

## LRC-106A

**Title:** “Carbon Ore, Rare Earth, and Critical Minerals (CORE-CM) Initiative – Phase II”

**Submitted By:** UND EERC

**PM/PI:** John Kay

**Duration:** 36 Months

**Purpose:** The EERC is proposing the Phase II work scope for the CORE-CM team focused on producing rare-earth elements (REEs), critical minerals (CMs), and nonfuel carbon-based products (CBPs) from Williston Basin coals. The EERC has received additional funding from the DOE and industry support, providing the leveraging of NDIC project funding. The EERC led Phase II effort would focus on advancing the opportunity in North Dakota as part of two regions within the realigned DOE. The proposed additional effort is aimed at collecting more resource data for rare earth elements (REEs) and critical minerals (CMs) in the Williston Basin. This involves identifying data gaps that need to be addressed and developing strategies to move forward. It also includes implementing necessary workforce training and establishing technology innovation centers.

**Funding:** NDIC: \$1,500,000; Total Project Costs: \$3,830,000

### **Technical Advisor’s Recommendation:**

**Fund** – The proposed project is a great fit for the Lignite Research Program, as part of the pursuit of emerging markets for North Dakota lignite. All three of the technical reviewers recommended funding, and the proposal received an average score of 204 out of 250. The project leverages state funding by obtaining funding from the DOE and industry.

### **Funding would be subject to:**

- Technical advisor participates in project reviews
- Technical advisor reviews the project management plan with the project team

**Conflicts of Interest:** EERC, North American Coal, and BNI.

**Reviewers:** Fund - 3; Consider Funding - 0; Do Not Fund – 0

**LRC:** **Fund: Yes - 15;** No – 0



Energy & Environmental Research Center

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February 14, 2025

Mr. Jordan Kannianen  
Deputy Executive Director  
North Dakota Industrial Commission  
600 East Boulevard Avenue, Dept. 405  
State Capitol, 14th Floor  
Bismarck, ND 58505-0840

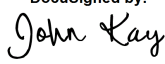
Dear Mr. Kannianen:

Subject: EERC Proposal No. 2025-0116 Entitled "Carbon Ore, Rare Earth, and Critical Minerals (CORE-CM) Initiative – Phase II"

The Energy & Environmental Research Center (EERC) of the University of North Dakota is pleased to submit the subject proposal to the Lignite Research, Development and Marketing Program. The ACH transaction number is 287130 for the \$100 application fee. The EERC is committed to completing the project as described in the proposal if the Commission grants the request.

If you have any questions, please contact me by telephone at (701) 777-4580 or by email at [jkay@undeerc.org](mailto:jkay@undeerc.org).

Sincerely,

DocuSigned by:  
  
6E1D21EBB3594A6...  
John P. Kay  
Principal Engineer Emissions  
and Carbon Capture

Approved by:

DocuSigned by:  
  
29489751F2894D7  
Charles D. Gorecki, CEO  
Energy & Environmental Research Center

JPK/kal

Attachment

c: Erin Stieg, North Dakota Industrial Commission

Lignite Research, Development  
and Marketing Program

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North Dakota Industrial Commission

## Application

**Project Title:** Carbon Ore, Rare Earth, and  
Critical Minerals (CORE-CM)  
Initiative – Phase II

**Applicant:** University of North Dakota Energy &  
Environmental Research Center

**Principal Investigator:** John P. Kay

**Date of Application:** February 14, 2025

**Amount of Request:** \$1,500,000

**Total Amount of Proposed Project:** \$3,830,000

**Duration of Project:** 36 months

**Point of Contact (POC):** John P. Kay

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## ABSTRACT

The University of North Dakota (UND) Energy & Environmental Research Center (EERC) is continuing to lay the foundation for a new industry in the Williston Basin focused on producing rare earth elements (REEs), critical minerals (CMs), and nonfuel carbon-based products (CBPs). This has been an ongoing effort since October 2021, with the U.S. Department of Energy (DOE) award of the Phase I “Williston Basin CORE-CM Initiative,” also supported by the North Dakota Industrial Commission (NDIC) Lignite Research, Development and Marketing Program (LRDMP). DOE realigned its national divisions for Phase II awards, which divided North Dakota into two regions: Region 3 and Region 4. Region 4 consolidates three Phase I programs and part of a fourth, and it was agreed by those teams that the University of Wyoming will lead the Phase II program with the EERC taking a vital role. **Objective:** The goal of Phase II funding is to collect additional field-derived data and identify areas that show potential for the development of a new industry and drive the expansion and transformation of resources in the Williston Basin to produce REEs, CMs, and CBPs. The information will be incorporated into the full Region 4 assessment. For Region 3, the EERC will provide information to the project team regarding business opportunities in the eastern region of North Dakota. **Expected Results:** This program is the second phase of a DOE-funded multiphase effort. Phase II focuses on gathering and assessing data for REEs, CMs, and CBPs in the Williston Basin, identifying gaps and developing strategies necessary to move forward, and implementing needed workforce training and technology innovation center(s). **Duration and Total Project Cost:** This is a 36-month program (May 1, 2025 – April 30, 2028) with a total value of this effort of \$3,830,000. The proposal requests a total of \$1,500,000 from NDIC LRDMP. BNI Energy (BNI) and North American Coal Corporation (NACCO) offered letters of support with the option of providing in-kind cost share. **Participants:** DOE, NDIC LRDMP, BNI, and NACCO, along with continued input from the original coalition of nearly 30 partners, formed under the formation of the Phase I program in 2021.

## PROJECT SUMMARY

Through the creation of the Williston Basin CORE-CM (carbon ore, rare earth, and critical minerals) Initiative in 2021, the University of North Dakota (UND) Energy & Environmental Research Center (EERC) formed and continues to lead a diverse and experienced coalition team of nearly 30 partners, encompassing all value chain segments, focused on laying the foundation for a new industry for the Williston Basin by expanding the use of coal and coal-based products to produce rare earth elements (REEs), critical minerals (CMs), and nonfuel carbon-based projects (CBPs). REEs have become a critical topic within the United States as they are used extensively in modern electronics, batteries, and other materials, and the majority are imported from China.

This proposed work is the second phase of a much larger program defined by the U.S. Department of Energy (DOE). The first phase was intended to lay the foundation by assembling the existing information, identifying information gaps, developing strategies to move the opportunity forward, and initiating outreach. DOE designated Phase II to focus on a larger region. As shown in Figure 1, North Dakota lies within two DOE regions, Region 3 and Region 4, with Phase I work falling into Region 4. The coalition team has extensive experience and expertise in lignite coal, REE and CM analysis, REE and CM extraction and enrichment, and developing nonfuel CBPs. Additionally, the EERC has a long history of bringing together regional and national stakeholders to tackle critical and complex topics, involving large partnerships in the Williston Basin. The coalition team includes research organizations, state entities, coal producers, mineral processors, business and financial partners, end users, policy experts, and more to guide future opportunities in the Williston Basin.

Region 4 includes three major Phase I project basins: the Powder River Basin in Wyoming, the Williston Basin in North Dakota, and most of the Cherokee–Forest City Basin which stretches from Iowa down to Oklahoma. A portion of the Gulf Coast Basin also lies within Region 4. These Phase I teams elected to collaborate in the proposal to DOE for Phase II, with the University of Wyoming (UoW) acting



Figure 1. Nationwide map of CORE-CM regions.

as program lead, with extensive assistance from the EERC and the Kansas Geological Survey. The University of Illinois (UoI) submitted the proposal for Region 3 with the EERC providing a small role pursuing business opportunities in North Dakota in that program as well. Both proposals were selected for contract negotiations by DOE.

The project will:

- Assist UoW in a regional resource assessment (RRA) by integrating Williston Basin data.
- Collect additional field data to improve the Phase I dataset and expand it beyond coal-related sources to others, such as clays, shales, and produced water.
- Address infrastructure, accessibility, regulatory compliance, and permitting on a regional scale through the EERC working with UoW and UoI to formulate strategies.
- Conduct stakeholder engagement, outreach, and workforce development in Region 4.
- Assist UoW in a technology innovation center (TIC) road map and begin the creation of TICs in the region.

- Participate in DOE-led working groups.
- Participate in the Critical Materials Collaborative (CMC).

### PROJECT DESCRIPTION

The EERC will continue to lead the diverse and experienced coalition team of nearly 30 partners, encompassing all segments of the REE/CM/CBP value chain. The Phase I Williston Basin CORE-CM Initiative had harnessed coalition team experience and Williston Basin resources and infrastructure to begin the development of a new industry that will catalyze economic growth and job creation in the region and enhance national and economic security as well as support the existing coal and coal-based resource industry. The CORE-CM Phase II project will continue to focus Phase I's findings to enhance and transform the use of coal and coal-based resources within the Williston Basin and throughout Region 4.

**Objectives:** The goal of Phase II is to continue to develop expansion and transformation of coal and coal-based resource utilization within Regions 3 and 4 to produce REEs, CMs, and nonfuel CBPs. The objectives are to extend the understanding of the three-dimensional deposition of potential sources, develop a coalition team to create and implement a workforce development plan, and implement plans for technology innovation centers that will be operated by regional-specific public-private partnerships. The coalition teams for Regions 3 and 4 will comprise entities such as private industry; university; local, state, and federal government; local communities; and tribes and tribal organizations.

**Methodology:** Building upon the previous work, the Williston Basin CORE-CM Phase II project wants to expand upon data collected in Phase I to include potential REE/CM/CBP sources beyond coal and fly ash alone and potential sources such as clay, shale, produced water, and non-fuel CBP; extend the understanding of the three-dimensional deposition of potential sources; and continue collaboration with Geological Surveys of North Dakota, South Dakota, Montana, and of the rest of Region 4. Data from each state within the region will be accumulated and compiled and additional field sampling will be conducted within the Williston Basin to expand data already gathered. The CORE-CM Phase II project



will perform work through eight tasks. For Region 3, the work will focus on infrastructure and business opportunities.

**Task 1.0 – Project Management, Planning, and Reporting.** The EERC will manage and direct the project work involving North Dakota and the Williston Basin in accordance with the scope of work to meet all technical, schedule, and budget objectives and requirements. Interim and final reports will summarize the activities of the project and include key findings, results, and lessons learned. This work will be performed in conjunction with the overall work outlined by the CORE-CM Region 4 program manager (UoW). The project team will also participate in UoW-led meetings and DOE-led working groups. The intent of the working groups is to share lessons learned across all DOE project awardees as well as aid in the development of best practices manuals.

**Task 2.0 – Regional Resource Assessment and Initial Planning.** The EERC will assist UoW in developing a RRA, which will be a high-level prospective assessment and will serve as the foundation for future data and information refinements of the regional REE- and CM-containing resources. The RRA will serve as a primary evaluation identifying the most promising resources within Region 4. The focus of the EERC activities will be to incorporate the Williston Basin resources with the other basins in Region 4. Additional sampling will gather new samples across the basin to further refine REE/CM/CBP occurrence. The work performed in Phase I of the DOE program will be used to target promising locations within the Williston Basin for additional sample collection and analysis. The regional RRA will consist of the following data.

- A review and assessment of prior state-of-the-art (SOTA) critical minerals and materials (CMM) data, as well as ongoing studies, that will address how these data were/are being obtained.
- Identification of the carbon ore-based resources and/or other resources, their location within the region, and quantitative estimates of each resource contained within the region.

- Identification of reusable waste streams (coal ash, refuse, produced water brines, etc.) or other CMM-containing waste streams (including industrial and mineral processing waste streams), their location within the region, and estimates of the quantity of each material contained within each resource location.
- The results of a gap analysis that addresses the potential need for additional field sampling activities to adequately reflect the region's resources.
- A description of the requirements, processes, and methodologies for acquiring additional field materials and performing respective characterization analysis of resource materials in each U.S. region.

This will lead to leveraging existing and needed new characterization data to assist in developing geologic models and identifying gaps in the understanding of the resources available and methods to correct those gaps. An example of potential resources in North Dakota are the shales that are ubiquitous throughout the state.

**Task 3.0 – Regional Assessment of CORE-CM Resources, Sampling, and Characterization.** The EERC will assist UoW in a regional assessment of CORE-CM resource types. The assessment will integrate basinal data and will be expanded by regional assessment and characterization of CMM. This assessment will be a broad overview of regional resources by assessment and characterization of contained CMM. The assessment will include leveraging existing and new field characterization data, developing analytical geological models, identifying information gaps and ways to fill those gaps, and informing future research and development (R&D) on resource recovery. Resource characterization and assessment should include, but not be limited to:

- Coal and sedimentary rock associated with coal beds.
- Sedimentary hosted minerals.
- Coal ash (ponded materials, combustion by-products).

- Refuse, preparation plant, or mining waste (coal, other ores).
- Acid mine drainage (coal, other ores).
- Oil and gas produced water, including petroleum industry by-products, carbon storage produced brines, or other waters.
- Other region-specific resources such as gasifier char materials, drill cuttings, produced brines, etc.

The EERC will conduct additional sampling across the Williston Basin, based upon results of CORE-CM Phase I, to be included in the assessment described previously, and engage in collaboration with the North Dakota Geological Survey on work it's conducting. The EERC will work with UoW to integrate coal sediments into a validated CMM geologic model that will include structural and stratigraphic frameworks, paleo depositional environments, and post-depositional processes to as great an extent as possible. The geologic model will be extrapolated across the region. Assays that can be directly associated with specific stratigraphic intervals will be addressed and included in the geologic model. If available, other geophysical data such as well logs, seismic and geochemical information, etc., will be identified. The predictive capability of the resource assessment geological models will include sensitivity analysis, confidence testing, and validation. Model assumptions will be included where geophysical data are missing or not clear.

#### **Task 4.0 – Regional Overview for Infrastructure, Industries, and Business That Include Site Strategies.**

The EERC will work with UoW to formulate strategies to address infrastructure, accessibility, regulatory compliance, and permitting on a regional scale and to integrate and leverage regional infrastructure, industries, and businesses to spur economic growth by utilizing the region's CORE-CM resources as well as other minerals and waste streams. This strategy will address the regional infrastructure needs and economic challenges and identify supply chain gaps. An evaluation using a decision-based matrix will be conducted to down select from regional overview and identify, prioritize sites for consideration for a more detailed analysis, and will include:

- Existing regional industries and businesses' energy needs and infrastructure.
- Regional infrastructure available to active mines, coal, or waste streams and how those materials will be transported to regional locations for further processing.
- Currently available or needed CMM mining and raw material refining infrastructure.
- Additional information that may be needed to complete the analysis of the technologies and infrastructure available to active mines, coal, coal by-products, waste streams, or alternate source materials, and how those materials are transported to current (or future) facilities that refine these raw resource materials into feedstock materials. Facilities that refine these materials may be outside of Region 4, and this will be considered.

Task 4.0 will serve as the basis for the development of an initial regional business commercialization plan. The regional infrastructure, industries, and business assessment will begin development through the collaborative effort and expertise of coalition members across various technology supply chains. This plan will address:

- Integrating current and possible future industries that utilize (or may potentially utilize) coal, coal-based resources, and regional wastes as process feedstock materials.
- Identifying industries in Region 4 that utilize CMM as materials incorporated into intermediate and end products such as magnets, batteries, sensors, electrolyzers, lasers, phosphors, fluorescents, catalysts, and many other products.
- The potential economic impact and challenges of not only producing CMM and valuable, nonfuel, carbon products within Region 4, but also transport requirements for the development of environmentally safe and sustainable projects, businesses, and industries.
- Infrastructure needs, potential business/industry integration, economic challenges, and supply chain gaps that need to be addressed to promote economic growth and create jobs.

- Critical needs to realize the full economic value of the region's resources for producing and utilizing CMM and valuable, nonfuel, carbon products, and/or alternate non-coal-based resource materials.

The EERC will assist UoI with infrastructure and business opportunities in the eastern region of North Dakota in Region 3. Existing infrastructure will be identified as well as potential CMM users and business strategies that may use material from Region 3 or other nearby facilities.

**Task 5.0 – Stakeholder Outreach, Education, and Workforce Development.** The EERC will assist UoW to develop a regional plan for stakeholder outreach, education, and preparation of a workforce development and community engagement plan for CORE-CM resources in the region. This encompasses training (or retraining/uptraining) the next generation of technicians, skilled workers, and STEM (science, technology, engineering, mathematics) professionals, for securing domestic feedstocks and material component production. The plans will integrate accredited mining schools and other academic institutions, local and regional training, and workforce development organizations within Region 4. The plan will address training needs and how to develop and implement training for (1) technicians, (2) skilled workers, and (3) STEM professionals. The plan will also explore potential collaborations with other R&D projects funded by DOE that are relevant to the CORE-CM Initiative.

Stakeholder outreach and education includes (but is not limited to):

- Workforce training and education ongoing during the project outside of the awardee coalition team that encompassed the entire region.
- Open workshops and forums to engage and disseminate information to stakeholder industries, such as mining companies, power plant operators, oil and natural gas companies, and entrepreneurs throughout the region, as well as to the general public and potential future workforce personnel, addressing technical and nontechnical challenges of CORE-CM projects being conducted in their region.

- Engagement with tribal, federal, state, local governments, and nonprofit/non-governmental groups to provide information on technology development, environmentally sustainable pathways, and economic potential within their region for production CMM and valuable, non-fuel, carbon products.

**Task 6.0 – Technology Innovation Center Plans.** The EERC will work with UoW to refine plans and develop a road map to implementation for TICs that will be developed and operated by regional public–private partnerships. The TICs will provide a centralized and consistent platform to develop and validate CORE-CM technologies at laboratory-scale or larger, including technologies that utilize advanced manufacturing techniques. This road map will identify partnerships with other entities for conducting future small-scale R&D projects for innovative waste stream material technology and/or test facility development to prove out and demonstrate innovative waste stream material technology that may include potential coproduction as well as process development such as:

- Extracting and recovering CMM for manufacturing and supply chain needs.
- Using acid and basic chemicals generated from the chlor-alkali process using produced water brines as the chemical leaching media to extract CMM feedstock material.
- Identifying the challenges and potential solutions needed to realize the above.

As part of this road map, the EERC will assist UoW to submit a summary of additional considerations of the proposed TIC addressing:

- The relationship between the amount of resources used and the amount of product formed.
- The associated near-term and legacy environmental impacts of secondary and unconventional mineral recovery when using particular feedstocks.
- How the planned technology remediates legacy environmental impacts of the energy industry, including environmental impacts, and future land use associated with the use of mine waste products in the region.

- The project’s waste management strategy and the anticipated impacts of residual waste on local residents.
- How the project incorporates a plan to ensure community and stakeholder input and engagement from underserved communities, which include persons of color, members of religious minorities, lesbian, gay, bisexual, transgender, and queer (LGBTQ+) persons, persons with disabilities, persons who live in rural areas, and persons otherwise adversely affected by persistent poverty or inequality.

Once the road map is complete, the EERC will work with UoW to develop the TIC plan, which will include the management and operational structure of the TIC that is envisioned for the Region 4 CORE-CM Initiative. This plan will discuss how the TICs will integrate the region’s natural resources, infrastructure, industrial needs, and waste stream reuse opportunities. The EERC, in conjunction with UoW, will address the TIC establishment, focus, organizational involvement, and potential management of the TIC within Region 4 with a primary purpose to:

- Accelerate research that will enable commercial deployment of advanced processing and production of CMM and valuable, nonfuel, carbon products.
- Support engagement of public–private partnerships and regional industries to advance new and innovative technology development as well as the potential for new product production.
- Advance opportunities for the education and training of the next generation of technicians, skilled workers, and STEM professionals.

The TIC plan for Region 4 will develop a regional plan to identify partnerships with industry and other stakeholders who represent a variety of industries and institutions and will include opportunities to engage potential partners through project meetings and through the building of the TIC.

**Task 7.0 – CORE-CM Closed Workgroups.** The EERC will participate in DOE-led closed working groups with other CORE-CM recipients as required during the term of the project, including attendance at

related workshops led by National Energy Technology Laboratory (NETL)/DOE staff or contractor personnel. The EERC will attend working group meetings that are both in-person and virtual.

**Task 8.0 – Critical Materials Collaborative.** The EERC will participate as a member of the CMC to:

- Align the DOE research portfolio to achieve climate goals and crosscutting science and technology objectives.
- Support crosscutting RD&D related to critical minerals and materials.
- Accelerate the adoption and deployment of innovative technologies.
- Nurture and expand the innovation ecosystem.
- Facilitate scientific and technical exchange and discussion.

**Anticipated Results:** The Williston Basin CORE-CM Initiative will continue to build the foundation to develop a new industry as well as play a vital role in expanding and transforming the use of coal, coal-based resources, and other sources of REE/CM/CBP within the Williston Basin. As the second phase of an anticipated three-phase program, this phase will build upon the results of Phase I, with a focus on further data collection for the Williston Basin with integration into data for the entirety of Region 4, developing a workforce training strategy that can be implemented within Region 4, and provide the information to start the development of a TIC.

**Facilities:** The EERC employs a multidisciplinary staff of about 275 and occupies a research complex consisting of 254,000 square feet of laboratories, fabrication facilities, technology demonstration facilities, and offices. It has large meeting facilities as well as capabilities to host remote meetings if needed. The EERC houses eight laboratories with extensive analytical capabilities.

**Resources:** Collectively, the coalition team has significant experience characterizing potential CM resources in various Williston Basin deposits and/or waste streams. Over 2400 samples have been previously analyzed for REE content, and UND has laboratory equipment for analyzing additional



samples, if needed, including an inductively coupled plasma (ICP)—optical emission spectrophotometer and an ICP—mass spectrometer.

**Techniques to Be Used, Their Availability, and Capability:** The techniques to be used and their capabilities are described in the methodology section. The CORE-CM Phase II project will harness the knowledge of the diverse coalition team through collaboration, meetings, reports, etc., to assess the opportunity and solve technical and nontechnical challenges. The initiative will leverage existing REE data for resources and mining, processing, and upgrading technologies. The coalition team will provide guidance and direction for the project.

**Environmental and Economic Impacts While Project Is Underway:** The proposed scope of work will have minimal environmental impact. This effort consists primarily of data compilation, analysis, and dissemination by the EERC and coalition team members, with limited sample characterization and analysis at UND laboratories. Economic impacts will also be minimal during this project phase; however, as opportunities are identified, the CORE-CM Phase II project has the potential to create large economic benefits to North Dakota and the Williston Basin region.

**Ultimate Technological and Economic Impacts:** The ultimate impacts of the proposed CORE-CM Phase II project have the potential to be enormous, including expanded support for the existing coal industry as well as establishing a new North Dakota industry. The existing coal industry supports over 3600 direct jobs, provides over \$70 million in state tax revenue, and has an overall economic impact of \$1.8 billion. Supporting and strengthening the current lignite industry has the potential to save significant jobs and regional and state revenues, especially in the event of a future carbon tax or cases where other social or economic impacts are felt. A future REE industry has the potential to provide significant revenue to the state through employment opportunities and state and regional excise and sales taxes. Based on Version 1.0.2 of the North Dakota energy sustainability model developed at the EERC, a fully developed REE industry itself could contribute \$500 million per year in state taxes based on an excise tax alone.

**Why the Project Is Needed:** The production of REEs is of critical importance to the national security of the United States. A REE industry, along with CMs and CBPs, would strengthen and support the existing North Dakota coal industry, provide an additional revenue stream and employer in North Dakota, and reduce the country's dependence on REE and CM imports.

### **STANDARDS OF SUCCESS**

The success of this project will be measured by advancing to Phase III of the DOE program, resulting in further development of this opportunity in the Williston Basin. To accomplish this, we must successfully 1) acquire the information needed for refining the Phase I initial assessments, 2) identify information gaps, and 3) develop plans to drive the future opportunity forward. Products that together will create the overall strategy to move into Phase III include 1) the continued basinal assessment, along with an assessment of Region 4; 2) further development of basinal strategies for infrastructure, industries, and business assessment; 3) technology assessment, development, and field-testing; 4) workforce training development; 5) TIC plan(s); and 6) continued stakeholder outreach and education. Information presented through discussions, webinars, and symposiums, which have already been successful in highlighting the potential of REEs and CMs within the Williston Basin.

### **BACKGROUND/QUALIFICATIONS**

In Phase I, the coalition team included nearly 30 partners across all value chain segments, including over 70 years of experience in supporting coal development and utilization within the Williston Basin (Figure 2). In Phase II, this team will be greatly expanded to include team members from the Phase I program carried out by UoI and UoW and others within Regions 3 and 4. Letters of support are included in Appendix A. The core research members of the coalition team will be responsible for the day-to-day research being performed. All partners will provide advisory guidance in the areas noted, and the following have also indicated the potential to provide in-kind cost share: NACCO and BNI.

John Kay, EERC Principal Engineer, serves as principal investigator (PI) for the Williston Basin portion of Region 4. Mr. Kay has over 28 years of experience in coal research and has extensive project management and leadership experience. He has led the development of advanced analytical techniques for coal characterization and was the project manager (PM) for the Partnership for Plains CO<sub>2</sub> Capture (PCO<sub>2</sub>C) Program. Other key personnel were chosen for their roles because they have successfully managed similar work. Key personnel are listed in Table 1, and resumes of key personnel are provided in Appendix B.

	Mining	Coal Utilities	Research/Academic Institutions/Mining Schools	State Geological Surveys	Mineral Processing	Manufacturing	Business/Financial	CORE-CM Cooperation
<b>Core Research Team</b>								
UND Energy & Environmental Research Center			X					
UND College of Engineering & Mines Research Institute			X					
UND Nistler College of Business & Public Administration			X					
Pacific Northwest National Laboratory			X				X	
North Dakota State University			X				X	
Montana Tech University			X					
Critical Materials Institute (Ames)					X			
<b>Project Partners</b>								
NDIC Lignite Research Program	X	X					X	
North American Coal	X				X			
BNI Energy	X	X						
Minnkota		X						
Basin Electric Cooperative		X						
Current Lighting Solutions					X	X		
Northrup Grumman						X		
General Atomics					X	X		
North Dakota Geological Survey				X				
South Dakota Geological Survey				X				
North Dakota Department of Commerce							X	
Semplastics					X	X		
Lignite Energy Council	X	X						
Western Dakota Energy Association	X	X				X	X	
North Dakota Governor's Office				X			X	
U.S. Geological Survey				X				
Wyoming School of Energy Resources CORE-CM Team								X
Illinois Geological Survey CORE-CM Team								X
University of Alaska CORE-CM Team								X
University of Utah CORE-CM Team								X

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Figure 2. List of coalition team members.

**Table 1. Key Personnel Roles**

<b>Key Personnel</b>	<b>Role(s)</b>	<b>Key Personnel</b>	<b>Role(s)</b>
John Kay	PI; Task 1	Charlene Crocker	Task 5 lead
Bruce Folkedahl	Task 2 lead	Bruce Folkedahl	Task 6 lead
Ian Feole	Task 3 lead	Nolan Theaker, UND College of Engineering & Mines Research Institute	Task 7 lead
Jason Laumb	Task 4 lead	Nolan Theaker, UND College of Engineering & Mines Research Institute	Task 8 lead

The EERC has extensive experience in understanding, sampling, characterizing, and processing lignite coal for a wide variety of applications. From the earliest existence of the EERC in the 1950s, a significant component of its work has been on Williston Basin lignite coal. More recently, the EERC has successfully led numerous programs that bring together regional stakeholders to advance new concepts. One of the most successful programs is the Plains CO<sub>2</sub> Reduction (PCOR) Partnership. Similar to the vision of the CORE-CM Initiative, the PCOR Partnership, over the course of 20+ years, has advanced the concept of carbon capture, utilization, and storage from a regional assessment to commercial demonstration (e.g., Project Tundra in North Dakota). The EERC has also led and/or participated in numerous projects within the last few years focused on REE/CM characterization, extraction, and concentration of REEs/CMs and the production of graphene and carbon-based building materials in conjunction with Semplastics.

The UND College of Engineering & Mines Research Institute (CEMRI) has been conducting REE and CM extraction research from coal-based materials for 4 years and has been involved in conventional and novel processes ranging in scale from proof of concept to pilot demonstrations. CEMRI has specific expertise in the available extraction mechanisms for REEs from coal-based materials, specifically on the mode of occurrence within the material and identifying nontraditional ore bodies and/or associations. Additional support is also provided by the UND Nistler College of Business & Public Administration. In addition to the members named above, the coalition team has an extensive group of cooperating partners and cost-share providers.

### **VALUE TO NORTH DAKOTA**

Advancement of a REE industry from Williston Basin coal in North Dakota has the potential to support and strengthen the existing coal industry and develop a new industry in North Dakota, providing employment opportunities and regional and state revenues. This second phase of a longer-term effort will provide the basis to move forward and develop the strategy, further resulting in significant investment in the Williston Basin by DOE. As noted previously, this industry, fully developed, could provide \$500 million in state tax revenues alone.

### **MANAGEMENT**

The EERC manages over 200 contracts a year, with over 1330 clients in 53 countries. Systems are in place to ensure that projects are managed within budget, schedule, and scope. Mr. Kay will oversee the entire program, including integration of tasks, collaboration with stakeholders, and organization of meetings. The task leads are shown in Table 1. Regular meetings will be scheduled to provide updates on research activities and discuss the direction of future activities.

### **TIMETABLE**

This effort is proposed as a 36-month program (May 1, 2025 – April 30, 2028). Figure 3 summarizes the preliminary program timetable. Additional timetable detail will be developed as the program evolves.

### **BUDGET AND MATCHING FUNDS**

The estimated cost for the proposed effort is \$3,830,000. The budget breakdown is given in Table 2. \$1,500,000 of cash cost share is requested from NDIC's Lignite Research, Development and Marketing Program. \$20,000 of the request is to support the work in Region 3, with the remainder of the requested funds being applied to support Region 4. All money given by NDIC for this project will be used to increase the information and knowledge of the Williston Basin, which adds to the overall DOE work for Region 4. Letters of commitment provided by BNI and NACCO can be found in Appendix A. Budget notes can be found in Appendix C. If less funding is available than requested, changes to the scope will be

considered. Deliverables for this program will be delivered to NDIC's Lignite Research, Development and Marketing Program as annual presentations, with a final comprehensive report at the end of the project, April 30, 2028.

#### **TAX LIABILITY**

The EERC, a department within UND, is a state-controlled institution of higher education and is not a taxable entity; therefore, it has no tax liability to the state of North Dakota or any of its political subdivisions.

#### **CONFIDENTIAL INFORMATION**

This proposal has no confidential information.

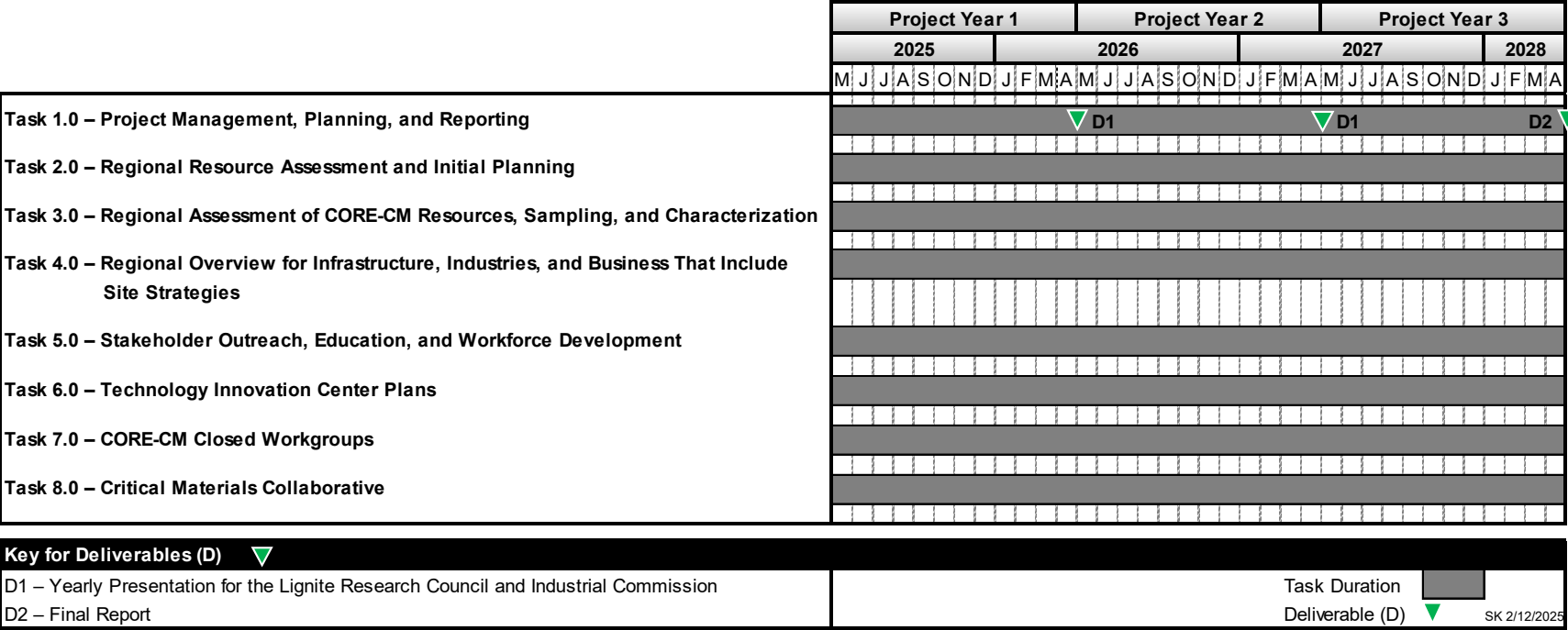


Figure 3. Preliminary timetable.

**Table 2. Budget Breakdown**

	Region 3			Region 4			Total		
<b>Project-Associated Expense</b>	<b>NDIC Share (Cash)</b>	<b>DOE Share (Cash)</b>	<b>Total Project</b>	<b>NDIC Share (Cash)</b>	<b>DOE Share (Cash)</b>	<b>Total Project</b>	<b>NDIC Share (Cash)</b>	<b>DOE Share (Cash)</b>	<b>Total Project</b>
<b>Labor</b>	\$13,079	\$38,869	<b>\$51,948</b>	\$960,156	\$1,015,678	<b>\$1,975,834</b>	\$973,235	\$1,054,547	<b>\$2,027,782</b>
<b>Travel</b>	\$0	\$8,216	<b>\$8,216</b>	\$0	\$77,386	<b>\$77,386</b>	\$0	\$85,602	<b>\$85,602</b>
<b>Tuition Remission</b>	\$0	\$0	<b>\$0</b>	\$0	\$30,331	<b>\$30,331</b>	\$0	\$30,331	<b>\$30,331</b>
<b>Supplies</b>	\$0	\$0	<b>\$0</b>	\$0	\$20,500	<b>\$20,500</b>	\$0	\$20,500	<b>\$20,500</b>
<b>Subcontractor – North Dakota State University</b>	\$0	\$0	<b>\$0</b>	\$0	\$29,805	<b>\$29,805</b>	\$0	\$29,805	<b>\$29,805</b>
<b>Communications</b>	\$0	\$0	<b>\$0</b>	\$1,061	\$699	<b>\$1,760</b>	\$1,061	\$699	<b>\$1,760</b>
<b>Printing and Duplicating</b>	\$166	\$160	<b>\$326</b>	\$1,193	\$1,021	<b>\$2,214</b>	\$1,359	\$1,181	<b>\$2,540</b>
<b>Laboratory Fees and Services</b>									
EERC Natural Materials Analytical Research Lab	\$0	\$0	<b>\$0</b>	\$17,720	\$22,100	<b>\$39,820</b>	\$17,720	\$22,100	<b>\$39,820</b>
EERC Analytical Research Lab	\$0	\$0	<b>\$0</b>	\$0	\$157,740	<b>\$157,740</b>	\$0	\$157,740	<b>\$157,740</b>
EERC Document Production Service	\$0	\$5,389	<b>\$5,389</b>	\$0	\$64,570	<b>\$64,570</b>	\$0	\$69,959	<b>\$69,959</b>
EERC Engineering Services Fee	\$0	\$346	<b>\$346</b>	\$0	\$11,600	<b>\$11,600</b>	\$0	\$11,946	<b>\$11,946</b>
EERC Geoscience Services Fee	\$0	\$0	<b>\$0</b>	\$0	\$4,203	<b>\$4,203</b>	\$0	\$4,203	<b>\$4,203</b>
Outside Lab - Standard Laboratories	\$0	\$0	<b>\$0</b>	\$0	\$100,000	<b>\$100,000</b>	\$0	\$100,000	<b>\$100,000</b>
College of Engineering & Mines Recharge Center	\$0	\$0	<b>\$0</b>	\$0	\$25,000	<b>\$25,000</b>	\$0	\$25,000	<b>\$25,000</b>
<b>Total Direct Costs</b>	\$13,245	\$52,980	<b>\$66,225</b>	\$980,130	\$1,560,633	<b>\$2,540,763</b>	\$993,375	\$1,613,613	<b>\$2,606,988</b>
<b>Facilities and Administration</b>	\$6,755	\$27,020	<b>\$33,775</b>	\$499,870	\$689,367	<b>\$1,189,237</b>	\$506,625	\$716,387	<b>\$1,223,012</b>
<b>Total Project Costs</b>	<b>\$20,000</b>	<b>\$80,000</b>	<b>\$100,000</b>	<b>\$1,480,000</b>	<b>\$2,250,000</b>	<b>\$3,730,000</b>	<b>\$1,500,000</b>	<b>\$2,330,000</b>	<b>\$3,830,000</b>