrial Commission Contract Nos. FY20-XCI-226 and G-050-96, Grand Forks, North Dakota, Energy & Environmental Research Center, February.

Burton-Kelly, M.E., Azzolina, N.A., Connors, K.C., Peck, W.D., Nakles, D.V., and Jiang, T., 2022, Risk-based area of review estimation in overpressured reservoirs to support injection well storage facility permit requirements for CO_2 storage projects: Paper presented at the 16th International Conference on Greenhouse Gas Control Technologies (GHGT-16), Lyon, France, October 23–27, 2022. DOI: /10.2139/ssrn.4274259.

Connors, K.C., Peck, W.D., Sorensen, J.A., Hamling, J.A., and Gorecki, C.D., 2022, PCOR Partnership—breaking down the barriers in CCUS: Paper presented at the 16th International Conference on Greenhouse Gas Control Technologies (GHGT-16), Lyon, France, October 23–27, 2022.

Kay, J.P., Laumb, J.D., Peck, W.D., and Connors, K.C., 2021, Matching capture technologies with point sources in the PCOR partnership region: White paper for U.S. Department of Energy National Energy Technology Laboratory Cooperative Agreement No. DE-FE0031838, Grand Forks, North Dakota, Energy & Environmental Research Center, December.

Leroux, K.M., Ayash, S.C., Crossland, J.L., Livers-Douglas, A.J., Crocker, C.R., Connors, K.C., Hamling, J.A., and Willett, D., 2021, First North Dakota CCS project—advancing North Dakota ethanol economics: Paper presented at 15th Greenhouse Gas Control Technologies Conference (GHGT-15), virtual, March 15–18, 2021. DOI: 10.2139/ssrn.3812021.

Peck, W.P., Battle, E.P., Suedel, K.B., Glazewski, K.A., Connors, K.C., Sorensen, J.A., Hamling, J.A., Steadman, E.N., and Harju, J.A., 2021, PCOR Partnership atlas, 6th ed.: Prepared for the U.S. Department of Energy National Energy Technology Laboratory and the PCOR Partnership Initiative, Grand Forks, North Dakota, Energy & Environmental Research Center, 109 p.

Synergistic Activities

- Member, CCUS Legal and Regulatory Subgroup, 2021–present
- Member, Ground Water Protection Council Class VI Workgroup, 2021–present
- Member, Nebraska Oil and Gas Conservation Commission Rules Committee, 2021
- For the CarbonSAFE-North Dakota Phase II project, developed storage facility-permitting timeline for North Dakota's Class VI UIC program and incorporated the timeline into a general CO_2 storage project schedule.
- At the EERC, integrating legal and regulatory policy, economics, and tax perspectives with applied research related to incremental oil recovery, unconventional oil recovery, and CO_2 capture and geologic storage and developing Class VI UIC permitting strategies for commercial CO_2 storage in North Dakota.

CHARLENE R. CROCKER
Senior Research Scientist, Outreach Team Lead
701.777.5018 (phone), 701.777.5181 (fax), ccrocker@undeerc.org

Education and Training

B.S., Chemistry, University of North Dakota, 1994.
B.A., French, Colby College, Waterville, ME, 1986.

Research and Professional Experience

2002–Present: Senior Research Scientist, Outreach Team Lead, EERC, UND. Ms. Crocker's responsibilities include managerial and principal investigator duties for projects related to public outreach and scientific research. With respect to outreach, this included the development of public outreach programs for CO_2 sequestration, water, and fish advisories and the development of CO_2 sequestration public outreach materials, water quality education, and a water-based geoscience education program and outreach activities for middle and high school students. Research responsibilities included projects related to development of sorbents for emission control strategies in fossil fuel-fired energy systems; projects related to environmental management and air quality; collaborating with other scientists on the development of carbon-based flue gas sorbents, particulate matter (PM) sampling, evaluation of bioassessment tools, fish consumption survey development, proposal and report writing, data analysis, presentation of results, and budget tracking; developing PM-sampling protocols; and directing the activities of student assistants. Specific roles and activities include the following:

- Outreach Task Lead for the U.S. Department of Energy (DOE)–North Dakota Industrial Commission (NDIC)–Red Trail Energy (RTE)-funded Phase III Integrated Carbon Capture and Storage for North Dakota Ethanol Production project. Activities include public outreach materials development and support for research and fieldwork associated with project activities in Stark County, North Dakota.
- Outreach Task Lead and team member for the North Dakota CarbonSAFE Phase II project, funded by DOE, NDIC, Minnkota Power Cooperative, Basin Electric Power Cooperative, BNI Energy, North American Coal, and ALLETE Clean Energy. Activities include public outreach materials development and support for research and fieldwork associated with project activities in central North Dakota.
- Outreach Team member for the Wyoming CarbonSAFE Phase II project, funded by DOE, Basin Electric Power Cooperative, et al. Activities include public outreach materials development and consulting for research and fieldwork associated with project activities in central North Dakota.
- Program Coordinator and student supervisor for the EERC Energy Hawks internship program, funded by the State Energy Research Center at the EERC. Activities include development and implementation of an energy literacy syllabus for a multidisciplinary team of graduate and undergraduate students during a 10-week internship; supervision of student activities; and guidance in the development of white papers focused on value-added energy topics for North Dakota.

1994–2002: Research Chemist, EERC, UND. Ms. Crocker's responsibilities included managing projects relating to environmental management and air quality; collaborating with other scientists on fish consumption survey development, PM sampling, corrosion of ceramic and alloy materials, coal ash, water purification, and surface decontamination research; proposal and report writing, data analysis, presentation of results, and budget tracking; developing PM sampling protocols; participating in development of a water-based geoscience education program and outreach activities for school children; directing activities of student assistants; developing and implementing analytical methods employing LIBS. Previous duties performed in the Analytical Research Laboratory focused on water quality and energy-related analyses. Responsibilities included preparing and analyzing ultratrace element samples in aqueous and inorganic media using AAS, ICP, and IC; recording and disseminating

analytical results and quality control checks; performing research on ultratrace elemental analysis of mercury using AFS; and preparing reagents and solutions.

1993–1994: Research Assistant, EERC, UND. Ms. Crocker's responsibilities included preparing and analyzing ultratrace element samples in inorganic media; performing research on ultratrace element analysis of mercury in air using AFS; and preparing reagents and solutions.

1990: Naturalist, Deep Portage Conservation Reserve, Hackensack, Minnesota. Ms. Crocker's responsibilities included planning and conducting environmental education programs for children and adults; evaluating curriculum; and organizing lending of educational learning stations.

1988–1990: Sanctuary Manager, Wetlands, Pines & Prairie Audubon Sanctuary, Warren, Minnesota. Ms. Crocker's responsibilities included planning and conducting environmental education programs; organizing chapter meetings; publishing the Sanctuary newsletter; and performing administrative tasks.

1988: Park Ranger/Interpreter, Boston Harbor Islands State Park, Boston, Massachusetts. Ms. Crocker's responsibilities included interpreting natural and human history; developing special programs and leading walking tours of the islands; and conducting school programs.

Relevant Publications

Crocker, C.R.; Krueger, N.M. Energy and CO_2 Management: Carbon Capture and Storage. Presented at 2023 Lignite Education Seminar, Bismarck, ND, June 13, 2023.

Crocker, C.R.; Leroux, K.M.; Massmann, N.M.; Crossland, J.L.; Manthei, M.M.; Glazewski, K.A.; Daly, D.J.; Hamling, J.A. Public Outreach Package for Carbon Capture and Storage in North Dakota; Task 5 Deliverable D3 for North Dakota Industrial Commission Contract No. R-038-047; EERC, Feb 2020.

Daly, D.J.; Crossland, J.L.; Crocker, C.R. Glazewski, K.A.; Massmann, N.M.; Peck, W.D. North Dakota CarbonSAFE Updated Outreach Plan Phase II, May 2019.

Crocker, C.R.; Daly, D.J. Low-Carbon Energy for North Dakota [documentary short]; Dambach, B.; Olien, M., Site Producers; Prairie Public Broadcasting (PPB): Fargo, ND, and EERC, 2019.

Crocker, C.R.; Daly, D.J. Coal: Engine of Change [DVD]; Dambach, B.; Steadman, E.N., Executive Producers; PPB and EERC, 2018.

Daly, D.J.; Crocker, C.R.; Crossland, J.L.; Massmann, N.M.; Peck, W.D. North Dakota Integrated Carbon Storage Complex Feasibility Study; Deliverable D3 (Outreach Toolkit) for DOE Cooperative Agreement (CA) DE-FE0029488; EERC: Grand Forks, ND, Feb 2018.

Daly, D.J.; Crossland, J.L.; Crocker, C.R.; Gorecki, C.D. Outreach Action Plan; Plains CO_2 Reduction (PCOR) Partnership Phase III Task 2 Deliverable D11 (Update 2) for DOE National Energy Technology Laboratory CA DE-FC26-05NT42592; EERC Publication 2016-EERC-09-02; March.

Daly, D.J.; Crocker, C.R.; Gorecki, C.D. Regionwide Outreach in a Project-Level World – Lessons from the PCOR Partnership. *Energy Procedia* **2017**, *114*, 7224–7236.

Crocker, C.R.; Daly, D.J.; Dambach, B.; Pearson, B.; Anderson, D. A Collaboration among PPB, Classroom Teachers, and the PCOR Partnership to Produce Classroom-Ready CCS lessons. Presented at the International Workshop on Public Education, Training, and Community Outreach for Carbon Capture, Utilization, and Storage, Decatur, IL, July 30, 2014.

Synergistic Activities

Outreach Team Lead (Oct 2018–present)/member of ND CarbonSAFE team (Phases II and III) since inception in June 2017, developing and implementing project outreach plan, facilitating Outreach Advisory Board, developing outreach materials, engaging educators and K–12 to post-secondary students on CCS, and providing input and guidance to project timelines, budgets, and objectives.

- Outreach Team Lead (Jan 2019–Nov 2021)/member of RTE Ethanol CCS project since 2017, developing and implementing project outreach plan; developing outreach materials; handling media, talking points, and logistics for county commission appearances; preparing landowner packets and public notices for seismic surveys, environmental sampling events, and research results; overseeing logistics, preparing advertising, and developing materials for community open houses; and providing input and guidance to project timelines, budgets, and objectives.
- Outreach Team member for Regional Carbon Sequestration Partnerships (RCSP) Initiative's PCOR Partnership Program since inception in 2003.
- Associate Producer and Cowriter for seven CCS-related public television documentaries—*Coal: Engine of Change, The Bell Creek Story: CO_2 in Action, Global Energy and Carbon: Tracking Our Footprint, Managing Carbon Dioxide: The Geologic Solution, Out of the Air – Into the Soil: Land Practices That Reduce Atmospheric Carbon Levels, Reducing Our Carbon Footprint: The Role of Markets, Nature in the Balance: CO_2 Sequestration.*
- Codeveloped 20 CBPs, six outreach plans, 23 outreach posters, numerous fact sheets, general public and educator and student presentations, and a website focused on aspects of CCS and CCS projects.

KATHERINE K. ANAGNOST
Senior Regulatory and Permitting Specialist
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Education and Training

B.S., Legal Assistance, Moorhead State University, 1992.

Research and Professional Experience

2021–Present: Senior Regulatory and Permitting Specialist, Energy & Environmental Research Center (EERC), University of North Dakota (UND), Grand Forks, ND. Ms. Anagnost works with a multidisciplinary team of scientists, engineers, and business professionals to integrate permitting, regulatory, legal, policy, economics, and tax perspectives with technical information and applied research related to geologic CO_2 capture utilization and storage (CCUS), power generation, emissions reduction, and renewable energy systems. Ms. Anagnost currently supports the Plains CO_2 Reduction (PCOR) Partnership Initiative to Accelerate CCUS Deployment as the technology transfer task lead. In this role she informs and educates stakeholders about CCUS technologies and project development, with particular emphasis placed on issues related to infrastructure development strategies and regulatory frameworks. Ms. Anagnost supports public and industry outreach efforts through development of products and website content to inform and educate about the opportunities associated with CCUS.

2015–2021: NERC Compliance Coordinator, Minnkota Power Cooperative (MPC), Grand Forks, ND. Ms. Anagnost coordinated with technical and support teams to establish, maintain, and demonstrate compliance with corporate requirements and North American Electric Reliability Corporation (NERC) regulations. She spearheaded the effort to bring comprehensive Critical Infrastructure Program regulatory compliance to the Milton R. Young Generating Station within the scheduled implementation timeframe; coordinated a multidisciplinary team in the development of a new Critical Infrastructure Program regulatory supply chain risk management program within the required implementation time frame; achieved expedited industry consensus to regulatory modifications as participating member (and first MPC employee) on a NERC Standard Drafting Team, and served (as the first MPC employee) on a North American Transmission Forum peer review team.

2009–2015: Research Specialist/Project Manager, EERC, UND. Ms. Anagnost worked for the PCOR Partnership, one of seven regional partnerships funded by the U.S. Department of Energy's National Energy Technology Laboratory Regional Carbon Sequestration Partnership Program, to assess the technical and economic feasibility of capturing and storing (sequestering) CO_2 emissions in the northern Great Plains and adjacent areas. In this capacity, she facilitated the development of project plans for research data, presentations, technical reports, peer-reviewed articles, and proposals for projects involving CO_2 sequestration technologies. Her work also included development, management, and dissemination of market-oriented materials for programs focused on CO_2 sequestration, including public outreach and education via print, video, and web forums.

2006–2009: Contracts Officer, EERC, UND. Ms. Anagnost's responsibilities included preparing, reviewing, negotiating, and administering sponsored research agreements, in-kind agreements, subcontracts, hotel agreements, and confidentiality agreements in accordance with federal and nonfederal contractual requirements, government and university regulations and policies, and EERC policies; disclosing intellectual property (IP) to research sponsors, including government agencies; tracking important contractual and U.S. Patent and Trademark Office compliance dates associated with IP; and effectively communicating and maintaining daily contact with research sponsors, agency representatives, UND employees, and EERC employees via telephone, email, and/or letter.

1994–2006: Legal Assistant, MPC. Ms. Anagnost's responsibilities included assisting legal counsel in the representation of Minnkota and six distribution cooperative member-owners, including drafting corporate governance documents, assisting with environmental matters including compliance with polychlorinated biphenyl use, storage, disposal, and recordkeeping, preparing and submitting federal

environmental reports for proposed cooperative construction activities; coordinating with engineering consultant and technical department supervisors on the preparation and organization of Spill Prevention Control and Countermeasures (SPCC) Plans; reviewing federal regulations and determining potential impacts and/or ensuring compliance; writing articles for corporate publications; and leading the Minnesota member-owner utilities compliance with the Conservation Improvement Program, created to provide improved awareness and adoption of energy efficient technologies and reduced energy costs for Minnesota households. In this role, she worked with regional Community Action Agencies on development of energy conservation measures benefitting low-income households.

Relevant Publications

Connors, K.C.; Nakles, D.V.; Anagnost, K.K.; McKenzie, S.L.; Stevens, C.R.; Hunt, J.E.; Regorrah, J.G.; Peck. E.N.; Olsen, C.M.; Livers-Douglas, A.J. *Regulatory Frameworks and Permitting Considerations for Geologic Storage of Carbon Dioxide in the PCOR Partnership Region*: Plains CO_2 Reduction (PCOR) Partnership Initiative Task 5 Deliverable 8a for North Dakota Industrial Commission Contract Nos. FY20-XCI-226 and G-050-96; EERC Publication 2023-EERC-01-04; Energy & Environmental Research Center: Grand Forks, ND, Jan 2023.

Anagnost, K.K., Peck, W.D., Regorrah, J.G., Livers-Douglas, A.J., Connors, K.C., and Mikula, S.R., 2022, North Dakota CarbonSAFE Phase III—permitting geologic storage of carbon dioxide: North Dakota CarbonSAFE Phase III Topical Report Task 5 Deliverable 6 for U.S. Department of Energy National Energy Technology Laboratory Cooperative Agreement No. DE-FE0031889, Grand Forks, North Dakota, Energy & Environmental Research Center, September.

Gorecki, C.D.; Harju, J.A.; Steadman, E.N.; Romuld, L.; Hamling, J.A.; Sorensen, J.A.; Botnen, L.S.; Daly, D.J.; Jensen, M.D.; Peck, W.D.; Smith, S.A.; Klapperich, R.J.; Anagnost, K.K.; Votava, T.J. *Annual Assessment Report*; Plains CO_2 Reduction (PCOR) Partnership Phase III Task 12 Deliverable D57 (Oct 1, 2013 – Sept 30, 2014) for U.S. Department of Energy National Energy Technology Laboratory Cooperative Agreement No. DE-FC26-05NT42592; EERC Publication 2015-EERC-02-04; Energy & Environmental Research Center: Grand Forks, ND, Feb 2015.

Gorecki, C.D.; Steadman, E.N.; Harju, J.A.; Hamling, J.A.; Sorensen, J.A.; Peck, W.D.; Daly, D.J.; Jensen, M.D.; Klapperich, R.J.; Ayash, S.C.; Anagnost, K.K. Implementing Carbon Capture and Storage: An Overview of the Plains CO_2 Reduction Partnership. Presented at the 10th CO_2GeoNet Open Forum, San Servolo Island, Venice, Italy, May 11–12, 2015.

Gorecki, C.D.; Hamling, J.A.; Sorensen, J.A.; Peck, W.D.; Daly, D.J.; Jensen, M.D.; Klapperich, R.J.; Ayash, S.C.; Anagnost, K.K.; Steadman, E.N.; Harju, J.A. Implementing Carbon Capture and Storage: An Overview of the Plains CO_2 Reduction Partnership. Presented at the 14th Annual Carbon Capture, Utilization & Storage Conference, Pittsburgh, PA, April 28 – May 1, 2015.

Crocker, C.R.; Crossland, J.L.; Chimote, S.A.; Daly, D.J.; Anagnost, K.K.; Gorecki, C.D.; Steadman, E.N.; Harju, J.A. *Public Site Updates*; Plains CO_2 Reduction (PCOR) Partnership Phase III Task 2 Deliverable D13 for U.S. Department of Energy National Energy Technology Laboratory Cooperative Agreement No. DE-FC26-05NT42592; EERC Publication 2014-EERC-09-06; Energy & Environmental Research Center: Grand Forks, ND, July 2014.

Synergistic Activities

- Ms. Anagnost currently serves as the President and Vice President of Education (2022–2023) of the Powerhouse Toastmasters Club No. 9663. This club was organized in 1993, and boasts multiple Distinguished Club Program awards for meeting membership prerequisites and goal achievement. She previously held the offices of Treasurer (2021–2022) and Vice President of Education (2019–2021).
- Ms. Anagnost was awarded the club Toastmaster of the Year in 2020 in recognition of dedicated and distinguished service.

WESLEY D. PECK
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Education and Training

M.S., Geology, University of North Dakota, 1992. Thesis: The Stratigraphy and Sedimentology of the Sentinel Butte Formation (Paleocene) in South-Central Williams County, North Dakota.
B.S., Earth Science, North Dakota State University, 1987.

Research and Professional Experience

2020–Present: Assistant Director for Subsurface Strategies, Energy & Environmental Research Center (EERC), University of North Dakota (UND), Grand Forks, ND. Leads efforts in subsurface resource development with emphasis on Williston and Powder River Basins. Serves as principal investigator (PI) on multiyear U.S. Department of Energy (DOE)-sponsored North Dakota CarbonSAFE Phase III Characterization and Permitting project. Served as task lead and PI for regional geologic characterization component of Plains CO_2 Reduction Partnership (PCOR) Partnership Program, focused on CO_2 storage in central North America. Led full-CO_2-chain techno-economic investigation in North Dakota linking lignite mining and electric generation to CO_2 EOR. Expertise includes geology, geologic storage of CO_2, CO_2 enhanced oil recovery (EOR), and geographic information systems (GIS).

2015–2019: Principal Geologist, EERC, UND. Involved in subsurface resource development with emphasis on Williston and Powder River Basins. Served as PI on multiyear DOE-sponsored North Dakota CarbonSAFE Feasibility project. Served as task lead and PI for regional geologic characterization component of PCOR Partnership Program. Led full-CO_2-chain techno-economic investigation in North Dakota linking lignite mining and electric generation to CO_2 EOR.

2011–2015: Research Manager, EERC, UND. Oversaw staff of geologists and GIS specialists involved with oil and gas research activities in Williston Basin as well as regional geologic characterization activities associated with PCOR Partnership.

1991–2011: Research Scientist, EERC, UND. Oversaw major EERC GIS activities, served as task lead for regional characterization component of PCOR Partnership, and wrote reports and proposals.

1989–1991: Graduate Research Assistant, EERC, UND. Acquired and managed geologic data related to Cretaceous and Tertiary geology of Williston Basin. Assisted in collection of Cretaceous and Tertiary fossils and stratigraphic information in western North Dakota and eastern Montana.

Relevant Publications

Warmack, M.P., Azzolina, N.A., Nakles, D.V., Peck, W.D., Connors, K.C., Lagorin, W., Lagorin, T., Blumenthal, T., Hanslik, J., and Shendye, R., 2022, Pipeline cost and CO_2 transport considerations based on three hypothetical pipelines in the PCOR Partnership Initiative region: White paper for U.S. Department of Energy National Energy Technology Laboratory Cooperative Agreement No. DE-FE0031838 and North Dakota Industrial Commission Contract Nos. FY20-XCI-226 and G-050-96, Grand Forks, North Dakota, Energy & Environmental Research Center, February.

Warmack, M.P., Azzolina, N.A., Nakles, D.V., Peck, W.D., Kurz, B.A., and Hamling, J.A., 2022, Balancing CO_2 pipeline infrastructure challenges: Poster presented at the AAPG Carbon Capture, Utilization, and Storage Conference, Houston, Texas, March 28–30, 2022.

Peck, W.D., Ayash, S.C., Klapperich, R.J., and Gorecki, C.D., 2019, The North Dakota integrated carbon storage complex feasibility study: International Journal of Greenhouse Gas Control, v. 84, p. 47–53. DOI: 10.1016/j.ijggc.2019.03.001.

Bosshart, N.W., Azzolina, N.A., Ayash, S.C., Peck, W.D., Gorecki, C.D., Ge, J., Jiang, T., and Dotzenrod, N.W., 2018, Quantifying the effects of depositional environment on deep saline formation CO_2 storage efficiency and rate: International Journal of Greenhouse Gas Control, v. 69, p. 8–19.

Bosshart, N.W., Pekot, L.J., Wildgust, N., Gorecki, C.D., Torres, J.A., Jin, L., Ge, J., Jiang, T., Heebink, L.V., Kurz, M.C., Dalkhaa, C., Peck, W.D., and Burnison, S.A., 2018, Best practices for modeling and simulation of CO_2 storage: Plains CO_2 Reduction (PCOR) Partnership Phase III Task 9 Deliverable D69 for U.S. Department of Energy National Energy Technology Laboratory Cooperative Agreement No. DE-FC26-05NT42592, EERC Publication 2018-EERC-03-13, Grand Forks, North Dakota, Energy & Environmental Research Center, March.

Daly, D.J., Crocker, C.R., Crossland, J.L., Massmann, N.M., and Peck, W.D., 2018, North Dakota integrated carbon storage complex feasibility study: Deliverable D3 (outreach toolkit) for U.S. Department of Energy Cooperative Agreement No. DE-FE0029488, Grand Forks, North Dakota, Energy & Environmental Research Center, February.

Nakles, D.V., Peck, W.D., Wildgust, N., Hamling, J.A., Gorecki, C.D., Steadman, E.N., and Harju, J.A., 2017, Geologic storage of carbon dioxide in the central plains of North America: 2017 American Institute of Chemical Engineers (AIChE) Annual Meeting, Minneapolis, Minnesota, October 29 – November 3, 2017.

Glazewski, K.A., Grove, M.M., Peck, W.D., Gorecki, C.D., Steadman, E.N., and Harju, J.A., 2015, Characterization of the PCOR Partnership region: Plains CO_2 Reduction (PCOR) Partnership value-added report for U.S. Department of Energy National Energy Technology Laboratory Cooperative Agreement No. DE-FC26-05NT42592, EERC Publication 2015-EERC-02-14, Grand Forks, North Dakota, Energy & Environmental Research Center, January.

Peck, W.D., Glazewski, K.A., Braunberger, J.R., Grove, M.M., Bailey, T.P., Bremer, J.M., Gorz, A.J., Sorensen, J.A., Gorecki, C.D., and Steadman, E.N., 2014, Broom Creek Formation outline: Plains CO_2 Reduction (PCOR) Partnership Phase III value-added report for U.S. Department of Energy National Energy Technology Laboratory Cooperative Agreement No. DE-FC26-05NT42592, EERC Publication 2014-EERC-09-09, Grand Forks, North Dakota, Energy & Environmental Research Center, August.

Peck, W.D., Liu, G., Klenner, R.C.L., Grove, M.M., Gorecki, C.D., Steadman, E.N., and Harju, J.A., 2014, Storage capacity and regional implications for large-scale storage in the basal Cambrian system: Plains CO_2 Reduction (PCOR) Partnership Phase III Task 16 Deliverable D92 for U.S. Department of Energy National Energy Technology Laboratory Cooperative Agreement No. DE-FC26-05NT42592, EERC Publication 2014-EERC-05-12, Grand Forks, North Dakota, Energy & Environmental Research Center, March.

Synergistic Activities

- Leads CarbonSAFE Phase III characterization and permitting study.
- Led CarbonSAFE study investigating two locations in North Dakota to determine feasibility of storing 2 million tons of CO_2 at one location and 4 million tons of CO_2 at the second location.
- Led full-CO_2-chain techno-economic investigation in North Dakota linking lignite mining and electric generation to CO_2 EOR.
- Led regional characterization activities for the PCOR Partnership Program to determine CO_2 storage resource potential of viable saline reservoirs in the central part of North America.
- Led geologic modeling and simulation assessment of CO_2 storage resource of the 500,000-mi^2 basal saline aquifer system of the Williston and Alberta Basins.

KYLE A. GLAZEWSKI
Principal Analyst, Data/GIS Team Lead
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Education and Training

M.S., Geography, University of North Dakota, 2005.
B.S., Geography, University of North Dakota, 2003.
Software experience includes ESRI ArcView 3.2 and 3.3, ArcMap 8.x, ArcGIS 9.x, and ArcGIS 10.x; Spatial Analyst Extension for GIS; ERDAS Imagine; HYSPLIT (Hybrid Single-Particle Lagrangian Integrated Trajectory) atmospheric dispersion model; AnnAGNPS (Annual Agricultural Non-Point Source Pollution) watershed model; Soil and Water Assessment Tool (SWAT); and Microsoft Office Suite.

Research and Professional Experience

2008–Present: Principal Analyst, Data/GIS Team Lead, Energy & Environmental Research Center (EERC), University of North Dakota (UND), Grand Forks, ND. Mr. Glazewski oversees data analysis and geographic information system (GIS) activities in oil and gas research. Mr. Glazewski's work primarily supports carbon capture, utilization, and storage (CCUS) project activities including storage facility permit development, monitoring programs, and site characterization. He is involved in a variety of oil and gas activities including produced water management and wellbore integrity evaluations.

2005–2008: Watershed Coordinator, Grand Forks County Soil Conservation District, Grand Forks, ND. Mr. Glazewski's responsibilities involved administering and managing all aspects of two U.S. Environmental Protection Agency 319 water quality projects, including field data collection, watershed modeling with GIS template, data organization and analysis, final assessment report preparation, project implementation proposal writing, assisting with total maximum daily load (TMDL) development, assisting with water quality assessment project planning, budget management and planning, public outreach, and assisting landowners with conservation planning to improve water quality as well as working with other agencies on water quality projects.

2005: Associate Geographic Technician, Special Projects Team, NAVTEQ, Fargo, ND. Mr. Glazewski's responsibilities included updating a global mapping database, completing quality checks on map data, helping develop steps for a new network updating process using ArcMap 8.3 software, providing feedback to simply the process.

2003–2005: Graduate Teaching Assistant, Department of Geography, UND, Grand Forks, ND. Mr. Glazewski's responsibilities included teaching Introduction to Physical Geography and Introduction to Climatology labs and assisting department professors as needed.

2002–2003: GIS Technician, Upper Midwest Aerospace Consortium, Grand Forks, ND. Mr. Glazewski worked on a western North Dakota wetlands project and a study of greenhouse gases in agricultural fields in eastern North Dakota and western Minnesota, including creating ArcGIS maps and land use maps and collecting and organizing field data.

Relevant Publications

Laumb, J.D., Glazewski, K.A., Hamling, J.A., Azenkeng, A., and Watson, T.L., 2016, Wellbore corrosion and failure assessment for CO_2 EOR and storage—two case studies in the Weyburn Field: International Journal of Greenhouse Gas Control, v. 54, p. 479–489.
Peck, W.P., Battle, E.P., Suedel, K.B., Glazewski, K.A., Connors, K.C., Sorensen, J.A., Hamling, J.A., Steadman, E.N., and Harju, J.A., 2021, PCOR Partnership atlas, 6th ed.: Prepared for the U.S.

Department of Energy National Energy Technology Laboratory and the PCOR Partnership Initiative, Grand Forks, North Dakota, Energy & Environmental Research Center, 109 p.

Peck, W.A., Glazewski, K.A., Klenner, R.C.L., Gorecki, C.D., Steadman, E.N., and Harju, J.A., 2014, A workflow to determine CO_2 storage potential in deep saline formations: Energy Procedia, v. 63, p. 5231–5238.

Glazewski, K.A., Martin, C.L., Salazar, A.Y., Beddoe, C.J., Nyberg, C.M., Taunton, M.A., Regorrah, J.G., Kurz, M.D., Connors, K.C., Vritis, J.L., Heebink, L.V., Schmidt, D.D., Hamling, J.A., Kurz, B.A., Sorensen, J.A., Zhang, X., and Dalkhaa, C. 2022, Subtask 3.2 – Produced water management through geologic homogenization, conditioning, and reuse: Final topical report (February 1, 2020 – January 31, 2022) for U.S. Department of Energy National Energy Technology Laboratory Cooperative Agreement No. DE-FE0024233, EERC Publication 2022-EERC-01-10, Grand Forks, North Dakota, Energy & Environmental Research Center, January.

Crocker, C.R., Leroux, K.M., Massmann, N.M., Crossland, J.L., Manthei, M.M.; Glazewski, K.A., Daly, D.J., and Hamling, J.A., 2020, Public outreach package for carbon capture and storage in North Dakota: Task 5 Deliverable D3 for North Dakota Industrial Commission Contract No. R-038-047, Grand Forks, North Dakota, Energy & Environmental Research Center, February.

Glazewski, K.A., Aulich, T.R., Wildgust, N., Nakles, D.V., Azzolina, N.A., Hamling, J.A., Burnison, S.A., Livers-Douglas, A.J., Peck, W.D., Klapperich, R.J., Sorensen, J.A., Ayash, S.C., Gorecki, C.D., Steadman, E.N., Harju, J.A., Stepan, D.J., Kalenze, N.S., Musich, M.A., Leroux, K.M., and Pekot, L.J., 2018, Best practices manual – monitoring for CO_2 storage: Plains CO_2 Reduction (PCOR) Partnership Phase III Task 9 Deliverable D51 for U.S. Department of Energy National Energy Technology Laboratory Cooperative Agreement No. DE-FC26-05NT42592, EERC Publication 2018-EERC-03-15, Grand Forks, North Dakota, Energy & Environmental Research Center, March.

Glazewski, K.A., Aulich, T.R., Wildgust, N., Nakles, D.V., Hamling, J.A., Burnison, S.A., Livers, A.J., Salako, O., Sorensen, J.A., Ayash, S.C., Pekot, L.J., Bosshart, N.W., Gorz, A.J., Peck, W.D., and Gorecki, C.D., 2017, Best practices manual (BPM) for site characterization: Plains CO_2 Reduction (PCOR) Partnership Phase III Task 4 Deliverable D35 for U.S. Department of Energy National Energy Technology Laboratory Cooperative Agreement No. DE-FC26-05NT42592, EERC Publication 2017-EERC-06-08, Grand Forks, North Dakota, Energy & Environmental Research Center, March.

Leroux, K.M., Klapperich, R.J., Azzolina, N.A., Jensen, M.D., Kalenze, N.S., Bosshart, N.W., Torres Rivero, J.A., Jacobson, L.L., Ayash, S.C., Nakles, D.V., Jiang, T., Oster, B.S., Feole, I.K., Fiala, N.J., Schlasner, S.M., Wilson IV, W.I., Doll, T.E., Hamling, J.A., Gorecki, C.D., Pekot, L.J., Peck, W.D., Harju, J.A., Burnison, S.A., Stevens, B.G., Smith, S.A., Butler, S.K., Glazewski, K.A., Piggott, B., and Vance, A.E., 2017, Integrated carbon capture and storage for North Dakota ethanol production: Final report (November 1, 2016 – May 31, 2017) for North Dakota Industrial Commission and Red Trail Energy, Grand Forks, North Dakota, Energy & Environmental Research Center, May.

Burton-Kelly, M.E., Peck, W.D., Glazewski, K.A., and Doll, T.E., 2014, Evaluation of near-term (5-year) potential for carbon dioxide enhanced oil recovery in conventional oil fields in North Dakota: Final report for Kadrmas, Lee & Jackson, EERC Publication 2014-EERC-07-07, Grand Forks, North Dakota, Energy & Environmental Research Center, July.

Glazewski, K.A., Hamling, J.A., Peck, W.D., Doll, T.E., Laumb, J.D., Gorecki, C.D., Steadman, E.N., and Harju, J.A., 2014, A regional wellbore evaluation of the basal Cambrian system: Energy Procedia, v. 63, p. 5715–5723.

Synergistic Activities

- Evaluates regional- and field-scale wellbore integrity utilizing GIS and available wellbore data.
- Evaluating CCUS build-out scenarios through PCOR Partnership activities.
- Task 4 lead (regional infrastructure) for the current PCOR Partnership Initiative.
- Utilizing GIS in carbon capture and storage-related activities.

APPENDIX C

BUDGET NOTES

BUDGET NOTES

ENERGY & ENVIRONMENTAL RESEARCH CENTER (EERC)

BACKGROUND

The 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). In the event that 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 between 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 result in a budget increase. 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 which 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 that 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 on the basis of 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 http://und.edu/finance-operations (Policies & Procedures, A–Z Policy Index, Travel). Daily meal rates are based on U.S. General Services Administration (GSA) 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.

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.

Subcontractor – TBD Graphic Design: Graphic design support for handouts, outreach, website, and public engagement. Cost based on historical cost from previous work.

Subcontractor – TBD Workshop Partner: For an industry expert to lead a workshop for stakeholders. Cost based on historical cost from previous work.

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: Food for hosting listening sessions, focus groups, and engagement trips with community stakeholders. 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 previous meetings.

Rent and Leases – Venue: Venue rental for listening sessions, focus groups, and engagement trips with community stakeholders. 18 rentals at $300.

Honorarium: Nominal compensation for stakeholders to participate in listening sessions and focus groups. Based on 12 sessions with 8 people at $50 per.

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.

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.

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.

Geoscience services recharge fees are discipline fees for costs associated with training, certifications, continuing education, and maintaining required software and databases. The estimated cost is based on the number of hours budgeted for this group of individuals.

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 (MTDC). 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.

APPENDIX D

EERC PROJECTS FUNDED BY THE NORTH DAKOTA INDUSTRIAL COMMISSION IN THE LAST 5 YEARS

EERC PROJECTS FUNDED BY THE NORTH DAKOTA INDUSTRIAL COMMISSION IN THE LAST 5 YEARS

Project Name	Start Date	End Date	Total Contracted
Bakken Production Optimization Program 2.0	11/01/16	05/31/20	$6,000,000.00
Initial Engineering, Testing, and Design of a Commercial-Scale CO_2 Capture System	09/01/17	12/31/19	$3,200,000.00
FERR 1.3 – Integrated Carbon Capture and Storage for North Dakota Ethanol Production	11/01/17	07/31/18	$345,000.00
iPIPE: The intelligent Pipeline Integrity Program	04/01/18	12/31/23	$2,600,000.00
Economic Extraction and Recovery of REES and Production of Clean Value-Added Products from Low-Rank Coal Fly Ash	06/16/18	02/15/20	$30,000.00
Low-Pressure Electrolytic Ammonia Production	06/16/18	06/30/22	$437,000.00
FERR 1.3 – Integrated Carbon Capture and Storage for North Dakota Ethanol Production	12/01/18	05/31/20	$500,000.00
State Energy Research Center	07/01/19	06/30/27	$20,000,000.00
Underground Storage of Produced Natural Gas – Conceptual Evaluation and Pilot Project(s)	06/01/19	06/30/23	$3,500,000.00
Assessment of Bakken and Three Forks Natural Gas Compositions	11/01/19	06/19/20	$300,650.00
Improving EOR Performance Through Data Analytics and Next-Generation Controllable Completions	01/27/20	09/30/24	$500,000.00
Wastewater Recycling Using a Hygroscopic Cooling System	01/31/20	09/30/22	$100,000.00
PCOR Partnership Initiative to Accelerate CCUS Deployment	02/01/20	09/30/24	$2,000,000.00
PCOR Partnership Initiative to Accelerate CCUS Deployment	02/01/20	09/30/24	$2,000,000.00
FERR 3.2 – Produced Water Management Through Geologic Homogenization, Conditioning, and Reuse	02/01/20	01/31/22	$300,000.00
Bakken Production Optimization Program 3.0	05/01/20	04/30/23	$6,000,000.00
EERC Technical Support for RTE CCS Activities – November 1, 2019	06/01/20	11/30/21	$500,000.00
Flue Gas Characterization and Testing	07/01/20	11/30/21	$3,741,450.00
Laboratory-Scale Coal-Derived Graphene Process	09/01/20	04/30/23	$162,500.00
Hydrogen Energy Development for North Dakota	07/01/21	06/30/23	$500,000.00
Ammonia-Based Energy Storage Technology	04/01/21	03/31/23	$101,390.00
Field Study to Determine the Feasibility of Developing Salt Caverns for Hydrocarbon Storage in Western North Dakota	07/01/21	06/30/23	$11,900,000.00
Williston Basin CORE-CM Initiative	02/01/22	05/31/23	$750,000.00
Front-End Engineering and Design for CO_2 Capture at Coal Creek Station	02/01/22	08/31/23	$7,000,000.00
Unitized Legacy Oil Fields: Prototypes for Revitalizing Conventional Oil Fields in North Dakota	07/01/21	06/30/24	$3,000,000.00
iPIPE 2.0: The intelligent Pipeline Integrity Program	01/01/22	12/31/23	$400,000.00
Advanced Processing of Coal and Waste Coal to Produce Graphite for Fast-Charging Lithium-Ion Battery	02/01/22	01/31/25	$500,000.00
Liberty H_2 Hub Front-End Engineering and Design	11/01/22	10/31/24	$10,000,000.00